



9th Annual Report on the International Status of Engineering Geology—Year 2003–2004. Encompassing hydrogeology, environmental geology and the applied geosciences

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Available online 30 April 2004

Abstract

The year began with additional evidence that global warming effects were bringing about unusual increases in free precipitation, as rain in greater amounts, but not as snow, in the mid latitudes of Europe and North America, setting new records for flooding. These effects surely will continue to magnify as practical concerns for Engineering Geologists, not the least of which will be slope instability. Worldwide, the profession appeared to be in a truly advanced state, as marked by a new high in indigenous practice, a broad base of authors in this journal, and of cooperation between practitioners of the various nations. © 2004 Elsevier B.V. All rights reserved.

Keywords: Engineering geology; Environmental protection; Natural hazards; Geotechnical engineering; Professional practice

1. New impetus for the annual report

It has always been our goal to cover the globe geologically, in the sense of what Engineering Geol-

ogists and other colleagues in the applied earth sciences are doing for and about the earth. Fortunately, we now are five in number, representing a good geopolitical distribution around the planet. We like to think that we have been selected because we are interested and can deliver, and that you the reader share our interests and will communicate with us.

Our initial observation in this ninth year of reporting is that the peoples of the world have a vested interest in what catches our attention. Sadly we sense that the

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media, such as *Geotimes* (its July, “Highlights” issue), which embedded “Engineering Geology” only in its supplemental (Internet) coverage, do not. We are the foot soldiers of the earth sciences and proudly lack glamour and glitz, and therefore, press attention.

Never mind that, we have work to do, for the World!

2. Noteworthy events

Uncertainty was the watchword of 2003. A preemptive war came and went in the Middle East, with the Anglo-American-Free World removal of dictator Saddam Hussein from his brutal 25-year grip on the Iraqi people. There was, however, a world-rippling undertow of near-seismic proportion when debates erupted over how much peoples and nations can and should accept the projection of force over regional powers whose leaders have become selfish to their own people and are dangerous to their neighbors.

Following the removal of dictator Saddam, there was a vacuum-of-answers needed to address a 50-year vacuum-of-action addressing destabilization of the sciences, including geology.

The fallout with respect to meeting humanity’s deferred obligations rippled in the way that the world has dealt with uncertainty in modern times of communication and power economics—economic hesitation.

For the profession, this meant another year of creeping forward and much failure and postponement. Cut to the daily life of the engineering geologist, many projects were put on hold and many private-sector jobs were cut by layoffs and firings. Not a good year for “your average bear” professional geologist both in and outside of government! In North America, some would cite the conservative political backlash of reduction in government as one of the effects, but the causes appear to be a genuine downturn in tax revenues collected for governmental expenditure. Reductions in funds available for public projects have also led to more privatization of government services, that are now conducted mostly on low-bid contracts leaving precious little funding for the contractor staff to attend professional society activities without dipping into their own pockets.

2.1. Natural disasters

The authors have traditionally maintained that there will always be a considered role for engineering geology in the mitigation of impact from natural disasters. The basic presumption here is that geologic evidence always points to the degree of potential magnitude of human suffering from these disasters; mainly, the prima facie evidence that a good geologic eye can detect geomorphologic evidence and potentially unstable structural geologic associations. We put forth some outstanding examples for Year 2003.

2.2. Earthquakes

Your authors gave up indulgence in close treatment of earthquakes back in Year 2001, but 2003 again delivered many seismic lessons, three of which we wish to record, for purposes of “lessons learned”.

2.2.1. Iran, 26 December 2003

By preliminary count, 50,000 persons died in the M6.5 Bam earthquake in Iran. Beyond this shocking figure, we now learn that Iran’s Supreme National Council has indicated that it will consider, by March 2004, moving its capital from Tehran, in recognition of its vulnerability to a major quake that could kill 700,000 and cost \$20 billion in damage. We think that this is a prime example of recognition of the connection between hard geologic evidence and reasoned mitigation.

2.2.2. California, 22 December 2003

Although its “official” name has not yet emerged, this M6.5, \$200 million-damage event brought forth the ugly connection between existing knowledge of general seismic activity but substantially lower population density, and older, nonseismic construction. This points out the grand dilemma of obvious knowledge of potential without enough seismic quiescence to raise a general alarm. The historic farm center of Paso Robles, rife with unreinforced masonry, suffered \$80 million of the total damage (<http://www.eri.org>). We are reminded that *La Cima Encantada* (*Enchanted Hill*; now Hearst’s Castle State Park, San Simeon), the baronial estate of the late newspaper magnate William Randolph Hearst, lies closer to the first-plot epicenter than does Paso Robles. The “castle” was designed

with reinforced concrete and the latest Berkeley-developed seismic-withstand capacity, by architect Julia Morgan, in the years 1915–1948.

2.2.3. *San Giuliani Di Puglia*

Two particular European disasters highlighted issues that will concern all geoscientists: the San Giuliani Di Puglia earthquake in southeast Italy and the central European floods. The San Giuliani event measured only Richter 4.8 but destroyed a school, killing 26 children and four teachers. The building's collapse was blamed on the addition of two storeys without strengthening of the shallow foundations and block walls. While investigations initially focussed on whether the extension complied with building regulations, a subsequent government inquiry was asked to address the area's seismic classification. A 1998 government report had stated that the whole region should be considered a seismic risk zone but by the time of the November 2002 earthquake, no official classification had been issued. The chief engineer of the Italian seismic survey noted that none of the buildings in the village were designed for seismic loading. A civil engineer at the Italian Department for Civil Protection is reported as saying that many areas in Italy used similar construction methods to those in San Giuliano Di Puglia, transposing, in effect, equal levels of risk. As geologists, we are getting much better at analyzing seismic risk; but it would appear that persuading governments to act on such analyses remains a problem.

2.3. *Central European floods*

Flooding in central Europe in August caused billions of dollars of infrastructure damage to many countries. The Czech Republic estimated flood damage or destruction of 30 motorway and trunk-road bridges plus the same fate for more than 130 secondary-road bridges. In addition, 120 km of trunk road and 780 km of secondary roads were deemed unusable without repairs. In Prague, the river burst its banks and the metro system was flooded. It is expected that one quarter of the flooded buildings in the city will have to be demolished. Throughout the Czech Republic, it is anticipated that as many as 24 months will be needed to repair all the damage. This is a story repeated in many countries and illustrates the

importance of long-term climate prediction in all future foundation and flood protection design work. In most cases, careful engineering geomorphological field mapping will disclose areas of major potential flood damage.

2.4. *SARS outbreak and impacts on geoengineering projects in SE Asia*

Terrorist attacks were sporadic throughout SE Asia and were addressed at the October 2003 Association of South East Asian Nations (ASEAN) summit in Bali, Indonesia. Besides the concern on spreading terrorism and the eventual outcome of restabilization democracy in Iraq and Afghanistan, the world's latest killer disease, Severe Acute Respiratory Syndrome (SARS) broke out of China, to become a threat to geoengineering projects of the region. Besides its effect to decrease tourism in the region, skilled foreign construction workers were concerned about their own personal safety. Some geoengineering projects in Vietnam, Singapore, Taiwan, and Hong Kong were stopped during the outbreak because most of the skilled workers returned home (mainly Thailand and Philippines). With superb international collaborative efforts, the outbreak was largely under control by September.

2.5. *Landslide risk maps of Thailand*

In 2001–2002, El Nino-Southern Oscillation brought heavy rains into SE Asia, causing, in particular, several tragic floods and landslides in northern Thailand. After 2 years of remote-image interpretation and field geologic mapping, the Environmental Geology and Geohazards Division, Department of Mineral Resources, Thailand, has recently published on-line, 1:250,000-scale country-wide maps of landslide hazard and risk (<http://www.dmr.go.th/geohazard/landslide/index.php>). A warning system was also established in designated high-risk areas. Global climatic changes do affect geoengineering jobs!

2.6. *Fall of the "Old man" of New Hampshire*

The physical symbol of the State of New Hampshire, chosen many years ago by the Granite State, was a lantern-jawed profile not unlike that of the cinema

recreations of Dr. Frankenstein's fabricated monster. The "Old Man of The Mountain" was clearly visible to motorists traveling by Federal highway in the canyon known as Franconia Notch. Old Man, first broadly recognized in 1880, consisted of five large joint-bounded blocks of Conway Granite. Stanton Young, a civil engineer of the New Hampshire Department of Transportation was selected in 1958 to undertake the first of a series of rock stabilization projects to hold in place the estimated 300 tons of rock creating the Old Man's profile.

Stabilization attempts included geologic mapping and recognition of the geologic imperatives of retention of the five blocks of granite, as well as compressional anchoring of block-bounding discontinuities, routing of runoff from the rock-joint network and surface sealing of open joints. Meanwhile gravity continued to pull on the Old Man's chin, which jutted a good 5 m out from the underface of Cannon Mountain. Yearly inspections and maintenance extended the Old Man's life, but it still ended abruptly in May 2003 in a shower of disintegrating, falling joint blocks. Like the fable of Humpty Dumpty, there's no putting the Old Man back together again.

2.7. Major construction projects

A wonderful array of projects involving engineering geologists, hydrogeologists and geotechnical engineers was underway around the globe in 2003.

2.7.1. Hydel power project in Pakistan

Ghazi Brotha Hydel Power Project (GBHPP) located downstream of Tarbela Dam in Pakistan was set in motion in August 2003. Two of the five turbines were set to work at full capacity, each generating 290 MW of electricity. The remaining three will start functioning next year, thus generating total power of 1450 MW, roughly equaling the output of three standard nuclear reactors. The \$2.25 billion total cost is being funded multinationally by the World Bank, Asian Development Bank, Japan Bank of International Cooperation, Islamic Development Bank, KFW Germany, and various European investment banks, with a total loan of \$ 1.1 billion, the remainder funded by the Government of Pakistan.

It is the first power project in Pakistan where there will be no need to store water. Electricity is to be

generated by direct flow of water through a 52-km channel, utilizing the head available in the Indus River between Tarbela Dam and its confluence with the Haro River. This long-range project was conceived by the Pakistan Water and Power Development Authority (WAPDA) in the 1980s, with pre-feasibility completed in 1987, and final approval in 1994.

Tragically, the project was raided by unscrupulous politicians and government officials in collusion with the land mafia, siphoning off some \$70 million from the national exchequer. Once discovered, the malpractice prompted the World Bank to conduct another feasibility study, whereby WAPDA formulated a Resettlement Action Plan (RAP) which actually gave proper benefit to country people who were adversely affected by the project.

2.7.2. Free trades and geoengineering projects in SE Asia

Debates and resolutions of the Asia Pacific Economic Cooperation (APEC) summit held in Bangkok, Thailand (October 2003) focused on free trade among many of the Asia Pacific nations. Free trading is seen to stimulate industrial investment by way of new geoengineering projects, especially in Vietnam, Laos, and Kamphuchea (Cambodia). The latest bilateral agreement on direct flights between the US and Vietnam is a good sign, bringing a degree of resolution to the decades-old struggle for independence from external influences and the emergence of relatively democratic governments for the peoples of those countries.

2.7.3. Blooming mining in Myanmar and Philippines

Mining industry remains blooming in Myanmar and the Philippines. Myanmar is once again producing heavy metals (silver, lead, zinc, copper, tin, tungsten and gold) and gemstones and Diwalwal gold-rush areas in the Philippines are being developed along rudimentary environmental and mining safety standards. There is a recognized need for mining and engineering geologists in many places.

2.7.4. Dam construction in Myanmar

Myanmar (Burma) continues to emerge from its totalitarian isolation and we welcome the news of its 2002–2006 hydroelectric plan. The Ministry of Electric Power will develop 14 dam-supported hydropower

station projects and one coal-fired power plant to meet country's demand and to export electricity to neighboring countries. Regional geoscientist authorities now consider the opportunities reasonably safe for international consulting firms. Details are available at http://www.myanmar.com/ministry/electric_power/.

2.7.5. *Completion of Suwannapum International Airport, Thailand*

Expected to go into service in 2005, the US\$6-billion Suwannapum (New Bangkok) International Airport (SIA), the largest public international airport in SE Asia, is now 40% complete. Expensive site preparation to deal with soft-clay problems reached the 99% level of ground improvement. However, the transportation service system is lagging and underground subway connections are still under serious consideration, even in this geotechnically difficult soft-clay environment. Within another year SIA is projected to serve 100 million passengers and 6.4 million tons of goods per year.

2.7.6. *Lutcher Tunnel, Switzerland*

This 34.6 km long, 9.5 m diameter tunnel between Fruitage and Raton in the Swiss Alps will be completed in 2007 at the cost of 1.8 billion euros. Construction techniques recognize variable geologic conditions and therefore employ both drill-and-blast and a tunnel boring machine (TBM). The TBM is being used to bore through a segment of predominantly granodiorite, achieving rates of more than 700 m in a month. However, problems were encountered in the village of St. Germain when extensive settlement damage to buildings was reported as excavations lowered the local groundwater surface. Total maximum settlements of 183 mm were recorded and building repairs became necessary.

2.7.7. *Elms Storm Dam, Germany*

This 210 million euro project was completed in 2002 after 4 years construction. Situated close to the border with the Netherlands, the project involved building a dam that would allow barge passage to take place both during and after construction, as well as raise the level of flood protection dykes by several meters. The decision to go ahead with the project was made following widespread regional flooding in 1994.

2.7.8. *Benefice football stadium, Luz, Portugal*

This oval-footprint stadium, 200 by 150 m long and incorporating a 1000-automobile basement garage, has been designed to withstand a magnitude 7.5 earthquake. This is comparable to the earthquake that flattened Lisbon in 1755 and equivalent to the one that destroyed much of Kobe, Japan in 1995. The stadium is built on stiff clay using pad foundations, and ground heave during the basement excavations proved to be a problem.

2.7.9. *Dublin Port Tunnel, Ireland*

Ireland's largest civil engineering project, estimated at 462 million euros, is an 11.8-m diameter, twin-bore, 4.5-km tunnel link with a major trunk road and an orbital road, thus by-passing Dublin's city center. One impressive feature of the construction is the 56.6-m diameter access shaft to the TBM. Dublin is predominantly built on stout glacial lodgment till but has a long history of human occupation, making the 56.6-m diameter starter shaft a geotechnical challenge due to ancient refuse dumping, that also includes various hazardous and medical-biological contaminants. Variable fill and dump-ground conditions in the road link areas led to the extensive use of proof rolling with a high energy impact compactor to help identify areas needing treatment. In places this led to the placement of 2–3 m surcharges on the site to induce settlement prior to road construction. We hasten to point out here that urban engineering geologic site characterization must be mindful of archaeological implications, both of historic value and for the sake of identifying "bad ground".

2.7.10. *Amsterdam to Brussels high speed rail link*

Plans to develop a Trans-European Transport network (TEN-T) are well underway and one notable component is the high-speed rail link between Amsterdam and Brussels. The part of the route between Amsterdam and Rotterdam crosses one of Holland's most important farming areas as well as a wildlife sanctuary. This led to the decision to tunnel underneath the low-lying waterlogged and reclaimed land rather than to cross the wetland on an embankment. The world's largest TBM (diameter nearly 15 m) has been engaged to bore through a section of 12 m of peat and clay, overlying 25–30 m of marine sand, then 2 m of clay, overlying more marine sand, all in a

freshwater hydrologic environment vital for local agriculture. Below this geologic profile is a deeper saline groundwater. All in all, this is as difficult a geologic/environmental construction scenario as we can imagine.

2.7.11. *TEN-T—European rail links*

Engineering geological inputs have been essential in developing viable rail links throughout Europe. The 958-km long new-build and upgrade of the rail link between Berlin, Germany and Verona, Italy. The 1000-km line, to finish in 2007, will link London, Paris, Brussels, Cologne and Amsterdam, a total of 1700 km of rail network through southern France and northern Spain, connecting the cities of Names, Montpellier, Pertinent, Barcelona, Madrid, Victoria, Bilbao and Dad.

2.7.12. *Nested offshore wind farm, Denmark*

Summer of 2002 saw completion of the last of the massive gravity foundations for a 215 million euro Plambeck Neue Energien, Danish wind farm “Borkum Riffgrund”, as these components left their casting yard in Poland. By year’s end, the financing and operation had gone from the Danes to the Germans. The task has been to build the 1300-ton concrete caisson foundations for 72 wind generators to be located 9 km off the east coast of Denmark. The caissons were each set in 22-m diameter circular excavations in the seabed, founded on stiff glacial till. Each generator will be standing in seawater depths between 7.5 and 12.75 m, with the three-bladed generator nacelles sitting 69 m above sea level. The wind farm will cover 24 km² and is expected to generate 158.4 MW of power. Wind farms further off shore can be expected to be constructed in Western Europe over the next decade given the commitment of the European Union to the reduction of greenhouse gas emissions and the development of renewable sources of energy. What was proven in the southern and northern California wind farms of the 1970s has now gone worldwide.

2.7.13. *Reconstruction of Iraq*

A contract worth up to \$680 million was awarded to the San Francisco based Bechtel Group to facilitate reconstruction of war-ravaged Iraq. The initial award was worth \$34.6 million, but it also provided for funding of up to \$680 million over 18 months,

subject to Congressional approval. Experts at the UN estimate that the reconstruction could cost \$25 to 30 billion, but others put the figure at around \$100 billion.

“Restoration of the country’s key infrastructure is a priority of the U.S. Government’s effort to strengthen Iraq’s economy and ensure delivery of essential public services to the Iraqi population”, USAID said in a statement. The contract called for the repair and rehabilitation or reconstruction of vital elements of Iraq’s historically neglected and war-damaged infrastructure. This includes assessment and repair of power generation facilities, electrical grids, municipal water systems and sewage systems. There is also a provision in the contract for rehabilitation or repair of airport facilities and dredging upgrading of the Umm Qasr Seaport to 12.5-m depth, and the construction of new bridges at Mosul and Tikrit. All of this will be in close cooperation with other USAID contractors working in those sectors and also in the repair and reconstruction of regime-neglected schools and clinics.

War partner Britain suffered anxiety over some of its companies being cut out of the most lucrative early contracts to build post-war Iraq, according to the *New York Times*. Canada and certain other anti-interventionist European nations were upset as well, as are several American companies with political connections who feel left out of the post-war profits, now that the direct combat is over. Bush Administration analysts say that the contracts granted to Bechtel are only a fraction of what it will cost to rebuild country’s power, rail, road and water supply infrastructure, as well as airports, all mostly neglected during the totalitarian reign. At year end, ABC TV News (<http://www.abc.com>) disclosed that certain European anti-interventionists had been favored with nearly a billion dollars in lucrative pre-war contracts to market Iraqi oil at \$0.50 per barrel kickbacks.

3. Prospects for the profession

With the new world economy emerging, it is certain that the degraded conditions of bid shopping, going “bare” without peer review and curtailed employee benefits will become the deplorable norm.

3.1. *European industrial perspective*

Construction in Europe was worth 900 billion euros in 2002, which was only 0.6% higher than 2001. The consensus is that Europe's economic slow-down, budget constraints within EU member states, and the Iraq war—all represent significant obstacles to any recovery in construction activity during 2003. However, the broad figures hide significant regional differences. The UK market grew by 8.1% and Spain's by 4.6%, largely because of infrastructure investment. In contrast, Germany had a fall of 5.8% and the German construction industry saw more than 4500 bankruptcies during the first 6 months of 2002. Ireland and Portugal, two countries where construction activity has formed an important part of the economy for a number of years, both saw significant drops in activity.

3.2. *UK industrial perspective*

Ground Engineering magazine has made a survey of UK national and multinational companies employing more than 5800 engineering geologists and geotechnical engineers. The greatest concern reported was a lack of skilled professional staff at all levels, recent graduates to experienced. Sharply reduced funding for training, especially at postgraduate level, was also regarded as a major long-term concern. In a lead article in *Ground Engineering* (April 2002), the in-coming Chairman of the Engineering Group of the Geological Society addressed the issue of the skills shortage, citing earlier economic downturns that had forced senior staff into premature retirement. Other factors were the relatively poor salaries in the arena of practice, as well as other better-paying employment alternatives available to good science and engineering graduates. This message was repeatedly emphasised throughout the ground engineering literature. Until the construction industry is able to compete in terms of financial reward for the best graduates, the sector will continue to loose out.

3.3. *Government activity in general*

Public agencies, since the time of Caesar, have represented little empires built up by "successful" bureaucrats. In the armies, the ratio of war-fighters

(combat troops) to support troops is known as the "tooth-to-tail" ratio and that concept has come to rest in the Civil Works program of the U.S. Corps of Engineers through its recognition of the burden of "executive direction and management". In 2003, the Corps began to reorganize toward a more lean stature with implementation of integrated design teams to serve across the 8 Divisions and 41 subordinate Engineer Districts. As many as 6% of the Corp's 2100 employees will be excessed in the course of the streamlining procedure, which means no layoffs, just less future hiring on the advent of retirements. Would that the universities heed the example of reining in their excessive administrative "tails"!

Other long-term cost savings in First-World government agencies have begotten a new wave of outsourcing of technical and clerical support services in 2003. Nontechnical managers also are downsizing on the lower rungs of the ladder and professional geologists and engineers have to do their own typing (word processing) and drafting (computer-assisted drawing). This continues and accelerates a trend begun two decades ago in the Reagan Administration of the 1980s. Outsourcing assures that immediate and long-term fringe benefits are held to a minimum, this reducing cost.

3.4. *U.S. Army corps of engineers conducts long-term training*

For the first time since 1988, the U.S. Army Corps of Engineers (America's national Federal construction agency) is conducting a long-term academic program for its professional geologists. The program was initiated in the 1970s at the urging of then-Chief Geologist Gordon Prescott, and was conducted by geological and geological engineering faculties at the University of Minnesota and again in the 1980s, under the urging of then-Assistant Chief Geologist Ben Kelly, this time by the Geological Engineering Department at the University of Missouri-Rolla. The present program will be conducted by the Civil Engineering Department at Virginia Polytechnic Institute, beginning in May 2004. The 5-week course will cover a full range of topics in engineering geology including structural geology, rock mechanics, underground construction, reinforcement of rock

slopes and foundations, hydrogeology, and engineering seismology. The program is open to professional geologists and engineers of all Federal and State agencies.

3.5. *Military geology*

It became apparent in 2003 that there were two streams of employment of military geology, at least in the United States. Beyond what most of us recognize as geology applied to military planning and to conduct of strategic and tactical warfare, lies the new substratum of professional-level geologic support work and emerging government careers in environmental and housekeeping activities to support soldiers, sailors and airmen. As noted above, U.S. military have abandoned the practice of designating members of the military force to provide housekeeping services at the installations. With this trend also comes the huge dedication of engineers and geologists, among other scientists, to environmental monitoring and works at the installation level.

This new application of geology to the support of military defense will open up more career work for geologists who wish to compete for these positions. This professional staffing, however, will be wholly diffuse and many of those so employed will lose contact with the professional societies and likely will not stir to participate, because they will have to do it at their own cost and on their own time. Part of this projected lack of participation will be that their employers will be bid-shopped government contractors who characteristically have no interest in professional development and generally are too penurious to support society membership, travel and volunteer work with funding.

3.6. *A resurgence in the practice of military geology*

Resurgence of military geology was grandly recognized by a week-long conference (June 2003) convened at the U.S. Military Academy, West Point, NY, bringing together active workers on all aspects of military geology, from all parts of the profession—government contractors, Department of Defense employees, academics funded by Army Research Office, and people simply with an interest in this

geologic specialty. The proceedings will be published in 2004 by Kluwer.

The year opened with satellite-image proof of the reactivation of fission activity at North Korea's Yongbyon reactor. While some might say that the field of image interpretation need not involve geologic expertise, it is our feeling that virtually all image interpreters working in the intelligence community should have more than a passing geologic competence for integrating geologic conditions into assessments of what "could be" and what is going on at sites of military interest.

4. **Consultants**

Consultants have traditionally provided the slack between demand and readiness to serve. Probably most engineering geology has been conducted through specialist firms and they were stalwart employers of our profession before the advent of bid-shopping for professional services.

Now time has come to take full note of the antithesis of the consulting firm, the not-for-profit, government-sheltered groups that thrive on set-aside Federal work that is not available to the consultants, whom we regard to be the fundamental but now diminishing source of employment and institutional support for the profession. We challenge the not-for-profits to come forth as supporters of the profession.

4.1. *Employment situation*

Chaos ruled the year for the employment situation. Expense-paid interview trips went away a decade ago. Recent graduates should expect networking assistance from their faculty, but must expect to personally bear the burden of planning and paying for job-search trips to geographic areas in which they wish to work. With that in mind the last link to success is to ply the network of professional society contacts through student chapter involvement, conference and job fair funding, and faculty assistance.

4.2. *Architectural/engineering (A/E) firms*

There is little question that consultants remain "on point" in our profession, bearing the brunt of

all of the constantly changing and seemingly deteriorating conditions of practice. By that we mean, of course, the deplorable procurement practices of the public agencies and of those of the remainder of our clients who adhere to bid-shopping and other forms of cost cutting. Added to this are the increasing public set-asides to nonprofit, disadvantaged and minority businesses.

Because of this we have seen, in these very reports, each year the Rest-in-Peace list of Corporate Deaths among the consulting firms. In the face of this, we have a bright spot or two to report this year concerning the seeming health and survival of at least three firms that need to be saluted for their abilities to survive and grow in the face of these constraints.

Four names come to mind this year, MWH (the old Montgomery-Watson-Harza) AMEC, Mott-MacDonald, and Parsons Brinkerhoff. All four are widely known for their expertise in characterization and design for underground construction. It is apparent to the authors that success must lie in a winning formula having at least the terms of sensitive management, astute marketing and superior technical talent. Three of the firms are British-based (though two are now Anglo-American).

AMEC spans the entire field of applied geosciences, ground engineering and even the trades field of construction. At 50,000 (+) employees, and 90 offices in some 50 countries, the firm's greatest secret has got to be its "formula".

Currently, the grand North American experiment has been the vitalization of Shaw Group, formerly a Louisiana pipeline construction contractor. With the bid-shopped breakup of such giants as IT, Stone and Webster, EMCON, and others, Shaw boldly stepped forward and swept up much talent and corporate remains and has now emerged as the leading (at least in numbers of available staff) North American geo-environmental firm. This part of Shaw's business has been placed at Mahwah, New Jersey, in order to capitalize on the hazardous waste cleanup and solid waste landfill siting market that is so concentrated in the Northeast.

4.3. *Geoenvironmental firms*

We were struck this year by the nature of marketing advertisements by geoenvironmental

firms, as compared with a decade ago. Adds appearing in *Geo-Strata*, the quarterly journal of the Geo Institute (former Geotechnical Division and originally the Soil Mechanics and Foundations Division of ASCE) are quite telling. Today's state of practice clearly is dominated by four fully emerged factors:

- Site characterization by push technology;
- Bid-shopping;
- Methods of improving ground condition;
- Instrumentation to monitor foundation performance.

At the same time, we must take into consideration that most civil engineering departments have dropped the mandatory course in *Geology for Engineers*, and most graduates of those departments go forth without a clue as to difficult nature, character and properties of earth materials.

So what are we facing here? A world of practice in which the geoenvironmental engineer is forced to use checklists and menus to gather and interpret subsurface data relating to response and performance in the built environment, and without basic instruction in the geologic factors defining the earth materials being utilized.

4.4. *Individual and small practice*

It is now well established that First-World professional geologists are in peril of keeping their employment after age 50. The reasons are purely economic on the part of employers—older workers are more expensive to support with fringe benefits and they generally earn higher salaries. Consequently, although modern social legislation prohibits dumping of older workers, the work place is particularly adroit at circumventing legal protections. These pressures have created a growing secondary professional service market for experienced geologists with valid professional licenses, established reputations, and a network of friends and clients. As we all grow older, the message to be heeded is clear for all readers! The solo practitioner should not, however, expect to receive assignments in peer-review, for bid-shopping has killed that aspect of quality assurance (QA) and total quality management (TQM) worldwide.

4.5. Bid-shopping

The year brought continued unwelcome inroads against professionalism in conduct of the practice of engineering geology. In Missouri, Westinghouse Nuclear moved forward to secure professional services for site and waste characterization of a manufacturing facility suffering from low-level radioactive waste contamination. Competition has shown up here in the form of a Request for Proposals (RFP) that actually calls for “bids” on the performance of some 15 categories of fixed-price activities. Clearly, the owner wants the engineer (and geologists) to take the assignment along with assumption of all related risks of unknown conditions, both geological and waste-related.

What is worse, bid-shopping abets inherently poor quality site and waste characterization, the existence of which invalidates and corrupts the entire concept of the use of risk to determine the objectives of design and construction of projects in jeopardy of natural hazards, geologic constraints and remedial engineering of environmental threats.

4.6. On-line “reverse auctions”

Out in bankrupt California, the venerable Pacific Gas and Electric (PG&E, est. 1905) has created a whole new threat to the survival of professional engineering and geology. PG&E terms this their “Online Reverse Auctions”. This is purely draconian, in that the competing firms are, in essence, given hand-axes with which to bludgeon each other into the lowest possible “bids” for conduct of professional work. The target?—Remedial action site and waste characterization of a former manufactured gas plant (FMGP) in northern California, surely the most difficult and generally environmentally threatening of all uncontrolled hazardous waste sites. We hope that PG&E, other utilities, and other users of our professional services learn something positive from pursuit of this dangerous policy.

4.7. Negative results of bid-shopping

Veteran Geotechnical Engineer Steven W. Hunt P.E. (MWH, Milwaukee, WI) spoke out in a *Geo-Strata* letter (July 2003) reiterating the current state

of affairs brought about by bid-shopping. He noted:

- Use of unfocused, thoughtless scopes of works from previous projects;
- Use of house-standard report formats and contents;
- Proposals with little/no time for analyses or client communication;
- Over-reliance on (computer-canned) simple, conservative rule-of-thumb analyses;
- Firm-standard scopes of work, irrespective of expected site conditions;
- Failure to conduct “desk studies” on existing site or site-area information, and;
- Lack of effort to become involved in the “big picture” of the project goals.

Most of our readers are well aware of this malaise, but we need to face this to the degree each of us can develop our own personal concepts of the ethic and sensibility of practice. Mr. Hunt leaves us with the working rule that “Most commodity-type (bid-shopped) reports do not identify previous subsurface investigations or include boring logs from them...If construction problems develop and lawyers for the contractor find out that other data existed, a claim of withholding critical information may be made...”. We also subscribe to engineer-defense in malpractice litigation by way of adopting the position of client bid-shopping practices represent the root cause of legal claims. Where possible, owners who indulge in seeking the cheapest geoenvironmental input as possible should be exposed for that practice, before judge and jury in litigation proceedings involving variable site conditions claims.

One of the predicted results of bid-shopping has been a withdrawal of “hands-on” practitioners of Engineering Geology from participating in meetings, delivering papers, and in publishing their findings and deliberations in general. In the words of Charles Daugherty, a US tunneling geologist of nearly 40 years of experience, this hesitance is due to complicating external factors. Charlie’s bullets are:

- “Too much contention in the form of disputes, claims, etc., which means the lawyers won’t let you publish;

- Contractor personnel work fast, ungodly hours, and publishing is the last thing they normally have time for, and;
- Designer personnel have become very bottom line driven.
- Clients don't want to be billed for their extracurricular activities, and the employer doesn't want the time charged to overhead because it affects the company profits.
- Moreover, writing on one's own time is often not as easy as it may sound."

Most geologic work assignments in the "underground" are in urban surroundings, requiring significant time-distance travel to and from the office or tunnel site. As Daugherty notes: "With my working hours and my commuting time, I get about four hours of face time with my wife each work night and writing papers is not a good way to keep the home fires burning. That leaves weekends, with their multiple chores that have to be performed. Mine is a fairly simple case, considering the total three hours and twenty minutes I spend commuting—there are people around here (New York City) who do it four to six hours every day. On top of which, many are constantly traveling and have to spend their plane and hotel time working on official reports and other submittals".

4.8. Corporate environmental deaths: rest in peace (R.I.P.)

After the rash of corporate failures in 2002, there has been a slackening of failures. We have heard, however, that several formerly robust firms have "gone on sick call" over symptoms of malnourishment at the hand of bid-shopping utility clients. Among the victims is Phillip Services Corporation (PSC), headquartered at Ottawa, Ontario, but formerly quite successful in the US, after taking over Burlington Resources (a division of Burlington North/Santa Fe and formerly John Mathes and Associates), at Columbia, IL. PSC was quite successful in gas works site and waste characterization work and in oversight of remedial actions. We understand that court-managed bankruptcy is the present status of the firm.

4.9. International market

We are assessing the coming effect of the European Union on employment opportunities in the profession. Certainly, the status of Eurogeologist, now in place since 1999, will provide some degree of opportunities probably more dependent on networking than on national identity. We know that the British remain firmly entrenched in the US, Canada, and throughout the old Empire. Their competition is based on competence and a willingness to serve.

4.10. Employment

Professional employment opportunities remained good for those applicants who have the drive to recognize that the "red carpet" is now gone forever and it is up to the individual to take appropriate action. Entry-level salaries in Engineering Geology and allied fields inched upward again, with those holding engineering degrees commanding around \$45,000 per annum in the USA. At the same time, we learn that North American business continues to hire as many professional and subprofessional staff as possible on the "part-time" basis of 39 hours per week, thus taking the position of not offering fringe benefits and yet staying outside prosecution over laws relating to employment benefits for full-time employees. What is worse is that projections are heard to the effect that by 2007 only one in three professional-technical employment jobs will be accompanied by fringe benefits.

University and departmental reputations and networking by concerned faculty remain positive factors for individual candidates. But, in the final analysis, it is the network, faculty assistance and the interview appearance of the candidate that carries the day. Students everywhere are urged to join the student ranks of their applied geological professional societies and to ask for practitioners to assist in making contacts and providing references to potential employers. The Geological Society of American, through the generosity of consultant Dr. Roy Shlemon, has been conducting the Shlemon Mentor Program, placing students and practitioners together at workshops at its Annual and Sectional meetings, in preparation for job searches and interviews.

4.11. ASFE provides help to the consultant

This organization (one known as the Association of Soil and Foundation Engineers, but now only by its initials) remains unique since it was created in 1968, of and by consultants in the “applied geosciences”, to serve the interests of survival in an increasingly difficult market (<http://www.asfe.org>). We think that our brethren in the European Union should look into this theme of cooperation.

5. Litigation

There is no doubt at all that each of us should prepare to offer our services as expert consultants and testifying witnesses, to the degree that we can justify our participation in this venue. Generally speaking, the basic qualifications are solid academic degrees, professional licensure and a string of relevant publications. We believe that all practitioners should consider developing specialties of interest to trial lawyers. As we see it, the interested professional should develop one or more engineering geologic specialties that commonly underlie claims for death, personal injury or monetary damages from events caused by or from phenomena of a geologic nature. Preparation for offering services in expert consultation and/or expert testimony, includes the following:

- Extensive personal experience and involvement;
- Personal publications or co-authorship in papers of relevance;
- Development and maintenance of a personal library of related books and other publications, graphic images and physical/chemical samples or verifiable laboratory analyses pertaining to such phenomena;
- Mastering of the skills of technical writing, public speaking, photography and artistic rendition, and field observational technique, and;
- A network of legal professionals who are aware of this degree of preparation and capacity.

Recognition of your technical capabilities for litigation should ideally be timed to be in place about the same age (50 years) at which modern society

tends to relegate its geoscience professionals to the trash heap.

6. Universities

The universities are in real structural trouble, and their financial troubles are restraining faculty involvement in our profession. The time has come for us to judge the future of our profession not so much by contact with the universities but by binding together in our professional societies. Hence, the good news (above) about societal involvement in our welfare as practitioners.

The Bologna Declaration in June 1999, enlarged at Prague in May 2001, set out the principles for a coherent, compatible and competitive European Higher Education area to be established by 2010. For geology and earth science degree programs over the next few years, the need will be to provide curricula that can be assigned credits under the European credit transfer system (ECTS). Critical to all geology departments, and for those taking the subject as vocational training, is recognition, through the European Federation of Geologists, that an important skill for any geologist is the ability to undertake fieldwork. At present, the question of what constitutes the basic competencies of a graduate has still to be defined. However, the prevailing view is that geoscientists should be able to bring together field and laboratory data and integrate this evidence with earth science theories. Earth science theory draws from concepts and methodologies not only of its own but also those in chemistry, physics, biology, mathematics and computing. It is this combination that provides geology (earth science) with its distinctive character among sciences.

6.1. UK education

The UK continues to see a decline in the number of applicants for geology degrees, which leads to a reduction in the number of universities offering bachelors degrees in the subject. Similarly, the loss of Natural Environment Research Council grants to a number of engineering geology masters course has placed them in jeopardy. Given the recognized skills shortage in the engineering sector (see above) some

observers see this is as a worrying development for the UK economy.

6.2. *Applied geosciences in Southeast Asian Universities*

With the maturation of home rule in Southeast Asia has come the recognition of the advantages, opportunities and burdens of management of rich natural resources. Countries in the region now have generally seized the opportunity to train their youth at home, in the geosciences.

6.3. *Restructuring of Thailand's Universities*

Like Japan in 2002, the Ministry of Universities was combined into the existing Ministry of Education in July 2003. Public universities, offering engineering geology courses are still without strong specialty programs, and are now in a new management structure where perhaps advances will come from addressing national needs for graduates who can bring geology into civil works programs. At the same a certain degree of university autonomy will be enforced very soon, in which faculty and support staff can choose to remain in the old government-supported system or to become nongovernment employees. A major concern is that tuition fees soon will need to be increased sharply because mandated changes and apparent opportunities for improvements are not anticipated to be appropriately funded by forthcoming block grants from government and the private sector has traditionally made only small endowments.

6.4. *Aging geoscience faculties and trends in SE Asia*

Most Southeast Asian geoscience departments were established in the 1960s. Pioneer faculty members will be all retired within the next 5 years and a realistic replacement effort is an important problem for these aging departments.

Engineering geology in Southeast Asia is a token one-course offering in most geology programs and strong degree specialties in engineering geology have yet to appear. The one outstanding example of applied geologic degrees is the Petroleum Geoscience program in Brunei, created in recognition of that nation's oil

resources. Broad geoscience curricula are now in place at two Thai institutions; Kasetsart University (Earth Science) and Mahidol University at Kanchanaburi (Geoscience) and Chiang Mai University now has support from the National Petroleum Authority to develop a Petroleum Geoscience degree very soon. The need for applied geologists has been demonstrated but strong specialty training for engineering geologist graduates is still not in place. We believe that these moves are appropriate to regional national needs and applaud the trend.

6.5. *Asia-link program*

The Asia-Link Program is an initiative by the European Commission to promote regional and multilateral networking between higher education institutions in EU Member States and South Asia, Southeast Asia and China. The program aims to promote the creation of new partnerships and sustainable links between European and Asian higher education institutions, and to reinforce existing partnerships. A curriculum development endeavor under the Asia Link Program has been launched in the field of Geoenvironmental Engineering at the Asian Institute of Technology (AIT), Bangkok, Thailand. The project aims to provide high quality teaching and research in the fields of contaminated industrial site clean up and georisk engineering. AIT, along with the two German and one Austrian universities has selected Bangladesh Institute of Technology as a South Asian partner.

The demand for Geoenvironmental engineers is high in Asia in general and South Asia in particular, where slope failures and issues related to solid waste disposal are crucial to creating and maintaining a safe environment, especially in crowded urban areas. Some of these issues were discussed in 2003 at a regional Geoenvironmental workshop held at Bangkok, where experts from all the participating universities along with people from the industry shared their ideas about the Geoenvironmental issues.

6.6. *Academic demise of geological engineering (United States)*

After an illustrious lifetime of 80 years, the end of training of geological engineers seemingly is upon us.

This fine discipline has the overwhelming fault of not having a prosperous industry dedicated to its existence, in that its practitioners work across the breadth of industrial endeavors that are more accessible to academic (read that university administrators) extraction of other disciplines. Established as a discipline in 1922 at the Colorado School of Mines, Geological Engineers have represented a difficult blend of engineering design integrated into applied geology. Our only close colleagues in that sense have been the chemical engineers, the mining engineers and the petroleum engineers. All three of these disciplines have traditionally benefited from their support industries, unlike geological engineers. Now with the US mining industry all but dead, and the mining engineering departments have little support. Oil companies now court geological engineering departments only with occasional gifts or scholarships.

Penuriousness at the State legislatures, and the demands of social welfare, aging infrastructure and environmental compliance, among other factors, have left the State-supported universities on the verge of bankruptcy, though they continue to limp along with larger-than-necessary cadres of administrators. Among the very first departments to become extinct, in order to save the cost of having administrators, are several outstanding historic programs in geological engineering. The University of Idaho went down late in 2002, Arizona is on the chopping block now, and there's talk of shoving the Geological Engineering program at Missouri-Rolla (established there in 1968) into Civil Engineering. It makes no sense to those of us who know the huge payoff of good geological engineering, but this means nothing to the administrators.

In 2002, we were delighted to report on the advanced program of Engineering Geology at the Delft Technical University, but now we learn that this splendid trial has not met with final approval of the administrators and all appears lost.

6.7. Effective death of mining as a profession and of the American mining schools

This entry warrants more than the usual corporate *Rest in Peace* (R.I.P.) tag, in that the minerals industry was the real home of Engineering Geology, at least until the end of World War II. This

year we were notified that two of the great American mining schools, integral parts of the Universities of Arizona and of Idaho were sucked into the vast bureaucratic morass of expensive administration costs and are to be, essentially no longer recognizable and independent academic departments. The causes are four-fold:

- Retreat of the mineral producing companies from both hiring and donations;
- Emotional, intellectual and professional gaps between the controlling administrators and the grand professions of the mining industry;
- Uncontrolled proliferation of seemingly purposeless assistant deans, provosts, vice-chancellors and other bureaucratic voids. This rapacious greed of the university administrators themselves, costs far more than the teaching faculty and adds so very little to the supposed mission of training graduates, and;
- General shortfall in State tax revenues as measured out against other imperatives including infrastructure, social welfare and protection (“homeland security”) from terrorism.

We are promised that degrees in Geological Engineering and Mining Engineering will continue to be available at Arizona and Idaho, but we are not likely to be “fooled” this time around.

Now we must watch with apprehension as to what will become of the last university (Colorado School of Mines) to remain as our undergraduate geological engineering flagship.

Who will service the diminished need of the mineral industries? We predict that the British, who have performed in such a sterling fashion in providing a legion of absolutely first-rate engineering geologists will do just that.

One of our reviewers succinctly reminded us that “mining companies of today, with few notable exceptions, devour and spit out geologists at each scratch of the accountant's pen. And, they send the survivors into parts of the world that the CIA would avoid!”

6.8. Adjunct faculty

Historically, engineering geology and all of the engineering disciplines have benefited greatly from

adjunct members of classical faculty, people who generally come to the podium from the realities and constant learning experience of practice. Where practice-experienced faculty are not present or otherwise available, well-qualified adjunct faculty can make a real difference in the education of graduates. This vast resource, however, is being tapped by resource-short administrators as a slave market of sorts. Sophie L. Wilkinson (C&EN, 2003) blows the whistle on the practice of using adjunct faculty to meet body-count requirements at cash-strapped universities. On the downside, she reports statistics that adjunct faculty have grown in the US from an average 20% in the 1980s to 33% in the 1990s and now rests at about 40% of the average university faculty. These teachers are without fringe benefits and are paid mainly in the prestige associated with the appointment.

Largely ignored are the huge potentials related to doctoral-level individuals who have access to expensive laboratory equipment in the relatively few surviving nonacademic research and applied research laboratories. Here the magic combination of funded, high-priced equipment coincides with high-volume analyses. Where university administrators are smart enough (not often) to make room for gifted adjunct faculty with access to such high-cost/high-volume equipment and analyses, many advances are made. Naturally, applied environmental geochemistry comes to mind in this connection.

There are a wide variety of reasons why qualified practitioners become adjunct faculty. The most relevant are those dealing with a commitment to pass on hard-earned knowledge that cannot be imparted directly from textbooks. We salute this as the most noble of motives and hope that such a role can be fostered by the professional societies.

So poorly paid are most adjunct faculty, that those who must rely on this form of income to earn a living, must obtain appointments at multiple colleges in their area, thus making the adjunct faculty members “roads scholars” or “freeway flyers”. Many adjunct faculties are offered opportunities to teach whatever it is for which the current faculty is lacking in capability. Counter to the noble goal of enriching the education of students is the selfish goal of many administrators to fill a classroom instruction slot with a cheap version of faculty. This is shameful and we can expect the

ranks of such people to expand, especially in the public institutions which are largely being abandoned by their funding legislatures. In fact, the current trend of plummeting funding has administrators thinking and threatening to drop low-profile specialty instruction in disciplines like engineering geology rather than to pare the administrative fat that is so prevalent at today’s universities.

For those of us who practice engineering geology, the one move that is possible is to raise alumni pressure and influence on university management to increase the substance of adjunct faculty participation in our profession. We are told that short-term, untenured teaching contracts are now appearing.

6.9. Endowed chairs

Cash-strapped campuses have discovered that they can have their administrative fat and still support some degree of academic excellence through appealing to rich alumni and wealthy “friends” to create endowed chairs, generally in their own names. According to the University of California at Los Angeles Alumni magazine, “Raising more chairs will catalyze the campus’ many friends around the imperative of providing essential support for UCLA’s academic core”. This public institution is blatantly offering named chairs in exchange for donor gifts of \$2.5 million down to the basic limit of \$1.5 million.

6.10. Distance learning

Professional societies are slowly stepping forward to replace the former role of the universities in what has been known since 2000 as “distance learning”. No longer can the universities meet the service role of affordable short-course tuition fees. England has set the new standard through efforts of The Geological Society (London) and its Regional Groups and Specialty Groups (such as the Engineering Group, encompassing Hydrogeology).

Now, in America, the American Rock Mechanics Association (<http://www.armarocks.org>), the 1993 outgrowth of the federally orphaned U.S. National Committees on Tunneling Technology and on Rock Mechanics. ARMA came forth in 2003 with a 3 day/ four instructor short course on “Rock Mechanics for Practitioners”. In our minds, the only practical ver-

sion of “Rock Mechanics” is indeed “Rock Engineering”. Let us recognize that! The good news is the 3-day course was offered at \$900, a price that used to seem outrageous, but now setting a new and somewhat more reasonable course-fee basis, when the average short-course fee has passed \$500 a day. Added to this, the costs of per diem and lost chargeability make the short-course market generally priced beyond the reach of nearly all consulting firms and most public agencies.

7. Societies

Professional societies remain the mechanism of our only real hope to adjust, if not to control our own destinies as true professionals within the profession. We continue to pay attention, here, to their activities as such for consideration of the readership.

7.1. ASTM, a technical society

While it clearly is not a professional society, ASTM International, under its new (2002) name, continues to codify standards and other forms of guidance for all manner of manufacturing activities as well as for the conduct of some forms of professional practice for those practicing in the applied earth sciences. While the authors do not embrace ASTM as a gathering of true engineering or science professionals, their activities have made inroads into our areas of practice on an international scale and to a degree that cannot be ignored.

The Society is a commercially oriented group that is keen to raise money through its activities, its products, and services. In 2003, it began to market a web-based alert system providing notification of new standards via e-mail. Interested parties can find the details on the Internet: http://www.astm.org/workitem_mail/sample.html.

ASTM strives to bring standardization to all routine and reproducible processes and practices, from the world of manufacturing to the world of professional technical services. By and large, engineering geologists and geotechnical engineers have had considerable reservations about attempts to standardize the conduct of their own professional work,

which most will agree is a professional work product and not that of a trade or manufactory. Stated another way, standardization can never duplicate the quality, breadth and inventiveness brought to the applied earth sciences by professional geologists and engineers.

As professional scientists, we should never lose recognition that a “standard” represents only the *minimally acceptable* level of effort or competence when applied to the work product of professional geologists or engineers. Dr. Judy Ehlen, acting as an internal reviewer, reminds us that standards do have the positive aspect of promoting the potential for consistency and thus direct comparison of results.

The downside of ASTM standardization is that bureaucrats and other public servants and officials tend not to give full value to the advantages of the quality that can be provided by professional geologists and engineers selected on the basis of their professional qualifications, training, and experience, and not solely on price. Granted, ASTM standards for fieldwork conducted within the purview of the professional of the applied geosciences may offer some way of assessing the work performed, but only by breadth of scope, not of its quality.

The Society does offer a variety of training courses such as Phase I and Phase II environmental assessment and requalification training. Prospective attendees should be critical of the qualifications of those teaching the courses before committing funds.

Our key to involvement in ASTM is to recognize Committees D-18 (Soil and Rock) and E-50 (Environment). The committees meet twice a year to vote on redrafted Standards and to decide on reissues or deletion of Standards. Attendees pay their own expenses and there is heavy lobbying by interests offering the services affected by the Standards.

ASTM has gone on a campaign to attract student membership and this may be an appropriate avenue toward first employment upon graduation.

Some heady advice was offered us in review (J. Hadley Williams) and we accept such: “Government, academia and the private sector are somewhat unevenly represented in ASTM”.

- “ASTM historically has pushed for government involvement in order to avoid controversy over government issued procedures that conflict with technical practicality. This effort has succeeded reasonably well, but there is a degree of vulnerability to those consultants, fortunately few in number, pushing new products; and to a few in academia who have a narrow focus on the real world of the consultant. State regulatory agencies also can have a problem where a standard is constructed that conflicts with a public law or rule. Rules are created with public hearings and post-ruling conflicts can cause real public administrative problems.
- ASTM has created a caveat to their standard guides that now reduces this potential difficulty and also the difficulties that consultants would have where site conditions do not fit the shoe constructed by the ASTM standard guide.” We would add that consultants should not be fearful of opposing ASTM Standards in litigation, where flaws may be pointed out to the court.

8. Technology and computation

We continue to track the development of technologies and computational methods for their impacts on our profession. The authors have always been concerned with the underlying trend of increasingly thoughtless use of “easy” computation through which solutions appear to be accurate and precise, but may lead to flawed reports relating to geological, hydrological, geochemical, geotechnical, and contaminant conditions that make up site and waste characterization.

8.1. Finite element analysis (FEM)

FEM reached a maturity back about 1975, largely around the work of the geotechnical faculty of the University of California-Berkeley. It has proven immensely successful when used as a predictive tool and especially when used with practice sensitivity for parametric analysis. Since that time, FEM has become a standard form of deformation analysis under a variety of stresses projected to be applied during construction and operation of civil and environmental projects, above and below ground. We were pleased

that ASCE’s Geo Institute, in offering its instruction has come forward with emphasis on its prime use: seepage, consolidation and settlement, and slope stability and that the prospective attendee is warned of the “possible pitfalls of the finite element method”. To this, we add the rejoinder that those pitfalls are nearly all geologic in nature and involve facies changes, geomorphic and other stratigraphic “holidays” and the unwise application toward *regionally important geologic materials* of unusual physical properties. Judy Ehlen of the U.S. Army Corps of Engineers reminds us that another potential flaw in the use of FEM is that it still “models” by way of a continuous approach to the typically discontinuous nature of geological phenomena.

8.2. Questionable international conferences

During 2003, we noted the appearance of e-mail traffic promoting blanket scientific conferences, generally held at vacation and resort locales likely suffering lack of patronage due to the worldwide terrorism threat. Key indicators to this activity are “International Scientific Advisory Committees” and other forms of imitation of seemingly legitimate conclaves. The announcements generally are quite broad in scope and give the impression that your proffered abstract will indeed be accepted and that you will be able to spend time at the resort against whatever tax relief might be gained from participating in an activity related to the profession. One such conference will concentrate on ‘monitoring, simulation and remediation of the geological environment’ with “aims to attract a multi-disciplinary audience of researchers, practitioners and government employees ... from diverse backgrounds, such as geologists, civil engineers, forest and agricultural specialists”. We will be watching this phenomenon with discerning, bemused and cautious interest.

9. The environment

The environment generally took a back seat to international imperatives, mainly those of Middle East peace and the general threats of terrorism. As well, the struggle between industry and environmentalists

reached a new low in which the usually emotional preservationists were moving ahead of the generally rational body of conservationists. Everywhere the costs of infrastructure repair, replacement and expansion were being challenged by increased clamor for social needs, all of which traditionally are considered fair game by politicians for taxation of both industry and individuals. More and more it was apparent that the international gross product cannot support expanded expenditures for infrastructure and social causes, all to come from the pocket of industry and taxpayers, while the preservationists call for shutting down industrial production and resource recovery.

First to suffer outwardly have been the European and North American auto and “fine” chemical industries. With the added costs of response to terrorism, both at home and in the Middle East, the year ended with politicians being tugged from both sides and severe shortages of public funding everywhere.

In the US, the Bush Administration was roundly criticized in June for its second editorial censorship of a white paper on global warming, this coming in the wake of the resignation of environmental activist EPA Administrator Christine Whitman, former Republican Governor of New Jersey, America’s most polluted State. In August, the President appointed Utah Governor Mike Leavitt, also a Republican, to the position.

World pollution control imperatives are driven not only by threads of national ethos, but by economics, and much of the fate of environmental protection initiatives of meaning to Engineering Geologists are likewise affected by broad national responses. For 2003 in general, at least for North America, most of the political noise has focused on air quality, an issue that usually does not directly involve engineering geologists. However, there was the disturbing, ongoing counterbalance event in 2003. China, for instance, has allowed a raging, uncontrolled lignite fire to continue to burn, probably representing one of the major world sources of hydrocarbon particles carried to the atmosphere.

9.1. Regional government (formerly “the states” in this report)

Perhaps the single most definitive factor in democratic national government is the decentralization of

the application of laws, to regions, be they States, Provinces, Departments or Counties. We observe that this is the first truly practical, technical, professional level at which Engineering Geology is practiced in government, worldwide. With Genske’s *Urban Land* published (2003), we sense that there is now a focal point for worldwide forces to read, comment, discuss, generally learn and begin to apply environmental regulatory and management techniques that seem to work elsewhere. Your authors will continue to pay great attention to this generic focus.

9.2. Groundwater protection

World population growth will not abate to the degree that water supply and water quality considerations can be reduced from our attention. Space between many cities is now filling in with human migration and the earth’s climate is becoming more depleted of surface water and ground water supplies. This problem we must recognize and this will and should be a major concern to Engineering Geologists.

9.3. Solid waste

We follow these developments because landfills literally cannot be sited, permitted, built, and maintained in compliance without engineering geologic expertise. For starters, we estimate that full-time positions in the public and private sectors, for such geologists number about 1000 in the US, perhaps 200 in Canada, 400 in the UK and some 250 in France. Professional registration is required in most cases and job security is high; even if one has to jump among employers, there always will be employment, commensurate with qualifications and experience.

For the past two decades hardly any greenfield landfills have been established for solid waste disposal, almost entirely due to local opposition by residents, usually organized by environmentalists or by intervening regional environmentalists. It is as if there is no societal conscience for the management of its own solid waste.

With this in mind, existing, environmentally permitted landfills have taken on a premium value nearly everywhere, for there is always a chance of having the height limit extended into “air space”, through a waiver application. Increasing landfill height, howev-

er, takes on questions of slope stability and large American landfills have experienced side-hill slope failures of compacted garbage, involving thousands of cubic meters of trash.

More often, expansions are affected by buying surrounding ground and then seeking a land-zoning variance or approval for lateral expansion, rather than trying to seek approval for a greenfield site. In the State of Ohio, the State EPA has allowed the Rumpke Sanitary Landfill, at Colerain Township (the “township” address itself indicates a rural location) to expand by adding some 200,000 m³ of additional volume to its western slope. The permit authorizing expansion prohibits additional heights, but local residents already call the facility “Mount Rumpke”, the top of which is at 300 m elevation, making it the highest point in Hamilton County. Rumpke Landfill is one of the facilities at which a 1996 slope failure has occurred, when 8 ha of waste slid downhill, starting fires and exposing old garbage.

9.4. American sanitary landfill activity

The environmental opposition is “having their cake and eating it as well”. National activity in the siting and permitting of sanitary landfills is at a decades-low activity in the US. Only the most wealthy of permit-seeking companies dare even think of requesting new permits, and then only with large (say, 200 ha) footprint sites in rural areas devoid of organized environmental resistance and with residents tolerant of the advantages of taxation-funded improvements, and a few local employment positions. One example is the 95 ha South Wake Landfill in Holly Springs, NC. The landfill will take over for the North Wake Landfill, which will otherwise have to close in 2006. The South Wake site will take approximately 18 months to construct and will handle more than 600,000 tons of garbage per year. Newer residents in Easton Acres, a nearby community, have filed a separate suit against the county in Federal court claiming that landfill placement represents a longstanding pattern of intentional discrimination.

Meanwhile, Pennsylvania, the State bearing (with Virginia) the disposal burden of most of the trash of New York City, has suffered a trash industry defeat of a Commonwealth court decision that upholds a harms/

benefits test for landfill permit applications. The test would have allowed landfill-permit applicants to demonstrate that social and economic benefits of granting the permit could outweigh environmental harm. Meanwhile urban Virginia workers suffer outrageous odors from passing trash trains, claimed to be the case even in winter time, when air emissions are as a seasonal low.

The world’s largest engineered landfill, Fresh Kills (880 ha), Staten Island, a Borough of New York City, has been officially closed and is being converted to a nature preserve that will encourage human visitation after June 2005. This landfill was to have been closed in 2002 but was extended as the final resting place of nonmetallic demolition debris from the Nine-Eleven terrorist destruction of the World Trade Center towers. Some of the debris are laced with pulverized human remains.

9.5. Integrated environmental planning in Southwest Asia

A workshop on the geological parameters for environmental protection was held at the Sultan Qaboos University under the sponsorship of UNESCO in collaboration with the University of Exeter (UK). About 40 delegates from Pakistan, Iran, Saudi Arabia, Bahrain, Kuwait, Jordan, Lebanon and Syria shared their experiences with the Omani participants. Funding was provided by the Islamic Educational Scientific and Cultural Organization (ISESCO) located in Rabat, Morocco. Another international conference on soil and water conservation was also held where one of the keynote speakers was Professor De Marsilly of the Ecole des Mines, France. Seawater intrusion as well as freshwater extrusion was identified as the main causes for the deterioration and conservation of water reserves of the Arabian Gulf area.

9.6. Canadians expand to Arizona

Capital Environmental Resource, Burlington, Ontario, has hired the former president and CEO of Allied Waste Industries, Scottsdale, AZ, and will establish a US headquarters in that city. Capital also completed a series of Arizona acquisitions, including a permit to construct a landfill with a lifetime

capacity of more than 100 million tons on a 305 ha property in Pinal County. Approximately 85 km miles from Mesa, the ritzy bedroom community for Phoenix. The company also is permitted to build a transfer station that will be able to process up to 3500 tons per day, and has a newly acquired collection company. Capital also has spent \$71 million in Florida, for the recently permitted 440 ha Osceola County Landfill, with its 20 million-plus m³ total capacity.

Operators of even the smallest of existing permitted American solid waste landfills are in line to become millionaires in the course of the ongoing big-money mergers of both trash-hauling and disposal companies, all of this spurred on by the Canadians.

9.7. *Canadians export solid waste to Michigan, USA*

Toronto's Keele Valley Landfill closed in July 2002 and now all of more than 23,000 tons of waste generated weekly in the Toronto area is being trucked to Sumpter Township, a suburb of Detroit, Michigan. At more than 1 million tons per year, this is equivalent to about 2% of the entire municipal solid waste of Japan. Michigan is becoming the No. 2 destination in Canadian trash export and 12 environmental groups have united under the "Don't Trash Michigan" campaign (<http://www.stoptrash.org>). In addition to Canadian trash, Michigan imports from Illinois, Indiana, Ohio and Wisconsin. Influential Michigan Democrats in Congress are invoking NIMBY (Not in My Back Yard) by introducing a Federal interstate law to ban Canadian waste from US landfills (<http://www.stabenow.senate.gov/stoptrash>).

9.8. *Sweden considers burning to replace recycling*

Swedish environmental and waste collection organizations are campaigning to stop recycling of cardboard, plastics and food and to destroy such by incineration. Advocates from Britain concur, and there are as many as 50 incinerators in the works in the UK. Shades of America's historic garbage crematoria, begun at New York City in 1899! The British Environmental Services Association has agreed that environmental and economic benefits of incineration have been overlooked. Where modern incineration is

adopted, there is the proven concern for generation of dioxins, when chlorinated compounds combine when under incineration temperatures are less than 500 °C.

9.9. *Hazardous waste management and cleanup*

Site and waste characterization for the management and remediation of hazardous wastes represent the most demanding test of the skills of engineering geologists. Just as important is the need for reasonable funding for site exploration through innovative engineering geophysical techniques, followed by confirmatory borings and exploration trenches. Often the first exploration procedures after image interpretation and field mapping now are the use of cone penetrometers (CPT) fitted for laser fluorescence-spectrometer scanning devices, and scanning outward during their downward pushes. Of course, CPT, invented by the Dutch just before WWII, works successfully only in under-consolidated to normally consolidated soils free of obstructions such as would damage the cone tip, generally valued at as much as \$10,000.

Paramount to accurate site and waste characterization is the ability of engineering geologists to predict "geologic possibilities" related to preferential pathways for migration of leachate and/or contaminated ground water. Often these pathways are geomorphic, stratigraphic, or structural geologic anomalies that cannot be detected by inexperienced geologists.

9.10. *Kölliken industrial waste landfill—Switzerland*

Kölliken, a 7 ha hillside hazardous waste landfill, was constructed to European state-of-the-art in 1978 in a former clay pit. The site was developed to some 4 ha when it was discovered that leachate had reached and entered coarse-grained sandstone channels. Now the site will be excavated and rebuilt at a cost of 300–500 million Euro. The project was briefly described in [Genske's excellent and essential 2003 book *Urban Land; Degradation, Investigation, Remediation*](#) (pp. 244–246), which is the only such industrial waste remediation guide, worldwide (<http://www.smdk.ch>). The point to be learned here is the recurring theme of necessary excellence in site characterization and the

role of potential “pitfalls” due to geologic “possibilities” that need to be postulated by astute engineering geologists.

9.11. Oregon clears up asbestos rules

Oregon Department of Environmental Quality (DEQ) has issued permanent rules on the removal and disposal of asbestos. The regulations define asbestos-containing material as “friable” (a good geologic term implying easy release of fibers) or “nonfriable”. DEQ has formed an advisory committee to resolve implementation and enforcement concerns. The regulations remove some January 2002 requirements that are subject to loose interpretation and a greater-than-necessary economic burden on solid waste haulers, building owners, and facility operators.

9.12. RCRA enforcement

America’s Resource Conservation and Recovery Act (RCRA; 1976, as amended) provides the law and implementing regulations for management of all solid and hazardous waste and has become the worldwide model for this type of regulatory control over toxic elements and compounds leaked or dumped into the environment. Much of the RCRA infrastructure mechanism has been adopted internationally and made country-specific. Briefly, this topic deals with the proper management and disposal of solid and liquid wastes, both municipal and industrial. Broad improvements have been made in the handling of industrial wastes and we must credit these achievements. A constant enforcement vigil is always proper, everywhere on the planet. Most waste management occurs on or in the ground and therefore this is an important specialty for many Engineering Geologists, especially those who wish to terminate their formal university training at the 4-year degree, as supplemented with constant efforts at continuing education. In this world, technical performance is measured every day and reputations spread rapidly.

9.13. Environmental site assessment

Embedded in the concept of environmental assessment is the real need to discover at the time of

property transfer, certain pre-existing site contamination conditions that will reflect on the ultimate value of the property transferred, and, in particular, on the legal obligations of the party taking possession of the land. America’s SUPERFUND hazardous waste environmental law (CERCLA, 1980 and amended, 1985) has always been careful to recognize the need of property owners to protect their interests. In 2003, USEPA was wrestling with compiling a rule that would be appropriate for engineering geologists to take into consideration. This is the “All Appropriate Inquiry” action that a defendant must show to have been accomplished in order to claim “innocent landowner” status and not to become involved in subsequent cleanup of contaminant conditions existing prior to ownership. This requirement came forth under the Brownfields Revitalization and Environmental Restoration Act of 2001.

From the standpoint of engineering geology, this is a sound list of site characterization considerations. Yet few of our clients are likely to approve of such a budget outlay for a competent survey of this magnitude. Nevertheless, we regard the list as being worthwhile for our consideration as a part of our professional practice (<http://www.epa.gov/brownfields/html-doc/aaisl.htm>).

9.14. Property condition assessments (PCAs)

This was a market worthy of Engineering Geologist participation but for the most part commoditization has ruined it for our consideration. There will always be a role for us, but not when poor-quality, bid-shopped PCAs lead to tort damages from unseen or unpredicted hazardous waste conditions, often combined with fatal geologic flaws not detected by the original consultant.

9.15. Brownfields

A nonpartisan bill was introduced in the Congress to assist communities in redevelopment of derelict urban sites as the Brownfields Redevelopment Assistance Act of 2003, to provide an additional \$60 million as seed money for cities to reclaim such lands through a program of revolving loan funds.

9.16. Voluntary cleanup program (VCP)

Here is another American concept that is being adopted worldwide, and it simply means that the site owner, or other interested persons, can conclude a binding legal agreement with the regulatory agency such that the applicant is in day-to-day control of efforts to remediate a particular site. This, however, is reminiscent of the old English fable of “the fox left in charge of the chicken coop”.

For uncontrolled hazardous waste sites (UHWS) in urban areas, there are many opportunities to clean up a site while converting it into valuable urban space. Often, the UHWS offers relatively large, contiguous parcels of ground for sports or public recreational facilities. State, Provincial, and other regional governments typically are the controlling agencies. Geologically speaking, the program is abused by those Responsible Parties (RPs) who wish to avoid full disclosure through well-funded, competent site and waste characterization, thereby leaving often considerable volumes of “undiscovered” hot spots of hazardous waste in place. Such wastes make the use of various forms of risk-based corrective action (RBCA) not only ludicrous, but downright dangerous to residents, visitors, and the environment at large.

9.17. “Tiered” risk assessments

This topic always has played against the body of reason and rationale of most competent Engineering Geologists. The “tiers” are generally three in number, each level becoming less conservative in terms of what must be accomplished in order to remediate the site. The first tier is what generally is known as a “look-up” (reference) table (matrix) in which limited site information is used to justify the selection and adherence to Maximum Concentration Levels (MCLs) on contamination that can be left in the ground at completion of remediation. Tiers two and three generally allow for assumptions and calculations to propose the selected MCL levels for key contaminants. It is at these levels that we are most concerned about the possibility of nongeologic override of geologic imperatives through which the site is left to an inappropriate degree of remediation (i.e., not enough hazard treated, contained and/or removed).

10. SUPERFUND

The SUPERFUND concept remains a worldwide model for government-mandated remediation of hazardous waste-fouled land. Dieter Genske notes (2003, pp. 278–279 of his *Urban Land*) that, in general, the European Commission is critical of hazardous waste cleanup by the SUPERFUND model.

The pioneering American version will see depletion of its fundamental trust fund in Fiscal Year 2004, beginning in 2003. We believe that improvements are always in order, including separation of the qualification of available funding at the time an uncontrolled hazardous waste site (UHWS) is named to the National Priority List of sites most needing cleanup. USEPA is guilty of counting cleanups at non-NPL sites as progress on SUPERFUND, which is not the case.

In November, for a third year, the number of completed SUPERFUND projects has declined. Forty toxic waste-site cleanups had been completed through the budget year that ended Sept. 30, 2003. During 2002, 42 projects were completed, and in 2001, 47. By straight-number comparison, the Clinton administration completed 76 SUPERFUND projects per year, but this is a numbers game and NPL sites are notoriously complex and varied. President Bush has asked Congress for a \$150 million increase in the SUPERFUND budget, but most of these complex cleanup projects require several years to more than a decade to complete the remediation.

In May, USEPA added seven new sites to the SUPERFUND National Priority List (NPL) and was considering 14 more proposed sites, including one landfill, at Troy, NH. For a list of sites, visit <http://www.epa.gov/SUPERFUND/sites/npl/newnpl.htm> (<http://www.mcb3.com/click.asp?x=caf7.2209.14604>).

10.1. Transnational pollution

Most of us know that metallic mineral recovery operations are conducted to concentrate and remove heavy metals for value, yet release small-particle toxic contamination. USEPA has therefore charged Canadian minerals producer Cominco of dumping as much as 20 million tons of its lead and zinc Teck (B.C.) smelter residues into the upper reaches of the Colum-

bia River prior to instituting environmental protection measures about 1995. America's giant Lake Franklin Roosevelt has become a toxic sediment sump, its discharged waters eventually enter the Pacific Ocean. Cominco is willing to conduct a US\$14 million study of its own design; EPA has ordered the company to comply with its own study provisions.

10.2. Former manufactured gas plants (FMGPs)

Riverfront Stadium, Cincinnati, OH, was demolished early in the year to make space for the new Cinergy Field (named for the sponsoring utility company). The second step in Phase-Three was a "green" demolition and environmental salvage operation. Remaining was the Great American Ballpark, immediately to one side. The demolished stadium will become the site of a parking structure. We suspect this to be the former site of yet another abandoned gas works, quietly converted to a public use area without adequate subsurface remediation (ENR, 13 Jan. 2003, p. 20).

Elsewhere, the City of Long Branch, New Jersey is hoping to remediate the Long Branch FMGP site into a City park.

As the harbinger of times to come, remediation of Barrie Park (Cicero Gas works; 1894–1926), a public playground in the Chicago suburb of Oak Park, grew in cost to \$120 million during the year. This cost escalation comes from enhanced recognition of the unique environmental characteristics of the semi-volatile organic compounds (SVOCs) and the growing scientific knowledge and public perception of the continually emerging threats of polycyclical aromatic hydrocarbons (PAHs; "coal tar"). Site remediation had been guided by the pioneer Canadian environmental engineering firm of Conestoga Rover Associates, then the third RP prime consultant that had been employed by the responsible parties (RPs). A 1 ha air emission control structure was erected. The latest closure date was October 2003 and 23 homes once adjacent to the original park have been abandoned and will likely be demolished. At issue is the nature and extent to which gas manufacturing residuals and wastes may have been dumped off the footprint of the original gas works, and later built-upon by developers. The known cancer cluster has not been dispensed with and one Illinois professional

engineer observer has noted to us that "Certainly it was not a successful project from a community relations perspective".

So severe has been the combined financial and sociopolitical impacts of this site that the RPs (Commonwealth Edison and Northern Illinois Gas; NiCor) have scuttled their plan for awarding a bid-shopped master consulting contract for site and waste characterization. The authors believe that as many as 70 FMGPs would have been subject to this effort.

While the utility industry continues to defend itself against increasing calls to address health and environmental effects of gas works residuals and wastes, individual energy companies have been withdrawing their financial support for the Gas Technology Institute (GTI), Des Plaines, IL. GTI is the hard-times survivor of the merged Gas Research Institute (GRI) and the Institute of Gas Technology (IGT), founded at Chicago in 1941. In response, GTI was forced to discharge perhaps half of its technical staff in December, including some of its key expertise in FMGP remediation.

10.3. Radioactive waste management and cleanup

Truly hazardous wastes are threats to the environment mainly because of their relatively high toxicity and long lives. Radioactivity maximizes both of these threats and geological emphasis on site and waste characterization therefore take on the highest imperative for competence and quality in their conduct.

10.4. Low-level wastes (LLW)

Recognizing a long-term international gap in dealing with radioactive wastes, USEPA (18 November) gave advance notice (<http://www.gpoaccess.gov/fr/index>) of a new low-end category of wastes with detectable radioactivity, below that currently defined as representing low-level wastes. These "low-activity wastes" are proposed for disposal with hazardous wastes.

10.5. High-level wastes (HLW) cleanup

USDOE, the huge-spending American Energy Department, known for its intrigues and "sweetheart" deals with favored contractors, has announced that the

Los Alamos National Laboratory management contract will be opened for full competition in 2005, after more than 50 years of control by the University of California, the original WWII atom bomb site contractor. Fairness has not been the greatest of motives, for Cal has been held responsible for a number of serious problems that emerged in the past few years, including the spy activity conducted on campus by China.

DOE has traditionally made much “noise” about including “stakeholders” (likely to have given birth to that marketing term) in its remediation deliberations. Not so at the old Cold War Fernald (named oddly for the US Government’s early 20th century expert on manufactured producer gas technology) weapons plant at Portsmouth, OH, where both the Ohio and Federal EPAs have charged DOE with “not allowing for sufficient outside input at a time in which DOE is moving strongly to “risk-based end-state vision” cleanup objectives. This is a new concept worthy of DOE’s struggle to spend huge amounts of money in its “forever” cleanup mentality.

10.6. High-level waste repository—Yucca Mountain, USA

Useful regulatory lives of many nuclear power plants are coming quickly toward their ends, and the world as a whole, excluding France (the leading high-level waste reprocessor), still has not solved the massive sociopolitical problems of long-term management of spent reactor fuel. This year we learn that some 42 of America’s 110 operating nuclear power plants have been judged by the Congressional watchdog office (General Accounting Office) not to be contributing enough set-aside funds to meet their eventual decommissioning costs. GAO further says that another 31 plants have lowered their contributions to insufficient rates as well.

Meanwhile, the State of Nevada, America’s least populated place, has “gone to bed” with six environmental groups to challenge the selection of Yucca Mountain, Nevada, as the final repository for over 70,000 tons of HLW from Cold War weapons manufacture and all of the HLW from America’s nuclear power stations. DOE’s final cost estimate is \$60 billion, with reception of incoming waste in 2010. The challengers are in the U.S.

Circuit Court of Appeals, Washington, DC, the favorite place of challenge of anti-management environmental movements. The suit argues that this attempt to place HLW in a national repository is flawed in terms of the Constitution, regulatory rules, and scientific concepts of environmental protection. The group aims next to appeal to the U.S. Supreme Court in the event that they are not successful in blocking the highly needed repository. In the interim, most NPS wastes are stored at the generating plants, constituting yet another potential target for terrorists.

11. Nuclear power

During the year, we became aware of the huge dichotomy over the Kyoto Accords (efforts to combat degradation of the ozone layer from combustion of fossil fuels) and the national position of France. France produces some 80% of its national energy using nuclear breeder reactors and the nation is steadfast in its acceptance of spent nuclear fuel for reprocessing, largely to maintain the French reliance on nuclear power and to recognize the Kyoto objectives.

France claims that it can deliver a functional breeder-reactor nuclear power plant in just 5 years, yet much of the remaining First World still relies on fossil energy. It was France that gained the lead in the actual manufacture of nuclear reactor components as early as 1970, when its biggest customer was the United States. Should there be a return to nuclear energy, *Engineering Geology* will be foremost in providing the expertise by which nuclear power plants can be safely sited, permitted, operated and maintained.

12. Water and groundwater

Rising populations and human aspirations for quality of life have placed huge emphases nearly everywhere on water supply. For geologists, these concerns breakdown to prospecting, storage, transmission and water quality protection, all of which require geologic characterization in order to be effective.

12.1. Water supply

Just at the time when First World environmentalists are fighting to decommission reclamation dams, the arid countries continue to suffer not only droughts, but the need to foster sustainable agriculture on a national basis. The call for dams on the upper Nile River brings into play yet another round of regional geopolitical difficulties. Egypt, however, is not seeing the potential benefits of losing some Nile water to irrigation storage for Ethiopia, in which the latter will trade water for less siltation in the former. The international development banks now are favoring the growth of food at home rather than heroic efforts to feed starving peoples during recurring famines. Incidentally, there will be a call for hydropower generation to support regional food sustainability.

12.2. Al Masarrat Aquifer in Oman

The rapid population growth and the fast pace of development in the Sultanate of Oman have, among other things, resulted in an increased demand for water, which, in turn, has increased pressure on available water resources. The government has devoted considerable efforts to address this challenge, mainly through the development and methodical exploitation of available water resources. A major accomplishment in this regard is the Al Massarat water supply project. Aimed at generating more than 8 million cubic meters of water per year and providing more than 115,000 people with safe water, the project is considered the biggest in the Arabian Gulf region.

Located within 200 km west of the capital city Muscat, the Al-Masarrat aquifer is primarily composed of alluvium and soft clastics. The mean annual rainfall in this arid area does not exceed 150 mm and thus the groundwater reserves are of utmost importance. At the moment, the Sultanate is engaged in the extension of Al-Masarrat water project to supply other villages and towns not covered in the first phases of the project. At the beginning of this year, the ministry began expanding the project by extending subsidiary water pipes to remote villages located far from urban centers. Here water supply was being used to counter the human urge to move into urban areas.

12.3. Groundwater resources development in Thailand

Consultants play an important role in many groundwater projects in SE Asia. The Thai Department of Groundwater Resources has completed a consolidated program of national evaluation of groundwater resources potential of the many separate groundwater basins of Thailand and the resulting information will be used to safely manage those resources.

12.4. Remediation of polluted ground water supplies

Solutia, the 1997 daughter of PCB-creator (1928) Monsanto, has spent \$54 million in removal of PCBs at Anniston, Alabama USA, much of it from residences of disadvantaged people who used contaminated foundry sand home improvement projects. Solutia has found that at least some of the foundry sand also bears heavy-metal contamination (lead, cadmium and arsenic) that is not linked to PCBs sourced from Monsanto. Using geologic evidence Solutia is countersuing 19 metal fabricators in the area for recovery of some of its SUPERFUND cleanup costs. Fate and transport studies are required and we know that these will not be successful unless site and waste characterization are applied at a high-level of planning and expertise of conduct. At yearend, Solutia filed for Chapter 11 bankruptcy protection.

13. Underground construction

We have the strong impression that underground construction experienced a banner year in 2003. Of all the fields of the engineered and constructed environment, the use of the underground will expand, virtually unimpeded, for it caters to optimal use of space in the crowded urban environment and in virtually all other situations in which access and passage are hampered by surface features. We believe this is a bright area for younger geologists, though gaining entry to the field requires patience, diligence, tenacity, and the influence of caring “insiders”. We advise that the optimal path is to choose a graduate program in a University department with a highly

competent specialized faculty who has contact with and the respect of the underground construction community.

Application of geology to the design, construction, operation and maintenance of tunnels and other underground structures has always been one of the most demanding challenges. Preparation of Engineering Geologists for practice underground has perhaps become only more complicated under the far-reaching effects of commoditization of professional services. This overall force has been repeatedly cited in this report as the most damaging of all external influences to the profession. The reader is reminded that the malaise was generated by the U.S. Department of Justice beginning in 1970 with its enforced sanctions against the professional societies, which insisted that consulting engineers and geologists be selected for retention based on qualifications and not price. Sadly, price now rules, to the detriment of the profession and to society at large.

13.1. Tunneling

Unimpeded advances in excavation equipment and muck-handling capacity continue to meet expanding worldwide needs for underground space, both to accommodate the pressures of urban population growth as well as dealing with progressively poorer surface ground available for siting. Tunnel geology is one of the more complex subdisciplines of our naturally complex profession. Insiders tell us that the average age of seasoned Engineering Geologists is hovering very near to that of typical corporate retirement. At the same time, breaking into worthwhile career assignments in tunnel geology remains as it ever was, extremely difficult. The combined effect is that the insular field of tunnel geology remains isolated and non-replenishing in terms of practical experience. Since most of the historic academic instruction has been in departments of geological and mining engineering, and these are withering, the solution is far from at hand.

Interested students, faculty, and younger practitioners interested in tunneling should avail themselves of the two excellent technical-trade journals, *T&T International* (<http://www.tunnelsonline.info>) and

Tunnels & Tunneling, as the industry continues to be close-mouthed and reluctant about publishing in our technical journals. Cited, of course, will be the usual sad-excuse routine about cautious owners and pending construction claims. A bright departure is the excellent review of tunneling in China's vast karst regions (by Engineering Geologists Wallace and Rule of Ove Arup Partners, 2003), and to Charles Daugherty's quarterly *Tunneling Committee Reports* in the *AEG News*.

13.2. Undercutting

German tunnel boring machine (TBM) manufacturer Wirth has bought forth its "undercutting" technology for use in reaming out pilot tunnels to larger diameter using radially repositioned cutter heads. This design displaces muck with each rotation of the cutting head, so that each cutter moves on a spiral trajectory causing face-rock failure in shear, a far more economical rock-breaking mode than compression. Wirth equipment has been used on its Tunnel Bore Extender (TBE) at Uetilberg, Switzerland, near Zurich, to expand its bore from an unlined 5 m to a final bore of 14.4 m ([World Tunneling, 2003a](#)). Each push-advance of the TBE is limited to only 20 cm forward, but the advance is completed in only 8 to 10 rotations of the head. The host rock is relatively weak-rock flysch. Cutter heads are mounted on six arms and each cutter furrow is tracked by an appropriate displaced cutter on the next cutter arm, thus shearing the rock to failure along a weakly positioned ridge and furrow pattern. The entire TBE trails 180 m, making it extremely long by way of comparison to most TBMs. Judging from the schematic diagram, tunnel geologists should have adequate observation space for wall mapping during progress.

A second notable German advance in bad-ground tunneling has been brought forward by Herrenknecht and applied to the Arrowhead Water Supply Tunnel in Southern California, closed since 1999 due to high-pressure cleft-water flow in the pre-Cambrian crystalline "basement" complex of the San Bernardino Mountains. The shielded full-face TBMs are equipped for rapid installation of pre-cast, gasketed segments capable of resisting 30 bar hydrostatic pressure ([World Tunneling, 2003b](#)).

13.3. Tunneling as a career geologic specialty

There is no doubt but that tunnel geology is a well-established but underplayed career specialty. Two factors, however, make it difficult for entry-level geologists to gain access to career employment in this field:

1. The “industry” is content to continue to ignore the universities and the universities remain essentially ignorant of the geologic protocols useful in tunneling and of employment paths into that corner of the profession.
2. The industry is a “chummy”, old-boy network that focuses its attention inwardly.

13.4. Dispute review boards (DRBs); form of alternative dispute resolution (ADR)

This unique form of negotiated settlement grew out of the now-defunct US National Committee on Tunneling Technology in the early 1970s and has matured over three decades into a powerful tool to resolve construction industry disagreements and disputes. Raymond Henn reminds us that the first recorded use of the DRB process was in 1975, for the second bore of the Eisenhower Tunnel for the Colorado Department of Transportation. DRBs are now widely used, not only in underground construction disputes, and have spread to include highway, bridge, and conventional building construction as well. DR Boards generally have three members, one appointed by the owner, one by the contractor, and one mutually agreed upon. Parties to the contract agree to general resolution terms before beginning construction. As we might imagine, DRB can be conducted more quickly and cheaply to mitigate the risks associated with unknown or undetected geologic site conditions that lead to changed designs and/or lengthened construction times.

Your authors proclaim, however, that most DRB, ADR and litigation cases stem from the two basic causes: (1) incomplete or inaccurate geologic site characterization; and/or (2) contractor incompetence or mistakes. And, the owner does not go free of consideration either, for some of these problems stem from owner insistence on cutting, paring or

bid-shopping its site characterization effort to levels less than are required to deal with site geologic complexities.

14. Risk assessment and probability

We have never seen fit to elevate this category of work in our report to a full-heading status. Now, we have good reason to do so. Appearing in 2002 was a remarkable book written by a geotechnical engineer member of our profession, Steven Vick, P.E. of Denver, CO. The take-note title is *Degrees of Belief* and of his work, Vick says:

In this one book, the Engineering Geologist can find example and comfort for dealing with risk assessment and probability in an honest and scientifically forthright manner. For too long, most of us have allowed others to step forward, usually to some degree of ignorance of the geologic truths that anchor engineered works to the natural environment, and deliver precise sounding predictions rooted mainly in fantasy.

Close attention to Vick’s book will assist the reader in developing a personal philosophy of how their work product can be useful in dealing with risks encountered in the application of any part of engineering geologic expertise.

15. The literature

Your senior author is very familiar with the trends and impacts going on at our own three leading journals; *Environmental and Engineering Geology*, *Engineering Geology*, and the *Quarterly Journal of Engineering Geology and Hydrogeology*. There is no denying that the task of eliciting and processing incoming manuscripts has become a major problem for editors and editorial boards. By early 2003, it became quite clear that shortages of worthwhile manuscripts are directly related to lack of support from university administrators, and consulting firms, the latter another of the down-sides of the rampant situation of bid-shopping.

15.1. Trends and changes

Our teaching colleagues in the UK have been subjected, as with all UK academics, to a hateful productivity rating made up of a numerical assessment of how frequently their published works are cited in the literature. This detrimental idea has now been carried over to the journals that have been rated under the UK Research Assessment Exercise. The result is that one of our three fine engineering geology journals, internationally (QJEGH), has been placed in direct rating competition with its own sister, the *Journal of The Geological Society* (London), and the latter comes out with a distinctly higher worth-rating than does QJEGH, where we practitioners look for meaningful citations.

Furthermore, we are told that the “popular” high-science journals *Nature* (UK) and *Science* (USA) are considered to be the “gold standard” among the rated literature. We all know that these two journals are indeed prestigious and worthwhile, but, in fact, we do not read them nor do we think about publishing in them. In terms of academic promotion and tenure retention, consultancy reports and assignments now have a zero factor in the UK, further depriving students of the huge and proven benefits of learning from faculty who have the pulse of the profession at their fingertips.

15.2. A UK viewpoint

Perhaps we must respond to the literature challenge as individual professionals who have a commitment to the calling of being Engineering Geologists.

In the words of one of our prominent British university faculty we are heartened:

I am someone who has spent 15 years in industry followed by 9 years in academe. I know that the case studies that interest my undergraduate and graduate students come from my own files and represent examples of actual industrial problems that I investigated. They might never reach the pages of *Nature* or *Science* but I know they will inspire future generations to enter our subject area, and that is more important than just preaching to a few isolated ‘ivory tower academics’. I will continue to publish in the engineering geological journals because that is where the practitioners will

look—they might not have the time to write papers themselves and cite my work but I know from correspondence that they do refer to it and use it, which surely is more important.

15.3. Site assessment and remediation handbook, 2e

Though we have generally given up the practice of reporting on individual publications in this report, the issuance of *Site Assessment and Remediation Handbook*, by Martin N. Sara (2003), merits our attention. This fine book is the most useful single source of method and technology dealing with site characterization for waste management facilities and for hazardous waste cleanup as well. Mr. Sara furthermore is to be congratulated for he has always been a hard-pressed practitioner in the private sector (ERM).

15.4. Arrival of the internet revolution in technical environmental literature

In 2003, USEPA provided unlimited public access to its huge, searchable *Science Inventory* database. The value of this gratis service, to all practitioners, is immense (<http://www.epa.gov/si>).

USEPA also began a gratis monthly update service whereby we may learn of the agency’s newest releases. This constitutes invaluable sources in the environmental arena (<http://www.epa.gov/ncepihom>).

Furthermore, the National Environmental Publications Internet Site (NEPIS), a collection of over 7000 full text publications, can be viewed, searched and printed on line: (<http://www.epa.gov/clariton>).

15.5. Looming dimensions of the worldwide water shortage

This was the year of emergence of long-term concerns over water as an essential factor in human life. There is little doubt that the next generation of Engineering Geologists must be cognizant of the principles involved in aquifer storage and recovery, reclamation of urban sanitary wastewaters and desalination. In recognition of the coming need to transport more potable water, Emeritus Missouri State Geologist J. Hadley Williams, predicts an emergence of long-distance water supply pipelines. We tend to agree with that prediction.

15.6. Increasing environmental awareness in SE Asia

The Philippine Department of Environment and Natural Resources has revitalized the mining industry to include appropriate environmental protection, and the premier campaign has been cleanup of the 1996 mine-tailings spill incident and subsequent tailing dams of the Diwalwal area. Also, geological site assessments have identified 47 favorable solid-waste disposal sites. Continuation and expansion of the program, however, requires allocation of additional financial support from the Philippine government (<http://www.mgb.gov.ph>).

Civic environmental action groups have begun to protesting large engineered regional development projects in the region. For example, the Thai-Malaysia gas pipelines involve the bilateral development of natural gas reservoirs located offshore of the Thai-Malaysia's boundary. Also coming along is the mega-project "Land Bridge Project" to transport petroleum from the Indian Ocean to the Pacific Ocean across Thai-Malaysian peninsula in southern Thailand.

15.7. Government environment and resource reorganization in Thailand

We are proud that our prominent brother as Dr. Prinya Nutalaya, retired professor of geology at the Asian Institute of Technology, became assistant to the Minister of Natural Resources and Environment of Thailand. This appointment follows the reorganization of the national Department of Mineral Resources, Ministry of Industry, and its Division of Environmental Geology and Geohazards remains intact. Roles of engineering and environmental geoscientists are expected to be enhanced and many applied geologists were busy moving and adapting to new working places and colleagues in 2003. Coincidentally, the Division of Groundwater Resources was separated from the Department of Mineral Resources and expanded into a new operating department under the new Ministry of Natural Resources and Environment.

16. Public safety activities

Most Engineering Geologists produce a work product that is somehow related to public safety. It is for

that very reason that the profession needs to embrace concepts and controls that will promote competence in its members, as well as to protect the public from those who are not capable of delivering accurate and responsible work product.

16.1. Professional licensure

We must not forget that the public warrants protection from those individuals who are unqualified by virtue of training or basic competence to offer services as geologists, particularly in the sense of health, welfare, and public safety. We are pleased each year to take note of advances in this sector of our practice.

16.2. European geologists

The European Federation of Geologists (EFG) met in June 2002 to elect a new Board for the period 2002–2005. The incoming President is Christer Ackerman (Sweden), and David Norbury (UK) was elected General Secretary. A key role of the EFG is to gain wider recognition for the Chartered European Geologist title, EurGeol, as a vital step towards benchmarking standards across Europe. The EFG also aims to expand its influence in the European Union. Three national geological societies (Ireland, UK and Spain) were granted licenses to award the EuroGeologist title to suitably qualified persons and progress in underway to establish a central licensing body for Europe.

16.3. Thailand

National licensing of geologists is being proposed as a requirement for environmental impact assessments (EIAs) in Thailand. EIAs now are generally required for major civil works, water resource projects and all manner of mining. Early Thai EIAs previously often were completed without participation by professional geologists and the licensure move is made to correct that great deficiency.

16.4. Washington State

The Washington State Legislature has passed legislation that establishes professional registration for

Geologists (<http://www.dol.wa.gov/design/geofront.htm>).

16.5. Consultant review boards

Public construction projects have long been subjected to Boards of Review of Experts, constituted to provide peer-review of the database, assumptions, and designs developed by the project's design engineers. Most of these boards have traditionally been staffed through closed-“network” selection. Now, California's Department of Water Resources has formally advertised for an Engineering Geology Consultant and a Geotechnical Engineer for its Dyer Reservoir Independent Consulting Board. We hope that this is a sign of truly “open” selection.

17. Techniques and technology

It remains incumbent upon all of us to become aware of changes and improvements in the technology of our practice. This year, we have detected the following developments.

17.1. Risk-based waste cleanup objectives

This concept has been lurking about since the early 1990s. Scenarios for human-receptor exposure are developed to match competing “alternatives” for selection as the objectives for remediation and closure of uncontrolled hazardous waste sites. Most geologists regard the concept as being highly flawed because Responsible Parties are allowed, to a degree, to design and conduct their own site and waste characterization, the results of which then form the basis for subsequent risk analyses. Again, this is a grand example of the fox guarding the chicken coop. For our concern, the US DOE has chosen “risk-based end-state visions” as its process to examine proposed and completed site remediation efforts. The question remains: how complete and accurate were the site and waste characterization efforts? Was the effort bid-shopped?!

17.2. Fullerenes—a lesson from organic chemistry

The late R. Buckminster Fuller (1895–1983), architectural engineer developer of the geodesic

dome, also brought organic chemists to discover the propensity of carbon-ring molecular structures to form significantly large “fullerene” cages resembling the form of soccer balls. We think that this chemistry will unfold to explain much about the now-unknown species of PAHs and associated carcinogenicity. There will be much for application here by Engineering Geologists working in the field of environmental pollution. Further treatments suggest that substitution of sulfur and nitrogen atoms may open up windows or doors in fullerenes capable of capturing and secreting the large H₂ atom, which has tremendous implications for cheap energy sources. At the same time, the cautious doomsayers of environmental chemistry are suggesting that combustion of hydrogen-entrapping carbon fullerenes will create excess water vapor in the atmosphere and that will extend the hole in the ozone layer.

17.3. Naphthalene

Once the bane of manufactured gas plants, this ubiquitous two-benzene-ring PAH is the stuff of mothballs and the most lasting and mobile of the LNAPL groundwater contaminants at former manufactured gas plants. We understand that USEPA is about to declare this duocyclic PAH a carcinogen, along with its one-ring sister benzene. This compound will not be on the required search and evaluate list for risk assessments applied to coal tar sites. We reported USEPA's referral of naphthalene to the National Institutes for Health last year.

17.4. A constructive use for fly ash

Many practitioners have had considerable experience in working up sites for utility generation fly ash, a burdensome solid waste resulting from air-pollution capture of power plant emissions. The quantities are huge, and elemental chemistry of the wastes, largely dependent upon the lithologic nature of the feedstock coal, can harm groundwater quality through released leachate. Now we are pleased to learn of a multinational effort (EMC Cement, Amsterdam, Verbier, Switzerland, and Ready Mix Concrete, Jasper, TX) will begin to produce a fly ash pozzolan alternative to Portland cement (<http://www.fewreadymix.com>) con-

taining 90–95% fly ash as calcium silicate hydrate as hardened concrete. EMC claims the concrete will harbor fewer microfractures on shrinkage and will be cost-competitive. This innovation could recycle huge quantities of fly ash and reduce the open-pit recovery of limestone as well.

17.5. Lesser-world competition for technical services

Notable this year was the functional startup of employing technician-grade specialists in overseas locations to service contracts marketed in the First World on price-competitive bases, then shopped out via e-mail to workers living in Lesser-World economies. We do not comment on the ethics of the process, only warn our readers that the practice can only grow. In 2003, this job-shopping got as close as competitive-bid aerial imagery products sold in the First World and completed elsewhere using global remote imagery and e. transmission of results to the home nation.

17.6. International manual for low-volume roads

Engineering geologists frequently become involved in layout, material supply and construction of low-volume roads, particularly in the developing world, where the roads provides the means for agricultural sustenance and trade. A manual for planning, constructing and maintaining these roads has been underway for a decade, directly mainly by geotechnical engineer Gordon R. Keller, P.E. of the Plumas National Forest, U.S. Forest Service, in California. Now the manual is available on the Internet, courtesy of the International Road Federa-

tion (2003) and can be downloaded courtesy of the German Agency for Technical Cooperation (GTZ), at <http://www.zietlow.com>.

Acknowledgements

We wish to thank the following contributors to this year's report: Emeritus Missouri State Geologist, James Hadley Williams; Dan Kelleher, of EarthTech, Chicago; Dieter D. Genske, EGS-Network Environmental Sciences, Bern, Switzerland; Judy Ehlen, U.S. Army, Engineer Research and Development Center, Alexandria, Virginia; Joe Cobbarubias, Los Angeles Country Engineer's Office; Douglas Hambley, Chicago; Raymond W. Henn, Haley and Aldrich, Denver, CO; and Editor-in-Chief Dr. Ellis L. Krinitzky, lastly for his in-depth review.

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