The background of the entire page is a landscape photograph. In the foreground, there are rolling hills with some green vegetation and a few buildings. In the middle ground, there is a large body of water, possibly a lake or a wide river. In the background, there are more hills and mountains under a clear sky.

NIST



ICMA

CHINA BROWNFIELDS REMEDIATION
A STANDARDS IN TRADE (SIT) WORKSHOP
Chicago, IL • September 1, 2015

Final Report
October 20, 2015

Prepared by
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For the
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Executive Summary

This report summarizes the presentations and discussions of the Standards in Trade Workshop on China Brownfields Remediation held September 1, 2015. Sponsored by the National Institute of Standards and Technology (NIST), the International City Management Association (ICMA), and the U. S. Trade and Development Agency (USTDA), this workshop introduced a group of Chinese environmental experts from government, business, and academia to U.S. best practices in brownfields remediation. In addition, the workshop provided an important opportunity that enabled seventy-six environmental practitioners and leaders from the U.S. and China to share their knowledge, perspectives, and experiences. The workshop agenda presented an overview of the key topics that must be addressed in a brownfields remediation project, including: development of the site conceptual model and site evaluation, management of a contaminated site, standards for assessment, risk management and remediation, testing and data management, groundwater and soil remediation, and the use of biochar for remediation. Workshop participants were unanimous in their appreciation for this event and the need for future engagements to support sharing of best practices and remediation techniques.

1. Introduction and Overview

NIST's mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life.

Since 1995, U.S. industry has looked to the NIST Standards in Trade (SIT) program to provide opportunities for cooperation on important topics related to standards, conformity assessment, and trade that are vital to the success of their businesses. SIT workshops are designed to introduce U.S. stakeholders to emerging standards and conformity assessment issues in other countries and regions, identify regulatory information and market access issues, and provide timely information to foreign government officials and business leaders on U.S. best practices in standards, metrology, and conformity assessment. Improved understanding of U.S. standards, conformity assessment, and regulatory practices by foreign governments and private sector officials provides an important basis for improving trade opportunities in key foreign markets, particularly those where standards and conformity assessment practices differ substantially from those in the United States.

Each SIT workshop is targeted to aid U.S. industry in becoming more competitive in foreign markets through increased transparency of market and regulatory requirements and/or promotion and use of U.S. and international standards, as well as U.S. approaches and information exchanges, thus increasing trade opportunities and exports. The goals of the SIT program are directly aligned with the U.S. Department of Commerce and NIST missions, and it is a major activity of the NIST Standards Coordination Office.

NIST organizes SIT workshops for domestic and international audiences and has conducted over 50 workshops in the U.S. and abroad on a wide variety of topics ranging from roadway infrastructure and safety to information technology, and building and construction codes to renewable energy and lighting. The SIT workshop on the topic of brownfields remediation took place in Chicago, IL on September 1, 2015. This date and place were chosen so that workshop attendees could further benefit from the 2015 National Brownfields Training Conference that took place immediately afterward on September 2-5, 2015.

Environmental protection and brownfields remediation are matters of great concern in China. A study of brownfields remediation and redevelopment in China issued by the World Bank in 2010 concluded:ⁱ

Poor industrial planning and inadequate pollution management in the past have made land contamination a serious problem in China. Rapid urbanization in recent years has resulted in the need to redevelop industrial land once occupied—and contaminated—by old industries, which has resulted in several high-profile pollution-related incidents that have increased environmental concerns over land reuse and which have helped bring the issue of brownfields remediation and redevelopment to the forefront... Both the

ⁱ Jian Xie and Fasheng Li. Overview of the Current Situation on Brownfields Remediation and Redevelopment in China. September 2010. The World Bank, Washington, DC. Discussion Paper 57953.

central government and city governments in China have begun to take action to control land contamination, emphasizing the remediation of polluted lands for the purpose of urban development.

The national Chinese government has identified environmental protection as a primary national objective.ⁱⁱ The need for the adoption of environmental standards and the application of appropriate technology to support environmental protection and remediation is now being recognized.

The U.S. has significant experience in the development of environmental improvement and remediation technologies.

The SIT workshop on brownfields remediation was held specifically to bring selected U.S. technology/specialty companies and standards and scientific experts together with selected Chinese government leaders from the national, provincial and/or city levels to provide accurate and timely information on the required standards, testing and analysis, and processes required to support successful brownfields remediation. The workshop provided participants with valuable information and experience on the key factors involved in addressing the remediation of contaminated sites and related water contamination issues, as well as underscored the purpose and relevance of standards and conformity assessment. It was particularly successful in forging new relationships that are needed to advance brownfields remediation in China and elsewhere.

The workshop was co-sponsored with the International City/County Management Association (ICMA) and the U.S. Trade and Development Administration (USTDA).

ⁱⁱ China's 12th Five Year Plan.

2. Workshop Structure

Standards in Trade Workshop: China Brownfields Remediation

September 1, 2015
Hilton Chicago Hotel
Chicago, IL.

<http://gsi.nist.gov/global/index.cfm/L1-4/L2-14/A-770>

This workshop was structured primarily for U.S. brownfields remediation experts to provide information to Chinese participants and to provide the opportunity for U.S. and Chinese participants to share their common interests. As a matter of protocol and to frame the discussion and workshop outcomes, heads of the U.S. and Chinese delegations were designated and each presented opening and closing remarks. NIST representatives emphasized the central role of standards and conformity assessment in remediation technologies as a

common thread throughout the program.

Simultaneous translation of the presentations was provided to enable all members of the multinational audience to participate actively. A series of talks providing an overview of U.S. approaches to brownfields remediation formed the central core of the workshop program, covering the top technical issues, training requirements, standards processes, management approaches, and policy implications impacting brownfields remediation. The Environmental Protection Agency's (EPA) Assistant Administrator for the Office of Solid Waste and Emergency Response joined the workshop to welcome participants to Chicago and introduce the Brownfields 2015 Conference, which EPA co-sponsors. A special presentation by Tad McGalliard expanded on the Conference highlights to help prepare participants, who were escorted by workshop personnel and interpreters throughout the Conference, to participate fully in Conference events.

Throughout the day, breaks and meals offered informal networking opportunities, as did a special reception sponsored post-workshop by the publisher, Mandarin Environment. A list of workshop attendees is provided in Appendix B.



Participants listen intently during the workshop.

The workshop agenda is provided in Appendix A. Workshop presentations are summarized below, including the opening presentations to frame the discussion, the presentations on specific brownfields remediation topics, and concluding remarks. Biographies of the speakers are provided in Appendix C. Where available, photos of speakers at the workshop are included.

3. Opening Session: Summary of Presentations

The following summarizes the opening presentations, which introduced the workshop themes and framed the discussions.

3.1 Welcoming Remarks



Gordon Gillerman of NIST welcomes participants to the workshop.

Mr. Gordon Gillerman, Director of NIST's Standards Coordination Office, opened the workshop with welcoming remarks. He discussed the important role of standards, with emphasis on the role that standards play in helping to reduce the burden on industry in marketing technology to other countries, thereby enlarging the opportunity for trade.

He noted the similarity of NIST with its counterpart in China, known as the National Institute of Metrology (NIM), and the importance of the ability to make scientific measurements,

which is especially important in brownfields remediation.

Mr. Gillerman reflected on his experience in the development of standards, and discussed two key lessons learned. First, harmonized standards development is better for all stakeholders. Second, certification and testing should not be a burden for the stakeholders who are trying to abide by the standards.

Mr. Gillerman concluded his remarks by saying he looked forward to the information exchange, and expressed his hope that the U.S., China, and other countries can address the issue of brownfield remediation together.

3.2 Remarks by the Head of the U.S. Delegation

Robert D. Agee, Assistant to the Mayor of Annapolis, MD, and ICMA Consultant, provided opening remarks and discussed the evolution of U.S. brownfields remediation and the expectations for this workshop.

Mr. Agee reminded the group that 150 years of rapid industrialization in the U.S. caused widespread water and soil contamination. It was not until forty years ago that the U.S. took the first steps toward addressing the resulting severe environmental problems. Agee observed that, in this sense, China has been experiencing a similar process.

While brownfields redevelopment began twenty years ago as a handful of projects in a few countries, it has now become a widespread practice. Experience has shown, however, that there is opportunity to improve the approaches to brownfield remediation. This workshop is a way for the China delegates and others to benefit from U.S. experience.

Mr. Agee emphasized that there is a heightened level of commitment of the Chinese government to address environmental improvements, as environmental quality is becoming inseparable from social

harmony and economic growth. The establishment of the Ministry of Environmental Protection (MEP) is one demonstration of this commitment.

Mr. Agee expressed his hope that a series of China-oriented national brownfields workshops and conferences will assist in the development of new tools, approaches, financing, and a business structure necessary to support a robust and effective brownfields assessment, cleanup, and redevelopment marketplace. Furthermore, Agee noted, this workshop will lay the foundation for expanding the discussion and cooperation between China and the U.S., as well as connecting with those experienced in the business of successfully resolving contamination problems.

Mr. Agee reminded the group the benefits of brownfields remediation, including:

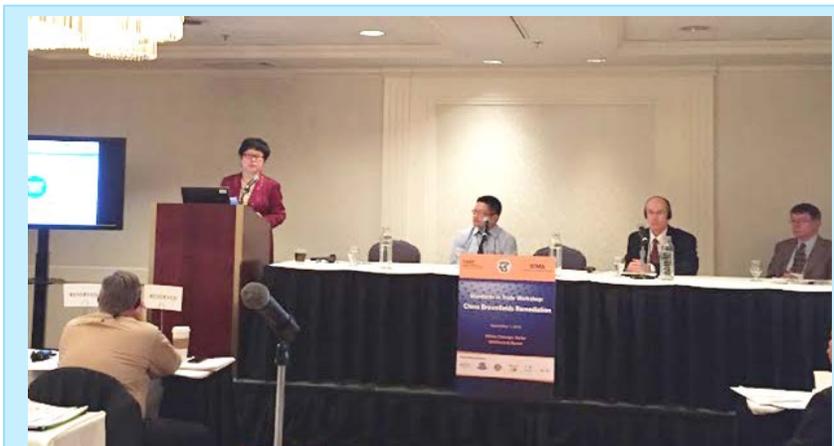
- it is good for the overall environment;
- it is good for people's health;
- it is good for the economy; and
- it is good for restoring damaged and stressed land and waters.

He concluded his remarks by reminding the audience of the heart of the Athenian oath, recited by citizens of Athens, Greece over two thousand years ago: We will leave our city better than we found it.

3.3 Remarks by the Head of the China Delegation

Ms. Wenchao Zang, Deputy Director and Chief Engineer, Solid Waste and Chemicals Management Center (SCC), Ministry of Environmental Protection (MEP), People's Republic of China, provided her remarks as the head of the China delegation. She focused on current brownfields remediation management in China and her expectations for this workshop.

Ms. Zang expressed her appreciation for the opportunity to participate in the workshop. She remarked that there had never been a delegation from China to discuss brownfields matters, nor the opportunity to participate in the Brownfields



Ms. Wenchao Zang presents opening remarks on behalf of China's Solid Waste and Chemicals Management Center (SCC), MEP.

Conference that took place immediately following the workshop.

Ms. Zang reviewed the role of the SCC, including:

- research on relevant policies, laws, strategies and technical standards on solid waste and chemicals;
- information analysis, technical service, training and social consultation; and,
- environment management of brownfield and the heavy metal pollution prevention and control.

Ms. Zang provided an overview of China's investigation into soil pollution, pointing out that 29.4% of industrial parks and 21.3% of solid waste disposal sites investigated exceeded industry standards. Since 1995, China has steadily increased its attention to brownfield remediation. In 2014, 335 remediation projects were conducted in China, with over 57% of the remediation projects focused on soil remediation and 29% on surface water remediation.

Ms. Zang emphasized China's commitment in environmental protection by discussing the newly revised Environment Protection Law, which came into effect in 2015. Article 32 of the law is written to:

- promote conservation of air, water, and soil; and
- establish the system of investigation, monitoring, and remediation.

In response to this new law, SCC's strategy on brownfields management has been developed; this strategy is based on five key tenets:

- prevention,
- investigation,
- remediation,
- protection, and
- redevelopment.

In addition, draft standards for agricultural soil have been completed. Critical issues remain, however, including risk prevention, laws and regulation, supervision and penalties, demonstration, and market and funding.

Ms. Zang reminded the attendees that there are significant opportunities ahead in the areas of economic development, new ways to increase public awareness, and a need for increased international collaboration. Ms. Zang advised that China can benefit from collaboration with the U.S. in four specific areas:

- techniques, including type of equipment and technology used, and project management;
- training in engineering, construction and project management;
- communication, for example, conferences, public education and outreach; and
- management, for example, technical standards.

Ms. Zang concluded by stating her hope for fruitful exchanges in this workshop and the Brownfields Conference.

4. U.S. Approaches to Brownfields Remediation: Summary of Presentations

David Grossman, Director, ICMA International, International City/County Management Association (ICMA), moderated the series of presentations on U.S. approaches to brownfields remediation, beginning the session with an introduction to the topics and their importance. The presentations and the question and answer discussions that followed are summarized below.

4.1 Importance of Site Conceptual Models (SCM) in Remediation

A successful brownfield remediation project requires a holistic approach that considers technical, government and regulatory, remediation market/industry, community, and environment points of view. Mr. Yong Wu, Vice President for Operations, Jiangsu DDBS Environment Remediation Co., LTD, emphasized the importance of a site conceptual model (SCM) to providing a holistic point of view.

Mr. Wu reminded attendees that an SCM takes into account the different geological variables that need to be accounted for during a remediation project. For example, the local area's geographic elevation, geologic composition (e.g., type of soil or sediment), and hydrology (both above ground and underground) must be examined. Each of these variables affects the spreading of the contaminant, and affects the appropriate strategy and technology needed to remediate the contaminant. Site-specific information, including the concentration range and hydrogeological conditions, must be gathered and reviewed when evaluating a remediation strategy.

Mr. Wu noted that, in his view, the potential growth in the China brownfield remediation market is huge and likely comparable to the U.S. market, which is estimated to reach \$209 billion by 2033. Given that brownfields remediation is now an emerging market in China, Mr. Wu emphasized the need for proper regulatory control to minimize market inefficiencies and enable the development of a healthy remediation market.

Mr. Wu further provided his view of the top three gaps in China's current practice in the source selection process for brownfield remediation projects. Specifically:

- Investigation data on the brownfield site, as conducted by MEP or a third party, should be provided to the bidders; more time, a detailed budget, and a thorough review are needed during the investigation process.
- Potential bidders need an opportunity to conduct pilot projects on the brownfields site; this will assure proper selection and implementation of the most effective remediation approach.
- The technical review committee must be familiar with the site being remediated, so price is not the sole selection criteria, as all bidders will claim to possess the proper remediation technology.

Mr. Wu concluded his presentation by reiterating the need to be site-specific in considering brownfields remediation solutions, due to the nuances of site geography. He also stressed that realistic goals should be set and can be achieved by applying sound science and engineering to protect the environment and human health.

Importance of SCM Discussion:

During the question and answer session, Dr. Atal Salhotra inquired about current standards for soil remediation in China, and if any of these standards differ across provinces. Mr. Wu indicated that only general standards currently exist.

Ms. Linda Yang of Terracon inquired about Mr. Wu's view on the biggest challenge in the development of the brownfield remediation market in China. Mr. Wu reflected on the need for all stakeholders to be involved in the development of new standards that can nurture the market for brownfields remediation.

Finally, Mr. David Dixon of Roux Associates Inc. noted that several examples of remediation projects shared in the presentation were very expensive and noted that guidance is available to support less expensive, smaller remediation projects.

4.2 Management of Contaminated Sites

Dr. Atul Salhotra, Founding President of the Risk Assessment & Management (RAM) Group of Gannett Fleming, Inc., provided his insights on how to approach the management of a contaminated site.

Dr. Salhotra reminded the audience of the variability of brownfield sites. This variability can come from the facility type, which may include landfills, gas stations, pipelines, manufacturing facilities, pesticide formulating facilities, or military installations. There is also a large variability in the type of contaminants encountered, among them pesticides, hydrocarbons, metals, radioactive materials, personal care chemicals, solvents, and unexploded ordnances. The challenge is how to manage these sites so they do not cause risks to human health and the environment.

In his experience, Dr. Salhotra has found that the proper management of a brownfield remediation project will need to balance three key elements: site characterization, risk assessment, and risk management.

Site characterization is needed to understand the project risk, identify and implement risk management, confirm stability of impacts of remediation, and understand fundamental processes (e.g., hydrology) that affect chemical behavior. The data needed in site characterization includes:

- source characteristics (size, location, chemicals of concern);
- land use and building characteristics (current and future);
- spatial and temporal variation in concentrations in soil, groundwater, surface water, soil vapor, and sediments; and
- characteristics of media (soil, groundwater, surface water, soil vapor, indoor and ambient air).

Dr. Salhotra cautioned attendees that this data collection process needs to be guided to understand the site and develop conceptual models, avoiding data collection for its own sake.

Risk assessment (RA): Dr. Salhotra defined risk assessment as a quasi-scientific and regulatory process used to:

- estimate risk based on site-specific factors and concentrations—this is known as the forward mode of RA (FMRA); and
- estimate cleanup levels based on site-specific factors and acceptable risk standards—this is called backward mode of RA (BMRA).

Risk Assessment (RA) is needed to balance the desire to clean properties to pristine conditions with the limitations of technology and resources. RA includes activities that look at the toxicology of chemicals, transport modeling (how chemicals behave in the environment), and potential routes of exposure (ingestion, inhalation, and dermal contact).

Risk management (RM), the third component, is used to:

- decide whether calculated site risk is acceptable; and
- determine cleanup levels or other institutional controls if risk is unacceptable.

RM includes technical and non-technical considerations, such as policy choices, cost, stakeholder agreements, risk perception, institutional controls, and others. This is of particular importance because of the need for long-term monitoring and maintenance of the remediated site, including monitoring and maintenance of the containment system.

Dr. Salhotra discussed the specific training required for people working in brownfields remediation. In his experience, the business of brownfields remediation involves multiple stakeholders, long timeframes, is very expensive, is regulatory driven, and requires consistency and standards. Brownfield remediation also demands multidisciplinary skill-sets across such fields as geology, chemistry, toxicology, engineering, ecology, and data analysis, as well as policy and regulatory process experts. All of these characteristics affect the nature, content, and method of training required. In Dr. Salhotra's experience, on the job training and learning is key.

Salhotra stressed that the need for training is not limited to the people working directly to execute a brownfields remediation project stakeholders require training, as well. Stakeholders in brownfields remediation include service providers, regulators and first responders, industry, developers, financial professionals, insurance professionals, adjacent landowners, and media. Training should be customized for each stakeholder community.

Finally, Dr. Salhotra emphasized regulations and standards as key parts of the training. These are needed for reliability of analysis, cost containment, and risk management of the brownfields remediation process.

Site Management Discussion:

During the question and answer session, Susan Flakus of SBA asked for guidance on good reference and training materials that are used in the brownfield remediation industry. According to Dr. Salhotra, there are no suitable training materials due to the variability of brownfields projects. Salhotra suggested that a guide to best practices needs to be developed.

David Friedman of David Friedman Consulting LLC commented on the need for local authorities to receive more training so that they can assess the risk correctly. Dr. Salhotra concurred with this comment, and noted a certification program would be beneficial.

4.3 ASTM Committee E50: Environmental Assessment, Risk Management, and Corrective Action

Timothy Haley, Partner, Barnes & Thornburg, presented a review of the ASTM International’s approach to standards development and the established and emerging standards affecting brownfields remediation.

Mr. Haley explained that ASTM International is a globally recognized leader in the development and delivery of voluntary consensus standards. Today, over 12,000 ASTM standards are used around the world to improve product quality, enhance health and safety, strengthen market access and trade, and build consumer confidence. ASTM standards development is driven by the contributions of its members, which include more than 30,000 of the world’s top technical experts and business professionals representing 140 countries.

Mr. Haley described the ASTM committee structure. ASTM Technical Committees are formed to address specific industry needs. Subcommittees are established to address subsets of specialized subject matter. Subcommittees organize their expertise into Task Groups to write standards.

Mr. Haley explained in some detail the work of ASTM Committee E50, which pertains to brownfield remediation. The E50 Committee was formed in 1990. It meets twice a year, in April and October, with about 75 members in attendance. There are six technical subcommittees. This committee focuses on environmental assessment and risk management issues including environmental assessment, environmental management, corrective action due diligence, and sustainability. Committee E50 is currently responsible for 93 active standards and eight draft proposed standards.

Mr. Haley concluded his presentation with detailed introduction to three standards developed by the Committee E50:

- E 1527-13 Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessments Process;
- E 2600-10 Standard Guide for Vapor Encroachment Screening on Property Involved in Real Estate Transactions; and
- E 2790-11 Standard Guide for Identifying and Complying with Continuing Obligations.

As he discussed each standard, Mr. Haley emphasized 1) the need for the standards, 2) the basic components of the standard, and 3) its uses in context.

4.4 Public Site Assessment and Future Use Determination

Jim Powell, Director, Permitting Services for Mostardi Platt, focused on the components of a Phase 1 Site Assessment and the importance of using all available information—including historical documents, interviews, and site visits—to determine the implications of onsite contamination.

Mr. Powell described this approach to site assessment as the “due diligence process.” He explained that it encompasses multiple components, including:

- interviews with past/present owners/operators/occupants;
- review of historical document on the site (e.g., change of title);

- determine previous uses and occupants of the site via review of photographs and building department/land use records;
- research recorded environmental cleanup liens; and
- review government records, i.e. waste disposal, underground storage tanks (USTs), and hazardous waste handling and management.

Mr. Powell also emphasized the need for visual inspection. Items such as asbestos-containing materials, lead based paint, and lead in drinking water are not covered during a Phase 1 assessment but these factors can affect the value and risk of the remediation.

Mr. Powell used case studies to illustrate his points. In one example, a warehouse remediation project incurred an additional \$1,000,000 in cost due to lead paint removal. In another example, a property buyer conducted a detailed review of property records in a Phase 1 assessment and learned of the existence of USTs on the property, thereby avoiding a \$250,000 expenditure.

Mr. Powell concluded his talk by emphasizing that due diligence is critical to avoiding costly surprises.

4.5 Testing & Data Management for an Effective and Efficient Remediation

David Friedman, Technical Advisor, American Council of Independent Laboratories, gave an overview of test data gathering, management, and use for effective site characterization and remediation.

Mr. Friedman described several aspects of data gathering, data management, and data use that are important to assure that site characterization and remediation are done correctly, effectively, and efficiently.

Mr. Friedman reflected on the pitfall of collecting data without having clearly stated the questions to be answered. This leads to spending time and money to collect data that is not important or useful, or not collecting necessary data the first time. Asking the right questions before one begins any fieldwork is critically important. Gathering and using appropriate data is essential to assuring that:

- remediation is done correctly and in a cost-effective manner; and
- all stakeholders (regulatory officials, site owners, public) have confidence in the approach being taken to carry out the remediation and the quality of the work that was done.

Mr. Friedman reviewed key inputs that will help guide the data collection. The first is Conceptual Site Model (CSM), which is synonymous with SCM. The reason CSM is so important is that it shows the decision maker/project manager what is known about the site and what needs to be known to conduct a proper remediation. Data collection should focus on resolving the uncertainties identified in the CSM.

The Quality Assurance Project Plan (QAPP) is the master plan for gathering data. The QAPP describes the sampling, analysis, and other data gathering that is to be conducted, methods to be used, who is responsible for conducting each task, how the work is to be documented, and how the results will be reviewed to assure usability. For effective testing, it is important to:

- take the correct number of samples, of the correct type, from the correct places, and using the correct sampling techniques; and
- analyze these samples with the proper methods and for the correct contaminants.

Mr. Friedman then discussed data quality objective (DQO). The DQO is the degree of confidence that you want in decisions. It is the statistical certainty or uncertainty in a decision. To determine the DQO, one needs to:

- define the specific question(s) to be answered. (For example: What areas of the site are contaminated by heavy metals? Is the remediation process working? Has the site been successfully cleaned?);
- define the decision criteria;
- determine the impact of a decision error (For example: Would the mistake have adverse health consequences or, would it just lead to a bit more cleaning up than needed? Would subsequent testing identify and correct any decision errors?); and
- determine the level of uncertainty that key stakeholders are willing to accept in the decision or characterization

The DOQs will then drive the selection of the data analysis methods as well as the field-testing method.

Mr. Friedman's talk concluded with a list of valuable references on CSM, QAPP, and analytical methods.

Testing and Data Management Discussion:

During the question and answer session, a member of the China delegation inquired about U.S. approaches to ensure the quality of laboratory testing. Mr. Friedman described various U.S. laboratory accreditation programs, the EPA, The NELAC Institute (TNI), and ISO IEC 17025 laboratory quality assurance guidelines. He also noted the importance of conducting regular inspections of laboratories to ensure that the testing they are carrying out complies with the method-specific quality assurance requirements and the QAPPs pertinent to the specific testing being conducted.

A member of the China delegation also asked how test results are evaluated for accuracy. Mr. Friedman noted there are policies and practices in place to ensure the validity of laboratory data. Mr. Gillerman spoke to the importance of the international standard ISO IEC 17011 Conformity assessment -- General requirements for accreditation bodies accrediting conformity assessment bodies as an international accreditation standard for laboratory accreditation organizations.

4.6 A Brief Summary of the Site Assessment, Investigation, and Cleanup Process

Mark Zeko, Vice President and Principal Hydrologist, and David Bernier, Senior Project Geologist/East Coast Manager, of EEC Environmental, described effective approaches for groundwater and soil remediation. Their presentation focused on two aspects:

- managing remediation to minimize removal and disposal of "clean" material using investigation, conceptual models, vapor intrusion integration, and risk based remediation; and
- subsurface mapping to identify potential areas of contamination and contaminant flow—groundwater sampling and subsurface measurement techniques.

Mr. Zeko reviewed the three phases of environmental site assessment and cleanup, as follows.

- **Phase I:** Initial Review, including historical records review, site reconnaissance, and interviews. This is required to evaluate the property for potential environmental pollution, assess source and responsibility for pollution, and evaluate potential investigative steps.

- **Phase II:** Confirm or Discount. Sampling, testing, and data analysis to identify pollution. Define the vertical and horizontal limits of the extent of pollution.
- **Phase III:** Delineation and Remediation. Evaluate risks to human health and environment; pilot testing; cleanup technology selection; cleanup of pollution.

Phase 1 can be performed on any property, including undeveloped or agricultural land, gas stations, shopping centers, industrial or commercial buildings, and major industrial properties.

In discussing Phase 2, Mr. Zeko and Mr. Bernier reminded the attendees that sources of contamination are not always obvious, and a variety of coarse resolution and high-resolution assessment technologies are required to identify the source. They noted that different types of testing might be required in Phase 2 and that there are over 150 techniques available for soil remediation. For example, soil testing is needed to test for chemicals within the soil underlying a site. A variety of environmental testing may be required, targeting volatile organics, semi-volatiles, or metals. Mr. Zeko and Mr. Bernier provided multiple examples of remediation approaches and the associated technology including soil vapor extraction, in-situ bioremediation, and gas thermal remediation.

Groundwater and Soil Site Cleanup Discussion:

During the question and answer session, an audience member asked about the process of vapor intrusion, and how it differs in California versus other states. Mr. Zeko noted that, to his knowledge, only California uses the process regularly.

Kyle Kuwitzky of XOS asked why the process of X-ray fluorescence (XRF) was not more widely used as a method for site assessment. Mr. Zeko responded that, in his experience, he has found this laboratory method not to be repeatable in terms of data collection, making it difficult to use on a regular basis. In a related discussion, some audience members noted that they have used XRF with some degree of success.

4.7 Heavy Metals Soil and Water Remediation Opportunities Using Biochar Produced Through Biomass Waste Upcycling



Chuck Hegberg addresses the workshop audience.

Charles Hegberg, Senior Environmental Consultant at Skelly and Loy, Inc. presented the final talk of the day. He focused on biochar, a charcoal produced from organic matter (biomass waste). Biochar is a porous carbon material similar to activated carbon that can be used in soil and water remediation. Hegberg explained how biochar is being successfully used to remediate Potentially Toxic Elements (PTEs), which are heavy metals contributing to soil and water contamination that is transferred to the food chain.

Mr. Hegberg remarked that, while biochar is not a new product, research on its characteristics and uses is still in its infancy. However, he noted, at this time, the biochar industry is growing as new equipment, such as energy gasifiers, has been developed to produce biochar.

Mr. Hegberg reviewed current results of using biochar to remove heavy metal contamination. Research has indicated positive results for metals such as arsenic, cadmium, copper, and zinc. It has been found, however, that performance may vary depending on the type of biochar feedstock.

He also reported on the results of recent projects that used biochar to remediate heavy metal contamination. For example, a mine reclamation project in Hope Mountain Mine, Aspen CO, used biochar successfully to remove metals such as cadmium and chromium. Similar results were achieved in a project conducted at the West Hylebos Log Yard at the Port of Tacoma in Washington State.

Biomass Waste Upcycling Discussion:

During the question and answer session, Yong Wu of Jiangsu DDBS Environment Remediation Co. inquired as to the source of biochar and its manufacturing capacity. Mr. Hegberg noted that biochar can be produced from any waste stream, and while his organization is currently increasing production, capacity is low, as they prefer to produce the biochar locally.

David Friedman asked about the quality control measures in place for the production of biochar. Mr. Hegberg said there are testing methods in use today that determine biochar characteristics.

5. Special Remarks and Introduction to the Brownfields 2015 Conference



Hon. Mathy Stanislaus addresses the Workshop audience.

Mathy Stanislaus, Assistant Administrator for the Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, greeted the China Delegates and other workshop participants and provided a brief review of the history of U.S. brownfields remediation. He reminded attendees that brownfields remediation in the U.S. originated with Superfund site clean-up and was expedited by the blight in urban centers. People began to see brownfields sites, whether they are large manufacturing sites or small dry cleaner facilities, as opportunities for redevelopment, as the remediated sites could then be used for the benefit of the community. Mr. Stanislaus introduced the Brownfields

Conference on behalf of EPA. Mr. Stanislaus reminded the attendees that EPA serves a role in working with industry to identify and assess contaminated sites. In 2015, 1300 properties were assessed and 120 properties are now being cleaned-up. EPA is investing many resources to help assure that all of the stakeholders involved in brownfields remediation win. For example, EPA is working actively with stakeholders to help build capacity and rigor in analysis so that site characterization is trustworthy and cost estimates are accurate.

Mr. Stanislaus concluded his comments by welcoming the Chinese delegates to this SIT workshop, to the Brownfields Conference, and to Chicago.

Ms. Wenchao Zang of Ministry of Environmental Protection of China (MEP), head of the China Delegation, responded to Mr. Stanislaus' remarks with deep appreciation. She emphasized that one goal of her participation in the workshop and Conference is to learn from our experiences. She concluded by emphasizing the need for future exchanges between the two countries to share expertise and experiences.

Mr. Tad McGalliard of ICMA also welcomed the group to Chicago, provided workshop participants with a brief overview of the 2015 Brownfields Conference agenda and events, and offered suggestions on how to make the most of their conference participation.

6. Closing Remarks and Next Steps

In closing, Ms. Wenchao Zang expressed her appreciation for this Standards in Trade workshop and thanked the workshop organizers and sponsors. She reflected on their newfound and deeper knowledge of U.S. practice and experience. She again expressed her hope for this workshop to be the first of many exchanges. As next steps, Ms. Zang envisioned future collaborative meetings so that both U.S. and China can discuss brownfield remediation technology and training. She also emphasized her desire to learn from the U.S. on effective standards development processes and practices.

Ms. Zang reflected on the need for additional training for key decisions makers, such as mayors and their staff members. These important decision makers need to be able to judge the risk and benefits of key remediation technologies or approaches.

Ms. Zang concluded by expressing her interest in continuing the dialogue with an exchange of case studies and lessons learned, and ongoing communication and education opportunities.

Mr. Agee closed by emphasizing the need for this type of information exchange, and remarked on the need for future exchanges between China's Ministry of Environmental Protection and U.S. experts, including NIST and EPA.

Mr. Erik Puskar of NIST closed by reflecting on the in-depth discussions that the China Delegation had with the U.S. presenters and attendees. Puskar also noted that he looks forward to sharing with China further details on the U.S. approach to standards development, as specifically applied to brownfield remediation.

Ms. Patricia Harris of NIST challenged the attendees to take the next steps. While NIST can convene key stakeholders to venues such as an SIT workshop, the attendees and participants need to take the next step in information exchange and collaboration. Ms. Harris also reminded the U.S. attendees that NIST, which is part of the Department of Commerce, is here to help U.S. industry grow and be globally competitive.



With appreciation to EPA's Brownfields Conference photographer, here is the group photo taken during the SIT Workshop on China Brownfields Remediation, September 1, 2015.

Appendix A: Agenda



CHINA BROWNFIELDS REMEDIATION A Standards in Trade (SIT) Workshop

Hilton Chicago Hotel, 720 South Michigan Avenue, Chicago IL

September 1, 2015

AGENDA

Time	Activity	Scope
8:00am	Registration and Refreshments	Refreshments sponsored by EEC Environmental
9:00am	WELCOME	
	<ul style="list-style-type: none"> ► Gordon Gillerman, Director, Standards Coordination Office, National Institute of Standards and Technology (NIST) 	<i>Workshop objectives & the role of standards</i>
9:10am	OPENING REMARKS	
	<ul style="list-style-type: none"> ► HEAD OF U.S. DELEGATION Robert D. Agee, Assistant to the Mayor of Annapolis, MD, and Consultant, ICMA ► HEAD OF CHINA DELEGATION Wenchao Zang, Deputy Director, Chief Engineer, Solid Waste and Chemicals Management Center (SCC), Ministry of Environmental Protection (MEP), People's Republic of China 	<ul style="list-style-type: none"> • <i>Evolution of U.S. brownfields remediation</i> • <i>Expectations for this workshop</i> • <i>Brownfield Remediation Management in China</i> • <i>Expectations for this workshop</i>
9:45am– 12:10pm	OVERVIEW OF U.S. APPROACHES TO BROWNFIELDS REMEDIATION	
	Moderator: David Grossman , Director, ICMA International, International City/County Management Association (ICMA)	
9:45am	<ul style="list-style-type: none"> ► SESSION PREVIEW David Grossman 	<i>Introduction to the topics to be addressed and session format</i>
9:50am	<ul style="list-style-type: none"> ► IMPORTANCE OF SITE CONCEPTUAL MODEL (SCM) IN REMEDIATION Yong Wu, Vice President for Operations, Jiangsu DDBS Environment Remediation Co., LTD (DDBS) 	<i>A holistic approach is needed that considers technical, government and regulatory, remediation market/industry, community and environment points of view</i>
10:30am	Networking Break	

Time	Activity	Scope
10:50am	<p>► MANAGEMENT OF CONTAMINATED SITES: AN OVERVIEW Atul Salhotra, Founding President, Risk Assessment & Management (RAM) Group of Gannett Fleming, Inc.</p>	<i>Prudent management of contaminated sites requires three key elements: site assessment, risk assessment, & risk management</i>
11:30am	<p>► ASTM COMMITTEE E50: ENVIRONMENTAL ASSESSMENT, RISK MANAGEMENT, AND CORRECTIVE ACTION Timothy Haley, Partner, Barnes & Thornburg</p>	<i>A review of the ASTM approach & established & emerging standards affecting brownfields remediation</i>
12:10pm	GREETINGS AND INTRODUCTION TO THE BROWNFIELDS 2015 CONFERENCE	
	<p>► Mathy Stanislaus, Assistant Administrator for the Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency</p>	<i>Mr. Stanislaus, who was nominated for his position by President Obama in 2009, introduces the Brownfields Conference on behalf of EPA</i>
12:20pm	Workshop Group Photo	
12:30pm	<p>Lunch & Overview of the Brownfields 2015 Conference Lunch sponsored by Skelly and Loy, Inc., USTDA, ASTM International, EEC Environmental, Terracon, and the American Council of Independent Laboratories</p>	
	<p>► BROWNFIELDS 2015 CONFERENCE OVERVIEW Tad McGalliard, ICMA</p>	<i>Information and suggestions on how to make the most of your Brownfields Conference participation</i>
1:15-4:45pm	OVERVIEW OF U.S. APPROACHES TO BROWNFIELDS REMEDIATION – continued	
1:15pm	<p>► PUBLIC SITE ASSESSMENT AND FUTURE USE DETERMINATION Jim Powell, Director, Permitting Services, Mostardi Platt, and former Executive Director, Air & Waste Management Association</p>	<i>Discussion of environmental site assessment & the use of historical documents, interviews, & site visits to determine the implications of onsite contamination</i>
1:55pm	<p>► TESTING & DATA MANAGEMENT FOR AN EFFECTIVE AND EFFICIENT REMEDIATION David Friedman, Technical Advisor, American Council of Independent Laboratories</p>	<i>Overview of test data gathering, management, & use for effective site characterization & remediation</i>
2:35pm	<p>► A BRIEF SUMMARY OF THE SITE ASSESSMENT, INVESTIGATION, AND CLEANUP PROCESS: GROUNDWATER: Mark Zeko, Vice President and Principal Hydrologist, EEC Environmental</p>	<p><i>Approaches for groundwater and soil remediation</i></p> <ul style="list-style-type: none"> • <i>Subsurface mapping to identify potential areas of contamination & contaminant flow; groundwater sampling & subsurface measurement techniques</i>

Time	Activity	Scope
	SOIL REMEDIATION: David Bernier , Senior Project Geologist/East Coast Manager, EEC Environmental	<ul style="list-style-type: none"> Managing remediation to minimize removal & disposal of "clean" material—using investigation, conceptual models, vapor intrusion integration, risk based remediation, etc.
3:55pm	Break	
4:05pm	<ul style="list-style-type: none"> HEAVY METALS SOIL AND WATER REMEDIATION OPPORTUNITIES USING BIOCHAR PRODUCED THROUGH BIOMASS WASTE UPCYCLING Charles Hegberg, Mid-Atlantic Manager/Sr. Environmental Consultant, Skelly and Loy, Inc. 	<p>Potentially Toxic Elements (PTEs) are heavy metals contributing to soil & water contamination that is transferred to the food chain. Biochar, which is made from biomass waste, is a porous carbon material similar to activated carbon that can be used in soil & water remediation</p>
4:45pm	CLOSING REMARKS AND NEXT STEPS	
	<ul style="list-style-type: none"> CHINA DELEGATION: Wenchao Zang U.S. DELEGATION: Robert D. Agee NIST: Erik Puskar and Pat Harris, Standards Coordination Office, NIST 	<p>Review of workshop outcomes, areas where further information is needed, & next steps</p>
5:00pm	ADJOURN WORKSHOP	
5:30pm-	NETWORKING RECEPTION	Reception sponsored by Mandarin Environment
7:30pm	K&L Gates at 70 W. Madison Street, 2 nd Floor	

Appendix B: Attendee List

First Name	Last Name	Organization
Chinese Delegation		
Yuanpeng	Dan	Chinese Consulate Chicago
Wangtao	Fan	Yulin Branch of Shaanxi Provincial Land Engineering Construction Group Co., Ltd
Jichang	Han	Shaanxi Provincial Land Engineering Construction Group Co., Ltd
Wei	Li	Beijing GeoEnvironmental Remediation Co., Ltd
Xing	Li	International Fund for China's Environment
Shupeng	Li	BCEG Environmental Remediation Co., Ltd.
Jianjian	Lu	EAST CHINA NORMAL UNIVERSITY
Zhengyong	Lu	Beijing GeoEnvironmental Remediation Co., Ltd
Yuanqin	Ma	EAST CHINA NORMAL UNIVERSITY
Zhongan	Mao	Shaanxi Provincial Land Engineering Construction Group Co., Ltd
Jingdong	Sun	Chinese Consulate Chicago
Ying	Wang	Shaanxi Provincial Land Engineering Construction Group Co., Ltd.
Huanyuan	Wang	Institute of Land Engineering & Technology, Shaanxi Land Construction Group, CO., Ltd.
Li	Wei	Research Center for Eco-Environmental Science in Shanxi
Li	Wei	Beijing Sustainable Development Center
Yong	Wu	Jiangsu DDBS Environmental Remediation Co, Ltd
Xiulan	Yan	IGSNRR, CAS
Zhiqing	Yang	Hebei Yuhuan Environmental Science And Technology Co., Ltd.
Sunpei	Yu	Hebei Delong Environmental Management Group
Wang	Yu	Ministry of Environmental Protection of China (MEP), Head of Delegation
Wenchao	Zang	Ministry of Environmental Protection of China (MEP)
Shao Ang	Zhao	Zhejiang Feida Environmental Science & Technology Co., Ltd
Xiaodi	Zheng	Tsinghua University School of Architecture
U.S. Delegation		
Robert	Agee	ICMA, Head of the U.S. Delegation
U.S. Industry		
David	Bernier	EEC Environmental
Karl	Bourdeau	Beveridge & Diamond, PC
Roland	Cain	Biosphere Consultants, LLC

First Name	Last Name	Organization
Dora	Chiang	AECOM
David	Dixon	Roux Associates Inc.
Falo	Fayanju	Mereo 4
Susan	Flakus	SBA
Kelly	Frasco	Carus Corporation
David	Friedman	David Friedman Consulting LLC
Jing	Gabriel	ARCADIS U.S., Inc.
Fang	Gao	JSDDBS
Tim	Haley	Barnes & Thornburg LLP
Charles	Hegberg	Skelly and Loy, Inc.
Pei-Fung	Hurst	AECOM Corp
Kyle	Kuwitzky	XOS
Joe	Marks	Stego Industries
Elliot	Nightingale	PM Environmental, Inc.
Jim	Olsta	Olsta Consulting
Matthew	Otto	Apex Companies, LLC
Jim	Powell	Mostardi Platt
Atul	Salhotra	Gannett Fleming RAM Group
Ben	Sandzer-Bell	Mereo 4
Jerry	Strub	Strategic Growth Consulting, Inc
Linda	Yang	Terracon
Mark	Zeko	EEC Environmental
Mark	Zeman	Cerebral Software, Inc
U.S. University		
Angelos	Lampousis	City College of New York, CUNY
Jeffrey	Strauss	Northwestern University
Pengfei	Zhang	City College of New York, CUNY
U.S. Association		
David	Grossman	ICMA
Madeleine	McDougall	American National Standards Institute
Tad	McGalliard	ICMA
Berna	Oztekin Gunaydin	ICMA
Kimberly	Simms	ASTM International
U.S. Government		
Jay	Biggs	Commercial Service, U.S. Embassy, Beijing
Gordon	Gillerman	NIST, Standards Coordination Office
Deb	Goldblum	EPA Region 3
Patricia	Harris	NIST, Standards Coordination Office
Jenny	May	International Trade Administration

First Name	Last Name	Organization
Erik	Puskar	NIST, Standards Coordination Office
Mathy	Stanislaus	U.S. EPA
Jiangyao	Zhang	Commercial Service, U.S. Embassy, Beijing
State Government		
J. Meade	Anderson	Virginia Department of Environmental Quality
Jennie	Cure	Arizona Department of Environmental Quality
Workshop support staff		
Dylan	Cotter	Administrative assistant
Xiaoming Helen	Gao	Translator

Appendix C: Speaker Biographies

Robert D. Agee



Bob Agee, an accredited credentialed city manager, has over eighteen years of experience in senior and local government management at the city and county levels. He has served as Assistant County Executive, Assistant Mayor, Assistant Secretary of Transportation for the State of Maryland, and Public Works Director, among other role. He is particularly experienced in land use, policy development, and intergovernmental relations.

Among Mr. Agee's current affiliations and involvement are: International City/County Managers Association, ICMA China, MD City/County Managers Association, Maryland Heritage Areas Commission, Maryland Urban Forestry Board, Maryland Port Dredge Material Reuse Commission, Maryland Chapter, Urban Land Institute, Academy for Excellence in Local Government, Chair of the Maryland Rural Council Foundation, Advisor to the Mayor of Annapolis for International Affairs and to the Mayor of Changsha, China, Chaney Nonprofit Foundation Board, Chair of the Maryland Secretary of State Sister City Consortium, and Maryland Coordinator of International Sister Cities.

David Bernier

David Bernier is the east coast Director of Operation and Senior Geologist of EEC Environmental, a professional service firm specializing in assessment and remediation of complex soil, soil vapor, and groundwater contamination issues. For the last 17 years, Mr. Bernier has worked in the environmental and geotechnical field focusing on the assessment of remediation of complex subsurface contaminate issues.

As a member of the EEC team for the last 15 years, Mr. Bernier has focused on the assessment of remediation soil, soil vapor, and groundwater impacted by a variety of contaminants including petroleum hydrocarbon, polychlorinated biphenyl, metal, and chlorinated solvent, and pesticides at sites ranging from privately owned dry cleaning facilities to oil refineries and Superfund sites. He also has experience in the implementation of new treatment technologies, such as in-situ treatment, including chemical oxidation and aerobic bioaugmentation, while understanding the benefit of classic methods including excavation and soil-vapor extraction. Mr. Bernier is known as an expert in the area of contaminate fate and transport and remedial design in near shore subsurface environments ranging from remote islands off the coast of California to the East River in New York City. Mr. Bernier has extensive experience working with local, state, and federal oversight agencies as well as leading community outreach and engagement efforts.

Born and raised in the Washington DC area, Mr. Bernier was the natural choice to head EEC's east coast expansion which began more than four years ago. In conjunction with heading EEC's East Coast operations, David is the primary contact to EEC's federal contracts which include work with the U.S. Army, Navy, Federal Aviation Administration, multiple Indian Reservations, and many others.

David holds a Bachelor of Science in Geology from West Virginia University and is a licensed Professional Geologist in multiple states. Mr. Bernier is also a long standing member of the Association of

Engineering Geologists, National Groundwater Association, Air and Waste Management Association, and the Water Environmental Federation.

David Friedman



David Friedman serves as a Technical Advisor to the American Council of Independent Laboratories (ACIL) Environmental Sciences Section. This role includes: leading their efforts to establish a partnership between the commercial environmental laboratory industry, the analytical instrument industry, and the Environmental Protection Agency (EPA) to advance environmental monitoring technologies and address environmental monitoring and measurement issues; overseeing the development of new analytical protocols and conduct validation studies to facilitate adoption of new testing technologies; and helping to establish training programs to improve the skill level of environmental laboratory staff. He also serves as a consultant to environmental laboratories and instrument manufacturers in areas of hazardous waste characterization, business development, method development and validation, laboratory accreditation, and market development.

Previously, Mr. Friedman worked at the U.S. Environmental Protection Agency (EPA) as a Senior Advisor to management on monitoring issues. He organized and served as Executive Director of Agency's Forum on Environmental Measurements (i.e., EPA's senior management measurement policy organizations), prepared speeches for senior management, conducted special studies and programs, managed the technical program to convert a former Soviet bioweapons laboratory to an environmental monitoring/commercial analytical services laboratory, served as internationally recognized expert on environmental monitoring and measurements, oversaw EPA effort to establish a national environmental laboratory accreditation program, initiated and oversaw major public communication and outreach programs such a national conferences and workshops, and developed and presented training courses needed to implement new Agency programs and initiatives.

While at EPA, he was also a Scientist and Section Chief in the Office of Solid Waste. Accomplishments included: development of both hazardous waste Toxicity and Reactivity Characteristics and the internationally recognized monitoring methods manual (Test Methods for Evaluating Solid Waste, SW-846), and for founding and, for managing the Waste Testing and Quality Assurance Conference which has become the National Environmental Monitoring Conference (NEMC). Responsibilities also included coordination of EPA's hazardous waste research program. His areas of expertise include environmental monitoring, laboratory accreditation, hazardous waste identification, hazardous waste characterization, and laboratory quality assurance and control.

Mr. Friedman has given training courses, presented papers, and given lectures on environmental testing and waste characterization in Australia, Belgium, Canada, China, Italy, Japan, Kazakhstan, Korea, Malaysia, Singapore, Thailand and Russia. At the request of the World Bank, oversaw the preparation of a model laboratory quality system manual and an associated training course for use by the Government of India in improving the quality of their regional environmental laboratories.

Gordon Gillerman



Gordon Gillerman, Director, Standards Coordination Office at the National Institute of Standards and Technology (NIST) leads NIST's work in standards coordination including the National Voluntary Laboratory Accreditation Program. Gordon coordinates and advises federal agencies and other stakeholders on standards and conformity assessment policy. The Standards Coordination Office is the NIST focal point for federal government standards coordination, administers the NIST Standards Curricula Development Cooperative Agreement Program, operates the U.S. Inquiry Point for the World Trade Organization's Technical Barriers to Trade Agreement and is a key information source for U.S. industry on standards related market access

issues. Gordon leads NIST's work with federal agencies to develop standards and conformity assessment policy and programs.

Gordon has extensive experience coordinating standards policy and development across a wide range of critical issues in the U.S. including homeland security, safety, health and protection of the environment. An expert on conformity assessment systems and their nexus with regulatory and trade issues and a sought after lecturer on standards, conformity assessment and regulation. Gordon has worked collaboratively within the standards community to enhance health, safety, the environment and security throughout his career.

Prior experience include leading government affairs for the largest U.S. product safety certification and standard development organization, Underwriters Laboratories (UL) in Washington, DC, and Staff Engineer for the medical device and information technology sectors at UL's Northbrook, IL headquarters.

Gordon has worked collaboratively within the standards community to enhance health, safety, the environment and security throughout his career. In 2008, he received an Environmental Protection Agency Gold Medal, a Department of Commerce Bronze Medal and the ANSI Meritorious Service Award. In 2010, Gordon received a Department of Commerce Gold Medal for leadership in enhancing the performance standards and certification program for law enforcement body armor and EPA's Award for Outstanding Leadership in Collaborative Problem-Solving for his work in guiding the development of a Green Clean-Up standard. In 2012, Gordon received the ANSI Gerald H. Ritterbusch Conformity Assessment Medal.

Gordon received a Bachelor's Degree BSEET from Bradley University in Peoria, IL.

David Grossman



David Grossman is a Director of ICMA International. He has directed ICMA's International programs since January 2008. David has brought thirty years of technical and managerial experience to this position with expertise in finance, credit, and urban infrastructure.

He began his professional career with the New York City Planning Commission, helping tenants to organize and maintain their buildings. After a year with the United Nations Development Program, he served for six years as a U.S. Agency for International Development (USAID) Foreign

Service Officer, in Honduras and Costa Rica. From 1984 to 1994, he worked in the USAID Office of Housing and Urban Programs, including serving as its chief operating officer (COO). He later held COO positions with USAID's Global Bureau Environment Center and USAID's Office of Development Credit. Most recently, he served as the senior advisor for research and development for the USAID Development Credit Authority. During his career at USAID, he received Honor Awards and other citations for outstanding performance.

David has a bachelor's degree in political science/Latin American studies from the State University of New York at Buffalo and a master's degree in international affairs, with a specialization in economics and urban planning, from Columbia University, in New York City. He speaks English and Spanish.

Timothy A. Haley



Timothy A. Haley is a partner in the Environmental Department in Barnes & Thornburg LLP's Indianapolis, Indiana office.

Mr. Haley focuses his practice on environmental issues in business and real estate transactions, enforcement defense, litigation, regulatory compliance in areas including remediation of impaired properties, cost recovery for environmentally impaired properties, Clean Air Act and Clean Water Act permitting, solid and hazardous waste, and storm water, flood plain and wetlands issues. Mr. Haley is a member of Barnes & Thornburg's Construction Law, Climate Change and Policyholder Insurance Recovery and Counseling Group practice groups.

Mr. Haley also serves as Barnes & Thornburg's representative to the ASTM International's E50 Committee; he actively participates in negotiating and drafting ASTM standards and guides, including ASTM's Standard Guide for Identifying and Complying with Continuing Obligations, (E2790-11), Standard Practice for Performing Phase I Environmental Site Assessments (E 1527-13), ASTM's Standard Guide for Performing Vapor Encroachment Screens (E 2600-10).

Mr. Haley received his B.A. summa cum laude from North Carolina State University in Raleigh, N.C. He received his J.D. cum laude from Indiana University School of Law Bloomington. He also received a M.P.A. from Indiana University's School of Public and Environmental Affairs. Mr. Haley is admitted to practice in the Northern and Southern District Courts of Indiana and the Indiana Supreme Court. He is a member of the Indiana State Bar Association.

Patricia Harris



Patricia Harris is an International Standards Specialist at NIST, managing the Standards in Trade Program. Previously she worked in the U.S. Inquiry Point supporting the WTO TBT Agreement. Pat is a frequent presenter at SCO training programs focusing on the standards development processes drawing on her extensive experience in the standards development arena at the national and international levels. For twenty years, Pat managed an ANSI-accredited standards setting organization and was directly involved in international standards development through the ISO. As secretariat for an ISO Subcommittee and the U.S. Technical Advisory Group to an ISO Technical Committee, she learned first-hand about

standards development processes and systems. In her career, Pat has engaged in a number of standards activities that have demonstrated the value of standardization to enabling innovations in information technology, including standardization of the file structures for the CD-ROM and eBooks. She is a graduate of the Randolph Macon Woman's College and holds an M.S. in Library Science from the University of North Carolina-Chapel Hill.

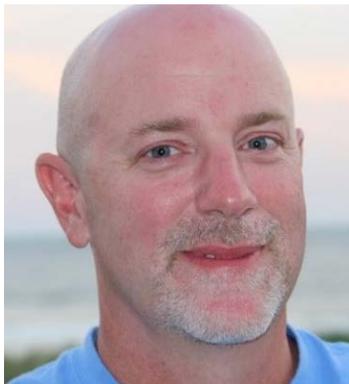
Chuck Hegberg



Chuck Hegberg is a Senior Environmental Consultant with Skelly & Loy, Inc. (SLI) and a technical partner with Coaltec Energy. He has nearly thirty years of technical and management experience in natural and water resources planning and ecological restoration markets globally. Mr. Hegberg has been with the biochar market since 2006 and is currently participating with the University of Delaware in the development of the next generation of smart BMPs through a number of research and development pilot projects associated with water treatment efficiency improvements and disturbed soil restoration using biochar as an enhanced media and/or soil amendment.

Skelly & Loy, Inc., established in 1969, is a woman-owned, mid-sized Mid-Atlantic corporation providing a breadth of professional environmental and engineering services to various public and private sector clients throughout the United States and abroad. SKI professional staff expertise includes ecological design engineers, environmental engineers, ecologists, geomorphologist, biologists, hydrogeologists, botanists, and other science professionals including cultural resources and GIS.

Tad McGalliard



Tad McGalliard is a Director, Research and Technical Assistance at ICMA the International City/County Management Association, which advances professional local government worldwide. Mr. McGalliard directs a multi-million-dollar cooperative agreement with EPA and has managed funding from a variety of other sources including the U.S. Economic Development Administration, New York State's Empire State Development, and numerous other private and public sector funders. Mr. McGalliard developed the concept for and managed Restoration 2006, a new national event focused on post-disaster recovery, which attracted more than 1,000 attendees to the inaugural event in New

Orleans. Mr. McGalliard supports the operational, project management deliverables, and outreach efforts associated with National Emergency Management Network members and potential customers. He is also working on networked approaches for local government leaders to help their communities prepare for, respond to and recover from disasters.

Prior to joining ICMA, Mr. McGalliard worked with Cornell University's Center for the Environment in a variety of capacities. From 1998-2003, he organized marketing and outreach programs for an applied research center focused on economic development, environmental management, risk analysis, GIS/remote sensing, environmental toxicology, natural resources, stakeholder involvement and water resources. Mr. McGalliard also managed fundraising and financial stewardship efforts for \$1.5-million in

endowments and annual giving; organized special events and programs for students, faculty, and alumni; and coordinated student educational and career programming including career fairs, funding, and seminar courses.

Previously he served as the Assistant Director of Cornell's Work and Environment Initiative, an applied research program focused on eco-industrial development and labor involvement in organization-wide environmental improvement. Mr. McGalliard developed and managed more than \$400,000 in sponsored research projects focused on eco-industrial development, environmental management, and labor involvement in sustainable development, including successful projects for the DOE's Golden Field Office, the U.S. EPA Region II, and the U.S. EDA. He also managed sponsored eco-industrial projects for the cities of Baltimore, MD; Trenton, NJ; Plattsburgh, NY; Cape Charles, VA; Chattanooga, TN; and Minneapolis, MN. Additionally, Mr. McGalliard organized international networking events, including conferences for the President's Council on Sustainable Development and roundtables for the Eco-Industrial Development Council.

Jim Powell



Jim Powell is the Director of Environmental Permitting Department of Mostardi Platt. Jim's role is to support and expand the service offerings including compliance management, auditing and due diligence, environmental testing and assessment, and continuous emissions monitoring (CEMS) services. His forty years of technical and project experience includes environmental permitting and engineering, EHS compliance auditing, and Mergers & Acquisitions due diligence with Fortune 500 companies.

Jim holds an M.S. in Environmental Engineering from the University of Florida and a B.S. from the University of Iowa. He is a Qualified

Environmental Professional and a Board Certified Environmental Engineering Member of the American Academy of Environmental Engineers.

Erik Puskar



Erik Puskar leads global standards information activities within Standards Services, Standards Coordination Office at NIST.

Erik provides technical information related to standards and supports Federal agencies by monitoring developments in standards and conformity assessment internationally. Erik also leads SSG's impact analysis efforts of voluntary consensus standards as well as NIST's efforts on education about standardization. He is a member of the ANSI Committee on Education and represents NIST on the International Cooperation for Education about Standardization (ICES).

In addition to standards, he has experience in the fields of information technology, funding innovative high-risk technology and fiscal affairs/taxation. Previous to SSD, Erik was a program manager with the Advanced Technology Program (now Technology Innovation Program) of

NIST and has held other positions with the U.S. Government, international development organizations, and consulting.

Erik holds a degree in Economics from Rutgers University and a Master's Degree in Public Management and Policy from Carnegie-Mellon University.

Atul M. Salhotra



Dr. Atul M. Salhotra is an internationally recognized expert in the area of contaminant fate and transport modeling; health risk assessment; statistical analysis of data; and regulatory negotiations for management of contaminated sites and siting of waste management facilities. His expertise and opinions are sought after and trusted by regulators, industries, and the courts by virtue of his having developed risk based decision making programs for the management of chemically impacted sites for more than 15 states in US. Dr. Salhotra has conducted training courses in over 25 states and 10 countries. Over 6,000 individuals (practicing engineers, consultants, regulators, decision makers, and responsible parties) have attended his courses, and their careers have benefited from the training received. These courses include the fate and transport of chemicals in soil, groundwater, surface waters, and air.

Since 1998, Dr. Salhotra has been involved in several projects in Israel. As a consultant to the Israel Ministry of Environment Water, he has developed the guidance document for the management of contaminated sites referred to as the Israel Risk Based Corrective Action Program. He has conducted several training courses for over 300 Israeli environmental professionals. His clients include several Israeli consulting companies, developers, trade groups and public and private organizations.

Dr. Salhotra's applied research work has involved the development and application of exposure and risk assessment methodologies for environmental decision making. Dr. Salhotra was the project manager for the team that developed the EPACML (EPA's Composite Model for Landfills), and EPAMMM (EPA's Multi-Med Model) for landfills. The EPACML model was used to develop USEPA's Toxicity Characteristic Leaching Procedure (TCLP) rule. Dr. Salhotra has used the following tools for evaluating the leachate production, regulatory negotiations, and risk at several landfill projects:

- Human health and ecological risk assessment
- Multi-media (soil, groundwater, surface water, and air) chemical fate and transport models
- Data interpretation and statistical evaluation of data including monte-carlo simulation
- Evaluation of LNAPL and DNAPL data
- Education of stakeholders, including regulators
- Preparation and delivery of clear and precise reports and presentations
- Application of "common sense" and "simplest possible" models
- Hydrologic Evaluation of Landfill Performance (HELP) model

Mathy Stanislaus



Mathy Stanislaus is the Assistant Administrator for EPA's Office of Solid Waste and Emergency Response (OSWER), Mr. Stanislaus leads EPA's programs that revitalizes communities through the cleanup and redevelopment of contaminated sites under Superfund, Brownfields and Resources Conservation and Recovery Act (RCRA) programs, oversees other federal agencies cleanup of contaminated properties, and advances hazardous and solid waste materials management under RCRA, chemical plant safety, oil spill prevention, underground storage tank program, and emergency response. Mr. Stanislaus has focused on continuing the

innovation of the brownfield program to advance the revitalization communities. Recognizing that successful, sustained community revitalization – particularly in communities facing economic distress/disruption – occurs by fostering inclusive revitalization planning among neighborhood stakeholders, local governments and the private sector, he established the innovative Area Wide Brownfields grant program. This tool enables the development of a plan for community-wide improvements such as infrastructure investments to catalyze redevelopment opportunities on brownfield sites to equitably revitalize communities and meet needs for affordable housing, jobs and open space.

Mr. Stanislaus leads EPA's efforts to advance the Obama Administration's Investing in Manufacturing Communities Partnership, a key aspect of the effort to expand middle class job opportunities. He served on the White House Council on Auto Communities and Workers which led the effort to assist local leaders to transition closed auto plants to productive reuses. He is tri-chair of the Obama Administration Chemical Facility Safety and Security Working Group that is leading efforts to assist state and local emergency preparedness organizations, policy changes to improve the safety of chemical plants and other actions set forth in "Executive Order 13650 Actions to Improve Chemical Facility Safety and Security – A Shared Commitment. Report to the President May 2014." He also is leading the effort to transition to a life-cycle based sustainable materials management approach to reduce greenhouse gas emissions and provide materials for manufacturing.

Mr. Stanislaus is a chemical engineer and environmental lawyer with over 20 years of experience in the environmental field in the private and public sectors. He served as senior environmental counsel at a law firm, and director of environmental compliance for an environmental consulting firm. He started and operated a small business providing consulting services to local governments and local communities on projects ranging from the cleanup and redevelopment of contaminated properties, the proposed siting and expansion of power plants, solid waste facilities and large highways. He has worked in the not-for-profit sector, co-founding and co-directing New Partners for Community Revitalization, a NY not-for-profit organization whose mission is to advance the renewal of New York's low and moderate income neighborhoods and communities of color through the redevelopment of Brownfields sites. He is also former counsel for EPA's Region 2 Office.

He received his law degree from Chicago Kent Law School and Chemical Engineering Degree from City College of New York.

Wenchao Zang



Wenchao Zang, Senior Engineer, is Deputy Chief Engineer of Solid Waste and Chemicals Management Center (SCC) of Ministry of Environmental Protection of China (MEP) which provides technical support on contaminated sites for MEP. She is the committee member of Environmental Chemical Specialized Committee of Chinese Society for Environmental Sciences, National Technical Committee on Dangerous Chemicals Management of Standardization Administration of China, and National Pesticide Registration and Review Committee. She has been working for the management of solid waste and chemicals, research on environmental management policies and technologies of contaminated sites remediation for almost thirty years. She took charge of the

formulation of the 12th Five Year Plan of Environmental Risk Prevention and Control of Chemicals, Guidelines on Environmental Investigation, Assessment and Remediation of Industrial Enterprises Sites (Trail) and the formulation of Environmental Protection Series Standards of Destruction of Chemical Weapons Abandoned in China by the Japanese Army.

Yong Wu



Yong Wu is the COO/Vice President of Jiangsu DDBS Environmental Remediation Ltd. (CNOOC), a full service engineering firm specialized in soil and groundwater remediation based in Nanjing, China; he is responsible for managing all Company operations and setting the strategic direction. Previously he was the Senior Environmental Consultant and Hydrologist for Golder Associates a global company providing consulting, design, and construction services in earth, environment, and related areas of energy. Prior to joining Golder he served as an Environmental Geologist at the Brookhaven National Laboratory from 2001-2004 and from 1991-1998 was a Geotechnical Engineer with the China National Petroleum Corporation.

Wong Wu is a graduate of the Chengdu Institute of Technology, has earned an MS in Environmental Geology from Temple University, and an MBA in Finance/Strategy for New York University's Stern School of Business.

Mark Zeko



Mark Zeko is the Vice President and Principal Hydrogeologist of EEC Environmental, a professional service firm specializing in assessment and remediation of complex soil and groundwater contamination issues. Mr. Zeko has built a career as a renowned environmental professional focused on the remediation of the subsurface environment—groundwater, soil, and soil vapor—that has been impacted by military, industrial, and commercial land uses. His expertise

covers the spectrum of environmental management, but focuses on soil and groundwater investigations, soil vapor surveys, aquifer tests, landfill investigations, litigation support, underground storage tank removals, and environmental due diligence in connection with property transfers. In

Southern California, he has led significant efforts to investigate and remove known contaminants from groundwater at sites used, currently or in the past, by the oil and aerospace industries.

Mr. Zeko's experience has included the cleanup of oil refinery sites where many meters of gasoline, diesel and jet fuel were found in drinking water, to industrial sites with soil and groundwater impacted with toxic heavy metals including chromium and mercury. Mr. Zeko has been at the forefront of the use of innovative methods for the investigation of remediation of contaminated sites including laser and infrared based tools such as the Rapid Optical Screening Tool (ROST) and Membrane Interphase Probe (MIP) which have greatly reduced the cost of investigation and remediation of contaminated sites by focusing remedial efforts on those portions of a property where it is most needed.

Having led the firm's expansion in the West (California), Mid-Atlantic (Maryland), and most recently, Southeast (Florida) United States, Mr. Zeko has established EEC as a top-tier national consulting firm sought after for environmental consulting and technical services.

Mr. Zeko is a Registered Professional Geologist/Hydrogeologist in fourteen states whose distinguished career in geology has taken him throughout the United States and abroad, including China. Today, he is an emerging expert in the complex environmental issues surrounding hydraulic fracturing, or fracking, a nascent industry for which he seeks to help devise fair, evidence-based regulations and guidelines for the safe and environmentally responsible extraction of raw materials. Mr. Zeko draws his expertise in this area from his early involvement in the evaluation of the potential environmental impacts of fracking underway in West Virginia, Wyoming, and Pennsylvania when the documentary Gasland (2010) catapulted fracking into the national discourse. The issue is now at the forefront of policymaking efforts, especially in California, which is expected to set the precedent for the regulation of this energy sector in America. Mr. Zeko speaks throughout the country on the emerging policies, risks, and opportunities that will shape the fracking industry in the coming years.

Mr. Zeko holds a Bachelor of Science in Geology and a Master of Science in Environmental Science/Hydrogeology and is a long-standing member of the Groundwater Resources Association, National Ground Water Association, Western States Petroleum Association, and Technical Advisory Service for Attorneys.

Appendix D: Acknowledgements

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- Mathy Stanislaus, Assistant Administrator for the Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency (EPA)
- Yong Wu, Vice President for Operations, Jiangsu DDBS Environment Remediation Co., LTD (DDBS)
- Wenchao Zang, Deputy Director, Chief Engineer, Solid Waste and Chemicals Management Center (SCC), Ministry of Environmental Protection (MEP), People's Republic of China
- Mark Zeko, Vice President and Principal Hydrologist, EEC Environmental

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