Technology Innovation News Survey

Entries for February 1-28, 2017

Market/Commercialization Information

PARKVIEW WELL OU1: OPERATION AND MAINTENANCE OF GROUNDWATER TREATMENT SYSTEM SERVICE CONTRACT

U.S. EPA, Office of Acquisition Management, Region VII, Lenexa, KS.
Federal Business Opportunities, FBO-5651, Solicitation SOL-R7-17-00009, 2017

EPA intends to release a solicitation for the long-term remedial action of the groundwater treatment system for the Parkview Well Superfund Site Operable Unit 1, located in the city of Grand Island, Nebraska. The scope of work includes the Groundwater Treatment Plant, which is housed in a 60-ft by 45-ft building; four extraction wells; and all associated system components and structures both at and below the surface. This requirement will be advertised as a woman-owned small business set-aside. EPA anticipates issuing a fixed-price contract for a one-year base period and four 1-year options, with an estimated dollar value between $1M and $2M. Release of the RFP is anticipated roughly in early June. Details are posted on FedConnect at https://www.fedconnect.net/FedConnect/?doc=SOL-R7-17-00009&agency=EPA. [Note: It might be necessary to copy/paste the URL into your browser for direct access].

REMEDIAL ACTION, A-E SERVICES, AND REGIONAL OVERSIGHT CONTRACTS CLASS: JUSTIFICATION FOR OTHER THAN FULL AND OPEN COMPETITION (JOFOC)

U.S. EPA, Superfund/RCRA Regional Procurement Operations Division, Washington, DC.
Federal Business Opportunities, FBO-5651, Solicitation SOL-HQ-17-00010, 2017

To allow EPA time to implement its planned Remedial Acquisition Framework (RAF) initiative, the Agency is extending the period of performance of the Regional Oversight contracts for Regions 1 and 2, the Remedial Action contract for Region 4, and the Architect-Engineering Services contracts for Region 7 for a base period of one year with one 1-year option and two 6-month option periods for a possible maximum 3-year period of performance. For further details regarding the RAF suite of procurements, use the FedConnect search interface at https://www.fedconnect.net/ to look for the following Reference Numbers: SOL-HQ-14-00022 (for the DES); SOL-HQ-14-00023 (for the RES); and SOL-R1-14-00003 (for the ESO). The JOFOC is posted on FedConnect at https://www.fedconnect.net/FedConnect/?doc=SOL-HQ-17-00010&agency=EPA [Note: It might be necessary to copy/paste the URL into your browser for direct access].

SBIR E-LEARNING FOR HAZMAT AND EMERGENCY RESPONSE (R43/R44)

DHHS, National Institutes of Health, Funding Opportunity RFA-ES-17-004, 2017

This funding opportunity announcement invites Small Business Innovation Research grant applications that propose to further the development of Advanced Technology Training (ATT) products for the health and safety training of hazardous materials workers; skilled support personnel; emergency responders in biosafety response, infectious disease training, and cleanup; and emergency responders in disasters and resiliency training. ATT tools are also needed to assist research into the acute and long-term health effects of environmental disasters. The proposed products must complement the goals and objectives described at http://www.niehs.nih.gov/careers/hazmat/about_wetp/. The closing date for applications is July 28, 2017.

- Posting at grants.gov: http://www.grants.gov/web/grants/view-opportunity.html?oppId=293834
- Additional information: http://grants.nih.gov/grants/guide/rfa-files/RFA-ES-17-004.html

Cleanup News

PERFORMANCE OF A PASSIVE TREATMENT SYSTEM OVER 20 YEARS IN TENNESSEE

Schmidt, T.W.
Proceedings of the 37th West Virginia Mine Drainage Task Force Symposium, 29-30 Mar 2016, Morgantown, WV. 56 slides, 2016

A passive treatment system consisting of an anoxic limestone drain (ALD) with ~6,000 tons of limestone, two basins, and two wetland cells was constructed at a reclaimed surface mine in east central Tennessee in 1995. The original system, which was designed for a flow rate of 200 gal/min to treat total Fe concentrations of 100 mg/L and meet permit effluent limits, performed well for about 15 years. Several years following construction, the flow rates peaked at more than double the design flow. Although the high flow rates stressed the system, it continued to meet discharge water quality targets. In 1999/2000, a supplemental ALD system was constructed to address the high flow periods. In 2009, sludge cleanout at the original primary basin restored the system's retention and settling capacity. The sludge was placed in Geotubes, dried, and subsequently sold for beneficial reuse and recycling in the paint pigment industry. In 2010, NPDES effluent limits for Mn were lowered, which required the following upgrades: hydraulic connection of the 1995 treatment system to the 2000 treatment system, installation of Mn removal beds, and provision of additional settling capacity. The final effluent has met new Mn effluent limits since completion of the construction upgrades in 2012.
Slides: https://wvmdtaskforce.files.wordpress.com/2016/04/2016-schmidt-2016wvmdtfs.pdf

FORMER RICE ENGINEERING FACILITY, GREAT BEND, BARTON COUNTY, KANSAS

Kansas Dept. of Health and Environment, Bureau of Environmental Remediation Website, 2017

A previous occupant, Rice Engineering, formerly manufactured fiberglass tubes on the property. An interim remedial measure (IRM) was conducted in fall 2012 to remove accessible Texatherm heat transfer oil in soils beneath the building and to dechlorinate 1,1,1-TCA in groundwater to the extent practicable. The IRM included soil source area excavation within the building and installation of a permeable reactive barrier (PRB). The PRB is 55 ft long, 3-5 ft wide, and 8-20 ft deep. The treatment zone comprises blended sand and 90-grade magnetite (an iron oxide mineral) in a mixture of ~85% sand and 15% magnetite by volume. Due to natural attenuation processes, the highest concentration of degradation product 1,1-DCA is now greater than the highest concentration of 1,1,1-TCA. Following PRB installation, 1,1-DCA concentrations in MW-1 (located immediately downgradient of the PRB) generally have decreased as recorded over the last six sampling events. *Click on* ***"Documents/Photos Available"*** *at* http://kensas.kdhe.state.ks.us/plsISL/ISL_Pub_Detail?id=C600570368.

F.E. WARREN AIR FORCE BASE (AFB), FORMER ATLAS "E" MISSILE SITE 12, WINDSOR, COLORADO

Atlas E Missile Site 12 ER Project Website, 2017

Remedial action was completed at Missile Site 12 in August 2015. The selected remedy for Site 12 is enhanced reductive dechlorination, which was implemented using a zero-valent iron (ZVI)/complex carbon amendment to reduce TCE concentrations. The ZVI/carbon amendment provides controlled-release carbon to support degradation of the chlorinated solvents. The elements of the work to implement the select remedy included drilling 18 boreholes, performing high-pressure injection in each borehole to create a network of injection pathways, emplacing the ZVI/carbon amendment into each pathway, installing two new monitoring wells, performing one year of quarterly groundwater quality monitoring, and three years of semi-annual groundwater quality monitoring to track remedy progress. The *Final May 2016 Groundwater Sampling Memorandum* states that based on statistical trend analysis and modeling, the selected remedy has been successful in reducing TCE concentrations significantly, with a slight fluctuation in concentrations of cis-1,2-DCE and significant increases in VC concentrations. These results indicate the reductive dechlorination process is successfully reducing TCE concentrations, and the predominant reduction process is the conversion of cis-1,2-DCE to VC. Additional treatment likely is required for some areas of higher TCE concentration. The total mass has been reduced from an annual average of 9.41 kg in 2008 to 2.92 kg in 2016, for a total mass reduction of 69%. *Technical documents for Missile Site 12 are available at* https://atlas12.northwindgrp.com/.

FORMER COASTAL REFINERY, EL DORADO, KANSAS

Kansas Dept of Health and Environment (KDHE), Bureau of Environmental Remediation Website, 2017

Site investigations identified elevated concentrations of refinery-related contaminants in soil and groundwater, primarily petroleum-related compounds that include benzene, naphthalene, total petroleum hydrocarbons, and select VOCs, plus isolated areas of metals contamination. Interim remedial measures completed at the site between 2006 and 2014 include construction of trenches for interception of groundwater, seep, and spring; storm water collection structures; a tar removal treatment system; a wetland-based groundwater treatment system; and soil and waste excavation, stabilization, consolidation, and capping. Semi-annual groundwater monitoring, operation, maintenance, and monitoring of interceptor trenches and associated groundwater and product treatment systems are ongoing to monitor site conditions and the effectiveness of the systems in place. A corrective action decision document for the site was finalized on November 21, 2016. KDHE selected a remedy consisting of hydraulic containment via operation of existing and proposed interceptor trenches, phytoremediation, additional soil excavation and disposal, surface water sampling, cap maintenance, and the following critical components: environmental use controls, long-term monitoring, receptor management surveys, product recovery, monitored natural attenuation and natural source zone depletion (if confirmed through assessment), and continued operation of the existing groundwater and product treatment systems.
http://kensas.kdhe.state.ks.us/plsISL/ISL_Pub_Detail?id=C200870243

REMEDIATION IN SITU OF HYDROCARBONS BY COMBINED TREATMENT IN A CONTAMINATED ALLUVIAL SOIL DUE TO AN ACCIDENTAL

SPILL OF LNAPL
Trulli, E., C. Morosini, E.C. Rada, and V. Torretta.
Sustainability 8(11):1086(2016)

To remediate the potential risk and observed negative effects on groundwater and soil following an accidental spill of diesel fuel from a tank truck, the groundwater was addressed with a pump-and-treat system coupled with air sparging, and three different technologies were applied to the unsaturated soil in a sequential process: soil vapor extraction, bioventing, and enhanced bioremediation. The sequential application of these remediation treatments allowed the quality standards for unsaturated soil and groundwater to be met as required by Italian law. http://www.mdpi.com/2071-1050/8/11/1086

JOINT TECHNICAL DOCUMENT, MSW LANDFILL B-19, KETTLEMAN HILLS FACILITY, KINGS COUNTY, CALIFORNIA
California Department of Resources Recycling and Recovery (CalRecycle), Vol 1, 122 pp, 2016

This document has been prepared to describe the design and operation of a portion of the Kettleman Hills facility—the Landfill B-19 Bioreactor—and to reflect its decommissioning. The anaerobic bioreactor operated within an 18.23-acre portion of B-19 and accepted liquid waste from 2008 to 2014. Nearly 4 million gal of non-hazardous liquid waste was placed in the B-19 bioreactor with no substantial change in leachate generation. The Class II/III waste footprint comprises (1) a bioreactor unit, to which liquids and high liquid content wastes were added as a beneficial use to enhance waste decomposition, and (2) a control unit to which liquids and high liquid content wastes are not added. The Landfill B19 Bioreactor Research Demonstration and Development (RD&D) Project ended September 15, 2014. Landfill B-19 is permitted to operate as a Class II/III landfill, but select monitoring and reporting activities for the Landfill B19 Bioreactor RD&D Project will be discontinued. https://clu-in.org/download/techfocus/bioreactors/BL-B19_Kettleman-Hills_2016.pdf

QUICKLIME-ENHANCED REMEDIATION OF VOLATILE CHLOROHYDROCARBON-CONTAMINATED SOIL IN AN ABANDONED CHEMICAL PLANT SITE BY MECHANICAL SOIL AERATION
Ma, Y., X.-M. Du, B.-B. Dong, Y. Shi, and F.-S. Li.
American Society of Civil Engineers, Reston, VA. Geotechnical Special Publication No 273:353-364(2016)

Quicklime was used to remove chlorohydrocarbons (1,2-DCA, TCE, and PCE) from soils in an abandoned chemical plant site in China in combination with mechanical soil aeration. Upon addition of 3% quicklime to the silty soil and silty clay during the soil aeration tailing period, residual contaminant concentrations quickly decreased. Quicklime addition changed the physical property of the soil and thus affected chlorohydrocarbons behavior. These results provide a basis for application of mechanical soil aeration in broader scope for this type of contaminated site.

COMBINED THERMAL AND ENHANCED REDUCTIVE DECHLORINATION REMEDIATION AT A FORMER DRY CLEANER SOURCE AREA
Smith, L.M., S. Price, M. Stallard, and D. Laduzinsky.
Tenth International Conference on Remediation of Chlorinated and Recalcitrant Compounds (Palm Springs, CA; May 2016). Battelle Press, Columbus, OH. ISBN 978-0-9964071-1-3, 7 pp, 2016

To address PCE at concentrations up to 32 mg/L in the first waterbearing zone and 42 mg/L in the second water-bearing zone, the remedial action implemented two primary components simultaneously: in situ thermal desorption (ISTD) for source area soil and groundwater, and in situ enhanced reductive dechlorination (ERD) using emulsified zero-valent iron plus biostimulation and bioaugmentation for dissolved plume remediation immediately downgradient of the tenant space. The proposed mass flux performance goal for the remedial action was a 75% decrease in mass flux within five years. The ISTD system operated from mid-2014 to mid-2015, ~6 months longer than anticipated in the engineering design. Although there were difficulties in achieving the ISTD target temperature, post-remediation sampling demonstrated that the ISTD system successfully attained the PCE remediation goals in source area soils. The ERD injection program was implemented in early 2014, and monitoring is ongoing. PCE concentrations in groundwater are orders of magnitude lower than concentrations detected prior to the in situ ERD injection program. These decreases are interpreted as indicative of PCE sequestration in the emulsified oil substrate. Following an initial dissolved PCE mass increase in sampled groundwater, evidence for the positive progression of ERD includes detection/increase of PCE degradation products, low oxidation-reduction potential and dissolved oxygen, low or declining nitrate and sulfate, and the generation of dissolved gases and fatty acids. A statistical trend evaluation shows that PCE concentrations in groundwater within or downgradient of the injection zone are stable or decreasing. One year after ERD implementation, PCE mass flux has declined by an estimated 80-99%.

SUSTAINABLE LOW TEMPERATURE IN SITU THERMAL REMEDIATION USING DISSOLVED GASES
Smith, G., J. Baldock, J. Brett, and J. Dablow.
Tenth International Conference on Remediation of Chlorinated and Recalcitrant Compounds (Palm Springs, CA; May 2016). Battelle Press, Columbus, OH. ISBN 978-0-9964071-1-3, 7 pp, 2016

The patent-pending low-temperature vaporization (LTV) process was applied at sites located in the U.K. and the U.S. and tested using conventional in situ thermal remediation technologies to raise soil and groundwater temperature. This paper presents LTV as a more sustainable approach to thermal treatment of chlorinated solvents, highlighting electrical resistance heating at the U.S. site and in situ thermal desorption at the U.K. site. The collected data were used to evaluate the hypothesis that natural geochemical reactions can be utilized to facilitate generation of carbon dioxide and other dissolved gases through one or a combination of reactions in groundwater to promote the ex-solution of CO_2 to remove VOCs from the subsurface. The physical properties of the gas facilitate VOC dissolution into CO_2 in preference to water or steam. The LTV treatment progress was tracked using geochemical modeling. Once LTV applicability was confirmed, the heating process ended with the subsurface temperature well below the temperature needed to volatize contaminants based on a co-boiling design paradigm. Contaminant recovery was maintained using dual-phase recovery alone, enabling expedited removal of the heating equipment. At both project sites, the LTV approach enabled heating to be performed using less energy than would be conventionally required and in a reduced remediation timeframe.

RESCISSION OF SITE CLEANUP REQUIREMENTS ORDER NO. R2-2006-0020 FOR EXXONMOBIL AND THE PORT OF SAN FRANCISCO, FORMER MOBIL BULK TERMINAL 04-394
San Francisco Bay Regional Water Quality Control Board, 7 pp, 2016

Full cleanup of gasoline and diesel hydrocarbons released from this 70-by-120 ft rectangular lot has encompassed soil excavation, soil vapor extraction, product removal via pumping and absorbent socks, multiple rounds of in situ chemical oxidation (2006-2008), installation of a permeable reactive barrier, and high-intensity vacuum extraction. The Water Board concludes that the Dischargers have successfully met the cleanup objectives.
http://www.waterboards.ca.gov/sanfranciscobay/board_decisions/adopted_orders/2016/R2-2016-0033.pdf
See more information on this cleanup at https://geotracker.waterboards.ca.gov/profile_report?global_id=T0607500186.

Demonstrations / Feasibility Studies

DESIGN AND PERFORMANCE EVALUATION OF A 1000-YEAR EVAPOTRANSPIRATION-CAPILLARY SURFACE BARRIER
Zhang, S.F., C.E. Strickland, and S.O. Link.
Journal of Environmental Management 187:31-42(2017)

Although surface barrier technology is used to isolate radioactive waste and to reduce or eliminate recharge water to the waste zone for 1000 years or longer, the extremely long design life is a tremendous design and evaluation challenge. The Prototype Hanford Barrier (PHB) was constructed in 1994 over an existing waste site as a demonstration. The barrier was tested to evaluate its design and performance at field scale under conditions of enhanced and natural precipitation and no vegetation. Monitoring data demonstrated that the barrier satisfied nearly all objectives over the past two decades. The PHB far exceeded the RCRA criteria, functioned in Hanford's semiarid climate, limited drainage to well below the 0.5 mm/yr performance criterion, limited runoff, and minimized erosion and bio-intrusion. The exposed subgrade receives protection against erosion, and institutional controls prevent inadvertent human activity at the barrier. Given the two-decade record of successful performance and consideration of the processes and mechanisms that could affect barrier stability and hydrology in the future, the PHB shows promise that it will be able to perform for its 1000-year design life. *See the 123-page 2016 PHB performance report at* https://clu-in.org/download/techfocus/et/ET-cover-DOE-RL-2016-37.pdf *and its appendices (A through R), most of which are individual papers, at* https://clu-in.org/download/techfocus/et/ET-cover-apps-DOE-RL-2016-37.pdf.

IN-SITU BIOSEQUESTRATION FOR REMEDIATION OF URANIUM IN GROUNDWATER AT THE MONUMENT VALLEY UMTRA SITE
Gutierrez, Diana Ivana, Master's thesis, University of Arizona, 57 pp, 2016

The Monument Valley Uranium Mill Tailings Remedial Action (UMTRA) project is a former uranium mining site located in Cane Valley, Arizona. Mining operations from 1943 to 1968 generated a groundwater contaminant plume consisting of nitrate, sulfate, and uranium. A novel treatment for this type of contamination—in situ biosequestration—is implemented by injecting an electron-donor substrate to promote microbial activity and sequester contaminants by bioprecipitation, biomineralization, and enhanced adsorption. Pilot-scale tests are underway in the source zone at the Monument Valley site to investigate the feasibility and effectiveness of using in situ biosequestration for cleanup of the uranium-contaminated groundwater. Preliminary pilot results are discussed.
http://arizona.openrepository.com/arizona/handle/10150/620727

HYDROGEOLOGICAL BEHAVIOUR OF AN INCLINED STORE-AND-RELEASE COVER EXPERIMENTAL CELL MADE WITH PHOSPHATE MINE WASTES
Knidiri, J., B. Bussiere, R. Hakkou, B. Bosse, A. Maqsoud, and M. Benzaazoua.
Canadian Geotechnical Journal 54(1):102-116(2017)

A field study was conducted at the arid Kettara mine site (Morocco) to assess the performance of an inclined store-and-release (SR) cover to reduce water

infiltration and control acid mine drainage (AMD). The SR cover was constructed using phosphate mine wastes (0.8 m) placed over a capillary break layer of coarse-grained materials at a slope inclination of 14.5°. Performance was monitored for one year under natural and artificial conditions representing important rainfall events using volumetric lysimeters, suction sensors, and volumetric water content sensors installed at four stations and at different depths. Under natural climatic conditions, the inclined SR cover limited water percolation by diverting and releasing water to the atmosphere through evaporation; however, the cover was unable to store and divert all the water at a precipitation rate >100 mm in 48 h, and percolation was observed in the lysimeters. Results nevertheless confirmed the suitability of phosphate mine wastes as cover material for a 31.5 m inclined SR cover placed over the Kettara mine wastes in natural climatic conditions and for precipitation events of

AMD IN THE BOLIVIAN ALTIPLANO: UNIQUE PROBLEMS AND SOLUTIONS

Strosnider, W. and T. Danehy.
Proceedings of the 37th West Virginia Mine Drainage Task Force Symposium, 29-30 Mar 2016, Morgantown, WV. 51 slides, 2016

The area surrounding Potosi in the Bolivian highlands (Altiplano) has been intensively mined for nearly five centuries, resulting in extensive environmental degradation. A demonstration project was established in a valley south of Cerro Rico, the world's richest silver deposit. Phase I included the installation of two open limestone channels (OLCs) and one anoxic limestone drain (ALD) as part of a broader project aimed at active treatment of an operating mine to restore Rio Juckucha as a safe irrigation water source. Phase II will include an automatically flushing limestone bed and a conduit to transmit safe irrigation water to fields downstream. Past and current activities have surmounted challenges both technical (e.g., lack of suitable equipment, road failures, work on extreme slopes, rainy season earth instability) and non-technical (e.g., general strikes, road blockades, inter-partner communication issues, volunteer workforce management). Despite the difficulties involved, this transfer of technology has improved waters in the area and provided regional officials with examples of more cost-effective and sustainable options with which to address longstanding environmental degradation.
Slides: https://wvmdtaskforce.files.wordpress.com/2016/04/2016-strosnider-danehy.pdf

ENHANCED BIOREMEDIATION OF TCE-CONTAMINATED GROUNDWATER WITH COEXISTENCE OF FUEL OIL: EFFECTIVENESS AND MECHANISM STUDY

Lien, P.J., Z.H. Yang, Y.M. Chang, Y.T. Tu, and C.M. Kao.
Chemical Engineering Journal 289:525-536(2016)

A pilot study was conducted to evaluate the effectiveness of intrinsic and enhanced bioremediation mechanisms for in situ remediation of TCE-contaminated groundwater. Under enhanced bioremediation processes, leaked fuel oil served as the primary substrate to activate reductive dechlorination of TCE. Within the fuel oil plume, natural attenuation of total petroleum hydrocarbons (TPH) and enhanced bioremediation of TCE were observed. Results from real-time polymerase chain reaction analysis, denaturing gradient gel electrophoresis, and nucleotide sequence analysis verified 32 bacterial species that might be related to TPH and TCE degradation within the TPH plume. Although natural attenuation mechanisms were sufficient to contain the TPH plume effectively and effect TPH removal, the dechlorination rate was insufficient for TCE plume control due to the limited biodegradable primary substrates released from the fuel oil. An alternative primary substrate supplement was necessary to increase the substrate concentrations and obtain a higher TCE dechlorination rate. The study also indicated that *Dehalococcoides* spp., one of the dominant bacteria in the site groundwater, could be used as a biomarker to evaluate TCE dechlorination efficacy.

DEMONSTRATION OF IN SITU TREATMENT WITH REACTIVE AMENDMENTS FOR CONTAMINATED SEDIMENTS IN ACTIVE DOD HARBORS

Kirtay, V., G. Rosen, M. Colvin, J. Guerrero, L. Hsu, E. Arias, R.K. Johnston, B. Chadwick, et al.
ESTCP Project ER-201131, 884 pp, 2017

In situ remediation of PCB-contaminated surface sediment was demonstrated by placing a reactive amendment (powdered activated carbon, or PAC) at a site located at the Puget Sound Naval Shipyard and Intermediate Maintenance Facility, Bremerton, Wash. The PAC was placed successfully on the seafloor of a half-acre target site to sorb PCBs in sediments, thereby reducing bioavailability and limiting bioaccumulation of contaminants into the tissues of benthic invertebrates. The sorbent material, AquaGate+PAC, was manufactured by coating an aggregate core with PAC held in a bentonite clay binder. The AquaGate, which is denser than water, sinks rapidly through the water column directly to the surface of the sediment. Over a short period of time (days), the PAC coating of the AquaGate releases from the aggregate, and bioturbation incorporates the PAC into the surface sediments over time. This project demonstrated the placement and quantitative integration of a suite of common and novel monitoring tools to evaluate amendment stability and performance in deep water (15 m) at an active Naval shipyard with high vessel traffic. https://www.estcp.com/content/download/41983/400036/file/ER-201131%20Final%20Report.pdf

PILOT STUDY ON ARSENIC REMOVAL FROM GROUNDWATER USING A SMALL-SCALE REVERSE OSMOSIS SYSTEM: TOWARDS SUSTAINABLE DRINKING WATER PRODUCTION

Schmidt, S.-A., E. Gukelberger, M. Hermann, F. Fiedler, B. Grossmann, J. Hoinkis, A. Ghosh, et al.
Journal of Hazardous Materials 318:671-678(2016)

Arsenic removal from groundwater was studied at pilot scale in two villages in Bihar, India, using a process based on reverse osmosis technology with an energy-recovery system. The system was used to treat both aerated and non-aerated groundwater. In trials with aerated groundwater, total arsenic removal efficiency at both locations was around 99%, and the arsenic concentration in permeate was in compliance with the WHO and National Indian Standard of 10µg/L; however, trials under anoxic conditions with non-aerated groundwater could not meet this standard.

PLUME 2 PILOT TEST ANNUAL MONITORING REPORT, CHEMOURS OAKLEY SITE, OAKLEY, CALIFORNIA

Central Valley Regional Water Quality Control Board, California. 87 pp, 2017

Historical operations at the Chemours Oakley Site anti-knock manufacturing area caused pollution of the soil and groundwater in what is referred to as Plume 2. The primary pollutants of concern in Plume 2 are organolead, 1,2-dibromoethane, 1,2-dichloroethane, PCE, lead, arsenic, and fluoride. A field pilot test is underway to evaluate the effectiveness of zero-valent iron (ZVI) in cleaning up an area of elevated organolead and 1,2-dibromoethane within Plume 2. Three new injections wells for the Plume 2 pilot were installed in addition to two new surficial aquifer monitoring wells downgradient of the injection well area to monitor pilot performance. The surficial aquifer is unconfined, composed of fine-grained sand typically from 5-20 ft thick, and is present at the ground surface in the primary former manufacturing areas. Surficial aquifer groundwater extracted from the injection wells were used as makeup water for the ZVI solution. About 1,000 lb of ZVI was injected. The ZVI amendment mixture (Ferox Target) shipped from the manufacturer was mixed with 1,920 gal of previously extracted site groundwater. Injection field activities were conducted between November 2 and December 2, 2016. Results to date indicate that the ROI was less than 8.5 ft. Measurement of geochemical and groundwater flow conditions will continue during future performance monitoring.
http://geotracker.waterboards.ca.gov/esi/uploads/geo_report/9401465058/SL0601340233.PDF
See this and other technical reports at http://geotracker.waterboards.ca.gov/profile_report.asp?global_id=SL0601340233.

FOURTH QUARTER 2016 AND ANNUAL GROUNDWATER MONITORING REPORT: FORMER VAN WATERS & ROGERS INC. FACILITY, 1152 G STREET, FRESNO, CALIFORNIA

Central Valley Regional Water Quality Control Board, California. 630 pp, 2017

From 1965 to 1986, the site was used to store bulk PCE in an aboveground storage tank at the northern section of the property. Several monitoring wells installed in 1996 showed PCE in the groundwater. In 1998 a soil vapor extraction (SVE) system was installed and operated until 2004, using two 2500-lb activated carbon vessels to remove the VOCs. Four new offsite SVE wells were installed during late 2008, and an SVE system currently extracts soil vapors from five wells located near the highest concentrations of PCE in groundwater and soil. Since the injection of potassium permanganate into groundwater beneath the source area in June 2015, PCE concentrations in the injection wells have been below the MCL, VOC concentrations in the three wells immediately downgradient of the injection locations have decreased by ~50% and all but three other wells monitored in 4th quarter 2016 show similar or decreasing VOC concentrations. This report covers site groundwater monitoring activities and results; the SVE system monitoring summary; in situ chemical oxidation remediation performance; and conclusions concerning cleanup progress. http://geotracker.waterboards.ca.gov/esi/uploads/geo_report/3333375930/SL185704255.PDF
See more info on this cleanup at http://geotracker.waterboards.ca.gov/profile_report?global_id=SL185704255.

WORKPLAN FOR ADDITIONAL PILOT STUDY INJECTION TESTING

Central Valley Regional Water Quality Control Board, California. 48 pp, 2016

The Diamond Foods facility has been operating as mainly a walnut processing plant since the 1950s. Hexavalent chromium previously used as corrosion inhibitor for a former cooling tower at the site is believed to be the source of Cr(VI) groundwater impacts immediately north of the main processing building. In a June 2015 pilot test, 1,500 gal of calcium polysulfide (Cascade®), a 29% solution, was injected into the water-bearing formation below the site via existing well MW-3 to create reducing conditions in the groundwater sufficient to convert Cr(VI) to Cr(III). Historically, MW-3 has been the site's most affected well. Nine months after the calcium polysulfide injection, the Cr(VI) concentration reported in MW-3 was less than the laboratory detection limit and showed no evidence of rebound. Additional calcium polysulfide injection is planned to treat chromium in the groundwater.
http://geotracker.waterboards.ca.gov/esi/uploads/geo_report/8166651129/T0607700325.PDF
See more information on this cleanup at http://geotracker.waterboards.ca.gov/profile_report?global_id=T0607700325.

Research

PHASE II: IDENTIFICATION AND CHARACTERIZATION OF NATURAL SOURCES OF PERCHLORATE

Hatzinger, P.B., G. Harvey, W.A. Jackson, J.K. Boehlke, N.C. Sturchio, B. Gu, D. Grantz, K. Burkey, and M. McGrath.
SERDP Project ER-1435, 362 pp, 2017

The project goal was to develop an improved understanding of (1) the distribution and isotopic characteristics of natural perchlorate worldwide, (2) the mechanisms of natural perchlorate production, and (3) the contributing processes resulting in the ubiquitous distribution of this anion and its stable isotope characteristics in soils, groundwater, and vegetation. Distribution of natural perchlorate in soils and groundwater in arid and semi-arid environments was observed worldwide. Natural perchlorate was also found to be the dominant source of this anion in the U.S. Great Lakes at concentrations ranging from 0.05-0.13 µg/L. UV-photolysis and ozone mediated mechanisms both may contribute to the formation of natural perchlorate and to its isotopic characteristics. Biological synthesis of perchlorate in bacteria or plants was not observed, although many plant species were seen to bioaccumulate perchlorate, particularly in leaf tissue. The isotopic signature of the plant-accumulated perchorate represented that of the dominant environmental source, potentially providing a means to identify sources in produce. https://www.estcp.com/content/download/41722/397674/file/ER-1435%20Final%20Report.pdf

DEVELOPMENT OF A PASSIVE MULTISAMPLING METHOD TO MEASURE DIOXINS/FURANS AND OTHER CONTAMINANT BIOAVAILABILITY IN AQUATIC SEDIMENTS

Lohmann, R. and M. Khairy.
SERDP Project ER-2538, 72 pp, 2016

A passive sampling method utilizing polyethylene samplers was developed for in situ sampling of dioxins/furans and a wide range of other hydrophobic organic contaminants in sediment and the overlying water column. Contaminant concentrations resulting from multi-sampler deployments at several sites along the Passaic River (New Jersey) were compared with those in benthic invertebrates to demonstrate the ability to predict tissue concentrations. Good agreement was generally observed between pore water concentrations obtained in the lab and the in situ sampler for dioxins/furans and PCBs. Lipid-normalized PCDD/Fs were better estimated from pore water and river water for the majority of the congeners.
https://www.estcp.com/content/download/41830/398731/file/ER-2538%20Final%20Report.pdf

OPTIMIZATION OF INTEGRATIVE PASSIVE SAMPLING APPROACHES FOR USE IN THE EPIBENTHIC ENVIRONMENT

Belden, J., P. Sims, G. Rosen, R. George, and G. Lotufo.
SERDP Project ER-2542, 35 pp, 2016

The main objective of this project was to develop an integrative passive sampler design and protocol that accurately integrates time-weighted concentrations of munitions constituents in aquatic systems regardless of the magnitude of flow. Current sampler designs and technology do not account for variations in sampling rate due to changes in flow and turbulence near the sampler (e.g., in complex environments at the sediment-water interface). Investigations focused on further development of the Polar Organic Chemical Integrative Sampler (POCIS), including (1) modification of sampler design, (2) addition of a performance reference compound (PRC), and (3) development of a microsensor for flow that can be co-deployed. Addition of a flow-disrupting nylon screen reduced the impact of flow and could be developed pending further research and optimization. PRCs were found to be helpful for some but not all analytes. Finally, a promising flow sensor was developed. Although all three approaches had relatively positive outcomes, the microsensor for flow appears to have better opportunities for technology transfer and is suggested for future development.
https://www.estcp.com/content/download/41832/398751/file/ER-2542%20Final%20Report.pdf

ACTIVELY SHAKEN IN-SITU PASSIVE SAMPLER PLATFORM FOR METHYLMERCURY AND ORGANICS

Ghosh, U., M. Jalalizadeh, J. Sanders, and C.C. Gilmour.
SERDP Project ER-2540, 128 pp, 2016

This report describes an engineering innovation of adapting low-cost motors used for producing haptic feedback in cell phones for use in disrupting the aqueous boundary layer in a passive sampler deployed in sediments. Lab experiments and numerical modeling showed that short periodic shaking of a passive sampler deployed in static sediment greatly enhanced the rate of mass transfer and reduced the difference in the extent of equilibrium achieved compared to a well-stirred equilibrium in the lab. The improvement over static sediment deployment was especially evident for the high molecular weight compounds, such as benzo(a)pyrene. The method was also tested on strongly hydrophobic chlorinated organics using PCB congeners in the log K_{OW} range of 6 to 8. Deployment of the vibrated passive sampler in laboratory mesocosms of field-collected sediments showed that pore water concentrations of up to octachlorobiphenyls can be measured accurately with 7-day in situ sampler deployment, whereas static deployment of passive samplers for 28 days gave a measurement 4-fold higher than the true equilibrium value. Further work is needed to make the vibrating passive sampler concept more operational.
https://www.estcp.com/content/download/41831/398741/file/ER-2540%20Final%20Report.pdf

MULTIPURPOSE SEDIMENT PASSIVE SAMPLER WITH IMPROVED TISSUE MIMICRY TO MEASURE THE BIOAVAILABLE FRACTION

Edmiston, P.L.
SERDP Project ER-2541, 62 pp, 2016

Passive samplers were developed and tested using three different versions of swellable organosilica (Osorb®, ABS Materials) media to determine the optimal formulation for capture of metals, chlorinated polyaromatic compounds, TNT, and RDX. Fundamental sampler performance was tested in water to determine (a) time to equilibrium for analyte absorption, (b) sampler response to absorption of varying analyte concentrations as a measure of sensitivity, and (c) resistance to back-diffusion to determine if response is integrative. The passive samplers test matrix comprised artificial sediment spiked with varying concentrations of analytes. Recovery of sequestered chemicals within the Osorb samplers was completed to determine the % capture of both metals and munitions. The samplers had fast response time (minutes-hours) due to the open mesh design, with linear correlation between concentration in the environment and sampler response. The high capacity and affinity of Osorb acted as a sink, allowing measurement of analytes in pore water as well as those reversibly bound to sediment.
https://www.estcp.com/content/download/41977/399976/file/ER-2541%20Final%20Report.pdf

PREDICTING THE FATE AND EFFECTS OF RESUSPENDED METAL CONTAMINATED SEDIMENTS

Burton, G.A. Jr., K. Farley, R. Carbonaro, K. Rader, and J. Gailani.
SERDP Project ER-1746, 239 pp, 2015

The over-arching project objective was to determine the environmental significance of resuspended sediments contaminated with metals (i.e., Cd, Cu, Pb, and Zn), considering spatial and temporal issues as they relate to exposure, fate, and real-time versus ecological effects. The focus was on strong resuspension events, such as those caused by propeller wash. Physical-chemical models were developed that predict metal contaminant speciation, partitioning, and transport, and link the resulting exposures to biological effects in these dynamic ecosystems. Results indicate that that most resuspension events, whether conducted in lab or field, are nontoxic events due to the short duration of the exposures. Metals released from sediments are quickly scavenged by Fe and Mn oxyhydroxides, become non-bioavailable, and then settle out on surficial sediments. If metal-sensitive epibenthic species, such as *Hyalella azteca*, are present in the area where these resuspension events occur, they may be chronically exposed during feeding. Model results showed that during short-term resuspension events metal bioavailability is limited due to the slow oxidation of metal sulfides and the binding of released metal to NOM and HFO. When the TICKET-PTM (Tableau Input Coupled Kinetic Equilibrium Transport-Particle Tracking Model) was applied to a pilot field test of a propeller-wash event in San Diego Bay, results demonstrated the importance of transport, oxidation kinetics, and metal partitioning behavior in assessing the effects of propeller-wash events on Cu bioavailability in the overlying water. https://www.estcp.com/content/download/41978/399986/file/ER-1746%20Final%20Report.pdf
See also recent work from Project ER-201031 for characterizing, mapping, and predicting fate and transport of sediment plumes and contamination by propeller wash at https://www.estcp.com/Program-Areas/Environmental-Restoration/Contaminated-Sediments/ER-201031.

MECHANISMS AND PERMANENCE OF SEQUESTERED PB AND AS IN SOILS: IMPACT ON HUMAN BIOAVAILABILITY

Basta, N., B. Stevens, S. Whitacre, K. Scheckel, A. Betts, K. Bradham, D. Thomas, C. Schadt.
SERDP Project ER-1742, 162 pp, 2016

Although in situ stabilization or sequestration of Pb-contaminated soil by amending the soil with phosphorus is a proven technology, concern over the long-term effect of natural biological and chemical processes on the bioavailability of the sequestered Pb can inhibit technology implementation. The project objectives were to (1) conduct a comprehensive study to link the binding mechanism of As in soil (i.e., speciation) with in vitro and in vivo methods used to predict current and potential future bioavailability of soil As to humans, and (2) evaluate the effect of key biological and chemical processes (i.e., fungal growth, soil acidification) on the permanence of binding and bioavailability of Pb in untreated and remediated soils. Neither biological fungal treatments nor chemical acidification (pH > 3) affected Pb mobility, bioaccessibility, or bioavailability in P-treated soils. In the tests conducted for this study, sequestered Pb in P-treated soil remained stable. https://www.estcp.com/content/download/41723/397684/file/ER-1742%20Final%20Report.pdf

EXPLOITED APPLICATION OF SULFATE-REDUCING BACTERIA FOR CONCOMITANT TREATMENT OF METALLIC AND NON-METALLIC WASTES: A MINI REVIEW

Hussain, A., A. Hasan, A. Javid, and J.I. Qazi.
3 Biotech 5(6):119(2016)

This review summarizes the productive utility of sulfate-reducing bacteria (SRB) for economical and concomitant treatment of heavy metals and various compound forms of sulfates. Utilization of agro-industrial wastes and some environmental contaminants, including hydrocarbons, as economical growth substrates for SRB has proved efficient. Mechanistically, SRB will use sulfates as their terminal electron acceptors during respiration while using agro-industrial or hydrocarbon wastes as electron donors/ carbon sources and generating H_2S. The biogenic H_2S then reacts vigorously with dissolved metals present in the

wastewaters, thus forming metal sulfide, which, being water-insoluble and heavier than water, will settle out as precipitate. In this way, metals, sulfates, and agro-industrial or hydrocarbon wastes can be treated simultaneously. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4902799/

COMPREHENSIVE REVIEW ON PHYTOTECHNOLOGY: HEAVY METALS REMOVAL BY DIVERSE AQUATIC PLANTS SPECIES FROM WASTEWATER

Rezania, S., S.M. Taib, M.F.M. Din, F.A. Dahalan, and H. Kamyab.
Journal of Hazardous Materials 318:587-599(2016)

Phytoremediation is a cost-effective cleanup technology that has been used to treat sites affected by heavy metals. The method has been implemented successfully in constructed wetlands to restore the aquatic biosystem naturally. Many aquatic plant species are being investigated to determine their potential and effectiveness for phytoremediation applications, especially plants with high growth rates (e.g., macrophytes). Phytofiltration or rhizofiltration is the mechanism for heavy metals removal from water by aquatic plants. Due to specific morphology and higher growth rate, free-floating plants appear to be more efficient in heavy metals uptake in comparison with submerged and emergent plants. This review mainly focuses on the potential of four well-known hyperaccumulator aquatic species: *Pistia stratiotes* (water lettuce), *Eicchornia* spp. (water hyacinth), *Lemna* spp. (duckweed), and *Salvinia* spp (watermoss). The history, methods, and future prospects of aquatic plants in phytoremediation of heavy metals are discussed.

SELENIUM BIOFORTIFICATION AND PHYTOREMEDIATION PHYTOTECHNOLOGIES: A REVIEW

Schiavon, M. and E.A.H. Pilon-Smits.
Journal of Environmental Quality 46:10-19(2017)

The element selenium (Se) is both essential and toxic for most life forms, with a narrow margin between deficiency and toxicity. Phytotechnologies, which use plants and their associated microbes, can be used to address both problems. Plants can be used to remove high levels of Se from soil or water; crops can be biofortified with Se to alleviate Se deficiency in humans or livestock; and Se-enriched plant material resulting from phytoremediation could be used as green fertilizer or as fortified food. Plants also can be used to "mine" or recover Se from seleniferous soils. Results of past research can be exploited in phytotechnology programs to optimize plant Se accumulation, transformation, volatilization, and tolerance via plant breeding, genetic engineering, and tailored agronomic practices. http://rydberg.biology.colostate.edu/epsmitslab/Schiavon%20and%20Pilon-Smits%20JEQ%202017.pdf

ACID WATER NEUTRALIZATION USING MICROBIAL FUEL CELLS: AN ALTERNATIVE FOR ACID MINE DRAINAGE TREATMENT

Leiva, E., E. Leiva-Aravena, and I. Vargas.
Water 8(11):536(2016)

Acid mine drainage (AMD) is a complex environmental problem that has adverse effects on ground and surface waters due to low pH, high toxic metals, and dissolved salts. The potential of a new bioremediation approach based on microbial fuel cells (MFCs) was investigated as a novel and sustainable alternative for AMD treatment. Researchers studied the potential of MFCs for acidic synthetic water treatment through pH neutralization in batch-mode and continuous-flow operation. A marked pH increase, from ~3.7 to ~7.9, was observed under batch conditions and to ~5.8 under continuous-flow operation. Likewise, batch reactors (non-MFC) inoculated with different MFC-enriched biofilms showed very similar pH increase, suggesting that the neutralization observed for batch operation was due to a synergistic influence of these communities. *This paper is* ***Open Access*** *at* http://www.mdpi.com/2073-4441/8/11/536.

DEVELOPMENT AND APPLICATION OF MINE SITE RECLAMATION METHODS TO CONTROL ACID GENERATION IN CANADA

Bussiere, B. and M. Aubertin.
Proceedings of the 37th West Virginia Mine Drainage Task Force Symposium, 29-30 Mar 2016, Morgantown, WV. 10 pp, 28 slides, 2016

Appropriate control and remediation measures must be applied at mine waste storage facilities that have the potential to generate acid mine drainage (AMD). A variety of techniques have been developed and implemented in Canada to limit AMD generation and mitigate its environmental impacts. These techniques usually aim at eliminating one (or more) of the three main reactants in the oxidation reactions that lead to acid production: oxygen, water, and sulfide minerals. Examples include sulfide separation and reuse of desulfurized tailings, oxygen barriers, water cover and elevated water table techniques, cover with capillary barrier effects, water infiltration barriers, and insulation covers for a cold climate.
Paper: https://wvmdtaskforce.files.wordpress.com/2016/04/2016-bussiere-canada.pdf
Slides: https://wvmdtaskforce.files.wordpress.com/2016/04/2016task-force-symposium-bussiere-v2.pdf

A BRIEF OVERVIEW OF CONTROL AND TREATMENT TECHNOLOGIES FOR ACID MINE DRAIANGE, WITH SPECIAL EMPHASIS ON PASSIVE SYSTEMS

Skousen, J., C. Zipper, A. Rose, B. Nairn, P. Ziemkiewicz, and L. McDonald.
Proceedings of the 37th West Virginia Mine Drainage Task Force Symposium, 29-30 Mar 2016, Morgantown, WV. 11 pp, 119 slides, 2016

Acid mine drainage (AMD) occurs when metal sulfides are exposed to oxidizing conditions. AMD control technologies being researched include injection of alkaline materials (ashes and limestone) into abandoned underground mines and into buried acid material in mine backfills, and installation of alkaline recharge trenches. Passive treatment technologies can be separated into biological types, which incorporate organic matter, and geochemical types that treat AMD through oxidation, precipitation, and mineral dissolution. Most passive treatment systems employ multiple methods, often in series. **Paper:** https://wvmdtaskforce.files.wordpress.com/2016/04/2016-skousen-amd-treatment-task-force-2016.pdf
Slides: https://wvmdtaskforce.files.wordpress.com/2016/04/2016-skousen-passive-2016.pdf

COMBINATION OF AQUIFER THERMAL ENERGY STORAGE AND ENHANCED BIOREMEDIATION: RESILIENCE OF REDUCTIVE DECHLORINATION TO REDOX CHANGES

Ni, Z., P. van Gaans, M. Smit, H. Rijnaarts, and T. Grotenhuis.
Applied Microbiology and Biotechnology 100:3767-3780(2016)

To meet the demand for sustainable energy, aquifer thermal energy storage (ATES) is widely used in the subsurface in urban areas of Europe; however, contamination of groundwater with chlorinated VOCs is often encountered. Although this circumstance is commonly seen as an impediment to ATES implementation, combining ATES and enhanced chlorinated VOC bioremediation has been proposed. Issues to be addressed include high water flow velocities and potential periodic redox fluctuation that accompany ATES. A column study was performed at a high water flow velocity of 2 m/h to simulate possible changes in subsurface redox conditions due to ATES operation by serial additions of lactate and nitrate. Overall results show that the microbial resilience of *Dehalococcoides* in biosimulated ATES conditions is sensitive to redox fluctuations, thus indicating that combining ATES with bioremediation requires dedicated operation and monitoring of the aquifer geochemical conditions. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4803826/

GEOCHEMICAL AND HYDROLOGIC FACTORS CONTROLLING SUBSURFACE TRANSPORT OF POLY- AND PERFLUOROALKYL SUBSTANCES, CAPE COD, MASSACHUSETTS

Weber, A.K., L.B. Barber, D.R. LeBlanc, E.M. Sunderland, and C.D. Vecitis.
Environmental Science & Technology 51(8):4269-4279(2017)

Given that groundwater is a major source of drinking water, the main objective of this work was to investigate geochemical and hydrological processes governing the subsurface transport of PFASs at a former fire training area (FTA) on Cape Cod, Mass., where PFAS-containing aqueous film-forming foams were used historically. A total of 148 groundwater samples and 4 sediment cores collected along a 1200-m-long downgradient transect originating near the FTA were analyzed for PFAS content. Results indicate that unsaturated zones at the FTA and at hydraulically downgradient former domestic wastewater effluent infiltration beds both act as continuous PFAS sources to the groundwater despite 18 and 20 years of inactivity, respectively. Historically different PFAS sources are evident from contrasting PFAS composition near the water table below the FTA and wastewater-infiltration beds. Results from total oxidizable precursor assays conducted using groundwater samples collected throughout the plume suggest that some perfluoroalkyl acid precursors at this site are transporting with perfluoroalkyl acids. http://bgc.seas.harvard.edu/assets/weber2017_pfas.pdf

VALIDATION OF AN INTEGRATIVE METHODOLOGY TO ASSESS AND MONITOR REDUCTIVE DECHLORINATION OF CHLORINATED ETHENES IN CONTAMINATED AQUIFERS

Tarnawski, S.-E., P. Rossi, M.V. Brennerova, M. Stavelova, and C. Holliger.
Frontiers in Environmental Science 4:7(2016) doi: 10.3389/fenvs.2016.00007

Bioremediation of aquifers affected by PCE and TCE is frequently hampered by incomplete dechlorination to the more toxic DCE and VC. A methodology based on the joint analysis of geochemical and microbiological datasets was developed to assess the presence of the biochemical potential for complete reductive dechlorination to harmless ethene and to explain why degradation often stalls at the more toxic intermediates. This methodology comprises three successive steps: (1) acquisition of geochemical data, including chlorinated ethenes; (2) detailed analysis of the bacterial community structures and the biochemical potential for complete dechlorination using microcosms, molecular detection of organohalide-respiring bacteria, and key reductive dehalogenases; and (3) a statistical multiple factor analysis combining the above-mentioned abiotic and biotic variables in a functional modeling of the contaminated aquifer. The methodology was validated by analyzing two chlorinated ethenes-contaminated sites. The proposed methodology successfully allowed the identification of biogeochemical processes limiting or supporting complete dechlorination in both aquifers. http://journal.frontiersin.org/article/10.3389/fenvs.2016.00007/full

FIELD ANALYSIS OF POLYCHLORINATED BIPHENYLS (PCBS) IN SOIL USING SOLID-PHASE MICROEXTRACTION (SPME) AND A PORTABLE GAS CHROMATOGRAPHY-MASS SPECTROMETRY SYSTEM

Zhang, M., N.A. Kruse, J.R. Bowman, and G.P. Jackson.
Applied Spectroscopy 70(5):785-793(2016)

An expedited field analysis method was developed for the determination of PCBs in soil matrices using a portable GC-MS instrument. Soil samples of ~0.5 g were measured with a portable scale for PCB extraction by headspace SPME with a 100 µm PDMS fiber. Two mL of 0.2 M potassium permanganate and 0.5 mL of 6 M sulfuric acid solution were added to the soil matrices to facilitate PCBs extraction performed for 30 min at 100°C in a portable heating block. Heating was powered by a portable generator. The portable GC-MS instrument took

EVALUATION OF DEEP VADOSE ZONE CONTAMINANT FLUX INTO GROUNDWATER: APPROACH AND CASE STUDY

Oostrom, M., M.J. Truex, G.V. Last, C.E. Strickland, and G.D. Tartakovsky.
Journal of Contaminant Hydrology 189:27-43(2016)

For sites with a contaminant source located in the vadose zone, the nature and extent of groundwater contaminant plumes are a function of the contaminant flux from the vadose zone to groundwater. Especially for thick vadose zones, transport may be relatively slow, making it difficult to directly measure contaminant flux. An integrated assessment approach supported by site characterization and monitoring data is presented to explain current vadose zone contaminant distributions and to estimate future contaminant flux to groundwater in support of remediation decisions. The SX Tank Farm at DOE's Hanford facility was used as a case study because of a large existing contaminant inventory in its deep vadose zone, the presence of a limited-extent groundwater plume, and the relatively large amount of available data for the site. The analysis revealed that site recharge is the most important flux-controlling process for future contaminant flux and that the vast majority of technetium-99 is expected to migrate into the groundwater during the next century. Tank leak characteristics and subsurface heterogeneities appeared to have a limited effect on long-term contaminant flux into groundwater. The approach provides a template for use in evaluating contaminant flux to groundwater using existing site data and has elements that are relevant to other disposal sites with a thick vadose zone. *See more information in the SX Tank Farm case study report (PNNL-23737) at* http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-23737.pdf.

MOLECULAR AND IONIC-SCALE CHEMICAL MECHANISMS BEHIND THE ROLE OF NITROCYL GROUP IN THE ELECTROCHEMICAL REMOVAL OF HEAVY METALS FROM SLUDGE

Hasan, S.W., I. Ahmed, A.A. Housani, and A. Giwa.
Nature: Scientific Reports 6:Article 31828(2016)

Researchers from Masdar Institute in the United Arab Emirates have developed an energy-efficient, low-cost method for removing heavy metals from biosolids. The system has demonstrated the ability to remove over 90% of zinc and over 60% of copper from sludge collected from the Masdar City wastewater treatment plant. The three-step treatment process combines chemical conditioning, electrokinetic remediation, and a post-treatment washing. The electrokinetic process was made significantly more energy-efficient by conditioning the biosolids first with aqua regia acid. Work is underway to determine if the high removal rates achieved at pilot scale can be reproduced at commercial scale. Treatment costs are detailed. http://www.nature.com/articles/srep31828

NON-PUMPED WELLS IN BACKFILLED TRENCHES VERSUS PERMEABLE REACTIVE BARRIERS FOR CONTAINING AND TREATING CONTAMINATED GROUNDWATER

Hudak, P.F.
Environmental Practice 18:247-252(2016)

A flow and mass transport model simulated two low-energy groundwater remediation strategies: (1) a permeable reactive barrier (PRB) and (2) non-pumped wells with filter cartridges in a backfilled trench. Both structures occupied a linear transect 5 m downgradient of the leading tip of a contaminant plume and perpendicular to the local hydraulic gradient. In each of four simulated homogeneous and heterogeneous settings, models identified the shortest PRB (measured lengthwise, normal to the ambient hydraulic gradient) or locations of the smallest number of non-pumped wells necessary to contain and remove a contaminant plume. Results suggest that non-pumped wells emplaced in trenches backfilled with aquifer material (when allowed from a regulatory perspective) may be a viable alternative to more costly PRBs in some settings.

ANALYTICAL MODEL FOR THE DESIGN OF IN SITU HORIZONTAL PERMEABLE REACTIVE BARRIERS (HPRBS) FOR THE MITIGATION OF CHLORINATED SOLVENT VAPORS IN THE UNSATURATED ZONE

Verginelli, I., O. Capobianco, N. Hartog, and R. Baciocchi.
Journal of Contaminant Hydrology 197:50-61(2017)

A 1-D analytical solution is presented that can be used for the design of horizontal permeable reactive barriers (HPRBs) as a vapor mitigation system at sites contaminated by chlorinated solvents. The model incorporates a transient diffusion-dominated transport with a second-order reaction rate constant, and it accounts for the HPRB lifetime as a function of the oxidant consumption by reaction with upward vapors and its progressive dissolution and leaching by infiltrating water. Simulation results by the new model closely replicate previous lab-scale tests carried out on TCE using an HPRB containing a mixture of potassium permanganate, water, and sand. Depending on the oxidation kinetic of the target contaminant, an HPRB 1 m thick can ensure an attenuation of vapor concentrations of orders of magnitude for up to 20 years, even for vapor source concentrations up to 10 g/m^3. A demonstrative application for representative contaminated site conditions also shows the feasibility of this mitigation system from an economical point of view, with capital costs potentially somewhat lower than those of other remediation options, such as soil vapor extraction. Field-scale tests are needed to verify the potential and cost-effectiveness of HPRBs for vapor mitigation control under a variety of conditions.

HEAVY METAL REMOVAL CAPACITY OF INDIVIDUAL COMPONENTS OF PERMEABLE REACTIVE CONCRETE

Holmes, R.R., M.L. Hart, and J.T. Kevern.
Journal of Contaminant Hydrology 196: 52-61(2017)

Permeable reactive barrier (PRB) technology uses industrialized reactive media, such as zero-valent iron and activated carbon, for groundwater remediation. Permeable reactive concrete (PRC) is a reactive medium composed of relatively inexpensive materials, such as cement and aggregate. A variety of multimodal, simultaneous processes drive remediation of metals from contaminated groundwater within PRC systems due to the complex heterogeneous matrix formed during cement hydration. Researchers investigated the influence of coarse aggregate, portland cement, fly ash, and various combinations on the removal of Pb, Cd, and Zn in solution. Absorption, adsorption, precipitation, co-precipitation, and internal diffusion of the metals are common mechanisms of removal in the hydrated cement matrix and are independent of the aggregate. Local aggregates can be used as the permeable structure also possessing high metal removal capabilities, although calcareous sources of aggregate are preferred due to improved removal with low leachability. Individual adsorption isotherms were linear or curvilinear up, indicating a preferred removal process. For the PRC samples used, metal saturation was not reached over the range of concentrations tested. Results then were used to compare removal against activated carbon and aggregate-based PRBs by estimating material costs for the remediation of an example heavy metal-contaminated Superfund site located in Joplin, Missouri. *This paper is* ***Open Access*** *at the bottom of the journal's table of contents at* http://www.sciencedirect.com/science/journal/01697722/196/supp/C.

TIME VS. MONEY: A QUANTITATIVE EVALUATION OF MONITORING FREQUENCY VS. MONITORING DURATION

McHugh, T.E., P.R. Kulkarni, and C.J. Newell.
Groundwater 54(5):692-698(2016)

Current monitoring optimization schemes rely on site-specific evaluations to optimize groundwater monitoring frequency; however, when using linear regression to estimate the long-term zero-order or first-order contaminant attenuation rate, the effect of monitoring frequency and monitoring duration on the accuracy and confidence for the estimated attenuation rate is not site-specific. For a fixed number of monitoring events, doubling the time between monitoring events (e.g., changing from quarterly monitoring to semi-annual monitoring) will double the accuracy of estimated attenuation rate. For a fixed monitoring frequency (e.g., semi-annual monitoring), increasing the number of monitoring events by 60% will double the accuracy of the estimated attenuation rate. Combining these two factors, doubling the time between monitoring events (e.g., quarterly monitoring to semi-annual monitoring) while decreasing the total number of monitoring events by 38% will result in no change in the accuracy of the estimated attenuation rate, but the time required to collect this dataset will increase by 25%. Understanding that the trade-off between monitoring frequency and monitoring duration is not site-specific might simplify the process of optimizing groundwater monitoring frequency at contaminated groundwater sites. *This paper is* ***Open Access*** *at* http://onlinelibrary.wiley.com/doi/10.1111/gwat.12407/full.

MECHANOCHEMICAL CONVERSION OF BROMINATED POPS INTO USEFUL OXYBROMIDES: A GREENER APPROACH

Cagnetta, G., H. Liu, K. Zhang, J. Huang, B. Wang, S. Deng, Y. Wang, and G. Yu.
Scientific Reports 6:Article 28394(2016)

Mechanochemical destruction is a promising technology for safe disposal of persistent organic pollutants (POPs) because it can achieve their complete carbonization by solvent-free high-energy ball milling at room temperature. A large amount of co-milling reagent usually is needed, however, with production of a considerable volume of residue. This paper proposes a different approach to POPs mechanochemical destruction. Employing stoichiometric quantities of bismuth oxide or lanthanum oxide as co-milling reagent, brominated POPs were selectively and completely converted into their corresponding oxybromides, which possess very peculiar properties and can be used for some actual and many potential applications. In this way, bromine can be beneficially reused in the final product, while the POPs carbon skeleton is safely destroyed to amorphous carbon. http://www.nature.com/articles/srep28394

PORTABLE DEEP-ULTRAVIOLET RAMAN SPECTROSCOPY FOR STANDOFF THREAT DETECTION
Hopkins, A.J., A.R. Ford, J.L. Cooper, L.T.M. Profeta.
DSIAC Journal 3(2):(2016)

A recently developed man-portable UV Raman spectrometer system is designed to provide rapid, standoff detection of compounds such as explosives, narcotics, and toxic industrial chemicals and materials. General aspects of the system design and user interface are discussed. In tests the device can identify suspect materials from distances of between 1 and 10 m.
https://www.dsiac.org/resources/journals/dsiac/spring-2016-volume-3-number-2/portable-deep-ultraviolet-raman-spectroscopy

General News

VAPOR INTRUSION ESTIMATION TOOL FOR UNSATURATED-ZONE CONTAMINANT SOURCES: USER'S GUIDE
Johnson, C.D., M.J. Truex, M. Oostrom, K.C. Carroll, and A.K. Rice.
ESTCP Project ER-201125, 50 pp, 2016

This document presents a tool for estimating vapor intrusion into buildings from unsaturated (vadose) zone contaminant sources. The tool builds on and is related to guidance for evaluation of soil vapor extraction performance relative to the impact of a vadose zone source on groundwater concentrations. This user guide is available with several tools for estimating vapor intrusion at the bottom of the project web page:
https://www.estcp.com/Program-Areas/Environmental-Restoration/Contaminated-Groundwater/Emerging-Issues/ER-201125.

PREVENTING ACID AND METALLIFEROUS DRAINAGE: LEADING PRACTICE SUSTAINABLE DEVELOPMENT PROGRAM FOR THE MINING INDUSTRY
Commonwealth of Australia, 221 pp, 2016

The emphasis in this handbook is on preventing the production of acid mine drainage (AMD) from exposed sulfidic materials, followed by managing existing AMD, and then treating AMD. Each type of mined material must be assessed on its own merits as part of a mine material characterization program to ensure that the waste is managed appropriately. This guide describes leading practice in Australia for prevention and management of AMD and addresses the following topics:

- Different types of AMD and how they are produced.
- Tools to address management issues and ways to predict and model AMD magnitude.
- Assessment of AMD risk.
- Strategies to limit the generation and release of AMD.
- Methods to treat existing AMD.
- Where, when, and how to monitor for AMD.
- Aspects of stakeholder communication.

These topics are illuminated in the handbook by numerous case studies.
https://industry.gov.au/resource/Documents/LPSDP/LPSDP-AcidHandbook.pdf

SUPERFUND SITES WORK FOR COMMUNITIES: HOW SUPERFUND REDEVELOPMENT IN EPA REGION 9 IS MAKING A DIFFERENCE IN COMMUNITIES
U.S. EPA Region 9, 24 pp, 2016

The revitalization of communities affected by contaminated lands is a key part of EPA's Superfund mission, delivering significant benefits one community at a time all across the country. Through EPA's Superfund Redevelopment Initiative, the Agency contributes to the economic vitality of these communities by supporting the return of sites to productive use. These regional profiles highlight community-led efforts in action.
https://semspub.epa.gov/work/HQ/191000.pdf

GEO-CHICAGO 2016: SUSTAINABLE WASTE MANAGEMENT AND REMEDIATION: SELECTED PAPERS
Yesiller, N., D. Zekkos, A. Farid, A. De, and K.R. Reddy (eds).
American Society of Civil Engineers, Reston, VA. Geotechnical Special Publication No 273, 2016

This publication contains 75 peer-reviewed papers selected from presentations made at the Geo-Chicago 2016 conference of August 14-18. Topics include sustainable waste management and remediation; contaminant fate and transport; electrokinetic, solidification/stabilization, and other remediation methods; contaminated sediments; and public policy and regulations. *The table of contents and abstracts can be viewed at*
http://ascelibrary.org/doi/book/10.1061/9780784480168.

ADVANCING IMPLEMENTATION OF DECOMMISSIONING AND ENVIRONMENTAL REMEDIATION PROGRAMMES — CIDER PROJECT: BASELINE REPORT
IAEA Nuclear Energy Series No. NW-T-1.10, 116 pp, 2016

This report identifies barriers that prevent the implementation of decommissioning and environmental remediation projects and provides potential solutions to overcome the challenges. Coverage includes technological issues and enabling infrastructure; resource and program management constraints; and societal constraints and approaches to overcome them. The nine appendices provide case studies.
http://www-pub.iaea.org/books/IAEABooks/10993/Advancing-Implementation-of-Decommissioning-and-Environmental-Remediation-Programmes

COMBINED REMEDY WITH A THERMAL COMPONENT
Heron, G.
SERDP/ESTCP Environmental Restoration Wiki, 2017

Complex sites often require a combination of technologies for remediation. At heavily contaminated sites, in situ thermal treatment is used to treat the source, while other technologies are used in the transition and plume zones. Three major in situ thermal remediation technologies are steam enhanced extraction, electrical resistance heating, and in situ thermal desorption. These technologies can be combined with in situ chemical oxidation, in situ chemical reduction, bioremediation, permeable reactive barriers, and monitored natural attenuation to provide complete site solutions. They may be enhanced using hydraulic or pneumatic fracturing and emplacement of permeable materials.
http://www.environmentalrestoration.wiki/index.php?title=Combined_Remedy_with_a_Thermal_Component

The Technology Innovation News Survey welcomes your comments and suggestions, as well as information about errors for correction. Please contact Michael Adam of the U.S. EPA Office of Superfund Remediation and Technology Innovation at adam.michael@epa.gov or (703) 603-9915 with any comments, suggestions, or corrections.

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