

Down to *Earth* Solutions



Welcome to the Summer 2001 edition of our newsletter. We're keeping you up-to-date on what's happening in our firm, contamination issues, new processes and technologies and the latest legislation.

Environmental monitoring at Sydney Olympic Park/ Homebush Bay, NSW



monitoring tasks for each site such as system integrity inspections, drainage system inspections, inspections of capping, toe and batter, water level monitoring, sampling of surface water, subsurface water, groundwater and leachate, surface gas emission monitoring, gas accumulation monitoring and subsequent reporting. These tasks are undertaken on fortnightly, monthly, quarterly and bi-annual predetermined schedules.

Environmental & Earth Sciences Pty Ltd commenced a tendered contract for the Olympic Co-ordination Authority (OCA) for the environmental monitoring for remediated landfill systems in July 2000.

The contract originally covered nine separate sites within the vicinity of the Sydney Olympic Park (SOP)/ Homebush Bay area. Two additional sites have since been added to the contract. The majority of these sites are individual landfills, which were uncontrolled dumping grounds for putrescible, construction, gasworks and industrial wastes prior to remediation. One of the sites was part of the former state brickworks which was filled with waste following the closure of the brickworks.

Each site contains a number of components to provide environmental control and a facility for leachate disposal. System components include manholes, piezometers, pumping pits, collection sumps, odour control units, solar panels, treatment ponds, evaporation ponds and holding tanks.

The contract involves numerous

Additional non-routine environmental monitoring tasks are also undertaken at the site. An example is the daily gas accumulation measurements which were taken during the Olympic Games within the many overlay (or temporary) structures located throughout SOP.

**For further information on environmental monitoring at SOP, please contact:
Lucy Vincent on (02) 9922 1777**

Profile – Mark Stuckey



In our previous issue we profiled the new Victorian State Manager, Stewart Black.

This issue we are pleased to introduce Mark Stuckey, a senior soil scientist based in our Sydney office. Mark (pictured) has been with the company for six years. In this time he has qualified for registration as a professional soil scientist (CPSS) and a professional agricultural scientist (Stage 1). He has completed his course work and is currently completing a thesis for the Masters of Hydrogeology at the University of NSW.

As a result of his extensive work in the area, Mark has written papers on the contamination of urban soil and on pesticide contamination in surface soil in Western Sydney. He has managed numerous soil and groundwater projects including many large scale projects in the Botany Basin, a considerable number of groundwater and leachate monitoring projects in landfills across New South Wales and several acid sulfate soil and associated hydrogeological investigations for major freeway developments and sand mining operations. Mark also has experience in agricultural and mining, soil and groundwater issues.

You can get the



- ... on all environmental issues, including:
- ✓ contaminated site assessments/remediation
- ✓ acid sulfate soil studies
- ✓ soil treatment and disposal
- ✓ asbestos and hazardous assessments
- ✓ EPA approved auditor



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Assisted desorption and natural degradation of benzene in an organic silt aquifer using low grade oxidants



Natural attenuation of petrol in an organic aquifer is not successful as benzene is readily attenuated by absorption onto the organic colloids and readily desorbed as concentrations drop. Specifically natural degradation needs to be monitored and promoted as attenuation alone is partly reversible.

A service station had leaked petrol over a number of years into a backfilled estuarine creek, likely to contain pyrite. The service station was located within 50 m of an estuarine waterway, that could have been used for recreational use. The tanks were replaced in 1993. Benzene, preferentially absorbed onto the organic silt, remained at high concentrations after the other aromatics and all aliphatics had been removed by natural means. Benzene was absorbed onto the surface of the organic colloids displacing native cations, as indicated by the alterations of the relative ratios of these cations in the pore water. This stored benzene was desorbed as soluble benzene was consumed, resulting in benzene remaining in solution after all other constituents had been degraded. Natural attenuation was monitored by the behaviour of groundwater redox, sulfate, N-species, iron, native cations, bicarbonate and dissolved carbon dioxide monitored infrequently over a five year period. During this time benzene dropped from 15 000 ug/L to 4000 ug/L but subject to seasonal variation. Benzene in soil was not measured over 1.5 ug/g.

Though levels of benzene were

reducing, benzene at up to 3 ug/L was recorded at the discharge to the creek at low tide. The regulatory authorities required more active remediation. Excavation was not possible. Monitoring indicated degradation was greatest at the edge of the plume as electron acceptors were limiting at the centre of the plume. To accelerate degradation an oxidant was required to be introduced into the centre of the plume,

where reduction was so great that even chemically bound oxygen such as in sulfate and carbon dioxide had been removed. The introduction of aggressive chemical oxidants such as peroxide would be expensive as excess reagent would be consumed by the oxidation of organic matter. Further, the use of these oxidants and less aggressive air (air sparging) would preferentially oxidise pyrite present in the estuarine silt. Sulfate and iron floc ($\text{Fe}(\text{OH})_3$) were added as socks to the bores. As N and P was also limiting, they were also added but in the oxidated form, superphosphate and urea. These were added initially, left for 2 months and then added weekly. Benzene and a range of attenuation indicators including dissolved carbon dioxide and displaced native cations were monitored. Degradation observed was up to an order of magnitude greater than that previously observed. As a result of this work it was apparent that native cations as well as sulfate and carbon dioxide are a good indicators of attenuation. Native cations being evidence of absorption and desorption and sulfate, carbon dioxide, redox, N-species and dissolved iron being indicators of natural biological degradation. In organic aquifers with petrol contamination natural attenuation is not enough and enhanced natural biological degradation may be required.

For further information on natural attenuation, please contact Philip Mulvey on (02) 9922 1777

Environmental performance/compliance of your company

Increasing regulatory control, enforcement and community concerns within Australia have reinforced the need for companies to have comprehensive environmental management systems capable of minimising and, to the extent possible, eliminating environmental risks and liabilities.

As a general rule, such systems are not compulsory, but it is possible for an environmental authority to require some form or management of compliance program to be developed under an environmental license or authorisation.

A primary defence to an environmental offence, and in some cases the only one available, is one of "due diligence" under which corporations or individuals are able to demonstrate that all reasonable and practical measures had been taken to prevent the company committing environmental offences. To this extent, the existence of an effective environmental management program and a pro-active approach to the identification, mitigation and management of environmental risks is important.

However, no system is capable of eliminating all environmental risks and the establishment of a comprehensive, efficient and proven environmental management system will go a long way to the environmental management of an operation and the minimising of potential liability and non-compliance for a company, its directors, managers and employees.

For further information on environmental performance/compliance, contact Stewart Black on (03) 9593 8770

STOP PRESS: Boots competition winner announced! Boots pictures were taken at: (1) East Timor (schist, gravel), (2) Melbourne, bluestone paving, (3) Melbourne, Coote Island silt (any acid sulfate soil was accepted), (4) A street in East Timor.

Ian Hollingworth of EWL Sciences Pty Ltd won the boots. Thankyou to everyone who entered. Competition No 2 is now underway!

Company training day



A few of the Sydney and Melbourne staff at the Christmas party following the training day.

from all our offices in Australia and New Zealand.

A five-year business plan for these offices was presented to the staff by the principal, Philip Mulvey, and then discussed amongst the staff.

A drilling session was undertaken in the afternoon. This comprised drilling into bedrock and installation of a groundwater well into the bedrock. Logging, sample collection and piezometer installation were undertaken by various staff members. Safety issues associated with drilling rigs and large plant were also discussed.

All staff, both new and continuing, benefited from the day and enjoyed the opportunity to interact with staff from other offices.

An Environmental & Earth Sciences company training day held on 15 December 2000 was attended by staff

Staff training and movement

As well as attending an updated QA/QC course, various staff members are attending management and marketing courses to improve the quality of service we can offer our clients.

New staff members are in the process of completing senior first aid courses in keeping with our occupational health and safety requirements.

We are sad to see the departure of Dr Kylie Hailes from our Sydney office. Kylie has moved overseas and we wish her all the best.

Staff who have recently joined our team include: Doris Samera (administrative assistant), Peter Graham (geologist), Dahmon Sorongan (soil scientist) and Silja Kuerzinger (soil scientist).

Acid sulfate soil revisited



A seminar on reducing the impact of acid sulfate soil on development and infrastructure was held in our Sydney office on 24 November 2000.

Over 50 representatives attended the seminar from areas as diverse as local councils, small developers,

surveyors, engineers, lawyers, project managers, construction companies, government departments, architects and large corporations.

Definitions of acid sulfate soil, examples of costs to industry and the environment, common problems for development and infrastructure and

innovative management were detailed in the seminar.

For an information pack regarding this issue, please contact Phil Mulvey on (02) 9922 1777.

Quality control and quality assurance



An external audit conducted by SGS has seen the update and extension of the quality assurance and quality control system implemented in the Sydney office.

The current system under which the office is accredited is the ISO 9001 (1994) standard. As this system is to be replaced by the ISO 9001 (2000), staff are to attend a training course organised by the Australian Organisation for Quality (NSW) in mid-February 2001.

For further information regarding our QA/QC system, please contact Tracey Bauer on (02) 9922 1777.

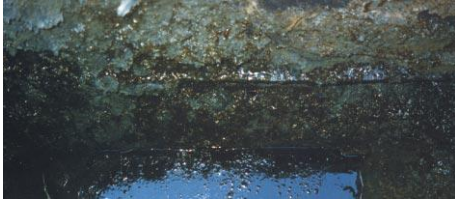
Contaminated site training course

Environmental & Earth Sciences Pty Ltd, The Centre for Contaminant Geoscience and The University of Technology, Sydney present a **TRAINING COURSE in SOIL TECHNOLOGY—CONTAMINATED LAND** to be held at UTS 26 Feb—2 March 2001. Presenters include NSW EPA, UTS, E&ES, UNSW, ANU, AGAL and other members of the Australian

Contaminated Land Consultants Association. Sessions include contaminated site remediation, physico-chemical properties of soil, current and future role of State and Federal statutory bodies and health risk assessments.

For further information or registration, please contact Miho on (02) 9922 1777.

The potential migration of contaminants in the groundwater of the Botany Basin, Sydney



A number of soil and water contamination assessments have been carried out by Environmental & Earth Sciences Pty Ltd within the Botany Basin which have provided a reasonably dense data set of anthropogenic contamination of soil and groundwater.

After reviewing these past reports, some interesting conclusions were made about the source of contamination on-site. In some cases, groundwater contamination was found some distance from point sources such as underground storage tanks (UST), and in totally the opposite direction in which the hydraulic gradient flowed at the time of assessment. This suggests that this contamination was sourced from offsite and has migrated down hydrological gradient to within the site boundary. In fact, there was evidence in other reports that there may be a number of offsite sources of contamination. This idea is well supported by the fact that the geology, soils and topography of the Botany Basin provide a relatively good hydrogeological environment for the migration of contaminated groundwater.

The Botany Basin is comprised of Quaternary aged (0-2 M years old) unconsolidated sediments known as Botany Sands, overlying Triassic aged (~ 200 M years old) bedrock of the

Hawkesbury Sandstone and Wianamatta Group. The Botany sands are comprised of wind-blown marine sands, inter-bedded with peat, estuarine sands and clay lenses that are inherently highly permeable. The inter-bedded layers of finer sediments act as semi-confining layers for vertical movement, and have been shown to enhance horizontal hydraulic conductivity. The underlying bedrock of Hawkesbury Sandstone is relatively impermeable and acts as a horizontal barrier to the downward flow of groundwater.

The depth to groundwater generally ranges from 1.4 - 2.5 metres and is recharged by surface infiltration of rainfall (average annual rainfall of 1207mm) into the unconsolidated sediments. The groundwater flow is generally from Centennial Park toward Botany Bay in a predominantly southerly direction but can vary due to local geological relief. The groundwater velocity has been measured as 0.05 – 0.1 m d^{-1} and has the potential to transport any present light non-aqueous phase liquids (L-NAPL's) such as benzene, toluene, ethyl benzene and xylene (BTEX) and total petroleum hydrocarbons (TPHs) at this velocity. This is due to the fact that the L-NAPL's will float on the surface of the water table.

Given the dense industrial use of the Botany area there are a number of potential sources of L-NAPL's that may have contributed to soil and groundwater contamination in the regional area. Large petroleum companies and chemical companies have been active

within the Botany area from as early as 1948, as well as a number of other chemical industries such as paint factories and small petrol stations. These can unfortunately be the sources of L-NAPL's through spillage, leaking pipes and/or leaking underground storage tanks (UST's). Any free product can rapidly infiltrate the coarse textured sediments and can reside in the finer textured sediments such as clay, peat or coffee rock lenses, or on top of the present water table. The free product then, depending of the groundwater movement, can migrate down the hydrological gradient towards Botany Bay.

For example, take a hypothetical situation where there may be a leak or spill within Botany in 1948, using an average groundwater flux of 0.075 m d^{-1} (27.38 m y^{-1}), theoretically the contamination front could have moved up to 1.4 km in the period between 1948-2001. Of course there are many other factors such as advection, dispersion, attenuation and dilution to take into consideration but the potential migration of contamination from one site to another is high. This should be taken into consideration when carrying out contamination assessments of soil and water within the Botany Basin area or in similar aquifers heavily used by industry. Examples are Kwinana and Western Melbourne.

For further information on the migration of contaminants in groundwater, please contact Mark Stuckey on 9922 1777.



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soil is the foundation of life