Issue 3 2010

Remediation Australasia

Dealing with the pollution from FIRE-FIGHTING FOAMS

DEVELOPING HEALTH INVESTIGATION LEVELS
Protecting human health

APPROACHES TO REMEDIATION
Is green or sustainable 'best'?

PETROLEUM VAPOUR DATA
Reviewing the health risks

CRCCARE™

Cooperative Research Centre for Contamination Assessment and Remediation of the Environment

CRC CARE is Australia's leading science-based partnership in assessing, preventing and remediating contamination of soil, water and air. With a unique mix of industry, university and government agency partners, CRC CARE research has five main programs:

- Risk assessment
- Remediation technologies
- Prevention technologies
- Social, legal, policy and economic issues
- National contaminated sites demonstration program

As part of an ambitious delivery agenda, CRC CARE has created the Australian Remediation Industry Cluster (ARIC) to promote SME access to new technology and knowledge, and developed an industry training and workshop program. It has forged key partnerships with major industry players and has a growing list of technology patents.

With university partners and strong ties to Asia, CRC CARE's support and supervision will enable 50 students to complete PhDs during its first seven-year term. Building regional leadership in this field represents an excellent investment for Australia as an international market for services emerges worth tens of billions of dollars.

A cleaner, safer future for all

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editor's note

Welcome to the third edition of *Remediation Australasia*. Despite a delay in the release of our third edition of the magazine, those of you visiting the *Remediation Australasia* website will have noticed that we have been busy over the past few months.

ARIC member services are now online and there are expanded services for the public. The new interactive pages for ARIC members finally went live on the ARIC website in February. This will provide members with a new interactive forum for discussing industry issues, as well as a growing reference library. Please take time to have a look at what is being offered. Thanks should go to Leigh Walters for his efforts in the early establishment of ARIC. While Leigh has moved to greener pastures, I am please to have Andrew Beveridge as the new ARIC coordinator.

ARIC has also commenced its knowledge transfer, and professional development, workshops and short courses.

Approximately 60 delegates attended the 1-day *Risk Communication* workshops in Melbourne and Sydney. Delegates heard industry experts who shared their experiences, and assisted participants in identifying key processes to support effective community engagement, and explore barriers in risk communication as they relate to site contamination.

Useful communication methods were presented which aimed to enhance learning skills, confidence, and encourage organisational involvement in effective environmental risk communication strategies. Workshop participants also received a copy of the CRC CARE guidance document: *Engaging the community: a handbook for professionals managing contaminated land*. The handbook covers an array of topics pertinent to any professional working in the field of site contamination and remediation. This handbook will complement existing guidelines and standards by providing practitioner perspectives and practical guidance through each stage of community engagement and is currently available from CRC CARE for purchase.

ARIC also held a 1-day master class in Melbourne entitled *Incorporating bioavailability into human health risk assessment*. The event brought together 45 delegates to listen the most current information on bioavailability, and synthesised this information into a practical context that explained concepts and identified types of data that need to be collected to assess bioavailability and incorporate it into human health risk assessment. The workshop drew upon the experience of industry specialists, who delivered case study presentations demonstrating the use of bioavailability-based risk assessments, and how they have been able to increase regulator and community confidence in permitting greater levels of residual soil and or sediment contaminants to remain at sites.

The use of bioavailability assessment is a growing area in the industry. If you are interested in further information, I encourage you to consider recent reports developed by CRC CARE as a resource for risk assessors on the assessment of bioavailability for use by human health and environmental health, and are expected to soon be included in the Assessment of Site Contamination NEPM.

ARIC will continue to develop industry training, networking events, thematic seminars and these will be advertised on the ARIC website. I hope you enjoy the articles and updates in our latest edition of the magazine and we look forward to your ongoing support.

Prof Ravi Naidu

Managing Director, CRC CARE

Editor, *Remediation Australasia*

Remediation Australasia is a quarterly industry magazine produced by the Australian Remediation Industry Cluster (ARIC) for the Australian remediation industry.

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Front cover image: 'Firefighter quenches burning tyres' © www.istockphoto.com/stock-photo-6447226-firefighter.php?welcomePage=download

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Health investigation levels, and the

Process of development for the NEPMs

Brian Priestly, Monash University

Health investigation levels (HILs) are established in the Contaminated Sites National Environment Protection Measure (or NEPM) to assist with management of sites contaminated with potentially hazardous chemicals. Only 31 contaminants had HILs established when the NEPM was first established in 1999. This list will be expanded as a result of the current review.

HILs are intended to act as a trigger for further site investigation once exceeded. The NEPM is explicit in saying they are not de facto goals which should drive site clean-up, although there has been an unfortunate trend to using them in this way. This may be because some consultants lack the skills to develop the more refined risk assessments which would enable them to propose and justify alternative health-protective clean up levels.

The reason for using HILs only as a device triggering further investigation is that they are set using a deliberately conservative health risk assessment (HRA) methodology, which assumes worst-case exposure scenarios for different types of site usage.

"Conservatism is also built into toxicological assessment of risk, mainly to overcome uncertainties in the data inputs, but also to ensure that more susceptible or vulnerable members of a community are protected such as the elderly and the sick."

Effectively, if the measured soil levels do not exceed the HIL, it can be assumed that health will not be compromised even for the most heavily exposed or vulnerable people exposed to the site. Refinement of the conceptual site models and exposure assessment may allow a more realistic estimate of risk to people living on or near the contaminated site.

In setting HILs, all potential exposure pathways need to be considered for each site use scenario. These would include:

- soil ingestion (particularly by children)
- skin deposition
- indoor intrusion of gases and vapours
- inhalation of dusts, gases and vapours
- contamination of groundwater.

Estimates of exposures by these pathways usually assume worst-case assumptions, and ingestion of soil by children (excluding deliberate soil ingestion behaviours) often drives the conservatism in the derived HILs. These estimates are often worst-case rather than most likely values, particularly when the absence of real data results in the use of defaults drawn from exposure tables.

Some exposure pathways are also characterised using modelling techniques, which may also be overly conservative in their assumptions. While there are HRA techniques which can manage variability and uncertainty in these models in a more realistic way (e.g. those which involve Monte Carlo-type computer simulations), these are 'data-hungry' techniques which contrast with the 'data-poor' scenarios usually confronted by a risk assessor for a particular site. Another factor is that conservatism is also built into toxicological assessment of risk, mainly to overcome uncertainties in the data inputs, but also to ensure that more susceptible or vulnerable members of a community are protected such as the elderly and the sick. Two different approaches are used in HRA methodology.

The first, and most commonly used technique, is to assume that dose-response data (usually from rodent-based animal experiments) can be used to derive a 'no observable adverse effect level', or NOAEL.

The NOAEL is a highest dose or exposure in the used studies, at and below which a toxic effect has not been demonstrated. The NOAEL is divided by a 100 - 10,000 fold 'safety factor' to derive an 'acceptable' or 'tolerable' daily dose estimate for humans. A 100-fold 'safety factor' accounts for uncertainties in extrapolating from rats to humans, and for the range of variation in sensitivity likely to occur in a heterogeneous human population. Additional safety factors are applied when the experimental database is limited, or is applied to a lowest observable adverse effect level (LOAEL) when a NOAEL has not been clearly established.

Where a NOAEL is not determined, an alternative procedure is to derive a benchmark dose (BMD) estimate. This is the dose which produces a defined level of excess risk (e.g. 5%) and it may be used as the 'point of departure' for further risk extrapolation in a HRA. The resultant estimate of a 'safe' level of exposure is thereby at least a couple of orders of magnitude lower than the putative NOAEL.

When the chemical of concern is suspected to be a carcinogen (i.e. capable of increasing the incidence of cancer in an exposed population) the HRA process is even more conservative, since no threshold for the effect is assumed and a NOAEL is not derived. Instead, the risk estimation for such a non-threshold process is based on a cancer slope factor, which is determined from a point on the dose-response curve where a lowest level of excess risk can be reliably estimated (or more conservatively, the upper 95% confidence level of this estimate) and then using a linear extrapolation from that point to zero dose.

The result is an estimate of the dose where the excess cancer risk appears to be from 1 in 10,000 to 1 in 1,000,000. The more conservative 1 in 1,000,000 is used in many types of carcinogenic HRAs, but a 1 in 100,000 risk level is becoming more accepted where multiple carcinogenic exposures may occur and the risk estimate is based on an aggregate of all these potential exposures.

It must be recognised that these estimates of risk are not real. The 1 in 1,000,000 risk level does not necessarily imply that if 1 million people are exposed, at least 1 will develop cancer as a direct result of the exposure. It is purely a mathematical construct which may be used to define a level of risk which regulatory authorities may consider to be negligible or devoid of health impact. Such low levels of risk could never be confirmed by direct measurement. This means that, even when a safe level of exposure appears to be exceeded in the HRA of a contaminated site, it does not necessarily mean that adverse effects are likely to occur, although the degree of conservatism built into the HRA will be eroded to some extent.

The degree to which erosion of the safety factors is acceptable is a matter for negotiation with the affected communities informed by expert opinion. A further consideration is that HRAs for contaminated sites may assume that exposure continues for most, if not all, of a person's lifetime. A shorter duration of exposure may reduce the overall risk estimate, unless it has already been factored into averaging the exposure associated with a specific site.

The conservatism of a HRA can be compounded to such an extent that exposure and risk estimates are far from realistic. This is the main reason that HILs are not intended to drive site clean-up, but to trigger a more refined risk assessment. The HIL setting process is currently being reviewed, with particular attention to using the most up-to-date HRA methodology to revise existing HILs and set some new ones.

Why are HILs set so conservatively?

HILs are set for four different site use scenarios:

- residential (with and without home-grown vegetable gardens)
- residential with minimal garden access (e.g. high-rise buildings)
- open space (parks & playing fields), and
- industrial or commercial use (but excluding child care centres, primary schools and kindergartens).

Since the four site-use scenarios involve quite different exposure estimates, the derived HIL numbers can vary over several orders of magnitude. A child playing in the backyard of a house has a greater risk of exposure to soils and any potential contaminants they may contain than a worker in a factory. The latter is not likely to play in the soil!

A consideration of three remediation practices:

Comparing green, sustainable and risk-based approaches

Paul Favara, John Lovenburg & James Davis, CH2M HILL

Costs and benefits of remediation activities need to be assessed early.

The concept of sustainable remediation was first introduced as a term in the United States in 2006 with the initiation of the first Sustainable Remediation Forum (SuRF) meeting in Wilmington, Delaware. Since this time, several other terms have sprouted up including green remediation, and green and sustainable remediation (GSR).

The main difference between the terms is the focus of green remediation on only the environmental domain of sustainability whereas sustainable remediation focuses on the environmental, social, and economic domains – collectively referred to as the triple bottom line.

In Australia, the term 'risk-based remediation' has become somewhat synonymous with the above terms as has 'integrated brownfield regeneration' in the UK, adding additional challenges in communicating the tenants of green and sustainable remediation.

This article provides a US-based perspective on green remediation, sustainable remediation, and risk-based remediation, the challenges associated with implementing them, how the terms are accepted by different industry stakeholders, and their implications for remediation in Australia. The fourth term, GSR, is mostly a hybrid of green and sustainable remediation and will not be discussed in detail.

What's in a name?

The information below provides a definition of green remediation, sustainable remediation, and risk-based remediation along with commentary on the acceptance of the concept from a regulatory stakeholder view, other stakeholder views, and implications for remediation projects. For the purposes of this article, 'other stakeholders' refers to owners of sites, consultants, service providers to the remediation industry and the community. While there is more than one definition for each of these terms, only a single definition is used.

Green remediation

The US EPA defines green remediation as *the practice of considering all environmental effects of remedy implementation and incorporating options to maximise net environmental benefit of cleanup actions.*

The focus of green remediation in the US is (starting to be) commonly accepted as consisting of the following five core elements:

- reducing total energy use and increasing renewable energy use
- reducing air pollutants and greenhouse gas emissions
- reducing water use and negative impacts on water resources
- improving materials management and waste reduction efforts, and
- enhancing land management and ecosystems protection.

The five elements above are just one of several lists of elements/principles/metrics that can be considered for green remediation. These green remediation metrics cover the environmental domain of sustainability, but not the social and economic domains. This is, perhaps, out of necessity and regulatory definitions. Most US regulatory agencies have resources trained to assess all facets of environmental issues but they are constrained by environmentally focused regulations and resource limitations which hamper addressing the social and economic domains of sustainability. While most US regulators embrace the term 'green remediation', some regulators feel it does not go far enough and that it should include the other domains of sustainability.

Like some regulators, other stakeholders think green remediation should also include the social and economic domains of sustainability. If regulators are not willing to consider the social and economic domains of sustainability, other stakeholders would at least like to see how the elements of green remediation can be implemented into the regulatory decision making process. Community stakeholders have not yet been vocal on this topic but it is perceived that they will embrace the elements of green remediation as they are more easily defined and measured.

At a minimum, the remediation industry needs to be prepared to identify green remediation metrics and quantify their impacts.

"Green/sustainable/risk-based remediation will be an important component of remediation planning and execution in the future. Industry is investing considerable resources to understand the contribution of green/sustainable/risk-based remediation to the industry, educating key stakeholders to enhance communication, and working towards standardised guidance and tools to deliver these services."

This will require a methodology for assessment, tools for quantification, general agreement on the type and quality of data that will be used in the assessments, and guidance on how green remediation results will be consistently incorporated into the regulatory process for remedial decision-making. Also, industry needs to identify and implement green remediation best practices to reduce the environmental footprint of future projects and optimise existing projects.

Sustainable remediation

SuRF defines sustainable remediation as: *a remedy or combination of remedies whose net benefit on human health and the environment is maximised through the judicious use of limited resources.* To accomplish this, SuRF embraces sustainable approaches to remediation that provide a net benefit to the environment. To the extent possible, these approaches should:

- minimise or eliminate energy consumption or the consumption of other natural resources
- reduce or eliminate releases to the environment, especially to the air
- harness or mimic a natural process
- result in the reuse or recycling of otherwise undesirable materials, and
- encourage the use of remedial technologies that permanently destroy contaminants.

The definition above has many elements in common with US EPA's core green remediation elements. However, the definition of sustainable remediation goes further to highlight a net benefit on human health and the environment that is maximised through judicious use of limited resources. The term 'judicious' brings in elements of the economic domain of sustainability. And remedies with a 'net benefit' addresses all three domains including impacts to the community (social domain) and the environment.

Some regulators in the US are concerned that a more encompassing definition of sustainable remediation will lead to work outside of their authority. Regulatory agencies typically only have jurisdiction over environmental issues and don't have the authority to make decisions based on social and economic issues. Also, regulatory agencies are concerned with 'green washing' – where property owners,

Communicating concepts of risk presents a challenge for stakeholder acceptance

or their representatives, will use sustainability as a reason to avoid costly action as increased costs reduce the net benefit.

Other stakeholders generally embrace the components of sustainable remediation. They think it leads to better decisions that are balanced and have the best net-environmental benefit. They equate the concern of 'green washing' as similar to the regulatory perceptions and resistance to the initial roll out of monitored natural attenuation and risk-based corrective action (RBCA) – concepts now commonly accepted by regulatory agencies. Other stakeholders think that with education, transparent communication, and standardisation of a sustainable methodology and tools, that regulatory concerns about green washing will be substantially reduced. However the perception of green washing can still be a significant concern in the community.

In addition to the issues identified above for green remediation, sustainable remediation will require identification of social and economic metrics to be used in evaluations and a methodology and tools for applying impact assessments and quantifying impacts. As the remediation industry is primarily composed of environmental professionals, incorporation of social and economic metrics will require engagement of social scientists and economists to support metric identification and quantification processes. If social and economic impacts can be considered in decision making, guidance will be required to consistently apply how the elements are incorporated in regulatory decision-making processes.

Risk-based remediation

RBCA in the US is generally recognised as cleaning up sites to risk-based concentrations considering land-use and receptors. This generally means that cleanup values are based on the receptor populations that can be exposed at the site, and the related land use. In the US, there has not been much of an intersection between green and sustainable remediation and risk based corrective action. This appears not to be the case in Australia.

The document *A framework for assessing the sustainability of soil and groundwater remediation* (CRC CARE 2009) states: *Sustainable remediation should deliver risk-based remediation of the environment acceptable to the key stakeholders and decision makers, with due consideration to the costs and benefits of the strategy. As part of this process, it must be recognised that on occasions non-optimum remediation decisions will be made because other factors are more influential in optimising the overall benefits of a scheme. Such consideration may include, for example, demographic factors, flood-risk management and transport.* As such, risk-based remediation is integral to the tenants of sustainable remediation in this document and borrows from the concept of integrated brownfield regeneration in the UK.

The use of a risk-based approach to decision making in remediation is not new and the management of risk has for some time been the basis for most remediation decisions. However, the assessment of the other tenets of sustainability (broader environmental considerations, economic and social costs and benefits with regard to the management of risk) is now being examined. This has led to the concept of integrated brownfield regeneration and the optimisation of land use planning to achieve a risk-based outcome that is defined as sustainable remediation.

Remediation based on the management of risk already holds a level of acceptance by regulators. However the assessment of the benefit of managing risk on a specific site against the social and economic costs required to achieve that risk management strategy, as with US regulators, may be beyond the resources of most regulator stakeholders in Australia. Usually these risk-based strategies are based on lessening the level of risk, not necessarily through the through the mitigation of contamination, but rather through adjusting the receptor and pathway components of the risk equation. This usually results in either a sub-optimal use of land, or other limitations with regard to land use which may run counter to policies of 'highest and best use' planning doctrine. Further, regulators are often confronted with permitting or allowing land contamination to continue to reside or discharge into the environment, admittedly at levels shown not to present a risk, against their obligations under environmental legislation where the definition of pollution is not necessarily defined in terms of risk.

A clean-up strategy based on what is viewed as the manipulation of urban planning ordinance can be, depending on your point of view either the cynical avoidance of required remediation at the expense of optimum land use or a savvy sustainable outcome. Stakeholder acceptance and the concern of 'green washing' remain issues in this regard and when tied into the difficulties of communicating concepts of risk, which presents a challenge for stakeholder acceptance at the best of times these issues can become insurmountable. The community may question this approach against the definition of sustainability, with the impression that those benefitting from the management of risk through cost savings in remediation are not bearing the future cost of the limitations placed on the future land use. On the face of it, this may appear contradictory to the concept that sustainable development meets the needs of the present generation without compromising the ability of future generations to meet their own needs.

The requirement for the early assessment of risk and the development of a conceptual site model so that there is an understanding of the sources, pathways and receptors will be essential if opportunities to manage risk are to be identified early in the project life cycle. It is only though the early identification of these elements that a risk-based strategy can be implemented and for the outcomes to be assessed. Remediation will need to be integrated into the overall planning and development of a site and not approached as a stand-alone activity, this in itself can add a level of complication to the timing and implementation of the remediation works both in the actual physical works, and also in the approvals required both for remediation and the associated development.

Conclusions

The above analysis shows that green/sustainable/risk-based remediation will be an important component of remediation planning and execution in the future. Even though the concepts have been with us only a short while, the industry is investing considerable resources to understand the contribution of green/sustainable/risk-based remediation to the industry, educating key stakeholders to enhance communication, and working towards standardised guidance and tools to deliver these services. As with other environmental guidance, the application of green/sustainable/risk-based remediation across different regulatory programs and countries is expected to be somewhat different and will be tailored to the specific needs of the stakeholder groups leading those remediation programs.

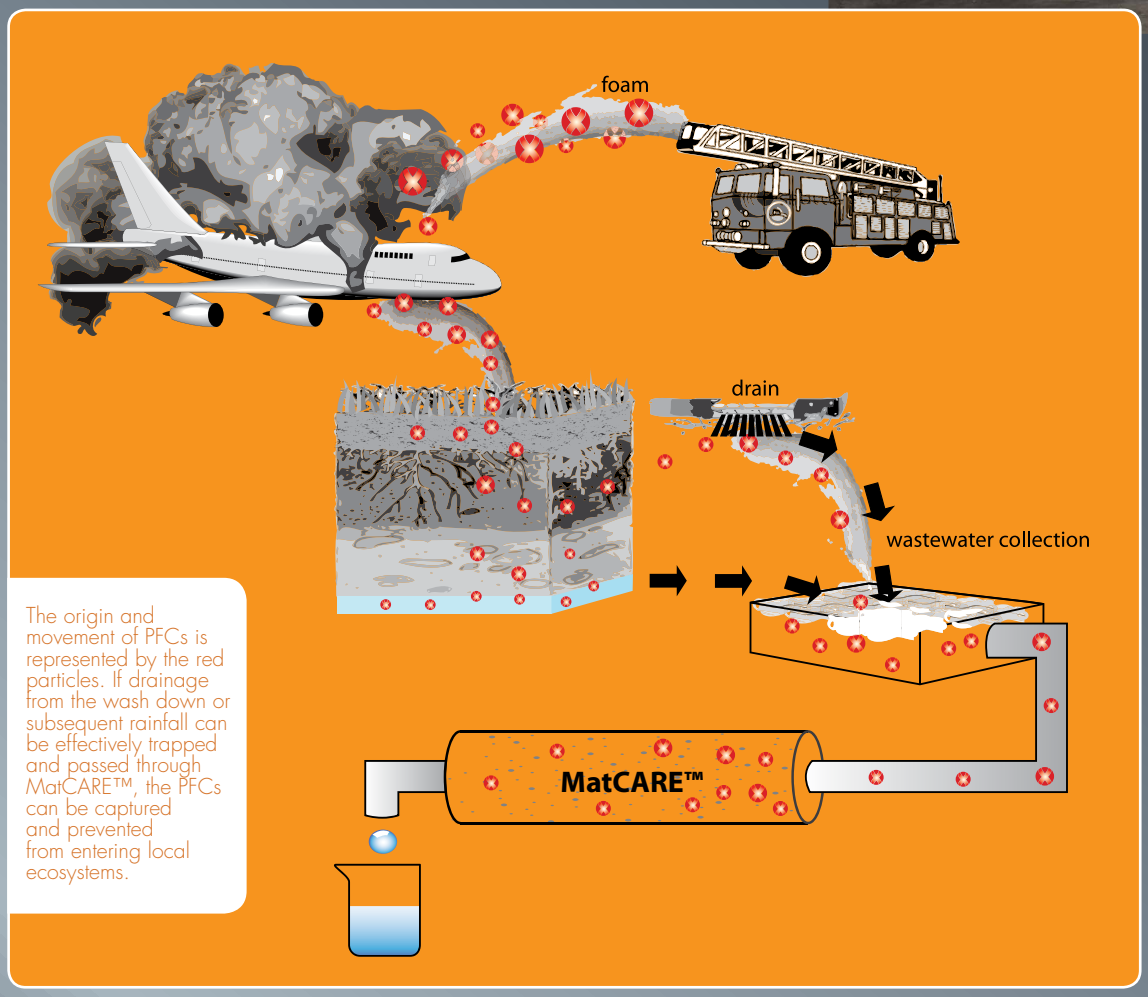
Fire-fighting foam: dealing with polluti after the fire

Venkata Kambala and Ravi Naidu, CRC CARE and Centre for Environmental Risk Assessment and Remediation (CERAR)

Perfluorooctane sulfonate (PFOS) pollution in water and soil from the use of fire-fighting foams is a global problem.

A new product called MatCARE™ (Australian Provisional Patent No. 2009905953) developed by CRC CARE has undergone field trials and is showing promising results in the cleanup of PFOS and perfluorooctanoic acid (PFOA) in contaminated water and soil.

Aqueous fire-fighting foams (AFFF) are widely used in fire suppression systems due to their superior fire fighting properties. AFFF formulations contain a class of chemicals called perfluorochemicals (PFC), namely PFOS and PFOA. PFCs are very stable chemicals that do not change or break down readily in the environment or living things. They have been detected in soil, sediments, and water where AFFF has been used. When spilled



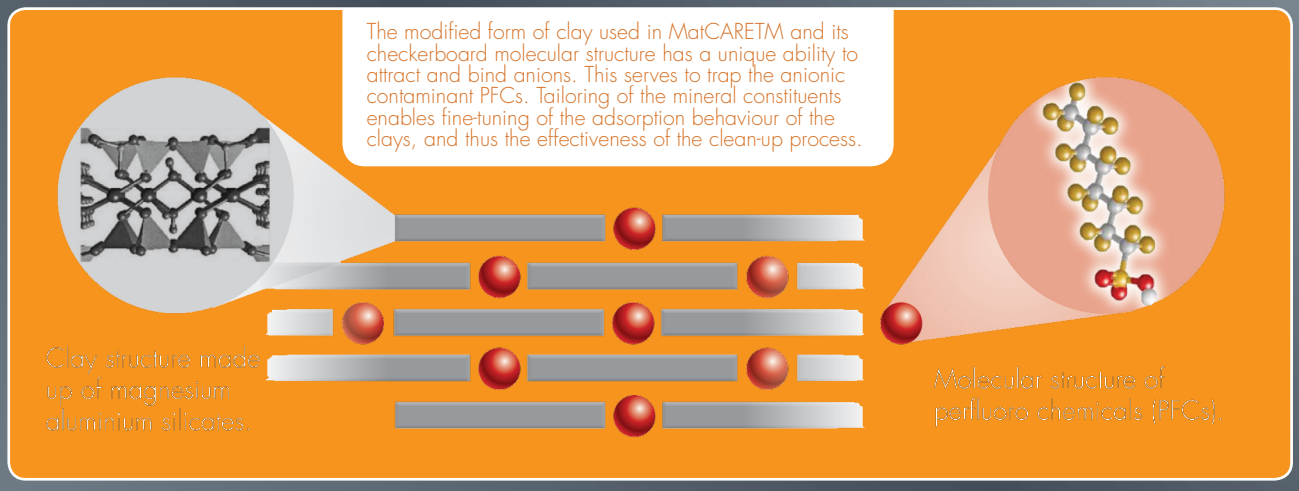
The origin and movement of PFCs is represented by the red particles. If drainage from the wash down or subsequent rainfall can be effectively trapped and passed through MatCARE™, the PFCs can be captured and prevented from entering local ecosystems.

or disposed of, these chemicals can move quite long distances posing potential risk to surface and groundwater. The chemicals are persistent, bio-accumulate and now globally distributed having been used extensively over many years.

CRC CARE's research has focused on developing a method for cleaning up AFFF wastewater containing PFCs.

MatCARE™ removes PFOS and PFOA from wastewater and soil. The product has recently undergone successful field trials with both wastewater and soil.

Results to date demonstrate complete removal of PFOS and PFOA from wastewater.



Assessing and managing contaminants in soil:

A proposal for new standards in New Zealand

James Court and Howard Ellis, New Zealand Ministry for the Environment

Earlier this year, New Zealanders were asked for their views on proposed new standards (regulations) for assessing and managing contaminants in soil.

The proposed standards will set comprehensive new rules for contaminated and potentially contaminated sites in New Zealand and include soil contaminant values that will define the concentrations at which the risk to human health is considered acceptable.

The problem addressed by the proposed standards can be summed up as follows: New Zealand has a legacy of soil contamination that is required to be identified, assessed and, if necessary, remediated or contained at the time of development or land-use change to ensure this land is safe for human use. However, the existing controls are either absent, inadequate or inconsistently or inappropriately applied.

New Zealand's legacy of soil contamination is mainly associated with past activities and industries involving chemicals where spills, leaks and the disposal of wastes have led to the presence of contaminants in the soil. The historical activities that have led to soil contamination include the manufacture and use of pesticides, fertilisers, petroleum products, production of coal and gas, mining, timber treatment and sheep dipping.

Since the early 1990s councils have identified approximately 20,000 sites that are affected or potentially affected by contaminants from industrial, domestic or agricultural activities.

Current New Zealand policy for managing land contamination includes a mix of laws and regulations, guidelines and funding arrangements. While these measures provide protection against any new land contamination, they do not ensure that the historical legacy of contamination is adequately and consistently addressed.

Day-to-day contaminated land management is largely the responsibility of regional councils and territorial authorities, while the role of the Ministry for the Environment is to provide leadership on land contamination issues across both central and local government.

The main New Zealand agencies involved in managing contaminants in soil include the groups outlined as follows:

Regional councils

There are 16 regional councils in New Zealand, including four unitary authorities (which have dual territorial and regional council functions). Regional councils:

- are generally organised along major catchment boundaries
- prepare regional policy statements and regional plans
- regulate discharges to air, water and land
- have the contaminated land function of: 'the investigation of land for the purposes of identifying and monitoring contaminated land'.

Territorial authorities

There are 73 district and city councils. They:

- prepare district plans
- regulate land use, development, subdivision and building control
- have the contaminated land function of: 'the prevention or mitigation of any adverse effects of the development, subdivision, or use of contaminated land'
- have a range of public health responsibilities under other legislation.

The Ministry for the Environment

The Ministry for the Environment has been involved with a number of initiatives to support local government fulfil their functions. Most notably are the following:

- ten contaminated land guidelines have been developed
- contaminated sites remediation fund has been established.

Contaminated land functions for councils and a definition of contaminated land have been added to the *Resource Management Act 1991* (RMA). Despite the work of these agencies, there are still important policy and administrative gaps in managing contaminated land, including:

- absent, inadequate and inconsistent controls on the land use, subdivision, and development of affected and potentially affected land – there are very few district planning controls that ensure land contamination is identified, assessed and managed (if necessary). Of 73 district plan sets assessed for the ministry, only 14 had rules that addressed their contaminated land function under section 31 of the RMA. (Under section 31(1)(b)(iia) district councils have a function for: *the prevention or mitigation of any adverse effects of the development, subdivision, or use of contaminated land.*)
- inconsistent and inappropriate use of guideline values to assess the effects of affected and potentially affected land – the use of guidelines among practitioners and councils is presently inconsistent and variable, and this is resulting in different soil contaminant values being applied.

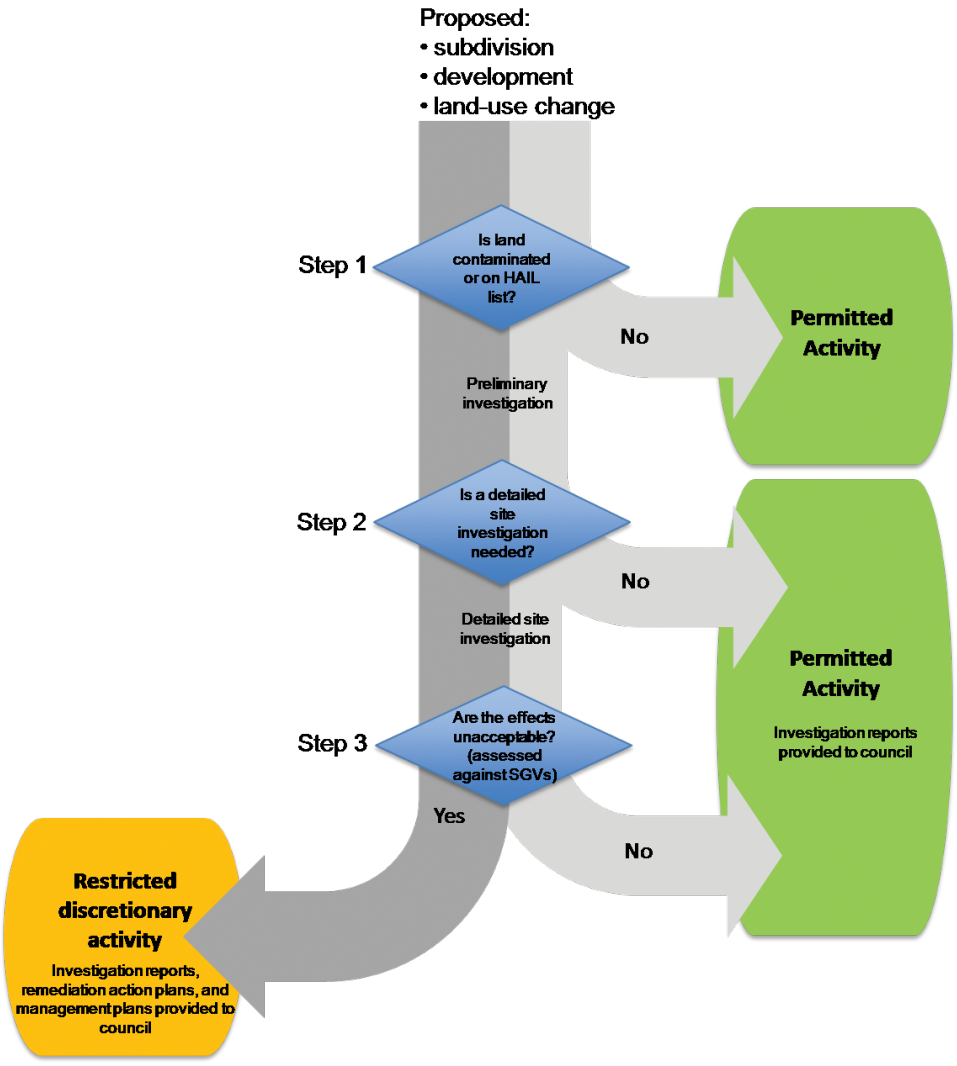
These gaps mean that there is no nationally consistent process being followed in identifying, assessing and cleaning up or containing the contaminants. The proposed standard would remove the existing risk of land being inappropriately developed, an outcome that:

- puts people's health at risk
- provokes community concern and outrage
- initiates expensive post-development disputes
- requires expensive post-development remediation or containment to correct.

Proposed National Environmental Standard (NES) – A regulation under the RMA for assessing contaminants in soil

The objective of the proposed NES is to ensure that land affected by contaminants in soil is appropriately identified and assessed at the time of being developed and if necessary remediated, or the contaminants contained, to make the land safe for human use.

As the quality of soil affected by hazardous substances has already been compromised, the new standard will focus on protecting human health. At least ensuring that human health is protected is a pragmatic approach to enabling a safe use of such land.



RIGHT Decision tree for determining resource consent requirements under the proposed NES

(HAIL – Hazardous activities and industries list; SGV – Soil guideline values for human health)

The NES will achieve the above objective via planning controls applicable to land affected by hazardous substances. The proposed NES will enable safe and economic use to be made of land affected by contaminants by ensuring that:

- district planning controls are adequate and nationally consistent
- councils are able to require the information needed to improve their registers and make efficient decisions, and
- the most appropriate thresholds for contaminants in soil are used.

In essence, the proposal is a mix of allowing (permitting) and controlling (requiring resource consents) certain activities on land affected or potentially affected by soil contaminants. The standard would require all 73 territorial authorities (district and city councils) in New Zealand to give effect to and enforce its requirements.

A decision tree for determining resource consent requirements under the proposed NES is shown on page 15. The proposed NES will be supported by soil contaminant values, and methods and a framework for applying them. Each soil contaminant value defines the land use-specific concentration at or under which the risks to human health are considered acceptable. The values are applied within a methodological and practical framework.

The development of the soil contaminant values for 12 contaminants has been assisted by an interdepartmental group of toxicologists (Ministry of Health, Environmental Risk Management Agency, New Zealand Food Safety Authority) and a practitioners group that includes local government and industry representatives. The work reviewed by these groups has also been subject to scientific peer review by experts in toxicology and contaminated land management.

The proposed national environmental standard was publicly notified on 6 February 2010. Fourteen consultation workshops on the proposed standard were held in main centres during March 2010 to inform people about the proposed standard, and to encourage and assist people to prepare submissions on the proposal. Around 460 people attended the workshops.

The period for submissions closed on 19 April 2010. The ministry is now analysing the submissions received. Visit **www.mfe.govt.nz/laws/standards/contaminants-in-soil** to read more about the proposed national environmental standard, the process of developing it and an overview of the submission received.

CleanUp 2011

6th International Workshop on Chemical Bioavailability in the Terrestrial Environment (7–9 September 2011)

and the

4th International Contaminated Site Remediation Conference (11–15 September 2011)

Hilton Adelaide hotel

On behalf of CRC CARE and the Australian Remediation Industry Cluster (ARIC), I invite you to join us for the biennial CleanUp conference, to be held at the Hilton Adelaide hotel, in South Australia.

CleanUp 11 will combine the 6th International Workshop on Chemical Bioavailability in the Terrestrial Environment (7–9 September 2011) and the 4th International Contaminated Site Remediation Conference (11–15 September 2011).

The CleanUp Conference is the premier Australian-based conference related to the contaminated site and remediation industry.

It is expected that CleanUp 2011 will have an attendance comparable to the 2009 conference, which attracted over 500 scientists, engineers, regulators, and other environmental professionals from 25 countries. Delegates were able to promote technology transfer and exchange information, innovations and developments in fundamental and applied environmental research towards the assessment, management and remediation of environmental contamination.

The organising committee is pleased to again have secured the Hilton Adelaide hotel as the host venue for the events. This medium sized venue enables attendees to focus on the tightly paced program and exhibits, and to easily meet and share ideas and information.

Ample networking will be possible with a full complement of lunches, receptions, and other meals being served during the breaks in the program. After the sessions conclude each evening there will be poster sessions and networking drinks, with the conference dinners again expected to be a highlight of the social program. At the conclusion of each day's activities, conference participants will find ample sightseeing, shopping and dining options nearby. Located on central Victoria Square, the Hilton Adelaide hotel is in the heart of Adelaide city.

Your contribution to these events is welcome as a presenter, sponsor, exhibitor or delegate.

I look forward to seeing you at the conference in 2011.
I know you will value the experience.

Professor Ravi Naidu
Managing Director
CRC CARE

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www.cleanupconference.com

Petroleum vapour data from Australia: A review

Jackie Wright, Environmental Risk Sciences

Questions are constantly raised as to whether vapour migration and intrusion of petroleum hydrocarbons is a significant issue with respect to long-term human health. There are ways of roughly estimating these processes using models. However, the best way of assessing this pathway is to directly collect data from areas of concern.

Data, most commonly soil gas data, has been collected on many sites across Australia to address this issue. Rather than continue with the vapour data being collected and used to address issues on one site only, I have, with the permission of the larger petroleum companies, been collating the data into a database. This is an ongoing process with the database currently including data from 112 sites, resulting in approximately 950 benzene data points in the subsurface.

The database will enable the examination of more significant trends and questions associated with the significance of petroleum vapour intrusion. The key aims of the work include:

- Understanding why a large number of sites have petroleum issues, yet few are associated with significant vapour intrusion to indoor air.
- Compiling high-quality basic data to evaluate the vapour migration and intrusion pathway (soil type, source extent, depth to groundwater, source strength such as dissolved phase or presence of light non-aqueous phase liquid) (LNAPL).
- Evaluating and showing mechanisms, characteristics and trends of aerobic biodegradation of petroleum hydrocarbon vapours. In addition, utilise the data to review the concept of vertical screening criteria (depths). This is the depth of overlying clean soil required to adequately attenuate petroleum hydrocarbon vapours such that vapour intrusion is not significant and risks to human health are not of concern.
- Identifying the key characteristics of sites where vapour intrusion is potentially significant.

While not all of these aims have been addressed at this stage there are some areas where key observations have been made.

It is important that the collection of vapour data addresses fundamental issues associated with the relevance to a vapour conceptual site model and data quality. In collating the data available, these aspects have been ranked so that during interpretation the quality of the data can be considered. To some extent, the available data is a 'mixed bag' ranging from low to high quality. Some of the key problems identified in the available data include:

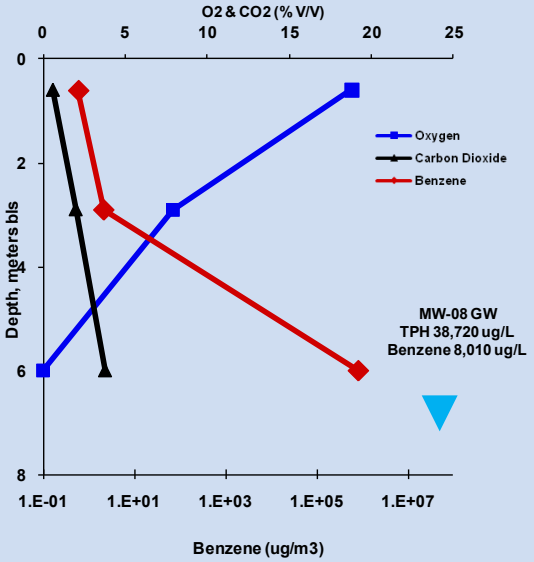
- collection of soil gas data from too shallow a depth relative to the source
- collection of very few soil gas samples from a large (and complex) area
- issues with data quality (and no subsequent re-sampling)
- different approaches used to quantify total petroleum hydrocarbons (TPH)
- not characterising sufficient key individual hydrocarbons (such as trimethylbenzenes and hexane, both of which are more toxic components of the TPH group), and
- not collecting gases (O_2, CO_2, CH_4) in the subsurface that can be used to review the likelihood of degradation processes.

Even with these issues the database is still very useful.

The database is not unique, as a similar exercise is being undertaken on data available from the US and Canada. Both databases are being reviewed for similar reasons and initially show much the same outcomes, despite the wide range of geological profiles and climate conditions considered. Initial review of data available from Australia has identified the following:

- Based on soil gas data collected the potential for vapour intrusion to be of potential concern has only been identified on 9% of the sites. A number of these sites have compounding issues of contamination in both soil and groundwater and have required further assessment.
- Biodegradation is an important aspect of the attenuation of petroleum hydrocarbons through the overlying soil. This occurs in the presence of oxygen in the subsurface. The US review suggests that approximately 6% oxygen is required for biodegradation to be significant.

Degradation benzene in subsurface – Australian data



An initial review of the data from Australia generally supports this observation; however, a more detailed review is still being undertaken.

- Vapour concentrations decrease rapidly vertically (attenuation) away from a source where clean soil is present. A conservative attenuation factor of 100-fold can be considered to apply to subsurface petroleum vapours.
- Separation distances required to attenuate petroleum hydrocarbons can be tentatively identified. Around 1.5 - 1.8m (5 - 6 ft) of clean soil attenuates vapours overlying dissolved phase groundwater sources. This is consistent with the outcomes of the review of the US data.

There is still much more work to be done in reviewing the data. In particular:

- additional review of the depth to an LNAPL source and potential for attenuation
- consideration of different soil types (including fractured rock systems)
- consideration of subsurface conditions where biodegradation is significant
- comparison of measured data with simplistic models and more recent models such as BioVapor that includes biodegradation.

Unlocking the potential of brownfield sites

ARIC held an Industry Summit on unlocking the productive potential of brownfield sites at CleanUp 09 last September. The information gleaned from the talks, forums and follow-up discussions will provide the basis of a draft conceptual framework for decisionmakers, to be developed by ARIC. Two of these presentations are as follows.

Niall Johnston, Department of Environment, Climate Change and Water

Australia's 200 years of involvement in industrial and commercial activity has resulted in numerous contaminated areas which are now being developed as high value commercial and residential precincts. Land redevelopment has a cycle of decline and renewal. It is a fairly recent phenomenon in Australia that large-scale contaminated sites have been redeveloped and remediation has been considered as a routine process during change of use.

Land contamination in Australia covers the normal range of polluting activities such as petrochemical refining, chemical manufacture, application and manufacture of biocides, coal gasification, mineral processing and ordinance manufacture, as well more unusual activities such as radium refining and nuclear weapons testing in the 1950s. Australia is fortunate in having a mature remediation industry supported by a robust, structured framework for the assessment of site contamination: the *National Environmental Protection Measure – Assessment of Site Contamination (NEPM)*. The NEPM is applied by the states and territories who then regulate the clean up of sites via their specific legislative and policy frameworks.

Capturing statistics for brownfield development is less than straight-forward, as all states report land issues slightly differently in their state of the environment reports. The opportunity provided for redevelopment and the scale of brownfield sites is also highly variable. Areas with a longer industrial history such as the Newcastle to Wollongong corridor in NSW have a larger stock of brownfield sites for redevelopment as well as higher inherent land value than inland areas.

The following statements explore the status, drivers and impediments (real and perceived) for brownfield redevelopment in Australia as well as identifying future opportunities and incentives to stimulate this area.

Statements

There are estimated to be somewhere between 10,000 - 160,000 contaminated sites in Australia. There has been no published national estimate of brownfield sites with only Queensland venturing an estimate of 4,000 brownfield sites in that state. Jurisdictionally, contaminated sites are regulated in a number of ways. For instance, in NSW, 264 sites are considered significant enough to warrant centralised regulation, whereas in Queensland, all contaminated sites are centrally regulated.

"Land redevelopment has a cycle of decline and renewal. It is a fairly recent phenomenon in Australia."

The key driver for brownfield redevelopment is the economic potential of the site, largely driven by the demand for sites in close proximity to urban centres. In general, the regulators in each jurisdiction have a mature framework to regulate brownfield redevelopment. NSW implemented the first specific legislation for contaminated sites in 1997, and South Australia followed suit in 2007.

The Northern Territory, Victoria and Tasmania do not have specific legislation for contaminated land instead using facets of planning and broader environmental legislation to regulate contamination.

While the philosophy of 'polluter pays' is the overarching principle, there are various other financial drivers including tax incentives to expedite brownfield development. These operate at both local and national levels.

Future liability is dealt with in a number of ways depending on the jurisdiction. In general, the polluter is responsible. If the polluter is unavailable, this responsibility often defaults to the landowner or developer.

Urban planning processes encourage reuse and renewal of land to optimise its potential. Key initiatives include urban renewal projects to develop new residential precincts in what were formerly industrial areas. These include the Rhodes peninsula in Sydney and the Docklands redevelopment in Melbourne. These sites have the advantage of existing infrastructure including transport links and access to utilities.

Groundwater is considered as a resource, and contemporary thinking values this resource for its beneficial capacity. This is often reflected in groundwater being considered as a societal resource whereas the land is the responsibility of the land owner.

The global financial crisis has slowed down the level of development, largely due to the difficulties in accessing appropriate finance. Due to the long-term nature of the projects this is likely to delay, rather than halt, redevelopment. Innovative approaches to stimulate brownfield development cover a range of areas including economic incentives (offsets, biobanking), support for research (CRCs, NSW Environment Trust, Australian Research Council and other grants), regulatory pragmatism and energy and sustainability programs.

The main impediments to brownfield development are perceptions regarding blight and the high cost of remediation compared to greenfield sites. However, if the broader environmental costs are taken into account then the viability of brownfield redevelopment becomes more attractive.

Conclusions

The main driver for brownfield development is property value. This is demonstrated by the significant levels of residential development in former industrial and commercial areas close to the major cities and towns, as well as in areas adjacent to waterways and the coast. Successful remediation of brownfield sites is a cornerstone of urban sustainability and incentives, and innovation can only assist in accessing this potential.

The above and following articles are based on papers presented at the Industry Summit at CleanUp 09. The presentation on the United Kingdom was unable to be presented in person, and has been excluded from this document.

Asia

Alex K. Leong, AECOM

When I was first approached to talk on brownfield development in the Asian region, two things came to mind. Number one, Asia is a very, very large area geographically covering many countries. Number two, in terms of brownfield development, one of the key drivers is the regulatory framework which is fast changing especially in the rapidly growing Asia region. The regulatory framework in the Asian region in the past has lagged behind the US, Australia and Europe but is now evolving very rapidly.

Out of the 10 countries I looked at that had significant industrial activities, 4 had some sort of established soil and groundwater regulations in place, while the other 6 are either in development or may start development in the near future. The regulators have also tended to adopt the 'polluter pays' principle, assuming the polluter can be identified or is still around. There is also some talk in the region about setting up a remediation fund, similar to the Superfund approach that exists in the US.

Soil and groundwater regulations arise due to urban development and industrialisation. Many Asian countries are in the early stages of formulating and implementing such a regulatory framework. For countries without regulations, soil and groundwater are indirectly regulated or embedded in general statements of environmental law(s). Where there are no specific regulations it does not mean industries have 'free hands' to pollute!

The current regulatory status on soil and groundwater regulations varies among the Asia countries, as follows:

- Countries with soil and groundwater standards: Taiwan, Japan, China and South Korea
- Countries without soil and groundwater standards: Malaysia, the Philippines, Indonesia, India, Thailand and Singapore.

There are two different approaches to the development of soil and groundwater regulations: adopting existing standard(s) from other countries, and developing their own standard based on a generic or risk-based approach. The risk-based approach is flexible in applying site-specific thresholds levels. The responsibility for dealing with the contamination falls firstly on the polluter(s), then the owner(s), then the occupants(s) and finally the government. More developed countries tend to have soil and groundwater standards and defined environmental liability. Future soil and groundwater development trends in the region include:

- increasing regulatory awareness and more stringent requirements
- the 'polluter pays' principle
- risk-based approaches, and
- financing/funding for remediation projects.

In general, the countries are moving towards a risk-based approach to remediation, although this does vary between countries. The following is a quick tour of the Asian region focusing on the regulatory framework and key regulatory issues.

INDIA

India's very large population and rapidly-growing economy makes the management of contaminated sites especially challenging. India's environmental regulations were promulgated in the 1970s, and are very general in nature, as outlined below:

- *Water (Prevention & Control of Pollution Act) Amendments, 1988* (originated 1974)
- *Water (Prevention & Control of Pollution) Rules* (originated 1975)
- *Water (Prevention & Control of Pollution) Cess Act* (originated 1977)
- *Water (Prevention & Control of Pollution) Cess Rules, 1978*
- *Environmental (Protection) Rules, 1986*

Although India has a central government, enforcement is largely carried out at the state level). Central Government involves the Ministry of Environment & Forest and its regional offices, and the Central Pollution Control Board (CPCB) and its 6 zonal offices. The State Government involves State Department of Environment and the State Pollution Control Board (SPCB)/ State Pollution Control Committee and regional offices. The SPCB oversees the enforcement of environmental regulations. The level of enforcement varies from state to state based on the level of industrialisation.

India currently has no soil and groundwater standards, and associated liability issues are not defined. Site investigations are conducted by the industry and are voluntary, occurring prior to property transactions to protect the investor's liability. There is no legal requirement for environmental site assessments.

Soil and groundwater contamination issues are often neglected. In general, public awareness is low with regard to contamination problems except where there are sensitive receptors such as rivers and lakes which are sources of drinking water.

In many areas groundwater is the primary source of drinking water and irrigation. Groundwater extraction is controlled and harvesting is being made mandatory in areas, where there has been a significant drop in groundwater levels. At this stage though there is insufficient focus on groundwater quality. There are no particular site closure requirements. However, judicial activism is significantly prevalent in India and the courts have ordered site closure based on complaints received from people near to the site in severe cases of contamination.

Like in many other countries in Asia, the Dutch Standards such as the Intervention Values (DIV) have often been used in the absence of any other regulations.

Visit the State Protection Pollution Control Board website at **www.cpcb.nic.in/** for further information.

SOUTH KOREA

The governing body in South Korea is the Ministry of Environment (MOE). Applicable regulations include the *Soil Environment Preservation Act, 1996* (SEPA) and *Groundwater Law* (GL), revised in 2001. Soil contamination and countermeasure standards for soil contamination are defined. Prior to a remediation project, a company must prepare a remediation plan of soil contamination and have it approved by the local government.

The *Water Quality Preservation Act* requires reporting when harmful substances are released into the environment. SEPA defines 'soil contaminating facilities', which includes facilities that store petroleum products and toxic chemicals, and requires them to perform regular monitoring.

Groundwater quality needs to be tested annually with 42 standards prescribed in the act.

SEPA follows the 'polluter pays' principle, assuming the polluter can be identified.Under a revised law in 2001, if a site assessment identifies pre-existing contamination, an innocent buyer may claim immunity.

Visit the Ministry of Environment website at **http://eng.me.go.kr/** for more information (*note:* web addresses may change over time).

PHILIPPINES

There are currently no specific soil and groundwater quality standards in the Philippines. The Department of Environment and Natural Resources is receptive to internationally recognised standards or approaches (risk-based) such as those used by the United States Environmental Protection Agency in determining soil and groundwater contamination. However, at present there is no disclosure requirement on industries unless it is related to a spill incident.

There are various regulations in place to protect surface water bodies such as rivers and oceans. If there are visible spills on the surface then those need to be reported and remediated. For water pollution, the clean-up requirements are to 'restore to pre-spill conditions'. There is currently no regulatory requirement for contaminated land remediation, although the *Civil Code on Nuisance to Property* may be applicable.

Visit the Department of Environment and Natural Resources website at **www.denr.gov.ph/** for more information.

THAILAND

A draft soil standard for Thailand was released in 2002, but is still being reviewed. It contains a short list of contaminants; if the stated concentration is exceeded for a site, then the soil is considered contaminated.

Groundwater standards were also issued in 2002 and focused on groundwater for drinking and agricultural purposes. They are not a clean-up standard, which is an area still requiring attention. There are no specific regulations for clean-up, although the *National Environmental Quality Act* Section 6, 96, 97 under 'Civil Liability' may be interpreted as requiring clean up of contaminated sites.

The 'polluter pays' principle applies and NEQA appears to lean towards protecting innocent new owners of pre-existing contaminated sites. Visit the Pollution Control website at **www.pcd.go.th/ indexEng.cfm** for more information (*note:* web addresses may change over time).

JAPAN

Japan has a soil and groundwater regulatory framework in place.

Soil

Soil pollution legislation was first issued in August 1991, and amended in 1994 under the *Basic Environmental Law.* The *Soil Pollution Control Law, 2002*, listed specified facilities and substances and allowable concentrations. The approach they take is that certain facilities are classified as requiring an assessment for soil such as petrochemical, polluting factories and oil refineries. If the company is not one of those facilities on the list then they are not required to do an assessment. These regulations seem to pay more attention to the soil than groundwater, even though they have groundwater regulations in place.

There are currently 27 chemical substances listed with soil quality standards that the Japanese EPA can use to evaluate whether there are any problems. Other relevant laws include:

- the *Agricultural Land Soil Contamination Prevention Law*
- *Fertiliser Controlling Law*
- *Agriculture Chemical Controlling Law*
- *Mining Protection Law*
- some local laws/ordinances.

These regulations they do not address the definition of liable or responsible parties. The *Japan Soil Contamination Countermeasure Law* (SCCL) was recently amended and announced in April 2009. The drivers for such amendments were:

- Increased soil contamination cases found through self-inspection (voluntary effort). This information needed to be available publicly to encourage better management.
- The current common practice of soil excavation and removal was performed regardless of the presence of any health risk. The remediation method should correspond to the degree of severity of the contamination condition and whether there are any surrounding receptors identified requiring better risk management.
- There needed to be proper management of excavated soil put in place following improper disposal of contaminated soil.

The effect of the draft amendment will be an obligation for those involved in residential building construction and other land development work which exceeds a certain land area to submit a notification. The prefectural and city governments can then authorise the developer to conduct an investigation if there is a possibility of land contamination.This will be an expansion of the current SCCL whereby authorities are only able to order such investigations to be conducted on factories that handled hazardous substances when they are decommissioned.

It is likely that the obligation is required for an area greater than 3,000m^2. The governor will be able to provide countermeasure instructions should a health risk be present. The amended SCCL will be enforced before April 1, 2010.

Groundwater

The Environment Protection Agency established the *Environmental Quality Standard* for groundwater in March 1997.

There is a list of 24 chemical substances with groundwater quality standards. These apply to all groundwater with the aim of protecting public water resources. Groundwater usage in Japan is not very common, but it is used in some remote areas and for agriculture. Where there are accidental releases of harmful substances and oil, these need to be reported immediately. The facility will have to pay the cost of compensation if human health and/or the environment is damaged. Other relevant laws include the *Water Pollution Prevention Law* and the *Waste Disposal and Refuse Collection Law* (indirect).

The *Ordinance on Prevention of Groundwater Contamination* was enforced on August 1, 2008 in Shiga Prefecture (in the Kinki region) of Japan. This was the first ordinance in Japan that catered for groundwater pollution prevention as well as pollution clean-up measures. This ordinance also attracted attention due to the obligation to investigate lands (facilities) that were decommissioned prior to the enforcement of the SCCL. It also required that monitoring wells be installed at a facility that handles hazardous substances, and that groundwater monitoring reports be submitted.

Visit the Ministry for the Environment website at **www.env.go.jp/en/** for more information.

MALAYSIA

At present there are no soil and groundwater quality standards in Malaysia. AECOM was engaged by the Department of Environment in Malaysia (DOE) to complete a study on a contaminated land management framework for Malaysia. This work was completed in 2008 and is currently being reviewed. The work included formulation of guidelines, a pilot study, a contaminated site information system, capacity building, stakeholder engagement and drafting of Contaminated Land Management (CLM) regulations. Currently remediation projects are evaluated on a case-by-case basis, although this can be quite subjective and the outcomes may vary from state to state.

DOE has shown a willingness to accept or adopt internationally recognised standards or approaches (risk-based) where these are applicable to the local context. In general Malaysia follows the 'polluter pays' principle as outlined in Section 47 of Environmental Quality Act, 1974:
….DOE may take such actions as is necessary to remove, disperse, destroy or mitigate the pollution and may recover from that polluter.

Recent cases of pollution have prompted the government to consider the setting up of a pollution fund, similar to the Superfund concept in the US. Visit the Malaysia Department of Environment website at **www.doe.gov.my/portal/** for more information.

INDONESIA

Indonesia is a fast developing country with tremendous population growth.

Although Indonesia's main agency for environmental issues, the National Environmental Impact Management Agency, has been in existence for some years, there are currently no specific soil and groundwater standards in Indonesia. Soil and groundwater contamination issues are often neglected and the level of awareness is low. (Since the presentation of this paper on September 28 during the Cleanup 09 conference, Indonesia has released the new regulation on this subject in October).

Regulations that require reporting and containment of spills or releases of contamination to the environment include:

- *Government Regulations No. 20* of 1990 – Water pollution control
- *Government Regulations No. 18* of 1999 – Hazardous & toxic waste management
- *Government Regulation No. 4*, Article 20 of 1982 – 'Polluter pays' principle

As in the Philippines, laws exist to deal with a spill into a waterway. However, there are no laws or regulations currently that impose and define the liabilities for pre-existing contamination.

Indonesia also has the 3R principle for waste management – reuse, recycle, recovery. these options need to be considered for waste, such as contaminated soil, before the use of offsite disposal. This provides opportunities for onsite remediation technologies rather than relying on offsite disposal.

Visit the National Environmental Impact Management Agency website (choose the appropriate language) at **www.menlh.go.id/** for more information (*note*: web addresses may change over time).

TAIWAN

Taiwan regulations largely mirror the US system, probably because many of the Taiwanese PhD students studied in the US then returned to Taiwan where they now hold senior government positions.

Taiwan has a regulatory framework in place, governed by the Environmental Protection Administration and operating under the *Soil and Groundwater Pollution Remediation Act, February 2000*. This works on the 'polluter pays' principle. Polluted sites are classified by the *Soil Pollution Control Standards* and *Groundwater Pollution Control Standards*. A detailed database of polluted sites is maintained. There are two types of classification:

- Pollution control site – where the source of soil and groundwater pollution has been identified and concentrations have exceeded the Soil and Groundwater Pollution Control Standards.
- Pollution remediation site – where a site has been assessed and declared by the central government agency to seriously endanger the national health and living environment.

Information about the site is entered by industry into an online database system which has been developed by the EPA, called the tier-I and tier-II risk assessment system. This is a mandatory process. The system then classifies the site.

The polluter of a remediation site needs to have a remediation plan, but the polluter can appeal to set site-specific remedial targets to replace the standards by considering three main pathways: ingestion, dermal contact, and inhalation (indoor & outdoor) of air from the soil.

Soil and Groundwater Pollution Remediation Fund – the Taiwan EPA has established a fund similar to the US Superfund, to deal with legal costs, administrative costs, and remediation costs where responsible parties cannot be identified. This fund is sourced through a specific tax.from industries such as the petroleum, petrochemical and others involved in manufacturing.

Visit the Environmental Protection Administration website at **www.epa.gov.tw/en/** for more information.

SINGAPORE

Currently there are no soil and groundwater clean up standards in Singapore. The *Environment Pollution Control Act, 1999*, Section 18 & 23 makes some reference to the clean up of contaminated land, but it is general and offers no specifics. The *Code of Practice on Pollution Control*, amended in June 2002 and February 2004, applies where a site that is used for polluting activities (defined in Appendix 21) is to be redeveloped, rezoned or re-used for a non-polluting activity.

Based on the *Code of Practice on Pollution Control* (February 2004), the following standards may be adopted for site assessment and remediation of contaminated sites:

- *Dutch Guidelines for Soil Protection*, and
- *Guidelines for Assessing and Managing Hydrocarbon Contaminated Sites in New Zealand*

Jurong Town Corporation is a very large semi-government company and the largest landlord in Singapore. It has established guidelines for an environmental baseline study (EBS) which incorporates a 'decontamination' clause in all new lease contracts. There is, however, a 'grandfather' exemption for existing leases which have been in place before 2000.

Owners of new sites are required to perform an EBS and to return the site to its initial condition. This means that any leasing party must perform an EBS and document they are not leaving behind anything that is contaminated. Anybody taking over the property will then have a document outlining the pre-existing condition. When they leave the property, they will perform an EBS and so the cycle continues. The EBS therefore protects Jurong Town Corporation as the landowner. Jurong Town Corporation has no specific standards for soil and groundwater; it uses the Dutch Standards. In general, remediation projects in Singapore are evaluated on a case-by-case basis and can be subjective, depending on the officer-in-charge.

The National Environment Agency encourages industry to be proactive and come forward so a management plan can be developed to deal with any contamination situation.

Visit the National Environment Agency at **http://app2.nea.gov.sg/index.aspx** for more information.

CHINA

China does not yet have soil and groundwater standards in place although draft legislation has been prepared. In approximately 2008, the State Environment Protection Administration (SEPA) was elevated to become the Ministry of Environmental Protection of the People's Republic of China (MEP). This was very significant as the MEP has higher authority, demonstrating the Chinese government's commitment to protecting the environment. However, enforcement is very much at the local level by the Environment Protection Bureau. In 2003, a guideline was put in place encouraging companies that leave a property to do an assessment, and if any remediation was required that it be carried out.

Multinationals usually complied as they were concerned about future liabilities. In Australia or other western countries brownfield sites may have a negative value, and after cleanup have a positive value. In China, especially in the major cities, all brownfield sites have a positive value, and property values remain high regardless whether there is any presence of contamination.

The various laws have adopted the 'polluter pays' principle (Article 41, *Environmental Pollution Legislation 1989*). The soil and groundwater-related guidelines tend to include risk assessment. SEPA, now known as MEP, published a risk-based guideline on soil and groundwater quality standards in 1999. This guideline was not enforceable, and it created much confusion as information in this guideline was not well thought through.

In general, the awareness of whether and how sites should be closed from the environmental perspective is low, varies from one province to another, and is subject to the officer-in-charge.

The management of the industrial estates (the corporation managing facilities within the estates) may have their own requirements, in addition to the local EPB requirements.

A *Circular on Earnestly Accomplishing Environmental Pollution Prevention Work in the Enterprise Relocation Process*, issued by MEP General Office on June 1, 2004 was the first mandatory measure on historical soil contamination liability/cleanup. A *Circular on Strengthening the Prevention and the Control of Soil Pollution* was issued by MEP on June 6, 2008. According to the circular:

- For pre-existing soil and groundwater contamination, the original polluter will be responsible for the remediation and recovery.
- Where an enterprise that caused contamination has been altered due to system transformation, or merger, acquisition or divestiture of a business unit, then the succeeding enterprise must take responsible for remediation unless responsibility has been otherwise defined by contractual agreement between the parties.

The *Guideline for the Prevention and Control of Soil Pollution in Earthquake-Strike Area (Trial Implementation)* was issued by MEP on June 30, 2008. This specifies the factors which may cause soil pollution in earthquake-stricken areas, and states the investigation and assessment of soil pollution as well as cleanup and remediation of the polluted soil.

A standard of *Soil Quality Assessment for Exhibition Sites* (HJ 350-2007) was issued by MEP on June 15, 2007 and implemented on August 1, 2007, specifically for the Shanghai World Expo site that will hold the 2010 World Expo. The standard sets forth the limits and monitoring methods in assessing soil quality for exhibition sites. The standard included 92 pollutants, with 14 non-organic pollutants, 24 volatile organic compounds (VOCs), 47 semi-VOCs and other 7 pollutants.

Visit the Ministry of Environmental Protection website at **http://english.mep.gov.cn/** for more information.

Publications Update

This section contains publications that have been published in the last three months since the last edition of *Remediation Australasia*. The publications may originate from research institutions, regulators or industry groups. Please let us know if you have any appropriate publications (no promotional material) to be included by sending details to **aric@crccare.com**.

Western Australia Department of Environment and Conservation

Contaminated sites management series – assessment levels for soil, sediment and water

This document is designed to provide consultants, local government authorities, industry and other interested parties with information about the assessment levels used by accredited contaminated sites auditors and the Department of Environment and Conservation (Western Australia) to determine whether a site is potentially contaminated and whether further investigation is required.

Public health and contamination of soil by asbestos cement material

This brochure provides information to the general public and landowners on safety and management of soil contaminated by sheets or pieces of asbestos cement material.

Management of small-scale low-risk soil asbestos contamination

This document provides guidance on the assessment and management of single residential blocks which have soil asbestos contamination resulting from poor demolition practices or dumping.

CRC CARE Technical Reports

Technical Report 13: *Field assessment of vapours*

Designed to provide consultants, local government authorities, industry and other interested parties with information about the assessment levels used by accredited contaminated sites auditors and DEC to determine whether a site is potentially contaminated and whether further investigation is required.

Technical Report 12: *Biodegradation of petroleum hydrocarbon vapours*

Reviews the role of biodegradation in reducing petroleum hydrocarbon vapour intrusion into slab-on-ground buildings for application at a Tier 1 or human health screening level; provides technical input to the current review of the Australian National Environment Protection (Assessment of Site Contamination) Measure (NEPM).

Technical Report 14: *Contaminant bioavailability and bioaccessibility part 2: guidance for industry*

Provides information relevant to evaluating the bioavailability of contaminants via the incidental soil ingestion pathway and is based on a comprehensive review undertaken as part of recommendation 24 of the National Environmental Protection Measure (NEPM) 5-year statutory review.

Visit www.crccare.com to see our full suite of Technical Reports. ■

SuRF Update

Sustainable Remediation Forum UK (SuRF-UK) Steering Group has recently published the document *A framework for assessing the sustainability of soil and groundwater remediation* through CL:AIRE.

The framework document sets out why sustainability issues associated with remediation need to be factored in right from the outset of a project, and identifies opportunities for considering sustainability at a number of key points in a site's (re)development or risk management process. The framework encourages the inclusion of sustainability issues in local planning strategies, project planning, design of remediation strategies, options appraisal, implementation and verification.

In doing so, the report highlights how an essential link between the principles of sustainable development and the key criteria (environmental, social and economic) in selecting land use design with sustainable remediation strategies and treatments is identified. The report allows the following to be done:

- place remediation at the heart of sustainable development
- use sustainability indicators to optimise remediation decisions
- measure the costs and wider benefits of remediation projects, and
- speed up decision-making by using a framework developed jointly by industry, regulators and other experts.

The framework draws on feedback from a broad range of organisations working in contaminated land and brownfield management via a series of open forums and consultations. For a copy of the report *A framework for assessing the sustainability of soil and groundwater remediation*, visit **www.claire.co.uk**.

The Sustainable Remediation Forum Australia is planning an open forum in August to communicate its framework document and gather further feedback from stakeholders. Details will be advertised by CRC CARE in due course.

ACTRA Update

Brian Priestly, Australasian College of Toxicology and Risk Assessment Inc (ACTRA)

The Australasian College of Toxicology & Risk Assessment (ACTRA) was established to promote professional development in the disciplines of toxicology and human health risk assessment in Australasia. ACTRA convenes an Annual Scientific Meeting (ASM) and sponsors workshops to assist with continuing education activities. The asbestos workshop held in conjunction with CRC CARE at the CleanUp 09 Conference was one such activity.

Annual scientific meetings

ACTRA's 2009 ASM was convened in Canberra on 4 December 2009. This meeting featured 14 contributed papers covering various themes: Health Risk Assessment (HRA) methodology, HRA and chemicals regulation, water & contaminated soils HRA. There were two invited presentations exploring HRA methodology for assessing bystander exposure to pesticide spray drift.

A highlight of the meeting was an address by Dr Christopher Portier, associate director of the US National Institute of Environmental Health Sciences (NIEHS) and director of the Office of Risk Assessment Research. He currently coordinates all NIEHS research activities related to risk assessment and was previously director of the Environmental Toxicology Program at the NIEHS and associate director of the National Toxicology Program. Dr Portier gave an overview of the potential for effects on cellular DNA which are not directly mutagenic to influence health outcomes. These epigenetic events may have particular toxicological relevance during early phases of human development and there is an increasing need to take them into consideration in formal HRA processes.

Visit the ACTRA website at **www.actra.org.au/news.html** for the full meeting program.

The 2010 ASM will be held in Sydney on 26-27 August. It will once again attract contributed papers and will feature symposia on the themes '*toxicity evaluation and risk assessment in the 21st century*' and 'quantitative structure activity relationships in toxicology'.

Workshop of carcinogenic risk assessment

ACTRA convened a well-attended (80 registrants) workshop in Sydney on 28 May 2010 on the topic of carcinogenic risk assessment. The workshop addressed issues such as:

- what is a carcinogen?
- is a human carcinogen something different?
- how are perceived 'cancer clusters' assessed and managed?
- what quantitative approaches to risk assessment work best?
- is qualitative risk assessment a possible substitute for quantitative risk assessment?
- how should risk assessors deal with short and intermittent exposures?
- what determines the 'target risk' level in a human health risk assessment?
- how do regulators approach cancer risk assessment?
- should the NHMRC mBMD approach have been allowed to die?

The keynote speaker was once again Dr Christopher Portier, who provided an overview of US regulatory policies relating to carcinogens and provided insights into future developments in regulatory toxicology and the use of advanced techniques to explore the cellular basis and predictive biomarkers of human disease. ■

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ACLCA Update

Alex Simopoulos, Australian Contaminated Land Consultants Association

Alex Simopoulos has been appointed the new national chair of the Australian Contaminated Land Consultants Association (ACLCA).

He is the state president of ACLCA Victoria, principal at the URS Australia Melbourne office, and has 20 years experience in the contaminated land assessment and remediation industry.

His current roles include project technical direction and client management for the URS contaminated land consulting practice.

ALEX: I would like to thank fellow State ACLCA Presidents for supporting my nomination to the role of national chair for ACLCA. I look forward to fulfilling this role over the coming years as it is an exciting period for the contaminated land assessment and remediation industry.

On behalf of all state ACLCA presidents we thank Ross for his most valuable contributions over the years and look forward to his on-going advice and mentorship in the years ahead. Ross is still actively involved in CRC CARE initiatives and we look forward to continued collaboration and co-operation.

The primary role of the ACLCA national chair is to provide a single unified voice for all the state ACLCAs and to provide a central point of disseminating national matters to the state associations. I will endeavour to accomplish this with vigour and enthusiasm. I also see the role of ACLCA national chair as an opportunity to facilitate closer collaboration between ACLCA and related organisations including CRC CARE, Australian Land and Groundwater Association (ALGA) and Australian Remediation Industry Cluster (ARIC). We are all essentially concerned with the same subject matter and have an interest in fostering technical excellence in a sustainable manner. Some of the initiatives that are on the national agenda for ACLCA are:

- professional accreditation of professionals practising in contaminated land
- national co-ordination of ACLCA activities, achieving uniformity between states
- greater collaboration with CRC CARE, including dissemination of research into industry
- providing meaningful and relevant input to policy and regulators in the field of contaminated land assessment and remediation
- continuing to foster high technical standards across the board
- the provision of relevant, cutting edge training for consulting professionals.

Som of these items have already been set in place and we will be continuing the good work of our predecessors. With other items we will need to consult people and gain consensus as to how best to move the issue forward.

We look forward to the support of our partner organisations CRC CARE, ALGA and ARIC in achieving our aims and hope to have many good news stories for subsequent editions of this industry journal.

Regulator Roundup

Tasmania

Kylie Bull, Department of Primary Industries, Parks, Water and Environment

Environmental Management and Pollution Control (Underground Petroleum Storage Systems) Regulations 2010

The *Tasmanian Environmental Management and Pollution Control (Underground Petroleum Storage Systems) Regulations 2010* commenced on 31 March 2010. The main requirements in the regulations are summarised below. Visit **www.environment.tas.gov.au/upss** for further information. Guidance documents issued by the EPA Board will also be available through this site. On commencement of regulations:

- All new underground petroleum storage systems (UPSS) must include items defined as mandatory equipment (e.g. double-walled tanks and lines). If a tank in a UPSS is replaced due to a decision by the owner, the whole UPSS must also be upgraded to include mandatory equipment.
- Excavations exposed when a UPSS, fill point or piping in the system is repaired or replaced must be scrutinised for contamination. If evidence of contamination is observed then an environmental site assessment must be conducted and the EPA director notified.
- All UPSS that are to be decommissioned must be removed, except where it is unsafe to do so. An assessment must also be conducted to determine whether the soil and/or groundwater in the vicinity of the UPSS is contaminated.

Staged requirements

For UPSS in use when the regulations commence, the implementation of some requirements have been staged to allow site-based practices and procedures to be developed and implemented. The main requirements include the following:

- Within 6 months of the regulations commencing, all UPSS must be registered with the EPA.
- Within 12 months of the regulations commencing, loss monitoring must have commenced. For UPSS with a small tank (less than 5,500 L) manual tank gauging or an alternative that is as accurate, must occur twice a year. All other systems must use a method that is able to detect a loss of 0.76 L/hr. If a loss is confirmed, an environmental site assessment must be conducted and the EPA director notified.

For UPSS that are installed after the commencement of the regulations, the above requirements must be implemented immediately.

Other

Groundwater protection zones will be declared to protect groundwater resources. Groundwater monitoring wells must be installed at sites in these zones within two years of a zone being declared.

New South Wales

Niall Johnston, Department of Environment, Climate Change and Water

Site auditors accreditation round

To meet the demand for auditors and increase the pool of accredited auditors available, the Department of Environment, Climate Change and Water NSW (DECCW) called for applications from appropriately qualified and experienced people to become accredited site auditors under the *Contaminated Land Management Act 1997*. Advertisements were run in both *The Sydney Morning Herald* and *The Weekend Australian*, on 1 February 2010 and 30 January 2010 (respectively). A briefing session for applicants was held at the DECCW offices in Goulburn Street on 16 February 2010. The closing date for applications was 1 March 2010. Final accreditation of the four successful applicants has now been completed.

New technical documents available online supporting UPSS Regulation 2008

To support the implementation of the *Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation 2008*, several technical notes have been developed and are available for download from the DECCW website.

- UPSS Technical Note: Site sensitivity assessment – outlines matters that should be considered when preparing a site sensitivity assessment as part of an application for an exemption from complying with specific provisions of the UPSS Regulation
- UPSS Technical Note: Site validation reporting – outlines the matters that should be considered when preparing a validation report that meets the requirements of clauses 13 and 15 of the UPSS Regulation
- UPSS Technical Note: Decommissioning, abandonment and removal of UPSS – seeks to clarify stakeholder roles and responsibilities in the decommissioning, abandonment and removal requirements of UPSS in line with relevant legislation, policies and industry best practice.

The technical notes are advisory only. They will be revised from time to time following feedback from stakeholders using them. This should ensure their ongoing relevance and reflect advances in best practice as the result of regulator and industry experience. Visit the DECCW website at **www.environment.nsw.gov.au/clm/upssguidelines.htm** to download these documents.

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- Case studies
- Regulator updates
- Reports from industry groups
- Technical articles
- News relating to new technologies and developments in the industry, and
- Training, international conferences or events in Australasia.

The editorial team welcome your suggestions for content, as well as article submissions.

Articles should clearly explain the topic of discussion (technology or research, for example), implications for industry, and how this information can be used to facilitate change or greater understanding of important issues.

Get in touch with the editorial team if you are interested in contributing any content - whether it be an article or simply a photo. You won't have to sweat over the editorial details; we can edit and format your article ready for publication.

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