Urban development and land contamination: incremental pressures and policy gaps

Peter J Davies[1], Jim Fraser[2] and Steve George[1]
[1]Department of Environmental Sciences, Macquarie University
[2]Marrickville Council

Abstract: Urban soil contamination presents a threefold risk to the community and government. One, residue pollution from former industrial and transport activities contributes to contamination that can have adverse human and environmental health outcomes. Two, current land use policy is primarily directed towards contemporary sites or activities having known or likely contamination risk and not incremental build-up of contaminants from diffuse sources. Three, as more is known on the impact of specific contaminants on human health and the environment, maximum permitted limits are reducing thereby increasing the number of people exposed to low level contaminants. The intersection of these factors brings to light some of the shortcomings of current policy and practice. For urban planners tasked to support residential consolidation and gentrification of former industrial inner suburbs, managing both the known and unknown risks is a significant and unresolved planning and environmental issue. This paper examines the current policy and practices of land contamination at a state and local government level. It draws on the historical land use and recent soil contamination sampling from discrete locations across the Marrickville local government area, an inner-wester region of metropolitan Sydney. The paper concludes with recommendations for planners and environmental regulators on how to incorporate contamination risk into strategic and statutory land use decisions.

Introduction

Urban renewal is one of the major tools planners have to facilitate housing provision and choice. This is actively promoted in Sydney's latest metropolitan plan, A Vision for Sydney (NSW Government 2014). Urban renewal is often characterised as either 'brownfield' or 'greyfield' development (Newton and Glackin 2014). Brownfield typically involves the development of abandoned or under-utilized industrial or commercial land and its rezoning and development is often captured by land contamination policies and may require rehabilitation or remediation. Greyfield land sits apart from this and typically involves the redevelopment of existing and 'underperforming' residential housing. Greyfield sites ordinarily fall outside the consideration of land contamination policies (Newton 2010).

The distinction between brownfield and greyfield development for the purpose of contamination assessment is less clear when considering the influence of: diffuse pollution from linear sources such as roads and rail; atmospheric or groundwater dispersion of pollutions beyond the boundary of the source; and historical contamination which occurred prior to contemporary land use and land contamination standards.

There have been a small number of studies in the peer reviewed literature that have examined urban metal contaminants in Australia cities (e.g. Tiller 1992, Olszowy et al. 1995, Markus and McBratney 1996, Snowdon and Birch 2004, Mival et al. 2006, Birch et al. 2011). In spite of the accumulating scientific knowledge there has been little discussion on the policy context and how governments need to adapt to known health concerns related to metal contaminants, how this relates to land use planning and the interaction of communities with their environment (e.g. Rodrigues et al 2009, Luo et al 2009, Cappuyns and Keesen 2014, USEPA 2014).

This paper will present the preliminary findings of an urban land contamination study focused on a number of suburbs within the inner-western region of metropolitan Sydney. It provides a deeper examination of the challenges faced by urban planning strategists and regulators in terms of when and how to apply current land contamination policies. Section 1 provides an overview of the policy and legislative framework affecting land contamination which, by and large, is directed to specific brownfield development sites. Section 2 discusses the implications of the current land contamination policy and how it is applied in practice to brownfield and greyfield development sites in NSW. Section 3 provides preliminary data from a soil sampling survey across six sites within the Marrickville local government area. The Discussion explores some of the implications for urban planners, policy makers and more broadly, the development industry. The study highlights that the distinction between brownfield and greyfield development from a contamination perspective may be misplaced in terms of assessing the risks to human health and that a more thorough review of policy and practice by land use planners is needed to ensure current and future development are safe.

Policy and legislative framework

In Australia, the regulation of land contamination is a matter for state and territory governments. Federally there is no specific legislation that relates to land contamination. There are however a number of policies and guidelines established under the framework of the Intergovernmental Agreement on the Environment (made on 1 May 1992). This Agreement has sought to, among other matters, facilitate a cooperative national approach to the management of the environment by States, Territories and the Australian Local Government Association. The primary document relevant to land contamination was the Australia and New Zealand Environment and Conservation Council (ANZECC) and the National Health and Medical Research Council (NHMRC) Guidelines for the Assessment and Management of Contaminated sites (ANZECC 1992). This has been replaced by the National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended in 2013) (ASC NEPM).

The ASC NEPM is made under section 14 of the National Environment Protection Council Act 1994 (Cth). The Measures are brought into effect by legislation and guidelines in each state and territory (such as the Contaminated Land Management Act 1997 (NSW) and Environmental Protection Act 1994 (Qld)). The purpose of the ASC NEPM or Measure is defined in clause 5 to 'establish a nationally consistent approach to the assessment of site contamination to ensure sound environmental management practices by the community which includes regulators, site assessors, environmental auditors, land owners, developers and industry' and that 'the desired environmental outcome … is to provide adequate protection of human health and the environment, where site contamination has occurred, through the development of an efficient and effective national approach to the assessment of site contamination.' The adherence to Measures is upheld by state and territory governments although there are exceptions that have tended to favour economic growth over the otherwise agreed environmental protection standards (refer to Taylor et al 2014).

The definition of contaminated land varies across state and territory jurisdictions. Generally it can be defined to mean 'land in, on or under which any substance is present at a concentration above the concentration at which the substance is normally present in, on or under (respectively) land in the same locality, being a presence that presents a risk of harm to human health or any other aspect of the environment' (Environmental Planning and Assessment Act (EPAA) 1979 (NSW) s145A). Not all jurisdictions include a formal definition of 'potentially contaminated land'. In Victoria it is defined as 'land used or known to have been used for industry, mining, or the storage of chemicals, gas, wastes or liquid fuels (if not ancillary to another ruse of land)' (State Environmental Protection Policy (Prevention and Management of Contaminated Land) 2002 (Vict) clause 32) (NSW does not include a specific definition for potentially contaminated land but the potential for contamination is referred to in the NSW EPA guideline on the duty to report contamination under the Contaminated Land Management Act 1997, (NSW EPA 2015).To overcome the lack of legal clarity and practical application as to what is potentially contaminated, a risk based approach is used to determine the potential and significance of contamination and its interaction with the environment and human health (NEPC, 1999 (also referred to as ASC NEPM 2013, Schedule B7 Appendix A1)).

For many contaminated or potentially contaminated sites, achieving a standard of remediation to meet all future development outcomes and support ecological process is not always technically or economically feasible (Preston 2008). This has and continues to be a barrier for urban redevelopment, particularly brownfield and orphan sites (Wiltshaw 1996, Christie and Teeuw 2000).

Practice of land contamination in NSW

In NSW, regulatory responsibility for contamination lies with the Environment Protection Authority (EPA) and local government. The NSW EPA typically deals with sites posing a significant risk of harm to the environment or the health of a community through the Contaminated Land Management Act 1997 (NSW) (CLM Act). The EPA can declare a site significantly contaminated, request a person to investigate or take actions to manage the contamination and they also maintain a register of contaminated sites.

Local government and other planning authorities have the responsibility to manage contamination through the EPAA 1979 (NSW). Generally this falls to contaminated sites that do not pose a 'significant' risk. State Environmental Planning Policy No. 55 - Remediation of Land (SEPP 55) and the Managing Land Contamination - Planning Guidelines (NSW Department of Planning and NSW EPA 1998) are used to inform strategic planning (such as changes in land use zoning), and development control (such as imposing conditions of consent related to remediation or other works) to reduce risk of harm to human health and the environment.

For councils that have sites that are contaminated or potentially contaminated, additional planning consideration and guidance may be incorporated into a local policy. In NSW this is through a Development Control Plan (DCP) (Division 6 Part 3 of the EPAA 1979). A DCP contains the more detailed planning and design guidelines for new development proposals. DCPs do not have the same statutory weight as a LEP, rather they provide guidance to developers and consent authorities when assessing a rezoning or development proposal (EPAA 1979 s74BA).

In practice SEPP 55 and controls related to land contamination included in a DCP work in concert. These outline the requirements to properly address contamination affecting human health and the environment during development. Failure to consider the possibility of contamination at appropriate stages of the planning process may result in inappropriate land use decisions that may increase the risk to human health and the broader biophysical environment. Beyond the health and environmental risks there are risk management issues for government in terms of negligence in relation to planning decisions that have not adequately considered and assessed contamination issues as part of the development assessment process (for example, Alec Finlayson Pty Limited v Armidale City Council and Basia Holdings Pty Limited [1994] FCA 1198; (1994) 123 ALR 155 (1994) 51 FCR 378, (13 July 1994)).

A risk management approach underlies much of the decision making by both the EPA and planning authorities. The CLM Act defines the process the EPA is required to follow before declaring land to be significantly contaminated. In evaluating significance the EPA take many factors into consideration including type, nature, quantity and concentration of contaminants, the current land use the receptors that might be exposed and the likelihood of exposure. No specific threshold or standard is provided for the EPA and each site is determined on a case by case basis (NSW EPA 1995).

Where regulation through the CLM Act is not significant the management of the contamination risk is left to planning authorities under the EPAA 1979 or through provisions under the Protection of the Environment Operations Act 1997 (NSW). This may include issuing a clean-up notice to the owner of the site (NSW EPA 2015).

For planning authorities, risk assessment processes are used to ascertain if and what level of contamination site audit is required. The site audit process follows SEPP 55 planning guidelines (NSW Department of Urban Affairs and Planning and NSW EPA 1998) and may also be captured by local council policy (such as the contaminated land provisions in the Marrickville DCP (Marrickville Council 2011 DCP General Provisions 2.24). In effect this is a three part process. 1. The initial risk assessment would look at, among other matters, the current and former land uses and near-by development or rezoning applications that may have required a similar site audit. 2. On receipt of this information the planning authority may then determine if a preliminary site investigation is required. 3. If potential contamination is then identified and the site is unsuitable for the proposed use, a detailed site investigation must be provided as part of the development application or rezoning proposal. The detailed investigation may also necessitate a remediation action plan as part of the proposed future use of the site. Following these reports, if conditional approval is granted for a development any site remediation identified must be validated by a third party auditor (CLM Act Part 4) to ensure it complies with the clean-up criteria set for the site (NSW EPA 1995).

Local government and other planning authorities have additional responsibilities and liabilities. A preliminary, or where required, a detailed site investigation must be considered as part of the development assessment process. For most councils this is undertaken solely by the assessment planners. In larger councils or those in areas known to have land contamination they may employ contamination specialists who would review site investigation reports and provide advice to the assessment planner. Irrespective of staff capability within the council there remains a strong reliance on the accuracy and recommendations of the site auditor and third party review process.

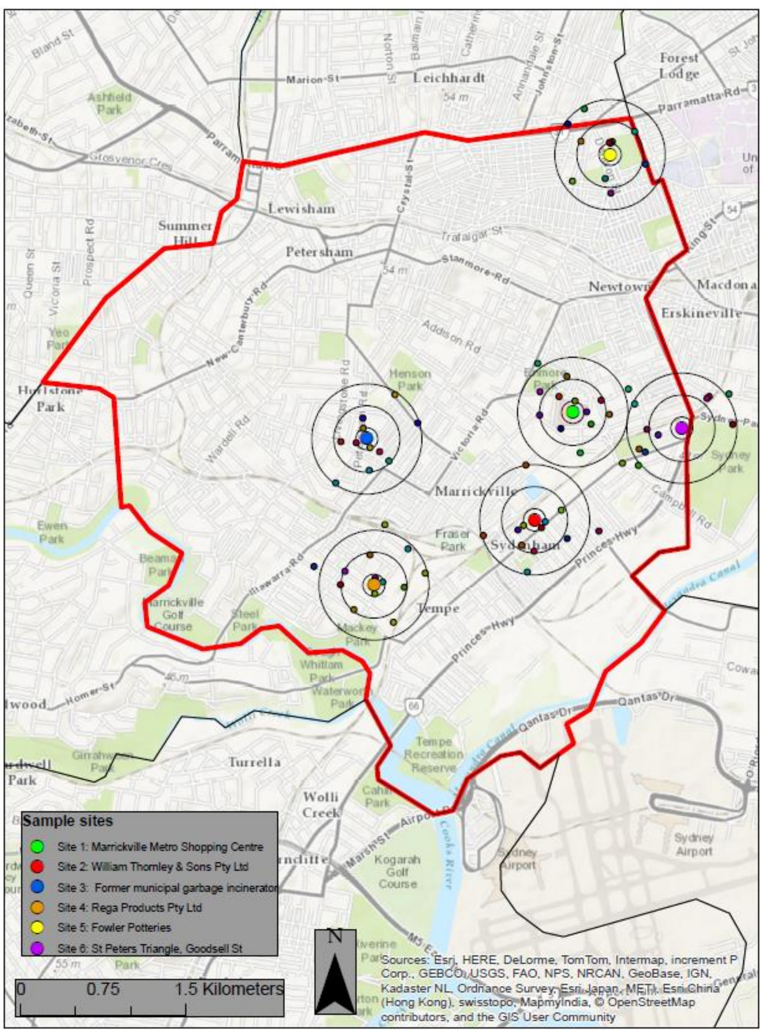
Soil sampling survey

Study area

Located less than 10km from the Sydney CBD, Marrickville Municipality was established in 1861 and has some of Australia's oldest suburbs. The council area is bounded by major regional transport corridors of Parramatta Road, Princes Hwy and intersected by Sydenham Road.

Marrickville has a long history of industrial use. Prior to the formation of municipality, in the 1830's industrial brickmaking commenced. This activity generated air pollution making the suburb less desirable for residential development. Consequently, industrial activities soon dominated the land use. Activities included potteries, tanneries, woollen mills, steel and metal operations and later automotive factories. Industry in the late 1800s also relied on water supply from the Botany Bay wetlands (Cashman et al. 1990).

Figure 1. Marrickville Local Government Area and sampling sites



Methods

The soil sampling program was designed to characterise and quantify the level of surface soil contamination across an inner-metropolitan urban area that has been the subject of historic industries and subsequent development of the brown and greyfield development. The selection of sites was based on two criteria.

1. To determine if a spatial pattern exists with respect to the deposition, burial or other contamination conditions resulting from the past industrial activities of six selected sites (Table 1). Each site had at some stage of their operation released atmospheric emissions that would have resulted in deposition of dust across the local area. It is also likely that in-situ burial of contaminated or other waste materials would have also occurred as many of the industries operated at a time predating contemporary environmental policy and legislation.

2. Sampling was limited to public land including road reserves, parks and gardens. This sampling effort was designed as a surrogate for the potential of soil contamination on both public and private land.

The rationale for the soil sampling recognises that both past and current land use contributes to the distribution of metals in the soils (Olszowy et al., 1995, Birch and Scollen, 2003; Snowdon and Birch, 2004; Laidlaw and Taylor, 2011; Rouillon et al 2013).

Table 1 Summary of the past and present use of the former industrial sites

Site	Site name	Address	Former use	Current use and zoning
1	Marrickville Metro Shopping Centre	34 Victoria Road Marrickville	Tannery 1863-1890s Brick manufacturer 1830 – 1914 Wool processing (dates unknown)	Commercial Marrickville metro shopping centre established 1988 Zone: B2 Local Centre
2	William Thornley and Sons Pty Ltd	23 Unwins Bridge Road, St Peters	Steel manufacturing and other metal fabrication. 1910-1990	Currently used as container storage depot. Adjacent site redeveloped as business park. Zone: IN1 General Industrial
3	Former municipal garbage incinerator	16 Cecilia Street (and adjacent sites)	Brick manufacture 1920-1940s Brick pit subsequently filled in with incinerator wastes possibly from the local hospital	Site became council depot now residential (developed over most of the site) Formally on EPA site audit register list Zone R4: High Density Residential
4	Rega Products Pty Ltd	47 Carrington Road Marrickville	Chemical and plastics manufacturing from 1937 then then electronics	Oils & cosmetics wholesaler Zone IN2: Light Industrial
5	Fowlers Potteries	1-33 Australia Street Camperdown	Potteries 1850's-1912	Converted to residential in around 2010 Zone: B2 Local Centre
6	St Peters Triangle	Goodsell Street, St Peters	Brickworks 1870 - 1970 Municipal garbage tip 1948 - 1976	Site became a park in 1991. Target area infill residential dwellings Zone RE1: Public Recreation

Soil sampling across the Marrickville local government area was undertaken between 3 February and 6 May 2015. Sampling was undertaken in a proximate radial pattern centered on each of the six former industrial sites (Table 1, Figure 1). Between 11 and 13 samples were collected inside incremental radial distances of 100 m, 300 m and 500 m. At each location 3 in-situ surface soil exposures (0-2cm in depth) were analyzed with an Olympus 40kV Delta Environmental portable X Ray Fluorescent (pXRF) spectrometer with a 4W Ta Anode X-ray tube excitation source and a Si-PIN diode detector at a resolution of 145eV. Analysis parameters of all exposures was conducted using a 60 second, live-count, 3 beam sequence, (Beam 1) 40kV - 100 μA, - (Beam 2) 40kV - 80 μA and (Beam 3) 15kV - 80 μA. Abundance data were produced by a 530 MHz CPU with integrated FPU and 128 MB RAM using proprietary Olympus Digital Pulse Processor (DPP).

The surface samples relied on scratching the surface with a stainless steel metal trowel to reveal the upper portion of natural soil. Prior to this the trowel was passed through an adjacent soil profile to eliminate cross contamination from the previous site soil.

To ensure Quality Assurance / Quality Control (QA/QC) during the field sampling phase, NIST certified reference samples NIST 2710a and 2711a were measured both pre and post in field analysis sessions and also during field sampling, every 15 – 20 samples. At these times, a further exposure to an SiO_2 blank was also conducted to satisfy pXRF field protocols and spectrometer functionality,

Results

The preliminary results from this study have identified that lead is the metal contaminant of greatest concern. From the raw data (incorporating the three samples per location) approximately 15% of surface soil samples exceeded the NEPM health based investigation levels of 300 mg/kg. Other contaminates (number and %) were reported to exceed the NEPM health based guideline included Chromium, (6, 3%), Cadmium (4, 2%), Arsenic (1, 0.5%) and Manganese (1, 0.5%) (Table 2). When compared to the Dutch Target and Intervention Values (2000), (generally considered as the highest or more conservative standard) molybdenum is the metal contaminant of greatest concern with all samples exceeding Investigation and Target levels. Copper, lead and zinc were exceeded in 50% or more of the samples related to the Dutch Target level.

Figure 2 shows the sites where the average of the samples exceeds the NPEM Standard for arsenic, chromium and lead. Figure 3 illustrates where the average concentration of the three surface samples at each site greater than 100 mg/kg.

Discussion

Concentrations of copper, lead and zinc are frequently identified as contaminants of concern in urban soil studies. When related to land use, industrial zones generally have the highest concentrations of these metals, followed by residential, parkland and undeveloped areas (e.g. Want et al 2006, Biasioli et al 2006). There is also a strong spatial association with soil lead concentrations proximate to major roads (e.g. Duong and Lee 2011, Dao et al 2014) and building materials, particularly where leaded paint is involved (e.g. Laidlaw et al 2014). From an urban soil contamination perspective past and present industrial activity is likely to contribute to soil contamination from atmospheric emissions (Kaitantzian et al 2013). Lead in petrol, which was a significant source, has been reducing in response its phasing out in Australia from 2002 (DEH 2001) and elsewhere (e.g. Rodriguez Martin et al 2015). Similarly lead in paint has been progressively reduced in Australia since the 1970's. However as a source, it still remains an ongoing issue particularly for older suburbs that are gentrifying (e.g. Duggan and Inskip 1995). It is important to note that lead, like many other heavy metals, remain as a long term problem as it does not readily dissipate and will continue to recycle in the environment.

The concentrations of copper, lead and zinc reported in this study are similar to other locally relevant studies. For example Markus and McBratney (1996) in their study across Glebe, Sydney, reported 50% of samples for lead, zinc and copper concentrations were above the ANZECC and NHMRC guideline. Birch and Scollen (2003) reported similar although lower percentage exceedances against the national guidelines for copper (9%), lead (6%) and zinc (25%). In both the Markus and McBratney (1996) and Birch and Scollen (2003) studies, copper, lead and zinc concentrations were higher closer to major roads. Similarly metal concentrations on industrial land were also higher compared to other locations.

In this study, surface soil concentrations from road verges and parks are likely to be influenced and reduced by re-turfing, addition of new topsoil and for some locations rehabilitation has occurred across a number of parks in the Marrickville area that is also likely to have incorporated removal of top soil from the road verge. A more detailed study on subsurface soil concentrations is currently underway by the authors.

Figure 2. Locations where average of the samples from a site exceeds the NPEM Standard for arsenic, chromium and lead

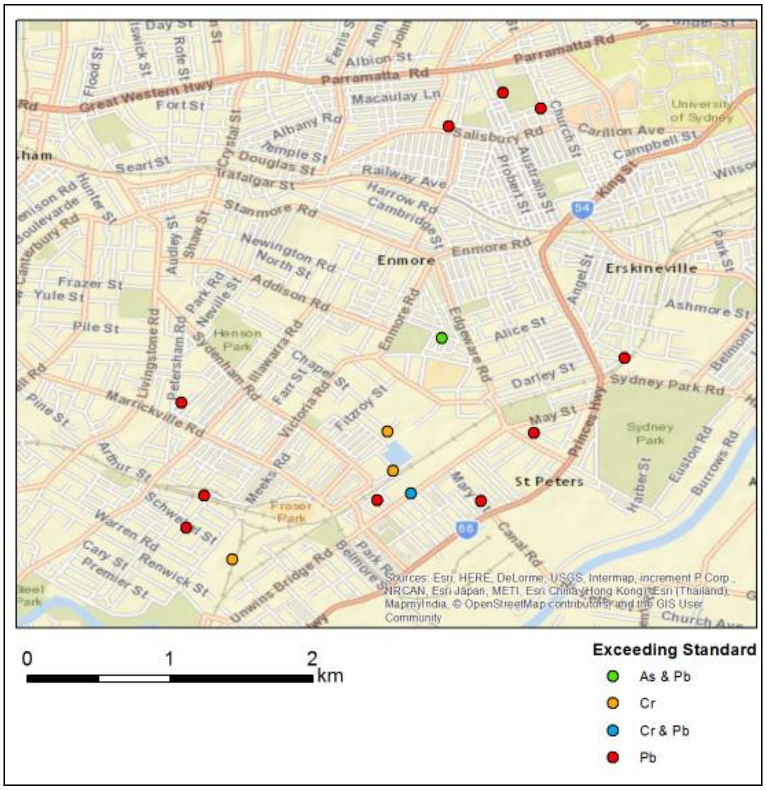


Figure 3. Average concentration of lead based on three surface samples (mg/kg)

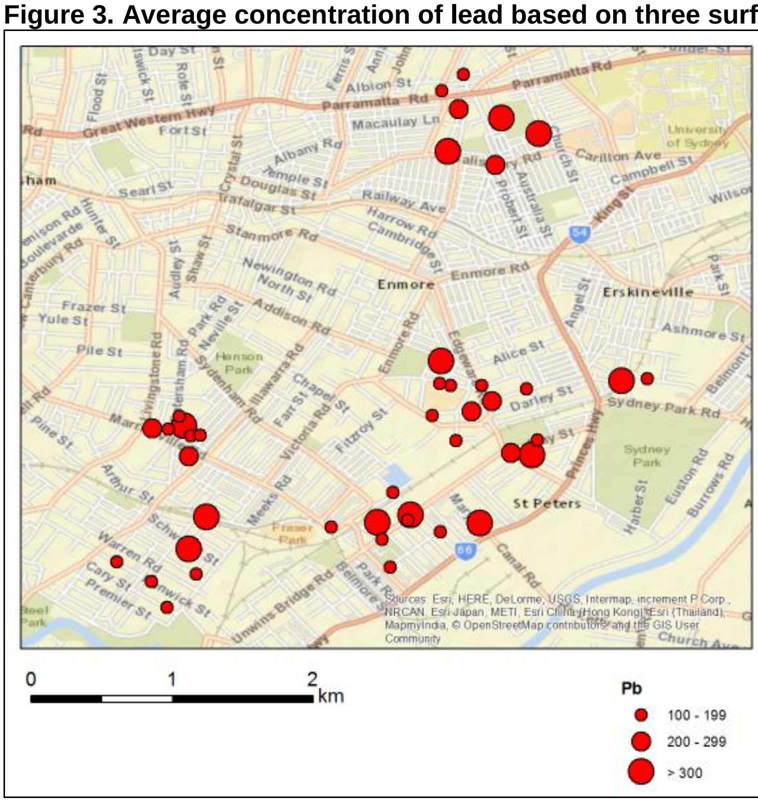


Table 2 Summary of all surface soil samples undertaken by XRF (mg/kg) and comparison against national standard and Dutch (Netherlands) target

	As	Cd	Cr	Cu	Mn	Ni	Pb	Zn
Mean	8.95	1.06	22.77	47.99	207.53	4.63	181.98	312.04
Standard Error	1.69	0.30	2.48	4.12	11.66	1.52	21.14	24.73
Median	4.45	0.00	17.50	36.00	170.50	0.00	105.00	208.00
Mode	0.00	0.00	0.00	0.00	149.00	0.00	102.00	365.00
Standard deviation	25.13	4.50	36.76	61.08	172.93	22.52	313.51	366.75
Sample Variance	631.31	20.23	1,351	3,731	29,904	507.23	98,289	134,507
Kurtosis	142.21	16.91	38.68	105.97	52.90	117.07	90.71	18.53
Skewness	10.91	4.22	5.39	8.84	5.69	9.86	8.18	3.71
Range	342.00	28.00	340.00	801.00	1,998	288.00	3,889	2,713
Minimum	0	0	0	0	0	0	4.0	13.4
Maximum	342.00	28.00	340.00	801.00	1,998	288.00	3,893	2,727
Count	220	220	220	220	220	220	220	220
Confidence Level (95.0%)	3.34	0.60	4.88	8.12	22.98	2.99	41.66	48.73
NEPM standard	100	20	100	6,000	1,500	400	300	7,400
Number exceeding NEPM (2013) standard	1	4	6	0	1	0	32	0
% samples exceeding NEPM standard	0.5	1.8	2.7	0.0	0.5	0.0	14.5	0.0
Netherlands investigation level (and % exceedance) (1)	76 (1.3%)	13 (5%)	100 (3%)	190 (1%)	200 (40%)	100 (1%)	530 (6%)	720 (6%)
Netherlands target value (and % exceedance) (1)	29 (1.3%)	0.8 (5%)	100 (3%)	36 (50%)	3 (100%)	35 (3.6%)	85 (57%)	140 (66%)

1. Dutch Target and Intervention values (2000) http://www.esdat.net/Environmental%20Standards/Dutch/annexS_I2000Dutch%20Environmental%20Standards.pdf

The grey area of greyfield liability?

Distinguishing between brownfield and greyfield sites for the purpose of identifying soil contamination risk and liability is likely to be a challenge for planners and regulators. From this study and others, land use is an important predictor to identify metal contamination. It is not the only factor. Transport, other fugitive emissions and dispersal of metals associated with building and renovations will also influence concentrations in soil and dust. This will affect soil and risk exposure outside and inside the house. In this context, it is suggested that the assumption that greyfield sites are considered contamination free (Newton and Glackin, 2014) should not be a default position.

From a policy perspective three options are provided for environmental regulators, land use planners and specifically the local government sector to reduce environmental and health risks and corporate liability.

1. Data collection and reporting

No level of government or agency in its own right has a general requirement or obligation to measure and publically report on the presence of contaminants in soil.

A framework exists under the National Pollution Inventory ((NPI) http://www.npi.gov.au/about-npi) which provides information to the community, industry and government on toxic emissions from major industries and related activities. At present this does not extend to a spatial data set on soil contamination. Further, the desired environmental outcomes of the NPI are specific to air and water quality, not soil.

At a state level, the NSW EPA (and equivalents in other jurisdictions) maintains a public register on contaminated sites listed under Part 5 of the CLM Act 1997 and the and the Environmentally Hazardous

Chemicals Act 1985 (http://www.epa.nsw.gov.au/clm/publiclist.htm). These records are directed to the 'significant' sites that fall to the responsibility of the EPA and not local government. The EPA also maintains a public register for range of sites including where an activity has an environmental protection licence (EPL) or a penalty notice has been issued under the Protection of the Environment Operations Act 1997 (NSW) (http://www.epa.nsw.gov.au/prpoeo/index.htm). General provisions relating to soil contamination and associated remediation reports are not readily available on these public registers. Neither are historical records of contamination or pollution licences that may suggest a residual contamination risk.

Local government does not have a specific responsibility to maintain a public register or list of contaminated sites of properties that may fall to its responsibility under the Environmental Planning and Assessment Act 1979 and associated planning instruments. There is a requirement under the Local Government Act 1993 (NSW) for a council to report annually on sites that have been the subject of an environmental upgrade or designed to reduce pollution (Local Government (General) Regulations 2005 clause 136A (2)). While a council's annual report is required publically available it would be unlikely that specific data would be included in this report.

As it stands there is no specific legal obligation to report on diffuse or other contamination that may exceed the NEPM standard including the outcomes of any works undertaken as part of development application requiring decontamination on private land nor the publication of any study related therein. The former state of the environmental reporting provisions (Local Government Act 1993 section 428(a)(1)) was not specific on the need for data related to soil contamination either on public or private. There is no requirement to collate and report on data from contamination investigations, audits or remediation plans. The general provisions under the NSW Local Government Act 1993 for information related to annual, term of council reports or community strategic plans do not mention any requirement for the collection of and reporting contaminates related to NEPM standards. Property related information, which may contain information on contamination risk, does exist through section 149 certificates (as discussed below). The collation of this information is not provided on a public register and access to property information is typically subject to fees and charges as permitted under the Local Government Act 1993 (for example: http://www.marrickville.nsw.gov.au/en/development/planning-controls/section-149-certificates/).

So where should the responsibility lie? Valid reasons could be provided for each of the levels of government to report on soil contamination levels.

Federally, there exists a spatial data base into which site specific contamination data could be added.

State government has overarching responsibility for contamination and land use planning. Accordingly there is justification that a centralised record should be kept by a relevant state government agency that would be able to draw on data held by the EPA, planning agencies and others. This could take the form of spatial database as used under the NPI with a caveat on all data that it is there to inform decision making. A central data repository should serve as a source of information for additional investigation not as an 'alarmist' record where a contaminant has been reported above the NPEM. A state based register and accompanying guideline would also enable data to be collected and analysed consistently. Such datasets could then form the basis of predictive models to estimate contaminate risk.

Councils are the level of government who are most likely to receive and be able to summarise and report on contamination risks relevant to their local area. However the skills in local government to interpret data, staff capacity to maintain a register and maintaining a consistent framework remain key risks. If there was a federal or state based centralised data system, councils could be obligated to report contamination related data from development applications, rezoning proposals and their own investigations and works to the appropriate body in a timely manner. An alternative to council reporting could be achieved through state based regulation that would require contamination consultants to upload data directly to a central data base as part of the sampling design guidelines (e.g. NSW EPA 1995).

An alternative model for data collection is to place the onus on the owner of the property. The timing of a contamination report could be triggered at the point of sale, rezoning or development application stage.

Precedents for an approach such as this occurs in the Australia Capital Territory (Act) where owners are required to demonstrate the energy performance of their house when applying for a building approval (Building Act 2004 (Act) and the sale of property (Civil Law (Sale of Residential Property) Act 2003 (Act). The appetite for such regulation is likely to be low from many fronts: it would be seen as additional red or green tape; raise the cost of building and development; and may unnecessarily heighten community concern over lower levels of contamination that may not be accessible or bioavailable from an environmental or health risk perspective.

University and community focused soil sampling programs could establish their own data base. Examples of this occurs through the Vegesafe program run by Macquarie University (http://research.science.mq.edu.au/vegesafe/latest-findings/), New York Department of Health (http://www.health.ny.gov/environmental/outdoors/garden/index.htm) and Brooklyn College New York (http://www.brooklyn.cuny.edu/web/academics/centers/esac/services/soil.php). Data from these programs are not designed to provide publically available site specific information. Rather data collection is used to inform the owners of the property of their risks and where relevant how to manage the risks. Data reporting, integrity and liability to property owners in receipt of information that may indicate their property is contaminated requires careful consideration particularly for residential (greyfield) sites, particularly where such programs are established to promote healthy gardening on broader sustainability principles.

2. Risk, liability and property information

The NSW guidelines for the management of contamination under SEPP 55 Remediation of Land states that an initial evaluation to determine the possibility of contamination should be done in 'good faith' (NSW Department of Urban Affairs and Planning and NSW Environment Protection Authority 1998, page 10). The policy also states that an initial evaluation 'can' (*note 'can' is used not 'must' or 'should' that have a more precise and onerous legal meaning)* be based on readily available factual information including 'current zoning and permissible uses, records from previous rezonings, development applications and building applications for the site, property files, information provided by the proponent such as a development application or rezoning request or an investigation, and the knowledge of council staff. Information provided by the owner or proponent should be checked against information held by the planning authority on the subject land and, if available, adjoining properties.' Readily available information on the subject property, properties that may have contributed to pollution in the past or other activities are unlikely reveal the full extent of the risk to contamination particularly given what we know about diffuse pollution, domestic sources such as lead in paint and transport related contamination linked to lead in petrol.

It is suggested that the words 'readily available' in the NSW Guidelines should extend to current data, reports and academic journal articles that have been published with peer review. As has been discussed in the climate change literature and how climate risk intersects with land use planning (e.g. Ghanem and Ruddock 2011), there will be a time when the legislation, courts and other determining bodies must consider contamination and its risks as part of the obligations under ecologically sustainable development provisions (for example refer to the judgements from the NSW Court of Appeal Minister for Planning v Walker (2008) 161 LGERA 423 and NSW Land and Environment Court in Gray v The Minister for Planning, Director-General of the Department of Planning and Centennial Hunter Pty Ltd [2006] NSWLEC 720 ('Anvil Hill Case').

All property in NSW is required to have a planning certificate which outlines specific matters relating to the land (s149 (2)) or general advisory matters (s149(5)) (s149 EPAA 1979 (NSW)). The Conveyancing Act 1919 (NSW) requires that a section 149 Planning Certificate be attached to the Contract for Sale. Section 149(2) specifically requires the inclusion of details related to a site that relate to matters arising under the CLM Act 1997 (Environmental Planning and Assessment Regulation 2000 (Schedule 4) (NSW). This will effectively capture the 'significant' sites as regulated by the EPA. General advisory information (s149(5)) can be added to a planning certificate where a council considers it relevant to the land. Options for the use of this approach may include:

1. Relating the land to its proximity to a major road or former industry. Such spatial affectations already exist for land that may be within a mine subsidence area (Mine Subsidence Compensation Act 1961

(NSW s15)) or flooding has this has been identified through studies and modelling (that in effect would not be too different if land contamination modelling was to be undertaken).

2. Providing a greater reliance on historical information held by council that may point to a past use/s that may have contributed to contamination. This may require additional recording keeping and historical reviews by local government and the use of this information by contamination consultants (for example the analysis or lack thereof past use was considered in Wallarah Minerals Pty Ltd v Mulwaree Shire Council]200] NSWLEC 238).

3. A temporal assessment, for example, if the residing property on the land was built prior to the 1970s when lead in paint was more prominent and thus presenting a health risk from both soil and dust.

Failing any site, spatial or temporal specificity, a general note could be included for all urban properties that reflects the increased risk of urbanisation and the concentration of metals (as reported by Beavington 1973 and many other since).

3. Education and awareness

There can be significant value in development and maintenance of community education campaigns around the health and environmental risks of urban pollutants. Information on urban contaminants exists on government web pages (for example http://www.environment.gov.au/protection/publications/factsheet-lead-alert-facts-lead-house-paint) and specific advisory sites (such as The Lead Group http://www.lead.org.au/). Some councils provide advisory notes on their web page that draws attention to the risks associated with urban contamination when undertaking regular residential activities such as gardening (e.g. http://www.marrickville.nsw.gov.au/en/environment/in-your-home/gardening/).

Given the acute and chronic risks of certain contaminants to human health, pets (Lopez-Alonso et al 2007) and broadly the environment, there are opportunities to expand and focus education and awareness to key target audiences (e.g. pregnant women), commercial centres (e.g. child care centres, vet clinics and hardware shops), and specific locations (e.g. Mt Isa http://www.livingwithlead.com.au/mount-isa/mount-isa-children/).

Conclusions

Metal contamination presents a health and environmental risk in urban environments. Levels of contaminants have been reported frequently that exceed national standards. This is particularly relevant to lead, a known neurotoxin. The distribution of metal contaminants in urban environments is not restricted to brownfield sites. While brownfield sites are most often the focus for urban contamination risk assessments, greyfield sites are subject to contamination risk, as are playgrounds and other areas of public open space including road reserves. For environmental regulators and urban planners it is important to recognise the distribution of metal contaminants in the environment is subject to multiple pathways. This includes:

- Direct deposition, as is typically associated with a brownfield site through land management practices of the regulated or non-regulated industry (past and present);
- Diffuse pollution arising from atmospheric emission from current and former industry;
- Linear sources such as motor vehicles where lead was added to petrol prior to 2002;
- Indirect sources that may incorporate dust contamination associated with renovating buildings with lead based paint; or
- Translocated or buried sources (that may account for particularly high concentrations as present in many soil sampling programs).

From a health risk perspective ingestion of soil and dust, particularly by young children, presents one of the major challenges and that the exposure pathway is more likely from surface sediments and dust than soil deeper in the profile (Zahran et al 2013, Filippelli et al 2015).

To improve policy and governance systems to better manage urban soil contamination, the following suggestions are provided:

A. There should be a publically accessible data base that provides spatial information on reported contamination studies and data.

B. Guidelines for the management of soil contamination need to reflect contemporary environmental science. Peer reviewed reports and government policy already note that certain industrial activities are more likely to be significant sources of contamination. We know that urban areas generally contain higher concentrations of metals than reference or background sites and those levels often exceed national environmental and health standards. The risks in urban environments are compounded with higher population densities and exposure pathways (e.g. dust, food, water).

C. Property based planning certificates in specific urban areas should contain an advisory note stating the land may be subject to contamination.

D. To manage community concern and provide appropriate information on both health and environmental risks, greater emphasis on education programs are needed that target key demographic cohorts (such as pregnant women), commercial activities (where exposure risks may be higher due to their location such as child care centres) or the nature of products sold (hardware shops relevant to renovating buildings with lead based paint) or specific locations of risk.

The final comment. While urban areas may be subject to contamination risk managing the risk is a shared responsibility. Liability should not rest solely with any particular level of government. In many cases the polluters are long gone, many of the sources have since been regulated (such as paint and petrol) and the distribution pathways are diffuse. The community must accept some personal responsibility and modify behavior and practices to maximise livability and minimise their health risk.

References

Australia and New Zealand Environment and Conservation Council (ANZECC) and the National Health and Medical Research Council (NHMRC). 1992. Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites. Available at: https://www.nhmrc.gov.au/guidelines-publications/eh17 [accessed 30 June 2015].

Beavington, F. 1973. Contamination of soil with zine, copper, lead, and cadmium in the Wollongong city area. Australian Journal of Soil Research, 11, 27-31.

Birch,G.F. & Scollen, A. 2003. Heavy metals in road dust, gully pots and parklands in a highly urbanized sub-catchment of Port Jackson, Australia. Australian Journal of Soil Research, 41, 1329–1342.

Birch, G.F. & Vanderhayden, M. 2011. The nature and distribution of metals in soils of the Sydney estuary catchment, Australia. Water Air Soil Pollution, 216, 581-604.

Christie, S.& Teeuw, R.M. 2000. Policy and administration of contaminated land within the European Union*. European Environment*,10 (1), 24.

Cappuyns, V. & Keesen, B,. 2014. Combining life cycle analysis, human health and financial risk assessment for the evaluation of contaminated site remediation. Journal of Environmental Planning and Management, 57(7), 1101-1121.

Cashman, R., Meader, C. & Carolan, A. 1990. Marrickville, rural outpost to inner city. Hale & Iremonger, Petersham, 146-179.

Department of the Environment and Heritage (DEH), 2001. National Phase out of Leaded Petrol. Australian Government. Available: <http://www.environment.gov.au/atmosphere/airquality/publications/qa.html> [accessed 15 October 2015].

Dao, L., Morrison, L., Zhang, H.& Shang, C. 2014. Influences of traffic on Pb, Cu and Zn concentrations in roadside soils of an urban park in Dublin, Ireland. Environmental Geochemistry Health 36, 333-343.

Duggan, M.J. & Inskip, M.J. 1985. Childhood exposure to lead in surface dust and soil: a community health problem. Public Health Review, 13, 1–54.

Duong, T.T.T. & Lee, B.K. 2011. Determining contamination level of heavy metals in road dust from busy traffic areas with different characteristics. Journal of Environmental Management, 92, 554-562.

Filippelli, G.M., Risch, M., Laidlaw, M.A.S., Nichols, D.E. & Crewe, J. 2015.Geochemical legacies and the future health of cities: A tale of two neurotoxins in urban soils. Elementa: Science of the Anthropocene. DOI: 10.12952/journal.elementa.000059.

Ghanem, R. & Ruddock, K. 2011. Are New South Wales' planning laws climate ready? Environment and Planning Law Journal, 28, 17-35.

Kaitantzianm, A., Kelepertzis, E. & Kelepertsis, A. 2013 Evaluation of the sources of contamination in the suburban area of Koropi-Markopoulo, Athens, Greece. Bulletin of Environmental Contamination and Toxicology, 91, 23-28.

Laidlaw, M.A.S., Taylor, M.P. 2011. Potential for childhood lead poisoning in the inner cities of Australia due to exposure to lead in soil dust. Environmental Pollution, 159 (1), 1–9.

Laidlaw, M.A.S., Zahran S., Pingitore, N., Clage, J., Devlin, G. & Taylor, M. P. 2014. Identification of lead sources in residential environments: Sydney Australia. Environmental Pollution, 184, 238-246.

Lopez-Alonso, M., Miranda, M., Garcia- Partida, P., Cantero, F., Hemandez, J.& Benedito, J.L. 2007. Use of dogs as indicators of metal exposure in rural and urban habitats in NW Spain. Science of the Total Environment. 372 (2-3), 668-675.

Lou, Q., Catney, P.& Lerner, D. 2009. Risk-based management of contaminated land in the UK: Lessons for China? Journal of Environmental Management, 90, 1123-1134.

Markus, J.A.& McBratney, A.B. 1996. An urban soil study: heavy metals in Glebe, Australia. Australian Journal of Soil Research, 34, 453–465.

Marrickville Council. 2011. Development Control Plan – Contaminated Land Generic Provisions 2.24. Available http://www.marrickville.nsw.gov.au/en/development/planning-controls/marrickville-dcp-2011/ [accessed 28 July 2015].

Mival, K., Pump, W. & Dixon, G. 2006. From Wasteland to Green Parkland, the Remediation of the Former West Melbourne Gasworks, Victoria, Australia. Land Contamination and Reclamation, 194–199.

National Environment Protection Council (NEPC). 1999. Schedule B (1) Guideline on the Investigation Levels for Soil and Groundwater National Environment Protection (Assessment of Site Contamination) Measure: National Protection Council Service Corporation, Adelaide.

New South Wales Department of Urban Affairs and Planning and New South Wales Environment Protection Authority (1998) Managing Land Contamination, Planning Guidelines SEPP 55 Remediation of Land, August. Available at http://www.planning.nsw.gov.au/assessingdev/pdf/gu_contam.pdf [accessed 28 July 2015].

New South Wales Government. 2014. A Plan for Growing Sydney. NSW Government, December.

New South Wales Environment Protection Authority (NSW EPA). 1995. Contaminated Sites Sampling Guidelines. Publication EPA 95/59, September.

New South Wales Environment Protection Authority (NSW EPA). 2015. Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act. New South Wales Environment Protection Authority, Report EPA 3015/0164, July.

Newton, P. & Glackin, S. 2014. Understanding Infill: Towards New Policy and Practice for Urban Regeneration in the Established Suburbs of Australia's Cities. Urban Policy and Research, 32(2), 121-143.

Newton, P. W. 2010. Beyond Greenfield and Brownfield: The Challenge of Regenerating Australia's Greyfield Suburbs. Built Environment, 36(1), 81–104.

Olszowy,H., Torr, P. & Imray., P. 1995 Trace element concentrations in soils from rural and urban areas of Australia. South Australian Health Commission. Contaminated Sites Monograph Series No. 4.

Preston, B.J. 2008. Ecologically Sustainable Development in the Context of Contaminated Land. Australian Land and Groundwater Association, 1st Annual Conference, Ecoforum, Gold Coast, Queensland, February.

Rodrigues, S.M., Pereira M.E., da Silva E, F., Hursthouse, A.A.& Daurte A.C. 2009 A review of the regulatory decisions for environmental protection: Part II –the case study of contamination land in Portugal. Environmental International, 25, 214-225.

Rodrigues Martin J. A., De Arana C., Romos-Miras J J.& Boluda R. 2015 Impact of 70 years urban growth associated with heavy metal pollution. Environmental Pollution, 196, 156-163.

Rouillon, M., Gore, D.B.& Taylor M.P. 2013. The nature and distribution of Cu, Zn, Hg, and Pb in urban soils of a regional city: Lithgow, Australia. Applied Geochemistry, 36, 83-91.

Snowdon, R. & Birch, G.F. 2004. The nature and distribution of copper, lead, and zinc in soils of a highly urbanised sub-catchment (Iron Cove) of Port Jackson, Sydney. Australian Journal of Soil Research, 42, 329–338.

Taylor, M.P., Davies, P.J., Kristensen, L.J. & Csavina, J., 2014. Licenced to pollute but not to poison: the ineffectiveness of regulatory authorities at protecting public health from atmospheric arsenic, lead and other contaminants resulting from mining and smelting operations. Aeolian Research, 14, 35–52.

Tiller, K.G. 1992. Urban soil contamination in Australia. Australian Journal of Soil Research, 30, 9037-957.

United States Environmental Protection Agency. 2014. Technical review working group recommendations regarding gardening and reducing exposure to lead-contaminated soils. Office of Solid Waste and Emergency Response, USEPA. Report OSWER 9200.0-142 May.

Wiltshaw, D.G. 1996. An economic analysis of contaminated land, remediation and liability, Journal of Property Research, 13(2), 131-141.

Zahran, S., Mielke, H. W., McElmurry, S.P., Filippelli, G.M., Laidlaw, M.A.S. & Taylor, M.P. 2013. Determining the relative importance of soil sample location to predict risk of child lead exposure. Environment International, 60, 7-14.