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**Topic:** Revisiting the Valuation of Contaminated Land in Australia

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**Abstract:**

The issue of the valuation of contaminated land was explored 10 years ago by the author. Since then, there have been new developments in the technology of decontamination and changes in people's risk perception over time. Due to the shortage of land supply, more rural land and former industrial sites are converted to commercial and residential uses than before. There is a need to carry out new research to see how contaminated land is valued in Australia today.

This paper is based on a recent survey of 300 practicing valuers in NSW, Queensland and Victoria. Since about 70% of Australian valuers work in these three states, the views of valuers in these states are deemed to be sufficiently representative of all valuers in Australia. The survey results reveal a number of interesting findings including that the use of the unaffected valuation approach is still dominant in Australia.

## **Introduction**

Australia is the only country in the world that occupies a whole continent. It has a land area of about 7.7 million square kilometres and a population of around 20 million. It is easy for one to form the opinion that land is plentiful in Australia and the people have the largest share of land per capita. In fact, habitable land in Australia is limited and the geographical features force the majority of the people to settle in several big cities around the country.

The expansion of population has seen vacant development land in urban areas getting scarce. Conversion of rural land and former industrial sites for higher value use has become an important means to increase land supply. For example, in Sydney, the state government has designated growth centres in the north-west and south-west to release rural land for 160,000 dwellings over the next 25 to 30 years (Sartor, 2005).

As for the redevelopment of former industrial sites, the list below provides some recent examples in Sydney:

1. The former Defence Naval Stores site (19.62 ha) on the northern shores of Parramatta River at Ermington. In November 2006, consent was granted for residential redevelopment of the site by stages. Site remediation is required to remediate various types of heavy metal and hydrocarbon contaminants (NSW DoP, 2008a).
2. The former Carlton & United Brewery site (5.8-hectare) on the western edge of the Sydney CBD. The redevelopment concept plan was approved in February 2007 to provide office space, apartments and a 5,400 square metre community park. Certain parts of the site were affected by petroleum hydrocarbons (TPH) and polycyclic aromatic hydrocarbons (PAHs). Remediation work is required for the redevelopment (NSW DoP, 2008b).
3. Residential development at Precinct C (6,795m<sup>2</sup>), Rhodes Peninsula. The site comprised reclaimed land formed by filling materials supplied by the former chemical manufacturer Union Carbide Australia. The backfill materials are very toxic that remediation must be completed before any construction certificate is released. The redevelopment project was approved in April 2008 (NSW DoP, 2008c).

Rural land or former industrial sites might be contaminated by previous uses. Contaminated site is defined by the Australian National Health and Medical Research Centre (NHMRC, 1999) as “a site where toxic chemicals that have the potential to be harmful to human health or to the environment are present at levels higher than those normally found in the area.” The document goes further to explain that land contamination “may occur following use of the land for industrial, agricultural or commercial activities. Contamination can also occur after waste disposal, spills or storage of raw materials, or from neighbouring properties following movement of the chemical (for example by wind, movement through the soil, or in ground or surface water). Chemicals that could be found at a contaminated site include metals (like lead or arsenic), oil, tar, explosive gases, solvents, or other poisonous or hazardous wastes.”

Before development or redevelopment, the market value of the subject contaminated land has to be assessed. Valuation of contaminated land is not a simple task. It is a cross-disciplinary practice that requires knowledge in economics, environmental

impact assessment and planning, property management, human health risk, identification and remediation of contaminated land, and valuation (Chan, 2003). Valuation methods have to be suitably adapted and specific valuation assumptions have to be made.

A survey of Australian valuers was conducted 1998 to find out how they valued contaminated land. The findings were reported in *The Appraisal Journal* (Chan, 2000). Since then, there have been new developments in the technology of decontamination and changes in people's risk perception over time; see more discussions below. In order to find out if Australian valuers have changed their approaches to value contaminated land, a new survey by questionnaire was conducted in August 2008. This paper is based on the findings from the new survey.

### **Progress in Remediation Technology and Change of Risk Perception**

There has been progress in remediation technology over the years. Some methods are innovative and some are cost effective, such as the removal of atrazine (a chemical commonly found in herbicides) by supercritical extraction method<sup>1</sup> (Castelo-Grande & Barbosa, 2003) and the removal of zinc from industrial effluent by sand (Aslam, Hassan & Malik, 2004). The World Intellectual Property Organisation's database has recorded 27 new patents of soil decontamination methods since 1998 (WIPO, 2009).

In Australia, innovative and reliable methods are used to remediate contaminated sites. For example, in the redevelopment of the Cabarita ICI site mentioned above, the developer used on-site contaminated soil excavation and advanced soil washing method to make the site "cleaner than clean" (i.e. cleaner than background level) (Chan, 1999). This helped reduce the risk perception and eventually the whole project was sold without stigma impact.

Another example is the Botany Industrial Park, commonly known as the Orica site. It is a 74ha site at 11km south of the Sydney CBD. Over the years, the industrial activities had contaminated the groundwater with 1, 2-Dichloroethane (EDC) and other toxic chemicals. The toxic groundwater plume has spread 2 km<sup>2</sup> covering the area under the homes of about 1000 residents (Skelsey, 2004). The remediation method chosen is air stripping plus recuperative thermal oxidiser. Construction works for the groundwater treatment plant were approved in February 2005, Orica needs to work non-stop for 30 years to clean up the toxic groundwater (Peatling, 2004). This remediation technology claims to have a destruction efficiency of greater than 99.99% (URS, 2004).

There is also change of risk perception too. Risk perception is defined as "the subjective judgment that people make about the characteristics and severity of a risk" (Wikipedia, 2009). Since contaminated land may cause health and environmental problems, the risk perception can significantly affect the market value of the land.

Residential use is a sensitive land use. It is a general belief that resident properties built on a widely publicised former contaminated site may cause concerns of buyers. This belief, however, is not always supported by market evidence. Given that risk perception is psychologically based, it may change over time and vary according to

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<sup>1</sup>The supercritical extraction method makes use of a supercritical fluid (i.e. any substance when used above its critical pressure and temperature forms a good solvent) to extract solutes from solid matrices.

the people's knowledge about the contaminated land and the condition of the property market. For example, due to the transparent communication with the local council and the public, and the use of advanced remediation method, the market inflicted no stigma value deduction on the residential redevelopment of the former ICI Dulux paint factory site in Cabarita, Sydney, when sales began in around 2000.

In a recent study of home buyers' risk perception of residential development built on former contaminated land, Petersen (2008) investigated the sales of residential units built on the former Union Carbide site (a notorious contaminated site at Homebush Bay in Sydney) in the Rhodes Peninsula. He finds that the "stigma effect is not getting much attention" as expected. Neither the real estate agents nor home purchasers he came across expressed that they had concern about the stigma issue. Petersen's finding appears to testify the finding of Starr (1969) that people will accept risks 1,000 greater if they are voluntary (e.g. driving a car) than if they are involuntary (e.g. a nuclear disaster).

### **The Old Survey**

The old survey was carried out in April 1998. Due to resource constraints, only valuers in New South Wales, Queensland and Victoria were surveyed. These three states were the most populous states in Australia and about 70% of the valuers worked there. Opinion from valuers in these three states was believed to be sufficiently representative of all Australian valuers. Questionnaires were sent to 500 valuers in the three states. The address of valuers was supplied by the divisional office of the Australian Property Institute (API) in the three states. The NSW office supplied 1368 addresses, the Queensland office 28 and the Victoria office 19. Since the number of addresses from Queensland and Victoria was relatively small, they were all taken. The remaining 453 addresses were randomly selected from the New South Wales list. There was also a follow up interview of 40 participating valuers – 22 in New South Wales, 11 in Queensland and 7 in Victoria.

### **The New Survey**

In the new survey, the same questionnaire, except with some minor updates, was posted to valuers in New South Wales, Queensland and Victoria. Due to resource constraints, a total of only 300 valuers were surveyed this time; 100 valuers were randomly picked from each of the states. For Victoria, the divisional office of the API supplied an address list of 126 valuers, 100 valuers were randomly chosen from the list. The address of valuers in New South Wales was randomly picked from the Certified Practicing Valuers booklet published by the New South Wales divisional office. For Queensland, the address of valuers was randomly selected from the Queensland Valuers Registration Board web site. The resource constraints did not allow a follow up interview this time.

### **Analysis of Survey Results**

The questionnaire was mailed to the valuers and two reminders were sent to them. The response rates are shown in the table below:

Table 1 Response rate analysis

<b>Action</b>	<b>New South Wales</b>	<b>Queensland</b>	<b>Victoria</b>	<b>Total</b>
No. of questionnaire sent	100 (453)	100 (28)	100 (19)	300 (500)
No. replied	29 (90)	25 (11)	29 (7)	83 (107)
Response rate (%)	29 (20)	25 (37)	29 (39)	28 (21)
Valuers with experience in valuing contaminated land	5 (45)	3 (11)	7 (7)	15 (63)
No. of contaminated land valuation done by individual valuer	3 – 6 (1 – 100)	5 – 10 (1 – 50)	3 – 50 (2 – 30)	n/a

Note: figures in brackets are from the survey in 1998

The response rates for the new survey are higher than those in 1998. However, the number of valuers with experience in valuing contaminated land has dropped significantly. In addition, the number of contaminated land valuations done by an individual valuer is less than the previous survey. This could be due to the smaller scale of the current survey and the small number of responses from valuers.

In the previous survey, for the purpose of data analysis, valuers who had valued 6 or less contaminated property were regarded as being less-experienced and those who valued more than 6 were regarded as being more-experienced. This grouping method is also used to analyse the feedback for the new survey. It should be noted that the grouping is for the purpose of this contaminated land valuation study only; it does not mean that valuers in the less-experienced group are inexperienced valuers.

Valuation of contaminated land in Australia is governed by documents published by the valuation professional body. The first Contaminated Land Practice Standard was published by the Australian Institute of Valuers and Land Economists (now the Australian Property Institute) in 1994. The document was replaced by a Practice Guidance Note in the subsequent years. In 2006, the Australian Property Institute and the New Zealand Property Institute (PINZ) jointly published a guidance note – Consideration of Hazardous and Toxic Substance in Valuation, and ARPGN1 Land Contamination Issues. In 2008, the two institutes joined force again to revise the two documents in the latest issue of practice guidance document – Valuation and Property Standards. The following table shows the participating valuers' opinion on the documents.

Table 2 Opinion on Contaminated Land Guidance Note

<b>Questions</b>	<b>Less-experienced group (%) (Yes)</b>	<b>More-experienced group (%) (Yes)</b>
Are you aware of the valuation Guidance Note “Consideration of Hazardous and Toxic Substances in Valuation” or the previous documents?	89 (90)	100 (91)
Do you refer to the Guidance Notes when valuing contaminated land?	78 (68)	83 (72)
Do you follow the valuation approaches outlined in the documents?	67 (65)	67 (78)
Do you think the valuation approaches reflect real life practice?	56 (45)	83 (59)
Do you find the contents of this document helpful/practical?	78 (77)	83 (78)

Note: figures in brackets are from the survey in 1998

It can be seen that valuers in the less-experienced group were marginally less aware of the Guidance Note; but overall there was more reference to the documents than the previous survey. In contrast to the 1998 survey figures, more valuers in both groups said that the Guidance Note reflects real life practice. It could be inferred that the contents of the current Guidance Note are more helpful than the previous versions.

Contaminated land may be valued by the unimpaired or impaired approach. The unimpaired approach, otherwise known as the unaffected valuation approach, requires the valuer to assess the contaminated property as if it were clean. This assumption is explicitly made in the valuation report and the client is warned about the likely value impacts due to the land being contaminated. No doubt valuation done in this manner is not very helpful and the value assessed does not reflect the actual condition of the property.

In contrast, the impaired approach, otherwise known as the affected valuation approach, requires the valuer to take into consideration that the property is contaminated. The first step is for the valuer to value the property as if it were clean. The valuer then makes a deduction for the operational loss due to land contamination, cost of investigation and remediation, and any value reduction due to stigma impact.

These two approaches are documented in the Guidance Note. The survey results regarding the application of the approaches are summarised in the table below.

Table 3 Contaminated Land Valuation Approach Adopted

<b>Suggested valuation basis</b>	<b>Less-experienced Group (%)</b>	<b>More-experienced Group (%)</b>
Unimpaired approach	67 (55)	83 (81)
Impaired approach	89 (52)	33 (56)

Note: figures in brackets are from the survey in 1998

Unlike the old survey results, there were more valuers in both groups using the unimpaired approach. The reasons given by the valuers for using this approach include “depends upon our instructions”, “depends on information available”, “if costs unknown”, and “if client wants that”, etc. It should be noted that instructing a valuer to use this valuation approach does not mean the client is not concerned about environmental issues or the stigma impact on the property value, see survey results in Table 5 below.

As for the use of the impaired approach, the reasons given by the valuers in the new survey include “if sufficient comparable sales evidence was available”, “depending on information provided”, “depends upon our instructions”, “depends on information available”, “if costs are known”, and “depends on expert, if more [information is] know[n]”, etc.

The survey figures also show that more valuers in the less-experienced group than the more-experienced group used the impaired approach. The discrepancy can be explained by the smaller scale of the current survey, the small number of responses and that there were more valuers in the less-experienced in this survey (9 versus 6).

The table below shows the valuation methods used by the responding valuers for contaminated land valuation in practice.

Table 4 Valuation Methods Used in Practice

<b>Valuation Methods</b>	<b>Less-experienced Group (%)</b>	<b>More-experienced Group (%)</b>
Comparison method	78 (81)	100 (78)
Capitalisation method	11 (52)	67 (56)
Cost approach	44 (71)	33 (59)
Hypothetical development method	56 (42)	67 (52)
Accounts method	0 (16)	0 (6)
DCF method	22 (32)	50 (16)
Environmental balance sheet approach	11 (3)	17 (13)

Note: figures in brackets are from the survey in 1998

It should be noted that the valuation methods listed in the table are the same methods used to value clean properties. The difference is, in contaminated land valuation, the valuer needs to make further adjustment for remediation cost, other financial losses and stigma factor, etc. if the impaired valuation approach is adopted.

The survey results show that the comparison method remains the most popular method in both old and new surveys. In the old survey, the cost approach was the second most popular valuation method. The ranking changed in the new survey that

the hypothetical development ranked second. The capitalisation method used to be the third most popular method; it remained popular this time only among valuers in the more-experienced group. There was no change to the ranking of the DCF method. The environmental balance sheet approach was only sparingly used and no valuer in the new survey used the accounts method.

Stigma “arises from the effect of present or past contamination upon the market’s perception of the property and represents a discount, beyond the direct and indirect costs likely to be incurred, required to compensate for the risks associated with contaminated or previously contaminated property including the risk of achieving the planned remediation” (API & PINZ 2008). The following table shows the attitude of clients and valuers in stigma issues.

Table 5 Attitude of Clients and Valuers

<b>Questions</b>	<b>Less-experienced Group (%)</b>	<b>More-experienced Group (%)</b>
Clients concern for stigma impact (Yes)	78 (48)	83 (56)
Allowance for stigma impact in valuation	89 (58)	75 (72)

Note: figures in brackets are from the survey in 1998

In the new survey, more valuers in both groups said that their clients were concerned about stigma impacts on the land value. This is a big jump from the old survey results. It shows that clients today are more concerned about the impact of stigma on property value than 10 years ago.

It should be noted that the client’s concern for stigma impact does not mean that the client cannot instruct the valuer to use the unimpaired approach to value the property. In certain circumstances, such as for book value or existing use purposes, despite knowing that the property is contaminated, a client may only want to know the value for the property on clean land basis. It has been seen from the survey results in Table 3 that the unimpaired approach remains the popular approach for valuing contaminated land.

Where the client requires stigma impact to be explicitly considered or the client does not ask for a valuation by the unimpaired approach, the valuer has to allow for stigma impact in the valuation. Adjustment for stigma impacts can be done by different methods. The table below summarises the new survey results of stigma adjustment methods.

Table 6 Stigma Adjustment Approaches

Questions	Less-experienced Group (%)	More-experienced Group (%)
Arbitrary discount rate	33 (16)	33 (22)
Percentage adjustment	89 (29)	67 (28)
Lump sum adjustment	44 (3)	33 (6)
Other methods	0 (3)	0 (13)

Note: figures in brackets are from the survey in 1998

The table shows that in the current survey, the number of valuers in both groups using all three adjustment methods has increased. There was a big increase in the application of the percentage adjustment method. None of the values in either group used other methods. This is a sharp contrast to the old survey results that valuers used other methods such as zero adjustment, arbitrary adjustment, higher profit and risk factor, using comparable evidence, and lower loan-to-value ratio method (Chan, 2000).

#### Analysis of the Australian Valuation Methods

The advance in soil decontamination technology and the change of risk perception can influence the choice of valuation methods. As valuers are not environmental experts, it is inappropriate to ask them about the progress in soil decontamination technology. They were instead asked in the new survey if they worked with an environmental auditor/consultant for each contaminated land valuation. The responses are summarised in Table 7 below. As the changes in soil decontamination techniques and risk perception were not studied in the old survey, Table 7 only lists the responses from the new survey.

Table 7 Working with environmental experts

Valuers	Yes (%)
Less-experienced group	67
More-experienced group	67

The figures show that 67% of valuers from either group worked with environmental experts for each contaminated land valuation. Those who did not work with an environmental expert might have been instructed by the client to use the unimpaired approach or that working with an environmental expert was not necessary for the individual valuation task. Thus it can be inferred that the valuers were indirectly aware of the progress in soil decontaminated technology through the contact with environmental experts and they chose the appropriate valuation method accordingly.

The impact of risk perception on contaminated land value is reflected by the stigma adjustment process. Being an expert in the property market, valuers are aware of any change in risk perception. As shown in Table 5, 89% and 75% of valuers in either group had made allowance for stigma adjustment in contaminated land valuation. The figures are higher than those in the old survey. Although only the arbitrary discount

rate, percentage adjustment and lump sum methods were used for stigma adjustment (see Table 6), the valuers must have chosen the appropriate stigma adjustment method with regard to the prevailing risk perception in the property market.

Against the background of new developments in soil decontamination methods and the change of risk perception, the new survey results show that the comparison method is still the preferred valuation methods among Australian valuers. This method is the best valuation method if comparables are available. It was used in the study of contaminated land valuation by a number of researchers, such as Patchin (1994), Mundy (1992), Wilson (1994), Simm (1997), Fisher, Lentz and Tse (1992), and others. Nevertheless, the transaction of contaminated land is infrequent and it is difficult to get good comparables. The valuers must endeavour to adapt this method to make it fit for the task.

The current survey shows that the hypothetical development method is the second preferred method. This method is generally used for estimating the market value of land with development or redevelopment potential. The fact that it is ranked second supports the earlier statement that more rural land and industrial sites are being converted for higher value use.

Regarding the capitalisation method or income approach, valuers in the more-experienced group give it the same ranking as the hypothetical development method. There is an increase in the application of the capitalisation method by the more-experienced valuers. However, the use of this method by valuers in the less-experienced group has dropped significantly. The sharp contrast may be due to the smaller scale of this survey and the small number of survey responses received. The same reason also explains the difference in the old and new survey results regarding the cost approach, DCF method and the environmental balance sheet approach.

None of the valuers from either group in the new survey applies the accounts method. The accounts method is generally used to value special properties such as hotels, licensed premises, and nursing homes, etc. The fact that it was not used by the valuers might be due to that the valuers did not come across contaminated properties in this category. Alternatively, the anomaly could be explained by the same reasons that the current survey has a smaller scale and there is less response to the survey.

In this round of survey, no valuer used other methods to value contaminated land. It appears that the progress in soil decontamination technology and the change of risk perception did not persuade the valuers to use other valuation methods. Over the years, researchers have suggested different alternative methods for valuing contaminated land, such as survey method (Greenberg & Huges, 1993, Mclean & Mundy, 1998), multiple regression analysis (Dotzour, 1997, Reichert, 1997), option pricing approach (Lentz & Tse, 1995), mortgage-equity analysis approach (Chalmers & Jackson, 1996), Monte Carlo simulation method (Gain, 1990, Weber, 1997), expected utility model (Whiltshaw, 1996), conjoint analysis (Bond, 2001), multi-criteria decision-making approach (Chan, 2002) and others. The finding that the valuers did not use other valuation methods might be due to that they were not aware of the existence of these methods or they did not have the necessary skills to apply the methods. If this is the case, it is not a healthy sign. In a highly competitive business environment, the lack of knowledge in the latest development in valuation methodology may make valuers

look conservative or even backward. It does not help promote the image of the valuation profession.

### **Conclusion**

Since the previous survey, there have been new developments in the technology of soil decontamination and changes in people's risk perception over time. The new survey shows that there is an increase in the awareness of the contaminated land Guidance Note published by the API and PINZ. There is also an increase in the number of valuers who found the contents of the guidance note helpful and practical. Regarding the valuation approach, the unimpaired approach is still most popular. The new survey also finds that clients are now more concerned about the environmental issues of the land, and there are more valuers making allowance for stigma impacts on land value.

The analysis above shows that Australian valuers are aware of new developments in soil decontamination technology and the change of risk perception in the property market. The new survey finds that the new developments in soil decontamination technology and the change of risk perception have little impact on the choice of valuation methods. The valuers still prefer to use the comparison method to value contaminated land. The new survey also finds that, apart from the valuation methods listed in Table 4, Australian valuers do not use other valuation methods. One possible reason is that the valuers are not aware of the alternative methods. As pointed out above, if this is the case, this is not a good thing to the profession.

Valuers, like other professionals, need to brush up their knowledge. However, valuers are generally busy with their business; it is difficult to expect them to update their knowledge from reading professional journals. It will be more effective if the API can organise seminars to broaden the valuers' knowledge in the alternative methods. In addition, the API may update the next issue of the contaminated land Guidance Note by incorporating the alternative methods in the document.

Due to resource constraints, the scale of this survey is smaller than the previous one. In addition, the number of valuers responding to the survey is also smaller. The results from this survey are thus not conclusive. Nevertheless they do provide some indication of the clients' attitude, and the preferred valuation approach and method used by Australian valuers. The representativeness of the survey results can be improved if sufficient resources become available in the future to support a larger scale of survey and follow up interviews.

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