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How Australian Valuers Value Contaminated Land

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## **Abstract**

Contaminated land is a liability to the owners, occupiers, financiers and insurers. Apart from public health problems, threats to the ecosystem, and potential legal liabilities, it also causes depreciation in rental and capital value of the property. In recent years, with the availability of more information about land contamination, the short supply of development land in urban areas and the relatively low value of contaminated land, a niche market for redeveloping contaminated land is emerging in Australia. Valuers are frequently required to assess the value of contaminated land.

This paper aims at finding out how Australian valuers value contaminated land. A survey of Australian valuers was conducted in 1998. The paper analyses the survey results and compares the Australian approaches with those in other countries. It finds out that there are two main approaches used by Australian valuers. Their main problems are the lack of market data and a reliable method to assess stigma impacts. The paper concludes with recommendations further researches in the area of stigma assessment.

## **Introduction**

The potential public health risk, environmental impacts, negative image and legal liabilities have made contaminated land a liability rather than an asset. Whether for occupation or investment reasons, landowners, vendors, purchasers and financiers are eager to know the value of contaminated land. In recent years, the short supply of development land in urban areas together with the rapid economic development and population expansion have seen landowners and developers look at contaminated land positively, and a niche market for redeveloping contaminated land is taking shape. For example, in Sydney, eight of the former industrial sites in the Balmain Peninsula are scheduled for residential and commercial redevelopment. Well located old industrial sites in other areas are also being cleaned up for similar purposes. Valuers are frequently appointed to assess the value of contaminated land.

This paper aims at studying how Australian valuers value contaminated land. The term “property value” used in this paper has the same meaning as “market value” defined by The International Assets Valuation Standards Committee (TIAVSC), ie, “the estimated amount for which an asset should exchange on the date of valuation between a willing buyer and a willing seller in an arm’s length transaction after proper marketing wherein the parties had each acted knowledgeably, prudently and without compulsion”. The terms ‘contaminated land’ and ‘contaminated property’ are interchangeable. The paper will finish with a conclusion and relevant recommendations.

## **Contaminated Land Valuation Approaches**

It has been well accepted that valuation of contaminated property is more than simply deducting the typical clean up cost from the uncontaminated value. Consideration should also be given to factors such as marketability (Mundy, 1992, Wilson, 1994), stigma (Patchin, 1991, Mundy, 1992, Roddewig, 1996, Neustein & Bell, 1998), and possible

change of highest and best use (Wilson, 1996). Regarding the last factor, it refers to the likely change in zoning of the land. If the land is cleaned up to an approved standard, more sensitive and lucrative uses such as residential and commercial may be allowed on a former industrial site.

There are two basic approaches to value contaminated land. The first one is the unimpaired valuation approach (or unaffected approach). It requires the valuer to value the property as if it were clean. The valuer highlights this assumption in the valuation report and warns the client about the possible impacts of the contamination of the site. This approach is not particularly helpful to the client, as the valuation does not reflect the real conditions on site.

The next approach is known as the impaired valuation approach (or affected value approach). It requires the valuer to take into consideration the contaminated state of the property. Using this approach, the valuer firstly values the property as if it were clean. A deduction is then made for any production (income) loss due to the contamination, and loss due to any investigation and remediation cost and stigma factor. This approach can be represented by the following expression:

$$V_c = V_u - L - C_r - S \quad \text{Equation 1}$$

Where  $V_c$  = contaminated value  
 $V_u$  = uncontaminated value  
 $L$  = Loss due to reduced income/productivity and/or legal liabilities  
 $C_r$  = investigation and remediation costs  
 $S$  = stigma impacts

The above expression may be presented in different ways. Some researchers prefer to refine and expand items 'L' and 'C<sub>r</sub>' in the expression to a detailed list of different income losses or cost deductions due to contamination. On the whole, the various expressions are similar to the one presented here. It should be noted that the loss of income/productivity and legal liabilities may not necessarily arise in every case. Depending on the case, it may be a zero figure.

Regarding the remediation cost, Kinnard (1992) points out that it should not be the cost to cure (a complete clean up) because an absolute cure simply may not exist. Instead, it should be the cost to correct, ie, the cost to clean up to the site to the current standards to meet the requirements of the intended use. This idea coincides with the proposal of the Draft National Environment Protection Measure and Impact Statement – Assessment of Site Contamination prepared by the National Environment Protection Council in Australia. The document suggests the adoption of a site specific assessment to determine if unacceptable health risks exist and the nature and magnitude of environment risks, rather than being de facto clean up or response levels (NEPCM, 1998)

### **The Australian valuation approaches**

Australia is generally regarded as a clean country. Unfortunately, there also exists contaminated land in this beautiful country. To help members carry out contaminated land valuation, the Australian Institute of Valuers and Land Economists (now the Australian Property Institute) published a Contaminated Land Valuation Practice Standard in 1994 (AIVLE, 1994). The document was subsequently incorporated in Guidance Note 15 “Reporting on Contaminated Land” of the API Professional Practice 2000 (API, 1999). Apart from giving members background information about contaminated land issues, the document also introduces four basis, i.e., unaffected basis, affected basis, environmental balance sheet basis and comparative basis, for the valuation of contaminated land.

To find out how Australian valuers value contaminated properties in practice, a mail survey of valuers in New South Wales, Victoria, and Queensland was carried out in April 1998. These three States are selected as study areas because they are more populous and have more commercial and industrial activities than other States and Territories. It is logical to assume that they have more contaminated land. It is also logical to assume that valuers in these three States have more contact with contaminated properties and therefore more experience in carrying out the relevant valuation.

Questionnaires were sent to valuers in the three States using a mailing list provided by the divisional office of the Australian Property Institute in New South Wales, Victoria and Queensland. At present, the Institute does not keep a register of valuers specialised in contaminated land valuation. The Institute supplied 1368 addresses in New South Wales, but only 19 in Victoria and 28 in Queensland. The addresses in Victoria and Queensland are the address of the biggest valuation firms selected by the respective divisional offices of the Institute. To keep the survey to a manageable scale, questionnaires were sent to 500 valuers in these three States. Since the number of addresses in Victoria and Queensland was substantially smaller, they were all chosen. For those in New South Wales, 453 addresses were selected randomly. A follow up interview of 40 valuers (22 in NSW, 7 in Victoria and 11 in Queensland) was subsequently conducted. The survey results are summarised in the following tables.

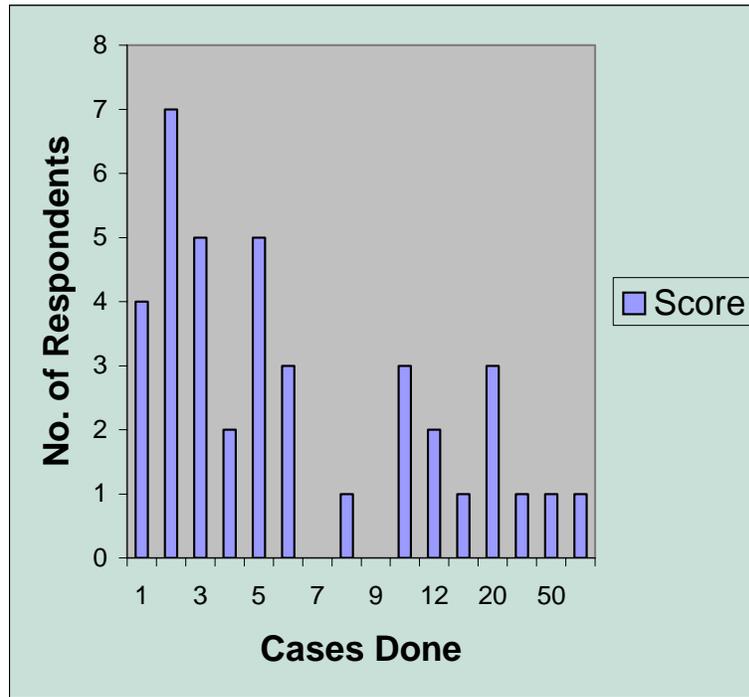
Table 1 Feedback of survey

Items	New South Wales	Victoria	Queensland	Total
Questionnaires sent	453	19	28	500
Questionnaires returned	90	7	11	105
Valuers with experience in contaminated land valuation	45	7	11	63
Number of contaminated land valuation done by individual valuers	1 to 100	2 to 30	1 to 50	N/A

The survey reveals that some of the respondents have valued up to 100 contaminated properties. It shows that experienced contaminated property valuers do exist in Australia although land contamination is not considered a common problem in the country.

Given the small sample size in Victoria and Queensland and the overall small number of returns, it is inappropriate to carry out a comparison of the States. Based on the return from respondents who have experience in contaminated land valuation, a distribution graph as shown in Figure 1 below is prepared. It is found that the respondents fall into two distinctive groups. Accordingly, the data are analysed on the basis of an 'experienced group' and a 'less experienced' group. Assuming respondents who have valued 6 or more contaminated properties as having sufficient experience, there are 31 less experienced respondents and 32 experienced respondents. The resulting sample sizes are big enough for meaningful analysis. The readers should note that the less experienced group refers to valuers who have less experience in the valuation of contaminated properties. It does not mean that they are less experience on the whole.

Figure 1 Number of Contaminated Properties Valued by Respondents



As mentioned above, the Australian Institute of Valuers and Land Economists published a Contaminated land Practice Standard in 1994 (now replaced by the API Professional Practice Guidance Note 15) to give members the necessary guidance in relation to contaminated land issues. Table 2 below shows the respondents' attitude towards this document.

Table 2 Opinion on Contaminated Land Practice Standard

Questions	Less experienced group (%)	Experienced group (%)
Awareness of the "Contaminated Land Practice Standard" (Yes)	90	91
Referring to the Practice Standard (Yes)	68	72
Follow suggested valuation approaches in Practice Standard (Yes)	65	78
Do the suggested valuation approaches reflect real life practice? (Yes)	45	59
Is the document helpful/useful? (Yes)	77	78

Table 2 shows that about 90% of both groups are aware of the document. It shows that the Institute has done a good job to introduce the document. However the number of respondents referring to the document or following the suggestions is not equally high. The reason is that a substantial number of respondents do not find the suggested valuation approaches reflect real life practice. The follow up interview revealed that the respondents like the document to provide more information on the valuation aspect and also information about the dangers involved in each of the problematic land uses and industries mentioned in the document.

As far as the application of valuation basis suggested by the document is concerned, the feedbacks from the respondents are summarised in Table 2a below:

Table 2 a Application of Suggested Valuation Basis

<b>Suggested basis</b>	<b>Less experienced group (%)</b>	<b>Experienced group (%)</b>
Unaffected Valuation Basis	55	81
Affected Valuation Basis	52	56
Environmental Balance Sheet	3	13
Comparative Approach	32	38

The table shows that there is a higher preference to use the unaffected valuation basis than the affected one. There are more respondents in the experienced group using the affected and unaffected valuation basis. Of the four suggested valuation approaches, the environmental balance sheet approach has the least support. Among the various reasons, a possible one could be that the respondents are not familiar with the balance sheet format of this method and are thus not confident to use it.

Table 3 below shows the valuation methods used by the respondents in practice. About 80% of both groups have used the comparison method in their valuation. It is interesting to note that this result contrasts sharply with the result in Table 2a, in which less than 40% of the respondents use this method. The reason may be that some respondents were not familiar with the contents of the Practice Standard and gave an uninformed answer to this question. The survey results show that the capitalisation method and the cost method are also popular methods used by the respondents.

The table shows that 40% - 50% of the respondents have used the hypothetical development method. Since the hypothetical development method is generally used to assess the development potential of land, it indicates that the highest and best use of the relevant contaminated land is not the existing use. This supports the earlier comment that there is a niche market to acquire contaminated land for redevelopment. In comparison, the use of the accounts

method and the DCF method is relatively low. The survey finds that the respondents do not use methods other than those contained in Table 3 to value contaminated land.

Table 3 Valuation methods used in practice

Questions	Less experienced group (%)	Experienced group (%)
Comparison Method	81	78
Capitalisation Method	52	56
Cost Method	71	59
Hypothetical Development Method	42	52
Accounts Method	16	6
DCF Method	32	16
Applicability of the above methods? (Yes)	77	72
Can/shall the methods be improved? (Yes)	26	44

Regarding the applicability of the existing methods to value contaminated land, over 70% of the respondents consider that the methods are suitable for the purpose. As far as room for improvement is concerned, less than 50% of the respondents think that the methods can/shall be improved. It shows that the respondents are content with the current methods used.

As far as the stigma factor is concerned, 48% of the less experienced respondents state that their clients have concern for this value impact, with 56% of the experienced respondents share the same view. It appears that the stigma issue has already caused a significant concern, if not an alarm, among clients in the three States. At the same time, a significant number of respondents, 58% and 72% respectively, have made allowance for the stigma factor in their valuations. This shows that valuers realise the seriousness of the issues and have taken appropriate action to carry out valuations. Table 4 below shows the relevant survey results.

Table 4 Stigma factor

Questions	Less experienced group (%)	Experienced group (%)
Clients concern for stigma impact (Yes)	48	56
Allowance for stigma factor in valuation (Yes)	58	72

For those respondents who claim to have made allowance for stigma impacts, various approaches have been applied, see Table 5 below. Despite that a number of respondents have chosen not to express their views, the figures show that the majority of respondents use the arbitrary discount rate and percentage adjustment methods to allow for stigma impacts. The lump sum adjustment method has the least support.

Table 5 Stigma adjustment approaches:

Questions	Less experienced group (%)	Experienced group (%)	Total respondents with experience (%)
Arbitrary discount rate	16	22	19
Percentage adjustment	29	28	29
Lump sum adjustment	3	6	5
Other methods	3	13	8
Need to have a dedicated method to value contaminated land (Yes)	10	13	11
Willingness to try new method to value contaminated land (Yes)	35	69	52

Regarding other methods, the respondents claim to have used methods such as zero adjustment, arbitrary adjustment, higher profit and risk factor, using comparable evidence, and lower loan to value ratio. The survey result shows that the respondents do not have an agreed approach to make adjustment for stigma impacts.

It is interesting to note that despite the lack of direction in making allowance for stigma, only a small fraction of the respondents consider that there needs to be a dedicated valuation method. The experienced group is more open, about 70% of them are willing to try the new method if one is available.

#### Valuation methods used in other countries

### **a) Conventional methods**

At present, overseas valuers are mainly using conventional methods to value contaminated properties. Property researchers also support the use of these methods, for example, the direct comparison method (Patchin, 1994), capitalisation method (Patchin, 1988, Mundy, 1992, Neustein, 1992, Dixon, 1996), cost approach (Wilson, 1994), hypothetical development method/residual method (Simm, 1992, and Liang, 1992, both cited in Syms, 1997) and discounted cash flow method (Fisher, Lentz and Tse, 1992, Gronow, 1998, Gronow, 1999).

### **b) Alternative methods**

As the conventional valuation methods rely heavily on market evidence, the use of these methods is not without problems. Firstly, there is a lack of transaction data on contaminated properties. It is thus difficult to rely on market evidence to estimate prices, rents and yields of contaminated properties (Kinnard, 1992, Syms, 1997). Secondly, as pointed out by Wilson (1992), “each environmental problem is as unique as a fingerprint”. It is difficult to get true comparables to apply the direct comparison method.

Finally, although the conventional methods may be adapted or modified for the purpose, it is very often that they do not have explicit allowance for value loss due to the stigma factor. For example, in the capitalisation approach, stigma is allowed for by using an upward adjustment of capitalisation rate. Syms (1997) considers that this arbitrary adjustment may lead to a misleading result. Accordingly property practitioners and researchers around the world are continuing to research for suitable methods to value contaminated properties. At present, there is more work done in this area in the USA and UK. The following sections highlight the alternative methods introduced in recent years in the USA and UK.

## **USA**

- **The Environmental Balance Sheet Method**

Wilson (1992) suggests that the valuation of a contaminated property should be carried out by way of teamwork. The team should consist of the valuer and other professionals such as accountants, engineers (civil, mechanical, electrical and geotechnical), finance consultants, hydrogeologists, industrial hygienists, management decision science specialists, public relations specialists, environmental law specialists and specialised investigative specialists. Regarding the valuation method, he suggests the use of an environmental balance sheet approach to value the contaminated property.

In essence, it requires the valuer to estimate the unaffected value of the property. The other professionals in the team have to provide figures that constitute the total environmental liabilities. The contaminated property value is estimated as the total owner’s impaired position and the environmental liabilities. A sample of the balance sheet is reproduced in Annex I. This method is basically the method already used by valuers in the affected valuation approach. Through the environmental balance sheet format it provides valuers with a framework to carry out the valuation. This approach has been incorporated into Guidance Notes 15 of the API Professional Practice 2000.

- Survey Method

The use of survey methods to assess environmental impacts has attracted a number of property researchers to apply the methods for contaminated property valuation. For example, Greenberg & Hughes (1993) use the survey method to obtain the opinion of 567 tax assessors in New Jersey to testify if hazardous waste sites have lowered the appreciation of property values, deterred land uses and affected community plans. They find that the survey approach is a quick and relatively inexpensive way to obtain the relevant data in the study. However it cannot replace detailed valuation of individual property. They consider that the survey results can be used to determine which communities may require further in-depth analysis. It should be noted that the first finding here is not universal because, depending on the size and design, a survey can be very costly.

Property researchers are also interested in studying the applicability of survey methods to contaminated property valuation and a substantial amount of research work has been done. A more recent one was carried out by McLean and Mundy (1998). They study the applicability of the contingent valuation method, the conjoint analysis and the perceived diminution approach. They find that the contingent valuation method is the most defensible one. This method has “the added benefit of providing behavioral insight to the market approach”. Nevertheless, they recommend using this method as a supplement only.

- Multiple regression analysis

The multiple regression analysis method is the hedonic pricing approach used by economists for environmental impacts assessment. It has been used by economists for a long time. Property researchers are interested to find out if this method can also be used to value contaminated properties. In general, they use two common hedonic housing models, the linear and log-linear models, to analyse the impact of contamination on property prices. The former model “implies constant partial effects between housing characteristics and selling price”, while the latter “allows for non-linear price effects” (Reichert, 1997). For example, Dotzour (1997) has use a multiple linear regression model to find the impact of ground water contamination on residential property values, and Reichert (1997) has used an exponential log-linear functional regression model to assess the impact of a toxic waste Superfund [priority] site on property values. Using the models, they have successfully identified the negative impacts of contamination on property values.

- Option Pricing Approach

There have been a number of researches for extending the financial option pricing model to value real property (Capozza & Sick, 1991, Williams, 1991, Quigg, 1991). Lentz & Tse (1995) have extended the idea and applied the method to value contaminated income producing properties. The model assumes a property owner has two options for improving the value of the property. The first option is to clean up the property at the optimal time and the second option is to redevelop the property to a higher and better use at the optimal time. Since the second option

cannot be undertaken without remediation, the first option is a compound option that not only relates to the clean up the property but also releases the opportunity to undertake the second option.

The model uses complicated mathematics - differential calculus - to analyse the property's cash flow in the unimpaired and impaired scenarios. It also requires the development of criteria to determine the value maximising strategy. Using the proposed model, Lentz & Tse manage to determine the value-maximising strategy of the contaminated property, ie, whether the redevelopment of the contaminated property is to be accelerated or postponed.

- Mortgage – Equity Analysis Approach

Leon Ellwood introduced in 1959 the mortgage – equity analysis technique to value income producing properties. He reckoned that the capitalisation rate of an income producing property should comprise a rate of return to the mortgagee and the investor respectively. The capitalisation rate is thus an overall rate used to capitalise the net income from the property. Chalmers & Jackson (1996) extend the idea to value contaminated properties.

They see value deduction as a function of the increased risk associated with contamination. Using the mortgage – equity analysis model, they estimate an overall capitalisation rate, which reflects the value reduction due to contamination. For this, it requires adjusting equity and lender requirements such as the equity interest rate, loan-to-value ratio, mortgage interest rate, expected value change over the holding period, expected income change over the holding period and percentage of load paid off during the hold period, etc. The overall capitalisation rate obtained is then used to assess the market value of the contaminated property using the conventional capitalisation method.

#### Monte Carlo-based Method

Ever since William Kinnard introduced in 1966 the idea of using statistical methods and computer in property valuation (Burton, 1982), there have been a lot of studies in the use of statistical methods and computer for property valuation. Researchers, such as Phyr (1973), Mollart (1988) Gain (1990), Byrne (1996) and others, advocate using simulation methods in property valuation. Unlike deterministic approaches such as the multiple regression analysis method, the Monte Carlo simulation method is a probabilistic approach which allows for random variations about a pattern or set of overriding influences. A computer is used to carry out a large number of repeated calculations based on the random occurrence of an event, and the most likely scenario is finally estimated.

Weber (1997) extends the application of the Monte Carlo simulation method to value contaminated land. By incorporating the Monte Carlo simulation method into a discounted cash flow model, he manages to assess the most likely value of a contaminated property after remediation. He claims that the model can also be used to quantify stigma.

## UK

- Expected Utility Model

In view of the general lack of data contaminated property, Wiltshaw (1996) suggests the use of an expected utility model based on the micro-economic theory of risk and uncertainty to value contaminated properties. Using the model, he demonstrates that the owner of a contaminated property can make decision as to whether the contaminated property should be sold as it is or after remediation. If remediation is to be carried out, what is the maximum amount that can be spent to shift liability from the vendor, and under what circumstances will liability be shifted or retained. Based on the model, he concludes that the decision whether to clean up the property prior to sale depends on whether the expected impaired land value is greater than the expected remediated land value. Obviously this finding causes no surprise.

- Risk Assessment Model

Regarding the value loss due to stigma, Patchin (1994) suggests using the direct comparison method to assess the unimpaired and impaired values of the property. The indicated stigma is estimated by subtracting the impaired value from the unimpaired value. He also suggests estimating the indicated stigma by subtracting the actual selling price from the unimpaired value. A similar yet more elaborate approach is also put forward by Syms (1996). Apart from having reference to the nature and extent of contamination of comparable properties, it also takes into consideration the present value of remediation costs. This approach again has been borrowed and put into the Professional Practice 2000 by the API. A sample of this method is reproduced at Annex II.

These approaches, however, have problems. Firstly, as mentioned above, it is difficult to get the unimpaired value by direct comparison because of the uniqueness of individual contaminated property. Secondly, it can be seen from Equation 1 that the difference between the unimpaired and impaired values is more than just the value loss due to stigma. Even if the expected repair cost (remediation cost) is added to the sale price (the impaired value), Sanders (1996) points out that it will not necessarily “give a good read on residual stigma”.

Syms (1997) has also introduced an improved approach known as the risk assessment model. The model applies the “professional perceptions which influence the judgements the valuer will have to make in order to arrive at his or her opinion of value”. The model consists of 5 sets of data based on 26 industrial activities that have a stigma value reduction range of 21% - 69%. It includes a survey of valuers and developers of contaminated properties on the perceived impact on value before redevelopment, the perceived post-remediation impact on value and perceived impact on value after remediation/redevelopment. A sample of the model is reproduced at Annex III.

The first set of data (21% - 29%) sets a baseline for stigma impact on property value. The second set of data is based on 26 selected industrial activities and ranked according to the perceived stigma effect. These two sets of data provide a framework for assessing the subject contaminated land. The rest three data sets are based on risk related data for the present and expected condition of the subject contaminated land. To apply the model, a valuer

needs to obtain 'value adjusters' from data set two to five. A mean value is calculated using the "value adjuster" figures.. The mean value obtained is the stigma factor required for the valuation.

### **Analysis of the Australian valuation approaches**

At present Australian valuers, like their overseas counterparts, are mainly using conventional valuation methods to value contaminated land. The more innovative alternative methods are rarely used. Among the conventional valuation methods, the comparison method, capitalisation method, cost method and hypothetical development method are more popular. The accounts method and discounted cash flow method are not frequently used. It may be due to the fact that the accounts method is normally used to value specialised properties such as hotels, nursing homes, pubs, etc. In general, contamination of these properties is not common. Accordingly this method is rarely used. As far as the discounted cash flow method is concerned, it is generally used to meet institutional clients' requirement. If not specifically required, valuers would rather use the more familiar traditional valuation methods such as the comparison method and direct capitalisation method for the job.

Australian valuers have a higher preference to using the unaffected valuation basis for valuing contaminated land. The reasons may be that the clients have given instructions to do so or that they do not insist the valuation to be done on an affected basis. The clients may ask for an unaffected basis valuation for specific purposes such as accounting or share floating. Where there is no clear instruction from the clients, valuers tend to perform an unaffected basis valuation for expedience.

There is also another possible reason for their reluctance to use the affected basis. As mentioned above, the assessment of various income and financial losses due to contamination and clean up costs is fairly straightforward. The former losses are based on facts given to them by the client and the latter figures are provided by environmental consultants. It is the assessment of value loss due to stigma impacts that has problems. Spencer (1993) points out that "[s]tigma is very difficult to measure when there is a comparative lack of satisfactory evidence related to stigma-affected properties in Australia". The lack of a reliable method to estimate stigma impacts may be one of the causes that Australian valuers are a bit reluctant to use this approach.

### **Conclusion**

In recent years, a niche market for redeveloping contaminated land is emerging in Australia and other countries. Valuers are getting more instructions to value contaminated properties. This study finds that valuers in Australia and overseas are mainly using conventional valuation methods to value contaminated land. These methods are fine for valuing the unimpaired value of contaminated properties. However, because of the lack of transaction data and the uniqueness of individual property, they are not suitable to value the impaired value of the properties. A number of alternative methods have been introduced by property researchers. The Australian Property Institute is aware of the development overseas and has incorporated the environmental balance sheet approach and Sym's stigma assessment approach in the Professional Practice 2000.

Regarding the valuation approaches, the survey shows that there are more Australian valuers using the unaffected approach than the affected approach. One possible reason why Australian valuers incline to use the unaffected approach is the difficulty of assessing stigma impacts.

At present, the stigma assessment methods used by Australian valuers are unsatisfactory and not defensible. The methods suggested by overseas property researchers are also far from satisfactory. Patchin's method suffers from its over simplicity. Syms's risk assessment model is an improvement, but it is not easy to use. There is no doubt a need to assess value loss due to stigma impacts. To achieve the goal, more resources such as research grants should be directed to relevant researches. On the other hand, practitioners and property researchers should carry out more research in this regard.

This paper has provided some insight into how Australian valuers value contaminated properties. However, the findings suffer from the small and unstructured sample sizes. The availability of larger random sample sizes will no doubt enhance the credibility of the findings. Nevertheless the paper should have inspired further research in this area.

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## EXHIBIT 1

<b>IMPAIRED VALUE OPINION BALANCE SHEET</b>			
UNIMPAIRED VALUE OPINION			\$
<b>ENVIRONMENTAL LIABILITIES:</b>			
Cost to Determine Suspect Impairments		\$	
Cost to Identify Magnitude of Impairments and Course of Action		\$	
Present Value of Action Plan Components:			
Operations and Maintenance Programs	\$		
Planned Response Actions	\$		
Notification, Training, and Recordkeeping	\$		
Emergency Response Actions	\$		
SUBTOTAL—Present Value of Action Plan		\$	
Estimated Additional CERCLA/SARA Liabilities		\$	
Estimated Negative Intangible (Stigma) Impact		\$	
<b>TOTAL ENVIRONMENTAL LIABILITIES</b>			<b>\$</b>
<b>OWNER'S IMPAIRED POSITION:</b>			
Impaired Property Value Opinion*		\$	
Owner's Equity**		\$	
<b>TOTAL OWNER'S IMPAIRED POSITION</b>			<b>\$</b>
<b>TOTAL OWNER'S IMPAIRED POSITION AND ENVIRONMENTAL LIABILITIES</b>			<b>\$</b>

\* The *GREATER* of: zero or unimpaired value *less* environmental liabilities.

\*\* The *LESSER* of: zero or unimpaired value *less* environmental liabilities.

Source: Wilson, 1992

**Box 9.6** A method of assessing stigma.

<b>Unimpaired value of land</b>		£1 500 000
(a medium hazard risk property as used in the example in Box 9.5)		
<b>Present value of remediation costs</b> (from Box 9.5)		<u>£ 108 290</u>
<b>Impaired value 1 – not allowing for stigma</b>		<u>£1 391 710</u>
<b>Comparable case studies</b>		
Case Study Number	Indicated percentage of impaired value 1 lost to Stigma	Comparison to the property to be Valued
1	25.9%	Treatment completed, stigma caused by fear of additional contamination, less severe than subject property.
2	29.2%	No treatment proposed at present, continued industrial use, similar risk level to subject property.
3	20.9%	Site not contaminated but is situated adjacent to a contaminated site.
4	32.7%	Similar type of contamination to subject property but slightly more severe.
5	45.4%	Heavily contaminated site, derelict land, more severe than the subject property.
Range of stigma effects indicated by comparables 20.9% to 45.4%		
Comparables closest to subject property; numbers 2 and 4, 29.2% to 32.7%		
Therefore percentage stigma applicable to the subject property is 31%		
<b>Amount of stigma @ 31% of impaired value 1</b>		<u>£ 431 430</u>
<b>Impaired value 2</b>		<u>£ 960 280</u>
(taking account of treatment and associated costs and stigma)		
<b>Add value of buildings</b> from Box 9.5		<u>£1 000 000</u>
<b>Total value of asset</b>		say <u>£1 960 000</u>
Percentage reduction in value attributable to contamination		21.60%

Source: Developed from Patchin (1994) and Syms (1995)

Source: Syms, 1977, p 190

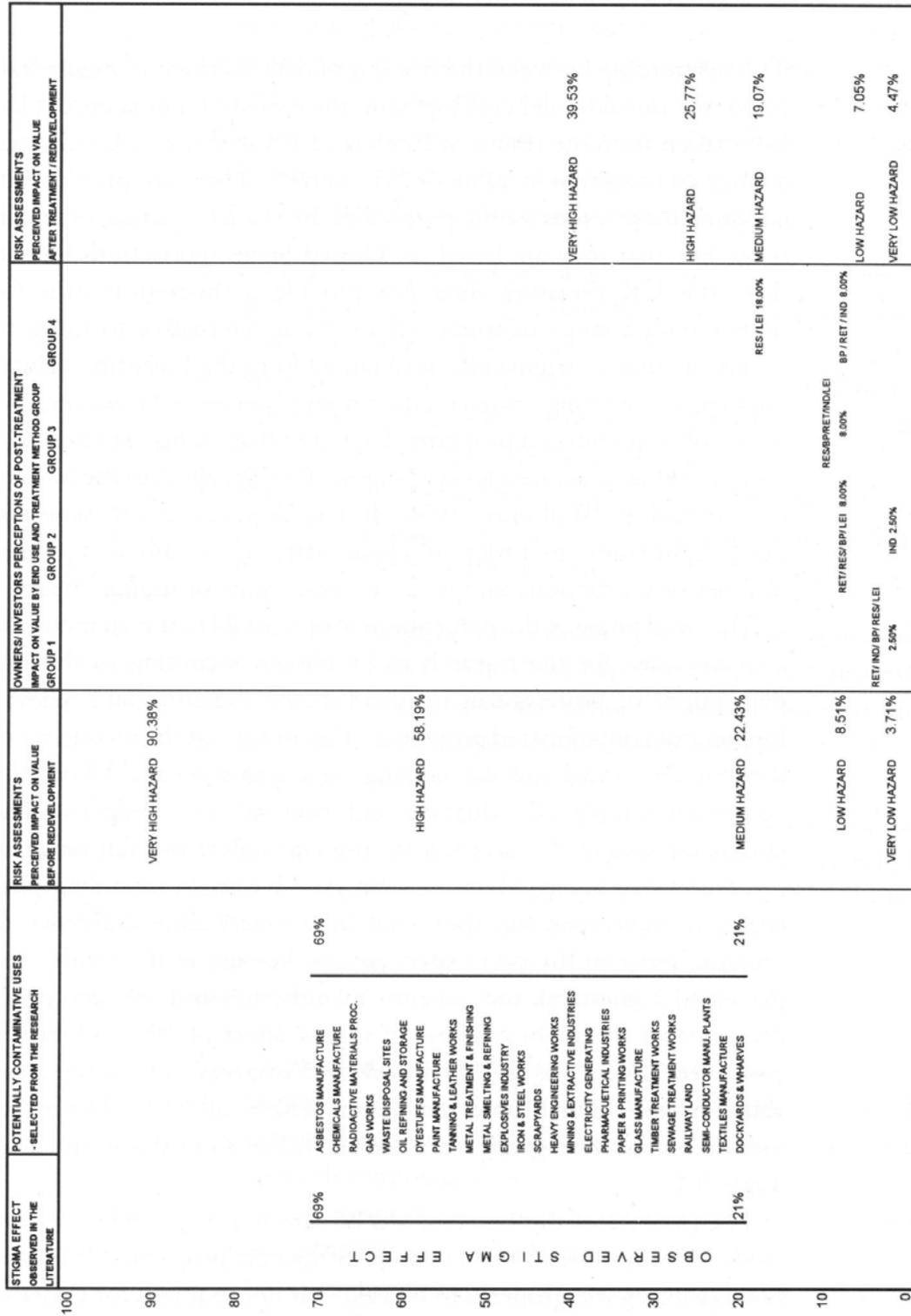


Fig. 9.4 The risk assessment model for the assessment of stigma. RET = retail park; RES = residential estate; BP = business park; IND = industrial estate; LEI = leisure use.

Source: Syms, 1977, p 200