

Investigating health concerns in populations living near the Cleanaway landfill in Tullamarine

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Environmental Health Unit
Public Health Branch
Department of Human Services

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Contents

Introduction	1
Background	2
Overview of Investigation	3
Which health conditions were investigated?	5
Cancer levels in the Victorian community	6
Investigation of Cancers	7
Results (1994–2003)	8
Investigation of Birth defects and birth-related outcomes	9
Results (1983–2003)	10
Discussion	13
Conclusion	14
Acknowledgements	15
References	16

Introduction

The Public Health Branch is located within the Victorian Department of Human Services, the state government health agency.

Public Health is a multidisciplinary field of expertise that looks at factors for maintaining and improving the health and wellbeing of Victorian populations¹. In this regard, the work of the Public Health Branch complements the work of the primary healthcare sector, which focuses specifically on the health of the individual.

In February 2006, the Hume City Council and a local community group approached the Public Health Branch for information and advice on available sources of health data for people living near an industrial landfill site in Western Avenue, Tullamarine, and how health concerns could be investigated. This request was referred to the Environmental Health Unit, which specifically looks at environmental factors that influence population health.

The Environmental Health Unit coordinated the following investigation with input, expertise and assistance from the Victorian Perinatal Data Collection Unit (within the Public Health Branch), Consultative Council on Obstetric and Paediatric Mortality and Morbidity and The Cancer Council Victoria.

Background

Brambles Australia Limited (trading as Cleanaway) operates the prescribed industrial waste landfill site in Tullamarine. Site operations are managed in line with license arrangements set by the Victorian Environment Protection Authority (or EPA Victoria), the statutory authority that administers the *Environment Protection Act 1970* and associated state environment protection policies.

Under these licensing arrangements, the company is required to manage leachate^a and stormwater; carry out rehabilitation and capping works across the site; manage daily operations (eg. odour, litter and dust control) and monitor groundwater, surface water and air to ensure that discharges do not impact on the environment or human health.

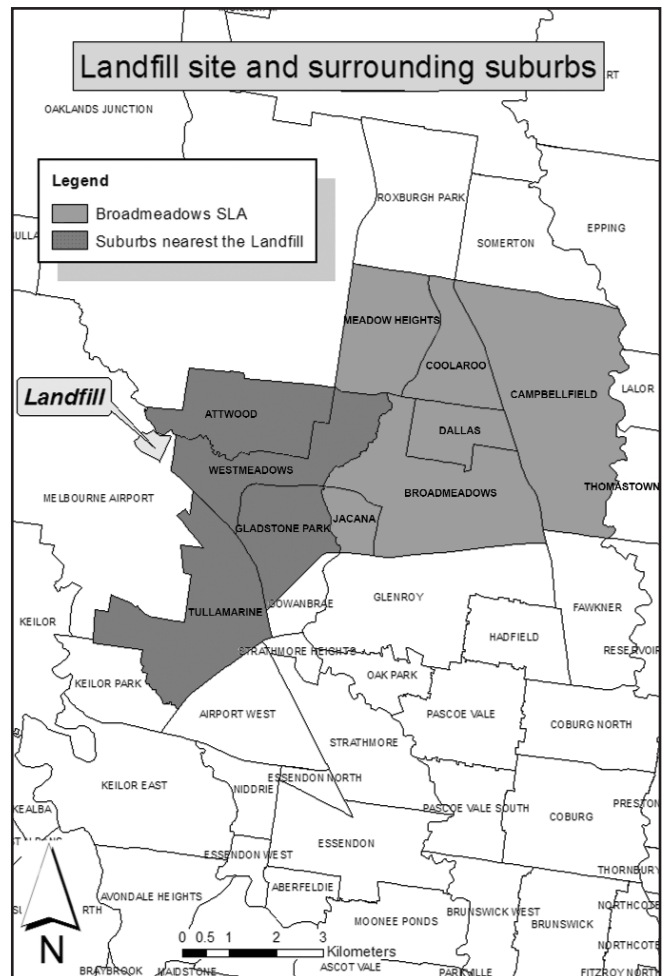
The landfill site:

- is located in a former stone quarry in Western Avenue, Tullamarine within the City of Hume municipality.
- is bounded by the Melbourne Airport (directly to the west); Moonee Ponds Creek and parkland (to the north); residential properties (600 to 700 metres to the east) and the Tullamarine freeway (to the south).
- is surrounded by the suburbs of Attwood, Tullamarine, Gladstone Park and Westmeadows within a 3km radius (*Map 1* or refer to *Melways Page 5 E6*), and
- received liquid and solid prescribed industrial waste from 1973 to 1988 and continues to receive solid wastes at present.

In late 2005, the company submitted applications to EPA Victoria, outlining future proposed works at the site. As part of this Authority’s assessment process, a meeting was held in February 2006 to hear submissions from a range of interested parties, including members of the local community and Hume City Council.

At this meeting a range of issues were discussed, including the potential for the landfill to directly impact on community health. Articles in the local newspapers reported anecdotal claims of higher levels of several health problems in people living near the landfill. These included cancer, miscarriages, multiple sclerosis, asthma and skin disorders.

Map 1—Location of Cleanaway Landfill and Surrounding Suburbs



a (ie. aqueous and non-aqueous leachate).

Overview of Investigation

Each year, the Department of Human Services and The Cancer Council Victoria receive public enquiries about certain health conditions in specific community locations. For example, people living in a particular street or neighbourhood may notice that a number of residents have a particular health condition and question whether a particular activity or source of environmental emissions in the local area could be responsible for this health effect.

A common approach used in responding to this type of question is a type of health study or epidemiological investigation sometimes referred to as a “cluster investigation”.

This analysis is:

- descriptive in nature as it examines health trends by factors such as age, sex, health condition, time and location; and
- a useful approach for understanding whether the reported occurrence of a specific health condition is in fact higher than the expected number in a given geographic location and time period.

If a health condition is found to be higher (and statistically significant), and potential risk factors for that condition suggest a plausible link to a potential environmental health hazard, this can inform whether a more detailed population health study is warranted.

More information about the use of epidemiology in assessing health hazards is contained in *Text Box 1* and in the *enHealth Council publication, Environmental Health Risk Assessment—Guidelines for Assessing Human Health Risks from Environmental Hazards (2002)*².

The following steps were undertaken as part of this investigation:

1. From the range of health concerns raised by members of the local community, the Environmental Health Unit identified high quality, comprehensive and available sources of health data that could be analysed.
2. These data sources were verified against data sources commonly considered in published environmental epidemiological investigations.
3. The selected data sources were analysed for populations living near the landfill compared to populations living in similar areas away from the landfill.
4. If differences were identified (either higher or lower), a statistical analysis was carried out to determine whether the difference was statistically significant.
5. For differences that were higher and also statistically significant, potential risk factors for each health outcome were discussed.
6. A recommendation was made as to whether a more detailed population health study is warranted.

Text Box 1

Epidemiology: Investigating perceived clusters of illness or disease in a population

The field of epidemiology studies the occurrence, spread and control of disease conditions in populations, rather than in individuals. The term literally means ‘the study of epidemics’.

In this study, ecological epidemiological methods were used in evaluating the rate and types of birth-related outcomes and cancers in the geographical area around the Cleanaway landfill, in Western Avenue, Tullamarine.

An ecological epidemiology study:

- is commonly applied in investigating perceived clusters of disease in a group of people
- is descriptive in nature
- is relatively inexpensive
- is a way of linking available health data sets and environmental information
- is useful in generating a hypothesis (for further, more detailed investigation), or in identifying potential hazards; but
- cannot be used to determine ‘cause and effect’.

A cause is ‘an event, condition, characteristic or a combination of these factors which plays an important role in producing the disease’.

Causation of adverse health effects is affected by four main factors:

1. Predisposing factors such as immune deficiencies, gender and previous illness;
2. Enabling factors such as poor nutrition may favour the development of disease;
3. Precipitating factors such as exposure to a specific disease agent; and
4. Reinforcing factors such as repeated exposure, which may aggravate an established disease or health condition.

Therefore, cluster investigations can only evaluate whether the reported occurrence of a specific disease or condition is higher than the expected number for a given geographic location and time period. They are conducted to confirm case reports, determine whether an unusual pattern of a specific disease exists or to explore potential risk factors.

For a more detailed explanation of the use of epidemiology in assessing health hazards, refer to the enHealth Council publication, *Environmental Health Risk Assessment—Guidelines for assessing human health risks from environmental hazards (2002)*².

Which health conditions were investigated?

Literature relating to the health of communities living around landfill sites often looks at population-based data for birth-related outcomes and cancers³⁻⁵. In Victoria, high quality data have been collected for these conditions since the early 1980s.

Victorian Cancer Registry

The Cancer Epidemiology Centre of The Cancer Council Victoria, administers the Victorian Cancer Registry, which has collected population-based cancer data since 1982⁶. The Victorian Cancer Registry records a person's address at the time of their cancer diagnosis.

For many environmental exposures there is usually a long lag time between exposure and development of a cancer, therefore where a person lives at the time of diagnosis may not be the same place they lived at the time of possible exposure. This issue of population mobility is recognised as a limitation in epidemiological investigations using cancer data. This effect is less pronounced when looking at birth defects and birth related issues, as the time frame is much shorter.

Victorian Birth & Birth Defects Registry

Under the auspices of the Consultative Council on Obstetric and Paediatric Mortality and Morbidity, the Victorian Perinatal Data Collection Unit of the Department of Human Services has collated information on all Victorian births since 1982. The Unit also maintains the Birth Defects Registry, which has collected data since 1983, and investigates reports of community concerns related to perceived clusters of birth defects.

The Environmental Health Unit coordinated a review of data on cancers, birth defects and other birth-related outcomes to see whether the rates of these conditions are higher in populations living near the landfill compared to control populations.

Other conditions reported in the local newspapers (eg. miscarriages, multiple sclerosis, asthma and skin disorders) have not been investigated because the existing data are less comprehensive or not collected over a long time period.

Cancer levels in the Victorian community

Over 30 percent of cancers are considered to be related to dietary factors, 30 percent to smoking, 8 percent to sexual or reproductive factors, 4 percent to occupational exposures, 3 percent to alcohol and less than 1 percent to all other single agents such as radiation. The principle risk factor for a person developing a cancer is their age, and cancer is more common in men than women⁶.

Text Box 2

2003 Cancer Data⁶

Cancer incidence is defined as the occurrence of new cancers in a defined population in a specified time period.

Nearly 22,500 Victorians develop cancer other than non-melanocytic skin cancer each year and nearly 10,000 deaths are caused by it.

In 2003, 12,286 men and 10,212 women presented with new cancers and 5,351 men and 4,340 women died from cancer in 2002.

Cancer was very age-dependent with less than 1 percent of tumours occurring before age 15 and 59 percent in persons over 65 years. More men than women developed cancer: 120 for every 100 females. The male excess was largely due to tobacco-related cancers.

The standardised incidence rates were 332.4 per 100,000 males and 254.1 per 100,000 females. The cumulative rates to age 75 were 39 percent for males and 28 percent for females. These represented risks of over 1 in 3 for men and almost 1 in 4 for women.

At least one in three Victorians will develop a cancer other than nonmelanocytic skin cancer by age 75.

Investigation of Cancers

Staff at The Cancer Council Victoria's Cancer Epidemiology Centre compared the levels and types of cancers in the population living near the landfill against the rest of metropolitan Melbourne. Ten years' worth of data (1994–2003) were analysed to provide large enough numbers to produce meaningful comparisons. Differences between the two subject populations were considered significant when the p-value^c was < 0.05.

The City of Hume local government area was created in 1994 when the Broadmeadows City Council amalgamated with most of Bulla Shire and parts of Keilor and Whittlesea cities⁷. Under this alignment, the City of Hume municipality was divided into three statistical local areas (or SLAs)—Broadmeadows, Craigieburn and Sunbury.

The Broadmeadows SLA (*Map 1*) is roughly equivalent to the old City of Broadmeadows boundaries. Although this is a relatively large area, it includes the four residential suburbs located within 3kms of the Tullamarine landfill site (ie. Westmeadows, Gladstone Park, Attwood and Tullamarine).

^c Probability value—a number that reflects the likelihood that statistical results have occurred by chance. Results with p values equal to or less than .05, .01 or .001 are labelled as statistically significant. Also known as the level of significance.

Results (1994–2003)

The cancer rates [*annual age-standardised incidence rate per 100,000 people*] for all cancers in the Broadmeadows statistical local area were compared to rates in people living in other metropolitan suburbs of Melbourne over a ten-year (1994–2003) period (*Table 1*).

When the figures were adjusted for the size and age of each population of interest, the yearly rate for new cancers between 1994 and 2003 was 321 per 100,000 in males and 246 per 100,000 in females. The overall age-standardised incidence rate for this area was 281 cases per 100,000 people. These values were consistently lower than the yearly rates for the rest of metropolitan Melbourne (although not statistically different).

The leading sites of new cancers in the Broadmeadows SLA were the breast, lung, bowel, prostate, melanoma and lymphoma, representing almost two thirds (ie. 57%) of all cancers diagnosed in this area. In comparison, the leading sites of new cancers in the rest of metropolitan Melbourne were the same as the Broadmeadows SLA (ie. the breast, lung, bowel, prostate, melanoma and lymphoma). These represented over two thirds (64%) of all cancers diagnosed.

The Cancer Council Victoria concluded that:

- cancer rates in the Broadmeadow SLA were slightly lower than the reference population (the rest of Metropolitan Melbourne) however this difference was not statistically significant.
- there is nothing in these figures to suggest any excess of cancers in the Broadmeadows region over a decade.

Overall, there were no significant differences between the cancer rates in the population living near the landfill compared to the rest of Metropolitan Melbourne.

Table 1—Age-standardised cancer rates from 1994 to 2003 for the Broadmeadows Statistical Local Area compared to the rest of metropolitan Melbourne

Cancer rates (age standardised) 1994–2003

Populations living near the landfill compared to the rest of metropolitan Melbourne

	Broadmeadows SLA*	Metropolitan Melbourne**
Male	321 new cancers diagnosed per 100,000 males	335 new cancers diagnosed per 100,000 males
Female	246 new cancers diagnosed per 100,000 females	264 new cancers diagnosed per 100,000 females
Both	281 cases per 100,000 people	294 cases per 100,000 people

* The Broadmeadows Statistical Local Area contains postcodes 3061 (Campbellfield), 3047 (Broadmeadows/Dallas), 3048 (Meadow Heights/Coolaroo), 3049 (Westmeadows/Attwood) and 3043 (Gladstone Park/Tullamarine).

** All suburbs in metropolitan Melbourne minus suburbs in the Broadmeadows Statistical Local Area

Investigation of Birth defects and birth-related outcomes

The Victorian Perinatal Data Collection Unit has collated information on all Victorian births since 1982, and has maintained the Birth Defects Registry since 1983. The Unit also investigates reports of community concerns related to perceived clusters of birth defects in consultation with the Consultative Council for Obstetric and Paediatric Mortality and Morbidity⁸.

A birth defect is a congenital abnormality of prenatal origin that is present at conception or occurs before the end of pregnancy. Abnormalities can be structural, functional, genetic, chromosomal, or biochemical.

Birth defects are seen in approximately 4 per cent of all births. The Victorian Birth Defects Register includes all children diagnosed with a birth defect up to 15 years of age who are born in Victoria⁹.

A birth-related outcome includes factors such as birth weight and length of gestation. For birth-related outcomes, the mother's suburb and postcode are recorded at the time of the child's birth.

For the purpose of this investigation, 20 years of data (1983–2003) were analysed for populations living in postcode 3043 (Tullamarine, Gladstone Park) and postcode 3049 (Westmeadows, Attwood). Two decades of data were pooled to offset the relatively low number of birth defects and other adverse birth-related outcomes in these two postcodes per year.

The rate of birth defects was calculated for all birth defects in children born between 1983–2003 and notified to the Victorian Birth Defects Register by 31 December 2004. The relative risk^d for each birth-related outcome was calculated from all births in Victoria between 1983–2003.

Over 90 separate analyses were undertaken and for this reason differences were considered significant when the p-value was < 0.01.

The following were investigated in these postcodes and compared to the rest of Victoria:

- all birth defects
- birth defects stratified by body system
- 28 sentinel birth defects that are routinely reported⁹
- perinatal death
- pre-term birth (less than 37 weeks gestation)
- earlier pre-term birth (less than 34 weeks gestation)
- low birth weight (less than 2500 grams)
- singleton and multiple births.

d A relative risk is the ratio of the risk of the condition in the population being investigated and the risk of the condition in the reference population. If the relative risk is greater than 1, and its entire 99% confidence interval is also greater than 1, it indicates an association between the condition and the exposure under investigation. The location of the population studied is one such exposure that could be investigated. Any such association does not necessarily imply that the exposure causes the condition. In comparison, if the relative risk is less than one it may indicate a possible protective effect.

Results (1983–2003)

Amongst all of the birth defects analysed there were no statistically significant differences between the suburbs within 3kms of the landfill (ie. 3043 and 3049) and the rest of Victoria. The proportion of all birth defects in these suburbs was 3.8% compared to 3.5% for the rest of the State, a relative risk of 1.08 (0.97–1.22, $p>0.15$).

Analyses of other birth-outcome data (ie. deaths, pre-term births and low birth weight) showed that there were no statistically significant differences compared to the rest of Victoria, except for pre-term birth.

Pre-term birth (< 37 weeks gestation)

Preterm babies (also known as premature babies) are born when the pregnancy is less than 37 weeks advanced, and usually these babies also have lower birth weights than normal. Factors that can influence preterm birth or whether babies are born with a low birth weight, include the mother's health and smoking habits, her socio-economic status and how many children she has had¹⁰.

In relation to this investigation:

- there were 632 reported cases of preterm birth in babies born in these two postcodes between 1983 and 2003 from a total of 8,046 births (7.9%).
- Statewide there were 91,619 cases of pre-term births from all other postcodes for 1983 to 2003 out of a total of 1,221,178 births (7.6%).
- this gives a relative risk of pre-term birth of 1.16 with a 99 per cent confidence ($p < 0.01$) that this value is between 1.07 and 1.24 ($\chi^2=12.23$).
- there was no difference between the two populations in terms of low birth weight.

Earlier pre-term birth (< 34 weeks gestation) and multiple births (1983–2003)

If a baby is born at less than 34 weeks gestation, this increases the likelihood of complications compared to babies born only slightly earlier than expected (ie. 34 to < 37 weeks)¹¹. Therefore, the analysis was repeated to see whether (or not) there was a difference in earlier preterm birth (< 34 weeks gestation) in the two study postcodes and the rest of Victoria. As multiple births are more likely to be delivered preterm, the contribution of this factor was also considered.

For singleton preterm births (< 34 weeks gestation):

- there were 156 singleton preterm births (< 34 weeks gestation) in the postcodes of 3043 and 3049 between 1983–2003 (ie. 2.0%)
- statewide there were 23,047 cases of preterm birth (< 34 weeks gestation) in singleton pregnancies from all other postcodes for the same period (ie. 1.8%)
- the relative risk of preterm birth (< 34 weeks gestation) in singleton pregnancies was 1.13 (0.96–1.32, $p=0.13$), which was not statistically different between the two populations.

Although preterm birth (< 37 weeks gestation) is slightly higher in the two study postcodes compared to the rest of Victoria, there is no difference in the earlier preterm births (< 34 weeks) and it is this group that is more likely to suffer ill effects of preterm birth.

For multiple births (< 34 weeks gestation):

- there were 129 sets of twins and 2 sets of triplets born to residents of postcodes 3043 and 3049 between 1983–2003 (ie. 1.6% of all confinements).
- in the rest of the State there were 18,094 sets of twins, 426 sets of triplets and 16 sets of quads delivered over the same period (ie. 1.4% of all confinements).
- the proportion of multiple births in the study postcodes compared to the rest of Victoria was not statistically different. Relative risk = 1.18 (0.98–1.41, $p=0.06$).
- therefore, this is probably not the explanation for the small excess in preterm births in the study area.

Preterm birth and socio-economic status

A known influence on the rate of preterm birth is socio-economic status. This was investigated as follows:

- (i) Preterm birth in the study postcodes was compared against a broader local population with similar characteristics to the study population (ie. the Department's Northern Region).
- (ii) The variation in preterm birth was compared across all Department of Human Services Regions in Victoria; and
- (iii) The Index of Relative Socio-Economic Disadvantage (IRSED) ratings for the study areas were compared against IRSED ratings for the City of Hume, Victoria and Australia.

(i) Preterm birth in study postcodes compared to the Department of Human Services Northern Region

The Department's Regional boundaries changed first in 1993 and again in 2003, so the period from 1993–2003 provides the most consistent period for the reporting of Regional trends. During this period the Department's Northern Region^e comprised seven municipalities, including the City of Hume.

This analysis found:

- 312 preterm births to women who lived in postcodes 3043 and 3049 (7.9%)
- 9611 preterm births to women living elsewhere in the Northern Region (7.6%).
- there was no statistically significant difference between preterm birth in the study postcodes and the Department's Northern Region for all births as well as singleton births. The relative risk for singleton births was 1.05 (0.93–1.19, $p > 0.05$).

Overall, the small increase in preterm birth (< 37 weeks) in the postcodes within 3kms of the landfill site is consistent with the level of preterm birth in the broader local area (ie. the Department's Northern Region), for this 10 year period.

(ii) Preterm birth across Department of Human Services Regions

For 1993 to 2003 the average percentage of preterm birth for Victoria was 7.5%. This value varies across the State. A comparison of Department of Human Services regional boundaries indicates that in addition to the Northern region (7.6%), preterm birth is also slightly higher than the State average in the Western (7.9%) metropolitan region and Gippsland (7.7%) and Grampians (7.6%) rural regions.

Graph 1—Comparing Preterm birth across Victorian DHS Regions

Preterm births in DHS Regions and statewide, 1993–2003



^e In 2004, the Northern Region of the Department of Human Services was amalgamated with the Western Region of the Department to form the North and West Metropolitan Region.

(iii) Index of Relative Socio-Economic Disadvantage (IRSED)

A measure of socio-economic status is the Index of Relative Socio-Economic Disadvantage or IRSED. This Index was developed by the Australian Bureau of Statistics using 2001 population and housing Census data and it categorises areas on the basis of social and economic characteristics, including educational attainment, income, employment and occupation¹².

The reference score for Australia is set at 1000. If the score for a population is higher than 1000, this indicates social advantage and, if the score is less than 1000, this indicates social disadvantage. The lower the score the greater the level of disadvantage.

The IRSED ratings for populations relevant to this investigation include:

- Victoria = 1014.56
- City of Hume municipality = 954.16
- Sunbury Statistical Local Area (SLA) = 1100 to 1125
- Craigeburn SLA = 975 to 1000
- Broadmeadows SLA = 850 to 925

The City of Hume municipality is the 5th most disadvantaged local government area in Victoria (out of 78 councils) and the 4th most disadvantaged in the metropolitan area (out of 31).

Within the City of Hume, the Broadmeadows statistical local area (SLA) is the most disadvantaged. The two postcodes studied in this investigation are located within the Broadmeadows SLA.

Socio-economic status is an influencing factor for pre-term birth. From the IRSED ratings, the study postcodes, and the area of Hume City Council are both socially disadvantaged areas relative to the State.

Discussion

Investigating whether activities at a particular site are associated with particular cancers, birth defects or other health conditions is very difficult due to a range of influencing factors. These include:

- whether a person develops a certain health condition or not depends on a range of personal risk factors, for example genetic make-up, general state of health, diet, level of activity, personal risk factors such as smoking, occupation, age and sex.
- accurate data on whether people have in fact been exposed to something (ie. the amount and length of potential exposure) is often not available; and
- focusing on a small number of people in this type of investigation. If the population size gets too small it is less likely that the results will accurately represent community health due to a loss of statistical confidence.

Although this investigation was not able to prove one way or another that the landfill has caused any of the health conditions studied (ie. cancers, birth defects and other birth-related outcomes), it has provided:

- an understanding of the similarities and differences between the study population and the reference (or control) populations;
- an opportunity to review potential health hazards when a difference is identified; and
- an opportunity to inform hypotheses for further investigation (as necessary).

Overall, this investigation:

- compared the rates of a number of conditions in the populations living near the landfill with rates for the State as a whole (or other control areas).
- found no significant difference in the rates or types of cancer, birth defects or the majority of birth-related outcomes.
- found no difference in low birth weight, the number of singleton births or the number of multiple births between these two postcodes and the rest of Victoria.
- identified a small, statistically significant increase in preterm birth (< 37 weeks) in the study postcodes compared to the rest of Victoria from analysis of 20 years worth of data. However, there was no statistically significant increase for earlier preterm birth (ie. < 34 weeks).
- found that the level of preterm birth (< 37 weeks) in the study postcodes is similar to the level of preterm birth in the broader local area (ie. the Department of Human Services Northern region), of which these postcodes are a part.
- found that the postcodes of 3043 (Tullamarine and Gladstone Park) and 3049 (Westmeadows and Attwood) are located with the Broadmeadows Statistical Local Area, which is the most disadvantaged SLA in the City of Hume municipality. Socio-demographic factors are known to influence pre-term birth.

Conclusion

This investigation of available, high-quality data sources:

- did not identify any difference in health conditions such as cancers, birth defects and other birth-related outcomes between populations living near the landfill and the rest of Victoria (or other control groups).
- identified pre-term birth (< 37 weeks gestation) as the only outcome with a small, but statistically significant, increase in the postcodes of 3043 (Tullamarine and Gladstone Park) and 3049 (Westmeadows and Attwood) compared to the rest of Victoria.
- identified that this difference in preterm birth (< 37 weeks) was not evident in earlier preterm births (< 34 weeks gestation) in these postcodes compared to the rest of Victoria.
- identified that the small increase in preterm birth (< 37 weeks) in the postcodes of 3043 and 3049 was similar to preterm birth (< 37 weeks) in the broader local regional area (ie. Department of Human Services Northern Region). Socio-demographic characteristics of the area are a likely influencing factor for this result.

Overall, this investigation does not provide evidence to support anecdotal claims that cancers, birth defects and other adverse birth-related outcomes are higher in people living near the Tullamarine landfill compared to reference populations such as the rest of metropolitan Melbourne or the rest of Victoria.

A copy of this report has been provided to the Hume City Council, EPA Victoria, the Department of Human Services North and West Metropolitan Regional Office and the local community group, Terminate Tullamarine Toxic Dump Action Group (or TTTDAG). It is also available on the Department's website address www.health.vic.gov.au/environment/.

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- Environmental Health Unit, Public Health Branch, Department of Human Services
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