Methods

Sources of data
Data were obtained from the NSW Central Cancer Registry. The registry is population-based and registers all cancers diagnosed in NSW residents. All public and private hospitals, departments of radiation oncology, nursing homes, pathology laboratories, outpatient departments, day procedure centres and the Registrar of Births, Deaths and Marriages notify cancer cases and deaths to the Registry. Notification of cancer is governed by a Public Health Act. For more details about the Registry refer to Cancer in New South Wales Incidence and Mortality 2004.

Incidence
Cancer incidence is defined as the number of new cases of cancer occurring in a given population during a specified period of time. The incidence data in this report are for persons with cancer diagnosed in NSW residents in the period from 1998 to 2002. These persons were assigned to respective LGAs according to their usual place of residence, at diagnosis, using the 1996 Census LGA boundaries.

This report includes incidence maps, separated for males and females, for all cancers combined and 21 major cancers. The cancer types included in this report are: head and neck, oesophageal, stomach, colon, rectal, liver, pancreatic, lung, melanoma of the skin, female breast, cervical, uterine, ovarian, prostate, kidney, bladder, brain, thyroid, non-Hodgkin lymphoma, multiple myeloma and leukaemia. A description of the cancer types included in this report is provided in Appendix 3.

Mortality
Cancer mortality is defined as the number of deaths primarily due to cancer occurring in a given population during a specified period of time. The mortality data in this report are for deaths due to cancer in NSW residents in the period from 1998 to 2002. This report included maps, separated for males and females, for all cancers combined and the 11 cancers with highest mortality. These deaths were assigned to the respective LGAs according to usual place of residence at death using the 1996 Census LGA boundaries.

Deaths from the cancer types included in this report are: stomach, colon, rectal, pancreatic, lung, melanoma of the skin, female breast, ovarian, prostate, non-Hodgkin lymphoma, and leukaemia.

Population
The Estimated Resident Population (ERP) was used as the denominator for the calculations of incidence and mortality rates. The ERP is compiled by the Australian Bureau of Statistics and is the official estimate of the Australian population at 30 June each year. It is categorised by five-year age groups (except for those aged 85 or over), sex, year, and Statistical Local Area (SLA) based on the 2001 Australian Standard Geographical Classification. The SLA data were then amalgamated to the 1996 LGA boundaries for this report.
Geographic units
Data for 176 LGAs of NSW are presented in this report. The boundaries used were those that existed during the 1996 Census of Population and Housing. The ‘Unincorporated Far West’ Statistical Local Area has been included as a separate unit. Lord Howe Island has been omitted. The LGAs of Pittwater and Warringah were combined as Warringah/Pittwater for mapping and analysis, as were Sydney and South Sydney into Sydney/South Sydney.

Statistical analysis
To examine possible differing cancer patterns according to sex, separate calculations were done for males and females. Different proportions by age across LGAs can affect the comparison of crude incidence or mortality rates across LGAs. To adjust for this, age standardisation using the ‘indirect method’ was used to produce summary measures of incidence and mortality for comparisons between LGAs.

Age standardised incidence and standardised mortality ratios
Standardised incidence ratios (SIR) and standardised mortality ratios (SMR) allow for the comparison of rates of new cases and deaths respectively, in study populations of interest relative to the incidence in a standard population where the age distributions differ. Using this method the number of cases expected or deaths expected in each LGA was estimated by applying the age specific incidence or mortality rates for the ‘standard population’ of NSW as a whole to the age-specific population for each LGA. The SIRs and SMRs were then calculated as the number of observed cases or observed deaths in each LGA divided by the expected number for that LGA multiplied by 100.

If the resulting SIR or SMR is above 100 for a specific LGA the cancer incidence rate or cancer mortality rate in that LGA is greater than that for the whole of NSW. If the ratio is below 100 the incidence or mortality rate is lower than that for the whole state. For example a SIR of 104 means that for that LGA, cancer incidence is four per cent above that of the whole of NSW.

Directly age-standardised incidence and mortality rates for NSW are provided in Table A4 in Appendix 4 as background information.

Smoothing of standardised incidence and mortality ratios
For small areas or rarer cancers, the least reliable data are often the most extreme and can dominate a map of cancer incidence. Variation in the observed number of cancers in an area can be caused by chance fluctuations as well as true differences in the risk of cancer in its population.

To reduce the chance of random variation leading to false positive or false negative results and to make the spatial patterns clearer, we smoothed the calculated SIRs and SMRs. We assumed that for a specific LGA, its rate was similar to that of neighbouring LGAs or of the whole state. The amount that a standardised ratio was altered due to smoothing was roughly inversely proportional to the population of the area. For areas with larger populations, the smoothing made little difference, but in less populous areas smoothing led to SIRs and SMRs that were much closer to the average values of their neighbouring areas or to the State mean than were originally calculated.

In this report 99% credible intervals were calculated. As we used little prior information in the modelling, the credible intervals have a similar interpretation to confidence intervals. These intervals give the range of values for an SIR or SMR that is likely to include the value that truly
represents the cancer incidence or cancer mortality in that population. For example, a SIR of 104 with a 99% credible interval of 78 to 137 indicates that 104 is the best estimate of the ratio, and that the interval 78 to 137 has a 99% chance of encompassing the true value of the ratio for that population.

An SIR or SMR was considered to be statistically significantly different from the state-wide average if the 99% credible intervals did not include 100. For a given level of credible intervals, there is a trade-off between false negative and false positive rates for detecting a spatial pattern; a recent review suggested that 70-80% credible intervals be used for a single comparison. Given the number of comparisons that were made, we selected 99% credible intervals to reduce the possibility that any differences identified were due to chance.

Spatial variation was measured using Moran’s I with an Empirical Bayes adjustment. A p-value of less than 0.01 was considered to indicate significant spatial variation.

For a more detailed explanation of the methods please refer to Appendix 5.

**Incidence and mortality maps**

Maps were created using ArcGIS 9.1 software with the use of boundaries modified from CDATA96. The shading patterns represent values of the standardised ratios in five categories. As the ratio increases it is displayed in progressively darker shades. Five categories were selected and used for all maps. They were chosen to be symmetrical around the NSW mean (100) on a ratio scale, and chosen to give a fair representation of variation across different cancers. For some maps however, this means that not all shading groups are used. A white cross inside a black circle represents where the LGA had a SIR or SMR significantly higher than the NSW average, and a white dash inside a black circle those significantly lower.

Some LGAs, particularly regional towns appear as small areas surrounded by a single larger LGA. For certain cancers some of these areas appear to have higher rates, after smoothing, than the surrounding area. It is possible that residential addresses recorded at the time of diagnosis were given as town addresses, or post office boxes for an unknown number of people living in the surrounding rural areas. Where these geographically small areas are significantly different from the State average the symbols used in the maps may obscure the shade of the map.

The Australian Capital Territory is a separate administrative region and is indicated on the maps with hashed lines.