



NOVEMBER 2005

CIVIL ENGINEER: OCCUPATIONAL SKILL SHORTAGE ASSESSMENT

Current Situation: Genuine skill shortage

Short-term Outlook: Genuine skill shortage

1 Executive Summary

1.1 Results from the 2004 Survey of Employers who have Recently Advertised indicate that there is a severe shortage of civil engineers in New Zealand. Only 29% of vacancies were filled within eight to ten weeks of advertising and there was an average of only 1.6 suitable applicants for every vacancy. This shortage has occurred as growth in demand has considerably exceeded growth in supply.

Table 1: Employer Survey Indicators, 2004

	Fill Rate	Average Number of Suitable Applicants
Civil Engineers	29%	1.6
All Professionals Surveyed	56%	1.7

Source: Survey of Employers who have Recently Advertised, Department of Labour.

1.2 Household Labour Force Survey data suggests the 2.3% annual growth in employment of civil engineers between 1991 and 2001 has continued over the past four years. Demand for civil engineers has been growing rapidly and will continue to grow in the next few years due to buoyant construction activity on a number of fronts. The strongest growth areas are likely to be in non-residential building and transport infrastructure.

1.3 The number of civil engineers graduating from tertiary education is low (training rate of 2.8%). While numbers appear to have been supplemented by migratory inflows of overseas trained professionals over the last few years, this has not been sufficient to meet surging demand in this occupation. There is little evidence that 'occupational detachment' (employees who voluntarily leave an occupation) is depleting numbers in this profession as most engineers tend to remain in a related field.

1.4 Demand for civil engineers will continue to rise over the next few years due to a wide range of non-residential construction, roading and infrastructure projects that are planned or underway. While the number of graduates achieving degree qualifications is expected to increase over the next two or three years this will not

be adequate to alleviate current shortfalls as well as meet new demand. The Department of Labour therefore foresees the shortage of civil engineers persisting in the short-term.

2 Introduction

- 2.1 The purpose of this report is to investigate skill shortages in the civil engineer profession in New Zealand. The report aims to assess whether there is a shortage, and to provide an insight into demand and supply factors contributing to this situation. It also offers a short-term outlook for shortages in this occupation group.
- 2.2 Professional civil engineers (code 2142 in the New Zealand Standard Classification of Occupations [NZSCO]) design and supervise the construction and repair of buildings, and transport and civil facilities such as roads, bridges, tunnels, dams, water supplies, and sewage systems. As well as having advanced technical skills, they are also increasingly required to have good skills in business planning, budgeting and tendering processes, and knowledge in project management. The main technical engineering disciplines within this group include structural, roading, environmental, and public health (including waste water and drinking water). The Department of Labour (the Department) estimates that there were approximately 6,100 civil engineers employed in New Zealand in 2003.
- 2.3 Further background to this occupational report, including a discussion of the methodology; a glossary of terms; and an overview of the Department's *Survey of Employers who have Recently Advertised* (SERA), including the survey questionnaire, can be found in the 'Background and technical note' at <http://www.dol.govt.nz/publications/jvm/job-ad-professionals.asp>.

2.4 **Note on Occupational Classification**

- 2.4.1 The 4-digit occupational category of 'civil engineers' (NZSCO code 2142) includes five smaller sub-categories of engineers. Group 21426, 'other civil engineer', comprises the largest sub-group with 52% of the total.
- 2.4.2 Some data sources such as the Household Labour Force Survey (HLFS) and External Migration, are only available at the broader 3-digit category, 'architects, engineers and related professionals' (NZSCO code 214), with civil engineers comprising about 26% of this broader group. This means that some of the data presented in this report must be interpreted with caution, as it includes professions other than civil engineers.

3 Demand for Civil Engineers

3.1 **Historical Demand**

- 3.1.1 According to the Census, between 1991 and 2001 the number of employed civil engineers grew by an annual average of 2.3% (see Table 2). There was a falloff of -0.5% per annum in numbers over the period 1996 to 2001, which could be due to a weaker economic cycle over this time.
- 3.1.2 Demand for civil engineering work has grown strongly across a number of sectors in the last three or four years. According to the Association of Consulting Engineers New Zealand (ACENZ), the largest amount of work currently

undertaken by engineers in their member firms is in building construction (predominantly non-residential). This is followed in descending order by: transport infrastructure, water and sewage, and projects to increase or replace energy generation capacity. A brief look at the main sectors shows how strong current demand is.

Table 2: Employment of Civil Engineers, 1991-2001¹

	Annual Growth in Employment		
	1991-1996	1996-2001	1991-2001
All Civil Engineers	5.1%	-0.5%	2.3%
All Professionals	2.7%	4.0%	3.4%
All Occupations	3.1%	1.2%	2.1%

Source: Census of Population and Dwellings, Statistics New Zealand.

- 3.1.3 Non-residential building construction work is gaining momentum, and the real value of work put in place for non-residential buildings rose by 11% in the 12 months to December 2004, after showing only moderate growth in preceding years².
- 3.1.4 Transport infrastructure projects involve engineers in a variety of design roles. As the national road network is in public ownership, the level of work historically is dependent on the amount of central and local government road funding available. Very large increases have occurred recently in funding available for roads, for example, an estimated 20% increase in State Highway expenditure in the 2004/2005 year³.
- 3.1.5 HLFS data indicates strong employment growth amongst architects, engineers and related professionals in recent years (NZSCO Minor Group 214). The number employed grew by an average of just over 4% per annum in the four years to December 2004 (see Table 3), although numbers appear to have eased somewhat in the past 12 months.

Table 3: Employment of Architects, Engineers and Related Professionals, 2000-2004, December Years (000's)

	2000	2001	2002	2003	2004	Annual Growth in Employment
Architects, Engineers and Related Professionals	29.0	35.1	37.7	37.4	34.4	4.4%

Source: Household Labour Force Survey, Statistics New Zealand.

¹ The total has been adjusted for a SNZ recoding that occurred from 'other civil engineers' to 'mechanical engineers' in 2001.

² Quarterly Building Activity Survey, Statistics New Zealand.

³ Ministry of Economic Development, 'Addressing the Buildability Constraints of the Auckland Transport Package', July 2004.

3.2 **Future Demand**

3.2.1 The Department's demand overview for the construction sector suggests that levels of building activity will remain buoyant through the next few years, driven mainly by growth in non-residential construction (see Appendix 1).

3.2.2 Strong demand increases in other areas employing civil engineers are also likely in the coming years. In March 2004 the Government confirmed an additional \$2.87 billion investment in land transport (including public transport) over the next 10 years. Auckland will receive \$1.52 billion, with the remaining \$1.35 billion allocated amongst the regions on a population basis.

Figure 1 shows the overall projected spending on land transport up to

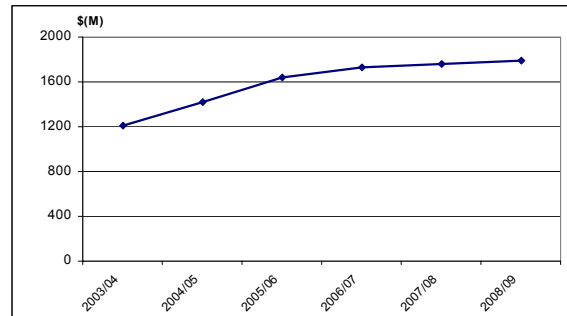
2008/2009, based on Transfund New Zealand's⁴ latest 10-year projections, and covers new road construction and maintenance, as well as other land transport services. The projections (which take into account the additional Government funding) show that total spending is expected to increase on average by about 8% per annum over the next five years (from around \$1.2 billion to around \$1.8 billion). Roading and bridge construction is estimated to account for 42% of employees in the civil engineering sector⁵. This forecast therefore provides a strong signal that more civil engineers will be required.

3.2.3 Other evidence of future growth for engineers comes from ACENZ's annual staff recruitment survey. The latest survey showed that 69% of firms that replied said they were likely to grow their businesses should the economic situation remain stable. The ACENZ membership covers all disciplines of engineering, but members indicated that future demand for civil engineers looked strong.

3.2.4 Growing public awareness of the need for improvements in health and environmental standards has led to continued increases in expenditure on public infrastructural facilities (such as water treatment, sanitation etc). In addition, the effects of deferred maintenance by some councils on their drainage and sewage networks, and growing urban population growth, has created an extra backlog of work in this area.

3.2.5 Finally, the upgrade and expansion of a variety of forms of power generation capacity is also stimulating increased demand for civil engineers⁶.

Figure 1: Projected Spending on Land Transport



Source: Transfund New Zealand.

⁴ Transfund New Zealand is the Government agency that allocates funding to the land transport system in New Zealand.

⁵ Statistics New Zealand Business Survey (2002) in Ministry of Economic Development, 'Addressing the Buildability Constraints of the Auckland Transport Package', July 2004.

⁶ A study by IPENZ in 2004 predicts that New Zealand needs to average 320 MW of new power generation every year, well above the 130-150 MW per annum that has been achieved over the last few years.

3.2.6 It is difficult to estimate the extent of the total increase in demand for civil engineers because not all planned activities proceed according to the original plans and timeframes. The size of some of these projects, such as motorway construction, means that whether they go ahead or not will significantly affect demand. However, the range and scale of different construction projects being planned is such that any spare civil engineering capacity in one area will soon be reabsorbed in another.

3.3 **Summary**

3.3.1 HLFS data suggests the growth in employment of civil engineers (2.3% per annum) recorded between 1991 and 2001 has continued over the past four years. Demand for civil engineers has been growing rapidly and will continue to grow in the next few years due to buoyant construction activity on a number of fronts. The strongest growth areas are likely to be in non-residential building work and infrastructure work.

4 **Supply of Civil Engineers**

4.1 **Graduates in Civil Engineering**

4.1.1 This section investigates the growth in supply of graduates in civil engineering through training – specifically the four-year Bachelor of Engineering (BE).

4.1.2 Table 4 shows that the numbers entering training as civil engineers are increasing although this increase has not yet flowed through to increased numbers of graduations. New enrolments into B.E courses (at year 2) have grown from 166 in 2002 to 263 in 2004 which suggests the outflow of new graduates will increase over the next few years.

Table 4: Enrolments and Qualification Achievements for BE (Civil Engineering)

Year	New Enrolments	Qualification Achievements
2002	166	198
2003	210	178
2004	263	162

Source: Canterbury, Auckland and Unitec Schools of Engineering.

4.1.3 A comparison of graduate numbers with the estimated number of employed civil engineers yields a training rate of 2.8% (see Table 5). The training rate is a rudimentary measure of the rate at which the supply of civil engineers can potentially grow through tertiary training. The equivalent training rate for civil engineers in New South Wales, Australia is substantially higher (4.4%)⁷. It is notable that the Australian training rate has been assessed as too low to meet

⁷ In this report, comparisons are made between New Zealand and New South Wales, Australia to contextualise the findings. Given that there are no national level estimates of training rates available for Australia, state-level data have been used. New South Wales is Australia's most populous state with the largest economy and its economy most closely resembles the structure of the New Zealand economy. It was thus deemed to provide the most suitable jurisdiction for labour market comparisons.

their work requirements. The New Zealand civil engineers training rate of 2.8% needs to be considered against the growth in demand for the services of civil engineers. The real growth in the value of non-residential work put in place was 11% in the 12 months to December 2004, which provides an indication of the growth in demand for civil engineering services. When added to the boost in expenditure on transport infrastructure, this growth suggests that training levels have been falling well short of the growth in demand for civil engineers.

Table 5: Training Rates for Civil Engineers, 2004

Indicator	Explanation	Civil Engineers (NZ)	All SERA Professionals Surveyed (NZ)	Civil Engineers (NSW, Australia)
Training Rate (BE)	Number of persons achieving a relevant qualification expressed as a percentage of employment in that occupation	2.8%	5.5%	4.4%

Source: Department of Labour (New Zealand), Department of Employment and Workplace Relations (Australia).

4.2 Migration

4.2.1 New Zealand has experienced a net migratory inflow of 646 architects, engineers and related professionals over the past three years, coinciding with the strengthening of the domestic economy (see Table 6). This recent increase occurred as the result of a large increase in arrivals in 2002, accompanied by a large decrease in departures. Both of these changes were sustained in the following two years.

Table 6: Permanent and Long-term Arrivals, Departures and Net Migration of Architects, Engineers and Related Professionals, 1997-2004 December Year End⁸

	1997	1998	1999	2000	2001	2002	2003	2004
Arrivals	775	610	519	426	462	565	560	594
Departures	483	510	513	562	483	370	325	378
Net Migration	292	100	6	-136	-21	195	235	216

Source: External Migration, Statistics New Zealand.

4.2.2 One of the main concerns of the engineering profession appears to be the loss of younger graduates overseas once they have reached sufficient experience to become a chartered professional engineer⁹. While the above figures include professionals other than engineers, they do suggest that migratory losses have been more than made up for by inflows over the past three years.

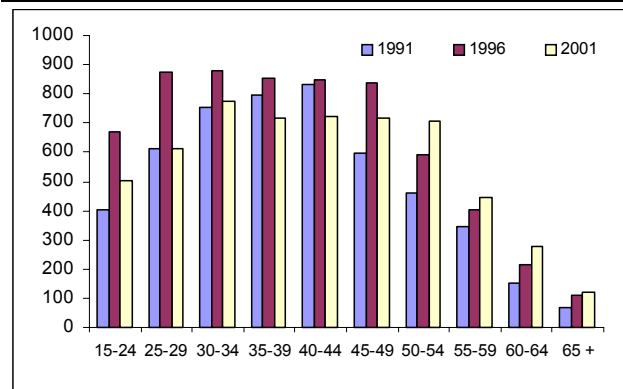
⁸ These estimates could underestimate the migrant flows of civil engineers because the occupations of approximately 40% of persons entering and leaving New Zealand are not recorded or are not identifiable.

⁹ IPENZ carries out the assessment and registration of engineers who meet the relevant standards. The Chartered Professional Engineer qualification is not compulsory but is necessary to meet Government regulations for certain types of work. To retain registration engineers must demonstrate regularly (five years or more frequently) that they are still able to practise competently.

4.3 Retirement

4.3.1 Based on 2001 Census data, it is estimated that about 1.4% of the civil engineer workforce retires each year. This is the same as the average for the broader architects, engineers and related professionals group, and similar to the average retirement rate for all professional occupations (1.3%). Figure 2 shows the percentage of civil engineers aged 50 years or more rose from 21% to 28% over the five-year intercensal period from 1996 to 2001. As the civil engineering workforce ages, the number of civil engineers retiring each year will increase. This indicates that further shortages could arise in the future.

Figure 2: Age Profile of Civil Engineers, 1991-2001



Source: Census of Population and Dwellings, Statistics New Zealand.

4.4 Occupational Detachment¹⁰

4.4.1 Employers interviewed in the Survey of Employers who have Recently Advertised (SERA) felt that most civil engineers tend to stay within the occupation once trained, although some move on to management positions as they get older. The main retention issue appears to be graduates moving overseas, especially those with 2-5 years of experience.

4.4.2 The ACENZ annual staff recruitment survey of member firms reinforces employer perceptions of relatively modest losses through occupational detachment. Whilst there was a considerable 13% staff turnover reported in 2005, 85% of the people who resigned from the firms surveyed, moved to another consulting engineering firm¹¹. This suggests engineers tend to keep working in a broadly similar field.

4.5 Summary

4.5.1 The number of civil engineers graduating from the tertiary education system has been low (training rate of 2.8%) although enrolments into this course are increasing strongly. Although new graduate numbers appear to have been supplemented by migratory inflows of overseas trained professionals over the last few years, this has not been sufficient to meet surging demand in this occupation. There is little evidence that occupational detachment is depleting numbers in this profession as most engineers tend to remain in a related field.

¹⁰ 'Occupational detachment' refers to individuals who choose not to continue practising in their occupation but retain a connection to the occupation (e.g. move into a management or supervisory role, or retain professional registration), or who leave the occupation entirely (e.g. by changing occupation or withdrawing from the labour market).

¹¹ Civil engineers are estimated by ACENZ as representing about 40% of total staff numbers among member firms which numbered 7,105 in January 2005 compared with 6,105 the year before.

5 Employer Recruiting Experiences – the Survey of Employers who have Recently Advertised

5.1 Overall Shortage of Civil Engineers

5.1.1 Employers interviewed in the 2004 SERA filled only 29% of vacancies within eight to ten weeks of advertising. This is substantially lower than the overall fill rate of 56% for all professionals surveyed. This indicates that there is a severe shortage of civil engineers in New Zealand¹². The relative size of the pool of suitable applicants was similar to the average for all professionals, with an average of 1.6 suitable applicants for each civil engineer vacancy, compared with 1.7 for all professionals surveyed.

Table 7: SERA Results for Civil Engineers and All Professionals Surveyed, July 2004

	Number of Employers	Number of Vacancies	Number of Vacancies Filled	Fill Rate	Number of Suitable Applicants	Average Number of Suitable Applicants per Vacancy
Civil Engineers	18	24	7	29%	39	1.6
All Professionals Surveyed	207	296	167	56%	503	1.7

Source: Survey of Employers who have Recently Advertised, Department of Labour.

5.1.2 Skill areas in particular shortage mentioned by employers in the SERA included: project management, geotechnical engineering, structural engineering, especially bridge and road design, and waste water experience. A deficit in the number of engineers with two or more years experience was observed by some employers - which may reflect the point at which many travel overseas. The ACENZ annual staff recruitment survey of member firms reported difficulties in recruiting graduates across all firm sizes, with the problem appearing especially severe for those firms located in smaller provincial centres.

5.2 What are Employers Paying?

5.2.1 Civil engineers' wages compare favourably with other professions. In 2004, the Labour Cost Index (LCI) measured an average hourly wage of \$34.21 for civil engineers, which is higher than the average wage of all professionals of \$30.55. According to the LCI, wages of civil engineers have risen strongly by 5.7% in the 12 months to June 2004, compared with an increase of 3.1% for all professionals.

5.3 Changes in Market Conditions

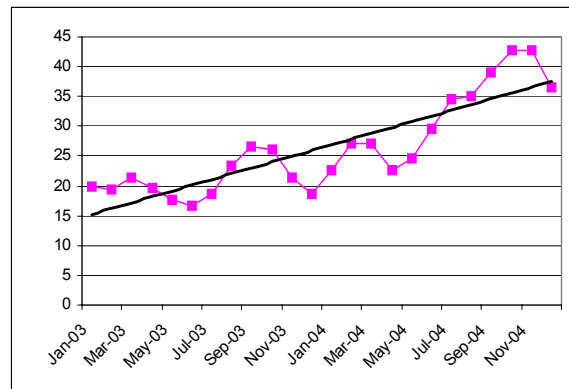
5.3.1 The Department's Job Vacancy Monitor shows that there has been a strong rise in advertised vacancies for civil engineers¹³ (see Figure 3). Over the last two years, the three-monthly moving average has risen from 20 to nearly 40 vacancies per month. The ACENZ annual staff recruitment survey reinforces these findings. In

¹² Occupations with fill rates lower than about 80% are typically regarded as being in shortage.

¹³ Note this also includes advertisements for civil engineering technicians (NZSCO 31124).

January 2004, the survey identified 220 current vacancies reported by 81 ACENZ member consulting engineering firms, and in the following year 473 vacancies reported by 95 firms. Over this period the total number of personnel employed by ACENZ members rose by about 15%. Many engineering firms have stated they would like to expand further if they could get more staff.

Figure 3: Advertised Civil Engineer Vacancies, 2003-2004



Source: Job Vacancy Monitor, Department of Labour.

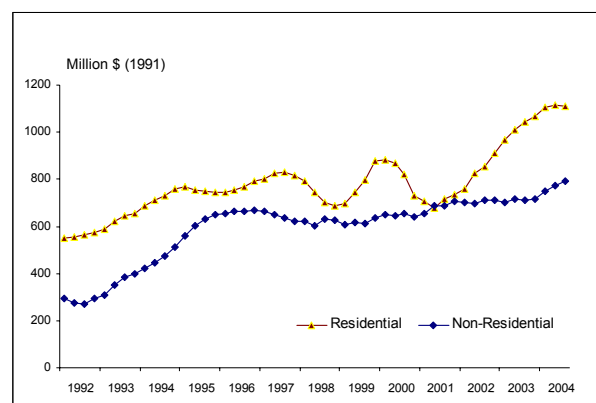
6 Outlook

- 6.1 Demand for civil engineers will continue to rise over the next few years due to a wide range of non-residential construction, roading and infrastructure projects that are planned or underway. While the number of graduates achieving degree qualifications is expected to increase over the next two or three years this will not be adequate to alleviate current shortfalls as well as meet new demand. The Department therefore foresees the shortage of civil engineers persisting in the short-term.

7 Appendix 1: Construction Industry Demand Overview

7.1 New Zealand has experienced three years of strong growth in construction activity. Figure 1 shows the rapid (35%) growth in building work which occurred between late 2001 and late 2004. The boom has resulted in construction industry employment growth of 34% over the same period. The strong construction industry growth has been driven mainly by activity in the residential sector. The non-residential sector has been much more static. Until recently, growth in the residential sector has been driven by a range of factors. These include: low real interest rates from early 2001 to early 2004, high population growth caused by record net immigration, strong wage and job growth, offshore investment, a previous lull in building activity, and falling household sizes.

Figure 4: Building Work Put in Place, Residential and Non-residential



Source: Statistics New Zealand.

Table 8: Construction Activity and Employment, Years to December, 2001-2004

Construction Indicator	Year to December 2001	Year to December 2004	% Change (2001-2004)
Work Put in Place (1991\$m)	5,622	7,612	35%
Residential Building Consents (number)	20,539	31,423	53%
Non-residential Building Consents (number)	17,052	16,638	-2%
Construction Employment (number of people)	113,500	152,400	34%

Source: Statistics New Zealand.

7.2 Outlook for the Residential Sector

7.2.1 The residential sector is beginning to slow after the high growth experienced in the past few years. This slowdown is likely to continue because all the key drivers of that growth have turned. Interest rates have risen¹⁴, lower levels of net inward migration¹⁵ have slowed population growth, the downturn in international students coming to New Zealand may hurt apartment building, and the high exchange rate may discourage offshore investors. December 2004 Consensus Forecasts from the New Zealand Institute of Economic Research predict that

¹⁴ The Reserve Bank of New Zealand increased its Official Cash Rate to 6.75 per cent in March 2005, a rise of 1.75 percentage points since the beginning of 2004.

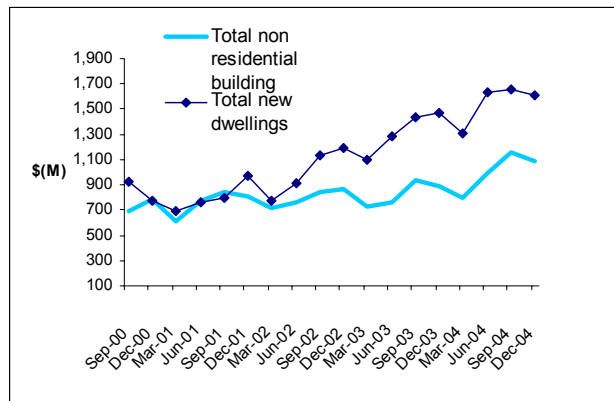
¹⁵ Net inward migration (permanent and long-term arrivals less departures) fell to 12,800 in the year to January 2005 from 33,300 in the year to January 2004 and the Department of Labour expects it to continue falling.

residential investment would grow by 4.8% in the year to March 2005 and then fall by 9.3% in the following year.

7.3 **Outlook for the Non-residential Sector**

7.3.1 The Department of Labour expects non-residential building activity will grow strongly over 2005. This is reflected in a generally upward trend in the value of building consents since late 2003 (Figure 2). Growth will be driven by increased government expenditure on corrections, education and health facilities, upgrading and construction of new power generation facilities, ongoing construction of retail premises and growing demand for office space arising from strong employment growth.

Figure 5: Quarterly Building Consents Issued, Residential and Non-residential



Source: Statistics New Zealand.

7.4 **Overall Outlook**

7.4.1 Current high levels of construction activity are expected to be maintained over 2005 as growth in the non-residential sector compensates for the slowdown in the residential sector. This is likely to result in current levels of employment being sustained. However, the shift in emphasis from residential activity to non-residential will require a change in the mix of professional skills applied in the construction sector as a whole.

For queries regarding this report please contact info@dol.govt.nz.

Disclaimer: The Department of Labour has made every effort to ensure that the information contained in this report is reliable, but makes no guarantee of its accuracy or completeness and does not accept any liability for any errors. The information and opinions contained in this report are not intended to be used as a basis for commercial decisions and the Department accepts no liability for any decisions made in reliance on them. The Department may change, add to, delete from, or otherwise amend the contents of this report at any time without notice. The material contained in this report is subject to Crown copyright protection unless otherwise indicated. The Crown copyright protected material may be reproduced free of charge in any format or media without requiring specific permission. This is subject to the material being reproduced accurately and not being used in a derogatory manner or in a misleading context. Where the material is being published or issued to others, the source and copyright status should be acknowledged. The permission to reproduce Crown copyright protected material does not extend to any material in this report that is identified as being the copyright of a third party. Authorisation to reproduce such material should be obtained from the copyright holders.