

'POPULATION STUDIES RESEARCH BRIEF

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Population Projections for the Northern Territory - an uncertain future

KEY FINDINGS

- Accurate assessments about the future size and composition of the Northern Territory's population are vital for planning, policy making and private investment decisions.
- Many different projections are available for the Northern Territory, each with a different set of numbers.
- It is extremely difficult to accurately model population growth and change for small and remote places like the Northern Territory and past projections have demonstrated this.
- No single model is likely to produce a definitive set of projections; nevertheless there are benefits in using one set across planning activities.
- While projections usually turn out to be wrong their importance is not diminished as they build our knowledge about the components of past and likely future change

RESEARCH AIM

To explore population
projections for the Northern
Territory

This research brief discusses the importance of population projections for the Northern Territory, why they are so difficult to construct, and why they turn out to be inaccurate. We examine the existing range of projections and briefly discuss the model developed specifically for the Territory (the NTPOP) as part of a research collaboration between the Northern Territory Treasury and the Population and Tourism Studies Group at CDU.

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Population Projections for the Northern Territory - an uncertain future?

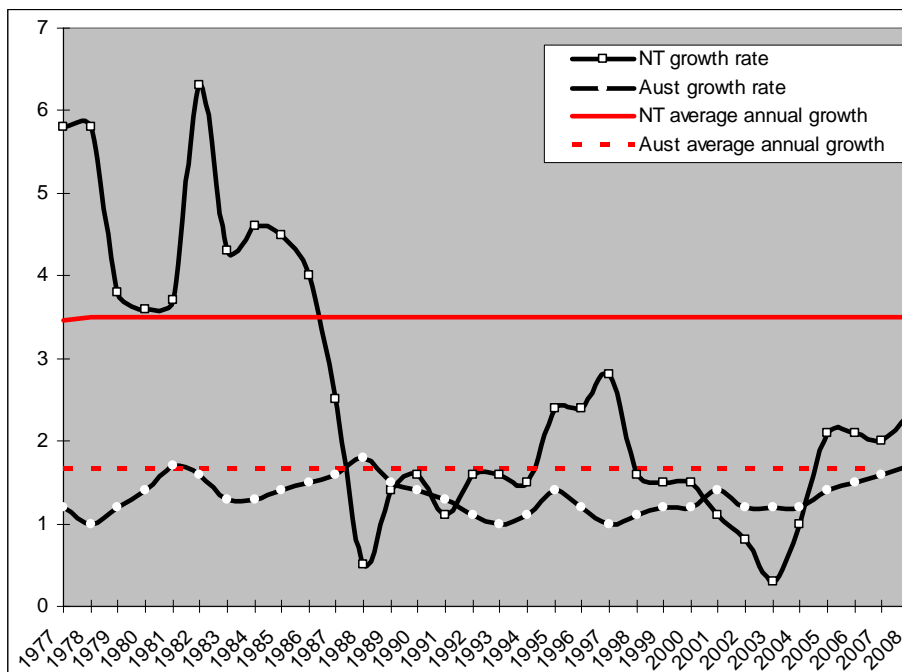
Background

Accurate assessments about the future size and composition of the population of the Northern Territory are vital for planning services, developing appropriate infrastructure, and for guiding public and private sector investment decisions. On a more practical level they contribute to determining the level of political representation the Territory holds in the House of Representatives (HOR) and the amount of Federal Goods and Services Taxation revenues distributed to the Northern Territory Government via the Horizontal Fiscal Equalisation Scheme (Wilkinson, 2003). In this brief we examine the role of projections in the context of the Territory, the key issues for their development and accuracy, why there are so many available, and how they can be applied. We then examine the variations in the numbers for current range of projections available at the Territory level to highlight the challenges for those modelling and those using projections output.

What's the big deal with projections?

Population growth in the Territory during the past 30 years has been quite volatile compared to Australia as a whole where steady growth has occurred (Figure 1). The main reason is significant volatility in the migration components of population change in for the Territory, and particularly the interstate migration component. In our Research Brief "Population Change in the Northern Territory – history matters" (Taylor, 2009) we highlighted the large standard errors for successive quarters of net interstate migration in particular. This volatility is often reflected in the assumptions made as the basis for projections and the impacts can be major as the following story illustrates.

Figure 1 – NT and Australian population growth rates, 1977 to 2007



Source: Australian Bureau of Statistics (Australian Historical Population Statistics)

In 2003-04 the Territory's growth rate fell to its lowest on record for the post-cyclone Tracy period (at just 0.32%) while the remainder of Australia continued to grow (1.24% in that year). The reduced share of the national population caused the Territory to lose its second seat in the

Population Projections for the Northern Territory - an uncertain future?

HOR, which it had obtained in 2000 (see Wilson et al., 2005, for a more detailed summary of the role of population size in determining our political representation). After much lobbying a Joint Standing Committee for Electoral Matters was held (Joint Standing Committee for Electoral Matters, 2003) to assess the situation. At the hearing, Mr David Tolner MP tabled Australian Bureau of Statistics population projections to demonstrate the decline in share was likely to be temporary and that by 2005 the Territory would have sufficient population to warrant its two seats. By contrast an ABS representative tabled the most recent set of projections which suggested the NT would continue to grow at a slower rate than the rest of Australia and fall further behind the threshold required to maintain two HOR seats. The Committee's response was very interesting. It put forward a change to the Electoral Act in 2004 which effectively recognised the inherent weaknesses in projections for the Territory caused by the volatility of a small population. Instead of specific numbers (the second seat was lost by a margin of just 300 people) for determining the HOR threshold the Committee proposed a population range be used in the case of the NT and the ACT. The Territory's seat was restored. As a side note, the Territory population has since grown at a much faster rate than projected by the ABS in 2004.

This account illustrates some key issues for both those charged with producing (modelling) population projections for the Territory and for those who use and apply the results. First, a number of sets of projections may be current in any given year. Variations to the assumptions used in each mean that users are left to decide which are the most relevant to the analysis at hand. Secondly, the Territory's population is inherently volatile and this makes it a difficult one to project. The small size of the population, its remoteness and sparse distribution, its high sex ratios, and the high proportion of Indigenous people make it a difficult jurisdiction to enumerate effectively at Census time, a difficult population to estimate during intercensal years, and, consequently, a difficult population to model for the future. Most projection models rely on historical data about births, deaths and migration and, in the case of the Territory, migration has been highly volatile. Getting the base year assumptions 'right' is extremely difficult because of imperfect input data. And where projections are disaggregated by age, sex and (in some cases) Indigenous status, this underlying uncertainty is magnified. The small size of the NT population means that even a small differential between the projected and actual numbers may result in relatively large percentage errors in the projections when comparisons are made between the projected figure for a given year and the Estimated Resident Population (ERP) which eventuates for the same year. This issue is commonly faced by small jurisdictions. Indeed research by Tayman et al. (1998) found that an inverse relationship existed between population size and the accuracy of projections for a group of county areas in the United States.

Finally, population projections usually rely on a continuation of the demographic structure of the population being modelled, and on accurate assumptions of future trends in demographic structures. In reality, the Territory's population system is complex and dynamic, partly as a function of its composition and partly because human behaviour is very difficult to predict. The ramification of these issues is that the application of projections in policy and planning functions must be made with due attention to the underlying assumptions and with an understanding about the extent to which projections are suitable for the job at hand.

Why population projections are never wrong but never right

Essentially population projections are a mathematically based assessment of future trends based on a set of assumptions made at the time they were modelled. In Australia the most widely used method is the 'cohort component' model. The ABS, for example, has used this

Population Projections for the Northern Territory - an uncertain future?

method to produce Australian, State and Territory projections every two or three years since 1978. At the core of cohort component modelling is a simple mathematical equation:

$$P_t = P_{t-1} + B_{t-1,t} - D_{t-1,t} + M_{t-1,t}$$

Where P_t = population at time t ;

P_{t-1} = population at time $t-1$;

$B_{t-1,t}$ = births, in the interval from time $t-1$ to time t ;

$D_{t-1,t}$ = deaths, in the interval from time $t-1$ to time t ; and

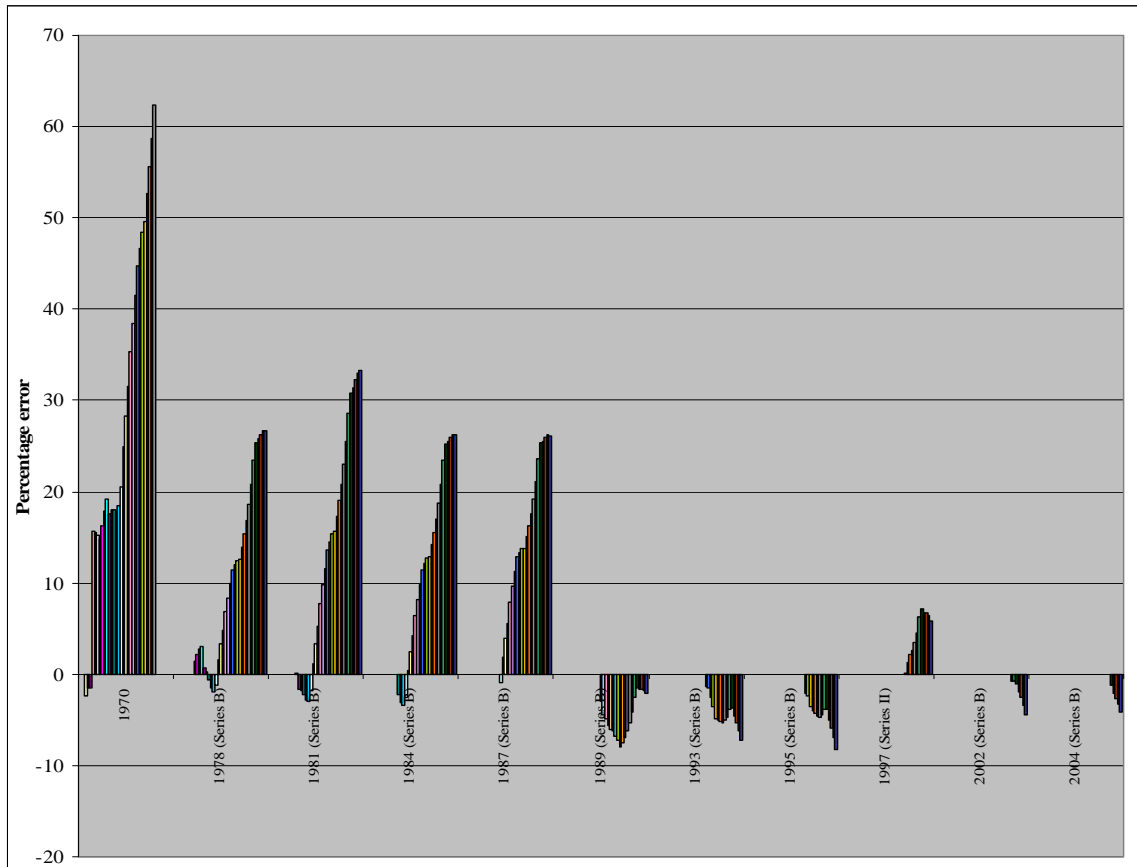
$M_{t-1,t}$ = net migration, in the interval from time $t-1$ to time t .

The equation states the population grows each year (or declines) by the addition of births, the subtraction of deaths, and the addition of net migration to the population of the year prior (or simply the by the sum of the components of population change). By definition projections can never be wrong since they are conditional on assumptions about the components holding true. Projection equations are relatively straightforward so that if assumptions do hold true, there is little room in the equations for calculation errors. Any deviation from the projected outcomes (as actual population data comes to light when we move forward through the projection years) can only be due to the assumptions about births, deaths or migration not holding true.

For the same reasons, projected numbers are almost never right because what transpires in population estimates (like the Estimated Resident Population) is never exactly what was projected for each of the components. In general a degree of error for each component becomes apparent and, when combined the effect is a magnitude of error in the total. In the case of small populations like the Territory, small forecast errors for components can generate relatively large errors in the projected population. Indeed the accuracy of past projections has been poor even at the Territory level and before any disaggregation. For example, the middle series of ABS projections made during the 1980s tended to over-estimated the eventual population by around 10 % within the first 10 years. Furthermore, the middle series for some base years for the Territory have over estimated the eventual (total) projected population of the Territory after 30 years by as much as 65% (for example the 1970 series shown in Figure 2). Meanwhile, the equivalent error rates for projections at the Australia level, modelled using the same methods and assumptions, are much lower and typically have been well within a 2% margin of error even after 30 years.

Population Projections for the Northern Territory - an uncertain future?

Figure 2 - Past projection errors for the Northern Territory (% by years into projection)



Sources: ABS Catalogue No. 322.0 (various years), catalogue No. 3101.0 and Catalogues 3102.0 (various years)

Note: each column represents the percentage difference (+/-) between the projected population and the ERP for each year in projections. For example, that projections made during the 1970s and 1980s over estimated the eventual population while those made in the 1990s under estimated the population.

If projections are always wrong, and often dramatically so as we see in Figure 2, it seems reasonable to ask “why bother?” to produce them at all. But in spite of their limitations, projections can provide a rational basis for decision making (George et al. 2004). And in the absence of other ways to assess future population trends they are much better than nothing at all. Smith et al. (2001) have identified the following as the major roles for projections (paraphrased):

- **Predicting future population change** – understanding likely rates of growth and the disparities between growth rates according to regions and between sub-populations is the central basis for planning and resource allocation. In the Territory’s context most of our growth is occurring in the Darwin region for the non-Indigenous population, while outside of Darwin the Indigenous population is growing at a faster rate than the non-Indigenous population. Planning for the outcomes of shifts in the settlement patterns is obviously an important process.

Population Projections for the Northern Territory - an uncertain future?

- **Analysing the determinants of population change** – projections make possible insights into the drivers of population change, past and future. They also facilitate ‘what if’ scenarios. In the case of the Territory, examples of scenarios which have been examined include improvements to Indigenous life expectancies, the effects of big projects on growth, and the impacts of high unemployment in other States.
- **Presenting alternative scenarios** – similarly, alternative scenarios can be tested by varying the input assumptions. For example, along with its Whole of Government projections developed recently, the Northern Territory Treasury (NTT) has produced two additional scenarios – a high migration and a short-term variable migration scenario to assess what impacts there might be on housing demand and long term population growth.
- **Sounding warnings** – projections can be applied to highlight impending issues like water availability for growing cities. And in the Territory context they provide research based evidence on which discussions around Australian Government resourcing of programs and services in the Territory can be based.
- **A basis for other projections** – projections are used as inputs to a wide variety of other projections and analyses including school enrolments, labour force, and household projections.
- **Capacity building for demographic research** – although not listed by Smith et al. this purpose is at least as important as the others in the Territory context. By default, parameters for projections must be carefully considered and examined and this requires a coming together of opinions and skills. It also necessitates careful examination of past and current available data to determine the most appropriate use of these in the modelling process. In response to a need for Indigenous projections, for example, the development of the NTT series has garnered engagement across a wide spectrum of Territory government departments. And through the examination of input data, several issues have been identified which, in the long-term will lead to improvements in population estimation processes and techniques.

Accordingly, the fact that projections are subject to errors makes them no less valuable. The key is to understand and work within their limitations and to continually explore methods for improving their accuracy and applicability.

Current projections for the Northern Territory

Since 1978 the Australian Bureau of Statistics has produced national and State/ Territory projections every two or three years using cohort the component methodology. In general each set has included three series (high, medium and low) based on varying assumptions. Base years (also known as the ‘jump off’ year) for Territory projections include 1978, 1981, 1984, 1987, 1989, 1993, 1995, 1997, 1999, 2002, 2004, and 2006. Meanwhile the NTT has recently made available its 2006 to 2056 projections (the NTPOP model) which were developed in a research-based collaboration with the Population and Tourism Studies group at Charles Darwin University (Northern Territory Government, 2009). This cohort component model is based on the movement population accounting framework as described in Rees (1984) and Willekens and Drewe (1984) and consequently it can compare the NT with the Rest of Australia. Most importantly, it provides disaggregation by Indigenous status. The Australian Government Department of Health and Ageing (2009) has also outputted projections for 2007 to 2021.

Population Projections for the Northern Territory - an uncertain future?

Figure 3 shows the middle series (Series B or Series II from the ABS, and the baseline series from NTT) which were 'live' at 2006 along with the NTT and Health and Ageing projections.

The first thing of notice is that by 2006 there were no accurate live projections (other than those made in or post-2008) which matched the ERP for that year. For example, the 1984 based projections over estimated by just over a 25% and even the 2002 and 2004 based projections were around 3% out by 2006. Variation between projected numbers and the ERP also tends to increase over time during the projections horizon (or life span). The mean error in all projections made for the Territory by the thirtieth year is over 30% while at 15 years it is far less at 11%.

Secondly, very large variations in the projected population for the Territory are evident. The middle series projection for 1987 based projections had the Territory population at 420,000 by the year 2031 for example, while the middle series from the 2002 projections, by contrast, suggest a much lower population of 307,000 and at a much later date of 2051. The NTT projections have the Territory population reaching around 315,000 by 2036, or total growth of around 50% over the thirty year period. Work by Wilson (2007) has shown that error rates for Australian level projections from the ABS have improved marginally over time but error rates for these were already quite low. For the Territory there does on the surface appear to have been significant improvements to the accuracy of projections based in the 1990s and 2000s (when compared to earlier years) but it is perhaps too soon to tell. Certainly high volatility in the components of change has not diminished and as a consequence we can expect relatively large discrepancies between projected (regardless of which set of projections) numbers and the ERP.

Advice to users of Territory projections

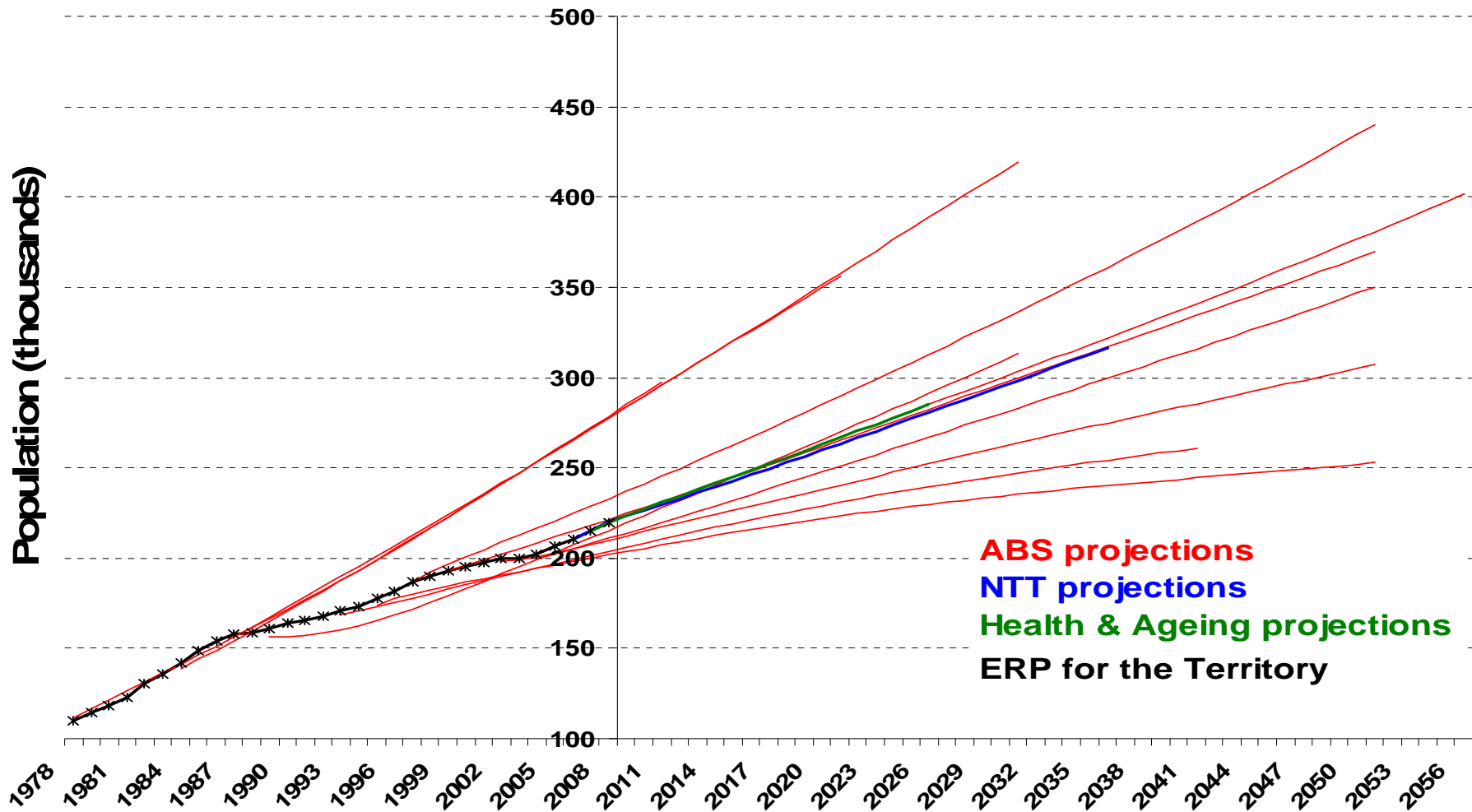
Every set of projections for the Territory, regardless of the magnitude of eventual error, is of value since each includes a different set of assumptions to provide us with retrospective scenarios against which we can analyse the actual outcomes. These processes inform our understanding of the characteristics and behaviour (represented by births, deaths and migration) of Territory residents as well as building our knowledge on developing techniques to improve future projections. The advice to users is not to take any projection numbers as given or indeed on face value. Instead it is important to invest time developing an understanding of the assumptions behind the numbers and knowledge about their limitations.

This brief also gives us some sense of the issues confronting the ABS in delivering accurate assessments on the size and composition of the Territory's population. We do not truly know the size of the population at any given point in time because of issues around Census enumeration, and due to the application of top down and consistent (across all States and Territories) population estimation methods. The ABS is active in identifying other suitable sources of data for improving population estimation and projections as well as exploring ways to better model projections which are disaggregated by Indigenous status. And this is by no means a circumstance unique to Australia. Instead it reflects a small, mobile, and remotely based population. Critically, with high rates of Census undercount, high levels of non-contacts, and high levels of not stated for key variables in the Census, we are reminded of our role as a statistical and research community in 'selling' the importance of the Census to the community at large.

Population Projections for the Northern Territory - an uncertain future?

At the current time, the NTT projections are the set which are most suitably tailored to the Territory's needs. The assumptions have been agreed to at the local level and incorporate some elements of local knowledge about the input data. Crucially they provide for disaggregation by Indigenous status as well as a detailed age breakdown (they are available online at www.nt.gov.au/ntt). Nevertheless, there is no evidence to suggest these projections will be more or less accurate than any other available for the Territory. Net interstate migration continues to fluctuate widely and high residential mobility will continue to create uncertainty around the true underlying growth rate for the Territory. A degree of this uncertainty may have already been fed into the NTT projections as well as the other sets which are currently available. Time will tell.

Figure 3 – Current live middle series ABS, NTT, Health and Ageing projections, and the ERP for the Territory, 1978 to 2056



Sources: ABS Catalogue No. 3222.0 (various years), ABS Catalogue No. 3101.0 (various years), and Catalogue No. 3102.0 (various years), NT (2009), Department of Health and Ageing (2009)

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