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## It's Raining Men in Darwin: Gendered Effects from the Construction of Major Oil and Gas Projects

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# **It's Raining Men in Darwin: Gendered Effects from the Construction of Major Oil and Gas Projects**

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## **Abstract**

Construction of large onshore oil and gas processing plants brings the promise of significant local economic attributions; however, the injection of a high churning male construction workforce can change and dominate the host community's demographics. This can generate a range of issues which are well documented in the literature on resource 'Boomtowns'. But because most studies are retrospective and focus on small towns, findings may hold limited transitivity to relatively large and economically diverse towns or cities. Consequently research based knowledge for the facilitation of dialogue between governments, the community and industry on the scale and timing of construction impacts is absent. Darwin, a city of around 130,000 residents in the north of Australia, has secured a large liquid natural gas processing plant which is currently under construction. The plant is touted to bring substantial economic benefits with a peak construction workforce of more than 3,500 anticipated. But little meaningful discussion on possible effects on population makeup and social fabric of the city has been forthcoming. This study profiles the INPEX plant construction workforce under several scenarios based on combinations of local worker engagement and total workforce size. Profiles are overlaid onto population projection data to appraise the scale of demographic and social impacts. Findings show that, despite Darwin's size and pre-existing population, labour force and family profiles, the project will contribute significant demographic and social upheaval during construction. Governments, the community and industry are advised to engage in an early and open dialogue focused on mitigating negative and garnering positive long-term outcomes with this research as the basis.

Keywords: boomtowns, Darwin, liquid natural gas, gender bias, resource development, oil and gas

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## **1.0 Introduction**

The construction of large onshore oil and gas processing facilities are known to spike the populations of rural or remote towns and cities which host them (Hoath & Haslam-McKenzie, 2013). On the one hand this brings the promise of significant economic attributions to local and regional economies; the coveted chalice for governments and industry who 'chase' such projects. But the injection of significant numbers of 'new people' into the population, primarily the high churning male construction workforce, can dominate and

completely change the demographic makeup of host towns and cities during construction (Taylor & Winter, 2013). Problems arising from such injections are articulated in a long history of studies on the social, demographic and economic legacies of resource led 'booms' and 'busts' for towns and cities in rural and remote parts of developed nations (Chang-I, 1985). On the whole, studies indicate smaller towns face larger scales of impacts (for example, Jacquet, 2009) both during construction and as the rapid draw down of the workforce towards the end of construction begins, sometimes triggering a 'bust' phase.

A number of research initiatives examining impacts from oil and gas projects in the western United States in the 1970's and 1980 have articulated economic and social consequences for small communities when projects are located within or adjacent to towns. These led to the development of the well-known "Boomtown Impact Models" (Gilmore, 1976; Jacquet, 2009). Boomtown models propose that communities become overwhelmed by the scale of construction worker arrivals and their impacts on community amenity, security and lifestyle, such that they succumb to the "Boomtown Syndrome" (Jacquet, 2009). The Syndrome is characterised by an initial period of community euphoria because of perceived and realised economic benefits, but this is followed by community fears over accompanying social impacts and deteriorations in services, which rapidly manifest once workers arrive. Social deterioration can be most acute after the labour intensive construction period is over and the far less labour demanding operational phase begins. In many cases an economic 'bust', hallmarked by real estate deflation and sudden declines in demand for local goods and services, follows (Wick & Bulte, 2009).

The issue of gender bias and its consequences as a result of the construction workforce also features in the literature on oil and gas ventures. Specifically the disproportionate numbers of males at the construction phase (Freudenburg, 1981) represents a period of extraordinary population growth. This places stress on services and infrastructure which is not scaled to adapt to or to compensate for such growth. Chang-I (1985) suggests that male arrivals adjust relatively poorly to their new environment and circumstances, creating feelings of loneliness and situations where alcoholism, drug abuse, and violence may develop. Increased crime rates, prostitution, and general social deterioration or a scaling up of anti-social behaviours have also been documented. Meanwhile conflicts between workers and locals over behaviour and differing pay rates may create worker alienation and mutual resentment. The literature emphasises that social deterioration can develop rapidly with governments and communities rarely in a position to plan for and mitigate them (Jacquet, 2009).

The presence of a large and male dominated construction workforce has also been noted for generating socially isolating conditions for women (Davidson, 2014). Remote area populations by and large exhibit a male bias (more men than women) in their resident populations and this is exacerbated by worker arrivals. Isolation can be felt on many levels. Examples are a fear of 'venturing out' from perceived risks of crime victimisation or a reticence to drive due to large numbers of heavy vehicles on the road (Griskevicius et al., 2012). Women may also fear or become victim to anti-social behaviour as a result of male competition for mates (Griskevicius et al., 2012). Although isolating effects will not exclusively be felt by females, remote places generally fare poorly when it comes to valuing the role of women in the community, as well as in the workforce more broadly a factor which has been

noted as significant in contributing to the high churn amongst the female populations of rural and remote areas (Carson & Schmallegger, 2009).

In the limited literature on ways to mitigate social isolation in the context of the construction phase for large oil and gas projects, a common theme is the need for early and public dialogue to take place well before arrival of construction workers (Jacquet, 2009). Scholars advocate for informed discussions through the exchange of information between all parties including companies, governments and researchers (Reed, 2008). But boomtown models, along with most research in this area, are retrospective. That is, studies have invariably articulated impacts from the construction of large oil and gas facilities after construction has been completed or the project has been shut down. The absence of place specific 'up front' and research based knowledge about the nature and scale of likely impacts can contribute to a vacuum of information and a paucity of dialogue. This not only contributes to a sense of community fear and trepidation, but also hampers the potential for governments, communities, and companies to actively engage with the view to ameliorating negative and maximising positive impacts from projects. This 'business as usual' approach sees governments (especially local) and communities left to deal with the costs and social legacies after construction (Gloersen et al, 2008).

Along with the retrospective scope of much of the research, most studies in this field have examined small communities of less than 10,000 residents (Jacquet, 2009). While this explains the sense of overwhelming change documented in the literature, it says little about how and why impacts might vary according to demographic and economic starting characteristics for 'host' towns or cities. A critical factor, therefore, in forecasting impacts for individual communities are pre-existing characteristics including population size, the existing growth trajectory, gender bias, labour force characteristics, educational profiles, and household and family characteristics. These determine a range of factors in relation to such projects like the extent to which locals might be engaged in construction, who becomes affected by negative impacts, who benefits, how well services and infrastructure cope, and how the population transitions through the life of the project. This study examines these issues in relation to the city of Darwin in the north of Australia. It seeks to address the information vacuum around possible demographic and social impacts from the construction of a major liquid natural gas processing plant there.

## **2.0 Darwin's Population and Economy**

Darwin is the capital of the Northern Territory of Australia and has a population of around 136,000 (Australian Bureau of Statistics [ABS], 2014). The remainder of the Northern Territory is very sparsely populated, with just one other centre (Alice Springs in the south) having more than 20,000 residents. The nearest Australian State capital city to Darwin is Adelaide, which is 2,700 kilometres (km) away. Sydney is 3,150 km distant, making cities in south-east Asia such as Dili (700 km) and Jakarta (2,700 km) more proximate to Darwin (see Figure 1).

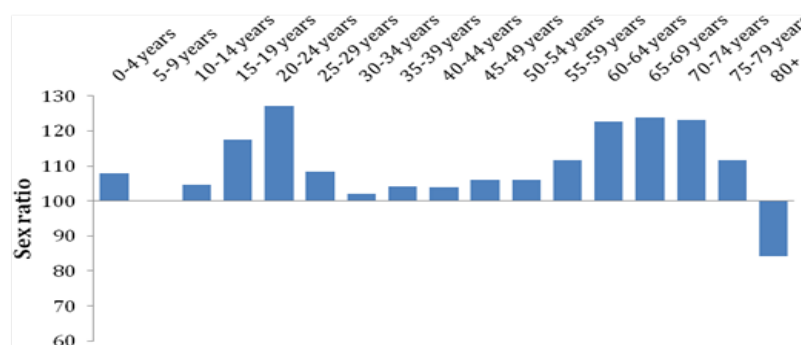
Figure 1: Darwin's location in the north of Australia.



Source: Google Maps, 2013.

Since European settlement in the late 19<sup>th</sup> century, Darwin has had a male dominated population. In 2012, its sex ratio (the number of males per 100 women) was 109 compared to 98 for the total Australian population (ABS, 2011a, 2011b). Demographers and sociologists label such populations as ‘male biased’ (Griskevicius et al., 2012) or ‘unbalanced’ (Reed, 2008). Statistically, male biased populations experience higher levels of violence and crime, higher rates of drug and alcohol abuse and other social problems arising from the limited opportunities for partnering and family formation, especially when young males substantially outnumber young females (Hudson & Den Boer, 2002). An accentuated sex ratio amongst young people has certainly been evident for Darwin. For 20-24 year olds in 2012, the ratio was 127 while for 15 to 19 year olds it stood at 117 (see Figure 2). The ratio increases substantially for pre- and early retirement ages (55-59 years and 65-74 years, respectively), because of males migrating to Darwin for employment just prior to retirement (see Martel et al, 2013), and from out-migration of women, who have or are about to retire (Voit & Carson, 2012). Differential life expectancies for males and females see Darwin’s sex ratio fall substantially after age 80 with fewer males surviving in this cohort.

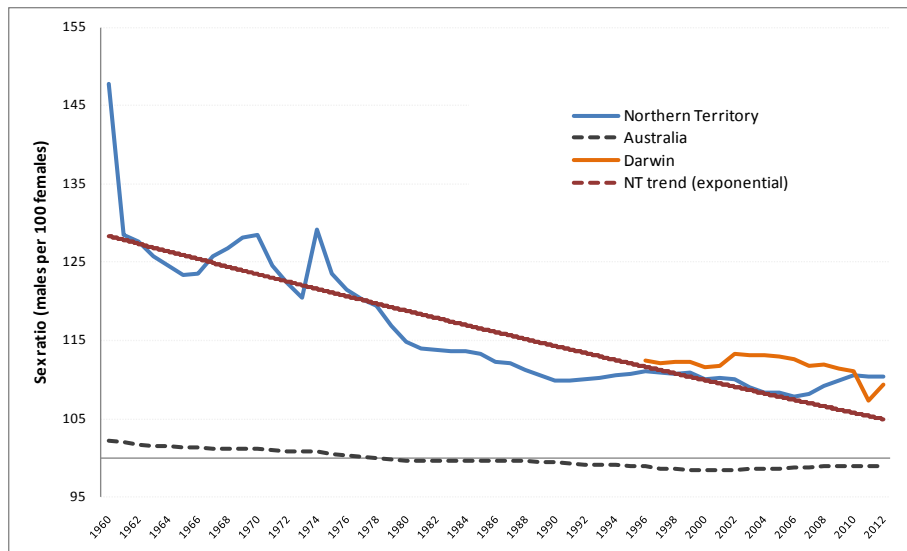
Figure 2: Darwin's sex ratios across age groups, 2011.



Source: ABS, 2011a.

Although Darwin's population is male dominated, the extent of male bias has declined significantly in recent decades such that a linear trend would see Darwin reach a 'balanced' sex ratio of 100 by the year 2020 (see Figure 3). Recent declines reflect the growth in the health, education, and administration sectors subsequent to the Northern Territory becoming a self-governing jurisdiction in 1978. The spike in the Territory's sex ratio seen in 1975 was from the influx of male builders and tradesmen after the devastating Cyclone Tracy of 1974, which all but flattened the city (Li, 2009).

Figure 3: Long term trends in sex ratios, 1960-2012.



Sources: ABS Catalogue no. 1362.7 (2001, 2003, 2004, 2007); ABS Catalogue no. 3105.0.65.001 Australian Historical Population Statistics, 2008; ABS Catalogue no. 3101.0

Carson (2011) explained the interplay between Darwin's high sex ratio and the approach taken to economic development. This might broadly be described as 'frontierist' (Instone, 2009), where development is based on the ethos of defending and 'opening up' the national frontier. This pathway features defence alliances and major projects, with diminishing industrial diversity leading to an increased male bias in the population (Schmallegger & Carson, 2010; Taylor et al, 2011; Wick & Bulte, 2009). While Darwin remains an important military post, the private sector economy is relatively poorly diversified. Mining contributes a quarter of the NT's Gross State Product, compared to less than 10% nationally (Northern Territory Department of Treasury and Finance, 2012), but does not feature in the top five industries for employment, which are public administration and safety (15%), health care and social assistance (11%), retail trade (10%) and construction (10%). Construction which is related to major government sponsored infrastructure projects has been an important driver for private sector economic activity (Carson et al., 2010) and more recently, the Northern Territory Government has attempted to attract foreign capital to develop Darwin as a South East Asian hub for the LNG industry (Yates & Schuppert, 2005).

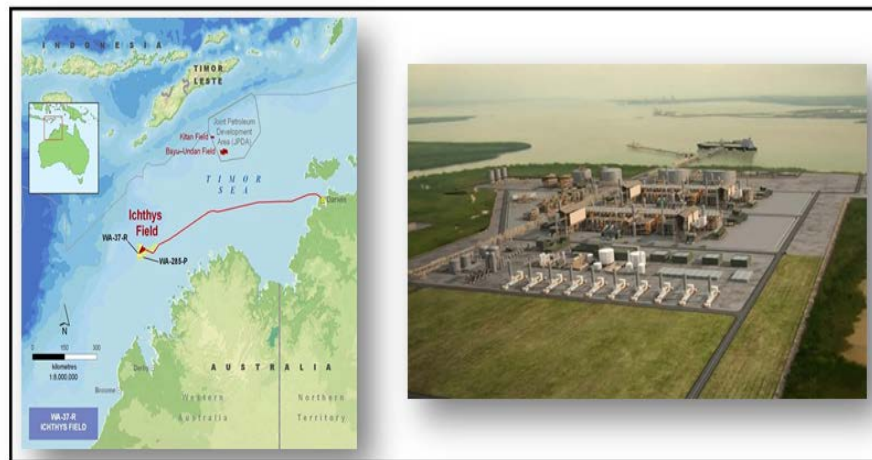
The combination of the defence and a large construction industry pathway towards economic development is not unusual in frontier regions (Carson, 2011; Gloersen et al, 2008), and helps explain not only high sex ratios, but high population turnover rates, difficulties in attracting and retaining skilled workers, and an inability to generate inter-generational population transitioning (where multiple generations of families remain in Darwin). This is because the very industries which are pursued for economic development

help to 'lock in' a particular stock of human capital, which is then reflected in the composition of the resident population (Carson, 2011).

### 3.0 The LNG Promise for Darwin

In January, 2012, the Japanese INPEX Corporation announced it had finalised a deal to construct and operate a major liquefied natural gas (LNG) processing plant near Darwin (Australian Broadcasting Corporation [ABC], 2012a). The project involves the extraction of natural gas from the Ichthys Field within the Browse Basin which is located offshore in the north-west of Western Australia (WA) and piping it sub-sea almost 900 km to Darwin for processing at the Darwin facility. The Darwin plant is to be built on Blaydin Point, only a few kilometres from the city centre of Darwin (see Figure 4).

Figure 4: Location of Ichthys field (left) and an Artist's Impression of the Blaydin Point Facility.



Source: INPEX, 2012a.

Originally the company wanted to build the processing plant closer to the Ichthys field in WA but complications arose during negotiations with local Indigenous groups. At this time (2003) the Chief Minister of the Northern Territory Government travelled to Japan and proposed to INPEX that the processing plant could be located in Darwin, thereby reducing uncertainty over land tenure and construction schedules (ABC, 2008). The total value of the Ichthys project (establishing offshore infrastructure, pipeline construction, processing plant construction, dredging, environmental works, workers accommodation village construction, etc.) is estimated at around \$34Aud billion, making it the biggest private sector funded project in Australia's history. Construction of the onshore processing facility in Darwin is estimated to require 3,000 to 3,500 workers during peak construction (INPEX, 2012a). The company has built a workers village at Howard Springs, south of Darwin, to house fly-in-fly-out plant construction workers.

The Ichthys project follows the 2006 commissioning of the Conoco Phillips Darwin LNG facility, which processes and stores LNG sourced from the Bayu-Undan field located around 502 kilometres north-west of Darwin. This LNG is sold to Tokyo Electric and Tokyo Gas in Japan under a 17 year agreement and has a 3.7 million tonne per annum production capacity. Comparatively, the Ichthys project will have nearly three times the production capacity at 8.4 million tonnes of LNG and 1.6 million tonnes of liquefied petroleum gas per annum (INPEX, 2012a). LNG development has prompted the Northern Territory Government to articulate a desire to establish the city

as the LNG hub for Asia (Sydney Morning Herald, 2010). In 2011, INPEX announced a \$91AUD million Community Benefits Package including establishing the North Australian Hydrocarbon Centre of Excellence at the university (Charles Darwin University, 2011).

As we have noted, Darwin's resident population has a substantial pre-existing male bias at the commencement of construction for the INPEX facility and social issues resulting from this bias have featured in the public discourse for some decades (Instone, 2009; Carson et al, 2010; Carson, 2011). There have also been suggestions that the male bias and focus on catering to male preferences for urban development and planning have contributed to a stifling of economic diversification, particularly through limiting potential for tourism development (Schmallegger & Carson, 2010).

In the case of Darwin, the demographic imposition of a large number of men for the construction of the onshore INPEX facility has the capacity to significantly alter its sex ratios and add to social issues identified by existing studies. These include anti-social behaviour as a result of competition for mates (Griskevicius et al., 2012), higher crime rates (Hudson & Den Boer, 2002), and a range of social costs associated with these (Dolan & Peasgood, 2007). This study examines the extent to which sex ratios might alter from their existing levels as construction workers for the LNG facility arrive and depart. The research recognises that the magnitude of impacts on the sex ratio, as well as for social issues, will be determined by a number of complex and interrelated factors. Not least are the eventual size of the construction workforce and the proportion of labour, which is sourced locally. In simple terms, the larger the workforce size and the lower the proportion sourced locally, the greater are the impacts on population gender balance. In this study we provide insights on the likely composition of the Blaydin Point facility construction workforce and the resulting population effects. We examine the former based on the gender, age, and partnering profiles for workers in the construction industry in Darwin using 2011 Census data while for the latter we model the effects of these profiles on population change and characteristics.

#### **4.0 Methods**

The research was conducted in two parts: (1) The extraction and analysis of secondary (Census of Population and Housing) data to profile the gender makeup, age and partnering profile of the Darwin construction workforce as it stood in 2011; and (2) The application of results from part one to the modelling of six construction workforce scenarios and the application of the net population effects under each scenario (namely the net addition of males and the change to Darwin's sex ratio) to pre-existing population projections data. The sex ratio is defined as the number of males per 100 females in the population.

First, we extracted custom census data tables using Table Builder software to profile the extent of gender bias, the age profile, and the partnering profile for employed people in the construction industry in Darwin. Industry of employment data is not available specifically for oil and gas construction, so the overall construction industry profile is adopted and assumed to be broadly similar. Secondly, we applied the results from the census analysis to model net population impacts from a range of construction workforce scenarios for the project. The scenarios vary according to expectations about the proportion of 'peak workforce demand', which might be met by locally residing employees combined with variations in the absolute size of the construction workforce. Thirdly, the net 'inflow' of male workers under each scenario is added to the results of population projections for Darwin for the years 2012



to 2016 (inclusive) to derive the effects on sex ratios. Population projections are sourced from the baseline scenario published by the Northern Territory Department of Treasury and Finance (Northern Territory Department of Treasury and Finance, 2011). In the results section of this brief, these existing population projections are labelled as ‘NTPOP’ (for Northern Territory Population Projections).

Six workforce scenarios were modelled. These are outlined in Table 1 and vary from zero (scenarios a1 and a2) to 50% (scenarios c1 and c2) local employment in the plant’s construction workforce. As a guide, one industry analyst has proposed that around 30% of work will be undertaken by local contractors (ABC, 2012b), but the real figure may not be known until after the event and, even then, it will be difficult to ascertain precisely. While INPEX is publically stating that it will endeavour to ensure labour is sourced from within the Northern Territory, very high labour force participation rates (recently around 80% for males and around 70% for females, compared to 72% and 59% respectively for Australia) (ABS, 2012b) indicate that a substantial share of the construction workforce will need to be sourced from interstate and overseas. Consequently, the middle scenario used in this study is for 20% local engagement.

Table 1. *Details of Scenarios Modelled*

<b>Scenario</b>	<b>Construction workforce size</b>	<b>Percent of local employment</b>	<b>Males to distribute</b>	<b>Females to distribute</b>
a1	2,000	0%	1,740	260
a2	3,000	0%	2,610	390
b1	2,000	20%	1,392	208
b2	3,000	20%	2,088	312
c1	2,000	50%	870	130
c2	3,000	50%	1,305	195

Source: Authors.

The total size of the onshore INPEX construction workforce is also varied for each scenario. This is anticipated to be somewhere between 1,500 and 3,000, with the latter reflecting the chairman of the company’s best estimates (ACIL Tasman, 2008; Northern Territory Government, 2012). We model sizes of 2,000 and 3,000 in combination with variations in the proportion of the workforce sourced locally. The size of the workforce engaged in construction will vary from year to year during the construction period. We use peak workforce ratios (with the peak workforce anticipated in year four of the construction period) provided by ACIL Tasman (ACIL Tasman, 2008). These ratios are 66.9% (of the peak workforce) in 2012, 99.5% in 2013, 99.8% in 2014, 100% in 2015, and 73.1% in 2016 (ACIL Tasman, 2008, Appendix b-2).

The two main limitations of our assumptions and approach are that the modelling excludes any offshore workforce (for construction of the pipeline, rigs, etc.) which might be based in Darwin, and that it is possible that the gender, age and partnering profile of construction workers on oil and gas projects differs from overall construction. The total workforce size is also suggested to be closer to 4,000. The net effect of these limitations is to

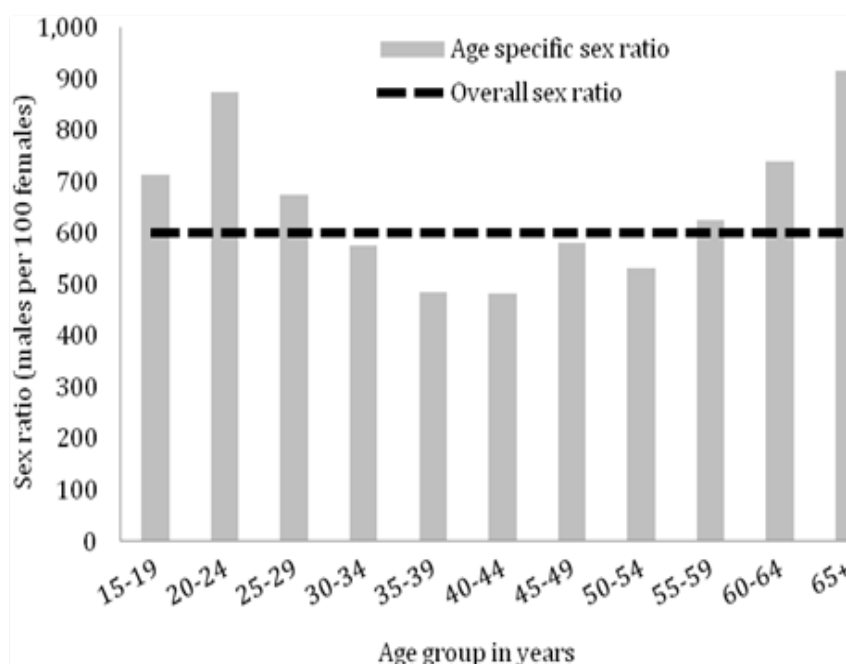
relatively under-estimate the effects on population and social fabric. But given that the key aim of the research is to demonstrate the extent of difference in net population outcomes under each scenario, these limitations do not affect the results and limitations are consistent across each of the scenarios we have modelled.

## 5.0 Results

### 5.1 Gender, Age, and Partnering Profiles for Construction in Darwin

In 2011 there were 5,750 workers recorded in the construction industry in Darwin. Of these, 4,930 were men, generating a sex ratio of 600 (that is, for every 100 women employed in the construction industry there were 600 men). But the sex ratio varied considerably according to age (see Figure 5). The workforce was highly male dominated for those aged from 15 to 29 years (874) and in the older age cohorts from 60 years onwards, although numbers of workers in older age groups were small.

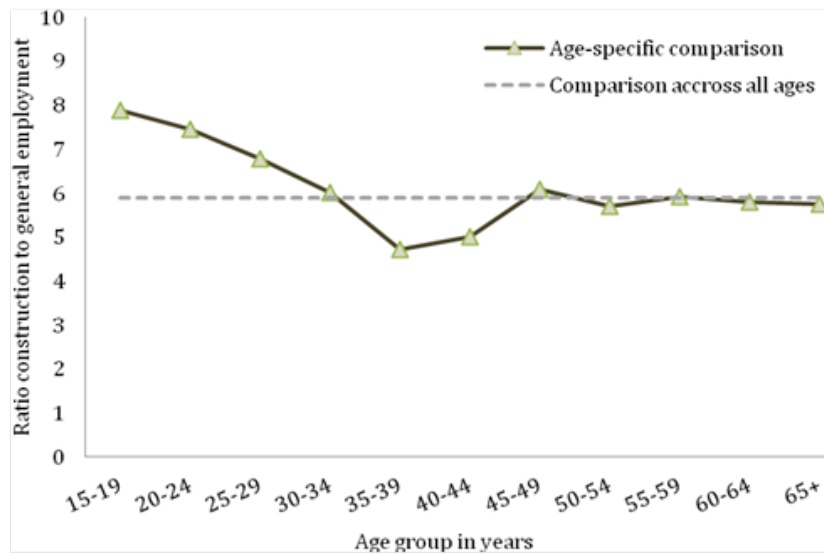
Figure 5: Sex Ratios by Age Group in the Darwin Construction Industry (2011).



Source: ABS Table Builder, Extracted by the Authors.

The male dominated and youthful age profile of workers in the Darwin construction industry is highlighted by comparing the construction industry sex ratio to that of all other industries combined. Plotting comparisons of the two by age groups shows the construction industry sex ratio was 5.9 times higher than that of other industries combined (see Figure 6). Differences are greatest for those less than 30 years of age, particularly for ages 15 to 19 years (7.9) and 20 to 24 years (7.5).

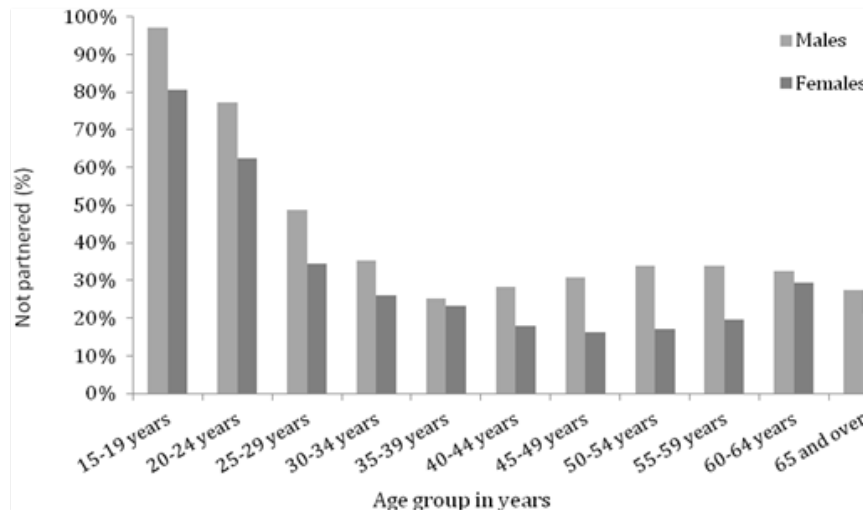
Figure 6: Comparisons of the Construction Industry Sex Ratio to Others in Darwin (2011).



Source: ABS Table Builder, Extracted by the Authors.

The partnering profile for construction workers in Darwin indicates the majority of those aged less than 30, who comprise a third of the total workforce, were not partnered (see Figure 7). Importantly, fewer males (who constitute more than 90% of the workforce) were partnered across all age groups. Nevertheless, most males and females aged over 40 years were partnered, indicating some potential for a long term contribution to the resident population through the addition of offspring.

Figure 7: Partnering Profile within the Darwin Construction Industry (2011).



Source: ABS Table Builder, Extracted by the Authors.

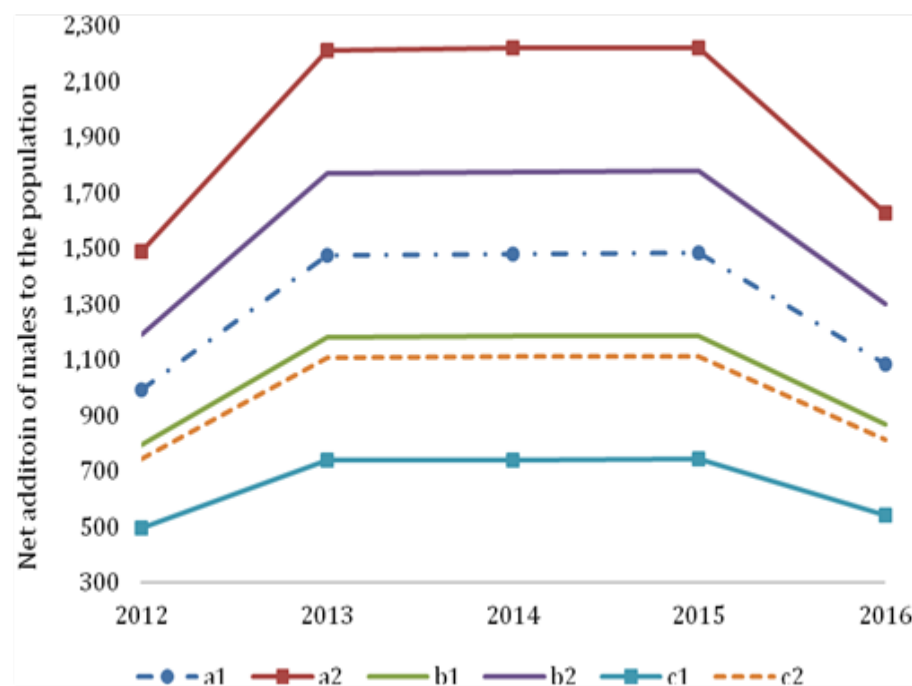
### 5.2 Net Population Effects from Construction

This section provides results from the application of the gender and age distributions reported in the section above to each scenario in relation to combinations of construction workforce sizes and proportions of locally sourced workers.

### 5.2.1 Net Addition of Males to the Population under Each Scenario

Figure 8 shows the net addition of males to Darwin’s population under each of the construction workforce scenarios outlined in the methods section. The largest absolute and net additions to the population will be made in 2014 and 2015 under scenario a2 (no local employment and a 3,000 person construction workforce). In peak construction, 2,610 men and 290 women will be added to Darwin’s population (a net of 2,220 men) under that scenario. The lowest net addition of males to the population will occur under scenario c1 which is a workforce of 2,000 and 50% local employment. In between, variations in local workforce and total workforce size produce a range of net additions of males during the course of construction.

Figure 8: Net of Males Added to Darwin’s Population under Each Construction Workforce Scenario (2012 to 2016).

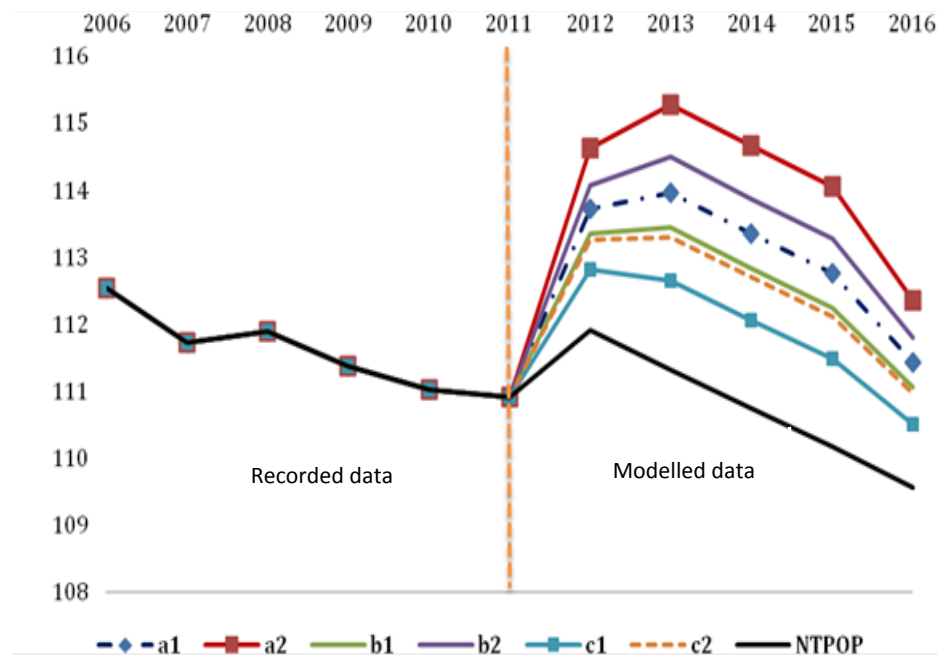


Source: ABS Table Builder, Extracted by the Authors, Northern Territory Department of Treasury and Finance, 2011, Author’s Calculations.

### 5.2.2 Changes to Darwin’s Sex Ratio under Each Construction Workforce Scenario

The scale of the net addition of males to Darwin’s population under each of the construction workforce scenarios modelled here will be sufficient to arrest the long-term decline in Darwin’s overall sex ratio. Differences between each scenario and between these and gender ratios, which might have eventuated in the absence of the gas plant construction phase, are provided in Figure 9. The line ‘NTPOP’ indicates the projected sex ratios for Darwin from 2010 to 2016. The greatest variation from these projections will be experienced under the scenario of a 3,000 construction workforce with zero local engagement (scenario a2), where the sex ratio would rise from a projected 111 to a peak of 115 in year two of construction (2013).

Figure 9: Darwin's Sex Ratio under Each Construction Workforce Scenario.



Note: The 'NTPOP' Line Represents the Baseline Population Projections for Darwin (see Northern Territory Department of Treasury and Finance, 2011).

## 6.0 Discussion

This study has reported on modelling of the likely impacts on Darwin's gender balance and population size from the construction phase for INPEX's Blaydin Point gas facility. The modelling examined short-term and temporary effects on Darwin's population using gender balance and net additions to the population to highlight differences in the scale of impacts under various scenarios. Even under the 'best case' scenario, where half of the construction workforce is sourced locally and the size of the workforce is at 2,000, the sex ratio for Darwin will increase from around 110 to 113, which in demographic terms is significant. With an anticipated construction workforce of around 3,000, the project will arrest Darwin's long-term declining sex ratio and enhance its male-biased population structure.

The construction industry in Darwin was found to be very highly male dominated when compared to other industries of employment. This was particularly the case for those aged less than 30 years and those aged 65 years or more. Gendered impacts will be greatest where a large workforce is engaged and few are sourced locally. A workforce of 3,000 and no local employment, for example, would see 2,605 people added to Darwin's population (or 2.6 percent) and a net increase of 2,216 males. This would lift the sex ratio for Darwin from 111 to a maximum of 115.3 in 2013. Added to this, the majority of young males in construction are not partnered and there is substantial turnover in the non-fly-in-fly-out workforce. These characteristics match those of populations in the 'boomtowns' research quite closely.

The logical inference from this study is that the injection of up to 2,200 males in one year can only exacerbate existing issues related to the pre-existing male bias in the population of Darwin. These include impacts on crime, violence and social dysfunction as well as social isolation for women and the continued

economic marginalisation of local Indigenous residents. Darwin's economic demography (well described by Carson, 2011) featuring high sex ratios, high turnover and external sourcing of labour to fill skilled vacancies will become further entrenched.

But the absolute numbers somewhat obscure the fact that there will be significant churn and transitioning within the construction workforce population, such that there is a continuum of new male arrivers who must adapt to their new environment and their co-residents. With the literature pointing to new arrivers as the most vulnerable and disruptive group for residents, there is a clear need for programs and services to assist with social integration. Intended short lengths of stay in Darwin will also reduce the probability that incoming male construction workers (few of whom will be in social or legal marriage-like relationships) will be accompanied by female partners.

Perhaps the biggest question to arise from this study is what might eventuate at the end of the construction period when the economic and physical presence of the workforce has been removed? Given Darwin's current economic profile with a poorly diversified private sector it is difficult to argue that a 'bust' of some proportion will not come about. Of course, what is different about Darwin in comparison to the small boomtowns studied previously are its larger population and economic base. These may shield it to some extent from a major economic bust after construction finishes. And, although the current Northern Territory Government is undertaking a program of fiscal tightening, it may be that by the end of the construction of the Blaydin Point facility the Government will be in a position to 'fill the hole' from construction termination by financing another major construction or infrastructure project. There are plans, for example, to build a new hospital to service the rapidly growing satellite city Palmerston and the surrounding rural areas which have also grown rapidly in recent years.

Outside of the scope of the modelling here, but nevertheless important, are possible longer-term impacts on the composition of Darwin's population. It may be, for example, that social and economic impacts felt by the community during and after the construction phase will alter migration patterns to and from Darwin. Rising house prices (there was evidence of speculative pricing and buying in the housing market almost immediately after the formal announcement of the project) might deter interstate residents from moving to Darwin (where prices are already relatively high). Local businesses may be significantly affected by further tightening in the labour market as they try to compete for skilled labour already in short supply.

Importantly, social issues which will inevitably accompany the injection of the large male construction workforce, may impact resident amenity such that some decide to leave Darwin altogether. Keeping abreast of tangential impacts such as these will require specific pieces of research and monitoring. Furthermore, INPEX may help re-enforce the focus and attention on Darwin as the hub for economic development and activity for the NT at the expense of the remainder of the Northern Territory. Increasing economic and population concentration in Darwin are factors conducive to growing the size and extent of 'have-nots', for example. Furthermore, it is far from clear whether and how the rest of the Northern Territory, including the Indigenous working age population for whom participation rates are extremely low, might benefit in meaningful ways, if at all, from LNG led development. These issues are of concern given that populations in some regions outside of Darwin are stagnant or in decline.

## 7.0 Conclusions

This study has shown that, unless the composition of the construction workforce for the Blaydin Point LNG processing facility is fundamentally less male dominated and different in age and partnering profiles than for construction overall, the gender balance of Darwin will be considerably affected. Net gains of males will overlay onto already high sex ratios and exacerbate social and other issues facing the city. While the announcement of the INPEX project for Darwin came with great fanfare, policy makers and planners will need to carefully consider whether and how issues identified in boomtown models and by the literature on social and other matters associated with large oil and gas ventures, might play out under these circumstances.

Our discussion highlights that, although the economic benefits which are realised for Darwin will be tangible, there may be a range of externalities which are not costed into reflections about net benefits from the INPEX project for Darwin and the Northern Territory as a whole. With construction now moving forward at a rapid pace, Darwin residents may be left scratching their heads in 2016 wondering where and why the 'boom' went wrong. In the longer-term, policy makers would benefit from considering how Darwin might develop with a more balanced population structure, so that negative impacts from major projects like INPEX are manageable, minimised, and serve actively towards garnering a development pathway featuring private sector economic diversification.

This study demonstrates that the size of Darwin's population will not shield it from significant population effects from the INPEX project. In the short term, efforts need to be made to engage the public and INPEX in frank and open discussions about these effects. The company can play a leading role by providing detailed information on the workforce size and composition ahead of time. Given the ongoing commitment and active pursuit of resource and major project based development in the Northern Territory, there is a critical need to devise ways to attract women and make them feel more comfortable, valued, and safe. Economically, Darwin is now, perhaps more so than ever, on the boomtown pathway. The options are to continue to adhere to the frontier-type development pathway (requiring the next big project to be instigated) or to plan for something different. The former almost guarantees that Darwin will experience boomtown consequences including a bust cycle after construction. The latter requires planning, innovation, entrepreneurship, and, not least, concerted and considerable political will because boomtown impacts are secondary in the thoughts of governments and investors when (on paper) economic growth and profits are being achieved.

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