



Coal mining and the resource community cycle: A longitudinal assessment of the social impacts of the Coppabella coal mine

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ABSTRACT

Two social impact assessment (SIA) studies of Central Queensland's Coppabella coal mine were undertaken in 2002–2003 and 2006–2007. As ex post studies of actual change, these provide a reference point for predictive assessments of proposed resource extraction projects at other sites, while the longitudinal element added by the second study illustrates how impacts associated with one mine may vary over time due to changing economic and social conditions. It was found that the traditional coupling of local economic vitality and community development to the life cycle of resource projects—the resource community cycle—was mediated by labour recruitment and social infrastructure policies that reduced the emphasis on localised employment and investment strategies, and by the cumulative impacts of multiple mining projects within relative proximity to each other. The resource community cycle was accelerated and local communities forced to consider ways of attracting secondary investment and/or alternative industries *early* in the operational life of the Coppabella mine in order to secure significant economic benefits and to guard against the erosion of social capital and the ability to cope with future downturns in the mining sector.

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1. Introduction

This paper reports the results of two social impact assessment (SIA) studies of Central Queensland's Coppabella coal mine. These studies were conducted both prior, and subsequent to, a major boom in coal prices and production. Additionally, both studies were undertaken outside Queensland's legislative framework for environmental impact assessment and project approval. This framework has been criticised for limiting impact assessment to major new projects, requiring assessment only at the beginning of those projects, and ignoring the influence of exogenous factors that may interact with the proposed project to affect economic and social outcomes (Rolfe et al., 2005; see also Vanclay, 2003). As a consequence, smaller projects, changes to or expansions of existing projects, cumulative impacts from multiple projects across a region, and impacts associated with project closure, are generally exempt from mandatory impact assessment, and few impact assessment studies are followed up post-development to test their accuracy, adjust mitigation strategies,

or inform the assessment of other proposals. In light of the project delays, reputational damage, and other costs that may arise from unmitigated social impacts, it is becoming increasingly common for mining companies to undertake a variety of voluntary SIA and/or community consultation activities (Esteves, 2008; Esteves and Vanclay, 2009; Lockie et al., 2008).

In the case of Coppabella, the first SIA was conducted in 2002–2003, some 5 years after the commencement of mining operations, and the follow-up study was performed in 2006–2007. The longitudinal element that has been added to the Coppabella study provides additional insight into how impacts associated with one mine may vary over time due to changing economic and social conditions. Before proceeding to an analysis of Coppabella this paper will contextualise this analysis in a review of other ex-post SIA studies and the role they play in SIA methodology and theory building.

2. Social impact assessment, extractive industry and the resource community cycle

Ex-post studies of actual processes of change following the implementation of projects and policies were identified in the *US Guidelines and Principles for Social Impact Assessment* as the foundation on which social impact assessors should base predictions regarding the likely consequences of proposed change in other communities

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(Burdge et al., 1995). Despite continuing debate over whether the primary purpose of SIA ought to be predicting future impacts or, by contrast, facilitating public involvement in planning and decision-making (see Lockie, 2001), the comparative methodology outlined in the *US Guidelines and Principles* can be used, in principle, to inform either model by helping to identify the potential range and magnitude of impacts both of initial project proposals and of suggested alternatives. At the same time that public involvement may help to ensure that the predictions of assessors are sensitive to local values, perceptions, aspirations and knowledge, the insights provided through comparative analysis may help to support democratic debate among impacted publics through the systematic identification of potentially disadvantaged groups and of possible impacts which stakeholders may not otherwise have considered (Bass, 1998). Ideally, the body of knowledge on which comparative analysis is based should be sensitive to secondary and cumulative impacts, consider the entire life-cycle of development projects (including closure and decommissioning), and be accessible through peer reviewed publications (Burdge and Vanclay, 2004; Taylor et al., 2003). However, the predominant application of SIA through legislative processes of project approval has limited the development of such a body of knowledge and contributed to what Taylor et al. (2003) refer to as a 'treadmill' of case studies.

According to Taylor et al. (2003), one way to move beyond this treadmill is to treat SIA as an inductive process of theory-building regarding the chains of effects (that is, the ongoing processes of social transformation) that are likely to follow planned intervention. To illustrate this, they examine processes of community formation and change as stimulated by developments in the forestry, mining, agriculture, fishing, energy and tourism sectors. Based on a synthesis

of SIA studies (including ex-post studies), they argue that assessing the impacts of any given proposal requires a parallel understanding of how communities are affected by a range of external linkages and processes. For small towns in rural New Zealand, they found that economic growth and decline was affected not only by the changing fortunes of the resource industries themselves, but by a range of inter-related factors including: technological changes that increased demand for skilled labour while reducing overall labour demand; multiple job holding by individuals and increased mobility promoting a regionalisation of labour pools; reduced opportunities for low skilled workers attracted to rural areas by relatively inexpensive accommodation; and an erosion of the human and social capital necessary to promote flexibility and entrepreneurialism. By mapping these factors against a conceptual model of the 'resource community cycle' (see Fig. 1), Taylor et al. (2003) are able to demonstrate their temporal relationships and to highlight a number of issues that typically receive limited attention in pre-approval SIA studies.

The resource community cycle draws explicit attention to the interplay between economic growth and decline, workforce and infrastructure decision-making, population dynamics and social capital. In doing so, it shows how decisions made prior to the implementation of a project have ongoing ramifications that, in the New Zealand case, have been shown to impact on a community's ability to cope with and move on from periods of economic stagnation in particular resource industries. While other types of social impact (e.g. criminality) will be more important in particular contexts, the dependence of rural communities on a limited number of resource industries means that conceptual models of change such as the resource community cycle are likely to remain useful in explicating the relationship of these impacts to planned interventions.

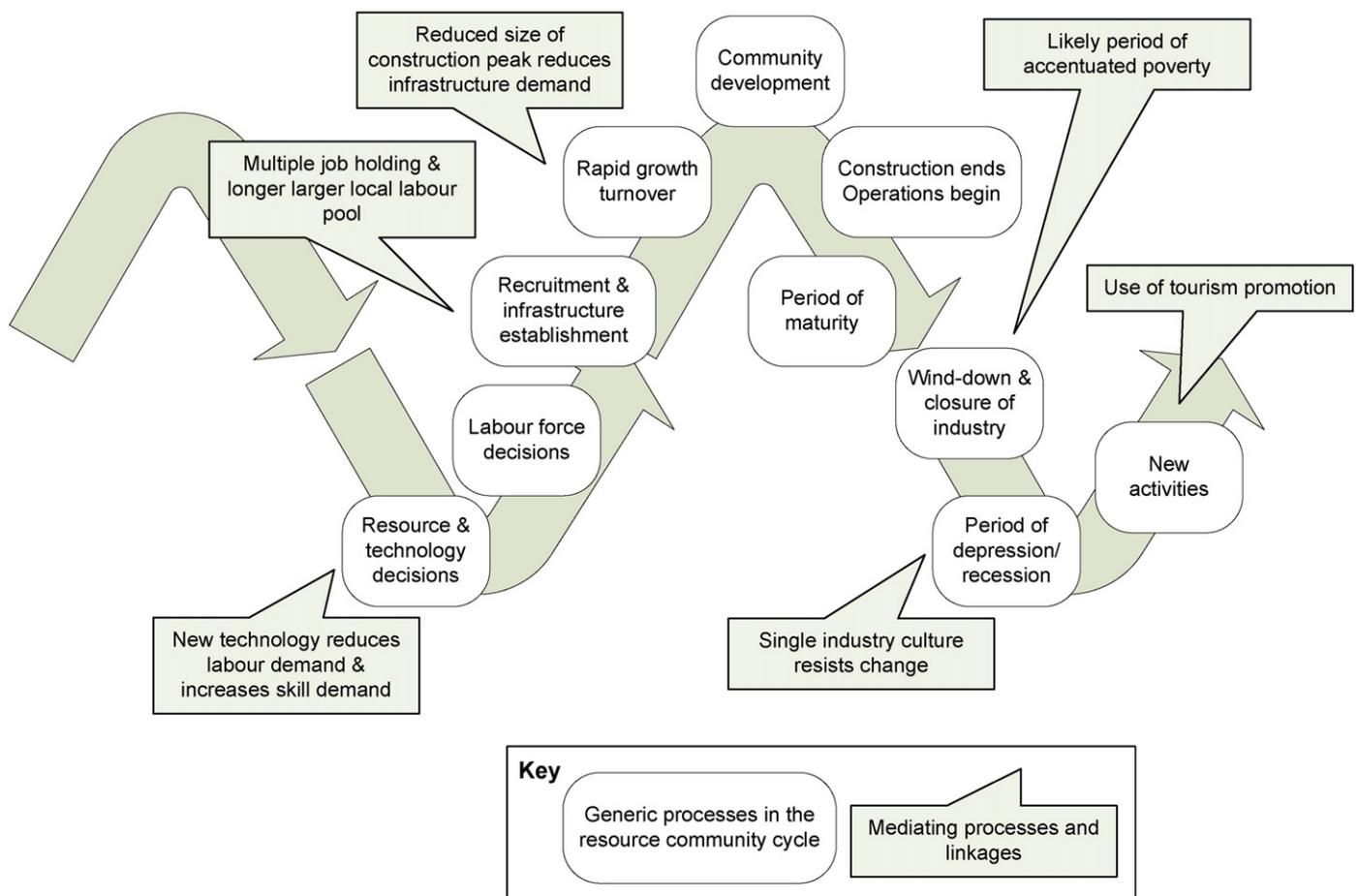


Fig. 1. The resource community cycle: recent findings from rural New Zealand (adapted from Taylor et al., 2003).

In applying this model to the Coppabella mine it is important to consider the outcomes of ex post SIA studies more specifically related to major resource extraction projects. Such studies have taken three broad foci: (1) the impacts of mines and their changing labour demands on resource dependent communities; (2) the social dynamics of purpose built mining towns; and (3) the impact of fly-in/fly-out or commuter workforce arrangements on workers and families. US research into social disruption and personal well-being in the resource development 'boomtowns' of the 1970s and 80s found that while these towns did not conform to the 'wild west' image of the popular imagination with rates, for example, of criminal victimisation that were no different to stable towns of similar size (Krannich et al., 1985), some towns and population sectors were vulnerable to rapid change. Freudenberg (1986) found that the declining density of acquaintanceship in smaller boomtowns led to a loss of informal surveillance and caring among community members that was associated with increases in criminal victimisation—albeit to levels that may still have been considered low. Krannich and Greider (1984), meanwhile, found that lack of integration within the community was highest among those living in temporary accommodation, such as mobile homes, while Freudenberg (1984) suggests that boomtown youth found the process of change more stressful than did adults.

Australian research over the same period concentrated on purpose built mining towns which many companies believed necessary to attract workers and minimise industrial disputes (Parker, 1988).¹ However, the majority of purpose built towns lacked the critical mass of population necessary to provide comprehensive human services, attract secondary investment, or achieve a balanced socio-demographic structure, providing residents with diminished quality of life and a sense of impermanence (Robinson and Newton, 1988; see also O'Faircheallaigh, 1988; Pilgrim, 1988; Sharma, 1983). Women especially were found to suffer more psychological stress and experience less social integration than did women in other rural towns (Cotterell, 1984; see also Williams, 1981). By the mid-1980s, these problems, together with declining terms of trade and regulatory changes that increased the cost of providing subsidised accommodation, saw movement away from the provision of social infrastructure and towards 'fly-in/fly-out' workforce arrangements (Newton and Robinson, 1987; Parker, 1988) which required both the periodic absence of workers from their permanent residences and the structuring of operations around compressed work schedules (generally involving 12 hour shifts worked in blocks of several days/nights on followed by a similar number of days off). Shiftwork of this nature is often associated with sleep disorders, fatigue and irritability (Knutsson, 2003); conditions that pose obvious risks to safety (at work and while commuting) and to participation in interpersonal relationships (Grosswald, 2003). While some families and individuals prefer long-distance commuting and compressed work schedules for the opportunities they present to earn relatively high incomes, to be flexible in where they choose to live, and to use the significant amount of time they have off work to pursue other interests or income, many complain of the difficulties workers face reintegrating into family life and the social and economic isolation they experience from the communities in which they ostensibly live (Shrimpton and Storey, 2001).

Fig. 2 summarises these findings in relation to the resource community cycle. It suggests that many of the social impacts on resource communities affected by major resource extraction projects from the

mid-1980s on—as the profitability of mining declined and companies reduced investment in social infrastructure—related to a partial social and economic de-coupling of resource communities from the mines in their proximity. Lack of social integration became as much a function of compressed work schedules and long-distance commuting as it was of local population flows, while the ensuing need to attract secondary investment and/or alternative industries in response to economic malaise earlier in the operational life of mines accelerated the resource community cycle. However, at least two aspects of the resource community cycle warrant further attention. First, the regionalisation of labour pools and economic flows suggests a need to investigate whether alternative units of social organisation—such as the region as a network of resource communities—might offer additional insights into the distribution and management of impacts (see Fenton et al., 2003). Second, the boom in resource prices since 2004 has created a new set of conditions under which resource communities have been simultaneously exposed both to rapid localised population growth and to large non-resident workforces housed in mostly temporary accommodation while on shift. It is with the second of these issues that we are concerned in the assessment of Coppabella.

3. Case study

Coppabella coal mine is located in the Bowen Basin region of Central Queensland; Australia's premier coal producing region. A relatively small mine by Bowen Basin standards (shipping some 1.5 million tonnes of coal per annum and providing employment for about 340 people on-site when first opened), Coppabella began operations in 1998 at a time when falling real prices saw the focus of the industry shift from development to cost reduction. Common strategies included job shedding, the replacement of permanent with contract labour, the introduction of compressed shiftwork patterns, and moves away from the provision of accommodation and other social infrastructure. In 2004, however, a major boom in coal prices stimulated substantial increases in production, investment and employment. By mid-2006, there were 37 mines operating in the Basin (NRM, 2006), producing over AU\$12 billion worth of coal (OESR, 2006a), with a further 21 mines under development or active consideration (NRM, 2006).

The Coppabella mine exemplifies both recent and historical trends in resource sector development. The mine is located approximately 160 km southwest of the coastal City of Mackay (population 84 890 in 2006) in the rural Shire of Nebo (population 2521 in 2006). Nebo Shire is 10 009 km² with land use dominated by low-intensity beef grazing. It contains three small towns: Nebo (the administrative hub); Coppabella (established in 1971 to house Queensland Rail employees) and Glenden (purpose built in 1983 as the residential base for the nearby Newlands Mine). Glenden was the last dedicated mining town constructed in the region. Since then, the expectation has been either that existing towns would expand to accommodate workforces for new mines or that employees would stay in temporary workcamps while on-shift and commute to permanent residences in centres like Mackay when off-shift. At the time of these studies, the operator of Coppabella, Macarthur Coal, employed directly less than 10 people on-site (the remainder working for contractors) and operated no accommodation infrastructure. The mine itself was a conventional open cut producing a range of Pulverised Coal Injection and Thermal Coal for export. Based on initial estimates of resources, mine life was expected to be 25–30 years. Following the commencement of operations, mining was expanded both on-site with the opening of the Coppabella East extension and through the development of an additional mine (sharing processing infrastructure with Coppabella) which came on-line in 2004 at Moorvale. Coppabella was the first, therefore, of several mines which have, in the last several years, driven a change within Nebo Shire from the partitioning of mine workforces within stand-alone company towns to the transformation of existing

¹ Preference for single company towns resulted in some townships being constructed within 70 km of each other and foregoing the economies of scale that were achieved in those mixed company towns that were also established to service several mines. While in the 1970s some 80% of capital expenditure associated with mining projects was concentrated on the mine itself, a decade later this had declined to only 50%, the balance being spent on social and transport infrastructure. Between 1979–80 and 1984–85 the value of company-provided social infrastructure assets jumped from 12% to 35% of annual labour costs (Parker 1988).

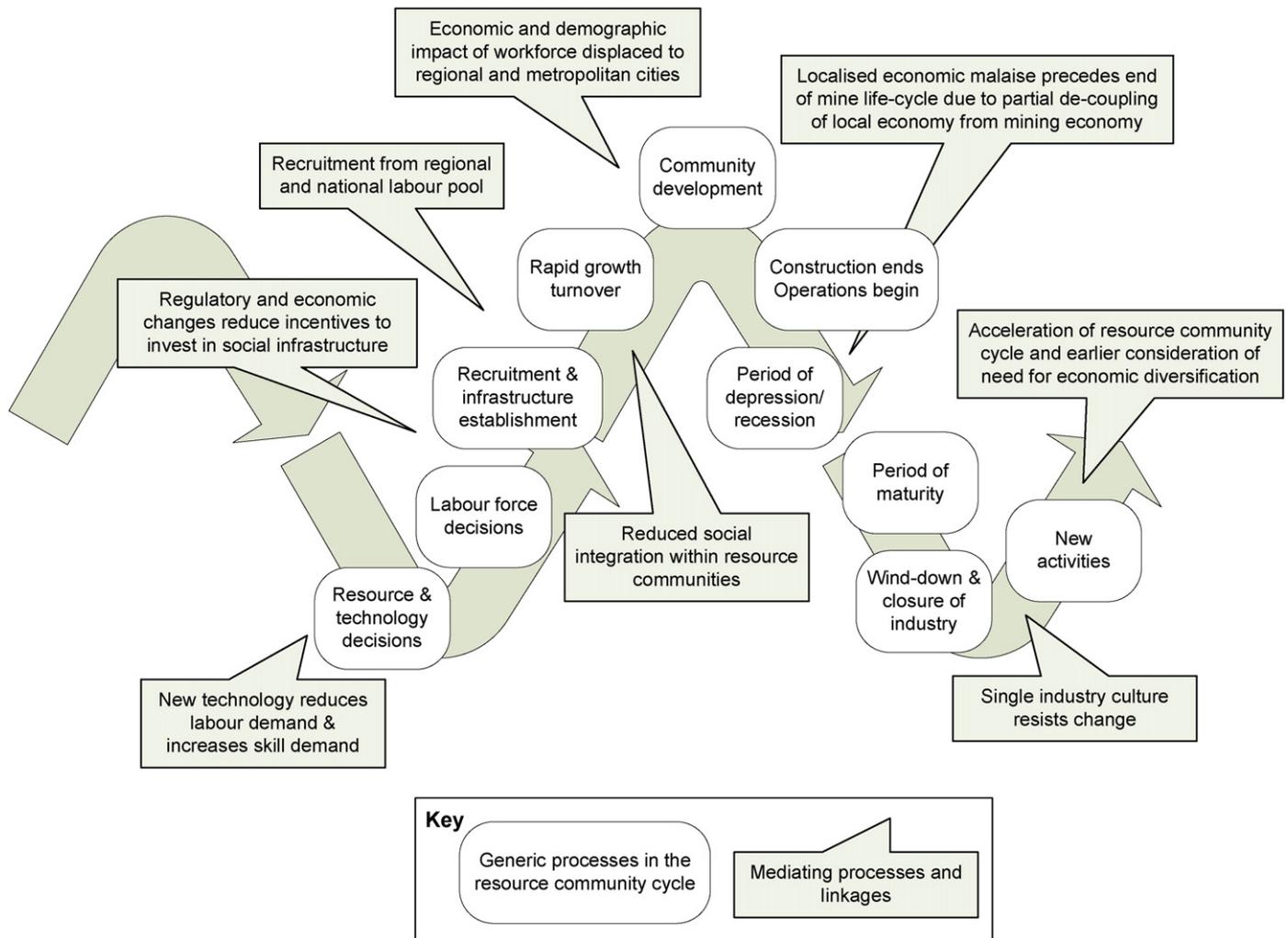


Fig. 2. The resource community cycle and recent trends in the management of major resource extraction projects.

agricultural and administrative service communities into mining boomtowns.

The methodology used for the first SIA study was based on a combination of comparative analysis and consultation with potentially affected stakeholders. A two phase methodology was adopted as detailed below.

3.1. Phase 1: scoping

The scoping phase aimed to identify all plausible impacts so that detailed plans could be developed for the rest of the study. Scoping involved two main activities. First, semi-structured interviews were conducted with stakeholder groups involved in, or affected by, the Coppabella Coal Mine to identify perceived social, economic and environmental impacts (positive and negative) and important elements of community structure. Second, a desktop study was undertaken of similar studies conducted elsewhere (see above) to identify potential impacts of which stakeholders may not have been aware.

3.2. Phase 2: baseline assessment of impacts and mitigation strategies

The assessment phase aimed to investigate further all plausible impacts identified through the scoping phase. Activities included:

- Estimation of social impacts. Based on more extensive community interviews and analysis of statistical data provided by a range of

agencies, including the Australian Bureau of Statistics, an assessment was made of the actual magnitude of potential impacts identified during Phase 1.

- Stakeholder analysis. Given that the significance of many social and economic impacts depends on the value that is placed on them by relevant stakeholders, interviews with community representatives were utilised to:
 - Evaluate the significance of social and economic impacts to the community.
 - Identify mitigation and other strategies to enhance local capture of positive impacts and ensure equitable distribution of impacts.
- Workforce, business and resident surveys. Short quantitative surveys were conducted with mine workers, Nebo-based businesses and residents of Nebo and Mackay to compare perceptions of the social and environmental impacts of coal mining and to collect data regarding residential location preferences.

The second SIA study utilised much the same methodology with the exception that no additional scoping was undertaken in light of the data that were already available from the first study.

4. Results

The outcomes of both studies are summarised in Table 1. This paper will not present detailed data on all dimensions of either expected or actual impact but will concentrate on those that were greatest in

Table 1
Summary of social impact trends 2003–2006.

Preliminary social impacts/issues	Summary of 2003 findings	Summary of trends 2003–2006
Demographic change	Demographic picture had changed so as to increase vulnerability to downturns in mining industry. Dimensions included long-term population decline, low education levels, highly polarised income levels, dependence on mining for employment, and dominance of unskilled and semi-skilled positions.	No major changes in the nature of demographic change were evident at the time of this study. It is most likely, therefore, that the population of Nebo Shire was continuing its trend towards larger numbers, in absolute and relative terms, of men working in unskilled and semi-skilled occupations and with corresponding net loss of women, children and lower income earners.
Demand for human services	Little change to historically low level of human services availability. Establishment of full-time ambulance service. No permanent or visiting doctors, allied health services or pharmacy. Expected increases in school enrolments not eventuating. Considerable unmet demand for housing.	Human service availability remained low.
Demand for and cost of access to housing and accommodation	Ability of market to meet housing demand constrained.	Some constraints on housing development removed (i.e. banks' reluctance to lend for housing in Nebo), but development of new accommodation still lagging behind demand contributing to dramatic inflation in purchase and rental markets. Considerable expansion of temporary accommodation facilities. Debates over who should pay for community infrastructure in Nebo and Coppabella remained unresolved.
Demand for community infrastructure (e.g. recreation facilities)	Unresolved debate over who should pay for community infrastructure. Sport and recreation facilities inequitably distributed while shiftwork patterns limited participation in sport and leisure activities by mine employees.	Residents believed that criminal and anti-social behaviour had increased.
Crime	Perception of increased crime risk. Some increase in crime rates evident but overall rates remained extremely low. Anecdotal evidence that social problems simply exported to locations of permanent residence for mine employees.	While police reported that any increase was proportional to population growth (temporary and permanent), this still represented increased exposure to anti-social and criminal activity in absolute terms. Little change was evident with community and volunteer organisations still under considerable pressure.
Community participation and integration	Participation in community activities and groups limited among mine employees. Extra burden placed on voluntary emergency service organisations.	This trend appears to have intensified as more mines have come on-line.
Traffic and fatigue	Increased volumes of commuter and commercial traffic. Extra burden on voluntary and professional emergency services. Shiftwork practices encourage fatigue through long hours and disturbance of sleep patterns, although fatigue management programs may help reduce accident rates. Nebo residents resistant to identity of 'mining town' as they believed this will limit economic diversification by discouraging new residents and investment in non-mining industries.	This was still evident in Nebo, but had also become an issue in Coppabella with the development of temporary accommodation in vicinity.
Community identity	Extremely low unemployment levels in Nebo Shire reflected both employment opportunities in mining sector and low availability of affordable housing. Reduction in labour availability for non-mining businesses.	No change.
Employment opportunities and labour availability	Limited flow-on expansion of other businesses in response to mining.	Nebo had experienced some industrial development although the continuation of this may be limited by increases in the price of land. Most development oriented towards servicing mines. Little diversification evident.
Business opportunities and constraints	Question over whether non-mining business expansion will be sustainable beyond the life of coal mining. mining business expansion will be sustainable beyond the life of coal mining.	No change.
Strength of local and regional institutions for planning and governance	Local government's capacity to participate in planning and governance limited by state-based approval processes and revenue flows. Perception that mines only do enough by way of communication, impact assessment and community contribution to progress mining development. Little engagement by the mining sector in regional planning processes that are more accessible to local institutions and people.	
Opportunities for Aboriginal people	The disturbance of country through mining is by itself a substantial negative impact. Macarthur's operations enhanced access to land for two Traditional Owner groups despite competing claims to Native Title over these lands. Cultural Heritage Management Plan negotiated with both groups that provided useful opportunities for capacity building and economic development. Consideration given in the rehabilitation plans for the mine sites for access and use by Traditional Owners post-mining for cultural and economic purposes. Training and employment programs largely successful, but challenges remained in recruiting Aboriginal people into senior positions within the mining industry and ensuring economic sustainability of Aboriginal enterprises post-mining. Support secured through Native Title compensation for a range of other community initiatives.	Some concern that training has not always translated into employment. Lack of input into non-mine related development.
Environmental impacts	Temporary accommodation facilities significant impact on visual amenity. Concern over long-term impacts of coal dust, land disturbance, tree clearing and water extraction on environment despite lack of evidence of immediate problem.	Expansion of temporary accommodation around both Nebo and Coppabella has increased the magnitude of this impact. Concern over water has intensified

magnitude and which illustrate most clearly the chains of effects that are likely to flow from and modify the resource community cycle as it pertains to communities impacted by extractive industries in the Bowen Basin.

4.1. Demographic change

The opening of the Coppabella mine had little immediate impact on the population of Nebo Shire. Despite an on-site workforce of 340, the permanent resident population of Nebo Shire decreased 5% from 2202 in 1996 to 2086 in 2001 (ABS, 2002). This proved a short-term trend, however, with the permanent resident population then growing 21% to 2521 in 2006 (ABS, 2007). In all likelihood, the early demographic impacts of the Coppabella workforce were offset by residential vacancies in mining towns that lay outside the Shire and which had suffered population declines during the 1990s. As those vacancies diminished and mines continued to expand post-2001, marked change was evident in both the permanent and temporary populations of Nebo Shire.

Of perhaps more importance than the absolute level of change in the permanent resident population was the type of population change. As Table 2 shows, the number of permanent residents fell in all age groups below 55 between 1996 and 2001 while those age groups 55 and above recorded substantial increases. With the largest fall in this period being in the 0–14 age group, it appeared that those leaving the community were families with children. This conclusion is borne out by Table 3, which shows that not only did the number of women in the community fall in the same age groups, but that the rate of population loss was greater among women than among men. Even as population loss was reversed post-2001, the lowest levels of population growth were in the 0–14 and 25–34 year age categories reflecting, again, the declining importance of families with children as a share of total population. In fact, the number of ‘two parent with children’ households in Nebo Shire declined from 353 (or 55% of all households) in 1996 to 267 (43%) in 2001 and 273 (42%) in 2006. Over the same 10 year period, the number of ‘sole parent with children’ households increased from a low 17 (<3%) in 1996 to 39 (6%) in 2006 (ABS, 2007) while the number of ‘couple with no children’ households grew from 155 (24%) to 182 (28%) in 2006 and the number of ‘lone occupant’ households increased from 108 (17%) to 137 (21%).

By 2003, mining had become the largest employer in Nebo Shire. An unemployment rate of only 0.6% in 2006 (OESR, 2007) suggests that locals either were recruited into the mines or forced to leave due to escalating housing costs (see below). Although this resulted in higher than average income levels, most mining jobs were in unskilled and semi-skilled categories and education levels were correspondingly low. Ethnic diversity was also low. Of particular note, few Aboriginal people lived in the area due to earlier periods of forced outmigration and limited employment opportunities.

Changes in the permanent resident population were, however, dwarfed by changes in the itinerant population of non-resident workers, with estimates that non-resident workers accommodated in various forms of single persons' quarters increased the population of

Table 2
Permanent resident population by age, 1996–2006.

Age (years)	1996	2001	% change	2006	% change
0–14	628	528	–15.9	566	7.2
15–24	257	236	–8.2	321	36.0
25–34	431	404	–6.3	462	14.4
35–44	418	394	–5.7	479	21.6
45–54	281	265	–5.7	376	41.9
55–64	111	140	26.1	220	57.1
65–74	48	67	39.6	72	7.5
74 and over	28	52	85.7	27	–48.1
Total	2 202	2 086	–5.3	2 521	20.9

Table 3
Change in resident female population by age, 1996–2006.

Age (years)	1996		2001		2006	
	No. females	Females as % of total pop.	No. females	Females as % of total pop.	No. females	Females as % of total pop.
0–14	318	50.6	259	49.1	270	47.7
15–24	114	44.4	93	39.4	123	38.3
25–34	197	45.7	176	43.6	199	43.1
35–44	177	42.3	150	38.1	179	37.4
45–54	111	39.5	95	35.8	148	39.4
55–64	43	38.7	51	36.4	80	36.4
65–74	16	33.3	29	43.3	32	44.4
74 and over	18	64.3	10	19.2	13	48.1
Total	994	45.1	863	41.4	1 044	41.4

Nebo Shire by around 20% on any given night in 2001 (QDLGP, 2001) and by over 150% in 2006 (PIFU, 2006). On census night 2006, 2082 non-resident visitors (of whom only 37 were above or below working age) were counted while 2263 Nebo Shire residents were counted at home.

One of the questions this raises is whether more mine employees and contractors would shift permanent residence to Nebo Shire if more suitable accommodation was available (see below). When mine employees were asked in 2003 whether they would like to move to a main town of residence closer to the mine site, 26% indicated that they would, 70% indicated that they would not, and 4% were undecided. For those indicating that they did not wish to move closer to the mine, the most important reasons related to their families' preferences not to move, together with the better employment, educational and recreational opportunities available to family members elsewhere. When temporary workcamp residents were interviewed 4 years later in 2007, 58% stated that they would prefer to continue living outside the area.

4.2. Housing

As indicated above, in 2003 approximately a quarter of the Coppabella mine workforce indicated that they would prefer permanent accommodation closer to the mine site while, in 2007, approximately one third of the residents of one of the major workcamps near Coppabella stated the same preference. Nevertheless, the ability of the market in 2003 to meet housing demand was severely constrained by a range of factors including reluctance among private entrepreneurs and banks to invest in residential development outside regional centres. Despite an increase in residential building approvals from zero in 2000 to around ten per year from 2003 to 2006, little change was evident in the total number of dwellings available for occupation. In fact, the number of occupied dwellings in Nebo Shire dropped from 645 to 622 between 1996 and 2001, before recovering to 647 in 2006 (ABS, 2007). No recovery, however, was evident in the availability of fully detached houses—the main and preferred dwelling type. While 579 fully detached houses were occupied in 1996, only 558 were occupied in 2001 and 2006. The increase in dwelling availability between 2001 and 2006 was almost entirely accounted for by temporary dwellings such as caravans (mobile homes), which grew in number from 15 to 77.

Shortages of both permanent and temporary accommodation led to dramatic inflation in the cost of buying and renting residential real estate. Residents of Nebo claimed that residential building blocks had increased in price from \$20 000 to \$160 000 and that workers were grouping together to share house rents of \$600–750/week. According to census data, ten households in Nebo were paying over \$550/week rent in 2006 (ABS, 2007). This was similar to the median weekly rent at the nearby mining town of Moranbah (Rolfe and O'Dea, 2007) and double the median rent of \$300/week for a three bedroom house located in Queensland's state capital, Brisbane, in December 2006

(RTA, 2007; see also OESR, 2006b). As a consequence, it was reported that low income earners were being forced out of town, that non-mine employers were finding it impossible to attract people to the town, and that a number of workers across all industries were resorting to sleeping in cars, caravans and tents.

4.3. Social integration

Participation in community activities and groups was extremely limited among mine employees in both 2002–2003 and 2006–2007 due to shiftwork patterns and the temporary nature of their residence in Nebo Shire. This created an extra burden for voluntary emergency service organisations such as the State Emergency Service due to the increase in road traffic in Nebo Shire associated with the movements of a workforce that provided no additional members to share the burden. Lack of integration and participation among mine employees suggested that when there is a downturn in the Shire's mining industry few will remain in the area or contribute to the development of new economic futures.

Lack of integration also promoted among residents of Nebo Shire a perception that they were at significantly greater risk of crime than prior to the development of the Coppabella mine due to the large number of unknown and temporary residents staying in camp-style accommodation around the town. While there was some evidence that that crime rates had increased since commencement of the Coppabella Coal Mine project, this may be entirely coincidental due to the diverse residence patterns of mining personnel and the location of staff from a number of other mining operations and industries in nearby towns. That said, offences against the person—especially sexual assault—increased in Nebo and the adjoining Belyando Shire rose from around 300 incidents per 100 000 people in 1998–1999 to 600 in 2000–2001 and 2483 in 2002–2003 (OESR, 2002, 2004). However, overall crime rates remained extremely low and a number of participants in the SIA study, including local police, believed that mine employees were subjected to surveillance and sanctions against anti-social behaviour while on-site and while in the general proximity of the mine. Formal surveillance included routine testing of mine employees for alcohol and other drugs, while informal surveillance operated through the communication networks operating between accommodation and other service providers.

By 2006, Nebo residents believed that crimes against property and general anti-social behaviour (public drunkenness, speeding etc) were accelerating. Conversely, Nebo police reported that any increases in criminal activity from 2003 to 2006 were proportional to the population increase over the same time. While in relative terms this would mean that there had been no increase in criminal activity, it would still signal an absolute increase in potential exposure to criminal activity. It would also suggest that as the itinerant population of the Shire grew, the application and effectiveness of informal sanctions fell.

4.4. Traffic and fatigue

Residents believed that traffic volumes—including volumes of large trailers and mining equipment—and accidents had increased both prior to and following the 2003 study. Road use statistics indicate that traffic volumes did increase with the bulk of additional traffic associated with miners travelling between their places of employment and residence area at the beginning and end of rostered blocks of 'days on.' Of the 204 accidents reported on the main road between Nebo and Mackay from January 1998 to September 2002, at least 28 were determined to have been related to fatigue. No data were available on accidents subsequent to 2002. Nevertheless, it is not unreasonable to speculate that the cumulative effects of fatigue may be an exacerbating factor in traffic safety for mining commuters and other road users. Di Milia's (2006) survey of over 1500 drivers, for example, on two major arterial routes from the Bowen Basin coalfields to the coast

found that shift workers who had completed night shift accounted for approximately 11% of all road users. On average, these shift workers intended driving 211 km and the majority (76%) did not intend taking a driving break. Some 19% of these shift workers displayed symptoms of severe sleepiness compared with 1% of non-shift workers.

In 2003, both Macarthur Coal and the wider community demonstrated their awareness of this with a range of policies and programs in place to educate employees about fatigue management. However, what employees do once they are off shift lies outside company control and many respondents believed that workers regularly drove to the coast as soon as their block of 12 hour shifts was over and returned, similarly, just in time to start their next block.

4.5. Business opportunities and constraints

During the 1990s, mining took over from agriculture as the dominant industry and driver of economic activity in Nebo Shire. By 2003, there was some evidence that secondary industry (i.e. the provision of services to mining) was also beginning to expand. However, the flow-on effects to other sectors were limited and the ability of Nebo Shire to capture economic benefit from mining constrained by the relative lack of secondary industry compared with regional centres such as Mackay. While Nebo Shire Council had acted to attract investment by establishing a serviced industrial estate, initial take-up was slow due to the proximity to Mackay and difficulties faced by non-mining businesses in attracting labour. Virtually all employers, including mines, expressed difficulty in attracting suitably qualified staff, particularly in more specialised fields. Location, lack of facilities (e.g. education for families) and infrastructure (e.g. housing) all impacted on capacity to attract and retain staff. Non-mining businesses faced the additional issue of substantial disparities between what they could afford to pay workers and what those same workers might be paid by the mines with mine worker salaries up to three times those of similarly skilled workers in agriculture or local government.

It is perhaps a reflection of the magnitude of the mining boom that by 2006 the establishment of secondary industries in Nebo had increased dramatically despite even greater skills shortages. However, it is important to stress that non-mining business expansion was concentrated in the mine-service sector with little evidence, therefore, of economic diversification. In responding to this situation, stakeholders emphasised the need they perceived to build community infrastructure so as provide a more attractive environment for investment and to build transferable and entrepreneurial skills among residents.

4.6. Cultural heritage, native title and opportunities for indigenous people

Economic development of Nebo Shire has historically generated considerable negative impacts for Aboriginal people. Early European settlement of the area through the 1860s and 70s was characterised by extensive conflict between Aborigines and white settlers and it is likely that a substantial proportion of the Aboriginal population were killed either by diseases like smallpox or through fighting with the Native Mounted Police and vigilante groups (L'Oste-Brown et al., 2002). Those Aborigines who survived were either absorbed into the pastoral economy as stationhands and domestic workers, became fringe dwellers, and/or left. This, in part, explains the very small Aboriginal population of the Shire and the importance placed by the two Aboriginal groups claiming Native Title rights in Nebo Shire on access to traditional lands for group members wishing to return. Thus, it was found that despite the profound negative impact that open cut mining could be expected to impose on Aboriginal peoples' spiritual and cultural connections with traditional lands, those people still regarded the opportunities afforded by mining to access sites from which they had been excluded by pastoralism, and to participate in cultural heritage surveys on those sites, as a net gain.

While the Native Title and cultural heritage implications of resource development give Aboriginal people rights of participation in planning and management that extend beyond those of other stakeholders, the reality is that legislative uncertainty over the precise nature of these rights, combined with limited resources among Indigenous communities, means that Aboriginal people are frequently marginalised. By way of contrast, the Coppabella mine was seen in 2003 as notable for the positive relationships that had been developed with the two Aboriginal groups claiming Native Title rights over the mine site (groups that easily could have been played off against each other), and opportunities were identified and acted on to pursue cultural, economic and social development. Training and employment programs were put in place for Indigenous people and Aboriginal enterprises established to service the mine by providing for cultural heritage advice and management. In 2006, however, it was evident that the marginal position of Aboriginal groups within the wider community and economy had been reinforced by the dramatic expansion of mining in the region. Although there was no suggestion that Macarthur itself had sought to undermine its positive relationship with Native Title claimants, expansion of Coppabella and other mines saw the influx of a range of other business operators and the development of land for purposes other than mining. Concerns were raised that contractors were less committed to Indigenous community development and that non-mining land uses were not necessarily subject to the same detailed examination and management of cultural heritage as were mining lands.

5. The resource community cycle and the Coppabella mine

The concept of the resource community cycle is clearly applicable only to settlements in which the main determinant of economic vitality is the life-cycle of major natural resource use industries and

projects. At the same time, proponents of this concept, such as Taylor et al. (2003), demonstrate that the chains of effects associated with development do not necessarily follow a straightforward pattern of positive benefits stimulated by economic growth followed by negative benefits associated with decline. Instead, the specific ways in which these chains of effects play out within the broad pattern of resource industry growth and decline are mediated by a host of technological, social and political processes such as the combined influence of labour saving technologies and multiple job holding on migration patterns. The two SIA studies of Coppabella coal mine illustrate a number of additional ways in which the impacts of the resource community cycle may be mediated; in particular, by labour recruitment and social infrastructure policies that reduce the emphasis on localised employment and investment strategies; and by the cumulative impacts of multiple projects within relative proximity to each other (see Fig. 3).

Most of the negative social impacts identified in the first ex post SIA study of Coppabella did not relate to social dislocation per se but to a failure to capture positive benefits that residents and local government had expected to flow from the establishment of major infrastructure. This was particularly evident in relation to the limited development of complementary and new enterprises and of more permanent housing. As a new mine, Coppabella could not *de-couple* from the local economy by compressing work schedules and reducing their provision of social infrastructure in favour of drive-in/drive-out workforce arrangements, as was the case with existing mines elsewhere in the Bowen Basin (see Fig. 2). However, the adoption of these same strategies to cope with tight terms of trade slowed the development of economic dependency on the mine among existing residents and businesses within Nebo Shire, and made many aware of the need to accelerate the resource community cycle by attracting secondary investment and/or alternative industries *early* in the operational life of the Coppabella mine if major economic benefits

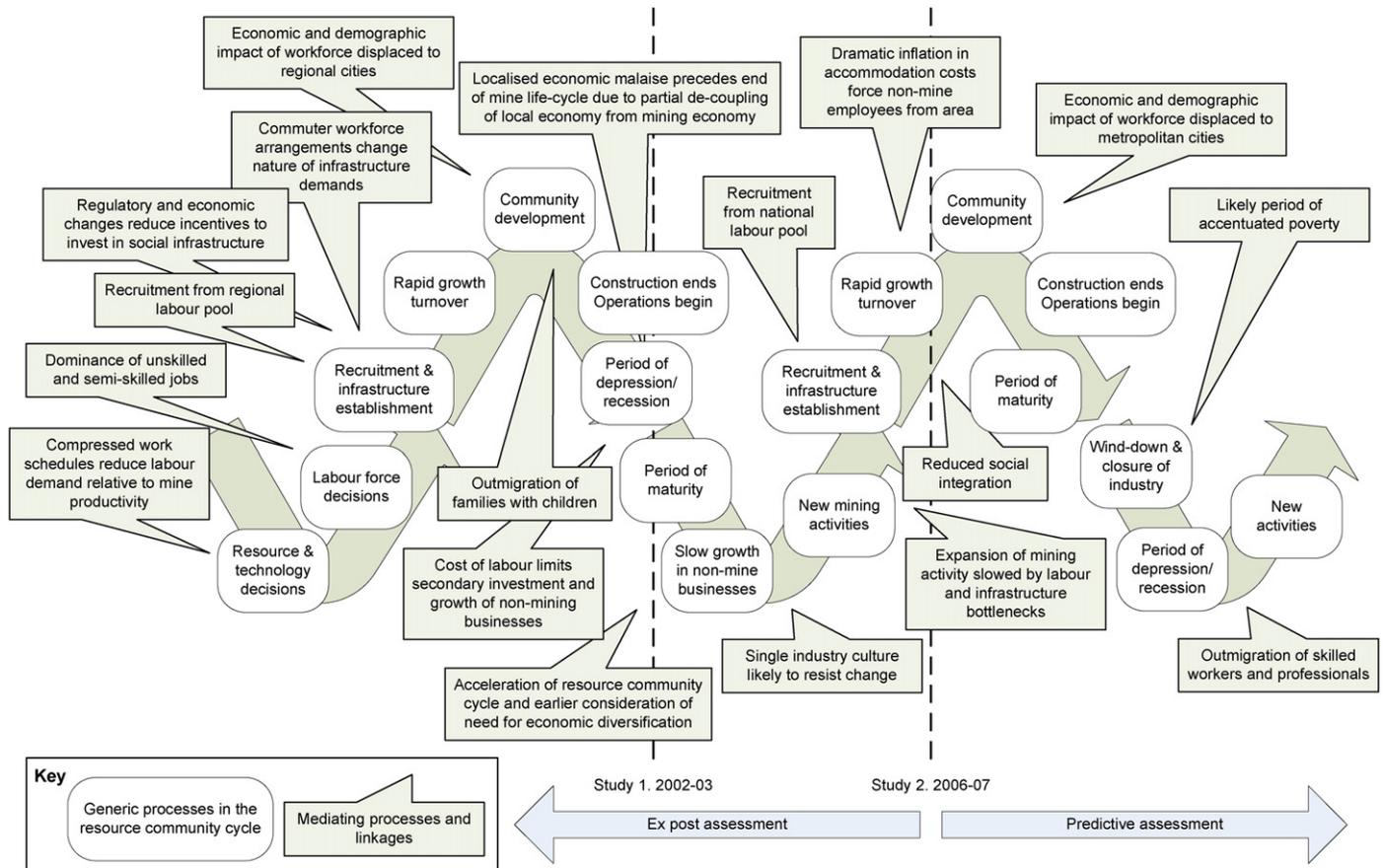


Fig. 3. The resource community cycle and Coppabella coal mine.

were to flow. In other words, the attraction of new activities was necessary not simply to replace mining as a source of employment and investment toward the end of the resource community cycle stimulated by the Coppabella mine, but to create the conditions under which employment and investment in the mining sector might contribute to higher levels of localised economic and community development throughout the cycle.

The most obvious cumulative social impact stemming from the increase in coal mining projects in the vicinity of Nebo Shire post-2004 was the acceleration of demographic changes associated with a more mining-dependent employment market and the dramatic rise in the number of non-resident workers housed in workcamps and other temporary accommodation. While these created a number of direct impacts (such as the perceived increase in criminal activity, traffic accidents etc), the impact that was of most direct relevance to the resource community cycle was the secondary impact on the community's likely capacity to cope with future downturns in the mining sector—whether as a consequence of falling profitability, technological innovations that reduce labour demands and/or the end of project life-cycles.

This can be illustrated with reference to indicators for the identification of vulnerable resource communities which were developed through the social impact assessment process used to inform Regional Forest Agreements (RFAs) in Queensland (QDNR et al., 1999). These indicators were grouped around three main concepts: (1) sensitivity to change in the local economy; (2) social values about resource use; and (3) the service capacity of the locale/region. Indicators relating to sensitivity to change in the local economy included: economic diversity, rates of unemployment, rates of employment in resource-use industries subject to change, levels of education and qualifications, income, housing ownership, purchasing and rental, and age. These indicators clearly point to areas of concern for Nebo. The Shire's economy was dependent on mining and agriculture with little evidence of diversification. Low unemployment was more a reflection of accommodation affordability than of employment opportunities and all businesses struggled to find sufficient labour—placing further constraints on diversification. Employment was thus concentrated in one industry—mining. Education levels were low and jobs were concentrated in the semi-skilled and unskilled categories. Housing availability was low. There was an increase in the population aged over 65. Social values on resource use in Nebo were conducive to mining, but recognised that the presence of mining in its current form was necessarily finite. The general community had no desire to become entirely dependent on mining and believed it necessary to use mining as a platform to support other development paths. However, the service capacity also placed constraints on the quality of life of residents and the ability of the Shire to attract investment and residents.

On the whole, the RFA indicators suggest that the capacity of the Nebo community to deal with any downturn in the mining industry will be limited. Further, with mining encouraging the masculinisation of the Nebo population without increasing participation in social activities and networks, it may be seen as having detrimental effects on those aspects of social capital that might support economic, social and cultural development; namely, constructive relationships between groups and individuals that support diversity, a climate of trust, acceptance of difference, and ability to resolve conflict (Flora et al., 1997; Gray and Lawrence, 2001). This is of concern due to the potential, in the event of a downturn in the mining industry, for Nebo to experience significant outmigration and income loss without sufficient capacity to generate alternative development paths and avoid the creation of a poverty trap for those left behind with unsaleable homes, limited capital and untransferable skills. Such a future is not inevitable and Macarthur Coal had engaged with some stakeholders in a manner that was likely to enhance capacity and social capital. The most obvious example of this was the capacity building approach that Macarthur took to dealing with Traditional

Owners. However, as mining operations expand, other mines continue to come online, and the sector in general continues to rely on contractors for a major share of their operations, the capacity building activities of any one mine operator are likely to be insignificant in the absence of integrated sector-wide programs.

6. Conclusion

These social impact assessments confirm the conclusion of several earlier boomtown studies that the pathological effects of rapid growth on small communities are easily overstated. However, they also support the conclusion that closer attention to the effect of change on particular sub-sectors of the population may still identify significant social impacts, and speak to debates about the role of SIA in managing as well as in predicting change.

In 2003, many of the social impacts evident at that stage of the resource community cycle related to a failure by the community to capture positive benefits (in particular, economic development) despite increasing dependence on mining for employment and income. At the same time, while mining was responsible for only a small increase in population, demographic and social changes undermined the likely ability of the community to generate alternative economic and cultural futures. This was not inevitable, and Macarthur had engaged with some stakeholders—Aboriginal groups in particular—in a manner that enhanced capacity and social capital. However, the cumulative impact of multiple mine expansions and developments from 2003 to 2006 saw the magnification of these issues and the emergence of several acute social impacts. These included severe shortages of skilled labour in other industries; reduced accommodation access and affordability; increases in traffic and fatigue-related road accidents; increased pressure on emergency services (particularly those provided by volunteers); and increases in criminal and other anti-social behaviour.

The increase in anti-social behaviour between the two studies appeared to be linked to the declining density of acquaintanceship and informal surveillance associated with population growth. Maintaining our focus on the entire resource community cycle, this particular issue highlights the manner in which acute social impacts—while important in their own right—potentially mask or divert attention from underlying processes of social transformation that also warrant attention if longer-term impacts are to be anticipated and managed. In this case, increases (real and perceived) in anti-social behaviour reflected two major demographic changes. Most obvious was exponential growth in the temporary resident population between 2003 and 2006. Less obvious was the progressive masculinisation of the permanent resident population. While this latter trend can partly be attributed to competition for housing, it was also due to the negative impact of a large and demographically unbalanced itinerant population on the attractiveness of Nebo as a residential location for women and families. As the resource community cycle continues to turn, demand for labour in the mining sector can be expected to decline (Fig. 3). While it cannot be assumed that the permanent resident population will reflect, at that point, its current composition, questions do need to be asked about the human capital likely to be left behind in the event of a contraction in mining employment.

Concepts such as the resource community cycle that are inductively derived from multiple SIA studies play a useful role in building a body of theory and knowledge from which to anticipate the long-term, cumulative, and perhaps less obvious, impacts of resource development. Applying this concept to the studies at Coppabella has highlighted, for example, the importance of impact mitigation strategies that focus not only on immediate, or acute, concerns but on the development of human and social capital necessary for communities to cope with a wind-down of mining activity that is likely to see significant outmigration of skilled workers and professionals. However, identifying potential impacts such as these through

the life-cycle of the project in question is only the first step in developing appropriate mitigation strategies. The long-term perspective encouraged by Taylor et al. (2003) serves to highlight the importance of integrating concepts such as the resource community cycle with SIA models designed specifically to facilitate the participation of impacted communities in planning and decision-making in ways that meet proponent needs (Esteves, 2008), build human and social capital (Esteves and Vanclay, 2009), and take account of the active roles that communities play in generating *unanticipated* outcomes as they interpret and respond to planned intervention (Lockie, 2007).

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References

- Australian Bureau of Statistics (ABS). 2001 Census Tables: Nebo (S)(Local Government Area. Canberra: Commonwealth of Australia; 2002.
- Australian Bureau of Statistics (ABS). 2006 Census Tables: Nebo (S)(Local Government Area. Canberra: Commonwealth of Australia; 2007.
- Bass R. Evaluating environmental justice under the national environmental policy act. *Environ Impact Assess Rev* 1998;18:83–92.
- Burdge R, Fricke P, Finsterbusch K, Freudenberg W, Gramling R, Holden A, et al. Guidelines and principles for social impact assessment. *Environ Impact Assess Rev* 1995;15:11–43.
- Burdge R, Vanclay F. The future practice of social impact assessment. In: Burdge R, editor. The concepts, process and methods of social impact assessment. Middleton, WI: Social Ecology Press; 2004. p. 283–92.
- Cotterell J. Social networks of mining town women. *Aust J Social Issues* 1984;19:101–12.
- Di Milia L. Shift work, sleepiness and long distance driving. *Transportation Res* 2006;278–85.
- Esteves AM. Evaluating community investments in the mining sector using multi-criteria decision analysis to integrate SIA with business planning. *Environ Impact Asses Rev* 2008;28(4–5):338–48.
- Esteves AM, Vanclay F. Social development needs Analysis as a tool for SIA to guide corporate–community investment: applications in the minerals industry. *Environ Impact Asses Rev* 2009;29(2):137–45.
- Fenton M, Coakes S, Marshall N. Vulnerability and capacity measurement. In: Becker H, Vanclay F, editors. *The International Handbook of Social Impact Assessment: conceptual and methodological advances*. Cheltenham, UK: Edward Elgar; 2003. p. 211–30.
- Flora J, Sharp J, Flora C. Entrepreneurial social infrastructure and locally initiated development in non metropolitan United States. *Social Quart* 1997;38:623–45.
- Freudenberg W. Boomtown's youth: the differential impact of community growth on adolescents and adults. *Am Sociol Rev* 1984;49:697–705.
- Freudenberg W. The density of acquaintanceship: an overlooked variable in community research. *Am J Sociol* 1986;92:27–63.
- Gray I, Lawrence G. A future for rural Australia: escaping global misfortune. Cambridge: Cambridge University Press; 2001.
- Grosswald B. Shift work and negative work–to family spillover. *J Sociol Soc Welf* 2003;30(4):31–56.
- Knutsson A. Health disorders of shift workers. *Occup Med* 2003;53:103–8.
- Krannich R, Greider T. Personal well-being in rapid growth and stable communities: multiple indicators and contrasting results. *Rural Sociol* 1984;49:541–52.
- Krannich R, Greider T, Little R. Rapid growth and fear of crime: a four-community comparison. *Rural Sociol* 1985;50:193–209.
- Lockie S. Social impact assessment in review: setting the agenda for impact assessment in the twenty-first century. *Impact Assess Proj Apprais* 2001;19:277–87.
- Lockie S. Deliberation and actor-networks: the 'practical' implications of social theory for the assessment of large dams and other interventions. *Soc Nat Res* 2007;20: 785–99.
- Lockie S, Franetovich M, Sharma S, Rolfe J. Democratisation versus engagement? Social and economic impact assessment and community participation in the coal mining industry of the Bowen Basin, Australia. *Impact Assess Proj Apprais* 2008.
- L'Oste-Brown S, Godwin L, Porter C, in association with the Bowen Basin Aboriginal Steering Committee. Towards an indigenous social and cultural landscape of the Bowen Basin. Brisbane: Queensland Department of the Environment; 2002.
- Natural Resources and Mines (NRM). Queensland mining and petroleum 2005: exploration, operations and developments. Brisbane: Queensland Government; 2006.
- Newton P, Robinson I. Settlement options: avoiding local government with fly-in fly-out. In: Parker P, editor. *Resource development and local government: policies for growth, decline and diversity*. Canberra: AGPS Press; 1987. p. 72–81.
- O'Faircheallaigh C. Economic base and employment structure in Northern Territory mining towns. In: Brealey T, Neil C, Newton P, editors. *Resource communities: settlement and workforce issues*. Melbourne: CSIRO; 1988. p. 41–63.
- Office of Economic and Social Research (OESR). Small area crime profiles: 2000–01. Belyando (S), Nebo (S) Local Government Areas (LGAs). Brisbane: Queensland Government; 2002.
- Office of Economic and Social Research (OESR). Small area crime profiles: 2002–03. Belyando (S), Nebo (S) Local Government Areas (LGAs). Brisbane: Queensland Government; 2004.
- Office of Economic and Social Research (OESR). Queensland economic review. Brisbane: Office of the Government Statistician; 2006a.
- Office of Economic and Social Research (OESR). Index of retail prices in Queensland Regional Centres. Brisbane: Office of the Government Statistician; 2006b.
- Office of Economic and Social Research (OESR). Queensland regional profiles: Mackay Statistical Division. Brisbane: Office of the Government Statistician; 2007.
- Parker P. The cost of remote locations: Queensland coal towns. In: Brealey T, Neil C, Newton P, editors. *Resource communities: settlement and workforce issues*. Melbourne: CSIRO Press; 1988. p. 79–95.
- Pilgrim R. Normalisation of the Pilbara townships in Western Australia. In: Brealey T, Neil C, Newton P, editors. *Resource communities: settlement and workforce issues*. Melbourne: CSIRO Press; 1988. p. 245–60.
- Planning Information and Forecasting Unit (PIFU). Full-time equivalent population estimates for nine local government areas in the Bowen Basin, June 2006. Brisbane: Queensland Government Department of Local Government, Planning, Sport and Recreation; 2006.
- Queensland Department of Local Government and Planning (QDLGP). Whitsunday Hinterland and Mackay (WHAM) 2015 regional plan (draft). Brisbane: Queensland Government; 2001.
- Queensland Department of Natural Resources (QDNR) CRA unit, agriculture, forestry and fisheries Australia: social impact assessment unit, Queensland CRA/RFA Steering Committee. South East Queensland Social Assessment Report. Brisbane and Canberra: Queensland Government and Commonwealth of Australia; 1999.
- Residential Tenancies Authority (RTA). Median weekly rents for three bedroom houses for new bonds lodged each quarter December 2006. Residential Tenancies Authority, Brisbane; 2007. accessed online at www.rta.qld.gov.au/zone_files/Stats_December_Quarter_2006/sa_3brm_houses.htm.
- Robinson I, Newton P. Settlement options for non-renewable resource development in Canada and Australia: a comparative evaluation and decision framework. In: Brealey T, Neil C, Newton P, editors. *Resource communities: settlement and workforce issues*. Melbourne: CSIRO; 1988. p. 313–52.
- Rolfe J, Lockie S, Ivanova G. Overview of social and economic issues associated with the Bowen Basin coal industry. Research report 1. Socio-economic impact assessment and community engagement to reduce conflict over mine operations. Rockhampton: Centre for Social Science Research. Central Queensland University; 2005.
- Rolfe J, O'Dea G. Identifying the potential and constraints for the growth of Moranbah. Research report 1. Economic and social impacts of the Moranbah Mines Research Reports. Rockhampton: Centre for Environmental Management. Central Queensland University; 2007.
- Sharma P. The new mining towns—'outback suburbias'? In: Richmond W, Sharma P, editors. *Mining and Australia*. St Lucia: University of Queensland Press; 1983. p. 150–79.
- Shrimpton M, Storey K. The effects of offshore employment in the petroleum industry: a cross-national perspective. OCS Study MMS 2001–041. Herndon, VA: US Department of the Interior, Minerals Management Service, Environmental Studies Program; 2001.
- Taylor N, Goodrich C, Fitzgerald G, McClintock W. Undertaking longitudinal research. In: Becker H, Vanclay F, editors. *The International Handbook of Social Impact Assessment: conceptual and methodological advances*. Cheltenham, UK: Edward Elgar; 2003. p. 13–25.
- Vanclay F. International principles for social impact assessment. *Impact Assess Proj Apprais* 2003;21:5–11.
- Williams C. Open cut: the working class in an Australian mining town. Sydney: Allen and Unwin; 1981.

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