Socio-economic assessments to inform water resource planning in the Darwin region: Howard East Water Allocation Planning Area (HEWAPA)

Report prepared for the Northern Territory Department of Natural Resources, Environment, the Arts and Sport
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## Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>In full</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABS</td>
<td>Australian Bureau of Statistics</td>
</tr>
<tr>
<td>ATNS</td>
<td>Agreements Treaties and Negotiated Settlements Project</td>
</tr>
<tr>
<td>CAMBA</td>
<td>China-Australia Migratory Bird Agreement</td>
</tr>
<tr>
<td>EPBC</td>
<td>Commonwealth <em>Environmental Protection and Biodiversity Act</em></td>
</tr>
<tr>
<td>FTE</td>
<td>Full time equivalent</td>
</tr>
<tr>
<td>GDEs</td>
<td>Groundwater Dependent Ecosystems</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographic Information System</td>
</tr>
<tr>
<td>GL</td>
<td>Gigalitre (1,000 megalitres or 1,000,000,000 litres)</td>
</tr>
<tr>
<td>HEWAP</td>
<td>Howard East Water Allocation Plan</td>
</tr>
<tr>
<td>HEWAPA</td>
<td>Howard East Water Allocation Planning Area</td>
</tr>
<tr>
<td>ILUA</td>
<td>Indigenous Land Use Agreement</td>
</tr>
<tr>
<td>INRM</td>
<td>Integrated Natural Resource Management</td>
</tr>
<tr>
<td>JAMBA</td>
<td>Japan-Australia Migratory Bird Agreement</td>
</tr>
<tr>
<td>LGA</td>
<td>Local Government Area</td>
</tr>
<tr>
<td>ML</td>
<td>Megalitre (1,000,000 litres)</td>
</tr>
<tr>
<td>NT</td>
<td>Northern Territory</td>
</tr>
<tr>
<td>NTG</td>
<td>Northern Territory Government</td>
</tr>
<tr>
<td>NWC</td>
<td>National Water Commission</td>
</tr>
<tr>
<td>NWI</td>
<td>National Water Initiative</td>
</tr>
<tr>
<td>PWC</td>
<td>Power and Water Corporation</td>
</tr>
<tr>
<td>TEV</td>
<td>Total Economic Value</td>
</tr>
<tr>
<td>WAC</td>
<td>Water Advisory Committee</td>
</tr>
<tr>
<td>WAP</td>
<td>Water Allocation Plan</td>
</tr>
</tbody>
</table>
Executive summary

MJA has been engaged to provide independent guidance to water planners and water advisory committees in the Howard East Water Allocation Planning Area (HEWAPA) on the use of baseline information on current social and economic condition of the area, from which to evaluate social and economic impacts of future water extraction scenarios; and how this information can be used in the development of an economically and socially acceptable water resources plan for the Howard East.

The HEWAPA has a mix of land uses with many of the principal land uses (horticulture, rural residential, pastoral and nature conservation) being highly reliant on the condition and performance of the aquifer.

Demographics in the HEWAPA

The population of the HEWAPA is estimated at between 9,700 and 10,000 and is generally expected to grow significantly in line with the overall Top End population. An analysis of key demographic data and other information for the HEWAPA revealed that:

- The Indigenous population is relatively smaller than the rest of the Top End. However, many Indigenous Territorians with an interest in the outcomes of the water allocation plan live outside the region.
- Educational attainment is skewed towards trades (as opposed to tertiary education) and Census data indicates that proficiency in English is relatively lower than the Top End in general.
- Income distribution in Howard East is roughly in line with the Top End, but incomes are generally higher in HEWAPA than in the Northern Territory (NT) as a whole.

The analysis of key demographic information indicates that population growth in the HEWAPA creates a significant potential risk to the condition of the aquifer. In addition, education attainment and English proficiency in the HEWAPA suggest that care will need to be taken during consultation for the development and implementation of the water allocation plan.

The HEWAPA economy

Analysis of the local economy indicates that the structure of the economy in the HEWAPA differs significantly from the Top End, with a higher reliance on agriculture, a lower reliance on white-collar economic activity, and a large proportion of small businesses.

Employment data shows that employment in primary industries in the HEWAPA and Litchfield is relatively three and a half times more important than in the Top End (2.51% compared to 0.68%). In excess of 100 people in the HEWAPA are directly employed in sectors reliant on irrigation.

MJA estimate that the value of irrigated agriculture in the HEWAPA is approximately $41 million per annum ($28 million fruit production and $13 million vegetables). Growth prospects for irrigated agriculture are relatively good. While the pastoral sector is relatively modest in value, the sector does impact on groundwater use.
The structure and prospects for the economy in the HEWAPA also has significant implications for the water allocation planning process as the region’s reliance on irrigated agriculture exacerbates the downside economic risk of declining aquifer performance and increases the need to manage future growth in groundwater use carefully. In addition, the prevalence for rural residential land use and future growth in the areas also creates significant risks to aquifer performance.

Groundwater use

MJA has assessed available data and information and developed estimates of current groundwater use and scenarios of future use. The figure below illustrates the bottom range scenario of groundwater use.

**Figure ES1: Bottom range scenario of groundwater use (Howard East aquifer)**

Even under a low growth scenario that builds on the lower end of the estimates of current usage, business as usual growth is relatively significant, and if unmanaged, may create risk to the performance of the aquifer with economic and social consequences.

It is important to note that around 3,560 ML (two-thirds) of the potential growth is for groundwater uses that are currently not regulated (i.e. small scale irrigation, pastoral and rural residential irrigation uses). Furthermore, the potential livestock use could be undertaken without any regulatory approvals. It is our understanding that the dominant source used for livestock is surface water, which will possibly impact on recharge. In effect, much of the risk to aquifer condition and performance will come from largely unregulated growth under current policies.

Under a high growth scenario, the increase in groundwater use could be as high as 16,800 ML, of which around 7,900 ML would be from largely unregulated uses. Under current policy and regulatory arrangements, this growth has the potential to create significant risks to aquifer health and function with few options in terms of management.
Economic and social implications

There are economic and social benefits and costs associated with further expansion in groundwater use in the HEWAPA. While there is generally very limited data available on many of the values, MJA has assessed some of the potential economic and social implications related to the water allocation plan. While the economic benefits are relatively easy to develop using indicative economic and social values, these benefits need to be weighed against the potential risks associated with further groundwater extraction.

The economic and social benefits of groundwater development

MJA has developed an economic impact assessment model for the irrigation sector in the HEWAPA to assess possible economic impacts (change in gross value of production and employment) associated with changes in groundwater use. The table below summarises key outputs from the economic impact modelling for 2021.

Table ES1: Potential economic impacts of primary industries growth (2021)

<table>
<thead>
<tr>
<th>Economic indicator</th>
<th>Low growth</th>
<th>High growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional economic activity ($ million p.a.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct economic activity</td>
<td>15</td>
<td>26</td>
</tr>
<tr>
<td>Indirect economic activity</td>
<td>7</td>
<td>14</td>
</tr>
<tr>
<td>Total economic activity</td>
<td>22</td>
<td>40</td>
</tr>
<tr>
<td>Additional employment (FTEs)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct employment</td>
<td>45</td>
<td>74</td>
</tr>
<tr>
<td>Indirect employment</td>
<td>21</td>
<td>36</td>
</tr>
<tr>
<td>Total employment</td>
<td>66</td>
<td>110</td>
</tr>
</tbody>
</table>

Source: MJA estimates

By 2021, total economic activity attributable to the higher levels of horticulture production could be $22-40 million per annum higher than current levels, of which $15-26 million would be focussed in the Litchfield Municipality. MJA estimates that growth in the HEWAPA would account for between 5% and 8% of growth in primary industries over the next 10 years.

Growth in irrigated agriculture will also create additional jobs. Under a low growth scenario, up to 66 additional full time equivalent (FTE) positions may be created (up to 45 direct and 21 indirect). Under a high growth scenario, up to 110 jobs could be created, with up to 74 being direct jobs principally in the Litchfield Municipality. Putting the employment growth into perspective, MJA estimate the additional direct jobs created are likely to account for between 0.2% and 0.4% of employment in the Litchfield Municipality in 2021.

In summary, while there is likely to be additional economic activity and employment from further development of the groundwater resource in the HEWAPA, this growth is negligible in terms of regional economic activity and employment.

Groundwater development also provides benefits to two other sectors in particular:

- **Public water supply.** The Howard East aquifer is a relatively small but highly strategic contributor to the potable water supply of the greater Darwin region. If further groundwater extraction from the Howard East aquifer is possible after completion of the water allocation...
planning process, this is likely to be a relatively cost-effective water supply option in the future.

- **Rural residential land use.** The use of the groundwater provides significant direct personal benefits to rural residential homeowners in the form of the amenity value derived from the ability to create and enjoy a watered garden year-round. This amenity value will be reflected in the values of properties. Discussions with local real estate agents indicate that established gardens often increase property values by in excess of 10% (typically $50-70,000 based in current market values). This capital value could not be realised without access to reliable water.

The economic and social risks of groundwater development

These benefits of groundwater development need to be weighed up against the risks of potential over-extraction to other sectors and values. While a formal physical risk assessment of alternative scenarios of groundwater extraction is yet to be completed, an indication of potential risks is outlined below.

**Primary production**

Where the performance of the aquifer declines, this will have negative impacts on all irrigators utilising that aquifer in the form of lower yields and revenue and higher production costs. MJA conducted a basic threshold analysis of risks to irrigated agriculture and found that declines in horticulture yields attributable to poor aquifer performance of only 5% would more than offset any gains from further horticultural development over the longer term (based on an assessment of revenue to farmers). Commercial viability for irrigators would be impacted at much lower levels of aquifer decline as both revenues would decline and costs would increase (e.g. deepening bores).

**Public water supply**

The Howard East is also very strategic to the water supply for the greater Darwin region. Over extraction places a risk on public water supply, both in terms of sustainable yields and water quality. If the aquifer’s ability to supply Power and Water Corporation failed, the cost of replacing the supply would be in the order of $10 million for the capital expenditure alone (based on the recent augmentation of the Darwin River Dam), while a significant decline in water quality may trigger a need for a water treatment plant (estimated capital cost over $40 million).

**Rural residential sector**

Declines in the performance of the aquifer will have economic and social impacts on the rural residential sector both for current dwellings and future dwellings. Amenity values will be lost and even temporary disruptions to groundwater availability will trigger rehabilitation costs to landholders and potentially trigger costly investment in water infrastructure to offset declines in groundwater reliability or quality.
Risks to non-consumptive and social values

Section 5.3 of this report outlines a suite of non-consumptive values associated with the maintenance of the Howard East aquifer. Over-extraction of groundwater may trigger a number of risks to those values.

Significant costs have already occurred in the region due to the closure of swimming access in Howard Springs Nature Park – an extremely popular recreational destination for the residents of the greater Darwin region and tourists alike. Based on the findings of recreational a value of nature parks elsewhere, the economic losses attributable to the banning of swimming and drop-off in visitation to the Nature Park would easily exceed $3 million per annum.

While there is insufficient information to quantify many of the other risks to non-consumptive and social values, they are briefly described in the table below.

<table>
<thead>
<tr>
<th>Social value</th>
<th>Risk to value</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tourism</td>
<td>Loss of tourism activity</td>
<td>Major values largely already lost due to decline in water quality Howard Springs.</td>
</tr>
<tr>
<td>Commercial fishing</td>
<td>Loss of breeding habitat condition</td>
<td>Potentially a major issue for an important sector, but relationships between groundwater extraction and fish breeding habitat not well understood.</td>
</tr>
<tr>
<td>Recreational fishing</td>
<td>Loss of breeding habitat condition</td>
<td>Potentially a significant issue for a major recreational pastime in the Top End, but relationships between groundwater extraction and fish breeding habitat not well understood.</td>
</tr>
<tr>
<td>Hunting</td>
<td>Loss of habitat</td>
<td>Some habitat may be groundwater dependent ecosystems. Loss of habitat will diminish bag rates and subsequent recreational values.</td>
</tr>
<tr>
<td>Nature study, birdwatching &amp; education</td>
<td>Loss of habitat</td>
<td>Some habitat may be groundwater dependent ecosystems. Associated social values will also diminish.</td>
</tr>
<tr>
<td>Environmental values</td>
<td>Loss of habitat &amp; ecosystem function</td>
<td>Some ecosystems may be groundwater dependent. Any decline in the extent and condition of these ecosystems will also diminish associated social values. Particular areas of concern include Black Jungle, Holmes Jungle, Micket Creek, and parts of the Howard River.</td>
</tr>
<tr>
<td>Indigenous values</td>
<td>Loss of traditional rights, environmental custodianship and cultural connections</td>
<td>Relationships between aquifer condition and these Indigenous values is complex and poorly understood. Any losses in these Indigenous values would be extremely difficult to quantify.</td>
</tr>
</tbody>
</table>

Source: MJA

While many of risks to non-consumptive uses and broader social values are difficult to measure, they are likely to be significant.
1. Introduction and background

MJA has been engaged to provide independent guidance to water planners and water advisory committees in the Howard East Water Allocation Planning Area (HEWAPA) on the evaluation of social and economic impacts of future water extraction scenarios. This guidance will be built upon baseline information on current social and economic conditions in the area, and will show how this information can be used in the development of an economically and socially acceptable water resources plan for the Howard East.

The report is intended to assist in the understanding of trade-offs between competing water planning objectives in the HEWAPA for the development of robust and balanced water allocation plans (WAPs) consistent with the NT Water Act 1992 (Water Act) and national commitments such as those under the National Water Initiative (NWI).

1.1 Water planning in the Top End

In the Northern Territory, the context for water planning differs significantly in comparison with other jurisdictions. Rainfall, river flows and groundwater recharge in the Top End are highly seasonal. In the Top End, storage yields are poor, as high temperatures and regional geology result in significant losses through evaporation and seepage.

The nature of consumptive water use in the Northern Territory is also very different to water use in southern jurisdictions. Proportionally speaking, very little water is stored in large dams,¹ and groundwater is a much more significant source of water in the north than in southern Australia, accounting for over 90% of freshwater use. Less than 1% of the total water resource in the Territory is used for economic purposes.² Indigenous cultural use of water is far more significant than in other jurisdictions. There is enormous potential for future economic growth in the Territory, and associated growth in consumptive water use. Some pressures are beginning to emerge in the HEWAPA. The challenge will be to balance the needs of growth, while maintaining ecological integrity of the ecosystems dependent on the groundwater in the HEWAPA.

Because of the, as yet relatively undeveloped nature of water resources in the Territory, many Northern Territory water plans aim to ensure that systems will be protected from future increases in consumptive use. Recognising that further scientific research is required to develop a full understanding of environmental water requirements in many systems, a precautionary approach to sustainable yield is used in the Territory. For example, in the northern part of the Territory, at least 80% of flow (in a surface water system) or annual recharge (in an aquifer) must be allocated to the environment or cultural water provisions. Even higher thresholds apply in the southern part of the Territory.

The Northern Territory is developing its water allocation and planning framework in this context. Water allocation plans are being developed under the Water Act and include:

- water allocations for towns, agriculture and industry;

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¹ For example, the National Water Commission’s (NWC’s) (2007) Australian Water Resources 2005 report found that of the Northern Territory’s total 2004-05 water resource of 55,784 GL, only 251 GL (less than half a percent of the total) was stored in large dams. By way of comparison, the equivalent figures in southeastern states were 30% (ACT), 18% (NSW), 20% (Victoria) and 30% (Tasmania).

² As reported in the NWC’s Australian Water Resources 2005 report.
water allocations for the environment, which are designed to protect river and groundwater ecology;

- strategies to achieve water use efficiency, including arrangements for water trading;
- information about the reliability of water allocations; and
- monitoring and reporting programs, to report on plan outcomes.


An overview of the national policy and planning requirements under the National Water Initiative (NWI) and the regulatory basis for water planning in the Northern Territory is outlined in more detail in Appendix A.

1.2 Purpose of report

The Northern Territory’s declared water allocation plans use socio-economic information to:

- construct a baseline ‘profile’ of communities covered by the plan;
- estimate future consumptive water demand; and
- comment on the economic implications of the estimated future patterns of water use.

In contrast to water plans in other parts of Australia (for example, plans that may be made in the Murray-Darling Basin), Northern Territory water plans anticipate future expansion of consumptive use, relative to the current very low levels of development. Thus, water plans do not consider the socio-economic implications of future cuts to water availability, but focus instead on the impacts of constraints to future growth in water extractions.

For example, the Tindall Limestone Aquifer (Katherine) Water Allocation Plan allocates a percentage of water resources to public benefit outcomes (including Indigenous cultural outcomes), this percentage being 87%, 80% or 70% depending on how wet or dry the conditions are. Chapter 6 of the Tindall (Katherine) Plan considers water demand for current and future consumptive uses. It estimates future urban water demand, drawing on population projections from the Australian Bureau of Statistics (ABS). It allows for future increases in agricultural water use, drawing on consultations with industry and the Katherine Water Advisory Committee. It also estimates future rural stock and domestic use on the basis of population and housing projections, and estimated consumptive demand per household per day.

The Alice Springs water plan draws on socio-economic information and population growth projections when forecasting future consumptive demand. It also estimates future industrial and agricultural use of water, based on land use assessments.

The water plan being developed for the HEWAPA will need to consider similar issues. Howard East is a priority area for the development of a WAP because of high levels of water
use and expected growth in the region over the next 10 years. Water use is already reaching the limits of sustainable extraction. The Howard East WAP will need to:

- Include basic community profiles and other relevant data to describe a ‘baseline’ for the water plan
- Identify and describe drivers of future consumptive demand. These will include projected population change
- Consider the economic implications of the likely future patterns of water use. This will include assessment of factors such as:
  - Data on consumptive water users, and how much water they use
  - How water resources are used, and the marginal contribution of those water resources to economic output and employment
  - Future economic trends and market outlook of key industries

Water plans should, among other things, define and describe outcomes (environmental, public benefit, and consumptive) which are to be achieved from the use of water resources, and allocate water between uses so that trade-offs between those outcomes take into account the best available science, social and economic analysis and community input.

In allocating water between uses, water plans need to (1) identify the different uses to which water will be put, including the water requirements of both consumptive users and non-consumptive uses (i.e. environmental and other public benefit outcomes); (2) place a value on these different uses, so that informed trade-offs between different allocations of water can be made; and (3) define the water requirements (quantities and/or timing) of these uses.

While social and economic data are a key input into this process, it is important to recognise that biophysical data are also important. Water planners need to use both socio-economic and biophysical data to (1) identify water requirements; and (2) place a value on different uses (human and environmental). They then need to integrate their understanding of water requirements, and the value of different water uses, with a biophysical understanding of environmental watering requirements. Therefore, in establishing the water plan for the HEWAPA, it is vital to consider both the biophysical analysis being prepared by SKM and the socio-economic information outlined in this report.

1.3 Approach to this assessment

Under the NWI the economic and social assessments are intended to assist in the development of water plans by:

- Advising on economic and social impacts of water allocation options as an input to the settling of tradeoffs.
- Identifying ways of mitigating negative impacts including structural adjustment options.
- Providing information to stakeholders.

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3 Department of Natural Resources, Environment, the Arts and Sport (NRETAS) (2011a), *Howard East Aquifer Water Allocation Plan: Information Report*, NT Department of Natural Resources, Environment, the Arts and Sport, May 2011.

Providing an understanding of the cultural context within which planning is taking place in order to identify public benefit outcomes, take relevant values (including Indigenous, social and spiritual) into account, and to minimise conflict.

The water plan being developed for Howard East will need to include:

- Profiles – to provide context (cultural, social, economic) as input to understanding potential conflicts and impacts.
- Baselines – to provide baseline of water use (consumptive and non-consumptive) against which changes can be compared as input to settling tradeoffs.
- Identify and describe drivers of future consumptive demand. These will include projected population change.
- Consider the economic implications of the likely future patterns of water use. This will include assessment of factors such as:
  - Data on consumptive water users, and how much water they use.
  - How water resources are used, and the contribution of those water resources to economic output and employment.
  - Future economic trends and market outlook of key industries.
  - Impact assessment as a means of understanding trade-offs and options for mitigating impacts. Identifying impacts also allows the identification of users of water and hence enables future pressures to be anticipated. This is important for understanding who has an interest in water planning and hence who should be a party to a WAP process (e.g. fishers, tourism operators), and whose values should be considered to avoid or minimise conflict.

The remainder of this report summarises the findings and recommendations from an application of this approach to the HEWAPA.
2. Overview of the region

The Howard East aquifer covers 1,500km² of the Darwin hinterland, lying within the Litchfield Shire with an estimated population of around 9,700 to 10,000 persons. Given the continued population growth in Darwin and Palmerston and the desire for rural residential living, as well as continued growth in the horticultural sector, the population is expected to increase significantly over the next decade. The intensification of land use and increased diversity of such land use has accompanied population growth.

The Howard East aquifer is a complex groundwater system that underlies a significant portion of the Darwin Rural Area. Groundwater discharges from the aquifer through a number of streams and springs, as well as a number of bores and groundwater pumping. Howard Springs is a major spring in the area.

The Howard East Aquifer is an important source of water for irrigated horticulture (e.g., mangoes and Asian vegetables), industrial production, rural domestic water supply and to augment reticulated urban water supply for Darwin and Palmerston, as well as a number of important ecosystems. Water thus underpins a variety of economic and environmental values in the HEWAPA (shown in Figure 1).

Figure 1: Howard East Water Allocation Plan area

Source: NRETAS 2011a.

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5 Ref 3.
6 Ref 3.
2.1 Climate and rainfall

The average annual rainfall in the Howard East area is 1,700 mm. 80% of this rainfall occurs between December and March, with little or no rainfall during the dry season from May to October. Stream flows are seasonal and typically start in December and end in June, with the majority of waterways drying out completely though some deep pools remain year round.

Annual evaporation is high at around 2,500mm per year. Evaporation rates are highest around October and lowest around February. Despite high rainfall during each wet season, the region is generally water deficient (total evaporation exceeds total rainfall).

There is a short lag between rainfall and runoff, with 96% of runoff between December and April.

However, climate during the recent period between 1996 and 2007 has been considerably wetter than during the earlier period between 1930 and 1996. Rainfall was 16% higher and runoff 44% higher. CSIRO anticipate that future rainfall and runoff (post 2030) will be closer to the historical average.

2.2 Land use

There are a number of land tenures in the HEWAPA, including pastoral leasehold, mineral extraction and exploration, defence, and freehold residential and horticultural. Land use is regulated through the NT Planning Scheme and relevant laws such as the Mining Act 1980. Land uses with particular water requirements are also regulated by the Water Act as amended in 2004. Significantly however, mining is not regulated by the Water Act and mining activity is not required to obtain a license for water extraction.

2.2.1 Customary uses

The original inhabitants of Litchfield Shire included the Larrakia and Wulna Aboriginal peoples. Larrakia are today the significant language group with customary associations with the Howard region – as their traditional lands include much of the Darwin rural and Gunn Point areas.

The Howard East region includes ‘tidal mudflats and mangrove lined creeks, freshwater lagoons, floodplains, open woodland areas and the sea itself which contains a variety of plants, animals and marine resource which are managed, harvested, hunted and fished by Larrakia people’.

The Melacca Swamp Conservation Area Indigenous Land Use Agreement (ILUA) was made between the Northern Land Council, the Northern Territory of Australia and the Native Title Parties to clarify the future title and management of the Melacca Swamp Conservation Area which contains several sacred sites.

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7 CSIRO (2009), Water in the Van Diemen region of the Timor Sea Drainage Division, a report to the Australian Government from the CSIRO Northern Australia Sustainable Yields Project, August 2009.


9 Quoted in ibid.

10 Agreements Treaties and Negotiated Settlements Project (ATNS) 2005.
Reserve ILUA was made between the Northern Land Council, the Northern Territory of Australia and the Native Title Parties to clarify the future title and management of the Black Jungle/Lambells Lagoon Conservation Reserve. Several sites have also been registered and recorded in this area. \(^{11}\)

### 2.2.2 Agricultural and pastoral uses

European settlement in the Litchfield Shire dates from 1864. Land use was mainly agricultural and pastoral. Agriculture was encouraged in the expectation that, because of its tropical location, the region would be well suited to crops such as sugar, rubber, coffee, tobacco, hemp, maize, rice, arrowroot, peanuts, tea and cotton.

These early attempts at agricultural development were not successful, but substantial horticultural growth took place in the post-war years, with significant development from the 1970s. Since 1996, Litchfield Shire has experienced a marked increase in population, a result of new residential development and increased interest in horticulture and other land uses.

By area, agricultural use is dominated by the pastoral sector. However, the region is an important area for horticultural production in the NT, providing produce for both local and interstate (sometime overseas) markets.

### 2.2.3 Defence

The Defence Department has a number of landholdings in the HEWAPA for military training purposes. Defence has a management regime in place for the use of potable water supply across defence operations in accordance with the Commonwealth Water Act 2007, and is therefore exempt from Territory water legislation. \(^{12}\) Nevertheless, Defence has expressed willingness to participate in the WAP process. \(^{13}\)

### 2.2.4 Mining

Minerals, sands and other construction materials are extracted from shallow mines in the Howard region. Woodward et al reported that mining for fine sand in the Darwin region removes approximately 41 ha of native vegetation per year, but that this was expected to rise by 70% by the year 2020. \(^{14}\) Fine sand is mined from shallow sandsheets around rivers and creeks.

There are approximately 250 extractive mining tenements within the outer Darwin area. Other extractive minerals used around Darwin include fine and coarse sand, natural gravel, crushed rock, porcellanite, clay, soil and dimension stone. The average consumption of extractive minerals (crushed rock, gravel and sand) in the Darwin region over the last four years was 1.3 million tonnes, estimated to be half the Territory average of 2.6 million tonnes. The projected demand for extractive minerals in the year 2020 for the Darwin region is 2.2 million tonnes. \(^{15}\)

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\(^{11}\) Ref 8.


\(^{13}\) Ibid.

\(^{14}\) Ref 8.

\(^{15}\) Ref 8.
Mining is exempt from groundwater and surface water licensing under the *Water Act* but is subject to licensing for discharge, waste management and pollution under the *Waste Management and Pollution Control Act 1998* (NT). There is no limit on water extraction for mining, but mining proposals are required to prepare a Notice of Intention and Public Environmental Report or an Environmental Impact Statement which must detail water extraction rates, discharge and usage, and indicate how the mine intends to ameliorate impacts.

Woodward et al reported, however, that few extractives mines have undergone this kind of environmental assessment, but are instead approved and regulated under the *Mining Act and Mine Management Act*. There is a Memorandum of Understanding between the Mines Department and NRETAS through which developments above a certain threshold are referred to NRETAS for environmental assessment.

A Bore Construction Permit is only required if the bore is drilled outside the mining lease and within a water control district i.e., on the adjacent parcel of land to the mining lease where the miner’s accommodation is located.

### 2.2.5 Rural residential uses

Litchfield Shire has developed as an alternative semi-rural place to live on the fringe of Darwin. Many residents have small blocks of between 2 and 8 hectares (ha). An increasing regional population, and increased demand for rural living, have seen a trend away from larger 8 ha subdivisions to predominantly 2 ha or smaller lots. Regulations requiring new subdivisions to provide reticulated water and septic systems for blocks smaller than 2 ha have been passed in response to increasing pressure on groundwater supply from local (stock and domestic) bores, as well as health considerations. Bores must now be a sufficient distance from septic tanks to prevent leaching and contamination. The Power and Water Corporation (PWC) has also undertaken a number of studies into the risks to groundwater, e.g. from domestic septic tanks and extractives mining in the rural area.

According to the Litchfield Shire Planning Concepts and Land Use Objectives 2002, the plan is to accommodate future population growth, maintain minimum lot sizes within existing subdivisions in established rural living areas, and create opportunities to cater for various aspirations in relation to rural lifestyle, through the:

- continuation of 2 ha subdivision predominantly for residential purposes in the Howard Springs, Bees Creek and Humpty Doo areas;
- continuation of 8 ha subdivision for a range of uses including rural living and agriculture (includes horticulture and aquaculture) in the southern part of the shire;
- provision for future rural residential subdivision of lots less than 2 ha in specific localities;
- creation of opportunities for alternative rural living lifestyles; and
- further provision of urban sized lots within appropriately serviced district centres.

A new high density rural living zoning is also proposed within the Land Use Objectives and described as ‘estate development’. The Greater Darwin Region Land Use Plan – Towards 2030 supports the development of more compact, interconnected urban and rural communities via a series of villages in the Litchfield area.

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2.2.6 National Parks

NT Parks and Wildlife is also a significant land holder, managing 4.7 million ha across the Territory as a whole. In the region surrounding the HEWAPA, the Litchfield National Park covers an area of 1,500km². Other conservation areas in the broader region include the Howard Springs Nature Park, the Berry Springs Nature Reserve, and the Territory Wildlife Park.

2.3 Key environmental features / assets

The Howard East sandsheet is an area of extremely high biodiversity with a number of species endemic to the Northern Territory. There is considerable plant diversity with 1,259 species within the Litchfield Shire. Three of these are found nowhere else in the world.

The region’s natural areas are predominantly eucalypt woodland, but there are also a number of important groundwater-dependent ecosystems (GDEs) such as Howard Springs, Howard River, a number of lagoons (McMinns, Lambells and Blackjungle), and Palm Forest. Some key points to note are:

- Surface water ecosystems maintained by discharge from the Howard East Aquifer during the dry season - such as Howard Springs, Melacca Creek, lagoons and patches of spring fed remnant jungle including Black Jungle Swamp - include a variety of waterways, wetlands, rainforests, springs, tropical woodlands, mangroves and tidal flats, and monsoon vine forest.

- These ecosystems support a variety of fish, plant and bird species. Associated social and cultural values include recreational fishing and hunting, customary hunting and collecting, and recreational and tourism activities.

- Rainforests, riparian vegetation and wetlands provide important habitats and watering points for wildlife. Rainforest patches, such as Howard Springs, support 13% of the Territory’s known plant species. There are more than 130 lagoons in the area, with well known ones including McMinns, Lambells and Girraween. Small patches of rainforest are sustained by groundwater runoff.

- Palm Forest is listed as vulnerable under the Commonwealth Environment Protection and Biodiversity (EPBC) Act. A number of birds listed under the Japan-Australia Migratory Bird Agreement (JAMBA) and the China-Australia Migratory Bird Agreement (CAMBA) are also found in wetlands in the Howard East area.

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18 Workshop held at SKM offices, 23 August 2011.
19 Ref 8.
3. Demographic overview

Social and/or economic impact assessment is a process for evaluating and managing the intended and unintended social consequences of changes in water allocations. This is done through the prediction of social and economic impacts that are likely to follow from the introduction of a WAP. These impacts include economic impacts such as on employment, income, or production; and non-economic impacts such as on a way of life, culture, environment, and health and well-being for either individuals or communities.²⁰

When developing economic and social assessments, it is vital to develop a base case against which alternative water allocation planning scenarios can be assessed.

This section provides an overview of the population of Howard East in terms of language; employment; income; and education characteristics. These numbers are all based on the 2006 Census of Population and Housing. Estimates for the HEWAPA have been established through a process of concording (matching) data from ABS collection districts (the smallest geographical scale of data availability) with the boundaries of the HEWAPA.

Section 3 of this report concludes with an outline of the demographic implications for water allocation planning. This information will assist with the development of the Plan and ultimately approaches to ensure compliance with the Plan during implementation.

3.1 Population

The current population of the HEWAPA is estimated at around 9,700-10,000 persons, approximately half of Litchfield Municipality population, and less than 9% of the Top End population. ABS data indicates that the population of Litchfield Municipality is growing at one of the fastest rates of any area in the Territory.²¹ Key population estimates are shown in the table below.

Based on official 2006 Census data, the population is slightly skewed towards males. This is generally consistent with data across the Territory.

**Table 1: Population – key statistics**

<table>
<thead>
<tr>
<th>Population</th>
<th>HEWAPA</th>
<th>Litchfield</th>
<th>Top End</th>
<th>NT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated residential population – number (end 2011)</td>
<td>9,700-10,000</td>
<td>19-20,000</td>
<td>128,000</td>
<td>225,000</td>
</tr>
<tr>
<td>Gender split - percentage (2006 Census data)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Male</td>
<td>52.8</td>
<td>54.9</td>
<td>52.0</td>
<td>51.5</td>
</tr>
<tr>
<td>% Female</td>
<td>47.2</td>
<td>45.1</td>
<td>48.0</td>
<td>48.5</td>
</tr>
</tbody>
</table>

*Source: MJA based on ABS 2006 Census*

Population by age indicates:

- Howard East has a much smaller cohort of 20-29 year olds (7.8%) than the Top End (15.6%) and the Northern Territory (16.0%).


Howard East has a larger proportion of 40-49 year olds (19.4%) than the Northern Territory as a whole (15.1%). Howard East also has larger proportions of 50-59 year olds, 60-69 year olds, and 70-79 year olds than the Northern Territory as a whole.

3.1.1 Population forecasts

Figure 2 below gives population projects for Howard East and Litchfield. The growth rates have been based on figures in the Northern Territory Population Projections released by NT Treasury. Under the high growth scenario (HG), Howard East’s population is expected to reach around 13,000 by 2025, while under the low growth scenario (LG) it is only expected to reach around 11,000. Litchfield is estimated to have a population of around 26,000 by 2025 under the high growth scenario, while it is only estimated to have a population of around 22,000 under the low growth scenario.

Figure 2: Population projections for Howard East and Litchfield


3.1.2 Indigenous population

There is a high proportion of Indigenous Territorians in the Top End, and Indigenous people have a particular affiliation with waterways and the environment that relies on the condition of groundwater. The table below summarises key Census data relating to the Indigenous population.

Key points to note are:

- The proportion of Aboriginal persons in Howard East (4.57%) is lower than for the Northern Territory as a whole (26.8%).
- A higher percentage of people in Howard East reported being Non-Indigenous (84.19%) than in the Northern Territory (63.63%).
Table 2: Population by Indigenous Status (2006)

<table>
<thead>
<tr>
<th>Indigenous Status</th>
<th>HEWAPA</th>
<th>Litchfield</th>
<th>Top End</th>
<th>Northern Territory</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Non-Indigenous</td>
<td>6,877</td>
<td>84.2</td>
<td>12,813</td>
<td>82.4</td>
</tr>
<tr>
<td>Aboriginal</td>
<td>374</td>
<td>4.6</td>
<td>815</td>
<td>5.2</td>
</tr>
<tr>
<td>Torres Strait Islander</td>
<td>30</td>
<td>0.4</td>
<td>62</td>
<td>0.4</td>
</tr>
<tr>
<td>Both Aboriginal and Torres Strait Islander</td>
<td>36</td>
<td>0.4</td>
<td>64</td>
<td>0.4</td>
</tr>
<tr>
<td>Not stated</td>
<td>853</td>
<td>10.4</td>
<td>1,800</td>
<td>11.6</td>
</tr>
<tr>
<td>Total</td>
<td>8,168</td>
<td>100.0</td>
<td>15,554</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*Source: ABS 2006 Census.*

3.2 Education and language

Education levels and language skills are also important to water allocation planning. Generally, education levels are an indicator of human capital and the ability to adapt to changing economic and social circumstances (e.g. through retraining and switching between sectors). Similarly, limited English language skills can also constrain an individual’s ability to adapt to changing economic conditions.

In addition, lower levels of education attainment or English speaking skills can inhibit an individual’s ability to engage in the water allocation planning process. They may also create a risk to long-term compliance with requirements under water allocation plans where individuals are unable to understand their rights and responsibilities under the Plan.

3.2.1 Education

Table 3 below outlines data on the highest level of schooling attained.

Table 3: Highest Level of Schooling

<table>
<thead>
<tr>
<th>Highest Level of Schooling</th>
<th>HEWAPA</th>
<th>Litchfield</th>
<th>Top End</th>
<th>Northern Territory</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Year 12 or equivalent</td>
<td>1,901</td>
<td>23.3</td>
<td>3,809</td>
<td>24.5</td>
</tr>
<tr>
<td>Year 11 or equivalent</td>
<td>1,027</td>
<td>12.6</td>
<td>1,884</td>
<td>12.1</td>
</tr>
<tr>
<td>Year 10 or equivalent</td>
<td>1,704</td>
<td>20.9</td>
<td>3,127</td>
<td>20.1</td>
</tr>
<tr>
<td>Year 9 or equivalent</td>
<td>429</td>
<td>5.3</td>
<td>832</td>
<td>5.4</td>
</tr>
<tr>
<td>Year 8 or below</td>
<td>298</td>
<td>3.6</td>
<td>582</td>
<td>3.7</td>
</tr>
<tr>
<td>Did not go to school</td>
<td>28</td>
<td>0.3</td>
<td>52</td>
<td>0.3</td>
</tr>
<tr>
<td>Not stated</td>
<td>847</td>
<td>10.4</td>
<td>1,728</td>
<td>11.1</td>
</tr>
<tr>
<td>Not applicable</td>
<td>1,938</td>
<td>23.7</td>
<td>3,540</td>
<td>22.8</td>
</tr>
<tr>
<td>Total</td>
<td>8,169</td>
<td>100.0</td>
<td>15,554</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*Source: ABS 2006 Census.*
Key points to note from the data are:

- Generally, the population of both HEWAPA and Litchfield have attained a lower level of schooling than the overall population of the Top End.
- A smaller proportion of Howard East residents completed Year 12 (23.3%) than in either the Top End (31.2%) or the Northern Territory as a whole (25.2%).
- A higher proportion of Howard East residents completed Year 10 (20.9%), than for the Top End (16.0%) and the Northern Territory as a whole (14.9%).

Table 4 outlines data for non-school education qualifications. Key points to note include:

- The HEWAPA (and Litchfield) has a greater proportion of trade qualifications than the Top End and a lower proportion of formal university educated people.
- 5% of residents from Howard East reported having a Bachelor Degree, compared to 8.3% in the Top End and 6.7% in the Northern Territory as a whole.
- In Howard East 18.4% of residents reported having a Certificate level non-school qualification, compared to 13.0% in the Northern Territory as a whole.

Table 4: Non-school Qualification

<table>
<thead>
<tr>
<th>Non-school Qualification</th>
<th>HEWAPA No.</th>
<th>HEWAPA %</th>
<th>Litchfield No.</th>
<th>Litchfield %</th>
<th>Top End No.</th>
<th>Top End %</th>
<th>Northern Territory No.</th>
<th>Northern Territory %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of education not stated</td>
<td>947</td>
<td>11.6</td>
<td>1,910</td>
<td>12.3</td>
<td>12,425</td>
<td>11.7</td>
<td>23,162</td>
<td>12.0</td>
</tr>
<tr>
<td>Level of education inadequately described</td>
<td>90</td>
<td>1.1</td>
<td>177</td>
<td>1.1</td>
<td>1,110</td>
<td>1.1</td>
<td>1,739</td>
<td>0.9</td>
</tr>
<tr>
<td>Postgraduate Degree Level</td>
<td>70</td>
<td>0.9</td>
<td>139</td>
<td>0.9</td>
<td>2,021</td>
<td>1.9</td>
<td>2,872</td>
<td>1.5</td>
</tr>
<tr>
<td>Graduate Diploma and Graduate Certificate</td>
<td>83</td>
<td>1.0</td>
<td>148</td>
<td>1.0</td>
<td>1,451</td>
<td>1.4</td>
<td>2,195</td>
<td>1.1</td>
</tr>
<tr>
<td>Bachelor Degree Level</td>
<td>409</td>
<td>5.0</td>
<td>822</td>
<td>5.3</td>
<td>8,745</td>
<td>8.3</td>
<td>12,907</td>
<td>6.7</td>
</tr>
<tr>
<td>Advanced Diploma and Diploma Level</td>
<td>408</td>
<td>5.0</td>
<td>752</td>
<td>4.8</td>
<td>5,669</td>
<td>5.4</td>
<td>8,476</td>
<td>4.4</td>
</tr>
<tr>
<td>Certificate Level</td>
<td>1,503</td>
<td>18.4</td>
<td>2,770</td>
<td>17.8</td>
<td>15,909</td>
<td>15.0</td>
<td>25,022</td>
<td>13.0</td>
</tr>
<tr>
<td>Not applicable</td>
<td>4,661</td>
<td>57.1</td>
<td>8,836</td>
<td>56.8</td>
<td>58,662</td>
<td>55.4</td>
<td>116,526</td>
<td>60.4</td>
</tr>
<tr>
<td>Total</td>
<td>8,168</td>
<td>100.0</td>
<td>15,554</td>
<td>100.0</td>
<td>105,992</td>
<td>100.0</td>
<td>192,899</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: ABS 2006 Census.

3.2.2 Language

Analysis of Census data also indicates that the population of HEWAPA has a different English language capacity than the Territory as a whole. Specifically:

- A much lower proportion of people in Howard East reported that they speak English “very well” or “well” (2.8% and 1.7% respectively) than in either the Top End (7.2%, 3.4%) or in the Northern Territory as a whole (10.4%, 8.0%).
- A larger proportion of people in Howard East (85.6%) reported speaking Northern European Languages at home than for the Northern Territory as a whole (66.6%).
The same proportion of people in Howard East and the Northern Territory reported speaking Southeast Asian Languages (2.1% in both).

The relative capacities in English language proficiency in Howard East indicate that care should be taken to ensure communication undertaken for the water allocation planning process is appropriate to the needs of the community.

3.3 Incomes

Incomes are also an indicator of the resilience of individuals and communities to cope with policy shocks, particularly when the policy may impact directly on incomes received. The figure below outlines key incomes data for the HEWAPA and other relevant regions for comparative purposes.

Figure 3: Family Income Profiles


Key points to note are that:

- Income distribution in Howard East is generally in line with the Top End as a whole. Incomes are generally higher in HEWAPA than in the NT.
- The Melbourne Institute has estimated the weekly poverty line for a family (a couple with two children) at $835.30 (including housing). The proportion of households in the HEWAPA area at or below the poverty line is similar to the Top End (12-13%), but significantly lower than the Territory as a whole (around 17%).
- While it is impossible to determine economic vulnerability of those impacted by water planning from the data, anecdotal information from the consultation phase of this project has indicated that many of the horticulturalists may be at the lower end of the income spectrum. This is consistent with studies conducted elsewhere in Australia.
3.4 Demographic implications for water allocation planning

Analysis of the demographic data indicates a number of potential implications for the development of the HEWAPA, specifically:

- **Risks from rural residential population and population growth.** The rapid population growth expected will largely be in rural residential areas. Based on the current understanding of water use by rural residential, and the likely location of future development, population growth and associated groundwater use creates a material risk to aquifer health if this increase in demand is not properly managed.

- **Indigenous population requires broad consultation.** While the Indigenous population living in the HEWAPA is relatively small, many Indigenous Territorians will have an interest in the outcomes of the Plan. Therefore, Indigenous engagement may need to be undertaken on a broader geographical scale (e.g. Top End) to ensure relevant Indigenous stakeholders have an appropriate opportunity to participate in the planning process.

- **Education and language differences create difficulties for planning and compliance.** Education and English language capacities in the HEWAPA have implications for water allocation planning. Targeted and carefully crafted consultation will be required during the development of the HEWAP, particularly for horticulturalists where there is significant anecdotal evidence to suggest that English is a second language for many of them. Furthermore, the implementation stage of the Plan will require targeted and ‘language specific’ communications to underpin any compliance regime. There will be a need to ensure consultation and compliance approaches are not overly bureaucratic (including language used).
4. Economic overview

This Section provides an economic overview of the HEWAPA and the Litchfield areas. Information in the Section is drawn from a number of official ABS, Northern Territory Government, and industry sources. That data has been augmented by qualitative information gathered during the consultation phase of the project.

A note on small economies

Economic analysis of small economies such as the HEWAPA is complicated by a number of factors that limit the extent to which quantitative economic analysis is possible, including:

- Very rarely is economic data actually available at the small scale required.
- What data does exist tends to be gross values of production, or turnover. While this is an indicator of economic activity, it is not a measure of net economic benefits from economic activity.
- Areas such as the HEWAPA tend to be very import and export orientated. Most of what is consumed is imported, while much of what is produced is exported, limiting the degree of economic value adding in the actual region.
- Often only a small proportion of economic activity and economic values are directly relevant to water allocation planning, particularly as much of the economic values associated with waterway health have no direct economic value (i.e. their value is not reflected in the prices of goods and services traded).

4.1 Structure - businesses

Data specific to the HEWAPA is not available from any source and the smallest scale of economic data availability is the Local Government Area (LGA) – i.e. the Litchfield Municipality. MJA has analysed available business registration data that provides insight into the structure of the local economy. Table 5 indicates the percentage of total business registrations by industry. The key points to note are that the structure of the Litchfield economy is significantly different to the Top End economy in a number of ways, specifically:

- The importance of agriculture. In Litchfield 20% of registered businesses are in agriculture, three times the level of the Top End as a whole. In addition, the makeup of the wholesale and retail trade sector (e.g. around Coolalinga) is also heavily skewed towards servicing the agriculture sector, indicating the flow-on impacts of changes in agricultural activity attributable to the water allocation plan could be significant at the local level.
- Construction. There is also a relatively high proportion of businesses in the construction industry reflecting the geographical and land use availability advantages of the region and the broader demographic makeup of the region (high proportion of tradespeople).
- Fewer business services. Business services (finance, insurance, property, other business services) account for 16% of businesses in Litchfield, compared to 30% in the Top End. This is largely due to the close proximity of Litchfield to Darwin. Essentially, many of the business services required in Litchfield can be provided out of Darwin.
In summary, the local economy in Litchfield is heavily skewed to agriculture and the availability of water (quantity, reliability, quality) and maintaining the condition of the Howard East Aquifer is vital to the future of the most significant industry in the region.

Table 5: Business registrations by industry

<table>
<thead>
<tr>
<th>Industry</th>
<th>Litchfield (%)</th>
<th>Top End (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture, forestry and fishing</td>
<td>20%</td>
<td>7%</td>
</tr>
<tr>
<td>Mining</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>6%</td>
<td>5%</td>
</tr>
<tr>
<td>Electricity, gas and water supply</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Construction</td>
<td>29%</td>
<td>23%</td>
</tr>
<tr>
<td>Wholesale trade</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Retail trade</td>
<td>10%</td>
<td>11%</td>
</tr>
<tr>
<td>Accommodation, cafes and restaurants</td>
<td>2%</td>
<td>3%</td>
</tr>
<tr>
<td>Transport and storage</td>
<td>6%</td>
<td>6%</td>
</tr>
<tr>
<td>Communication services</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Finance and insurance</td>
<td>2%</td>
<td>5%</td>
</tr>
<tr>
<td>Property and business services</td>
<td>14%</td>
<td>25%</td>
</tr>
<tr>
<td>Education</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Health and community services</td>
<td>2%</td>
<td>4%</td>
</tr>
<tr>
<td>Cultural and recreational services</td>
<td>1%</td>
<td>2%</td>
</tr>
<tr>
<td>Personal and other services</td>
<td>4%</td>
<td>3%</td>
</tr>
<tr>
<td>Total businesses</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Source: MJA based on online ABS National Regional Profile data (2007 data (latest available)).

Table 6 shows the count of businesses by size categories for Litchfield and the Top End. Key points to note are that:

- There are approximately 1,600 registered businesses in Litchfield, or approximately 18% of the total number of registered business in the Top End.
- Litchfield has a significantly higher percentage of businesses that do not directly employ individuals, or have less than five staff (89%) when compared to the Top End (84%). This is typical of areas dominated by regional and rural activities.

Table 6: Business structures by size

<table>
<thead>
<tr>
<th>Business Type</th>
<th>Litchfield Number</th>
<th>%</th>
<th>Top End Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-employing businesses</td>
<td>1,119</td>
<td>70%</td>
<td>5,472</td>
<td>62%</td>
</tr>
<tr>
<td>Employing businesses (1 to 4 employees)</td>
<td>300</td>
<td>19%</td>
<td>1,905</td>
<td>22%</td>
</tr>
<tr>
<td>Employing businesses (5 or more employees)</td>
<td>177</td>
<td>11%</td>
<td>1,443</td>
<td>16%</td>
</tr>
<tr>
<td>Total businesses</td>
<td>1,596</td>
<td>100%</td>
<td>8,820</td>
<td>100%</td>
</tr>
</tbody>
</table>

Source: MJA based on online ABS National Regional Profile data (2007 data (latest available)).

4.2 Structure - employment

An analysis of Census employment data in the region provides further insight into the structure of the economy. Given the very small area covered by the HEWAPA and its proximity to major
employment generating regions (i.e. the greater Darwin region), many residents of the HEWAPA area will actually be employed outside the planning area (for example most of the 602 persons employed in Public Administration and Safety). The key point to note from the employment data is that employment in primary industries in the HEWAPA and Litchfield is three and a half times more important relative to the Top End (2.51% compared to 0.68%).

Table 7: Employment by Industry

<table>
<thead>
<tr>
<th>Employment by Industry (1st digit)</th>
<th>Howard East</th>
<th>Litchfield</th>
<th>Top End</th>
<th>Northern Territory</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Not stated</td>
<td>58</td>
<td>0.7</td>
<td>99</td>
<td>0.6</td>
</tr>
<tr>
<td>Not applicable</td>
<td>4,019</td>
<td>49.2</td>
<td>7,576</td>
<td>48.7</td>
</tr>
<tr>
<td>Agriculture, Forestry and Fishing</td>
<td>205</td>
<td>2.5</td>
<td>395</td>
<td>2.5</td>
</tr>
<tr>
<td>Mining</td>
<td>129</td>
<td>1.6</td>
<td>220</td>
<td>1.4</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>274</td>
<td>3.4</td>
<td>459</td>
<td>3.0</td>
</tr>
<tr>
<td>Electricity, Gas, Water and Waste Services</td>
<td>40</td>
<td>0.5</td>
<td>80</td>
<td>0.1</td>
</tr>
<tr>
<td>Construction</td>
<td>499</td>
<td>6.1</td>
<td>932</td>
<td>6.0</td>
</tr>
<tr>
<td>Wholesale Trade</td>
<td>145</td>
<td>1.8</td>
<td>270</td>
<td>1.4</td>
</tr>
<tr>
<td>Retail Trade</td>
<td>421</td>
<td>5.2</td>
<td>697</td>
<td>4.5</td>
</tr>
<tr>
<td>Accommodation and Food Services</td>
<td>141</td>
<td>1.7</td>
<td>278</td>
<td>1.8</td>
</tr>
<tr>
<td>Transport, Postal and Warehousing</td>
<td>242</td>
<td>3.0</td>
<td>458</td>
<td>2.9</td>
</tr>
<tr>
<td>Information Media and Telecommunications</td>
<td>63</td>
<td>0.8</td>
<td>99</td>
<td>0.6</td>
</tr>
<tr>
<td>Financial and Insurance Services</td>
<td>65</td>
<td>0.8</td>
<td>98</td>
<td>0.6</td>
</tr>
<tr>
<td>Rental, Hiring and Real Estate Services</td>
<td>58</td>
<td>0.7</td>
<td>106</td>
<td>0.7</td>
</tr>
<tr>
<td>Professional, Scientific and Technical Services</td>
<td>191</td>
<td>2.3</td>
<td>357</td>
<td>2.3</td>
</tr>
<tr>
<td>Administrative and Support Services</td>
<td>127</td>
<td>1.6</td>
<td>218</td>
<td>1.4</td>
</tr>
<tr>
<td>Public Administration and Safety</td>
<td>602</td>
<td>7.4</td>
<td>1,590</td>
<td>10.2</td>
</tr>
<tr>
<td>Education and Training Health Care and Social Assistance</td>
<td>318</td>
<td>3.9</td>
<td>591</td>
<td>3.8</td>
</tr>
<tr>
<td>Arts and Recreation Services</td>
<td>256</td>
<td>3.1</td>
<td>435</td>
<td>2.8</td>
</tr>
<tr>
<td>Other Services</td>
<td>193</td>
<td>2.4</td>
<td>349</td>
<td>2.2</td>
</tr>
<tr>
<td>Inadequately described</td>
<td>73</td>
<td>0.9</td>
<td>126</td>
<td>0.8</td>
</tr>
<tr>
<td>Total</td>
<td>8,168</td>
<td>100.0</td>
<td>15,554</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: ABS 2006 Census

The prominence of agriculture in is consistent with business registration data that also indicates the regional importance of agriculture to the local economy.
### 4.2.1 Employment in primary industries

Given the importance of primary industries to the region, further analysis of the employment in the sector is warranted to determine the linkages between employment and agricultural water use. The table below shows agricultural employment data by sub-sector.

**Table 8: Detailed agricultural employment**

<table>
<thead>
<tr>
<th>Agricultural employment to the 4th digit</th>
<th>Howard East</th>
<th>Litchfield</th>
<th>Top End</th>
<th>Northern Territory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture, nfd</td>
<td>20</td>
<td>9.8</td>
<td>24</td>
<td>6.1</td>
</tr>
<tr>
<td>Nursery Production (Outdoors)</td>
<td>12</td>
<td>5.9</td>
<td>13</td>
<td>3.3</td>
</tr>
<tr>
<td>Horticulture Production (Outdoors)</td>
<td>7</td>
<td>3.4</td>
<td>21</td>
<td>5.3</td>
</tr>
<tr>
<td>Vegetable Growing (Outdoors)</td>
<td>24</td>
<td>11.7</td>
<td>59</td>
<td>14.9</td>
</tr>
<tr>
<td>Fruit and Tree Nut Growing, nfd</td>
<td>4</td>
<td>2.0</td>
<td>18</td>
<td>4.6</td>
</tr>
<tr>
<td>Citrus Fruit Growing</td>
<td>3</td>
<td>1.5</td>
<td>3</td>
<td>0.8</td>
</tr>
<tr>
<td>Other Fruit and Tree Nut Growing</td>
<td>51</td>
<td>24.9</td>
<td>111</td>
<td>28.1</td>
</tr>
</tbody>
</table>

|                                          | Howard East | Litchfield | Top End | Northern Territory |
|                                          | No. | %      | No. | %      | No. | %      | No. | %      |
| Beef Cattle Farming (Specialised)        | 11  | 5.1    | 22  | 5.6    | 36  | 5.0    | 1,060 | 50.7 |
| Other Grain Growing                      | 3   | 1.5    | 3   | 0.8    | 3   | 0.4    | 9    | 0.4    |
| Other Crop Growing, nec                  | 3   | 1.5    | 3   | 0.8    | 4   | 0.6    | 27   | 1.3    |
| Pig Farming                              | 0   | 0.0    | 4   | 1.0    | 3   | 0.4    | 4    | 0.2    |
| Other Livestock Farming, nec             | 12  | 5.9    | 23  | 5.8    | 38  | 5.3    | 38   | 1.8    |
| Aquaculture, nfd                         | 6   | 2.9    | 10  | 2.5    | 15  | 2.1    | 14   | 0.7    |
| Offshore Longline and Rack Aquaculture   | 6   | 2.9    | 3   | 0.8    | 21  | 2.9    | 23   | 1.1    |
| Onshore Aquaculture                      | 3   | 1.5    | 6   | 1.5    | 23  | 3.2    | 24   | 1.2    |
| Forestry                                | 3   | 1.5    | 3   | 0.8    | 11  | 1.5    | 22   | 1.1    |
| Fishing, Hunting and Trapping, nfd       | 9   | 4.4    | 12  | 3.0    | 42  | 5.8    | 52   | 2.5    |
| Rock Lobster and Crab Potting            | 3   | 1.5    | 3   | 0.8    | 12  | 1.7    | 13   | 0.6    |
| Prawn Fishing                            | 8   | 3.7    | 4   | 1.0    | 16  | 2.2    | 20   | 1.0    |
| Other Fishing                            | 3   | 1.5    | 18  | 4.6    | 105 | 14.5   | 129  | 6.2    |
| Forestry Support Services                | 0   | 0.0    | 0   | 0.0    | 8   | 1.1    | 28   | 1.3    |
| Agriculture and Fishing Support Services, nfd | 3  | 1.5    | 3   | 0.8    | 3   | 0.4    | 4    | 0.2    |
| Other Agriculture and Fishing Support Services | 9  | 4.2    | 18  | 4.6    | 26  | 3.6    | 77   | 3.7    |
| Agriculture, Forestry and Fishing, nfd   | 3   | 1.5    | 4   | 1.0    | 11  | 1.5    | 14   | 0.7    |
| Other                                   | 0   | 0.0    | 7   | 1.8    | 36  | 5.0    | 82   | 3.9    |
| Total                                   | 205 | 100.0  | 395 | 100.0  | 722 | 100.0  | 2,093 | 100.0 |

*Source: ABS 2006 Census.*
The key point to note from the data is that in excess of 100 full time jobs are in sectors reliant on irrigation (shaded in the table). This is approximately half of all employment in primary industries.

A comparison of the components of agricultural employment in Howard East and the Northern Territory follows:

- 24.9% of people employed in agriculture in Howard East work in Other Fruit and Tree Nut Growing (compared to 8.4% in the Northern Territory).
- 11.7% of people employed in agriculture in Howard East participate in Vegetable Growing (Outdoors) compared to 4.6% in the Northern Territory.
- 5.87% of people working in agriculture in Howard East participate in Nursery Production (Outdoors), as opposed to 1.34% in the Northern Territory.
- A remarkable 50.6% of people employed in Agriculture in the Northern Territory participate in Beef Cattle Farming (Specialised), compared to 5.1% in Howard East, indicating the fundamental difference between primary industries in the HEWAPA and the Territory as a whole.

4.3 Irrigated agriculture

Official statistics for agricultural production are not available for the HEWAPA region. Industry consultation indicated that reliable industry statistics are needed to underpin investment, and the lack of such data is a major impediment to sound policy and planning.

Consultation with industry indicated that the proportion of Litchfield’s horticulture production within the HEWAPA is probably about 50%. Furthermore, ABS historical data from 2006-07 indicates the Litchfield local government area accounts for approximately 55% of the Territory’s fruit crops and 95% of vegetable crops. Overall, the HEWAPA may account for up to 25% of the Territory’s relevant fruit crops and around 45% of vegetable crops.

Using that calculation to allocate production, it is possible to develop high-level estimates of the value of production in the HEWAPA and make comparisons with other relevant regions based in Territory-wide figures. Table 9 shows MJA’s estimates of the value of irrigated agriculture in the HEWAPA.

Table 9: Estimated value of irrigated agriculture 2011 ($ millions)

<table>
<thead>
<tr>
<th>Industry</th>
<th>HEWAPA</th>
<th>Litchfield (balance)</th>
<th>Top End (excluding Litchfield)</th>
<th>NT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit</td>
<td>28</td>
<td>28</td>
<td>37</td>
<td>103</td>
</tr>
<tr>
<td>Vegetables</td>
<td>13</td>
<td>13</td>
<td>1</td>
<td>26</td>
</tr>
<tr>
<td>Irrigated agriculture</td>
<td>41</td>
<td>41</td>
<td>38</td>
<td>129</td>
</tr>
</tbody>
</table>

Source: MJA based on ABS and NT Department of Resources data.

The data shows that the value of irrigated agriculture in the HEWAPA is regionally significant and is a major contributor to the horticulture sector in the Territory.

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22 ABS (2008), Category 1362.7 - Regional Statistics, Northern Territory.
23 Territory-wide figures were sourced from: Department of Resources (2011) Northern Territory Primary Industry and Fisheries Overview and Outlook 2010
Regionally, the main fruit crop grown is mangoes. Between 1993 and 2004 the growth of mango plantings in the Howard Springs/Virginia, Humpy Doo/Bees Creek and Lambells Lagoon/Middle Point areas increased from approximately 46,300 trees to 274,500 – nearly a six-fold increase.\footnote{ABS (2007) National Regional Profile data.}

The growth in market gardens since 2004 has supported a significant increase in the production of cucumbers and Asian vegetables. There are around 100 growers and 65 established Asian farms operating in the Darwin rural area producing a range of Asian and traditional vegetables for local and capital city markets.

There have been some significant changes in the structure of the horticulture industry over the last decade however, both in terms of the varieties grown and in terms of the nature of the industry organisation.

### 4.3.1 Key crops

#### Mangoes

Mangoes are the dominant irrigated crop in the region. The traditional variety of mango grown in the Howard East region is the Kensington Pride. These are low productivity crops averaging 10 tonnes per hectare. They are typically grown by growers on small blocks and sold to independent wholesalers.

In contrast, new varieties of mango – especially Calypso, but also other varieties such as Honey Gold and Mambula – are being produced through vertically integrated operations. For example, One Harvest manages the production of mangoes from the growing through the packaging and distribution to southern markets. Productivity is three times that of Kensington Pride at 35 tonnes per ha, and the time between planting and first harvest is three years compared to seven years. The single marketing desk arrangement also allows growers more control over price and quality. Calypso now supplies 15\% of the mango market.

Industry sources indicated during consultation that mango production has increased significantly over the last ten years and is expected to grow gradually in the short to medium term as key markets grow and new mango varieties impact on the composition of fruit consumption.

#### Asian vegetables

Asian vegetables are also a regionally significant crop. They are mostly grown on small blocks of 20 ha or less, and often grown by first generation Asian immigrants. They are the fastest growing horticultural sector in the Territory. Many growers bypass traditional marketing channels and sell direct to wholesale markets.

#### Melons

The production of melons (including rockmelons, watermelons and other varieties) has risen in the past few years and melons are becoming a regionally significant crop. The climate in the Howard East region provides significant counter-seasonal opportunities for producers selling into both the local market and the fresh market in southern states.
4.4 The pastoral industry

There are a number of pastoral properties that can carry up to 70,000 head of cattle and supply the live export market. Pastoralists require access to bore water and floodplains. Stocking rates vary with climatic and market conditions, such that pastoralists water entitlements under water allocation plans need to be flexible. However, large cattle (i.e. > 350 kg) can have a daily watering requirement of around 40 litres, which would indicate total annual watering requirements could be as high as 1,000 ML.

4.5 Local growth prospects – water dependent sectors

There are two key sectors that have a major implication on water use in the HEWAPA that also have significant growth prospects in the medium to longer term – horticulture and residential development.

4.5.1 Horticulture

Horticulture in the HEWAPA is a very significant regional industry and a major employer. While the emphasis of the horticulture industry is on the fresh market and growth in that market constrains feasible development on the HEWAPA, the area has distinct locational, logistical and counter-seasonal advantages over many other areas with horticultural prospects.

In short the prospects for further horticultural development are relatively positive and this will have a significant impact on groundwater use.

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25 Ref 12.

4.5.2 Residential development

ABS data indicates that residential building approvals for new properties in Litchfield Municipality typically exceed 120 new dwellings per year and there is no evidence to suggest this trend will slow unless significant constraints on land availability are imposed.\textsuperscript{27} Many of these new dwellings will be rural residential. For example, the proposed Howard Springs Pine Forest rural village is largely within the HEWAPA boundaries. Under the Land Use Plan for rural villages, a major component of new dwellings will be rural residential lots that currently have no material restrictions on groundwater use.\textsuperscript{28}

Given the emphasis of rural residential allotments within the growth strategy and the locational advantages Howard Springs has over other proposed rural residential villages (i.e. relatively close to Darwin), market demand is likely to drive rapid uptake of land available in the area and hence rapid growth in groundwater use.

Unless carefully managed, water use from growth of rural residential development has the potential to place significant additional pressures on groundwater resources in development hotspots.

4.6 Economic structure implications for water allocation planning

The economic structure and growth prospects for the HEWAPA has a number of implications for water allocation planning, specifically:

- **Structure of economy increases relative economic risks of aquifer deterioration or failure.** The structure of the local economy is significantly skewed towards a reliance on agriculture, particularly irrigated agriculture. Therefore, even marginal declines in the performance of the aquifer (water quantity and quality) could have significant impacts on regional productivity and the commercial viability of existing irrigators.

- **Growth of irrigated agriculture needs to be managed.** There is evidence to suggest the performance of the aquifer in some areas is already declining. This risk will only be further exacerbated by further growth in the irrigated agriculture sector unless growth in use is carefully monitored and managed.

- **Needs to include pastoral use in modelling of water use.** While there are no effective controls on pastoral water use, groundwater use for watering cattle could be significant (potentially up to 1,000 ML per annum). Although it is substantially less than that in practice, at the very least this potential demand should be included within the groundwater modelling underpinning the water allocation plan.

- **Risks from rural residential growth.** Currently groundwater use by rural residential lots is effectively unmanaged. Significant growth in demand from rural residential developments in the medium-term should be expected and this growth will have to be taken into account in the development of the HEWAP.

\textsuperscript{27} ABS (several years), *Category 1362.7 Regional Statistics, Northern Territory.*  
\textsuperscript{28} NTG (2011) *Greater Darwin Region Land Use Plan - Towards 2030.*
5. Economic and social values

This section outlines some of the key economic and social values that may be impacted by the water allocation planning process.

5.1 Framework for considering economic and social values

Resource economists often use the concept of total economic value (TEV) as a means of categorising and (sometimes) aggregating values attributable to natural resources (e.g., water).  

**Figure 4: Total economic values of Howard East aquifer**

<table>
<thead>
<tr>
<th>Total economic value framework</th>
<th>Non-consumptive use values</th>
<th>Non-use values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumptive use values</td>
<td>Indirect use values</td>
<td>Option Value</td>
</tr>
<tr>
<td>Option Value</td>
<td></td>
<td>Non-use values</td>
</tr>
<tr>
<td>Recreational</td>
<td>Aesthetic</td>
<td>Existence</td>
</tr>
<tr>
<td>Educational</td>
<td>Distant use</td>
<td>Bequest</td>
</tr>
<tr>
<td>Existence</td>
<td>Bequest</td>
<td>Philanthropic</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Primary industries</th>
<th>Irrigation</th>
<th>Farm use</th>
<th>Stock water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recreation</td>
<td>Primary recreation</td>
<td>Secondary recreation</td>
<td>Visual appreciation</td>
</tr>
<tr>
<td>Human consumption</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial and mining use</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cultural and spiritual use</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aquatic ecosystems</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: MJA based on Greiner, R & Hall, N (2006) Social, Economic, Cultural and Environmental Values of Streams and Wetlands in the Burdekin Dry Tropics Region.

There are a number of different types of values that comprise TEV. These include:

- Direct consumptive use values. These values relate to the use of natural resources as a factor of production or direct consumption. This includes values attributable to irrigation and human consumption.
- Indirect use values. These values relate to uses that are indirect in nature, such as visual appreciation of waters for recreation or to underpin tourism.

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Option values. These values relate to the preservation of options to either use or preserve a natural resource in the future, such as not allocating water for consumptive use to maintain the option to ensure more water for environmental flows in future.

Non-consumptive use values. These values relate to the use of a natural resource where the quantity or quality of the resource does not decline with use, such as swimming or kayaking in waters.

Non-use values. These values represent preservation of natural resources for their own sake, even if the resource will never be consumed. Typically, these values relate to values such as the protection of ecosystem functions or cultural values.

Figure 4 above outlines the relationship between different types of use and the TEV framework. The figure indicates that many of the uses relate to multiple types of economic values.

There is a distinct lack of data and information to enable estimation of most of these values for the HEWAPA. For example, there are no estimates available for cultural and spiritual values attributable to maintaining aquifer condition and function.

5.1.1 Estimating values under a TEV framework

While some economic and social values are revealed through market prices (e.g., the margin from the use of an extra ML of irrigation water), not all are revealed through market transactions (for example, the value of maintaining the extent and condition of groundwater dependent ecosystems). There are a number of valuation approaches that can be used as part of a TEV framework (outlined in Table 10 below). Which approach is finally adopted will be dependent on the priority natural assets and ecosystem services to be valued, and the risks to those assets.

Table 10: Approaches to estimating socio-economic values

<table>
<thead>
<tr>
<th>Method</th>
<th>Relevant values</th>
<th>Useful for…</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market techniques</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Market values</td>
<td>Based on market transactions</td>
<td>Situations where there are established markets such as irrigated agriculture</td>
</tr>
<tr>
<td>Productivity-based</td>
<td>Based on production of commercially marketed goods</td>
<td>Estimating changes in natural asset condition to key sectors such as nature-based tourism and recreation</td>
</tr>
<tr>
<td>Replacement / avoided cost</td>
<td>Based on costs of replacing, or value of avoiding costs</td>
<td>Value of water quality attributable to catchment management</td>
</tr>
<tr>
<td>Non-market techniques</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Travel cost</td>
<td>Based on cost to visit a site</td>
<td>Valuing reserves and visits to Howard Springs Reserve</td>
</tr>
<tr>
<td>Hedonic pricing</td>
<td>Values attributes</td>
<td>Value of a view, local green space</td>
</tr>
<tr>
<td>Choice modelling</td>
<td>Community willingness to pay to protect asset or avoid loss</td>
<td>Value of biodiversity and ecosystem function</td>
</tr>
</tbody>
</table>

Source: MJA

Previously MJA has tended towards using multiple approaches within the same study (depending on the asset/ecosystem service, data constraints, time and financial resource constraints etc.), for example:

- Productivity based approaches (often impacts on headline indicators of economic activity) for impacts on sectors such as tourism.
- Averted cost approaches for relationships between catchment condition, pollutant loads and water treatment or risk to human health from exposure to lower water quality.
- Choice modelling to value ecosystem functions and to obtain global estimates of changes to the extent of ecosystem assets/functions (e.g. native vegetation).

The remainder of this section outlines key economic and social values relevant to the HEWAPA. Consistent with the TEV framework, this has been structured based on consumptive and non-consumptive values. Quantitative data is used wherever possible, although it should be noted that this is limited for the HEWAPA.

## 5.2 Consumptive values

The greatest consumptive demand for water from the Howard East Aquifer is for irrigated horticulture and public water supply. It has been estimated that 50% of water use from the Howard East Aquifer is for agricultural use. A variety of crops are irrigated including mangoes, bananas, and annual vegetables. Water from the Howard East Aquifer is also used for stock and domestic purposes.

### 5.2.1 Irrigated horticulture

A large share of the Territories horticulture and Asian vegetables industry is based in the HEWAPA. The expansion of horticulture since the late 1990s has resulted in a long term overdraft (over-extraction) of groundwater, posing serious risks of saltwater incursion into the aquifer. The economic value of horticultural production in the HEWAPA (at around $41 million) is clearly outlined in Section 4.3. This production which is entirely dependent on the availability of reliable and good quality groundwater, generates approximately 100 full time equivalent jobs (based on census data). In effect, a job is created for every $400,000 increase in horticulture production.

There are a number of crops grown in Howard East, and the water demand and pattern of usage for each crop varies.

- Mangoes are the most significant crop grown in the HEWAPA. With new plantings, trees must be irrigated throughout the year for the first two years. After the second wet season trees are generally only irrigated during the flowering and fruit development period; the five month period between July and November in the dry season. The main variety grown is Kensington Pride, which tend to have a lower yield per tree compared to newer varieties. Calypso’s require more water, at between 5 and 8 ML/ha, but are more densely planted, yielding 35-40 tonnes/ha compared with 10 tonnes/ha for Kensington Prides.

- Asian vegetable production between 2004 and 2005 more than doubled to around 6,000 tonnes. In 2006-07 these farms contributed about $30 million dollars in sales to the wholesale markets. Cucumbers are a major vegetable crop of the Top End, because of

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30 Ref 12.
31 CSIRO (2009), Water in the Van Diemen region of the Timor Sea Drainage Division, a report to the Australian Government from the CSIRO Northern Australia Sustainable Yields Project.
greater water availability than in the southern states. Asian vegetables generally use between 5 and 8 ML/ha – but only 1-2 ML is used in the growing of the crop. The rest is used in the packing sheds to wash the vegetables before shipment to market.

- Bananas use around 15-17 ML/ha. For bananas grown near Darwin, the month in which there is the greatest difference between available rainfall and evaporative loss is October. The pumping requirement during this month is estimated to be 3.2 ML/ha to make up the shortfall between rainfall and evaporative loss.\(^{33}\)

- Pineapples are able to be grown on poor quality soil and have shallow root systems, enabling them to use lower quality water than other horticultural crops. Water use for pineapples is around 3-4 ML/ha.

- Paw paws are much more water intensive and are comparable to bananas, requiring around 15 ML/ha.

- Cut flowers are currently a minor industry but require approximately 10 ML/ha.

Annual vegetable and melon crops are particularly high users of water. Perennial tree crops tend to require less water and management than annual crops. However, perennial crops require high reliability in water supply to avoid large economic losses attributable to tree losses. Some tree crops (mango and cashew) require little or no water during non-flowering and non-fruiting growth periods; whereas, fruit trees (e.g. carambola, mangosteen, jackfruit and banana) require continuous irrigation throughout the year.

### 5.2.2 Potable water supply

The Howard East aquifer also provides significant economic benefits to the community of the Top End through its contribution to potable water supplies.

The PWC delivers water to secondary and tertiary industries, as well as urban water users. It is a government owned corporation and is the sole supplier and distributor of water and sewerage to urban and industrial users in Darwin and Palmerston.

The municipal water supply for the greater Darwin region is derived from a blend of approximately 90% surface water from Darwin Dam, with 10% groundwater pumped from the McMinns and Howard East Borefields.\(^ {34}\) Blending is undertaken by PWC to counteract the acidity of the dam water which is highly corrosive to water infrastructure. These borefields also provide emergency water supplies to the Darwin region in event of loss of supply from Darwin Dam.

- The Manton Dam was built to supply Darwin in 1939. Under the 1948 licence, PWC can take 7,000 ML/year from Manton. However, it is currently not used and would require infrastructure upgrade to bring it back into production.

- In 1964 the McMinns borefield was developed to supplement Manton Dam.

- In 1972 the Darwin River Dam was also built. PWC is licensed to take 40,000 ML/year from Darwin Dam.

The McMinns and Howard East borefields consist of a total of six production bores in the dolomite aquifer:

\(^{33}\) Ref 8.

\(^{34}\) PWC.
- McMinns Borefield - commissioned in the mid 1960s with 11 bores in use until the end of 1972. Seven bores were decommissioned in the 1970s, and four bores continue to be in use today.

- The Howard East Borefield - established in the 1980s with a number of bores drilled. Stage 1 was completed in December 2001 with two bores still in operation.

- The extraction licence for all six bores – McMinns and Howard East Stage 1 – allows PWC to draw up to 8,420 ML annually from the aquifer. They currently extract around 6,000 ML/year.

**The Howard East aquifer is a vital component of the portfolio of Top End water supply options. Maintenance of extraction rates and water quality from the Howard East Aquifer will deliver significant benefits to PWC in the form of avoided capital and operation expenditures to secure alternative sources of potable water supply.**

### 5.2.3 Stock

While research indicates a potential carrying capacity of the region for up to 70,000 head, ABS data indicates the number of cattle being carried in the Darwin Statistical Division is around 5,300, or 0.3% of the Territory herd. In effect, the HEWAPA is at an economic competitive disadvantage to the rangelands for cattle production and market conditions have significantly constrained the exploitation of agronomic opportunities.

**Based on NT Government estimates of the cattle industry,** this would indicate the value of the cattle industry in the HEWAPA is unlikely to exceed $0.5 million per annum.

### 5.2.4 Rural residential uses

There is a public right to take water for domestic and stock purposes. In the Darwin rural area this is groundwater extracted from private bores for personal use and the irrigation of approximately 0.5 ha of garden and the watering of stock Water Act.

Significant development in the area – both rural subdivision and urban growth in Darwin and Palmerston - has also led to substantial increase in the number of domestic water supply bores. Specifically the intensification of development in the rural area due to subdivision of rural blocks and new land releases as a result of the population growth, has contributed to significant growth in the sinking of new bores in the rural area for stock and domestic purposes. In addition, population growth in Darwin and Palmerston has exacerbated consumptive use pressures on the aquifer as approximately 10% of the potable water supply is sourced from the Howard East Aquifer. There are also a significant number of rural residential blocks running ‘hobby farms’, with estimated high water use, including cut flowers and mangoes. The total number of production bores in the Darwin catchment area, which is larger than the HEWAPA, is estimated to be 2,700.

An estimate of rural domestic rate of use is approximately 7 ML annually for each bore. This estimate is based on a ‘return to sewer’ of 380 litres/day/person for a family of four and the

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35 Ref 12.
37 Ref 8.
38 Ref 8.
Irrigation of 0.5 ha of garden at a rate of 50 mm per week for six months out of 12.\textsuperscript{39} However, this rate is significantly higher than the results of bore monitoring undertaken by NRETAS which indicates usage of less than 3 ML per bore.

The combination of initial connection costs to reticulated water systems, and the ongoing cost of water, creates little incentive for rural residents to convert to town water supply and relinquish their bore. The Litchfield Planning Concepts and Land Use Objectives state that to minimise impacts on both the amenity of existing rural living areas and the environment, rural lots less than 2 ha should be connected with both reticulated water and sewerage as well as other waste disposal. Currently, the cost of connection to sewerage is prohibitive and Alternative Septic Systems (individual tertiary treated systems) are the preferred option, according to PWC. The new rural residential developments are to be connected to Darwin’s reticulated water supply system and are charged for the use of water.

**Economic value to households**

While rural residential residents do not pay for the actual groundwater resources used, they do pay for the cost of extraction, with capital costs of between $12,000 and $20,000 in addition to the operating costs of bores.\textsuperscript{40} The use of the groundwater provides significant direct personal benefits to homeowners in the form of the amenity value derived from the ability to create and enjoy a watered garden year-round, with options for extensive use of lawns and exotic plant species. The value to the landholder from this is must be at least equal to the cost of groundwater extraction or they would not incur the capital and operating costs associated with bores.

This amenity value will also be reflected in the values of properties. Discussions with local real estate agents indicate that established gardens often increase property values by in excess of 10\% (typically $50-70,000 based in current market values). This capital value could not be realised without access to reliable water, and easily outweighs the costs of sinking a bore.

Using an avoided cost methodology it is possible to infer an approximate value of water for rural residential uses. If you assume that a loss of groundwater would be permanent and the value of impacted rural residential properties would decline by $50-70,000, then the value of permanent access to each ML of water is approximately $7,100-10,000 (based on average usage of 7 ML per property). An equivalent annual economic margin per ML is between $350 and $500 (assuming a 5\% discount rate).

**The key point to note is that consumptive groundwater use by the rural residential sector has a significant amenity value to households and that value is reflected in house prices.**

### 5.3 Non-consumptive values

As discussed above under Section 5.1.1, there are a number of methodologies for assessing the values placed on non-consumptive water uses by the community. These values include economic values such as those of the fishing and tourism industries and recreational users, as well as non-economic values such as ecological values, ecosystem services, biodiversity, and

\textsuperscript{39} Ref 8.

\textsuperscript{40} Nolan, S (2010), *Collaborative Water Planning: Howard East Water Planning Project.*
cultural and Indigenous values. Below is a description of the key non-consumptive values associated with the Howard East aquifer.

5.3.1 Tourism

Unlike other surrounding areas such as Berry Springs, there is no meaningful tourism industry in the HEWAPA that is directly reliant on the aquifer. Rather, tourism reliant on water management tends to be in areas surrounding the HEWAPA.

5.3.2 Tourism and recreational benefits already lost

The Howard River region is within close travelling distance from Darwin city, and many rivers, lagoons and creeks provide important places to ‘escape’ to. The proximity of these surface water features means they are readily accessible to Darwin city and rural residents after work and on weekends. Respondents appreciated wetlands for their quiet atmosphere, sense of refuge, sanctuary and relief from city life. 41

The economic benefits from the HEWAPA’s major tourism drawcard, the Howard Springs Nature Park, have been significantly degraded in recent years due to declines in water quality. Howard Springs has been a popular spot for tourists and locals alike for recreation since the 1940s. By the 1990s, around 180,000 visitors per annum were visiting the park – many to exploit the opportunities for swimming. 42 However, the springs were closed to swimming in 2006 due to water quality problems, thought to be at least partially attributable to low flow conditions due to over-extraction of the aquifer.

Studies undertaken elsewhere, although for other sites and undertaken several years ago, using the travel cost method indicate significant economic values from visits (often ranging from $10-30 per person per visit). 43 If similar values were derived from visitors to Howard Springs Nature Park, the economic losses attributable to the banning of swimming would easily exceed $3 million per annum. In 2009, the NT Government commenced a $3 million program to redevelop the Nature Park and enhance the visitor facilities to act as a drawcard to tourists and local visitors.

The key point is that the non-market economic losses from declines in tourism and recreation have been relatively significant (albeit unquantified). This point is of particular interest to the concurrent development of the Berry Springs water allocation plan. The Berry Springs Nature Park attracts around 330,000 visitors per annum, most of whom come directly to the springs and not as a consequences of visiting the wildlife park (Dion Wedd, personal communication). However, the waterhole is closed for part of each year due to water quality concerns. Based on studies undertaken elsewhere, any permanent closure of the waterhole would result in losses of economic value in the millions.

41 Ref 8.
5.3.3 Recreational fishing

The performance of the Howard east aquifer can impact on surface water flow regimes and critical fish breeding habitat. Therefore, the water allocation planning process can have an indirect impact on the economic and social benefits derived from recreational fishing.

Approximately 75% of the annual recreational fishing effort and 75% of the annual recreational fishing spend occurs in the Darwin region. Due to its proximity to Darwin, and reliable barramundi and mud crab fishing, many sites within the Howard region are popular with recreational fishers, including at permanent coastal and rivers as well as seasonally flooded inland sites. Ramp facilities at Buffalo Creek, Howard River, Leaders Creek and Shoal Bay make the river, creeks and inlets of the area easily accessible by boat:

- The Howard, Little Howard, Hope Inlet, Kings Creek, Micket Creek and Leaders Creek are all popular for recreational boating.
- Shoal Bay is an important recreational fishery with an extensive network of freshwater swamps backing up its tidal creeks. The area is also an important barramundi nursery. Net fishing was banned in Shoal Bay in 1997 and most of the area is also closed to commercial fishing. However the area is renowned for its barramundi fishing, and large (15kg plus) fish are caught in the creeks and at ‘the Rock’ on the Howard River by recreational fishers.
- Buffalo Creek is also popular due to its proximity to Darwin, ease of access via a public ramp, and consistently large barramundi caught each year.
- King and Micket Creeks are also popular but can only be accessed by boat, as the area is under Defence tenure and permits for access are no longer available.
- Leaders Creek is a good fishing and crabbing spot.

60-70% of recreational fishing is for barramundi, and there is a sizeable mud crab fishery as well as some recreational and commercial fishing for golden snapper and red jewfish. The Howard River is believed to be a major factor in the health of the barramundi fishery in Darwin Harbour and Shoal Bay. Between 70% and 80% of recreational fish are thrown back, but changes in the composition of recreational fishers are changing the nature of the fishery. For example, there is a growing population of grey nomads entering the fishery, who have a tendency to eat what they catch.

5.3.4 Hunting

Waterfowl hunting is a popular recreational activity in the Northern Territory, with an open season of up to four months. Eight species can be hunted - magpie geese, grass whistling-duck, Pacific black duck, grey teal, pink-eared duck, hardhead, and the maned duck. Length of season and bag limits are determined each year following an aerial survey of major waterfowl habitats. Limits are placed on the number of birds shot: seven ducks and seven geese each day per licence. The season is roughly September to December. Hunting is prohibited in parks, reserves, wilderness areas and sanctuaries or areas nominated under the Firearms Act, except in Shoal Bay Coastal Reserve, Howard Springs Hunting Reserve, Lambells Lagoon Conservation Reserve and Harrison Dam Conservation Reserve.

45 Personal communication with AFANT.
Pig hunting is also licensed within the NT hunting reserves of Shoal Bay and Harrison Dam. The number of hunting licenses issued by the Parks and Wildlife Commission in recent years has steadily increased.

Hunting in accordance with Aboriginal tradition is a legal right protected by the *Native Title Act 1993* (Cth), and by NT statute such as the *Pastoral Land Act 1992* (NT). Section 211 of the *Native Title Act* ensures that activities such as hunting and fishing can be undertaken without a licence or permit. A reservation in the *Pastoral Land Act* includes the right to enter onto land, the right to take and use water and the right to take wild animals and vegetation for food and ceremony.46

5.3.5  Nature study and appreciation

A number of groups, including the Top End Native Plant Society and NT Field Naturalist’s Club (Darwin) have specific interests in the observation and sighting of birds, butterflies, unusual or rare plant species, as well as group guided walks to learn more about the natural environment. Locations within the Howard East region are regularly used by both groups and individuals for the appreciation of nature include Howard Springs, Shoal Bay, the Gunn Point region and many of the lagoons including McMinns.

5.3.6  Bird watching

The Howard region has a diversity of habitat that in turn supports a diversity of bird species – both local birds as well as migratory species at specific times of the years. The wetlands just outside Darwin are particularly good for bird watching from about June to December. Small reserves such as at Howard Springs and Holmes Jungle provide good areas of spring-fed monsoon forest, where Rainbow Pitta, Rose-crowned Fruit-Dove and other monsoon forest birds can be.47

5.3.7  Educational value

The lagoons and other surface water features of the Howard East region are used by community groups, school groups, non-government organisations and government agencies, amongst others, to provide and facilitate educational and learning opportunities for school children and the broader public.

5.3.8  Commercial fishing

While the commercial fishing industry is not a ‘user’ of water, it is dependent upon the flow and quality of water from rivers for estuarine health. The Howard River flows into Darwin Harbour and (indirectly) the Timor Sea, and hence the health of prawn fisheries is indirectly linked to the health of the waterways in the Howard East region.

Similarly wild barramundi rely on freshwater rivers and streams. Adults move downstream to estuaries and coastal waters for spawning. Therefore barramundi fishermen are also reliant on the health of the Howard River.

The Northern Prawn Fishery in 2008-09 generated around $73 million – making it Australia’s most valuable Commonwealth-managed fishery (this is for the entire fishery, which extends

46  Ref 8.
47  Ref 8.
across the Gulf of Carpentaria and the Timor Sea). The fishery comprises nine commercial species of prawns including banana and tiger prawns, as well as scampi, squid, scallops and bugs.

The prawns enter shallow rivers and estuaries as part of their life-cycle, and are washed down-river into the ocean by flood events during the wet season. Anything that disrupts the natural flow of rivers in this region has the potential to affect the industry. Prawn fisheries are also reliant on estuarine habitat areas for spawning and for the development of juveniles and on substantial fresh water flows to flush adult prawns into marine areas for commercial harvesting.48

5.3.9 Environmental values

Given the time and budget constraints of this project, we have not been able to undertake any non-market valuations in the HEWAPA. However, a study undertaken in the Howard River catchment in 2011 by Straton et al found that there were strong community preferences for the water planning process to give high priority rankings to the condition of aquatic and terrestrial habitat, to minimising the risks to water quality, to encouraging development of new industry, to the accessibility of sites for hunting and fishing, and to increasing the availability of rural residential and rural living blocks.49 Water availability for horticulture and urban (i.e. Darwin) use were ranked as less important.

There are a number of significant natural heritage sites in the Howard East region that are highly dependent on water resources for the maintenance of their extent and condition. These include:

- **Black Jungle** contains diverse and representative patches of the type of monsoon vine forest that occurs on spring fed areas adjacent to coastal floodplains. The vine forest at Black Jungle is fragmented from similar forests and contains the nationally endangered palm Ptychosperma bleeseri, the nationally rare orchid Malaxis acuminata and the Whitewood tree Endospermum medullosum which is rare in the Northern Territory.

- **Black Jungle orchid site.** This area is one of only two or three recorded sites in Australia of the orchid species Malaxis acuminata which is considered vulnerable.

- **Black Jungle palm site** – one of only two known sites of the endangered Australian endemic palm species Ptychosperma Bleeseri Burret.

- **The Holmes Jungle, Holmes Jungle Swamp and Micket Creek complex** form a small spring-fed coastal wetland system on the eastern edge of Darwin that is a significant bird habitat. It is a regionally important dry season refuge for waterfowl and birds of prey. During the wet season the area is used by migratory birds, mainly waders and swifts. Twenty of these species are listed under JAMBA. The area is a habitat of two nationally rare species, the eastern grass owl and the peregrine falcon. The area also contains resident or seasonal populations of five bird species which are considered likely to become nationally rare or threatened in the near future (the radjah shelduck, the orange footed scrub fowl, the bush thick knee, the yellow chat and the Australian bustard).

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The Howard River site is one of two known sites of the endangered Australian endemic palm species Ptychosperma bleeseri Burret.

5.3.10 Indigenous values

The largest language group in the Howard East area is the Larrakia. Within this group are a number of interests:

- The Larrakia Nation Aboriginal Corporation is the peak representative body for the Larrakia people. As a key frontline service provider of housing and community services to indigenous people, the Larrakia Nation’s priorities include core issues of employment and jobs, protection of cultural sites, access to bush tucker and being able to stay on country. Interest in water focuses on the maintenance of ecosystem services and non-consumptive values for the maintenance of traditional cultural activities.

- Other representatives of the Larrakia such as the Larrakia Development Corporation promote the financial independence and lifestyle of the Larrakia people by providing employment and business opportunities through wealth creation and entrepreneurial activities. The Larrakia Development Corporation thus emphasises the commercial development of assets in such a way that promotes employment, training and business opportunities. This gives them a more commercial interest in water and other natural resources as economic assets from which they can earn a return for the advancement of the Larrakia.

Other Traditional Owner groups in the Howard East region include the Limilngan-Wulna people. This group has both an interest in the management and use of the Howard East Aquifer and the land directly above the aquifer and have specific responsibilities for key areas within the region such as Humpty Doo Station, Melacca Swamp, Black Jungle, Lambells Lagoon and Fogg Dam. This includes management of some tourism sites (i.e. Windows on the Wetlands).

Access to water thus has a number of elements for Aboriginal people in the Howard East region, involving economic development, employment and participation in the mainstream economy but within the context of ‘traditional rights, environmental custodianship and the maintenance of cultural connections.’\(^50\) The separation of land and water rights raises particular issues of equity and the ability to maintain cultural values within a water planning framework.

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6. Estimated groundwater consumptive use

This section outlines MJA’s estimates of current and potential consumptive use of groundwater uses in the HEWAPA. This section outlines the approach taken to estimating usage, the assumptions underpinning estimates and estimates of current and future use in the HEWAPA.

It should be noted that there is significantly less hard data to underpin the estimates of current use than would typically be available for a water allocation planning exercise. With the exception of the usage from PWC where extraction rates are metered and well documented, there are major deficiencies in data availability.

While NRETAS has estimated a total of around 3,300 productive bores are operating in the region (approximately 600 for horticulture), specific data on use is very limited:

- only about 10 of the bores are actually metered for regulatory purposes (as they exceed 15 L/second)
- the voluntary bore monitoring program provides useful but limited information on water use due to the relatively short time program has been running and the relatively small number of participants
- data on land use (e.g. crops and areas) is generally not available for the HEWAPA. Nor is data on irrigation application rates in the HEWAPA available for different crops.

However, it is possible to establish indicative estimates of groundwater extraction to inform the water allocation planning process based on available information and by making a number of assumptions.

6.1 Approach to developing estimates of current use

In developing these estimates, MJA has used a variety of information sources to establish estimates. The basic process of estimating usage was to:

- Use actual data where this was available, such as for PWC and large metered irrigators.
- For unmetered irrigated agriculture we estimated the area of irrigated agriculture and applied a range of irrigation application rates based on available information (e.g. estimated use = ha x ML/ha).
- For rural residential, we estimated the number of bores and applied a range of use rates (based on available information).
- For cattle, we estimated the number of cattle and applied a watering requirement (based on available information).
- We then summed all uses from all sources to estimate total water use.

Key assumptions used to estimate existing demand are shown in the table below.
Table 11: Key assumptions underpinning estimates of existing use

<table>
<thead>
<tr>
<th>Data item</th>
<th>Estimates</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land use – total irrigated area (ha)</td>
<td>1,700 ha</td>
<td>Based on ABS Agricultural census data for Darwin Statistical division. $^{51}$ 50% of irrigation area allocated to HEWAPA based on information from stakeholders. Large irrigators account for 980 ha, small fruit growers 570 ha and vegetable growers 220 ha.</td>
</tr>
<tr>
<td>Irrigation use (large irrigators)</td>
<td>4,900 ML</td>
<td>Based on NRETAS data.</td>
</tr>
<tr>
<td>Irrigation use (small fruit irrigators)</td>
<td>5-8 ML / ha</td>
<td>Based on industry guidance, previous research reports and stakeholder consultation.</td>
</tr>
<tr>
<td>Irrigation use (small vegetable irrigators)</td>
<td>5-8 ML / ha</td>
<td>Based on industry guidance, previous research reports and stakeholder consultation. Note: this includes water use in packing sheds.</td>
</tr>
<tr>
<td>Irrigation use PWC</td>
<td>8,500 ML</td>
<td>Based on existing license conditions. It is assumed that PWC will fully utilise their allocation if necessary.</td>
</tr>
<tr>
<td>Number of rural residential bores</td>
<td>2,700</td>
<td>Based on NRETAS estimates of bores (i.e. 3,300 – 600 irrigators).</td>
</tr>
<tr>
<td>Annual usage per rural residential bores</td>
<td>2.75-4.0 ML</td>
<td>Based on NRETAS bore monitoring program. Note. NRETAS data indicates no real relationship between usage and block size.</td>
</tr>
<tr>
<td>Livestock (cattle) number</td>
<td>5,000</td>
<td>Based on ABS Agricultural census data for Darwin Statistical division. $^{52}$</td>
</tr>
<tr>
<td>Cattle daily usage (litres)</td>
<td>40 L</td>
<td>Based on recommended watering rates outlined in Department of Resources guidelines.</td>
</tr>
</tbody>
</table>

Source: MJA estimates.

6.2 Estimates of current use

Based on the approach and assumptions outlined in Section 6.1, MJA has established a range of estimates of water use in the HEWAPA (low and high estimates). The bottom of the range of water use is based on low estimates of irrigation application rates per area (or by bore for rural residential lots), while the top of the range is based on the high estimates of usage per area. The range of estimates for current use is shown in the table below. Key points to note are:

- Total use is estimated in the range of approximately 25,000-31,000 ML.
- For the low end of the range of estimates, water use is roughly split between public use, irrigated agriculture and rural residential use. This split indicates a lower proportion of use for irrigated agriculture than previous estimates undertaken by NRETAS. However, this is largely due to the assumption that PWC can fully utilise their existing license.

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$^{52}$ Ibid.
The major driver of the variation in spread in the range is the uncertainty regarding irrigation application rates for unmetered groundwater users.

These estimates are higher than previous estimates established by Woodward et al in 2008 as the MJA estimates cover a broader suite of usage. In addition, it should be noted that Woodward et al stated their estimate of around 20,000 ML per annum was an underestimate.

The accuracy of these estimates could be further enhanced at little cost through developing more accurate estimates of land use (by land use type) using a geographic information system (GIS).

### Table 12: Estimated current annual groundwater use in the HEWAPA

<table>
<thead>
<tr>
<th>Use</th>
<th>Bottom range estimates</th>
<th>Top range estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ML</td>
<td>%</td>
</tr>
<tr>
<td>Public water supply (PWC)</td>
<td>8,500</td>
<td>34</td>
</tr>
<tr>
<td>Major agriculture (metered)</td>
<td>4,900</td>
<td>20</td>
</tr>
<tr>
<td>Small horticulture (mangoes &amp; other fruit)</td>
<td>2,900</td>
<td>12</td>
</tr>
<tr>
<td>Small horticulture - vegetables</td>
<td>1,100</td>
<td>4</td>
</tr>
<tr>
<td>Cattle</td>
<td>80</td>
<td>0</td>
</tr>
<tr>
<td>Rural residential</td>
<td>7,500</td>
<td>30</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>24,900</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Source: MJA estimates.

### 6.3 Estimated future use scenarios

Scenarios of potential future water use have been built upon estimates of current water use. Key growth assumptions underpinning future water use are outlined below.

### Table 13: Key assumptions underpinning growth estimates (Howard East aquifer)

<table>
<thead>
<tr>
<th>Water use</th>
<th>Low growth</th>
<th>High growth</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public water supply</td>
<td>Nil</td>
<td>+5,900 ML</td>
<td>For low growth scenario, PWC meets supply requirements through other supply augmentations and demand management. For high growth scenario, two previously considered expansions (totalling 5,900 ML) are undertaken.</td>
</tr>
<tr>
<td>Major agriculture (metered)</td>
<td>3.0%</td>
<td>5.0%</td>
<td>Low growth scenario based on Dept of Resources forecasts (extrapolated out to 10 years). High growth slightly higher reflecting greater market share captured as water availability on southern competing regions is further constrained.</td>
</tr>
<tr>
<td>Small horticulture (mangoes &amp; other fruit)</td>
<td>3.0%</td>
<td>5.0%</td>
<td>As per major agriculture.</td>
</tr>
<tr>
<td>Small horticulture - vegetables</td>
<td>3.0%</td>
<td>5.0%</td>
<td>As per major agriculture.</td>
</tr>
<tr>
<td>Livestock (potential use)</td>
<td>6.5%</td>
<td>10.0%</td>
<td>While industry indicates most use is surface water use, there is no regulatory restriction to use of groundwater for livestock. Therefore, it is prudent to include an allowance in demand estimates for livestock.</td>
</tr>
</tbody>
</table>
Other key points underpinning growth assumptions include:

- **Public water supply.** The current population of Darwin is 112,000. The capacity of the McMinns and Howard East Borefields are 294 L/second in the wet season – enough to supply a population of 141,000 – and 227 L/second in the dry season, which can support a population of 110,000.\(^{53}\) PWC consider the Howard East aquifer an important component of their portfolio of water supply options. As PWC is not actively seeking augmentation options, expansion of groundwater extraction from the Howard East aquifer is likely providing access to licences is possible. Stages 2 to 4 of the groundwater development were planned for the relatively undeveloped parts of the Howard East aquifer. Under the original proposal for the expansion of the borefield by PWC, Stage 1 would have supplied 2,680 ML/year, Stage 2 2,400 ML/year, Stage 3,500 ML/year, and Stage 4 would have supplied 4,750 ML/year. Note: unlike much of the rest of the growth in demand, growth in public water supply will tend to be ‘lumpy’ reflecting the large infrastructure nature of the projects. These augmentation are only included in the high growth scenario.

- **Irrigated horticulture.** While irrigated horticulture production and water use will fluctuate in the short-term, conditions will continue to underpin future growth. Further expansion of irrigated horticulture will be driven by growth in local and interstate demand for product and the ability of producers in the HEWAPA to exploit any competitive advantages into those markets. While producers in the region are disadvantaged by distance to markets, they are able to exploit counter-seasonal marketing opportunities into domestic markets in southern states. Given the resources boom in Australia, the level of the Australian dollar is likely to remain relatively high in the foreseeable future. This will constrain opportunities for major expansion into overseas export markets.

- **Livestock (primarily cattle).** Production in the HEWAPA is currently relatively limited as the region has a competitive disadvantage when compared to many areas in the Australian rangelands. However, the region is likely to have the potential to grow at least as fast as the industry as a whole and may be able to exploit some locational opportunities in the future due to the region’s proximity to Darwin as an export base for live cattle.

- **Rural residential.** Growth in groundwater demand will generally be in line with population growth expectations and the availability of land releases. Given the proximity of the region to Darwin and the popularity of the area as one of Darwin’s premier rural residential areas, where land is available within the more accessible areas of the HEWAPA, growth rates may exceed those for Litchfield as a whole.

The low growth and high growth assumptions have then been applied to the bottom end and top end estimates of current water use to establish estimates of future water use over the next 10 years. These estimates are presented in the following sections.

\(^{53}\) Personal communication with PWC.
6.3.1 Bottom range groundwater use scenario

Current bottom of the range estimates of groundwater use in the HEWAPA are approximately 25,000 ML. The table below shows the bottom range growth in groundwater use for the period to 2021. Key points to note include:

- Overall use is expected to grow approximately 21% to around 30,000 ML per annum over the 10 years.
- In absolute terms, irrigated horticulture will be the biggest contributor to growth.
- In relative terms, growth in pastoral use is likely to be very high, albeit from a low base.
- Rural residential development is also likely to be a major contributor to growth, potentially increasing around 2,000 ML.

Table 14: Bottom range scenario of groundwater use in ML (Howard East aquifer)

<table>
<thead>
<tr>
<th>Use</th>
<th>2011 ML</th>
<th>2016 ML</th>
<th>2021 ML</th>
<th>growth 2011-2021 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public water supply (PWC)</td>
<td>8,500</td>
<td>8,500</td>
<td>8,500</td>
<td>0</td>
</tr>
<tr>
<td>Major agriculture (metered)</td>
<td>4,900</td>
<td>5,700</td>
<td>6,600</td>
<td>35</td>
</tr>
<tr>
<td>Small horticulture (mangos &amp; other fruit)</td>
<td>2,900</td>
<td>3,400</td>
<td>3,900</td>
<td>34</td>
</tr>
<tr>
<td>Small horticulture - vegetables</td>
<td>1,100</td>
<td>1,300</td>
<td>1,500</td>
<td>36</td>
</tr>
<tr>
<td>Livestock (potential use)</td>
<td>80</td>
<td>110</td>
<td>140</td>
<td>75</td>
</tr>
<tr>
<td>Rural residential</td>
<td>7,500</td>
<td>8,500</td>
<td>9,600</td>
<td>28</td>
</tr>
<tr>
<td>Totals</td>
<td>24,900</td>
<td>27,300</td>
<td>30,100</td>
<td>21</td>
</tr>
</tbody>
</table>

Source: MJA estimates.

The figure below shows existing use and growth for each major class of water use. It indicates the increasing proportion of water use for horticulture (up from 36% to 40% over the period) and rural residential (up from 30% to 32%).

Figure 5: Bottom range scenario of groundwater use (Howard East aquifer)
Even under a low growth scenario that builds upon the lower end of the estimates of current usage, business as usual growth is relatively significant, and if unmanaged, may create risk to the performance of the aquifer with economic and social consequences.

It is important to note that around 3,560 ML (two-thirds) of the potential growth is in areas that are currently not regulated (i.e. small scale irrigation, pastoral and rural residential irrigation uses). In effect, much of the risk to aquifer condition and performance will come from largely unregulated growth under current policies.

6.3.2 Top range groundwater use scenario

Current top of the range estimates of groundwater use in the HEWAPA are approximately 31,000 ML. The table below shows the top range growth in groundwater use for the period to 2021. Key points to note include:

- Overall use is expected to grow approximately 55% to around 48,000 ML per annum over the 10 years.
- In absolute terms, irrigated horticulture will be the biggest contributor to growth (an additional 7,100 ML, while the next two stages of PWC augmentations would account for growth of around 5,900 ML depending on the timing of augmentations (we have assumed the first augmentation in 2014 and the second in 2018 to contribute to the growing supply requirements of the greater Darwin region).
- In relative terms, growth in pastoral use is likely to be very high, albeit from a low base.
- Rural residential development is also likely to be a major contributor to growth, potentially increasing by around 3,800 ML.

Table 15: Top range scenario of groundwater use (Howard East aquifer)

<table>
<thead>
<tr>
<th>Use</th>
<th>2011 ML</th>
<th>2016 ML</th>
<th>2021 ML</th>
<th>growth 2011-2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public water supply (PWC)</td>
<td>8,500</td>
<td>10,900</td>
<td>14,400</td>
<td>69%</td>
</tr>
<tr>
<td>Major agriculture (metered)</td>
<td>4,900</td>
<td>6,300</td>
<td>8,000</td>
<td>63%</td>
</tr>
<tr>
<td>Small horticulture (mangos &amp; other fruit)</td>
<td>4,600</td>
<td>5,900</td>
<td>7,500</td>
<td>63%</td>
</tr>
<tr>
<td>Small horticulture - vegetables</td>
<td>1,800</td>
<td>2,300</td>
<td>2,900</td>
<td>61%</td>
</tr>
<tr>
<td>Livestock (potential use)</td>
<td>80</td>
<td>120</td>
<td>190</td>
<td>138%</td>
</tr>
<tr>
<td>Rural residential</td>
<td>10,800</td>
<td>12,600</td>
<td>14,600</td>
<td>35%</td>
</tr>
<tr>
<td>Totals</td>
<td>30,600</td>
<td>37,900</td>
<td>47,400</td>
<td>55%</td>
</tr>
</tbody>
</table>

The figure below shows existing use and growth for each major class of water use. It indicates that the proportion of water use for horticulture is relatively steady at 37% over the period, but that public water supplies increase from 28% to 30% of total use while rural residential actually declines moderately (down from 35% to 31%).

Under a high growth scenario, the increase in groundwater use could be as high as 16,800 ML, of which around 7,900 would be from largely unregulated uses.

Under current policy and regulatory arrangements, this growth has the potential to create significant risk to aquifer health and function with few options in terms of management.
6.4 Implications for water allocation planning

The estimates of current and potential consumptive use of the groundwater resource in the HEWAPA over the next 10 years have a number of implications for water allocation planning in the HEWAPA, specifically:

- **Policy and planning uncertainties.** Because only a proportion of groundwater use is actually measured, this uncertainty will undermine the effectiveness of water allocation and planning (e.g. the accuracy of groundwater modelling to inform management decisions). As the water allocation plan is progressed, additional effort should be made to enhance estimates through more accurate land use mapping and additional analysis of data available from existing meters to establish groundwater usage patterns for different land uses.

- **Metering and risk.** While a lack of metering creates uncertainties for policy, it also reduces the potential effectiveness of any future management regime as compliance and enforcement would be compromised.

- **Perverse outcomes from land use planning.** Proactive planning is underway to expand urban development in the region that, under existing policy and planning arrangements, will result in major growth in unregulated groundwater use. The potential unintended consequences of this for the condition and function of the aquifer need to be more formally recognised in land use planning.

- **Growth exacerbates risk to aquifer and groundwater-dependent sectors.** Both scenarios of growth in groundwater use would see major increases in groundwater extraction. While it is beyond the scope of this report, it should be recognised that increased extraction will increase the risk to aquifer condition, groundwater dependent ecosystems and sectors highly reliant on groundwater (particularly horticulture).
7. Possible economic and social implications

This section outlines some of the possible economic and social implications from water allocation planning in the HEWAPA. While this section provides an indication of the tradeoffs between possible outcomes, these should be treated as indicative as it is too early in the planning process to formally establish planning scenarios and undertake in-depth assessments of trade-offs between outcomes.

7.1 Potential economic benefits associated with primary industries growth

MJA has developed a relatively simple economic impact model to assess the economic impacts of changes in horticulture and cattle production in the HEWAPA. The model uses relevant data from the ABS, NRETAS and broad employment multipliers. Key assumptions in the model include:

- The gross value of production per ML remains constant at current estimated levels for the HEWAPA (i.e. fruit at $3,600, vegetables at $11,800, cattle $8,600). It is assumed that these values remain constant.
- Growth occurs at the rate outlined in Table 13.
- Output multipliers are 0.51 for both horticulture and beef cattle, while employment multipliers are 0.51 for horticulture and 0.36 for beef cattle.\(^\text{54}\)

Using the model it is possible to assess the economic impacts (change in gross value of production and employment) associated with growth in groundwater use outlined in Section 6 of this report. It should be noted, that these economic impacts require two key conditions to be met before they would be realised. Firstly, market demand is sufficient to drive the investment in expanded production. Secondly, the performance of the aquifer does not deteriorate (water availability or quality) and productivity and yields are maintained. Given the fact there is already evidence that the performance of the aquifer is declining, this second condition may not be met. The table below summarises key outputs from the economic impact modelling.

<table>
<thead>
<tr>
<th>Economic indicator</th>
<th>Low growth</th>
<th>High growth</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Additional economic activity ($ million p.a.)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct economic activity</td>
<td>15</td>
<td>26</td>
</tr>
<tr>
<td>Indirect economic activity</td>
<td>7</td>
<td>14</td>
</tr>
<tr>
<td>Total economic activity</td>
<td>22</td>
<td>40</td>
</tr>
<tr>
<td><strong>Additional employment (FTEs)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct employment</td>
<td>45</td>
<td>74</td>
</tr>
<tr>
<td>Indirect employment</td>
<td>21</td>
<td>36</td>
</tr>
<tr>
<td>Total employment</td>
<td>66</td>
<td>110</td>
</tr>
</tbody>
</table>

*Source: MJA estimates.*

\(^{54}\) Ref 36.
The key points to note are that by 2021:

- The increase in direct economic activity would be in the range of $15-26 million per annum.
- Flow-on economic activity to the broader Territory economy would be in the range of $7-14 million per annum. Only a small proportion of this benefit would be realised in the HEWAPA.
- Total economic activity attributable to the higher levels of horticulture production would be in the range of $22-40 million per annum.
- Putting this growth in additional economic activity into perspective, assuming the NRETAS forecast growth rates continue beyond 2012 until 2021, the growth in the HEWAPA would only constitute between 5% and 8% of the total growth of primary industries in the Territory.
- Under a low growth scenario, up to 66 additional full time equivalent positions may be created (up to 45 direct and 21 indirect). While a number of these jobs will be filled by people living in the HEWAPA, it is more likely that many of the direct jobs would be fulfilled by residents from across the Litchfield Municipality.
- Under a high growth scenario, up to 110 jobs could be created, with up to 74 being direct jobs principally in the Litchfield Municipality.
- The additional direct jobs created are likely to account for between 0.2% and 0.4% of employment in the Litchfield Municipality.

In summary, while there is likely to be additional economic activity and employment from further development of the groundwater resource in the HEWAPA, this growth is negligible in terms of regional economic activity and employment. These benefits need to be weighed up against the risks of potential over-extraction to other sectors and values.

7.2 Public water supply issues

The Howard East aquifer is a relatively small but highly strategic contributor to the potable water supply of the greater Darwin region both from a quantity and quality perspective. PWC has recently invested $10 million in raising the Darwin River Dam wall by 1.3 metres to provide an extra 9,000 ML (20% increase).\(^{55}\)

If further groundwater extraction from the Howard East aquifer is possible after completion of the water allocation planning process, this is likely to be a relatively cost-effective water supply option in the future.

Importantly, water from the aquifer is vital to ensuring appropriate water quality. Any material decline in source water quality would trigger the need for PWC to establish a water treatment plant with a cost in excess of $40 million.\(^{56}\)

Where the Howard East aquifer’s performance drops, this will trigger further investment by PWC in the portfolio of supply and treatment options for the greater Darwin region. Avoiding those costs through proper management of the Howard East aquifer will provide significant benefit to the Territory.

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7.3 Economic and social risks from declines in aquifer condition

At the time of writing this report, a formal risk assessment of alternative scenarios of groundwater extraction had not been completed. However, given the fact there is already evidence of a decline in the performance of the aquifer, it is instructive to consider the economic and social consequences of this decline.

It should be noted that for most of these risk there is virtually no quantitative data to underpin a formal assessment.

7.3.1 Primary production

Where the performance of the aquifer declines, this will have negative impacts on all irrigators utilising that aquifer in the form of lower yields and revenue and higher production costs. Often relatively small marginal changes in either yields or input costs can have significant impacts on the commercial viability of farms and subsequent employment.

Previous economic modelling assessments undertaken in other groundwater irrigation districts have found that declines in aquifer condition (yield and water quality) can occur very quickly and take decades to recover.\(^ {57}\) In effect, the risks of over-extraction can be virtually permanent in an investment timeframe and offset any gains from further expansion of groundwater extraction.\(^ {58}\)

While there is no quantitative relationship between extraction volumes and bore yields to underpin any sophisticated economic analysis of the risks to irrigators, it is possible to do some relatively basic threshold analysis to determine the reduction in effective bore yields that would be sufficient to completely offset the potential gains from future horticultural development. A simple threshold analysis based on the data and model used for Section 6.1 found that declines in horticulture yields attributable to poor aquifer performance of only 5% would more than offset any gains from further horticultural development over the longer term (based on an assessment of revenue to farmers). Commercial viability for irrigators would be impacted at much lower levels of aquifer decline as both revenues would decline and costs would increase (e.g. deepening bores). In summary, extreme care should be taken in the water allocation planning process to ensure over-extraction does not occur, as the economic consequences can be considerable.

7.3.2 Rural residential sector

The rural residential sector are major beneficiaries of relatively unregulated access to groundwater in the HEWAPA. The ability to access groundwater and establish and maintain gardens year-round adds significantly to the amenity of households and the value of houses.

Declines in the performance of the aquifer will have economic and social impacts on the rural residential sector both for current dwellings and future dwellings. However, this impact cannot be quantitatively determined without detailed groundwater modelling including

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\(^ {57}\) MJA (2008) \textit{Social and economic assessment of the amendment of the Pioneer WRP to incorporate groundwater}, for the Queensland Department of Natural Resources and Water.

\(^ {58}\) MJA (2008), \textit{North Queensland regional water supply strategy: rural demand}, for the Queensland Department of Natural Resources and Water.
estimation of the potential for material changes in reliability and/or permanent changes to yields or quality.

### 7.3.3 Risks to non-consumptive and social values

Section 5.3 outlined suite of non-consumptive values associated with the maintenance of the Howard East aquifer. Over-extraction of groundwater may trigger a number of risks to social values. While there is insufficient information to quantify these risks, they are briefly described in the table below.

**Table 17: Potential risks to social values from declining aquifer condition**

<table>
<thead>
<tr>
<th>Social value</th>
<th>Risk to value</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tourism</td>
<td>Loss of tourism activity</td>
<td>Major values largely already lost due to decline in water quality Howard Springs.</td>
</tr>
<tr>
<td>Commercial fishing</td>
<td>Loss of breeding habitat condition</td>
<td>Potentially a major issue for an important sector, but relationships between groundwater extraction and fish breeding habitat not well understood.</td>
</tr>
<tr>
<td>Recreational fishing</td>
<td>Loss of breeding habitat condition</td>
<td>Potentially a significant issue for a major recreational pastime in the Top End, but relationships between groundwater extraction and fish breeding habitat not well understood.</td>
</tr>
<tr>
<td>Hunting</td>
<td>Loss of habitat</td>
<td>Some habitat may be groundwater dependent ecosystems. Loss of habitat will diminish bag rates and subsequent recreational values.</td>
</tr>
<tr>
<td>Nature study, birdwatching &amp; education</td>
<td>Loss of habitat</td>
<td>Some habitat may be groundwater dependent ecosystems. Associated social values will also diminish.</td>
</tr>
<tr>
<td>Environmental values</td>
<td>Loss of habitat &amp; ecosystem function</td>
<td>Some ecosystems may be groundwater dependent. Any decline in the extent and condition of these ecosystems will also diminish associated social values. Particular areas of concern include Black Jungle, Holmes Jungle, Micket Creek, and parts of the Howard River.</td>
</tr>
<tr>
<td>Indigenous values</td>
<td>Loss of traditional rights, environmental custodianship and cultural connections</td>
<td>Relationships between aquifer condition and these Indigenous values is complex and poorly understood. Any losses in these Indigenous values would be extremely difficult to quantify.</td>
</tr>
</tbody>
</table>

*Source: MJA*

While many of risks to non-consumptive uses and broader social values are difficult to measure, they are likely to be significant.
References


ABS (2006-07), Agricultural Commodities: Small Area Data, Australia


CSIRO (2009), Water in the Van Diemen region of the Timor Sea Drainage Division, a report to the Australian Government from the CSIRO Northern Australia Sustainable Yields Project, August 2009.


Department of Resources (2011), Northern Territory Primary Industry and Fisheries Overview and Outlook 2010.


Greiner, R & Hall, N (2006), Social, Economic, Cultural and Environmental Values of Streams and Wetlands in the Burdekin Dry Tropics Region.


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MJA (2008b), *North Queensland regional water supply strategy: rural demand*, for the Queensland Department of Natural Resources and Water.

Natural Resources, Environment, the Arts and Sport (NRETAS) (Department of) (2011a), *Howard East Aquifer Water Allocation Plan: Information Report*, NT Department of Natural Resources, Environment, the Arts and Sport, May 2011.


Appendix A – policy context (National Water Initiative and NT arrangements)

Water planning at its simplest is the formalised regulatory planning process for the allocation of water between consumptive and non-consumptive uses. The objective is to ensure that water is used and managed in a way to underpin economic, social development, while simultaneously ensuring ecosystem functions reliant on water are maintained.

Water planning arrangements vary across jurisdictions. Water planning instruments have different names, and adopt differing approaches to how they allocate water to consumptive users and the environment.59

National requirements

The National Water Initiative 2004 (NWI) is an agreement between jurisdictions to undertake transparent, statutory based water planning (clause 23ii), using best available information (clause 36) to: define and describe environmental and other public benefit outcomes and put management arrangements in place to achieve those outcomes (clause 37); adequately define resource security outcomes and water allocation and trading rules and adjust over-allocated and/or overused systems (clauses 37, 43); and put in place mechanisms to manage risk and adapt to improved information and knowledge, including monitoring and reporting (clause 40).

Under the NWI, water plans need to (1) identify productive, environmental and other public benefit uses of water (clause 25iii); (2) identify surface and groundwater systems of high conservation value (clause 25x); (3) describe (geographically and physically) the water resource to be covered by the water plan (schedule E1i); (4) describe the health and condition of the system (schedule E1ii); (5) describe the risks to the system that can affect the availability of water or the allocation of water resources to different uses (schedule E1iii); (6) describe uses and users of water including indigenous use (schedule E1vi); and (7) assess the connectivity between groundwater and surface water (schedule E5ii).60

The objectives of the NWI are to:61

- Achieve transparent statutory based water planning.
- Provide investment certainty through improved water security.
- Provide for environmental flows and other public benefit outcomes.
- Meet the water needs of Indigenous people.
- Enable water trading for more profitable (efficient) use of water.
- Enhance water use efficiency in urban and rural areas.
- Enhance water planning and management through improved metering.


60 Ref 4.

61 Ref 3.
- Recognise the connectivity between groundwater and surface water.

Through the NWI, jurisdictions have also committed to water planning processes, which: (1) consult and involve the community, including Indigenous communities (clauses 52, 95); (2) actively consider and settle the trade-offs between competing outcomes for water systems, using best available science, social and economic analysis and community input; and (3) address impacts on affected entitlement holders and communities (clauses 36, 97).

Effective water planning is thus fundamental to the NWI. When fully implemented, water planning under the NWI will provide a clear and secure basis for water access entitlements and allocations, providing certainty to both consumptive water users and non-consumptive water use (the environment and other public benefits), and ‘appropriately’ balance economic, social and environmental considerations. Through providing a basis for the allocation of water between uses, water planning is integral to efforts to deal with the challenges of stressed water systems, or – in the case of the Territory – efforts to avoid stressed water systems in the future, ensuring environmental and resource sustainability, and a secure basis for continued economic growth and development.

**Water Planning in the NT**

The Northern Territory *Water Act 1992* (amended 2004) provides for the allocation, use, control, protection and management of water resources. Water in the Territory (both surface and groundwater) are owned by the Crown and managed through a regulatory framework shown in Figure 1.

Under the *Water Act 1992*, statutory water allocation plans are to be developed in all declared water control districts to provide for the allocation of water to beneficial uses in accordance with the principle of sustainable yield. Beneficial uses include environmental uses. To date only three water allocation plans have been developed, but a number of others are underway. Water Allocation Plans (WAP) developed under the Act will be in accordance with the Territory’s obligations under the NWI.

Water allocation plans must (1) be in Water Control District; (2) be reviewed every five years, with a maximum life of 10 years; (3) allocate water within sustainable yields to beneficial uses; (4) allocate water to the environment; (5) allow for trade of licenses. The *Water Act 2004* also allows for the creation of Water Advisory Committees (WACs) for each Water Control District for which a management plan is being developed, but the interests represented by the WAC are at the discretion of the Minister.

In areas covered by a water allocation plan, water is allocated to consumptive uses which are licensed (such as agriculture or public water supplies) and non-consumptive uses (such as environmental or other public benefit uses) which are not licensed. Water licenses allow the holder to take surface or groundwater subject to conditions. The issue and transfer of water

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63 Ref 3.


65 Ibid.
licences must be in accordance with that plan. Water plans determine the allocation of the water pool between consumptive and non-consumptive uses.

The Water Act 1992 does not provide explicit guidance on the development of water allocation plans however – and hence sustainability of water use under water allocation plans is provided for by the concept of beneficial use.

Under the NT Water Act 2004, water control districts can be declared to ensure that water systems do not become stressed or over-allocated. They are declared for areas with relatively high water demands to enable better water management through control of water extraction.

Water allocation plans in the Territory must also be consistent with the Integrated Natural Resource Management Plan for the Northern Territory: Sustaining our Resources – People, Country and Enterprises (INRM Plan). The INRM Plan embodies the principles of ecologically sustainable development, the precautionary principle, and adaptive management. It incorporates specific actions and targets in relation to water allocation.66

A WAP must allocate water to beneficial uses. There are two categories of beneficial use:

1. Consumptive use:
   a. Public water supply
   b. Rural stock and domestic
   c. Agriculture
   d. Industry (commercial use other than primary)
   e. Aquaculture

2. Non-consumptive:
   a. Environmental values
   b. Public benefit outcomes (such as public health, indigenous and cultural values, recreational uses, fisheries, tourism, navigation and amenity values).67

Beneficial uses thus include economic uses, social and cultural uses (including Indigenous), and environmental and public benefit uses. Some of these uses are – or can be – met through in-stream flows rather than water abstraction. Some also require physical access to a river or waterway.

66 Ref 4 (pages 477-478).
67 Ref 8.