



# THE POTENTIAL ENVIRONMENTAL IMPACTS OF A SUBSTANTIAL POPULATION GROWTH IN THE NORTHERN REGION OF SYDNEY

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## **ACKNOWLEDGEMENTS**

This report was produced in consultation with the environment representatives of the seven Local Councils that comprise the NSROC region. Not only were their State of the Environment Reports called upon extensively for local information to describe the prevailing environmental picture across the region, but relevant staff within each Council invested time providing additional material and input to this report.

Considerable assistance was given by Dominic Johnson, the Executive Director of NSROC. Dominic provided a valuable perspective on the issues facing the region as a whole, and how the report should best be designed to meet the needs of its readers. He also helped us to formulate our views on how the NSROC region could work productively with the *Metro Strategy* planning team in the NSW Department of Infrastructure Planning and Natural Resources to obtain the best long-term environmental outcomes for the region.

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OF A SUBSTANTIAL POPULATION GROWTH  
IN THE NORTHERN REGION OF SYDNEY***

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## **1. INTRODUCTION**

### **1-1 THE TERMS OF REFERENCE FOR THE REVIEW**

*The Middle Way* was commissioned in April 2005 to undertake a comprehensive analysis of the potential environmental impacts of the population increase expected to occur over the next 30 years within the NSROC boundaries in the northern sector of Sydney. It was requested to pay particular attention to the growth deployment strategies being envisaged by the draft Sydney Metropolitan Strategy (the *Metro Strategy*) for the region.

At the time of the commissioning, the draft recommendations in the NSW Government's *Metro Strategy* identified the need for the NSROC region to accommodate in the vicinity of an additional 100,000 people by 2034. The *Metro Strategy* was only partially released at the time of the analysis, and was silent on the specific locations considered most appropriate for significant residential growth in this area.

This review therefore firstly sought to identify if there was a general association between a population density increase and a deterioration of the urban and bushland environments. It then attempted to characterize the adverse impacts on the natural biological and physical features that dominate the NSROC region, or on the environmental amenities that are underpinned by the critical economic infrastructure that functions throughout it. In each case, priority was given to the environmental attributes that were valued highly by its residents, with a starting point being that urban growth should be pursued only if these were not degraded.

The analysis conducted by *The Middle Way* is an independent one. The member Councils of NSROC were consulted during the preparation of the report; they were invited to comment on the issues that they saw as a priority for either their local area or for the region as a whole; and they were invited to provide any relevant data that may be helpful. Considerable attention was also paid to the State of the Environment Reports that each Council prepared in 2004, and any technical reports they had produced that were in the public domain. The information obtained was then repackaged to prepare a regional perspective overall rather than a synthesis of the individual circumstances applying in each LGA. This is an important consideration, because not every Council may share all of the perspectives or environmental priorities as presented in the report.

This report, together with others being prepared for NSROC on related topics, will assist the Councils in the region to understand how best to respond to the changes proposed in the *Metro Strategy* and to ensure that they are implemented sustainably.

## **1-2 EXECUTIVE SUMMARY**

The report that follows discusses in detail the key environmental impacts expected to be associated with an intensification of the population in the NSROC region. Initially, it outlines the concepts underpinning the generic relationship between human settlement and the natural environment, and then establishes tests that should be considered when applying the relevant principles to the NSROC region.

A characteristic feature of the NSROC region that dominates our analysis is that it is already extensively urbanised. Growth will come largely from re-engineering existing settlement areas, rather than from the strategic urbanisation of green-field sites. This poses many impediments to the implementation of good planning intentions. Unlike the green-field areas identified for new growth centres, fewer opportunities will be available to match the needs of the built environment with demands to protect nearby vulnerable natural environmental assets.

Within this constraint, there are various matters that we identify for consideration by NSROC as its plans to accommodate a population increase. These are:

1. Intensification of the population of the NSROC region will unavoidably impact on the key environmental assets that are highly valued by its residents. Some changes will be manageable, but others will be irreversible.
2. The environmental outcomes will be superior if the expected population growth in the region occurs through a structured and comprehensive land-use planning strategy such as the *Metro Strategy*. The current fragmented and case-by-case approvals regime for development projects that is administered by the NSROC Councils in concert with the NSW Minister for Infrastructure, Planning and Natural Resources, will be inadequate to respond to the stresses that the anticipated growth will place on the local environment of the region.
3. Some environmental impacts will become obvious far earlier than the 30 year planning horizon considered by the *Metro Strategy*. The timing and magnitude of some will be greater if key parts of the economic infrastructure servicing the region continue to deteriorate. Sewerage, stormwater and transport management functions are ready examples.

This investment will however, need to be made judiciously. It will fail to mitigate the adverse population effects on the local environment if it does not focus on providing specific improvements that address recognised threats. For example, a new road may service a particular user group, but may also increase the private use of vehicles and lead to further congestion at other locations.

4. Notwithstanding the best planning intentions and even the availability of substantial infrastructure funding, there is the distinct possibility that the population density of the region could reach a point where it is no longer sustainable against a wide range of commonly accepted environmental sustainability indicators. There may for example, be absolute limits to the tolerance of water quality in the rivers and coastal foreshore of the region, or the condition of its extensive native bushland and ecosystem habitats.
5. If this point is reached, some blame must lie at the feet of past developers who have left the legacy of an inadequately conceived building stock which will dominate the region for decades. Many residential and commercial buildings are not only poorly designed to cope with potential energy and water constrained circumstances, but are also located where they generate the most severe anthropocentric impacts on sensitive natural systems.

It is acknowledged that this criticism could be levelled at all historical settlement patterns right across Australia, but there are factors that amplify the problem here. The NSROC region is characterised by steep inclines, hills and gorges, many of which rise above environmentally sensitive land or aquatic features. The higher sites have been preferred for residential development for a variety of reasons, but disturbance of the land at the top of the sensitive areas has caused soil mobilisation and fast stormwater flows. Both have resulted in significant environmental problems for the vulnerable ecology below, and they will continue to be at risk from future building activity.

The following comments are discussed in the issue-specific sections in Section 3 of the report. Their order below differs from that in the body of the report because an attempt has been made here to focus on the most significant issues first.

#### **TRANSPORT ISSUES**

6. The arterial roads of the region appear to be on an unavoidable trajectory towards extreme traffic congestion during peak hours. The major roads in the region are prominent thoroughfares for the vehicle-bound commuters of the outer suburbs, as well as an accelerating intra-regional commercial traffic flow. Eight of the major roads were taking more than 70,000 vehicles daily as far back as 2002, and they will continue to be conduits for the growth areas in the north west sector and the Central Coast.
7. It is therefore imperative that initiatives be taken urgently to implement a fully integrated public transport system that will maximise the effectiveness of the bus, rail and ferry systems in moving the greatest volume of people as quickly as possible, using the lowest number of conveyances. A failure to develop a comprehensive and sustainable transport strategy could seriously impede the goal of increasing the population within NSROC

It should be noted that our projection takes into account the \$5 billion worth of transport-related infrastructure currently being built within the region or on its outskirts. These

projects should delay some aspects of the problem, but the evidence implies that the eventual strain will be overwhelming.

8. The *Metro Strategy* should also facilitate the competitiveness of buses as a major form of public transport, but to do so in a manner that is sustainable against even the strictest of the environmental criteria that are likely to apply in foreseeable future. Their operations are already well established in the region, and especially for conveying passengers into and across the city. But their services often appear poorly co-ordinated, and there are circumstances where the fleet becomes an environmental problem on its own. There is an urgent need to optimise their effectiveness as a mass transit system.
9. Similarly, the *Metro Strategy* should provide funding for a study to identify the circumstances in which light rail could be used to augment the movement of people within NSROC or across the Bridge to the city. If shown to be commercially viable, this could prove to be a valuable component of an integrated transport system.

#### **DRINKING WATER SECURITY**

10. Even if the current dry spell in the catchment of Sydney's drinking water relents, there is still a long-term need for measures to ensure that the growing NSROC region is less vulnerable to future supply constraints. It is legitimate to expect the community of the region to position itself to support any city-wide demand management initiatives, and to take clear steps to reduce its call on the reticulated system operated by Sydney Water.

This analysis identified initiatives that could enhance the water-conservation goals of the NSROC Councils, but which have languished in the past from a lack of interest. Two examples in particular are:

- (a) an investigation should be undertaken under the *Metro Strategy* umbrella into the viability of using the Northside Storage Tunnel as a conduit for high quality recycled water to be transported from the North Head sewerage treatment plant, to large volume users in the LGAs in the vicinity of the Tunnel. This water should be sold for application to parklands and sports grounds as a substitute for potable water, wherever this satisfies strict public health guidelines.
- (b) there should be a thorough investigation of the options available for recycling stormwater for similar types of applications. Models are available that specifically capitalise on the natural advantages of the NSROC region. The Ku-ring-gai Council has recently received funding to implement a program, and the North Sydney Council has a similar approach that appears admirably suited to its circumstances. These should be investigated early, and if they appear viable, pursued quickly under the *Metro Strategy* umbrella for funding to extend them across the region.

11. Consideration should be given to further extending the need for any multi-unit dwelling development to include stormwater retention basins as a condition of their development approval. These would need to be designed to suit their local circumstances, but should reduce the peak volumes entering the drainage system and hence the speed of its total flow. The water that is collected should be made available for recycling in the vicinity of the basin.

#### **SEWERAGE MANAGEMENT**

12. Sydney Water should regularly publish its perspective on the capacity-constraints that are likely to be faced if any part of its sewerage network in the NSROC region is to be required to cope with a population increase.
13. Should any land-use planning changes be proposed for Development Consent that are contrary to this advice, the proponents should describe how the published limitations will be addressed prior to approval being granted for their projects. The alternative is that future sewerage system augmentations will be exercises in crisis management if Sydney Water is merely left to retrofit upgrades to cope with the additional strain on the system
14. Further development of the unsewered areas identified across the region should be prevented, preferably until they are properly reticulated, or at least until it is established that they satisfy an objective risk profiling against key environmental performance criteria.

#### **BIODIVERSITY CONSERVATION**

15. The NSROC region includes some of the most extensive and highly valued natural bushland in the Sydney basin, and also includes wildlife corridors that enhance the survival of sensitive fauna inhabitants. These areas are currently under perpetual threat, not only from commercial quarters, but also from the creeping impacts of soil erosion and chemical contamination from stormwater drainage; attacks on the natural inhabitants from domestic pets or an increase in the numbers of their feral cousins; and increased pressure for recreational access to areas that are ill-adapted to cope with the human intrusion. All will compound as the population density of the region increases.
16. NSROC should therefore enter into early negotiations with the *Metro Strategy* planners to identify approaches for arresting these threats. One suggestion is for the planning law reform program to include the statutory capacity to place highly valued native bushland areas beyond development pressures. This should declare the areas "out-of-bounds" with a force that resists legal challenge.
17. The stricter planning controls should also prescribe risk-mitigation measures for proposed developments adjacent to sensitive natural settings. Their effects can be gradual, cumulative and less easily predicted, and are of particular risk on steep slopes above



bushland, for example, in the Hornsby and Ku-ring-gai local government areas. Here there is a higher risk of soil erosion, weed invasion and pollution from increased volumes of stormwater flowing off the impervious surfaces created by residential development.

### **AIR QUALITY**

18. The air quality sampling data routinely collected by the NSW Department of Environment and Conservation shows very few exceedances of the national standards for health and environment protection throughout this region.

Unfortunately, the limited data available does not allow us to make projections about the future impacts of a more intensive urbanisation of this region, and especially on a sub-region basis. Only one site at Lindfield describes the air quality of the NSROC region, and this is unable to identify micrometeorological changes or localised pollution that may be impacting on the residents of vulnerable residential pockets elsewhere in the region.

If the Lindfield site under-reports local pollution levels, then any future deterioration in air quality would be from a lower base than is currently described by the published data. This may be particularly so for photochemical smog or contamination by air-borne particles of 10 microns or less, since these are expected to increase with the growth of vehicle usage in the region. Anecdotal comments in the Sydney press refer to local pockets of "haze" or "smog" from time to time, so there may be other factors at play that need to be investigated further.

### **GREENHOUSE GAS MANAGEMENT**

19. The NSROC members have collectively identified the need to reduce the growth of greenhouse gas production as a major policy target, and are examining ways in which they can influence their communities to move in this direction. Notwithstanding this commitment, it appears unavoidable that the impacts of a substantial increase in urban density will make this goal very difficult to meet.

The key contributors to the increased greenhouse gas emissions will include local heating effects from the loss of the extensive vegetation cover that characterises the region now, as the land allocation per capita decreases; increased non-renewable energy consumption notably from the expected growth in air conditioning that will accompany the proliferation of multi-dwelling structures lacking adequate natural shading; and the expectation of significant increases in localised traffic congestion by cars that will be significant greenhouse gas emitters for many years into the future.

### **GENERAL COMMENTS**

20. The issues above are explored further in the body of the report. It is pointed out however that, in the eight week period over which this analysis was conducted, more public debate

occurred on the future of human settlement in Sydney than perhaps at any other period in the past 10-15 years.

The media raised its concerns about the deteriorating transport systems across the city, while at the same time the NSW Government announced a range of long-term initiatives to address the most threatening drinking water supply position for the city in a life-time. It is expected that this public positioning will feed into the further designs of the *Metro Strategy* that are to be announced before the end of 2005. This, in turn, could alter some of the conclusions we have formed about the future environmental risks that are likely to be faced in the region.

21. In addition, the NSW Government announced changes to the *Environmental Planning and Assessment Act 1979* that may turn out to represent its most significant overhaul since its introduction. Some of these were implemented immediately, but at the time of finalizing this report it was unclear when the key reform, the introduction of a new Part 3A, would come into force. It is expected that the new provisions will support the policy initiatives identified in the *Metro Strategy*.

22. Because the NSW planning system is in a state of 'dynamic flux', we consider that there is considerable scope for NSROC as a corporate entity to position itself as a lead negotiator with the State Government over the implementation of key features of the *Metro Strategy* in this region. Whilst some issues will be negotiated more effectively on a bilateral basis with each Council, most of those relating to environment protection affect more than one NSROC member, so would be better addressed on a regional basis.

There could also be value in framing planning strategies within the context of sub-regions that comprise two or three LGAs within NSROC facing similar issues. One such split could, for example, be Hornsby - Ku-ring-gai which have large areas of bushland, and another North Sydney-Lane Cove-Ryde-Hunters Hill that face intensive residential and commercial development. Willoughby could fit comfortably into either group.

23. Our final point emphasizes the limitations that automatically attach to any predictive analyses, and especially relating to the environmental performance of natural systems. In this report, the quality of our projections varies considerably across the issues discussed.

Some predictions, such as those relating to the concerns about future drinking water security in the region, or the potential for traffic gridlock to occur throughout the region at peak hours, are expected with a reasonable level of certainty if suitable policy interventions to prevent them are not forthcoming. Others, such as the possible association between an increased local population and decreasing air quality, are more tenuous because of the limited availability of high quality local data. These qualifications need to be remembered if the findings of the analysis are to be called up in further work.

## 2. THE PLANNING FRAMEWORK

### 2-1 THE FOCUS OF THE REPORT

This paper sets out to identify the issues that need to be taken into account if the NSROC region is to accommodate a significant increase in its residential population without causing the highly valued environmental assets of the region to be degraded. Three points appear relevant to our analysis.

*The first is that the region is already highly urbanised.*

The NSROC region contains very few areas that have not been settled and which are available for development. Importantly,

- ✚ We consider it inconceivable that the wide areas of natural bushland would be sacrificed for development, because they are already a very scarce resource for all of Sydney.
- ✚ substantial changes to the design of the existing settlement patterns throughout the region will be technically difficult or prohibitively expensive, even if they are shown to enhance the sustainability of the region overall.
- ✚ any areas that were to be subject to extensive refurbishment to cope with an influx of people still need to link into existing and often ageing economic infrastructure. This will eventually become stressed by the new demands placed on it, to the point of frequently being unreliable .

*Secondly, re-development of existing areas offers fewer opportunities to pursue environment management initiatives for protecting sensitive natural features than the development of greenfield sites.*

With greenfield site developments, not only are there opportunities to exercise creativity when designing the landscape for each new building project, but a regional approach can also be taken to the layout and function of key economic infrastructure elements. For example, the stormwater, sewage and energy management infrastructure can more easily be designed to reduce pollution incidents, and to encourage greater conservation or recycling of scarce natural resources. Best available environment management approaches can therefore be prescribed and implemented cost –effectively.

*Thirdly, key environmental values of the region such as its clean air, natural waterways and widespread vegetation, will underpin the long-term growth of the burgeoning knowledge industries that are locating in an arc from Port Botany through North Ryde.*

It is estimated that the NSROC region contributed 4% of the nations GDP in 2003-2004, 88% of which came from the services sector. Its workforce comprised a significant proportion of knowledge workers, with about a third of its population possessing tertiary qualifications. Indications are that a high quality environment can be influential in commercial decisions about where a firm will choose to locate, and this in turn will have implications for where their workers will choose to live. Preservation of the high quality environmental values of the region will therefore directly underpin its long term economic growth, and this in turn will be valuable for Sydney and the State as well.

Our analysis looked at the environmental issues associated with a population growth in the region that have the potential to generate concern, and then stratified them into three groups. These include risks that a population growth:

- 1. will contribute to a marked deterioration of key attributes of either the natural environment of the region, or the reliability of the key economic infrastructure elements that support its liveability.*

Examples of the first include threats to the protection of biodiversity, protection of the natural receiving waters, or to the clean air that generally prevails across the region. Examples of the second include threats to the security of drinking water supplies, energy supply reliability, and the efficiency of transport systems across the region.

- 2. threaten changes to the environmental amenity enjoyed by the residents of the region, and of the workers who travel to it daily from other areas.*

These include noise impacts, exposure to electromagnetic radiation or a threat to the survival of the rural lands of the region.

- 3. pose changes to features of the environment that are also an important part of its social structure.*

These include European and Aboriginal heritage; the allocation of open spaces for social or recreational activities; and visual amenity issues stemming from changes to the built environment.

The level of commitment to protecting these and the concerns generated by changes to the status quo are often highly subjective. Even though they may be addressed

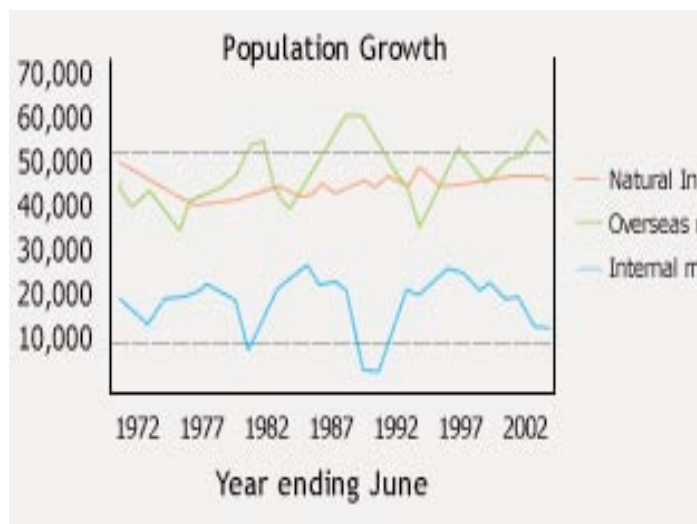
through the environmental planning statutory framework, they are not considered in this report.

Those issues identified in (1) are each the subject of a separate section of the report. Those in (2) are addressed in Section 3.7. Those in (3) are considered in a separate project being organised by NSROC on the social impacts of the *Metro Strategy*.

## 2-2 RELEVANT ASPECTS OF THE METRO STRATEGY

At the time of preparation of the report, the NSW Minister for Infrastructure Planning and Natural Resources is progressively releasing various elements of the *Metro Strategy*, and it is understood that papers on sustainability and transport planning will be released later in 2005. In the interim, the aspects of the *Metro Strategy* that are most relevant to the environmental issues facing the region are discussed below.

In April 2004 the NSW Premier announced the development of a Metropolitan Strategy to guide Sydney's growth over the coming 30 years. The Strategy anticipates growth of around 40,600 people a year over this period, two thirds by natural growth, and the remainder by immigration from overseas and interstate.



The character of the population is also changing towards an older population and a growing proportion of couple only or lone person households. This suggests a wider mix of housing types and a greater number of homes for the same number of people will be required. These demographic trends will also influence requirements for services and recreational assets.

Employment opportunities are expected to continue their uneven distribution across the Sydney metropolitan region with strongest rates of job growth, particularly in professional jobs, in the arc from Macquarie Park to Botany Bay (Sydney's *Global Arc*).



The Metropolitan Strategy proposes that the current balance in where growth occurs across different regions is maintained. This means around 60-70% of new dwellings in established areas and 30-40% in green-fields. New release areas have been announced in North-West and South West Sydney to cater for at least a quarter of a million people in around 150,000 homes in 30 years time. Growth in existing areas of Sydney will primarily be focused in centres and corridors particularly where spare infrastructure capacity exists.

As outlined throughout this paper, natural vegetation and fauna habitats are vulnerable to environmental impacts arising from development activity on adjacent urban lands. This will place further limitations on the extent and type of further residential development which is consistent with environmental sustainability. Hard won improvements in the water quality of creeks and waterways, and restoration of bushland are in danger of being reversed by inappropriate residential development.

### **2-3 EFFECTS OF URBANISATION ON THE NATURAL ENVIRONMENT**

Historical evidence repeatedly demonstrates that there is a strong correlation between urban population growth and a reduction in the ability to protect locally important environmental assets. More building usually means less natural soil coverage, less greenery, less tree canopy cover, increased impacts from stormwater run-off, more wind impacts and less natural sunlight being available at ground level.

The reasons for the association vary according to the patterns of human settlement and the sensitivity of the different receiving environments exposed to them. There may, for example, be threats to the survival of highly valued plant or animal species; degradation in the quality of the water or air that is vital for the safe and sustained survival of all life in the region; or the amenity of existing residents may deteriorate from annoyances such as an increase in intrusive noise or destruction of the visually aesthetic features of their natural surrounds. Urbanisation that occurs past the capacity of the infrastructure to reliably provide drinking water, sewerage management, stormwater management and electricity, introduces further amenity reductions that can also generate significant environmental health threats.

Fortunately, implementation of modern environmental management practices and technologies have substantially reduced the risk of these occurrences, so there is a general expectation that all Development Applications for a material change of use of a parcel of land will include best available environment management strategies. If handled well, the pursuit of eco-sensitive developments can improve the environmental performance of the locality, but on the other hand, changes to the landscape may also occur leaving a residual impact that cannot be eliminated by even exemplary approaches.

In NSW, environment protection and conservation regulation is shared between the State and Local Government sectors, but the dominant statutory framework resides clearly with the State. There are also Commonwealth laws that apply in certain circumstances, either in concert with the State requirements or as a separate regime. Local Government exercises its discretion in this area either through specific powers given to them in State law (such as having the status of a Consent Authority in the Environmental Planning and Assessment Act (NSW, 1979) or as a delegated authority that is granted by the administrator of the Act (e.g. through the NSW Department of Environment and Conservation under the Protection of the Environment (Operations) Act 1997.

Local Government in NSW therefore inherits three obligations, namely to:

- ✚ exercise a duty of care in providing for the sustainable management of the ecological or other environmental assets within its control;
- ✚ represent the local community's priorities and concerns about environment management issues where the statutory authority resides at the State or Federal level;
- ✚ co-ordinate regional intervention where issues traverse the boundaries of multiple LGAs.

While many environmental issues lend themselves to management by a Local Authority, there is often a paucity of environmental impact data available at the local level to adequately describe the specific impacts of a proposed land-use change. As well, many environmental impacts exert their influence well away from the development site, so can only be considered

within a wider regional context. Examples include water and soil issues that may need to be managed on a catchment basis, or air quality that is managed in a basin-wide context.

We see the continued strengthening of the role of the Regional Organisation of Councils as a valuable mechanism for fostering environment protection and conservation, and discuss later how we consider NSROC can position itself to play an important future role in the environmental planning for Sydney's future.

## **2-4 APPLICATION OF THE PRINCIPLES TO THE NSROC REGION**

The Northern Sydney Regional Organisation of Councils (NSROC) is the representative body for seven of the Local Government authorities in the area in the north and west of the Sydney Harbour. These are the LGAs of North Sydney; Lane Cove; Willoughby; Ku-ring-gai; Hornsby; Ryde and Hunters Hill. The region and covers a land area of 681 sq km that includes 7000 hectares of bushland. In addition, nearly all of the LGAs are contiguous with at least one National Park, and share a substantial riverine interface or interface with Sydney Harbour.

The region includes four major centres situated on bus and rail corridors (Chatswood, Hornsby, North Sydney and St Leonard's). Other centres located on bus and/or rail corridors are four town centres (Carlingford Court, Eastwood, Gordon and Macquarie Centre) and numerous villages and neighbourhood centres. The *Metro Strategy* envisages that population growth will be housed in these centres and villages.

The Department of Infrastructure Planning and Natural Resources has proposed that by 2034 the population of NSROC should grow by 30,000-45,000 households or 81,000 – 121,500 people (*Futures Forum 2*), giving a total population of 628,265. As of June 2002, 2001, the region had a resident population in the vicinity of 530,000. It also supports in excess of 50,000 businesses.

The ability to absorb additional growth across the NSROC region will not be uniform. Some NSROC areas are already characterized by a higher proportion of medium and high-density dwellings than Sydney in general (North Sydney 76%, Lane Cove 47% and Willoughby 41%). The ability to increase the density of dwellings in these regions will be limited, and there is the possibility that growth achieved under the *Metro Strategy* may result in a different distribution across the seven LGAs than in the absence of it. This, in turn, could have a marked influence on the type of environmental impacts that occur, and where.





Our discussions with the Councils in the region established that there is a widespread and very strong commitment to protecting the diversity of high value environmental assets present throughout it. Some assets, such as the extensive bushland that follows Sydney Harbour or freshwater systems such as the Lane Cove River and Berowra Creek, are icons for all of Sydney and are appreciated across the State. NSROC has expressed an interest in

understanding how a growth in its population can best be accommodated, either under the *Metro Strategy* or within the scenario where it continues in the absence of a defined strategic plan. For both, there is to be a minimum of adverse impacts on its natural environment, or on the environmental amenity currently enjoyed by its residential and worker populations.

The question arises if a strategically directed planning approach to population growth can deliver a superior environmental performance when compared with the current land development arrangements. We would argue that it should, if handled sensitively. Not only should the integration of residential planning, transport planning and a transparent and strong environmental protection agenda progressively remove the types of environmental threats that are discussed later in this paper, but it may also offer a more solid platform for entities such as NSROC to participate productively in the future delivery of key infrastructure services that affect all of its region.

Currently, local governments are provided only a limited opportunity to influence decisions about the future of major longitudinal economic infrastructure projects that pass through their LGA. The residents therefore inherit a poorly integrated mix of strategic and locally designed services. We consider that this lack of integration has contributed to many of the environmental problems we discuss, and more are certain to arise if the population grows in the face of inadequately co-ordinated land-use management regimes.

On the other hand, for the ideal approach mentioned above is to be successful, the key agencies within the NSW Government responsible for infrastructure services will need to significantly modify how they provide the Local Government sector with relevant data and forecasts on the environmental implications of land-use changes. Both Councils and the development industry can share a heavier responsibility to improve the environmental outcomes of planning decisions that approve residential or commercial growth, and it is fair that they be provided with improved data if the longer-term implications are to be better understood. We found that the data that is published for Sydney on key water, energy and transport services was often fragmented and out-of-date. A revitalised focus on transparency could pay significant dividends for the local environment for this region (and no doubt others as well).

## **POTENTIAL IMPACTS ON THE KEY ENVIRONMENTAL ISSUES IN THE REGION**

### **3.1 WATER QUALITY IN FRESH & COASTAL WATERS**

#### **3.1.1 Background**

A vital component of urban water management is the need to protect the quality of the water in natural systems such as rivers, creeks, estuaries and coastal waters. Poor quality water reduces the survival of a wide range of aquatic plant and animal species, or of those which live on the land but are highly dependent on the local aquatic systems for survival. For example, exposure to substances such as herbicides or pesticides from normal household activities, or to petrol or oils washed off roads, can have a direct toxic effect on the local aquatic ecosystem or native vegetation in bushland supported. Nutrients such as phosphorus or nitrogen can generate blooms of algae or dinoflagellates in fresh or saline waters respectively, or cause weed overgrowth that chokes out native vegetation in the riparian zone of creeks.

But more insidious is the progressive sedimentation by fine particles washed down to creeks or the shoreline from areas with soil disturbance. Modern environment protection regimes have been successful in preventing the gross movement of soil from areas of activity such as construction sites, but concerns remain about the potential impacts from the longer-term accumulation of finer and less visible particles that continue to move across the catchment during periods of heavy rain. Their accumulation in creek beds smothers sensitive benthic inhabitants or reduces the transmission of light that is important to their survival.

What is important with all of these problems in an urban setting is that no malicious or reckless polluting acts are required for the local aquatic environment to suffer. The change from the "soft engineering" of the catchment with native vegetation to a progressively wider coverage by impervious surfaces such as roads and concrete tarmacs, makes the area hostile to the aquatic ecosystem. The harder surfaces increase the speed with which the rainwater run-off flows across the land, and this in turn makes the water more efficient in carrying offensive substances across longer distances. It also means the flow is more likely to gouge softer soils, such as those around the riparian zone of a creek, when the run-off first encounters the natural environment.

The *National Land and Water Resources Audit of 2002* assessed the overall riverine ecosystem health of the waters throughout NSW. It based its findings on the macro-invertebrate data collected in the National River Health Program between 1994 and 1999, as well as other data available on catchment and riverine habitat condition, hydrological disturbance and water quality. The Audit's main findings were:

- NSW has the poorest aquatic biota condition of any Australian State or Territory, with macro-invertebrate communities impaired along 50% of the length of the rivers assessed.
- The environmental condition of 97% of the assessed river length in NSW had been modified, resulting in catchment disturbance from nutrients (especially total phosphorus) and suspended sediments in 97% of the assessed river length; altered hydrologic regimes in 87% of the assessed river length; and modified aquatic habitat in 70% of the assessed river length.

Of relevance was the comment that the most severely impaired sites were close to urban areas that included the Parramatta and Lane Cove Rivers.

### **3.1.2 Application of the concepts to the NSROC region**

#### **Water quality management**

A stand-out of the NSROC region is its extensive interface with water bodies that are important for all of Sydney, but particularly the Sydney Harbour, Parramatta River, Lane Cove River and estuarine reaches of the Hawkesbury River. These are not only iconic for Sydney residents, but also feature prominently in their contemporary and historical standing for all Australians. The seven Councils in the organisation share responsibility for the management of river, estuarine or coastal stretches of one or more of these prominent water-bodies, with up to 20 other agencies or groups.

These Councils also participate with other organisations such as the Sydney Harbour Foreshore Authority and the Upper Parramatta River Catchment Trust in the management of the various freshwater creeks that feed into the Harbour, and which have a significant impact on its environmental health. Each Council is acutely conscious of the need to ensure that future land-use planning recognises the need to protect the quality of their waters and the ecology they support, and report on their various initiatives to achieve this end in their SOE reports.

The NSW Department of Environment and Conservation (DEC) has negotiated priority water quality and river flow objectives for the Sydney Harbour and Parramatta River catchments in accordance with the provisions of the *Protection of the Environment (Operations) Act 1997*. From their negotiations with a wide range of stakeholders, the DEC formed the same conclusions as the national Audit that, because of the extensive urban development in the catchment, the waterways are affected by poor water quality and a changed flow regime.

The DEC reported that these areas have been greatly modified, with creek systems being extensively channelised or hard-edged with concrete. Wetlands have been destroyed or degraded and, where natural remnants of vegetation exist, they are often impacted by

weeds and rubbish. They also found that some streams carry poor-quality stormwater which further impacts on their health.

The DEC's concerns are reflected in a wide range of specific circumstances throughout the region. For example:

- ✚ The Hornsby Council has expressed concerns about sewage contamination from defective sewage infrastructure in wet weather, overflow from poorly managed onsite sewage management systems, and inadequate private connections or illegal connections. Pollution from onsite sewage disposal or pump out of effluent is also particularly evident within rural areas such as with Glenorie Creek.
- ✚ The industrial areas within its LGA at Thornleigh, Mount Ku-ring-gai and Hornsby continue to create poor water quality by releasing run-off with high concentrations of suspended solids, nitrogen and faecal coliforms.
- ✚ Ku-ring-gai Council has highlighted the pressure that is being placed on its waterways by the inappropriate management of erosion and sediment from building sites in the area. The steepness of many parts of the terrain in this area aggravates the problems normally caused by soil disturbance
- ✚ Northbridge Baths within the Willoughby LGA is an enclosed tidal swimming area in Sailor's Bay. Water quality in the baths is affected by urban runoff discharging to Sailor's Bay. The baths are closed for 48 hours after a rainfall event of 20mm or greater over a three day period.
- ✚ Macro-invertebrate monitoring of at seven sites in the freshwater creeks of Middle Harbour and the Lane Cove River, conducted by the Willoughby Council, shows impaired water and habitat quality. Water quality at Scott's Creek continues to be severely degraded despite the opening of the Northside Storage Tunnel nearby.

Notwithstanding these concerns, the environmental values that were nominated for formal acceptance for the Sydney Harbour and NSROC region are the need to: maintain healthy ecosystems; support recreation (including swimming, boating, fishing and aesthetics); and support commercial activities (such as commercial shipping and fishing, and tourism). These remain as Interim Water Quality Objectives within the legislative regime mentioned and form the basis for future strategies for determining how they should be managed.

The natural water bodies influenced by the NSROC region will continue to deteriorate if exposed to increasing sediment, nutrients, or chemical loads. The most likely sources of these throughout the region are stormwater run-off or sewage contamination, each of which is discussed below.

## **Stormwater impacts**

Considerable progress has been made in recent years in trapping and removing solid pollutants such as litter from the stormwater flows into the Harbour and rivers in its catchment, but one feature in particular represents an ongoing threat from development.

The region is characterised by steep inclines that lead directly down to a natural waterbody at many locations. The topography of LGAs such as North Sydney, Lane Cove, Willoughby and Hornsby provides for spectacular scenery, but at the same time facilitates rapid flows during heavy rainfall. This renders the normal pollution mitigation practices less effective than they would be in a flat area, so that any development activities that cause soil disturbance need to be particularly diligent in the application of their soil erosion mitigation practices.

This feature alone establishes that there are sound reasons to be concerned that a longer term urbanisation program in this region could stress the surrounding receiving waters. Not only will the demands on the stormwater infrastructure increase proportionally to the scale of development, but the intensification will most likely be at the expense of pockets of the existing vegetation cover. Whilst some of this would hopefully be replanted over time, it will be cleared immediately prior to construction. Its potential aid in retarding the movement of soil at the most critical period of soil disturbance will therefore be lost.

Sydney Water's *Water Plan 21*, which was last updated in 2000, advises that Sydney Water manages only 5% of the stormwater in Sydney, but none of the drainage network in the NSROC region. It also considers that there are institutional limitations to the way in which stormwater is currently managed throughout the Sydney basin, and cites as reasons for this:

- ✚ a lack of uniform performance standards among the drainage asset owners with respect to capacity requirements and water quality objectives;
- ✚ a lack of a common, efficient and equitable funding mechanism that reflects the true costs of providing stormwater services;
- ✚ a lack of coordination due to fragmented ownership of stormwater assets; and
- ✚ localised approaches to catchment-wide problems.

Within the NSROC region, the asset owners referred to by Sydney Water are its seven Council members. Each has acknowledged the future problems that could be associated with the system, but none was confident that their future capacity to raise revenue would provide them with the funding needed to address the types of threats mentioned earlier. Neither property rates nor developer levies are likely to be adequate to retro-engineer the vast stormwater drainage networks that each own, even taking into account the \$75m that the NSW Government has allocated in grants across all of NSW to improve the management and planning of the drainage systems

## **Sewerage impacts**

One element of the infrastructure that is vital for any urbanized settlement is a reliable and effective reticulated sewerage system that transports and manages human wastes in a way that protects the local receiving environment. Anything less increases the risk of the transmission of human gastrointestinal infections, degrades the ecology of the receiving waters, or destroys native vegetation exposed to its contamination.

The NSW Government has allocated a high priority over the past two decades to measures that ensure that the raw sewage generated in major urban centres receives suitable treatment before the effluent is discharged to either the oceans or local rivers. This function is carried out by the Sydney Water Corporation for all of the Greater Metropolitan Region, so that none of the Councils within NSROC have any responsibility for providing reticulated sewerage services.

Sydney Water maintains a discrete budget for sewerage management that includes operation and maintenance of the existing system and its augmentation to cope with residential expansion. There are unfortunately, features of the NSROC region that make this task more difficult, and as such may offer a potential problem for future growth.

The first of these relates to the capacity of Sydney Water to guarantee that the already ageing sewerage transport infrastructure across the region will continue to perform adequately over the next 20-30 years without significant investment. Part of this will involve the pipeline infrastructure owned and operated by Sydney Water, but there is also a considerable portion that exists on private land that could create problems as well. One offender, on both public and private lands and particularly in drought conditions, is the root system of the extensive and aesthetically pleasing vegetation cover across the region. But other factors, such as the steepness of the terrain can accentuate the impact of system failures when they do occur.

Considerable capital investment has been made over the past decade in the region to address this concern, with the most significant being the construction of the Northside Storage Tunnel. This cost in excess of \$500m and is designed to support the northern suburbs main sewerage transport system that feeds the North Head treatment plant. It has proven to be successful in reducing environmental contamination in the areas it services. There have also been significant augmentations of the sewerage treatment plants in the catchments of the sensitive creeks in the Hornsby region that have made a substantial improvement on the water quality of the estuarine zone of the Hawkesbury River.

The second issue is Sydney Water's ability to manage discharges from designed sewer overflows. These are installed in the system as pressure relief points that release sewerage when the volume in a pipe exceeds its carrying capacity. The result is the outpouring of raw sewage to the environment, and unfortunately occasionally at ecologically sensitive or socially

offensive spots. They can occur in wet weather from stormwater intrusion into the system, or in dry weather if the number of people using the system exceeds its design limits.

The reports from the NSROC Councils record a total of about 500 sewer overflow incidents in 2003/2004 throughout the region, many of which occurred in dry weather. Whether or not this is significant needs to be considered in light of the fact that Sydney Water attended 17,000 call-outs in that year. It is also interesting to note that the 2004 Annual Report from Sydney Water states that since its commissioning in 2001, the Northside Storage Tunnel had prevented an estimated 12 billion litres of diluted sewage from entering Sydney Harbour.

The third relates to the fact that there remain some residential areas in Hornsby, Hunters Hill, Ryde and Willoughby that are unsewered and rely on septic tanks, other on-site management systems, or pump-out facilities. By modern environment protection and public health standards, this is generally unacceptable for any urban environment but especially so in a major capital city. As an interim measure, performance tests have been recommended by the NSW Department of Local Government, and require an on-site system to satisfy aspects relating, for example, to the topography of the area, a stated minimum area of land for the residence, and the need for a suitable soil type to be available.

Failure to meet these tests increases the risk that the system will eventually threaten surface or groundwater quality, impact severely on natural bushland within the effluent diffusion zone, or threaten public health. All of these threats can be elevated in sustained wet weather, and more so as the terrain steepens. Currently, however, Hornsby Council considers that of the 4077 on-site residential systems in its LGA, 57% have a low risk rating, 36% have a medium risk rating and 7% have a high risk rating. Whilst this suggests that there is minimal cause for concern with the existing arrangements, it is not difficult to envisage the risks increasing if the number of properties in these areas were to increase significantly.

Similarly, the Ryde Council monitors the 24 sites in its area. Whilst it reports that it has not detected recent environmental problems with these, the sites in the Tarban area within Hunters Hill have been shown to increase the faecal coliform levels in Tarban Creek during wet weather. All Councils supported the extension of reticulation to all areas that have on-site or pump-out facilities.

### **3.1.3 Discussion**

1. Significant gains have been made in recent years in water quality in the rivers and creeks & coastal waters in the NSROC region, but the predicted population growth will be certain to challenge these achievements. The major threats will be exerted through additional stormwater run-off and further demands on the local sewer systems.



2. Questions remain about how suitable measures can be implemented to ensure the projected future population growth in this region will not aggravate existing problems with the stormwater drainage system. There is substantial evidence that pollution of environmentally sensitive river and coastal locations will increase in wet weather if this ageing is not addressed. Remediation measures should also pursue opportunities to recycle the run-off wherever possible.
3. Similarly, there are concerns that the problems that may be associated with the ageing sewer system throughout the NSROC region could impose a brake on substantial further residential development.

#### **3.1.4 Conclusions and recommendations**

1. Sydney Water should regularly publish its perspective on the capacity-constraints that are likely to be faced if any part of its sewerage network in the NSROC region is to be required to cope with a population increase.

Should any land-use planning changes be proposed for Development Consent that are contrary to this advice, the proponents should describe how the limitations will be addressed prior to approval being granted for their projects. The alternative is that future sewerage system augmentations will be exercises in crisis management as Sydney Water attempts to retrofit improvements to prevent the occurrence of environmentally unpleasant incidents.

2. Further development of the unsewered areas identified across the region should be prevented, preferably until they are properly reticulated or at least until it is established that they satisfy an objective risk profiling against key environmental performance criteria.
3. Consideration should be given to further extending the need for any multi-unit dwelling development to include stormwater retention basins as a condition of their development approval. These would need to be designed to suit their local circumstances, but should reduce the peak volumes entering the drainage system and hence the speed of its total flow. The water that is collected could be released into the system after a rainfall event, or better still, be available for recycling in the vicinity of the basin when the need arises.

## **3.2 TRANSPORT IMPLICATIONS**

### **3.2.1 Background**

Widespread media publicity has occurred recently over the growing concerns that the Greater Metropolitan Region of Sydney is facing traffic gridlock in the foreseeable future, and initially at peak hours. These stem from extrapolating the association between the rapid growth in private vehicle journeys over the past five years with proposals for substantial residential growth areas in the outer fringe of the city that unlikely to be serviced by new rail infrastructure within the next decade.

There will also be a substantial contribution to congestion in many areas from the rapidly increasing number of truck movements through the GMR. These are either smaller units working in the light industrial or commercial sectors and making local trips, or heavy rigid trucks or B-doubles carrying upwards of five tons across longer distances. A national debate is occurring over how Australia will cope with the need to move an increasing freight load around the country, and especially to and from its key shipping ports. Various policy initiatives have been announced recently at both the Federal and State Government levels to ensure the road-rail freight balance is optimised, but there is a growing expectation that cities like Sydney will experience a much greater interaction with heavy vehicles before changes can take effect.

The most sophisticated estimates are that the number of movements will double by 2015, but whilst a substantial portion of this will be cross-country by trucks carrying in excess of 35 tonnes, or by freight trains, almost 70% will involve intra-urban movements. This has focused the attention of Government and industry on the need for reform of this critical sector of the macro-economy, and an agenda is being developed by the bodies such as the National Transport Commission that will most likely include proposals for a number of long-term changes to way in which heavy vehicles use, and pay for their use of, Australian roads. Recent press releases from the NSW Government have voiced a commitment to "get trucks off the road" when the topic of the future planning of Sydney has been discussed.

At the same time, there is evidence of an increasing strain on the existing passenger rail system across all of Sydney, as well as an upward projection in the container freight that will be moved across suburban rail lines on its way to, or from, Port Botany. Congestion on the lines from both of these could induce a move to road transport so that the traffic problems are compounded.

There are various environmental impacts of a congested traffic system. In addition to the traffic effects discussed in Section 3.4 on air quality, it severely constrains communications between commercial players, and especially small businesses who need to travel across town to their customers; the quality of the local air-shed can be severely affected because stationary engines do not perform at their most efficient point and are in the air-shed for a longer period; and local communities are often disadvantaged because of the more frequent intrusion by

back-street traffic when drivers experiment with alternative pathways around a jam on a major arterial. Severe traffic congestion is therefore a significant environmental problem in whatever urban setting it occurs.

There are many solutions to this problem that have been applied successfully in other cities in Australia and overseas, and some are considered later. An important one involves planning for people to live near where they work, so that walking and bicycling become prominent forms of transport. This is relevant to Sydney noting the inordinate dominance of single person trips at peak hour.

Similarly, the strategic placement of small localised shopping facilities can reduce the need for vehicle trips between home and the shop, and construction of neighbourhood bicycle paths can aid in this change considerably. It should therefore be taken as a given that implementation of measures of this type are socially and environmentally superior to the passenger transport initiatives discussed below. They should be explored whenever possible to assist with the transport planning agenda, and to capitalise on the health and social benefits that result as well. It is recognised however, that bicycle paths are far easier to install in greenfield development areas than in infill suburbs.

### **3.2.2 Application to the NSROC region**

Discussions with each of the NSROC Councils showed that they ranked the current level of traffic congestion high in their concerns about environmental problems, and shared the observation that it appeared to be becoming progressively worse in all of the NSROC areas. Considerable recent attention has been given to the severe impacts likely to be created by the traffic congestion in the south and west of Sydney, but it appears that the point will be reached at some time in the future when the pain will be shared equally across the entire city.

The NSROC region is serviced by five major arterial roads in particular. These are the F3 Freeway from the north, the Pacific Highway, Pennant Hills Road, Lane Cove/Ryde Road, and Epping Road / M2 tollway. Anecdotally, peak hours on most of these roads on weekdays already extends from 6.30am to 9am and 3.30pm till 7pm. A characteristic of each is that none services only this region – all are corridors linking Newcastle, the Central Coast or the Northern Beaches to the city and further south (Pennant Hills Rd and Pacific Highway); or the city and Eastern Suburbs to the Western Suburbs and the Blue Mountains (Victoria Rd & Epping Rd); or the south-west region to the north and north east (Lane Cove Rd / Ryde Rd).

One addition to the road complex will occur soon that could aggravate the existing congestion on Pennant Hills Rd and Epping Rd / M2. Each will be fed by the new M7 tollway. Vehicles travelling from Melbourne to Brisbane will peel off the M7 to confront a set of 20-30 traffic lights on Pennant Hills Rd before they reach the F3 on their way north. Alternatively, they will concentrate on the M2 east of Pennant Hills Rd if they are heading to the city. Longer term, the progressive growth of the North West sector and then the addition of its new growth

centre, will also cause more cars to feed out onto both the M2 and Pennant Hills Rd depending on their destination. This build up can be expected to occur unabated at least until the proposed rail line to the new growth centre in the north-west sector becomes operational after 2017.

In the longer term, the population of the Central Coast and Hunter Region are also likely continue to swell in parallel with that of the Sydney Basin, be this strategically directed or as a product of market forces. Again, there are no short-term plans to augment the rail system between the three regions, so that passenger cars are likely to remain the transport-mode of choice. The Pacific Highway at Wahroonga and Pennant Hills Rd at the F3 termination points will be the immediate recipients of this increasing pressure.

The evidence therefore points to an inescapable move towards severe traffic congestion throughout the NSROC region well before the 2034, and most likely gridlock during morning and evening peak hours. However, it is useful to question if the key roads mentioned above are more likely to be impacted than others that will feed the new population growth centres proposed for the South West of Sydney. An inspection of the current traffic flows was undertaken to see if each faced a comparable base for future projections.

The most relevant data available was that collected in the traffic survey undertaken during 2002 by the RTA as part of a three year repeating cycle covering the whole of the State of NSW. This recorded the Annual Average Daily Traffic (AADT), which is assessed as the total volume of traffic recorded at a specific road location taken over a calendar year, and divided by the number of days in that year.

For the purposes of this exercise, only those roads that recorded a minimum AADT of 70,000 vehicles per day at some point along their monitored length was included, since this figure was considered to represent considerable existing congestion. This showed that, of the 19 arterial roads that exceeded this flow throughout all of the Greater Metropolitan Region, eight were in the NSROC region and another three were contiguous with it (i.e. as feeder or off-take roads). That is, half of the most congested traffic thoroughfares throughout Sydney were either in the region or skirted it. The maximum traffic counts recoded on the key roads of interest were:

Epping Rd	76,000	
F3 freeway at Wahroonga	79,000	(feeder road)
James Ruse Drive	73,000	(feeder road)
Lane Cove / Ryde Rd	77,000	
Military Rd	77,000	
Pacific Highway	71,000	
Pennant Hills Rd	79,000	
Victoria Rd	89,000	

*(For comparison purposes, certain roads on the southern side of the Harbour Bridge showed inordinate congestion as well. General Holmes Drive carried 134,000; Southern Cross Drive 119,000, Parramatta Rd 89,000, and the Princes Highway 87,000. The M5 east was not functional when the AADT data was collected but now probably matches the worst of these)*

The data excluded the M2 tollway which crosses the boundaries of three of the NSROC LGAs. This carried an AADT of 69,000 in November 2002. Since most of this traffic would have entered or exited at Epping Rd in the east, it could have represented a significant double-counting to include it. Nevertheless, the volume of traffic carried on this road reinforces the notion of the region facing a dismal future from heavy congestion.

Importantly though, the figure for the M2 for May 2005 was 76,000, notwithstanding there was a significant toll increase in that period. If this percentage increase were to be applied to the table above on a compounding basis, the totals that result would be disturbing.

There is one LGA that warrants specific attention in this analysis, and that is North Sydney. It sits at the northern confluence of the Sydney Harbour Bridge, the Sydney Harbour Tunnel and the Cahill Expressway. The total AADT recorded for these three roads was 350,000 vehicles per day, all of which travelled past or through the Council's area, and reflects the adage that "all roads lead to Rome". The underlying stress on this part of the road system is demonstrated quickly if a car breaks down on any of these Harbour crossings at morning or evening peaks hours. The jam occurs swiftly and can take hours to clear.

**Heavy vehicle traffic:** Sydney is certain to gain from measures by the Australian Rail Track Corporation to increase the capacity of the rail freight system between Melbourne, Brisbane and Sydney, and hopefully within five to seven years. It is not yet clear how changes to the rail freight infrastructure will influence traffic movements in the NSROC region, but they will benefit the road corridors leading to and from Port Botany. A significant majority of the imports collected from ships are destined for the manufacturing hub in Western Sydney, as are the exports being delivered to the port, and proposals are on the table for the construction of inter-modal facilities that will enhance the capacity of these corridors to move freight further to the far-west as well.

The bulk of the freight travelling east-west should continue to move through the southern suburbs. But it remains to be seen if the opening of the M7 makes it more competitive to bring the trucks through the M2 and over the Harbour Bridge, especially after the Lane Cove Tunnel opens to link the M2 to the Gore Hill Freeway.

Of more immediate concern is the carriage of small freight consignments on a daily basis within the region, since this underpins the survival of many smaller businesses and especially those operating on just-in-time principles. Severe traffic congestion makes this part of the transport sector unreliable and expensive, and this is an important consideration if it is

accepted that the growth of the knowledge industries in the NSROC region is based in part on their ability to minimize transaction costs and perform efficiently. So there may be a point in the population growth cycle where this impediment causes the region to lose its competitiveness to other locations outside Sydney.

**Buses:** One of the modes of public transport that is widely used throughout Sydney is public buses. These travel from outer suburbs to the city and criss-cross the inner suburbs so are a preferred mode in many areas because they are flexible in their routes and timetables. Their use will continue to be preferred by many to the private vehicle in inner areas because of their relative efficiency in moving people at peak hours, and especially where the RTA is able to provide preferred lane access. (One anecdote received was that more people are carried across the Harbour Bridge in the bus lane than in all of the other lanes combined)

Buses are not, however, without environmental problems. For reasons which are not understood, the NSW Government has chosen to move away from the gas powered units becoming popular in other cities because of their cleaner emissions profile, and to persist with the use of a diesel-engine fleet. The management of their exhaust emissions has not always been exemplary, so that buses under heavy load may release black smoke that aggravates local air-shed quality at stressed periods.

Other parts of this report offer support for bus use – such as the suggestion for a new high speed service from Lane Cove below, since the future environmental performance of diesel engines will improve considerably in 2006 when the new fuel standards will apply. Nevertheless, further effort should be made to improve the logistics of their movements because it is foreseeable that they will create a severe form of congestion on their own as the city grows.

The City of Sydney Council has recently expressed its concerns about the backing-up of buses through the city at peak times to the extent that there are spots where they form a continuous line that covers multiple blocks. A similar pattern is witnessed on the Harbour Bridge in morning peak hours as the units heading into the city from a various northern suburbs, queue to enter near Wynyard. Not all of these are loaded with passengers to their capacity, and some at the fringe of the peak morning period have quite a few seats empty.

Hence, if the bus network in the northern region is make a major contribution to improving the traffic congestion that is developing north of the Harbour Bridge, new strategies must be found. These could include an increased commitment to bus / rail links (such as is being developed at Chatswood); an investigation of possible sites where buses from outlying areas can consolidate their passenger loads into a lesser number of units that are dedicated to travel into the city; and greater incorporation of car-parks near bus access points in the outer suburbs so that car commuters can use public transport for the last segment of their trip.

These suggestions are neither new nor creative, but are repeated because there appears to be an inertia in the reforming the efficiency of this vital public transport mode. Approaches similar to those been used successfully in Europe for decades, and are also implemented in different ways in most other Australian capital cities. We therefore consider that because the traffic congestion risk for the NSROC region is highly probably and likely to be very severe, NSROC should develop a comprehensive position on the need to reform the use of buses through its area, and argue for this strongly to be incorporated in the transport planning for the *Metro Strategy*.

**Ferries:** The final issue examined, albeit in passing, relates to the relatively low number of passengers carried between the NSROC region and the city by ferry.

On the face of it, there seems to be considerable potential for an integrated transport system to take greater advantage of the fact that Sydney is built around an extensive waterways system. From an environmental perspective, ferries have the potential to create problems for the integrity of the riparian zone of a river or other sensitive waterbody, and the risk increases with the speed of the craft. But this is not new, so should be manageable with modern craft designs and management arrangements. Logically, therefore, the ferry system is perfectly positioned to participate very effectively in an integrated transport program, and to serve the needs of the NSROC region well.

The question was not explored further in this review because the relationship between the State Government and the NSROC members appears to be a somewhat complex at present. The arrangement applying to the ownership of the shoreline assets used by the ferries appears to be a matter of contention, with the main question being about exactly which assets are owned by whom.

Concerns were expressed that some of the key public assets accessed by commuters have deteriorated and are in need of early and extensive repair. If so, this is an issue that must be resolved immediately. Until then, it seems fruitless to contemplate how this key part of the infrastructure could be taken advantage of and to assume a greater role in Sydney's transport network

### **3.2.3 Discussion**

1. The trend for the northern regions of Sydney is for the volume of traffic to unavoidably grow to unmanageable levels, or at least in the absence of a major paradigm-shift in the land-use planning or transport management thinking. The *Metro Strategy* is expected to release a statement on sustainable transport planning later in 2005, so it will be interesting to note which interventions are recommended that include benefits for the NSROC region.

2. Much of the congestion that currently occurs involves peak-period travel between home and work, and this is the most likely element to face gridlock the earliest. Many people are living further distances away from their place of employment, and increasingly in areas that are poorly serviced by efficient public transport. The pressure to use a private vehicle is irresistible in these circumstances and will continue to be so until suitable travel alternatives are offered.

But this, in turn, is creating a second pressure, and that is for new industrial or commercial workplaces to be provided with an increasing number of car spaces for the key workers of the firms who own or lease them. If this circular nexus is to be broken at some point, then perhaps both the Minister for Planning and NSROC member Councils may need to consider if their assessment of Development Applications for new projects should include negotiations for car parks to be restricted in favour of alternatives (perhaps such as providing company buses to the nearest rail station).

3. Certain initiatives are either work-in-progress or on the design table to reduce traffic pressure in the NSROC region. The first is the construction of the Epping to Chatswood rail line that will have two tracks and a 12 km underground tunnel, and which is expected to be operational by mid 2008. The second is the construction of the Lane Cove Tunnel that will address the traffic blockage between the M2 tollway and the Gore Hill Freeway; and the third is the announcement on 9 June 2005 that the Government will build an underground city rail line and a tunnel under Sydney Harbour to St Leonard's, as well as a north-west rail line to Rouse Hill, both by 2017. The extent to which these projects will help stave-off extreme traffic congestion throughout the remains to be seen.
4. There is an immediate need for an evaluation to be conducted to establish if light rail could play a role as an alternative form of transport, either for travel within the region or across the Bridge into the city. One determinant will be if there are likely to be sufficient commuters to make a service commercially viable, but consideration should also be given to seeking funding from the State as a Community Service Obligation, and especially if there is a need to underpin a project if it is likely to require an establishment period before passenger growth makes the line self-funding. Considerable attention has been paid to this mode by the City of Sydney Council, so their arguments should be reviewed to establish if there is scope for the two sides of the Harbour to work together in presenting a joint case to the NSW Government.
5. All possible opportunities should be taken to extend the scope and use of bicycle paths to retail and commercial centres, because a very large number of the passenger vehicle trips that are unrelated to employment, cover relatively short distances. To date, bicycle paths have not proliferated in built-up areas as much as would have been hoped, not only because of the difficulty in obtaining the dedicated easements



required, but also because of safety concerns that could result in a legal liability for the Council as their owner. The trend is also not helped by the hilly terrain often found throughout the region

The developers of recent major road projects such as the M7 and M5 freeways were required to consider the inclusion of substantial cycle paths in their design, but it is interesting to note the concerns of the North Sydney Council about the designs of the Falcon St ramps at the Warringah Freeway that are to be associated with the Lane Cove Tunnel. These are apparently noteworthy in their lack of regard for the needs of pedestrians and bicyclists, so much still needs to be done to ensure that these facilities are an automatic inclusion in future transport projects.

6. If the traffic difficulties are as acute as predicted, it may eventually be appropriate for consideration to be given to congestion pricing (or demand management tolling). The objective of this should be to increase the person-to-vehicle ratio in peak hours by encouraging traffic to spread more evenly through the day. Of course considerable research will be needed to establish how this could be applied properly, but the technique has been used successfully elsewhere in the world.

#### **3.2.4 Conclusions and recommendations**

1. The NSROC region is facing extreme traffic pressures over the next 30 years, and gridlock at many pressure points well before this time. This represents the single most important environmental impact in the region of a substantial population growth, and in the absence of a comprehensive sustainable transport strategy, will seriously impede the goal of increasing the population within the NSROC borders.
2. The *Metro Strategy* should therefore include a description of how the various forms of transport through the NSROC region are to be integrated to allow the greatest volume of people to be moved as quickly as possible using the lowest number of conveyances. This should include for example, providing facilities at rail stations that have car-parking and bus access, single tickets to cover the costs of all three, and bus and train timetables that truly link.
3. The *Metro Strategy* should also facilitate the competitiveness of buses as a major form of public transport, but to do so in a manner that is sustainable against even the strictest of the environmental criteria that are likely to apply in foreseeable future. Their operations are already well established in the region, and especially for conveying passengers into and across the city. It should therefore be a priority to identify opportunities to integrate their services with trains or high speed ferries.
4. Similarly, the *Metro Strategy* should provide funding for a study to identify the circumstances in which light rail could be used to augment the movement of people

within NSROC or across the Bridge to the city. This could prove to be a valuable component of an integrated transport system, and especially between Chatswood, Lane Cove and North Sydney.

5. Opportunities should be taken to extend the scope and use of bicycle paths to retail and commercial centres or public transport nodes, to encourage the use of bicycles for journeys that cover relatively short distances. This would not only provide substantial social benefits, but could assist with the removal of some private cars from peak hour traffic.

### **3.3 ECONOMIC INFRASTRUCTURE SERVICES**

The preceding discussion of the potential transport impacts on the environment and amenity of the NSROC region has a parallel with the provision of other key forms of infrastructure, and in particular the provision of drinking water and electricity. That is, it seems logical to assume that there will come a point when the population of the Sydney Basin will exceed the capacity of the installed infrastructure to meet its expected needs for the services that are provided.

When exactly this point occurs is moot. It is reasonable to expect that the city will have the capacity to respond to threats to the delivery of key services well before they reach a critical stage, and hopefully policy interventions would be made well in advance of this point to prevent a need for crisis management. Experience shows however, that the environmental impacts of a creeping population increase may not be expressed as acute incidents, but more as a "death by a thousand cuts" Early policy interventions may therefore require painful trade-offs to be made by the community well before it is conscious of the severity of the future threats, and this can retard timely action

In this context, the term "economic infrastructure" refers to physical facilities such as roads, rail, reticulated water, sewerage, telecommunications, electricity and gas distribution. "Social infrastructure" is used to refer to housing, educational, recreational and law and order facilities that support the community's need for social interaction, but these elements are not considered in this report.

The study also assumes that the demand for these services by consumers is always reasonable, and is set at those levels that are necessary for a sustainable living or production. There can be no expectation of a right by individuals to irresponsible consumption of natural resources, or a reckless and wasteful use by business. This will become an important concept later when we discuss policy instruments for encouraging demand management, since there is an expectation that all consumers will recognise the imperative to participate voluntarily in measures to conserve resources, and not rely on punitive regulation to achieve the desired end-points.

### **3.3.1 DRINKING WATER SUPPLIES and POTABLE WATER SUBSTITUTION**

#### **3.3.1.1 Background**

There are many reasons a city can go short on drinking water, other than the obvious that the rains cease to fall where the water is collected for the reticulation system. There are also various interpretations of what is considered to be capable planning for a growing city that needs to finely balance the long term demand for water with its expected availability. The debate becomes even more complex when the catchment managers also attempt to balance the needs of humans with those of the ecology of the catchment, since this can be a significant factor when assessing if additional drinking water storage systems should be constructed.

During the preparation of this report, Sydney was placed under the severest level of water restriction ever (described as 'Stage 3' by the Government), and a warning was issued that yet further constraints may be applied if dam levels do not improve. Both the Government and residents of Sydney are conscious of the fact that the dam levels at Goulburn, another town in the Sydney's drinking water catchment, had at one stage dwindled to 10%, so the imposition of the new restrictions was received as a 'matter of fact' occurrence.

It is also possible that Sydney's growing population will create unsustainable demands for drinking water supplies if current consumption patterns continue unabated, and of low rainfall patterns in the catchment persist into the future. More so, even if the supply of water becomes unavoidably and severely constrained, even a substantial reduction in consumption by both existing and future residents and business may not be sufficient to guarantee supply reliability.

Not surprisingly, the future reliability of drinking water supplies throughout the Sydney region has gained a prominent status in the development of the *Metro Strategy*. A specific plan was released last year that highlighted the major intentions of the Government, and a relevant extract is as follows:

#### **Sydney Metro Strategy Metropolitan Water Plan (DIPNR September 2004)**

The Metropolitan Water Plan is the NSW Government's strategy to ensure that Sydney has enough water for consumption and environmental purposes over the next 25 years. While the plan indicates that the Government will still play a central role in achieving additional supplies and savings of water, one of its key elements (or aims) is to encourage the private sector to find innovative solutions.

Specific actions under the plan include:

- modifying dams to allow extraction of previously inaccessible deep water
- increasing transfers of surplus water from the Shoalhaven to Sydney
- developing a contingency plan for building a desalination plant for Sydney
- planning the construction and operation of a western Sydney recycling initiative, to supply recycled water to 'growth centres'

- establishing a new \$30 million demand management fund for cost effective water conservation projects
- requiring Government agencies, local councils and the largest water-using businesses to develop and implement water conservation plans and water efficiency measures
- taking measures to reduce leakage in Sydney Water's system, including Operating Licence conditions
- implementing a water labelling and standards scheme for appliances and fixtures
- developing a new water education plan for NSW
- extending the subsidy for the installation of water efficient showers and other fittings in households
- continuing to subsidise installation of rainwater tanks in existing homes, until July 2008
- requiring dwellings in Sydney to be water efficient at the point of sale, from 1 July 2007
- constructing improved outlet works at dams to facilitate environmental flow releases

So, even though there will be a clear push to reduce the demand for potable water, other initiatives may be needed as well. One of these is the evolving agenda for recycling all forms of water, including stormwater, grey-water (from showers and laundries etc) and water mined from sewer systems. Each offers advantages and disadvantages, and is discussed below.

The NSW DEC has expressed its concern about the fact that the only credible stormwater recycling being conducted in Sydney is at the site of the 2000 Olympic Games at Homebush. They considered that valuable opportunities were being lost throughout the city where it was possible to re-use stormwater in the immediate vicinity of its collection site (such as on sports playing grounds etc) where the costs of pumping are minimised. This notion has gained increased credibility in the past 12 months, because suitable rains have fallen at some periods on Sydney's coastal strip even though they have been absent in the drinking water catchment. Improvements in recycling are also expected from the recent change to the Local Government legislation permitting the installation of rainwater collection tanks of up to 10,000 litres in private residences.

The level of interest in grey-water re-use is less clear. Whilst there is a push in favour of increasing residential re-use, some horticulturalists have warned about the detrimental effects of trace metal contaminants on gardens, and health authorities have warned about the possibility of exposure to elevated pathogenic bacterial counts. It may therefore be that grey-water will not become a significant source of water with current management arrangements, and especially within more densely populated residential enclaves, until clear guidelines are widely available on how it can be used safely and the most productively. These are currently being developed for NSW.

The re-use of sewage effluent is also complex, but offers far more promise than the previous two because it can be produced to provide significant quantities of high quality water in the driest of conditions (compared with stormwater harvesting that offers water when it is needed less). Note that there is no suggestion that recycled water be made available for drinking – its use must be restricted to applications where it can safely be substituted for potable water.

Major coastal towns like Sydney discharge large volumes of effluent to the ocean since, even though wastewater recycling is becoming a progressively more important feature of the water-supply regimes in the inland dryer regions of Australia, it has yet to be implemented in heavily urbanized coastal centres.

There is therefore, in principle, an enormous potential source of water available for Sydney if water quality and public health issues can be reliably addressed. The National Water Quality Management *Guidelines for Sewerage Systems - Use of Reclaimed Water* (1999) advance this aim by documenting a risk-profiling framework that matches the level of treatment required to the different types of end-use in urban settings. For example, high quality recycled water can be safely applied to parklands and sports grounds out-of hours when human contact with the spray is improbable, and when it can soak in before the grounds are used for contact recreation.

Some advocates propose that the sewerage effluent be re-used as close as possible to its source, because this has the potential to reduce the peak sewage transport demands, and especially in wet weather. To do so would assist to address the concerns about the sewer overflows mentioned earlier, and could even offer capital investment savings by postponing the need for the transfer systems to be augmented as the population they service increases. The most probable approach is however, to utilise the sophisticated treatment technologies that are available at a sewage treatment plant and then return the treated water to high volume end-users through a dedicated pipeline. (The recycling system established in the north-western suburb of Rouse Hill is an advanced experiment that has now worked successfully for about a decade, but is likely to be very expensive if it were to be repeated in established areas).

It is difficult to predict what opportunities will be taken over the next 10-15 years to facilitate sewerage effluent re-use in Australia's major towns, but the *Metro Strategy* has included dual reticulation systems in its plans for the new growth centres. The treatment technologies will certainly improve and become less costly, and the drivers to use more reclaimed water for non-potable applications will become more pressing if we continue to be dominated by a highly constrained water supply.

In this context, it is worth commenting that at the time of preparation of this report, negotiations were occurring between a private company, 'Services Sydney', and Sydney Water over the possibility that the former may be able to mine water from the sewer mains and sell it to industrial clients. If so, this will be one of the first examples of a major third party access to this type of infrastructure in the capital cities, so will be watched very closely

### **3.3.1.2 Application to the NSROC region**

Clearly a key issue for the NSROC region is the capacity of the natural and built water infrastructure to provide a reliable supply of quality drinking water in the face of a substantial population growth. Three assumptions are relevant :

1. Whilst the use of lower quality water for non-potable uses in urban settings is highly encouraged, this review assumes that there can be no compromise over drinking water quality. As stated above, we do not entertain the option of recycling wastewater into the potable water system with the prevailing management systems, nor in the face of a somewhat cautious community attitude towards the practice.
2. There is limited useful information on the price-elasticity-of-demand for drinking water for consumers in the NSROC region, nor therefore on how increases in the price of water would influence consumption patterns. Some people may be genuinely disadvantaged by a price hike and respond accordingly, whereas others would accept paying multiple times the prevailing price. As well, the responses of each group may change over time with their personal circumstances or perception of their wealth status. We therefore do not know the long term equilibrium price for drinking water that would be assured of balancing the demand at any point in time within the region, with the availability of water at that point (even though there may be predictable short-term reactions and behavioural changes).
3. Decisions over how to supply and manage drinking water to a large city are essentially political ones in the end, because difficult trade-offs are inevitable. Whilst legitimate decision-making structures can be put in place to plan for and deliver the commodity, enormous pressures can be applied to Government to influence the outcome. This needs to be recognised in any strategic planning agenda.

The current rates of average annual water consumption per property vary between different NSROC areas. Some such as North Sydney have been consistently below Sydney average consumption in recent years, while other such as Hunters Hill have been significantly above average.

All Councils have initiated programs to reduce their own water consumption and to educate and assist the community in water conservation measures. Significant improvements in water consumption have been achieved coinciding with these measures and the introduction of water restrictions across Sydney. For example comparing January – March 2003 to the same period in 2004, Ku-ring-gai and Hornsby residents achieved water savings of over 40%, while Hunters Hill achieved 30%. In the first full year of water restrictions, Ku-ring-gai achieved the biggest fall of water usage (43%) of any Sydney local government area.

Some examples of the initiatives that NSROC members have adopted to promote water conservation include:

- Hornsby, North Sydney and Willoughby Councils are members of the ICLEI (International Council of Local Environmental Initiatives) Water Campaign to achieve

tangible targets in the sustainable use of fresh water. Ryde and Ku-ring-gai have joined Sydney Water's *Every Drop Counts* program.

- Hornsby has implemented water conservation measures in all its building and parks to achieve 20% water savings per year and has installed a stormwater reuse system at its nursery at Pennant Hills.
- Ryde and Willoughby Councils have actively encouraged the installation of rainwater tanks by residents.
- Ku-ring-gai Council has received substantial funding to establish a stormwater harvesting facility at St Ives which should serve as a model for application in other parts of the region.

Notwithstanding this progress, the region will be unable to compete on efficiency grounds with the newer growth centres outlined in the *Metro Strategy*. All buildings and the underground water mains there will be new, so will enjoy the benefit of the BASIX designs that are targeting a reduction in the household use of water by 40% and less system loss from major leaks etc. Unfortunately the water delivery infrastructure in those parts of the NSROC region that will not experience urban renewal in the next 20-30 years will continue to deteriorate as it ages. The task of achieving substantial region-wide improvements will therefore need to be augmented by other initiatives.

One avenue for this could be to pursue substantial potable water substitution with high quality recycled water from the North Head STP. The sewer system feeding this from the northern suburbs was recently augmented by the addition of the Northside Storage Tunnel that travels from Hunters Hill to Manly. At the time of its construction, there was a debate about whether or not a pipe could be fitted to the ceiling of the Tunnel to convey recycled water back from the STP to suitable location in the lower North Shore, but it is understood this was rejected on the basis of the cost/benefit calculations that applied at the time.

We suggest that it is now appropriate to revisit that proposal, not only applying the retail price of water likely to be approved by IPART for 2006, but also to take account of some of the more expensive alternatives that are being considered to augment Sydney's drinking water supply.

A second consideration for the region is to look more closely at the stormwater harvesting model developed by the North Sydney Council. They have published a comprehensive approach to recycling stormwater for application on a number of public spaces in their LGA. A strength of the model is that it capitalises on one natural feature of the region, and that is the proliferation of steep hills. The model suggests relatively inexpensive pumping is needed to be able to distribute the stormwater to a number of application sites through gravity feed. Costs are further reduced by the use of existing stormwater drainage channels as conduits. This could be considered alongside the initiative of the Kur-ing-gai Council mentioned above.

### **3.3.1.3 Discussion**

1. A significant population increase in the NSROC region will place a substantial burden on the ability to supply potable water to all consumers with a high level of service quality. The stress will come from the possibility that water will continue to be a scarce resource over the long-term, and also from the additional carrying load that will be placed on the ageing infrastructure feeding the older parts of the region. Neither will be assisted by the fact that the retrofitting of modern water saving devices to older homes can be a difficult or expensive exercise.
2. Water conservation in the NSROC region would be greatly assisted by bodies such as the Sydney Catchment Management Authority and Sydney Water periodically publishing papers that model the association between the prevailing water availability and consumption patterns within the area. The data should then be applied to predict, on five year rolling cycles, how different options for a population density increase in the region would need to be managed to ensure that the water supply and demand functions are balanced as closely as possible.

This document should be vital reading for all land-use planners and development proponents, and should be referenced in Development Applications proposing commercial or residential intensification. It should for example be incorporated into the NSW State of Environment Report that is produced every three years.

3. One advantage of this publication is that it would allow the city to progressively capitalise on the success of any water demand management initiatives (such as from the BASIX described below), since the dynamic modelling should in itself eventually allow for a performance benchmark to evolve. Both Sydney Water and the Sydney Catchment Authority should also be invited to comment on proposals for major population increases, to ensure that each Council has the most contemporary information available at the time of making its determination on a Development Application.
4. A review should be conducted of the opportunities available for capturing and recycling stormwater and sewage effluent and publish this for consideration by the NSW Government and the development industry. This should catalogue sites where the substitution of potable water would be sustainable against stringent environment and public health criteria, and cost effective taking into account the initial capital investment and on-going management costs. It should also build in a strategically designed community participation program to foster support where public spaces are to be involved.
5. NSROC should lobby DIPNR and Sydney Water to investigate the options available for retrofitting the Northside Storage Tunnel with a dedicated pipeline for transporting



high quality treated effluent back from the North Head STP. If technically viable, an exercise should then be conducted to identify suitable locations for water storage facilities in the vicinity of the Tunnel, from where the water could be allocated most cost-effectively in the region for applications that are suitable for potable water substitution.

6. Similarly, NSROC should ensure that the *Metro Strategy* planners are aware if the stormwater harvesting model developed by the North Sydney Council, with a view to identifying similar circumstances in other parts of the region that may allow its ready application.
7. Urban intensification in any areas of the NSROC region that are unsewered should be prevented. An argument should be made to the *Metro Strategy* team for funds to reticulate of all unsewered sites that currently exist

### **3.3.2 ELECTRICITY SUPPLIES**

#### **3.3.2.1 Background**

Energy consumption patterns by stationary sources in all Australian capital cities have shown a marked increase over the past decade, and even over the past five years. This appears to exceed both the population growth in that period and the increase in commercial activity that has been associated with a buoyant economy. For Sydney, which receives very little natural gas supplies, this has been consumed largely as electricity and most of which comes from coal-fired power stations.

A dissection of current non-industrial energy consumption patterns, which is relevant to the strategic planning initiatives of NSROC because of the low industrial base there, shows that there has also been an increasing trend in the ratio of energy consumed per capita. This implies the emergence of changed behaviours underpinning the demand by individuals for energy, which has occurred at a time notwithstanding when consumers have supposedly been progressively sensitized to the possibility of living in a greenhouse-impacted world.

One feature of Sydney's consumption is the change that occurred in the late 1990s where the winter peak was for the first time overshadowed by a new summer peak. Previously, electric heating had driven the heaviest load demands across the city, but the newfound popularity of residential and commercial air-conditioners began to make an impact. In fact, summer loads became so great in the city centre, where the energy supply also needed to support very large computing installations that require tight temperature controls, that shutdowns were threatened by the end of 2004. The result was that a new 330 kv. line was fed through the city in 2003 at a cost of \$330m.

Considerable hope is being attached by many to the ability of the emerging renewable energy technologies to provide a significant fillip to the supply of energy to constrained areas facing high demand, and to Australia's efforts to reduce its greenhouse emissions. It is difficult to predict if, and when, quantum jumps are likely to occur in the technological and economic competitiveness of the various renewable energy sources under development in Australia, but there is every reason to be optimistic that niche products will become cost-effective for application in normal residential dwellings and offices.

For example, low heating and cooling requirements for both air conditioning and water heating can best be met from direct solar thermal applications, boosted by gas or electricity as needed. As water heating alone can make up 50 percent of electricity use in all-electric households, significant opportunities exist to reduce energy demands from this activity alone. Solar water heaters may be relatively expensive at present (ignoring rebates that are offered by Government), but they do provide a mechanism for helping the peak demand periods through the day to be shortened and the peak loads reduced. If so, it may even be possible to organise sufficient relief to postpone the need for the expensive infrastructure augmentations to cope with the expected population growth.

Although larger electricity generating installations are more likely to offer better economies of scale and more efficiency in the provision of secure and reliable electricity supply, there is increasing interest in fostering distributed energy generation systems and facilitating their "seamless" integration into the current electricity supply system. In principle, this should be supported wherever it can be shown to be cost-effective and environmentally acceptable, since an efficient network of renewable energy generators for example, can reduce load stresses in over-stretched localities. In time, solar and gas could work in tandem to meet the needs of small users, & where the installation produces surplus outputs, these could be sold onto the grid.

### **3.3.2.2            *Application to the NSROC region***

The picture above presents the obvious question about the future electricity demand and supply implications for those areas of the NSROC region that may experience a major increase in residential or commercial structures and especially at nodes where capacity constraints are already ominous. Concern was expressed by some Councils that, without substantial augmentation or changed consumption behaviours, the region could experience power failures at a number of locations, and well before the 30 year time frame of the review.

For example, comments were received that the Lower North Shore and the commercial centre of Lane Cove experienced shutdowns from network overloading in the 2004/05 summer, presumably from the limitations of the capacity of the relevant substations feeding these centres. The rural areas of the Hornsby Shire also experience service interruptions from time to time, to the extent that this Council has resolved to enter into formal negotiations with Energy Australia to have their supply augmented.

These concerns were discussed with Energy Australia who retails electricity to the entire NSROC region. They responded that they were aware of the likely future demands in the region, and acknowledged the need for the system to be upgraded over time to guarantee a high level of supply reliability. Their position appears to be supported by their published information that shows that they completed a new zone substation at Macquarie Park in 2002; have allocated \$15 million over five years to upgrade the 11kV network across the North Shore (and across to the Northern Beaches); will refurbish or replace the Crows Nest, Chatswood and Pymble substations between 2005 & 2007; and replace a number of ageing 33kv feeders by the same time.

There are other factors working to positively influence the future energy demand and supply balance in the NSROC region.

Firstly, the NSW Government introduced the requirement that all new dwellings after 1 July 2004 be designed to achieve a 25% reduction in their energy demand, and included a requirement that this be extended to all new unit developments after 1 July 2005. On the face of it, this should support a significant energy saving agenda across the Sydney basin, but its earlier effects will be more identifiable in the new growth centres of the north and south west than in existing developed areas such as NSROC. Nevertheless, it can be expected that the BASIX requirements will become a building performance benchmark and will be reflected in additions or refurbishment of existing structures over time.

Secondly, a \$10m. investment is being made by the NSW electricity industry and the NSW Government in an energy demand management strategy for Sydney that will be implemented over a five year period. This was a requirement on the industry as part of the Government's approval of the 330kv transmission line for the city mentioned earlier, and an industry-based Demand Management Code is now in practices. The section of the Conditions of Approval for the new line, which provides a good insight into the factors that can be considered, is included as **Appendix 1.**

And thirdly, there are various initiatives underway by the NSROC members to reduce energy demand across the region. These include community education programs and the application of energy conservation policies at sites managed by Council staff. Cumulatively, these initiatives have the potential to make a substantial savings in consumption over the long-term.

### **3.3.2.3 Discussion**

1. Whilst there is a legitimate expectation that each of these positive influences will apply in the NSROC area, there are limitations to the relative contribution they will be able to offer when compared with the alternative of a large green-field development such as with the proposed growth centres. For example

- ✚ Intensification of a residential area works against the aim of reducing energy demands when it is applied to the type of settlement that currently characterises the NSROC region, namely larger blocks highly vegetated areas. Developers either choose to remove existing vegetation prior to construction of a new dwelling or are unable to avoid it, especially in cases where the number of dwellings on a block increases. The impacts of this loss of vegetation-cover are discussed elsewhere in the report, but they include removal of a key source of shade and cooling for the property in question, and usually its neighbours as well
  - ✚ The smaller block sizes that will be an inevitable feature of a more densely populated area will reduce opportunities for their immediate surrounds to be revegetated, as well as reduce opportunities to position dwellings creatively within the available parcel of land to best mitigate the sun's heating effects. The increasing popularity of home air- conditioners is therefore likely to continue, and if recent trends persist, they will also be larger and more sophisticated.
2. Whilst there is very strong support for the introduction of the BASIX energy controls by the NSROC Councils, there is as of yet no clear picture on how effectively or comprehensively the requirements will be enforced before an occupation certificate is granted. This is more than a resource question for Councils, and there is a certain level of subjectivity involved in determining if a particular construct satisfies the standards that are set.

For instance, it is possible to accumulate the minimum number of points required to gain approval by incorporating higher rated whitegoods in the building than making significant environmental improvements to its functional design. Whitegoods are seen to have a more transient role in the residence, while the basic building design could last for 30-40 years.

Very significant opportunities exist to improve the energy efficiency of new commercial and residential buildings and the refurbishment of existing buildings. Aspects such as thermal mass, orientation and fenestration, as well as standards for lighting, heating, cooling and ventilation can all be optimised to reduce energy demand. We therefore concluded that whilst the BASIX scheme is to be commended in principle, it is merely a start in the right direction. The aim should be to strengthen the system as rapidly as the market will accept to ensure that there is a concrete foundation that will be highly effective in ensuring energy-sensitive designs prevail.

Importantly though, BASIX should not be regarded as a surrogate for other macro-scale energy management initiatives that will be needed to reduce the *per capita* consumption of energy and water in all buildings in the NSROC region, be they old or new, or single or multi-occupancy.

### 3.4 AIR QUALITY

#### 3.4.1 Background

Community attitude surveys on environmental issues in urban areas of Australia repeatedly demonstrate the high value that is placed on access to clean air. This reflects concerns about the public health implications of poor quality air and the loss of amenity it creates.

Their concerns are well founded. Extensive evidence shows that increased ozone or sulphur dioxide levels can cause respiratory distress in sensitive individuals. The World Health Organisation has recently drawn attention to the potential carcinogenic effects of elevated ambient benzene levels, so there is a *prima facie* case against the variety of other volatile organic carbon chemicals that often found in differing concentrations in urban air sheds, and especially in heavy industrialized regions, until they are confirmed as benign.

More obvious are the circumstances where the air shed is contaminated by particles, and communities report discomfort when they are exposed to smoke haze from events such as bushfires or back-burning. But comparatively little publicity is given to the growing evidence showing that the very small and less visible air particles (less than 10 microns and of late, less than 2.5 microns) can be associated with respiratory conditions of clinical concern. In Australian cities, these are more likely to come from vehicle exhausts than any other single category of activity after bush-fires .

Diesel particles also adsorb unburnt hydrocarbons and other potentially carcinogenic organic compounds such as polycyclic aromatic hydrocarbons. It is not surprising therefore that new Federal legislation is to come into effect in January 2006 that significantly reduces the emissions of these particles from the major offenders, diesel powered vehicles.

#### Contribution (%) of motor vehicles to air emissions in major Australian cities

Carbon monoxide (CO)	Hydrocarbons (HC)	Oxides of nitrogen (NO <sub>x</sub> )	Particulates ( < 10microns)
70-95%	40-50%	70-80%	10-50%

[REF]

Concerns about photochemical smog stem from the fact that exposure to elevated concentrations of ozone for up to several hours can cause respiratory irritation and changes in lung function, particularly for those suffering a respiratory illness. Ozone is a secondary pollutant formed by the reaction of oxides of nitrogen (NO<sub>x</sub>) and volatile organic compounds (VOCs) in warm sunny conditions, and the aerosols that accompany it produce the haze that characterizes photochemical smog. Again, motor vehicles are significant sources of the precursor pollutants, and in the Sydney region are responsible for about 79% of NO<sub>x</sub> and 44%

of anthropogenic VOCs. There is therefore a valid question surrounding the potential for a return to the smog of previous decades if appropriate measures are not forthcoming to prevent severe traffic congestion.

Recent studies have investigated the potential link between urban air pollution and the very clear increase that has occurred in the numbers of juvenile and adult asthma cases both in Australia and other developed countries. Nevertheless the role of exogenous environmental sources as a cause of asthma remains unclear, especially in the presence of other primary causes. For example, other work has examined endogenous influences such as the immunogenetic make-up of asthma patients, or the contribution from features of the living environment inside the residence. It is hoped that in time, clarification will be provided of the relative roles of the human and environmental variables, so the issue has not be considered in this study. It is complex and is more appropriately considered within a professionally prepared public health review.

#### **3.4.2 Application to the NSROC region**

NSROC has a strong interest in ensuring that a significant population increase in its region does not lead to deterioration in the air quality overall, or at locations that may have a higher risk of poorer air because of contributing natural features. Its major difficulty is, however, that its Councils have very limited influence over problems of this type because, when they do occur, they are rarely limited to a single part of Sydney. Episodes where the air quality is poor are more likely to be experienced across a wide area of Sydney, so there are very few steps that even groups of Councils can take collectively to address the cause.

There are of course exceptions. If for example, a Local Council were to be the regulator of a single point industrial source of a toxic air pollutant causing localized impacts, it has statutory mechanisms available to prevent further occurrences. This type of problem does not feature prominently in the NSROC area, not the least because of the relatively small industrial base that operates within it.

In fact, the region appears to enjoy a high level of amenity relating to air quality. Monitoring is conducted by the DEC across Sydney on an ongoing basis, and a station located at Lindfield samples the air quality of the NSROC area in mornings and afternoons. Inspection of the data collected for the Lindfield station of for the 2003-2004 year shows that of roughly 3300 readings, only 95 exceeded a Regional Pollution Index of 50, which is the trigger point at which the pollution reading is regarded as "high". Furthermore, only 25 of these exceeded a reading of 60. A similar high quality was reported for the Rozelle site which may better reflect the air prevailing in parts of the Ryde LGA.

This data does not imply that every single resident of the NSROC area is totally free from high levels of air-borne contaminants, since there may be micro-meteorological circumstances that make certain locations perform more poorly than the reference site. An example is a resident

along an arterial road that is continually carrying a high traffic load. There appears, however, to be little further data available to investigate this, but one comment received suggested that the Lindfield monitoring station may be a little too high to reflect the worst case circumstances that occur in the region.

Nevertheless, there were anecdotal comments that some zones in the region experience photochemical smog from time to time. Without structured supporting data, this is difficult to examine, but it is noted that there were exceedances of the 4-hour standard for ozone on 21 days in 2001 on a Sydney-wide basis. This needs to be considered in the light of the discussion in Section 3.2 that suggested the NSROC region could eventually face severe traffic congestion, so this environmental variable could deteriorate in this region over time.

It is interesting to note the views of the NSW Auditor General in this respect in his review of the management of air quality released April 2005 ie

"NSW has made significant progress in controlling certain air pollutants since the release of Action for Air and Action for Transport. NSW has met four of the key national goals for air quality ahead of target. It is not likely, however, to meet the other two in the short term. They are the ozone and particles goals. Both are important, but the ozone goal is the bigger challenge for NSW.

Vehicles and fuels are increasingly more efficient and cleaner but this will not be enough to meet the ozone goal without reducing private car use. The Government is not succeeding in encouraging people to reduce their reliance on cars and promoting greater use of public transport. Private car use in NSW is growing faster than population.

We also noted during our discussions with the Councils that some were concerned about the air quality implications of the Lane Cove Tunnel that is currently under construction. A strong lobby is in process to have the ventilation stack proposed for the Tunnel to be filtered, since there are concerns that there will be local public health implications if this step is not taken. However, no aspect of this debate was examined in this analysis.

### **3.4.3 Discussion**

1. The structured and broad scale air quality monitoring that is conducted of the air quality in the NSROC region does not identify public health or environmental problems, and generally shows a reasonable picture on most days of the years. Obvious exceptions are when bushfires or back-burning activities provide high levels of particulates across the region, but these are usually short-lived.
2. The current monitoring program is not designed to provide site-specific nor real-time data, so anecdotal reports of photochemical smog are difficult to analyse. However, because smog derives largely from motor vehicles, and because traffic congestion is an issue throughout the region, it is impossible to reject the concern that the ill-effects of smog (or other elevated contaminant levels, are now being experienced on some

days throughout the year.

3. It is possible that the photochemical smog problem in the region, irrespective of how prominent it is or isn't at present, will feature in the future. Even though it is expected that there will be progressive improvements in the management of vehicle emissions over time, the predictions of increased traffic congestion in the region may outweigh the gains achieved in engine technology and fuel quality.

### **3.5 GREENHOUSE GAS ISSUES**

Even though Australia is not a signatory to the Kyoto Treaty on greenhouse gases, there is widespread acceptance in this country of the threats posed by climate change globally, and to Australia in particular. For many, the effects are more than a generation away, so are of a lower priority and not worthy of the economic pain that would be associated with the policy shift that would be needed to make substantial gains. Others are very aware of the inter-generational equity issues that are raised by our current energy consumption patterns and argue for immediate action. And there is a yet a third group of observers whose risk-profiling leads them to conclude that significant adverse effects will start to be experienced well within the next decade.

Notwithstanding this polarisation of views, many organisations in Australia are participating in programs to reduce their emissions of contributing gases, and we found that the member Councils within NSROC generally placed a high priority on this issue within their overall concerns about the future environment of the region. They were also concerned that further urbanisation strategies would challenge their existing initiatives for reducing its emissions profile.

The weight of recent published evidence is that fossil fuels will continue to dominate as the source of our energy past 2020, and these will be largely coal-based. Energy-production efficiencies are expected from the extensive research underway in clean coal technologies occurring in the US and Australia, and this should produce greenhouse benefits. But the growth of energy consumption patterns in areas such as NSROC is nevertheless likely to be inextricably linked to additional carbon dioxide generation somewhere in the energy production or transmission chain.

As part of our review, we attempted to identify greenhouse – related factors that could be influenced by an increased urban density. We assumed that each local area of Australia would respond differently since each would be starting from a different baseline. For example, a region characterised by the presence of heavy manufacturing or coal mining would logically improve its greenhouse-gas-accounting position if these activities were to cease and be replaced by a new clean-and-green urban community. In this case, the density of the urbanisation is irrelevant – even wall-to-wall dwellings would improve the profile.



It is clear however, that there could be no such comfort for the NSROC region, and that any population increase must on balance attract a deteriorating greenhouse response. There are two main reasons for this.

Firstly, the region is currently fortunate in that it has a substantial area of public and private land that is generously covered with shade-giving vegetation. When placed near a low level residence such as a single story house, which is also prominent in the existing building mix, this vegetation provides a strong opportunity to capture natural cooling effects for the building during summer. In principle, there should be a reduced demand for air-conditioners to keep the home habitable (although in practice there is no evidence that air-conditioning sales to the NSOC region in the past 3-5 years have lagged those in other areas of Sydney).

If the NSROC region is to intensify its dwelling stock, then it is clear that this will come from back-filling existing urban areas, and probably with many more structures which are higher than the single-level structures that are currently prominent. This will have three possible effects as follows ie

1. the shade-trees and shrubs will be removed so that any buildings nearby will experience a more intense sun exposure
2. the smaller the portion of land allocated to each building, the lesser the opportunity there is to orient each on the block to mitigate the heating effects of the sun, and
3. the higher the structure, the greater the direct exposure of at least some of its walls to the sun.

Collectively, these describe a strong market force for buildings to be sold with air-conditioning as a standard appliance, with significant adverse greenhouse implications.

The second feature of the region's future that is relevant is the deterioration in the greenhouse picture that will be caused by the traffic congestion that is predicted in our analysis. There is a compounding effect when fossil-fuel burning engines operate in heavy traffic ie

1. They spend longer at any given spot than they would if the traffic were flowing smoothly. Hence, if an engine emits a set number of grams of carbon dioxide *per minute* whilst travelling in the NSROC region, and its number of minutes in the NSROC region increases, it isn't difficult to extrapolate to the conclusion that the total mass of carbon dioxide released during the vehicle's passage through the region increases linearly.

2. It is an unfortunate feature of petrol and diesel engines that their efficiency decreases when they are travelling in stop-start circumstances. They therefore emit a higher carbon dioxide load *per km* in congested traffic, than they would in smooth flowing circumstances (and other chemicals from the tail-pipe that are also greenhouse negative). A simple reference to any sales literature for a new vehicle will see two drive cycles quoted against the relevant Australian Standard – and the city cycle is generally about 20% poorer than the country cycle.

In short, the move towards increased traffic congestion across the NSROC region will have a significant detrimental influence on the greenhouse gas profile for the region.

### **MITIGATION OPPORTUNITIES**

Because the greenhouse issue is currently the subject of intensive international debate, a number of measures are receiving attention that should offer the opportunity for highly urbanised areas such as NSROC to moderate the growth in their total greenhouse contributions. Some are locally focussed, while others such as the planting of large scale forests and perhaps eventually geosequestration, will have a wider application ie.

1. The introduction of the energy conservation opportunities proposed in schemes like BASIX should eventually show a positive impact. As discussed in the report, the timing of this support will be influenced by the proportional change in the residential dwellings that incorporate the improved performance features, and this may not be as fast in the NSROC region as it will be in new greenfield development areas. Nevertheless, it will still be positive.
2. There is strong reason to be optimistic about the potential for the various renewable energy sources that are currently in their technologically embryonic stages, to make a substantial contribution to urban greenhouse gas reduction. Japan and Germany for instance are investing heavily in solar-cell technologies, which if successful, should be of great interest to solar-intensive countries such as Australia. In addition, if the developments include items that are effective in dwellings and offices, their cumulative daily contribution could serve to reduce peak load electricity demands to a region like NSROC. This, in turn, could prolong the need for additional fossil-fuel dependent systems to meet the population growth consumption patterns.
3. Similarly, the macro-utilisation of renewable sources such as wind farms, large scale waste-to-energy landfills, gas powered generators and co-generation power stations, offer compensating opportunities. Again, it is not inappropriate to be optimistic that these will become progressively more cost-competitive within the 30 year time frame of the Metro Strategy, or that their eventual contribution to the greenhouse mitigation efforts already underway in the NSROC region will be substantial.



## **3.6 BUSHLAND AND BIODIVERSITY**

### **3.6.1 Background**

Sydney is privileged to be surrounded by national parks such as the extensive Ku-ring-gai and Murrumbidgee National Parks to the north, and to include important areas of native bushland within its borders. Native bushland is highly valued by the community for its cultural, recreational and aesthetic values. It contributes to air and water quality and provides unique habitats which are essential for the preservation of native flora and fauna species. The conservation of bushland is critical to the protection of biodiversity - the variety of different plants, animals and micro-organisms, their genes and the ecosystems of which they are a part. Bushland's economic value includes its significant contribution to tourism.

Urban development has impacted severely on bushland areas and on biodiversity in the Sydney metropolitan area with only around 12% of the original bushland remaining. The Metro Strategy has recognized biodiversity conservation as one of the key environmental challenges to be faced in planning for continued urban growth to provide for Sydney's expanding population

The *Threatened Species Conservation Act 1995* protects all threatened plants and animals native to NSW (with the exception of fish and marine plants). It recognizes clearing of native vegetation as a major factor contributing to loss of biological diversity. The Scientific Committee established by the Act identifies the following impacts of clearing native vegetation on biodiversity:

- Fragmentation of areas of native vegetation separating contiguous areas of habitat and reducing gene flow between populations.
- Deterioration of water quality, sedimentation and reduction in aquatic biodiversity following clearing of riparian native vegetation.
- Increased greenhouse gas emissions
- Establishment and spread of weeds and other exotic species
- Loss of habitat for native fauna
- Loss or disruption of ecological function as complex communities are disturbed and local populations may become extinct.

(Ref: *Clearing of native vegetation – key threatening process declaration, NSW Scientific Committee – final determination.* [www.nationalparks.nsw.gov.au](http://www.nationalparks.nsw.gov.au) )

Local government plays an important role in protecting bushland and biodiversity in their region through the development of biodiversity strategies and plans, developing and implementing land use planning instruments, and actively managing bushland and biodiversity through specific projects.

They have responsibility under the *Threatened Species Conservation Act 1995* and the *Environmental Planning and Assessment Act 1979* for conserving and protecting threatened species, populations and ecological communities of flora, fauna and their respective habitats.

Development applications that occur on land containing bushland or adjacent to bushland are assessed for their impact on bushland, fauna habitats and threatened species, populations, endangered ecological communities or their habitats. Councils must comply with planning legislation and policies in making these assessments. These include the *Environmental Planning and Assessment Act 1979*; the *Threatened Species Conservation Act 1995*; and State Environmental Planning Policies (SEPP) such as SEPP No. 19 - Urban Bushland; SEPP No. 44 - Koala Habitat; and Sydney Regional Environmental Plan No. 20 - Hawkesbury-Nepean River (1996). Relevant provisions in Local Environmental Plans and Development Control Plans are also observed.

### **3.6.2 Application to the NSROC region**

Some of the largest tracts of bushland in the Sydney metropolitan area are located in the NSROC region. The condition and management of bushland is of particular importance to the residents in these areas and the amenity provided by bushland is one of the reasons they choose to live and work there. For example, a survey of Hornsby residents in 2002 ranked the importance of the protection of natural bushland at the top of a list of 24 issues.

Bushcare groups across the NSROC region involve the community in restoring degraded bushland in their local neighbourhoods. Over 1400 Bushcarers are working in Hornsby and Ku-ring-gai areas alone to restore degraded bushland environments in their local neighbourhoods and to promote community awareness.

NSROC Councils undertake active management of the bushland including fieldwork in bushland regeneration; native re-generation; noxious weed control; noxious weed inspections on private lands; bushland track construction and maintenance; and feral animal control.

### **The extent of bushland in NSROC**

The geographically largest member of NSROC, Hornsby, is known as the Bushland Shire because of its extensive bushland areas and scenic amenity. Bushland areas cover more than 65% of the Shire with approximately 5,750 hectares managed by Council. This includes the 4,000 hectare Berowra Valley Regional Park that is jointly managed by Hornsby Council and the National Parks and Wildlife Service.

Ku-ring-gai has over 100 bushland reserves making up 1,100 hectares of bushland. Ku-ring-gai also adjoins three national parks (Garigal, Lane Cove and Ku-ring-gai Chase). Most bushland reserves are isolated small pockets of bushland of less than 1 ha with the majority of

bushland held within 10-12 larger reserve areas. The major bushland reserves are continuous with adjoining National Parks and form valuable wildlife corridors.

There are approximately 290 ha of native bushland in Willoughby of which 83 ha is national park. Native bushland cover 12% of this local government area. Willoughby Council and the community together manage 75% of all bushland.

In Ryde, there are 146 ha of remnant vegetation along riparian corridors that link with the Lane Cove National Park and the foreshores of Parramatta River. Approximately 140 ha is under Council's jurisdiction. There is also Wallumatta Nature Reserve, a portion of Lane Cove National Park and the Saltwater Estuarine Complex and Freshwater Wetland Complex totalling 350ha.

In Lane Cove, 90% of bushland has been cleared since European settlement, leaving 90 ha on public land.

In North Sydney there are 47 ha of bushland located mostly on the foreshores of Middle Harbour and Port Jackson. This represents only 4.5% of original bushland cover.

Hunters Hill has 30 ha of remnant bushland on public land, mostly located along creeks and foreshore edges. Though small in area, these areas of bushland provide valuable link between Sydney Harbour and Lane Cove National Park.

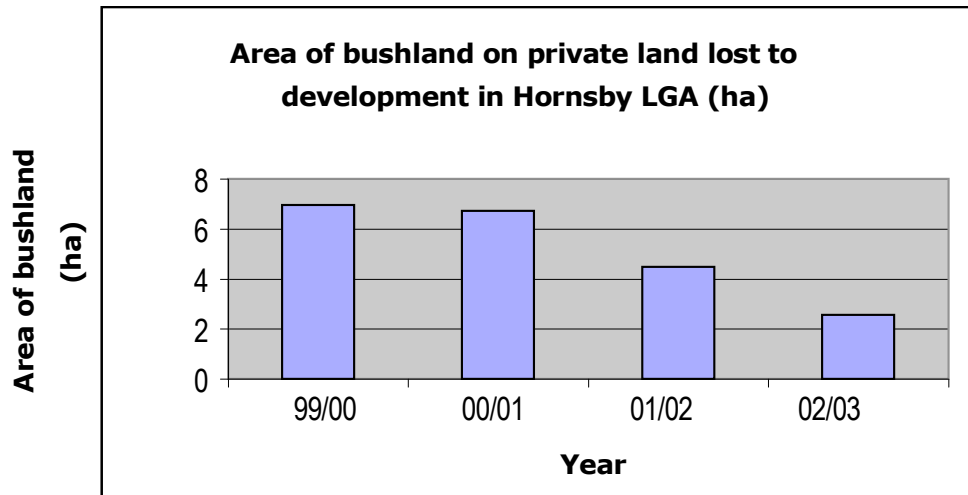
<b>Local government area</b>	<b>Bushland area on public land excluding national parks (ha)</b>
Hornsby	5,750
Kur-ring-gai	1,100
Willoughby	217
Ryde	140
Lane Cove	90
North Sydney	47
Hunters Hill	30

### **Threats to bushland and biodiversity**

The bushland areas of NSROC are home to a rich diversity of native plants and animals. For example, Hornsby Shire has over 1000 native plant species and 338 native vertebrate animal species and Ku-ring-gai has recorded over 800 native plant species, 170 fungi, 360 vertebrate animals, and more than 170 insect and invertebrate species.

However the survival of native plants and animals is under continuing threat from the destruction of their habitat, land degradation and feral animals. The greatest threat comes from the increased demand for urban development and the associated clearing of land.

Between 1999/00 and 2002/03 the area of bushland lost for residential development through development applications approved by Hornsby Council was approximately 21 hectares.



In addition to the direct impacts of land clearing and urban development, often more subtle degradation can be caused in neighbouring bushland areas. Some of the mechanisms mediating these indirect impacts are outlined below:

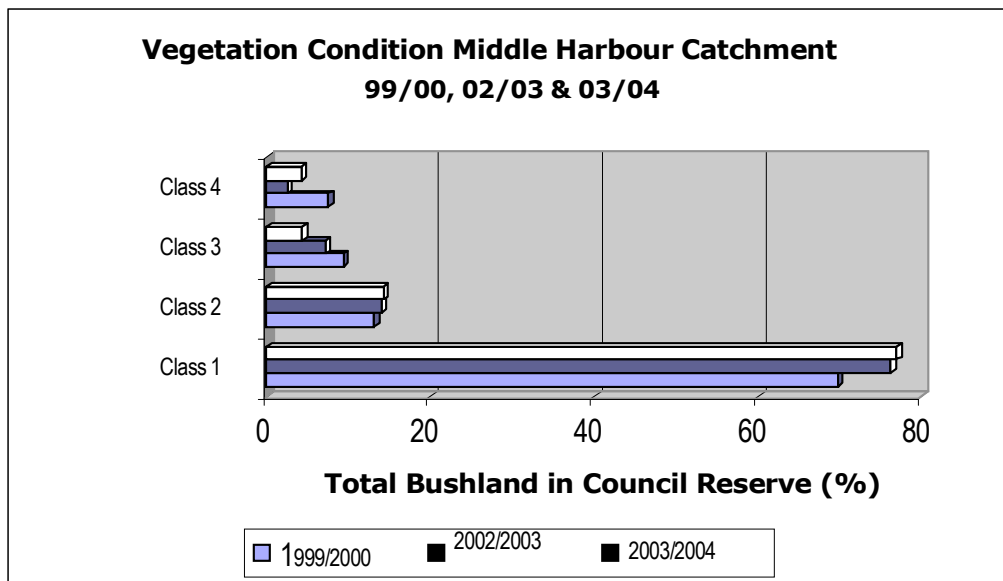
#### **Stormwater runoff**

Increased areas of impervious surfaces associated with urban development cause greater stormwater run-off into bushland. The stormwater carries weed seeds, nutrients and other pollutants picked up from gardens, and pavements along the way. The infestation of exotic plant species is a significant threat to the biodiversity of native vegetation particularly along creek lines, below stormwater outlets and in other nutrient rich and disturbed areas. Stormwater runoff also contributes to erosion of slopes and often ends up in creeks, waterways and estuaries causing sediment build-up and reduced water quality. Middle Harbour, Lane Cove River and Cowan Creek, for example, are all subject to urban run-off.

#### **Introduced species**

Introduced species can displace native species, reduce biodiversity and contribute to land degradation. Weed infestation is a major problem in bushland in the NSROC region. For example, in Hornsby there are 46 species on the noxious weed list including the common lantana, pampas grass, castor oil plant and blackberry along with aquatic plants alligator weed, water hyacinth and Salvinia. Weed invasion

threatens the Blue Gum High Forest and Sydney Turpentine Ironbark threatened plant communities in Ku-ring-gai.



**Bushland Vegetation Condition for Middle Harbour Catchment for 99/00, 02/03 and 03/04 (Information sourced from Council's GIS System).**

**Key:**

- Class 1 – Little or no weeds
- Class 2 – Moderate levels of weeds
- Class 3 – High levels of weeds
- Class 4 – Severely degraded by weeds

Introduced animals notably the fox, feral cat, rabbits and Myna birds take their toll on native animals. NSROC councils are members of the Sydney-north Regional Fox-baiting Program which undertakes a co-ordinated baiting program to reduce the threat of this introduced species to native fauna..

**Fragmentation of bushland**

Clearing of native vegetation often results in fragmentation of bushland that prevents the free movement of species between different areas isolating populations in small islands of remnant bushland. In-breeding weakens genetic variation and the potential to respond to environmental changes.

**Illegal dumping and removal of rocks, wood and plants**

Illegal dumping of rubbish and removal of rocks, wood and plants from bushland areas also destroy habitat and threaten native fauna and flora.

In Hornsby and Ku-ring-gai the sensitivity of land to clearing and urban development is exacerbated by the topography of the area. In Hornsby much of the urban development has



occurred in the upper reaches of the catchments and stormwater washes weed seeds and nutrients down into bushland areas.

Similarly in Ku-ring-gai development has occurred along a crest and run-off is a threat to nearby bushland particularly on the western side of the Pacific Highway. As the population increases so does the pressure for residential development to extend from the existing development on the ridges and hilltops to the more steeply sloping areas.

Loss of vegetation outside of bushland reserves is also a concern particularly loss of the tree canopy from private property. Tree preservation regulations are in place in all NSROC areas.

### **Threatened species**

Schedule 1 to the *Threatened Species Conservation Act 1995* lists the species, populations and ecological communities considered to be threatened in NSW. It also lists endangered ecological communities. Schedule 2 of the Act lists vulnerable species.

Some appreciation of the importance of native bushland in the NSROC region can be gained by considering the number of threatened and vulnerable flora and fauna species that have been identified in the region as summarised in the table below and listed in detail at Appendix 1. This table is based on National Parks and Wildlife's *Atlas of NSW Wildlife*. In addition to the confirmed species included in this table there have been unconfirmed sightings of additional threatened species. For example, a further 12 fauna species may be present in the Hornsby area based on unconfirmed records and/or suitable habitat. North Sydney Council has reported 69 species of threatened or vulnerable species of flora in that area while only six appear in the *Atlas of NSW Wildlife*.

There is also a wide range of species that are not listed as threatened but which are rare and have local significance in urban environments. For example the orchid *Genoplesium Baueri* which occurs in Hunters Hill is not listed under the *Threatened Species Conservation Act 1995* but is listed on ROTAAP (Rare or Threatened Australian Plant) list.

<b>Local government area</b>	<b>Number of threatened species</b>	<b>Number of vulnerable species</b>
Hornsby	20	44
Kur-ring-gai	11	27
Willoughby	3	8
Ryde	2	14
Lane Cove	7	10
North Sydney	2	4

Hunters Hill	0	5
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**Threatened and vulnerable species identified in NSROC local government areas.**  
(ref: *Atlas of NSW Wildlife, National Parks and Wildlife*,  
<http://wildlifeatlas.nationalparks.nsw.gov.au>)

In addition , the following Endangered Ecological Communities that are listed under Part 3 of the *Threatened Species Conservation Act 1995* have been identified in the NSROC region:

- Blue Gum High Forest
- Sydney Turpentine Ironbark Forest
- Shale/Sandstone Transition Forest
- Sydney Coastal River-flat Forest
- Sydney Coastal Estuary Swamp Forest Complex
- Duffys Forest Ecological Community
- Coastal saltmarsh

**Case study: Sydney Turpentine-Ironbark Forest**

Sydney Turpentine-Ironbark Forest is found on shale derived soils overlaying Hawkesbury sandstone within the Sydney Basin including Ryde, Hunters Hill, Ku-ring-gai and Hornsby. The pre-European extent of the Sydney Turpentine-Ironbark Forest is estimated at 13,000 hectares. The estimated current extent of the community is 29 hectares or less than 1% of its previous coverage.

Threats to its existence include clearing for agriculture and urban development, physical damage from recreational activities, rubbish dumping, grazing, mowing and weed invasion. In view of the small size of existing remnants and the factors threatening their existence the Scientific Community is of the opinion that Sydney Turpentine Ironbark Forest will become extinct in the Sydney Basin unless the pressures they face cease.

A nomination for the inclusion of the Sydney Turpentine-Ironbark Forest under the *Environment Protection and Biodiversity Conservation Act 1999* as a critically endangered ecological community was submitted to Environment Australia in 2003.

**Case study: Blue Gum High Forest**

Prior to 1788 Blue Gum High Forest covered approximately 1,678ha (25%) of the Ku-ring-gai area. Subsequent clearing has left only 23 ha (1.4%) remaining in Council controlled reserves. Remnants also exist in Lane Cove, Willoughby, Hornsby and Ryde and some other areas in the Sydney Basin.

In 1997 the NSW Scientific Committee, established by the *Threatened Species Conservation Act 1995* declared Blue Gum High Forest occurring on the North Shore and in the northern suburbs of Sydney as an "Endangered Ecological Community on Part 3 of Schedule 1 of the Act."

The main threats to Blue Gum High Forest include fragmentation, development, increased nutrients in runoff, inappropriate fire regimes, invasion of weeds, mowing and clearing. A nomination for the inclusion of the Blue Gum High Forest under the *Environment Protection and Biodiversity Conservation Act 1999* as a critically endangered ecological community has been submitted to Environment Australia.

**Case study: Phytophthora dieback** *Phytophthora cinnamomi* is a soil born that causes root rot in a wide variety of plant species both native and exotic. It requires warm, moist soil conditions to survive and spread and these conditions can be provided by stormwater run-off flows. Plants which are already stressed by other factors such as increased nutrient levels and erosion are more susceptible to infection. *Phytophthora dieback* has become apparent in patches of bushland along the northern shores of Sydney and Middle Harbours over the past few years. There is no way to eradicate the organism once it has infected an area and control strategies are directed at reducing its further spread.

### **Fire management**

Bushland throughout the NSROC region frequently borders onto private property and the possibility of bushfire limits further development into neighbouring new areas. In Hornsby for example, large areas of land interfacing residential development and bushland have been assessed as medium to high bushfire hazard.

The *Rural Fires and Environmental Assessment Act 2002* requires local government councils to record on maps, land identified by the Commissioner of the NSW Rural Fire Service as bush fire prone land. Councils are required to prevent Development Consent being granted for the for certain purposes on bush fire prone land, unless the consent authority is satisfied that the development conforms to documented bush fire protection specifications or has consulted with the Commissioner.

Bushfire control measures including controlled burns are undertaken by NSROC Councils. These protect property from bushfire hazards but at the same time can impact on biodiversity. Controlled burns change the natural bushfire regime in terms of frequency, season and intensity. This can effect the capacity of native species grow, flower and produce seeds and of the seeds to germinate. Willoughby Council advised that its burns are managed as ecological burns, for which the preparation is undertaken years in advance of the actual burn to get the right ecological outcomes.

### **3.6.3 FINDINGS & RECOMMENDATIONS**

1. Some of the largest areas of bushland in metropolitan Sydney are located in the NSROC region particularly in the Hornsby and, to a lesser extent, Ku-ring-gai areas. Even in the NSROC areas located closer to the Sydney CBD, notably North Sydney and Hunters Hill, there are relatively small but important pockets of remnant native vegetation often providing important wildlife corridors and leisure opportunities for residents living in an otherwise highly urbanized environment.
2. Native bushland is highly valued by the community and its conservation has been awarded a high priority in community surveys undertaken by NSROC councils.
3. The protection of native bushland is intimately related to the conservation of biodiversity and as such, is an essential component of ecologically sustainable development. Bushland supports a wide range of endangered plant and animal species in the NSROC region and also includes a number of endangered Ecological Communities such as the Sydney Turpentine-Ironbark and Blue Gum High Forests. It is also vital to the water quality and the health of adjacent streams, water bodies and estuaries.
4. Native bushland and the biodiversity it supports have been severely impacted by the clearing of land since European settlement. There are examples of local extinctions of plant and animal species which have occurred in living memory. Work by NSROC councils and the community, particularly Bushcare workers, has been successful in halting and restoring damage in many remaining areas of bushland.
5. Predicted population growth in the NSROC region in the coming decades will increase the pressure on native bushland and therefore biodiversity. If not carefully planned and implemented, it threatens to wind back recent gains in bushland restoration and also water quality improvements.
6. **It is therefore recommended that** NSROC enter into early negotiations with the *Metro Strategy* planners to identify approaches for arresting these threats. One suggestion is for the planning law reform program to include the statutory capacity to place highly valued native bushland areas beyond development pressure. This should declare the areas "out-of-bounds" with a force that resists legal challenge.

Such an approach is consistent with the thrust of the *Metro Strategy* towards promoting the population increase to occur in defined growth centres that are well supported by facilities such as rail lines etc, and not in environmentally sensitive areas.

7. **It is also recommended that** the stricter planning controls prescribe risk-mitigation measures for proposed developments adjacent to sensitive natural settings. Their

effects can be gradual, cumulative and less easily predicted, and are of particular risk on steep slopes above bushland, for example, in the Hornsby and Ku-ring-gai local government areas. Here there is a higher risk of soil erosion, weed invasion, pollution from increased volumes of stormwater flowing off the impervious surfaces created by residential development, and domestic pet invasion.

8. The NSROC region also contains significant areas of rural lands. Properly managed, these can also assist in the protection of biodiversity since they can be designed to provide wildlife corridors

A comprehensive list of the threatened, vulnerable and species throughout the NSROC region is attached as Appendix 2.

## 3.7 OTHER ISSUES

### 3.7.1 NOISE IMPACTS

#### 3.7.1.1 Background

Poor noise management represents one of the potentially great nuisances of intense urban living. Offensive noise can be generated by sources that vary with the circumstances applying in a local area, but there is a certain level of subjectivity attached to defining when a specific noise becomes offensive. Variables such as volume, pitch and duration lead to differing interpretations of when noise is intrusive or offensive. Day and night are associated with different levels of concern because of the variability in their background noise levels.

#### Recommended Amenity Criteria

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended $L_{Aeq}$ Noise Level, dB(A)	
			Acceptable	Recommended Maximum
Residence	Urban	Day	60	65
		Evening	50	55
		Night	45	50
School classroom – Internal	All	Noisiest 1 hour period when in use	40	40
Place of worship – Internal	All	When in use	40	45
Area specifically reserved for passive recreation (Parks)	All	When in use	55	55
Active recreation area (eg school playground, golf course)	All	When in use	55	60

There are various ways to mitigate urban noise. Techniques such as the use of sensitive building designs and noise barriers can be particularly helpful, but certain features of the natural environment can assist as well. Topographical separation between the source and the recipient, such as a hill, can be very effective, as can suitable vegetation cover.

Urban intensification can remove the buffers provided by beneficial natural assets and introduce features that amplify sounds that are normal to an area. As described earlier, redevelopment of an area usually involves removing the surrounding vegetation cover and then replacing with hard reflective surfaces. Buildings on concrete surfaces put close to each other can become echo chambers, and with the proliferation of air conditioners that is

occurring in high rise complexes, there are increasing opportunities for noise to be available for transmission.

### **3.7.1.2 Application to the NSROC region**

On this basis, it is not unreasonable to conclude that many areas in the NSROC region, where the liveability now is aided substantially by hilly terrain and extensive vegetation cover, are facing a noisier outcome from further development.

Throughout the NSROC region, five causes of annoyance currently stand out, namely: barking dogs; air conditioners; swimming pool pumps; early morning garbage trucks; and less frequently, improperly set building intruder alarms and the use of power tools. This is based on the most common complaints reported to each of the Councils, but is not inconsistent with the patterns reported to DEC for all of Sydney.

However, other areas of Sydney may also record a higher percentage of offensive noise from industrial operations, noisy sporting events, or rock concerts etc. that tend not to be as prominent in the NSROC region. These areas and NSROC are also impacted by aircraft noise, but there is evidence in recent months that the fly-overs for some North Shore suburbs are up to twice the number agreed by Air Services Australia as appropriate. If this pattern continues, aircraft noise could become a more prominent environment issue in the future.

Complaints-reporting is but one subset of the noise concerns. Road traffic and rail can also be major causes of amenity loss, especially when heavy vehicles apply their engine brakes or a motorcycle with a lower quality muffler accelerates. Concerns such as these are more likely to be detected in environmental surveys rather than in complaints registers, because they are more diffuse and harder to tag to specific offenders. But more recent additions to the traffic-borne offenders, including offensive motor vehicle alarms and sound systems, have provoked regulatory action.

Exactly how and where the greatest sources of noise will occur in the future across the region are unpredictable, especially if the estimation seeks to take into account all possible mitigation options.

For example, construction noise will be a major influence wherever there is activity, as it is now, but this is hopefully short-lived at a given location. Sensible site planning, building layouts and the use of noise reducing insulation can reduce the chance and extent of on-going noise intrusion in a newly developing area, especially if the planning includes estimation of the most probably noise transmission paths and circumstances. Similarly, nomination of transport corridors for traffic management can take account of the impacts on residents within the impact zone, and noise-barriers installed at the most vulnerable locations.

Hypothetically, it should be possible to prepare and respond to a noise risk profile to ensure that new residences are able to be added to an existing suburb with minimal residual noise impacts. On this basis, the manner in which this issue is contained is a matter for negotiation between a project proponent and the development approving authority assessing the land-use change.

### **3.7.2 EFFECTS OF ELECTROMAGNETIC RADIATION FROM ELECTRICITY TRANSMISSION AND TELECOMMUNICATIONS**

Unlike the other linear infrastructure components discussed above, the provision of the telecommunications infrastructure is a dynamic industry that has changed significantly over the past 10-15 years. The early 1990s saw considerable debate about the roll-out of cabling by both Telstra and Optus for transmitting large volumes of data or audio-visual analogue signals, and Federal legislation underpinned their move through the suburbs of all of the towns across Australia where this was provided. Since then, technology breakthroughs have allowed high speed data to be transmitted along telephone lines; satellite transmission of data and television has progressed; city-wide wireless networks are being operated by a number of commercial entities; and trials are being conducted with optic fibre transmission networks in suburban settings.

On the face of it, there appears to be less of a risk of capacity constraints in this industry than with water and energy. Not only is the technology evolving to offer competing modes of communications to the fixed cable transmission, but there are more competitors in the market who able to offer genuine options. There is however, one environmental issue that may be associated with this industry as it attempts to cope with growing populations, and that is the potential health impacts of electromagnetic radiation (emr).

Elevated levels of emr can be detected in the vicinity of radio-wave transmitters used for sending communications signals, and of high tension electricity transmission lines. Their specific health effects have been controversial for decades, and although many in the community have been convinced that they are carcinogenic, the scientific evidence has been equivocal. Nevertheless, one of the pervading concerns has been the potential impact of emr on young children, and many parent- groups have expressed concern that playgrounds, pre-schools or schools are too close to transmission sources. These concerns have featured prominently in the assessment of applications seeking planning approval for new mobile phone transmission towers and electricity lines, and the approving authorities have responded in different ways. But recent evidence appears to point in the direction of a positive link between emr and childhood leukaemia, so this needs to be an area of further and urgent research.

The issue is relevant to the NSROC region for two reasons. Firstly, the Willoughby LGA includes three television transmission towers on the ABC site at Gore Hill. The Willoughby



Council has noted the risks attached to these, so zoning constraints restrict the use of the land in their immediate vicinity. Nevertheless, it is conscious that this restriction is sterilising near-city land that will always be in high demand for development in the future, so emphasises that this must be taken into account when the *Metro Strategy* makes recommendations about exactly where residential intensification should occur in the NSROC region.

The emr question in turn raises a further issue that may need to be addressed before 2034, and that relates to the eventual need for a further 330kv electricity line to be fed to the Macquarie Park area if its commercial workforce is to grow to 50,000. Notwithstanding the hope that demand management will become progressively more sophisticated up until then, the possibility is strong that this area and those around it that support it, will exceed the capacity of the (then) severely ageing electricity infrastructure. If so, it will be inescapable that any line would need to pass through existing residential areas and even if placed underground, there may still be locations where the health of the community becomes a perceived or real issue.

At this stage, the public health risks from emr exposure is a matter to be addressed by the NSW Department of Health, as is the definition of the action that should be taken to manage the development approval process to adequately take this into account. It is therefore recommended that NSROC note that this issue has been raised, and monitor developments as more scientific information becomes available.

### **3.7.3 Rural lands in Hornsby local government area.**

Small farm enterprises between Glenhaven-Dural and Wiseman's Ferry are responsible for providing about 10% by value of Sydney's agriculture production. Although this is a small component overall, Hornsby is the leading local government area in the Sydney region for stone fruit, strawberries, cut flowers and nursery production.

In addition, agricultural activity in this region contributes to its rural character and to its attraction as a local tourist destination. Agricultural and related uses are also an important source of employment for both full-time and part-time seasonal workers. Hornsby Council is currently investigating a range of initiatives to enhance the tourism potential of its rural areas with a view to seeking their long-term retention. One immediate task is the preparation of a draft LEP and DCP amendments to allow retail plant nurseries in rural zones.

Urban and rural/residential development in the Hornsby area is already putting pressure on rural lands and the value of agricultural production in the region is declining as a result. Uncertainty about the future of rural lands is encouraging speculation, raising land prices above agricultural land values and discouraging new agricultural investment.

Farmers are finding it difficult to make an economic return from agriculture under the current circumstances. Properties are small. Fruit orchards in particular must compete against fruit imported from the large Australian fruit growing areas and from overseas products. Agricultural activities such as spraying and truck movements can be incompatible with neighbouring residential development.

In 2001, the Hornsby Council received representations to allow the allotment size in Galston area to be reduced from the minimum allowable 2 hectares. Broad community consultation found only 50% support for the proposition. The former NSW Agriculture in 2003 supported the retention of agricultural lands in the Shire noting the importance of retaining viable agricultural land in close proximity to Sydney markets. They pointed out that reducing lot sizes reduces the flexibility for future agricultural opportunities. The Department of Infrastructure and Natural Resources also supported the continued protection of agricultural lands, and the retention of policies focussed on a 'compact city' rather than new development in poorly serviced areas such as Galston.

The Council decided not to allow further subdivision. Rather, it is joining with Baulkham Hills, Campbelltown, Gosford and Penrith Councils in seeking funding from the Department of Infrastructure Planning and Natural Resources for a study to identify values of rural lands that should be protected, and to recommend planning controls and other incentives to create an environment that is conducive to facilitating rural viability and maintaining rural amenity.

#### **3.7.3.1 Discussion**

The presence of substantial areas of rural lands within the NSROC region is an asset that will be compromised if the land-use planning process is insensitive to their importance to the Sydney community as a whole and sacrifices them for subdivision before the need to do so is critical.

The natural features of the area provide a range of social and economic opportunities over and above the value-added commercial activities that are pursued successfully across the zone. On the other hand, the zone is relatively poorly serviced by most of the key infrastructure components that would be imperative for an increased population density, but particularly mass transport systems, reticulated sewerage and reliably electricity supplies. Early development seems inappropriate on both counts.

## **4. CONCLUSIONS**

The analysis conducted in this review establishes that a significant population growth in the NSROC region will exert considerable pressure on the key environmental values prized by its community.

Some features, such as the extensive native bushland and interface with important fresh water and marine systems that characterise the region, are considered to be particularly vulnerable to an extension of the built environment.

There are strong doubts about the competence of the key economic infrastructure to properly service an intensified population without the risk of environmental incidents. It will be both impractical and inappropriate to provide an ever increasing supply of water and energy to the region, so any increase in the population will be possible only if it is accompanied by effective demand management strategies.

Similarly, the sewerage management system will be strained if suitable augmentation isn't provided, and subdivision of areas lacking reticulated sewerage systems will need to be prevented. Suggestions are made for enhancing the capacity to recycle stormwater and highly treated sewerage effluent for purpose-specific applications that will relieve the demand for potable water in the region. Their feasibility should be investigated.

The single greatest threat to the environmental amenity of the region will be created by the severe traffic congestion that will occur on the most of the major arterial roads feeding into the region from its outskirts, or passing through it on the way to centres such as the Sydney CBD. Initially, a growing reliance on private vehicles will cause peak hour travel to be very slow, but intra-regional commercial trips throughout the day will also cause congestion in many smaller streets around retail or office nodes.

No evidence was found of strategies that will allow this transport crisis to be avoided in the foreseeable future, and it is most likely that a significant paradigm shift will be needed if it is to be resolved in the longer-term. We consider that this will need to centre on a re-think of how the public mass-transit systems are managed to compete successfully with the amenity offered by private vehicles, but measures such as congestion pricing may need to be considered as well.

The growing transport problems could threaten the relatively clean air that is enjoyed by residents across the region. It will certainly make the greenhouse mitigation policies of the Councils in the region harder to achieve.

The analysis concludes that, if population intensification is inevitable for the region, it will be more environmentally sensitive if it is implemented within the framework of a comprehensive

planning strategy such as *the Metro Strategy* than outside it. The report also encourages the *Metro Strategy* planners to negotiate with the community on a region-wide basis rather than with individual Councils, because none of the environmental threats discussed will be limited to a single LGA. A wider policy framework will have more chance of success.

## 5. SOURCE MATERIAL

### GENERAL MATERIAL ON ENVIRONMENTAL PLANNING

*Economic contribution of the NSROC region* Centre for International Economics: December 2004 (Prepared for NSROC)

*State of the Environment Report for NSW (2003)* NSW Department of Environment and Conservation. A three yearly report produced in accordance with the requirements of the Protection of the Environment (Administration) Act [www.dec.nsw.gov.au](http://www.dec.nsw.gov.au)

NSW Department of Local Government [www.dlg.nsw.gov.au](http://www.dlg.nsw.gov.au)

(Various issues are covered on this site, but refer in particular to the feature that discusses the requirement for all Councils in NSW to prepare annual State of the Environment reports in accordance with the requirements of the Local Government Act (NSW 1993) )

*Environmental Planning and Assessment Act (NSW, 1979)*. A new Part 3A to this Act passed through the Parliament in June 2005 and is awaiting implementation

*Metro Strategy for Sydney*: [www.metrostrategy.nsw.gov.au](http://www.metrostrategy.nsw.gov.au)

*State of the Environment Reports* for each of the seven NSROC Councils (2004)

*Submission to the Sustainable Cities 2025 Inquiry*, The Middle Way Pty Ltd, June 2004 (Discusses land use conflicts and the development of linear infrastructure in urban areas)

*Western Australia Sustainability Strategy* [www.sustainability.dpc.wa.gov.au](http://www.sustainability.dpc.wa.gov.au) 2003 (A comprehensive review of sustainability issues applicable throughout Western Australia)

WBCSD World Business Council for Sustainable Development, Geneva [www.wbcsd.org](http://www.wbcsd.org)

WSROC : Western Suburbs Regional Organisation of Councils [www.wsroc.com.au](http://www.wsroc.com.au)

### WATER QUALITY ISSUES & DRINKING WATER SUPPLIES

BASIX: Described at [www.dipnr.nsw.gov.au](http://www.dipnr.nsw.gov.au)

*Guidelines for Sewerage Systems, use of reclaimed water* National Health Medical Research Council Canberra [www.nhmrc.gov.au](http://www.nhmrc.gov.au)

*Guidelines on on-site sewerage management* NSW Department of Local Government [www.dlg.nsw.gov.au](http://www.dlg.nsw.gov.au)

*Investigation into water & wastewater service provisions in the greater Sydney region* NSW Independent Pricing and Regulatory Tribunal May 2005

*Keynote address the Victorian Water Industry Association annual conference on sustainability reporting*. The Middle Way Pty Ltd, Bendigo, September 2003

*Metro Strategy for Sydney (ibid)*

*National Water Quality Management Strategy* Commonwealth Department of Agriculture Fisheries & Forestry [www.daff.gov.au](http://www.daff.gov.au)

*Report into Planning for Sydney's Water Needs: Department of Infrastructure, Planning and Natural Resources, Sydney Water Corporation, Sydney Catchment Authority.* Auditor General of NSW May 2005

*State of the Environment Report (2003)* NSW Department of Environment and Conservation

*Sustainable Cities 2025 Inquiry* [Standing Committee on Environment and Heritage](#)  
House of Representatives, Parliament of Australia (to report late 2005)  
[www.australia.gov.au](http://www.australia.gov.au)

Sydney Water Corporation, [www.sydneywater.com.au](http://www.sydneywater.com.au)

## **TRANSPORT ISSUES**

*Infrastructure: action for future prosperity* Business Council of Australia March 2005  
Available at [www.pjpl.com.au](http://www.pjpl.com.au) 133 pp

National Transport Commission: [www.ntc.gov.au](http://www.ntc.gov.au) (Website includes considerable information on the regulation of heavy vehicle movements across the country)

Roads and Traffic Authority of NSW *AADT Survey* 2002 [www.rta.nsw.gov.au](http://www.rta.nsw.gov.au)

*EIS for the expansion of Botany Bay* Sydney Ports Corporation, 2004

## **ENERGY SUPPLY & GREENHOUSE ISSUES**

*Australian gas supply and demand balance to 2019-2020.* August 2002  
Australian Bureau of Agriculture and Resource Economics (ABARE): Canberra

BASIX: Described at [www.dipnr.nsw.gov.au](http://www.dipnr.nsw.gov.au)

*Clean Fuels Act* (Cwlth, 2000)

*Regulatory Impact Statement for the Clean Fuels Act (Cwlth 2000)* Commonwealth  
Department of Environment and Heritage [www.deh.gov.au](http://www.deh.gov.au)

Australian Greenhouse Office [www.greenhouse.gov.au](http://www.greenhouse.gov.au) - *Science and Emissions Monitoring:*

*Climate Change: An Australian Guide to the Science and Potential Impacts,* 2003  
Edited by Barrie Pittock for the Australian Greenhouse Office (250 pp)

Energy Australia, [www.energyaustralia.com.au](http://www.energyaustralia.com.au)

*Energy Efficiency* Productivity Commission, Melbourne 2005, [www.ccnco.gov.au](http://www.ccnco.gov.au)  
(Draft Report 470 pp)

Energy Supply Association of Australia *Submission to the Sustainable Cities Inquiry* June  
2004, Parliament of Australia, Canberra

*Residential energy use in Sydney, the Blue Mountains and Illawarra: Results from the 2003 household survey.* IPART NSW Independent Pricing and Regulatory Tribunal,  
December 2004

*Towards a truly national and efficient energy market* ("Parer Report") Commonwealth of  
Australia, 2002 168 pp [www.daff.gov.au](http://www.daff.gov.au)

Transgrid: For discussion on electricity demand management, see the *Assessment Report for the approval by the NSW Minister for Planning for the 330kv cable into Sydney city* at  
[www.dipnr.nsw.gov.au](http://www.dipnr.nsw.gov.au) ; *Notices of Determination 2001*

## **AIR QUALITY**

*Managing Air Quality: Department of Environment and Conservation.* Auditor-General of NSW , April 2005

*Statement of Environmental Effects for the Clean Fuels Project, Kurnell, Caltex Petroleum Australia* February 2004 (Air quality chapter) [www.caltex.com.au](http://www.caltex.com.au)

National Environment Protection Council [www.nepc.gov.au](http://www.nepc.gov.au) (Sie has a range of environment standards for national application)

## **BUSHLAND & BIODIVERSITY ISSUES**

*Biodiversity Planning: Guide for NSW Local Government.* Conservation Planning Unit, NSW Department of Environment and Conservation 2001

*Environment Protection and Biodiversity Conservation Act* (Cwlth 2000)

*General guidelines for impact assessment* Conservation Planning Unit, NSW Department of Environment and Conservation, January 2003

*Green Web for Sydney: A vegetation management plan for the Sydney region* prepared by the Sydney Regional Organisation of Councils. February 1997

*Species Profile and Threats (SPRAT) database* Commonwealth Department of Environment & Heritage [www.deh.gov.au](http://www.deh.gov.au)

Threatened and vulnerable species identified in NSROC local government areas. (ref: *Atlas of NSW Wildlife, National Parks and Wildlife*, [www.wildlifeatlas.nationalparks.nsw.gov.au](http://www.wildlifeatlas.nationalparks.nsw.gov.au) *Threatened Species Act* ( NSW 1995)

## **OTHER ISSUES**

Electromagnetic radiation See the Assessment Report for the approval by the NSW Minister for Planning for the 330kv cable into Sydney city at [www.dipnr.nsw.gov.au](http://www.dipnr.nsw.gov.au) *Notices of Determination 2001*

*Noise Guidelines for Local Councils* NSW Department of Environment and Conservation

Waste management see comparative data on waste collection and recycling in the *Comparative Tables 2003-2004* at [www.dlg.nsw.gov.au](http://www.dlg.nsw.gov.au)

## **APPENDIX 1**

### **EXTRACT FROM THE DEVELOPMENT APPROVAL ISSUED BY THE MINISTER FOR PLANNING IN JANUARY 2002 TO TRANSGRID (NSW) FOR THE CONSTRUCTION OF A NEW 330kv UNDERGROUND CABLE FROM PICNIC POINT TO HAYMARKET**

#### **Demand Management**

144. The Proponent is to contribute to a special purpose fund, in partnership with EnergyAustralia, to underwrite a programme of activities to offset the environmental and social impacts of providing additional electricity supplies to the inner Sydney Region, by investigating the potential for reducing the demand for electricity by all classes of consumers.

145. The fund will receive a total injection of \$10m over a period of five years, split equally between the two contributors.

146. The fund will be established and supported by the Director-General. It will be managed by a Committee comprising a nominee of the Director-General and a representative from both TransGrid and EnergyAustralia. The region covered by the fund will be the distribution sector of the Sydney region generally supplied from the interconnected network between TransGrid's Sydney North, Sydney South, Beaconsfield and Haymarket substations.

147. The Management Committee will produce guidelines describing how the fund will operate and be administered and submit these for approval by the Director-General, who may also approve variations to it on the advice of the Committee. The guidelines will include provisions for independent auditing to ensure transparency and the prudent disposition of the funds in achieving the required outcomes.

148. A report on the activities supported by the fund and its administration will be prepared and made publicly available at the end of each financial year.

149. The activities to be supported by the fund are to include, but not be limited to: Preparing an inventory of the existing standby generation facilities in public and private sector premises in the CBD and inner Sydney region that may be suitable for supplementing the supply of electricity in the network. The inventory (which can be modelled on the detailed California database) should include:

- (a) the type, age, capacity, location, owner and service contractor for each on-site generator with a nameplate capacity exceeding 300kW;
- (b) a quantitative and qualitative rating of the generator for its efficiency and environmental performance. The aim would be to identify cleaner systems that may be more appropriate for more extended use and ones with higher emissions and/or lower efficiencies that are suitable for emergency back-up purposes only; and,
- (c) an assessment of the average and peak electricity demand for the sites being supplied and a determination of the likely capacity available for network demand reduction.

150. Subsequent to the preparation of a comprehensive inventory, an implementation strategy is to be prepared, with due consideration to environmental impact, demonstrating how each standby generator could best be called upon at times of stress on the supply network to:

- (a) take load off the system by meeting the load requirements of the sites they serve; and,
- (b) if practicable, reduce network demand further by supplying any surplus electricity into the network.

151. The implementation strategy is to recommend technical, commercial and operational approaches to maximising the opportunities to rely on this distributed energy source, and provide a model business case for the owners of standby generators that demonstrates how they could be compensated to make their involvement commercially viable. Following implementation, the model is to be documented and made available for use in other constrained regions in NSW seeking to implement distributed generation.

152. The strategy is to evaluate the major facilities in the region that offer opportunities for power factor correction. Each site evaluation should include:

- (a) measurement of the current power factor;
- (b) assessment of opportunities for power factor correction; and
- (c) preparation of a summary business case for each site where opportunities exist.



The evaluation approach and summary information is to be documented and made available for use in other constrained regions in NSW seeking to implement a power factor correction initiative.

153. The strategy should evaluate the major facilities for interruptible load opportunities. Each site evaluation should include:

- (a) identification of any loads that could potentially be interrupted without causing major disruption or inconvenience;
- (b) a technical and commercial assessment of the feasibility of interrupting identified loads; and
- (c) preparation of a summary business case for each site where opportunities exist.

A summary of the database that results from this project is to be documented and made available for use in other constrained regions in NSW seeking to implement load interruptibility initiatives.

154. The strategy should evaluate the major facilities for their energy demand reduction opportunities, including improvements in equipment efficiency, cogeneration and energy management controls. Each site evaluation should include:

- (a) an energy audit, including evaluation of energy usage characteristics and characterisation of thermal loads;
- (b) technical and commercial assessment of the feasibility of any energy demand reduction opportunities identified;
- (c) preparation of an energy demand reduction programme; and
- (d) preparation of a summary business case for each site where opportunities exist.

155. Where relevant to the objectives of providing practical and accurate information on the opportunities for demand reduction, the strategy should support the implementation and promotion of demonstration projects. The range of projects considered should encompass a wide range of target sites and include documentation of the technical and commercial aspects to assist in the dissemination of information to building owners, developers, design professionals, energy service providers, other network service providers and the general public.

## **Magnetic Fields**

156. The Proponent is to undertake pre-operation magnetic field monitoring to establish existing magnetic field levels at representative locations along the preferred route. Results from these studies are to form a baseline monitoring report that is to be included in the Magnetic Field Management Sub Plan referred to in Condition 158. The monitoring details are to be approved by the Director-General at least six (6) months prior to the commencement of operation.

157. Dependent on the location of existing services and traffic management considerations, the Proponent shall maximise distance of the cable from dwellings, schools and other sensitive receivers to the satisfaction of the Director-General by locating the cable in the centre of the roadway. This measure only applies in cases where dwellings are located on both sides of the road.

158. The Proponent shall prepare a detailed Magnetic Field Management Sub Plan as part of the Construction EMP referred to in Condition 20. The Sub Plan is to identify how TransGrid will ensure that the levels of magnetic fields surrounding the cable are minimised during its operation.

The Sub Plan shall include but not be limited to:

- (a) identification of dwellings, schools and other sensitive receivers within 20m of the cable route;
- (b) identification of all available magnetic field reduction strategies, technologies and design measures together with their estimated costs and impacts; already used, and proposed to be used, to minimise the exposure of residents in dwellings, schools and other sensitive receivers along the route of the cable. If any techniques are found to be reasonable and feasible, they are to be employed in the installation of the cable;
- (c) report on the predicted distance between cable and dwelling houses, and any other magnetic field reduction measures undertaken;
- (d) site specific details of any field reduction measures such as shielding or any other field reduction measures to be used;
- (e) impacts associated with any field reduction measures, such as shielding; and,
- (f) details of existing and predicted magnetic field levels along the cable route, joint bay locations, adit sites, and the tunnel section following the application of the measures identified in (b).

The Magnetic Field Management Sub Plan shall be approved by the Director-General prior to commencement of substantial construction of each section of the cable route, as agreed by the Director-General.

159. The Proponent shall prepare a detailed Magnetic Field Monitoring Programme as part of the Operational EMP referred to in Condition 22. The programme shall be applicable to sensitive

receivers likely to be exposed to the effects of the cable. The Programme is to identify how TransGrid will ensure that the levels of magnetic fields surrounding the cable are minimised during its operation.

The Programme shall include but not be limited to:

- (a) report on the final, as constructed, distances between cable and dwellings, schools and other sensitive receivers;
- (b) report on all field reduction measures undertaken (including site specific details);
- (c) results of pre-operation magnetic field monitoring of existing magnetic fields undertaken in accordance with Condition 156 as a baseline monitoring report;
- (d) site specific details of existing and predicted magnetic field levels along the cable trench, joint bay locations, adit sites, and the tunnel section following the application of the measures identified in (b); and,
- (e) annual monitoring for 5 years at representative locations identified in the baseline monitoring report as specified in Condition 156, and as otherwise required by or agreed to by the Director-General.

The Magnetic Field Monitoring Programme shall be approved by the Director-General prior to commissioning, and monitoring results shall be made publicly available upon request

160. The Proponent shall comply with the Director-General's reasonable and feasible requirements to mitigate impacts in light of the monitoring undertaken in accordance with condition 159, where results show exceedances of predicted levels specified in the Magnetic Field Management Sub Plan (prepared in accordance with condition 158).

## APPENDIX 2

### List of threatened species in the NSROC region from the Atlas of NSW Wildlife.

**Key:**

The Atlas of NSW Wildlife is the NSW Department of Environment and Conservation's database of fauna and flora records. The following lists include entries in the Atlas marked as:

- V** - Vulnerable (Threatened Species Conservation Act, 1995)
- E1** - Endangered (Threatened Species Conservation Act, 1995)
- E2** - Endangered (Threatened Species Conservation Act, 1995)

The Atlas states that data it contains, while extensive, is by definition patchy. It will not provide full distribution of a species. Except in areas where comprehensive survey information has been incorporated into the database, the search results for a particular area are based on a mix of reported sightings

**LGA – Hornsby Fauna threatened species**

<i>Scientific Name</i>	<i>Common Name</i>	<i>Legal Status</i>
<i>Pandion haliaetus</i>	Osprey	V
<i>Ixobrychus flavicollis</i>	Black Bittern	V
<i>Callocephalon fimbriatum</i>	Gang Gang Cockatoo Population, Hornsby & Ku-ring-gai LGAs	E2
<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo	V
<i>Climacteris picumnus</i>	Brown Treecreeper	V
<i>Ptilinopus superbus</i>	Superb Fruit-Dove	V
<i>Stagonopleura guttata</i>	Diamond Firetail	V
<i>Falco hypoleucos</i>	Grey Falcon	V
<i>Xanthomyza phrygia</i>	Regent Honeyeater	E1
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler (eastern subsp.)	V
<i>Macronectes giganteus</i>	Southern Giant-Petrel	E1
<i>Neophema pulchella</i>	Turquoise Parrot	V
<i>Ninox connivens</i>	Barking Owl	V
<i>Ninox strenua</i>	Powerful Owl	V
<i>Tyto novaehollandiae</i>	Masked Owl	V
<i>Tyto tenebricosa</i>	Sooty Owl	V
<i>Litoria aurea</i>	Green and Golden Bell Frog	E1
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V
<i>Pseudophryne australis</i>	Red-crowned Toadlet	V
<i>Eubalaena australis</i>	Southern Right Whale	V
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	V
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	V
<i>Dugong dugon</i>	Dugong	E1
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	V
<i>Isodon obesulus obesulus</i>	Southern Brown Bandicoot (eastern)	E1
<i>Phascolarctos cinereus</i>	Koala	V
<i>Phascolarctos cinereus</i>	Koala in the Pittwater LGA	E2

Pteropus poliocephalus	Grey-headed Flying-fox	V
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat	V
Myotis adversus	Large-footed Myotis	V
Dermochelys coriacea	Leathery Turtle	V
Varanus rosenbergi	Rosenberg's Goanna	V

**LGA – Hornsby Flora threatened species**

<i>Scientific Name</i>	<i>Common Name</i>	<i>Legal Status</i>
Olearia cordata		V
Epacris purpurascens var. purpurascens		V
Acacia bynoeana	Bynoe's Wattle	E1
Acacia gordonii		E1
Grammitis stenophylla		E1
Haloragis exalata		V
Haloragis exalata subsp. exalata		V
Pilularia novae-hollandiae	Austral Pillwort	E1
Callistemon linearifolius		V
Darwinia biflora		V
Darwinia fascicularis subsp. oligantha	Darwinia fascicularis subsp. oligantha population in the Baulkham Hills and Hornsby Local Government Areas	E2
Darwinia peduncularis		V
Eucalyptus camfieldii	Heart-leaved Stringybark	V
Eucalyptus scoparia		E1
Kunzea rupestris		V
Leptospermum deanei		V
Melaleuca deanei		V
Micromyrtus blakelyi		V
Syzygium paniculatum		V
Caladenia tessellata	Thick Lip Spider Orchid	E1
Genoplesium baueri		V
Ancistrachne maidenii		V
Grevillea parviflora		V
Grevillea parviflora subsp. supplicans		E1
Persoonia hirsuta		E1
Persoonia mollis subsp. maxima		E1
Galium australe	Tangled Bedstraw	E1
Asterolasia elegans		E1
Zieria involucreta		E1
Lasiopetalum joyceae		V
Pimelea curviflora var. curviflora		V
Tetratheca glandulosa		V

**LGA – Hunters Hill Fauna threatened species**

<i>Scientific Name</i>	<i>Common Name</i>	<i>Legal Status</i>
Ninox connivens	Barking Owl	V
Ninox strenua	Powerful Owl	V
Pseudophryne australis	Red-crowned Toadlet	V

**LGA – Hunters Hill Flora threatened species**

<i>Scientific Name</i>	<i>Common Name</i>	<i>Legal Status</i>
Darwinia biflora		V
Genoplesium baueri		V

**LGA – Ku-ring-gai Fauna threatened species**

<i>Scientific Name</i>	<i>Common Name</i>	<i>Legal Status</i>
<i>Nettapus coromandelianus</i>	Cotton Pygmy-Goose	E1
<i>Botaurus poiciloptilus</i>	Australasian Bittern	V
<i>Callocephalon fimbriatum</i>	Gang Gang Cockatoo Population, Hornsby & Ku-ring-gai LGAs	E2
<i>Calyptorhynchus lathamii</i>	Glossy Black-Cockatoo	V
<i>Ptilinopus superbus</i>	Superb Fruit-Dove	V
<i>Haematopus fuliginosus</i>	Sooty Oystercatcher	V
<i>Haematopus longirostris</i>	Pied Oystercatcher	V
<i>Xanthomyza phrygia</i>	Regent Honeyeater	E1
<i>Lathamus discolor</i>	Swift Parrot	E1
<i>Polytelis swainsonii</i>	Superb Parrot	V
<i>Limicola falcinellus</i>	Broad-billed Sandpiper	V
<i>Ninox connivens</i>	Barking Owl	V
<i>Ninox strenua</i>	Powerful Owl	V
<i>Litoria aurea</i>	Green and Golden Bell Frog	E1
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V
<i>Pseudophryne australis</i>	Red-crowned Toadlet	V
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	V
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	V
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	V
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	V
<i>Isoodon obesulus obesulus</i>	Southern Brown Bandicoot (eastern)	E1
<i>Phascolarctos cinereus</i>	Koala	V
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bent-wing Bat	V
<i>Dermochelys coriacea</i>	Leathery Turtle	V
<i>Varanus rosenbergi</i>	Rosenberg's Goanna	V

**LGA – Ku-ring-gai Flora threatened species**

<i>Scientific Name</i>	<i>Common Name</i>	<i>Legal Status</i>
<i>Epacris purpurascens</i> var. <i>purpurascens</i>		V
<i>Acacia bynoeana</i>	Bynoe's Wattle	E1
<i>Grammitis stenophylla</i>		E1
<i>Haloragodendron lucasii</i>		E1
<i>Darwinia biflora</i>		V
<i>Eucalyptus camfieldii</i>	Heart-leaved Stringybark	V
<i>Melaleuca deanei</i>		V
<i>Syzygium paniculatum</i>		V
<i>Deyeuxia appressa</i>		E1
<i>Persoonia mollis</i> subsp. <i>maxima</i>		E1
<i>Tetratheca glandulosa</i>		V

**LGA – Lane Cove Fauna threatened species**

<i>Scientific Name</i>	<i>Common Name</i>	<i>Legal Status</i>
<i>Ptilinopus superbus</i>	Superb Fruit-Dove	V
<i>Xanthomyza phrygia</i>	Regent Honeyeater	E1
<i>Ninox strenua</i>	Powerful Owl	V
<i>Litoria aurea</i>	Green and Golden Bell Frog	E1
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	V
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V

**LGA – Lane Cove Flora threatened species**

<i>Scientific Name</i>	<i>Common Name</i>	<i>Legal Status</i>
<i>Camarophyllopsis kearneyi</i>		E1

Hygrocybe anomala var. ianthinmarginata		V
Hygrocybe aurantipes		V
Hygrocybe austropratensis		E1
Hygrocybe collucera		E1
Hygrocybe griseoramosa		E1
Hygrocybe lanecovensis		E1
Hygrocybe reesiaae		V
Hygrocybe rubronivea		V
Melaleuca deanei		V
Syzygium paniculatum		V

**LGA – North Sydney Fauna threatened species**

<i>Scientific Name</i>	<i>Common Name</i>	<i>Legal Status</i>
Burhinus grallarius	Bush Stone-curlew	E1
Ptilinopus superbus	Superb Fruit-Dove	V
Ninox strenua	Powerful Owl	V
Pteropus poliocephalus	Grey-headed Flying-fox	V
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat	V

**LGA – North Sydney Flora threatened species**

<i>Scientific Name</i>	<i>Common Name</i>	<i>Legal Status</i>
Acacia terminalis subsp. terminalis		E1

**LGA – Ryde Fauna threatened species**

<i>Scientific Name</i>	<i>Common Name</i>	<i>Legal Status</i>
Pandion haliaetus	Osprey	V
Ixobrychus flavicollis	Black Bittern	V
Callocephalon fimbriatum	Gang Gang Cockatoo Population, Hornsby & Kuring-gai LGAs	E2
Limosa limosa	Black-tailed Godwit	V
Ninox strenua	Powerful Owl	V
Litoria aurea	Green and Golden Bell Frog	E1
Pseudophryne australis	Red-crowned Toadlet	V
Petaurus australis	Yellow-bellied Glider	V
Pteropus poliocephalus	Grey-headed Flying-fox	V
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat	V

**LGA – Ryde Flora threatened species**

<i>Scientific Name</i>	<i>Common Name</i>	<i>Legal Status</i>
Epacris purpurascens var. purpurascens		V
Callistemon linearifolius		V
Darwinia biflora		V
Leptospermum deanei		V
Melaleuca deanei		V
Tetradlea glandulosa		V

**LGA – Willoughby Fauna threatened species**

<i>Scientific Name</i>	<i>Common Name</i>	<i>Legal Status</i>
Ptilinopus superbus	Superb Fruit-Dove	V
Xanthomyza phrygia	Regent Honeyeater	E1
Ninox strenua	Powerful Owl	V
Pseudophryne australis	Red-crowned Toadlet	V
Cercartetus nanus	Eastern Pygmy-possum	V
Dasyurus maculatus	Spotted-tailed Quoll	V
Pteropus poliocephalus	Grey-headed Flying-fox	V

**LGA – Willoughby Flora threatened species**

<i>Scientific Name</i>	<i>Common Name</i>	<i>Legal Status</i>
Acacia bynoeana	Bynoe's Wattle	E1
Eucalyptus camfieldii	Heart-leaved Stringybark	V
Caladenia tessellata	Thick Lip Spider Orchid	E1
Tetratheca glandulosa		V