Landcare Research
Manaaki Whenua
POLICY BRIEF

Protecting the Urban Forest

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KEY MESSAGES

The protection of the urban forest in Auckland and elsewhere is vital to protect biodiversity and ecosystem services, mitigate against climate change, and enhance human well-being. This study demonstrates how the patterns of loss of the urban forest correlate with the regulatory provisions designed to retain it. Three key messages arise:

1. Loss of the urban forest is generally irreversible, as trees and other vegetation removed are usually replaced with impervious surface and other land uses not compatible with significant vegetation retention.
2. Tree and vegetation protection rules are effective at reducing the removal of the urban forest, evidenced by retention in areas of high protection and substantial rates of removal where rules were permissive or non-existent.
3. It is important to track the effectiveness of policy interventions as required by section 35 of the Resource Management Act 1991, and agencies should ensure that adequate resource and expertise are available to do so.

INTRODUCTION

Urbanisation is a driver of profound change in ecosystems in or near cities in New Zealand and around the world. Urbanisation causes removal of vegetation, species homogenisation, and loss of ecological integrity, natural character, and function.[1] The pressure on the urban forest of Auckland has in the past prompted the introduction of rules in district plans that seek to limit the removal of individual trees and vegetation. In this policy brief we assessed whether changes in the extent of vegetation cover are correlated with the extent and stringency of the relevant legacy planning rules in Auckland controlling removal of the urban forest. This assessment used the Land Cover Database (LCDB2 and LCDB3; see Box 1) with a subsequent analysis using aerial photograph and other GIS layers (e.g. impervious surface) to provide more detail. A summary of the research methodology is outlined in the Appendix and the accompanying technical document.[2] The assessment captured changes in larger vegetated areas rather than individual trees.

In this policy brief, we use the term 'urban forest' to refer to the full extent of vegetation within urban and peri-urban areas. For the purpose of this paper, in the absence of a generally accepted definition, the urban forest is defined as 'comprising the trees and associated vegetation, and indigenous ecosystems within a city; in parks, gardens and streets, planted singly, in groups, or dense stands; or occurring natively or via naturalisation'.

The protection of urban forest is important for achieving national and international biodiversity goals.[3] Auckland's urban and peri-urban areas have regionally and nationally important biodiversity values and contribute many ecosystem services on which we rely, including soil retention, shading, amenity, and Māori customary values.[4] Auckland's biodiversity values were recognised in the botanical literature as far back as 1871, by prominent botanist Thomas Kirk.[5] The biodiversity values of the scheduled and generally protected trees and vegetation in Auckland have also been more specifically recognised and described numerous times, including by Denyer and Baber (2007)[6] and Wilcox (2012).[7] They have also been discussed at length in the Environment Court on more than one occasion.[8]

METHODS FOR PROTECTING THE URBAN FOREST

To recognise and protect the values associated with the urban forest, the legacy councils in the Auckland region[9] developed a suite of regulatory and non-regulatory methods. Most councils used a mix of methods.

Regulatory methods included:

- Purchase or receipt of important biodiversity areas to be included within the protected area network as a reserve or similar
- Preparation of heritage schedules of notable trees that were considered outstanding and worthy of individual recognition and usually accompanied by more stringent protection in district plans
- Introduction of rules to limit the extent of indigenous vegetation removal, or in particular sensitive locations such as riparian corridors and the coastal conservation areas
- Inclusion of identified Significant Natural Areas (SNAs) on planning maps (although some SNAs had no rules associated with them, so were not regulatory)
- Economic incentives to landowners with important parts of the urban forest on their property, such as tree maintenance contributions and rates relief
- General tree and vegetation protection rules (that were sometimes extended to non-invasive exotic species), which automatically invoked protection rules once a tree reached a nominal height and/or girth.

Non-regulatory approaches included:

- Landowner advice and assistance with tree care and planting
- Provision of plants and other materials to help restore and protect areas of native vegetation
- Urban biodiversity programmes such as the North West Wildlink
- Covenanting assistance for private landowners
- Community education and outreach programmes.

Box 1: What is the Land Cover Database?

The Land Cover Database is a nationwide layer of geospatial information that is maintained by Landcare Research NZ and updated at regular intervals.[10] The land surface of New Zealand is mapped and classified into a range of categories, and the data are freely available to agencies and the public. The data are used for a wide variety of reasons, including informing resource management decisions. The first (LCDB1) captured images from summer 1996/97, LCDB2 from 2000/01, LCDB3 from 2008/09, and LCDB4 (released in mid-2014) is based on 2012/13 images.

LCDB has a nominal minimum mapping area of 1 ha. Our analysis using the LCDB accurately detected changes to polygons where more than about 0.8 ha of urban vegetation was removed or disturbed. This disturbance was often adjacent to already large areas of vegetation. This means it is likely that our analysis underestimates both vegetation losses (e.g. thinning of vegetation within a polygon or removal of edges) and gains from small areas of additional planting or from narrow strips of planting such as riparian restoration. For example, detailed analysis using aerial photographs revealed 43 ha of woody vegetation were lost from within areas with dominant grass cover. Our analysis also did not identify all areas that were replanted with shrubs or trees due to coarse resolution. Our more detailed assessment using aerial photograph interpretation indicated that some of these replanted areas are likely to take 3–8 years to be sufficiently different from grass/pasture to trigger a reclassification to indigenous vegetation in the LCDB.

Different methods for protecting the urban forest were developed by each legacy city or district, ranging in stringency and design. The methods reflected local characteristics and community priorities and were administered separately. This assessment considers only the rules in the district plans controlling tree and other vegetation removal and does not address the impact of non-regulatory methods and the recognition of SNAs. Rules in district plans generally follow the processes outlined in the Resource Management Act (RMA), including the evaluation of costs and benefits, stakeholder consultation and public notification.[11] The purpose of district plans is to help territorial authorities carry out their functions to achieve the sustainable management purpose of the RMA. Rules to control urban forest removal were put in place to help North Shore City Council give effect to statutory responsibilities under the RMA, most particularly to sections 5, 6 and 7.

NORTH SHORE CITY: THE ASSESSMENT AREA

We used North Shore City for the assessment because its tree and vegetation protection rules have a long litigation history. The rules restricting removal of the urban forest in North Shore City before the 2009 RMA amendments were formulated in response to concern over the management of the urban forest in the mid to late 1990s, including a report from the Parliamentary Commissioner for the Environment.[12] The proposed rules and the associated section 32 assessment for the first generation North Shore City District Plan were subject to challenge in 2001/2002 and upheld in the Environment Court.[13] In 2008, the newly elected National Government initiated legislative reform to limit the ability of councils to protect the urban forest culminating in section 152 of the Resource Management (Simplifying and Streamlining) Amendment Act 2009. A declaration process followed to clarify the impact of the amendments.[14] During this time, the councils of the Auckland region were amalgamated into the sole Auckland Council, a unitary authority with both district and regional powers under the RMA.

THE ASSESSMENT FINDINGS

There were three key findings of our assessment of the effectiveness of protection provisions for the urban forest on the North Shore of the Auckland metropolitan area between 2000/01 (LCDB2) and 2008/9 (LCBD3):

- Irreversibility: Where urban forest was removed, it was generally replaced with a high proportion of impervious surfaces making urbanisation largely irreversible
- Effectiveness: Parts of North Short City with relatively stringent tree protection rules retained a greater amount of vegetation than areas where rules were permissive
- Monitoring: There is a need to invest in monitoring policy effectiveness for protecting the urban forest, and that innovation in monitoring methodologies may be needed to track change over time.

Between 2001 and 2009, 590 ha of North Shore City was urbanised, representing a 7% increase in the urban area and a 33% loss in the area of exotic vegetation (Fig. 1). The losses were most rapid and wide-ranging on flatter areas. During this period there was also a 333-ha increase in the area of indigenous tree and shrub-lands. This was predominantly from replacing exotic forest with native forest in areas with the highest level of protection and the land unsuitable for development in areas with low protection levels being restored (Table 1).

Figure 2 Percent of North Shore City in each major land cover class in 2000/2001 (LCDB 2) and 2008/2009 (LCDB3).

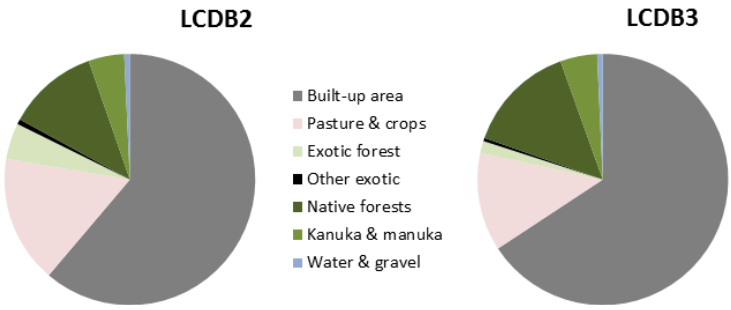

Table1 Change in area (ha) classified as indigenous vegetation between LCDB2 and LCDB3

Typology/Protection level	1: None to very low	2: Low	3: Medium	4: Medium to high	5: Very high	Sum (ha)
Broadleaf Indigenous Hardwood Forest	12	–0.1	0.2	4.7	18.5	36
Indigenous Forest	72.8	–0.6	–3.3	9.1	195.3	273
Manuka/kanuka	4.6	–3.1	0	1.0	14.4	17

Note: green represents a cumulative increase in forest cover, and red a decrease.

There was much greater retention of vegetation on steep slopes and 'unbuildable' gullies in North Shore City, mirroring neighbouring Waitakere City and national patterns of development.[15] Most of New Zealand's protected areas are in the steepest, wettest, and least populated areas of the country, while the flat and fertile lowlands have been most modified. The ecological implication of this pattern of urbanisation is that ecosystems confined to flatter areas and lowlands tend to be quickly fragmented and lost, while higher altitude areas are more likely to stay intact. Lowland biodiversity is thus most threatened because it is generally the most economically attractive land to develop.[16]

Irreversibility: There's no going back on built land

Urbanisation is largely irreversible. North Shore City data demonstrate a net gain in urban forest between 2001 and 2009. Where forest was removed, however, this area was typically covered by impermeable surfaces or grass. Even in the areas with the most stringent tree protection (level 5 in the taxonomy outlined in the Appendix), approximately 86 hectares (15% of the indigenous vegetation that was removed) is now paved or 'built-up'. The rate of removal and increase in impervious surface were also correlated with stringency of tree protection rules.

Indigenous vegetation cover was lost at the fastest rate in business and industrial zones where no or very limited tree protection rules were present. These areas also have the highest impervious cover (37%, compared with 3% in the most protected areas). Impervious surface also increased by the greatest amount in areas with limited tree protection but much more slowly in areas with more stringent tree protection rules.

No instances were recorded in our analysis where areas classified as 'built' were replaced by new indigenous vegetation over a substantial (i.e. detectable) area. Daylighting of streams is a potential example of where this might have occurred. However, for daylighting to be detectable at this scale would require upwards of 200 m of stream daylighting (similar projects have cost c $1.2 million in the Auckland Region) and anecdotally it would highly unusual for this to happen. Other situations where built structures and areas may be removed over significant areas include major brownfields developments in industrial areas, particularly those using Water Sensitive Design (WSD).[17] Wynyard Quarter and Stonefields Quarry in Auckland City are examples of significant increases in vegetated areas associated with WSD in brownfields. As noted above, approximately 333 ha were reclassified as indigenous vegetation from exotic vegetation.

Where these new plantings did occur, two key trends emerged. The first was that most replanting was in areas with the highest protection zoning (including established regional parks). Many areas with the highest protection ranking are not suitable for building due to hazards (flooding, coastal erosion, instability). This landscape-scale trend implies that large areas of the city where people live, work, and play are highly vulnerable to losing vegetation cover, particularly tree cover. The second area with major replanting is on life-style blocks in farmed areas (not in established bush) on the urban fringes of North Shore City. New plantings appeared to buffer and/or link existing areas of habitat at a landscape scale, which is positive and will likely improve habitat availability and survival of fauna. Enhancing natural regeneration by removing weeds or cattle or through replanting can help reinstate ecosystem services, improve habitat availability for wildlife, and contribute to amenity. The resolution of the LCDB means it is likely that the regenerating vegetation is under-reported, particularly where planting has occurred underneath or around existing tracts of urban forest.

Regeneration or new planting may be carried out for a range of reasons, including storm-water management, ecological restoration or amenity and beautification, and some is required by law. Under the RMA, new planting or enhancement of existing habitat is a common requirement of consent conditions. In areas where vegetation rules were weak, less replanting was observed (i.e. industrial areas). The weakening or removal of tree protection rules over time means that where trees are removed,

mitigation is less likely. This leads to both accelerated rates of loss of the urban forest and a reduction in new plantings to mitigate such loss at a landscape level.

The reduction in general tree protection as a result of the RMA amendments is likely to lead to accelerated loss of the urban forest, and fewer instances in which mitigation planting is required to address that loss. This risk is highest on private land where only a small percentage of the urban forest is now legally protected.[18]

Our analysis has demonstrated that most urban vegetation losses are permanent, with cleared areas usually replaced with impervious surface or grass. During urbanisation there is only a fleeting opportunity to balance the natural and built environment by preserving sufficient habitat, limiting fragmentation, preserving and enhancing buffers and corridors, and providing for region-wide 'stepping stones' for mobile fauna. It is costly to retrospectively restore the ecological functions of an area. This was demonstrated by the expense incurred by Project Twin Streams in West Auckland where 37 hectares of land were purchased (part or all of 156 properties)[19] to reinstate natural connections. This involved planting more than 700 000 plants. The cost of the land was about half the total $39 Million over 10 years.[20] Our analysis also showed limited increases in connectivity of shrub and tree vegetation along some riparian areas after urbanisation (e.g. as part of the management of stormwater in North Shore City, including detention ponds and flood zones).

Landscape-level planning in advance of urbanisation will help ensure natural values are preserved during development. If these connections are not created or preserved during greenfield development it is highly unlikely and extremely expensive to retrofit and revegetate these areas.

Effectiveness: Protection rules are an effective means of protecting the urban forest

Protection rules have been effective at reducing the loss of the urban forest, evidenced by the retention of urban forest in areas of high protection and substantial rates of removal where rules were permissive or non-existent. This confirms earlier studies, including Bellingham (2008), which demonstrated the value and efficacy of regulatory approaches in retaining the urban forest.[21] Where planning rules that safeguard indigenous remnants were in place and were sufficiently stringent, as on the North Shore, the remnants were retained more often than they were removed. There were a few exceptions to this trend; most particularly for large tracts of urban forest on private land. In this case, even Level 5 protection areas (see Appendix) were able to be partly cleared for development purposes.

Tree protection rules are a critical method for protecting the urban forest and are effective in helping retain the urban forest for future generations. The assessment also illustrates that in determining what to protect, a choice is made over what not to protect, and what is not protected is likely to be lost.

General tree protection rules did not always extend to all areas with important biodiversity values, which led to the loss of these areas and values. For example, habitat with an exotic canopy and an indigenous understorey (mainly pine forests but including some wetlands), and those characterised by indigenous tree and shrub-lands (lots of trees scattered over a wide area) commonly had limited rules protecting them from removal. These areas are important in cities and their peri-urban areas. Indigenous tree and shrub-lands include scattered but often old growth trees that provide important ecological connections and potentially critical habitat for species such as bats and epiphytic plants. They also have aesthetic and cultural history values. Other forms of protection, such as recognition of an area as a SNA, reserve or protective covenant may not recognise these areas.

The removal of urban forest was frequently immediately adjacent to areas subject to general tree protection, SNAs, and reserves. This was particularly marked where private land was in a zone subject to limited general tree protection and the lot was able to be subdivided. Once new housing had been built, the potential for such sites to buffer the adjacent protected area was greatly reduced. It is highly likely that the cumulative vegetation losses from small subdivisions or on a lot-by-lot basis, i.e. 'death by a thousand cuts', are significantly underestimated. This is primarily because the 1-ha resolution for LCDB2 was too coarse to pick up these small-scale changes. Once a polygon was defined as 'built', further vegetation losses were not detected by LCDB. Conversely, small gains in vegetated areas may not be picked up.

It is important to recognise the significance of ecological connections and buffers and ensure planning frameworks contain the necessary provisions to protect and enhance these areas and the key services they provide to urban residents.

Monitoring: Tracking effectiveness of rules is important and this requires resources and expertise

For policy purposes, agencies have a statutory requirement to monitor the efficiency and effectiveness of rules for the purposes of section 35 of the RMA. While our LCDB analysis is able to identify changes in land cover of about 0.8 ha in size, it is not sufficient for monitoring where all urban vegetation changes (both gains and losses) are occurring. It can, however, be useful to identify those areas that should be looked at more closely, especially in peri-urban areas. It is highly likely that investment in other monitoring approaches, such as LIDAR or differential pervious surface mapping (alongside impervious surface

mapping), would be necessary to monitor tree protection provisions effectively. These approaches should be supplemented by on-the-ground monitoring to pick up local level changes and track cumulative effects.

Our analysis demonstrated that some tree protection rules require different monitoring approaches to others. For example, many legacy cities had rules that protected only certain species at certain heights (e.g. some of Papakura City's residential zones). This means aerial imagery could not be used to assess the effectiveness of these provisions as individual species are not easy to identify without a site visit, particularly when grouped with other trees.

The methods required to monitor different kinds of rules protecting the urban forest should be considered during the planning process, resources allocated, and methods developed to ensure the efficiency and efficacy of the rules are tracked over time. The North Shore City litigation history demonstrates that innovative monitoring methods are important for validating policy tools in the event of legal challenge.

IN SUMMARY

Our analysis demonstrated that tree protection rules can be effective at slowing the overall loss of vegetation and increasing desirable indigenous vegetation during urban expansion and intensification, while still allowing significant urban development to proceed. It also demonstrated that without such rules a healthy and high quality urban environment would be difficult to maintain. The importance of monitoring the changes in the urban forest and the effectiveness of policy interventions has been demonstrated by this assessment and the extensive litigation history in more than one of the legacy cities. We also showed that where tree rules are absent, clearance was almost certain.

The RMA reforms since 2009 have progressively diminished the ability of councils to protect the urban forest, outside of reserves, roadsides, some sensitive areas (such as riparian corridors), and a schedule of notable trees. We have shown that the retention of urban forest is not antithetical to urban development but makes an argument for tree protection rules to be seen as crucial tools in the maintenance of urban amenity and ecological processes. The urban forest outside protected areas can now only be legally safeguarded by way of scheduling. Before the RMA reforms just 6% of urban vegetation remained in the Auckland urban area, with only a small proportion protected by the Notable Trees Register.[22] Therefore, given that the RMA reforms have removed most tree protection rules in urban areas, the area of urban forest is highly likely to have since diminished even further. In the absence of regulatory controls, the ability to require mitigation planting also disappears.

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APPENDIX: SUMMARY OF APPROACH TO COMPARE TREE PROTECTION RULES

To account for the different rules in each of the legacy councils, the relevant rules were standardised by developing a 'stringency of rule' taxonomy (Box 2). Zones with different types of protection were divided into five categories according to the stringency of the protection provisions in the planning rules (Box 2). The process of classifying the zones was somewhat arduous owing to the highly disparate protection approaches in the various councils and the often unclear rules. Although this rule classification was completed for all legacy city and district councils in the Greater Auckland Region, the actual data analysis was restricted to the North Shore City jurisdiction. This was because the rules for North Shore City were more straightforward, quite comprehensive relative to other councils, and more easily mapped. The taxonomy could therefore be fully populated with example zones, on a scale large enough to compare rates of loss.

The change in extent of different vegetation classes within those zones was investigated using a comparison of LCDB2 and LCDB3 as the tree protection rules in North Shore City were continuously active through this time period. We also overlaid impervious surface and building footprint data layers. As the minimum mapping unit of LCDB was approximately 1 ha, this meant that those polygons where a change in land cover was noted was manually checked against aerial photographs to reduce error. Approximately 38% of polygons with vegetation change were over 5 ha in size. The manual correction processes looked at what changes were consistently detected, what were not, and considered why some were missed or misrepresented in the analysis. A more detailed description of the method used to do this is provided in the accompanying technical report.[23]

Box 2: Taxonomy of the stringency of tree protection rules

Level 1 (None to very low protection)
Only scheduled trees protected. No protection in place for areas not otherwise protected via covenant/reserve status (this includes non-regulatory SNA layers – i.e. those areas that do not have accompanying rules restricting vegetation removal).

Level 2 (Low protection)
Significant scope for the removal of both young and mature vegetation with a controlled activity status or lesser.

Level 3 (Medium protection)
Mature vegetation is protected with an activity status of restricted discretionary or higher, but includes a permitted allowance for removal and does not apply to immature vegetation or contiguous areas.

Level 4 (Medium to High protection)
Vegetation is protected with an activity status of restricted discretionary or higher and can include continuous vegetation protection provisions. Minimal permitted clearance allowed.

Level 5 (Very high protection)
Only minor modification to any onsite indigenous vegetation is allowed and then often only when subject to strict assessment criteria that provide for a limited range of reasons why removal can occur.

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