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Indicator M17: Extent of indigenous vegetation in water catchment

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Overview

In 2010, the Technical Group of the Regional Council Biodiversity Forum worked with Landcare Research to develop the Regional Council Terrestrial Biodiversity Monitoring Framework.[1]

This framework is designed as part of 'a national, standardised, biodiversity monitoring programme, focusing on the assessment of biodiversity outcomes, to meet regional council statutory, planning and operational requirements for sustaining terrestrial indigenous biodiversity'

The terrestrial biodiversity monitoring framework adopts the same approach as the ecological integrity framework designed by Landcare Research for the Department of Conservation (DOC) and consists of three components: (i) indigenous dominance, (ii) species occupancy, and (iii) environmental representation.[2] To inform the framework, there are four broad areas: (i) state and condition, (ii) threats and pressures, (iii) effectiveness of policy and management, and (iv) community engagement.

A standardised monitoring framework ensures that data for each measure are consistent among regional councils, which allows for reliable State of Environment reporting. Furthermore, to enable national reporting across public and private land, it is also desirable that where possible, measures can be integrated with those from DOC'sBiodiversity Monitoring and Reporting System (DOC BMRS).[3] The monitoring framework covers most categories of essential biodiversity variables[4] recommended for reporting internationally, addressing species populations, species traits, community composition, and ecosystem structure adequately, but does not address genetic composition and only in part ecosystem function.

This report contains descriptions of 18 terrestrial biodiversity indicators developed within this framework by scientists who worked with regional council counterparts and representatives from individual regional councils. Each indicator is described in terms of its rationale, current efforts to evaluate the indicator, data requirements, a standardised method for implementation as a minimum requirement for each council, and a reporting template. Recommendations are made for data management for each indicator and, for some, research and development needed before the indicator can be implemented.

The terrestrial biodiversity indicators in this report are designed to enable reporting at a whole-region scale. Some of the indicators are also suitable for use at individual sites of interest within regions. Each indicator is described in terms of a minimum standard for all

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[1] Lee and Allen 2011. Recommended monitoring framework for regional councils assessing biodiversity outcomes in terrestrial ecosystems. Lincoln, Landcare Research.

[2] Lee et al. 2005. Biodiversity inventory and monitoring: a review of national and international systems and a proposed framework for future biodiversity monitoring by the Department of Conservation. Lincoln, Landcare Research.

[3] Allen et al. 2013. Designing an inventory and monitoring programme for the Department of Conservation's Natural Heritage Management System. Lincoln, Landcare Research.

[4] Pereira et al. 2013. Essential biodiversity variables. Science 339, 277–278.

councils. If implemented by all councils, each measure can then be aggregated to allow national-scale reporting (e.g., for State of Environment reports, or for international obligations such as reporting on achievement of Aichi Targets for the Convention on Biodiversity). Individual councils could add additional measurements to supplement the minimum standards recommended.

Three of the 18 terrestrial biodiversity indicators – Measures 1 ‘Land under indigenous vegetation’, 11 ‘Change in temperature and precipitation’, and 18 ‘Area and type of legal biodiversity protection’ – were implemented and reported on for all regional councils in June 2014. An attempt to implement and report two others at that time – Measures 19 ‘Contribution of initiatives to (i) species translocations and (ii) habitat restoration’ and 20 ‘Community contribution to weed and animal pest control and reductions’ – was unsuccessful because the data needed for these indicators was either not readily available or not collected in a consistent way, and investment will be needed to remedy these issues before they can be reported successfully.

14 Indicator M17: Extent of indigenous vegetation in water catchment

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14.1 Introduction

The definition of indicator M17 in Lee and Allen (2011) is a state indicator, with the elements (i) percentage of catchment and (ii) extent of riparian zone under indigenous cover. It is the only indicator for ecosystem services, although there is considerable interest in ecosystem services from councils. While the ecosystem services that this indicator refers to are not specified in Lee and Allen (2011), we can infer that water quality and supply, and the tangible and intangible benefits of indigenous biodiversity are important. Of course, the implementation of this indicator is not confined to this original definition, but it does provide the starting point for its development.

This indicator, like all indicators, uses a variable that is fairly easy to measure to provide information on something else of interest that is harder to measure. The classic analogy used for biodiversity indicators is that of the canary in the coal mine. The death of canaries taken into coal mines provided an early warning of dangerous methane levels before effective methane monitors were developed. Canaries were less useful as warnings of other safety risks, such as the risk of roof collapse.

The degree to which indigenous vegetation in catchments and riparian areas reflects ecosystem services will depend on the patterns and types of indigenous vegetation in the catchment, the physical environment of the catchment (e.g. gradient and geology), the surrounding land uses, and the choice of the ecosystem service. For example, indigenous forest in a catchment will generally increase water quality, lower erosion, decrease flooding, but decrease water quantity (e.g. Grip et al. 2005). Indigenous vegetation also provides habitat for a range of native plants, animals and microorganisms. However the absolute 'value' of the biodiversity-related ecosystem services provided by a given patch of vegetation will be very dependent on its composition, history of modification, size and shape, location within the catchment, and location in relation to other vegetation remnants if the landscape is a modified one.

Forested riparian areas might increase some components of water quality via shading and temperature reduction, but may have little benefit for the removal of some nutrients, especially if livestock are not excluded. For any given ecosystem service, it could be possible to estimate the benefits of indigenous biodiversity in the catchments and riparian areas – in some cases using existing models – but these results would differ for each ecosystem service.

The above discussion suggests that an explicit choice should be whether to implement the elements as defined by Lee and Allen (2011) and accept that they will have a variable and unknown application to various ecosystem services of interest, or to choose specific ecosystem services and make detailed estimates of the contribution of indigenous biodiversity to supplying those services. The latter would require choosing each service, and tailoring an estimation to each.

A second important decision is whether to report on their state only (e.g. ecosystem services provided, or the indicators of them) or to also report on their change. Reporting change is appealing, but the current data are unlikely to provide useful estimates of change. The reliable estimation of change is likely to require detailed studies. These can be done in conjunction with M8 and M9.

Together, the above choices exemplify options spanning a broad range of cost and detail. At its simplest, this indicator could be little more than an elaboration of M1, which characterises the distribution of vegetation in catchments and riparian areas by catchment units. At its most complex, this indicator could estimate the contribution (and change in contribution) of indigenous biodiversity to a range of ecosystem services.

In discussions within the working group, it was decided that this iteration of M17 should focus on simple indicators of ecosystem services arising from indigenous vegetation and water quality. The method presented below has some significant limitations in terms of its ability to provide a full and accurate assessment of ecosystem services. For example, there will probably be little coverage of first order streams for most regions, there is no consideration of grazing or any other land-use intensity effects, and there is no consideration of the ecosystem services provided by largely exotic habitat (e.g. plantation forest) or the negative impact of some NZ Landcover Database (LCDB) classes (e.g. roads and dumps) on ecosystem services. Nevertheless, it is able to be implemented nationwide and provides a starting point for future consideration of indicators of ecosystem services. A separate set of indicators that can more accurately depict the level of other ecosystems services and those provided by all ecosystems, including possibly non-indigenous dominated ones (e.g. low production pasture vs urban land cover) can be considered at a later date, or in regions where other suitable data are available.

14.2 Scoping and analysis

14.2.1 Data requirements

Landcover and indigenous vegetation

The various versions of the LCDB are the most suitable data sources to measure extent of indigenous vegetation for this measure. LCDB is not designed for monitoring changes in land cover by catchment and, therefore, its ability to detect change at this scale is limited. However, higher resolution land cover information can be expensive to derive and is not available for most regional councils; therefore, LCDB is the only practical option for a national indicator.

In landscapes where indigenous vegetation clearance occurs as a large number of relatively small clearances (i.e. ‘death by a thousand cuts’) and all at a scale of resolution below the detection scale of the LCDB, this indicator will ‘lag’ behind actual clearance. Small clearances of <0.5 ha are below the practical detection scale of LCDB; a number of these small changes would have to accumulate contiguously or close to each other before their larger combined clearance was detected by LCDB comparisons.

Some individual regional councils have more accurate digital maps of the spatial extent of indigenous vegetation (e.g. from aerial photograph analysis and fieldwork) at the regional or sub-regional scale. Where this information is available, the same riparian indicators outlined below should be reported also using the more accurate indigenous vegetation layer(s). However, even when more accurate data are available, LCDB data should be reported for the whole region, to allow comparisons across regions, and to allow aggregation nationally.

Catchment and watercourses

For regional catchment and watercourse maps it is best to use the River Environment Classification (REC) version 1, which provides national coverage. Individual regional councils may have better quality digital catchment and watercourse data available such as LIDAR, terrain modelling, and/or fieldwork. These data should be used to define the catchment boundaries and watercourses where appropriate.

Future iterations of this measure may consider more comprehensive information on the ecosystem services and pollutants/sediment/nutrients, etc. ‘provided’ by all land cover classes (i.e. including non-indigenous vegetation) with better physical data from terrain modelling to derive more accurate indicators. For example, the Auckland region terrain attributes model divides the region into eleven different landform attributes: ridge, shoulder, valley, slope, foot-slope, back-slope, channel, hollow, spur, terrace and plateau. The relative contribution of each hectare of a catchment to ecosystem services such as water quality, water quantity, sediment load, provision of indigenous biodiversity, carbon sequestration, removal of aerial pollutants, etc. will depend on the interaction between its physical location and land cover.

14.2.2 Definitions

For the indicator ‘extent of indigenous vegetation’, extent is defined as the percentage cover of indigenous vegetation in the specified area. Indigenous vegetation is defined according to Table 14-1.

Table 14-1 Definition of indigenous vegetation cover by data source

Data-source	Indigenous vegetation	Not indigenous vegetation
LCDB1, 2 & 3...	Indigenous forest Mānuka and kānuka Broadleaved indigenous hardwoods Flaxland Herbaceous freshwater vegetation Herbaceous saline vegetation Mangrove, River, & Lake or pond	All other LCDB classes not listed under indigenous vegetation. Open space LCDB classes such as 'Gravel or rock', 'Sand or gravel' and 'Landslide' are included in this class.
Sub-regional mapping	Indigenous vegetation mapped as part of more detailed vegetation survey(s). Indigenous vegetation includes forest, shrubland and scrub stature vegetation (as defined in Atkinson 1985) with >75% cover of indigenous plants in the canopy tier and smaller stature vegetation (e.g. herbfield, grassland, rushland, etc.) with >25% cover of indigenous plants in the uppermost/ canopy tier.	All vegetation not fitting the definition of 'indigenous vegetation' outlined for sub-regional mapping.

The LCDB class 'Estuarine Open Water' should be excluded from the analysis

For the indicator 'water catchment', the water catchments within the region should be selected as follows: (1) List all catchments in the region, from largest to smallest; (2) Starting with the largest catchment, calculate the proportion of the region covered by this catchment; (3) Continue 'adding' individual catchments, starting with the next largest and continuing in decreasing size order, until the cumulative total area of catchments to be included in the measure is >80% of the total area of the region.

Catchments shared between regions have their 'catchment boundary' along the regional political boundary. Some regions may wish to aggregate or split catchments to ensure this indicator includes a practical number (typically 50–200) of different catchments. Multiple, small, co-located catchments that share similar landforms and development pressures can be combined. In some regions, very large catchments may need to be split into sub-catchments for reporting purposes.

Each water catchment that is included in the analysis should also have a digital 'water course line(s)' associated with it. These lines will be used to calculate indigenous vegetation within the riparian zone of water courses.

For the indicator 'riparian area' or 'riparian zone', riparian area, zone or extent is defined as the land within 20 m either side of a water course. For larger rivers and streams the 20 metres is taken from the edge of the digitised watercourse line.

Two **research and development needs** arise:

1. The recommendation of *cumulative total area of catchments* to be included in the measure at >80% of the total area of the region is provisional, and requires testing and acceptance in other regions.
2. The definition of *riparian area* as land within 20 m either side of a water course is provisional, pending further testing of this methodology in other regions, especially with respect to the 20-m distance rule.

14.2.3 Statistics to report

The statistics or elements to report by catchment are (1) the proportion of total catchment in indigenous vegetation, and (2) the proportion of catchment riparian area in indigenous vegetation.

14.2.4 Reporting frequency

Regional councils should update statistics relating to M17 as new LCDB information is released, and these should be incorporated into a national report and made available to the public. Sub-regional analyses should be compiled and distributed to other regional councils by the Biodiversity Working Group on an annual basis, as they are completed.

14.3 Development of a sampling scheme

There is no sampling scheme associated with M17. It might be more efficient for a single, central agency to provide GIS analysis and indicator values for some regional councils, particularly those that lack specialist GIS expertise.

14.4 Data management and access requirements

There should not be any issues with data access for this measure as it draws on two national datasets that have been widely disseminated in the past. These are the New Zealand Landcover Database, and the digitised NZMS 260 map series for catchment and stream boundaries. The digitised NZMS 260 map series provides a minimum national standard as a framework in which all councils can report and this will allow aggregation to a national scale. Individual councils might have their own catchment and/ or stream layers that provide better information than the NZMS 260 data; if so they can report in this framework in addition to reporting in the framework of the NZMS 260 map series.

14.5 Reporting indices and formats

For the region, the two statistics defined above would be reported in map and tabular form.

1. Two maps of region showing catchments with (1) the proportion of catchment in indigenous vegetation, and (2) proportion of catchment riparian area in indigenous vegetation
2. Table showing the two elements displayed in figures. If desired, this can be presented for hierarchical catchments (e.g. entire Waikato catchment and sub-catchments within it, and sub-catchments within those).

Example analysis: Auckland region

Table 14-2 shows the percentage of the whole catchment area that is characterised by native vegetation cover in LCDB4 (column 2). Column 3 shows the percentage of the 20 m riparian buffer area within each catchment that has native vegetation cover according to LCDB4. Columns 2 and 3 are based on 50 aggregated catchment data for the Auckland region. The table shows actual figures for the 25 aggregated catchments that collectively cover just over 80% of the land area of the Auckland region. Example maps from the Auckland region show indigenous in major catchments (Figure 14-1) and sub-catchments (Figure 14-2), and riparian vegetation in major catchments (Figure 14-3) and sub-catchments (Figure 14-4).

Table 14-2 Analysis of %catchment area covered by native vegetation for Auckland region

Catchment name	% native LCDB cover in catchment	% native LCDB cover in 20 m riparian	Cumulative % of regional land area
Hauraki Gulf Islands	76	82	9.6
Hoteo	19	27	17.9
Pahurehure	7	14	25.8
Wairoa	27	34	32.4
Kaipara	10	16	37.9
Upper Waitemata Harbour	14	23	41.8
Awhitu	15	19	44.8
Okiritoto	8	24	47.6
Makarau	19	28	50.3
Taihiki River	2	4	53
Okahukura	13	29	55.5
Kaukapakapa	18	23	57.9
Oruawharo	12	16	60.3
Waiuku River	5	12	62.6
Araparera Stream	24	26	64.9
West Kaipara	17	18	67.1
Tamaki River	2	7	69.2
Henderson	37	56	71.3
Mahurangi	22	35	73.1
Auckland	3	24	74.8
North Kaipara	15	44	76.4
Te Arai	12	22	78
Orere	51	62	79.5
Waitakere	74	82	80.9
Tawharanui	28	47	82.2

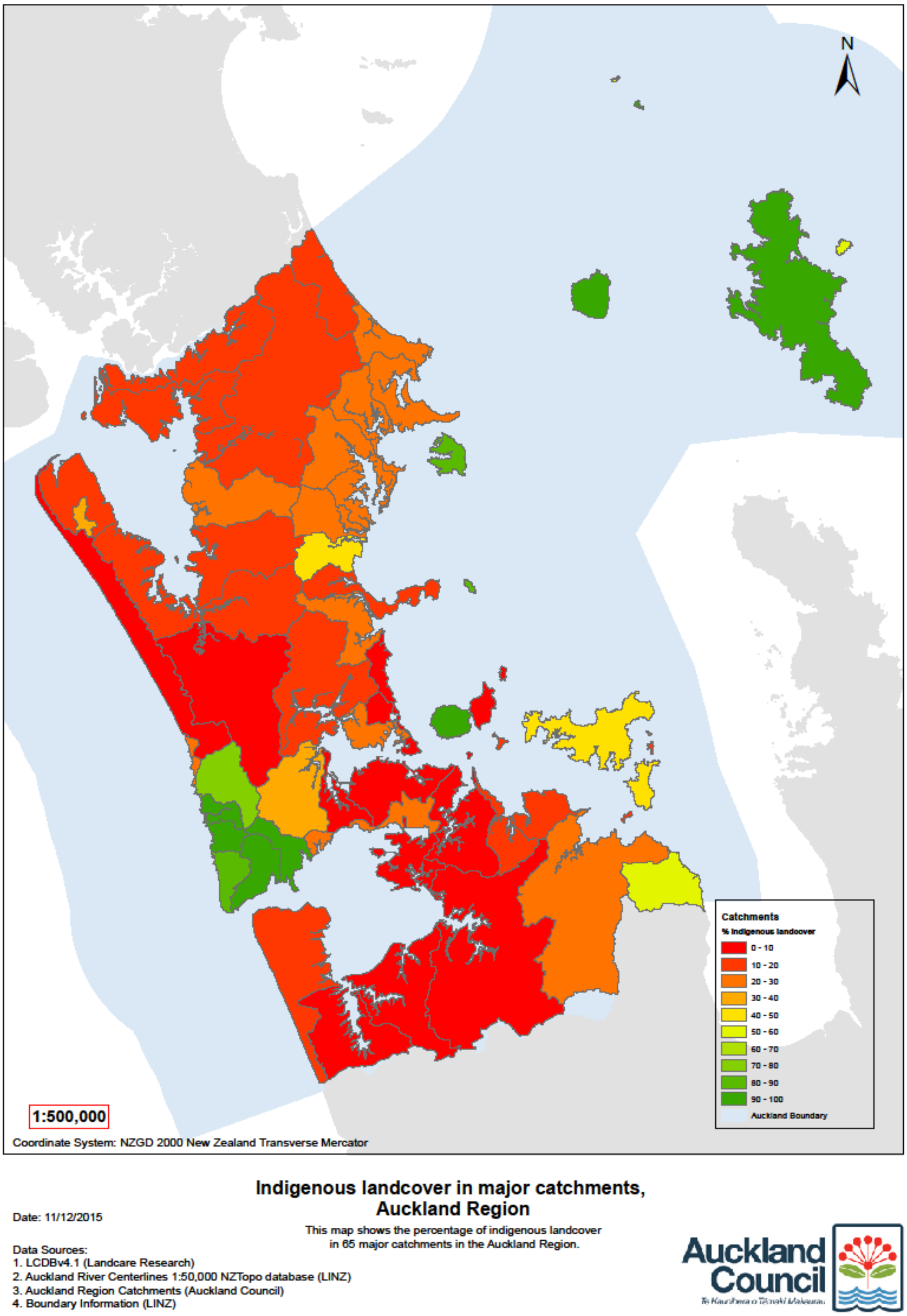

Figure 14-1 Indigenous land cover in major catchments in the Auckland Region.

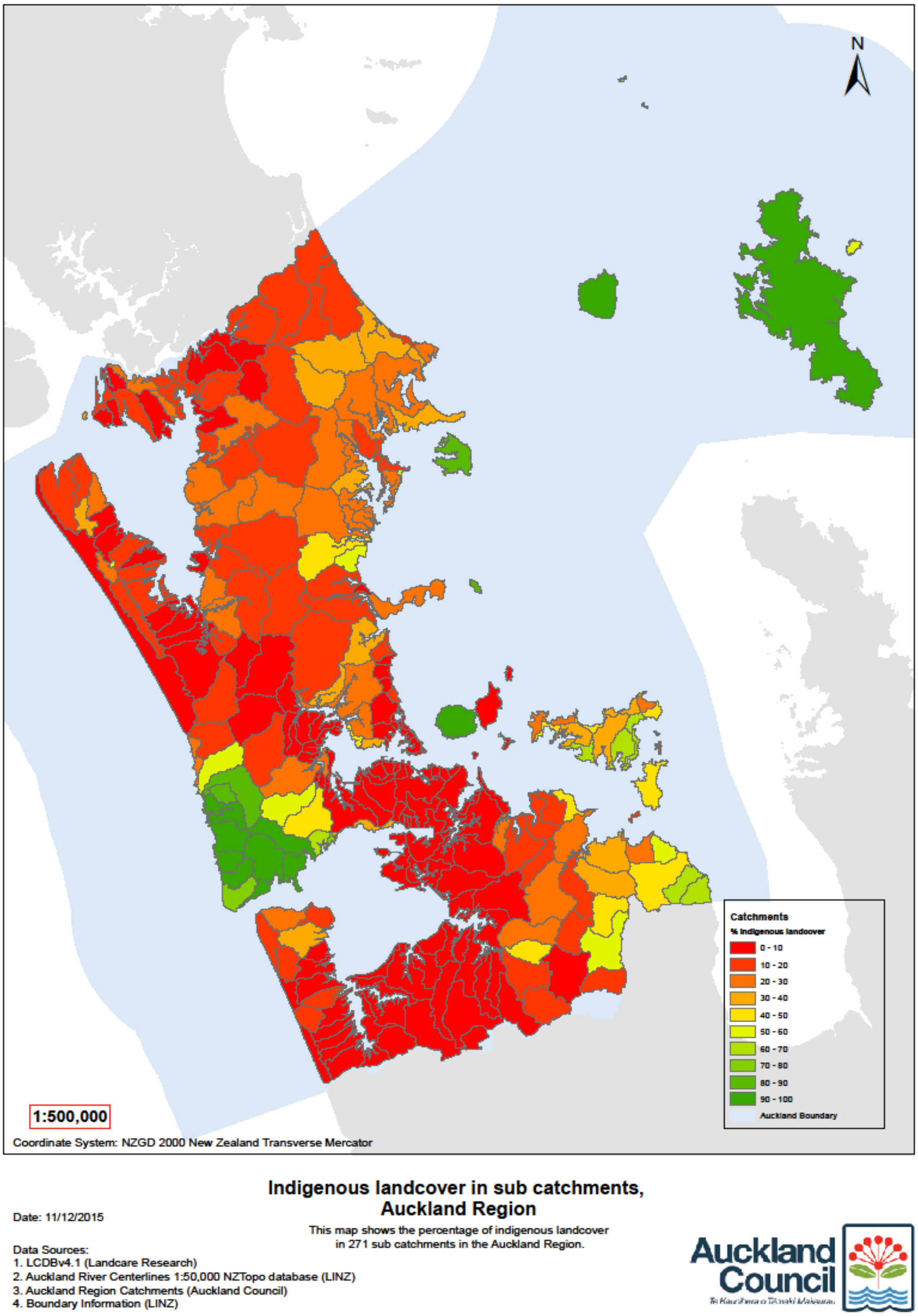

Figure 14-2 Indigenous land cover in sub-catchments in the Auckland Region.

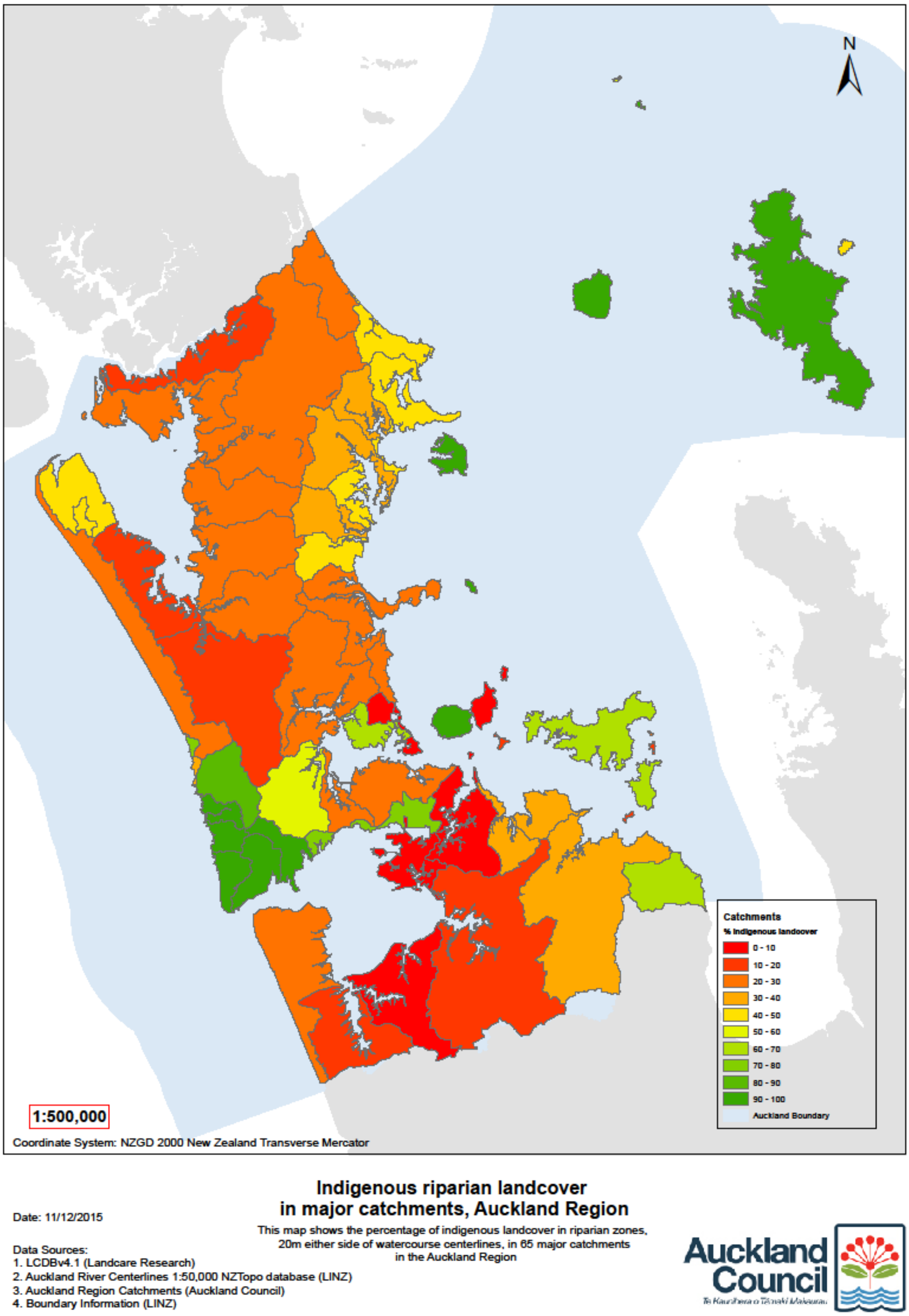

Figure 14-3 Indigenous riparian land cover in major catchments in the Auckland Region.

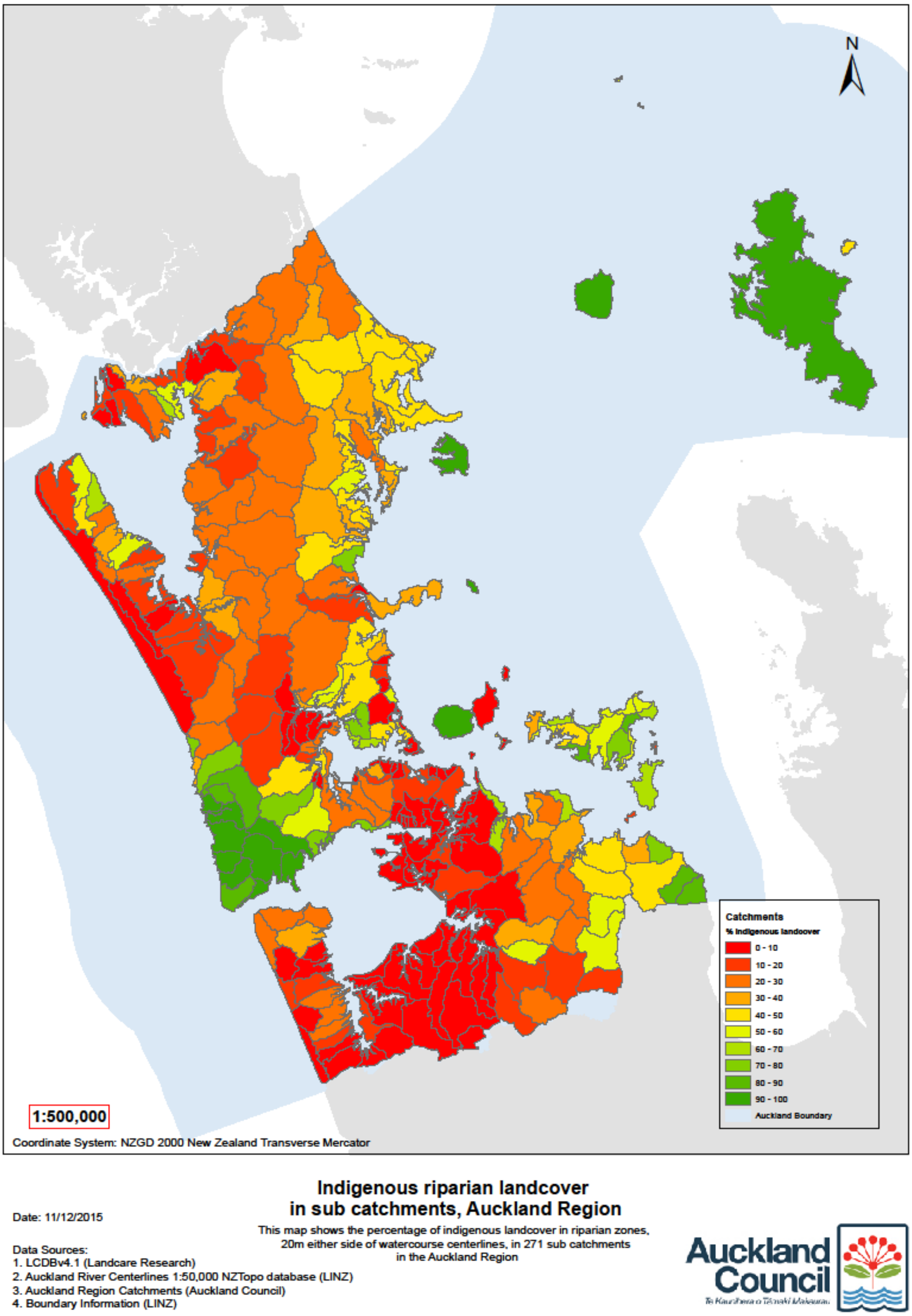

Figure 14-4 Indigenous riparian land cover in sub-catchments in the Auckland Region

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