forestry

Forestry Effects on Low Volume Rural Roads.

30 year Regional Forecast Study

Compiled by Moore and Associates for the Wanganui District Council (WDC) and New Zealand Transport Agency

1. Summary

The last two decades has seen intense phases of afforestation in the Wanganui region. Due to these phases of large scale forest establishment, forest harvest schedules will coincide, changing road useage patterns *(Graph 1 – Regional volume by harvest period)* and placing pressure on rural road maintenance schedules *(Appendices Chart 1- Potential road usage caused by forestry -30 year forecast).* The size and remote locations of major forest lots will require road maintenance and harvest regimes that maintain both public use and harvest sustainability.

Forest harvest schedules will be most intense in the period 2020-2030 with over 50 % of the regions forest estate reaching harvestable age. A number of factors will influence the saleability of these forest areas. Nationally and internationally these include log and wood related product demand; speculation suggests the influence of carbon markets will also be a major factor. Locally, saleability will be influenced by forest harvest infrastructure such as staff, machinery (e.g. haulers) accessibility and forecast profit margins.

Maintaining a road usage quality standard through harvesting periods will require proactive road maintenance schedules. Egress point and forestry related road usage data forecast in this study will aid these maintenance schedules. Sustainable road maintenance schedules need to consider not just road base course development but also road width, vision benching, road gradient, corner turning radius and bridge width/height and weight loading.

Regionally, forest stakeholders include small and large private ownership, farm forestry, local authorities, syndicates and large multinational companies.

Generally, forest areas closer to State Highways are of small to medium size and include multiple age classes, and as distances increase forest lots are characterised by large areas of even age class trees.

2. Introduction

This study investigates current regional trends in forest establishment and consequent forest harvest. Specifically, recommendations are made that allow for sustainable forest harvest and public road useage without net loss in road usage quality.

3.Methodology: Regional forecasts

3.1 Regional averages

In quantifying the regions expected logging volume and subsequent logging related traffic flows a number of regional averages were calculated for the purpose of this study.

3.2 Expected Yield (tons per hectare)

Variables affecting log yield include soil type, average annual rainfall, altitude, forest management regimes and to a lesser extent, storm related weather events. Local average log yields can vary from 400 tons/hectare to 650 tons/hectare based on these variables. The average log yield/per hectare adopted for the purpose of this study was chosen at 500 tons/hectare for inland steepland forests and 400 tons for coastal forests to best represent log yields across the region and also across harvest periods.

3.3 Log extraction and traffic flows

Extraction methods used in modern production forest regimes can vary depending on forest size, forest type, location, accessibility and staff experience. Extraction rates and processing ability has a direct influence on logging related traffic flows.

Experienced logging gangs working on accessible country with minimum hindrance to production (i.e.cutover, slope relief, brush) can be expected to average up to 200 tonnes a day through hauler extraction. Ground based operations can be expected to average 100 tonnes a day.

Ground based operations are expected to be the predominant method for small scale extraction i.e. <10 hectares.

Subsequent logging related traffic volume is therefore a measure of lot yield, gang productivity and forest lot accessibility.

Table 1: Key Regional Forecast Figures

Factor	***Rate***
Per hectare harvest yield (regional average)	*500 tonnes*
Average annual forest harvest (per gang)	*100 hectares*
Hauler extraction (per day)	200 tonnes/day
Ground based extraction (per day)	100 tonnes/day
Per truckload tonnage	28.8 tonnes

3.4 Trade flows (log haulage direction)

3.4.1 Local transport flow

The direction of forestry related traffic flows is influenced by a number of factors. Locally, route choice will be influenced by road standard, site access, bridges (e.g. loading limits, entry and exit angles), overhead obstructions (i.e. height limits), passing width, site access, paved/unpaved surface, traffic volume and road gradient. Key figures relating to rural road transport are set out below.

***Table 2:** Local Transport Flow: Key Figures*

Factor	*Average*
Minimum passing width (Logging truck)	5.5 metres
Minimum turning radius (Logging truck)	22-25 metres
Truckloads per day (per hauler)	6-7

3.4.2 Regional transport flow

Log quality and current log markets are primary indicators of the direction of logging related traffic flows on a regional scale. Regional location will also determine which route trucks will haul logs to market.

Other key determinants of route choice will be: distance to market, features enroute e.g. difficult intersections, towns, 'give way' and 'stop' points, speed limits, efficiency of turnaround times and access to paved roads.

The table below provides an estimate of the directional quantity split enroute to market by showing the end route (state highway number) of the regions logs. These figures are based on current estimates of market stability and regional log grade quality.

***Table 3:** Regional Log Volume: Directional Transport Figures*

Volume split estimated enroute	*Percentage %*	*Route*
Pulp	10	S.H.4 North
Export	40	S.H.1 South
Sawlog	25	S.H.1, 3 (Market dependant)
Pruned log	25	S.H.1, 3 (Market dependant)

A key factor affecting up to 50% of log volume is the viability and activity of local mills and their ability to purchase and process a number of other log grades (i.e. other than pulp and export grade logs). This model also assumes current forest management regimes (i.e. pruning and silvicultural programmes) will exist with newly established plantings.

3.5 Forest Harvest Schedules

The regional forest estate comprises over 600 separate forest lots. Forest management structures range from large commercial forest companies and joint venture forest initiatives to large and small scale farm forestry units and privately owned forests. Forest ownership is primarily private, however, company forests make up a large percentage of the total area of local forests.

3.5.1 Forest age at harvest

Forest age at harvest can vary depending on forest management, market dynamics, lot size and infrastructure e.g. roading. Across the region forest ages at harvest can vary from 25-35 years depending on local growing conditions. For practical purposes a harvest age of 30 years has been adopted for this study.

To forecast the predicted dynamics in forest harvest volumes over the next 30 years, 5 year age class harvest groups have been used to represent predicted harvest schedules.

***Table 4**: Harvest Groups*

Harvest group	*Year Planted*	*Harvest Year*
1	1980-1984	2010-2014
2	1985-1989	2015-2019
3	1990-1994	2020-2024
4	1995-1999	2025-2029
5	2000-2004	2030-2034
6	2005-2009	2035-2039
7	2010-2014	2040-2044
8	2015-2019	2045-2049

3.6 Egress point data

Egress points determine the entry point of forest related transport onto rural roads. These points provide a reference from which to forecast road maintenance schedules based on forestry related vehicular movements and tonnage travelling along the remaining section of road.

Egress point data and road usage forecasts show the regions potential forestry related transport activity. When combined with forest volume data this interplay creates a key indicator of forecasting forest impacts on low volume roads.

Factors influencing rural road egress points relate primarily to forest location; specifically local topography, aspect, soil substrate and private ancillary roading development by forest managers. Forests may have more than one egress point for a single forest compartment (i.e. even age crop) and this can be influenced by proximity roads, major waterways e.g. creeks, gorges and harvest techniques i.e. hauler versus ground based.

Maintenance of egress points relates to size and age class structure of the forest. Larger commercial forest lots often maintaining stable egress points based on prior harvesting and perpetual harvest regimes. However, smaller even age lots with remote access often have little or no forest roading infrastructure.

Actual location of egress points is often decided by road visibility, turning radius, soil type and local topographical features e.g. leading ridges, sunny northern aspects.

Egress point data is therefore a combination of known and forecast points based on information extracted through interviews and observation of roading trends.

3.7 Assumptions

This study has not allowed time to fine tune future yields but with continuing genetic improvements and management techniques volume production per hectare is only going to increase with time thus adding to the dimension of future roading volume.

Mapping has focused on larger growers with other blocks determined by age class by shadow interpretation. Given the photography used varies from one to five years old, some smaller and older aged blocks may have already been harvested.

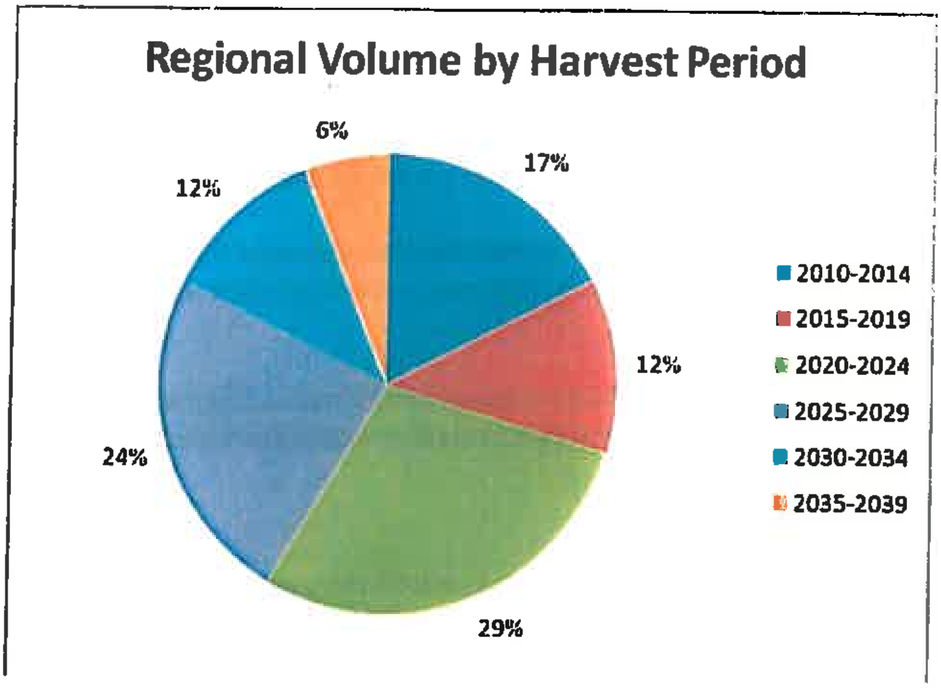
Egress points have been determined from Google photos and local knowledge. For greater accuracy, far more time would be required in a site by site inspection using GPS and related to local issues like corner adjustment to allow for hauler access.

4. Results

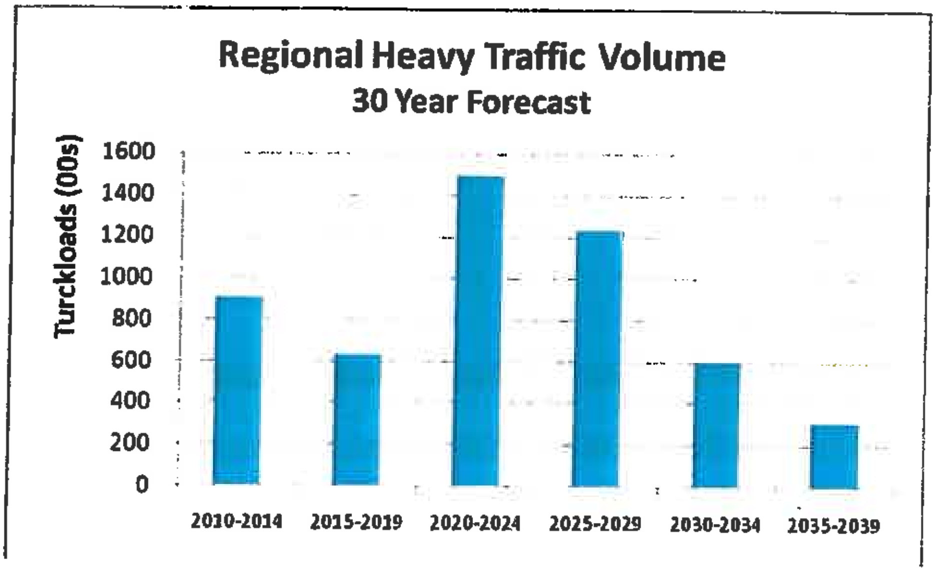
4.1 Chart 1-7 Potential road usage caused by forestry (appendices)

4.2 Chart 8 Regional egress point location by harvest period (appendices)

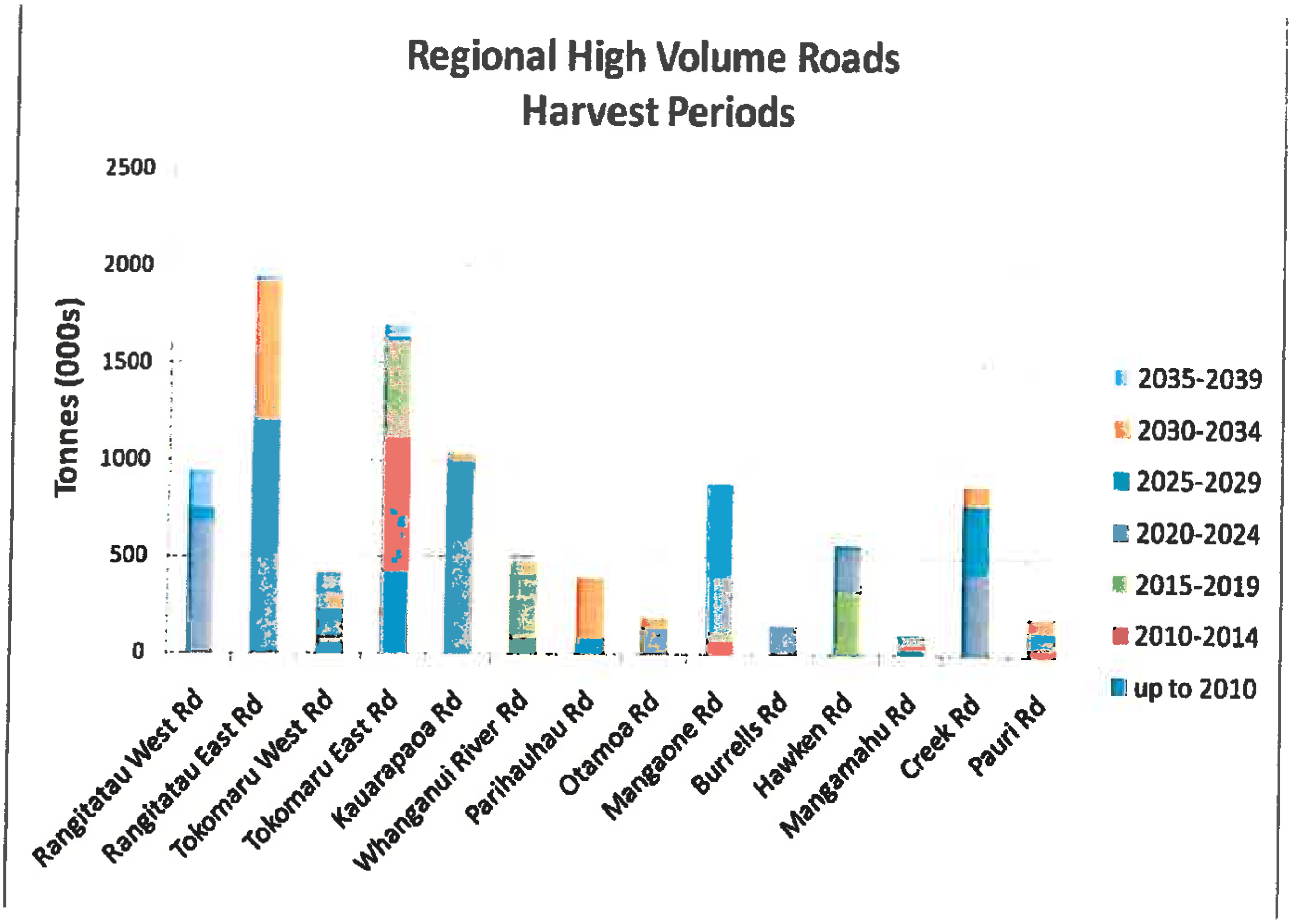
4.3.1 Regional volume by harvest period



4.3.2 Regional heavy traffic volume – 30 Year Forecast



4.3.3 Regional high volume roads-30 year forecast



5. Key findings

Results show a clear trend towards peak harvesting periods, egress point density and subsequent road usage. (appendices)

5.1 Peak harvest periods

The most intense period of harvest is forecast to occur between 2020 and 2030. Over 50 percent (approx 15,000ha) of the regions current forest estate will reach harvest age in this period. (graph-appendices)

5.2 Egress Point density

Key high volume egress areas potentially influencing low volume roads occur in the following areas.

- ***Major western roads***
  - Tokomaru East Rd, Tokomaru West Rd, Rangitatau East Rd, Rangitatau West Rd, and Kauarapaoa Rd.
- ***Major eastern roads***
  - Creek Rd, Mangamahu Rd, Kauangaroa Rd, Warrengate Rd.
- ***Major northern roads***
  - Mangaone Rd, Whanganui River Rd, Parihauhau Rd, Otamoa Rd, Hawken Rd, Burrells Rd.
- ***Major southern roads***
- Pauri Rd, Pauri Domain Rd, Wikitoria Rd

5.3 Egress point characteristics

5.3.1 Location, size and harvest schedule

Western, Northern and Eastern roads

In western, northern and eastern areas egress points closer to state highways often represent smaller mixed age forest lots and in more remote areas are characterised by larger even age lots.

Roads in these areas that will experience the biggest change in forestry related heavy traffic are those with large forest lots maturing simultaneously.

Exceptions occur on Tokomaru East and Mangaone road where current forest harvest regimes are similar to that of a production forest.

Southern roads

In major southern areas (i.e. Harakeke and Kaitoke) egress points are fewer but represent an ongoing production forest cycle. As such, road usage will remain constant and is unlikely to be influenced by major even age harvest. Forestry related heavy traffic volumes are unlikely to change significantly.

5.3.2 Trade flows: Log haulage direction

Convergence of heavy traffic flows will place pressure on other roads enroute to State Highways.

Western roads

In western areas these areas include Brunswick Road, and Blueskin Road as Tokomaru and Rangitatau group related traffic access S.H.3.

Eastern roads

In eastern areas Mangamahu and Whangaehu Valley related traffic will affect Kauangaroa Rd and Warrengate Road enroute to S.H.3.

Northern roads

All high volume northern roads access S.H.4 directly.

Currently, these junction areas are relatively stable however, market dynamics could affect route change based on log grade demand. This may see minor road usage change enroute to state highways. If change occurs it will primarily affect roads in the eastern and western areas. Roads such as No 2 line and Brunswick Road could experience change in usage patterns based on these market driven forces.

5.3 Roading

Safety Considerations /Maintenance schedules

Pre-emption of factor influencing road usage quality during peak harvest periods will rely on proactive road maintenance schedules and effective communication between roading engineers, forest managers and public users.

Road safety

- Public traffic volume, potential traffic interactions, visibility, average speed on carriageway and communication are key determinants of accident causation.
- Road users need to be aware of forest operations and understand daily and weekly traffic flows to minimise accident potential.
- Public meetings/notices, heavy traffic signage, laybys, distance (km) markers, vision benching, driveway mirrors and, in some cases. radio communication are all effective means of minimising accident potential.

Road maintenance schedules

- Base course development will need to allow for appropriate consolidation periods prior to increased forest traffic volume. In this regard net material loss i.e. from roads will be more efficient and require less re-supply.
- Base course development should allow for seasonal models in harvesting, harvest volumes and also severe weather events.
- Carriageway width needs to allow for appropriate visibility, speed limits, passing areas and overhead obstructions.
- Perimeter road fencing should also be assessed as a factor influencing potential low volume road width.
- Road gradient, to minimise base course degradation, should be considered in maintenance schedules. Especially on tight uphill corners.
- Culverts and road drainage systems need to be of a grade and quality to withstand increased weight loading and potentially, increased sediment flow from forest operations and severe weather events. The interplay between severe weather and poorly maintained culverts can be crucial in sustainable road use.
- Entry and exit angles from corners, bridges and egress points needs to be considered and allow appropriate distance for heavy traffic entry set up.
- Vision benching should be considered on blind corners and egress points to minimise accident potential.
- Forest managers and roading engineers need to discuss mechanisms for harvest machinery accessibility e.g. haulers. Potential exists for this to be a major limiting factor in forest harvestability and harvest periods. The Kauarapaoa and Creek Roads will be the most affected.
- Bridges will also have to be considered as many legal roads end on the property side. Width and weight loading are also issues.

6. Key Considerations

6.1 Carbon Trading

Current trends towards 'carbon' forests (i.e. carbon storage through exotic plantation forestry) may influence regional log grade quality and affect transport route trends. Currently, any attempt to predict this directional flow is speculative and depends on the stabilising of factors such as the ETS (Emissions Trading Scheme), international carbon markets/policy and its manifestation in NZ markets. Of importance to rural roading is that the most likely areas to be forested will be those areas like the Ahu Ahu Valley Road, Whanganui River Road, upper Paraparas and Whangaehu Valley with an indeterminate of whether they are harvested, in whole, partially, or at all.

Pre 1990 forests- Logging may cause liabilities.

If domestic carbon regulations tighten harvestable woodlots established pre-1990 may be penalised dependant on their size. If this coincides with poor wood markets net benefit for forest owners would be minimal. Presently, size will influence the ability of woodlot harvestability under this scheme.

Areas under 2 ha and under 50 ha both have mechanisms to apply for exemptions under this scheme. This may have a large influence on harvest potential for small private blocks, farm forestry and group title syndicates.

Post 1989 forest – Carbon trading potential, realising cash flow

Currently, exotic forest established after 1989 may be eligible for collecting NZUs (New Zealand Units) under the ETS. However, this has to occur within a stipulated timeframe. When committed to the ETS these forests will also be liable for any corresponding penalties incurred through deforestation relative to the carbon storage potential of their woodlot.

6.2. Re-establishment/silvicultural trends

A key factor of 'carbon' forest management will be the extent of, or lack of, silvicultural regimes. Large even age carbon forests are likely to be established in remote areas; the costs and benefit of silvicultural regimes will be negligible compared to producing the maximum volume per hectare.

Based on current demand for carbon storage it is likely the character of regional log grade quality will change. This could mean large woodlots of poor average log grade quality will exist in remote areas. On skeletal soils and during storm events, these may cause slippage affecting roading infrastructure such as bridges and causing debris blockages onto some roads as was well evidenced during the 2004 storm events.

A number of interviewees speculated a large increase in establishment trends in the next 2-5 years based on carbon trading.

6.3 Forest Industry Infrastructure: Limiting factors

All harvest periods outlined in this study rely on the availability of supporting forest infrastructure. The condition of local infrastructure relating to forest harvest could have a major influence on forest harvest timeframes and related traffic volumes.

Extraction timeframes

Extraction timeframes will rely on machinery and skilled staff availability. Currently, levels of appropriately skilled staff and machinery in the region will not be able to match the expected log harvest forecast.

Logging timeframes will also be influenced largely by gang productivity. Daily hill country production levels in this study have been based on 200 tonnes a day (hauler extraction). However, if insufficient harvest infrastructure influences a fall in average productivity harvest time frames will increase. In this scenario, forest traffic volumes will be less intense but longer. Whilst this may lengthen the extraction window, it will also increase the volume.

7. Conclusions

This study reaffirms the increase in afforestation that occurred during the early to mid 1990s. It also quantifies expected log yields per road and in doing so, prioritises road maintenance schedules for high volume roads in the region.

Road usage and egress point forecast identify both high volume periods and harvest areas. Key harvest periods exist between 2020 and 2030 when over 50 percent of the regions forests reach harvestable age. Variable log grade and wood product demand, carbon trading, local mill viability and forest infrastructure (machinery & skilled staff) are all major factors influencing future forest harvest, re-establishment and harvest timeframes. In reality, it is most unlikely that these areas will be harvested within the designated harvest groups but will result in larger tonnages over an extended period. Likewise, there may be areas that are not harvested.

High volume areas influencing low volume roads are located in western, northern and eastern roading groups. Rangitatau, Tokomaru, Kauarapaoa, Parihauhau and Mangamahu group roads carry a large percentage of regional volume. A relationship exists on these roads between distance from state highway, large average lot size and even age plantations. This relationship has implications for road maintenance schedules.

The implications for roading maintenance must also be extended to sealed roads where a combination of poor basement and trucking intensity will cause severe breakdown of surfaces. Pauri, Warrengate and Brunswick Roads are such examples.

Ancillary service traffic will add to the total vehicular movement.

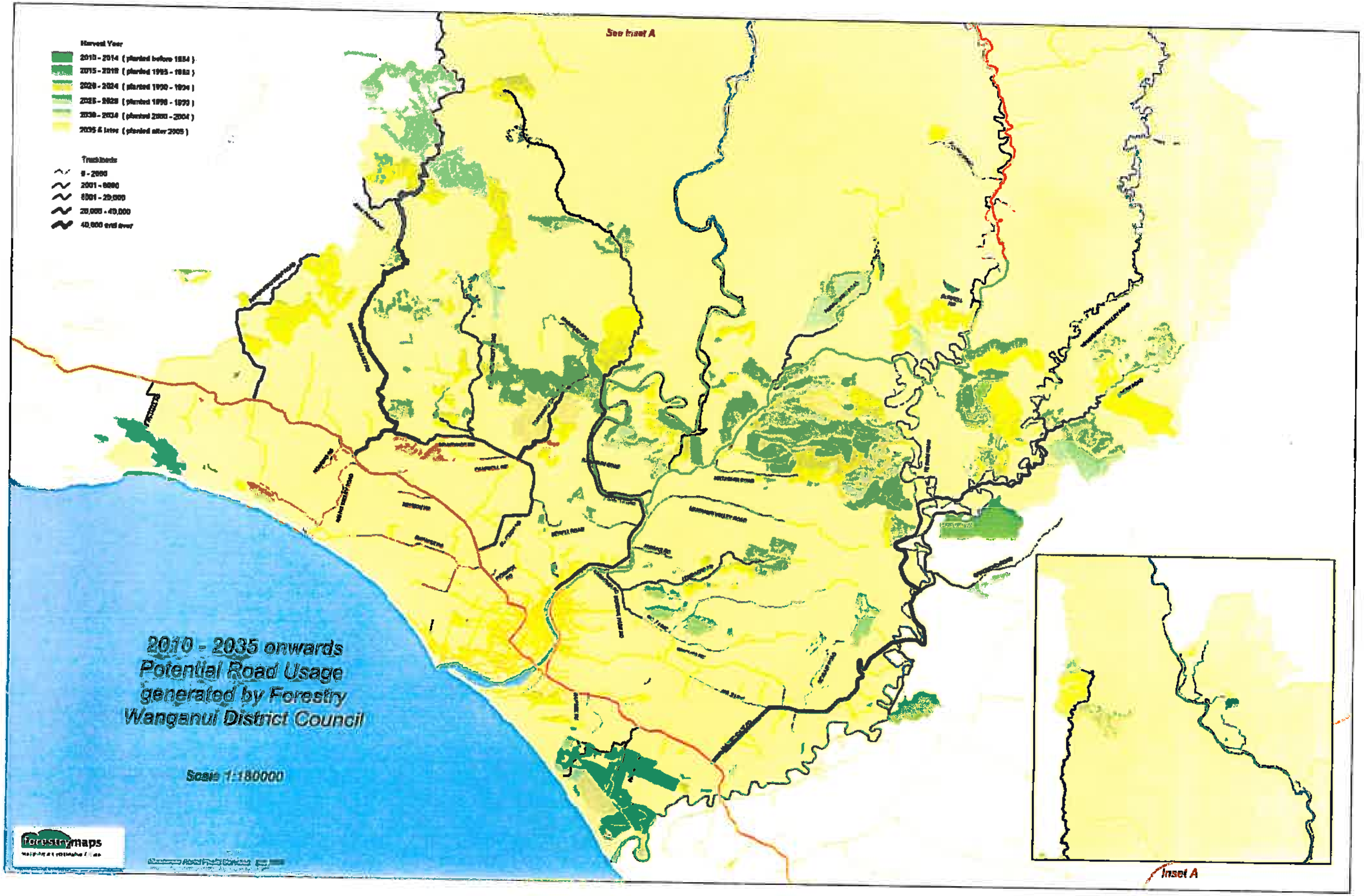
Wanganui District Council roads will be used to service afforested areas outside Wanganui's territorial boundary, especially on the mid-western and eastern margins.

Ian Moore

14Th October 2009

Appendix 4.1

Chart 1-7 Potential road usage caused by forestry



Harvest Year
2010 - 2014 (planted before 1984)
2015 - 2019 (planted 1985 - 1989)
2020 - 2024 (planted 1990 - 1994)
2025 - 2029 (planted 1995 - 1999)
2030 - 2034 (planted 2000 - 2004)
2035 & later (planted after 2005)
Truckloads
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6001 - 20,000
20,000 - 40,000
40,000 and over
See Inset A
Inset A
2010 - 2035 onwards
Potential Road Usage
generated by Forestry
Wanganui District Council
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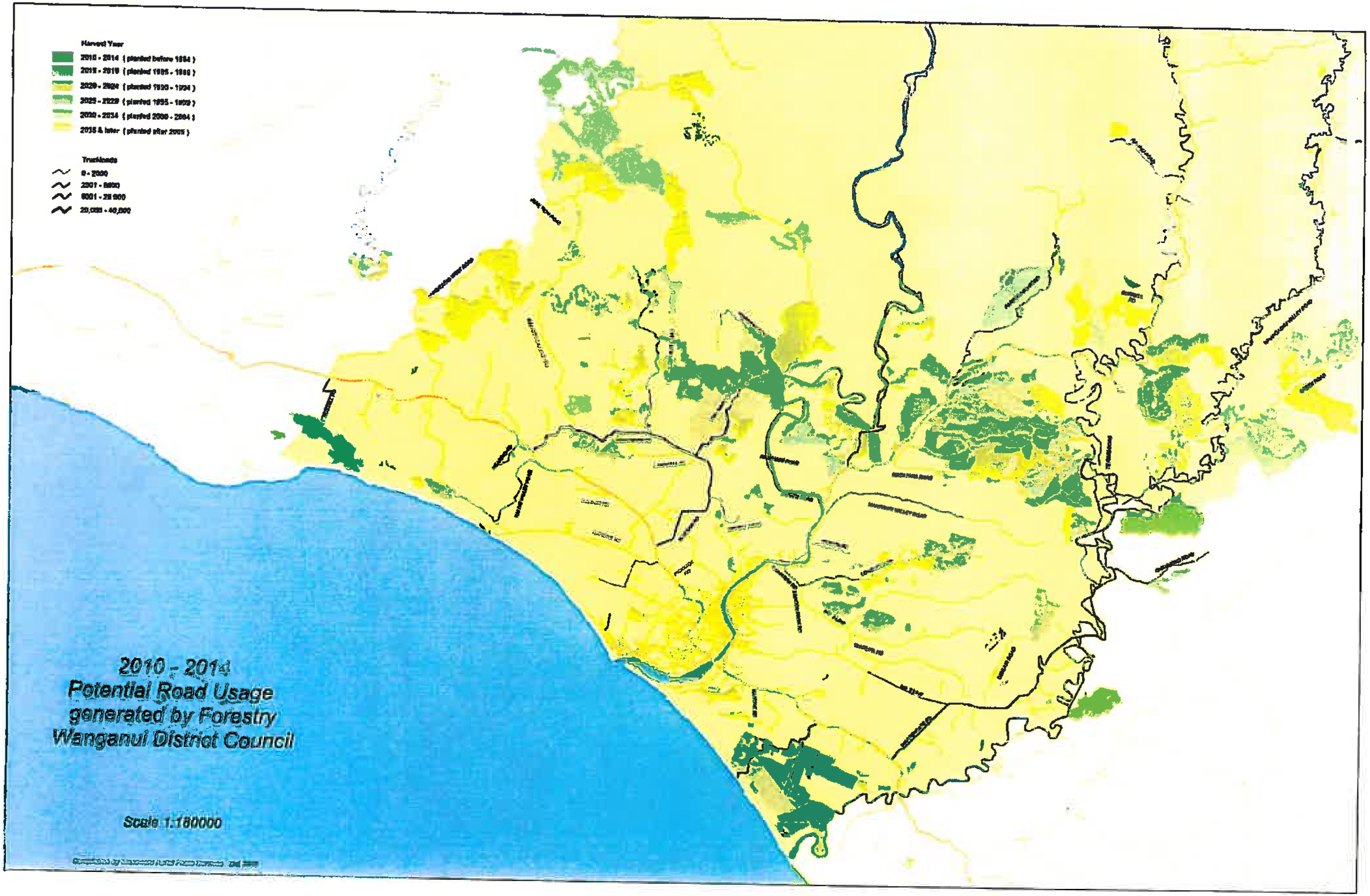
forestrymaps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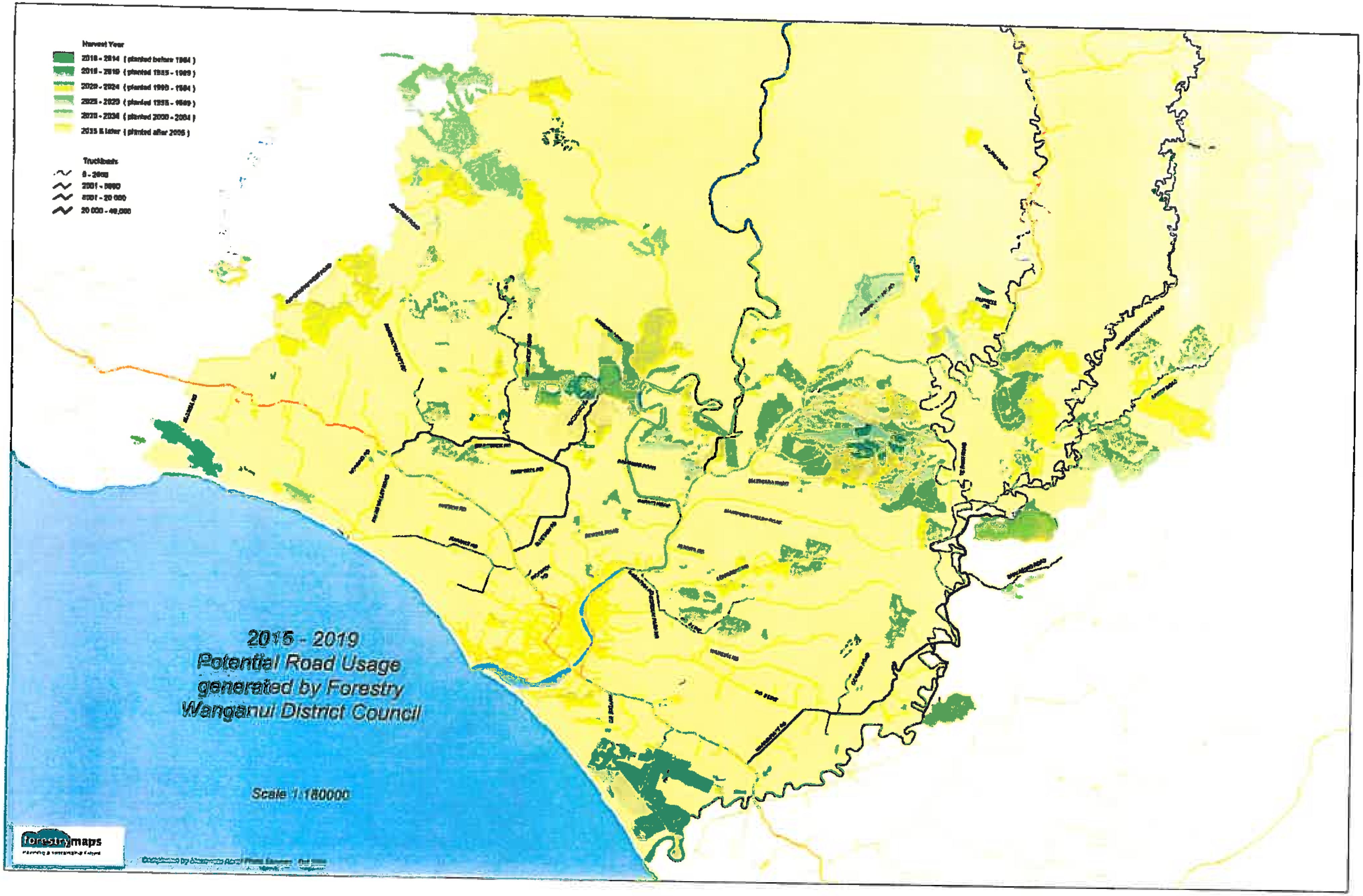
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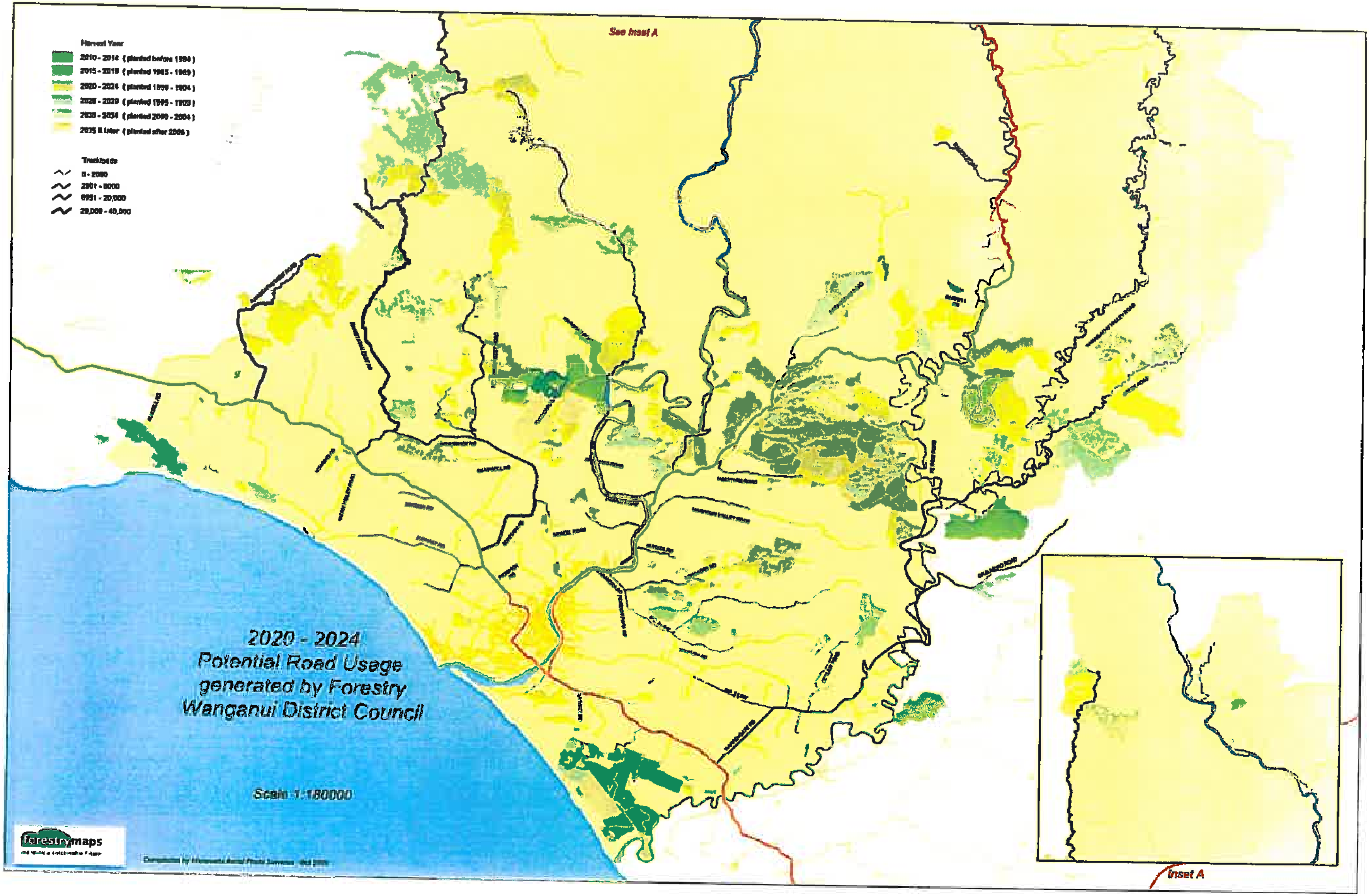

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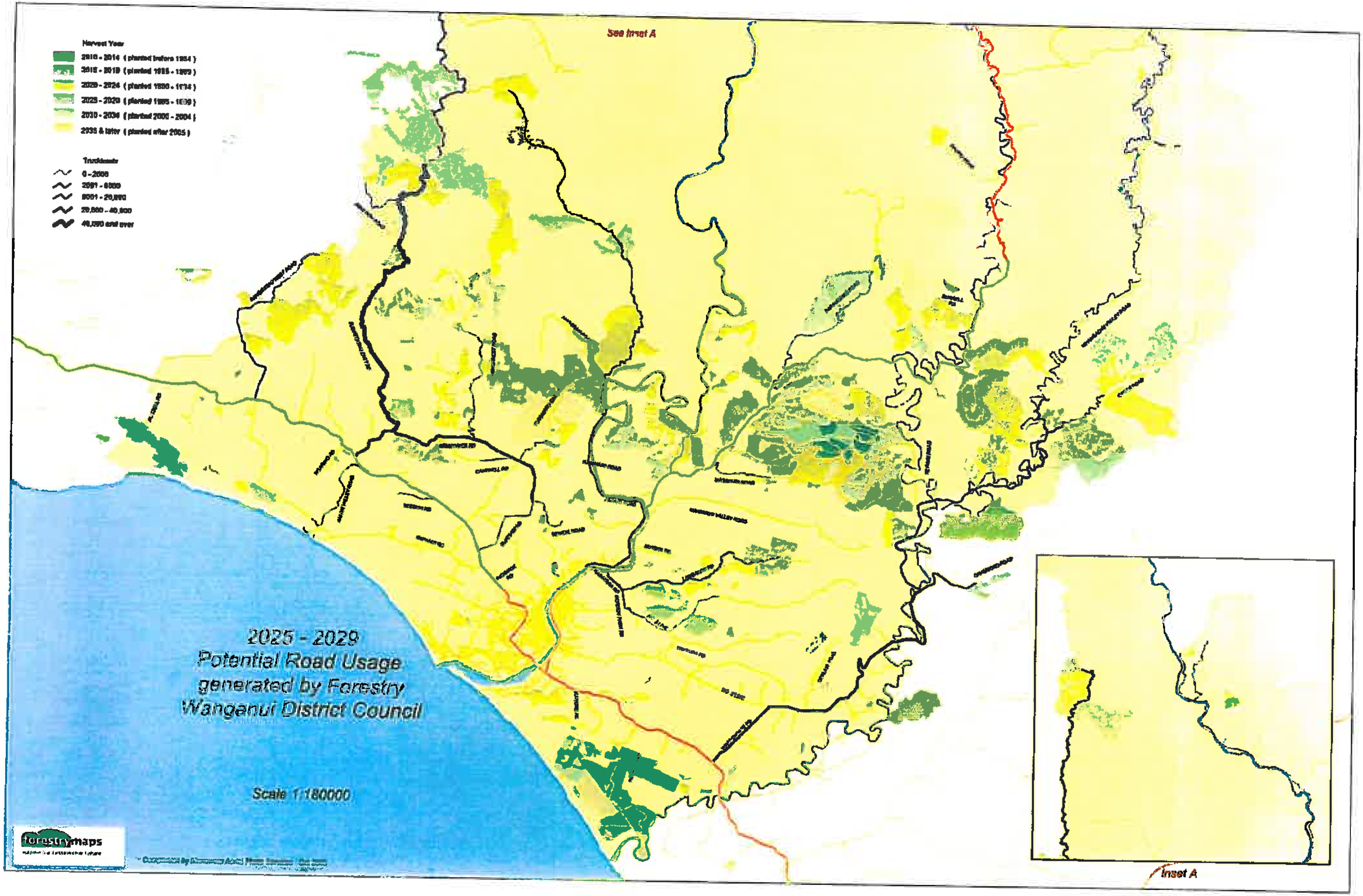
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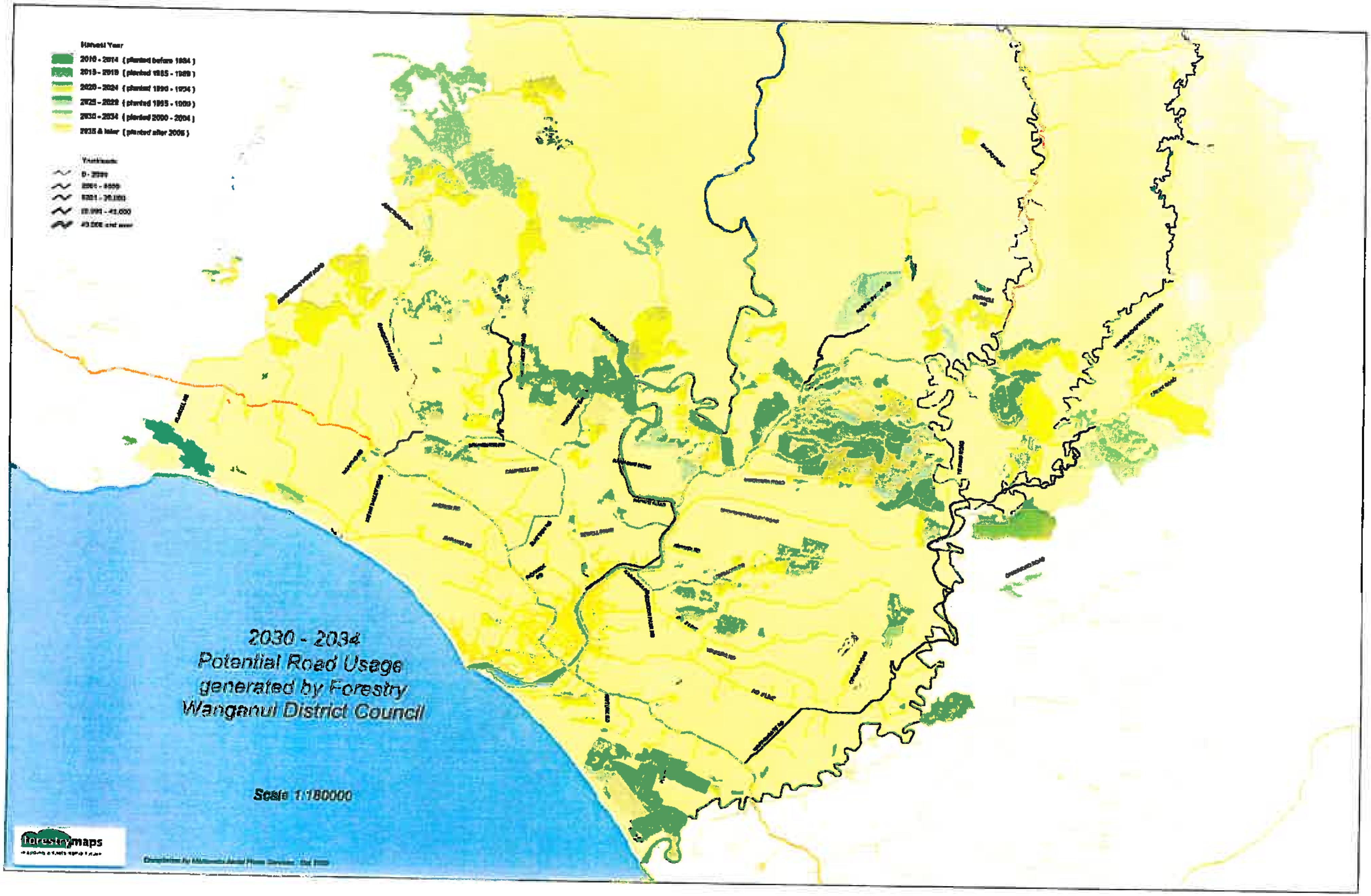

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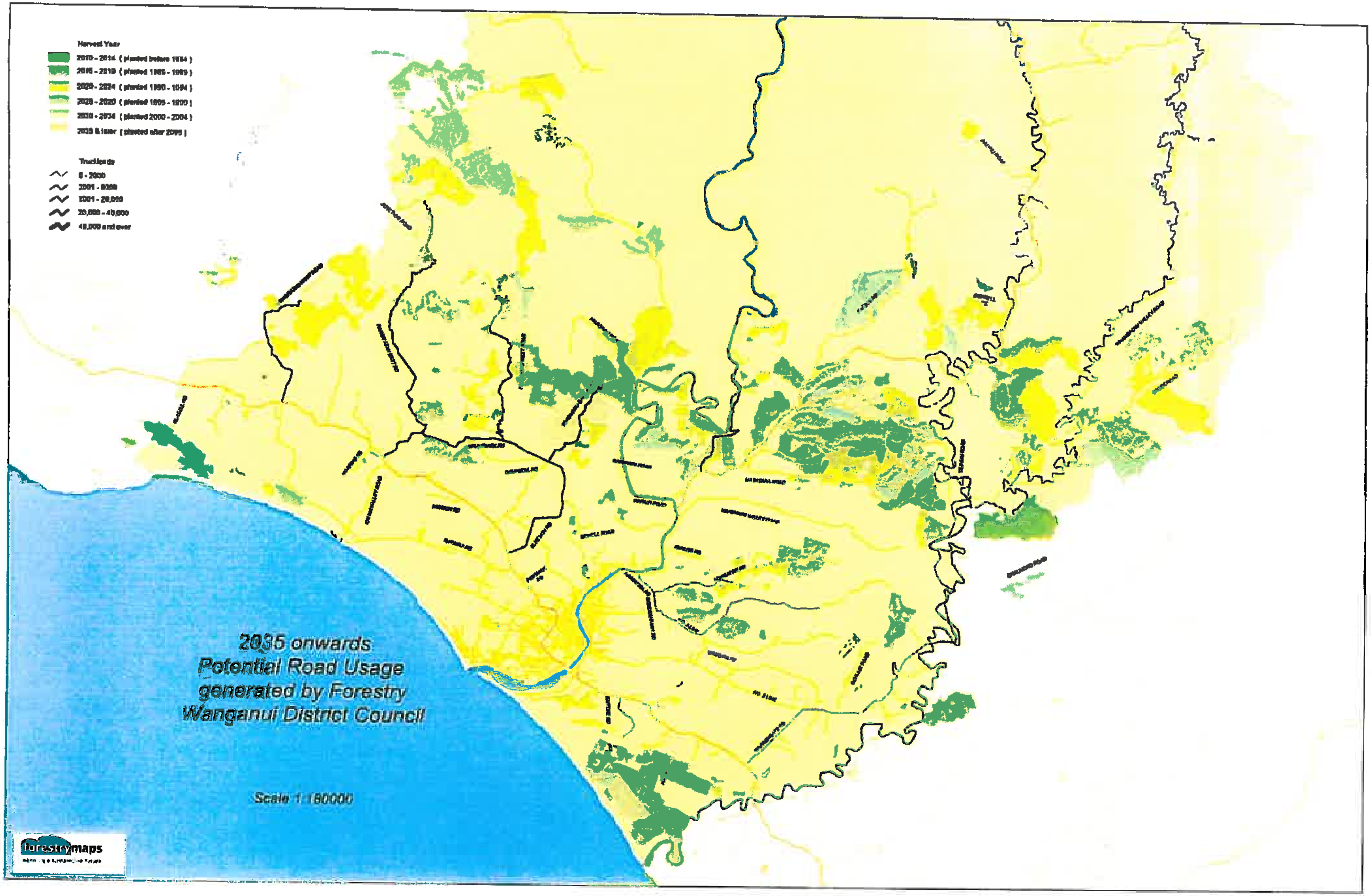

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Truckloads
0 - 2000
2001 - 8000
8001 - 20,000
20,000 - 40,000
40,000 and over
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Potential Road Usage
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Wanganui District Council
Scale 1:180000
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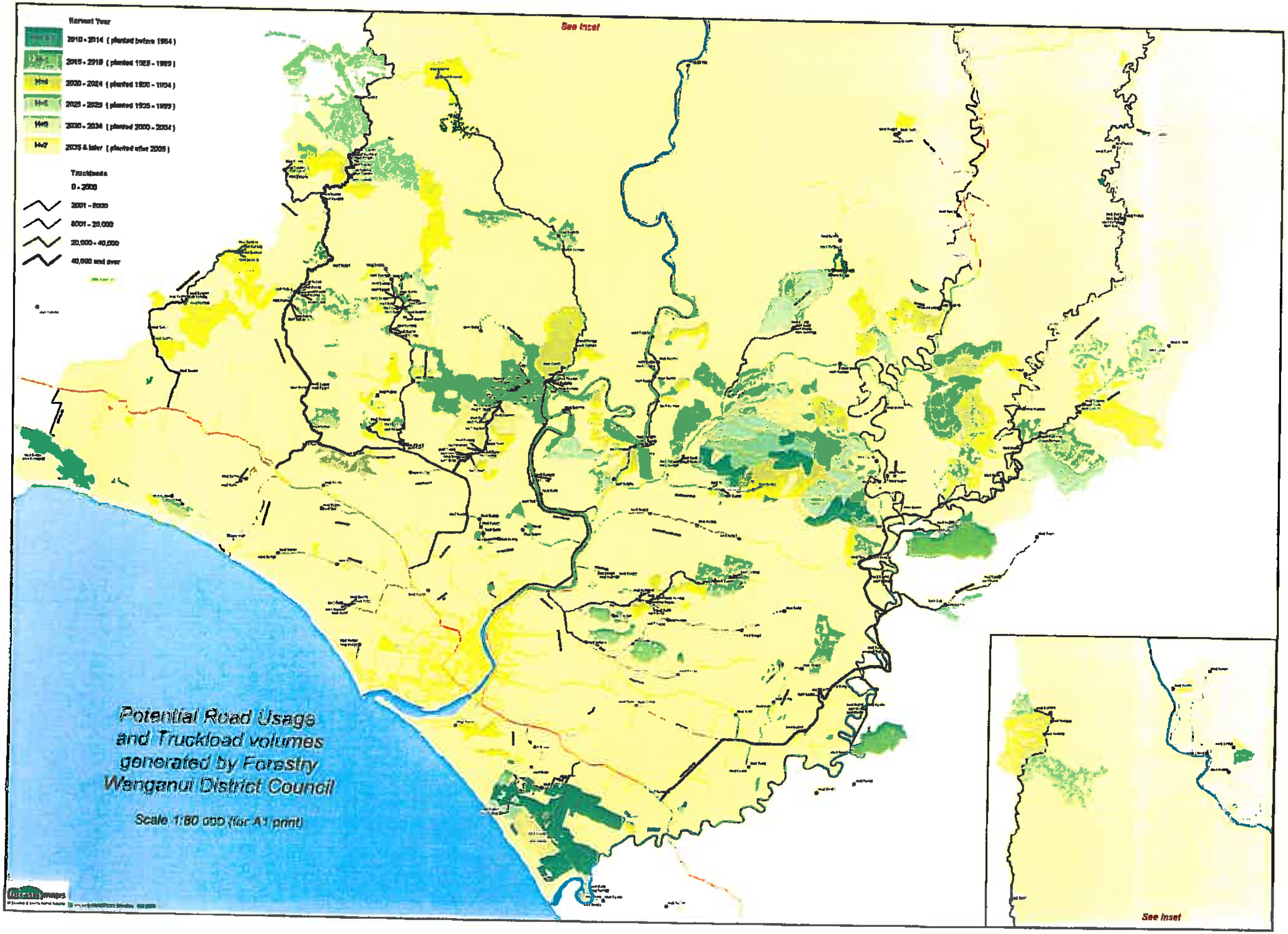
Appendix 4.2

Chart 8 Regional egress point location by harvest period



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Wanganui District Council
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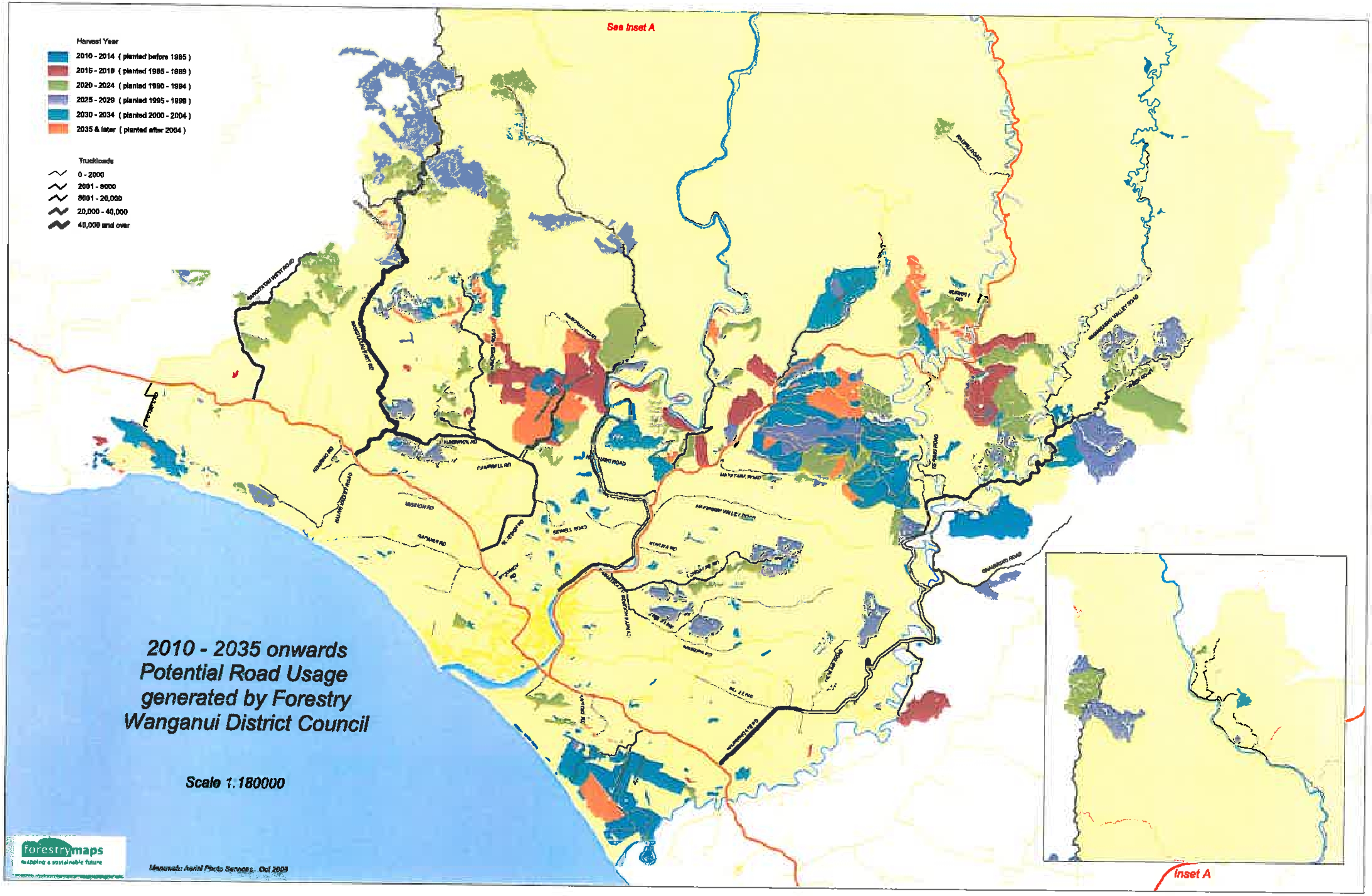

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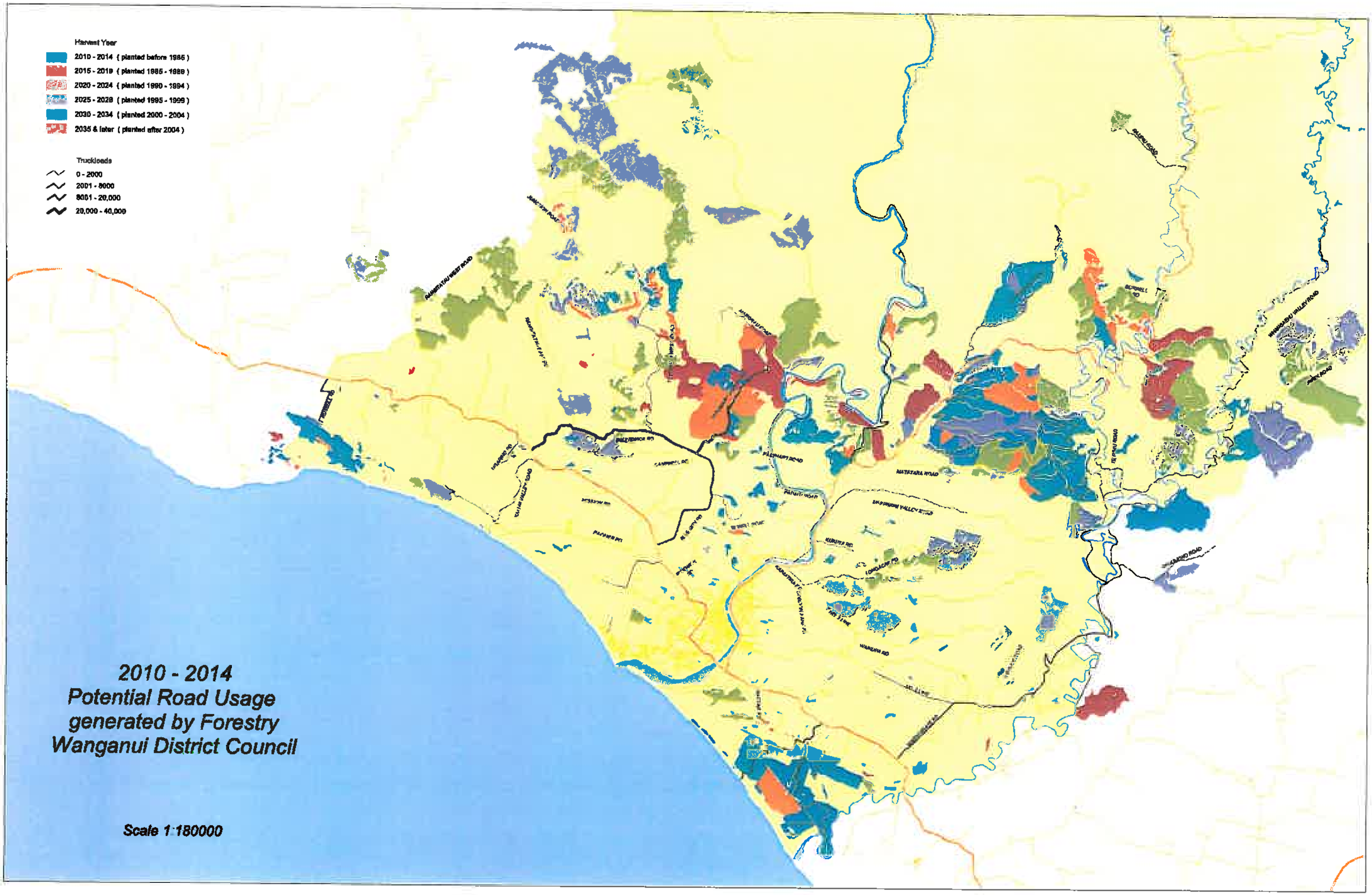
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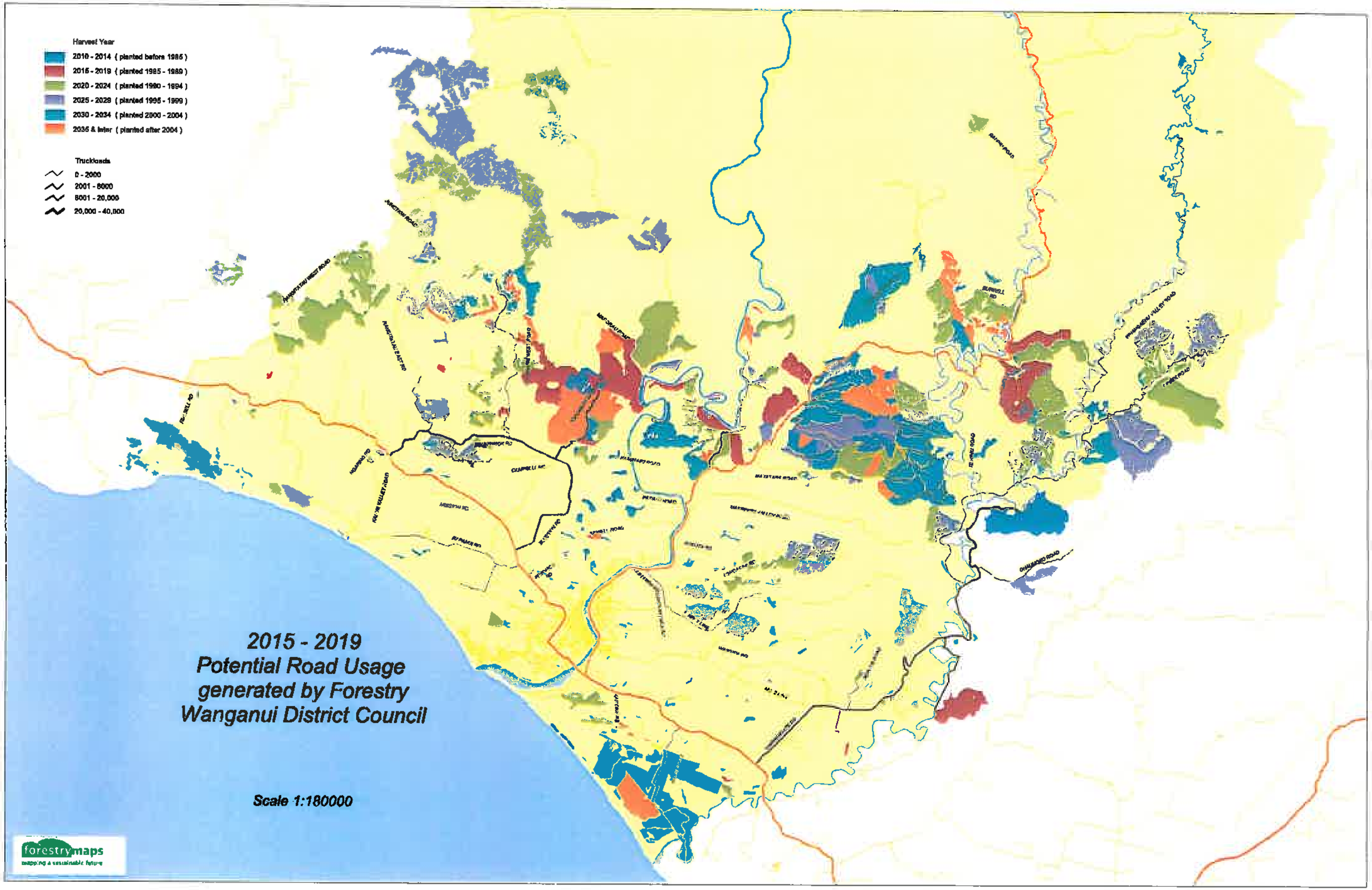
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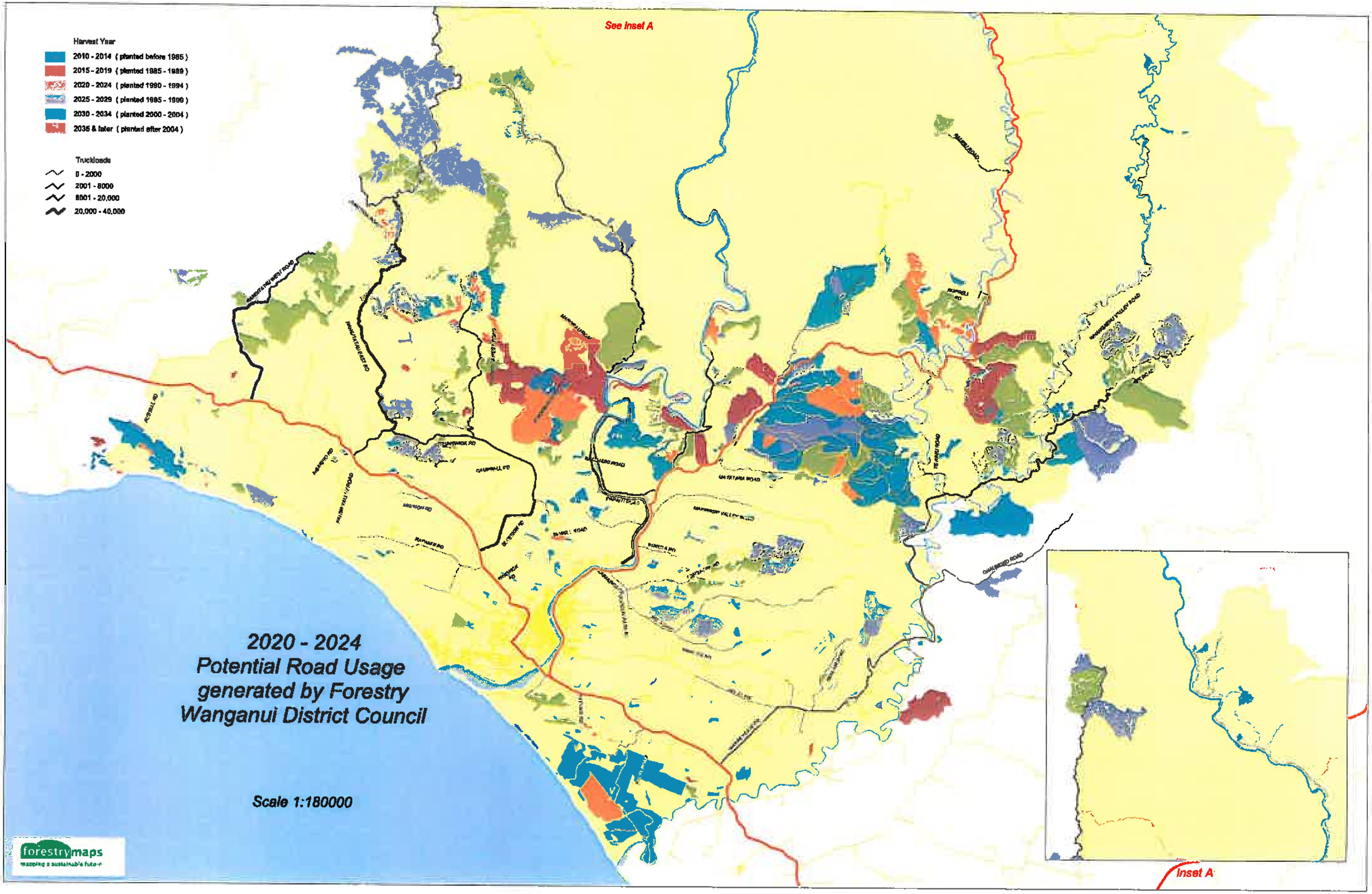
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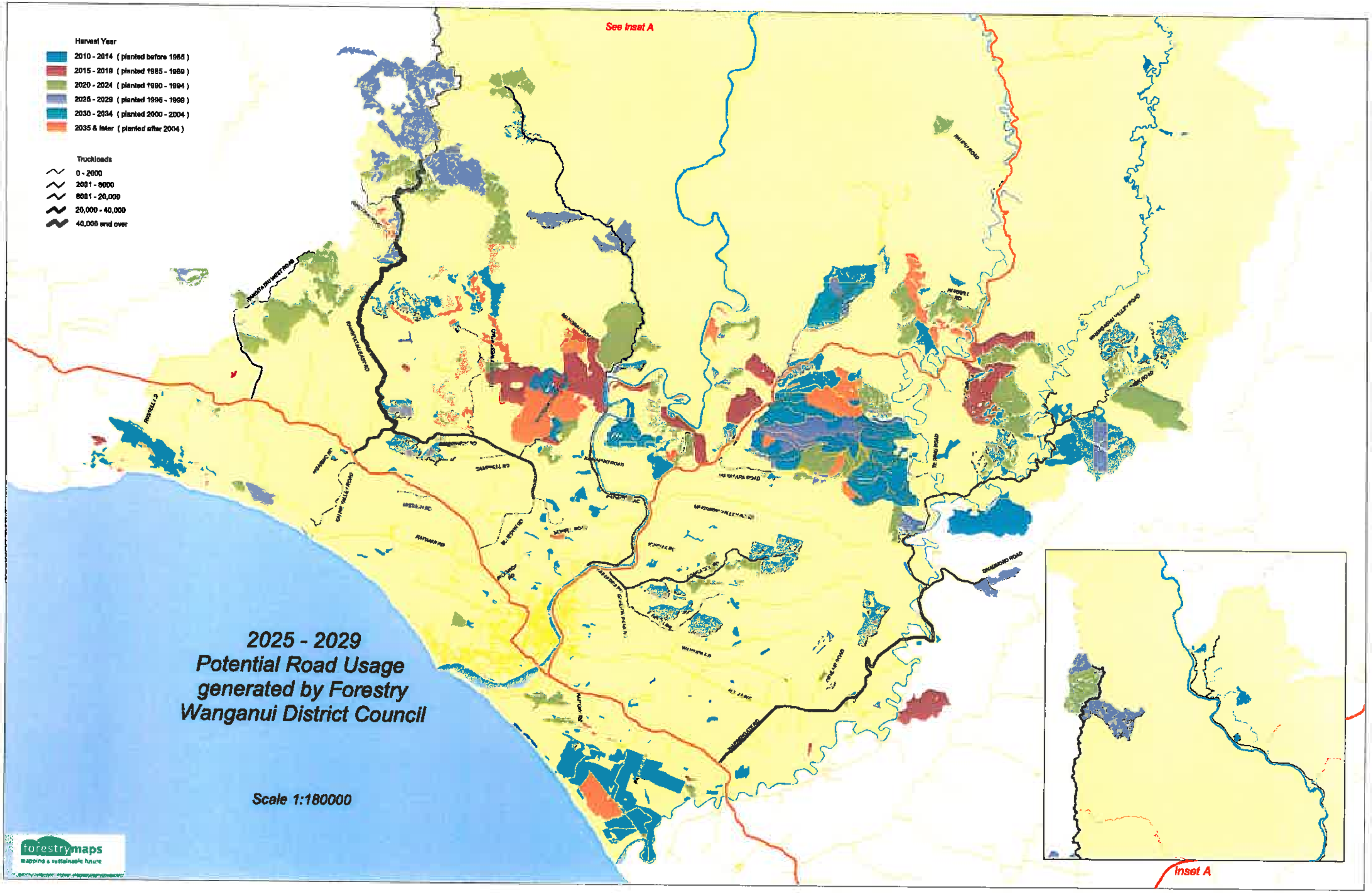

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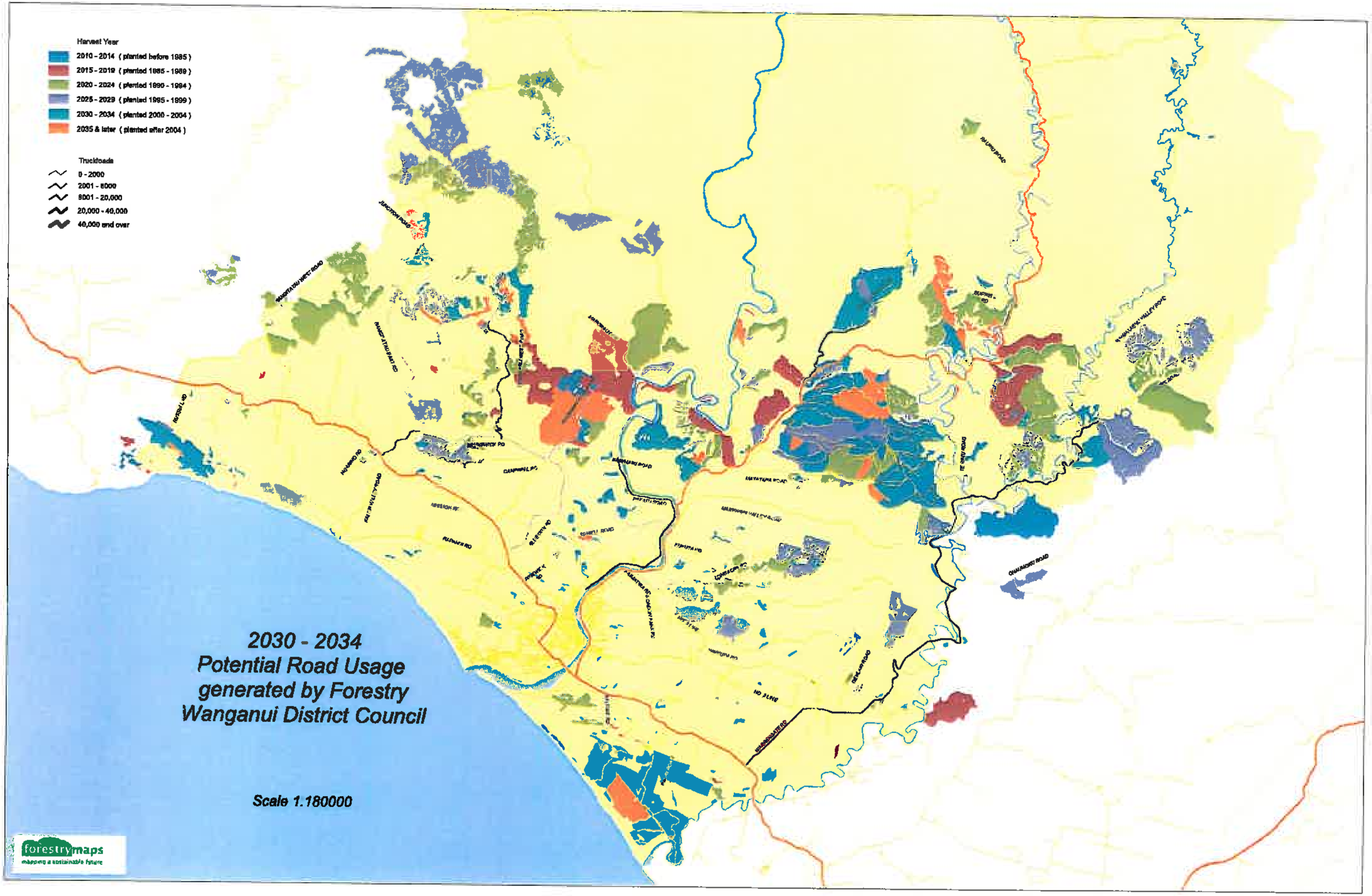
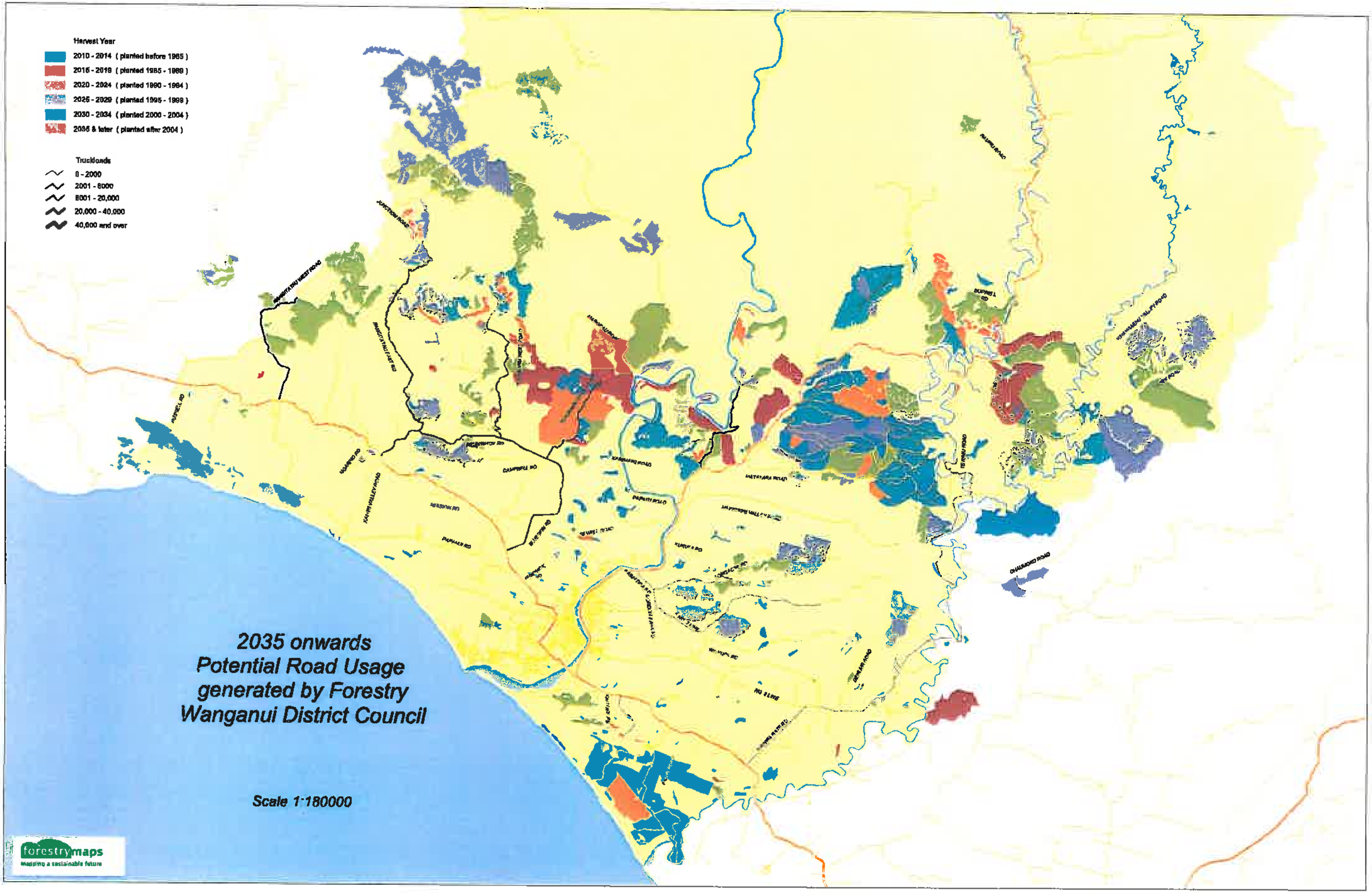

Harvest Year
2010 - 2014 (planted before 1985)
2015 - 2019 (planted 1985 - 1989)
2020 - 2024 (planted 1990 - 1994)
2025 - 2029 (planted 1995 - 1999)
2030 - 2034 (planted 2000 - 2004)
2035 & later (planted after 2004)
Truckloads
0 - 2000
20,000 - 40,000
40,000 and over
2030 - 2034
Potential Road Usage
generated by Forestry
Wanganui District Council
Scale 1.180000
forestrymaps
mapping a sustainable future


Harvest Year
2010 - 2014 (planted before 1985)
2015 - 2019 (planted 1985 - 1989)
2020 - 2024 (planted 1990 - 1994)
2025 - 2029 (planted 1995 - 1999)
2030 - 2034 (planted 2000 - 2004)
2035 & later (planted after 2004)
Truckloads
0 - 2000
2001 - 8000
8001 - 20,000
20,000 - 40,000
40,000 and over
2035 onwards
Potential Road Usage
generated by Forestry
Wanganui District Council
Scale 1:180000
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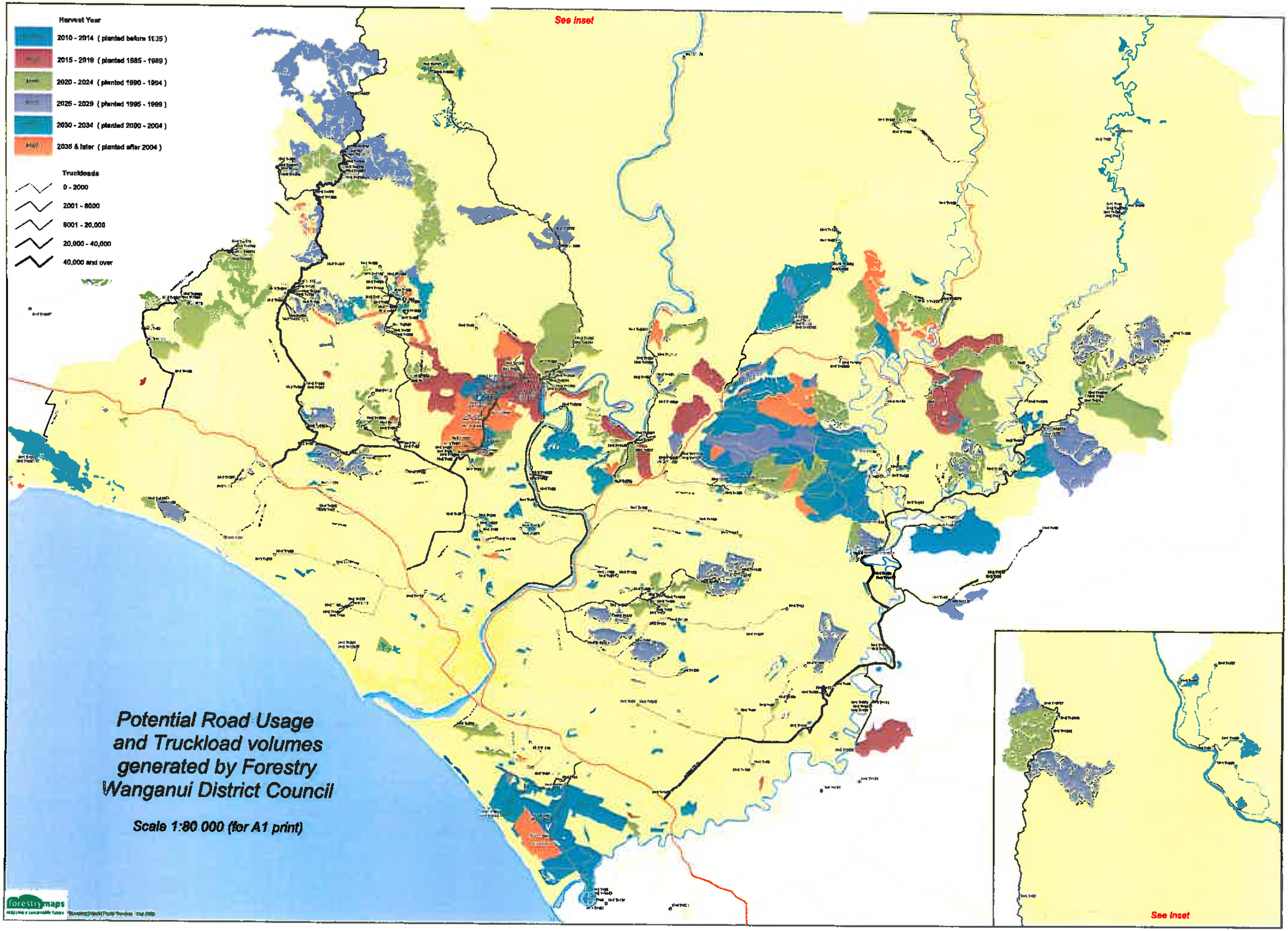
Harvest Year
2010 - 2014 (planted before 1985)
2015 - 2019 (planted 1985 - 1989)
2020 - 2024 (planted 1990 - 1994)
2025 - 2029 (planted 1995 - 1999)
2030 - 2034 (planted 2000 - 2004)
2035 & later (planted after 2004)
Truckloads
0 - 2000
2001 - 8000
8001 - 20,000
20,000 - 40,000
40,000 and over
See Inset
See Inset
Potential Road Usage
and Truckload volumes
generated by Forestry
Wanganui District Council
Scale 1:80 000 (for A1 print)
forestrymaps