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TRAnsport Network Strategic Investment Tool (TRANSIT)

Overview and Applications

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Important disclaimer

Contents

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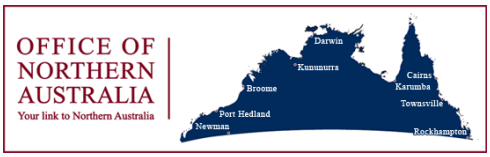
A large amount of industry, State and Territory government support was provided to the project team in the form of local expertise and data. The authors particularly acknowledge the following: Chris Chilcott, Carly Waide and others (Queensland Department of Agriculture and Fisheries); Andrew Armstrong and others (Queensland Department of Transport and Main Roads); Adele Kluth and Barb Littler (Northern Territory Government); Brad McCormick and Peter Cunningham (Western Australia Department of Agriculture and Food); Renee Clegg and Alice Gillam (Western Australia Department of Main Roads); Cameron Best (Australian Agricultural Company (AACo)); Liz Schmidt (Queensland Livestock Transport Association); John Berry (JBS Australia). The authors thank Scott Wauchope (NT Department of Resources) for co-ordinating workshops in Darwin.

The MLA project, *Cost of transport infrastructure and regulatory constraints in Australian cattle supply chains*, allowed TRANSIT to be applied to transport of cattle across all of Australia and the assessment of several infrastructure/policy options. As part of this project, we thank Paul Fry (MLA) for co-ordinating the work with industry including data provision, validation and scenario development.



Executive summary

TRANSIT is a computer-based tool which provides options for most efficient investment, based on assessment of costs and benefits of infrastructure investments and policy changes associated with commodity transport. Here, we provide an outline of the TRANSIT tool, along with examples of its application to evaluation of scenarios that have been developed by industry and governments and which aim to provide solutions for most cost-effective improvement of cattle value chains across Australia.

In Australia's cattle industry, transport infrastructure is essential to moving about 20 million head of cattle through supply chains each year. The industry, particularly in the north, is characterised by long supply chains that link properties, feedlots, abattoirs, live export ports and markets. Distance between production, processing and markets often exceeds 1,000 km, with costs of transport exceeding $150/head. Industry and all levels of government are seeking to reduce cattle transport costs per head by using a range of approaches (e.g. road upgrades, increased use of rail, new abattoirs; and changes to policy in tick clearing, driver fatigue and animal welfare).

A baseline analysis of cattle transport across Australia was undertaken using TRANSIT to emulate the number of vehicles travelling along each road segment, given an average year between 2008 and 2013. It involved mapping the path of about 60,000 origin-to-destination movements representing 20 million cattle transported per year. The analysis determined that the cost of transporting cattle nationally was about $245 million (including the cost of travel, break down into smaller vehicle configurations and driver rests) and that there was an additional cost of about $220 million moving empty trailers during return trips. For cattle transported to abattoirs, an additional shrinkage (weight loss) cost was also calculated. For all cattle transport to abattoirs, the total shrinkage was 8,412 tonnes at a cost of $20.2 million, based on $2.40 per kg live weight. This baseline information has been used to compare with results of scenarios that have been developed and evaluated in TRANSIT, analysing the effects on cattle transport costs due to proposed infrastructure or policy changes.

Several scenarios focusing on the cattle industry were developed with a range of stakeholders between 2012 and 2014, via a range of projects and workshops. Some scenarios are presented in this report, representing a small subset of all possible scenarios across Australia. Future work will examine the savings possible for a more comprehensive range of scenarios throughout northern Australia, with further extension to all of Australia. The scenarios assessed and savings determined were:

- Bridge upgrade between Theodore and Eidsvold – saving $364,000 per year or $4 per head
- Toowoomba bypass - saving $140,000 per year or $0.18 per head
- Type 1 vehicle access between Biloela and Gladstone – saving $20,000 per year or $0.60 per head
- Type 2 vehicle access between Rolleston and Miles - via Taroom - saving $5.8 million per year or $5.76 per head
- Type 2 vehicle access between Rolleston and Miles - via Roma – saving $7.2 million per year or $4.71 per head, with additional savings of $17,000 per year by removing tick clearing requirements
- Type 2 Bypass road to abattoir Townsville – saving up to $753,000 per year or $2.18 per head
- Type 1 Road from Roundabout near Rockhampton – saving $775,000 per year or $2.11 per head
- Type 2 vehicle access around Roma from outskirts to the saleyards - saving $3.9 million per year or $3.71 per head
- Type 2 vehicle access between Clermont and Rockhampton – saving $4.5 million per year or $5.30 per head
- Type 2 vehicle access from Roma to Toowoomba – saving $12.7 million per year or $4.17 per head
- Type 2 vehicle access from Alpha to Rockhampton – saving $4.6 million per year or $5.19 per head

- Sealing of Hann Highway – saving $248,000 per year
- New processing facility at Hughenden – saving $2.2 million per year
- Removal of tick clearing requirements for cattle transported directly to SEQ abattoirs through a tick free zone – saving $1.1 million per year

The cost savings could be almost doubled by including savings made for return trips of empty trailers. Further, the calculation of cost savings above is confined to beef transport and would, in many instances (such as the Toowoomba bypass) be many times greater when other industries and road users are considered.

A key finding for many of these scenarios is that change in a particular part of the network unlocks savings (up to 70% of the total) across the network as a whole. This is because a regulatory or infrastructure change in one location allows a larger number of vehicle trips to optimally run as a larger configuration (e.g. Type 2) for the entire journey, not just for the road segment directly associated with that change. The analyses to date have considered only transport cost savings and not the costs of infrastructure upgrades, risks associated with greater access of heavier vehicles on some roads and broader economic implications. For example, the above scenarios which allow higher combination vehicles on some roads will require infrastructure upgrades of some form requiring expenditure, such as bridges, culverts and intersections.

For many of the scenarios, co-benefits for communities and other road users as well as environmental benefits are achieved, but have not been quantified in our analyses. These benefits can improve safety, sustainability and efficiency and may include:

- increased road safety for all road users;
- increased health and safety for drivers;
- improved animal welfare;
- less congestion leading to increased productivity;
- decreased road and bridge maintenance due to reduction in pavement wear;
- decreased tyre use and maintenance for vehicles;
- decreased greenhouse gas emissions and decrease in energy consumption.

These additional costs and benefits can be incorporated in to future analyses.

As part of the northern Australia White Paper, TRANSIT will inform the $100 million beef roads fund by estimating the cost savings to cattle transport for a range of roads infrastructure scenarios put forward. That work is expected to be completed late 2015. The next generation of TRANSIT is currently being developed by CSIRO and will be adapted to analyse transport efficiency of all major Australian agricultural commodities as part of an initiative associated with the Agriculture Competitiveness White Paper. This will entail application to more than 20 agricultural commodities - greater than 95% of volume transported - including sheep, pigs, sugar, horticulture and broad acre crops. These analyses will provide a broader perspective of heavy vehicle freight flows across the road/rail network within and between agricultural commodities and provide options for increasing the value of investment in transport infrastructure.

1 Introduction

In Australia's cattle industry, transport infrastructure is essential to moving about 20 million head of cattle through the supply chains in Australia each year. The industry, particularly in the north, is characterised by long supply chains between properties, feedlots, abattoirs, live export ports and markets. Distance between production, processing and markets often exceeds 1,000 km, with costs of transport exceeding $150/head and the distance to final export customers often exceeding 5,000 km. Despite the longevity, scale and importance of the cattle industry in Australia, the supply chains are usually characterised by high costs, seasonal utilisation, and significant vulnerability to market and weather-related shocks.

To provide a holistic view of the costs and benefits associated with infrastructure investments and policy changes in agriculture supply chains, CSIRO developed a TRAnsport Network Strategic Investment Tool (TRANSIT). The tool, which was initially co-funded in 2012/2013 by the Office of Northern Australia, Northern Territory Government, Western Australia Government and Queensland Government, was built to assess the cattle supply chains in northern Australia. Although initially developed for cattle supply chains, TRANSIT can be adapted to any commodity supply chain.

TRANSIT can provide stakeholders with advice on both small- or large-scale investments in the agriculture supply chain, and the benefits to all enterprises, including:

- Analysing the impact of road upgrades (such as sealing or improving for higher combination vehicles), where the financial benefits to individual agricultural enterprises and to the industry as a whole are quantified;
- Optimising the use of road versus rail transport and their integration, at different locations;
- Optimally locating new supply chain infrastructure facilities (e.g. abattoirs and spelling yards);
- Testing potential outcomes for changes in policy, e.g. alignment of driver and animal welfare stops, changing truck limitations for road classes, removal of tick-clearing regulations for cattle transported directly to abattoirs;
- Selecting infrastructure investment and regulatory change opportunities that maximise transport cost reductions for a given investment budget.

To evaluate and optimise capital investments and operations in commodity logistics, TRANSIT combines information on commodity supply chains with information on the road/rail network, heavy vehicle access and regulatory constraints covering driver fatigue and biosecurity protocols. TRANSIT performs a mass optimal routing of vehicle movements between the (sometimes) thousands of enterprises in the specific commodity industry, and provides industry- or locality-wide logistics costs. This enables testing of logistics opportunities that could benefit thousands of cattle enterprises. Its application to northern Australia's herd of 12 million cattle across 52,000 registered properties, accommodated the movement of over 50 million cattle between enterprises (2007 to 2011) and 88,000 unique origin to destination enterprises. Through a subsequent project with MLA, TRANSIT's application was extended to the cattle industry across all of Australia and to evaluate additional priority infrastructure and regulatory scenarios.

A range of possible future industry scenarios was also developed between 2012 and 2014 via projects undertaken with industry and State, Territory and Federal governments. These scenarios included road upgrades, increased use of rail, new abattoirs and changes to policy in tick clearing, driver fatigue and animal welfare. Understanding what those scenarios mean to supply chain flows and transport costs across all enterprises is critical to optimising the value achieved from the investment options available.

2 Overview of TRANSIT

TRANSIT is a computer-based tool, designed to assess costs and benefits associated with infrastructure investments and policy changes impacting commodity transport, providing options for most efficient investment.

TRANSIT was constructed in the ArcGIS platform due to its vehicle routing capability whilst accommodating multiple characteristics associated with the road/rail network and individual road/rail segments. Road rankings (primary, secondary and minor (including unsealed roads)) are shown in Figure 1 and affect average speed, transport cost per km and the route taken. Road access restrictions for Single, B-Double, Type 1 and Type 2 vehicles are also specified (Figure 1). Different restrictions will exist for different commodities due to their supply chain paths. For example, with cattle transport in Australia, the main restrictions are in moving cattle to east coast abattoirs and ports, as access roads to these facilities are limited to B-double access. Not only is there a higher cost per tonne (Table 1) for transport using smaller vehicle combinations, but there is an additional cost for breaking down larger vehicles (e.g. Type 2) into smaller configurations (e.g. B-Double). Another restriction is the requirement of tick clearing when transporting cattle from a tick-infested location to a tick-free location. Drivers will often avoid travelling into the tick-free zone (where possible) even if/when it involves a significant detour and a higher transport cost.

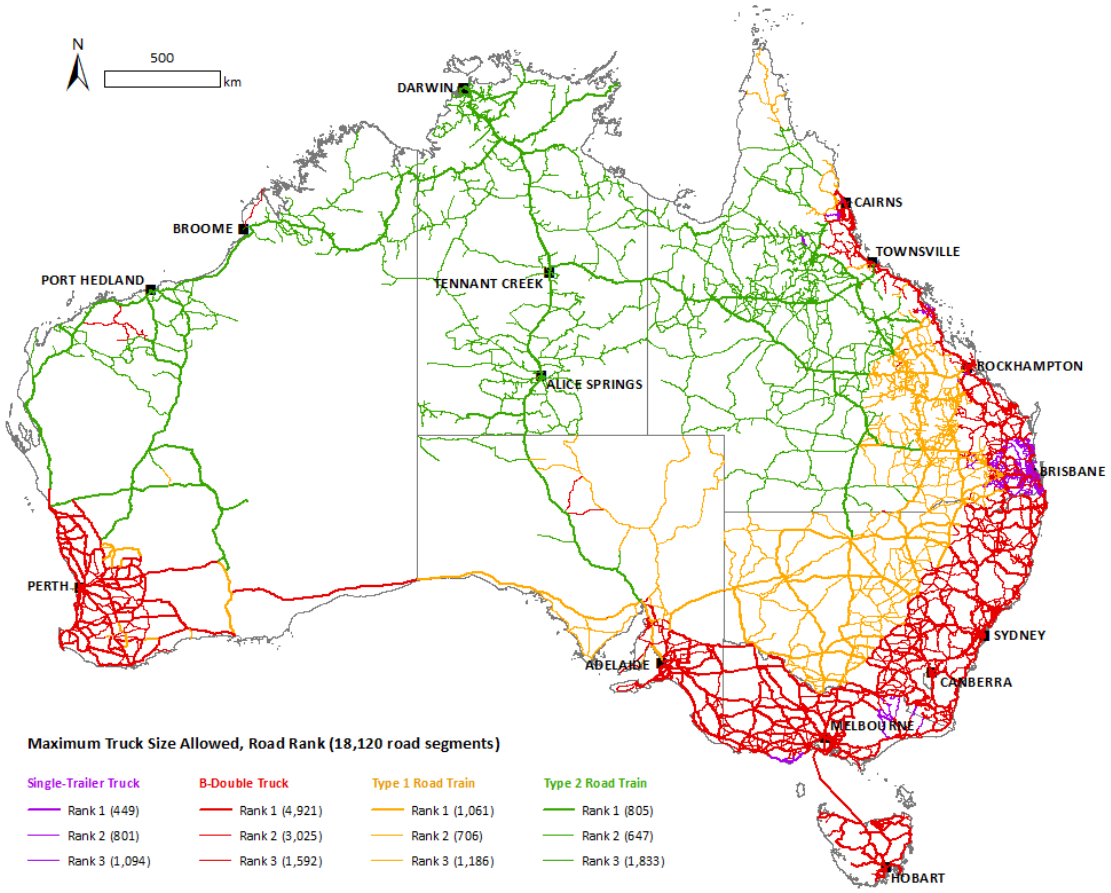


Figure 1: Accessibility and road ranking map of heavy vehicles in Australia, with accessibility based on National Heavy Vehicle Regulations

Table 1: Road transport costs per cattle vehicle

Vehicle Classification	Cost (A$/km) for a given travel speed				Idle Cost ($/hr)
	100 km/h	80 km/h	60 km/h	40 km/h	
Single Trailer	1.91	2.16	2.58	3.43	119
B-Double	2.35	2.64	3.13	4.10	141
Type 1	3.24	3.59	4.17	5.33	169
Type 2	3.43	3.78	4.36	5.52	177

A process diagram of TRANSIT is provided in Figure 2. TRANSIT is based on simulating the number of vehicle trips per month moved between origin and destination enterprises. The goal of the TRANSIT module is to optimise (based on travel time) the transport route along the road/rail network for each of these trips from origin to destination, and then calculate the cumulative impacts at the enterprise or regional scale whilst evaluating against constraints on the number of vehicle trips on each route. To determine the optimal route, the analysis takes into account such parameters as costs, restrictions or hierarchical value. It is essential that all these parameters work together logically, to allow proper solving of optimal routes. Network segments must be linked to neighbouring segments and carry attributes that will enable travel through, unless a restriction is in place. Since a property is not always geographically attached to a road, a trip from an origin to destination (O-D) is modelled to have travelled to the closest road segment from the origin, and finishing at the closest point on a road segment to the destination point. This process is repeated for all routes, always searching for the minimum cost (including penalty costs) and selecting it as the optimal route. These costs are then aggregated over all O-D pairs to provide a total cost of transport for the scenario. It currently takes about 12 hours, or two working days, to run and check all steps of TRANSIT shown in Figure 2.

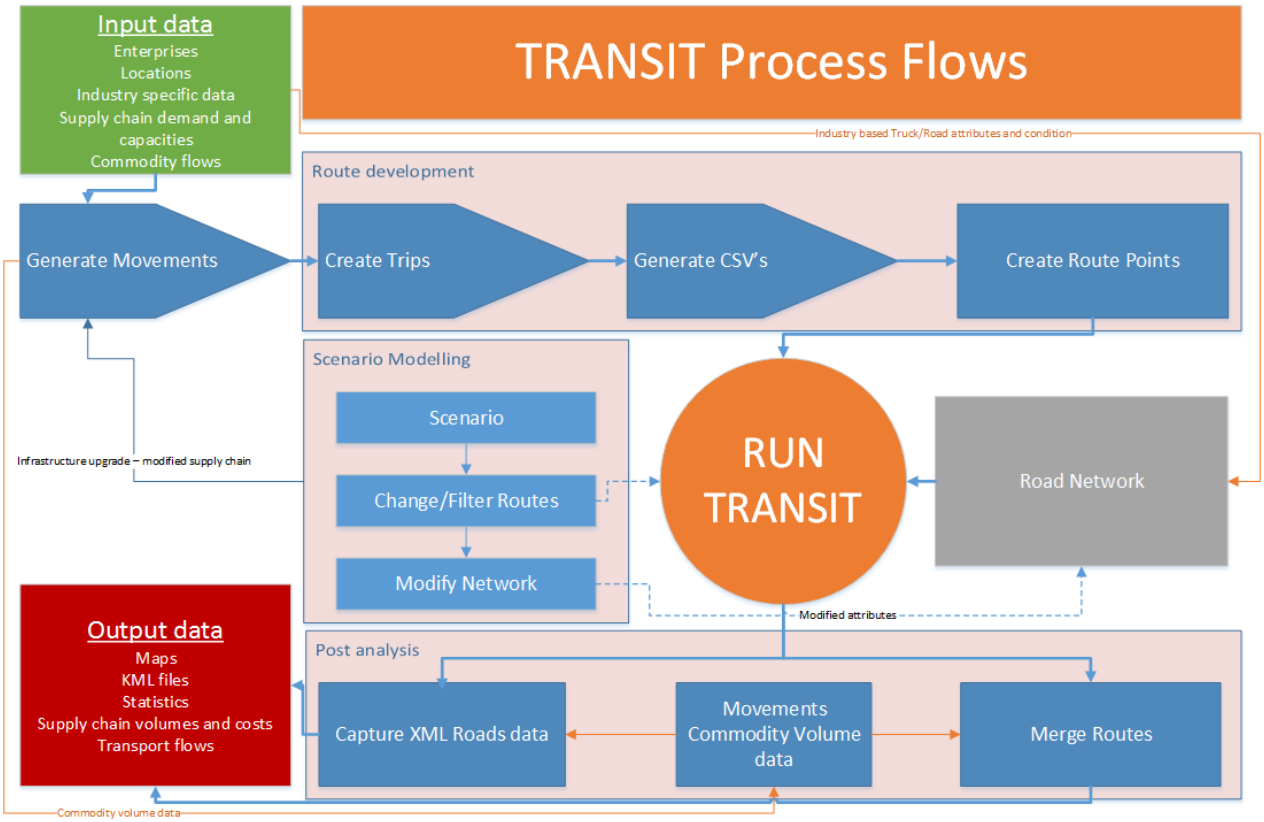


Figure 2: Technical diagram of TRANSIT, showing the stages of setting up and running each model component

3 Baseline Analysis

A baseline analysis provides information on the number of vehicles travelling along each road/rail segment, and needs to be undertaken before scenarios can be run and assessed.

In the application of TRANSIT to cattle across the whole of Australia, this baseline analysis was run for an average year between 2008 and 2013. It was derived by mapping the path of about 80,000 origin to destination movements, representing 20 million cattle transported in a given year. A summary map for all cattle vehicle movements is provided in Figure 3. The blue line between Devonport and Melbourne represents cattle shipped between Tasmania and the mainland. There is a similar line between Kangaroo Island and the mainland of South Australia. The vehicle counts in Figure 3 take in to consideration whether the vehicle is a B-Double, Type 1 or Type 2 road train. The largest vehicle counts are those on major corridors towards large abattoirs, feedlots and saleyards along the east and southern coast. Large vehicle numbers on road segments of the Stuart Highway between the export depots and Darwin port are associated with live export. There is a large number of interstate vehicle trips - particularly cattle transported to abattoirs and feedlots between Queensland and NSW. A significant number of cattle are transported from the Northern Territory to Queensland, particularly en-route to feedlots and abattoirs. Figure 4 shows the rail component of the cattle transport, where the demand at loading points was based on a 2008 to 2011 average. Figure 5 shows how Figure 3 can be disaggregated into vehicle numbers on each road/rail segment, including directional information. Figure 5 is specifically relevant to the busy road corridor between Roma and Toowoomba (including Toowoomba bypass). Note that segments are not of equal length.

Figure 6 shows the vehicle numbers along the road/rail network in relation to numbers at each of the major enterprises, providing additional context as to why some corridors have much higher vehicle counts than others. For example, the Warrego Highway is the main east-west route supplying several abattoirs in south east Queensland and the large Roma saleyards. Similar trends can be seen for roads/rail leading towards large abattoir/saleyard/feedlot/port enterprises.

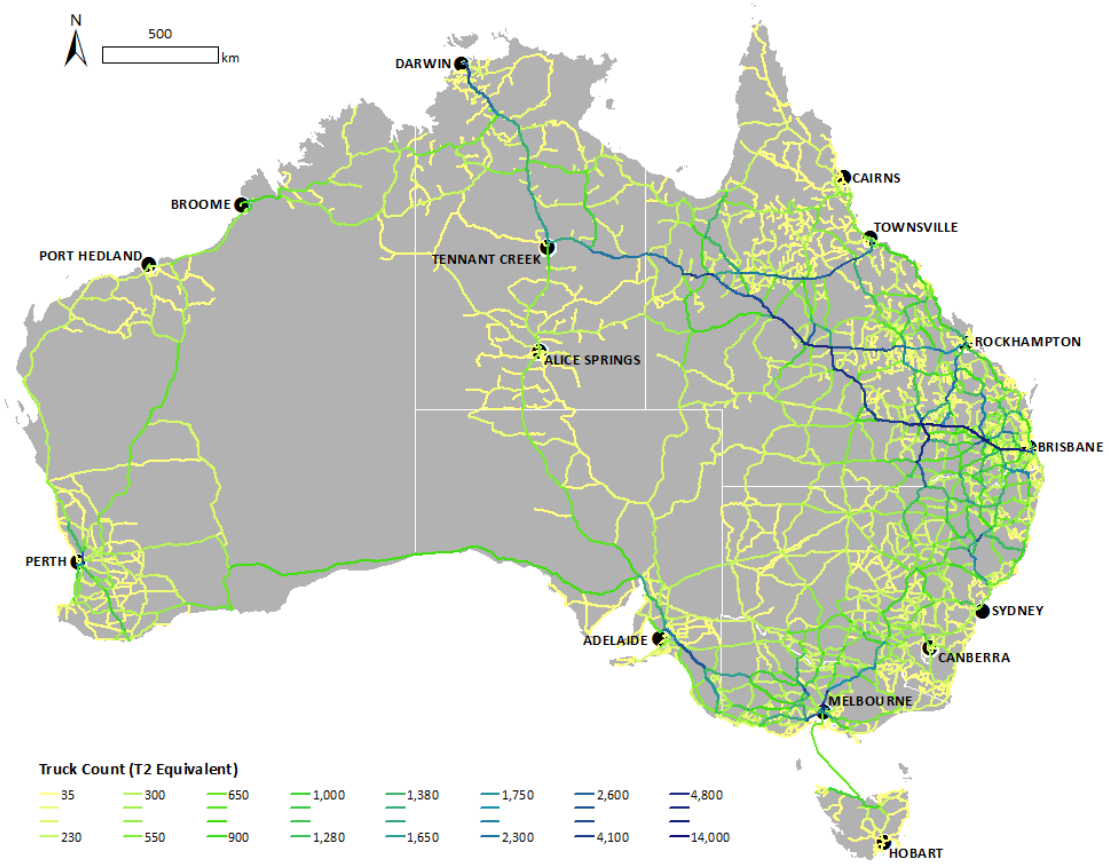


Figure 3: Cattle vehicle numbers across the Australian road network as estimated by TRANSIT, for an average year between 2008 and 2013

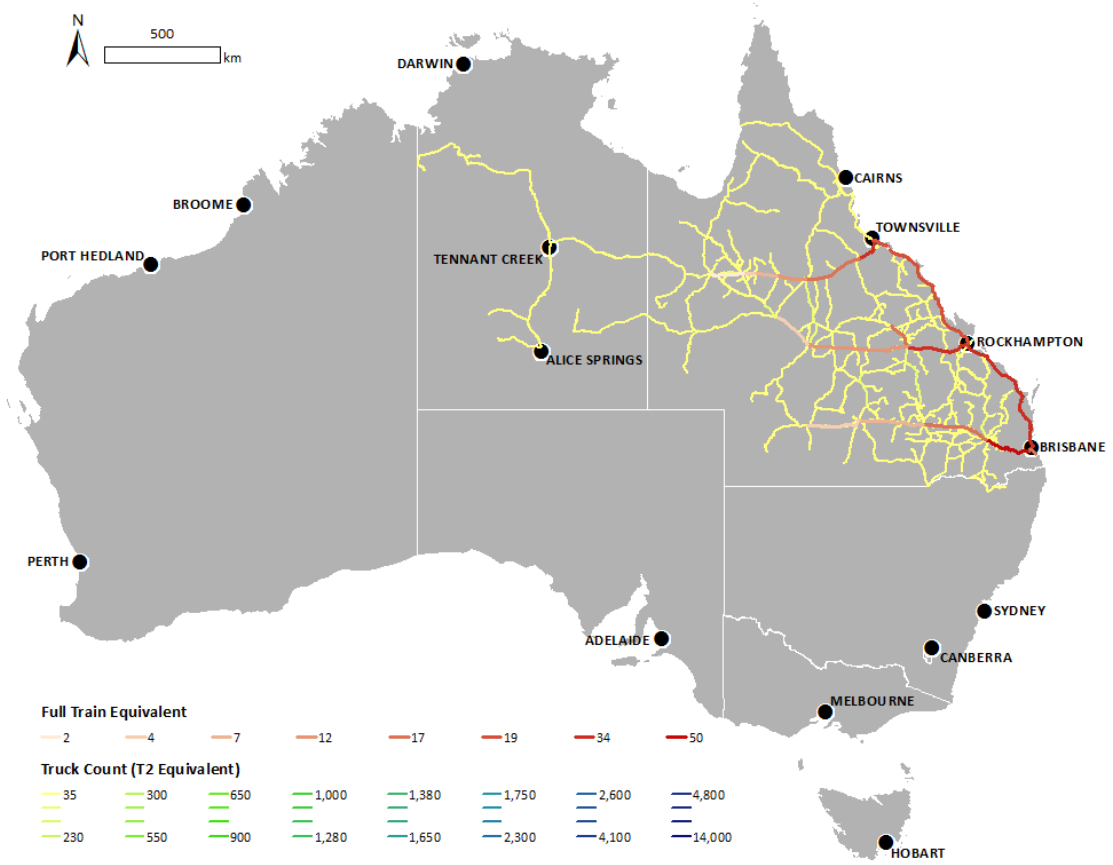


Figure 4: Rail transport component for the baseline scenario of Figure 3.

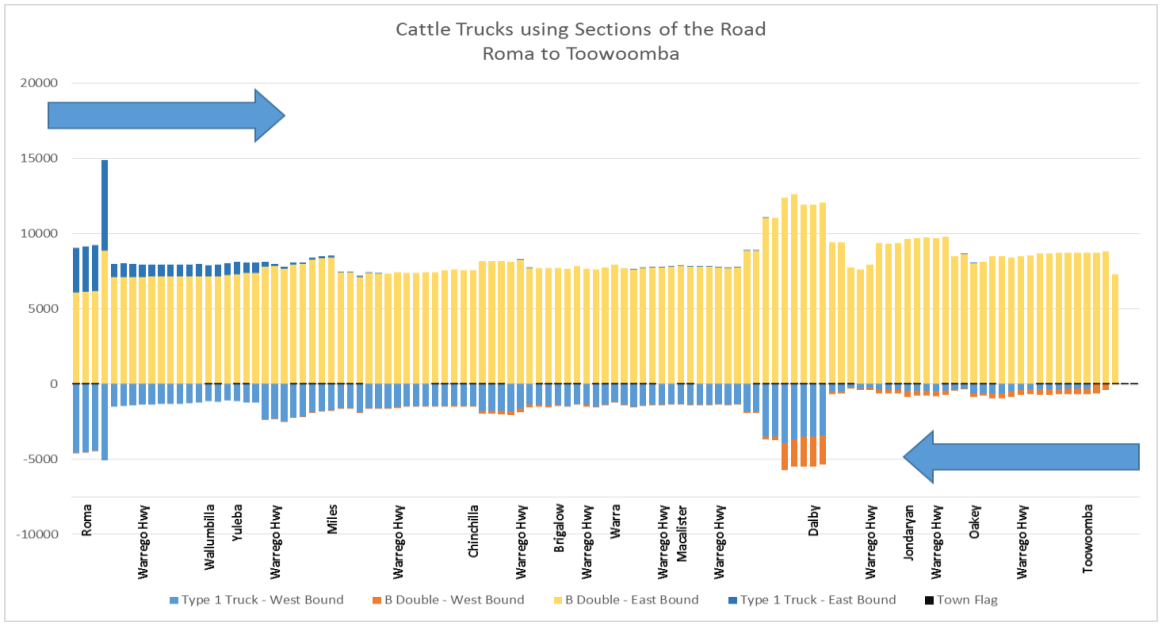


Figure 5: Modelled number of cattle vehicle by road segment between Roma and Toowoomba. Arrows indicate whether vehicles travel from Roma to Toowoomba (top) or from Toowoomba to Roma (bottom). Segments are not of equal length. There are higher vehicle counts in towns (e.g. Dalby) due to intersections with north-south traffic.

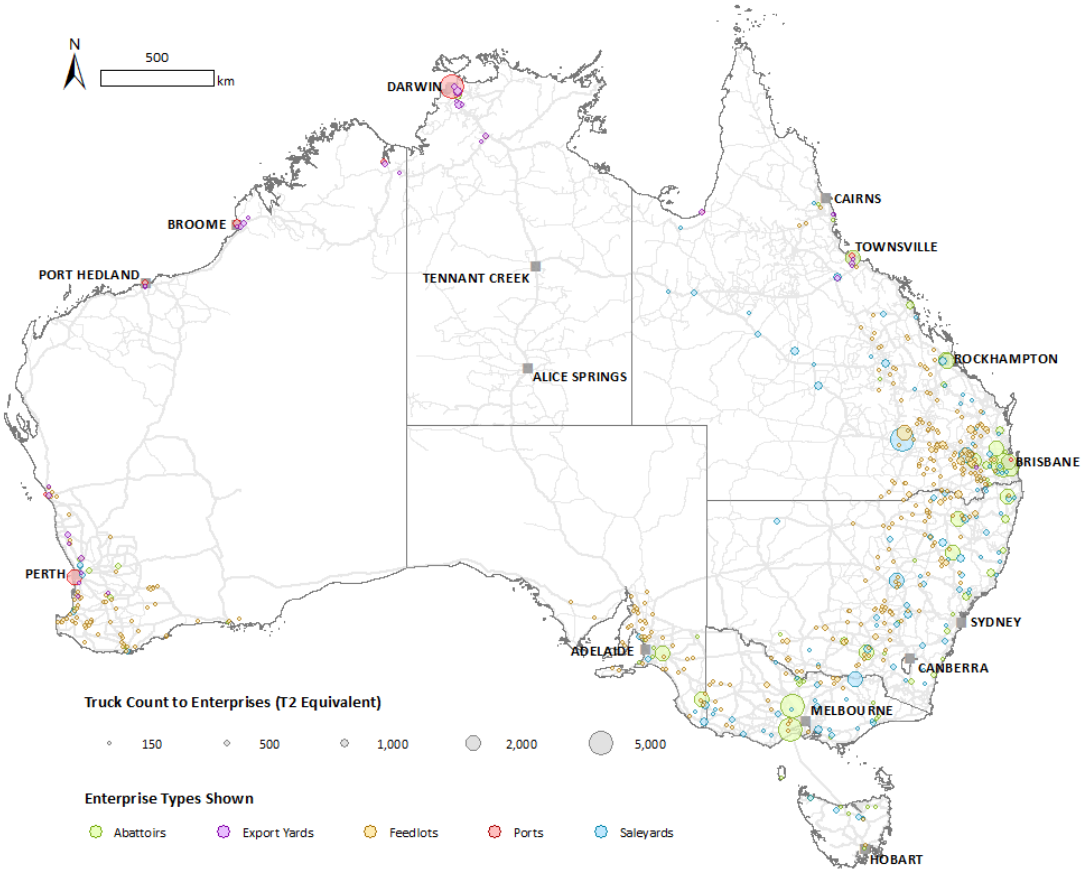


Figure 6: Cattle vehicle counts across the Australian road network (for an average year between 2008 and 2013) combined with vehicle counts at each major enterprise

Table 2 summarises the cost of cattle transport (full vehicles) for each State/Territory and for all of Australia. Results for each State/Territory are for trips where the destination occurs in that State/Territory. Costs are separated out for driving (i.e. when the vehicle is moving), break down of vehicles into smaller configurations, and costs associated with stopping for driver rests. For cattle transport across Australia, the total cost is about $245 million and this cost almost doubles to $425 million if return trips of empty trailers (i.e. no backloading) are considered. Total costs vary substantially between States/Territories, mainly due to the number of cattle transported. Costs per head are based on each supply chain link. For example, transport from property to feedlot then to abattoir are two separate trips with separate costs. The same applies to transport from property to export depot then to port. Cost per head differences between States/Territories are not as high as initially expected. Cost per head in Northern Territory is lower compared to most other States/Territories, due to the vast majority of cattle being transported to convenient export depots and then to Darwin port. Also, all cattle transport in the Northern Territory is via Type 2 road trains, which substantially reduces the cost per head per km, compared to Victoria and Tasmania which are restricted to B-Doubles. Cost per head for South Australia is higher due to a significant number of cattle being transported to that State from Queensland, New South Wales and Victoria mostly on B-Double and Type 1 Road trains. Vehicle break down costs are high for Queensland and New South Wales due to the large amount of cattle transported eastwards from Type 2 and Type 1 roads to abattoirs located in regions limited to B-Double access.

Table 3 shows the total cost of transport broken down by enterprise type. Cattle transported to properties and abattoirs represents the highest total and per head costs. Costs of transport to abattoirs are high due to these enterprises being predominately located in regions limited to B-Double access. Low transport costs to ports are due to the close proximity of export depots to the major ports (e.g. Darwin, Townsville, and Wyndham) from which live animals are exported. For cattle transported to abattoirs, an additional shrinkage cost is also calculated. For all cattle transport to abattoirs (Table 3), the total shrinkage is 8,412 tonnes at a cost of $20.2 million, based on $2.40 per kg live weight.

Table 2: Summary of cattle transport costs for each State and Territory[1] in Australia (not including return trips of empty trailers)

Destination	Total Cattle	Total Driving Cost	Total Break down Cost	Total Cost of Driver Fatigue Stops	Cost Per Head
SA	697,200	$9,509,105	$530,406	$814,023	$15.57
cost per head		$13.64	$0.76	$1.17	
WA	1,084,530	$12,565,513	$483,888	$945,180	$12.90
cost per head		$11.59	$0.45	$0.87	
QLD	10,638,862	$120,526,924	$9,187,051	$6,015,695	$12.76
cost per head		$11.33	$0.86	$0.57	
NT	1,059,394	$11,004,167	$2,298	$628,527	$10.98
cost per head		$10.39	$0.00	$0.59	
VIC	1,826,400	$18,698,405	$1,430,102	$595,959	$11.35
cost per head		$10.24	$0.78	$0.33	
NSW	4,635,120	$46,751,343	$4,455,036	$606,402	$11.18
cost per head		$10.09	$0.96	$0.13	
TAS	153,840	$1,079,088	$112,816	$9,646	$7.81
cost per head		$7.01	$0.73	$0.06	
Australia	20,096,786	$220,134,547	$16,201,598	$9,615,433	$12.24
cost per head			$10.95	$0.81	$0.48

[1] No modelled trips with destinations in ACT

Table 3: Summary of cattle transport costs to each enterprise type in Australia (not including return trip of empty trailers)

Destination Enterprise	Total Cattle	Total Driving Cost	Total Break down Cost	Total Costs of Driver Fatigue Stops	Cost Per Head
Property	7,659,840	$101,950,442	$5,679,510	$5,985,255	$14.83
cost per head		$13.31	$0.74	$0.78	
Abattoir	5,513,760	$72,075,290	$5,627,128	$2,340,559	$14.52
cost per head		$13.07	$1.02	$0.42	
Saleyard	3,400,080	$20,534,308	$2,736,840	$324,795	$6.94
cost per head		$6.04	$0.80	$0.10	
Feedlot	2,010,000	$13,056,251	$1,858,210	$340,813	$7.59
cost per head		$6.50	$0.92	$0.17	
Export yard	759,600	$9,441,535	$103,580	$596,401	$13.35
cost per head		$12.43	$0.14	$0.79	
Port	753,506	$3,076,718	$196,330	$27,608	$4.38
cost per head		$4.08	$0.26	$0.04	

4 Scenarios

Following baseline analysis, scenarios are developed based on infrastructure and/or policy changes which will impact a commodity's transport cost. Such changes may include upgrading of road/rail infrastructure, the locating of new facilities such as ports and abattoirs, or changed biosecurity conditions. The TRANSIT tool is re-run using data that conform to the scenario/s and comparisons can then be made with the baseline and/or between different scenarios.

This chapter presents examples of a number of scenarios which were analysed by the CSIRO team. Section 4.1 focuses on several road upgrade options, Section 4.2 focuses on an abattoir proposed for Hughenden and section 4.3 examines the removal of tick-free zones. All these scenarios were developed via workshops for various sub-projects between 2012 and 2014.

4.1 Road Upgrade Scenarios

Total direct and indirect transport cost savings for a range of road upgrade scenarios are presented in Table 4. Most of these scenarios were identified at a MLA workshop in August 2014 and are based on average annual cattle movements over the period 2008-2013 and 2013 live export numbers. The analyses in this section consider transport cost savings but can be extended to accommodate the costs of infrastructure upgrades, risks associated with greater access of heavier vehicles on some roads and broader economic implications.

Table 4: Summary of direct and indirect savings as derived for cattle movements for 11 road upgrade scenarios

Scenario	Total Transport cost savings /yr	Savings per head
Bridge upgrade Theodore to Eidsvold	$364,000	$4.00
Toowoomba bypass	$140,000	$0.18
Type 2 access Rolleston to Miles - via Taroom	$5,800,000	$5.76
Type 1 access Biloela to Gladstone	$20,000	$0.60
Type 2 access Rolleston to Miles - via Roma	$7,200,000	$4.71[#]
Type 2 Bypass road to abattoir Townsville	$753,000	$2.18
Type 1 Road from Gracemere to Rockhampton	$775,000	$2.11
Type 2 access around Roma from outskirts to the saleyards	$3,900,000	$3.71
Type 2 access Clermont to Rockhampton	$4,500,000	$5.30
Type 2 access from Roma to Toowoomba	$12,700,000	$4.17
Type 2 access from Alpha to Rockhampton	$4,600,000	$5.19

Policy scenarios allowing higher combination vehicles on some roads will require infrastructure upgrades of some form, such as bridges, culverts and intersections. Our analyses did not consider the costs associated

with this additional infrastructure. Their identification would require an assessment of the suitability of the road infrastructure for higher combination and heavier vehicle access.

In each of the scenario analyses undertaken, the results are direct industry benefits only, such as improved freight productivity and efficiency, transport cost savings, driver health and safety, truck maintenance and fuel savings. Indirect benefits and costs have not been taken into account.

Note that the analyses were based on full vehicles and did not account for additional cost savings from the return trip carrying empty cattle trailers. This analysis assumed backloading is negligible (i.e. there are minimal occasions where cattle are loaded at a point near the destination and transported back towards the origin). Transport cost savings will be almost double to accommodate savings from the return journey of empty trailers. We stress that the scenarios tested to date are not representative of all possible options in northern Australia, and further work will be conducted to evaluate a comprehensive list of identified scenarios.

Full details of these scenario analyses can be found in the MLA report Higgins et al (2015), and some are presented in the following sub-sections of this report.

4.1.1 BRIDGE UPGRADE: THEODORE - EIDSVOLD ROAD

The 142 km road connecting Theodore (565 km north-west of Brisbane) to Eidsvold has several bridges that have load limits. Due to these limitations, cattle transportation is restricted to B-Doubles. Figure 7 shows the section of road of interest, within the surrounding road network. Access to the road from the west allows the use of Type 1 road trains; only B Double access is, however, permitted to the east of Eidsvold.

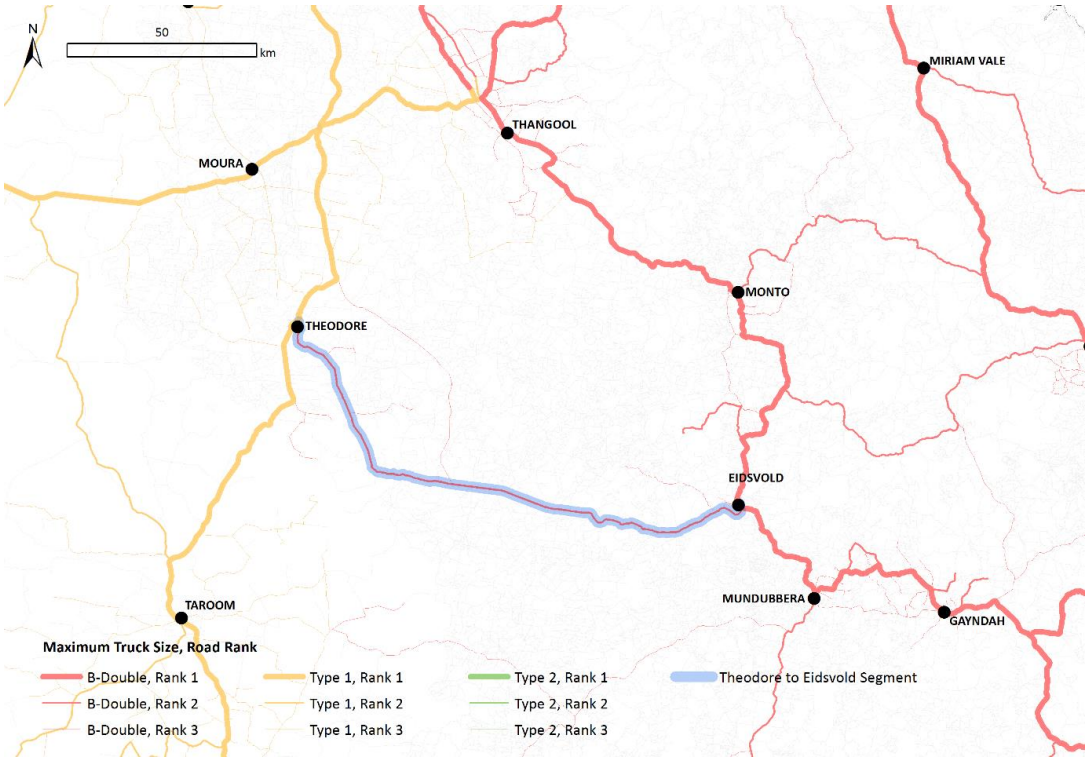


Figure 7: Heavy vehicle accessibility and road ranking for roads between and around Theodore/Eidsvold

The total estimated transport costs are $1,552,000, requiring 1,092 B-Double trucks travelling a total of 445,000 km over 6,000 hours with $30,000 in driver fatigue costs. In all, there are approximately 2,000 break downs required at a cost of $181,000. From analysis in TRANSIT, we determined that about half of these trips used 75-85 km of the road (Figure 8), rather than the full length. Removing the limitation to allow Type 1

access increases the number of cattle that would be transported along the road, because this route then becomes an optimal travel path for more origin-destination routes. Total distance travelled by these additional trucks would reduce from 445,000 km to 337,000 km and time travelled reduce by around 1,400 hours. Transport costs would reduce from $1,552,000 to $1,188,000 – a saving of about 23% and 900 fewer break downs.

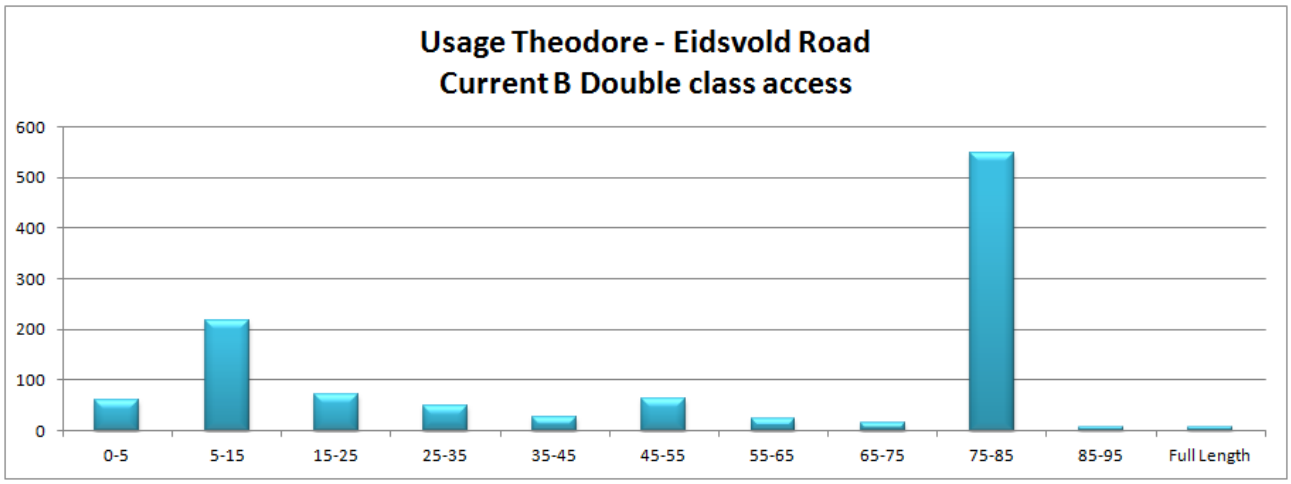


Figure 8: Distribution of vehicle distance travelled (x axis) across the Theodore to Eidsvold connection road, with current heavy vehicle access restrictions

4.1.2 NEW TOOWOOMBA BYPASS

TRANSIT estimated that 7,558 cattle trucks (906,960 cattle) pass through the Toowoomba Range on the Warrego Highway in an average year. If the bypass were available (Figure 9), only an additional 54 trucks (moving 6,480 cattle) would use the bypass route. The negligible increase in vehicle numbers using the bypass is due to the bypass not changing the optimal transport routes across the freight network in that region. The total cost of the movements (between their origins and destinations) without the bypass is $10,859,484, which would reduce to $10,713,563 using the planned bypass. This is a saving of $0.18 per head of cattle.

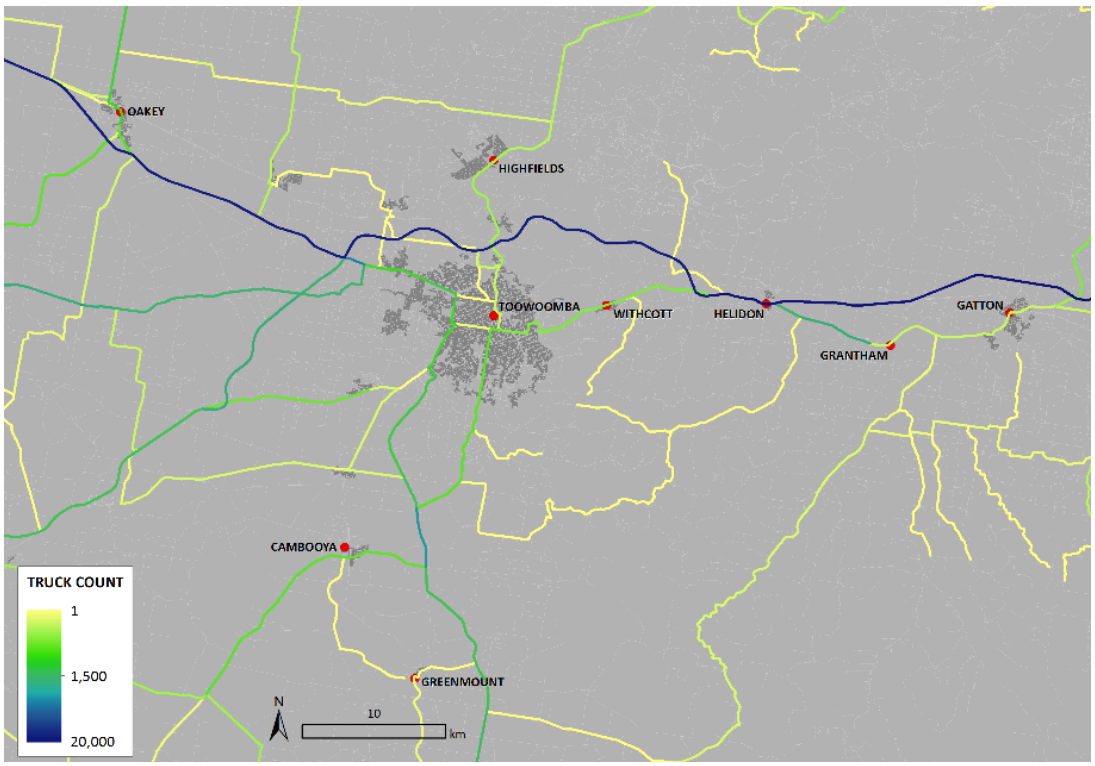


Figure 9: Cattle freight flows through Toowoomba with the proposed bypass

4.1.3 ROAD UPGRADE: ROLLESTON TO MILES VIA TAROOM OR ROMA

This scenario was developed to test the potential for savings if trucks were able to travel through these sections of road and not be impacted by current biosecurity regulations which require cattle trucks to stop for tick clearing when entering a tick-free zone. It was hypothesised by stakeholders at the MLA workshop that currently vehicle drivers are detouring around the tick line (i.e. staying within the tick infested areas) to avoid the expense and time costs associated with tick clearing. It was expected it would be more efficient to travel south either via Roma or via Taroom (Figure 10). With tick-clearing requirements abolished, of the 8,500 trucks using the Rolleston to Miles road via Taroom, approximately half cross the tick line at some point, but of these only 900 originate and finish in the tick-infected region. Of the 12,800 cattle trucks using the Rolleston to Miles road via Roma, approximately 33% cross the tick line at some point but of these only 1,180 originate and finish in the tick-infected region. For these scenarios, a combined total of 1,295 cattle trucks travel from tick-infected regions to tick-infected regions. These trucks move 95,000 cattle and travel costs total $1.27 million, taking 5,000 hours. Removal of the biosecurity regulations for these trips would result in average saving of approximately $17,000 per annum.

Aside from the biosecurity analysis, an analysis of the benefits of upgrading the road sections between Rolleston and Miles via both Taroom and Roma to allow access to Type 2 combination vehicles was also undertaken. Tables 5 and 6 show the savings that occur on the road segments that were upgraded to allow Type 2 vehicle access, along with additional savings ($3.7 million and $4.7 million respectively) across the connecting road network due to increased number of vehicle trips choosing Type 2 as the least-cost configuration.

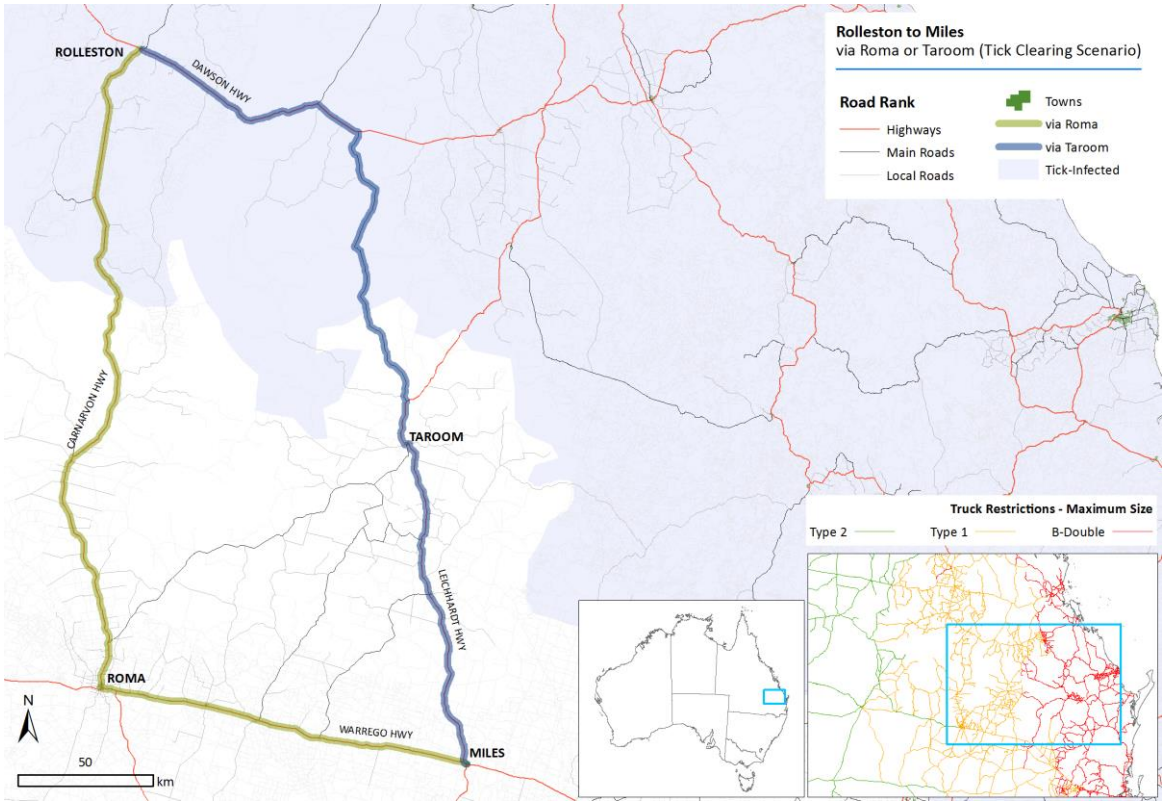


Figure 10: Travel paths between Rolleston and Miles, via Roma and via Taroom

Table 5: Summary of costs and savings from Rolleston to Miles via Taroom

	Total Current Costs	Savings with Scenario	Total Cattle	Total Trucks	Savings Per Head	%saved
Rolleston to Miles via Taroom		$902,351				
Break down component		$1,212,756				
Broader network		$3,759,836				
Total	$20,519,169	$5,874,944	1,020,240	8502	$5.76	29%

Table 6: Summary of costs and savings from Rolleston to Miles via Roma

	Total Current Costs	Savings with Scenario	Total Cattle	Total Trucks	Savings Per Head	% saved
Rolleston to Miles via Roma		$936,605				
Break down component		$1,598,448				
Broader network		$4,697,912				
Total	$28,482,782	$7,232,966	1,536,960	12808	$4.71	25%

4.1.4 ROAD UPGRADE: GRACEMERE ROUNDABOUT TO ROCKHAMPTON ABATTOIRS

This scenario examined the impact on cattle transport of upgrading the road between Gracemere roundabout and Rockhampton abattoirs (currently B-Double access) to allow Type 1 vehicles. TRANSIT estimated there were 6,140 B-Double cattle-transporting vehicles using the Gracemere to Rockhampton section (Figure 11) of road in an average year. This 12 km section is the primary route for the movement of 368,000 cattle/year. Based on current road restrictions, the total costs for movements are $7,968,000 including $510,000 in break down costs (Table 7), based on the optimal route from origin to destination break down. If this 12 km segment is upgraded to Type 1 vehicle access, the number of cattle trucks reduces to 4,600 (from 6,140) with direct savings of $61,000 plus additional savings of $593,000 in break down costs comprising 1,532 hours of break down time. As with the "Bypass to Townsville abattoir" scenario, there are very large transport cost savings across the broader network ($620,000) which occur due to the reclassification of the short 12 km segment. This is because a large number of vehicle trips would use a Type 1 as opposed to a B-Double for the entire journey, thus leading to transport costs savings on other Type 1 roads leading into Rockhampton. This analysis assumes all other sections remain at the current classification.

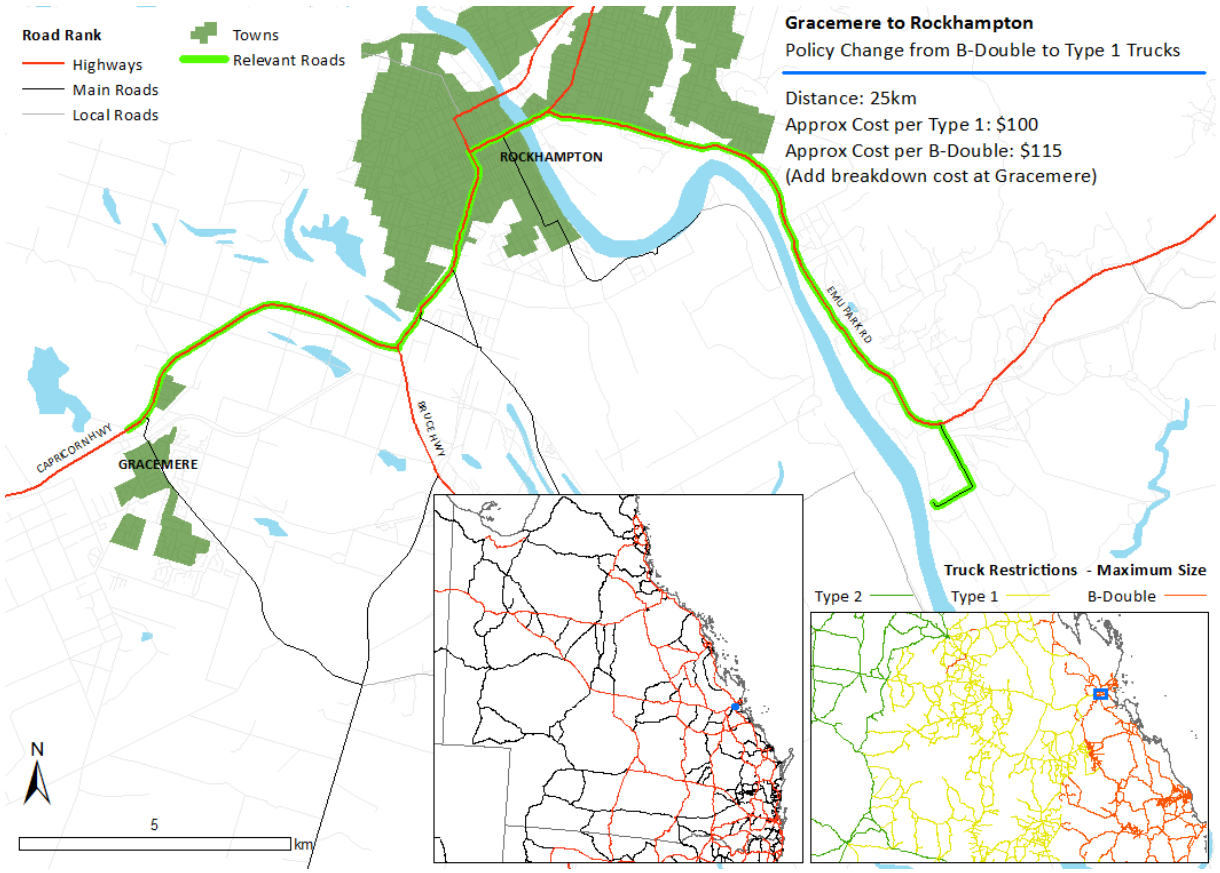


Figure 11: Upgrade to allow Type 1 vehicles between Gracemere and Rockhampton abattoirs near the river

Table 7: Summary of costs and savings between Gracemere and Rockhampton port abattoirs if current road is upgraded to allow Type 1 vehicle access

	Total Current Costs	Savings with Scenario	Total Cattle	Total T1 Trucks	Savings Per Head	%saved
Gracemere to Rockhampton segment		$61,140				
Break down component		$93,808				
Broader Network		$620,182				
Total	$7,968,274	$775,130	368,400	4602	$2.11	10%

4.1.5 ROAD UPGRADE: ROMA OUTSKIRTS TO THE ROMA SALEYARD

In an average year, approximately 1 million cattle are transported on the section of road connecting the saleyard in Roma to the Type 2 access section of the Warrego Highway from the west, represented by 2,900 origin to destination routes at a current total cost of over $16.6 million (Table 8). These trucks are typically expected to break down from Type 2 combination vehicles to Type 1 vehicles for the balance of the journey. In all, 8,500 Type 2 vehicles need to be broken down to Type 1 combinations, resulting in over 12,500 cattle trucks. A road upgrade to allow Type 2 access would see annual savings of $52,000 in transport costs over the 7 km section and further savings of $1,932,000 in break down costs. There are also additional savings of $2,768,000 from efficiencies gained from greater Type 2 travel in the connecting road network.

Table 8: Summary of costs and savings if current road is upgraded to allow Type 2 vehicle access between Roma and the Roma saleyard

	Total Current Costs	Savings with Scenario	Total Cattle	Total T2 Trucks	Savings Per Head	%saved
Roma saleyard connection		$52,531				
Break down component		$932,942				
Broader network		$2,768,189				
Total	$16,664,778	$3,944,663	1,010,160	8418	$3.71	22%

4.1.6 ROAD UPGRADE: ROMA TO TOOWOOMBA

The Warrego Highway between Roma and Toowoomba is approximately 340 km in length and currently limited to Type 1 vehicle access, excluding a small section of the highway at Macalister which is B-Double access. This section is expected to take 5 hours to travel over with a Type 1 vehicle, costing $1,224.. This segment of highway is a critical section in the broader cattle transport network, used to transport 3,046,239 cattle per year. These trips cover 7,856,733 vehicle km, taking 153,611 hours. For optimal movements based on the current vehicle access limitations, each route requires the use of more than one class of truck. For these movements, a total of 4,728 Type 2, 37,632 Type 1 and 34,338 B-Double vehicle trips are required. The total costs of these movements are $41,570,618 including $3,735,516 in break down costs and a further $1,100,055 in fatigue management costs (Table 9).

In terms of transport savings for the segment only, upgrading this section of highway to Type 2 class would see a saving of 9,290 hours of travel, 712,031 km distance travelled, $2,083,717 in transport costs and $3,735,516 in break down costs.

Table 9: Summary of costs and savings if current road is upgraded to allow Type 2 vehicle access between Roma and Toowoomba

	Total Current Costs	Savings	Total Cattle	Total T2 Trucks	Savings Per Head	%saved
Roma to Toowoomba segment		$2,083,717				
Break down component		$3,735,516				
Broader network		$6,889,266				
Total	$41,570,618	$12,708,499	3,046,239	25,385	4.17	30%

4.1.7 SEALING OF HANN HIGHWAY

The Hann Highway is about 260 km in length and is part of an inland corridor between Cairns and Melbourne. It is also an important north-south route for transporting cattle in the larger Type 2 road trains. By fully sealing the road, average speed of the heavy vehicles along those segments would increase to about 80 km/h, reducing total travel time from 5 hours to about 3.5 hours. We determined savings in cattle transport if the road was fully sealed. These savings comprise reduced transport costs (due to shorter travel time) for cattle vehicles currently using the Hann Highway, along with additional cattle vehicles that would use the highway when upgraded as it would become a lower-cost (alternative?) route.

Based on current road condition and speed limits, TRANSIT estimated the highway is used by 1,200 Type 2 vehicles per year. The length along the Hann Highway used by each route was calculated and combined with the number of vehicles used. Not all of the vehicle trips traverse the full distance of the Hann Highway, and nearly half of vehicle movements traverse 200 km or more of the highway.

If the Hann highway were fully sealed, the total cost saving for existing and likely additional cattle routes using the highway would be about $248,000 per year plus additional cost savings for fewer driver fatigue stops and additional cost savings of return journey of empty trailers. Since an additional 290 Type 2 cattle vehicles would use the Hann Highway per year if it were sealed (plus return journeys of empty trailers), vehicle numbers on other roads in the region would change as well. Figure 12 shows the modelled change in vehicle numbers for each road segment as a result of sealing the Hann highway. A notable trend is increased north-south traffic volumes through Hughenden and less north-south traffic through Charters Towers. This map gives an example of how TRANSIT can be used to show the impacts of road upgrades on the utilisation of other roads across the region, State and country. It provides a holistic view of where best to target different investments.

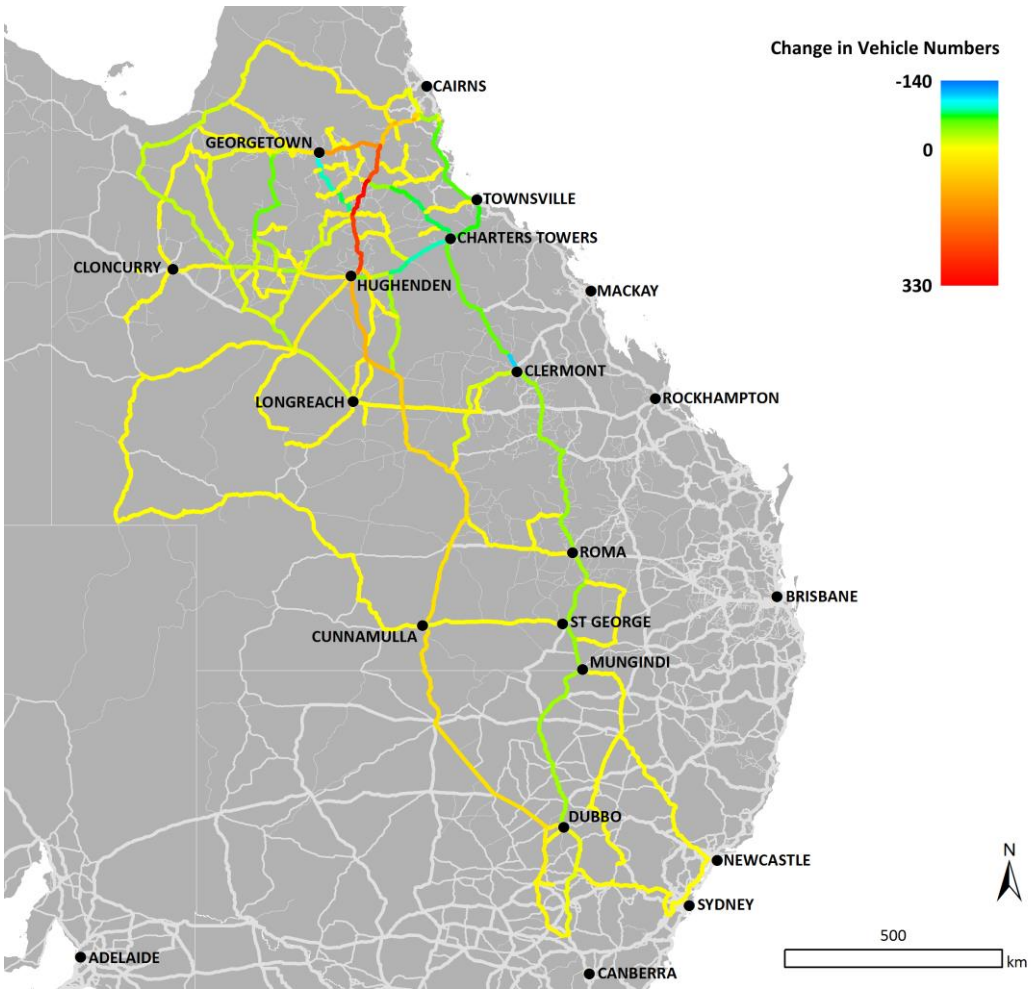


Figure 12: Average change in cattle vehicle counts across the road network per year, if the Hann highway was fully sealed

4.2 New Processing Facility

Cattle produced in the Northern Territory and north-west Queensland that are not sold for live export, require long distance transport to be processed at abattoirs in southern and eastern Australia. As part of expanding the cattle industry in the north and reducing supply chain costs, feasibility studies of new abattoirs at different locations have been considered. In this case study, we used TRANSIT to identify average transport savings if an abattoir was built at Hughenden. The new abattoir would process about 400 head of cattle per day except during the summer months where production levels are reduced. Figure 13 shows the optimal catchment of roads supplying each of the major abattoirs in the north, including that proposed for Hughenden, based on least travel time.

To estimate the total transport cost savings for a new abattoir, cattle movements to the proposed abattoir (given 400 head per day processing rate) were simulated and compared to the most efficient transport route if they were transported to an alternative abattoir. Without the new abattoir at Hughenden, the cattle would be sent to live export or east coast abattoirs at a total average cost of $4.1 million per year ($34 per head). Supplying cattle to a proposed abattoir at Hughenden would cost $1.9 million ($16 per head), reducing transport costs by about 50%, when compared to transporting the same cattle to an alternative facility. Note that whilst the optimal catchment of roads for a Hughenden abattoir is large (as with other identified western Queensland sites such as Richmond and Cloncurry), the cattle densities within this catchment are much less than for catchments located closer to the coast.

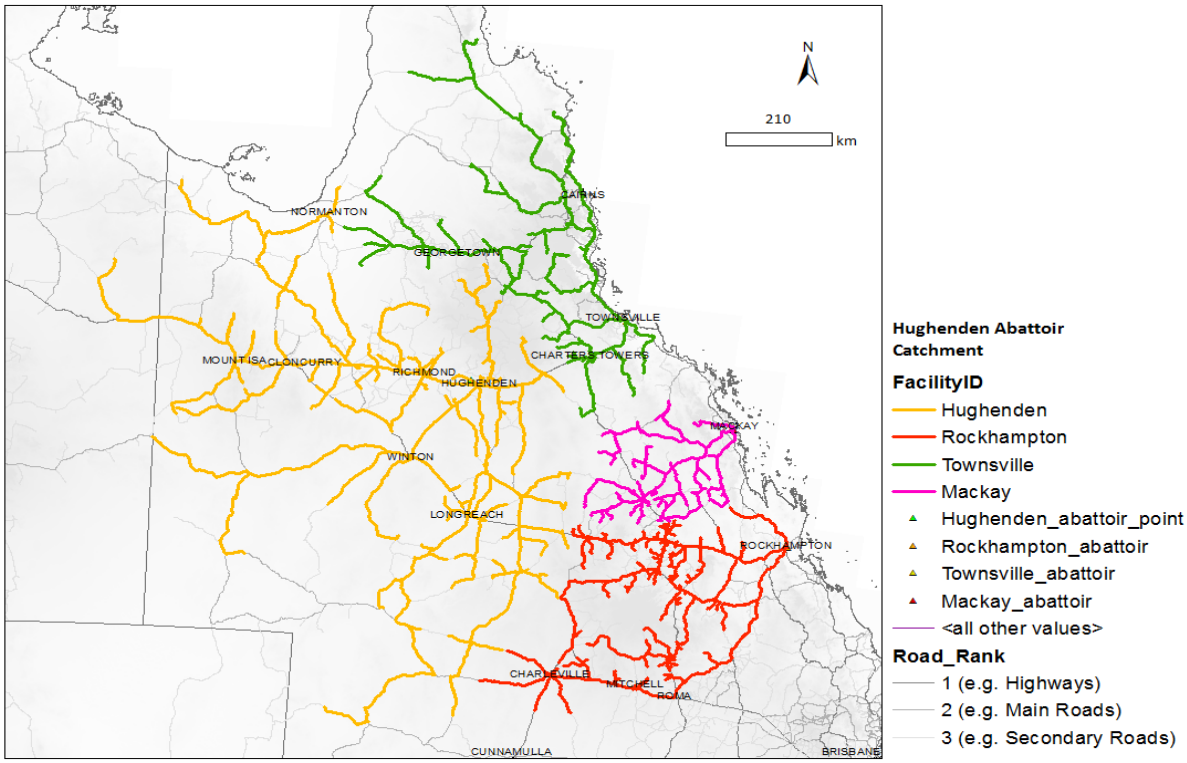


Figure 3: Optimal allocation ('catchment') of roads to each Queensland abattoir based on transport cost

4.3 Biosecurity Regulations

A goal of this work was to estimate the transport cost savings resulting from regulatory changes that allow cattle to be transported directly to abattoirs and feedlots without the requirement of tick clearing in tick-free zones. Figure 14 shows the tick-free and tick-infested regions of Queensland, along with the locations of feedlots and major abattoirs in and beyond South-East Queensland (SEQ). With current tick clearing requirements, for cattle transported to feedlots and abattoirs on the east coast, vehicles detour around the tick-free areas (e.g. via Bruce Highway), often in smaller vehicle configurations, to avoid the cost and delays of tick clearing.

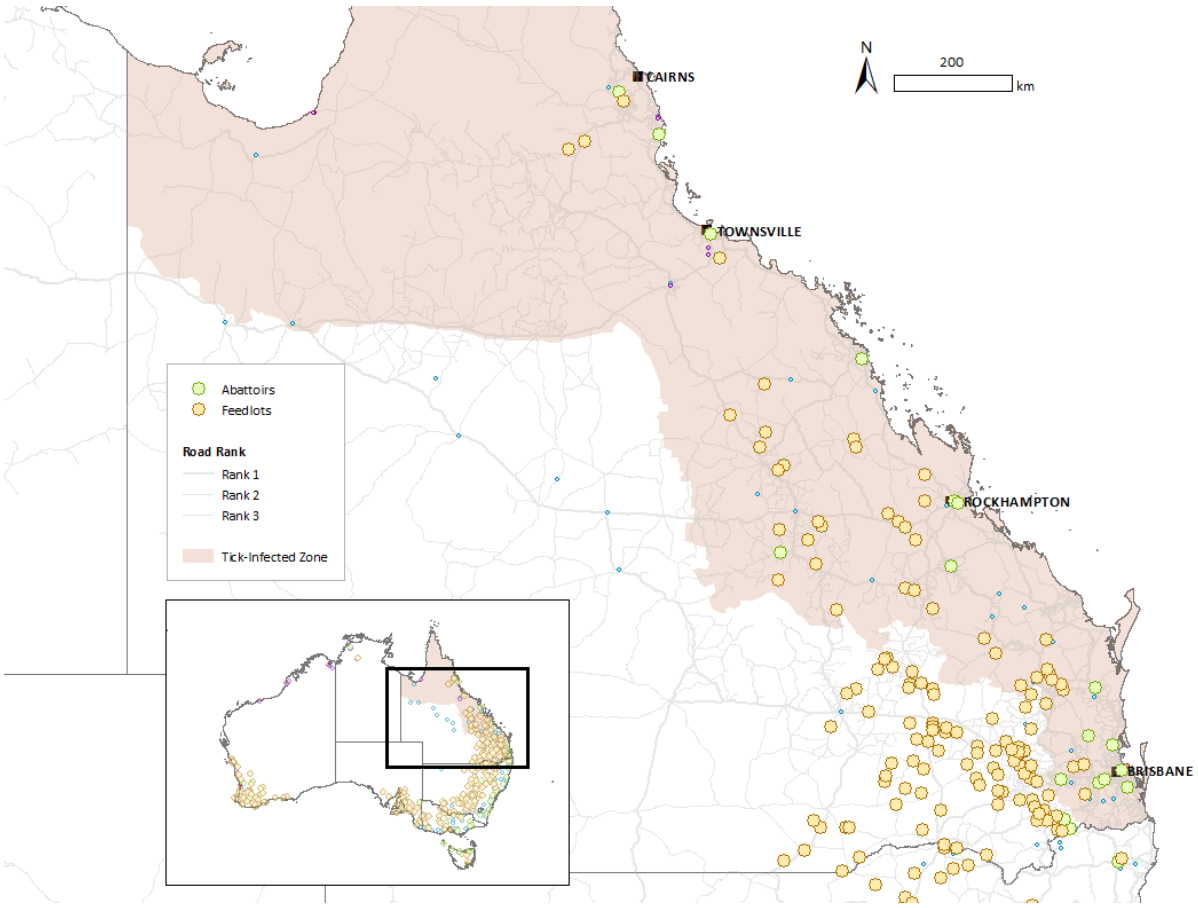


Figure 14: Location of tick zones, feedlots and major abattoirs in Queensland

Based on current conditions, TRANSIT estimated the total cost of vehicle trips to the top ten SEQ abattoirs is approximately $26 million per year ($22 per head). If the direct route is used, about 62% of the vehicle trips cross the tick line, with 2,500 vehicles crossing from a tick-infested zones to tick-free zone and back into a tick-infested zone en-route to the abattoirs. With the abolition of tick clearing, the savings for using the most direct route through the tick-free zone versus detouring around it are approximately $1.1 million per year ($5.52 per head), representing a saving of 12%.

Unlike SEQ abattoirs, the vast majority of feedlots are located in the tick-free zone, whereas those feedlots in tick-infested zones are generally further west and closer to the tick line than the SEQ abattoirs. TRANSIT was used to estimate that about 13,000 vehicle trips are made each year to Queensland feedlots. There are about 9,325 vehicle trips into feedlots in tick-free zones with the remainder to feedlots in tick-infested zones. The total cost of this transport is approximately $22.2 million ($22.38 per head). With the abolition of tick clearing, preferential use of direct routes results in in about 692 vehicle trips from enterprises in the tick-infested zone to a tick-free zone then to the feedlot in a tick-infested zone. The savings for using the direct routes rather than detours would be approximately $105,000 per year ($1.89 per head), representing a saving of 6%. The transport cost savings to feedlots are considerably less than those to abattoirs. This is because a large proportion of the SEQ feedlots are close to the tick line (particularly west of Gympie), so subsequent transport detours around the tick free-zone are quite short.

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