The Effects of Overloading on Road Assets

Prepared for the

Mid North
Weight of Loads Group
Outline

- Overview of Operation
- Why have a WOL Operation
- The Effect of Overloading
- How this Effects Our Road Assets
The Role of Weight of Loads

To improve safety & reduce the costs of maintaining roads by preventing the damage caused by overloaded vehicles

HOW?

Education ~ through working with the transport industry to promote an awareness of the negative impacts of overloading on our roads systems

Regulation ~ through patrolling state & regional roads monitoring compliance with legislative requirements

Key Challenges include the prevention of overloading during peak periods of high intensity freight movements such as harvest periods
Mid North Weight of Loads - Member Councils

Arimdale / Dumaresq
Guyra
Bellingen
Nambucca
Coffs Harbour
Kempsey
Greater Taree
Port Macquarie Hastings
Great Lakes
Gloucester
Walcha
Uralla
Tamworth Regional
Liverpool Plains
Upper Hunter
Dungog
Why have a WEIGHT OF LOADS OPERATION?
Why Do We Need Rules?

WHY HAVE VEHICLE LIMITS?

... because

LOTS OF VEHICLES HAVE TO SHARE LIMITED ROAD SPACE

TWO LARGE AN OVERHANG ON REAR AXLES CAN CAUSE ALL SORTS OF PROBLEMS

OVERLOADED VEHICLES ARE UNSAFE TO DRIVE AND INEFFICIENT TO OPERATE

VEHICLES WITH INCORRECT INTERNAL DIMENSIONS HAVE DIFFICULTY NEGOTIATING CORNERS

VEHICLES THAT ARE TOO HIGH MAY DAMAGE SIGNS, OVERBRIDGES AND THEMSELVES

OVERLOADED VEHICLES CAUSE DAMAGE TO OUR ROADS
How It Used To Be
Belltrees Bridge, Scone Shire Council
March 1921

First vehicle (H. L. White's Ford car) to cross "Belltrees" bridge over the Hunter River. March 1921
Photo by H. L. White
Belltrees Bridge, Scone Shire Council
October 1996
Could a bridge designer of the 1920’s have foreseen a *Super-Dog combination* or a *B-Double*?
NOT JUST BRIDGES....
Age of Australian Road Pavements

Bar chart showing the percentage of road pavements by age:
- Age unknown but greater than 20 years
- 5% aged 5 years
- 10% aged 10 years
- 15% aged 15 years
- 20% aged 20 years
- 25% aged 25 years
- 30% aged 30 years
- 35% aged 35 years
- 40% aged 40 years
IN DAYS GONE BY
TO WHAT THEY NOW HAVE TO CARRY
What We'd Like Our Roads To Be
Pavement Life Curve

- Pavement Condition Index
- Time (Years)

- 75% Condition drop
- 48% Condition drop
- 15% Condition drop
- 42% Condition drop

Pavement Life Curve
WHAT IS THE EFFECT OF OVERLOADING ON THE ROAD?
Testing Pavement Durability
Accelerated Load Facility
What is an ESA?

An ESA is an Equivalent Standard Axle

A Standard Axle is defined as a Dual-tyred, Single Axle transmitting a load of 80kn (or 8.2 tonne) to the pavement.
## Comparison of Axle Groups

<table>
<thead>
<tr>
<th>Axle Configuration</th>
<th>Load (kN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Axle; Single Tyres</td>
<td>53</td>
</tr>
<tr>
<td>Single Axle; Dual Tyres</td>
<td>80</td>
</tr>
<tr>
<td>Tandem Axle; Single Tyres</td>
<td>90</td>
</tr>
<tr>
<td>Tandem Axle; Dual Tyres</td>
<td>135</td>
</tr>
<tr>
<td>Tri-Axle</td>
<td>181</td>
</tr>
<tr>
<td>Quad-Axle</td>
<td>221</td>
</tr>
</tbody>
</table>
The 4th Power Rule

Number of Standard Axle Repetitions = \{ Load On Axle Group \quad \text{Standard Load For Axle Group} \} = 4
Application of the 4th Power Rule

The effect of 5% overload

\[ 1.05 \times 1.05 \times 1.05 \times 1.05 = 1.22 \]

or **22% increase in damage** and **18% reduction in pavement life**

The effect of 10% overload

\[ 1.10 \times 1.10 \times 1.10 \times 1.10 = 1.46 \]

or **46% increase in damage** and **32% reduction in pavement life**
Car vs Truck

To help add context

2 tonne car = 1/2250th ESA’s
Average Articulated Truck = 2.65 ESA
Articulated Truck = 6000 cars
Car vs Truck

- 82% of traffic on National Highways are cars

- Cars contribute 0.03% to pavement loadings based on ESA-km travelled
## Overloading Vs Pavement Life

<table>
<thead>
<tr>
<th>% Overload on Standard Axle</th>
<th>% Increase in Damage</th>
<th>Working Life of Twenty Year Pavement Reduced to (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>45</td>
<td>13.8</td>
</tr>
<tr>
<td>20</td>
<td>105</td>
<td>9.8</td>
</tr>
<tr>
<td>30</td>
<td>185</td>
<td>7.0</td>
</tr>
<tr>
<td>40</td>
<td>285</td>
<td>5.2</td>
</tr>
</tbody>
</table>
ESA's in Road Pavement Design

![Graph showing the relationship between minimum thickness of base material, CBR, design traffic, and thickness of granular material.](image-url)
Pavement Life

- Pavement Life is determined by Number of Equivalent Standard Axles (ESA’s)
- Local Rural Road (200 AADT 20% HV) typically 150-200,000 ESA’s over 20 yrs
- Greater ESA’s requires greater pavement depth and greater initial cost
4th Power Summary

- Pavement Damage is Related to Truck Axle Loads, **Not Truck Gross Mass**
- The 4th Power Rule refers to Pavement Wear, **Not Overload Failure**
- Even Greater Loads are Imposed by **Dynamic Loads**
HOW
This Effects Our Road Asset...
## Gloucester’s Road Asset

<table>
<thead>
<tr>
<th>Road Type</th>
<th>Length (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Sealed Roads</td>
<td>174</td>
</tr>
<tr>
<td>Local Unsealed Roads</td>
<td>464</td>
</tr>
<tr>
<td>Regional Roads</td>
<td>105</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>743</strong></td>
</tr>
</tbody>
</table>
## Gloucester's Asset Value

<table>
<thead>
<tr>
<th>Asset Class</th>
<th>Carrying Value</th>
<th>Av. Dep’n Expence</th>
<th>Program Maint.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural Roads</td>
<td>21m</td>
<td>315,000</td>
<td>715,000</td>
</tr>
<tr>
<td>Local Seal</td>
<td>26 m</td>
<td>390,000</td>
<td>300,000</td>
</tr>
<tr>
<td>Local Unseal</td>
<td>20 m</td>
<td>200,000</td>
<td>1 m</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>67 m</strong></td>
<td><strong>905,000</strong></td>
<td><strong>2.015 m</strong></td>
</tr>
</tbody>
</table>
## Gloucester’s Asset Value

<table>
<thead>
<tr>
<th></th>
<th>Listed Value $</th>
<th>Annual Dep’n. $</th>
<th>Maintenance $</th>
</tr>
</thead>
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<tr>
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The Cost of MNWOL to Gloucester?

$0.008 \text{ m}

i.e. 0.1\% \text{ of Asset Value}

or

0.4\% \text{ of Annual Maintenance Vote}
## Mid North Weight of Loads Summary

<table>
<thead>
<tr>
<th>Mid North WOL Group</th>
<th>01/02</th>
<th>02/03</th>
<th>03/04</th>
<th>04/05</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of Vehicles Stopped</td>
<td>1749</td>
<td>1770</td>
<td>2043</td>
<td>2163</td>
</tr>
<tr>
<td>No of Vehicles Weighed</td>
<td>739</td>
<td>675</td>
<td>854</td>
<td>932</td>
</tr>
<tr>
<td>No of Vehicles Breached</td>
<td>179</td>
<td>143</td>
<td>246</td>
<td>220</td>
</tr>
<tr>
<td>Person Hours of Operation</td>
<td>3522.25</td>
<td>3060</td>
<td>3612.5</td>
<td>3710.5</td>
</tr>
<tr>
<td>Variation (No. of Breached)</td>
<td>36</td>
<td>103</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>Variation (Hrs of Operation)</td>
<td>462.25</td>
<td>552.5</td>
<td>98</td>
<td></td>
</tr>
<tr>
<td>Group Costs</td>
<td>352570.03</td>
<td>356490.83</td>
<td>424227.27</td>
<td>426894.55</td>
</tr>
<tr>
<td>Variation (Costs)</td>
<td>39208.80</td>
<td>67736.44</td>
<td>2667.28</td>
<td></td>
</tr>
<tr>
<td>Group Average Costs per Hour</td>
<td>100.09</td>
<td>116.50</td>
<td>117.43</td>
<td>115.05</td>
</tr>
<tr>
<td>Variation (Avg. Costs p/hr)</td>
<td>+16.41</td>
<td>+0.93</td>
<td>-2.38</td>
<td></td>
</tr>
</tbody>
</table>
Number of Trucks Stopped to Breached

Vehicles Intercepted - Vehicles Breached

Calendar Years

Number of Vehicles

Intercepts
Breaches
Vehicles Intercepted Vs Vehicles Breached

![Graph showing the comparison of vehicles intercepted vs vehicles breached from 1995 to 2005. The graph displays the number of intercepts and breaches for each year, with a notable increase in breaches from 2002 to 2004.]
Compliance Rates

% Of Intercepted Vehicles Which Complied


100% 90% 80% 70% 60% 50%
Too much information can cause mental overload

And... like our roads

Wear Us Out
Thank You

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