GLADSTONE
REGIONAL COUNCIL

Pavement Impact Assessment Methodology

Revision D
March 2022

Rev	Date	Description	Author	Reviewed	Approved
A	December 2010	For Adoption	PJB	MM	RP
B	07 December 2010	Adopted By Council	PJB	MM	RP
C	15 December 2015	Amended/Adopted By Council	PJB	JP	PK
D	16 February 2022	For amendments	CLS	PB	

Contents

1. Introduction

The purpose of this report is to provide a consistent methodology that will assist Council and Applicants that trigger the Environmental Impact Statement (EIS) process in addition to other development applications or proposed activities on local road networks, to determine the level of impact the traffic will have on council's road pavement assets within the Gladstone Regional Council area and provide a basis for compensation payments.

2. Initial Step

The initial step of the Pavement Impact Assessment (PIA) is for the Applicant to contact Council and indicate which local roads are being proposed to be used by heavy vehicles during the project and for what purpose each road will be used for. Council can then undertake an audit to determine if:

- The current road formation and condition can support the proposed traffic volume and/or type; and
- If it is safe for the existing traffic to use the road with the additional traffic / configurations proposed.

If either of these conditions is not met, possible alignment and strength improvements, and/or alternative solutions will need to be discussed with Council.

3. Information to be Provided to Council by Applicant

The following information is to be submitted to Council by the Applicant so that a Pavement Impact Assessment can be conducted:

- A list of proposed roads that are to be used by the project. These are to be supplied in the form of:
  - A map showing the roads to be used and the sections of each road to be used, as shown in Appendix A.
  - An excel spreadsheet listing the road sections to be used and the length of the section of road, as shown in Appendix B.
  - A brief summary describing what purpose each section of road will be used for during the life of the project. Eg, Blain Drive (Dawson Hwy to Garfield St) will be used by employees travelling to and from the site and miscellaneous deliveries. Blain Drive (Garfield Street to Hanson Road) will be used by employees travelling to and from the site, miscellaneous deliveries, and materials sourced from the adjacent industrial estate.
- The total project generated Equivalent Standard Axles (ESA’s) in each direction of travel for each road section, as shown in Appendix B. The total project generated ESA's is the combined total of all construction and operation traffic produced by the project, from the start of construction until 10 years after the final stage of construction has been completed and commissioned. This will be used to calculate the reconstruction contribution.
- The total construction generated ESA’s in each direction of travel during each construction phase. This includes both operation and construction traffic that occurs during each construction phase, as shown in Appendix B. This will be used to calculate the maintenance contribution.
- The total number of years over which construction will occur for each road segment for each phase.

3.1. Input Data

To begin the Pavement Impact Assessment process the assessor requires all of the following data:

- A list of Roads broken down into segments depending on changes in traffic conditions produced by the project.
- The length of road for each road segment.
- A Current Traffic Count giving:
  - The Average Annual Daily Traffic (AADT) in the direction of the most traffic that is being generated by the project in regards to ESA's.
  - The Percentage of Heavy Vehicles (%HV) for the AADT.
  - The Average ESA value for the Heavy Vehicles (HV), if no value is available a value of 3.2 is used (as recommended by Department of Transport and Main Roads Queensland (DTMR)).
- The Predicted Life of the pavement, this value is assumed to be 20 years unless otherwise agreed.
- The growth rate of the background traffic of the road. If this value is not attainable a value will be calculated by using the current population data for the Gladstone Region and comparing it with the projected population for a 20 year horizon and converting it to a compound growth rate. Demographic population data is to be attained from the Office of Economic and Statistical Research (OESR).
- The Total ESA's generated over the life of the project in the direction of travel with the greatest traffic impact in terms of ESA's.
- The Total ESA's in the direction of travel with the greatest traffic impact in terms of ESA's generated by the project during the construction phase or combined total of construction phases if it is a multi stage project. This includes operation traffic that occurs during the construction phase/s.
- The total years of construction for each section of road.
- The Reconstruction Cost for the section of road being assessed. When the applicant contacts council as part of the initial step and identifies which roads they intend to use Council will then attain the Reconstruction Cost from its Asset Department for the specific section of road.
- The Design Life ESA value taken from
  - Historical pavement design records OR
  - An available traffic count OR
  - Minimum traffic loadings for the relevant Council Road Hierarchy from the Capricorn Municipal Design Guidelines (Pavement Design)

Using Gladstone Regional Councils Pavement Impact Assessment Calculations Spreadsheet the above information is entered into their respective columns in the Input Table as shown in Appendix C.

4. Methodology

The methodology used to conduct a Pavement Impact Assessment for Gladstone Regional Council is outlined in the following sections. The following methodology steps through the process used in the Gladstone Regional Councils Pavement Impact Assessment Calculations Spreadsheet.

An example Summary Table for the Gladstone Regional Councils Pavement Impact Assessment Spreadsheet is displayed in Appendix D.

4.1. Reconstruction Contribution

The first step in calculating the cost associated with the reconstruction contribution is to determine whether the proposed road is in a condition fit for the use proposed by the project. This is determined by Council after the initial meeting / contact between Council and the applicant has occurred, where the applicant identifies all roads that are being proposed to be used by heavy vehicles and the type of use for each road. This information allows council to determine if the identified roads are fit for use. The Gladstone Regional Council's Asset Database is then used to determine the Reconstruction and Maintenance costs for Roads that are determined to be fit for use. Roads that are determined NOT to be fit for use will require the applicant to enter into an infrastructure agreement with Council.

The next step is to determine the Design ESA's for each road. Council does not currently have pavement design information for most of its existing road network and therefore does not have design ESA's for the existing roads. Therefore, in instances where design ESA’s are not available the following method has been adopted by Council which is adapted from equation 7-1 from DTMR's Pavement Design Manual and uses current traffic count data and then increases the traffic by the growth rate for the Design Life of the pavement, as shown in equation 1.

Equation 1 - Design Life ESA's

$$DE_p = \sum_{n=1}^{DL_p} AADT_L \times 365 \times \%HV \times Average\ HV\ ESA(1+G)^{(n-1)}$$

Where

DE_P = Design Life ESA's for Pavement
DL_P = Design Life of Pavement (Input Table Column G)
G = Growth Rate (Input Table Column F)
$AADT_L$ = Average Annual Daily Traffic per Lane (Input Table Column C)
%HV = Percentage Heavy Vehicles (Input Table Column D)
Average HV ESA = Average Heavy vehicle Equivalent Standard Axles (Input Table Column E)

If no Traffic Count was available to use to calculate the Design Life ESA's then the Minimum ESA's from Capricorn Municipal Development Guidelines Pavement Design – Minimum Traffic Loadings are to be used.
http://www.cmdg.com.au/Guidelines/DesignSpecifications/Files/CMDG%20D2%20-%20Pavement%20Design%20V5%20Dec%202021.pdf

Once the Design Life ESA's for the pavement have been calculated, the Design life ESA are compared to the Design Life ESA's in Councils Road Hierarchy and the Larger of the two (2) values is used as the Design Life ESA value from this point forward. The impact the project will have on the road pavement can be determined in the form of a Percentage Impact. This is calculated by dividing the Project Generated ESA's by the Design Life ESA's for the pavement, shown in Equation 2. The total ESA generated by the project are used in the reconstruction contribution calculation as it is assessing the total impact the project will have on Gladstone Regional Councils road network. Main Roads have a percentage impact trigger of 5% while there is no percentage impact trigger for council roads.

Equation 2 - Percentage Impact

$$PI_P = \frac{PE_P}{DE_P}$$

Where
- PI_P = Percentage Impact of Pavement
- DE_P = Design Life ESA's (Equation 1)
- PE_P = Project Generated ESA's (Input Table Column H)

The Reconstruction Contribution for each section of road can be calculated using Equation 3.

Equation 3 - Reconstruction Contribution

$$Reconstruction\ Contribution = L_P \times PI_P \times C_P$$

Where
- L_P = Length of Road (Input Table Column B)
- PI_P = Percentage Impact (Equation 2)
- C_P = Reconstruction Cost (Input Table Column L, requested from GRCs assets department – Replacement Cost)

Reconstruction cost is calculated using the sum of all of the replacement values of the identified segments for each road, divided by the total length of all of the segments.

4.2. Maintenance Contribution

The Maintenance Contribution calculation is undertaken having regard to the traffic produced during the construction phase, or phases of the project if it has multiple stages, as this is generally the period where the most traffic for the project is generated, and therefore has the greatest impact on Councils road pavement assets and will require an increase in road maintenance effort during these periods.

Council has opted for a simplified approach to determining the pavement impact. Rather than looking at each year individually, the total number of years over which construction phase occurs is grouped together and a Design Life ESA calculation which is adapted from equation 7-1 from DTMR's Pavement Design Manual is undertaken for the construction period, as shown in Equation 4.

Equation 4 - Construction Life ESA's

$$DE_C = \sum_{n=1}^{DL_C} AADT_L \times 365 \times \%HV \times Average\_HV\_ESA(1+G)^{(n-1)}$$

Where

DE_C = Construction Life ESA's
DL_C = Years of Construction (Input Table Column I)
G = Growth Rate (Input Table Column F)
$AADT_L$ = Average Annual Daily Traffic per Lane (Input Table Column C)
%HV = Percentage Heavy Vehicles (Input Table Column D)
Average HV ESA = Average Heavy vehicle Equivalent Standard Axles (Input Table Column E)

If there is no historic data to calculate a Construction Life ESA, the Design Life ESA value in Council Hierarchy is to be used to calculate the Construction Life ESA's.

Using the Construction Life ESA's and the Construction Generated ESA's an Average Yearly Percentage Impact during Construction can be calculated, shown in Equation 5.

Equation 5 - Average Percentage Impact During Construction

$$PI_C = \frac{PE_C}{DE_C}$$

Where

PI_C = Average Yearly Percentage Impact during Construction
DE_C = Construction Life ESA's (Equation 4)
PE_C = Construction Generated ESA's (Input Table Column J)

The Maintenance Contribution is calculated using Equation 6.

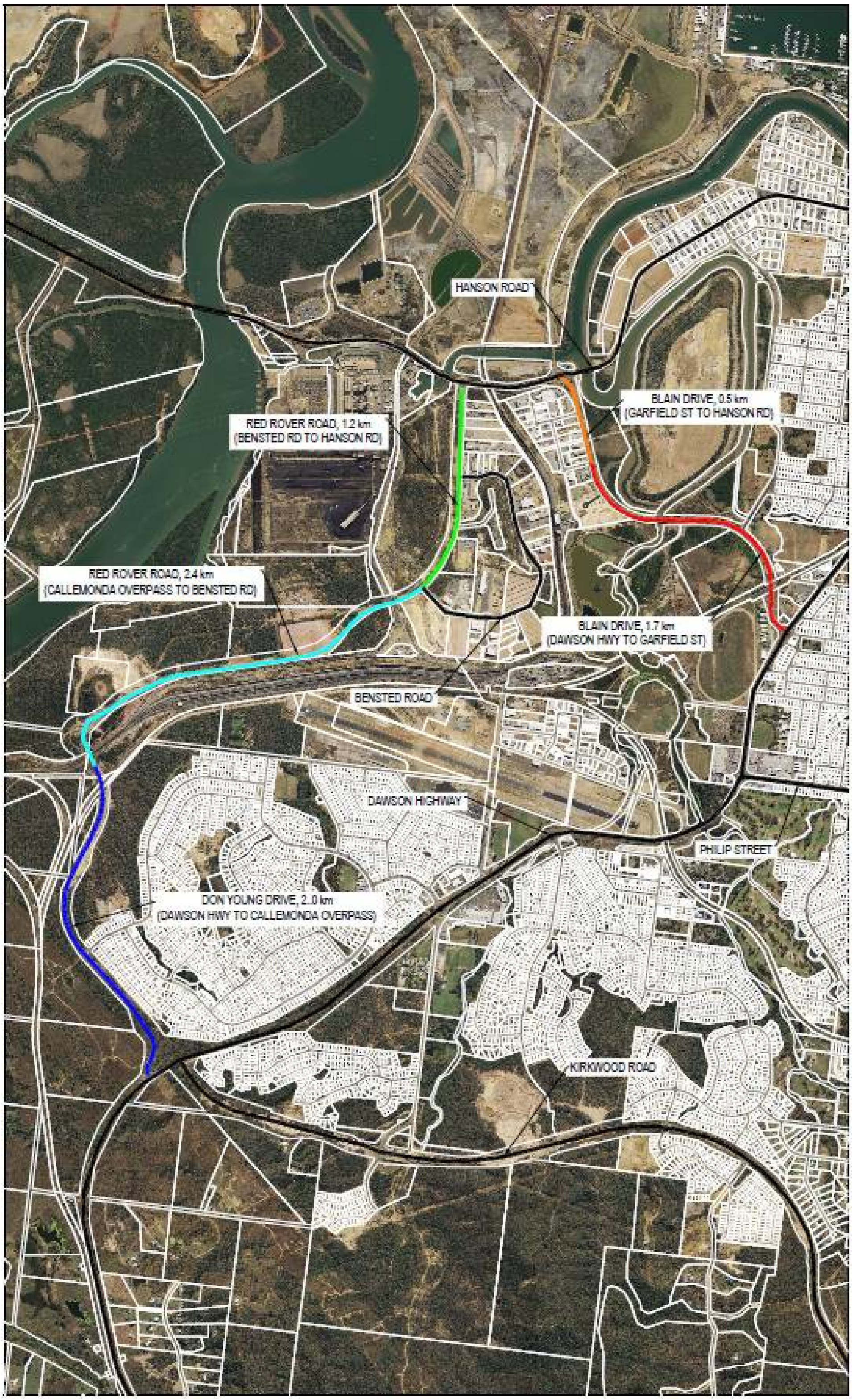
Equation 6 - Maintenance Contribution

$$Maintenance\ Contribution = L_R \times T_C \times PI_C \times C_M$$

Where
L_R = Length of Road (Input Table Column B)
T_C = Years of Construction (Input Table Column I)
PI_C = Average Yearly percentage Impact during construction (Equation 5)
C_M = Maintenance Cost (Summary Table Column M, requested from GRCs assets department, if no value is available, an indicative value of 3% could be used (based on historical data))

5. Appendices

5.1. Appendix A



5.2. Appendix B

Road Sections	Road Section Lengths (km)	Project Generated Traffic (ESAs)		Traffic Generated During Construction (ESAs)		Years of Construction (Years)
		Inbound	Outbound	Inbound	Outbound	
Blain Drive (Dawson Hwy to Garfield St)	1.7	7.20E+04	3.20E+04			
Blain Drive (Garfield St to Hanson Rd)	0.5	8.40E+04	5.30E+04			
Don Young Dr (Dawson Hwy to Callemondah Overpass)	2	5.00E+05	2.10E+05			
Red Rover Rd (Callemondah Overpass to Bensted Rd)	2.4	5.00E+05	2.10E+05			
Red Rover Rd (Bensted Rd to Hanson Rd)	1.2	6.10E+05	2.20E+05			
Blain Drive (Dawson Hwy to Garfield St) (phase 1)	1.7			6.80E+04	3.20E+04	3
Blain Drive (Garfield St to Hanson Rd) (phase 1)	0.5			7.90E+04	5.30E+04	3
Don Young Dr (Dawson Hwy to Callemondah Overpass) (Phase 1)	2			3.00E+05	1.20E+05	3
Red Rover Rd (Callemondah Overpass to Bensted Rd) (Phase 1)	2.4			3.00E+05	1.20E+05	3
Red Rover Rd (Bensted Rd to Hanson Rd) (Phase 1)	1.2			3.20E+05	2.10E+05	3
Blain Drive (Dawson Hwy to Garfield St) (phase 2)	1.7					
Blain Drive (Garfield St to Hanson Rd) (phase 2)	0.5					
Don Young Dr (Dawson Hwy to Callemondah Overpass) (Phase 2)	2			1.90E+05		2
Red Rover Rd (Callemondah Overpass to Bensted Rd) (Phase 2)	2.4			1.90E+05	7.00E+04	2
Red Rover Rd (Bensted Rd to Hanson Rd) (Phase 2)	1.2			2.80E+05	7.00E+04	2

5.3. Appendix C

A	B	C	D	E	F
Road	**Road length** *(km)*	**AADT per Lane** *(vehicles/day/Lane)*	**%HV** *(%)*	**Average HV ESA** *(ESA)*	**Growth** *(%)*
Blain Drive (Dawson Hwy to Garfield St)	1.7	2629	18.39%	3.2	2.40%
Blain Drive (Garfield St to Hanson Rd)	0.5	2629	18.39%	3.2	2.40%
Don Young Dr (Dawson Hwy to Callemondah Overpass)	2	1800	16.58%	3.2	2.40%
Red Rover Rd (Callemondah Overpass to Bensted Rd)	2.4	1800	16.58%	3.2	2.40%
Red Rover Rd (Bensted Rd to Hanson Rd)	1.2	1939	18.20%	3.2	2.40%

G	H	I	J	K	L
Predicted Pavement Life *(years)*	**Project Generated ESA's** *(ESA)*	**Years of Construction** *(Years)*	**Construction Generated ESA's** *(ESA)*	**Design Life ESA's (Hierarchy)** *(ESA)*	**Reconstruction Cost** *($ per KM)*
20	7.2E+04	3.00	6.8E+04	8.0E+05	$ 1,000,000.00
20	8.4E+04	3.00	7.9E+04	8.0E+05	$ 1,000,000.00
20	5.0E+05	5.00	4.9E+05	8.0E+05	$ 750,000.00
20	5.0E+05	5.00	4.9E+05	8.0E+05	$ 750,000.00
20	6.1E+05	5.00	6.0E+05	8.0E+05	$ 750,000.00

5.4. Appendix D

A	B	C	D	E
Road	**Road length** *(km)*	**Predicted Pavement Life** *(years)*	**Design Life ESA's (Historical)** *(ESA)*	**Design Life ESA's (Hierarchy)** *(ESA)*
Blain Drive (Dawson Hwy to Garfield St)	1.7	20	1.43E+07	8.00E+05
Blain Drive (Garfield St to Hanson Rd)	0.5	20	1.43E+07	8.00E+05
Don Young Dr (Dawson Hwy to Callemondah Overpass)	2	20	8.82E+06	8.00E+05
Red Rover Rd (Callemondah Overpass to Bensted Rd)	2.4	20	8.82E+06	8.00E+05
Red Rover Rd (Bensted Rd to Hanson Rd)	1.2	20	1.04E+07	8.00E+05

F	G	H	I	J	K	L
Design Life ESA's (Value to Use) *(ESA)*	**Project Generated ESA's** *(ESA)*	**Percentage Impact** *(%)*	**Reconstruction Cost** *(ESA)*	**Reconstruction Contribution** *($)*	**Years of Construction** *(Years)*	**Construction Life ESA's (Historical)** *(ESA)*
				$ 140,036.21		
1.4E+07	7.20E+04	0.5%	$ 1,000,000.00	$ 5,041.78	3.0	1.7E+06
1.4E+07	8.36E+04	0.6%	$ 1,000,000.00	$ 5,854.07	3.0	1.7E+06
8.8E+06	5.01E+05	5.7%	$ 750,000.00	$ 42,625.16	5.0	1.8E+06
8.8E+06	5.01E+05	5.7%	$ 750,000.00	$ 42,625.16	5.0	1.8E+06
1.0E+07	6.10E+05	5.9%	$ 750,000.00	$ 43,890.04	5.0	2.2E+06

M	N	O	P	Q	R	S
Construction Life ESA's (Hirarchy) *(ESA)*	**Construction Life ESA's (Value to Use)** *(ESA)*	**Construction Generated ESA's** *(ESA)*	**Average Yearly Percentage Impact during Construction** *(%)*	**Maintenance Cost** ($/km/Year)	**Maintenance Contribution** *($)*	**Total**
					$ 178,150.03	***$ 318,186.24***
4.0E+04	1.7E+06	6.80E+04	3.9%	$ 30,000.00	$ 5,996.29	
4.0E+04	1.7E+06	7.90E+04	4.6%	$ 30,000.00	$ 2,048.90	
4.0E+04	1.8E+06	4.90E+05	26.8%	$ 22,500.00	$ 60,292.68	
4.0E+04	1.8E+06	4.90E+05	26.8%	$ 22,500.00	$ 72,351.21	
4.0E+04	2.2E+06	6.00E+05	27.7%	$ 22,500.00	$ 37,460.95	