Appendix 4

Guide for calculation of maintenance cost contributions

Road Maintenance Cost Contribution Calculation – Heavy vehicles

1. Overview of the process and limitations

While the Town of Port Hedland's economy is highly dependent on heavy vehicles, intensive presence of heavy vehicles has a significant impact on roads managed by the local government. Increased maintenance requirements due to extraordinary wear and tear cannot be covered with standard local government budgets. This is one of key reasons for considering maintenance cost contribution policy.

This document is based on existing WALGA cost recovery policies and supplementary research reports prepared by ARRB.

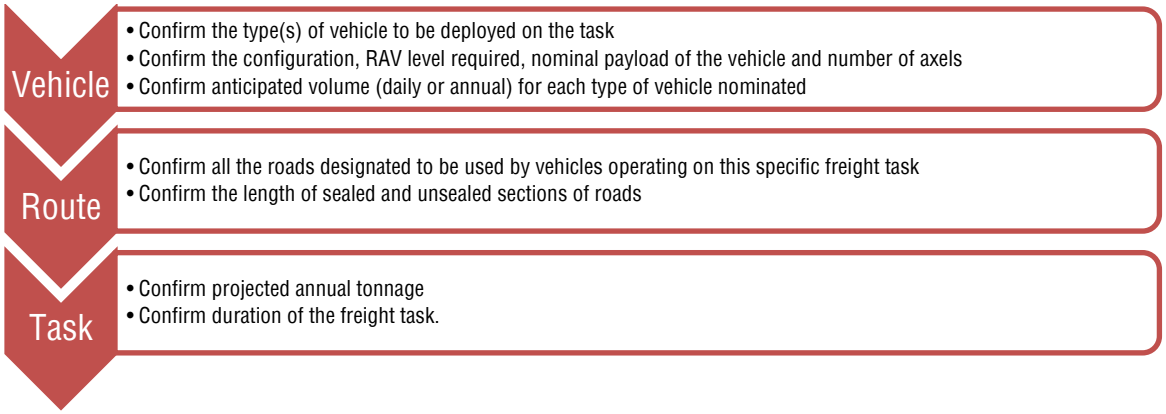
Marginal costs are current as 2015 for sealed roads and 2017 for unsealed roads. Prior to application of process outlined in this document, confirm if there are more current data on actual cost of maintenance of the particular section of the road.

The marginal cost as set out in this document does not allow for:

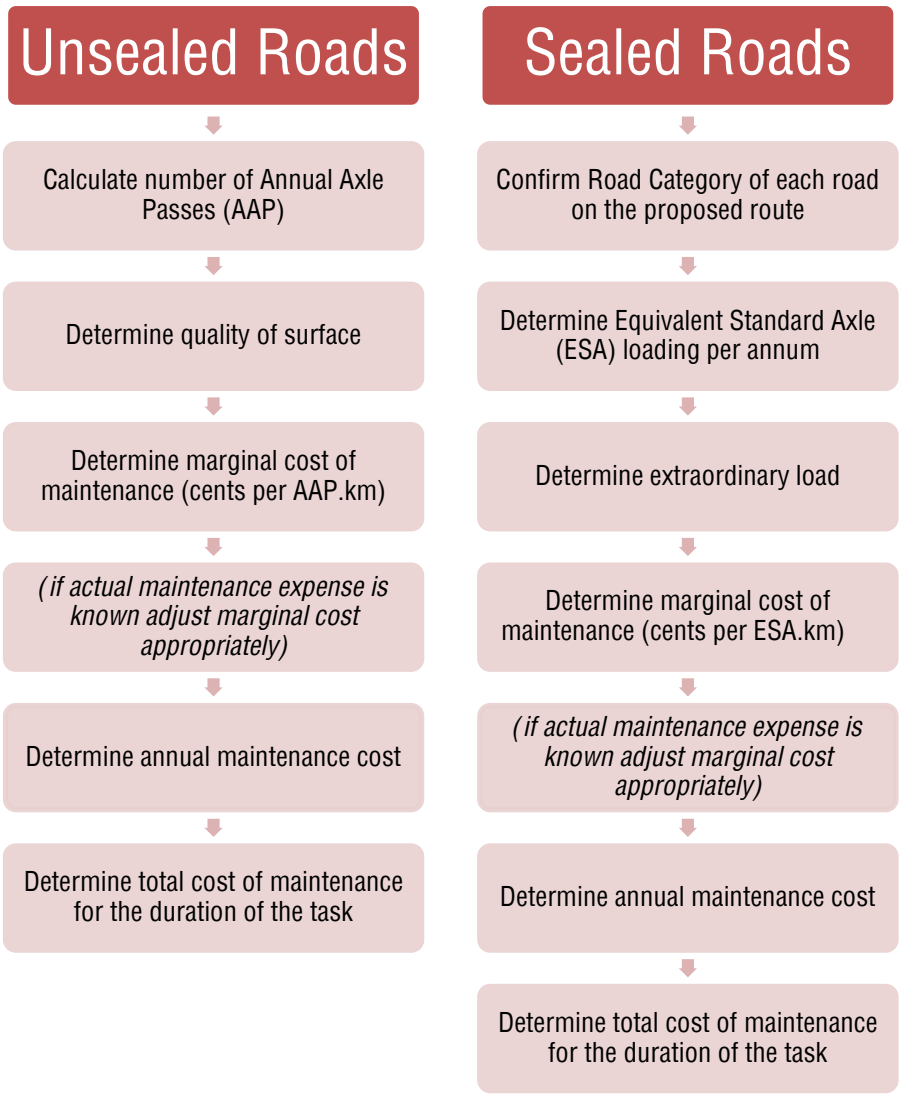
- remediation or upgrade of bridges, culverts or drainage assets.
- recovery from natural disasters
- asphalt seals.

1.1 Overview of the process

Process of calculation of maintenance cost contribution for sealed and unsealed roads differs slightly, however the first steps to be taken are common ones as outlined below:



Once all of these details are confirmed, appropriate procedure for sealed and unsealed roads is outlined below:


Unsealed Roads
Calculate number of Annual Axle Passes (AAP)
Determine quality of surface
Determine marginal cost of maintenance (cents per AAP.km)
(if actual maintenance expense is known adjust marginal cost appropriately)
Determine annual maintenance cost
Determine total cost of maintenance for the duration of the task
Sealed Roads
Confirm Road Category of each road on the proposed route
Determine Equivalent Standard Axle (ESA) loading per annum
Determine extraordinary load
Determine marginal cost of maintenance (cents per ESA.km)
(if actual maintenance expense is known adjust marginal cost appropriately)
Determine annual maintenance cost
Determine total cost of maintenance for the duration of the task

2. Instruction on calculating maintenance contributions on Local Government roads

2.1 General data

2.1.1 Vehicle

Type of vehicles used	RAV network level required	Number of Axels

ESTIMATED PAYLOADS AND AXLE QUANTITIES FOR TYPICAL VEHICLE TYPES					
Vehicle Type	*GCM (Max permitted mass tonnes)*	*RAV*	*Approximate Payload* (tonnes)*		*Total Axles****
			Regulation mass limit	*AMMS L3***	
3 Axle Rigid Truck (12.5m)	*22.5*	*N/A*	*13*	*14*	*3*
6 Axle Articulated (19m)	*42.5*	*2 (B)*	*24*	*29*	*6*
B Double (27.5m)	*67.5*	*2 (C)*	*45*	*53*	*10*
PM + Semi + 5 axle DT (27.5m)	*84.0*	*3 (A)*	*54*	*63*	*12*
PM + Semi + 6 axle DT (27.5m)	*87.5*	*4 (A) / 6(A)*	*56*	*68*	*13*
Truck + 2 x 6 axle DT (36.5m)	*107.5*	*7 (A)*	*72*	*87*	*16*
PM + Semi + 2 x 6 axle DT (53.5m)	*127.5*	*10(A)*	*84*	*102*	*19*

**These figures have been estimated using typical WA vehicle combinations and tare weights. Actual tare weights may vary across vehicle models resulting in slight differences in payload tonnage.*
***The Accredited Mass Management Scheme (AMMS) allows up to an additional 3.5 tonnes per tri-axle combination and 1.0 tonne per tandem axle combination. The AMMS has three loading levels. If a lower level is applicable, then use a proportionate value between RML and AMML L3.*
****Assumes a twin-drive configuration. Adjust total axles for tri-drive and single drive configurations.*

Is this AMMS vehicle? **If it is, what is the level?**		☐ Yes ☐ No
☐ AMMS 1	☐ AMMS 2	☐ AMMS 3
Maximum approved payload of the vehicle		

Note: If payload tonnage is available only for Regulation Mass Limit and for AMMS3 (as the highest level) for a particular vehicle on AMMS1 or AMMS2 level – payload tonnage should be appropriately extrapolated.

2.1.2 Route

Road name (SLK commencing route – SLK ending route)	Sealed portion (km)	Unsealed Portion (km)	Total (km)

2.1.3 Freight Task

Freight task description	Annual payload (t) (annual tonnage of the task)	Duration of the task (years)

2.2 Unsealed roads

2.2.1 Annual axel passes

Annual axel passes should be calculated for a two-way movement. Annual Axel Passes (AAP) can be calculated in two ways. Both options are shown below: -

Option 1:

AAP= APL/PL x NoA x 2

AAP = Annual Axel Passes

APL = Annual PayLoad (annual tonnage of freight task) (t)

PL = Approved vehicle payload (refer Section 3.1.1)

NoA = Number of Axels (refer Section 3.1.1)

Option 2:

AAP = AADT x NoA

AAP = Annual Axel Passes

AADT = Annual Average Daily Traffic (annual tonnage of freight task) (t)

NoA = Number of Axels (refer Section 3.1.1)

2.2.2 Quality of Surface

Quality of surface should be assessed as per the table below. The table was developed by ARRB for this purpose.

Table 1 - Indicative compliance level and performance of unsealed road granular surfacing materials (prepared by ARRB)

Indicative compliance level	*Materials and performance attributes*
Non-compliant below	*High rate of material loss (> 20 – 40 mm per year per 100 AADT) with surface ravelling and corrugations under traffic. Shrinkage Product (SP) below 100, whereas the Grading Coefficient (GC) may vary widely. Uniformly graded fine materials with a low GC display low resistance to erosion and coarsely graded higher GC materials tend to ravel badly and are generally unsuitable*
Borderline below	*Moderate rate of material loss (10 – 20 mm per year per 100 AADT), with the surface tending to loosen and corrugate under the action of traffic but may remain tolerable to heavy traffic at low to moderate speeds. SP below 200, whereas GC may vary widely. Performance can improve with regular grading/cushioning operations*
Compliant	*Low rate of material loss, typically less than 5 – 10 mm per year per 100 AADT, with a well-knit surface resulting from a mechanically stable particle size distribution with few weak particles and containing a sufficient quantity of plastic fines. Ideal materials typically have a SP greater than 200 with an upper limit of 600 depending on the proportion of heavy traffic and tolerance for dust, and a GC of between 20 and 30. Arm-chair type (or gap) gradings are acceptable with concretionary materials, such as calcretes and laterites.*
Borderline above	*Moderate rate of material loss (10 – 20 mm per year per 100 AADT), with the surface tending to rut and become slippery in the wet but may remain tolerable to heavy traffic under wet conditions. SP above 600, whereas GC may vary widely. Performance can improve with regular grading/cushioning operations.*
Non-compliant above	*Moderate to high rate of material loss (> 20 mm per year per 100 AADT) with risk of severe rutting and slipperiness in the wet. SP above 700, whereas GC may vary widely. Uniformly*

	graded fine materials with lower GC display low resistance to erosion and are generally unsuitable, whereas high GC materials tend to be ravel badly leading to extensive potholes.

Section of the route (unsealed)	Indicative Compliance Level

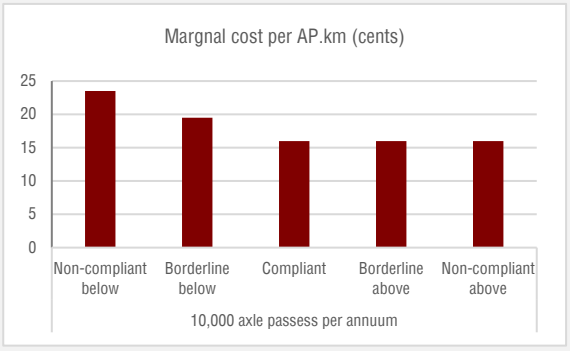
2.2.3 Marginal Cost (MC) of maintenance

Review calculation of AAP in Section 3.2.1 and determine the nearest value to be used:

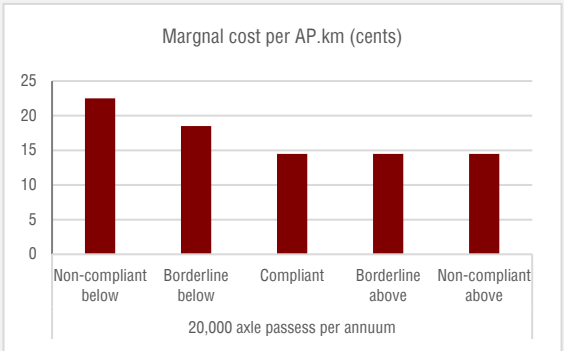
☐ 10,000 AAP	☐ 20,000 AAP	☐ 40,000 AAP	☐ 100,000 AAP	☐ 200,000 AAP
Marginal Cost of Maintenance (in cents per AAP km)				

Determine Marginal Cost from an appropriate graph below (adapted from document prepared by WALGA and ARRB):

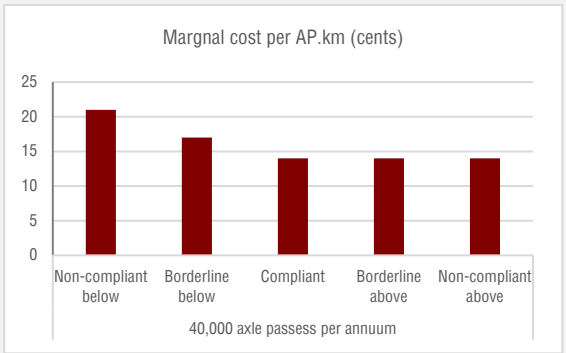
Marginal cost per additional axle pass (cents per km) for 10,000 AP per annum



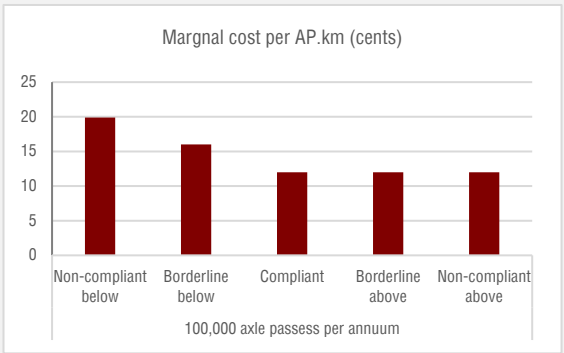
Marginal cost per additional axle pass (cents per km) for 20,000 AP per annum



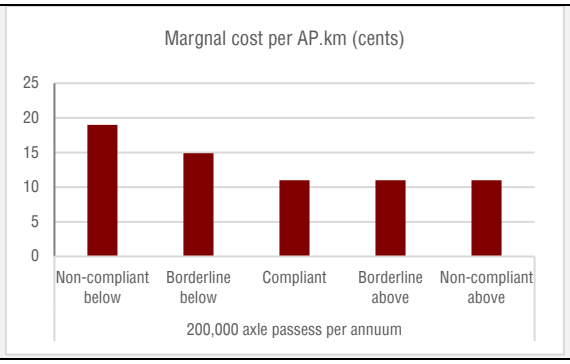
Marginal cost per additional axle pass (cents per km) for 40,000 AP per annum



Marginal cost per additional axle pass (cents per km) for 100,000 AP per annum



Marginal cost per additional axle pass (cents per km) for Zone 4 and 40,000 AP per annum


Margnal cost per AP.km (cents)
25
20
15
10
5
0
Non-compliant below
Borderline below
Compliant
Borderline above
Non-compliant above
200,000 axle passess per annuum

2.2.4 Adjusted Marginal Cost

If the actual cost of re-sheeting for a particular section of the road is known, the marginal cost should be adjusted to reflect local conditions.

AMC= MC* AC / IC ($78,133)

AMC = Adjusted marginal cost ($)

MC - Marginal cost ($)

AC = Actual Cost of re-sheeting per kilometre of the road ($)

IC = Indicative cost of re-sheeting per kilometre of the road (currently $78,133 for Pilbara region) ($)

As previously mentioned, indicative costs and nominal marginal costs are based on 2017 pricing. If the actual cost of re-sheeting is unavailable, appropriate CPI should be considered.

2.2.5 Annual Maintenance Cost

Annual cost of re-sheeting attributable to a task for a particular type of surface should be calculated as per below:

C= (A)MC x d x AAP

C = annual cost of maintenance ($)

(A)MC = Marginal Cost or Adjusted Marginal Cost value ($)

d= distance - route length (km)

AAP = Annual Axel Pass

2.2.6 Total Maintenance Cost

Total maintenance cost is the sum required to maintain the road for the duration of the freight task.

TC = C x t x CPI

TC = Total cost of maintenance

C = annual cost of maintenance

t= duration of the freight task (years)

CPI = Consumer Price Index

Caution should be exercised with blanket application of CPI rates, as the inflation rate does not reflect the change in pricing accurately in every sector. Ideally, the cost of similar works should be tracked, and local trends can be spotted and applied.

2.2.7 Cost sharing between proponents

2.3 Sealed Roads

2.3.1 Road Category

Review Main Roads WA categorisation of the sealed roads on the proposed route:

Road name and SLK (commencing and ending)	Length of the section belonging to each class			
	Access Road	Local Distributor	Regional Distributor	District Distributor

2.3.2 Equivalent Standard Axel (ESA) Loading per annum

There are two methods for calculation of Equivalent Standard Axel Loading per annum, depending on information available.

Method 1 – Per payload tonne

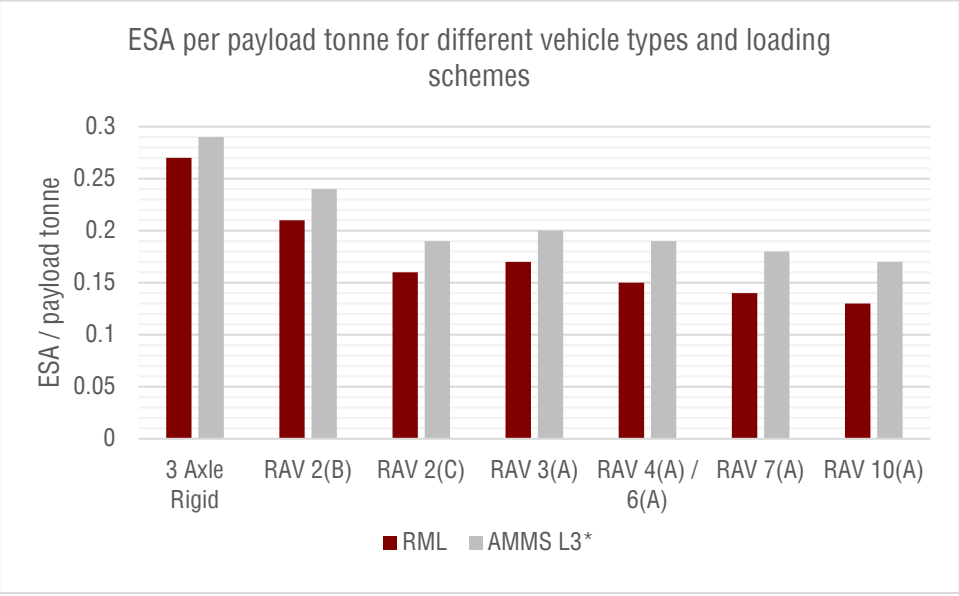
This method should be used if annual tonnage and the type of vehicle is known. ESA can be calculated per formula below:

ESA = ESAPT x AT

ESA = Equivalent Standard Axel (ESA) load per annum

ESAPT = ESA per payload tonne (from the graph below)

AT = Annual Tonnage



**Note: The AMMS has three levels. The displayed values are for Level 3. If the vehicle is operating at a lower level, then select a proportionate value between the RML value and the AMMS L3 value (data by ARRB)*

Method 2 – Per vehicle

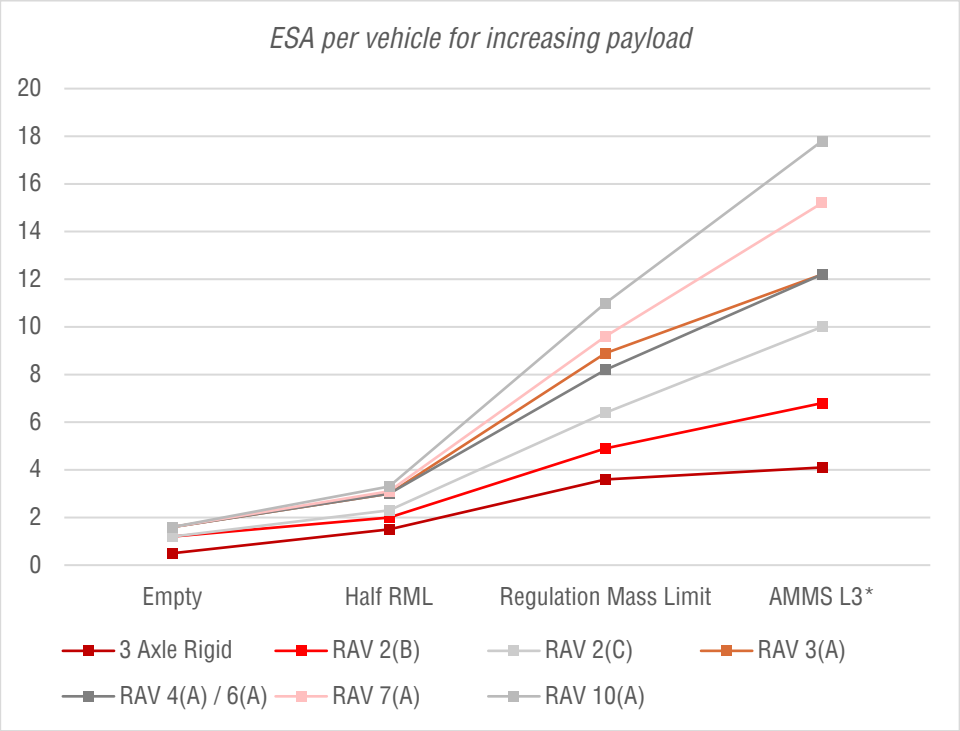
This method is to be used if only the number of vehicles is known, not the tonnage of the entire task. If all data is available both methods should be used for verifying the ESA estimate.

ESA = ESAV x AADT

ESA = Equivalent Standard Axel (ESA) load per annum

ESAV = ESA per vehicle (from the graph below)

AADT = Annual Average Daily Traffic (estimation for the specific vehicle type)



Note: The AMMS has three levels. The displayed values are for Level 3. If the vehicle is operating at a lower level, then select a proportionate value between the RML value and the AMMS L3 value (data by ARRB)

2.3.3 Extraordinary Load

Given that sealed roads are designed to carry a certain amount of traffic, only the maintenance cost arising from what is deemed "extraordinary load" can be recovered.

Extraordinary load can be calculated through formula below:

ELESA = 0.5 x ADESA - ESA

ELESA = Extraordinary Load ESA
ADESA = Annual Design ESA

ADESA value can be obtained in following ways:
- *from the original road and pavement design information, if available,*
- *through engineering reporting (assessment of on-site condition) or*
- *through table below (for spray-sealed roads)*

Table 2 - Nominal values for 50% ADESA per road category (Table prepared by WALGA)

Road Category	*50% ADESA*
Access Road	*400*
Local Distributor	*2,000*
Regional Distributor	*12,000*
District Distributor	*40,000*

2.3.4 Marginal Cost

Once ELESA value is determined, select the nearest rounding value:

Rounding Value	20,000	60,000	100,000	200,000

Based on the classification of the road and the nearest ELESA value, select the appropriate graph from the matrix below:

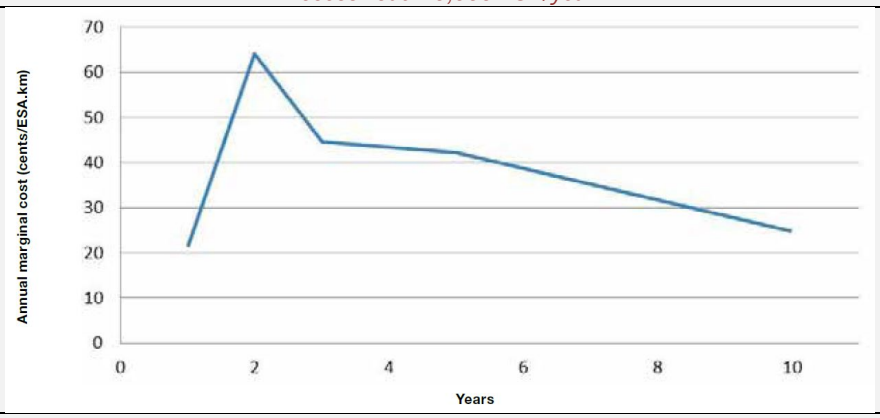
		Nearest ELESA Value			
		20,000	60,000	100,000	200,000
Road Classification	Access Road				
	Local Distributor				
	Regional Distributor				
	District Distributor				

Please determine the Marginal Cost from the appropriate graph, based on the duration of freight task:

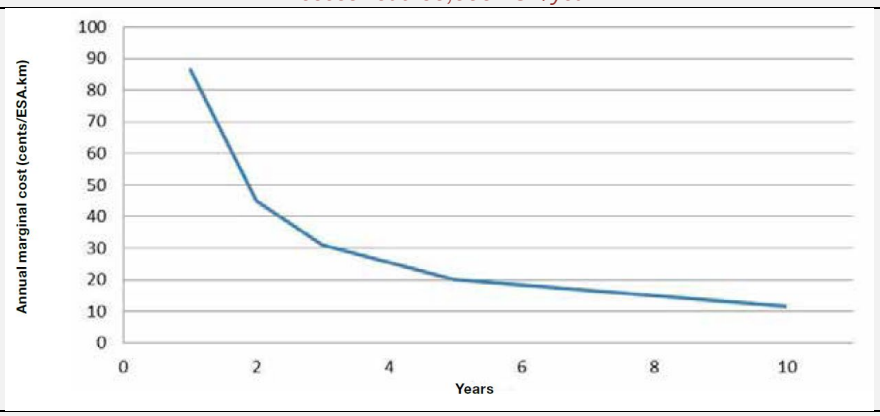
Given that marginal cost values date from 2015 (research by ARRB), if the actual cost of maintenance is available, please adjust the marginal cost appropriately.

ACCESS ROAD

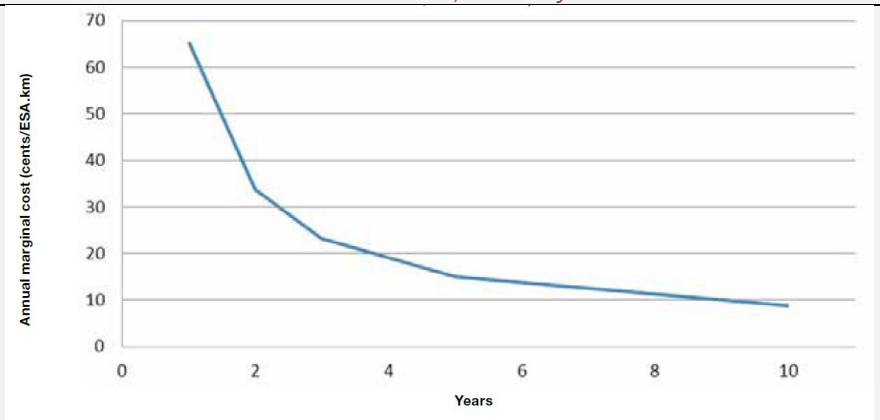
Access road 20,000 ESA/year



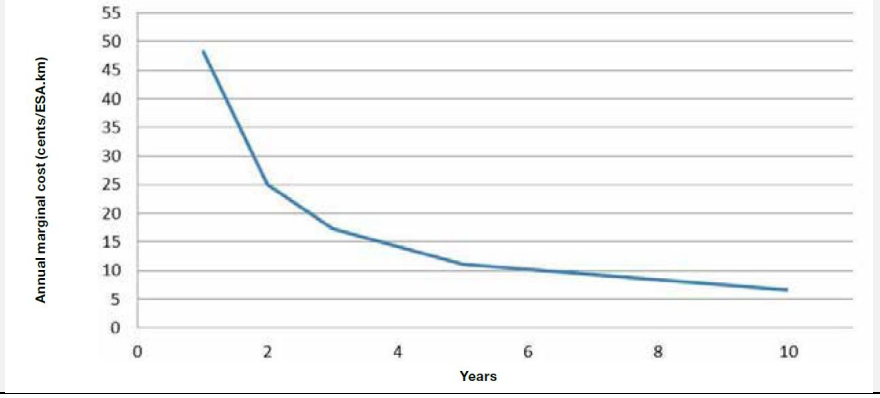
Access road 60,000 ESA/year



Access road 100,000 ESA/year

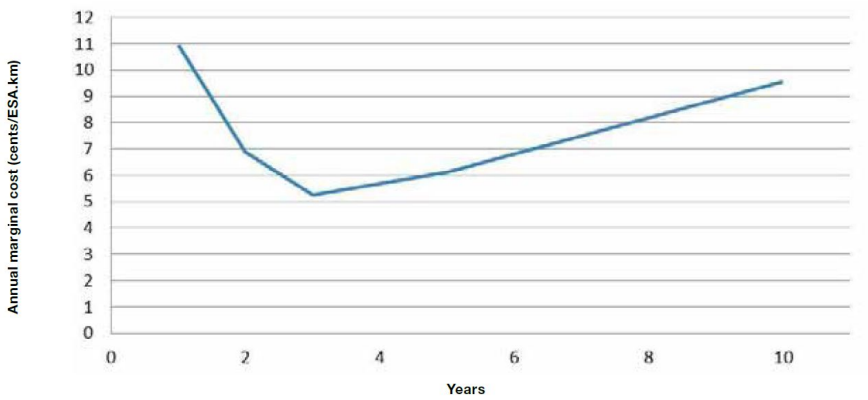


Access road 200,000 ESA/year

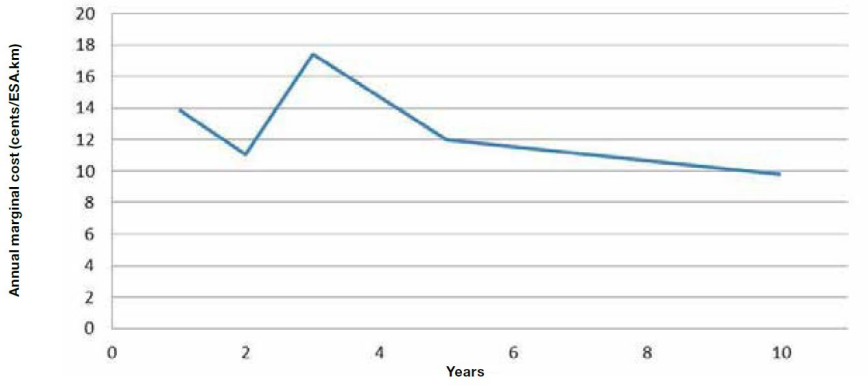


LOCAL DISTRIBUTOR

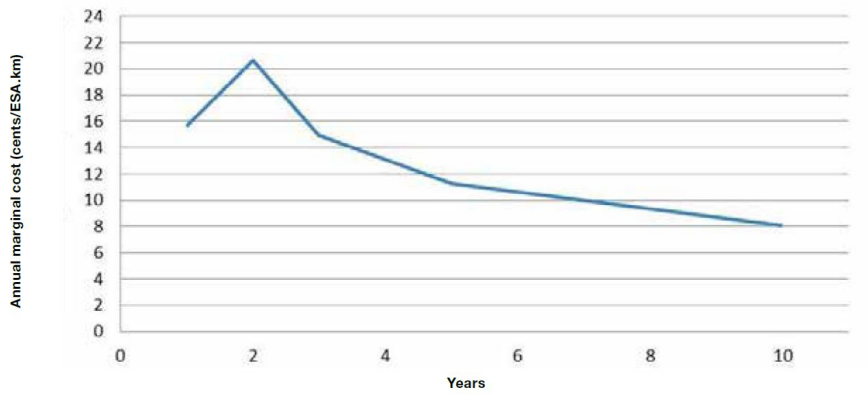
Local Distributor 20,000 ESA/year



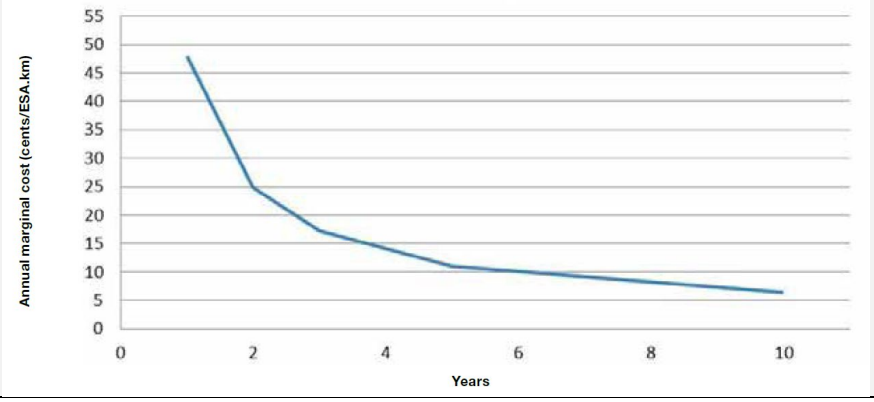
Local Distributor 60,000 ESA/year



Local Distributor 100,000 ESA/year

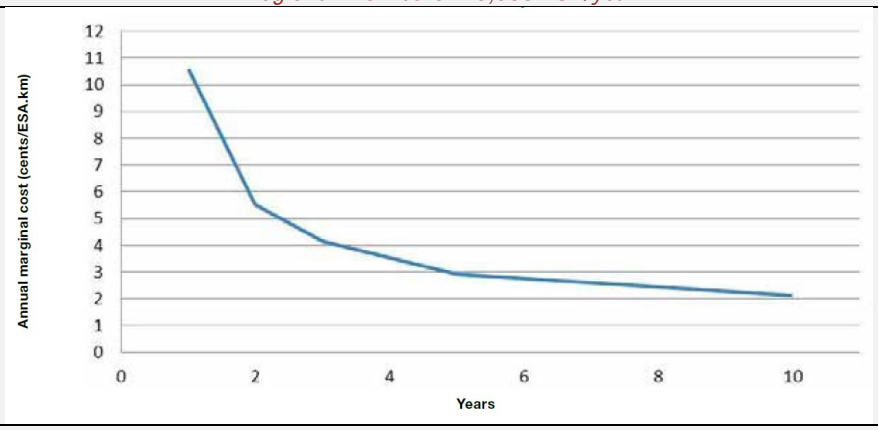


Local Distributor 200,000 ESA/year

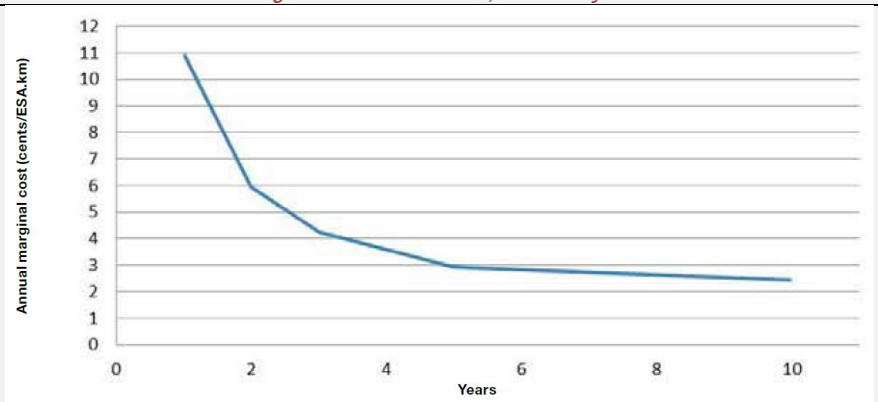


REGIONAL DISTRIBUTOR

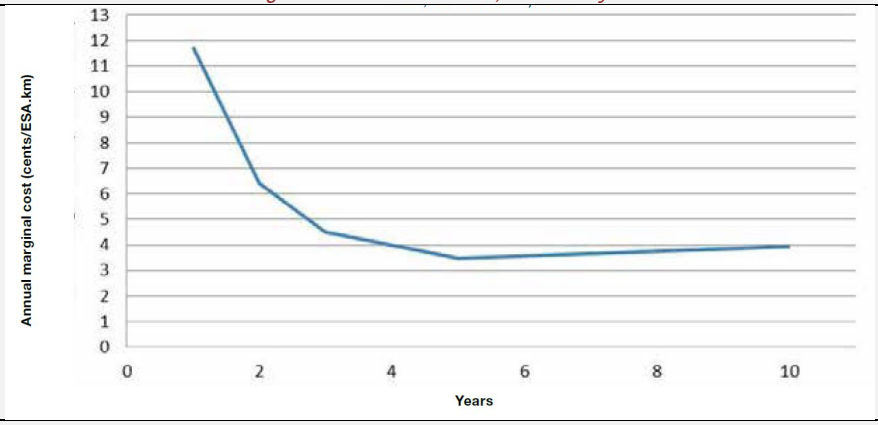
Regional Distributor 20,000 ESA/year



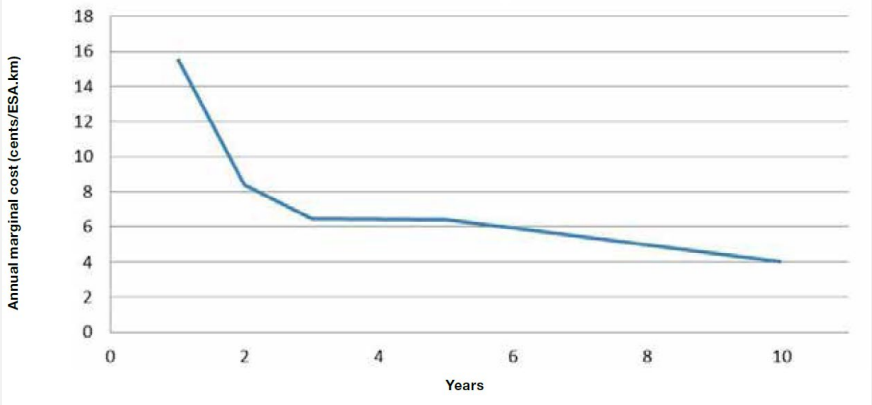
Regional Distributor 60,000 ESA/year



Regional Distributor 100,000 ESA/year

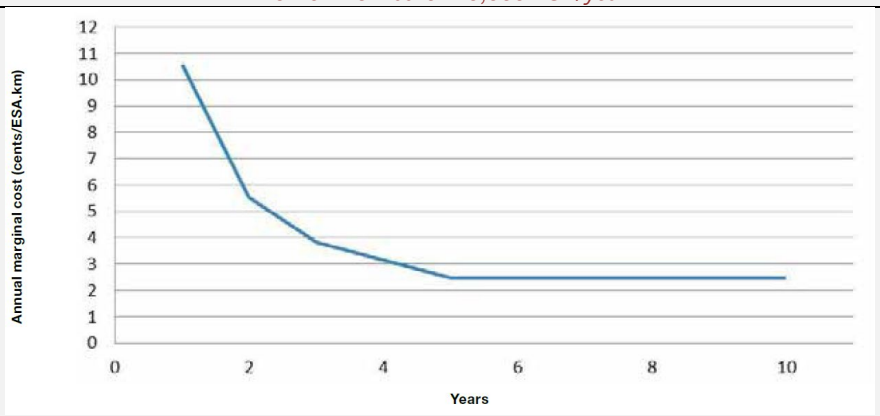


Regional Distributor 200,000 ESA/year

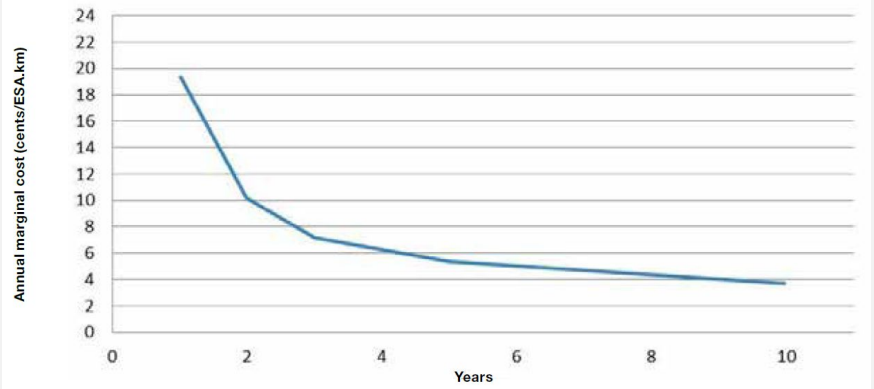


DISTRICT DISTRIBUTOR

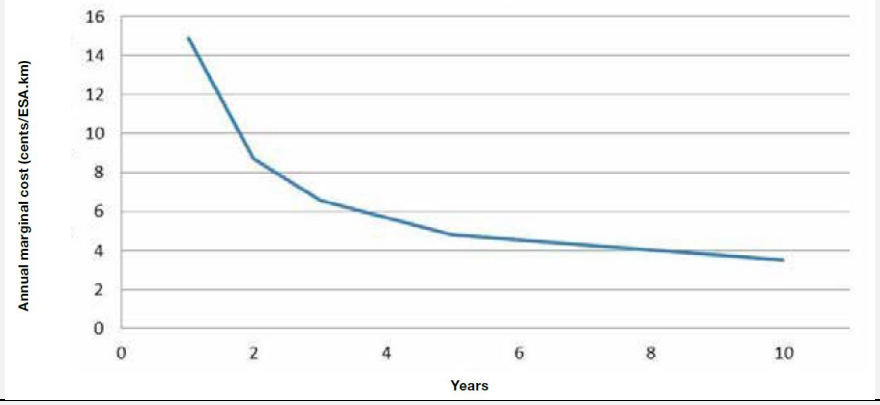
District Distributor 20,000 ESA/year



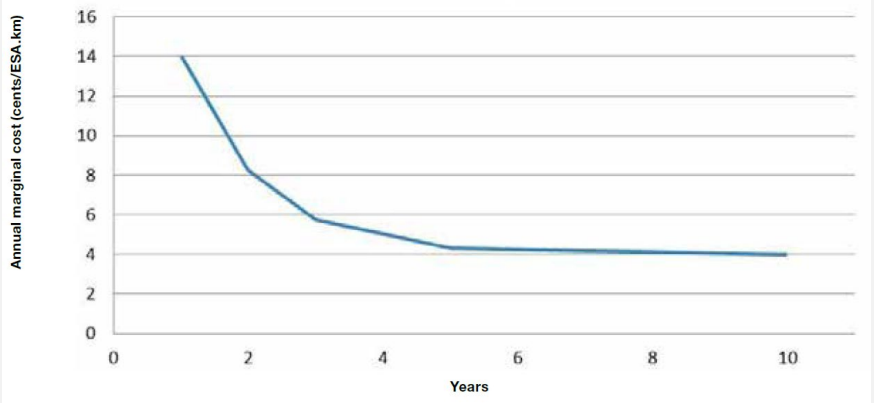
District Distributor 60,000 ESA/year



District Distributor 100,000 ESA/year



District Distributor 200,000 ESA/year



2.3.5 Annual Cost of Maintenance

Annual cost of maintenance can be calculated from the formula below:

C= MC x d x ELESA

C = annual cost of maintenance ($)
MC = Marginal Cost ($)
d= distance - route length (km)
ELESA = Extraordinary Load Equivalent Standard Axle

Please note this is the averaged annual cost of maintenance for the duration of freight task, which can be attributed to the specific task.

2.3.6 Total cost of maintenance

Total cost of maintenance attributable to a specific freight task can be determined as follows:

TC = C x t x CPI

TC = Total cost of maintenance
C = annual cost of maintenance
t= duration of the freight task (years)
CPI = Consumer Price Index

While the graph shows the marginal cost of maintenance in relation to the length of the freight task, this cost is derived through analysis of past financial performances. If the freight task lasts for longer than three years, CPI projections should be considered.