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P4584.001T 144 Calderwood Road Calderwood TRACKS Modelling Technical Note	S. Daizli / M. Hassan	A. Bitzios	A. Bitzios	29/09/2020	Ryhan.Thomson@indesco.com.au

142/144 Calderwood Road, Calderwood

TRACKS Modelling Technical Note

1. Introduction

1.1 Background

A subdivision for 684 lots including 651 standard residential lots, is proposed at 142 and 144 Calderwood Road, Calderwood, in the Shellharbour Local Government Area, NSW. The site is located within the overall Calderwood Valley development area and is to the immediate east of the Calderwood Urban Development project area.

1.2 Calderwood Urban Development Project

A Major Project (MP 09-0082) for the Calderwood Urban Development Project (CUDP) concept plan was approved by the then Department of Planning on 8 December 2010. To be predominantly developed by Lendlease, the concept plan included 4,800 residential dwellings and approximately 50 hectares of retail, commercial and light industrial land uses. Cardno was engaged by Lendlease to prepare a Transport Management and Accessibility Plan (TMAP) for the CUDP (dated 18 February 2010) for the area bounded by Dapto, Oak Flats and Calderwood. Transport modelling was undertaken using the Wollongong-Shellharbour (WOLSH) TRACKS strategic traffic model to assess the AM and PM peak operation of the road network under various 2031 with CUDP scenarios and identify future road upgrades.

1.3 Purpose of this Technical Note

Bitzios Consulting (Bitzios) has been engaged by Indesco to provide traffic advice for the proposed subdivision at 142 and 144 Calderwood Road taking into consideration previous traffic studies within the area (predominantly CUDP related).

This technical note includes:

- a review summary of the current version of the WOLSH TRACKS models with respect to the proposed subdivision
- a review summary of related traffic and transport study documents available for CUDP with respect to the proposed subdivision
- a performance assessment of the section of Calderwood Road between the eastern boundary of CUDP and Tripoli Way
- updated WOLSH TRACKS model (2036+) outputs based on the proposed subdivision yield (which is less than what was included in the current version of the WOLSH model)
- a sensitivity test using the WOLSH TRACKS model (2036+) to include additional yields associated with further intensification of the CUDP.

2. Existing TRACKS Models Review

2.1 Overview

Wollongong City Council provided 2036 and 2036+ WOLSH TRACKS models. These models were investigated by Bitzios to understand the land use assumptions and traffic distributions for the subject site and CUDP. The site boundaries in the TRACKS model and corresponding zones are illustrated in Figure 2.1. The subject site has two zones (324 and 331) and the CUDP has 33 zones.

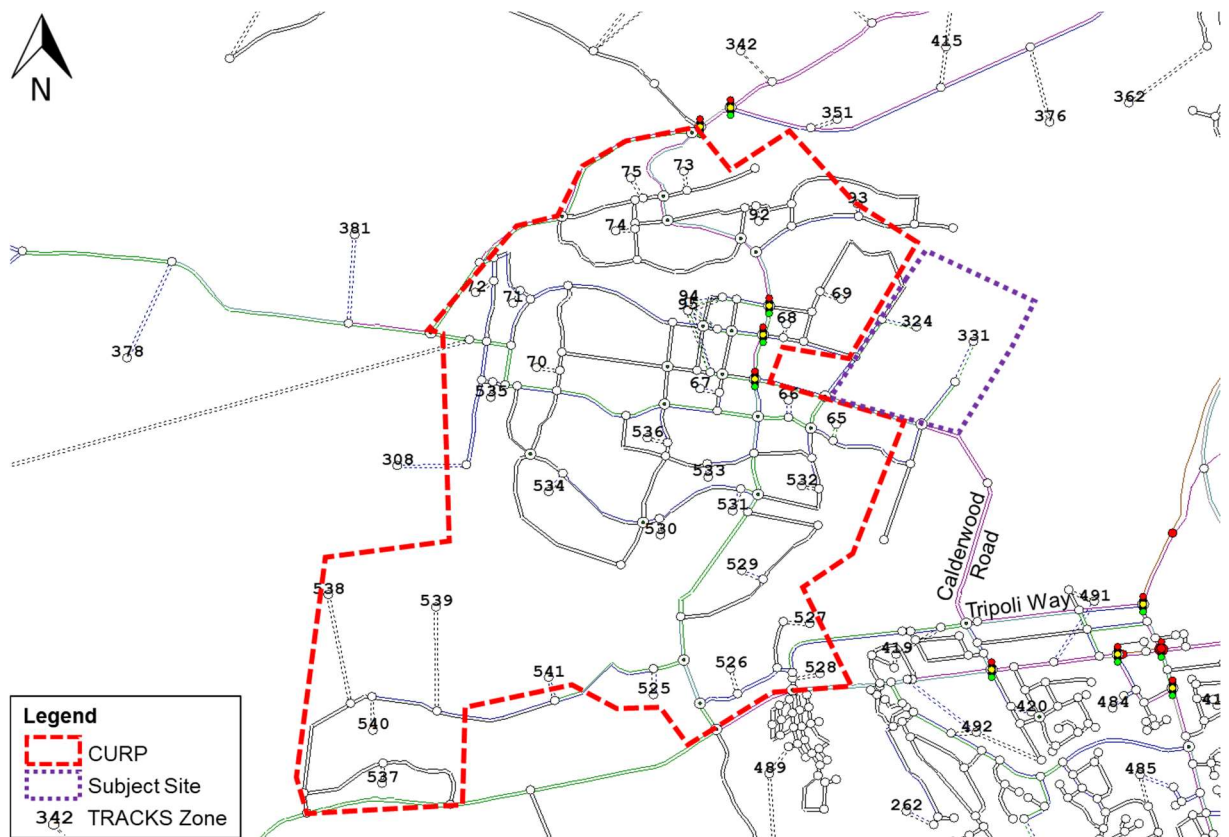


Figure 2.1: Site Boundaries and TRACKS Model Zones

2.2 Development Yields

The assumed 2036 and 2036+ TRACKS yield (number of Households) for the subject sites and CUDP are summarised in Table 2.1.

Table 2.1: 2036 and 2036+ TRACKS Development Yields (HHs)

Development	2036	2036+
Subject Site	1,000	1,000
CUDP	4,801	4,801
Total	5,801	5,801

2.3 Link Speeds and Flows

The TRACKS link speeds along Calderwood Road model are illustrated in Figure 2.2, comprising of 50km/h near the CUDP and 60km/h within the rural area towards Tripoli Way. The 2036 and 2036+ AM and PM peak one hour and 24-hour link flows along Calderwood Road between the CUDP and Tripoli Way (see Figure 2.2) are summarised in Table 2.2.

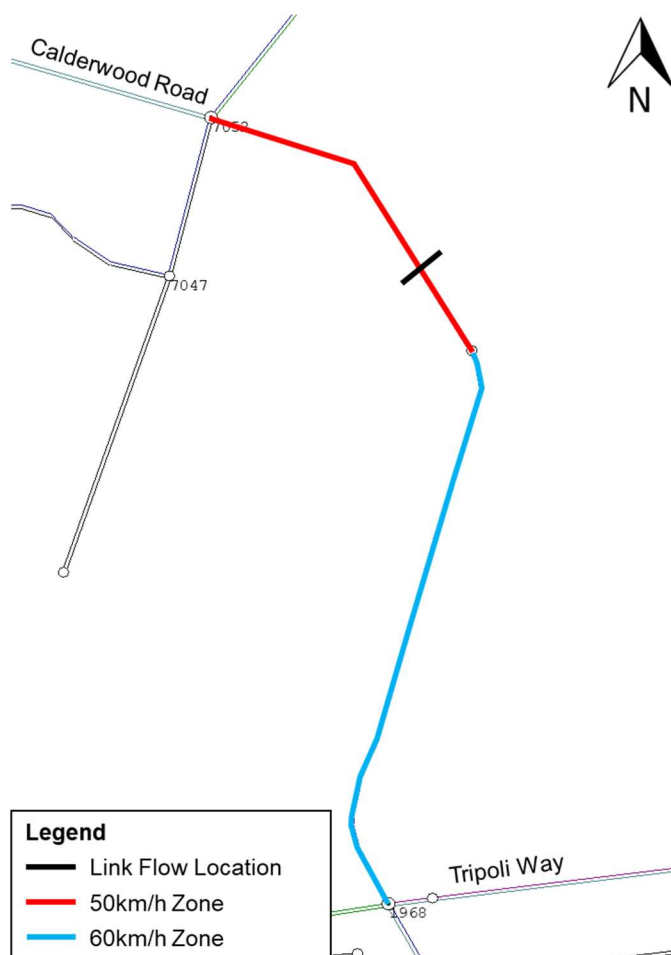


Figure 2.2: Calderwood Road TRACKS Link Speed Limit and Flow Location

Table 2.2: 2036 and 2036+ TRACKS Calderwood Road Link Flows

Direction	AM Peak		PM Peak		24 Hour	
	2036	2036+	2036	2036+	2036	2036+
Northbound	695	688	873	864	10,152	10,142
Southbound	806	927	830	824	10,169	11,912
Total	1,501	1,615	1,703	1,688	20,321	22,054

2.4 Link Travel Speeds

The average 2036 and 2036+ AM and PM peak one hour link travel speeds along Calderwood Road between the CUDP and Tripoli Way are summarised in Table 2.3.

Table 2.3: 2036 and 2036+ TRACKS Calderwood Road Link Travel Speeds

Direction	AM Peak				PM Peak			
	2036		2036+		2036		2036+	
	50km/h Zone (km/h)	60km/h Zone (km/h)	50km/h Zone (km/h)	60km/h Zone (km/h)	50km/h Zone (km/h)	60km/h Zone (km/h)	50km/h Zone (km/h)	60km/h Zone (km/h)
Northbound	45.8	56.3	45.8	56.3	44.3	55.3	44.4	55.3
Southbound	45.2	55.7	44.0	55.2	44.8	55.5	44.9	55.5

3. Assessment Measures

3.1 Capacity

The link flows in Table 2.2 and link travel speeds in Table 2.3 were assessed against Section 6.2 of *Austrroads Guide to Traffic Management Part 3: Transport Study and Analysis Methods* (AGTM03-20).

Table 6.1 in AGTM03-20 sets out typical mid-block capacities for various types of urban roads with interrupted flow, unflared major intersections and interruptions from cross and turning traffic at minor intersections. This is reproduced in Table 3.1. The applicable mid-block capacity (in both directions) is shown in a red box. The link flows are generally within this capacity.

Table 3.1: Typical mid-block capacities for urban roads with interrupted flow

Type of lane	One-way mid-block capacity (pc/h)
Median or inner lane	
Divided road	1000
Undivided road	900
Middle lane (of a 3 lane carriageway)	
Divided road	900
Undivided road	1000
Kerb lane	
Adjacent to parking lane	900
Occasional parked vehicles	600
Clearway conditions	900

Section 6.2.1 of AGTM03-20 also states that, “*Peak-period mid-block traffic volumes may increase to 1,200 to 1,400 passenger cars per hour per lane (pc/h/ln) on any approach road when the following conditions exist or can be implemented:*

- *adequate flaring at major upstream intersections*
- *uninterrupted flow from a wider carriageway upstream of an intersection approach and flowing at capacity*
- *control or absence of crossing or entering traffic at minor intersections by major road priority controls*
- *control or absence of parking*
- *control or absence of right turns by banning turning at difficult intersections*
- *high-volume flows of traffic from upstream intersections during more than one phase of a signal cycle*
- *good co-ordination of traffic signals along the route.”*

Calderwood Road between the CUDP and Tripoli Way will be of a limited access nature containing many of the above attributes, and as such, is expected to contain lane capacities upward of 1,200 passenger cars per hour per lane. The volumes forecast on this section shown within the TRACKS models are well below this threshold. The average link speeds reflect this higher level of performance, further described below.

3.2 Descriptions of Levels of Service

The Austroads Guide to Traffic Management – Part 3 – Transport Study and Analysis Methods (AGTM03-20) Table 4-1 specifies that travel speed is the primary performance measure to describe Level of Service for urban streets with interrupted flow. Further guidance is provided on how to measure the performance of travel speed (section 6.2.2 within AGTM03-20), with the key table from the guideline reproduced in Table 3.2 below.

Table 3.2: LoS for urban/suburban arterial roads with interrupted flow conditions

Level of Service	% of BFFS ¹	50km/h Zone (km/h)	60km/h Zone (km/h)
A	80%	40	48
B	67%	33.5	40.2
C	50%	25	30
D	40%	20	24
E	30%	15	18

¹Base (conditions) free-flow speed

3.3 Calderwood Road Level of Service

Based on the link travel speeds in Table 2.3 and level of service criteria in Table 3.2, the 2036 and 2036+ AM and PM peak one hour level of service along Calderwood Road between the CUDP and Tripoli Way are summarised in Table 3.3. The results show that the entire section of the road achieves a level of service A.

Table 3.3: 2036 and 2036+ TRACKS Calderwood Road Level of Service

Direction	AM Peak				PM Peak			
	2036		2036+		2036		2036+	
	50km/h Zone LoS	60km/h Zone LoS	50km/h Zone LoS	60km/h Zone LoS	50km/h Zone LoS	60km/h Zone LoS	50km/h Zone LoS	60km/h Zone LoS
Northbound	A	A	A	A	A	A	A	A
Southbound	A	A	A	A	A	A	A	A

4. Related Traffic and Transport Study

In the approved CUDP concept plan TMAP, Upgrade 32 includes upgrading Calderwood Road between the CUDP and Tripoli Way to an undivided two-way, two-lane rural collector road (ie one lane each way) with minimum 3.5-metre-wide travel lanes and minimum 2.5-metre-wide sealed shoulders.

In August 2018, a Modification Application to the CUDP concept plan (MP 09_0082 MOD 4) was submitted to the Department of Planning, Industry and Environment (DPIE). The modification proposed to increase the number of residential dwellings from the approved 4,800 dwellings to 6,500 dwellings and a retail space of 25,000sqm within the town centre and 5,000sqm in the Village centre. Cardno undertook Aimsun and TRACKS modelling for the revised CUDP (Cardno, 2018).

In May 2019, Cardno updated the previous traffic report and revised the number of households from 6,500 dwellings down to 6,000 dwellings (Cardno, 2019). In that report, Cardno recommended upgrading Calderwood Road between the CUDP and Tripoli Way as per Upgrade 32 in the TMAP.

Later, in July 2020, in an RFI letter (dated 17 July 2020), Lendlease submitted a revised plan of 20,000sqm of retail space for the town centre area of Calderwood.

In an Addendum letter to the Response to Submissions (dated 10 June 2020), Shellharbour City Council (SCC) stated that the said section of Calderwood Road should be widened to four lanes with a 2.5-metre-wide shared path to improve level of service and provide safe pedestrian and cycle access.

In Cardno's responding letter (dated 10 June 2020), citing a 2013 Land and Environment Court of NSW case for the CUDP:

- *At our first meeting held on 13 May 2020, Shellharbour Council's expert shared a copy of a cross section for a Major Collector Rural Road (B3) for Calderwood Urban Development Plan (CUDP) as proposed by MOD 4 showing what was proposed for Calderwood Road where one side had urban development and the other still rural. "It was agreed by all experts that this wasn't appropriate for the section of Calderwood Road to the east of the CUDP and that we will use the Austroads standard for a rural road."*
- *"The expert witnesses from both the Applicant (Calderwood Heights Pty Ltd) and Second Respondents (Lendlease) believe that is inappropriate for this road as this section has rural land on both sides of the road and the Road Hierarchy that was agreed and signed off by all experts (including Shellharbour Council experts) is described as a **Collector Road – Rural**. This is an important point as Shellharbour Council doesn't have any design criteria for this type of road in their Engineering Codes or DCP, nor does Lendlease in their project DCP, so it was agreed to use Austroads, as per my previous point."*
- *"We also note there is little likelihood of any development along that section of road due to flooding constraints."*

5. Revised TRACKS Model

5.1 Overview

Since the WOLSH TRACKS model is the acceptable tool for the road network assessment, we have used the model to assess the current known developments of Calderwood including CUDP and the proposed development. In this regard, the WOLSH 2036+ AM and PM models were used as this model included the ultimate development scenario of this region reflecting an ultimate 'masterplan' assessment scenario, rather than the traditional 10 year post-opening design horizon.

5.2 Updating the TRACKS Model

5.2.1 Road Network

No changes were made for the road network and the intersections from the current WOLSH models supplied by Wollongong City Council.

5.2.2 Zone Data

The zone data was updated according to the latest information including an increased CUDP yield of 6,000 HHs (1,200 increase) and retail area of 20,000sqm (20% decreased from the WOLSH TRACKS zonal data for the town centre).

It was assumed that the 20% decrease of retail area will decrease 20% of the retail jobs. The number of households are assumed to be increased closer to the town centre zones as mentioned in Cardno's report (2019).

Table 5.1 documents the household and retail job changes made in the TRACKS models for relevant zones.

Table 5.1: TRACKS Model Changes - Zone Data

Zone Number	Land	Number of Households			Number of Retail Jobs		
		Existing	Updated	Change	Existing	Updated	Change
65	CUDP	-	-	-	220	176	-44
66	CUDP	-	-	-	146	117	-29
67	CUDP	372	622	+250	-	-	-
68	CUDP	93	243	+150	-	-	-
69	CUDP	340	590	+250	-	-	-
95	CUDP	155	205	+50	-	-	-
531	CUDP	255	405	+150	-	-	-
532	CUDP	183	283	+100	-	-	-
533	CUDP	365	515	+150	-	-	-
536	CUDP	183	283	+100	-	-	-
Total	CUDP	1,946	3,146	+1,200	366	293	-73
324	Subject Site	500	241	-259	-	-	-
331	Subject Site	500	410	-90	-	-	-
Total	Subject Site	1,000	651	-349	-	-	-

5.3 TRACKS Model Results

The WOLSH TRACKS 2036+ models for the AM and PM peak periods were re-run with all the steps including trip generation, trip distribution, CALM, matrix and assignment.

5.3.1 Calderwood Road Level of Service

The resultant link flows on Calderwood Road is shown in Table 5.2 and the link speeds and level of service are shown in Table 5.3. The link flow volumes have remained relatively consistent with the current WOLSH model outputs. A slight increase in traffic volumes was noticed due an increase in yield of the CUDP which is offset by the reduction in retail/commercial uses within the CUDP town centre and the reduction of yield proposed for the subject site.

Table 5.3.

Table 5.2: Comparison of Calderwood Road Link Flows

Direction	AM Peak		PM Peak	
	2036+	Revised 2036+	2036+	Revised 2036+
Northbound	688	656	864	902
Southbound	927	978	824	812
Total	1,615	1,634	1,688	1,714

The link flow volumes have remained relatively consistent with the current WOLSH model outputs. A slight increase in traffic volumes was noticed due an increase in yield of the CUDP which is offset by the reduction in retail/commercial uses within the CUDP town centre and the reduction of yield proposed for the subject site.

Table 5.3: Calderwood Road Link Travel Speeds and Level of Service

Direction	AM Peak				PM Peak			
	2036+		Revised 2036+		2036+		Revised 2036+	
	50km/h Zone (km/h)	60km/h Zone (km/h)	50km/h Zone (km/h)	60km/h Zone (km/h)	50km/h Zone (km/h)	60km/h Zone (km/h)	50km/h Zone (km/h)	60km/h Zone (km/h)
Northbound	45.8 (A)	56.3 (A)	46.0 (A)	56.5 (A)	44.4 (A)	55.3 (A)	43.9 (A)	55.1 (A)
Southbound	44.0 (A)	55.2 (A)	43.3 (A)	54.8 (A)	44.9 (A)	55.5 (A)	45 (A)	55.6 (A)

The link flow volumes have remained relatively consistent with the current WOLSH model outputs. A slight increase in traffic volumes was noticed due an increase in yield of the CUDP which is offset by the reduction in retail/commercial uses within the CUDP town centre and the reduction of yield proposed for the subject site.

Table 5.3 re-affirms that the change in traffic volumes is marginal and it has no significant change to the level of service predicted for Calderwood Road (between the CUDP and Tripoli Way).

5.3.2 Intersection Level of Service

Intersections that will be used to access the subject site are shown in Figure 5.1. TRACKS model outputs of these two intersections were assessed and presented in Table 5.4. The results show that the intersections will perform with acceptable level of service in all the scenarios. It should be noted that delay is used as the intersection performance measure to describe level of service.

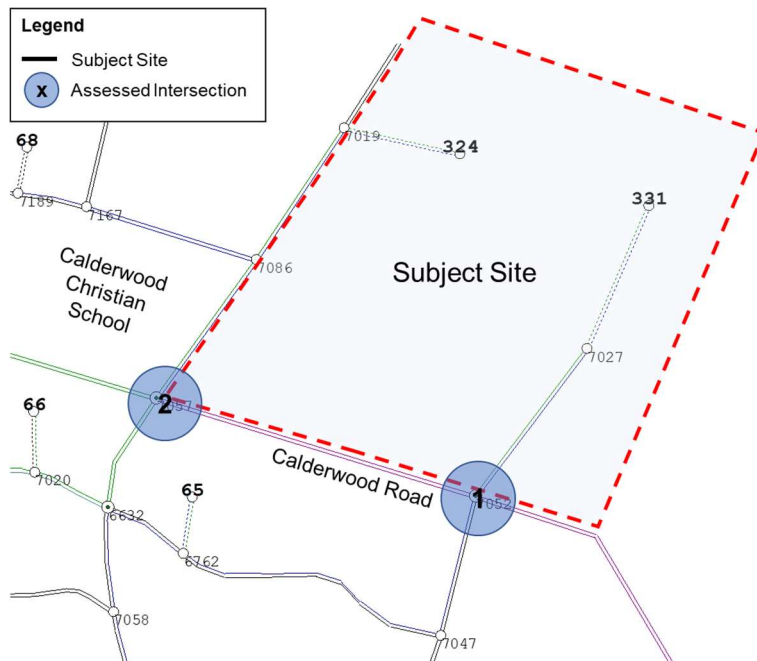


Figure 5.1: Locations of the Intersections Assessed

Table 5.4: Comparison of Intersection Level of Service¹

Intersection	AM Peak		PM Peak	
	2036+	Revised 2036+	2036+	Revised 2036+
1	B (19)	B (19)	B (18)	B (19)
2	A (15)	B (16)	B (16)	B (16)

¹ Maximum Delay of all turning movements (in seconds) are shown in the bracket

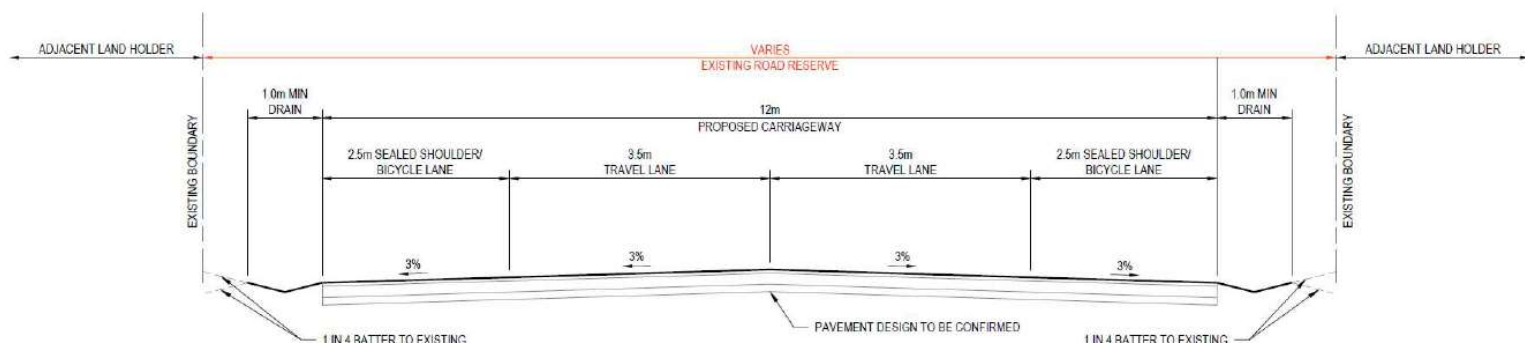
6. Proposed Calderwood Road Cross-section

Cardno's letter (10 June 2020) also cited Shellharbour City Council's concern that any change to the road levels along Calderwood Road between the CUDP and Tripoli Way or current stormwater discharge points levels would cause significant impacts in the event of a storm. To avoid this, Cardno designed a concept cross-section of Calderwood Road incorporating the single carriageway rural road lane width requirements in Table 4.5 in *Austroads Guide to Road Design Part 3: Geometric Design*. This is reproduced in Table 6.1. The applicable design Average Annual Daily Traffic requirements are shown in a red box. The cross-section is shown in Figure 6.1 (as provided in the Cardno letter).

Table 6.1: Single carriageway rural road lane widths (m)

Element	Design AADT				
	1–150	150–500	500–1000	1000–3000	> 3000
Traffic lanes ⁽¹⁾	3.7 (1 x 3.7)	6.2 (2 x 3.1)	6.2–7.0 (2 x 3.1/3.5)	7.0 (2 x 3.5)	7.0 (2 x 3.5)
Total shoulder	2.5	1.5	1.5	2.0	2.5
Minimum shoulder seal (2),(3),(4),(5),(6)	0	0.5	0.5	1.0	1.5
Total carriageway	8.7	9.2	9.2–10.0	11.0	12.0

- 1 Traffic lane widths include centrelines but are exclusive of edge-lines.
- 2 Where significant numbers of cyclists use the roadway, consideration should be given to fully sealing the shoulders. Suggest use of a maximum size 10 mm seal within a 20 km radius of towns.
- 3 Wider shoulder seals may be appropriate depending on requirements for maintenance costs, soil and climatic conditions or to accommodate the tracked width requirements for Large Combination Vehicles.
- 4 Short lengths of wider shoulder seal or lay-bys to be provided at suitable locations to provide for discretionary stops.
- 5 Full width shoulder seals may be appropriate adjacent to safety barriers and on the high side of superelevation.
- 6 A minimum 7.0 m seal should be provided on designated heavy vehicle routes (or where the AADT contains more than 15% heavy vehicles).



Source: Calderwood Concept Plan (MP 09_0082 MOD4) – Response to Shellharbour Council's Submission dated 10 June 2020

Figure 6.1: Typical Calderwood Road Cross-section

The proposed Calderwood Road cross-section would:

- Result in relatively small drainage swales on either side of the road and would not need a lot of additional width within the road reserve
- Contain the drainage swales within the current (typical) 15.2-metre-wide road reserve
- Result in no significant land acquisition and hence all the inherent negotiations, delays and costs for no public benefit.

Furthermore, Lendlease will provide the sealed shoulders required to accommodate cyclists and improve safety as per Note 2 under Table 6.1.

Bitzios Consulting supports Cardno's view on the cross-section proposed for Calderwood Road. Furthermore, the distance between the CUDP town centre and Albion Park centres

is considered to be too far apart to attract walking trips, with the strategy to support walking and recreational cycling along Escarpment Drive supported.

The only revision that may need consideration is the proximity of schools and likelihood of children to cycle to school utilising Calderwood Road (between the CUDP and Tripoli Way). Minor modifications to the cross-section may be required to better protect children using this facility should this be the case (ie through the use of kerb-blocks or a raised treatment).

7. Conclusions

The key findings are summarised as follows:

- Both the 2036 and 2036+ models assume 1,000 households for the subject site and 4,801 for the CUDP concept plan
- The 2036+ TRACKS models were updated to include the CUDP's latest development yield (6,000 households and 20,000sqm retail area within the town centre) and the yield of the subject site (651 lots)
- The forecast flows on Calderwood Road (between the CUDP and Tripoli Way) from the updated the TRACKS models are within capacity limits for a one lane each way road of this nature
- Southbound AM peak flows in the updated TRACKS model forecasts 978 passenger car per hour per lane which is higher than the usual mid-block capacity. However, as mentioned in Section 3.1, the capacity can be increased to 1,200 to 1,400 passenger cars per hour per lane as this section of Calderwood Road has the following characteristics:
 - Adequate flaring at major upstream intersections
 - Uninterrupted flow from a wider carriageway upstream of an intersection approach and flowing at capacity
 - Control or absence of crossing or entering traffic at minor intersections by major road priority controls
 - Control or absence of parking.
- The average travel speeds in both directions are forecast to be between around 43km/h to 56km/h, achieving a level of service "A"
- The intersections that will be used to access the subject site contains an acceptable level of service of "B"
- Cardno designed a concept cross-section of Calderwood Road incorporating the single carriageway rural road lane width requirements. This would contain small drainage swales within the road reserve and provide sealed shoulders to accommodate cyclists and improve safety. Further treatments may be required to improve safety for children cycling to local schools should this be expected to be the case.
- Bitzios also believes that a cycleway bridge adjacent to the existing Manson's bridge on Macquarie Rivulet, committed by Lendlease for the CUDP development, will better accommodate cyclists and improve safety.

In conclusion, the proposed sub-division associated with the subject site is consistent with the inclusions / allowances made for within the current WOLSH TRACKS models.

No additional impact is expected from the subject site that would require any further transport infrastructure treatment to what has already been planned for within the area.