SB CIVIL LIMITED

1618 Ararimu Road Hunua

Pavement Impact Assessment Report

Ararimu Road, Hunua between

CH15800-CH16800

DOCUMENT CONTROL RECORD

Document:	Pavement Impact Assessment Report
Project:	1618 Ararimu Road Hunua
Client Name:	SB Civil Limited
CP Project No:	2660
CP Document No:	2660 - PIA-v1-scp rjp-20241024
Date of Issue:	24 October 2024
Status:	Final
Originator:	.... **Shane Piper** Associate
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ACTIONS REGISTER

Version	Reviewed by
Auckland Transport Review	Chief Engineer & Asset Management and Consent Team:
Auckland Council Review	Approved by the Development Engineer / Team Leader:

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1. Introduction

1.1 Applicant and Property Details

Applicant Details:	SB Civil Limited
Address for Service	SB Civil Limited C/- CivilPlan Consultants Limited PO Box 97796, Manukau 2241
Site Address:	1618 Ararimu Road, Hunua
Legal Description:	Pt Lot 2 DP 77813
Site Area:	19.2 hectares
Site Owners:	SAL Land Limited

1.2 Limitations

This report has been prepared for SB Civil Limited, for the specific purpose of satisfying the statutory information requirements under the Resource Management Act 1991 for a resource consent application to Auckland Council.

This report has been prepared to support a resource consent for cleanfill operations at 1618 Ararimu Road, Hunua.

1.3 Purpose of the Report

This assessment has been prepared in accordance with AUSTROADS Guide to Pavement Technology Part 5: Pavement Evaluation and Treatment Design and considers the following:

- Identification of causes and modes of pavement distress from a visual assessment of the existing pavement surface;
- Summary of Falling Weight Deflectometer (FWD) testing;
- Evaluation of pavement defects and test results;
- Selection of pavement rehabilitation treatments;
- Preliminary design of structural overlays and stabilisation treatments required to achieve a suitable safe operational life for the pavement for all road users for the proposed activity.

2. Summary of Investigations

The following investigations were completed to assess the pavement:

1) 7 day traffic count in April 2024 (Auckland Transport Traffic Counts July 2012 to September 2024).

2) Obtaining the road RAMM data for Ararimu Road, 500m either side of the proposed site entrance point. This reported on roughness and rutting of the road, AADT, FWD and pavement layers construction.

Site visit and visual survey of the existing road carriageway, 500m either side of the site entrance point completed on 22 October 2024 between CH 15800 to CH 16800 along Ararimu Road.

3. Project Summary and Site Location

3.1 Project Summary

3.1.1 Proposed Consent

The proposal seeks to obtain resource consent to establish an earth-fill facility at 1618 Ararimu Road, Hunua, Auckland.

The operation will provide for 1.56 million m^3 of fill delivered to the site, over an approximate 10-15 year period. For the calculations, a worst case 10 year period has been used.

3.2 Location

<table>
<tr><td>Address</td><td>1618 Ararimu Road, Hunua

Entrance to site is mid-way along the sites road frontage to Ararimu Road at the following coordinates, and at CH15300:

WGS84   -37.141188   175.108166
NZTM   1787244   5887385
NZMG   2697612   6449024</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td colspan="2">Intended travel routes</td></tr>
<tr><td colspan="2">The fill site is located on the south side of Ararimu Road, some 1.1km from the Paparimu Road / Ararimu Road intersection. The site is zoned Rural – Rural Production Zone as per the Auckland Unitary Plan. Figure 1 shows the site location.

The exact origin and destination of the trucks depends on the origin of the earth to be removed. The trucks will turn both left and right into and out of the site.

The site's proximity to NZ State Highway 1 – Auckland Southern Motorway is approximately 14km from SH1 Ramarama interchange and 17km from SH1 Bombay interchange. From NZ State Highway 2 the site is approximately 14km from SH2 Mangatawhiri interchange.</td></tr>
</table>

VEHICLE MOVEMENTS

The site is proposed to receive 1.56 million m3 over 10 - 15 years. Accordingly, the maximum volumes expected in any one hour equates to 9 truckloads (18 truck movements) per hour. In terms of a typical average over the 10 - 15 years, the following can be anticipated:

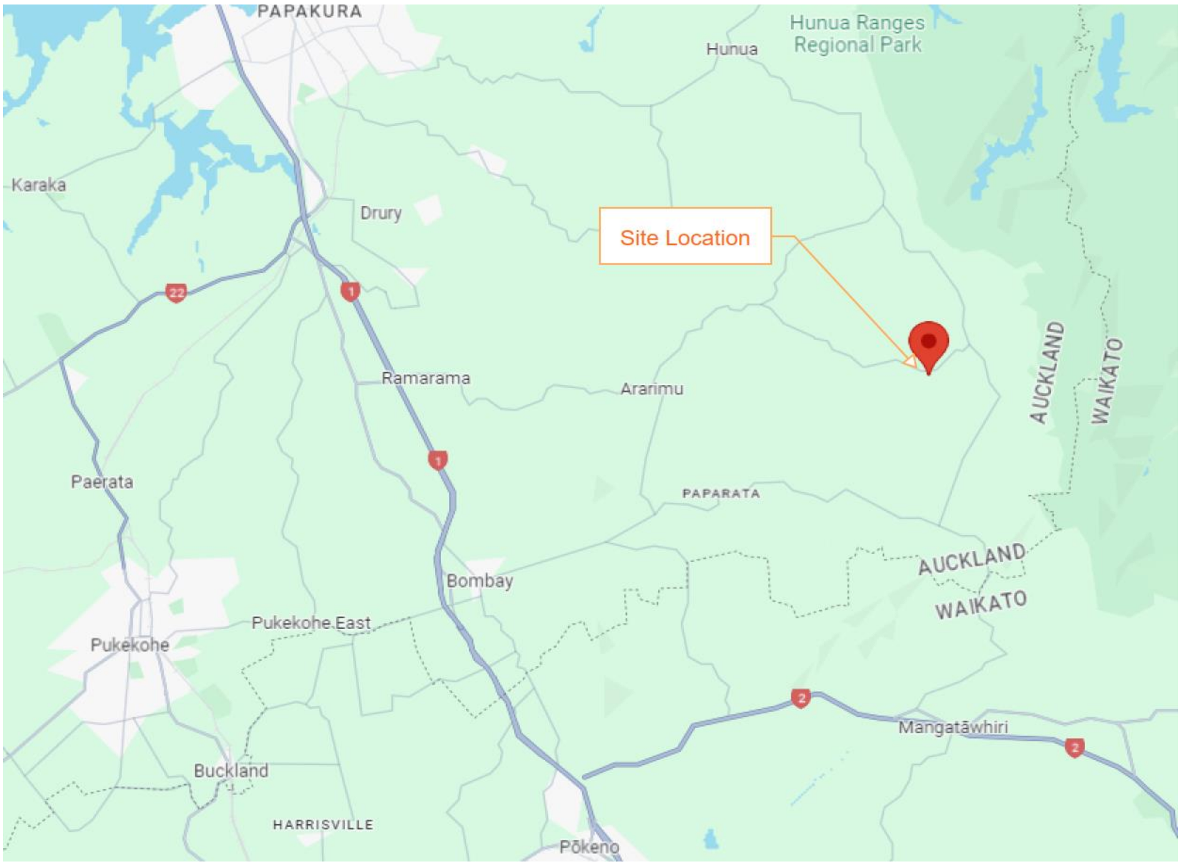
- 1,560,000m^3 of fill volume imported to the site;
- 10-15 years maximum duration;
- Average truck size of 6m3;
- 5.7 days per week (approximately 300 days per year); and
- Average of 10 hours during weekdays and Saturday.

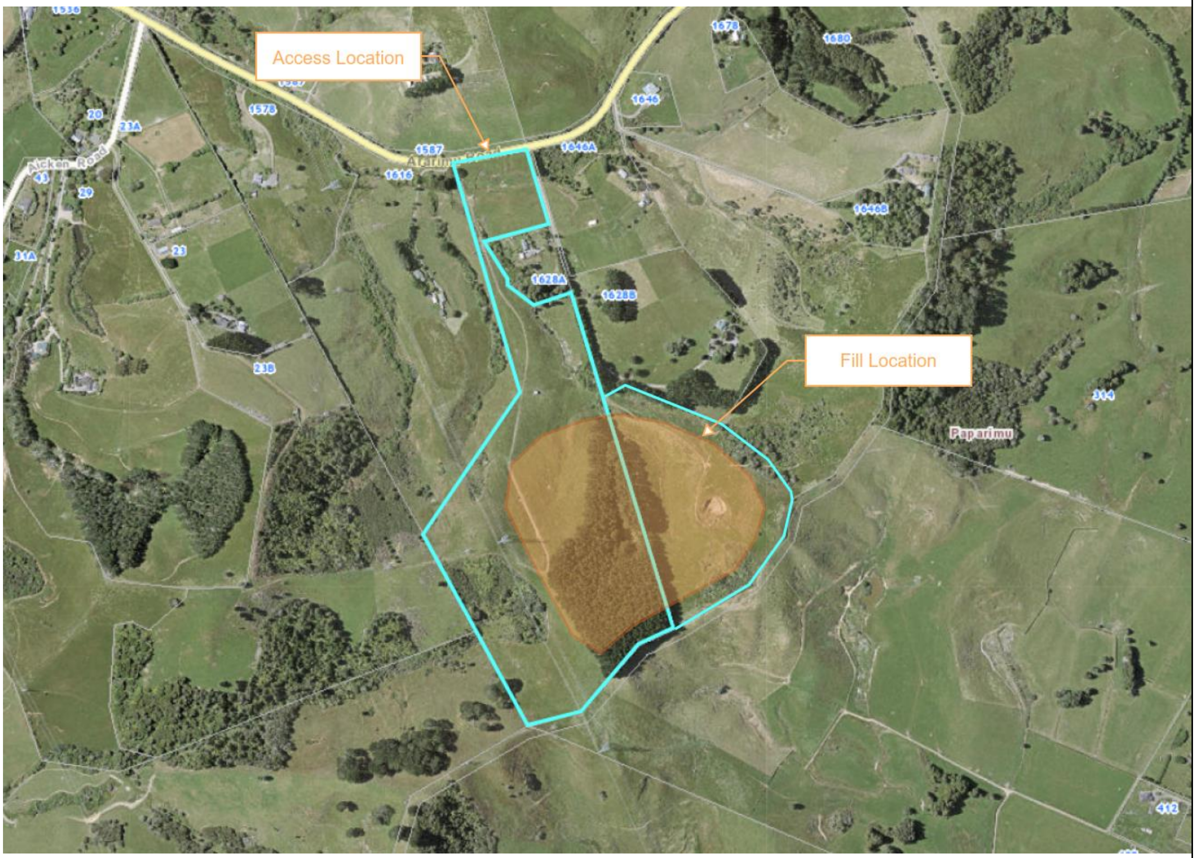
The above translates to 104,000 – 156,000m3 per year, 346 - 520m^3 per day, thus approximately 58 - 87 trucks per day and 6 - 9 trucks each hour. This further equates to 116 - 174 truck movements per day (in and out) and 12 - 18 truck movements per hour.

For the purposes of this assessment the maximum volumes expected in an hour (9 truckloads, 18 truck movements) have been used.

The site access will be from a new vehicle crossing mid-way along the site's road frontage. The crossing will be designed to cater for two-way vehicle movements for a truck and trailer.

Figure 1: Location Maps




Access Location
Fill Location
Paparimu
Aicken Road


ARARIMU RD/15.800
15800
ARARIMU RD/16.300
16300
ARARIMU RD/16.800
16800
Ararimu Rd
Downs Rd
Aicken Rd
Paparimu

4. Visual Observations

Site Visit:
22.10.2024, 9.00am to 9.20am Fine weather conditions, dry road
Observed road users:
A mixture of light and heavy vehicles were observed, 6 in total (1 HCV, 3 LMV) during the site survey. The heavy vehicle was a 6 wheeler rock truck. No pedestrians or cyclists were seen. Speed Limit is 80km/h
Road Features:
Power poles are on the northern side of road to CH 15810, power is undergrounded to traverse Transpower's Brownhill-Whakamaru and Otahuhu-Whakamaru A lines before returning onto overhead poles, the remaining length ofoverhead lines switch sides of Ararimu Road due to cornering. Road edge markers are not in place. Rural fencing, steep cut faces and vegetation are in place at certain locations. From a drone survey the marked lane widths vary between 2.5m and 3.26m. On average lanes on both sides of Ararimu Road are between 2.7m and 3m wide.
Drainage Features and Condition:
Within the assessment area there are 3 culverts crossing Ararimu Road, the first at CH 15915 passes flows from south to north under Ararimu Road, the second and third at CH 16315 and CH 16510 passes flow from catchments to the north to the south. The flows from the second and third culvert traverse the subject site. The sizes of these are unknown due to dense overgrown vegetation in these locations. Equally the condition of these culverts is unknown. Table drains run parallel to and on each side of the double cross fall road and look to be in good condition. No ponding issues appear to be present.
Pavement and Surfacing Failure Mechanisms Observed:
A list of the potential carriageway pavement faults assessed in this survey included: 1. Rutting – a depression of a section of the pavement surface which usually occurs in the wheel track. 2. Shoving – where material is displaced to form a bulge and depression. 3. Alligator Cracks – fine cracks on the surface resembling alligator skin and can result in weakening of the pavement subgrade by allowing water pass through the cracks. 4. Longitudinal & Transverse Cracks – cracks running along or across the road. 5. Joint Cracks – visible joints between two surfacings. 6. Scabbing – where sealing chip are separated from the bitumen.

7. Flushing – where the binder has risen over the level of the aggregate leaving a smooth polished surface with poor traction.

8. Potholes – loss of surface material due to ravelling, stripping or cracking to the extent that the layer below the surface is exposed.

9. Pothole patches – repairs to fill potholes.

10. Maintenance patches – repairs to areas of rutting, shoving and cracking.

11. Blocked channel – drainage channel is blocked preventing the conveyance of stormwater.

12. Inadequate drainage – locations where conveyance of stormwater is not achieved.

13. Ineffective shoulder – where there is lack of support for the pavement due to lack of shoulder width.

Each fault, where identified within the scope of the assessment section were noted. The location and a photograph of the faults were also captured.

4.1 Visual Condition Assessment – CH 15800-CH 16800

The pavement failures observed were

1. Minor Surface flushing – intermittently for the length, both sides from CH15880 to CH

2. Minor rutting at previous patch repairs on edges and in wheel paths CH 15910 to CH 15970.

3. Scabbing mostly on east bound lane CH 16060 to CH 16130

4. Recent patch repairs, good condition, east bound lane CH 16220 and CH 16240

5. Shoving and pothole west bound lane CH 16258

6. Shoving and pothole west bound lane CH16535, west bound lane, rutting in wheel path.

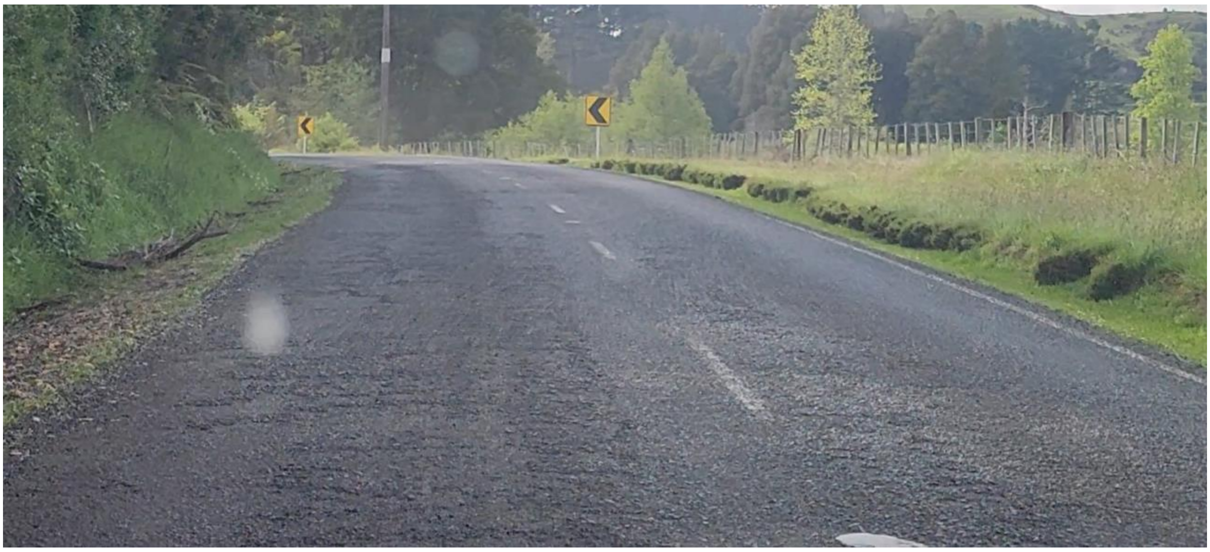
7. Rutting in wheel path, east bound lane CH 16610 and CH 16700

These are as shown in the following photos.

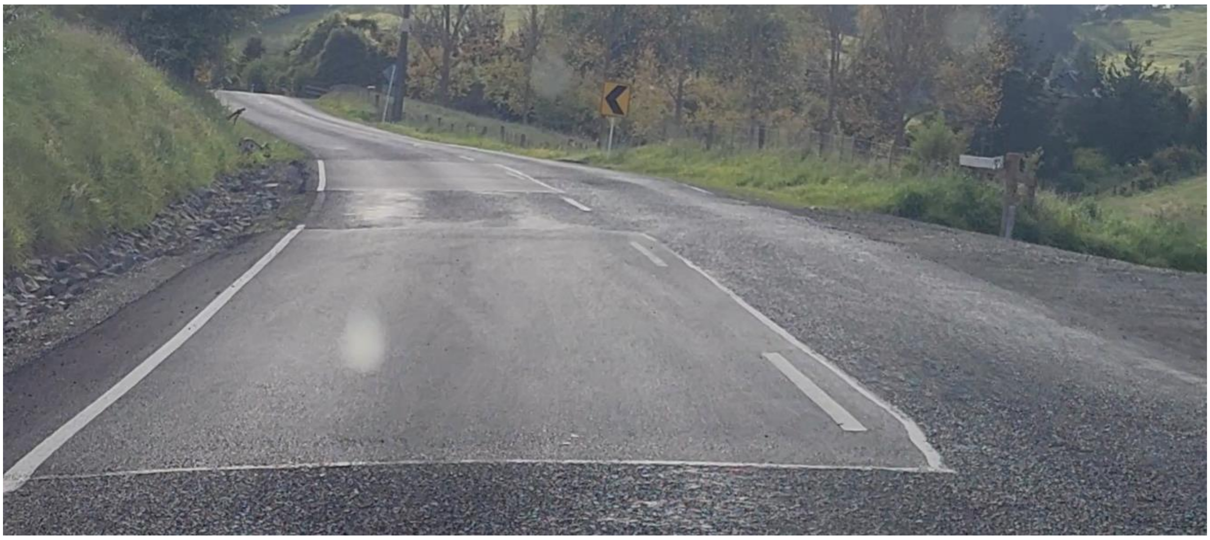
General Surface Flushing

CH 15910 to 16020, West bound lane. Previous repair rutting on edges and inside wheel path.

CH16060 to CH 16130, east bound lane. Scabbing.



CH 16220 & CH 16240, Patch Repairs to east bound lane



CH16258, west bound lane, Pothole and shoving.

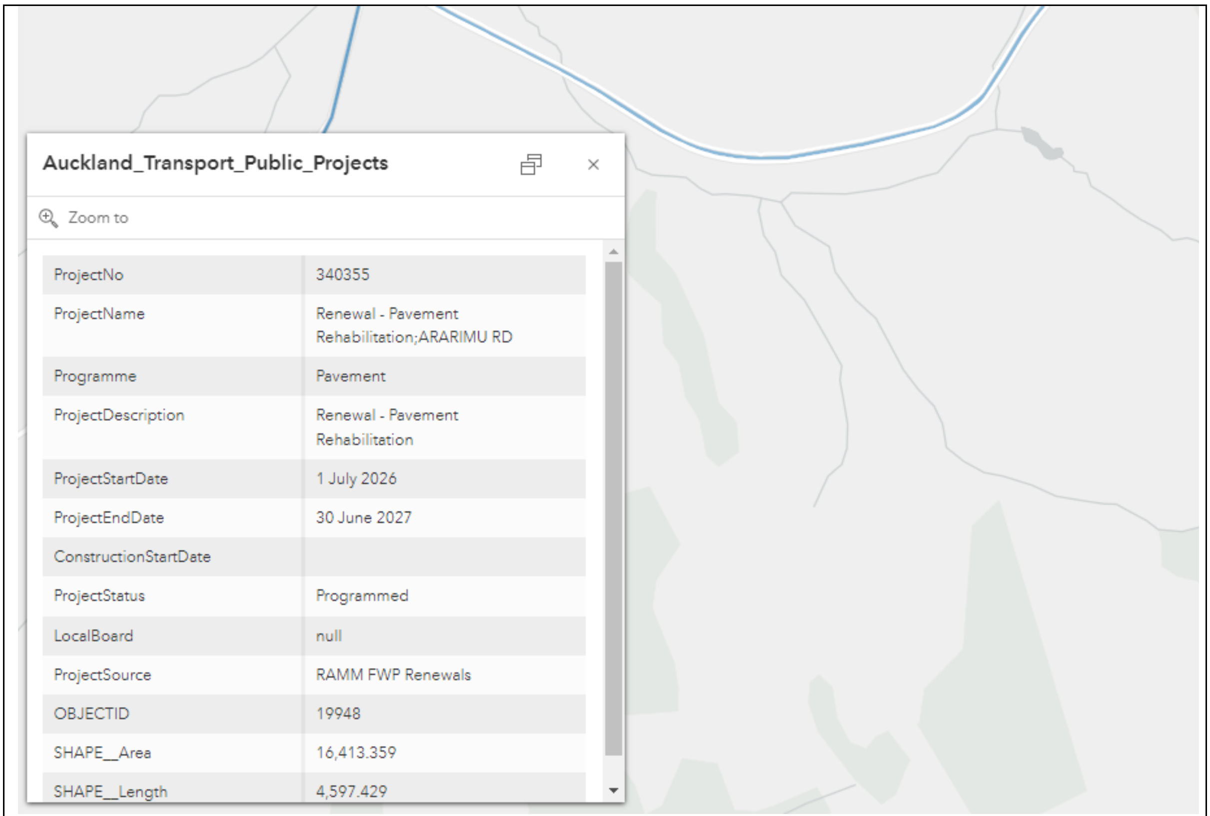
CH16535, west bound lane, Pothole and shoving, east bound lane rutting in wheel path.

CH 16610 and CH 16700– Rutting in wheel path, east bound lane.

5. Road Carriageway Information (Auckland Transport to provide)

The information below is supplied by Auckland Transport for the purpose of this pavement impact assessment only. It is intended to be used as a guide only.

Historic Surfacing Information
The last surfacing date as available for the full length of the analysis length, CH15800 to CH16800 was on 8.11.2010, where a 1.350km length of road between CH15632 and CH16990 was completed. Over the 1km length of data available, the surfacing age is 14 years. The Surface Structure RAMM data shows that this surfacing has a default end of life (expiry) in 2019, and a modified default expiry of 2024. This implies that the seal is now at its end of life. The site inspection on 22.10.2024 revealed a number of historical patches and recent patches present along the length under analysis.
Historic Pavement Information
The last pavement construction date as available to AT was in October 1984. The last Grade 2/4 two coat chip reseal record for the assessment length was in October 2010, although there is evidence on site of patch repairs. Based off the RAMM data however, theoretically this seal is now at its end of life.
Pavement Maintenance Cost History
A summary of the maintenance cost history as available to AT was not provided.
Forward Works Programme (check GIS Viewer):
There is currently a renewal – Pavement Rehabilitation planned for this section of Ararimu Road. This renewal is for a 4.6km length and is programmed for a start on 1 July 2026 through to 30 June 2027, as shown on the GIS viewer below.



Current One Network Road Classification (ONRC)

The current ONRC of the section of road carriageway(s) in the affected zone is **Secondary Collector.**

6. Investigation (Site Specific Testing)

Traffic Count Information

A 7-day traffic count has been completed to establish a pre-consent vehicle count. The Traffic Assessment Report for 1618 Ararimu Road, Hunua (dated September 2023 by TPC Limited) noted that the 7 day traffic count taken in March 2023 revealed:

- 5-day ADT of 299 vpd
- peak hour volumes of 37 vph (2 way)

as a comparison, the RAMM data supplied from AT showed that

- the max 5 day ADT for the 1km section of road occurred on 18/05/2021 and was estimated at 253 vpd (2 way) 11% HCVs. Max HCVs were 14.7% in 2023.

Existing Pavement Construction

RAMM data pavement layers supplied by AT indicated the pavement was constructed in December 1983 (41 years old) and resurfaced with 2 coat chip seal with 130/150 binder in November 2010 (14 years old), on a subgrade CBR of 6 and a single 200mm thick pavement layer.

The RAMM data shows the following existing pavement layer make up:

Surfacing = 2 coat chip seal with 130/150 binder

Basecourse GAP40 = 200mm thick stabilised (TNZ M4 assumed E=500MPa anisotropic, cracked) – further discussion below

Subgrade at time of construction = CBR = 6 (clay assumed E=60MPa)

Reference to the 200mm pavement layers being stabilised 'stab' as per below.

4	6832	ARARIMU	16233	16980	747						Subgrade			39		26/10/1984	10	CBR	UNKNOWN	
5	6833	ARARIMU	16233	16980	747	5.7	3.6	200	4257.9	851.58	Pavement Layer	UNKNOWN	UNKNOWN	39		28/10/1984		CBR		STAB
6	6830	ARARIMU	16980	17463	483						Subgrade			40	PAPARIMU RD	14/12/1983	6	CBR	UNKNOWN	
7	6831	ARARIMU	16980	17463	483	5.7	0.3	200	2753.1	550.62	Pavement Layer	UNKNOWN	UNKNOWN	40	PAPARIMU RD	16/12/1983		CBR		STAB

Falling Weight Deflectometer Analysis

FWD RAMM data (CH15800-CH16800), were taken at 11/12/2023 and the results are as follows:

Falling Weight ID	Road	Location	Lane	Def 0 (mm)	Def 2 (mm)	Curv (mm)
417203	ARARIMU RD	15800	Left lane 1	0.779	0.448	0.331
417992	ARARIMU RD	15811	Right lane 1	0.611	0.298	0.313
417204	ARARIMU RD	15820	Left lane 1	1.054	0.637	0.417
417993	ARARIMU RD	15831	Right lane 1	0.527	0.281	0.246
417205	ARARIMU RD	15840	Left lane 1	1.085	0.535	0.550
417994	ARARIMU RD	15851	Right lane 1	1.149	0.668	0.481

417206	ARARIMU RD	15860	Left lane 1	1.847	0.808	1.039
417995	ARARIMU RD	15871	Right lane 1	0.208	0.179	0.029
417207	ARARIMU RD	15880	Left lane 1	0.314	0.246	0.068
417996	ARARIMU RD	15891	Right lane 1	0.161	0.131	0.030
417208	ARARIMU RD	15900	Left lane 1	0.974	0.468	0.506
417997	ARARIMU RD	15911	Right lane 1	1.112	0.285	0.827
417209	ARARIMU RD	15920	Left lane 1	0.227	0.182	0.045
417998	ARARIMU RD	15931	Right lane 1	0.742	0.279	0.463
417210	ARARIMU RD	15940	Left lane 1	0.225	0.189	0.036
417999	ARARIMU RD	15951	Right lane 1	0.824	0.327	0.497
417211	ARARIMU RD	15960	Left lane 1	0.233	0.176	0.057
418000	ARARIMU RD	15971	Right lane 1	0.196	0.149	0.047
417212	ARARIMU RD	15980	Left lane 1	1.062	0.616	0.446
418001	ARARIMU RD	15991	Right lane 1	1.887	0.404	1.483
417213	ARARIMU RD	16000	Left lane 1	2.136	0.633	1.503
418002	ARARIMU RD	16011	Right lane 1	1.712	0.591	1.121
417214	ARARIMU RD	16020	Left lane 1	0.863	0.394	0.469
418003	ARARIMU RD	16031	Right lane 1	1.883	0.536	1.347
417215	ARARIMU RD	16040	Left lane 1	1.667	0.591	1.076
418004	ARARIMU RD	16051	Right lane 1	2.280	0.630	1.650
417216	ARARIMU RD	16060	Left lane 1	1.612	0.774	0.838
418005	ARARIMU RD	16071	Right lane 1	2.172	0.196	1.976
417217	ARARIMU RD	16080	Left lane 1	0.871	0.457	0.414
418006	ARARIMU RD	16091	Right lane 1	0.688	0.365	0.323
417218	ARARIMU RD	16100	Left lane 1	1.383	0.810	0.573
418007	ARARIMU RD	16111	Right lane 1	1.685	0.584	1.101

417219	ARARIMU RD	16120	Left lane 1	1.642	0.757	0.885
418008	ARARIMU RD	16131	Right lane 1	0.972	0.437	0.535
417220	ARARIMU RD	16140	Left lane 1	1.807	1.050	0.757
418009	ARARIMU RD	16151	Right lane 1	0.935	0.397	0.538
417221	ARARIMU RD	16160	Left lane 1	1.924	1.043	0.881
418010	ARARIMU RD	16171	Right lane 1	1.553	0.585	0.968
417222	ARARIMU RD	16180	Left lane 1	2.504	1.054	1.450
418011	ARARIMU RD	16191	Right lane 1	1.433	0.311	1.122
417223	ARARIMU RD	16200	Left lane 1	2.593	0.834	1.759
418012	ARARIMU RD	16211	Right lane 1	1.497	0.309	1.188
417224	ARARIMU RD	16220	Left lane 1	0.362	0.264	0.098
418013	ARARIMU RD	16231	Right lane 1	0.997	0.333	0.664
417225	ARARIMU RD	16240	Left lane 1	1.048	0.494	0.554
418014	ARARIMU RD	16251	Right lane 1	0.436	0.241	0.195
417226	ARARIMU RD	16260	Left lane 1	0.991	0.456	0.535
418015	ARARIMU RD	16271	Right lane 1	0.168	0.127	0.041
417227	ARARIMU RD	16280	Left lane 1	1.180	0.541	0.639
418016	ARARIMU RD	16291	Right lane 1	0.215	0.178	0.037
417228	ARARIMU RD	16300	Left lane 1	1.629	0.607	1.022
418017	ARARIMU RD	16311	Right lane 1	0.304	0.129	0.175
417229	ARARIMU RD	16320	Left lane 1	1.319	0.532	0.787
418018	ARARIMU RD	16331	Right lane 1	0.645	0.222	0.423
417230	ARARIMU RD	16340	Left lane 1	1.169	0.576	0.593
418019	ARARIMU RD	16351	Right lane 1	0.142	0.129	0.013
417231	ARARIMU RD	16360	Left lane 1	1.560	0.667	0.893
418020	ARARIMU RD	16371	Right lane 1	0.264	0.171	0.093

417232	ARARIMU RD	16380	Left lane 1	1.254	0.623	0.631
418021	ARARIMU RD	16391	Right lane 1	1.367	0.434	0.933
417233	ARARIMU RD	16400	Left lane 1	1.125	0.580	0.545
418022	ARARIMU RD	16411	Right lane 1	0.550	0.291	0.259
417234	ARARIMU RD	16420	Left lane 1	1.254	0.531	0.723
418023	ARARIMU RD	16431	Right lane 1	1.234	0.462	0.772
417235	ARARIMU RD	16440	Left lane 1	1.728	0.664	1.064
418024	ARARIMU RD	16451	Right lane 1	0.895	0.339	0.556
417236	ARARIMU RD	16460	Left lane 1	2.508	1.390	1.118
418025	ARARIMU RD	16471	Right lane 1	1.034	0.522	0.512
417237	ARARIMU RD	16480	Left lane 1	2.006	0.920	1.086
418026	ARARIMU RD	16491	Right lane 1	0.639	0.335	0.304
417238	ARARIMU RD	16500	Left lane 1	0.339	0.314	0.025
418027	ARARIMU RD	16511	Right lane 1	1.038	0.563	0.475
417239	ARARIMU RD	16520	Left lane 1	0.564	0.408	0.156
418028	ARARIMU RD	16531	Right lane 1	1.054	0.441	0.613
417240	ARARIMU RD	16540	Left lane 1	0.329	0.290	0.039
418029	ARARIMU RD	16551	Right lane 1	0.595	0.250	0.345
417241	ARARIMU RD	16560	Left lane 1	1.403	0.762	0.641
418030	ARARIMU RD	16571	Right lane 1	1.154	0.458	0.696
417242	ARARIMU RD	16580	Left lane 1	2.199	0.980	1.219
418031	ARARIMU RD	16591	Right lane 1	1.346	0.410	0.936
417243	ARARIMU RD	16600	Left lane 1	1.271	0.840	0.431
418032	ARARIMU RD	16611	Right lane 1	0.774	0.334	0.440
417244	ARARIMU RD	16620	Left lane 1	1.154	0.771	0.383
418033	ARARIMU RD	16631	Right lane 1	0.579	0.268	0.311

417245	ARARIMU RD	16640	Left lane 1	1.586	0.833	0.753
418034	ARARIMU RD	16651	Right lane 1	1.196	0.590	0.606
417246	ARARIMU RD	16660	Left lane 1	1.244	0.631	0.613
418035	ARARIMU RD	16671	Right lane 1	0.988	0.392	0.596
417247	ARARIMU RD	16680	Left lane 1	1.398	0.666	0.732
418036	ARARIMU RD	16691	Right lane 1	0.976	0.466	0.510
417248	ARARIMU RD	16700	Left lane 1	1.330	0.519	0.811
418037	ARARIMU RD	16711	Right lane 1	1.463	0.522	0.941
417249	ARARIMU RD	16720	Left lane 1	1.633	0.472	1.161
418038	ARARIMU RD	16731	Right lane 1	0.953	0.276	0.677
417250	ARARIMU RD	16740	Left lane 1	0.308	0.193	0.115
418039	ARARIMU RD	16751	Right lane 1	0.446	0.132	0.314
417251	ARARIMU RD	16760	Left lane 1	0.723	0.244	0.479
418040	ARARIMU RD	16771	Right lane 1	0.449	0.171	0.278
417252	ARARIMU RD	16780	Left lane 1	0.783	0.258	0.525
418041	ARARIMU RD	16791	Right lane 1	0.670	0.315	0.355
417253	ARARIMU RD	16800	Left lane 1	0.809	0.392	0.417
90th Percentile				**1.883**	**0.808**	**1.122**
Average				**1.087**	**0.471**	**0.616**
Max				**2.593**	**1.390**	**1.976**
Min				**0.142**	**0.127**	**0.013**

Notes:

The central deflection D0 is average of 1.087mm - compare with the D0 maximum limit of 1.0mm for new roads with the secondary collector classification. This also indicates the insitu subgrade is still performing well and it should be assumed that the CBR of 6 seen during construction can be used currently. This is further confirmed by the visual assessment where there was good table drains and subgrade drainage and no evidence of clay pumping to the surface of the road.

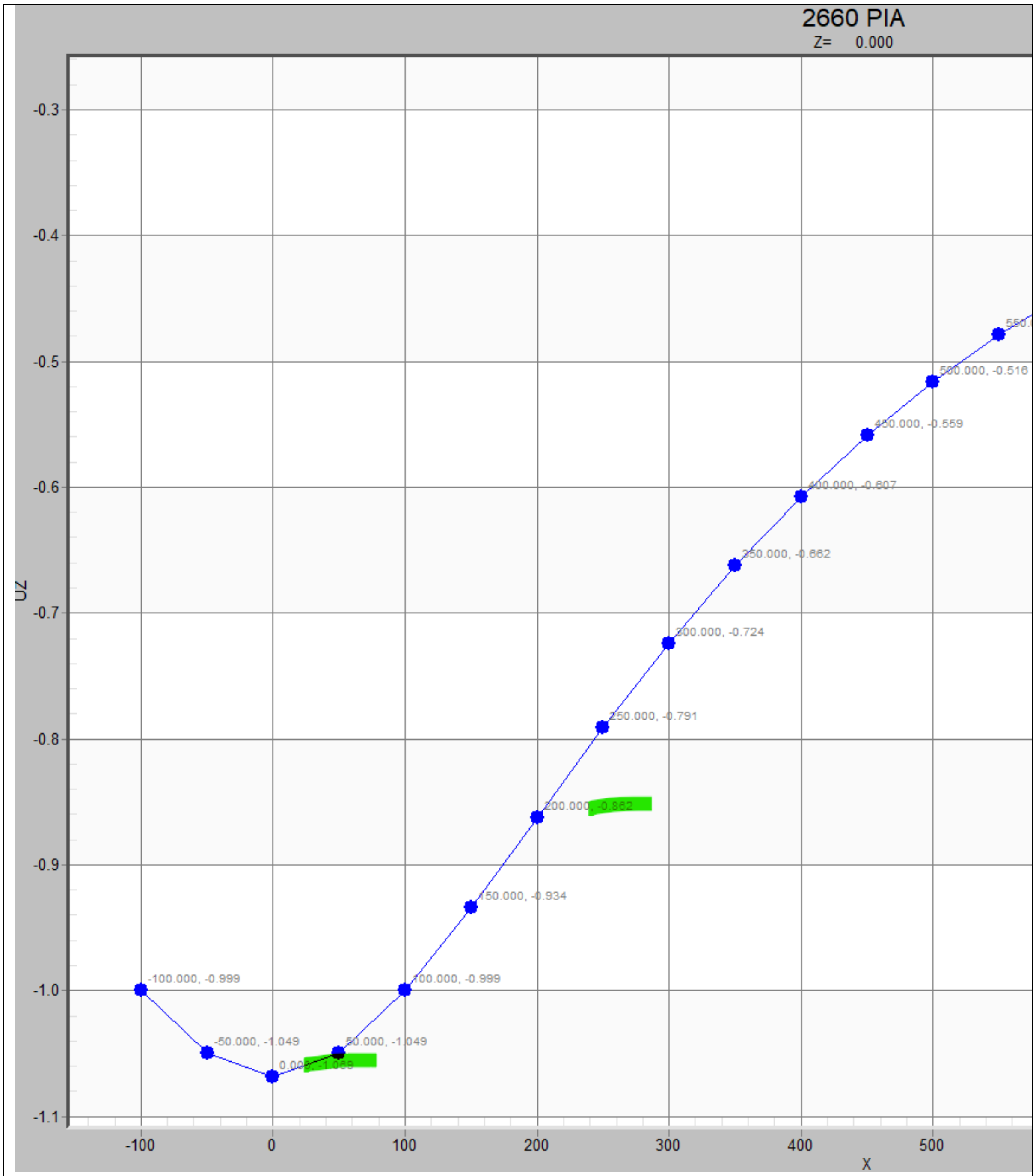
The deflection curvature (D0-D200=CF) is very high with an average of 0.616mm and 90th percentile of 1.122 mm and this indicates either weak basecourse or unstable chip seal layers (at the end of its life as noted in section 5). It is likely successive chip seal layers have been overlaid, and this is evidenced by the flushing noted in the site inspection. The high deflection curvature is likely related to unstable chip seal rather than a weak basecourse, but could be a combination of both given the age of the pavement (40 plus years).

The RAMM data confirmed that the 200mm granular layer was stabilised. Due to the relatively thin layer this was likely cement modified at 1.5-2% to prevent block cracking through the asphalt layer. Block cracking is normally seen when basecourse layers within 200mm of the surface are treated at higher cement rates such as 4%, and should be avoided.

As the high CF points to the upper basecourse layer showing signs of weakness, it is has been assumed to split the pavement layer into 2 with a weaker upper post cracked basecourse, and use the following pavement build up to model the existing pavement.

No.	ID	Material	Thickness
1	Cem350A	Cemented Granular- E=350 MPa, anisotropic, cracked	100.00
2	Cem500A	Cemented Granular- E=500 MPa, anisotropic, cracked - 2% cement	100.00
3	Sub_CBR6	Subgrade,CBR6,Aniso	0.00

Below, D0=1.07mm, D200=0.86mm, CF=0.21mm which correlates to the FWD results above.



Laboratory Test Results – if applicable

No laboratory testing was deemed necessary for this pavement. AT does not allow intrusive investigations and FWD results are sufficient for this reporting.

CCTV Survey – if applicable

No CCTV surveys were deemed necessary for the drainage associated with this pavement.

7. Traffic Loading

Below is the excerpt from the Traffic report from TPC Traffic Planning Consultants Ltd regarding trip generation.

3.1 Trip Generation

Based on the site accommodating 1.56 million m^3 of fill over the next 10-15 years, the site is estimated to receive approximately 104,000-156,000 m^3 per annum. Based on an average single body truck fill volume of 6 m^3 approximately 17,350-26,000 trucks can be anticipated each year to the site, or 58-87 trucks per working day (Monday-Saturday, ~300 days per year). Over an approximate 10-hour operation day (Monday-Saturday), this equates to 6-9 trucks each hour, or 12-18 truck movements (split equally between in-out of the site) each hour, on average.

With the existing traffic volumes on Ararimu Road being relatively low (299 daily vehicles, with 37 peak hour vehicles), truck traffic to/from the site are forecast to be able to turn freely with minimal delay/queuing along Ararimu Road or within the site's access. As well, the vehicle traffic associated with the site can be accommodated within the surrounding road environment with less than minor effects.

Currently, Ararimu Rd is a Secondary Collector with an average of 44 HCV per day (2023 count data). The current proposal is to have 87 trucks per day access the site. The increase in DESA's over the 10 year consent period is shown as a comparison below.

Total ESA of Existing Vehicles over 10 years

Analysis Period (in years)	10
Average Daily Traffic *Obtained from relevant traffic count information*	299
% Heavy Commercial Vehicles (HCV) *Obtained from relevant traffic count information*	14.7%
Direction Factor	0.5
Lane Distribution Factor	1
Average No. of Axle Groups per Heavy Vehicle, N(HVAG) =	2.40 from NZTA supplement
ESA/HVAG	0.6 from NZTA supplement
ESA/HCV	1.4 from NZTA supplement
Cumulative Design Traffic, N(DT)	2.21x10^5
Cumulative DESA	1.32x10^5

Total ESA of Proposed Additional Vehicles over 10 years

Consent Period (in years)	10
Annual Average Daily HCV *Based on consent development project*	87 in and out - See above
Type of HCV used (e.g. truck and trailer or 6-wheeler) *Based on consent development project*	Average truck size 6m3 (truck and trailer)
Average No. of Axle Groups per Heavy Vehicle, N(HVAG) =	2.40 from NZTA supplement
ESA/HVAG	1.33
ESA/HCV *Loaded ESA/HCV for a 6-wheeler is 2.6 and 3.8 for T&T*	Average = 3.2
Direction Factor (HCVs above are in and out)	0.5
Lane Distribution Factor (use 1)	1
Cumulative Design Traffic, N(DT)	3.81x10^5
Cumulative DESA	5.07x10^5

DESIGN TRAFFIC AND PAVEMENT THICKNESS CALCULATION FOR HEAVILY TRAFFICKED PAVEMENTS AND THIN SURFACING (<40mm)
CHAPTER 7 OF AUSTROADS PT2 (2012)

CLIENT:	SB Civil Ltd	DESIGNER:	SCP	CHECKED:	RJP
PROJECT:	1618 Ararimu Road, Hunua	JOB NO.:	2660	DATE:	23.10.2024
ROAD NAME:	Existing Road	DATE:	22.10.2024		

NOTES: Refer to Pavement Impact Assessment

USER INPUTS

Design Period (P) =	10	years	Table 7.2 - Typical pavement design periods are: Flexible Pavements = 20-40years, Rigid Pavements = 30-40years
Average Daily Traffic (ADT) =	299.0	veh/day	from 5-day traffic count dated 3.03.2023 to 9.03.2023, provided by TPC
Annual growth rate throughout Design Period (R) =	3.00	% per year	Section 7.4.5
Average percentage of heavy vehicles =	14.70	%HV	average percentage of HVs over the first year - Section 7.4.4
Direction Factor (DF) =	0.50		Proportion of the two-way AADT travelling in the direction of the design lane
Lane Distribution Factor (LDF) =	1.00		Where there are 2 or more lanes in each direction. Table 7.3 - ranges from 0.5-1.0 - conservative is 1.0, i.e. all AADT travels in one lane
Average No. of Axle Groups per Heavy Vehicle, N(HVAG) =	2.40		Refer to Transit NZ supplement to APDG 2004 appendix 7.4
ESA/HVAG	0.60		Refer to Transit NZ supplement to APDG 2004 appendix 7.4
ESA/HV	1.40		Refer to Transit NZ supplement to APDG 2004 appendix 7.4

Damage Index	Value
N_{HVAG}	2.4
ESA / HVAG	0.6
ESA / HV	1.4
SAR_s / ESA	1.0
SAR_t / ESA	1.2
SAR_c / ESA	3.6

DESIGN TRAFFIC CALCULATION

Cumulative Growth Factor = 11.5 Section 7.4.5

Design Traffic, N(DT) = 365 * AADT * DF * (%HV/100) * LDF * CGF * N(HVAG) - Equation 14

Design Traffic, N(DT) = 2.21E+05

N(DT) is applicable for both flexible and rigid pavements, and additional calculations are required to dervie standard axles of loading for flexible pavements (in Section 7.6)

DESIGN EQUIVALENT STANDARD AXLES (DESA) CALCULATION

DESA = N(DT) * ESA/HVAG - Equation 17 = 1.32E+05 DESA Section 7.6.3 - Suitable for use to design unbound granular pavements with thin bituminous surfacings (Figure 8.4)

DESIGN TRAFFIC AND PAVEMENT THICKNESS CALCULATION FOR HEAVILY TRAFFICKED PAVEMENTS AND THIN SURFACING (<40mm)
CHAPTER 7 OF AUSTROADS PT2 (2012)

CLIENT:	SB Civil Ltd	DESIGNER:	SCP	CHECKED:	RJP
PROJECT:	1618 Ararimu Road, Hunua	JOB NO.:	2295	DATE:	23.10.2024
ROAD NAME:	Proposed Road with Trucks	DATE:	22.10.2024		

NOTES: Refer to Pavement Impact Assessment

USER INPUTS

Design Period (P) =	10	years	Table 7.2 - Typical pavement design periods are: Flexible Pavements = 20-40years, Rigid Pavements = 30-40years
Annual Average Daily Traffic (AADT) =	87.0	veh/day	refer to Section 3.1 of TPC report
Annual growth rate throughout Design Period (R) =	0.00	% per year	N/A
Average percentage of heavy vehicles =	100.00	%HV	average percentage of HVs over the first year - Section 7.4.4
Direction Factor (DF) =	0.50		Proportion of the two-way AADT travelling in the direction of the design lane
Lane Distribution Factor (LDF) =	1.00		Where there are 2 or more lanes in each direction. Table 7.3 - ranges from 0.5-1.0 - conservative is 1.0, i.e. all AADT travels in one lane
Average No. of Axle Groups per Heavy Vehicle, N(HVAG) =	2.40		Refer to Transit NZ supplement to APDG 2004 appendix 7.4
ESA/HVAG	1.33		
ESA/HV	3.20		***Loaded ESA/HCV for a 6-wheeler is 2.6 and 3.8 for T&T, Average = 3.2***

Damage Index	Value
N_{HVAG}	2.4
ESA / HVAG	0.6
ESA / HV	1.4
SAR_s / ESA	1.0
SAR_t / ESA	1.2
SAR_c / ESA	3.6

DESIGN TRAFFIC CALCULATION

Cumulative Growth Factor = 10.0 Section 7.4.5

Design Traffic, N(DT) = 365 * AADT * DF * (%HV/100) * LDF * CGF * N(HVAG) - Equation 14

Design Traffic, N(DT) = 3.81E+05

N(DT) is applicable for both flexible and rigid pavements, and additional calculations are required to dervie standard axles of loading for flexible pavements (in Section 7.6)

DESIGN EQUIVALENT STANDARD AXLES (DESA) CALCULATION

DESA = N(DT) * ESA/HVAG - Equation 17 = 5.07E+05 DESA Section 7.6.3 - Suitable for use to design unbound granular pavements with thin bituminous surfacings (Figure 8.4)

The above shows that the proposal increases the axle loading on the pavement by 384% over the 10 year analysis period.

8. Pavement Condition and Impacts from Proposed Activities

8.1 Existing Traffic Pavement Damage (Do nothing, business as usual)

A Circly analysis was completed with the pavement build identified in Section 6:

1. Basecourse TNZ M4 GAP40 2% cement modified, weakened = 100mm thick (assumed E=350MPa anisotropic, post cracked)
2. Basecourse TNZ M4 GAP40 2% cement modified = 100mm thick (assumed E=500MPa anisotropic, post cracked)
3. Subgrade CBR = 6 (assumed E=60MPa)

Note that no asphalt surfacing was modelled as it is not a structural layer. This means the results are conservative.

The existing 10-year traffic N(DT) = 2.21x10^5, with a standard traffic load distribution (TLD) and ESA/HVAG = 0.6, assuming 3% growth.

This showed that the subgrade CDF over 10 years = 2.85, which is greater than 1 and shows that the pavement would fail without intervention/rehabilitation, and without the proposed truck movements (business as usual).

It was found that **the existing pavement has 3.5 years of residual life left until the subgrade fails under business as usual conditions (ie in 2027).** This is shown below with the 3.5 year N(DT) of 6.99x10^4, and a subgrade CDF of practically 1, as shown below.

This aligns with the proposed pavement upgrade planned by Auckland Transport starting in July 2026, therefore is recommended to implement at that time. The next section considers the effect of this proposed pavement rehabilitation.

DESIGN TRAFFIC AND PAVEMENT THICKNESS CALCULATION FOR HEAVILY TRAFFICKED PAVEMENTS AND THIN SURFACING (<40mm)
CHAPTER 7 OF AUSTROADS PT2 (2012)

CLIENT:	SB Civil Ltd	**DESIGNER:**	SCP	**CHECKED:**	RJP
PROJECT:	1618 Ararimu Road, Hunua	**JOB NO.:**	2660	**DATE:**	23.10.2024
ROAD NAME:	Existing Road life left	**DATE:**	22.10.2024		
NOTES:	**Refer to Pavement Impact Assessment**				

USER INPUTS

Design Period (P) =	**3.5**	years	Table 7.2 - Typical pavement design periods are: Flexible Pavements = 20-40years, Rigid Pavements = 30-40years
Average Daily Traffic (ADT) =	**299.0**	veh/day	from 5-day traffic count dated 3.03.2023 to 9.03.2023, provided by TPC
Annual growth rate throughout Design Period (R) =	**3.00**	% per year	Section 7.4.5
Average percentage of heavy vehicles =	**14.70**	%HV	average percentage of HVs over the first year - Section 7.4.4
Direction Factor (DF) =	**0.50**		Proportion of the two-way AADT travelling in the direction of the design lane
Lane Distribution Factor (LDF) =	**1.00**		Where there are 2 or more lanes in each direction. Table 7.3 - ranges from 0.5-1.0 - conservative is 1.0, i.e. all AADT travels in one lane
Average No. of Axle Groups per Heavy Vehicle, N(HVAG) =	**2.40**		Refer to Transit NZ supplement to APDG 2004 appendix 7.4
ESA/HVAG	**0.60**		Refer to Transit NZ supplement to APDG 2004 appendix 7.4
ESA/HV	**1.40**		Refer to Transit NZ supplement to APDG 2004 appendix 7.4

Damage Index	Value
N_{HVAG}	2.4
ESA / HVAG	0.6
ESA / HV	1.4
SAR_a / ESA	1.0
SAR_s / ESA	1.2
SAR_c / ESA	3.6

DESIGN TRAFFIC CALCULATION

Cumulative Growth Factor = 3.6 — Section 7.4.5

Design Traffic, N(DT) = 365 * AADT * DF * (%HV/100) * LDF * CGF * N(HVAG) - Equation 14

Design Traffic, N(DT) = 6.99E+04

N(DT) is applicable for both flexible and rigid pavements, and additional calculations are required to dervie standard axles of loading for flexible pavements (in Section 7.6)

DESIGN EQUIVALENT STANDARD AXLES (DESA) CALCULATION

DESA = N(DT) * ESA/HVAG - Equation 17 = **4.20E+04 DESA** — **Section 7.6.3 - Suitable for use to design unbound granular pavements with thin bituminous surfacings (Figure 8.4)**

Use Lightly Trafficked Design!

Job Details	
Design Method	Austroads Pavement Design (2017)
Layered System	
ID:	1-ExgColCBR6
Title::	1-Exg Pavement Collector Road CBR=6
Traffic Load Distribution:	
ID:	01N00463 - Decreasing
Name:	01N00463 - SH1N - Drury - Decreasing - N
ESA/HVAG:	0.605
NDT	6.99E+4
Project Reliability	
Project Reliability	95%
Parametric Analysis	
Use Parametric	☐

☐ Design thickness of layer highlighted below ☐ Calculate Cost

No.	ID	Title	Current Thickness	CDF
1	Cem350A	Cemented Granular- E=350 MPa, anisotropic,	100.00	
2	Cem500A	Cemented Granular- E=500 MPa, anisotropic, cracked - 2%	100.00	
3	Sub_CBR6	Subgrade,CBR6,Aniso	0.00	9.03E-01

8.2 Auckland Transport 2027 Pavement Rehabilitation Works

The design details of the proposed pavement rehabilitation and renewal planned by Auckland Transport starting in July 2026 is currently unknown, however could involve the following options to add the standard 25 years of life back into the pavement.

- insitu cement stabilisation of existing materials to bring strength back into the pavement
- the above plus additional layer(s) of cement stabilised material

A typical pavement rehabilitation design often implemented by Highway Stabilizers, involves both of these options, and adding a 150mm 1.5-2% cement stabilised overlay. This is a hypothetical upgrade design which has been modelled in Circly as follows.

a) Grade 2/4, 2 coat chip seal

b) 150mm 1.5-2% cement stabilised AP40 basecourse overlay (stabilised 175mm deep to ensure lower layer is tied in adequately)

c) Existing basecourse TNZ M4 GAP40 upgraded with insitu cement hoeing 100mm 1.5-2% cement stabilised AP40 basecourse and part 2 coat chip seal hoed insitu (stabilised 125mm deep to ensure lower layer is tied in adequately) (assumed E=500MPa anisotropic, post cracked)

d) Existing basecourse left in place - TNZ M4 GAP40 2% cement modified = 100mm thick (assumed E=500MPa anisotropic, post cracked)

e) Existing Subgrade CBR = 6 (assumed E=60MPa)

The design traffic with business as usual (without the subject site's added proposed truck movements) for a design period of 28 years is N(DT) = 8.26x10^5:

DESIGN TRAFFIC AND PAVEMENT THICKNESS CALCULATION FOR HEAVILY TRAFFICKED PAVEMENTS AND THIN SURFACING (<40mm)

CHAPTER 7 OF AUSTROADS PT2 (2012)

CLIENT:	SB Civil Ltd	**DESIGNER:**	RJP	**CHECKED:**	RJP
PROJECT:	1618 Ararimu Road, Hunua	**JOB NO.:**	2660	**DATE:**	23.10.2024
ROAD NAME:	AT Pavement rehab adding 25 yrs	**DATE:**	22.10.2024		
NOTES:	**Refer to Pavement Impact Assessment**				

USER INPUTS

Design Period (P) =	**28**	years	Table 7.2 - Typical pavement design periods are: Flexible Pavements = 20-40years, Rigid Pavements = 30-40years
Average Daily Traffic (ADT) =	**299.0**	veh/day	from 5-day traffic count dated 3.03.2023 to 9.03.2023, provided by TPC
Annual growth rate throughout Design Period (R) =	**3.00**	% per year	Section 7.4.5
Average percentage of heavy vehicles =	**14.70**	%HV	average percentage of HVs over the first year - Section 7.4.4
Direction Factor (DF) =	**0.50**		Proportion of the two-way AADT travelling in the direction of the design lane
Lane Distribution Factor (LDF) =	**1.00**		Where there are 2 or more lanes in each direction. Table 7.3 - ranges from 0.5-1.0 - conservative is 1.0, i.e. all AADT travels in one lane
Average No. of Axle Groups per Heavy Vehicle, N(HVAG) =	**2.40**		Refer to Transit NZ supplement to APDG 2004 appendix 7.4
ESA/HVAG	**0.60**		Refer to Transit NZ supplement to APDG 2004 appendix 7.4
ESA/HV	**1.40**		Refer to Transit NZ supplement to APDG 2004 appendix 7.4

Damage Index	Value
N_{HVAG}	2.4
ESA / HVAG	0.6
ESA / HV	1.4
SAR_a / ESA	1.0
SAR_s / ESA	1.2
SAR_c / ESA	3.6

DESIGN TRAFFIC CALCULATION

Cumulative Growth Factor =	42.9	Section 7.4.5

Design Traffic, N(DT) = 365 * AADT * DF * (%HV/100) * LDF * CGF * N(HVAG) - Equation 14

Design Traffic, N(DT) =	8.26E+05

N(DT) is applicable for both flexible and rigid pavements, and additional calculations are required to dervie standard axles of loading for flexible pavements (in Section 7.6)

DESIGN EQUIVALENT STANDARD AXLES (DESA) CALCULATION

DESA = N(DT) * ESA/HVAG - Equation 17 =	**4.96E+05 DESA**	**Section 7.6.3 - Suitable for use to design unbound granular pavements with thin bituminous surfacings (Figure 8.4)**

The above was modelled in Circly with the results below, showing that the pavement performs with a subgrade CDF of 0.032, <1 so OK.

No.	ID	Material	Thickness
1	Cem500A	Cemented Granular- E=500 MPa, anisotropic, cracked - 2% cement	150.00
2	Cem500A	Cemented Granular- E=500 MPa, anisotropic, cracked - 2% cement	100.00
3	Cem500A	Cemented Granular- E=500 MPa, anisotropic, cracked - 2% cement	100.00
4	Sub_CBR6	Subgrade,CBR6,Aniso	0.00

⊟ **Job Details**	
Design Method	Austroads Pavement Design (2017)
⊟ Layered System	
ID:	2-AT Rehab ColCBR6
Title::	2-AT Rehab Pavement Collector Road CBR=6
⊟ Traffic Load Distribution:	
ID:	01N00463 - Decreasing
Name:	01N00463 - SH1N - Drury - Decreasing - N
ESA/HVAG:	0.605
NDT	8.26E+5
⊟ **Project Reliability**	
Project Reliability	95%
⊟ **Parametric Analysis**	
Use Parametric	☐

☐ Design thickness of layer highlighted below ☐ Calculate Cost

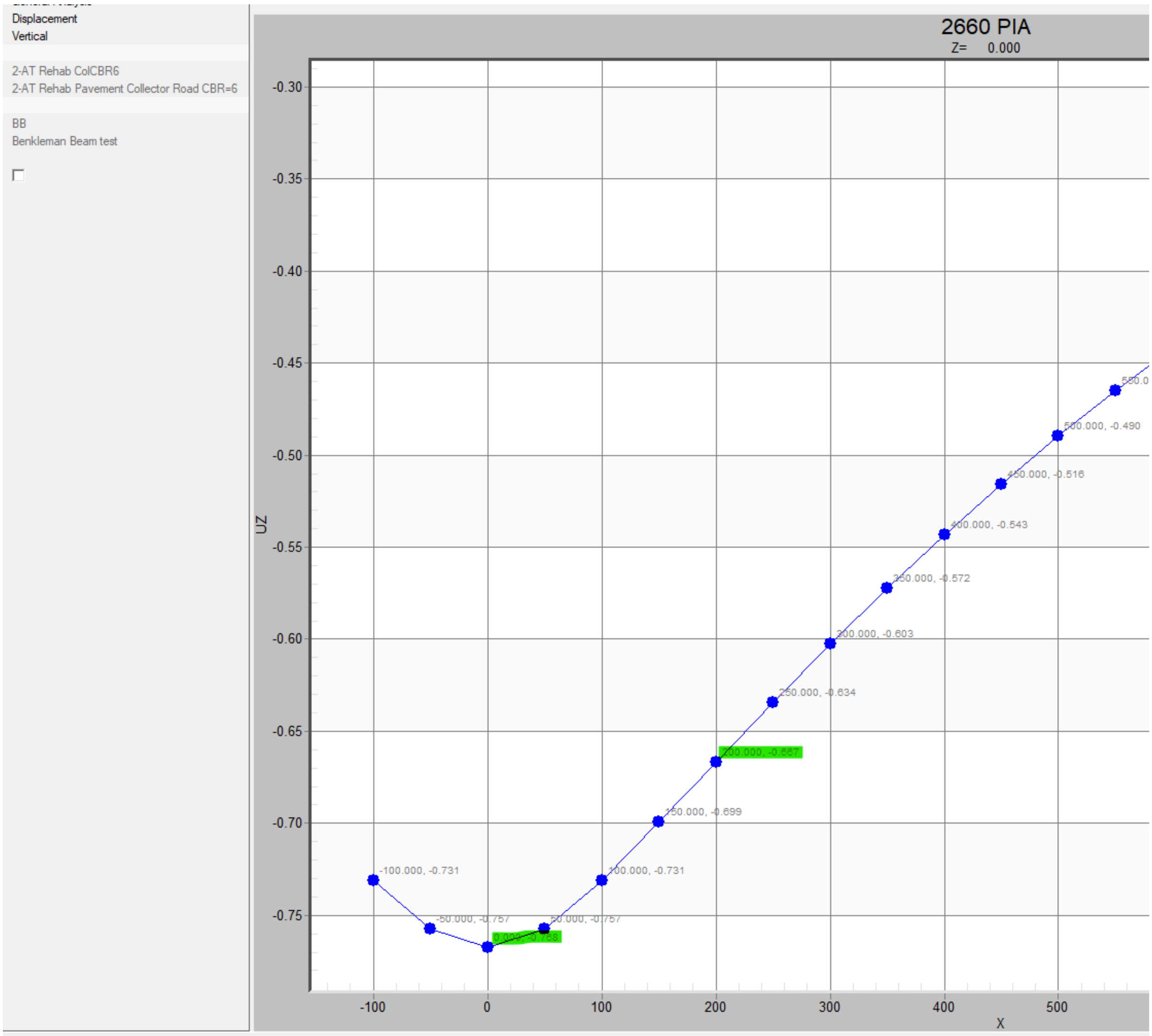
No.	ID	Title	Current Thickness	CDF
2	Cem500A	Cemented Granular- E=500 MPa, anisotropic, cracked - 2%	100.00	
3	Cem500A	Cemented Granular- E=500 MPa, anisotropic, cracked - 2%	100.00	
4	Sub_CBR6	Subgrade,CBR6,Aniso	0.00	3.20E-02

This design would also improve the deflections to be compliant with standards for a newly constructed Collector Road, as shown below:

D0 = 0.77mm (AT D0 design max for Secondary Collector is 1.00mm, complies)

D200 = 0.67mm

CF = 0.10mm (AT CF design max for Secondary Collector is 0.15mm, complies)



The above pavement rehabilitation will also remediate the pavement failures identified in Section 4 relating to alligator cracking, longitudinal rutting, shoving and surface flushing.

8.2.1 Lime/Cement Option and Reactivity testing

This option has been discussed with a stabilisation company and a lime/cement combination could also be considered, which has worked well on other sections of roads in the area. A mix design could be reviewed and submitted to Auckland Transport for approval as part of a consent condition, for example to be presented at the preconstruction meeting.

Consideration should also be given to reactivity testing prior to construction to ensure that the current pavement is able to react appropriately to the amount of stabilizing agent proposed.

8.3 Proposed Traffic Pavement Damage

The proposed truck movements over the 10 year period equates to N(DT) = 3.81x10^5, which can be added to either:

- The existing (business as usual) 10 year traffic N(DT) = 2.21x10^5 **(totalling 6.02x10^5)** or
- The rehabilitated pavement design traffic for a 28 year design period - N(DT) = 8.26x10^5 **(totalling 1.21x10^6)**

8.3.1 Effect on Existing Pavement

Applying the total 10 year traffic N(DT)=6.02x10^5 to the existing pavement shows a failure as shown below – CDF>1.

As explained in section 8.1, there is 3.5 years of residual life in the existing pavement without the proposed truck movements. **With the proposed truck movements added, this residual life reduces to 1 year, as shown with the N(DT) and CDF results below.**

N(DT) Existing Business as Usual = 1.93x10^4

N(DT) proposed truck movements = 3.81x10^4

Total N(DT) = 5.74x10^4

CDF = 0.742 (practically failed)

Job Details	
Design Method	Austroads Pavement Design (2017)
Layered System	
ID:	1-ExgColCBR6
Title::	1-Exg Pavement Collector Road CBR=6
Traffic Load Distribution:	
ID:	01N00463 - Decreasing
Name:	01N00463 - SH1N - Drury - Decreasing - N
ESA/HVAG:	0.605
NDT	5.74E+4
Project Reliability	
Project Reliability	95%
Parametric Analysis	
Use Parametric	☐

☐ Design thickness of layer highlighted below ☐ Calculate Cost

No.	ID	Title	Current Thickness	CDF
1	Cem350A	Cemented Granular- E=350 MPa, anisotropic,	100.00	
2	Cem500A	Cemented Granular- E=500 MPa, anisotropic, cracked - 2%	100.00	
3	Sub_CBR6	Subgrade,CBR6,A niso	0.00	7.42E-01

Practically the road should therefore be upgraded to the specification described in section 8.2 within the first year of truck movements starting.

8.3.2 Effect on Auckland Transport Rehabilitated Pavement

The total proposed 28 year traffic N(DT)= 1.21x10^6 was modelled in Circly on the Auckland Transport rehabilitated pavement described in section 8.2 with the results below, showing that the pavement also performs without failure with the proposed truck movements added, with a subgrade CDF of 0.047, <1 so OK.

Job Details	
Design Method	Austroads Pavement Design (2017)
Layered System	
ID:	2-AT Rehab ColCBR6
Title::	2-AT Rehab Pavement Collector Road CBR=6
Traffic Load Distribution:	
ID:	01N00463 - Decreasing
Name:	01N00463 - SH1N - Drury - Decreasing - N
ESA/HVAG:	0.605
NDT	1.21E+6
Project Reliability	
Project Reliability	95%
Parametric Analysis	
Use Parametric	☐

☐ Design thickness of layer highlighted below ☐ Calculate Cost

No.	ID	Title	Current Thickness	CDF
2	Cem500A	Cemented Granular- E=500 MPa, anisotropic, cracked - 2%	100.00	
3	Cem500A	Cemented Granular- E=500 MPa, anisotropic, cracked - 2%	100.00	
4	Sub_CBR6	Subgrade,CBR6,A niso	0.00	4.69E-02

Therefore, it can be concluded that if the pavement is rehabilitated as described in section 8.2 within the first year of truck movements starting, or by July 2026 as planned by Auckland Transport (whichever is sooner), then the effects of both the business as usual traffic and the proposed truck movements will be mitigated.

Practically, this rehabilitation work could be completed by the same contractor and at the same time, with a contribution made by either the client or Auckland Transport for the work (depending on timing and which work is first to start). Funding discussions should be had with Auckland Transport to develop a funding agreement accordingly, and is outside the scope of this document.

9. Conclusion and Recommendations

For the 1km extent of pavement assessed (500m either side of the site entrance), it is concluded that the existing pavement has a residual design life of 3.5 years. With the proposed truck movements, this reduces to 1 year.

The existing pavement is not able to withstand the increased traffic from either business as usual traffic increases, or the additional truck movements over the proposed 10 year period.

As noted in Section 8, Auckland Transport has a planned pavement rehabilitation for this section of Ararimu Road to be implemented within the proposed 10 year period, starting in July 2026. A hypothetical but common pavement rehabilitation design has been considered to understand the effect that this upgrade will have on the pavement's ability to carry the business as usual design traffic for the typical design period of 25 years, as well as the proposed truck movement traffic over a 10 year period within the 25 years.

The proposed pavement is as follows:

a) Grade 2/4, 2 coat chip seal

b) 150mm 1.5-2% cement stabilised AP40 basecourse overlay (stabilised 175mm deep to ensure lower layer is tied in adequately)

c) Existing basecourse TNZ M4 GAP40 upgraded with insitu cement hoeing 100mm 1.5-2% cement stabilised AP40 basecourse and part 2 coat chip seal hoed insitu (stabilised 125mm deep to ensure lower layer is tied in adequately) (assumed E=500MPa anisotropic, post cracked)

d) Existing basecourse left in place - TNZ M4 GAP40 2% cement modified = 100mm thick (assumed E=500MPa anisotropic, post cracked)

e) Existing Subgrade CBR = 6 (assumed E=60MPa)

This pavement rehabilitation will not only allow to mitigate the effects of the increased traffic loading over the 10 years, but also allow for the current defects such as rutting and shoving to be reshaped, without the risk of block or reflective cracking. Then the surface should be resealed with a Grade 2/4, 2 coat chip seal to seal and protect the surface, with line marking reinstated.

The report concludes that if the pavement is rehabilitated as described above and in section 8.2 within the first year of truck movements starting, or by July 2026 as planned by Auckland Transport (whichever is sooner), then the effects of both the business as usual traffic and the proposed truck movements will be mitigated.

Practically, this rehabilitation work could be completed by the same contractor and at the same time, with a contribution made by either the client or Auckland Transport for the work (depending on timing and which work is first to start). Funding discussions should be had with Auckland Transport to develop a funding agreement accordingly, and is outside the scope of this document.

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APPENDIX 1

Existing and Proposed Traffic Calculation

DESIGN TRAFFIC AND PAVEMENT THICKNESS CALCULATION FOR HEAVILY TRAFFICKED PAVEMENTS AND THIN SURFACING (<40mm)

CHAPTER 7 OF AUSTROADS PT2 (2012)

CLIENT:	SB Civil Ltd	DESIGNER:	SCP	CHECKED:	RJP
PROJECT:	1618 Ararimu Road, Hunua	JOB NO.:	2660	DATE:	23.10.2024
ROAD NAME:	Existing Road - 10 year design period	DATE:	22.10.2024		

NOTES: Refer to Pavement Impact Assessment

USER INPUTS

Design Period (P) =	10	years	Table 7.2 - Typical pavement design periods are: Flexible Pavements = 20-40years, Rigid Pavements = 30-40years
Average Daily Traffic (ADT) =	299.0	veh/day	from 5-day traffic count dated 3.03.2023 to 9.03.2023, provided by TPC
Annual growth rate throughout Design Period (R) =	3.00	% per year	Section 7.4.5
Average percentage of heavy vehicles =	14.70	%HV	average percentage of HVs over the first year - Section 7.4.4
Direction Factor (DF) =	0.50		Proportion of the two-way AADT travelling in the direction of the design lane
Lane Distribution Factor (LDF) =	1.00		Where there are 2 or more lanes in each direction. Table 7.3 - ranges from 0.5-1.0 - conservative is 1.0, i.e. all AADT travels in one lane
Average No. of Axle Groups per Heavy Vehicle, N(HVAG) =	2.40		Refer to Transit NZ supplement to APDG 2004 appendix 7.4
ESA/HVAG	0.60		Refer to Transit NZ supplement to APDG 2004 appendix 7.4
ESA/HV	1.40		Refer to Transit NZ supplement to APDG 2004 appendix 7.4

Damage Index	Value
N_{HVAG}	2.4
ESA / HVAG	0.6
ESA / HV	1.4
SAR_5 / ESA	1.0
SAR_7 / ESA	1.2
SAR_{12} / ESA	3.6

DESIGN TRAFFIC CALCULATION

Cumulative Growth Factor = 11.5 Section 7.4.5

Design Traffic, N(DT) = 365 * AADT * DF * (%HV/100) * LDF * CGF * N(HVAG) - Equation 14

Design Traffic, N(DT) = 2.21E+05

N(DT) is applicable for both flexible and rigid pavements, and additional calculations are required to dervie standard axles of loading for flexible pavements (in Section 7.6)

DESIGN EQUIVALENT STANDARD AXLES (DESA) CALCULATION

DESA = N(DT) * ESA/HVAG - Equation 17 = 1.32E+05 DESA Section 7.6.3 - Suitable for use to design unbound granular pavements with thin bituminous surfacings (Figure 8.4)

Figure 8.4 Calculation for DESA >= 1x10^5			
1.32E+05	DESA		
CBR	Thickness of Granular Material (t) (mm)	Min. Thickness of Base Material (Gap 40, TNZ M/4)(mm)	Thickness of GAP 65 (mm)
0.5	880	110	770
1	670	110	560
2	490	110	380
3	410	110	300
4	350	110	240
5	310	110	200
6	280	110	170
7	250	110	140
8	240	110	130
9	220	110	110
10	210	110	100
15	160	110	50
20	130	110	20
30	110	110	0

GUIDE TO PAVEMENT TECHNOLOGY PART 2: PAVEMENT STRUCTURAL DESIGN

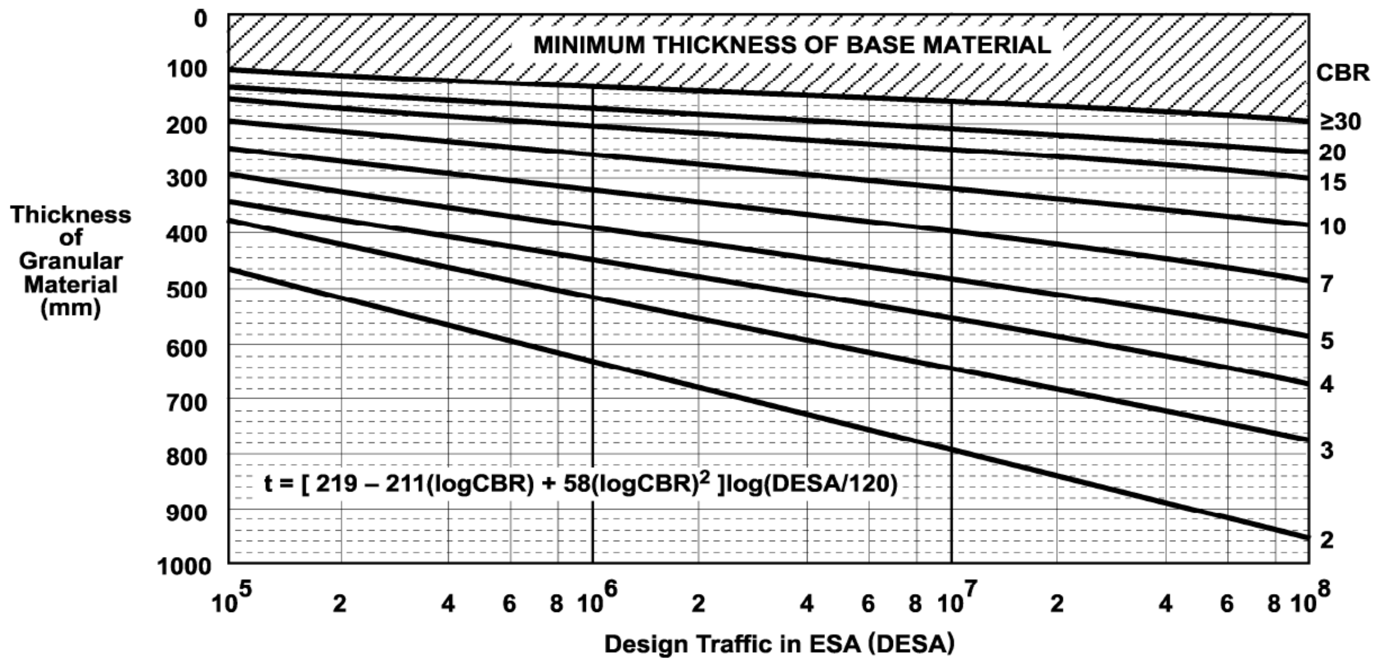

Figure 8.4: Design chart for granular pavements with thin bituminous surfacing

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CIVILPLAN CONSULTANTS

DESIGN TRAFFIC AND PAVEMENT THICKNESS CALCULATION FOR HEAVILY TRAFFICKED PAVEMENTS AND THIN SURFACING (<40mm)

CHAPTER 7 OF AUSTROADS PT2 (2012)

CLIENT:	SB Civil Ltd	DESIGNER:	SCP	CHECKED:	RJP
PROJECT:	1618 Ararimu Road, Hunua	JOB NO.:	2660	DATE:	23.10.2024
ROAD NAME:	Existing Road life left	DATE:	22.10.2024		

NOTES: Refer to Pavement Impact Assessment

USER INPUTS

Design Period (P) =	3.5	years	Table 7.2 - Typical pavement design periods are: Flexible Pavements = 20-40years, Rigid Pavements = 30-40years
Average Daily Traffic (ADT) =	299.0	veh/day	from 5-day traffic count dated 3.03.2023 to 9.03.2023, provided by TPC
Annual growth rate throughout Design Period (R) =	3.00	% per year	Section 7.4.5
Average percentage of heavy vehicles =	14.70	%HV	average percentage of HVs over the first year - Section 7.4.4
Direction Factor (DF) =	0.50		Proportion of the two-way AADT travelling in the direction of the design lane
Lane Distribution Factor (LDF) =	1.00		Where there are 2 or more lanes in each direction. Table 7.3 - ranges from 0.5-1.0 - conservative is 1.0, i.e. all AADT travels in one lane
Average No. of Axle Groups per Heavy Vehicle, N(HVAG) =	2.40		Refer to Transit NZ supplement to APDG 2004 appendix 7.4
ESA/HVAG	0.60		Refer to Transit NZ supplement to APDG 2004 appendix 7.4
ESA/HV	1.40		Refer to Transit NZ supplement to APDG 2004 appendix 7.4

Damage Index	Value
N_{HVAG}	2.4
ESA / HVAG	0.6
ESA / HV	1.4
SAR_a / ESA	1.0
SAR_s / ESA	1.2
SAR_c / ESA	3.6

DESIGN TRAFFIC CALCULATION

Cumulative Growth Factor = 3.6 Section 7.4.5

Design Traffic, N(DT) = 365 * AADT * DF * (%HV/100) * LDF * CGF * N(HVAG) - Equation 14

Design Traffic, N(DT) = 6.99E+04

N(DT) is applicable for both flexible and rigid pavements, and additional calculations are required to dervie standard axles of loading for flexible pavements (in Section 7.6)

DESIGN EQUIVALENT STANDARD AXLES (DESA) CALCULATION

DESA = N(DT) * ESA/HVAG - Equation 17 = 4.20E+04 DESA Section 7.6.3 - Suitable for use to design unbound granular pavements with thin bituminous surfacings (Figure 8.4)

Use Lightly Trafficked Design!

Figure 8.4 Calculation for DESA >= 1x10^5			
4.20E+04	DESA		
CBR	Thickness of Granular Material (t) (mm)	Min. Thickness of Base Material (Gap 40, TNZ M/4)(mm)	Thickness of GAP 65 (mm)
0.5	740	90	650
1	560	90	470
2	410	90	320
3	340	90	250
4	290	90	200
5	260	90	170
6	230	90	140
7	210	90	120
8	200	90	110
9	180	90	90
10	170	90	80
15	130	90	40
20	110	90	20
30	90	90	0

GUIDE TO PAVEMENT TECHNOLOGY PART 2: PAVEMENT STRUCTURAL DESIGN

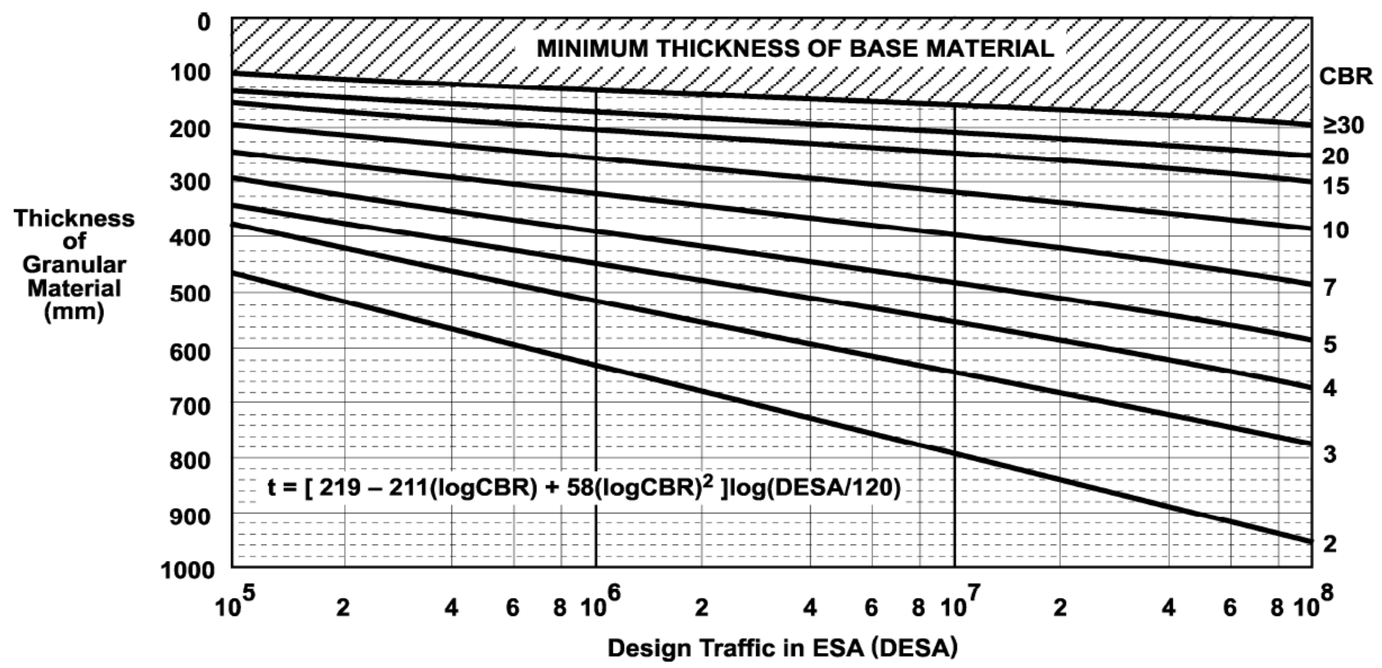

Figure 8.4: Design chart for granular pavements with thin bituminous surfacing

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DESIGN TRAFFIC AND PAVEMENT THICKNESS CALCULATION FOR HEAVILY TRAFFICKED PAVEMENTS AND THIN SURFACING (<40mm)

CHAPTER 7 OF AUSTROADS PT2 (2012)

CLIENT:	SB Civil Ltd	DESIGNER:	SCP	CHECKED:	RJP
PROJECT:	1618 Ararimu Road, Hunua	JOB NO.:	2295	DATE:	23.10.2024
ROAD NAME:	Proposed Road with Trucks	DATE:	22.10.2024		

NOTES: Refer to Pavement Impact Assessment

USER INPUTS

Design Period (P) =	10	years	Table 7.2 - Typical pavement design periods are: Flexible Pavements = 20-40years, Rigid Pavements = 30-40years
Annual Average Daily Traffic (AADT) =	87.0	veh/day	refer to Section 3.1 of TPC report
Annual growth rate throughout Design Period (R) =	0.00	% per year	N/A
Average percentage of heavy vehicles =	100.00	%HV	average percentage of HVs over the first year - Section 7.4.4
Direction Factor (DF) =	0.50		Proportion of the two-way AADT travelling in the direction of the design lane
Lane Distribution Factor (LDF) =	1.00		Where there are 2 or more lanes in each direction. Table 7.3 - ranges from 0.5-1.0 - conservative is 1.0, i.e. all AADT travels in one lane
Average No. of Axle Groups per Heavy Vehicle, N(HVAG) =	2.40		Refer to Transit NZ supplement to APDG 2004 appendix 7.4
ESA/HVAG	1.33		
ESA/HV	3.20		*Loaded ESA/HCV for a 6-wheeler is 2.6 and 3.8 for T&T, Average = 3.2*

Damage Index	Value
N_{HVAG}	2.4
ESA / HVAG	0.6
ESA / HV	1.4
SAR_a / ESA	1.0
SAR_s / ESA	1.2
SAR_c / ESA	3.6

DESIGN TRAFFIC CALCULATION

Cumulative Growth Factor = 10.0 Section 7.4.5

Design Traffic, N(DT) = 365 * AADT * DF * (%HV/100) * LDF * CGF * N(HVAG) - Equation 14

Design Traffic, N(DT) = 3.81E+05

N(DT) is applicable for both flexible and rigid pavements, and additional calculations are required to dervie standard axles of loading for flexible pavements (in Section 7.6)

DESIGN EQUIVALENT STANDARD AXLES (DESA) CALCULATION

DESA = N(DT) * ESA/HVAG - Equation 17 = **5.07E+05 DESA** Section 7.6.3 - Suitable for use to design unbound granular pavements with thin bituminous surfacings (Figure 8.4)

Figure 8.4 Calculation for DESA >= 1x10^5			
5.07E+05	DESA		
CBR	Thickness of Granular Material (t) (mm)	Min. Thickness of Base Material (Gap 40, TNZ M/4)(mm)	Thickness of GAP 65 (mm)
0.5	1050	130	920
1	800	130	670
2	590	130	460
3	480	130	350
4	410	130	280
5	370	130	240
6	330	130	200
7	300	130	170
8	280	130	150
9	260	130	130
10	240	130	110
15	190	130	60
20	160	130	30
30	130	130	0

GUIDE TO PAVEMENT TECHNOLOGY PART 2: PAVEMENT STRUCTURAL DESIGN

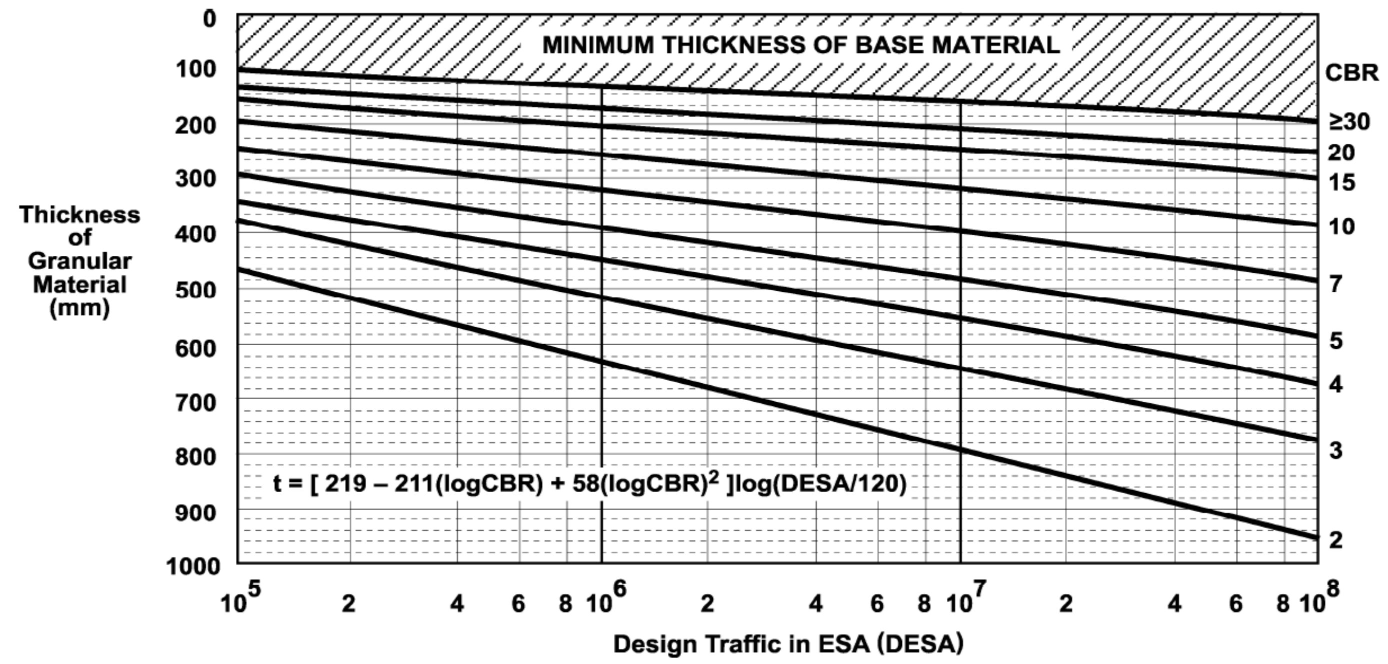

Figure 8.4: Design chart for granular pavements with thin bituminous surfacing

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DESIGN TRAFFIC AND PAVEMENT THICKNESS CALCULATION FOR HEAVILY TRAFFICKED PAVEMENTS AND THIN SURFACING (<40mm)

CHAPTER 7 OF AUSTROADS PT2 (2012)

CLIENT:	SB Civil Ltd	DESIGNER:	SCP	CHECKED:	RJP
PROJECT:	1618 Ararimu Road, Hunua	JOB NO.:	2295	DATE:	23.10.2024
ROAD NAME:	Proposed Road with Trucks - 1 year design pe	DATE:	22.10.2024		

NOTES: Refer to Pavement Impact Assessment

USER INPUTS

Design Period (P) =	1	years	Table 7.2 - Typical pavement design periods are: Flexible Pavements = 20-40years, Rigid Pavements = 30-40years
Annual Average Daily Traffic (AADT) =	87.0	veh/day	refer to Section 3.1 of TPC report
Annual growth rate throughout Design Period (R) =	0.00	% per year	N/A
Average percentage of heavy vehicles =	100.00	%HV	average percentage of HVs over the first year - Section 7.4.4
Direction Factor (DF) =	0.50		Proportion of the two-way AADT travelling in the direction of the design lane
Lane Distribution Factor (LDF) =	1.00		Where there are 2 or more lanes in each direction. Table 7.3 - ranges from 0.5-1.0 - conservative is 1.0, i.e. all AADT travels in one lane
Average No. of Axle Groups per Heavy Vehicle, N(HVAG) =	2.40		Refer to Transit NZ supplement to APDG 2004 appendix 7.4
ESA/HVAG	1.33		
ESA/HV	3.20		*Loaded ESA/HCV for a 6-wheeler is 2.6 and 3.8 for T&T, Average = 3.2*

Damage Index	Value
N_{HVAG}	2.4
ESA / HVAG	0.6
ESA / HV	1.4
SAR_a / ESA	1.0
SAR_s / ESA	1.2
SAR_c / ESA	3.6

DESIGN TRAFFIC CALCULATION

Cumulative Growth Factor = 1.0 Section 7.4.5

Design Traffic, N(DT) = 365 * AADT * DF * (%HV/100) * LDF * CGF * N(HVAG) - Equation 14

Design Traffic, N(DT) = 3.81E+04

N(DT) is applicable for both flexible and rigid pavements, and additional calculations are required to dervie standard axles of loading for flexible pavements (in Section 7.6)

DESIGN EQUIVALENT STANDARD AXLES (DESA) CALCULATION

DESA = N(DT) * ESA/HVAG - Equation 17 = 5.07E+04 DESA Section 7.6.3 - Suitable for use to design unbound granular pavements with thin bituminous surfacings (Figure 8.4)

Use Lightly Trafficked Design!

Figure 8.4 Calculation for DESA >= 1x10^5			
5.07E+04	DESA		
CBR	Thickness of Granular Material (t) (mm)	Min. Thickness of Base Material (Gap 40, TNZ M/4)(mm)	Thickness of GAP 65 (mm)
0.5	760	90	670
1	580	90	490
2	430	90	340
3	350	90	260
4	300	90	210
5	270	90	180
6	240	90	150
7	220	90	130
8	200	90	110
9	190	90	100
10	180	90	90
15	140	90	50
20	120	90	30
30	90	90	0

GUIDE TO PAVEMENT TECHNOLOGY PART 2: PAVEMENT STRUCTURAL DESIGN

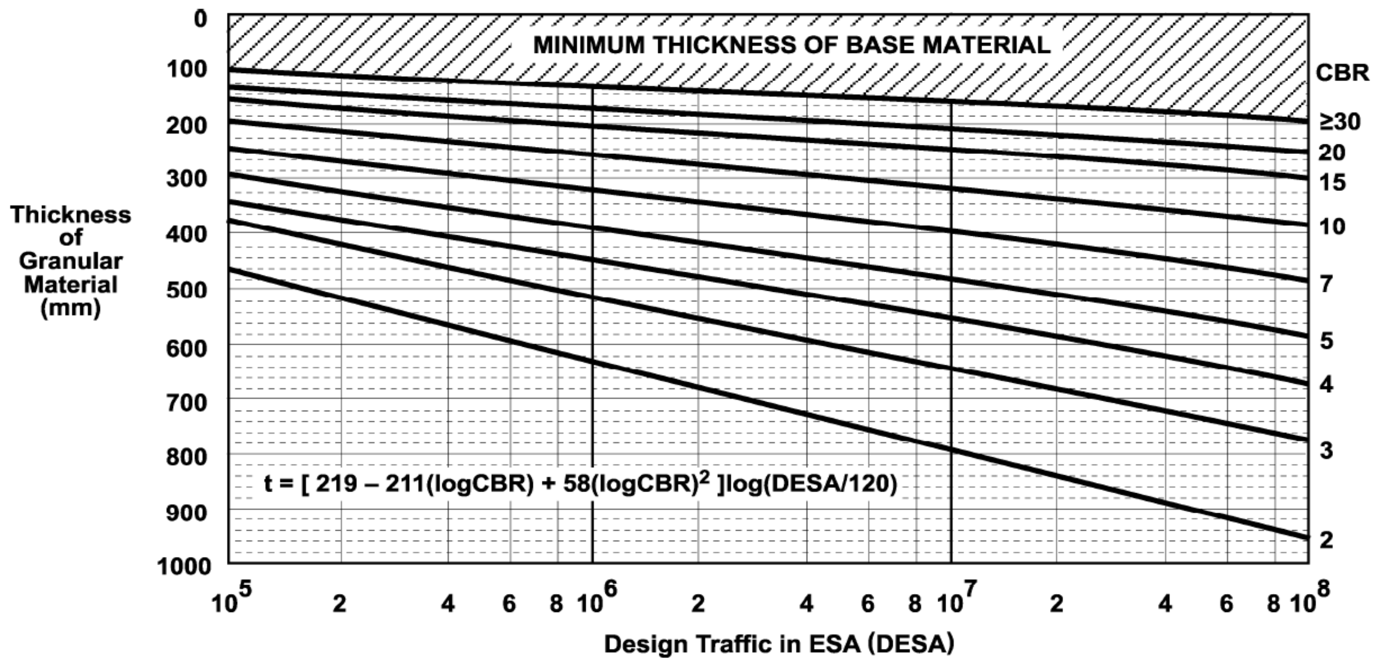

Figure 8.4: Design chart for granular pavements with thin bituminous surfacing

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CIVILPLAN CONSULTANTS

DESIGN TRAFFIC AND PAVEMENT THICKNESS CALCULATION FOR HEAVILY TRAFFICKED PAVEMENTS AND THIN SURFACING (<40mm)

CHAPTER 7 OF AUSTROADS PT2 (2012)

CLIENT:	SB Civil Ltd	DESIGNER:	RJP	CHECKED:	RJP
PROJECT:	1618 Ararimu Road, Hunua	JOB NO.:	2660	DATE:	23.10.2024
ROAD NAME:	AT Pavement rehab adding 25 yrs	DATE:	22.10.2024		

NOTES: Refer to Pavement Impact Assessment

USER INPUTS

Design Period (P) =	28	years	Table 7.2 - Typical pavement design periods are: Flexible Pavements = 20-40years, Rigid Pavements = 30-40years
Average Daily Traffic (ADT) =	299.0	veh/day	from 5-day traffic count dated 3.03.2023 to 9.03.2023, provided by TPC
Annual growth rate throughout Design Period (R) =	3.00	% per year	Section 7.4.5
Average percentage of heavy vehicles =	14.70	%HV	average percentage of HVs over the first year - Section 7.4.4
Direction Factor (DF) =	0.50		Proportion of the two-way AADT travelling in the direction of the design lane
Lane Distribution Factor (LDF) =	1.00		Where there are 2 or more lanes in each direction. Table 7.3 - ranges from 0.5-1.0 - conservative is 1.0, i.e. all AADT travels in one lane
Average No. of Axle Groups per Heavy Vehicle, N(HVAG) =	2.40		Refer to Transit NZ supplement to APDG 2004 appendix 7.4
ESA/HVAG	0.60		Refer to Transit NZ supplement to APDG 2004 appendix 7.4
ESA/HV	1.40		Refer to Transit NZ supplement to APDG 2004 appendix 7.4

Damage Index	Value
N_{HVAG}	2.4
ESA / HVAG	0.6
ESA / HV	1.4
SAR_a / ESA	1.0
SAR_s / ESA	1.2
SAR_c / ESA	3.6

DESIGN TRAFFIC CALCULATION

Cumulative Growth Factor = 42.9 Section 7.4.5

Design Traffic, N(DT) = 365 * AADT * DF * (%HV/100) * LDF * CGF * N(HVAG) - Equation 14

Design Traffic, N(DT) = 8.26E+05

N(DT) is applicable for both flexible and rigid pavements, and additional calculations are required to dervie standard axles of loading for flexible pavements (in Section 7.6)

DESIGN EQUIVALENT STANDARD AXLES (DESA) CALCULATION

DESA = N(DT) * ESA/HVAG - Equation 17 = **4.96E+05 DESA** Section 7.6.3 - Suitable for use to design unbound granular pavements with thin bituminous surfacings (Figure 8.4)

Figure 8.4 Calculation for DESA >= 1x10^5			
4.96E+05	DESA		
CBR	Thickness of Granular Material (t) (mm)	Min. Thickness of Base Material (Gap 40, TNZ M/4)(mm)	Thickness of GAP 65 (mm)
0.5	1050	130	920
1	800	130	670
2	590	130	460
3	480	130	350
4	410	130	280
5	370	130	240
6	330	130	200
7	300	130	170
8	280	130	150
9	260	130	130
10	240	130	110
15	190	130	60
20	160	130	30
30	130	130	0

GUIDE TO PAVEMENT TECHNOLOGY PART 2: PAVEMENT STRUCTURAL DESIGN

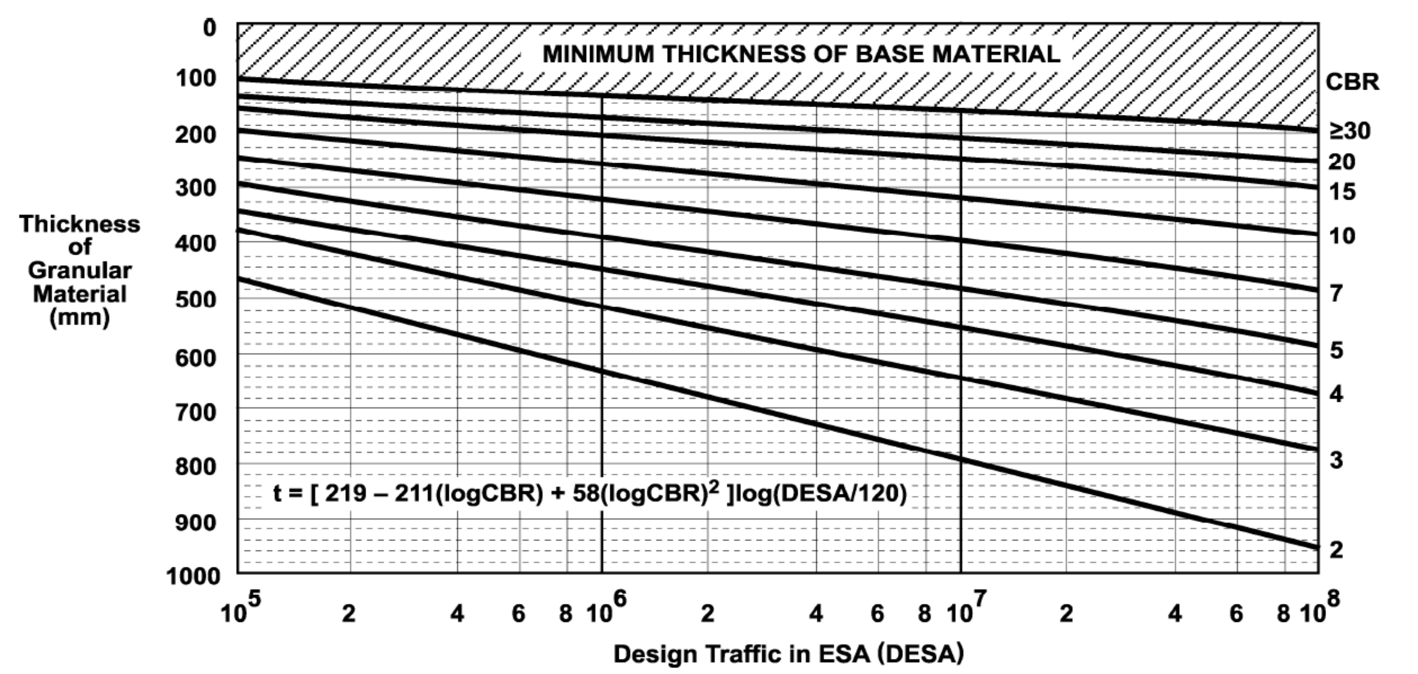

Figure 8.4: Design chart for granular pavements with thin bituminous surfacing

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APPENDIX 2

Auckland Transport Guidance on Pavement Impact Assessments

Purpose of the Report

In reviewing cleanfill and development consents, Auckland Transport is seeking information from the applicant under s92 of the Resource Management Act regarding the potential pavement impact where the development involves significant haulage during the construction or operational phases. This information is used to inform Auckland Transport and Auckland Council on the potential impacts on road safety, maintenance and renewal programme and budgets.

Auckland Transport has a duty in ensuring a safe and efficient network for all users. Where the road pavement is operating beyond its capacity, the condition will rapidly decline and may result in unsafe driving behaviours or a lower operating speed. Unplanned heavy maintenance works and renewals can also result in unnecessary road user disruptions. As such, this Pavement Impact Assessment is relied on to document likely impacts of the development project with respect to:

- Remaining road pavement life
- Additional strengthening needs and its location

This Pavement Impact Assessment will supplement any recommended geometric upgrades identified by Auckland Transport. The Pavement Impact Assessment needs to be undertaken by a suitably qualified and experienced Engineer.

Safety Impacts

Just like a bridge structure, there is a limit to the total number of vehicles a road pavement is designed to carry. Each road asset has a design life prior to initial construction. However, depending on its use and other external factors, the in-service operating life may not be consistent with the initial design life. As such, when a change in loading occurs1, the remaining operational life needs to be assessed and quantified to enable safe and appropriate decisions to be made.

When the road pavement capacity is exceeded (e.g., when the in-service operational life is met), the following failure modes are likely to be observed. The presence of these failures can pose significant risk to safe driving behaviour (for example, attempts to avoid road failures by navigating beyond the traffic lane is considered an unsafe driver behaviour).

Typical pavement failures can include:

- Rutting / pavement deformation
- Potholing
- Cracking
- Pumping (clay/silt fines being brought up to the road surface)

[1] A change in traffic loading is considered a trigger for Pavement Impact Assessment either when the consent related HCV exceeds 10% of the current HCV volume, or if the increase in consent related vehicles results in a substantial or permanent change in the road carriageway's One Network Road Classification (ONRC).

- Shoulder subsidence

Below are some examples of road pavement failures appearing within 6 months from starting a consent development project:

Figure 1: Urban Road Failure on a Housing Development Project

Figure 2: Rural Road Failure on a Cleanfill Project

Zone of Influence

The zone of influence will typically be varied depending on the location of the development site in reference to the nearest connecting arterial or higher classified roads which serve a strategic purpose to the movement of HCV. For the purpose of this assessment, the zone of influence is defined as the lesser of either

- 500m either side of the main entrance, OR
- The entire road

Pavement Impact Assessment Triggers

The need for a Pavement Impact Assessment is triggered either when the expected development related HCV exceeds the current proportion of HCV in the zone of influence by 10% or when the expected development related vehicles result in a substantial or permanent change in the classification of the road carriageway based on the New Zealand national One Network Road Classification (ONRC) system.

An example of a substantial change is a low volume Access or a Secondary Collector Road becoming the equivalent of a Primary Collector or Arterial road when the development works are in progress.

An assessment is needed to understand whether the current pavement structural condition, surface condition, safety condition and geometric condition is able to withstand the impact from the consent activity.

Testing

When undertaking investigative testing, AT do not allow intrusive testing into the pavement unless a commitment has been made to strengthen or upgrade that particular section. Non-intrusive testing such as FWD is preferred over Benkelman Beam.

Typical FWD testing for this type of analysis is set at a frequency of a test point per 20m per lane (staggered).