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Thredbo Sewer Capacity Assessment

**- To inform the Proposed Development of 19 Lot
Residential Subdivision**

Prepared for Kosciuszko Thredbo Pty Ltd



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Table of Contents

Table of Contents	3
Executive Summary	4
1. Introduction	5
2. Site Context	5
2.1 Golf Course Development Proposal	6
3. Thredbo Sewage Treatment System	8
3.1 System Overview	8
3.2 Sewer Network	11
4. Sewer Code Provisions	13
4.1 Sewerage Code of Australia	13
4.2 Capacity Assessment DN150 and DN225 Pipes	13
4.3 Capacity Assessment DN300 Pipe	15
5. Conclusions and Recommendations	16
6. Bibliography/References	17
Appendix A – Subdivision Layout (CLM Civil)	18
Appendix B – Site Plan	19
Appendix C – Sewage Pumping Station Locations	20
Appendix D – Sewer Main Network	21
 <i>FIGURE 1 - LOCALITY PLAN</i>	 5
<i>FIGURE 2 – GOLF COURSE SUBDIVISION - LAYOUT PLAN</i>	6
<i>FIGURE 3 – DIURNAL INFLOWS AT STW – HIGHEST 5 PDWF DAYS</i>	9
<i>FIGURE 4 – THREDBO VILLAGE BED DISTRIBUTION BY ZONE</i>	10
<i>FIGURE 5 – DOWNSTREAM SEWER PIPE ROUTE</i>	11
<i>FIGURE 6 – SEWER CAPACITY – WSAA GRAVITY SEWERAGE CODE OF AUSTRALIA WSA-02</i>	14
 <i>TABLE 1 – PROPOSED SUBDIVISION LOTS AND BED NUMBERS</i>	 7
<i>TABLE 2 - THREDBO VILLAGE SEWAGE TREATMENT SYSTEM – SYSTEM METRICS.</i>	8
<i>TABLE 3 - THREDBO VILLAGE BED NUMBERS DISTRIBUTION.</i>	10
<i>TABLE 4 – DOWNSTREAM PIPE METRICS</i>	12
<i>TABLE 5 – WSAA CODE PROVISIONS</i>	13
<i>TABLE 6 – EQUIVALENT TENEMENTS (ET)</i>	14
<i>TABLE 7 – DEPTH OF PIPE FLOW CALCULATION SUMMARY - DN300 PIPE</i>	15

Executive Summary

Kosciuszko Thredbo Pty Ltd (KT) are the head leasees of Thredbo Alpine Village and associated snow resort lift operations within Kosciuszko National Park, NSW. KT is considering developing a 19 lot residential/tourist accommodation subdivision to provide for an additional 186 beds within the resort. The site is a green field development site on land currently utilised as part of the Thredbo Golf Course. The Golf Course is to be retained in a reconfigured layout.

KT has identified that it requires an assessment of the capacity of the downstream sewerage pipe network infrastructure to assess the impacts of the additional service loading upon that infrastructure. The information from the assessment will inform the proposed development planning.

Robert Staples and Associates (Consulting Engineers and Project Managers) have undertaken an investigative analysis of the downstream sewerage pipe network including an analysis of the impact of the additional proposed development.

The conclusions arising from this analysis are:

1. The evidence both from statutory monitoring reports and by calculation indicates the capacity of the existing sewer pipe network downstream of the proposed Golf Course Development site is compliant with Water Services Association of Australia (WSAA) Code provisions
2. By calculation using factual data and assumptive reasoning the capacity of the sewer pipe network downstream of the proposed Golf Course Development site will remain compliant with WSAA Code provisions post-development ie after the sites have been developed (rounded up to an additional 190 beds) and are placing demand upon the sewer network
3. It is evident that the trunk main servicing the whole of the Thredbo resort leading to the Thredbo Sewage Treatment Works is nearing the WSAA Code compliance limits for Peak Dry Weather Flow (PDWF) under certain operating conditions (ie at minimum scour velocity)
4. Further development beyond the immediately planned growth (ie beyond the additional 190 beds), the subject of this analysis, may result in the need to upgrade the 300mm diameter trunk main in the future.

In line with the above conclusions and findings of this analysis it is recommended that:

1. The existing routine mains cleaning program be continued particularly along the trunk main to ensure network efficiency is maintained.
2. Consideration be given toward establishing a 'Continual Flow Depth Monitoring Point' along the trunk main to provide empirical data to inform any future expansion of development that results in increases on the sewer load within the resort.

1. Introduction

Kosciuszko Thredbo Pty Ltd (KT) are the head leasees of Thredbo Alpine Village and associated snow resort lift operations within Kosciuszko National Park, NSW. KT is considering developing a 19 lot residential/tourist accommodation subdivision to provide for an additional 186 beds within the resort. The site is a green field development site on land currently utilised as part of the Thredbo Golf Course. The Golf Course is to be retained in a reconfigured layout.

Robert Staples and Associates (Consulting Engineers and Project Managers) (RSA) jointly with CLM Civil has been engaged to assist with the infrastructure planning and preliminary civil designs as part of the planning and investigation phase of the project. KT has identified that it requires an assessment of the capacity of the downstream sewerage pipe network infrastructure to assess the impacts of the additional service loading upon that infrastructure. The information from the assessment will inform the proposed development planning. It is noted this assessment does not include asset condition assessment nor capacity assessment of the downstream sewage treatment facilities. This report presents the findings of the investigation and assessment.

2. Site Context

The proposed subdivision development site is located on the existing Thredbo Golf Course within Lot 876 DP 1243112 being part of the head lease area of Thredbo village. It is within the Kosciuszko National Park. The locality of the development site and its relationship to the existing built areas of Thredbo Village is shown in **Figure 1** below.

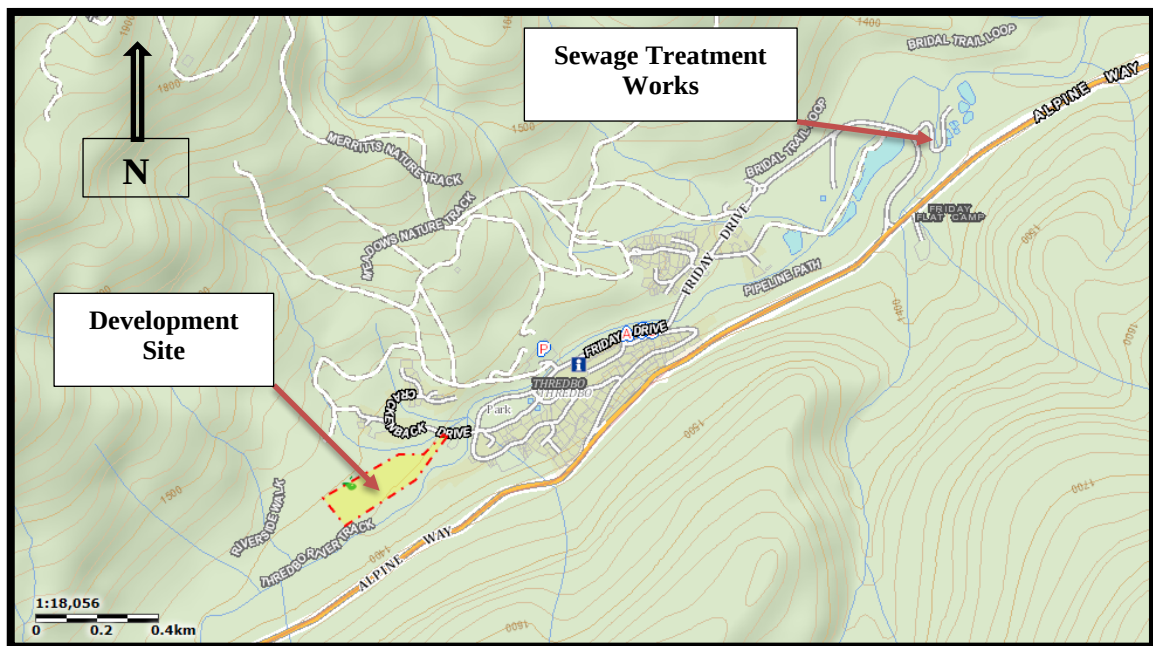


Figure 1 - Locality Plan

The development site is at the western extremity of Thredbo Village. Development in Thredbo has occurred either side of the Thredbo River which flows from the southwest to northeast through the village. With reference to **Figure 1** the development site to the west adjoins the Thredbo River upstream of the village. The river flows through the village with a relatively constant grade toward the northeast. The sewage treatment works shown to the right of the figure adjoins the Thredbo River downstream of the village.

2.1 Golf Course Development Proposal

The proposed subdivision layout is reproduced below in **Figure 2**. The proposal includes 19 fully serviced development lots plus access road and additional resort parking. Refer to **Appendix A** for the engineering plan of the subdivision.

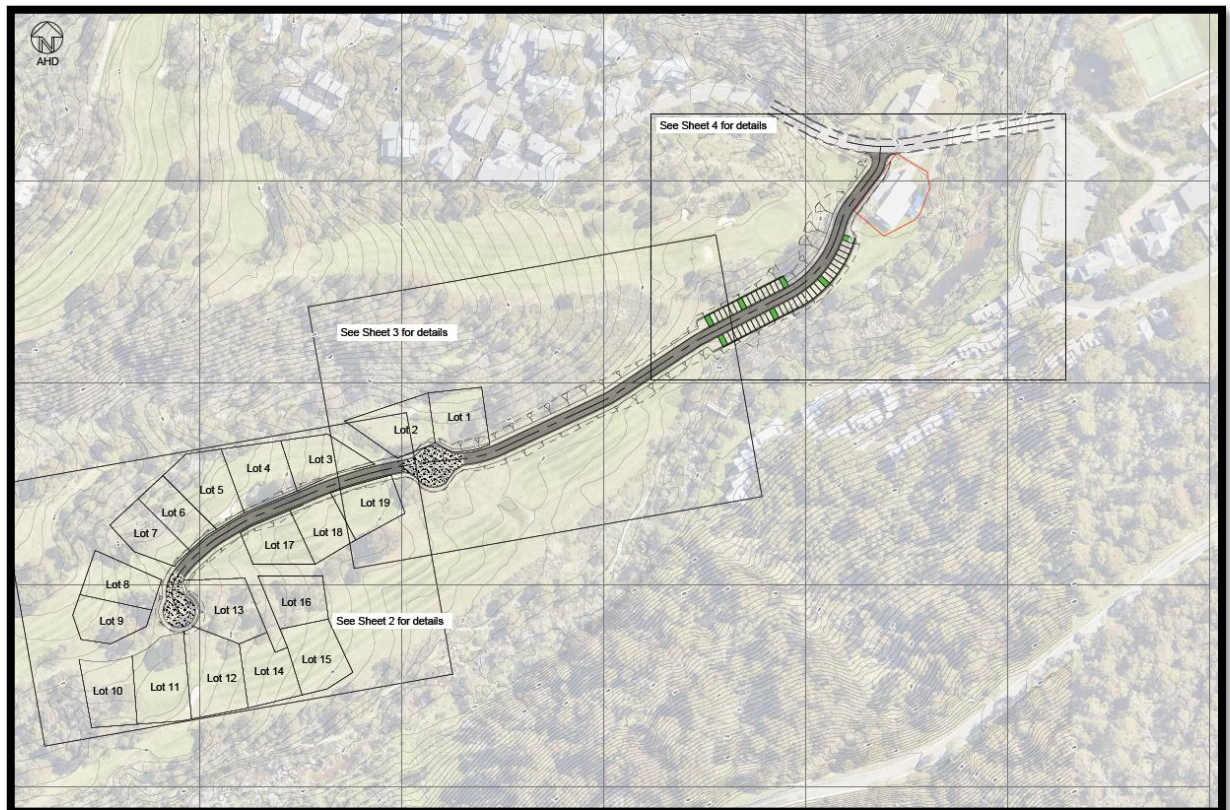


Figure 2 – Golf Course Subdivision - Layout Plan

Source: CLM Civil Concept Drawings

Details of the lot areas and proposed bed numbers are presented in **Table 1** below. The estimated number of 186 additional resort beds as presented in the table may be subject to some minor variation in the final proposed bed numbers. For the purpose of this assessment it has been rounded up to 190 beds.

The development proposal includes provision for services including water supply, sewerage connection, stormwater drainage, asphalt sealed roads, kerb and gutter, gas, electricity, communications, additional resort parking plus road design that includes turning provision for service vehicles and rural fire service vehicles.

With specific reference to sewerage connectivity this will be via a gravity sewer network leading to the sewage treatment plant some 2km northeast of the development site. New sewerage reticulation will be constructed to service the newly created lots and this new pipework will connect to an existing sewer maintenance hole in Crackenback Drive (identified in the KT asset management system as SMH0113). The impact of the proposed development on sewer capacity is discussed later in this report.

Reference is given to **Appendix B** which shows the architectural layout including the proposed bed numbers applicable to each development lot. **Table 1** below is a summary of the proposed lots and bed number allocations for each lot. It is noted the table shows an additional 186 beds to be allocated. For the purpose of this analysis the number of beds has been rounded up to 190 beds to allow for any subsequent design variations as the proposal evolves.

Lot	Lot Area m²	Estimated Beds
1	783	12
2	812	12
3	710	8
4	858	12
5	903	10
6	612	6
7	637	6
8	701	8
9	640	8
10	802	12
11	1061	10
12	1093	12
13	899	16
14	759	10
15	836	12
16	678	8
17	644	14
18	632	6
19	689	6
Total	14749	186

Table 1 – Proposed Subdivision Lots and Bed Numbers

3. Thredbo Sewage Treatment System

3.1 System Overview

KT has responsibility for operation and management of the municipal sewerage system servicing the Thredbo Village. The 'Thredbo Sewage Treatment System' operates under Environment Protection Licence #1599 (Section 55, Protection of the Environment Operations Act 1997). The annual reporting period is from 1 March to end February.

For the purposes of this report KT provided a copy of the Annual System Performance Report as provided to the Environmental regulator for the reporting period 1 March 2021 to 28 February 2022. Relevant extracts from the report are presented below in **Table 2** together with additional relevant operating performance information provided by KT to provide an overview of the system metrics.

Item	Details
License Conditions	Environment Protection Licence #1599
Sewage Treatment Works	Discharges appx. 184 ML per annum.
Peak Daily Discharge (DWF)	1,610 kl (licence volume/mass limit)
Peak Annual Discharge	>219ML and up to 1000ML (licence volume limit)
STP By Passes recorded	Zero wet or dry weather bypasses recorded during the past 5 years
Network overflows and by-passes	11 dry weather overflows (sewer chokes) and zero wet weather overflows recorded during past 5 years
Total Annual Rainfall	2276.3mm for reporting period
System Parameters	
Average Dry Weather Flow	ADWF = 17.1 L/s (calculated)
Peak Dry Weather Flow	PDWF = 27.89 L/s measured inflow STW
Peak Wet Weather Flow	PWWF = 52.99 L/s (calculated from measured flows – multiplier 1.9)
Total Existing Bed Numbers	4364 (1247 ET)
Total estimated Day Visitors	3000 persons (375 ET)
Current Peak Design Loading	1622 ET (calculated)
System Components	
SPS 1	Friday Flat
SPS 2	Snowmaking Shed
SPS 3	Woodridge Stage 3
SPS 4	Merrits Ski Patrol Building
SPS 5	Merrits Restaurant
SPS 6	Eagles Nest Restaurant
Reticulation pipe work	10.52 km of pipe plus 192 manholes
Sewage Characteristics	Domestic only. No industrial discharge.
Treatment level	Full tertiary treatment including pressure media filtration and UV disinfection.

Table 2 - Thredbo Village Sewage Treatment System – system metrics.

Figure 3 below is a graph of the diurnal flows for each of the 5 peak dry weather flow days within the last 4 years. This shows consistent peak flows around 8:30am – 9:00 am in the morning and 5:30pm to 6pm in the evening. These flows are recorded via the calibrated inflow meter at the Sewage Treatment Works as required under the license.

The highest peak flow rate of 27.89 litres per second was recorded at 5:30pm on 10 August 2022. This value has been used for the purposes of this analysis.

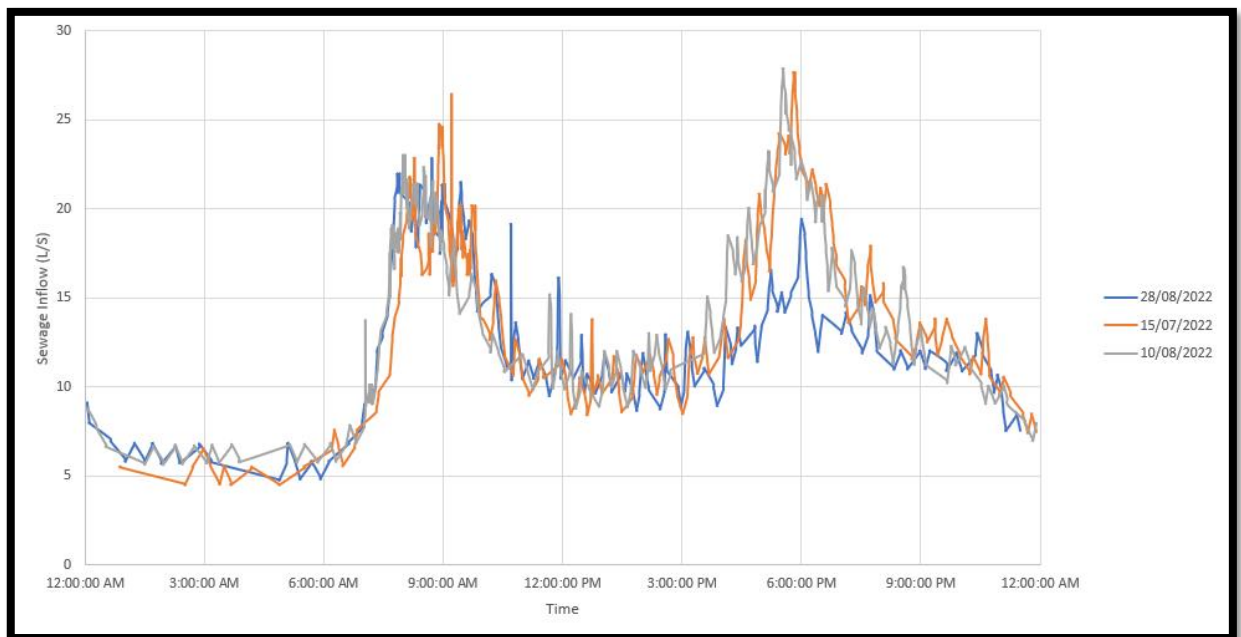


Figure 3 – Diurnal Inflows at STW – Highest 5 PDWF Days

Source: Kosciuszko Thredbo Pty Ltd operational flow monitoring data

The bulk of the Thredbo Sewer Network is serviced by a network of gravity discharge sewers with a gravity trunk main discharging to the sewage treatment works. There are 6 sewage pumping stations (SPS) servicing outlying areas with catchments described as follows:

- Friday Flat SPS – Catchment of Friday Flat Buildings and Gunbarrel
- Snowmaking SPS – Catchment of village lunchroom and snowmaking pumphouse
- Leisure Centre SPS – Catchment of Leisure Centre and Woodridge stage 3.
- Merritts Ski Patrol Building – catchment of ski patrol building only
- Merritts Restaurant – catchment of Merritts Restaurant plus ski patrol building.
- Eagles Nest SPS – Catchment of Eagles Nest restaurant & toilets

Refer to **Appendix C** for a plan showing the pumping station locations.

Below is the distribution of beds throughout the resort allocated by Village precincts (Source: KT). **Table 3** and **Figure 4** refer.

<u>Summary</u>	
Group	Beds
Zone 03: Thredbo - Woodridge 3	175
Zone 05: Thredbo - Woodridge	566
Zone 07: Thredbo - Inner Village	1196
Zone 09: Thredbo - Riverside Cabins	144
Zone 11: Thredbo - Crackenback Ridge	336
Zone 6A: Thredbo - Village Centre	549
Zone 8A: Thredbo - Outer Eastern Precinct	639
Zone 8B: Thredbo - Outer Western Precinct	759
Total Beds :	4364

Table 3 - Thredbo Village Bed Numbers Distribution.

Source: Kosciuszko Thredbo Pty Ltd operational data

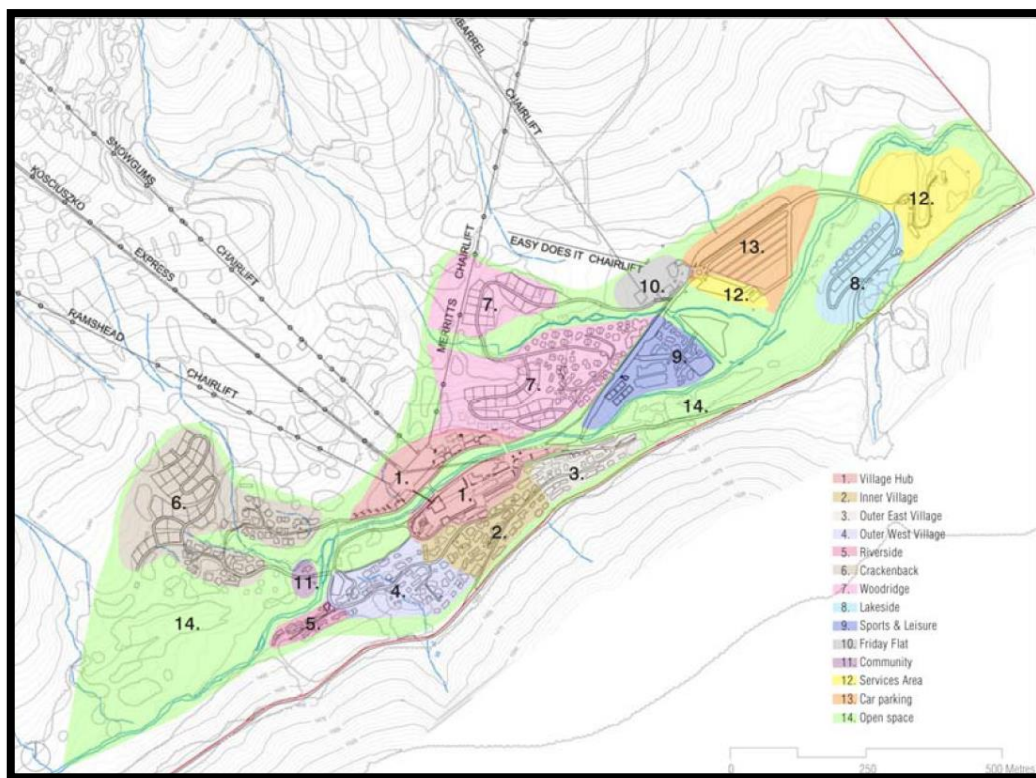


Figure 4 – Thredbo Village Bed Distribution by Zone

Source: Kosciuszko Thredbo Pty Ltd operational data

3.2 Sewer Network

The overall gravity sewer network is presented at **Appendix D**. This analysis is concerned with the downstream sewer network from the point of connection to the Sewage Treatment Works (STW).

At **Figure 5** below the route of the gravity sewer from the proposed development site is shown highlighted in yellow.

The proposed subdivision will be serviced by a gravity sewer system comprising 150mm diameter sewer pipes and associated maintenance access structures (SMH). The WSAA Code stipulates a minimum 150mm diameter reticulation main for municipal infrastructure. This new pipe network will connect to the existing sewer network at SMH0113 (Asset Register reference) located in Crackenback Drive west of the Thredbo River bridge crossing on Crackenback Drive. The upper catchment for this SMH is the Crackenback Ridge development area.

This pipe network then flows downstream, crossing the Thredbo River in a pipe underslung to the road bridge superstructure. The main then runs partly along Friday Drive and then through the Village Green and back to Friday Drive past the Thredbo Alpine Hotel to SMH 0037. This SMH is on the river side of Friday Drive opposite the Visitor Centre car park area. Total length of downstream 150mm diameter pipe is 565m between SMH 0113 to SMH 0037. It is noted that SMH 0037 is also the receiving SMH for sewage from the Village Central catchment.

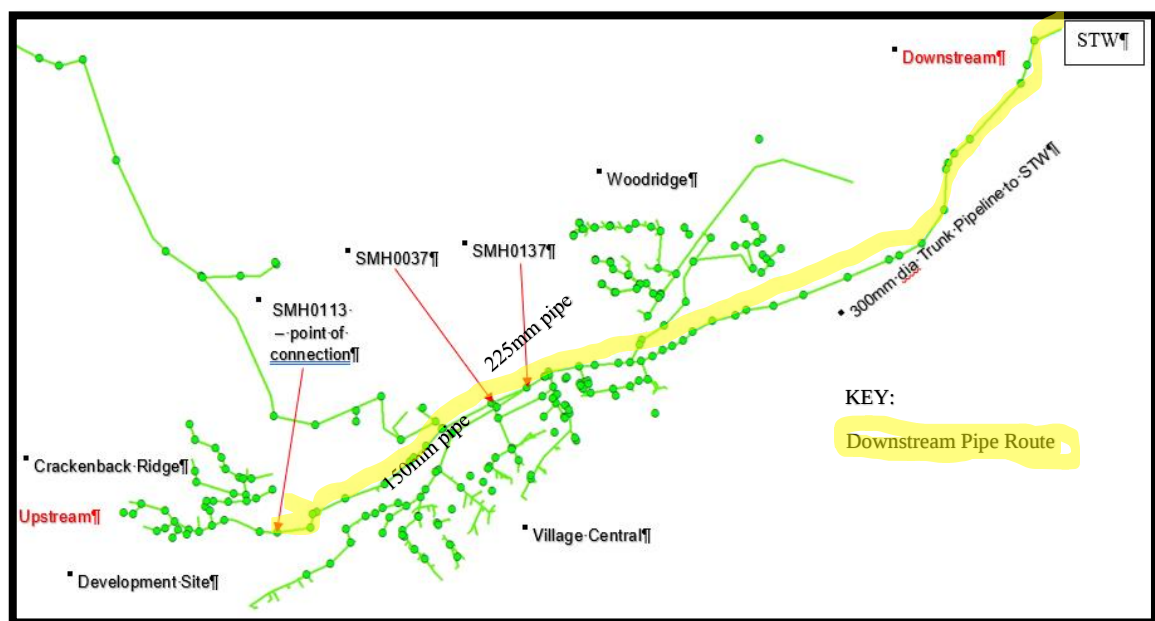


Figure 5 – Downstream Sewer Pipe Route

From SMH 0037 the pipe enlarges to a relatively short section of 225mm diameter pipe (91.3m) to accommodate the additional flow from Village Central and the terminal area. This 225mm diameter pipe flows downstream to SMH 0137.

This downstream SMH 0137 is also the receiving SMH for flows from the Village West precinct (Thredbo Alpine and west) which comprises the original 300mm diameter trunk main spine through the village. From SMH 0137 the combined flows then continue in a 300mm diameter trunk main right through to the Sewage Treatment Works. Along the way this pipeline receives additional flow inputs from the Village East Catchment, Woodridge and other service catchments within the village. The total length of this 300mm diameter pipeline is 1.4km.

In summary the metrics for the downstream gravity sewer from the point of connection in Crackenback Drive to the discharge point at the STW are presented in **Table 4** below.

Description U/Stream to D/Stream	Pipe Size mm	Material	Length m	Minimum slope m/m
SMH0113 to SMH0037	150	PVC / AC	565	0.01
SMH0037 to SMH0137	225	RC	91.3	0.005
SMH0137 to SMH0258 at STW	300	AC/RC	1400	0.005

Table 4 – Downstream Pipe Metrics

Source: Kosciuszko Thredbo Pty Ltd asset data

4. Sewer Code Provisions

4.1 Sewerage Code of Australia

For the purpose of determining whether or not the downstream sewer has sufficient capacity to carry the existing sewer load plus that of the proposed development the relevant Code provisions need to be referenced.

The Gravity Sewerage Code of Australia (WSA02-Third Edition 2014 – Water Services Association of Australia) is the relevant guide. The following extracts from section 5.5 (p97) of the Code are of relevance to the analysis.

Section / Clause	Requirements
5.5 Pipe Sizing and Grading	
4.5.1	...Sizing of pipes shall provide for sewer ventilation by ensuring a suitable air space exists in the pipe at either peak dry weather flow (PDWF) or at design flow (Refer to Clause 5.5.3)
5.5.3 Minimum air space for ventilation	Air space at PDWF, the depth of flow shall be not more than 60% of the pipe internal diameter ie a minimum air space equivalent to 40% of pipe internal diameter at PDWF

Table 5 – WSAA Code provisions

Source: WSAA Gravity Sewerage Code WSA02-2014

4.2 Capacity Assessment DN150 and DN225 Pipes

The WSAA Code provides specific guidance to determine capacity of small diameter sewer pipes. Specifically 150mm diameter pipes and 225 mm diameter pipes.

Figure 6 provides an extract from the WSAA Code showing the requirements for DN150 and DN225 pipes for various gradients and also various localities. It is noted from this that groundwater and stormwater infiltration have been taken into consideration in the derivation of the table.

Rainfall intensities are part of the consideration and an assessment from the Bureau of Meteorology website (BOM) indicates Thredbo and Canberra have similar rainfall intensity characteristics for the 1hr duration 2 Year Average Recurrence Interval storm. This The calculation for Canberra (circled in red in the table) has been adopted for the purpose of the determination.

From the table it is shown the maximum number of ET for a DN150 pipe with a grade of 1 in 100 is 204 ET. Similarly the maximum number of ET for a DN225 pipe with a grade of 1 in 200 is 487 ET.

MAXIMUM CAPACITIES FOR GRAVITY SEWERS FOR VARIOUS LOCATIONS

To determine the maximum ET at locations other than those listed, determine the relevant $I_{1.2}$ and interpolate between the intensities given for the known locations.

			Darwin	Cairns	Gold Coast	Broome	Brisbane	Sydney	Gosford	Port Hedland	Newcastle	Dubbo	Canberra	Salice Springs	Perth	Ballarat	Melbourne	Geelong	Adelaide	Wyalilla	Hobart
	$I_{1.2}$	mm/h	60.2	59.5	50.6	47.0	46.7	40.5	37.3	35.3	34.5	25.9	21.4	20.9	20.5	19.1	18.4	17.4	16.5	14.5	13.9
	Grade		Maximum No. of Equivalent Tenements																		
DN 150	1 in 175	0.57%			71	76	77	87	93	98	100	126	146	148	150	158	162	169	175	190	195
	1 in 150	0.67%	67	67	78	84	84	95	102	107	110	138	160	163	165	174	178	185	192	209	215
	1 in 125	0.80%	74	75	87	93	94	106	114	120	122	154	176	182	184	194	199	207	214	233	240
	1 in 100	1.00%	85	86	99	106	107	121	130	137	139	171	204	208	211	222	228	237	245	267	275
	1 in 80	1.25%	96	98	113	121	122	139	149	156	159	201	233	237	241	253	260	271	281	306	314
	1 in 60	1.67%	114	115	134	144	145	164	177	185	189	239	277	282	286	301	309	322	334	364	374
DN 225	1 in 300	0.33%										330	383	389	395	416	427	445	461	503	517
	1 in 250	0.40%			176	206	220	221	252	271	284	368	426	434	440	464	477	496	515	561	577
	1 in 200	0.50%			199	201	234	251	252	287	309	324	330	411	487	496	503	530	544	566	588
	1 in 150	0.67%	235	238	277	297	299	340	366	384	391	497	527	588	596	628	645	672	697	761	782
	1 in 125	0.80%	262	265	308	330	332	378	407	427	436	554	643	654	664	700	719	748	776	847	871
	1 in 100	1.00%	298	301	351	376	379	431	464	487	496	631	733	746	757	798	820	853	888	966	993
	1 in 80	1.25%	339	343	400	429	431	491	528	555	566	719	836	851	863	910	935	973	1010	1102	1133
	1 in 60	1.67%	401	406	473	507	510	581	625	656	669	851	989	1007	1021	1076	1106	1151	1195	1304	1341

NOTES:

- For the latest 1 h rainfall intensity at the location, or an average recurrence interval of 2 years $I_{1.2}$ refer to the Bureau of Meteorology at <http://www.bom.gov.au/hydro/has/odirwebx/odirwebx.shtml>. Coordinates for particular locations for use in the Bureau of Meteorology's site may be found at <http://www.ga.gov.au/place-name/>.
- For design assumptions, other than those specified in Clause 5.5.5.2, refer to Sewer Pipe Sizing Calculator.

Figure 6 – Sewer Capacity – WSAA Gravity Sewerage Code of Australia WSA-02

Presented below in **Table 6** is the determination of the ET for the relevant catchments. Included in the table are the existing bed number allocations as referred to by catchment in Section 3.1 of this report. It is noted that provision has also been made in the catchment assessment for the additional 190 beds as part of the proposed Golf Course subdivision development.

Description	Sewer Catchment Map Zone		SMH0113 - SMH0037	ET	SMH0037 - SMH0137	ET
			150 dia pipe	ET=Bed/3.5	225 dia pipe	ET=Bed/3.5
Zone 03: Thredbo - Woodridge 3	7	175		0		0
Zone 05: Thredbo - Woodridge	7	566		0		0
Zone 07: Thredbo - Inner Village	2	1196		0		0
Zone 09: Thredbo - Riverside Cabins	5	144		0		0
Zone 11: Thredbo - Crackenback Ridge	6	336	336	112	336	112
Zone 6A: Thredbo - Village Centre	2	549		0	549	183
Zone 8A: Thredbo - Outer Eastern Precinct	3	639		0		0
Zone 8B: Thredbo - Outer Western Precinct	4	759		0		0
Golf Course Subdivision			190	63	190	63
Totals		4364	526	175	1075	358

Table 6 – Equivalent Tenements (ET)

Comparing **Figure 5** Code provisions with **Table 6** calculations:

DN150 – a total load of 175 ET is predicted compared to the Code maximum of 204 ET
 DN225 – a total load of 358 ET is predicted compared to the Code maximum of 487 ET.

4.3 Capacity Assessment DN300 Pipe

The WSAA Code provisions pertaining to the capacity of DN300 and above pipes have been presented earlier at section 4.1 and it is also noted that a minimum scour velocity of 0.7 m/s is a design criteria for sewer pipes.

The code requirement is that the depth of flow in the pipe at Peak Dry Weather Flow (PDWF) must not exceed 60% of the internal diameter of the pipe. **Table 7** below provides comparative detail for different flow velocities. The table shows the situation for 'Existing Flows PDWF Conditions' and compares this with 'Post-development Flows PDWF Conditions'. This allows us to compare the impact of the additional sewer flow resultant from the proposed development.

Estimated Flow increase from New Development per bed								
Existing								
Beds	4364							
PDWF rate recorded L/s	27.89	Note: This includes day visitors and ground water infiltration under existing conditions						
PDWF rate per bed L/s	0.006391							
Post Development								
Additional Beds	190							
Additional Flow L/s	1.21							
Total Combined Flow Rate	29.10	Note: This includes provision for day visitors and ground water infiltration						
		Pipe Dia mm	Velocity m/s	Flow Rate Q L/s	Depth of Flow d mm	Ratio d/D percentage	Code Permissible	Outcome
Existing Flows PDWF Conditions								
Minimum Scour Velocity		300	0.7	27.89	165	55%	60%	Compliant
		300	1	27.89	125	42%	60%	Compliant
		300	1.5	27.89	92	31%	60%	Compliant
		300	2	27.89	76	25%	60%	Compliant
Post-development Flows PDWF Conditions								
Minimum Scour Velocity		300	0.7	29.1	171	57%	60%	Compliant
		300	1	29.1	129	43%	60%	Compliant
		300	1.5	29.1	95.8	32%	60%	Compliant
		300	2	29.1	77.8	26%	60%	Compliant

Table 7 – Depth of Pipe Flow Calculation Summary - DN300 Pipe

There are some key points with the calculation presented in the table. The PDWF used is the actual measured peak inflow at the Sewage Treatment Works. This measure includes the underlying ground water infiltration (GWI) applicable to the system and therefore is a useful basis for determining design flows.

Further at the time of measurement of this PDWF (August 2022) there was peak occupancy in the village as well as day visitation. Thus a calculation based upon peak visitation and PDWF parameters enables the determination of a design flow per bed. This has then been extrapolated to allow for the additional flow resultant from the additional 190 beds.

The outcomes in the table relate to the depth of flow and the need for that flow to be no greater than 60% of pipe diameter. The table analysis indicates compliance in all scenarios, ie the DN300 pipe is suitable for current and predicted flows arising from the proposed development.

5. Conclusions and Recommendations

The conclusions arising from this analysis are:

1. The evidence both from statutory monitoring reports and by calculation indicates the capacity of the existing sewer pipe network downstream of the proposed Golf Course Development site is compliant with Water Services Association of Australia (WSAA) Code provisions
2. By calculation using factual data and assumptive reasoning the capacity of the sewer pipe network downstream of the proposed Golf Course Development site will remain compliant with WSAA Code provisions post-development ie after the sites have been developed (rounded up to an additional 190 beds) and are placing demand upon the sewer network
3. It is evident that the trunk main servicing the whole of the Thredbo resort leading to the Thredbo Sewage Treatment Works is nearing the WSAA Code compliance limits for Peak Dry Weather Flow (PDWF) under certain operating conditions (ie at minimum scour velocity)
4. Further development beyond the immediately planned growth (ie beyond the additional 190 beds), the subject of this analysis, may result in the need to upgrade the 300mm diameter trunk main in the future.

In line with the above conclusions and findings of this analysis it is recommended that:

1. The existing routine mains cleaning program be continued particularly along the trunk main to ensure network efficiency is maintained.
2. Consideration be given toward establishing a 'Continual Flow Depth Monitoring Point' along the trunk main to provide empirical data to inform any future expansion of development that results in increases on the sewer load within the resort.

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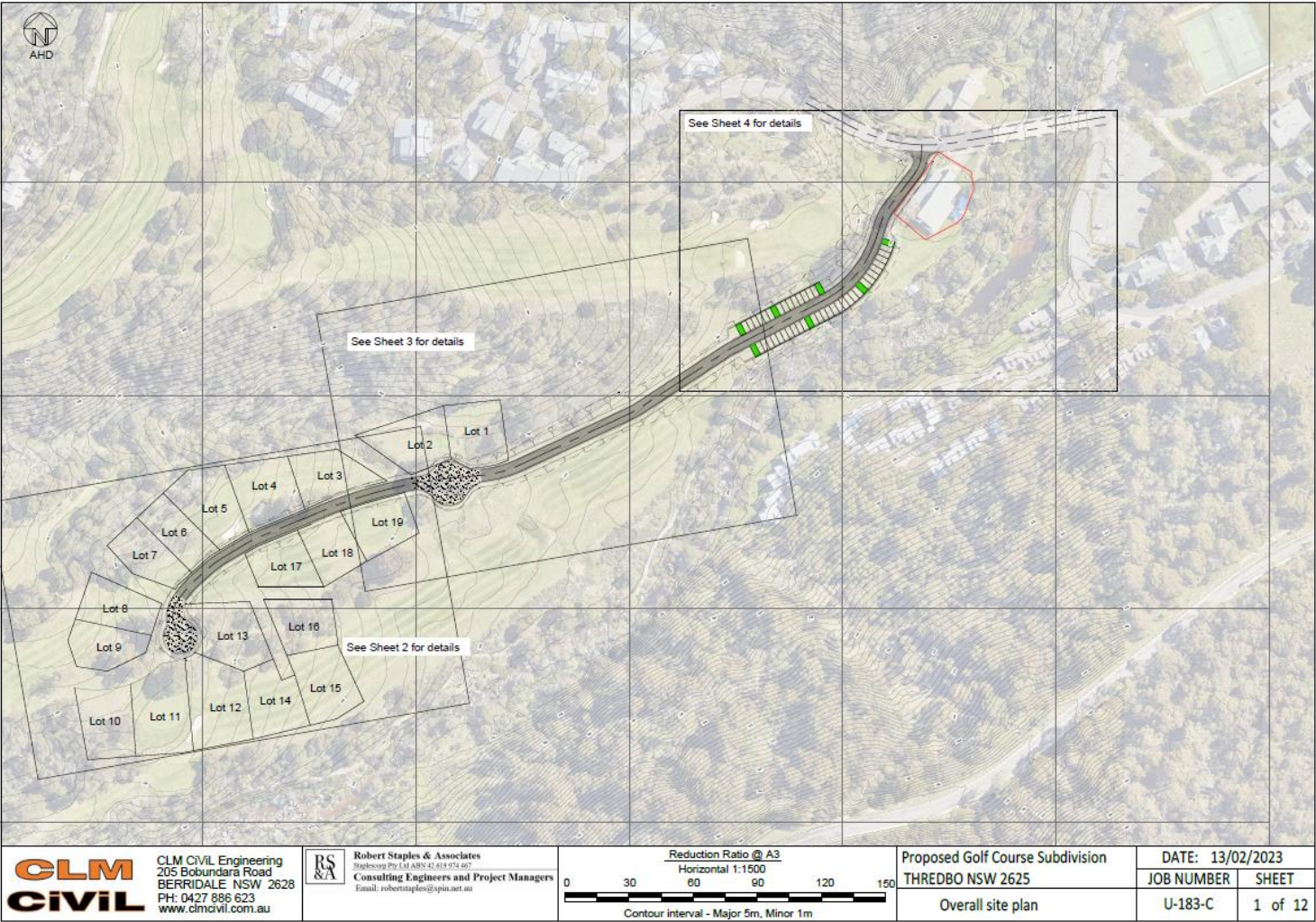
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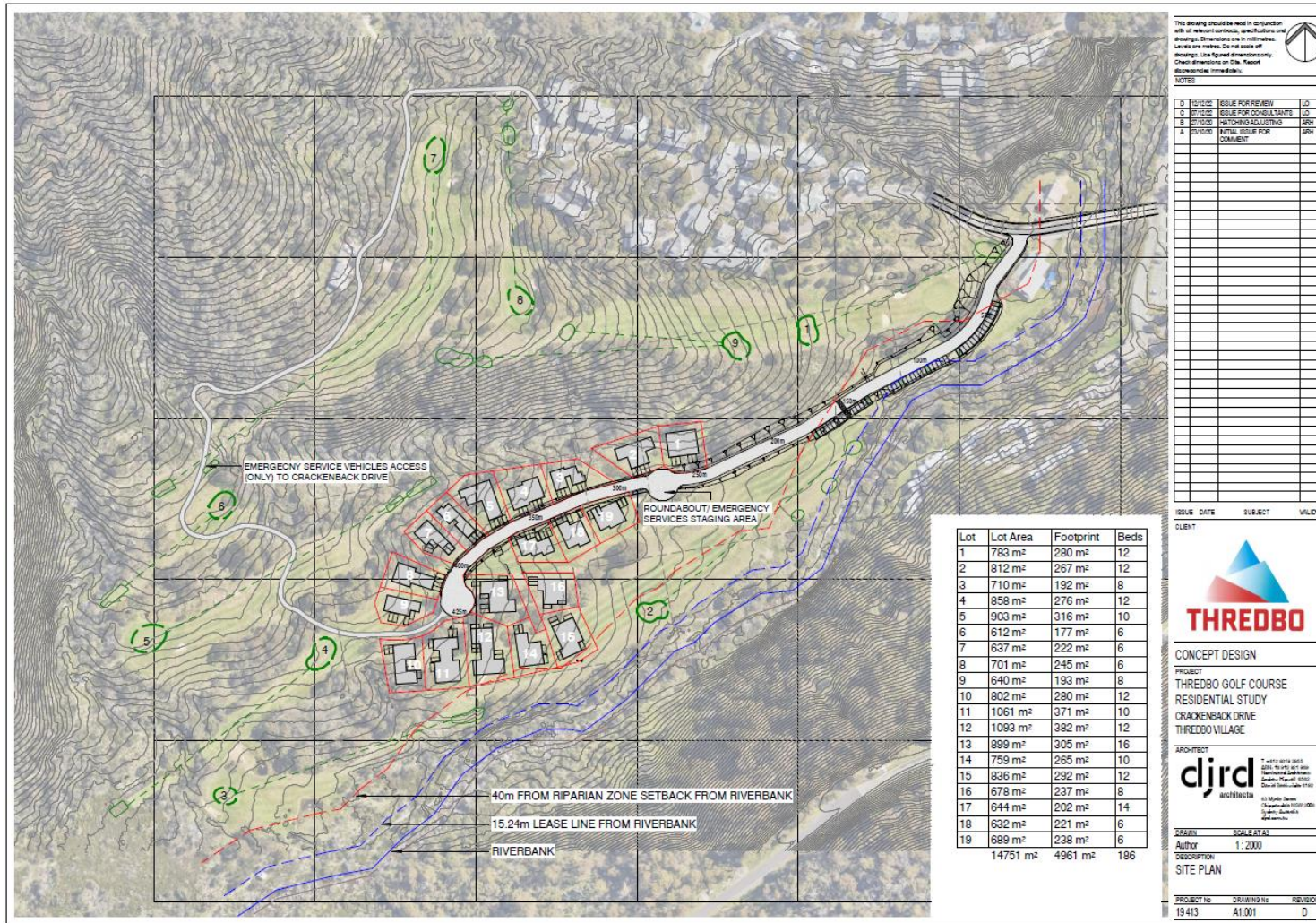
Water Services Association of Australia, *WSA 02 - Gravity Sewerage Code of Australia* (3rd Edition 2014 Version 3.1)

Appendix A – Subdivision Layout (CLM Civil)



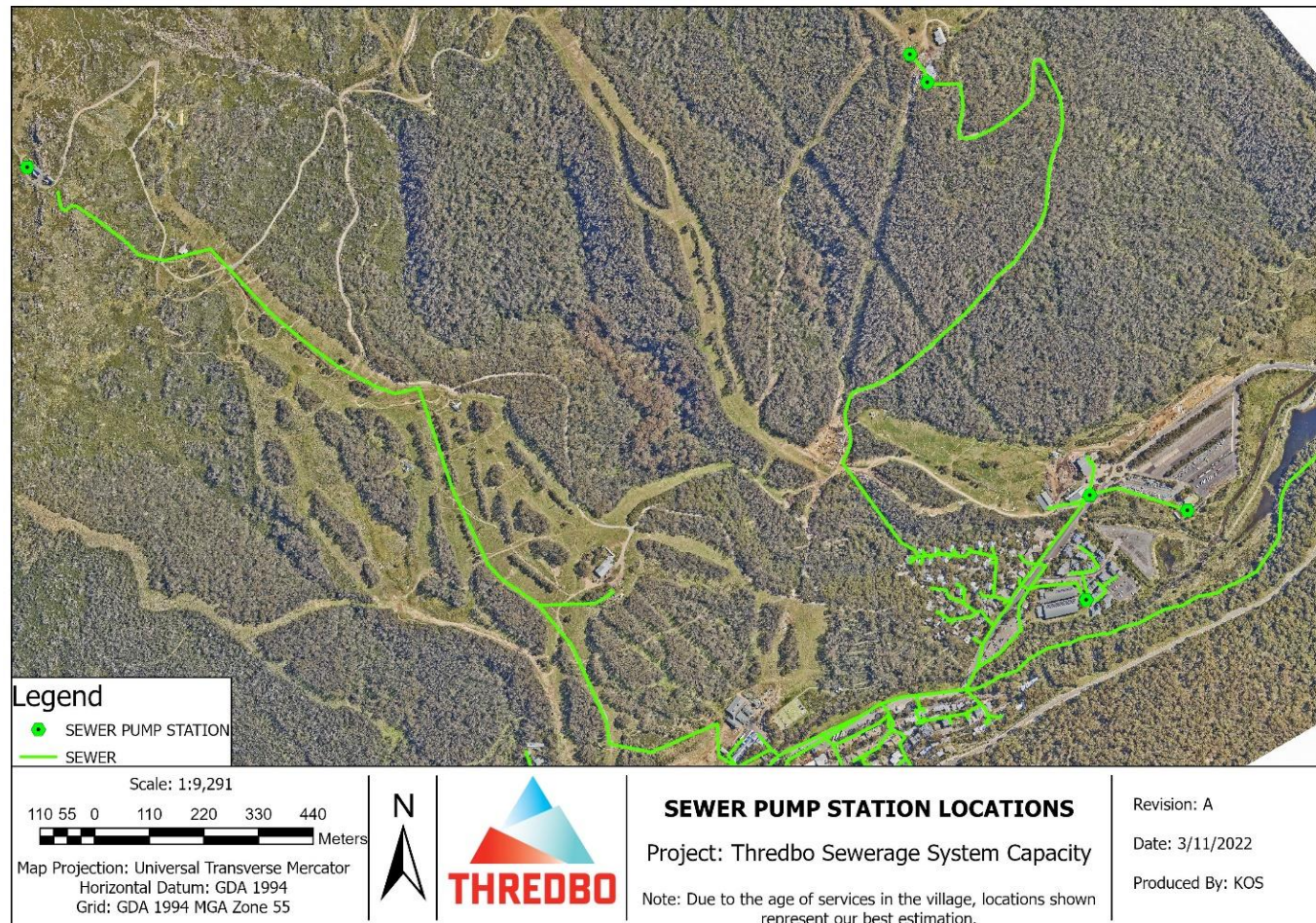
Appendix B – Site Plan

Source: Kosciuszko Thredbo Pty Ltd



Appendix C – Sewage Pumping Station Locations

Source: Kosciuszko Thredbo Pty Ltd



Appendix D – Sewer Main Network

Source: Kosciuszko Thredbo Pty Ltd – GIS Sewer Assets (Modified by RSA)

