Remarkables Ski Area Doolans Expansion – Electric Power Concept Report

Prepared for:
NZSki Limited

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Prepared by:
Stantec New Zealand

Project/File:
310104671

Stantec New Zealand

Revision Schedule

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Prepared by: [redacted]

Reviewed by:

Approved by:

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Executive Summary

This report covers the Electrical works associated with the proposed expansion of the Remarkables Ski Area into Doolans Basin.

The approach recommended is to upgrade the existing overhead line to 33kV and establish a 33/11kV substation on site.

The power system capacity proposed is 7.5MVA which will permit operation of the existing and proposed new facilities, provide a margin for future load increases, plus relieving the constraints on snow making that presently exist.

Power to the Doolans Basin, from the existing Remarkables Base Building facilities, will be by buried cable along the infield access trails, with a backup supply available from an extension of the existing supply to the top of the Curvey Basin chairlift.

The new substation will incorporate the Ski Field emergency diesel generation with 3 x 550kVA generators conceived for the ultimate development. A concept substation layout is included in Appendix A.

Code of Conduct

The author of this report is Robin Spittle. I am a Technical Director with specific expertise in electrical power engineering.

I hold a Bachelor of Engineering (Electrical and Electronic) from the University of Canterbury, May 1984 and have over 40 years' experience in the electrical power sector.

I confirm that I have read the Code of Conduct for expert witnesses contained in the Environment Court Practice Note 2023. This report has been prepared in compliance with that Code, as if it was expert evidence presented in proceedings before the Environment Court. Unless I state otherwise, this report is within my area of expertise, and I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed in this report.

1 Background

NZSki are applying for a Fast Track consent for an extension of the Remarkables Ski Area into the adjacent Doolans Basin.

The proposed development will include:

- Expansion of the existing Remarkables Base Building facilities in the Rastus Burn catchment. This will involve effectively doubling the size of the existing Remarkables Base Building.
- Construction of a new gondola from the existing base area and down to a return station in the Doolans Basin.
- Construction of new access roads, which double as winter ski trails, to the Doolans Basin.
- Construction of snow making infrastructure including a reservoir, pump stations, snow making pumping lines and snow making guns along the trail route.
- Upgrading of the existing Rastus Burn wastewater system to handle increased visitor numbers
- Providing limited guest facilities (limited food and beverage facilities and toilet facilities) at the gondola return station.
- Installing a conveyor lift adjacent to the gondola return facility.

The scope of this report is to consider the power supply works required to service the expansion. In addition, operations of the existing facilities are constrained by the capacity of the main power supply to the ski field. Options to reduce some of these constraints are also considered. Upgrades to the mains power supply to the Ski Field are not proposed as part of this fast-track consent application. NZSki will progress any future required upgrades to the mains power supply under future separate approvals processes as necessary.

2 Existing Ski Field Power Supply

2.1 Arrangement/Capacity of Existing Supply

Electrical energy for the Remarkables Ski Area is delivered by the local network company, Aurora, at a substation located on the right bank of the Kawerau river just north of the confluence with the Shotover River. Access to the substation is across private land via a farm track from Boyd Road.

The substation is supplied at 33kV from an approximately 3.8km long spur line off the Aurora main trunk system serving Frankton and the Whakatipu basin as shown on Figure 1.

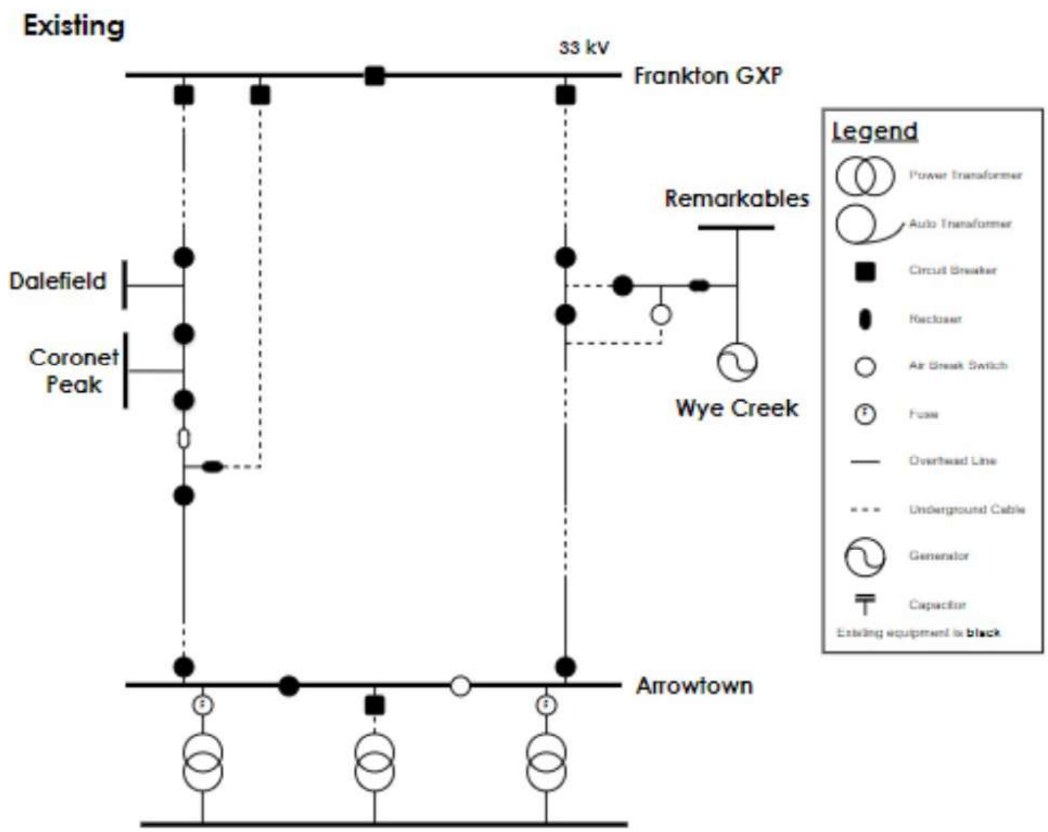

Figure 1 – Aurora 33kV Network (credit Aurora Energy)

A transformer, rated at 3MVA, provides electricity at 11kV for delivery to the Ski Field.

From the substation an 11kV overhead line owned by NZSki follows the farm track to the Rastus Burn and then up the Rastus Burn valley towards the Ski Field. At a point near the “W’s” on the access road the overhead line terminates into a recently installed buried cable that then follows the access road to the base facilities.

The first 2.7 km of overhead line uses Aluminium Conductor Steel Reinforced (ACSR) of type Mink. Mink conductor consists of 6 aluminium strands and 1 steel strand with an overall diameter of 11mm and an equivalent aluminium cross section area of 62.2mm^2. Mink has a rated strength of 21.8kN.

The second 1.1km section of overhead line uses Snipe ACSR conductor. Snipe has an overall diameter of slightly over 10mm and consists of 3 aluminium strands and 4 steel strands. Snipe has a rated strength of 43.8kN. The higher number of steel strands provide additional strength for the conductor which, presumably, was assessed as required by the original line designer to cater for high wind and snow loadings at higher altitudes. The equivalent aluminium cross section for Snipe conductor is 26.8mm^2, significantly less than the Mink conductor. It is noted that Snipe is a Canadian conductor not in general use within New Zealand distribution utilities.

At the W’s the overhead line is terminated and connected to a buried cable for the remaining 3.7km to the Remarkables Base Building. The cable was recently installed and is 3 core, 185mm^2 Aluminium conductor. The cable operates at 11kV but is insulated at 33kV to allow for a possible future voltage change. It is understood that this new cable terminates into an existing 11kV cable in the vicinity of carpark 1.

Figure 2 shows the overall supply route from the Aurora 33kV ring with Aurora 33kV (yellow) and 11kV power supply (red = Mink conductor, blue = Snipe conductor, green = cable).

Figure 2 - Existing Power Supply Routes

Determining the capacity of an overhead power line requires detailed calculations based on ambient temperature, permitted maximum conductor temperature, individual span distances, wind speeds, voltage drop and other parameters. For the purposes of this study "typical" ampacities have been assumed.

Mink conductor typically has a 'still air" 75C rating of around 152A and Snipe 111A. It is noted that Aurora have indicated[1] a winter rating for the line (both sections) of 178A (3.4MVA) which seems optimistic given the voltage regulation issues observed by NZSki which effectively limit supply to the Ski Field to about 2.4MVA.

The recently installed power cable has a current rating of around 326A[2] (~ 6.2MVA at 11kV).

2.2 Existing On-Field Power Distribution

The existing 11kV power supply to the Ski Field terminates into an 11kV switchboard located in the Remarkables Base Building. The switchboard and associated circuit breakers are rated at 630A (12MVA).

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[1] Scorpion Engineering Assessment – August 2019.
[2] Nexans cable catalogue

A network of 11kV cables, ring main units and fused tees supplies power to distribution transformers located at various locations. Refer to Figure 3 below.

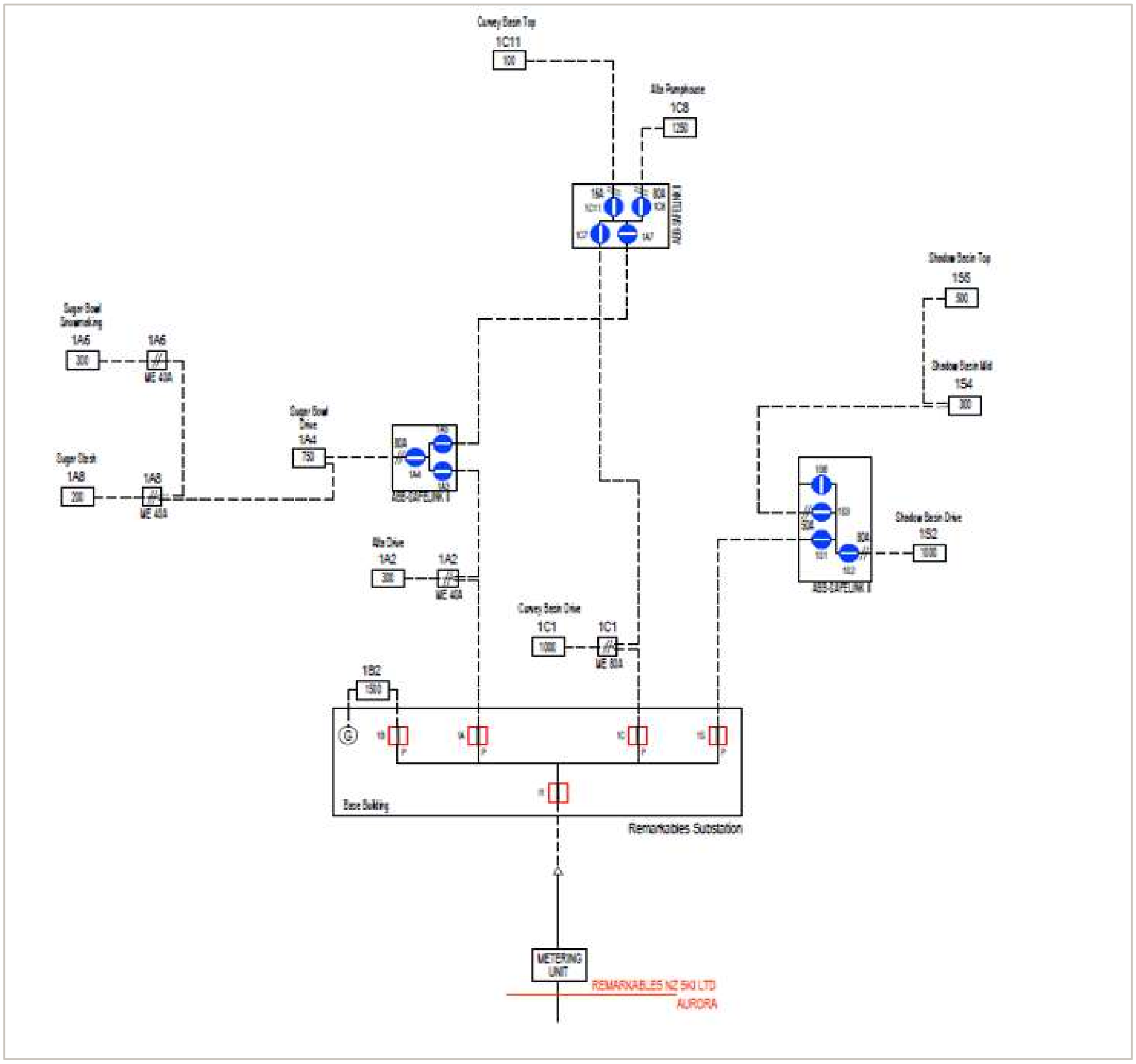

Figure 3 - Existing Site 11kV Distribution (credit PowerNet)

The distribution system comprises one feeder (1B) for the Remarkables Base Building (which is also used for connection of the emergency generator) and feeders for the three main chairlift lines; Sugar Bowl (1A), Shadow Basin (1S) and Curvey Basin (1C). Provision is made to allow interconnection of the 1B and 1C circuits which provides a level of backup in case of circuit breaker or cable fault.

Of interest for this study is the Curvey Basin circuit which supplies the Curvey Basin chair transformers and the Alta pumphouse. This 11kV circuit extends to the top of the Curvey Basin chair, which is on the proposed access route to the Doolans Basin. This cable is recorded[3] as being 3 core 95mm^2 XLPE cable which, according to Nexans will have a current rating of around 228A (4.3MVA) if direct buried. The winter rating is likely higher as the Nexans values are based on a ground temperature of 15C whereas sub-zero temperatures are likely in winter.

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[3] PowerNet reference 51940 as built drawings

3 Load Assessments

3.1 Existing Connected Load

An estimate of the load connected to each of the existing transformers has been made based on the existing drawings/equipment data as well as design information from the Remarkables Base Building construction.

Table 1 details these loads:

Table 1 - Existing Connected Load

Transformer	Load Description	Estimated Connected Load (kW)	Information Source
1B2 - Remarkables Base Building	Kitchen	221.7	Cosgroves
	Lighting	28	Cosgroves
	Mechanical Services	620	Site visit
	Deck and Roof Heating	450	NZSki
	Snow Making Compressor 1	132	Site visit
	Snow Making Compressor 2	132	Site visit
	Snow Making Pump PS100	160	Site visit
1A2 - Alta	Alta Drive	100	NZSki
	Platter Lifts	65	NZSki
	Snow Makers	14	From TechnoAlpin master plan
1A4 - Sugar Bowl Drive	Sugar Bowl Chair Drive	393	Doppelmayr
	Snow Makers	255	From TechnoAlpin master plan
1A6 - Sugar Bowl Snowmaking	Snow Makers	78	From TechnoAlpin master plan
1A8 - Sugar Stash	Snow Makers	131	From TechnoAlpin master plan
1C1 - Curvey Basin	Curvey Basin Chair Drive	460	Site visit
	Snow Makers	412	From TechnoAlpin master plan
1C8 - Alta Pumphouse	Pump 1	250	Site visit
	Pump 2	250	Site visit
	Pump 3	250	Site visit
	Compressor	110	Site visit
	Lake Alta pumps (3 x 11kW)	33	Site visit
	Snow Makers	72	From TechnoAlpin master plan
1C11 - Curvey Basin Top	Chair top	20	Estimate
	Snow Makers	49	From TechnoAlpin master plan
1S2 - Shadow Basin Base	Shadow Basin Base Drive	421	Doppelmayr

Transformer	Load Description	Estimated Connected Load (kW)	Information Source
1S4 - Shadow Basin Mid	Snow Makers	154	From TechnoAlpin master plan
1S5 - Shadow Basin Top	Chair top	10	Doppelmayr
	Snow Makers	276	From TechnoAlpin master plan
Subtotal – Remarkables Base Building Load		**1,320kW**	
Subtotal – Snowmaking compressor/pump load		**1,320kW**	
Subtotal – Snowmaker gun load		**1,440kW**	
Subtotal - Lifts		**1,470kW**	
TOTAL CONNECTED LOAD ESTIMATE		**5,550kW**	

Notes:

- snowmaker allocation against specific transformers may not be 100% correct as not essential for the purposes of this study.
- Shadow Basin and Sugar Bowl lift loads are the rated continuous load as advised by Doppelmayr. The same ratio of continuous to starting load has been applied to the Curvey Basin chair.
- General purpose outlets in the Remarkables Base Building not included as difficult to assess.

A total of 2,350kVA of transformer load is connected to the Curvey Basin feeder, with an estimated connected load of 1,906kW.

3.2 Existing Power Demand

NZSki have provided power consumption data (in 30 min intervals) from their energy supplier (Meridian) for the 2024 and 2025 seasons. In our assessment we have used the period May through October as the operating season. Measured loads outside these periods were substantially reduced.

In addition, limited data from the Remarkables Base Building BMS of the Remarkables Base Building loads was provided for the 2025 season. It is understood that the BMS data are instantaneous readings at various times through the day.

As the 2025 season was the first with the new Shadow Basin chairlift operating our assessment is based on the 2025 data.

Figure 4 below shows the 2025 power consumption. Points to note:

- The maximum recorded demand was 2,288kW on 25 June at 10:30AM.
- The largest demand peaks occur early in the season, with a number occurring before opening day (14 June). These peaks are likely to be snow making.
- Once the field has opened to the public the minimum demand is typically around 650kVA.

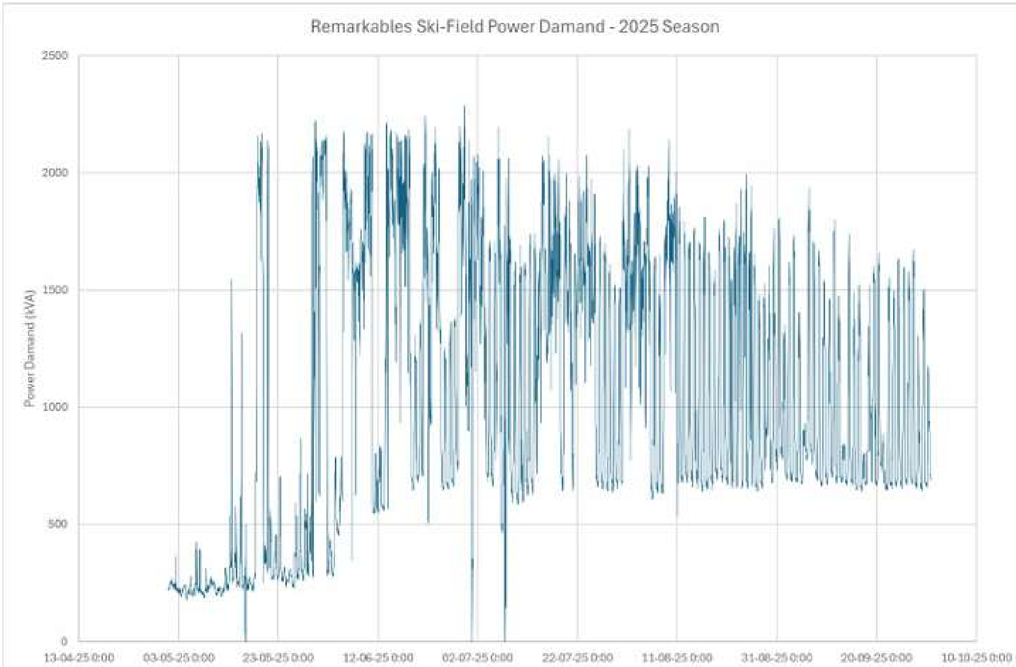

Figure 4 - 2025 Power Demand

From discussions with NZSki it is understood snowmaking generally takes place outside lift operation periods, with maximum power demand further managed by turning off the Remarkables Base Building deck heating and transferring space heating to the diesel boiler.

Figure 5 below shows the 2025 demand profile daily at 2100 hours. On the assumption that the peaks represent snowmaking load (pumps, compressors and snow machines) it would appear a snowmaking demand of around 1,400kW is typical, with a higher demand early in the season.

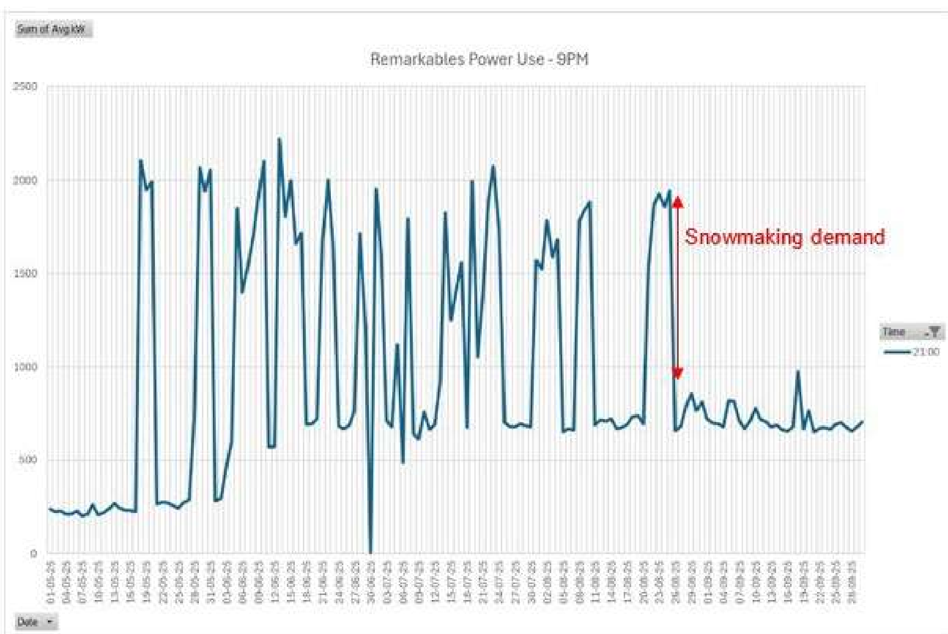

Figure 5 – Demand Profile 2100 hrs

The demand profile during lift operations is shown in Figure 6.

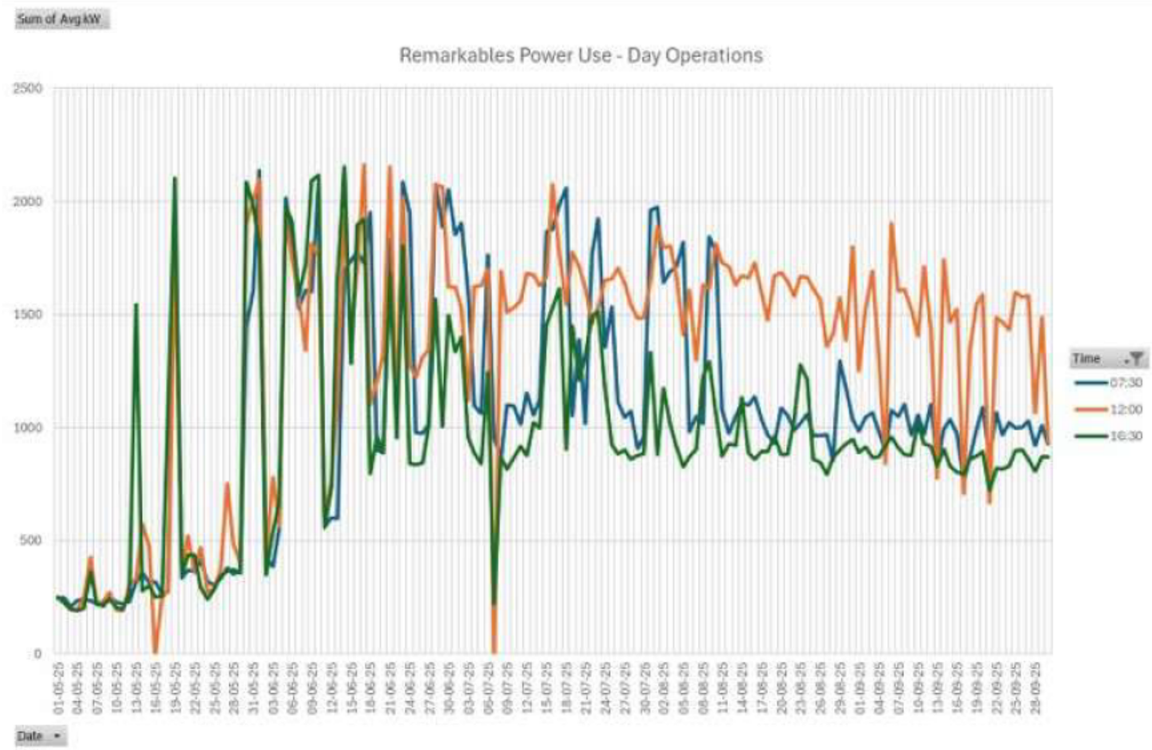

Figure 6 – Remarkables Ski Area - Daytime Power Consumption

During the pre-season the base power demand ramps up, with some high usage periods – presumably snow making immediately before opening day (14 June). During the open season the demand immediately before 9:00AM (chairlift opening) and immediately after 4PM (chairlift closing) is around 750kW lower than the demand at noon. It is anticipated that the bulk of the load increase is due to chairlift power draw, although we would note that if this is the case then the power consumed by the chairlifts would seem quite a bit lower than indicated by Doppelmayr. This is possibly due to chairlift loading being less than capacity.

Should the power supply constraint to the Ski Field be removed then it would be likely that the maximum power demand of the existing facility would also increase as snowmaking could take place when conditions permit rather than only outside of operating hours. Based on the above discussion it is suggested that an allowance of 1,400kW over the existing site operations be adopted for planning purposes. If agreed then the existing site assumed maximum demand would be 3,288kVA, up from the existing 2,288kW.

3.3 Estimated New Loads

Loads for the proposed Doolans Basin expansion, along with the basis behind the load estimated, and preliminary transformer allocation, are provided in Table 2 below.

Table 2 - Doolans Basin Expansion New Loads

Transformer	Load Description	Estimated Connected Load (kW)	Basis
2B2 – Remarkables Base Building Extension	Kitchen/Cooking loads	221.7	100% of the estimated kitchen load of the existing Remarkables Base Building
	Lighting	28	100% of the estimated lighting load of the existing

Transformer	Load Description	Estimated Connected Load (kW)	Basis
			Remarkables Base Building
	Mechanical Services	620	100% of the estimated services load of the existing Remarkables Base Building
	Deck and roof heating	50	A small allowance to cover additional roof heating. The expansion is understood to not include a significant increase in deck area.
Sub-total Transformer 2B2		**920kW**	**1,000kVA Transformer**
2G1 – Gondola Base Station	Gondola base drive S1	462	Doppelmayr
Sub-total Transformer 2G1		**462kW**	**750kVA Transformer**
2D1 – Gondola Mid Station	Gondola mid drive S1	25	Doppelmayr
	Gondola mid drive S2	384	Doppelmayr
	Snowmaking	200	TechnoAlpin
	Wastewater pumping	5	Stantec
Sub-total Transformer 2D1		**614kW**	**750kVA Transformer**
2D2 – Doolans Basin Main Trail	Snowmaking	230	TechnoAlpin
	Wastewater pumping	10	Stantec
Sub-total Transformer 2D2		**240kW**	**300kVA Transformer**
2D3 – MR600 pump house	Pump 1	160	TechnoAlpin
	Pump 2	160	TechnoAlpin
	Pump 3	315	TechnoAlpin
	Pump 4	315	TechnoAlpin
	Snowmaking	92	TechnoAlpin
	Wastewater pumping	5	Stantec
Sub-total Transformer 2D3		**1,047kW**	**1,250kVA Transformer**
2D4 – MR700 Pump House	Pump 1	15	TechnoAlpin
	Pump 2	200	TechnoAlpin
	Snowmaking	230	TechnoAlpin
	Wastewater pumping	5	Stantec
Sub-total Transformer 2D4		**450kW**	**500kVA Transformer**
2D5 – Gondola Return	Gondola return S2	40	Doppelmayr
	Snowmaking	92	TechnoAlpin
	Gondola Return facilities	50	Estimate
	Wastewater pumping	5	Stantec
	Potable water	15	Stantec

Transformer	Load Description	Estimated Connected Load (kW)	Basis
	Conveyor lift	15	Estimate
Sub-total Transformer 2D5		**217kW**	**300kVA Transformer**
Allowance for future facility load increases		**613kW**	
Allowance for future snowmaking load increases		**476kW**	
Subtotal – Remarkables Base Building Expansion Loads		**970kW**	
Subtotal – Snowmaking pump loads		**1,165kW**	
Subtotal – Snowmaker gun/factory load		**1,044kW**	
Subtotal - Lifts		**962kW**	
Subtotal - Other		**95kW**	
Subtotal - future allowances		**1,089kW**	
TOTAL CONNECTED LOAD ESTIMATE		**5,089kW**	
TOTAL CONNECTED LOAD AT BASE[4]		**1,432kW**	
TOTAL CONNECTED LOAD IN DOOLANS BASIN[5]		**3,657kW**	

The estimated connected load of the proposed Doolans Basin expansion will represent almost a doubling of the Ski Field connected load, from around 5,550kW to a total just under 11,000kW.

3.4 Estimated Maximum Demand of Doolans Basin Expansion

3.4.1 Discussion on Approach

For this study, the purpose of estimating the facility maximum demand is to provide a realistic assessment of the electrical power requirements in order to assess the most appropriate method of delivering that quantum of power from the Aurora network and confirming with Aurora their ability to deliver. In addition, it drives the basis of on-field reticulation requirements to transport power across into Doolans Basin. Finally, it provides a basis for selecting the amount of emergency diesel generator capacity required.

Estimating the maximum demand of a facility such as the Remarkables Ski Area is difficult owing to the high proportion of load that is discretionary. In particular, snow making load which, at an estimated 5,245kW represents close to 50% of the connected load. As is observed with the existing installation, careful management of the snowmaking time of use, coupled with the ability to turn off or change energy source for some Remarkables Base Building loads, allows the field to operate with a maximum demand of just over 2,000kW despite a connected load considerably greater than that.

As noted earlier, the power demand of the existing chairlifts also seems lower than indicated by the manufacturers.

It is also recognised that the facility is only operating at peak capacity for four months of the year and this provides a short period for a return on investment.

In assessing the Doolans Basin expansion maximum demand estimate, we have firstly assessed the anticipated demand of the base facilities and day-time operations (chairlifts etc) using a similar ratio of

[4] Sum of load on transformers 2B2 and 2G1
[5] Sum of load on transformers 2D1 thru 2D7

installed load to maximum demand as the existing facilities. Combined with the demand of the existing facilities this then gives a lower range limit for the expected overall demand.

Similarly, we have assessed the expected Doolans Basin snow making demand based on the existing snowmaking capacity/load ratio. This is used to update the expected overall load in two ways:

- Estimating the total field load should snow making take place mostly at night with similar load management processes as presently employed.
- Estimating the total field load should snow making take place in the daytime, alongside lift operations.

Finally, we have assessed an upper range limit for the field assuming "unrestrained" snow making alongside lift operations.

3.4.2 Expanded Base Facility/Lift Demand Assessment

From Table 1 the estimated connected load of the existing facilities (excluding snowmaking) is 2,790kW and the recorded maximum demand is 2,288kW. From Table 2 the Doolans Basin connected load (excluding snowmaking) is 1,992kW potentially increasing to 2,605kW should future load increases arise, and applying the same ratio as the existing facilities would give maximum demand estimates of 1,600/2,100kW respectively.

As a cross check, a maximum demand estimate has been made based on the individual connected loads assuming a load factor of 0.8 for lifts (i.e., assuming that the plant will operate at 80% of their rated continuous load) and diversity factors of:

- 0.75 for kitchen equipment.
- 0.2 for socket outlets.
- 0.9 for building heating.
- 0.5 for deck and room heating.
- 1.0 for lifts.
- 0.9 for other loads.

Similar diversity factors were used in the original Remarkables Base Building design calculations, and the observed maximum demand is close to the estimated levels.

On this basis, the estimated maximum demands 1,678/2,150kW (Doolans Basin/Doolans Basin plus future allowance) excluding snowmaking. The demand of the facilities within the Doolans Basin represents some 450/925kW of this estimate, with the balance at the base facilities.

Adopting a similar approach for estimating the snowmaking demand, the existing snowmaking connected load is 2,760kW and the estimated maximum demand is around 1400kW, i.e., a ratio of 0.5.

The Doolans Basin connected snowmaking load is 2,000/2,485kW (Doolans Basin/Doolans Basin plus future allowance) leading to an estimated demand of 1,000/1,240 kW.

A bottom-up assessment of estimated maximum demand has been carried out as a check. A load factor of 0.9 has been adopted for all snowmaking equipment and a diversity factor also of 0.9. These are relatively conservative values indicating that 70% of the snow making system would be operational at the same time. Based on these criteria the snowmaking demand would be 1,325/1,625 kW.

3.4.3 Summary of Maximum Demand Estimates

As indicated earlier the Remarkables Ski Area power consumption includes a significant proportion of snowmaking loads that are discretionary. Although the power supply to the site could be sized to accommodate all loads operating simultaneously, such an approach would result in a supply capacity that would rarely be used to its full extent.

It also needs to be realized that some electrical equipment (e.g., transformers) can be operated at higher than their nameplate rating for short periods and also ratings are normally established for an ambient temperature of 20°C, whereas for winter operation in the mountains a much lower ambient temperature can be expected, which will permit higher equipment loads (for equipment located outdoors).

Table 3 below summarises the estimated loads as presented in earlier sections:

Table 3 - Overall Maximum Demand

Item	Daytime maximum demand (no snowmaking)	Plus Daytime Snowmaking	Maximal snowmaking nighttime (no lifts operating)
Existing facilities	2,288 kW	2,288 kW	1,500 kW[6]
New Doolans Basin facilities (incl allowance for future increase)	2,150 kW	2,150 kW	100 kW[7]
Existing snowmaking		1,400 kW	1,800 kW[8]
Doolans Basin snowmaking (incl allowance for future increase)		1,240 kW	1,600 kW
Estimated Maximum Demand	**4,438 kW**	**7,078 kW**	**5,000 kW**
Estimated Maximum Demand Doolans Basin Facilities at Base	**1,225kW**	**1,225kW**	**NA**
Estimated Maximum Demand Doolans Basin Facilities in Basin	**925kW**	**2,165kW[9]**	**1,700kW**

Based on the above assessment it would seem sensible to investigate options to deliver a maximum of 7,100kW of electric power to the Ski Field and identify what bottlenecks exist. In addition, delivery of up to 2,165 kW of power is required into the Doolans Basin.

Upgrades to the mains power supply to the Ski Field are not proposed as part of this fast-track consent application however have been considered to inform the design of infield power distribution for the Ski Field expansion. NZSki will progress any future required upgrades to the mains power supply under future separate approvals processes as necessary.

4 33/11kV Substation

4.1.1 General

The location proposed for the 33/11kV substation is on the existing carpark 3 site and construction of the substation is included within the fast-track application.

The substation would include:

- A 33/11kV power transformer.
- 33kV and 11kV switchgear and possibly metering depending on ownership.
- Emergency diesel generation for the Ski Field.

The required area for the substation is estimated at around 25 x 6m. In addition, approximately 4m clear space in front of the building would need to be maintained for access.

It is usual for distribution utility substations to include more than one transformer for reliability/security of supply reasons. Normally the firm capacity is provided by one transformer, with an identical transformer installed as backup. Whilst transformers are highly reliable, they have a long delivery period which is problematic for substations where continuity of supply is essential, hence the common provision of two transformers. Given the short duration of the ski season at the Remarkables Ski Area, the additional

[6] Double the existing base building nighttime load to accommodate the expanded facilities
[7] Estimate allowing for limited building heating etc overnight
[8] Assuming a load factor of 0.9 and diversity of 0.7
[9] 925kW of buildings/lifts plus 1240kW snowmaking

capital expense of installing two identical transformers is unlikely to be justifiable. Other options to reduce the risk of one transformer failing could include:

i. Installation of two smaller sized (say 50% rated) transformers. This would permit commercial operations to continue, with reduced daytime snowmaking capacity.
ii. Increasing the capacity of the on-site emergency diesel-generation to permit limited commercial operation to continue while a replacement transformer is sought.
iii. Make provision for parking a mobile substation adjacent to the permanent substation. Many Utilities (including Aurora) now have such substations, and it is possible that one could be sourced at short notice, especially if prior arrangements had been made.
iv. Make prior arrangements for a Utility to provide a 33/11kV transformer at short notice. Many Utilities will hold 33/11kV transformers in their yard, and it is probable that one could be delivered relatively quickly.

In designing the substation concept arrangements, we have assumed that the substation will consist of a single transformer, with risk mitigation being achieved through points ii, iii or iv above (or likely a combination of these). Such measures would be undertaken outside of the fast track application process.

Detailed design of the substation is proposed to be certified by QLDC as a condition of consent.

4.1.2 Transformer Selection

Determination of the final transformer parameters will require discussions with the manufacturer / designer to determine the optimal rated power and provisions for short term and emergency overload.

Although the established maximum demand is 7.1MVA[10], this does not necessarily mean a transformer rated for ~ 7MVA continuous needs to be installed. A lower rated transformer could be employed, designed for regular cyclical peaks as well as short term emergency overloads. Often peak loads are achieved by incorporating a form of forced cooling of the transformer, with fans being the most common, but pumped oil can also be used. Given the potential for snow accumulation, Stantec would not recommend the use of fans (ONAF[11] type transformers) as the fans may become blocked reducing the cooling system efficiency. Cooling pumps (OFAN[12] type transformers) would likely be a better solution if forced cooling were determined necessary. In addition, the likely low ambient temperatures during maximum demand periods as well as during demand recovery periods will allow greater output for a given transfer.

For the purposes of this study, we have adopted a typical ONAN[13] transformer as this will require the largest footprint and thereby provide a conservative arrangement for consenting purposes. The transformer would be specified to include an on-load tap changer and voltage regulator. This will allow the transformer to maintain the 11kV system at a constant voltage (within bounds) as load changes, thereby alleviating the voltage issues the site presently has.

4.1.3 33kV and 11kV switchgear

Indoor type, metal clad 33kV and 11kV switchgear will be provided in a switchroom adjacent to the main transformer.

The 33kV switchgear will comprise a single, draw-out, type circuit breaker which can be drawn out during maintenance to isolate the 33kV switchboard. No provision to extend the 33kV switchgear to allow for future expansion is made as it would seem unlikely that there would be any future requirement to progress beyond a single incomer/single transformer configuration.

[10] Refer Section 3.4.3
[11] ONAF = Oil natural, air forced
[12] OFAN = Oil forced, air natural
[13] ONAN = Oil natural, air natural

The 11kV switchgear will comprise a single incoming circuit breaker and multiple outgoing circuit breakers using equipment similar to the existing 11kV switchboard (refer photo below).

At a concept stage the switchboard will include five outgoing feeders (one supplying the existing 11kV board) and provision for expansion will be made in the switchroom.

Photo 1 - Existing 11kV Switchboard

4.1.4 Transformer Enclosure and Substation Building

A conceptual layout sketch for the transformer enclosure and switchroom is provided in Figure 8 below.

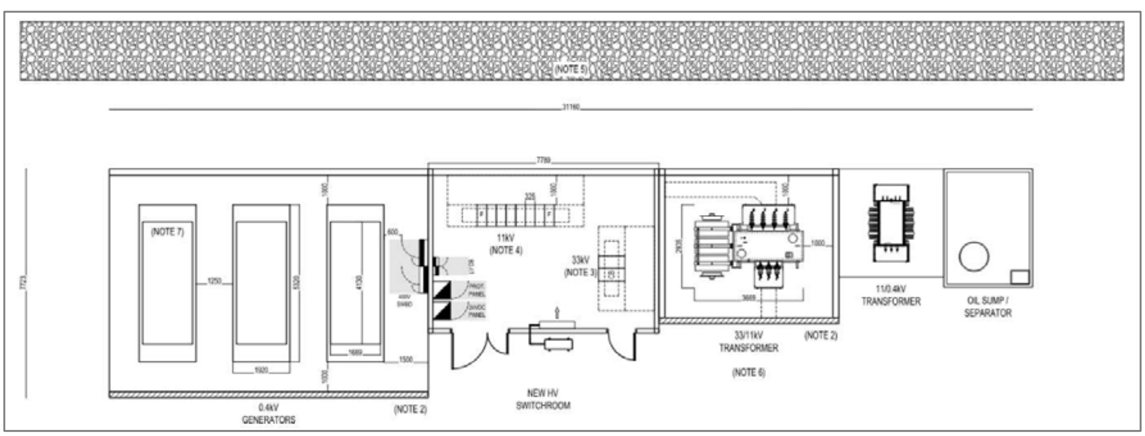

Figure 7. Indicative switchroom layout

Key details include:

- Precast concrete switchroom walls and transformer “blast” walls, with two-hour fire rating.

- Louvred panelling at the transformer enclosure front side to screen the transformer from view whilst retaining airflow for ventilation purposes.
- Steel tray roofing, similar to that used on the Remarkables Base Building.
- Access doors (personal and equipment) on the front side of the building only. Two egress routes will be required from the switchroom to comply with electrical safety regulations.
- The transformer will contain in the region of 3500l of transformer oil and will require bunding[14] to hold the oil in the event of a major leak or fire, as well as an oil separation system to treat any discharge from the bunded are. The bund will be sized[15] to accommodate all of the oil in the transformer, plus an allowance for firefighting and rainwater.
- A buried copper earthing conductor will be installed around the perimeter of the building – approx. 1m from the building face. This will form the main earth electrode for the substation and will be connected into the existing extensive Ski Field earthing conductor network. The earthing design will need some careful consideration during detailed design as, with the creation of a 33/11kV substation the fault levels will increase over existing. However, given the extent of the existing earthing system, it is not expected that a large earth electrode will be required.
- Subject to any requirements of NZSki's insurers, no permanent firefighting system (sprinklers, etc.) are envisaged for the switchroom or transformer enclosure. An early warning "sniffer" type smoke detection system (e.g., VESDA) is recommended for the switchroom.
- A small 24V DC battery bank and charger will be provided to power the transformer and switchgear control and protection systems. It is envisaged that the batteries would be valve regulated lead acid (VRLA) type with low hydrogen discharges, removing any need for a separate battery room/ventilation system, etc.

5 Site Power Distribution Upgrades

5.1 Existing Remarkables Base Building Area

As identified in Section 1, the expected additional connected load at the Ski Field base owing to the Doolans Basin expansion is 1,432kW (comprising additional Remarkables Base Building load, plus the gondola drive station S1), with a maximum demand estimate of 1,225kW.

It is proposed to install two additional transformers to service this load: a 1,000kVA transformer (2B2) for the Remarkables Base Building extension and a 750kVA transformer (2G1) for the gondola drive station S1. It is envisaged that these transformers would be located outdoors at a convenient location as determined during the detailed design of the buildings. The transformers could be located indoors (as with the existing Remarkables Base Building transformer) if required for aesthetic reasons but outdoors is preferred in order to reduce ventilation requirements in the services part of the building.

At this stage the concept is for each of these transformers to be fed directly from the new 11kV switchboard. Potentially detailed design could incorporate the gondola load into a larger (say) 1,500kVA base extension transformer, removing the need for one transformer. However, it is noted that all lift drives presently installed in the Ski Field have dedicated transformers and careful consideration of the effect of harmonics from the gondola drive systems would be required.

11kV cables from the 11kV switchboard would be direct buried from carpark 3, along the access road and across carpark 1, to the Remarkables Base Building facilities.

5.2 Doolans Basin Area

As identified in Section 1, the expected connected load in the Doolans Basin is 3657kW, with a maximum demand estimate of 2165kW.

The power is utilised at a number of locations, including the gondola mid station, snow making pump stations, gondola return station and facilities in that area, plus snowmaking along the main access trail.

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[14] To comply with the Resource Management Act and other Regulations such as hazardous goods .
[15] Bunding will be sized in accordance with AS2067 (Substations and high voltage electrical installations exceeding 1kV)

As all of the loads are along the main access trail into the Doolans Basin, it makes sense to route the power supply along the same route, combined with other services such as wastewater and snowmaking services.

As noted earlier the existing cable from the base facilities to the top of the Curvey Basin chair utilises 95mm2 Aluminium cable, with a capacity of around 228A (4.3MVA). At present this cable supplies the Curvey Basin chair, Alta pumphouse plus snowmaking in Curvey Basin area. The connected transformer capacity on the cable is 2,350kVA and estimated maximum demand around 1500kVA, leaving some 2.5MVA capacity spare.

It is therefore proposed to extend this existing cable from the top of the Curvey Basin chair top station through to the Doolans Basin return station to service loads in the Doolans Basin. It is recommended however that this be considered a backup supply and that a primary supply, also of 95mm^2 be provided between the base and Doolans Basin return facility. This would then create a ring supply, similar to that already in place in the main basin.

The primary cable would follow the same route as the backup cable and would also utilise trenching established for other services. Alternative options such as stringing cables to the gondola pylons or taking a direct route from the top of the Curvey Basin chair were considered but discounted owing to challenging terrain (and potentially consent issues) in the case of a Curvey Basin extension and susceptibility to weather events in the case of a strung cable option.

Bare copper earth conductors will be buried with all 11kV cables to provide a site-wide, low impedance earthing system.

The proposed single line diagram for the expansion is provided in Figure 8 below. A larger copy of this diagram is provided in the Appendices.

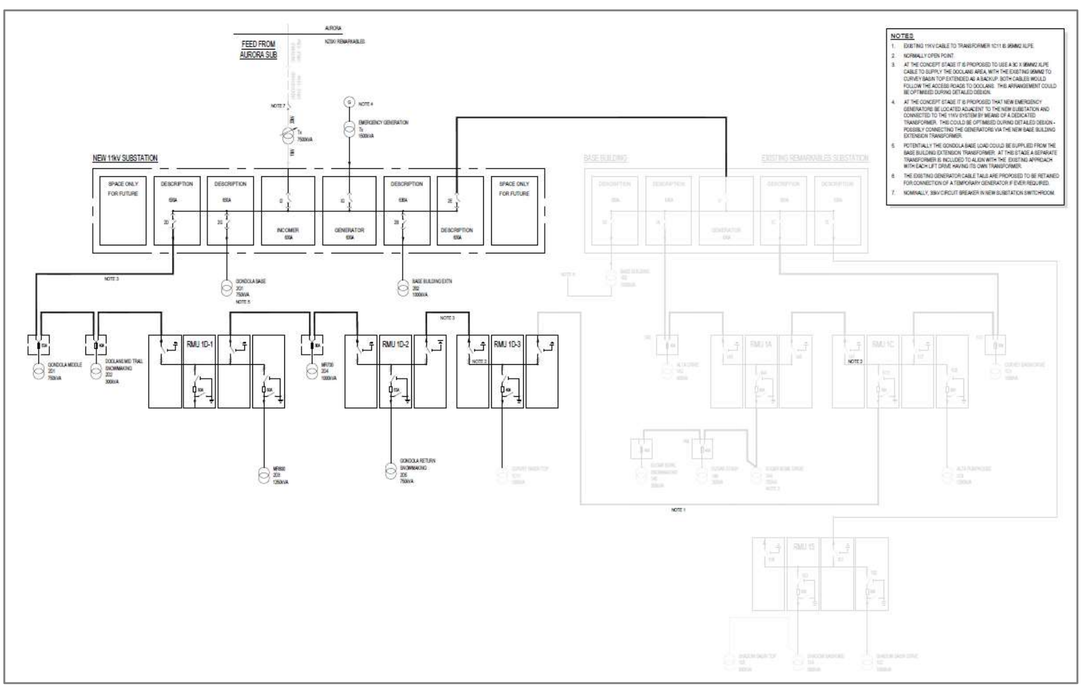


Figure 8 - Doolans Basin Expansion - Proposed Single Line Diagram

The gondola base station transformer (2G1) and Remarkables Base Building extension transformer (2B2) will be supplied from the new 11kV switchboard. Five transformers will be located within the Doolans Basin area all along the main access trail.

Locations of the transformers have been selected primarily based on the required gondola drive station locations and the snow making transformer locations nominated by TechnoAlpin. Figure 9 shows the proposed locations and summarises the transformer ratings and connected loads.

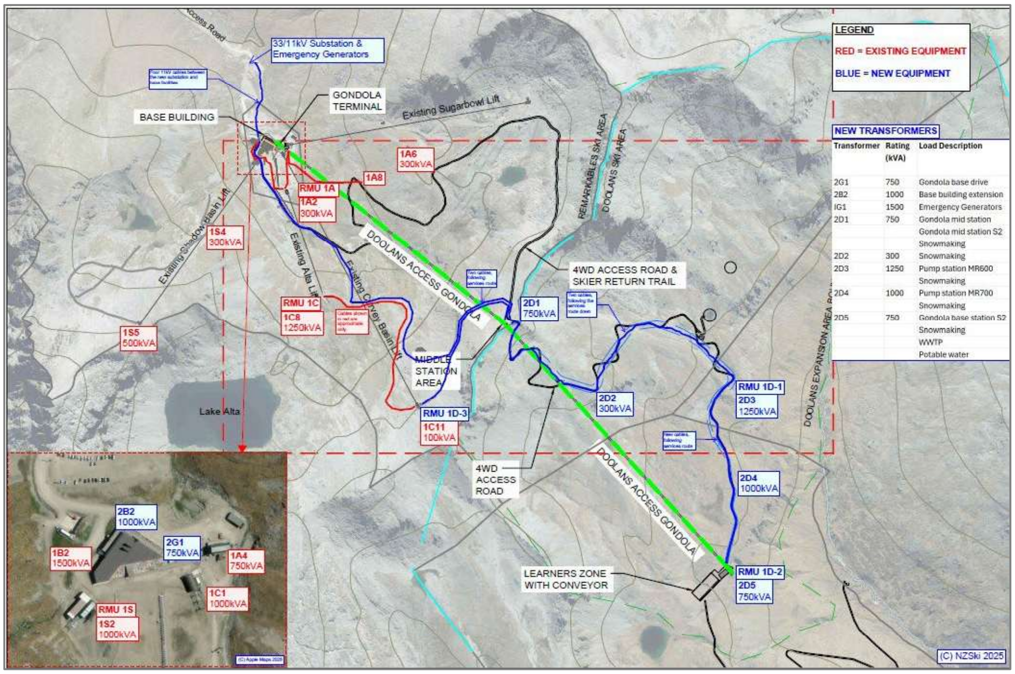


Figure 9 - Doolans Basin Expansion Transformer and Switchgear Locations

Ring main units (RMUs) will be provided at the top of Curvey Basin chair, pumphouse MR600, and at the gondola terminal station. It is suggested that these RMUs be provided with remote control facilities to enable reconfiguration of the 11kV system from base in the event of a fault.

Transformers and ring main units will be of a similar type to those already utilised as in the photo below.

Photo 2 – Typical RMU (left) and Kiosk Transformer (right)

5.3 Emergency Generation

According to the Principals Requirements emergency generation is required for the following loads:

- Existing and extended Remarkables Base Building kitchen equipment, lighting and GPOs.
- Bottom (west) conveyor lift.
- Alta chair.
- Doolans Basin lift top station S1.

- Doolans Basin gondola return station S2.
- Doolans Basin wastewater treatment and pumping.
- An allowance for future loads

The connected load associated with these items is 2,100kW and the estimated maximum demand 1,238kVA.

NZSki have expressed a preference not to be reliant on a single large genset but to instead have two or three smaller sets. Based on the estimated maximum demand it is proposed to install three off 550kVA standby rated gensets. Two would be installed initially, with a third if needed in the future.

It is noted that a loss of all the main chairlifts and the gondola during a power outage could have significant commercial impact, and it is foreseen that a need for larger emergency generation capacity could arise in the future. It is therefore proposed to size the emergency generator building for 3 x 750kVA gensets (2,250kVA in total) which would offer the ability to meet the Rastus burn side chairlift load (with some load control measures) once larger generators were installed.

It is proposed to locate the generators immediately adjacent to the new substation on carpark 3. Each generator would have its own “day” tank that would allow a few hours operation, with top up from the main diesel tanks.

The estimated fuel consumption of 550kVA gensets is just under 500l/hour (all three sets operating at 100% load) and either a permanent bulk storage tank or trailer mounted tank would be used for fuel storage. Given the distance from the existing Remarkables Base Building facilities use of the existing bulk storage tanks is not proposed.

The diesel generators will generate at 400V and will be connected to a 400V switchboard within the generator room. A dedicated 1,500kVA 0.4/11kV transformer will be provided adjacent to the generator building to connect the emergency generation to the main 11kV switchboard.

5.4 Other Loads

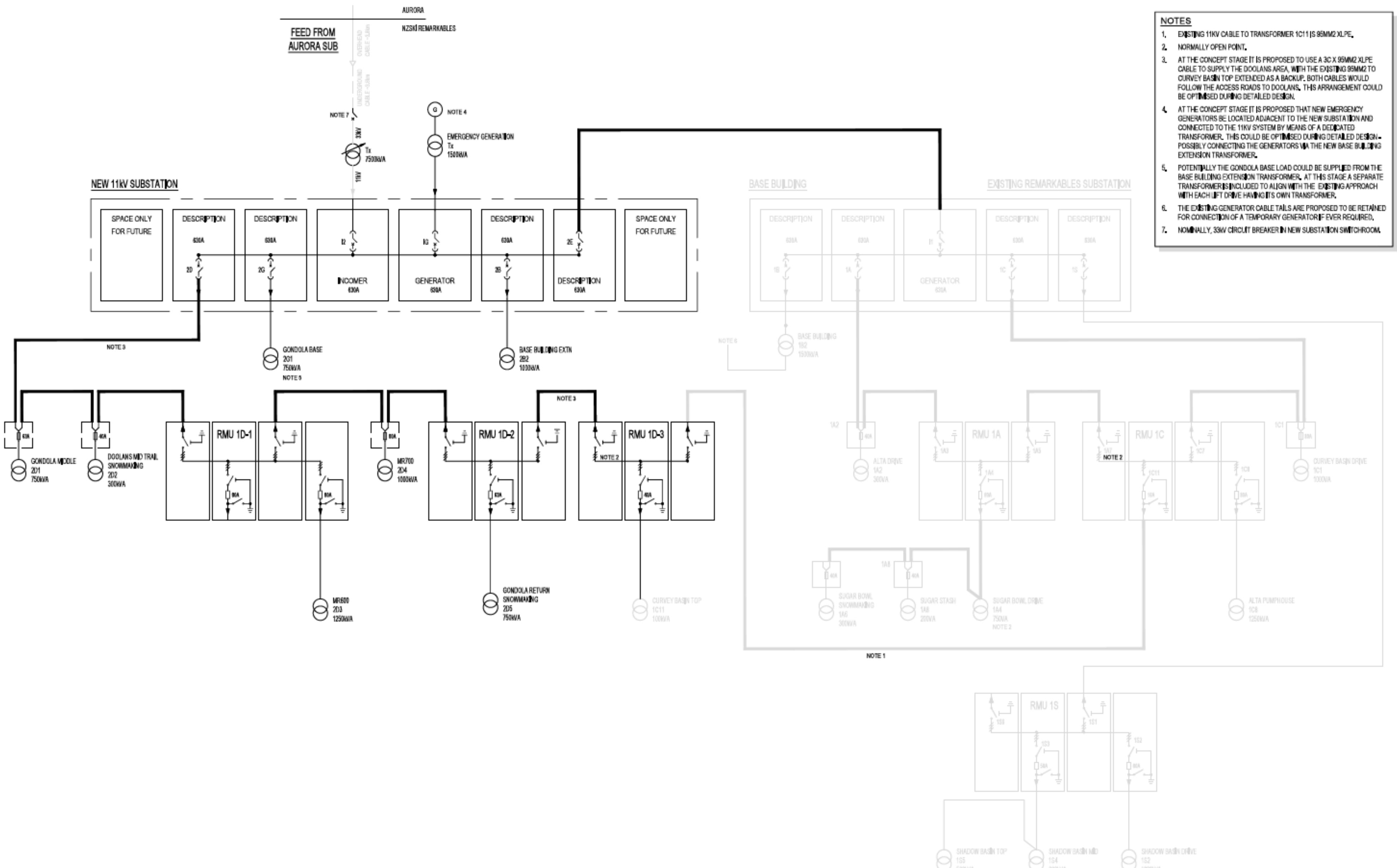
Other loads that NZSki have identified as being required as part of the redevelopment include a new maintenance facility (groomer shed). A load allowance for the maintenance facility has been included within the new Remarkables Base Building expansion loads and it is envisaged that the facility will be supplied at 400V from the building extension switchboard. Alternatively, it could likely be supplied off the nearest existing or new transformer.

Appendices

Appendix A

Drawings:

- **Single Line Diagram**
- **Site Layout**
- **Substation concept arrangement**



NOTES

1. EXISTING 11KV CABLE TO TRANSFORMER 1C11 IS 95MM2 XLPE.
2. NORMALLY OPEN POINT.
3. AT THE CONCEPT STAGE IT IS PROPOSED TO USE A 3C X 95MM2 XLPE CABLE TO SUPPLY THE DOOLANS AREA, WITH THE EXISTING 95MM2 TO CURVEY BASIN TOP EXTENDED AS A BACKUP. BOTH CABLES WOULD FOLLOW THE ACCESS ROADS TO DOOLANS. THIS ARRANGEMENT COULD BE OPTIMISED DURING DETAILED DESIGN.
4. AT THE CONCEPT STAGE IT IS PROPOSED THAT NEW EMERGENCY GENERATORS BE LOCATED ADJACENT TO THE NEW SUBSTATION AND CONNECTED TO THE 11KV SYSTEM BY MEANS OF A DEDICATED TRANSFORMER. THIS COULD BE OPTIMISED DURING DETAILED DESIGN - POSSIBLY CONNECTING THE GENERATORS VIA THE NEW BASE BUILDING EXTENSION TRANSFORMER.
5. POTENTIALLY THE GONDOLA BASE LOAD COULD BE SUPPLIED FROM THE BASE BUILDING EXTENSION TRANSFORMER. AT THIS STAGE A SEPARATE TRANSFORMER IS INCLUDED TO ALIGN WITH THE EXISTING APPROACH WITH EACH LIFT DRIVE HAVING ITS OWN TRANSFORMER.
6. THE EXISTING GENERATOR CABLE TAILS ARE PROPOSED TO BE RETAINED FOR CONNECTION OF A TEMPORARY GENERATOR IF EVER REQUIRED.
7. NOMINALLY, 33kV CIRCUIT BREAKER IN NEW SUBSTATION SWITCHROOM.

NZSKI
REMARKABLES UPGRADE AND
DOOLANS EXPANSION
SINGLE LINE DIAGRAM AND MAIN RING

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SKETCH

No.

E-001

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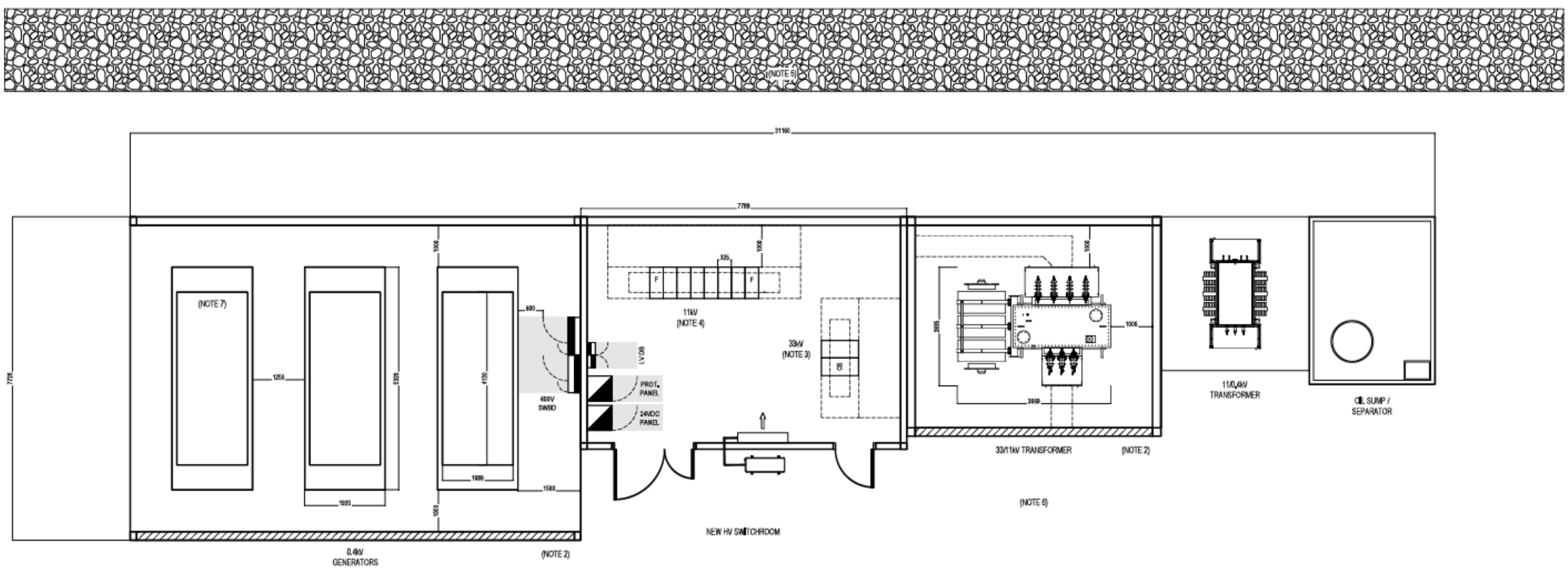
NOTES

1. SUBSTATION COMPOUND LAYOUT IS CONCEPT ONLY AND WILL BE FURTHER REFINED AS PART OF THE NEXT PHASE.
2. LOUVRE FRONT.
3. ABB SAFEPLUS RATED 36kV.
4. ABB SAFEPLUS RATED 12kV. "F" INDICATES SPACE FOR FUTURE TIERS.
5. BACK OF SUBSTATION UP AGAINST BANK.
6. IF EARTHING TRANSFORMER REQUIRED, NOMINALLY TO BE LOCATED IN THE MAIN TRANSFORMER BUNDED AREA.
7. INDICATIVE GENERATOR, SHOWN INSIDE AN ACOUSTIC/ENVIRONMENTAL ENCLOSURE.



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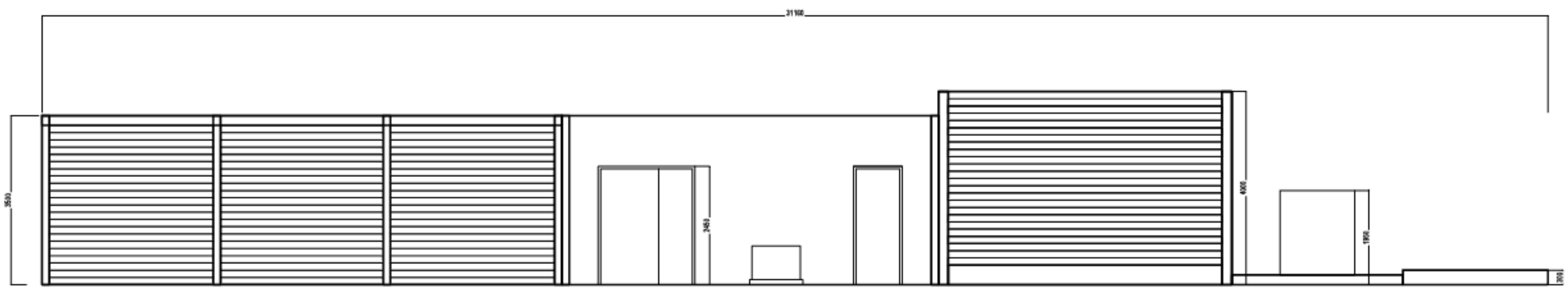
NOTES
1. SUBSTATION COMPOUND LAYOUT IS CONCEPT ONLY AND WILL BE FURTHER REFINED AS PART OF THE NEXT PHASE.
2. TRANSFORMER AND OIL SEPARATOR AREAS TO BE BUNDED.



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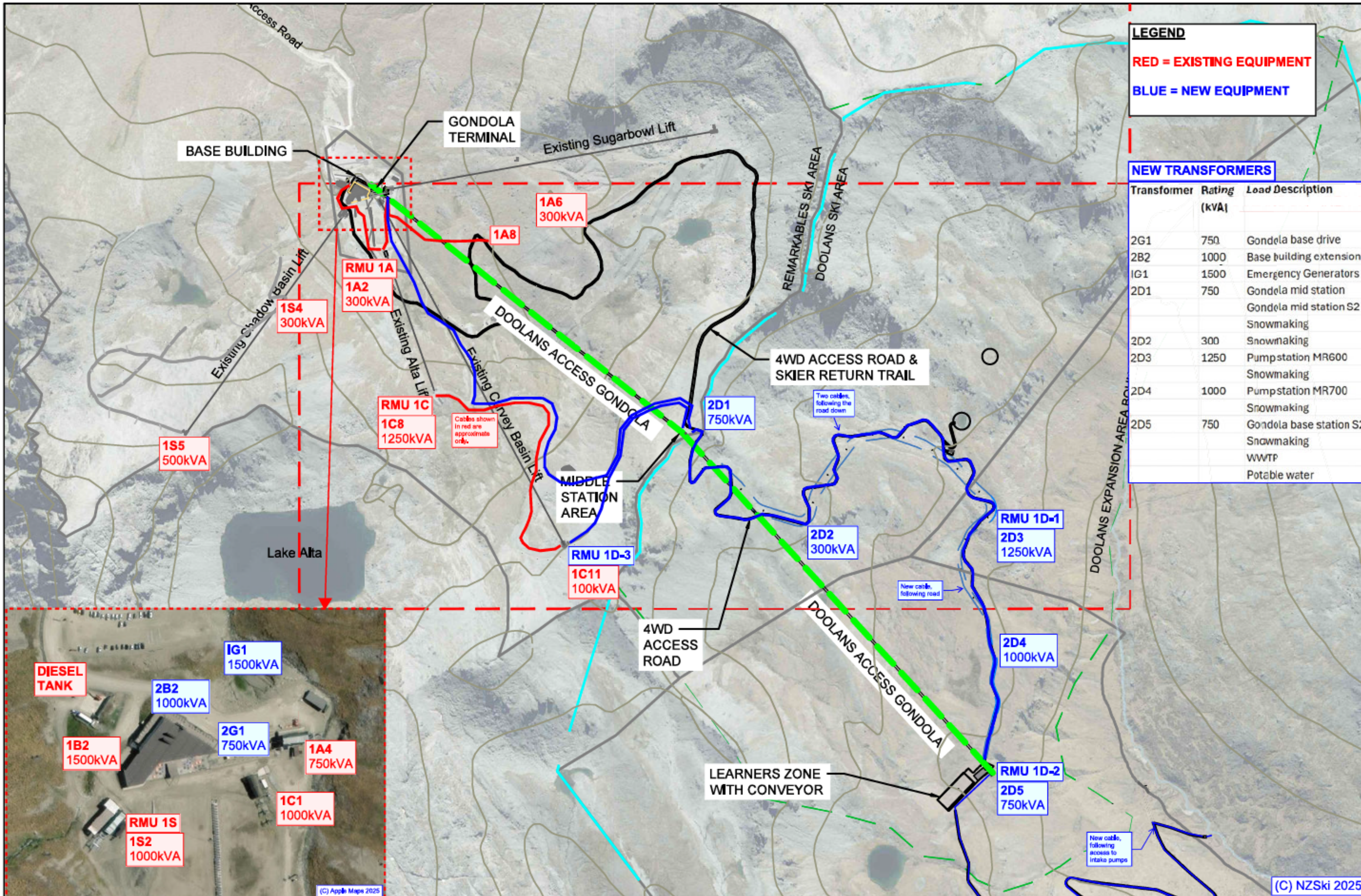

NEW TRANSFORMERS

Transformer	Rating (kVA)	Load Description	Load rating (kVA)
2G1	750	Gondola base drive	505
2B2	1000	Base building extension	1000
IG1	1500	Emergency Generators	-
2D1	750	Gondola mid station	25
		Gondola mid station S2	420
		Snowmaking	200
2D2	300	Snowmaking	250
2D3	1250	Pumpstation MR600	1000
		Snowmaking	175
2D4	1000	Pumpstation MR700	225
		Snowmaking	475
2D5	750	Gondola base station S2	40
		Snowmaking	100
		WWTP	15
		Potable water	15

NZSKI

REMARKABLES UPGRADE AND DOOLANS EXPANSION OVERALL SITE POWER LAYOUT

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Stantec New Zealand
Unit D1-03, 19 Grant Road, Frankton
Queenstown 9300
Mail to: PO Box 13052, Christchurch 8140
stantec.com