BEFORE THE PROPOSED OTAGO REGIONAL POLICY STATEMENT HEARINGS PANEL

UNDER the Resource Management Act 1991

AND

IN THE MATTER of submissions lodged on the proposed Otago Regional Policy Statement (excluding parts determined to be a Freshwater Planning Instrument)

EVIDENCE IN CHIEF OF ROY JOHN CLEMENT NOBLE ON BEHALF OF TRANSPOWER NEW ZEALAND LIMITED (314)

23 November 2022

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1. SUMMARY OF EVIDENCE

1.1 This evidence sets out the nature of Transpower New Zealand's (**Transpower**) activities in the Otago region and provides context to inform the panel as to why Transpower is seeking specific changes to the proposed Otago Regional Policy Statement 2021 (**pRPS**).

1.2 The National Grid is nationally significant infrastructure. Transpower, whose main role is to ensure the delivery of a reliable and secure supply of electricity to New Zealand, has a fundamental role in the industry and in New Zealand's economy.

1.3 Additionally, the National Grid plays a very important role in the sustainable management of natural and physical resources across the Otago Region and New Zealand.

1.4 In light of the significant benefits of the National Grid to both New Zealand and the Otago Region, it is important that the pRPS recognises the role and strategic importance of the National Grid and provides for its effective operation, maintenance, upgrading, and development.

1.5 Given its extensive and linear nature, it is sometimes not possible (or practical) to completely avoid locating parts of the National Grid in environmentally sensitive areas such as outstanding natural landscapes (**ONLs**), areas of significant indigenous vegetation and areas of high natural character.

1.6 While most maintenance activities are classified as permitted, there remain some activities that require consent under district plans. This can be problematic where Transpower assets are situated on, or span across, these same environmentally sensitive areas.

1.7 Increased electrification is beginning to have a major impact in our ability to predict future grid requirements. This increase is influenced by many factors, such as the Government Initiative to Decarbonise Industry (**GIDI**). The Otago region has many industries with considerable potential for decarbonising their businesses. The National Grid is an enabler to decarbonising.

1.8 The National Grid will need to develop in the Otago region in the future, to facilitate the construction of new generation and to account for the predicted increases in electrical loads.

1.9 Should a new line need to be built then the selection of a new route would follow Transpower's Area, Corridor, Route and Easement/Designation methodology (the **ACRE** process). Consideration is given to the location of the proposed infrastructure, with negative scoring being given to any special areas, such as significant indigenous biodiversity. While efforts are made to avoid these areas, in certain situations it may not be practicable (or even possible) given the sometimes large geographic extent of those areas.

1.10 It is critical that there is a planning framework in place that will enable development and other asset maintenance to occur efficiently. Transpower needs to respond to growth in generation and load, and also to new generation technologies. The size, nature and location of any future assets remains uncertain.

2. QUALIFICATIONS AND EXPERIENCE

2.1 My full name is Roy John Clement Noble. I am employed by Transpower as the Head of Engineering Integration based in Wellington.

2.2 I have over 38 years' experience in the design, construction and maintenance of high voltage transmission lines. I hold a

New Zealand Certificate of Engineering (Civil).

2.3 My previous roles at Transpower have included being the General Manager of Transformation (seconded) from April 2015 to February 2017, acting General Manager Grid Performance from February 2017 to June 2017, and Tactical Engineering Manager from June 2017 to March 2020. Most recently, and prior to my return to Wellington, I held the role of Project Director for the Clutha Upper Waitaki Lines Projects (**CUWLP**) based in Cromwell between September 2020 and June 2022.

2.4 My experience also includes five years as a South Island Transmission Line Maintenance Manager for a contractor for Transpower, followed by three years working in a transmission line design and project management consultancy.

2.5 I have worked for Transpower directly for 24 years, initially in a national engineering support role for maintenance works. I then transitioned into engineering design, construction and asset management roles for transmission line development and enhancement projects.

2.6 I am familiar with the National Grid assets within the Otago Region.

2.7 While this is a Council hearing, I confirm I have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2014. As I am employed by Transpower, I acknowledge I am not independent, however I have sought to comply with the Code. I confirm that I have considered all the material facts that I am aware of that might alter or detract from the opinions that I express, and that this evidence is within my area of expertise.

2.8 While I am employed by Transpower, I am providing this evidence in my capacity as an expert in transmission engineering and matters relating to the National Grid.

3. SCOPE OF EVIDENCE

3.1 My evidence sets out the nature of Transpower's activities in the Otago region, so that the Panel understands why Transpower is seeking specific changes to the pRPS. While that relief is set out in full in Ms McLeod's evidence, it can be summarised as:

(a) refine approaches to nationally significant infrastructure and regionally significant infrastructure to provide greater clarity in the provisions;

(b) align the 'effects tests' provisions for the development of the National Grid with the direction given in the National Policy Statement for Electricity Transmission (**NPS-ET**) through the inclusion of a bespoke policy;

(c) appropriately enable the operation, maintenance and minor upgrading of the National Grid without undue constraint; and

(d) require the avoidance of direct effects of activities on the National Grid, in addition to reverse sensitivity effects.

3.2 I explain in detail the nature and location of Transpower's current and future National Grid assets in the Otago Region, and the works Transpower undertakes to operate, maintain, upgrade and develop the National Grid.

3.3 Specifically, my evidence will address the following matters:

(a) Overview of the National Grid assets within the Otago Region;

(b) Operation, maintenance and minor upgrading of the National Grid;

(c) The issues created by third party activities which restrict or prevent access to National Grid assets;

(d) The role of the National Grid in facilitating growth for the Otago Region;

(e) Technical, operational and functional requirements of the National Grid;

(f) The future of electricity transmission in the Otago Region;

(g) Transpower's process for selecting the location of new transmission lines;

(h) Case Study 1: Queenstown Lakes District; and

(i) Case Study 2: Dunedin City.

4. THE NATIONAL GRID

Description of National Grid in the Otago Region

4.1 Transpower is the State-Owned Enterprise that plans, builds, maintains, owns and operates New Zealand's electricity transmission network - the "National Grid". The National Grid is the physical infrastructure that transports electricity throughout New Zealand.

4.2 The National Grid is nationally significant infrastructure. It comprises around 11,000 km of high voltage transmission lines, and 37,000 towers and poles, connecting 169 substations and switching stations across the country. The core National Grid is long and narrow linear infrastructure, reflecting New Zealand's topography. What happens at one point on the National Grid can have consequences much further away, in another region or even in another island.

4.3 The core National Grid comprises a high voltage backbone which runs the length of the country and links major generation (such as the hydro power stations in the Waitaki and Clutha Valleys) to major loads in large cities and towns. The bulk of the backbone National Grid was built around 60 years ago and comprises most of the 220 kV and 110kV lines throughout New Zealand, along with the High Voltage Direct Current (**HVDC**) link between the North and South Islands.

4.4 Given its extensive and linear nature, it is sometimes not possible (or practical) to completely avoid locating parts of the National Grid in environmentally sensitive areas such as outstanding natural landscapes and areas of high natural character.

4.5 Transpower's existing interests in the Region can be seen in **Appendix 1**. At the district level, those assets are:

<u>**Dunedin City**</u>

(a) **South Dunedin substation:** This station is the supply point for the southern and central part of Dunedin providing a grid connection to the Aurora Energy distribution network.

(b) **Halfway Bush substation:** This station is the supply point for the northern and central part of Dunedin providing a grid connection to the Aurora Energy distribution network. There is a core grid connection at 220kV and two connections to the regional 110kV network.

(c) **Three Mile Hill substation:** This station is the primary 220kV core grid hub in the Dunedin area, linking the generation outputs from Southland and Roxburgh to the electrical load of Dunedin.

(d) **Berwick substation:** This station is the grid injection point for the Waipori hydro generation scheme and renewable wind generation in the area.

(e) **Rudd Road communications site:** This communications site provides a link between local substations. There are also a number of other third-party lifeline providers that utilise the mast for their communications (e.g. NZ Police).

(f) **Part of Gore – Halfway Bush A (GOR-HWB A) 110kV transmission line:** This is a single circuit 110kV pole line constructed in 1938. The line forms part of an interconnected regional 110kV grid and includes connections to generation at Waipori Falls and regional electrical load in South Otago and Southland.

(g) **Part of Halfway Bush - Roxburgh A (HWB-ROX A) 110kV transmission line:** This is a double circuit 110kV steel tower line constructed in 1956. The line forms part of an interconnected regional 110kV grid.

(h) **Part of North Makarewa – Three Mile Hill A (NMA-TMH A) 220kV transmission line:** This is a double circuit 220kV steel tower line constructed in 1984. The line is part of the core National Grid connecting Otago to Southland.

(i) **Halfway Bush – South Dunedin A (HWB-SDN A) 220kV transmission line:** This is a double circuit 220kV steel tower and steel mono-pole line constructed in 1975. The line provides the sole point of supply to the South Dunedin substation.

(j) **Part of Roxburgh – Three Mile Hill A (ROX-TMH A) 220kV transmission line:** This is a double circuit 220kV steel tower line constructed in 1975. The line is part of the core National Grid.

<u>Waitaki District</u>

(a) **Livingstone substation:** This station is the interconnection point for the core National Grid between the Clutha, Waitaki and Canterbury regions.

(b) **Oamaru substation:** This station is the only National Grid connection and supply point for the Oamaru area (via the distribution company Network Waitaki).

(c) **Big Hill communications site:** This communications site provides a link between local substations allowing the control and management of load flows through the signalling to specific protection schemes in the area.

(d) **Parts of Roxburgh – Islington A (ROX-ISL A) 220kV transmission line:** This is a single circuit 220kV steel tower line constructed in 1956. The line provides connection between generation and load in the Clutha, Waitaki and Canterbury regions.

(e) **Glenavy – Oamaru A (GNY-OAM A) 110kV transmission line:** This is a single circuit 110kV pole line constructed in 1926. This is one of two lines that provides Oamaru and the surrounding area with electricity from Transpower's 110kV substation at Glenavy (on the north bank of the Waitaki River).

(f) **Glenavy – Oamaru B (GNY-OAM A) 110kV transmission line:** This is a single circuit 110kV pole line constructed in 1932. This is one of two lines that provides Oamaru and the surrounding area with electricity from Transpower's 110kV substation at Glenavy (on the north bank of the Waitaki River).

<u>**Central Otago District**</u>

(a) **Roxburgh substation:** This station is the main grid connection point for the Roxburgh hydro station. It provides a large connection hub to the National Grid lines through connections at both 110kV and 220kV.

(b) **Clyde substation:** This station is the grid connection point for the Clyde hydro station. It provides a connection to the National Grid lines to Roxburgh and to the Waitaki Valley (via the Cromwell Substation).

(c) **Cromwell substation:** This station the only supply point for the Frankton substation and (via the distribution company Aurora Energy) the electricity supply to Wanaka.

(d) **Naseby substation:** This station is the only supply point Maniototo area (via the distribution company PowerNet). It is also the potential connection point for renewable generation projects (solar) that are currently being explored.

(e) **Part of Halfway Bush - Roxburgh A (HWB-ROX A) 110kV transmission line:** This is a double circuit 110kV steel tower line constructed in 1956. The line forms part of an interconnected regional 110kV grid.

(f) **Part of Gore - Roxburgh A (GOR-ROX A) 110kV transmission line:** This is a single circuit 110kV pole line constructed in 1953. The line forms part of an interconnected regional 110kV grid.

(g) **Part of Cromwell - Frankton A (CML-FKN A) 110kV transmission line:** This is a double circuit 110kV steel tower line constructed in 1976. Both circuits provide Queenstown with electricity from Transpower's 220/110kV substation at Cromwell. This is the only transmission line that connects Queenstown to the National Grid.

(h) **Part of Roxburgh – Three Mile Hill A (ROX-TMH A) 220kV transmission line:** This is a double circuit 220kV steel tower line constructed in 1975. The line is part of the core National Grid.

(i) **Part of Invercargill – Roxburgh A (INV-ROX A) 220kV transmission line:** This is a single circuit 220kV steel tower line constructed in 1967. The line is part of the core National Grid forming an interconnection between the Roxburgh substation and the Southland region.

(j) **Part of Invercargill – Roxburgh B (INV-ROX A) 220kV transmission line:** This is a single circuit 220kV steel tower line constructed in 1973. The line is part of the core National Grid forming an interconnection between the Roxburgh substation and the Southland region.

(k) **Part of Roxburgh – Islington A (ROX-ISL A) 220kV transmission line:** This is a single circuit 220kV steel tower line constructed in 1956. The line provides connection between generation and load in the Clutha, Waitaki and Canterbury regions.

(l) **Part of Roxburgh – Twizel A (ROX-TWZ A) 220kV transmission line:** This is a double circuit 220kV steel tower line constructed in 1971. The line provides a connection to the Cromwell substation (that in turn supplies Queenstown) and provides a link between generation in the Clutha and Waitaki valleys.

Queenstown Lakes District

(a) **Frankton Substation:** This is the National Grid Exit Point Substation that supplies Queenstown and the surrounding area with electricity via the two distribution companies Aurora Energy and PowerNet.

(b) **Cromwell - Frankton A (CML-FKN A) 110kV transmission line:** This is a double circuit 110kV steel tower line constructed in 1976. Both circuits provide Queenstown with electricity from Transpower’s 220/110kV substation at Cromwell. This is the only transmission line that connects Queenstown to the National Grid.

Clutha District

(a) **Balclutha substation:** This station is the only supply point for the Balclutha and South Otago area ((via the distribution company PowerNet). It is connected to a double circuit spur line that in turn connects to the Gore-Halfway Bush line.

(b) **Part of Halfway Bush - Roxburgh A (HWB-ROX A) 110kV transmission line:** This is a double circuit 110kV steel tower line constructed in 1956. The line forms part of an interconnected regional 110kV grid.

(c) **Part of Gore – Halfway Bush A (GOR-HWB A) 110kV transmission line:** This is a single circuit 110kV pole line constructed in 1938. The line forms part of an interconnected regional 110kV grid and includes connections to generation at Waipori Falls and regional electrical load in South Otago.

(d) **Balclutha – Deviation A (BAL-DEV A) 110kV transmission line:** This is a double circuit 110kV steel tower line constructed in 1963. Both circuits provide Balclutha with electricity from Transpower's 110kV Gore-Halfway Bush line. This is the only transmission line that connects Balclutha and surrounds to the National Grid.

(e) **Part of Gore - Roxburgh A (GOR-ROX A) 110kV transmission line:** This is a single circuit 110kV pole line constructed in 1953. The line forms part of an interconnected regional 110kV grid.

(f) **Part of Invercargill – Roxburgh A (INV-ROX A) 220kV transmission line:** This is a single circuit 220kV steel tower line constructed in 1967. The line is part of the core National Grid forming an interconnection between the Roxburgh substation and the Southland region.

(g) **Part of Invercargill – Roxburgh B (INV-ROX A) 220kV transmission line:** This is a single circuit 220kV steel tower line constructed in 1973. The line is part of the core National Grid forming an interconnection between the Roxburgh substation and the Southland region.

(h) **Part of North Makarewa – Three Mile Hill A (NMA-TMH) 220kV transmission line:** This is a double circuit 220kV steel tower line constructed in 1984. The line is part of the core National Grid connecting Otago to Southland.

Role of the National Grid

4.6 New Zealand has become increasingly dependent on electricity, which is an intrinsic part of living and working in the 21st century. Electricity accounts for about 24% of all energy used in New Zealand. Each year, $5 billion of electricity is traded on the wholesale electricity market. Transpower, whose main role is to ensure the delivery of a reliable and secure supply of electricity to New Zealand, has a fundamental role in the industry and in New Zealand's economy. Transpower's role is illustrated at **Appendix 2**, by the components two to five as Grid owner and component six as Grid Operator.

4.7 Without the National Grid, communities across New Zealand would be dependent on locally generated electricity which would be more expensive and less reliable. In most areas of New Zealand the locally generated electricity would simply be insufficient to meet demand. For example, Queenstown District currently has the capacity to generate only a few megawatts for short periods of time but electricity demand currently has a peak of more than 78MW, and this is increasing. Due to this function, the National Grid plays a very important role in the sustainable management of natural and physical resources across the Otago Region.

4.8 In light of the significant benefits of the National Grid to both New Zealand and the Otago Region, it is important that the pRPS recognises the role and strategic importance of the National Grid and provides for its effective operation, maintenance, upgrading, and development. This includes in particular:

(a) Enabling the ongoing operation, inspection, maintenance and upgrading of the existing National Grid;

(b) Protecting the National Grid from the direct and indirect (reverse sensitivity) effects of land use, subdivision and development; and

(c) Enabling the development of the National Grid in new locations in the future, in response to changes in New Zealand's electricity supply needs.

4.9 The National Grid is an ever-developing system, responding to changing supply and demand patterns, growth, reliability and security needs. A key part of this is connecting new renewable energy generation to the National Grid. Transpower expects demand for electricity to increase over time as New Zealand transitions to a zero-carbon economy, and Transpower is uniquely placed to help enable that transition.

5. OPERATION, MAINTENANCE AND MINOR UPGRADING OF THE NATIONAL GRID

5.1 Transpower's asset strategy for its transmission line fleet is that all lines have a perpetual life. Transmission line structures can be maintained almost indefinitely by practices such as painting of towers, concrete encasement of existing grillage foundations and replacement of insulators. Conductors are replaced and increased in size and, at times, in the number of conductors per phase to meet additional carrying capacity needs.

5.2 Meeting the needs of future grid development to connect new generation and load, remains uncertain and challenging as New Zealand moves to decarbonise. In order to keep pace with these externally driven changes, it is essential that Transpower has the ability to enhance the existing grid.

5.3 The majority of the grid has been developed over the last 100 years, with the core 220kV grid being developed between 35 and 55 years ago. The linear nature of the transmission lines and the requirement to move electricity from generation to load centre has led to parts of the grid being unavoidably constructed within the likes of ONLs, significant natural areas and landscapes and areas of high natural character. The ability to maintain and enhance the existing grid in these sensitive areas remains essential.

5.4 Maintaining the National Grid is a core part of Transpower's business. It is important that appropriate access to the National Grid is retained in order to allow maintenance and development activities to take place. This is particularly relevant to changing land use and subdivisions.

Inspections of our assets

5.5 Transpower carries out two main types of inspection activities in order to determine maintenance, refurbishment or upgrade requirements – routine patrols and condition assessments.

Routine patrols

5.6 A routine patrol involves viewing every asset annually, as a minimum, to identify any short term defects or situations that may affect the operation or safety of the National Grid in the shorter term. Items identified on patrols include damaged or broken insulators, impediments on the conductors, broken climb guards, faded signs, vegetation growth, access issues, land subsidence, and developments or activities under or near the line that may affect its safe and reliable operation.

5.7 I emphasise in particular that developments or activities under or near the lines, which are unsafe, will potentially only be identified by Transpower once per year (assuming that the activity occurs on the day of the patrol and is identified by the patrol team).

Condition assessments

5.8 A full condition assessment involves every line component being inspected and, in some cases, tested on a time-based schedule (which, for the most part occurs once every 3-7 years depending on the asset type and environment). Condition assessments require access to all transmission line structures and conductors. From these detailed inspections, a work programme is developed to ensure components are replaced or refurbished well in advance of their failure point.

5.9 Routine patrols and condition assessments of towers are carried out by field staff or contractors using a 4x4 ute or all-terrain vehicle to get as close as possible to the base of each structure.

5.10 Transpower also undertakes mid-span inspections of conductors, conductor joints and hardware as part of the condition assessment programme. Conductor tests can be carried by linemen accessing the conductor via a conductor trolley or by helicopter. Helicopters and drones are also used to take thermal images, high resolution photos, mid-span joint resistance tests or direct visual inspections.

Maintenance activities

5.11 From these routine patrols and condition assessment inspections, a wide range of maintenance work is identified and incorporated into a consolidated work programme. The maintenance activities that occur most frequently are:

(a) Foundation refurbishment;

(b) Tower refurbishment including abrasive blasting and painting;

(c) Pole replacement;

(d) All aspects of tower conductor and insulator (and associated hardware) maintenance or replacement;

(e) Vegetation and tree control; and

(f) Repairs and reinstatement to access tracks.

5.12 Some of these activities also involve related land disturbances.

5.13 While most maintenance activities are classified as permitted,[1] e.g. replacing insulators and fittings, there are a number that may require consent under district plans. This can be problematic some cases where our structures are located in, or conductors span across mapped areas such as ONLs, significant natural areas and landscapes and areas of high natural character. An example of this would be the repair and maintenance of access tracks that service the tower sites (these tracks are maintained to four-wheel drive standard only).

5.1 Another maintenance activity that may require a resource consent is the replacement of a tower, either with another tower or a pole structure, in the event of significant damage. Given the linear nature of a transmission line, the new structure needs to be constructed on the same alignment as the existing line, but the replacement (or additional) structure would be set away from the existing structure to ensure at least one circuit could remain in service while repairs were made. There is very little flexibility in the location of replacement structures.

Vegetation and tree control

5.2 Trees and vegetation need to be monitored to ensure they are not growing too close to the lines. Transpower undertakes

1 Resource Management (National Environmental Standards for Electricity Transmission Activities) Regulations 2009, regs 5, 6, 7, 14, 17, 19, 23, 25, 28, 30, 33 and 37.

vegetation clearance in accordance with the Electricity (Hazards from Trees) Regulations 2003.

6. ISSUES CREATED BY THIRD PARTY ACTIVITIES RESTRICTING OR PREVENTING ACCESS TO ASSETS

6.1 The National Grid is enduring critical infrastructure, both locally and nationally. It is critical that there is a planning framework in place that will enable development and other asset maintenance to occur efficiently. Transpower has statutory rights to access its assets on private land under the provisions set out in the Electricity Act 1992. The Act provides for access to maintain, inspect and operate the National Grid. In some cases, Transpower has contractual or property rights to access new assets constructed on private land. It is important to note that my evidence is about the physical ability to access Transpower's assets. Issues regarding establishing legal access are distinct issues that are handled by other divisions in Transpower.

6.2 It is crucial that Transpower is not restricted from accessing its assets due to third party activities. Despite the NPS-ET being gazetted over 14 years ago, inappropriate development continues to occur under and around National Grid assets.

6.3 It is therefore important that the planning framework:

(a) Prevents sensitive and incompatible activities from being established under the transmission lines; and

(b) Includes controls on activities that will occur near lines.

6.4 These measures will assist the National Grid to be reliable, and to have a managed environmental footprint while serving future generations.

7. TECHNICAL, OPERATIONAL AND FUNCTIONAL REQUIREMENTS OF THE NATIONAL GRID

7.1 The National Grid has special characteristics that affect its positioning and structural makeup. These characteristics include:

(a) The historical location, with lines needing to be constructed between generation sources and electrical load. An example of where transmission lines were required to be located in an ONL, due to their linear nature and effects, is near the Loganburn Reservoir when the Roxburgh hydro scheme was constructed.

(b) The current location of these existing lines is unlikely to change as alternative routes would be difficult to find without creating significant impacts to adjacent environments and other properties.

(c) Transpower needs to respond to growth in generation and load, and also to new generation technologies. The size, nature and location of this remains uncertain (e.g. the possible Lake Onslow scheme). The requirement to connect these to the National Grid requires flexibility in the ability to plan, locate and construct infrastructure of a linear nature.

(d) The development and operation of the National Grid is planned in conjunction with local electricity distributors who operate local networks. The future expansion of the Grid will be based around the growing urban zones and industrial loads in the Region, and the sub-grid of the local distributors.

(e) The fact that the operation, maintenance, development and upgrade of the National Grid can be significantly constrained by the adverse impacts of third party activities and development. Effects can include reverse sensitivity effects, as well as direct effects. In some cases, it may not be immediately (or at all) apparent to a council or a developer that a proposal might impact on or compromise the National Grid. For example, in my experience, I have encountered situations where council officers appear to believe that if a development complies with NZECP34, there will be no effects on the National Grid. That is not the case. Issues would also arise if a development restricts Transpower's ability to use an existing access track to access its infrastructure for maintenance, repair or upgrade.

(f) The perceived adverse environmental effects of the National Grid are often local, while the benefits often extend beyond that and benefit the wider region or nation.

8. FUTURE NATIONAL GRID INFRASTRUCTURE AND SYSTEM PLANNING WITHIN OTAGO REGION

8.1 Transpower undertakes a detailed analysis of the grid capacity annually and publishes this in its Transmission Planning Report.[2] Forecasting peak load is inherently uncertain, therefore we use what is termed a prudent load forecast. This uses a 10 per cent probability of exceedance forecast of underlying demand for the first seven years of the forecast period, and for following years, an expected (or mean) rate of

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2 2022 Transmission Planning Report https://tpow-corp-production.s3.ap-southeast-2.amazonaws.com/public/uncontrolled_docs/2022%20Transmission%20Planning%20Report.pdf?VersionId=v6h_P0Vwhmys9BEpp3OGicM1aj4Fr_OZ

underlying growth. This report identifies development and enhancement works required on the grid.

8.2 Prudent forecast annual peak demand for the Otago region is currently 409MW with a forecast increase to 482MW in 2032 (18% increase), and 504MW by 2037.

8.3 Generation within the region is currently 977MW of which 784MW is generated by Roxburgh and Clyde hydro stations. Surplus generation is exported via the National Grid to other demand centres in the South Island, and via the HVDC link to the North Island.

8.4 Grid capacity in the Otago region is in most cases sufficient in its existing state, however the one major outlier of this is the constrained transmission capacity to the Queenstown area – this is described in detail in a case study in section 10 of my evidence below.

8.5 Increased electrification however is beginning to have a major impact in our ability to predict future grid requirements. This is influenced by many factors, such as the Government Initiative to Decarbonise Industry (**GIDI**), existing coal users transitioning to electricity (or electricity and biofuels), and industry and residential users seeking new low carbon alternatives. Therefore, where increased electrification occurs at a grid exit point, the magnitude and timing of the peak load can be challenging to forecast.

8.6 The Otago region has many industries with considerable potential for decarbonising their businesses. The National Grid is an enabler to decarbonising as industry can increase electricity demand, either by converting directly to electric heating or converting to biomass, which is often also paired with partially electrifying processes (such as heatpumps for low temperature heat).

8.7 Transpower estimates that demand for renewable energy will increase by 68% by 2025. Renewable energy will take many forms such as solar (such as the potential Tarras solar development) and wind. The National Grid is the primary mode of moving this renewable energy from generation to the load centres.

8.8 In addition to the above, there is also the possibility of a pumped storage facility at Lake Onslow (NZ Battery Project). This project will have significant impacts on the National Grid, and the grid will require significant development and expansion to enable connection with sufficient transfer capacity to meet the project outcomes.

8.9 It is my understanding that Transpower does not presently have any existing lines or substations located within the Coast in the Otago region. However, future development of generation such as offshore windfarms or hydrogen production facilities could potentially require the National Grid to be located within the Coast to enable those developments. All endeavours will be made to avoid the Coast through the ACRE process described in Section 9 below, however in all cases avoidance may not be practicably achievable.

8.10 In summary, the National Grid will need to develop in the Otago Region in the future. Consideration and facilitation of this development should be recognised and allowed for in the pRPS.

9. TRANSPOWER'S PROCESS FOR SELECTING THE LOCATION OF NEW TRANSMISSION LINES

9.1 When selecting the route of any new transmission line, Transpower follows the Area, Corridor, Route and Easement/Designation (the **ACRE** process. This section of my evidence briefly describes the ACRE process because it shows how landscape and other values factor into the process, but also how the constraints imposed by linear infrastructure are considered but cannot always be avoided.

9.2 Transpower developed the ACRE model to identify and secure the most suitable location for transmission infrastructure. The ACRE model is based on a progressive filtering approach, where increasing and more specialised detail is provided on environmental, property and engineering constraints throughout the process to enable the identification of a preferred route or site.

9.3 The key stages of the ACRE process are summarised below (these can be modified or combined, depending on the scale and nature of the project):

(a) **A - Area** (identification of the wider study area within which the project might occur; undertaking constraints and opportunities mapping);

(b) **C - Corridor** (identification and confirmation of alternative corridors, ranking and selection of preferred corridor);

(c) **R - Route** (selection and evaluation of a route, or alternative routes, within the preferred corridor, consultation on one or more routes and confirmation of preferred route, following public consultation); and

(d) **E - Easement/Designation** (identification and confirmation of the easement and designation centreline). There are two further process steps, referred to as "D" and "S":

(i) **D - Documentation** (preparation of full documentation for lodgement with councils); and

(ii) **S - Statutory Process** (lodgement of documents for statutory approvals under the

RMA, board of inquiry/council hearings, Environment Court appeal process where relevant).

9.4 During the Area, Corridor, Route and Easement/Designation stages consideration is given to the location of the proposed infrastructure, with negative scoring being given to any special areas, such as significant indigenous biodiversity. While efforts are made to avoid these areas, in certain situations it may not be practicable (or even possible) given the sometimes large geographic extent of those areas.

9.5 The ACRE process allows for a trade-off between a number of factors, with the intent of finding a preferred solution:

(a) It takes into account technical and operational requirements, such as the need to connect to existing assets, or maintain safety clearances;

(b) It demonstrates that adverse effects have been avoided through the site, route and method selection;

(c) Sensitive activities such as residential areas can be mapped, so that options which reduce effects on sensitive activities can be explored; and

(d) Town centres and other valued locations such as areas of high recreational value, ONLs, Maori land, ecological areas and areas of high natural character are also mapped, so they can be avoided if practicable.

9.6 Often it is not practicable to avoid effects on all identified values. For example:

(a) Avoidance of urban areas and sensitive activities can often deflect assets towards areas with greater landscape, natural character or recreational value (i.e. non-urban locations);

(b) Avoiding particular locations can also mean a National Grid line must take a longer route, impacting a greater number of people and values along that longer route, and costing more to develop, operate and maintain (that cost being borne by electricity users);

(c) Reducing the height of lines (to reduce their visibility) can mean that a greater number of support structures (towers or poles) are required in order to maintain safe ground-to-conductor clearances. Lower conductors can require greater vegetation clearance, and more extensive access tracks for the greater number of support structures; and

(d) Undergrounding lines is often prohibitively expensive, and still requires earthworks and a clear corridor (including clear of vegetation and above-ground structures). Further, it can complicate maintenance and repairs.

9.7 I would support a policy statement framework which supports the ACRE process and recognises this process as a key tool for managing the effects of National Grid development, particularly given that it is not always possible to avoid effects.

10. CASE STUDY 1: QUEENSTOWN LAKES DISTRICT

The future of electricity transmission in the Queenstown-Lakes District

10.1 Peak electricity demand for the Queenstown urban area is forecast to grow over the next 10 years, from 78MW in 2022 to 97MW by 2030. This growth is higher than the national average annual demand growth. Similar load growth patterns are observed to be occurring in and around Wanaka, and demand from Cromwell is forecast to increase from 44MW to 54MW over the same time.

10.2 Increases in electricity demand in Queenstown are due to factors such as population growth, electrification of heating and transport, and increased commercial activity.

10.3 Peak demand for the Queenstown urban area is forecast to exceed the maximum 80MW post contingency capacity of the Frankton Substation by 2023. A special protection scheme has been installed that increases pre-contingency capacity, however a fault during a peak period will likely now lead to load shedding or contracted demand response (i.e. use of hot-water ripple control to reduce load or a contracted reduction in electricity availability for selected industry). Due to the potential for these outcomes, this protection scheme is not a viable long-term solution.

10.4 The resilience of the double circuit spur line into Queenstown also needs to be considered. Failure of any structure on this line would lead to a total loss of supply to Queenstown and surrounding areas. It could take anywhere between one day to a week to return service, depending on the extent of failure.

10.5 To address these supply and resilience issues, the existing National Grid assets in Queenstown Lakes District (both the CML-FKN A transmission and the Frankton substation) will require an upgrade in the near future, to temporarily address capacity issues. The Queenstown urban area and surrounds may also need a new transmission line at some point in the future to address longer term supply and resilience issues.

Upgrading electricity transmission in the Queenstown-Lakes District

10.6 As noted above, electricity demand in Queenstown is forecast to exceed the post contingent capacity of the existing transmission system into Queenstown by 2023. Incremental upgrading solutions are being employed to increase the capacity of both the line and the substation for a few more years while a more permanent capacity and resilience solution can be identified and approved.

10.7 The next step after the incremental fixes is increasing the capacity of the existing transmission line. This can only be achieved by increasing the maximum operating temperature. However, increasing temperature means that when the circuits run at capacity the conductors sag more, and some spans will potentially infringe the clearance requirements of the New Zealand Electrical Code of Practice for Electrical Safe Distances (NZECP34:2001). These clearance infringements can be mitigated using a number of solutions, including:

(a) Installing mid-span pole structures;
(b) Re-tensioning sections of line (any increase in tension often leads to a requirement to strengthen structures and foundations);
(c) Undertaking earthworks to recontour the ground to achieve clearances;
(d) Converting suspension towers to strain towers; and
(e) Increasing the height of towers using inserted body extensions.

10.8 While a number of the activities that are critical in upgrading the electricity supply are likely to be permitted, others will require a consent under the Resource Management (National Environmental Standards for Electricity Transmission Activities) Regulations 2009. Consenting uncertainty places the ability to design and build the upgrade at risk. Failure to be able to undertake this work places the supply of electricity to Queenstown at risk.

Construction of new Electricity Transmission Infrastructure in the Queenstown-Lakes District

10.9 A long-term solution is required to secure a reliable and resilient supply of electricity to Queenstown and surrounding areas. There may potentially be future alternative options, such as embedded generation (e.g. small-scale hydro schemes, wood pellet thermal generation, or hydrogen fuel cells), solar or wind generation and battery storage options. However, to date, these options have not been found to be practical solutions to load growth in the Queenstown area. My evidence only addresses National Grid connected transmission solutions.

10.10 Transpower has previously investigated the possibility of reconstructing (i.e. replacing) the existing transmission line with a larger capacity line. This would not remove the risks involved with only being supplied by a single spur line. However, Transpower found this to be an impractical solution as the existing line would need to be removed from service therefore removing all National Grid supply to Queenstown and surrounding areas, or a temporary bypass line would be required to be built to divert electricity while a new line was built. Any temporary bypass line would have similar effects as the construction of a new line and would not avoid the likes of the Wāhi Tūpuna or ONLs mapped in the Queenstown Lakes Proposed District Plan, as the existing line route already traverses those areas.

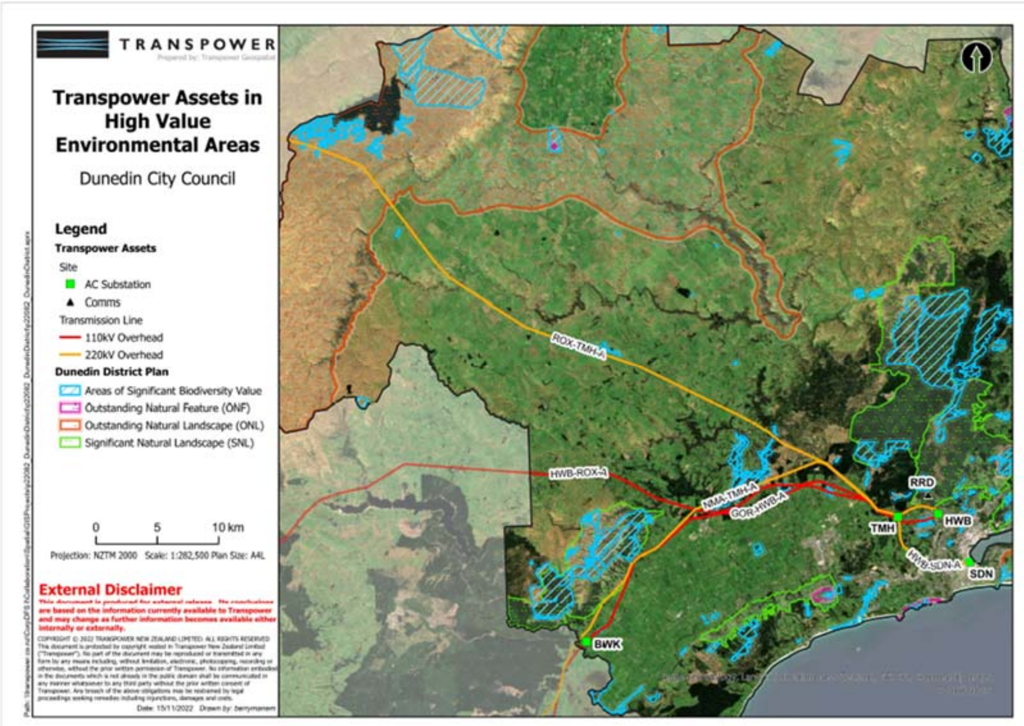
10.11 The construction of a new transmission line connection to the Queenstown area would provide a robust and resilient solution for the long-term electricity needs of the community. I consider that the preferred solution would likely be an overhead line connection, rather than an underground solution, given the terrain, geology, operational constraints (ground heating), reliability, time for repair, and cost. Even if these constraints could be overcome (and I am not confident that they could be), an underground solution would have substantial visual impacts, given the extensive earthworks required during construction, assuming a route could even be found. Any transmission solution would need to connect to the backbone grid either to the east or south of the Queenstown Lakes District.

11. CASE STUDY 2: DUNEDIN CITY DISTRICT

The maintenance of electricity transmission in the Dunedin City District

11.1 A review of mapping in the Dunedin 2GP Plan identifies a number of sections of the National Grid that traverse Areas of Significant Biodiversity Value, ONL and Significant Natural Landscape. These are shown at a high level at **Figure 1** below.

Figure 1

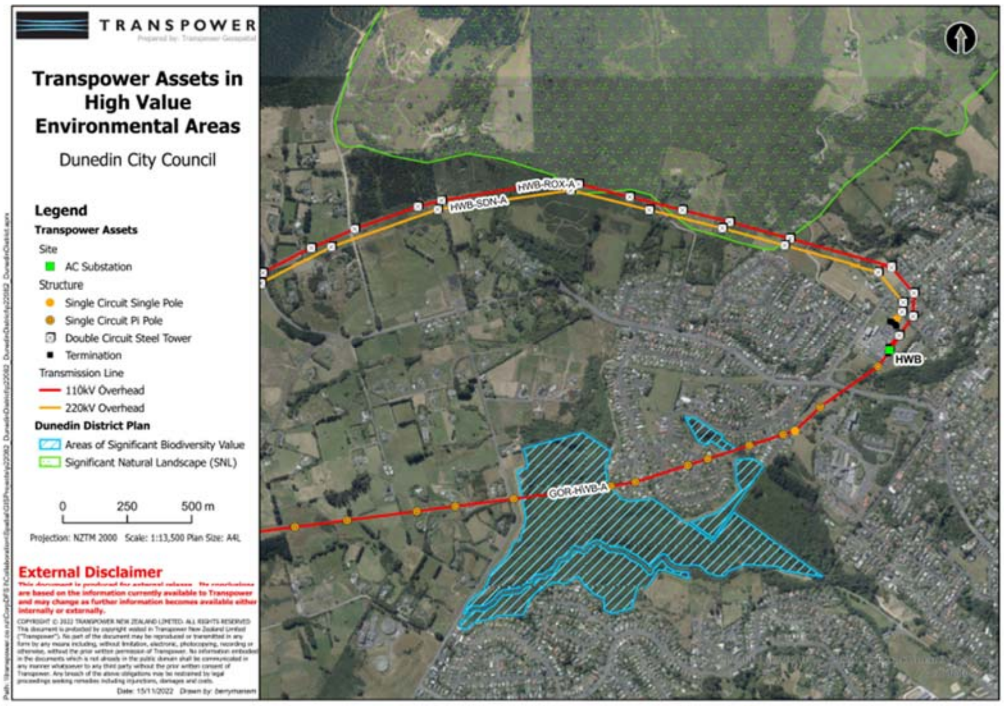


11.2 As noted earlier in my evidence, maintenance of the National Grid is essential to ensure a safe and reliable supply of electricity to the region and the nation. The location of the Grid dates back to the time of construction and the route selection methods used at that time. I provide below some examples where Transpower needs to be able to undertake maintenance activities in areas that have high environmental value:

(a) Transpower needs to be able to undertake vegetation control work to maintain safe electrical clearance distances in mapped Areas of Significant Biodiversity Value. The Gore-Halfway Bush line was constructed in 1938 and is located across a heavily vegetated gully (**Figure 2** and **Figure 3**). While the vast majority of the vegetation does not impact the operation of the line, there are trees directly below the line at the upper extents of the gully that require routine trimming in accordance with the Electricity (Hazards from Trees) Regulations 2003.

Figure 2

Figure 3



(b) Sections of the North Makarewa – Three Mile Hill 220kV line and Gore-Halfway Bush 110kV line traverse a mapped Significant Natural Landscape on the western slopes of the Taieri Plains (see **Figure 4** and **Figure 5** below). Maintenance activities on these lines include vegetation control work, access track maintenance, pole replacement (GOR-HWB line), and reinsulation.

Figure 4

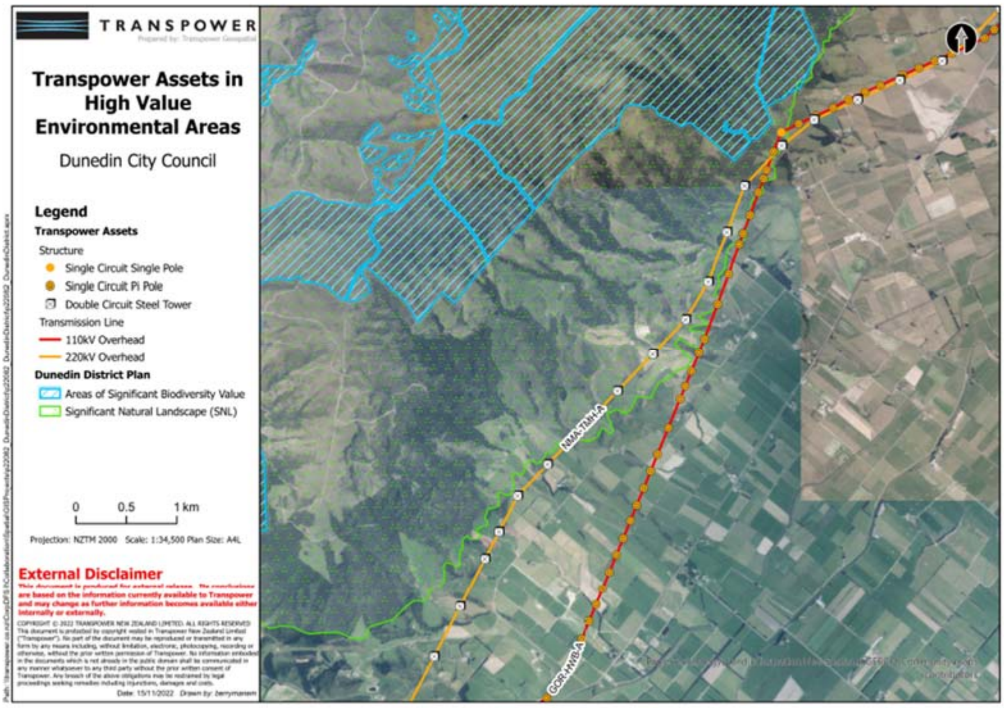


Figure 5

11.3 A large section of the Roxburgh-Three Mile Hill 220kV line traverses a large area of mapped ONL near the Loganburn Reservoir in the west of the Dunedin City District (see **Figure 6** below). Given the location and importance of this line, the maintenance of access tracks to each structure is imperative. This constructed access track network is shown at **Figure 6** below. For reference and a fuller understanding of that landscape, I also include a photo of a typical structure in this ONL (**Figure 7**).

Figure 6

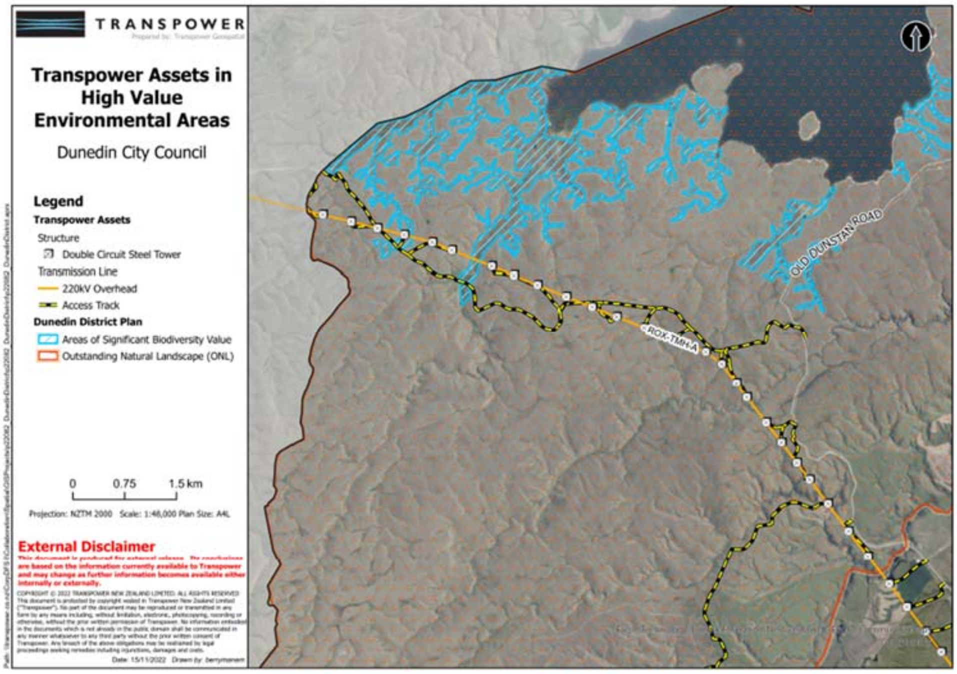


Figure 7

12. CONCLUSION

12.1 In order to support the role and strategic importance of the National Grid, the pRPS needs to provide for the Grid's effective operation, maintenance, upgrading, and development. This includes:

(a) Enabling the ongoing operation, inspection, maintenance and upgrading of the existing National Grid;

(b) Protecting the National Grid from the direct and indirect (reverse sensitivity) effects of land use, subdivision and development; and

(c) Enabling the development of the National Grid in new locations in the future to meet New Zealand's electricity supply needs, and recognising that avoiding some effects is not always possible.

Roy John Clement Noble
Dated 23 November 2022

Transpower Assets

Otago Region

Legend

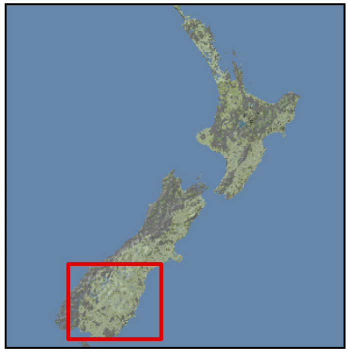
Region
- Boundary

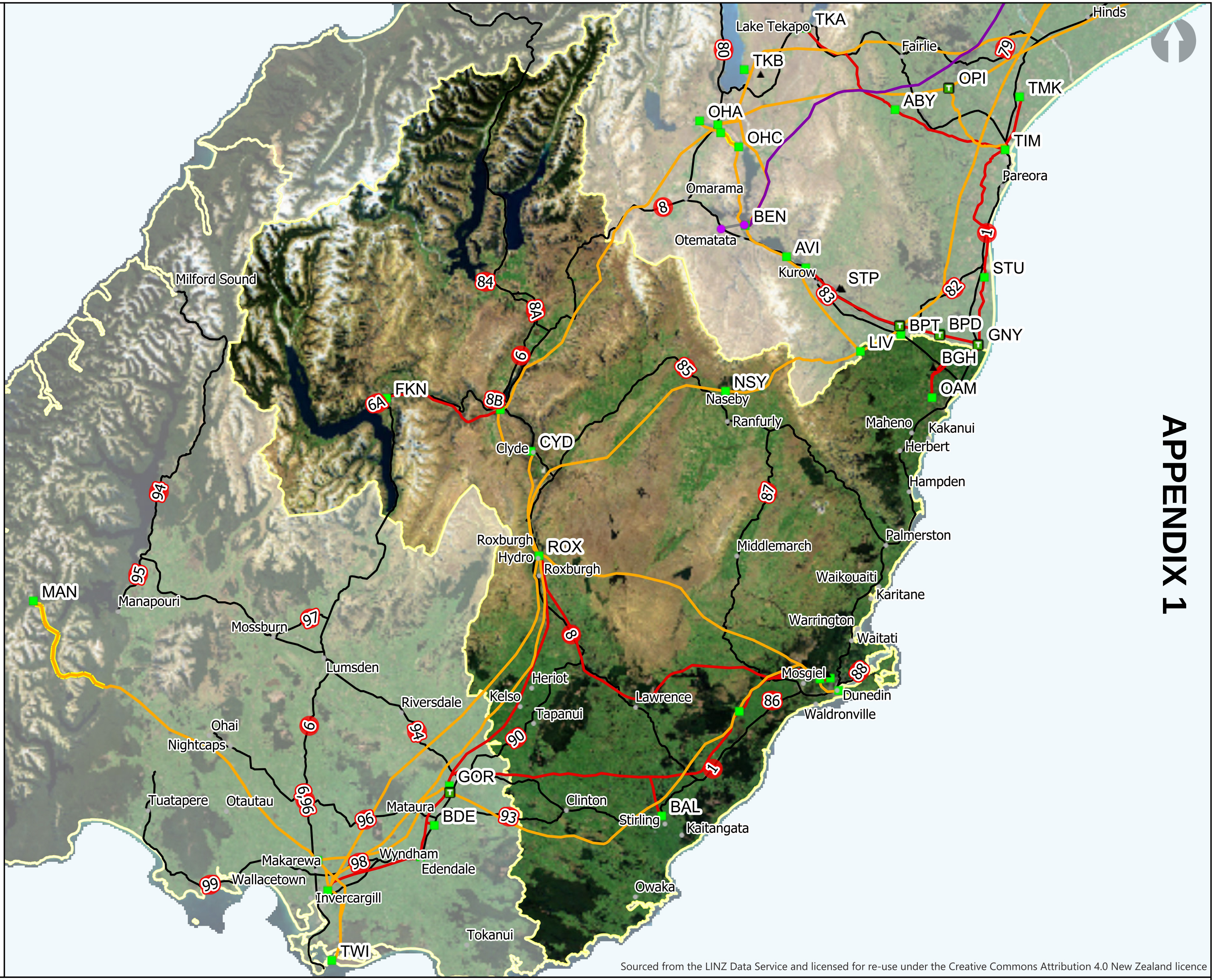
NZ Roads
- Highways

Transpower Assets
- Cable Protection Zone
- Overhead Fibre Cable
- Underground Fibre Cables

Site
- ACSTN
- COMMS
- HVDC
- TEE

Transmission Line
- 0kV Overhead
- 11, 66kV Underground
- 11, 33, 66 kV Overhead
- 110kV Underground
- 110 kV Overhead
- 220kV Underground
- 220 kV Overhead
- 350 kV Overhead
- 350kV Submarine
- 400kV Overhead





TRANSPOWER
Prepared by: Transpower Geospatial

0 1,000 2,000 km

Projection: NZTM 2000 Scale: 1:1,183,000 Plan Size: A3L

External Disclaimer

This document is produced for external release. Its conclusions are based on the information currently available to Transpower and may change as further information becomes available either internally or externally.

Date: 8/04/2020 *Drawn by: berrymanem*

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APPENDIX 2

Where we fit in

We own and operate New Zealand's national electricity transmission network and run the electricity market system.

1 Generation
Generation companies generate power from wind, thermal, hydro and geothermal. They sell the power they generate on the electricity market. Emerging distributed generation includes electric vehicles, batteries and solar photovoltaic.

2 New Grid Connects
As New Zealand moves to electrify its economy, Transpower is receiving more requests to connect to the grid. This includes new generation such as solar and wind, as well as new industrial demand.

3 Transmission
Transpower transports high voltage electricity from where it is generated to distribution companies and some large directly connected customers.

4 Industrial Customers
A few major industrial companies receive their power directly from Transpower.

5 Substations
Substations reduce the voltage at the point where electricity is delivered to distribution companies – our customers.

6 System Operator
Operates the wholesale electricity market and manages system security.

7 Distribution
The lower voltage electricity is transported by distribution companies to homes and businesses throughout New Zealand.

8 Commercial
Some commercial customers that consume large quantities of energy purchase power directly from the wholesale electricity market.

9 Retail
Retailers buy power on the electricity market, package it together with other costs of delivering power (transmission and distribution), and on-sell it to customers.

10 Domestic and Business Users
Domestic and business users receive their electricity directly from retail companies, which deliver power to homes, businesses and commercial operations using distribution companies' lines.