BEFORE THE DISTRICT HEARINGS PANEL

Under the Resource Management Act 1991

In the matter of

Proposed Queenstown Lakes District Plan – Chapter 3 Strategic Directions, Chapter 4 Urban Development, and Chapter 6 Landscape

and

Transpower New Zealand Limited (Submitter 805)

Submitter

Statement of Evidence in Chief of Andrew Renton on behalf of Transpower New Zealand Limited dated 29 February 2016

BELL GULLY
BARRISTERS AND SOLICITORS
AJLBEATSON/ NJ GARVAN
AUCKLAND LEVEL 22, VERO CENTRE, 48 SHORTLAND STREET
PO BOX 4199, AUCKLAND 1140, DX CP20509, NEW ZEALAND
TEL 64 9 916 8800 FAX 64 9 916 8801

Introduction

1. My full name is Andrew Charles Renton.

2. I am employed by Transpower New Zealand Limited (**Transpower**) as the Senior Principal Engineer. I have a New Zealand Certificate of Engineering and Bachelor of Engineering (Electrical).

3. I have over 26 years' experience in transmission engineering work. I currently work in the Grid Development Division of Transpower. My role involves investigating and providing holistic, pragmatic and strategic advice to developers and the infrastructure divisions of councils, on suitable and cost effective transmission solutions as well as new developments and technologies. My previous roles at Transpower have included the Asset Development Engineering Manager responsible for all substation and transmission line engineering development work.

4. I am familiar with the National Grid assets within the Queenstown Lakes District.

Code of Conduct

5. I confirm that I have read the 'Code of Conduct for Expert Witnesses' contained in the Environment Court Consolidated Practice Note 2014. I agree to comply with this Code of Conduct. In particular, unless I state otherwise, this evidence is within my sphere of expertise and I have not omitted to consider material facts known to me that might alter or detract from the opinions I express. While I am employed by Transpower, I am providing this evidence in my capacity as an expert in electrical engineering and matters relating to the National Grid.

Scope of Evidence

6. My evidence will address the following matters:

   (a) The critical role of the National Grid;

   (b) The National Grid as a facilitator of growth for the Queenstown Lakes District;

   (c) Potential for adverse effects on the National Grid; and

   (d) Conclusions.

Critical Role of the National Grid

What is the National Grid?

7. Transpower is the State Owned Enterprise that plans, builds, maintains, owns and operates New Zealand's electricity transmission network – the National Grid. The Grid, which extends from Kaikohe in the North Island down to the Tiwai Point Smelter in the South Island, is the physical infrastructure that transports electricity throughout New Zealand.

8. The National Grid is critical infrastructure. It comprises around 12,000 km of high voltage transmission lines, and 41,000 towers and poles, connecting 176 substations and switching stations across the country. The National Grid is long and narrow linear infrastructure, reflecting New Zealand's topography. What happens at one point on the Grid can have consequences much further away, even in another region.

9. The 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 Grid was built around 60 years ago and comprises most of the 220 kV lines throughout New Zealand, along with the High Voltage Direct Current (**HVDC**) link between the North and South Islands.

10. Connected to this Grid backbone are regional Grid lines (also owned or operated by Transpower) which connect smaller generation stations and supply regional communities. The regional Grid lines in the Queenstown Lakes District Council Area are 110kV.

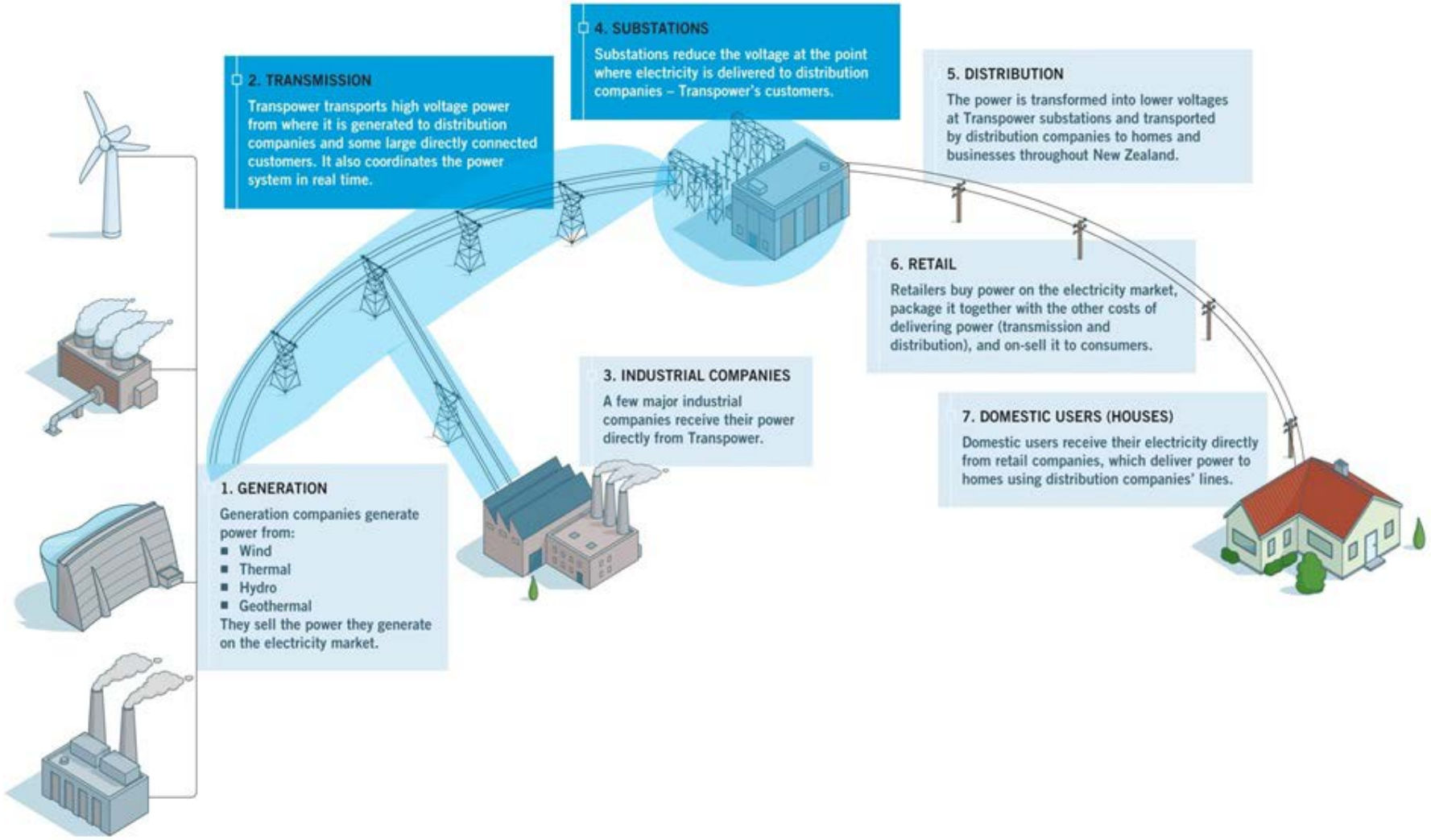
11. The Grid is an interlinked network. Electricity flows along transmission lines and varies in any instant, depending on actual generation at power stations and the demand for electricity across New Zealand. As System Operator, Transpower uses real-time information about electricity use by consumers and electricity generation available from generators to balance electricity demand and supply, ensuring optimum performance of the network.

Role of the National Grid

12. New Zealand has become increasingly dependent on electricity. It is an intrinsic part of living and working in the 21st century. Electricity now accounts for about 25% of all energy used in New Zealand.[1] 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 in **Diagram 1** below.

[1] Ministry of Business, Innovation and Employment Energy in New Zealand 2014. This figure is for the 2013 calendar year.

Diagram 1


4. SUBSTATIONS
Substations reduce the voltage at the point where electricity is delivered to distribution companies – Transpower's customers.
2. TRANSMISSION
Transpower transports high voltage power from where it is generated to distribution companies and some large directly connected customers. It also coordinates the power system in real time.
5. DISTRIBUTION
The power is transformed into lower voltages at Transpower substations and transported by distribution companies to homes and businesses throughout New Zealand.
6. RETAIL
Retailers buy power on the electricity market, package it together with the other costs of delivering power (transmission and distribution), and on-sell it to consumers.
3. INDUSTRIAL COMPANIES
A few major industrial companies receive their power directly from Transpower.
7. DOMESTIC USERS (HOUSES)
Domestic users receive their electricity directly from retail companies, which deliver power to homes using distribution companies' lines.
1. GENERATION
Generation companies generate power from:
Wind
Thermal
Hydro
Geothermal
They sell the power they generate on the electricity market.

13. Without the National Grid, communities across New Zealand would be dependent on locally generated electricity which would be more expensive and less reliable. As such, the National Grid plays a very important role in the sustainable management of natural and physical resources.

14. In light of the significant benefits of the National Grid to both New Zealand and the Queenstown Lakes District it is important that the Proposed Queenstown Lakes District Plan (the **Proposed Plan**) recognises the role and strategic importance of the National Grid and provides for its effective operation, maintenance, upgrading, and development, as sought by Transpower in its submission.[2]

What is Transpower's role?

15. Transpower is not a generator of electricity and has no retail sales of electricity.[3] It can be considered to be a 'freight company' for electricity, in that it transports bulk electricity from where it is generated by companies such as Meridian Energy, Contact, Trustpower and Genesis Energy to the local lines distribution companies which supply electricity to our homes, farms, communities and businesses. The Grid also directly supplies some major users of electricity (e.g. Tiwai aluminium smelter).

16. Transpower also manages New Zealand's power system in real time. In its role as System Operator, Transpower ensures electricity transmitted through the Grid is delivered whenever and wherever it is needed, 24 hours a day, seven days a week.

17. Transpower is required to deliver and operate a National Grid that meets the needs of users now and into the future.[4] Prudent investment

[2] Transpower's submission seeking new objectives and policies

[3] As a State Owned Enterprise, Transpower's principal objective is to operate as a successful business. It must operate within certain legislative constraints and report regularly to its shareholding Ministers. The National Grid is a natural monopoly. Transpower's investments in the Grid and transmission charges are regulated by the Commerce Commission.

[4] Statement of Corporate Intent 2014/2015

in the Grid, long term transmission planning strategies, and developing technologies are crucial to ensure the most can be made out of existing infrastructure. As I will explain below, managing development near or under lines provides the necessary access to the Grid to allow required regular maintenance to be undertaken in a safe and efficient manner, and ensures a reliable and safe supply to consumers.

18. Transpower's publication "Transmission Tomorrow" sets out Transpower's strategy for the future development of the Grid for the next 30 years and beyond.[5] Transmission Tomorrow confirms Transpower's view that there is an enduring role for the National Grid. Transpower's lines and substations will be required for many years into the future to power the economy while enabling New Zealand's continued reliance on renewable forms of electricity generation.

19. To meet the future needs for the Grid, Transmission Tomorrow identifies that Transpower must maintain its ability to use existing transmission corridors to the greatest extent possible. Availability of corridors for National Grid lines is the largest constraint in ensuring the Grid can meet future needs. The importance of corridors has also been recognised by Government. The National Policy Statement on Electricity Transmission (**NPSET**), introduced in 2008, requires councils to give effect to its provisions in their district plans.

Facilitator of Growth for Queenstown Lakes District and Enabler of greater penetration of renewable energy for consumer use

20. The National Grid is fundamental to the continued sustainable growth of the Queenstown Lakes District communities. It serves two key purposes. First, it provides a secure source of renewable electricity for both residential and industrial consumers in Wanaka, and Queenstown. Secondly, it provides the ability to utilise the electricity generated from the hydro stations in the Waitaki and Clutha Valleys, and the Mackenzie Basin.

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https://www.transpower.co.nz/sites/default/files/publications/resources/SCI-2014-15.pdf at 4.

[5] A copy of *Transmission Tomorrow* is available at https://www.transpower.co.nz/resources/transmission-tomorrow

21. Transpower is seeking recognition of the role of the Grid in facilitating growth in the District, as well as an acknowledgement that the National Grid has positive effects in terms of enabling people and communities to provide for their social, economic, and cultural well-being and for their health and safety.

22. Transpower's interests in Queenstown Lakes District include National Grid lines and substations and associated infrastructure that traverse the greater Central Otago Region in order to supply electricity to Queenstown and Wanaka (see **Map B**) and to transmit electricity across the broader Region and the Regions to the North and South (see **Map A**).

23. The following National Grid assets are within, or traverse, the Council's jurisdiction:

    (a) **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 Grid and supplies the vast majority of the electricity used in the town and surrounding area.

    (b) **Frankton 110/33kV Substation**

    This is the Grid Exit Point Substation that supplies Queenstown and the surrounding area with electricity via the two distribution companies Auroa Energy and PowerNet. Presently supplying a peak demand of 50MW the site is designed to manage up to 80MW.

24. Located in the wider Central Otago Region is Transpower's Cromwell substation. This station is located in the Central Otago District Council's jurisdiction, and is the only supply point for the Frankton substation and via the distribution company Auroa Energy the electricity supply to Wanaka.

25. These substations are subject to designations that Transpower has requested be “rolled-over” as part of the Plan Review process.

26. The National Grid in the greater Central Otago region has been developed over the last 60 years, with most of the lines that now exist in particular the CML-FKN A being established in 1976. The infrastructure is all above ground, being developed based on available technologies at the time (and the rights of acquisition for land for substations and line routes). It should be noted that during the Canterbury and Bay of Plenty earthquakes this type of overhead line technology performed very well whereas buried cables were severely affected.

27. Similarly, the historical development of Transpower's substations was based on standard outdoor air-insulated technologies which were consistent with international practices.

28. The Queenstown Lakes District has some of the highest and most seasonal load densities in the region, coupled with relatively low levels of local generation. As the majority of Queenstown’s peak electricity demand is supplied by generation located in the greater Central Otago and South Canterbury regions, transmission infrastructure is necessary to keep power flowing into the region.

29. Electricity demand for the Queenstown area is forecast to grow on average by 1.8% annually over the next 15 years, from 50MW in 2015 to 77 MW by 2030. This growth is higher than the national average demand growth of 1.1% annually. Similar load growth patterns are observed to be occurring in and around Wanaka with demand from Cromwell increasing from 33MW to 46MW over the same time. Should this demand continue as expected around Cromwell and Wanaka then reinforcement options such as a establishing a new bulk supply point closer to Wanaka around the wider Tarras area may be required.

Potential for Adverse Effects on the National Grid

30. Buildings and activities in close proximity to the National Grid can compromise its on-going operation, maintenance, upgrade and

development. Transpower seeks that this issue be recognised within the strategic directions for the Queenstown Lakes District.

Health and Safety Risks

31. The main hazard associated with National Grid lines is receiving an electric shock. The risk and severity of electric shocks varies depending on the transmission voltage and type of exposure (e.g. direct human contact, mobile plant, or vegetation). Risks are most likely to be highest within 12 metres of a line, however some associated effects can be transferred further than this.

32. Lethal electric shocks can be caused by:

    (a) earth potential rise;

    (b) step and touch voltages;

    (c) induction voltages;

    (d) conductor drop;

    (e) flashovers (coming into contact with the line conductors or where the electricity arcs from a conductor onto an object such as a structure or fence); and

    (f) vegetation growing too close to a line and causing a flashover.

33. These hazards can occur as a result of third party activities (such as mobile plant or machinery) coming into contact or near to conductors causing flashover, and excavations occurring too close to structures or mid-span thereby reducing safe clearance distances. Less obvious but just as real are where buildings and structures are located close to or under transmission lines where the finished building may not present a hazard, but the construction or maintenance of it does. For example the finished roof height of a building is clear of the lines but the installation of the roof, or maintenance of it such as painting causes the personnel involved to be placed at risk. All of these things can endanger safety and affect the operation of the Grid.

34. Other hazards and issues associated with National Grid infrastructure include equipment or structure failure, earthworks, electrical (corona) noise, wind noise, and the perceived effects of electric and magnetic fields. Physical separation from National Grid infrastructure greatly reduces the likelihood of nuisance, harm or damage occurring to people or property.

Reverse Sensitivity Effects

35. Physical separation of third party activities from transmission lines is also important from Transpower's perspective to reduce incidents of people who live and work nearby complaining about the line and requesting changes (i.e. limits or restrictions) to its operation.

36. Reverse sensitivity effects are caused not only by residential activities which locate near lines, but also by commercial, industrial and farming operations which can be affected by electrical interference, or suffer animal welfare issues or business costs when maintenance and upgrading of lines occurs.

37. The area or distance from the lines within which reverse sensitivity effects can arise may vary according to the type of issue raised, but they are most noticeable in the area where the conductor swings out to. Depending on asset type in the Proposed Plan area, conductor swing can be out to 37 metres either side of the centreline.

38. The presence of a National Grid line can also give rise to perceived health concerns and visual amenity issues, even some distance from the line. Furthermore, sometimes people complain of electrical interference (such as a fuzzy television picture or electronic devices not working properly). In addition to general complaints arising from the presence of transmission infrastructure, Transpower also receives requests from landowners to underground existing overhead lines, raise conductors, or restrict future Grid works, particularly if they involve changes in visual appearance. Although the distances that these types of effects are experienced at vary according to the type of effect, I expect they are most noticeable within 12m of the centreline.

39. Transpower is seeking recognition in the Proposed Plan that urban development can have an adverse impact on existing infrastructure, including reverse sensitivity effects. This is consistent with Policy 10 of the NPSET that councils manage activities to avoid reverse sensitivity effects (as well as direct effects) on the National Grid.

Challenges for Corridor Management

40. Physical access to transmission lines is required for all routine and urgent maintenance and National Grid project works. The very nature of the works can significantly inconvenience people if they work or live near the line where the works are being carried out. Most importantly, maintenance and project work requires adequate working space around a tower or pole.

41. “Under-build" (i.e. having buildings under Transpower's lines) may delay, or in some instances severely restrict, Transpower's ability to undertake maintenance or project work. The New Zealand Electrical Code of Practice for Electrical Safe Distances NZECP34:2001 does not ensure adequate, proactive, management of these risks. The images below show examples of underbuild and also how in a subdivision the lines can be accommodate to mitigate this.

Figure 1 Industrial underbuild of CML-FKN A 110kV Line

Figure 2 Development accommodating CML-FKN A 110kV Line

42. Uncontrolled in-fill of industry and housing in the Queenstown area impacts on the safe operation and maintenance of the National Grid. In order to overcome these challenges for corridor management it is vital that there is integration of land use and infrastructure in such a way as to ensure that strategic infrastructure such as the National Grid is protected. This integration involves establishing and retaining transmission corridors which provide adequate access and working space at the towers or poles, and also mid-span, and physical separation from the infrastructure. Prudently designing buildings or activities with National Grid lines in mind (including beneath conductors) ensures vital infrastructure is protected and can be maintained and upgraded when needed.

43. Transpower does not oppose appropriate development around substations and near transmission lines but it is critical that this development occurs in an appropriate and safe way. This will ensure risks such as electricity shocks are minimised to the greatest extent possible, and will also ensure the infrastructure can continue to operate in the long-term, keeping the lights on for the community.

44. Transpower is very willing to accommodate and support new development provided it takes the transmission assets fully into account. Recent examples of Transpower working with developers are the Waterloo Business Park, near the Islington Substation in Christchurch and the Lake Hayes Development in Queenstown. Transpower had numerous discussions with the developers' consultants to ensure the design of these developments under and

around our towers and lines took the line into account. Through consultation with the developers, the design and development was altered, so that Transpower's ability to operate, maintain and develop the line was not compromised. In particular, use of corridors and 12m building setbacks from the centreline of the transmission line and the choice of vegetation to be planted are ways the line was accommodated. These outcomes are possible due to there being rules in the operative plan triggering the need for consent, and the willingness of both parties to engage in producing a satisfactory outcome.

Conclusion

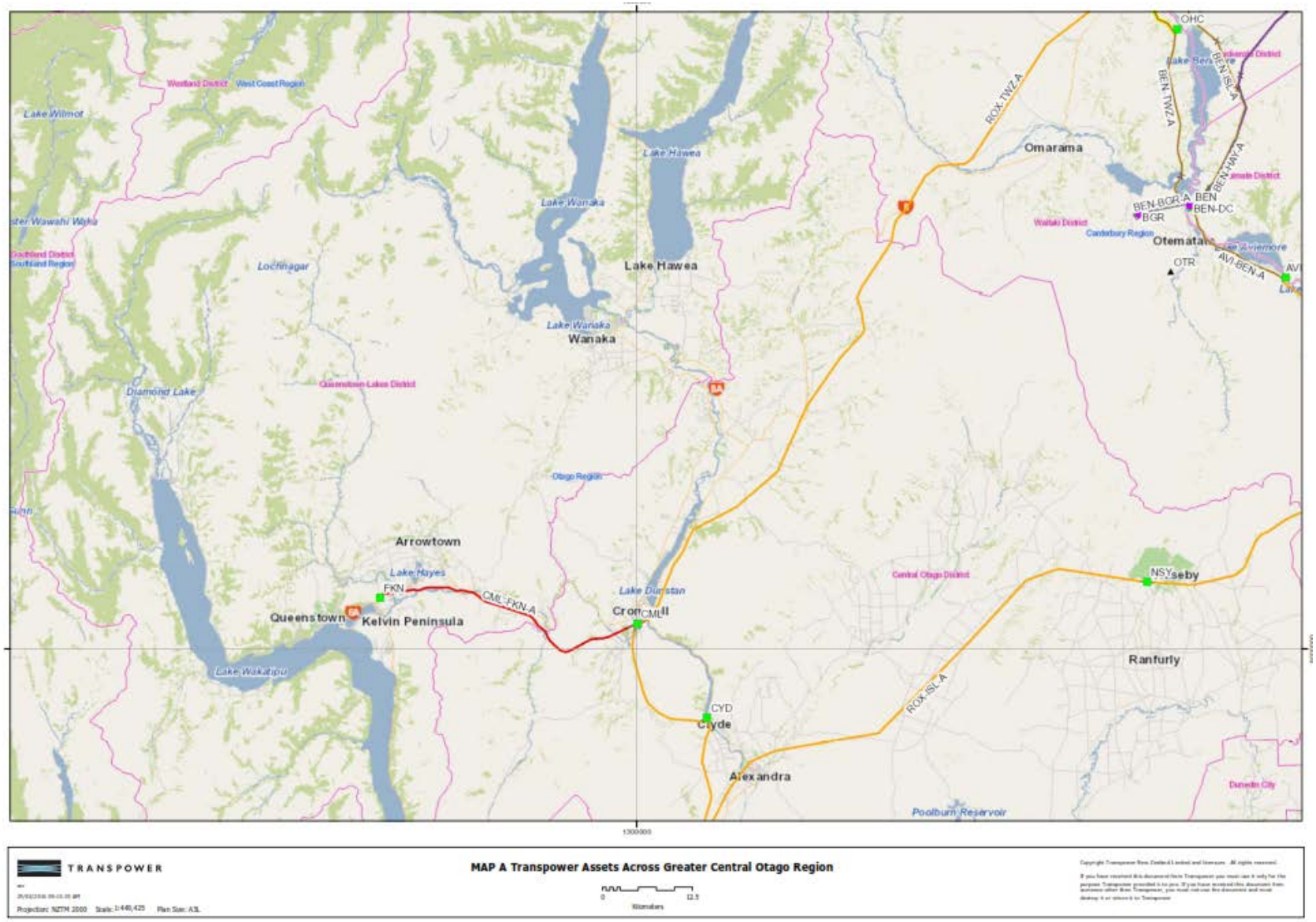
45. The NPSET obliges local authorities to provide for the long-term strategic planning of the National Grid.

46. The National Grid is enduring critical infrastructure, both locally and nationally. Preventing sensitive and incompatible activities from establishing under the transmission lines, along with controls on activities that will occur near lines, will assist the National Grid to be reliable, and to have a managed environmental footprint while serving future generations.

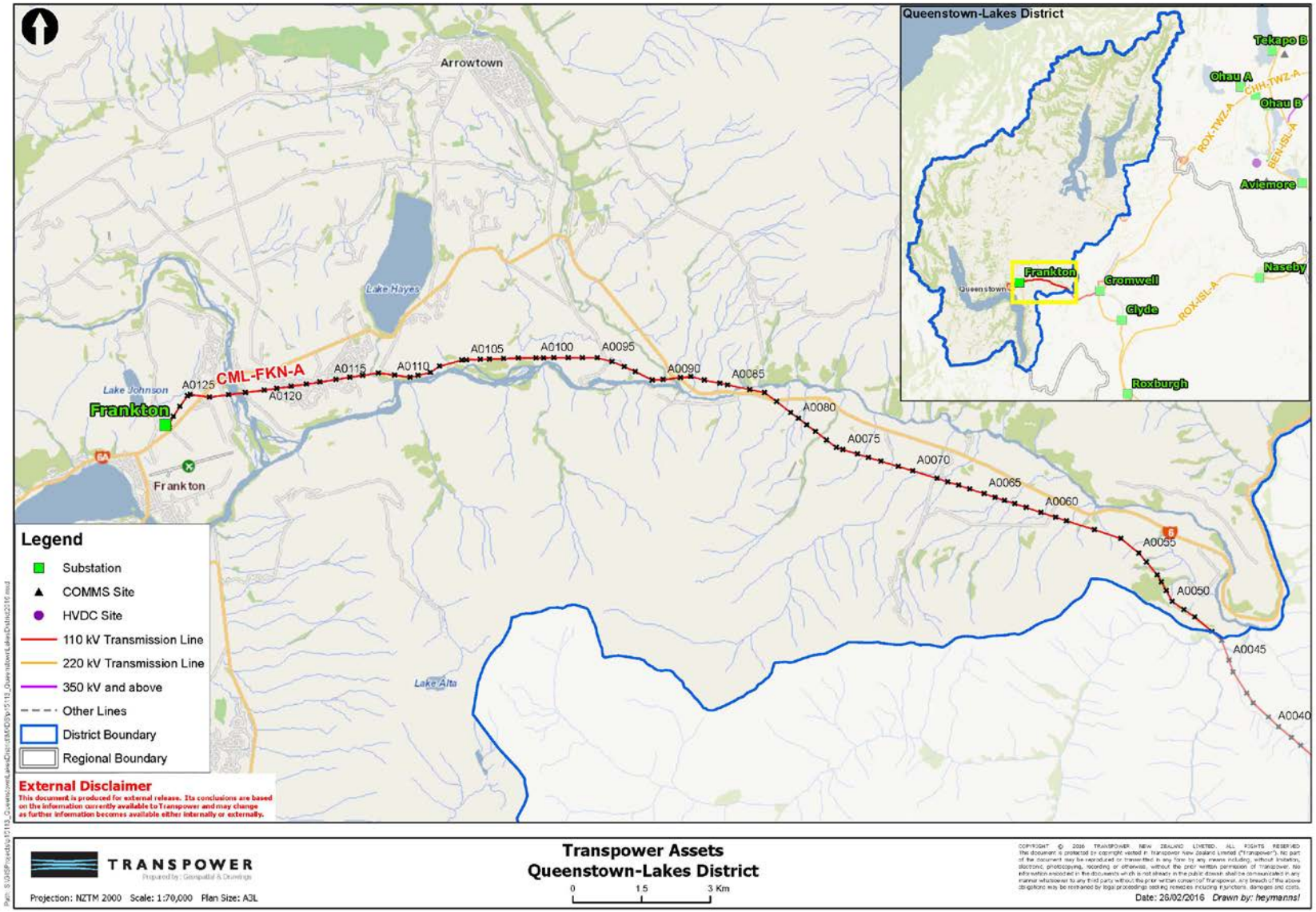
Andrew Renton

29 February 2016

Attachment A:- MAP A.



Attachment B:- MAP B



Attachment C:- Frankton Substation