

Area Report

Wairakei to Whakamaru 220kV Transmission Line

30 June 2009

Keeping the energy flowing



TRANSPower



APPROVED FOR RELEASE



A handwritten signature in black ink, appearing to read 'J. Brown', written in a cursive style.



On behalf of the Environment Group Manager
Transpower NZ Ltd

Report

Area Report - Wairakei to Whakamaru 220kV Transmission Line

Prepared for Transpower New Zealand Limited (Client)

By Beca Carter Hollings & Ferner Ltd (Beca)

30 June 2009

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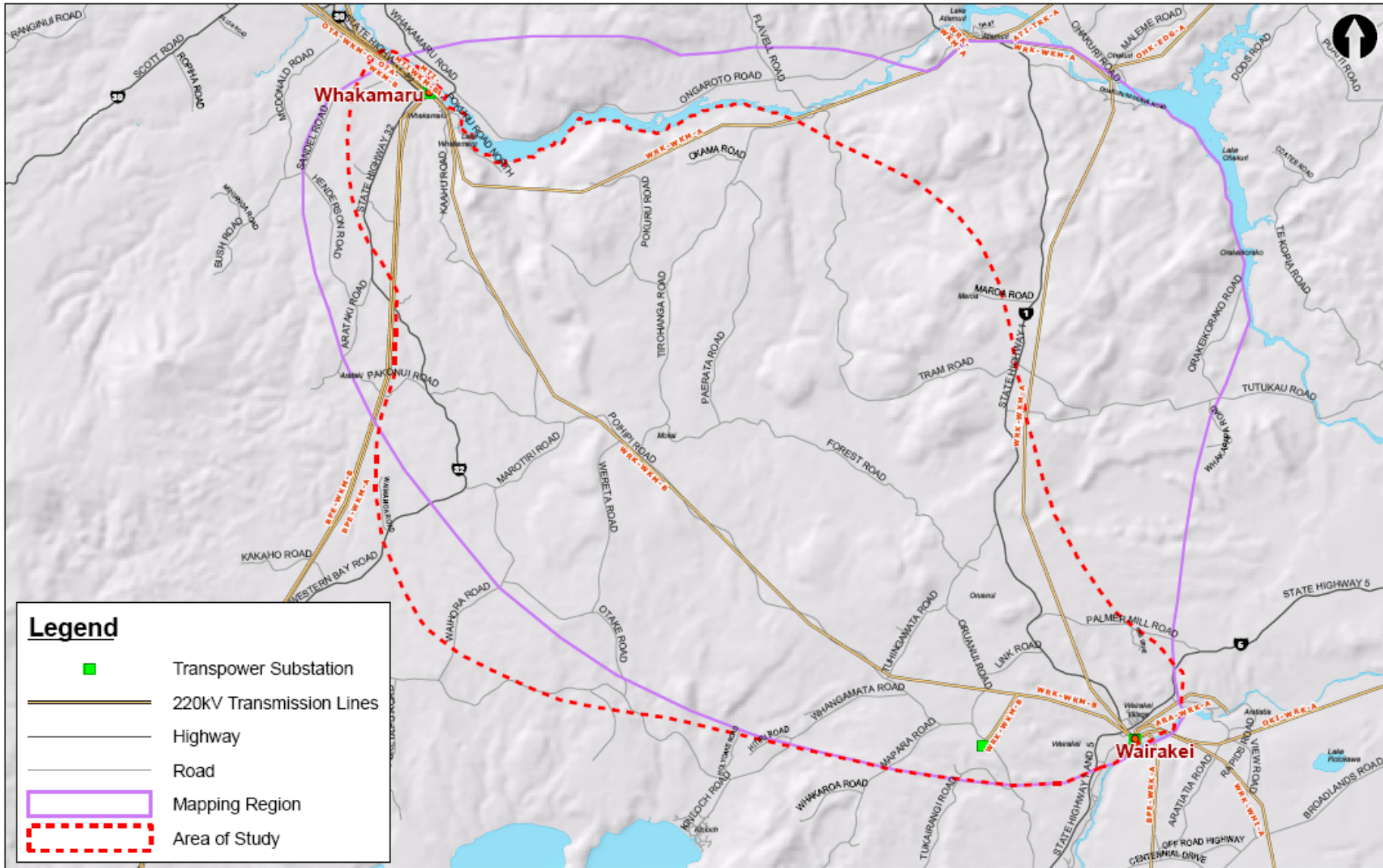
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Executive Summary

1. Transpower has identified the need to enhance the electricity transmission system between the Wairakei and Whakamaru substations to facilitate connection of increased renewable generation to the National Grid. The preferred option is the construction of a new 220 kV transmission line between Wairakei and Whakamaru referred to as the Wairakei–Whakamaru C line. Construction of the new 220 kV transmission line was presented to, and approved by the Electricity Commission in March 2009.
2. This report describes the work undertaken to identify an area within which the new Wairakei–Whakamaru C line could be located.
3. The process has generally followed the 'Area' stage of the Area, Corridor, Route and Easement (ACRE) model. This process starts with the broadest feasible area and systematically and progressively narrows the area of interest down to a single route through enhanced information and analysis. The use of this approach will assist in meeting the requirements of the Resource Management Act 1991 and the National Policy Statement for Electricity Transmission. This includes the assessment of alternatives and avoiding, remedying or mitigating the environmental effects of the new transmission line.
4. This report concentrates on the first stage of the ACRE process, the identification of an Area, within the Region of Study (as described in Section 1.3 of this report). It describes the following:
 - the investigations undertaken to date;
 - the key considerations for the identification and documentation of the Area;
 - the collection and mapping of features that influence identification of the Area;
 - the identification of the Area for further study; and
 - recommendations regarding the application of the ACRE process for subsequent stages of the project.
5. The result of this work has been the identification of an area of approximately 546 km² generally centred on a straight line 20 km wide route following the existing Wairakei–Whakamaru B line between the Wairakei and Whakamaru substations, as identified in **Figure 1**.
6. Based on the size of the Area of Study and the fixed sites at Wairakei and Whakamaru, it is recommended that investigations move to the Route Stage of the route selection process. The area has been designed to take into account particular features including the following:
 - areas of large land holdings;
 - the Wairakei and Whakamaru Substations;
 - the Wairakei–Whakamaru A Line and the Bunnythorpe–Whakamaru A and B lines; and
 - the Waikato River and Lake Whakamaru.

This Area of Study will be the focus of more detailed investigations and consultation to identify a route for the new line.

Figure 1: Area Study Map



1 Introduction

1.1 Purpose of this Report

Transpower New Zealand (Transpower), as owner and operator of the National Grid, has identified the need to enhance the electricity transmission network between the Wairakei and Whakamaru substations. The preferred option is the construction of a new 220 kV transmission line referred to as the Wairakei to Whakamaru C Line and removal of the existing Wairakei to Whakamaru B Line. This report documents the investigations and selection of an area for further investigation into possible routes for the proposed line. This work is the first stage of the assessment of alternatives and identifying measures to avoid, remedy or mitigate the adverse effects of a new transmission line under the Resource Management Act 1991 (RMA). The ultimate aim being for Transpower to consider a range of issues, consult with local communities and affected parties and identify a project that can achieve the sustainable management purpose of the RMA.

1.2 Report Structure

The rest of this Area Report is structured as follows:

Section 2: Background on the project and relevant work to date

Section 3: The key considerations under the Resource Management Act

Section 4: The methodology for identifying the Area of Study

Section 5: Identification and discussion of features relevant to defining the Area of Study

Section 6: Identification of the Area of Study

Section 7: Conclusions and recommendations

1.3 Definitions Used in this Report

There are several terms used throughout this report that require definition. These are:

- The “Region of Study” is the broad area defined as the notional extent of where a new Wairakei–Whakamaru C line could be located, being the area north of Taupo around the existing A and B lines. The Region of Study is an area of 734 km² generally shown in Figure 1 above.
- The “Area of Study” is a subset of the Region of Study and is the subject of this report.
- The term “features” is used in this report to refer to existing or proposed engineering, environmental and property features. These have been identified based on a review of existing information for the Region of Study.
- “Technical features” refers to those features that are relevant to engineering aspects of the project, including design and construction (e.g. Soils).
- “Environmental features” refers to those features that are relevant to planning and resource management aspects of the project (e.g. District plan zones).
- “Property features” refers to those features that are relevant to property aspects of the project including negotiating easements (e.g. Lot size).

Where required, other technical terms are defined within the report itself.

2 Background and Relevant Work to Date

Transpower has been investigating the upgrade of the Wairakei Ring since February 2008. This section sets out the investigations and discussions that affect the selection of the Area of Study.

2.1 The Wairakei Ring

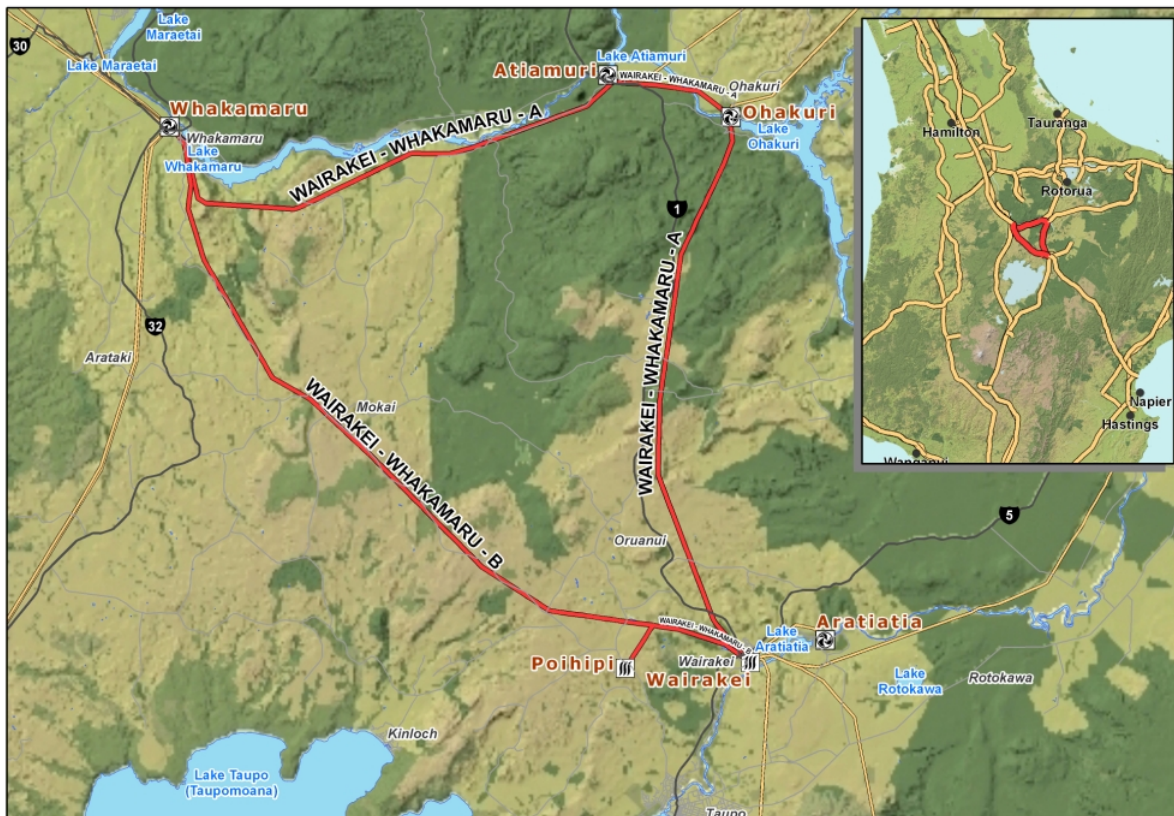
The existing National Grid between the Whakamaru, Atiamuri, Wairakei and Pohipi substations (referred to as the Wairakei Ring) is an important part of Transpower's core network. It helps transfer power north and south, while also supplying the Bay of Plenty and Hawke's Bay Regions.

The Wairakei Ring comprises two transmission lines defined in the south by the Wairakei substation and in the north by the Whakamaru substation. The lines connecting these are:

- The Wairakei–Whakamaru A line between Wairakei, Ohakuri, Atiamuri and Whakamaru; and
- The Wairakei–Whakamaru B line between Wairakei and Whakamaru via Pohipi Road.

The Wairakei Ring is shown in **Figure 2** below.

Figure 2: The Wairakei Ring



The area contains both significant amounts of existing and proposed renewable energy resource, particularly geothermal and wind. The amount of new generation being built in the next five years in and around the Taupo Geothermal Region is in the order of 700 MW. These projects will increase the amount of generation injected into the National Grid at the Wairakei substation.

Both existing transmission lines are single circuit 'flat top' lines operated at 220 kV. The capacity of the transmission assets in the region has already been enhanced with both circuits already thermally upgraded. While the existing National Grid in this area is sufficient to cope with existing

generation, large amounts of new generation could be constrained at peak times. Transpower's Wairakei Ring investigation was about helping connect this renewable energy generation to the National Grid.

2.2 Identification of Options

In May and June 2008, Transpower consulted with key stakeholders on the various assumptions, methodologies and models for the Wairakei Ring. Workshops were also held with generators to receive feedback on nationwide generation plans which could impact on transmission investment. From this consultation and workshops a long list of options (including both transmission and non-transmission options) for the Wairakei Ring project was developed.

The long list of options was refined to the following four possible transmission upgrades that could be implemented for either one or both of the existing two transmission lines:

- reconductoring of existing lines with a single conductor;
- duplexing existing lines;
- constructing a new single circuit flat top line; and
- constructing a new double circuit line.

From these four broad options, 12 combined transmission upgrade options were selected for the draft short list. The 12 combinations were then staged so that each upgrade is completed only as required by the growing need for the transmission. As a result of the staging process seven options were selected for the final short list. **Table 1** below provides the short list of options.

Table 1: Short List of Options¹

Short List Option	Stage 1 Upgrade	Stage 2 Upgrade
Base Case	Do nothing	None
1	Reconductor – A Line	Reconductor – B Line
2	Reconductor – A Line	New Single Circuit – B Line
3	Reconductor – A Line	New Double Circuit – B Line
4	New Double Circuit – B Line	None
5	New Single Circuit – B Line	None
6	New Double Circuit – A Line	None
7	New Single Circuit – A Line	None

Notes:

New double circuits include removal of the relevant existing line.

New single circuit options are additional to the existing lines.

The actual route of any new build option is subject to more detailed investigations, the assumed alignments are notional and are used for the purpose of costing only.

¹ Sourced from the Transpower New Zealand Limited, Wairakei Ring Investment Proposal, Part III (2008).

2.3 Discussions with Stakeholders

In August 2008, Transpower began discussing upgrade options and the process for progressing the investigation with community stakeholders in the Wairakei Ring area.

Transpower sent out a full information pack to all potentially affected community members and landowners in the Wairakei Ring area, detailing the project need and seeking feedback on the four broad upgrade options (discussed above). This information is contained in **Appendix A**. The purpose was to ensure that all likely costs, constraints and other issues that could influence the selection of a preferred option could be identified before the Grid Investment Test (GIT) analysis was undertaken (see further discussion of the GIT, including definition, in **Section 2.4**). A total of 71 feedback forms were received from a total of approximately 1,200 that were sent out).

The consultation undertaken (including feedback received through feedback forms, letters, meetings with community groups, and an open day) has provided a broad overview of community concerns in relation to the project. Detailed discussion of the consultation feedback is provided in the Preliminary Social Impact Assessment in **Section 2.5** below and contained as **Appendix B**).

In particular, the feedback highlighted some matters of direct relevance to the selection of the Area of Study:

- Concerns in relation to visual impact, the proximity of upgrades / new lines to houses and populated areas, and the perceived effect on property values and population health.
- The need to keep the community informed about key decisions made in subsequent phases of the project, particularly in relation to chosen options and the detailed design of where actual pylons and upgrades are proposed.

While the consultation undertaken to date has provided an overview of some of the key concerns and issues expressed by local residents and landowners, the low sample size and a high proportion of submitters that did not provide feedback, means that the results cannot necessarily be seen to provide a conclusive or accurate representation of the opinions of the greater Whakamaru – Wairakei community. Continued consultation with the community and key stakeholders will play an important role in subsequent stages of the project.

Consultation with industry stakeholders on Transpower's draft application of the GIT was undertaken between 29 October and 19 November and this feedback was incorporated into the Wairakei Ring Investment Proposal submitted to the Electricity Commission.

2.4 The Electricity Commission Process

Transpower made a formal submission to the Electricity Commission in December 2008 for approval of the costs associated with a new double circuit 220 kV the Wairakei–Whakamaru C line and removal of the existing single circuit Wairakei–Whakamaru B line.

The Wairakei Ring Investment Proposal presented the results of the GIT² that were applied to the shortlisted options set out in **Section 2.2**. The GIT is a form of national cost benefit analysis applied to determine the most cost effective and efficient solution. The Proposal reflected the option with the highest net benefit compared to the other options (like reconductoring) when assessed over the next 20+ years. It was also robust in changes in assumptions (e.g. more or less generation,

² A test for reliability investments and economic investments in the grid developed in accordance with rule 6 of section III of Part F, Electricity Governance Rules. The specific rules defining the Grid Investment test, as developed according to the process in rule 6 of section III, are set out in Schedule F4 of section III of Part F.

higher easement costs etc). The results of the GIT analysis are set out in detail in the Wairakei Ring Investment Proposal. The Electricity Commission may approve proposed investments where Transpower has applied the GIT reasonably.

The Electricity Commission issued a Notice of Intention to approve the project on 20 February. A public conference has not been called for and therefore the approval is now final. Transpower therefore intends to proceed with the Project.

2.5 Preliminary Social Impact Assessment

The GIT analysis is primarily focused on an economic assessment of the options for the Wairakei Ring. However, Transpower has also considered a number of costs and benefits which cannot be quantified, but the direction and likely magnitude of which can be identified. This includes consideration of the potential impact on the communities of Whakamaru, Tirohanga, Atiamuri and Wairakei and opportunities (and costs) to avoid or mitigate these impacts. To assist in the identification of social impacts, Transpower commissioned Beca to prepare a Preliminary Social Impact Assessment (SIA) for the Region of Study. The Preliminary SIA is contained in **Appendix B**.

The Preliminary SIA sets the scope of social issues and identifies the communities of interest. The social impacts identified will be further investigated during subsequent stages of the project to enable a more complete understanding of how particular routes and design options will affect the communities of interest. The Preliminary SIA incorporated submissions received by Transpower from industry stakeholders in the first stage of consultation (undertaken in May 2008) and from the community and feedback received in September and early October 2008.

The Preliminary SIA identifies four significant communities of interest in the Region of Study. These communities are Whakamaru, Wairakei, Mokai and Tirohanga. The communities contain dwellings, schools, tourist activities, and areas of cultural significance. Wairakei and Whakamaru are identified as the two larger residential settlements. Mokai contains a number of papakainga housing units and glasshouses based around the geothermal resources in this area. There is less housing and activity around Tirohanga. Atiamuri does not appear to hold specific identity at the same scale as the other four communities.

The key recommendation from the Preliminary SIA is that further consultation be undertaken as potential routes are developed and refined, and during the detailed design phase of the project as part of the integrated assessment process under the RMA. These recommendations have been incorporated into the recommendations contained in **Section 7** of this report.

2.6 Preliminary Landscape and Visual Assessment

In recognition of the importance that areas of outstanding natural landscapes, areas of high natural character and areas of high recreation value and amenity will have on the selection of options and routes for the Wairakei–Whakamaru C Line, Transpower engaged Boffa Miskell to provide advice on landscape and visual aspects of the Project. The preliminary landscape and visual assessment considered the four broad upgrade options (as outlined in **Section 2.2**) and identified landscape principles that should inform the overall analysis and selection of transmission routes. The Preliminary Landscape Assessment is contained as **Appendix C**.

The assessment considered the broad landscape context for the Region of Study. In summary, it was identified that the existing Wairakei–Whakamaru A and B transmission lines traverse a diverse working rural landscape including: volcanic hills and associated landforms, the Waikato River and manmade lakes, pastoral farming, production forestry, remnant and regenerating bush, geothermal and hydro energy production and transmission, and State Highway 1. These features are discussed further in **Section 5** of this Report.

The assessment considered the potential landscape and visual effects of the four broad options on existing Wairakei–Whakamaru A line and Wairakei–Whakamaru B line corridors. The outcomes of that work were incorporated into the overall assessment of options presented in Wairakei Ring Investment Proposal (as discussed in **Section 2**). In summary, from a landscape perspective the following options/considerations are preferable:

- Reconductoring and/or duplexing the A and/or B lines is preferable to an additional line adjacent to either the A or B line or a new green fields line.
- The Wairakei–Whakamaru B line alignment is generally more accommodating to upgrades than line Wairakei–Whakamaru A line.
- Avoid if possible additional lines and upgrades in the Waikato River corridor between Ohakuri and Whakamaru.
- Line deviation of Wairakei–Whakamaru A and/or B lines around the Whakamaru village would be desirable.

The Preliminary Landscape assessment identified a number of principles to provide a rationale for assessing the landscape and visual effects of the four upgrade options. The principles are specific to the Wairakei Ring and can also be used during the route selection process to avoid areas of outstanding natural landscapes, areas of high natural character and areas of high recreation value and amenity. This will enable Transpower to present a project that is consistent with Policies 7 and 8 of the NPS.

The area of Study on selection of routes and options for the new line should be guided by the following principles:

- Avoid identified landscapes and natural areas;
- Avoid other 'sensitive landscapes';
- Consider the rapidly changing land use and appearance of the landscape;
- Work within the framework of existing transmission corridors;
- The option of least change and least effects is preferable; and,
- As appropriate, opportunities for minor adjustments to existing alignments should be considered.

A more comprehensive landscape and visual assessment of any route option/s would be an integral part of the any future constraint analysis and undertaken during a subsequent stage of that process.

3 Key Resource Management Act Considerations of Alternatives

While Transpower has obtained Electricity Commission approval to proceed, it must also obtain relevant consents and/or approvals under the RMA. This section details the relevant considerations for that assessment, and helps set the context for the methodology in selecting an Area of Study in **Section 6**.

3.1 Assessment of Alternatives under Section 171 of the RMA

Transpower is a requiring authority under the RMA (Section 167) for the purpose of network operations and the supply of line functions and can therefore apply to local councils to set aside land in a district plan for use in fulfilling these functions. At this stage, it is likely that Transpower will prepare a notice of requirement (NoR) for the designation of land for the new Wairakei–Whakamaru C Line along with resource consents and any other approvals required. The designation would facilitate the long term planning for the construction, operation and maintenance of the new line.

The designation process is controlled by the provisions of the RMA, with the requirements for the Requiring Authority (Transpower) and the Territorial Authority (the District Council) set out in section 171 of the Act. Section 171 of the RMA requires:

“(1) When considering a requirement and any submissions received, a territorial authority must, subject to Part 2, consider the effects on the environment of allowing the requirement, having particular regard to—

(a) any relevant provisions of—

(i) a national policy statement:

(ii) a New Zealand coastal policy statement:

(iii) a regional policy statement or proposed regional policy statement:

(iv) a plan or proposed plan; and

(b) whether adequate consideration has been given to alternative sites, routes, or methods of undertaking the work if—

(i) the requiring authority does not have an interest in the land sufficient for undertaking the work; or

(ii) it is likely that the work will have a significant adverse effect on the environment; and

(c) whether the work and designation are reasonably necessary for achieving the objectives of the requiring authority for which the designation is sought; and

(d) any other matter the territorial authority considers reasonably necessary in order to make a recommendation on the requirement.”

The relevant considerations in terms of Part II of the Act are discussed in **Section 3.2** below.

In regards to section 171 (1)(a), when considering a requirement for this project, the District Council will need to have particular regard to the provisions of:

- The National Policy Statement on Electricity Transmission (NPS). This is discussed in **Section 3.3** below;
- The Waikato Regional Policy Statement; and
- The Waikato Regional Plan and Taupo District Plan.

In regard to section 171 (1)(b), the District Council must have particular regard to whether adequate consideration has been given to alternative sites, routes, or methods of undertaking the work. The route selection model discussed in **Section 4.3** of this report has been developed to ensure that Transpower can demonstrate that it has undertaken a level of investigation sufficient to meet this requirement.

In regard to section 171 (1)(c), the District Council must have particular regard to the necessity for the project. The need for this project has been established following investigation of the capacity of the existing transmission lines in the area and future capacity requirements. These investigations will need to be included in any NoR for designation of land associated with the project.

In regard to section 171 (1)(d), other matters that the District Council may consider necessary for this project could include the following:

- Relevant national policy such as the Government Policy Statement on Electricity Governance (May 2008) (GPS);
- Non-statutory documents such as structure plans;
- Relevant standards and guidelines such as standards relating to construction noise and electric and magnetic fields; and
- Documents prepared under legislation that may impact on the work such as reserve management plans developed under the Reserves Act 1977 and protected areas under the Conservation Act 1987.

3.2 Part II – Effects on the Environment

Assessment of the proposal under section 171 is subject to Part II of the RMA. Part II sets out the purpose of the Act, which is to promote the sustainable management of natural and physical resources. Within the Act, sustainable management means *“managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic and cultural wellbeing and for their health and safety while-*

- a) Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and*
- b) Safeguarding the life-supporting capacity of air, water, soil and ecosystems; and*
- c) Avoiding, remedying, or mitigating any adverse effects of activities on the environment.”*

Within the RMA the term ‘effect’ includes; positive or adverse effects, any temporary or permanent effect, any past present or future effect, and any cumulative effect. The effects of the new Wairakei–Whakamaru C line will also need to be considered in combination with the effects of the existing lines and associated infrastructure. The scale of the project means that there will be adverse effects associated with the construction, operation and maintenance of the new transmission line. Some of these effects may be considered more than minor. Therefore, Transpower will need to demonstrate the measures it has taken to avoid, remedy and mitigate any adverse effects of activities on the environment, including cumulative effects. This could include,

amongst others, effects on natural character, landscapes, areas of indigenous vegetation, public access, historic heritage and cultural values. The weighing of the various positive and adverse effects does not require that all adverse effects are avoided, but rather requires an overall balance is reached. The notice of requirement allows the identification and consideration of the effects of developing significant infrastructure.

3.3 Relevant National Policy

The National Policy Statement on Electricity Transmission (NPSET) was gazetted on 13 March 2008. It is a statement from central government to recognise the national significance of the national grid in RMA plans and local decision-making and a high-level framework that will give guidance across New Zealand for the management and future planning of the national grid. There are several provisions in the NPS which will influence the investigations into appropriate routes for the Wairakei–Whakamaru C Line.

The NPS recognises the national significance of the electricity transmission network and the importance of facilitating the operation, maintenance and upgrading of the existing transmission network and the establishment of new transmission resources. At the same time, the NPS also identifies that the adverse environmental effects of the network need to be managed. The route selection process for the Wairakei–Whakamaru C Line will need to demonstrate how the relevant policies of the NPS have been provided for.

In selecting and designating an appropriate route for the new line and seeking approvals for the removal of the existing line, Transpower will need to demonstrate that it has given particular consideration of the policies below.

Policy 1

“In achieving the purpose of the Act, decision-makers must recognise and provide for the national, regional and local benefits of sustainable, secure and efficient electricity transmission. The benefits relevant to any particular project or development of the electricity transmission network may include:

- i. maintained or improved security of supply of electricity; or*
- ii. efficient transfer of energy through a reduction of transmission losses; or*
- iii. the facilitation of the use and development of new electricity generation, including renewable generation which assists in the management of the effects of climate change; or*
- iv. enhanced supply of electricity through the removal of points of congestion.*
- v. The above list of benefits is not intended to be exhaustive and a particular policy, plan, project or development may have or recognise other benefits.”*

To assist decision makers in the assessment of benefits for the project, Transpower will need to clearly set out the benefits of the project in any planning approvals.

Policy 3

“When considering measures to avoid, remedy or mitigate adverse environmental effects of transmission activities, decision-makers must consider the constraints imposed on achieving those measures by the technical and operational requirements of the network.”

To assist decisions makers in this consideration, Transpower will need to set out any technical and operational constraints which have resulted in the selection of options for the project.

Policy 4

“When considering the environmental effects of new transmission infrastructure or major upgrades of existing transmission infrastructure, decision-makers must have regard to the extent to which any adverse effects have been avoided, remedied or mitigated by the route, site and method selection.”

In selecting an appropriate route for the new line, Transpower will need to demonstrate that it has canvassed the alternatives. This should include the reasoning for the choices and refinements which have been made and the consequences of alternatives. This would highlight why the selected route is the most favourable in comparison. If there are limited options for mitigation with respect to the route then these should be explained. Documentation throughout the route selection process should be used to demonstrate how Transpower has achieved consistency with Policy 4.

Policy 6

“Substantial upgrades of transmission infrastructure should be used as an opportunity to reduce existing adverse effects of transmission including such effects on sensitive activities where appropriate.”

The project represents a substantial upgrade of transmission infrastructure and therefore, Transpower will need to demonstrate that it has considered opportunities to reduce existing adverse effects associated with transmission infrastructure in the area. The project involves the removal of the existing Wairakei–Whakamaru B Line. Removal of the existing line provides an opportunity to mitigate the cumulative effects of the construction and operation of a new transmission line where mitigation would not otherwise be available. These opportunities will need to be identified, assessed and documented as part of the overall route selection and design process.

Policy 7

Planning and development of the transmission system should minimise adverse effects on urban amenity and avoid adverse effects on town centres and areas of high recreational value or amenity and existing sensitive activities.

Policy 8

In rural environments, planning and development of the transmission system should seek to avoid adverse effects on outstanding natural landscapes, areas of high natural character and areas of high recreation value and amenity and existing sensitive activities.

In the selection of options and routes, Transpower will need to demonstrate that it has avoided or minimised effects on urban areas, recreation areas, outstanding landscapes, areas of natural character and existing sensitive activities. The identification of these areas will allow opportunities to avoid these where possible and, where they cannot be avoided, appropriate mitigation is developed.

Policy 9

Provisions dealing with electric and magnetic fields associated with the electricity transmission network must be based on the International Commission on Non-ionising Radiation Protection Guidelines for limiting exposure to time varying electric magnetic fields (up to 300 GHz) (Health Physics, 1998, 74(4): 494-522) and recommendations from the World Health Organisation monograph Environment Health Criteria (No 238, June 2007) or revisions thereof and any applicable New Zealand standards or national environmental standards

The selection of routes and the design of the transmission line will need to assess compliance with the above guideline and criteria.

At the Area stage of the Wairakei–Whakamaru C Line project, the policies outlined above can be provided for by ensuring that key features in the Region of Study are identified and considered when identifying the Area for further investigation. These features would include those identified in Policies 6, 7 and 8 above and other features that are present within the Region of Study that may influence the transmission route. The features that were identified and investigated for the Region of Study are discussed in **Section 5** of this report.

4 Methodology for the Identification of the Area of Study

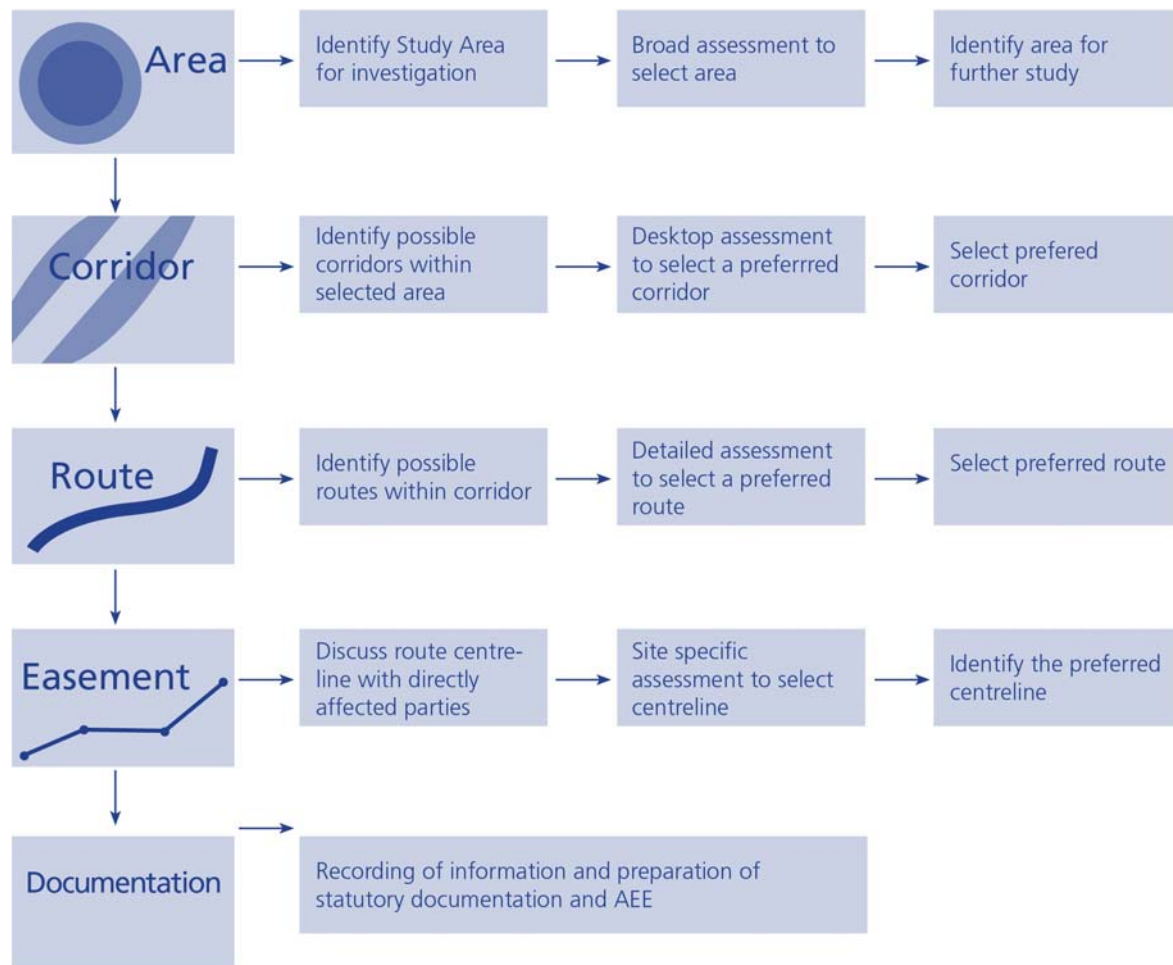
This section sets out how the Area of Study in **Section 6** fits within the wider ACRE methodology of determining a route.

4.1 The Transpower ACRE Model

Transpower has used a process of analysis called the ACRE model (Area, Corridor, Route and Easement) for the selection of routes/sites for transmission lines and substations in the past. A detailed description of the ACRE model is contained within **Appendix D**. For a transmission line, the ACRE process involves a progressive filtering approach, where increasing and more specialised detail is provided on technical, environmental and property constraints and features throughout the process to enable the identification of a preferred easement. Once the easement centreline has been identified, the planning approvals (NoR for a designation and/or resource consent applications) can be lodged with the relevant local authorities under the RMA for the purpose of securing approvals for the line and any associated works. The application of the ACRE process differs for each project depending on the nature of the project and the particular Region of Study.

The purpose of undertaking an ACRE type analysis for a project is to provide a robust and pragmatic method for locating new transmission infrastructure. Following such a process should assist in minimising difficulties associated with gaining planning approvals by reducing the chance of locating in areas with significant features, identifying issues early and enabling them to be addressed during the planning and design of the line. Most importantly, the documentation of the process assists in demonstrating the consideration of alternatives as required under section 171 of the RMA (as discussed in **Section 3.1** above), and provides a critical input to the Assessment of Environmental Effects (AEE) report to accompany the NoR. The ACRE process is summarised in **Figure 3** below.

Figure 3: Generic ACRE Process



The evaluation and weighting of the technical, environmental and property features does not form part of the Area stage. The Area investigations identify the criteria and areas for further assessment during the subsequent stages of the ACRE process.

The next stage of the ACRE process consists of further consideration of the features identified, as well as an analysis of additional information and outcomes of consultation with affected parties and stakeholders to determine the preferred corridors/routes for a new transmission line. The particular process for the identification of the 'Area of Study' for the Wairakei–Whakamaru C Line is detailed in **Section 4.3**.

4.2 Relevant Lessons from the North Island Grid Upgrade Project

The North Island Grid Upgrade Project (NIGUP) involves six subprojects, the largest of which is a new 400 kV transmission line between Auckland and Whakamaru. The ACRE process was developed specifically for delivering the regulatory and engineering requirements for the NIGUP. Transpower recognises that there are opportunities to input the lessons learnt from NIGUP into the Wairakei–Whakamaru C line project while at the same time recognising that the ACRE process needs to be revisited to account for the points of difference between the two projects. The key differences relate to: location and project scope, Transpower internal context, and the community and consultation context. In addition, the Region of Study associated with the Wairakei–Whakamaru C line is smaller than that of the NIGUP. These differences will be reflected in how the ACRE model is applied to the Wairakei–Whakamaru C line project.

An initial internal workshop was held at Transpower in December 2008 to fine tune the ACRE process for the Wairakei–Whakamaru C line. The workshop was held to ensure that the ACRE model used for the project is robust, transparent and non-arbitrary and at the same time meeting the requirements of the RMA and the Electricity Act 1992. The key lessons discussed at the workshop and the fine tuning of the ACRE process have been incorporated into the ACRE process for this project as set out in **Section 6**.

Section 7.1 of this report provides recommendations as to what the next stages of the ACRE process for the project should include, based on the particular context of the Wairakei–Whakamaru C Line.

4.3 The Process for the Identification of the Area of Study

The identification of the Area of Study started with confirmation of the Region of Study. This region is defined by the Wairakei Ring and is shown in **Figure 2** of this report.

All of the possible technical, environmental and property features within the Region of Study are provided in **Table 2, 3 and 4** below. These features were identified by the project team based on key features from previous Area investigations undertaken by Transpower and knowledge of other features likely to be present within the Wairakei Ring. A description of each feature is provided within the tables.

Table 2: Technical Features

Technical Feature	Description
Swamps	Swamp or wetland areas marked on 1:50,000 maps and identified by Land Information New Zealand.
Lakes and rivers	Waterbodies including lakes, rivers marked on 1:50,000 maps and identified by Land Information New Zealand. Large/major rivers are those with an average width greater than 50m.
Urban areas	Areas used for residential activities including cities, towns and settlements.
Cliffs	Cliffs identified by Land Information New Zealand.
Slope	Areas of land where the grade is greater than 35°.
Relief	The profile of physical features of land showing elevated areas, valleys, plateaus etc.
Contours	Areas which have the same altitude identified in 20m increments.
Elevation	Height above mean sea-level.
Aspect	The direction which an area faces (orientation).
Generation and geothermal areas	Areas where geothermal resources are used for generation activities.
Roads	Legally formed roads and paper roads marked on district plan and topographical maps.
Radio Masts	Antennae and masts used for communication purposes.
Erosion	Areas susceptible to erosion due to soil type, rainfall and other contributing factors etc.
Base rock	Base rock type (e.g. Peat, alluvium etc)
Surface geology	Surface geology type (e.g. lavas and ash etc)
Soils	Soil types identified by Landcare New Zealand.

Technical Feature	Description
Active fault lines	Active fault lines identified by Taupo District Council.
Geotechnical	Areas of geotechnical interest including geothermal springs and geothermal activity.
Transmission lines	High voltage transmission lines, generation and local lines (where their location is known)
Major transport corridors	Rail, road and other transport corridors.

Table 3: Environmental Land Features

Environmental Feature	Description
Infrastructure	Gas pipelines, substations, telecommunication facilities etc.
Office of Treaty Settlements Land	Land identified by the Office of Treaty Settlements as set aside for future Treaty claims.
Airstrips and aerodromes	Aerodromes identified by CAA and airstrips noted on topographical maps.
Residential zones	Land zoned for residential land use in district plans.
Rural residential parcels	Land zoned for land use in district plans or parcels of less than 10 ha in area.
Foreshore protection zone	Areas of land adjacent to major waterbodies that are identified as Foreshore Protection Zone in district plans.
Industrial zoned land	Land zoned for industrial land use in district plans.
Rural zones	Land zoned for rural land use in district plans.
Tourist and Recreational areas	Areas of known tourist activities/use and recreation areas identified by district plans and DoC.
Electricity switchyards and substations	Electricity switchyards and substations relating to the national grid or local electricity supply.
Electricity core generation sites	Areas identified in the District Plan as electricity core generation sites.
State highways	Roads identified as State highways by NZTA.
Hot ground hazard areas	Areas identified in district and regional plan as hot ground hazard areas.
Archaeological and heritage sites	Known archaeological and heritage sites identified by district plan and New Zealand Archaeological Society records.
Contaminated sites	Areas of known contaminated land identified in district plans.
Marae	Marae identified from topographical maps, district plans and field visits.
Schools	Private and government primary and secondary schools.
DoC areas	Areas administered by DoC including reserves and protected areas.
Ecological and Landscape areas	Areas identified by district or regional plans as having significant landscape or ecological values.
Major waterways/waterbodies	Waterways/waterbodies identified as having particular values identified in district and regional plans.
Reserve zones/areas	Areas of land zoned in district plans as reserves.

Table 4: Property Features

Property Feature	Description
Lot size	The size of properties identified in hectares.
Transpower owned properties	Areas of land owned by Transpower.
Maori Trust Land	Areas of land identified from consultation with Iwi and Quotable Value as being Maori Trust owned land and held in multiple ownership.
Capital value	The value of land parcels sourced from Quotable Value.
Land use	Use of land (e.g. Commercial, vacant, agricultural etc).
Forestry areas	Areas of exotic plantation forestry.
Property owners	Owners of property sourced from national property databases.
Building points	Structures (including dwellings and ancillary structures) identified by LINZ and aerial photographs.
Specific owners	Areas of land that are owned by specific organisations (DoC, Queen Elizabeth II, covenants, crown land and council land) indicating possible protection, legal requirements and land use.
Properties in common ownership	Parcels of land that are owned by multiple owners.

Desktop investigations were carried out for each of the features identified above. This involved investigating information from sources including:

- District and Regional Plans for the Waikato Region, South Waikato, Rotorua and Taupo Districts;
- Land Information New Zealand (LINZ);
- Department of Conservation (DoC);
- Quotable Value;
- Office of Treaty Settlements;
- Civil Aviation Authority;
- Ministry of Economic Development (MED);
- New Zealand Historic Places Trust and New Zealand Archaeological Association;
- Topographic Sources.

Information on each of these features was sourced and mapped. A full set of maps showing all these features is contained in **Appendix E**. A complete list of information sources used for the mapping of these features is contained at the beginning of that appendix. These maps are intended to serve as a record of the desk top assessment undertaken during this stage of the project even though some of these features may not have a direct bearing on the selection of the Area of Study.

The identification of these features is based on desk top studies of available information, and it is likely that, during more detailed investigations (including site visits) additional features may be identified that will influence the selection of routes or options for the new transmission line.

All of the identified features in **Tables 2, 3 and 4** above were discussed by relevant Transpower technical, environmental and property experts at a workshop held in early March 2009. The purpose of the workshop was to discuss and agree which of these features should have a direct influence on the identification of the boundaries for the Area of Study. The selection of these features does not mean that other features in the tables will not influence the selection of routes or

options as part of a subsequent stage of the project. The workshop also did not rank the particular features as again, this exercise will be undertaken at a subsequent stage of the route selection process. The outcomes of this workshop are set out in **Section 6**.

In summary, it was agreed at the workshop that the features set out in **Table 5** below should influence the Area of Study. The reasons for the selection of each feature is set out in Section 5. The other features in **Table 2, 3 and 4** above will become particularly relevant at subsequent stages of the ACRE process and will be further investigated at that stage.

Table 5: Features of Influence

Technical Features	Environmental Features	Property Features
Lakes and large /major rivers	Population Density (using zoning and lot size)	Lot Size
Urban Areas	Regional and District Plan Notations	Maori Trust Land
Topography (Slope)	Ecological and Landscape	
Relief and Contours	Tourism and Recreation	
Geothermal and Generation areas		
Roads		
Transmission lines		

At this Area stage, all of the above features were considered in determining the Area of Study

The features of influence were discussed at the March 2009 workshop and a draft boundary for the Area of Study was agreed. This boundary was checked in the field by a site visit involving Transpower technical and property personnel on 13 and 14 March 2009. The boundary of the Area of Study was then refined based on these site visits and confirmed by those who attended the March 2009 workshop. The confirmed boundary for the Area of Study is shown and discussed in **Section 6** of this report.

5 Identification and Discussion of Features

The reasons for the selection of technical, environmental and property features used to identify the Area of Study for the Wairakei–Whakamaru C line in **Section 6** are considered below.

5.1 Technical Features

5.1.1 Lakes and Rivers

Lakes and large rivers are important for the selection of transmission line routes because they can require larger spans and taller and stronger towers to cross them. Smaller streams and waterbodies can be spanned by transmission lines, however wide waterbodies may require mid stream structures to span them. There is greater cost in establishing and accessing these tower structures. Lakes and large rivers are also valued by the community and represent significant amenity and recreation features in many areas.

The lakes and rivers within the Region of Study are shown on **Map 11** of **Appendix E**. Within the Region of Study, the Waikato River dominates the northern portion of the area, running from Whakamaru through to Lake Taupo. Lakes Whakamaru, Atiamuri and Ohakuri provide hydro generation and recreational activities along sections of the river. The Waikato River is identified as having particular cultural importance as it is largely from the river that the key iwi groups in the region derive their identity and coherence.

Crossing the Waikato River should be avoided and therefore the river forms the logical northern boundary of the Area of Study.

5.1.2 Urban Areas

Urban areas are more densely populated and are centres of community, facilities and activities. There is less flexibility to locate transmission structures in these areas due to property, social and environmental difficulties. It is not desirable for new transmission lines to be located within or near urban areas.

Within the Region of Study there are small areas of residential zoned land. These are located at Whakamaru, Wairakei and Atiamuri. These areas are shown on **Map 12** within **Appendix E**.

The Wairakei and Whakamaru substations are the tie in points for the Wairakei–Whakamaru C line and therefore these areas cannot be avoided in the selection of routes for the new transmission line. However, providing sufficient area of land around these communities in the Area of Study will enable Transpower to investigate alternatives for entry into the substations which minimise routes directly over or adjacent to the two settlements. This is particularly relevant for the area at Whakamaru where the existing line (which will be removed) crosses a number of dwellings and the local school.

5.1.3 Topography and Slope Greater than 35°

The slope of land can affect decisions about the location of individual transmission towers. Steep areas make construction and maintenance access more difficult. For this reason, slopes of greater than 35° should generally be avoided for siting transmission towers where less steep areas of land exist.

The existing slopes within the Region of Study are shown on **Map 15** within **Appendix E**. There are pockets of steeper land located throughout the Region of Study. These occur predominately in the north-east and areas of elevated land located to the south of Whakamaru.

Whilst information about the slopes is useful in determining potential routes for a new line, steeper areas of land should not be excluded from the Area of Study at this stage, as it is possible to engineer solutions to any problems due to terrain.

5.1.4 Relief and Contours

Relief and contour is an indicator of the type of terrain within an area. Significant hills, plateaus and valleys can be identified by examining relief and contour maps. These areas can be difficult to access (e.g. bluffs or valleys) and can make construction more difficult and costly. Elevation of the area has engineering implications due to different loading conditions at higher altitudes. Areas of high altitude should be avoided if possible, but can be engineered around if required. Where possible, these features should be avoided in the selection of transmission line routes in favour of less challenging terrain due to the challenges they pose to construction, operation and maintenance.

The relief and contours within the Region of Study are shown on **Map 16 and 17** within **Appendix E**. This shows that the land within the Region of Study ranges from around 250 metres above sea level adjacent to the Waikato River through to around 897 metres in elevated areas in the south and east of the area. None of these changes in altitude are considered significant enough to impose engineering related requirements.

5.1.5 Generation and Geothermal Areas

Geothermal activity near transmission lines can increase corrosion of metalwork, such as structures, fittings, and conductors. There can also be issues with increased ground subsidence affecting tower foundations resulting in, at worst, structure failure.

Within the Region of Study there are several geothermal areas and related geothermal generation. The existing generation sites are located at Wairakei, Te Mihi, Poihipi and Mokai (with Te Mihi under construction). The two large areas of geothermal activity and active geothermal springs are located around Mokai, north-west of Wairakei and at Orakeikorako Road. These areas have been identified as geothermal hazard areas by the Waikato Regional Plan and the Wairakei and Orakeikorako Road areas are identified as hot ground hazard zones within the Taupo District Plan.

The geothermal areas within the Region of Study are shown on **Map 18** within **Appendix E**.

The Wairakei substation is the southern tie in for the new line. This means that the geothermal area around Wairakei cannot be excluded from the Area of Study, however the selection of the Area should include a 'buffer' around the Wairakei substation to give flexibility of location and direction of line terminations particularly around the geothermal area. Several existing transmission towers for the Whakamaru–Wairakei A and B lines are located within the Wairakei geothermal area and have experienced some level of ground subsidence indicating that further investigation of these areas is required during the selection and design of new transmission structures.

5.1.6 Major Roads

Minimising major road crossings for transmission lines is desirable as this reduces the visibility of the line. This needs to be balanced against the reduced access costs for construction and maintenance provided by close proximity to a road.

Within the Region of Study there are several significant road corridors. These are:

- State Highway 1 (SH1) which is the main north-south road transport route within the North Island. Within the Region of Study it lies between Wairakei and Atiamuri and then crosses the Waikato River before heading north.

- State Highway 32 (SH32) forms part of the western access route around Lake Taupo. Within the Region of Study, SH32 travels from Whakamaru heading south before leaving the Region of Study when it intersects with Marotiri Road, about a third of the way along the Wairakei–Whakamaru B line.
- State Highway 30 (SH30) provides a link between Atiamuri, Whakamaru and the western side of Lake Taupo. The sections of SH30 within the Region of Study are located around Whakamaru and along the northern bank of the Waikato River between Whakamaru and Atiamuri.
- State Highway 5 (SH5) is located to the south of Wairakei and lies just within the Region of Study. The new Taupo Bypass starts at the intersection of SH5 and SH1 within the Region of Study.

The major roads within the Region of Study are shown on **Map 19** within **Appendix E**.

5.1.7 Transmission Lines

Where possible, the crossing of existing transmission lines should be avoided when selecting transmission lines routes to maintain asset reliability, and reduce construction cost and restrictions due to outage timing for existing lines.

The existing transmission lines within the Region of Study are shown on **Map 27** within **Appendix E**.

The Wairakei–Whakamaru A and B Lines and the two circuits of the Bunnythorpe to Whakamaru A and B lines lie within the Region of Study. From Whakamaru, the Bunnythorpe–Whakamaru A and B lines generally follow the same route as SH32 before veering further west around an area of high land (referred to as Te Paotetamatahura) and then leaving the Region of Study.

Crossing the Wairakei–Whakamaru A line and the two circuits of the Bunnythorpe–Whakamaru A and B lines should be avoided if possible and therefore these features should be considered when selecting the Area of Study.

Although the construction of the new Wairakei–Whakamaru C line will enable the removal of the existing Wairakei–Whakamaru B line, the existing line must remain in service during construction. Therefore, the number of any crossings should be minimised.

5.2 Environmental Features

5.2.1 Population Density

The siting of new transmission lines should avoid areas that are more densely populated.

For the Region of Study, an indication of population density was available from the Statistics New Zealand 2006 Census of Population and Dwellings. The area lies within the Oruanui, Wairakei-Aratiatia and Marotiri census units.

The following populations are present within these units:

- The Oruanui unit has a population of 2,187 peoples and has grown 22% since the 2001 Census. This represents less than 1% of the Waikato Region's population. There are 765 occupied dwellings within the area. This includes Atiamuri settlement.
- The Wairakei-Aratiatia unit has a population of 630 people and has grown 3% since the 2001. There are 195 occupied dwellings within the area. This includes the Wairakei settlement.
- Marotiri unit has a population of 1,308 people and has grown 2% since the 2001. There are 480 occupied dwellings within the area. This includes the Mokai, Tirohanga and Whakamaru settlements.

As a whole, the Region of Study is sparsely populated; however, the census information above does not give an indication of the geographical spread of this population. To understand the geographical spread, the cadastral information for the area can be used to identify lot size. Where smaller lots exist, this is taken as proxy for habitation and indicative of population concentrations outside settlement areas. The rural parcels less than 10 hectares in size have been mapped and are shown on **Map 29 in Appendix E**. The location of these areas are discussed in **Section 5.3.1** above.

Building points have also been sourced from LINZ and shown on **Map 9** within **Appendix E**. The information does not distinguish between habitable buildings and ancillary farm structures (e.g. barns and shearing sheds). Therefore, the building point information only provides an indication of the concentration of buildings within the area. Notwithstanding this, the building points generally correlate with the smaller lot sizes discussed above.

5.2.2 Regional and District Plan Notations

District Plan Zones are used to identify and protect areas from incompatible development. Within The Region of Study there are a number of District and Regional Planning notations that should be considered. These are:

- Residential zoned land around Whakamaru, Wairakei and Atiamuri;
- Hot ground hazard areas north east of Wairakei and at Orakeikorako Road;
- Waikato Foreshore Protection Zone which runs the length of the Waikato River within the Region of Study; and,
- Wairakei Tourist Park Zone, an old district plan zone which is located around Wairakei. Even though this zone no longer exists, it provides an indication of the areas around Wairakei that were considered to possess tourism values and these were protected through the District Plan.

Within the Region of Study, the only relevant regional planning notations are the geothermal systems noted in the Geothermal Variation of the Waikato Regional Plan. These areas are identified as geothermal features and are discussed in Section 5.1.5 and identified on **Engineering Map 18: Generation & Geothermal** in **Appendix E** to avoid double counting these features.

The District Plan notations within the Region of Study are shown on **Map 32** within **Appendix E**.

The residential zoned land at Whakamaru and Wairakei, the hot ground hazard areas and Wairakei Tourist Park Zone are located near the tie in points for the new transmission line and therefore are difficult to avoid in the selection of an Area of Study. The Area of Study should therefore include sufficient land around the Wairakei and Whakamaru substations to allow alternative options for access and possibly avoiding these features.

5.2.3 Ecological and Landscape

Part II of RMA and the NPS on Electricity Transmission requires Transpower to avoid adverse effects on outstanding natural landscapes, areas of high natural character and areas of high recreation value and amenity in the selection of transmission line routes.

Areas of landscape value within the area have been identified from the Preliminary Landscape and Visual Assessment and the Taupo District Council Landscape and Natural Values Plan Change.

The Preliminary Landscape and Visual Assessment identified the following landscape features for the existing transmission line corridors:

- The Wairakei-Ohakuri Dam section of the Wairakei-Whakamaru A line comprises two distinct landscape types: in the south rolling farmland and in the north steep exotic forestry. The

southern section passes through an amenity landscape and two significant natural areas (SNAs).

- The Ohakuri Dam to Whakamaru section of the Wairakei–Whakamaru A line essentially follows the Waikato River Corridor. The eastern section runs along flat river terraces before ascending the hills south of the Whakamaru (or Whakaahu) Bluffs. The western section traverses steep hilly farmland, with rocky bluffs and outcrops, including the peaks of Whakaahu and Kaahu (Outstanding Landscapes) and two SNAs.
- The Whakamaru to Wairakei section of the Wairakei–Whakamaru B line traverses hilly to undulating pastoral land for much of its length and is visible from a number of public roads. The line passes through the northern end of Te Tarata-Pokuru Ridge (an Amenity Landscape).

The Preliminary Landscape and Visual Assessment also identified sensitive landscapes in the Region of Study. These are landscapes with less ability to accommodate change or the introduction of new structures. These include:

- The Waikato River corridor valued as a recreation/scenic resource;
- Changing land use in the Kinleith Forest area due to dairy conversions;
- Rural residential land use to the east of Whakamaru on the southern side of the Waikato River;
- Whakamaru township and outskirts; and,
- Other potential areas of rural residential development.

The Taupo District Council Landscape and Natural Values Plan Change is currently in the process of public consultation. It identifies a number of areas within the Region of Study as significant, outstanding and amenity landscapes. These include the Te Tarata-Pokuru Ridge, and the peaks of Whakaahu and Kaahu. The entire length of the Waikato River within the Region of Study is identified as an outstanding landscape.

Areas of ecological value within the Region of Study have been identified as areas of the conservation estate administered by the Tongariro/Taupo Conservancy for the Department of Conservation. The location of these areas were sourced from the Department of Conservation's GIS database. These areas include the following:

- Whakamaru Marginal strip;
- Okama Stream Marginal Strip;
- Kaahu Scenic Reserve;
- Tirohanga Scenic and Recreation Reserves;
- Pokuru Road Conservation Area;
- Whakamaru Conservation area; and,
- Atiamuri Marginal Strip.

The ecological and landscape areas within the Region of Study are shown on **Map 33** within **Appendix E**. These areas should be avoided far as practicable in the selection of the Area of Study. This can be achieved by excluding the particular area or ensuring that sufficient areas exist around these landscape and recreation features to avoid them in the identification of transmission line routes.

5.2.4 Tourism and Recreation

Transmission lines can reduce the amenity and aesthetic values of landscapes which form the basis of tourism and recreation activities.

Within the Region of Study, areas of tourism and recreation include the conservation estate identified above, local government reserves, and waterbodies used for water related recreation

activities (such as water skiing). The significant tourist activities associated with the geothermal areas at Wairakei are located just south of the Region of Study.

There are a number of local government reserves within the Region of Study. These are concentrated around the Whakamaru and Wairakei settlements and a large area located on the eastern side of the Waikato River at Ohakuri.

The entire length of the Waikato River in this area, and particularly Lake Whakamaru and Atiamuri is used for water related recreation. The Waikato River Trail is currently being developed and is located on the northern side of the Waikato River between Whakamaru and Atiamuri.

The tourism and recreation areas within the Region of Study are shown on **Map 34** within **Appendix E**. These areas should be avoided far as practicable in the selection of the Area of Study.

5.3 Property Features

5.3.1 Lot Size

Smaller lots are linked with other indicators such as greater population density and more intensive land use which are preferable to avoid for new transmission lines. It includes rural lifestyle type development, but excludes urban areas. The impact of transmission lines on smaller lots is also generally greater in terms of disruption of existing land use from towers and lines and effects on visual amenity. Therefore knowledge of locations of lots will be a factor in determining the area to analyse for the most suitable place to locate a transmission line and indicating the degree of difficulty in siting structures. The more fragmented an area, the greater the number of individual landowners which Transpower will need to negotiate with in order to secure an easement and land access. Conversely, the presence of larger lots may mean that fewer individual properties are affected by a new transmission line.

The lot sizes for the Region of Study were sourced from LINZ and are shown on **Map 1** within **Appendix E**. Within the Region of Study lot sizes range from under 1 hectare to over 1000 hectares in size. The smaller lots are concentrated predominantly in the south-east along Whangamata, Pohipi, Oruanui and Palmers Roads and off State Highway 1. There are also other areas of smaller lots scattered throughout the Region of Study such as at Mokai, Tirohanga and along the shores of Lake Whakamaru.

5.3.2 Maori Trust Land

The Land Information New Zealand Standard for the Acquisition of Land Under the Public Works Act 1981 states that:

“Where land in multiple Māori ownership is required for a public work, evidence should be provided that the acquiring authority has recorded that:

- *All other practical alternatives to taking Māori land have been considered, even if not ideal, and are not reasonably acceptable (e.g. impracticable or unreasonably expensive).”*
- *Leasing the land from the owners (rather than acquiring the freehold) has been genuinely considered and has not been accepted because leasing would be impractical or unreasonably expensive;*
- *No more land than is necessary is to be taken for the public work, subject to the agreement of the owner(s) to acquire a larger area to avoid leaving severances; Guidelines to the Standard for the Acquisition of Land under the Public Works Act 1981;*
- *Where practical the acquisition of the land will be formally completed before the public work commences.”*

Based on the above, areas of Maori Trust land within the Region of Study need to be identified and whilst a new transmission route affecting Maori Trust land is, based on discussions to date, very likely to be practical in this situation, Transpower needs to engage in discussions with the owners to identify an appropriate and acceptable route. The ownership of this land was identified from LINZ information and mapped on the basis of cadastral boundaries.

There are two large areas of known Maori Trust owned land in the Region of Study. These are shown on **Map 3** within **Appendix E**. One lies immediately either side of the existing Wairakei–Whakamaru A Line and the other lies immediately either side of the existing Wairakei–Whakamaru B Line. In order to consider alternative routes for the new line, it is considered prudent that the Area of Study is wide enough to allow possible routes on either side of this Maori Trust land, should crossing this land not be possible.

6 Identification of the Area of Study

For this Area assessment, the project team have set out to identify an Area of Study within the larger indicative Region of Study that will then be carried forward for further identification for a new transmission line route. The identification of the Area of Study is based on a desk-top study of features of influence and discussions between technical, environmental and property personnel. This section identifies the key considerations in determining the Area of Study.

6.1 Key Principles for the Identification of the Area of Study

To guide the selection of the Area of Study for the new transmission line, technical, environmental and property personnel identified a number of principles that draw on the key lessons learnt from the NIGUP project and also took account of the particular context of this project. It was considered that the following principles should guide the selection of the Area of Study:

- The Area should have a “smooth” boundary. This reflects the fact that the geometry of any transmission line is unlikely to include drastic changes in direction (e.g. 90° changes in direction).
- The identification of the Area should start with those boundaries that are fixed. For the Wairakei Ring these include the Wairakei and Whakamaru substations; being the tie in points of the new line.
- The Area needs to be large enough so that significant constraints can be avoided wherever possible³.
- The Area needs to reflect a common sense approach, including when it comes to the practicality of constructing a line and costs associated with this.
- The Area should facilitate minimal crossing of existing transmission lines for security of supply.
- The Area needs to balance the identified features with the value of those features.

A further observation is that the existing Wairakei–Whakamaru B Line should be contained within the Area as it represents the existing route between the Wairakei and Whakamaru substations.

Each of these considerations is discussed in turn below.

6.2 The Boundaries of the Area of Study

The tie in points for the Wairakei–Whakamaru C line are fixed and therefore the Whakamaru and Wairakei substations form the starting points for the selection of the Area of Study. The shortest route between these two substations is obtained by drawing a straight route line between them. A significant deviation from this straight line will increase the length, and possible associated potential adverse environmental and property related effects (because a greater of land area is then crossed by the line) as well as costs of the new line. A deviation of up to 10 km was considered the maximum deviation that should be considered and this provides a starting point for selection of the Area of Study. Therefore, the Area of Study should initially be centred on the 20 km wide straight line route between the two substations and the outer boundaries then determined based on the assessment of engineering, environmental and property features provided in **Section 5**.

³ In some areas, this analysis led to the Area of Study expanding across the boundaries of the Region of Study.

6.2.1 The Whakamaru and Wairakei Substations

The Whakamaru substation is in close proximity to the existing Bunnythorpe–Whakamaru A and B lines, SH30 and SH32, the Whakamaru settlement (with dwellings and educational facilities) and several recreation areas. Therefore, a large area of land should be provided around the substation to allow alternative routes to be investigated for entering the substation and avoiding these features if possible. This buffer area should include, but not extend past the proposed Whakamaru North 400 kV substation site because the north of the substation, the new 400 kV transmission lines represent a constraint to siting any additional lines in that area.

At Wairakei, the substation is in close proximity to the existing Wairakei settlement, the Wairakei geothermal plant, areas of hot ground hazard and tourist areas. Therefore, a large area of land should also be provided around this substation to allow alternative routes to be investigated for entering the substation and avoid these features if possible.

A 3 km buffer is considered appropriate around the two substations and provides the defined area boundary.

6.2.2 The Waikato River

The Waikato River forms a prominent physical feature within the Region of Study. It is identified as having particular significance including as an identified outstanding landscape and an area of recreational value. The Regional and District Plans identify the values of the river and seek to protect these values. There are also rural residential activities concentrated along the terraces of the River. From an engineering perspective, crossing the Waikato River is not desirable as there are areas of steep land (including bluffs) adjacent to the river and the width of the river will require taller and stronger towers and spans to cross it.

For these reasons, the Area of Study should not extend north of the Waikato River between Whakamaru and Atiamuri or south of the river at Wairakei.

6.2.3 Maori Trust Land

Land held under multiple ownership arrangements (such as Maori Trust land) has the potential to be problematic in terms of obtaining appropriate legal rights to cross it. There are two large areas of Maori Trust land sites directly within the straight line route between the Wairakei and Whakamaru substations and part of the land in the south extend to the edge of the 10km deviation. Given the size and location of this Maori Trust land, a potential route may traverse through this area. However, it is prudent for the Area of Study to provide multiple route options which includes alternative properties, recognising landowners within the Area of Study may have different aspirations for their land, and some landowners may be more willing to accommodate a new transmission line than others.

6.2.4 The Bunnythorpe–Whakamaru A and B and Lines

Sections of the existing Bunnythorpe–Whakamaru A and B lines and the Wairakei–Whakamaru A line lie within the straight line route between the Wairakei and Whakamaru substations. For the sections of the Bunnythorpe–Whakamaru A and B lines, SH 32 also follows some of the same route, increasing the visibility of any new infrastructure.

Any crossing of the Wairakei–Whakamaru C line should be minimised to maintain reliability, and reduce construction cost and restrictions due to outage timing for existing lines.

In consideration of the above, from the outer edge of the buffer around the Wairakei substation, the boundary of the Area of Study has been defined by the following:

- The 10km outer edge of the straight line route between the two substations;
- A wider area around the area of Maori Trust land (discussed above); and
- The existing Bunnythorpe–Whakamaru A and B lines.

The southern boundary of the Area has been pragmatically smoothed (as discussed in Section 6.1 above).

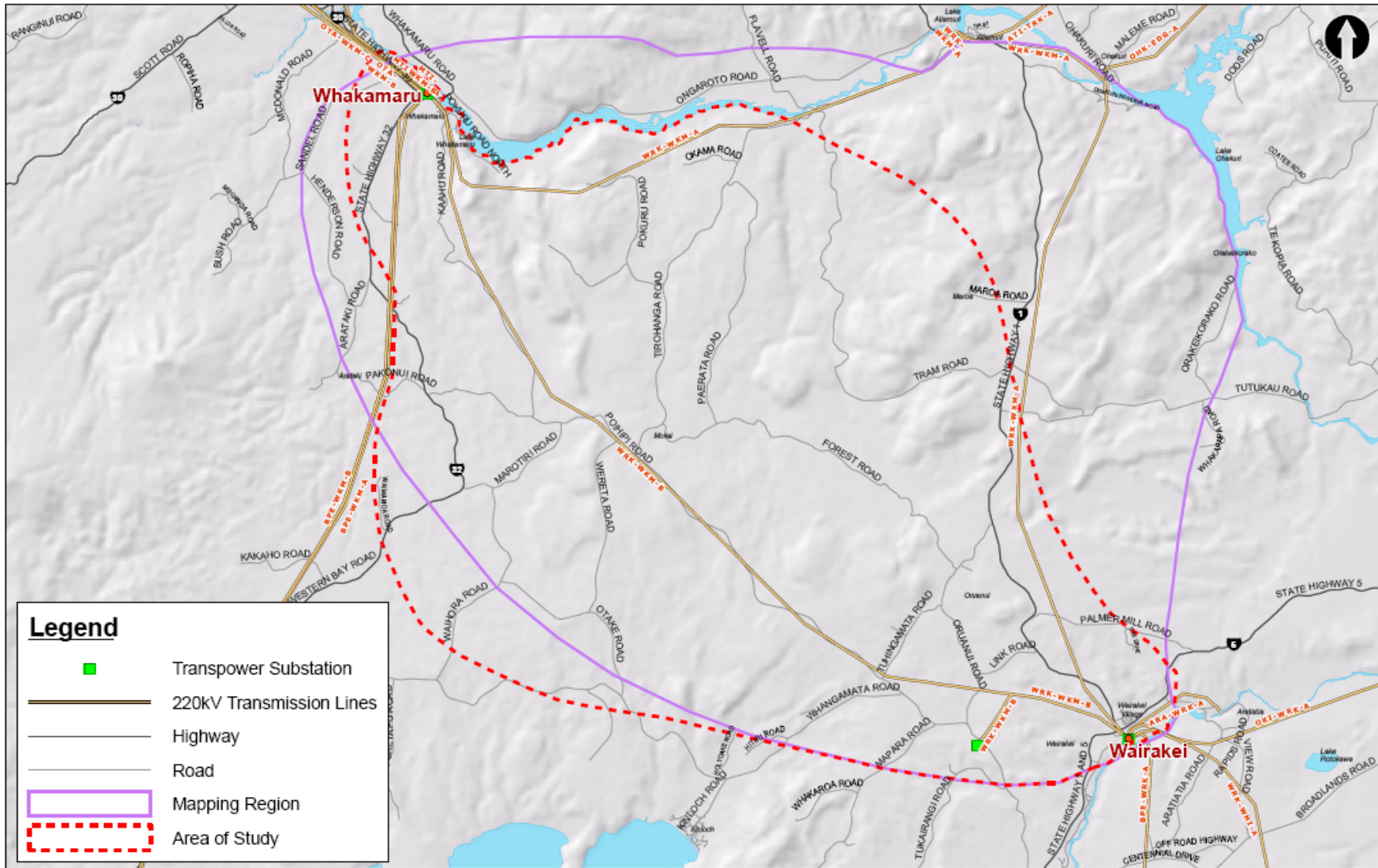
6.2.5 Steeper Areas of Land

The Region of Study includes areas of land on the north-east that are steeper and higher in comparison to the rest of the area. Locating the Wairakei–Whakamaru C line within this area will increase the costs of the line and difficulty for construction. Notwithstanding this, the technical challenges associated with siting and constructing a transmission line in this area can largely be overcome. A site visit to the area confirmed that, while the area is steeper and more challenging than the remainder of the Region of Study, the area is not as extreme as other locations where Transpower has transmission lines. Therefore, the portion of this steeper and higher that is within the 10km wide straight line route between the Wairakei and Whakamaru substations has been included within the Area of Study.

6.3 The Confirmed Area of Study

Based on the analysis above, the confirmed area of study is shown in **Figure 2** below. This area will form the basis of further investigations to identify possible routes for the Wairakei–Whakamaru C line.

Figure 4: The Area of Study



Legend

- Transpower Substation
- 220kV Transmission Lines
- Highway
- Road
- Mapping Region
- Area of Study

7 Conclusions and Recommendations

7.1 The Next Stage of Assessment

The selection and confirmation of the Area of Study is the first stage of the route selection process for the investigation of a new transmission line between Wairakei and Whakamaru. The typical stages of the ACRE process were shown and discussed in **Section 4.1** of this report. The ACRE process was specifically developed for the NIGUP. It is recognised that the ACRE process for selecting a line route for the Wairakei–Whakamaru C line needs to be tuned for this project. As discussed in **Section 4.2** of this report, key differences between the projects relate to: location and project scope, Transpower internal context, and the community and consultation context.

In the ACRE process developed and applied to the NIGUP, the corridor stage of the process involved the identification of corridors with a minimum width of 5km. The distance between the Wairakei and Whakamaru substations is approximately 40km and the proposed Area of Study is approximately 24km at its widest point. The two tie-in points for a line route are also clearly defined by the substations.

Given the size, dimensions and nature of the Area of Study for the Wairakei–Whakamaru C line, it is therefore considered that investigations for the Wairakei–Whakamaru C line should move to the route stage of the process as there are no meaningful opportunities to define alternative corridors within the area (i.e. the area in itself could be considered to constitute a large corridor). The route stage would involve the identification of alternative routes and would involve further analysis of the constraint posed by the features identified during the Area stage including all the features set out in **Table 2**.

7.2 Key Information and Discussions Required for the Next Stage

Based on the assessment of key features during this Area stage, in addition to further investigation of all features identified in **Tables 2, 3 and 4** of this report, there are several areas of further information and discussion that are considered particularly important for the next stage of the Wairakei–Whakamaru C line route selection process. These are:

1. Proactive discussions with the Maori Trust owners of land located around the existing Wairakei–Whakamaru B line will be crucial to the identification of possible routes through this area. Discussions should concentrate on whether a route crossing this area of land is possible. The possible removal of the existing line should also be addressed. It is noted that the Area of Study does provide sufficient opportunities for alternative alignments that do not require Maori Trust land to be utilised.
2. Proactive discussions with land owners in the vicinity of the Wairakei & Whakamaru substations. As noted in **Section 6.2.1**, the approaches to these two locations present challenges for line routing.
3. Further investigation of the geotechnical and both regional and district plan restrictions relating to the geothermal area around Wairakei to identify possible routes through/near this area. These investigations should include (but not be limited to) an investigation of possible ground subsidence, the extent of the geothermal field and possible design responses. Discussions should also be held with the District and Regional Council regarding rules within their relevant planning documents for these areas and the implications for transmission structures.

4. Consultation with active interested communities for the identification of possible routes. This could include but not be limited to:
 - _ the Whakamaru community to identify routes which could avoid the Whakamaru settlement, the Whakamaru School and recreation area;
 - _ the Wairakei community; and
 - _ Maori community groups (to ensure that new routes avoid sites of cultural and spiritual significance).
5. Undertake consultation and disseminate information to affected communities that have been under-represented in the initial consultation phase for the project, including Tirohanga, Mokai, and Oruanui areas.
6. Develop and implement a communication and consultation plan for key agencies and stakeholders, including (but not limited to) the Ministry of Education, Whakamaru School, Taupo District Council, New Zealand Transport Agency, Department of Conservation and generators.
7. Further investigate the other features identified in **Table 2** in this report at the Route level to identify any critical RMA related issues, as well as any technical and property concerns.