Totara Valley Micro-Hydro Development

A thesis presented in partial fulfillment of the requirements for the degree of

Master of Applied Science

in Renewable Energy Engineering

Massey University, Palmerston North,

New Zealand

David Ronald Donnelly

2008

Abstract

This study focuses on the design, construction and operation of a distributed generation system based on micro-hydro technology.

The project is sited in the Totara Valley, a small rural community approximately 70km from the Massey University, Turitea campus, Palmerston North.

The Massey University Centre for Energy Research (MUCER) has a long history of renewable energy research within the Totara Valley community. This project complements these existing schemes and provides a foundation for future research into distributed generation technologies. The project encompasses the following objectives:

- to gain practical experience in the design, engineering and implementation of a distributed generation system in rural New Zealand;
- to evaluate contemporary micro-hydro technology and compare the performance of this equipment in a theoretical and practical context;
- to identify barriers that hinder the widespread adoption of micro-hydro systems in rural New Zealand;
- to develop a spreadsheet based life cycle costing tool.

The results from this study demonstrate that economic considerations are the fundamental aspect to be considered when assessing the long-term viability of these projects.

The viability of micro-hydro projects are primarily determined by four factors:

- the volume and head (height) of water available above the turbine site;
- the length and therefore the cost of the pipeline required for transporting water to the turbine;
- the legal and administrative costs involved in obtaining a resource consent to maintain access to the water resources;
- the prices received and paid for electricity.

Considerable charges were payable to the local authority to secure and maintain the right to harness the water resources at this site. This cost contributed considerable risk to the project and creates a significant barrier to establishing similar systems at other sites.

The reduction of resource consent charges to levels that fairly reflect the negligible environmental impacts of these projects would encourage the adoption of this technology and deliver benefits to rural New Zealand communities.

Cover image: Looking west down the Totara Valley, taken 200m from intake site June 2005.

Acknowledgements

The author would like to sincerely thank all of those who have joined and supported me in this interesting and rewarding project. I am grateful to have had the opportunity to work with you all and feel privileged to be involved in the development and construction of this project. In particular I gratefully acknowledge…

Dr Jim Hargreaves, Massey University: assistance with engineering, survey and construction

Prof. Ralph Sims, Massey University: Convener supervisor, sponsor recruitment and project oversight

Michael Lawley, Eco innovations: turbine supply, installation and technical advice

Ben Mc Queen, IRL: supply of Energy Recyclers Inverter, project sponsor

Tabitha Anthony, Horizons Regional Council: Assistance with Resource Consent

Andrew Hurley/Todd Mead, Main Power: Interconnection agreement management and project sponsor

Rachael Boisen, Massey University: Previous environmental report on the Totara Valley stream

The *Smith family* of Croftlea farm Totara valley Road for their neighbourly support

The *Poulton family* for their continued support of Massey University research in the Totara Valley and for allowing us access to their property and its natural resources to complete this project.

It is also with regret that I record the passing of *Mike Poulton (Snr)* during 2006. Mike kindly offered his property as the location for this project. Over the years Mike tirelessly supported Massey University research projects in the Totara Valley.

Table of Contents

List of Figures

List of Tables