DISTRICT HEATING SCHEME
FEASIBILITY STUDY

FRANKTON FLATS
QUEENSTOWN

2010

Prepared by

aircomm

building services design engineers

DISTRICT HEATING FEASIBILITY STUDY

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Revision	Description	Date	By
A	Preliminary	01/10/10	Mika Miettinen
B	Final	03/12/10	Glenn Hill

CONTENTS

1 INTRODUCTION

This report has been commissioned by Queenstown Lakes District Council (referred to as 'QLDC') to ascertain the viability of using a wood-chip boiler type area heating system to provide hot water heating for Queenstown Airport, Lakes District Hospital, Alpine Aqualand (swimming pool) and the Queenstown Events Centre.

The structure of this study will be the following. In Section 2, the buildings included in this study and their existing heating systems are described. In Section 3, the approximate peak heat loads and annual heat energy usages in each building that could be supplied by a wood-chip boiler type heating system are estimated. A typical district heat system is described in Section 4. The total costs of the area heat system in this study are covered in Section 5, and the conclusions are presented in Section 6.

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2 BUILDINGS

2.1 Queenstown Airport

Queenstown Airport in Frankton serves the resort town of Queenstown and is operated by Queenstown Airport Corporation Ltd. The first stage of the buildings was operational 2006. The total floor area of the buildings to date is 11000 m². The airport area does not have an appropriate space for the wood-chip boiler plant.

Queenstown Airport is generally heated by roof-mounted heat pumps and a 400 kW diesel boiler. In this study the new centralised wood boiler district heating system would replace the existing diesel boiler, although the diesel boiler would be retained as a back-up boiler. The existing diesel boiler is used to provide Low Temperature Heating Water (LTHW) to air curtains, fan coil units and heating coils to preheat fresh air in the roof top heat pumps.

The bulk of the airport heating and all cooling are provided via the roof top air-to-air heat pumps. The centralised wood-chip plant cannot compete against the existing air-to-air heat pump system with the current electricity rates and thus energy usage via the heat pump system is excluded in this study.

2.2 Lakes District Hospital

Lakes District Hospital (LDH) on Douglas Street in Frankton is owned and operated by Southern District Health Board (referred to as 'SDHB'). The overall site plan is shown in Appendix 1. The building also includes an elderly people's home as indicated on the site plan. The hospital part of the building accommodates 21 beds and the elderly people's home part has 31 single bedrooms. The total floor area of the building is 2936 m².

The building is heated by three packaged water-to-water type heat pumps with nominal capacities of 195 kW and two times 185 kW, providing LTHW. It is shown that the hospital never needs more than one heat pump operating at peak. One of the heat pumps was replaced with a new one in April 2009 (195 kW nominal capacity one). The other two are originals and were commissioned in November 1989. Over the years older heat pumps have had rebuilds. [1] The heat pumps use lake water as their primary heat source, producing heating water at 55 °C with a 10 °C temperature difference between flow and return. Lake water is pumped from a pumping station located near the lake to a 22500 litre storage tank

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in the Energy Centre (see site plan for further details). Lake water from the storage tank is then pumped to individual heat pumps from where part of the lake water runs to a water feature located outside the elderly people's home section of the building. Heating water from the heat pumps is circulated from a 22500 litre accumulator tank which acts as a heat sink between the heat pumps and the heat distribution system. Heat distribution is via a main header fed directly from the accumulator tank. The heat is distributed from the main header to heat air handlers' heating coils, underfloor heating circuits and to pre-heat Domestic Hot Water (DHW). The DHW system temperature is topped up with electric elements located in the DHW cylinders.

In this study the new centralised wood boiler district heating system would replace the existing water-to-water type heat pumps, although one of the water-to-water type heat pumps would be retained as a back-up. The DHW could also be fully heated via the wood boiler district heating system.

LDH has a good area for the substation or a wood-chip boiler and fuel bunker installation in the Energy Centre. The photo of the South elevation of the Energy Centre is shown in Figure 1. The space in the basement in the Energy Centre is L11000mm x W6000mm x H3600mm. At the moment the area is used as a storage space.

Figure 1 LDH Energy Centre

2.3 Alpine Aqualand

Alpine Aqualand (swimming pool complex) on Joe O'Connell Drive in Frankton in Queenstown is owned by QLDC and operated by Lakes Leisure Limited. The overall site plan is shown in Appendix 2. The building is located beside the Events Centre. Alpine Aqualand was opened in May 2008.

Alpine Aqualand is heated by air-to-water heat pumps and a 500 kW LPG boiler. It is proposed that the new centralised wood-chip boiler district heating system would replace the existing LPG boiler. The existing LPG boiler is used to heat two fan coil units (maximum total load 24 kW), the spa pool (maximum total load 100 kW), the domestic hot water (maximum load 100 kW) and it also provides boosted pool heating (maximum load 450 kW).

The bulk of the pool heating is provided via the heat pump system. The centralised wood-chip plant can't compete against the existing heat pump system with current electricity rates and thus energy usage via the heat pump system is excluded in this study.

There is not a very suitable space on the site for a wood-chip boiler and fuel bunker installation.

2.4 Events Centre

The Events Centre on Joe O'Connell Drive in Frankton in Queenstown is owned by QLDC and operated by Lakes Leisure Limited. The overall site plan is shown in Appendix 2. The building is located beside Alpine Aqualand.

The Events Centre accommodates the following spaces:

- Main Auditorium, 1621 m², heated by eight electrical fan convectors and 31 ceiling radiant panel heaters
- Mezzanine Function Room, 200 m², heated by three gas heaters and six electrical ceiling radiant panel heaters
- Mezzanine Meeting Room, 57 m², four electrical ceiling radiant panel heaters
- Ground Floor Function Room, 170 m², eight electrical ceiling radiant panel heaters
- Bar and kitchen areas

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The wood energy district heating scheme could be used to provide LTHW heating to some or all of these spaces via new LTHW radiators, fan heaters, etc.

There is suitable space on the site for a wood-chip boiler and fuel bunker installation.

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3 PEAK HEAT LOADS AND HEAT ENERGY USAGES

3.1 Queenstown Airport

Enercon Ltd prepared an energy audit report for Queenstown Airport. In the study, Enercon Ltd estimated that the annual energy usage produced by the diesel boiler is 343 MWh. The peak heat load is estimated to be same as the output of the diesel boiler, that is, 400 kW. It is estimated that in the near future the airport will expand approximately 30%. It is assumed that the LTHW energy usage will increase by the same amount. Thus the total annual LTHW energy usage for the airport would be 446 MWh and the peak heat load is assumed to be the same at 400 kW.

3.2 Lakes District Hospital

Spotless Services Ltd prepared a Wood Energy Feasibility Study for LDH. In the study, Spotless Services Ltd estimated that the peak heat load is 130 kW and the annual heating energy usage is 591 MWh, excluding electrically heated DHW and panel heaters. With electrically heated DHW, the total annual heating energy usage is 605 MWh. [1]

3.3 Alpine Aqualand

The average electricity loads for Alpine Aqualand over four hourly periods are shown in Figure 2. The total annual electricity usage for this period is 1546 MWh. It is estimated that the heating energy proportion of the total annual usage is 80%, and therefore the annual heating energy usage produced by the heat pump systems is approximately 3700 MWh when the annual average coefficient of performance (COP) of the heat pumps is estimated to be 3.0. The peak heat load is estimated to be 450 kW when the COP of the heat pumps at the peak heat load time is assumed to be 2.0.

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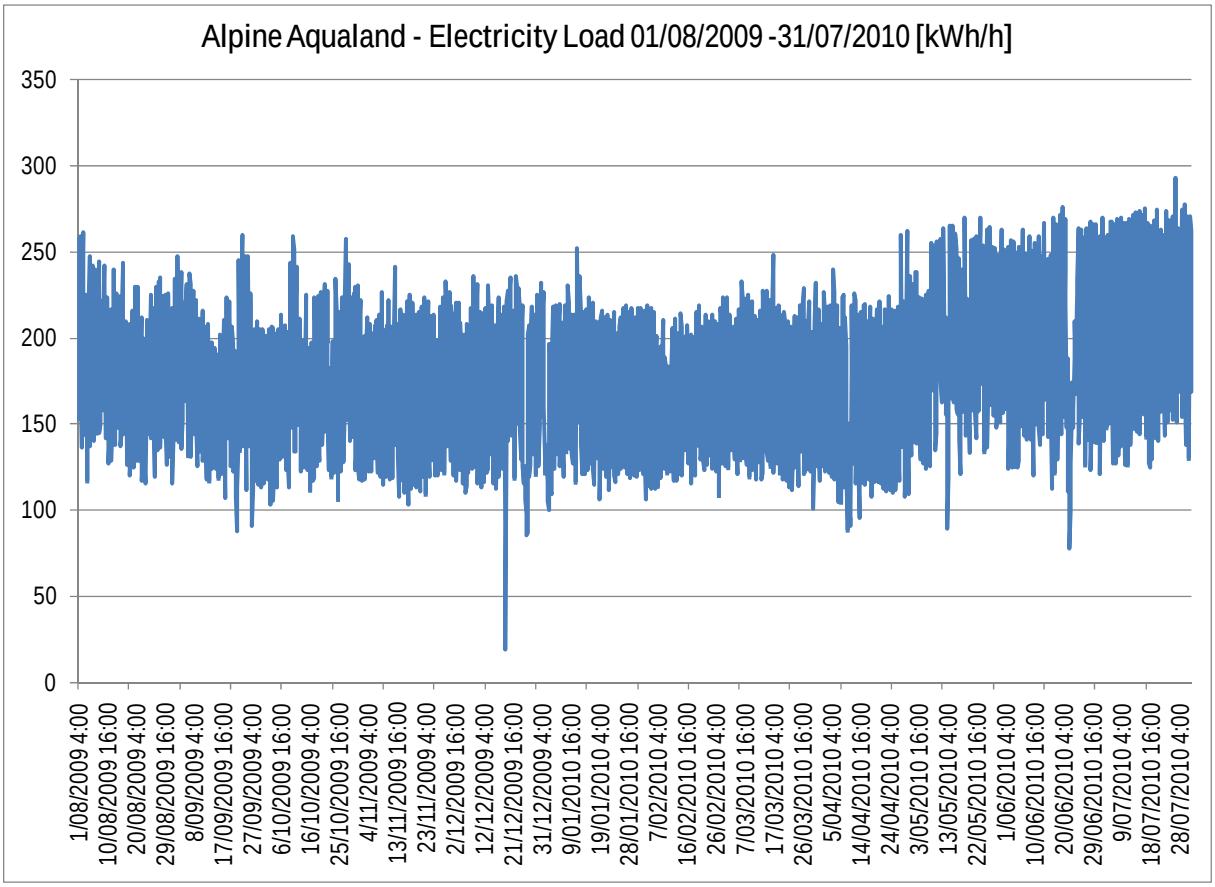

Figure 2 Average electricity loads for Alpine Aqualand

The specifications for the LPG and the LPG boiler efficiency are shown in Table 1. The LPG boiler energy production and usage for Alpine Aqualand are shown in Table 2. The peak heat load at 500 kW is estimated to be same as the LPG boiler output. The LPG boiler acts as a back-up for the heat pump system.

Table 1 LPG specification and LPG boiler efficiency

Description	Unit	Value
Net calorific value of LPG	[MJ/kg]	46.1
Density of LPG, typical	[kg/l]	0.537
LPG boiler efficiency	[%]	90

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Table 2 Monthly LPG usage and annual heating energy usage

Month and year	LPG usage [kg]	Period [days]	LPG usage [MJ]	LPG usage [kWh]
Jul-09	7102	31	327,402	90,945
Aug-09	4136	31	190,670	52,964
Sep-09	3667	30	169,049	46,958
Oct-09	4434	31	204,407	56,780
Nov-09	3235	30	149,134	41,426
Dec-09	2164	31	99,760	27,711
Jan-10	2015	31	92,892	25,803
Feb-10	1563	28	72,054	20,015
Mar-10	1903	31	87,728	24,369
Apr-10	3582	30	165,130	45,870
May-10	4340	31	200,074	55,576
Jun-10	6841	30	315,370	87,603
	44,982	365	2,073,670	576,020
Annual heating energy usage [MWh]				518

3.4 Events Centre

The average electricity loads over four hourly periods for the Events Centre are shown in Figure 3. The total annual electricity usage for this period is 379 MWh. It is estimated that the heating energy proportion of the total annual usage is 80%, with the annual heating energy usage being approximately 300 MWh. The peak heat load is assumed to be 150 kW. The future plans for the Events Centre indicates that the building area would be four times larger with the new extensions. These extensions are not included to this study.

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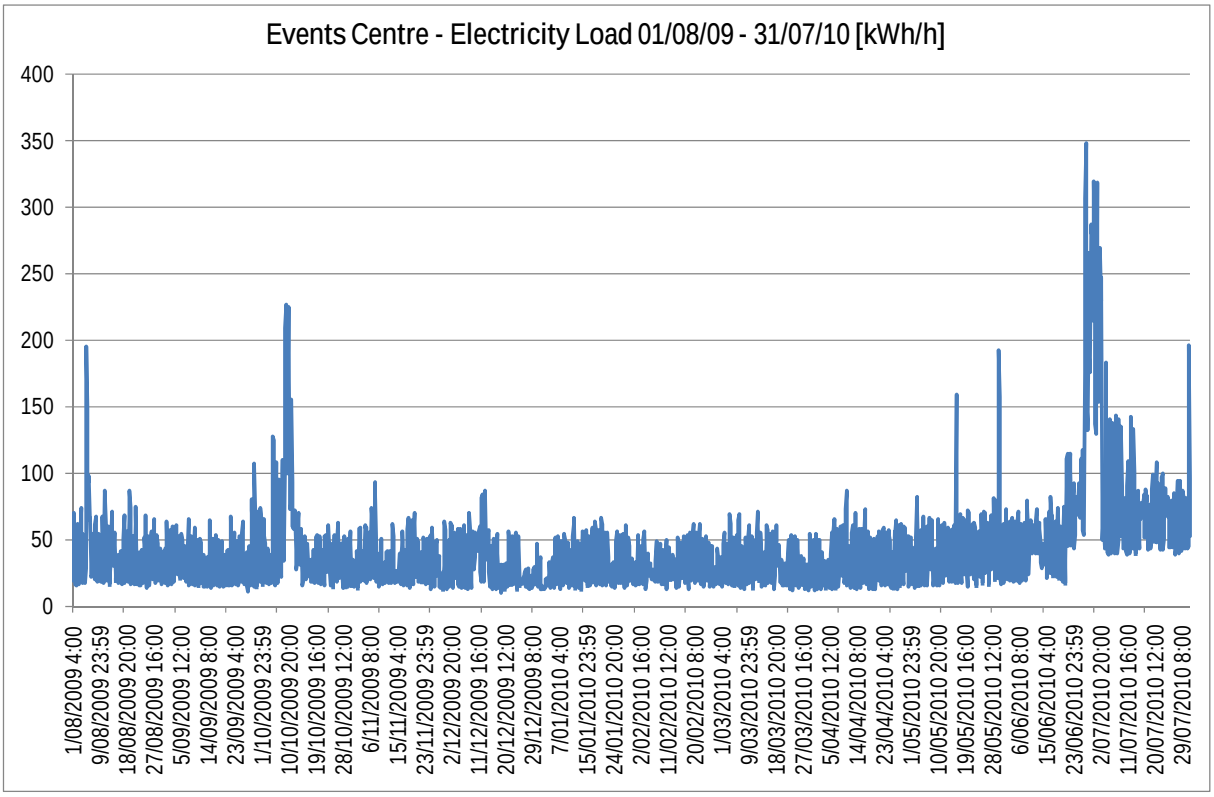

Figure 3 Average electricity loads for Events Centre

3.5 Total Overview

The annual energy usages and peak heat loads for the properties in this study are shown in Table 3. The best location for the centralised wood-chip boiler plant is somewhere on the Events Centre land. This is because Alpine Aqualand and the Events Centre are the biggest heat users and there are some areas in which to locate the plant without it being too close to the airport run ways.

Table 3 Annual energy usages and peak heat loads for the properties in this study.

Property	Energy source	Heating system	Energy usage [MWh/yr]	Peak heat load [kW]
Queenstown Airport	Diesel	LTHW boiler	446	400
Lakes District Hospital	Electricity	Water-to-water heat pumps	605	130
Alpine Aqualand	LPG	LTHW boiler	518	500
Events Centre	Electricity	Radiant panel heaters	300	150
Total			1,869	1,180
Total peak load with overlapping diversity (0.85)				1,000