



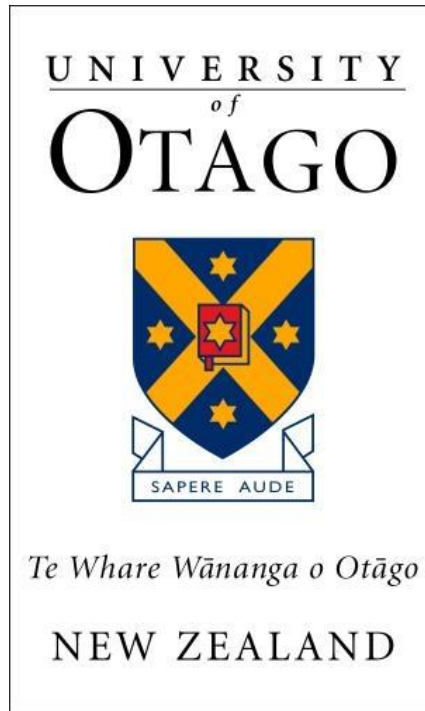
THE LAKE ONSLOW BATTERY PROJECT

Investigating Impacts and Strategies for Success

Document prepared for PLAN435/535 by
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MASTER OF PLANNING 2023





The Lake Onslow Battery Project: Investigating Impacts and Strategies for Success

A research report submitted in fulfilment of the requirements for PLAN435/535 – Planning Case Study 2023

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Central Otago District Council

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This report presents work undertaken by students from the Master of Planning program at the University of Otago and should in no way be seen to represent the views of the University of Otago.

Executive Summary

Aotearoa, along with the rest of the world, is currently transitioning away from fossil fuels and increasingly becoming more reliant on renewable energy sources. In doing so, New Zealand will become more reliant on favorable weather conditions which allow for sunshine, wind, and rainfall in order for electricity to be generated.

To make this transition viable, the Ministry for Business, Innovation, and Employment has proposed the Lake Onslow Battery Project. This is located in the Teviot Valley of the Central Otago district. In effect, the expansion of Lake Onslow will create a battery which will enable a reliable source of water for electricity generation.

The Teviot Valley boasts a range of significant natural and physical landscapes, features, and resources. These are highly valued by the communities in the Teviot Valley, namely Lake Roxburgh Village, Roxburgh, Teviot, Ettrick, and Millers Flat. Based on past examples, it is thought that there will be significant environmental impacts (Kong et al., 2017; Liu et al., 2013), social impacts (Magee 2006; Mouratidis, 2021; Sovacool and Griffiths 2020; Supriyasilp, 2009), and cultural impacts (Fujikura, 2021; Huang et al., 2017; Supriyasilp, 2009) on the aforementioned communities. Conversely, case studies have suggested that there are many opportunities associated with such projects (Meridian Energy, 2023; Wang, 2012).

This research sets out to provide the Central Otago District Council with a report which enables an understanding of the impacts and opportunities of large-scale pumped hydro schemes in the context of Central Otago. Specifically, this research seeks to answer the following questions;

1. What are the primary social, cultural, economic, and environmental impacts of the Lake Onslow Battery Project as perceived by the Teviot Valley community?
2. What are the opportunities and limitations of the required infrastructure associated with the Lake Onslow Battery Project in the short-term and long-term?
3. What is the community's perception of the Lake Onslow Battery Project in terms of consultation adequacy and desired outcomes for the future?

The scope of this research focuses on the social, cultural, economic, environmental, and infrastructural impacts of the Lake Onslow Battery project as perceived by members of the Teviot

Valley community. This research also focused on opportunities of the Lake Onslow Battery Project.

A mixed methods approach was undertaken, with use of secondary and primary data sources. Secondary methods used included a review of the existing literature on large scale hydro schemes, and a policy analysis of the relevant planning documents.

Primary research methods used in the research included interviews with key informants. Selected key informants were made up of Teviot Valley community members, local landowners, community board members, experts, and councillors. A questionnaire survey was also put out to the general public living in the Teviot Valley and surrounding areas. This enabled the research team to gain insight into key impacts of the Lake Onslow Battery Project on the Teviot Valley as perceived by community members.

The findings suggested that members of the public were very concerned about the Lake Onslow Battery Project as a whole. They could identify a range of potential impacts, many of which were consistent with literature relating to large scale hydro schemes. While, generally speaking, members of the public would prefer that the project did not go ahead at all, they thought that the Lake Onslow Battery Project could be of great ongoing benefit to communities in the Teviot Valley if undertaken correctly.

Taking into consideration the findings from this research, five key recommendations have been derived for the Central Otago District Council that could potentially be utilised throughout the development stages of the Lake Onslow Battery Project. These recommendations are as follows:

Recommendation One: Direct communication and consultation with the community (i.e., early information system, greater meeting accessibility)

Recommendation Two: More localised research

Recommendation Three: Support a new community-led body

Recommendation Four: Ensure the Lake Onslow Battery Project will be a long-term, sustainable asset with balanced national and community benefits

Recommendation Five: Invest and plan for upgrades to local infrastructure and community initiatives

Acknowledgements

The Master of Planning 2023 *Lake Onslow Battery Project: Investigating Impacts and Strategies for Success* group would like to share our appreciation and acknowledge the contribution of several groups who contributed to the completion of this research.

Firstly, thank you to the various community members and groups, community leaders and planning consultants for giving up your time to speak to us about your perceptions, experiences, and opinions about the proposed Lake Onslow Battery Project. It is due to these contributions that the research was able to be completed.

To the Central Otago District Council staff who gave their time in one way or another to our group, thank you for providing the brief, supporting us throughout the research process, for attending the presentation, and guiding us on data collection. Without these contributions, the research could not have gone ahead or been successful.

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1 Introduction

The climate crisis is a pressing global issue that encompasses the urgent and severe challenges posed by ongoing climate change. It is driven by human activities, primarily the excessive emissions of greenhouse gases (GHGs) into the atmosphere (Pierrehumbert, 2019). The consequences of the climate crisis are far reaching and include rising global temperatures, extreme weather events, sea-level rise, and biodiversity loss (Pierrehumbert, 2019). These impacts have profound effects on ecosystems, societies, and economies worldwide, posing risks to vulnerable communities, exacerbating social inequalities, and threatening the stability of natural systems (McNutt, 2013). Global warming is a significant aspect of the climate crisis, it refers to the long-term increase in Earth's average surface temperature caused by the accumulation of GHGs in the atmosphere, mainly carbon dioxide (CO₂) from human activities (McNutt, 2013). Addressing global warming is crucial to mitigating the broader climate crisis and requires urgent actions to reduce GHG emissions and transition to cleaner and more sustainable energy sources (Houghton, 2005).

Transitioning from fossil fuel-based energy generation to renewable energy sources is a key strategy in combating the climate crisis and mitigating global warming. Renewable energy refers to energy derived from sources that are naturally replenished, such as sunlight, wind, water, and geothermal heat (Damle, 2014). Unlike fossil fuels, renewable energy sources do not emit significant GHGs during operation, making them a cleaner and more sustainable alternative. The move towards renewable energy generation is driven by several factors (Damle, 2014). Firstly, renewable energy reduces reliance on fossil fuels, decreasing greenhouse gas emissions and mitigating climate change (Gross et al., 2003). energy security by diversifying energy sources and reducing dependence on finite resources. Additionally, renewable energy technologies have seen significant advancements and cost reductions in recent years, making them more economically viable and competitive (Gross et al., 2003).

Dry year storage, also known as drought storage or water reserve, refers to the practice of storing water, particularly during periods of high normal rainfall, to prepare for and mitigate the impacts of dry periods or droughts (Gielen et al., 2019). Lake Onslow's potential as a dry year storage site is closely tied to its suitability for pumped hydro storage (Gielen et al., 2019). The primary objective of the Lake Onslow Battery Project (LOBP) is to function as a colossal energy storage

facility, ensuring resilience against hydroelectric power shortages and enhancing market stability. The LOBP encompasses an envisioned solution that aims to supply stored energy to the New Zealand electricity system, akin to the energy storage capabilities of a conventional battery (Lohani & Blakers, 2021). Its objective is to contribute to the Government's ambitious target of achieving 100 percent renewable electricity generation by the year 2030, while facilitating the decarbonisation of the broader energy system (Phetpasak, 2022). In its initial phase, the project assessed the feasibility of different scale pumped hydro schemes at Lake Onslow, as well as other potential locations across the country (Phetpasak, 2022). Comparative evaluations were performed between pumped hydro and alternative methods to identify the optimal approach, or approaches, for resolving New Zealand's dry year problem—a situation where the country's existing hydropower catchments experience insufficient rainfall or snowmelt, leading to depletion of the storage lakes (Phetpasak, 2022). Currently, fossil fuel generation serves as a backup during such periods of low storage levels. The LOBP was established to investigate the potential of pumped hydro as a means to address this dry year challenge (Bardsley et al., 2022). Its operational mechanism resembles that of a conventional hydroelectric power station, with the distinction that excess power is employed to pump water back into the lake during periods of low electricity prices (Bardsley et al., 2022). A schematic of a typical pumped storage hydropower (PSH) system has been provided in Figure 1 below. This demonstrates how stored water is utilised during drier periods to generate electricity, reducing the reliance on fossil fuels to compensate for the power deficit.

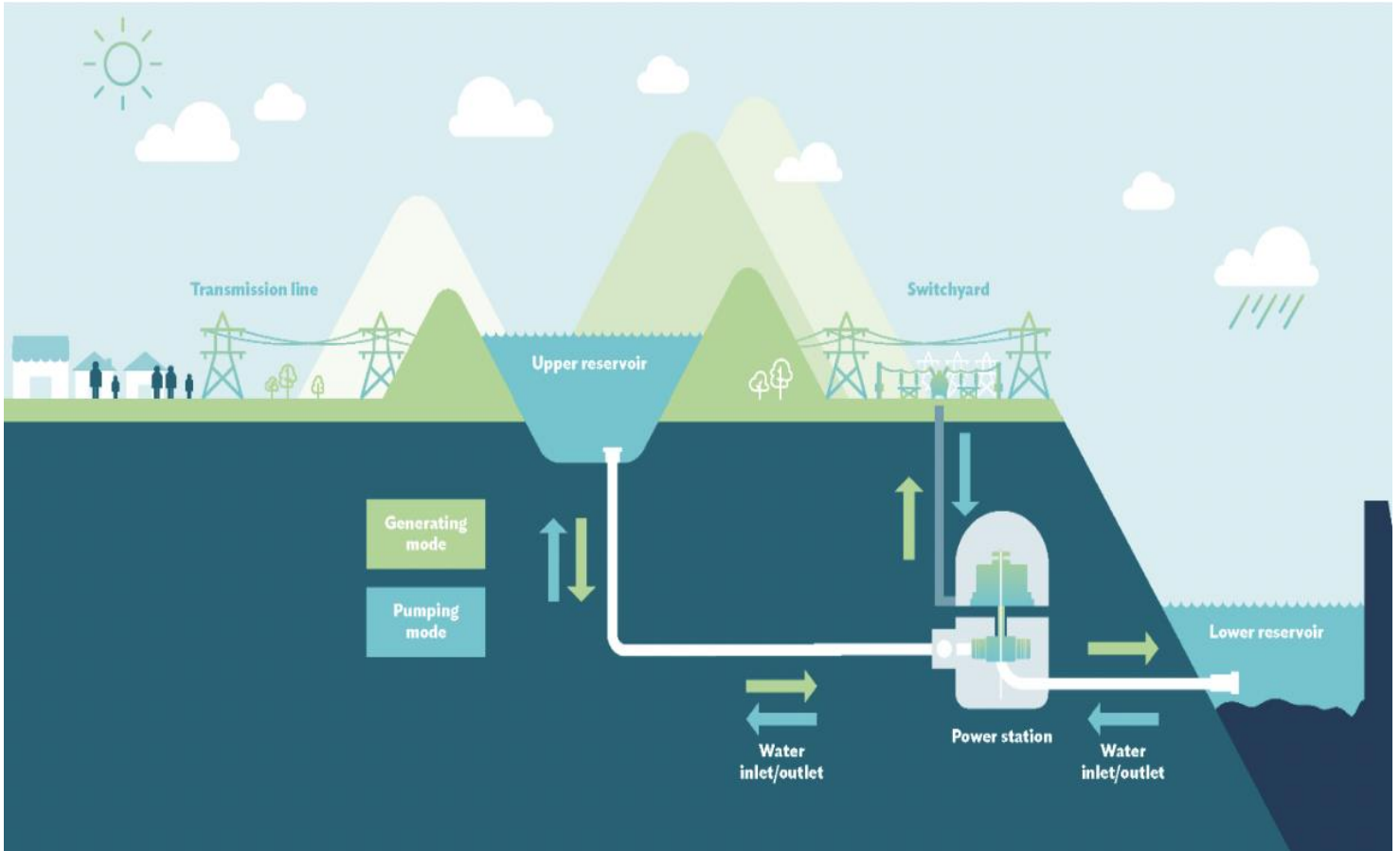


Figure 1: Schematic of a typical Pumped Storage Hydropower System

However, there has been political, social and environmental controversy as a result of the proposed LOBP. The LOBPs estimated cost of \$15.7 billion (Ministry of Business, Innovation and Employment, 2023), has been a topic of controversy and scrutiny for several reasons (Phetpasak, 2022). Firstly, developing such a project involves substantial engineering, construction, and infrastructure costs, which have led to concerns about the overall financial feasibility and cost-effectiveness of the LOBP (Phetpasak, 2022). Secondly, some critics argue that the projected costs might outweigh the potential benefits, considering alternative energy storage solutions (Phetpasak, 2022). Lastly, the controversy also stems from debates about the allocation of resources and whether the investment in the LOBP is the most efficient and effective use of funds (Phetpasak, 2022).

The LOBP generated debate and questions about potential environmental issues. The ecological impact, visual impact, and carbon footprint are some of the major environmental concerns voiced in regard to the LOBP. The development of a large-scale pumped hydro storage project at Lake

Onslow would result in severe changes to the natural landscape (Ministry of Business, Innovation and Employment, 2023). This might have an influence on the local ecology, especially the flora and wildlife (Phetpasak, 2022). It is also likely that changing water flows and habitats throughout the development and operating phases of the LOBP will have ecological repercussions. Furthermore, the building of big infrastructure, such as dams and accompanying transmission lines, can have a visual impact on the surrounding landscape and natural beauty (Kong et al., 2017). The visible intrusion of such infrastructure, critics warn, might detract from the picturesque appeal of the area and hinder its tourist potential. Finally, while the LOBP's goal is to promote renewable energy integration and reduce greenhouse gas emissions, the LOBP's development and operation may have a carbon impact. To ensure the LOBP's net environmental advantages, the emissions from building materials, transportation, and ongoing maintenance must be addressed.

This research explores the expected impacts that the LOBP may have on communities within the Teviot Valley region. These include social, cultural, environmental, and infrastructure impacts. This will be achieved by a review of literature, the use of case studies, and engaging with the Teviot Valley community. Throughout this research it became apparent that engaging with communities surrounding Teviot Valley should be included due to the size and anticipated impacts of the LOBP.

1.1 Research Questions

The purpose of this research is to provide the Central Otago District Council (CODC) with a report which enables an understanding of the impacts and opportunities of large-scale pumped hydro schemes in the context of Central Otago. Following the brief provided by the CODC, the aim is to consider the potential impacts of a large-scale hydro (LSH) scheme project on the communities of the Teviot Valley.

To achieve this aim, three research questions have been developed. These are:

1. What are the primary social, cultural, economic, and environmental impacts of the Lake Onslow Battery Project as perceived by the Teviot Valley community?
2. What are the opportunities and limitations of the required infrastructure associated with the Lake Onslow Battery Project in the short-term and long-term?

3. What are the community's perceptions of the Lake Onslow Battery Project in terms of consultation adequacy and desired future outcomes?

1.2 Report Structure

This report will be divided into nine core chapters as detailed below.

Chapter One outlines the introduction to the report, detailing the rationale, direction and purpose, and the research questions and aims of the study.

Chapter Two reviews the relevant literature for the research. This provides context and scope to the study. It explores the global transition towards hydropower generation and case studies of projects similar to the LOBP. This section concludes that while many hydropower generation projects are successful, social, cultural, and environmental impacts on the surrounding areas must be carefully considered.

Chapter Three provides context for the LOBP, describing the social, environmental, and cultural setting in which it lies.

Chapter Four outlines the national legislative context in which the LOBP must fit. This section concludes that due to the scale of impacts, it is unlikely that the LOBP will align with the purpose and principles of the RMA.

Chapter Five explains the research design and details both the primary and secondary methods used for data collection and analysis. It also considers the ethical issues and positionality of the researchers and limitations of the research.

Chapter Six presents the results of the research. The structure of this chapter is based components of the research questions and aim of this project. Information derived from Key Informant (KI) data and survey findings inform the results in this chapter.

Chapter Seven discusses the results presented in chapter six, situating them in the context of relevant academic literature and policy to answer the research questions. Based on the findings, five key recommendations have been developed that the CODC can utilize to ensure positive outcomes for communities in the Central Otago Region as a result of large-scale projects being either proposed or constructed.

Chapter Eight illustrates various recommendations aimed at the Central Otago District Council based on the results and discussion chapters.

Chapter Nine concludes the report.

2 Literature Review

2.1 Introduction

The rise of renewable energy sources may be related to two key factors, rising concerns about climate change and the harmful environmental effects of fossil fuels (Damle, 2014; Gielen et al., 2019; Kapitonov, 2018). Renewable energy technologies have grown increasingly competitive with traditional fossil fuel sources as they have become more efficient and cost-effective (Lohani & Blakers, 2021). This review examines the global context of climate change and the growing need for a shift towards renewable energy sources. It will then investigate a global history of renewable energy use and analyse the shifting landscape of renewable energy generation throughout time (Gielen et al., 2019). The review also examines the advantages, challenges, and constraints associated with LSH infrastructure projects, as well as the shift to renewable and hydro energy sources. This includes international case studies of LSH projects, as well as an evaluation of their effects on the surrounding environment, populations, and infrastructure. This is achieved through examining how different case studies were carried out which provides insight into the important variables that contributed to their success or failure (Bardsley et al., 2022). Lastly, this literature review provides recommendations and lessons gained for future hydro infrastructure projects. Examples of large-scale infrastructure projects from New Zealand, including success and failure stories, as well as insights into what can be gained from them have also been included in this review (Ming et al., 2010). This review of literature concludes that LSH projects do provide the ability to meet rising renewable energy demands. However, these demands must be met in an environmentally, socially, economically, and culturally responsible manner (Ming et al., 2010).

2.2 Climate Change

The climate has fluctuated dramatically over geological timeframes; however, the last few decades have seen an almost unprecedented global warming trend which is of great concern (Pittock, 2005). Long-term changes in temperature and weather patterns are referred to as climate change (Pittock, 2005). These changes have often been attributed to natural patterns such as shifts in the solar cycle (Shine & Forster, 1999). However, since the 1800s, human activities have been the primary cause of climate change, owing mostly to the use of fossil fuels such as coal, oil, and gas (Shine & Forster, 1999). According to Soeder (2022), human activities including altering natural river flows,

modifying coastlines, generating hazardous air in cities, and drastically changing landscapes have all had an impact on the climate. Svante Arrhenius, a Swedish scientist, was the first to assert in 1896 that the use of fossil fuels may lead to increased global warming. He postulated a link between atmospheric CO₂ concentrations and temperature (Soeder, 2022). Fossil fuels meet 80-90 percent of our energy demands, therefore, globally we are highly reliant on these fuels (Damle, 2014). Furthermore, Damle (2014) explains that because of burning fossil fuels, combustion products are emitted into the atmosphere. This contributes considerably to climate change. According to recent estimates, fossil fuels such as coal, oil, and gas account for more than 75 percent of global greenhouse gas emissions and approximately 90 percent of total carbon dioxide emissions (Damle, 2014). Consequently, the United Nations (UN) directed that emissions must be cut in half by 2030 and reach net zero by 2050 to avert worst effects of climate change (United Nations, 2022).

2.3 History of Renewable Energy Use

Renewable energy has been a dominant and accessible energy source throughout most of human history (Sørensen, 1991). Only in the past few centuries have non-renewable energy sources like fossil fuels and nuclear power come into widespread use, replacing the historical reliance on renewable energy (Sørensen, 1991). The usage of renewable energy in the form of traditional biomass to fuel fires dates back over a million years (Sørensen, 1991). The second oldest application of renewable energy is the use of wind to propel ships across water. This practice dates back around 7000 years, to ships in the Persian Gulf and on the Nile (Kelly, 2011). Geothermal energy, derived from hot springs, has been utilised for bathing since Palaeolithic times and for room heating since Roman times. Human labour, animal power, waterpower, wind, firewood, and traditional biomass were formerly the principal sources of traditional renewable energy (Kelly, 2011). As the usage of fossil-fuelled energy became more widespread, few renewable energy technologies could compete. In 1900, solar power was estimated to cost roughly ten times that of competing fossil power (Kelly, 2011). Additionally, while wind power may have been as efficient as its fossil fuel counterpart, fossil fuels proved more reliable as energy could be generated on demand (Sims et al., 2003). As a result, the viability of less efficient and intermittent renewable sources was diminished since they often necessitated the presence of energy storage facilities to

be on par with their fossil fuel equivalents. Additionally, increased costs associated with renewable energy further decreased their viability. The exception to this discourse was hydropower, as it was commonly cheaper than the construction, maintenance, and ongoing transport of fuel associated with fossil power plants (Sims et al., 2003).

Concerns in recent years regarding the changing climate have coincided with a noticeable global increase of renewable energy usage (Gross et al., 2003). The significant global expansion of renewable energy infrastructure has been driven by causes such as emission reduction, energy supply security, employment, political gain, and economic gain (Gielen et al., 2019). This global expansion of renewable energy sources was initially observed in the 1970's during two worldwide oil crises. The contribution of renewable energy sources has steadily expanded to the global energy supply since then (Lohani & Blakers, 2021). The importance of renewable energy was first discussed at the 1981 Nairobi UN Conference, as a means of achieving a sustainable future for the planet. The idea of reducing greenhouse gas emissions has emerged as the primary motivator since renewable energy is frequently viewed as the most effective alternative for reducing CO₂ emissions (Gielen et al., 2019).

The main current forms of renewable energy include solar, wind, hydropower, biomass energy, and geothermal energy (Gross et al., 2003). Despite the costs of construction for these forms of renewable energy, the recent growth in renewable energy uptake has enabled the generation of 295 gigawatts of green generating capacity globally. This recent increase in renewable electricity usage has contributed to stronger policies and setting higher climate goals (Gielen et al., 2019).

2.4 A Transition Towards Renewable Energy

In recent years, the global transition towards renewable energy has gained significant momentum (Sen & Ganguly, 2017). Renewable energy sources such as solar, wind, hydropower, biomass energy, and geothermal energy are becoming increasingly accepted and desired by governments, businesses and individuals as they strive to look for sustainable and clean energy alternatives (Sen & Ganguly, 2017). This transition has been driven by a range of different factors, including climate change concerns, energy security and economic competitiveness (Sen & Ganguly, 2017).

Marques & Fuinhas (2011), argue that the leading driver in the transition towards renewable energy is the need to reduce greenhouse gas emissions and mitigate climate change. In recent times, the Intergovernmental Panel on Climate Change has stressed the importance of reducing emissions to limit global warming to less than 2 degrees above pre-industrial levels (Marques & Fuinhas, 2011). This has resulted in many countries setting ambitious renewable energy targets (Marques & Fuinhas, 2011). Knopf et al. (2015), uses the example to the European Union (EU), highlighting that they have set a target to generate 32 percent of its energy from renewable sources by 2030. Another study undertaken by Ram et al. (2020), analysed the potential for renewable energy to meet global electricity demands by 2050. This study found that through a combination of solar, wind, and hydropower, 80 percent of the world's electricity demands could be met with renewable energy sources by 2050. The remaining 20 percent would be provided by means of bioenergy and geothermal power (Ram et al., 2020).

Another key factor propelling the transition towards renewable energy is the need for energy security. Kaygusuz (2017), emphasises that many countries are heavily reliant on imported fossil fuels, which can be subject to price fluctuations and supply disruptions. This is a major contrast from renewable energy sources which are generally more distributed and can provide a more stable source of energy (Kaygusuz, 2017). Resultantly, many countries around the world have invested significantly in renewable energy as a way to reduce their dependence on fossil fuels (Kaygusuz, 2017). However, Lund (2018) argues that renewable sources such as wind and solar power are intermittent, therefore, they too are not always available when energy is required. Furthermore, Lund (2018) suggests that integrating high levels of renewable energy into the grid requires significant investments in energy storage and grid infrastructure which proves another barrier to the mass integration of renewable energy.

Kapitonov (2018) argues that the economic competitiveness of renewable energy has improved notably in recent years. Kapitonov (2018), states that the cost of renewable energy technologies such as solar and wind power has fallen dramatically, therefore, making them more competitive with fossil fuels. This has led to a growing number of businesses and individuals investing in renewable energy to save on their energy bills. A study undertaken by Jacobson et al. (2018), analysed the feasibility of transitioning to 100 percent renewable energy globally by 2050. This study found that such a transition was technically and economically attainable and could present

additional health and environmental benefits. Furthermore, Cehn et al. (2020) emphasised the vast amounts of job opportunities that a transition to renewable energy creates. It was estimated that this could create up to 40 million jobs globally by the year 2050, thus increasing many individuals' standard of living and further stimulating economic growth. However, the transition towards renewable energy sources does require high upfront costs that are associated with building renewable energy infrastructure. Sovacool & Griffiths (2020) argue that these projects often require high initial capital costs compared to traditional fossil fuel infrastructure. Additionally, they emphasised the long-term economic benefits of renewable energy sources but state that these are only able to occur on the basis that countries can afford the large upfront costs. Therefore, it is important to acknowledge that renewable energy sources are limited only to those countries which can afford them (Khatib, 1993). Over the last century New Zealand has implemented a large range of different renewable energy sources with the aim to reduce carbon emissions and supply clean energy throughout the country, as shown in Figure 2 and Figure 3 below.

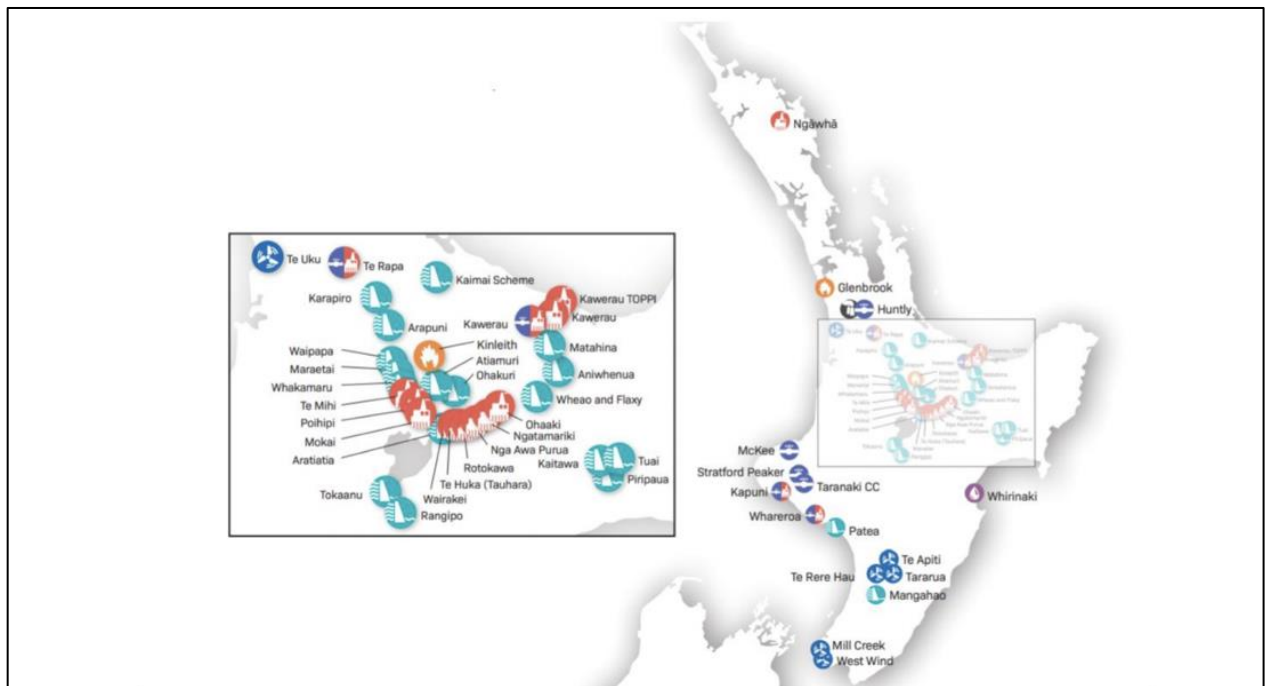


Figure 2: Locations of Electricity Generators in the North Island (Source: adapted from Electricity Authority, 2018)

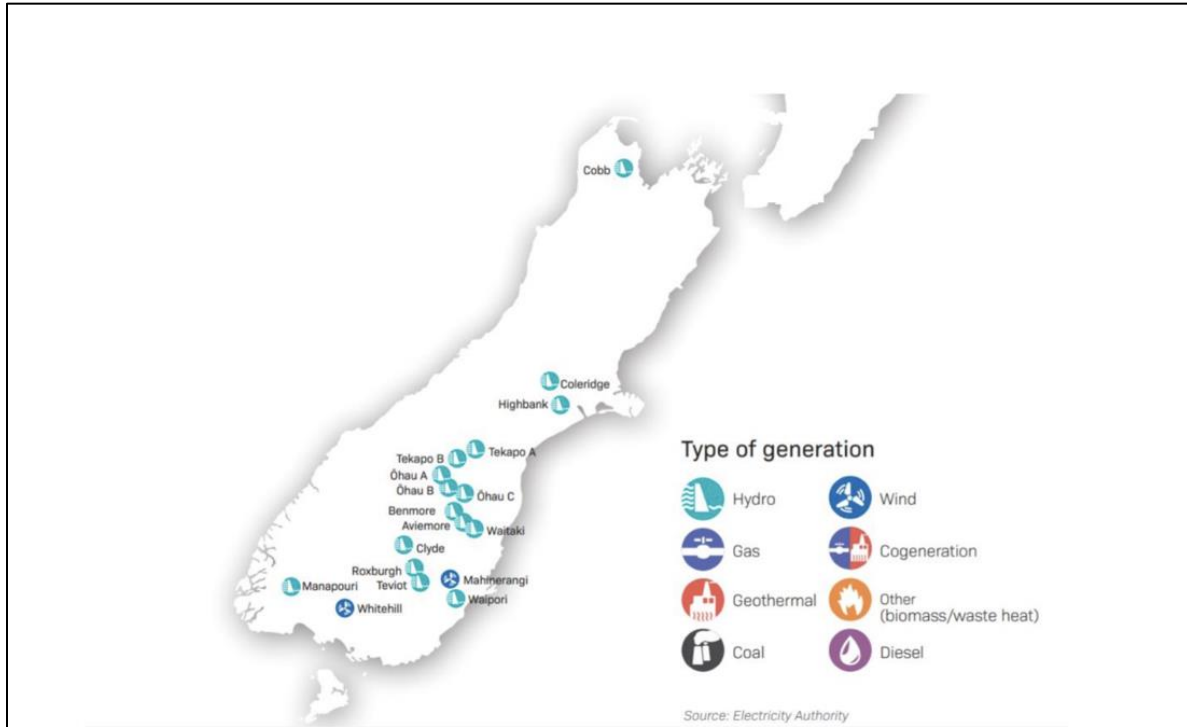


Figure 3: Locations of Electricity Generators in the South Island (Source: adapted from Electricity Authority, 2018)

The energy trilemma, as seen in Figure 4, refers to the World Energy Council's (WEC) definition, which encompasses three fundamental dimensions of energy sustainability: energy security, energy equity, and environmental sustainability (WEC, 2020). Achieving a healthy and sustainable energy system requires striking a balance among these dimensions (WEC, 2021). However, this task is highly challenging and involves trade-offs between the competing dimensions of the trilemma, particularly during the transition from fossil fuel-based to decarbonized energy systems (WEC, 2021). Furthermore, the energy trilemma entails economic trade-offs and varying costs and benefits for different stakeholders. Striking a balance among the dimensions of the trilemma is essential for achieving a healthy and sustainable energy future.

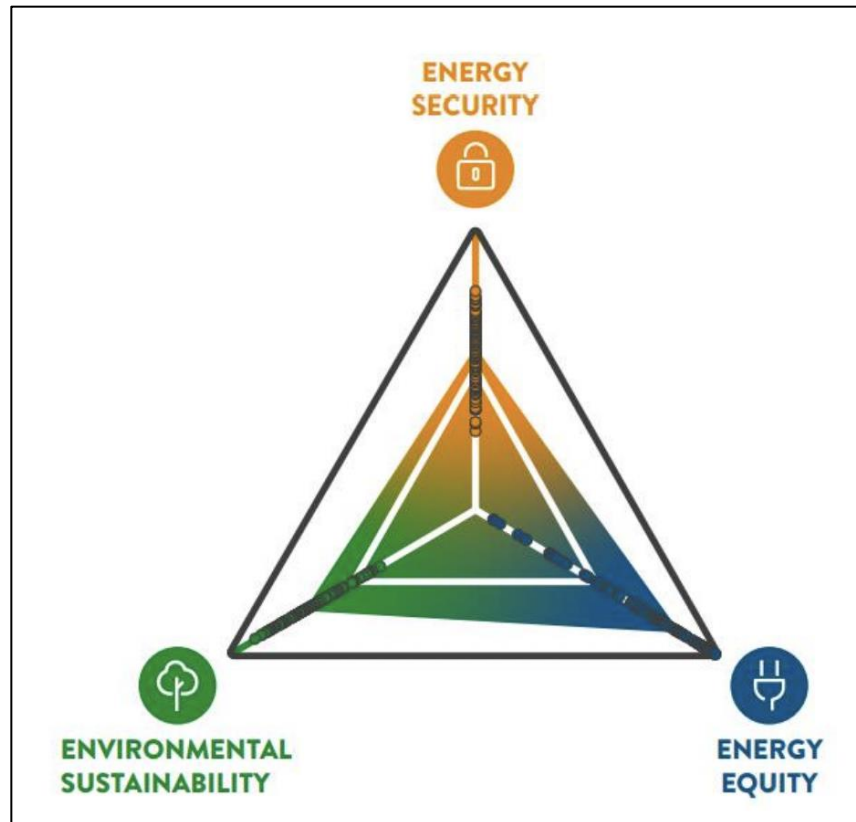


Figure 4: Energy trilemma (Source: World Energy Council, 2020).

Finally, there are many concerns that some renewable energy sources require a significant amount of land, which can result in negative impacts for biodiversity and ecosystems. LSH and bioenergy require a significant land area and can often lead to land-use conflicts and environmental damage (Fthenakis & Kim, 2010). It is, therefore, crucial that location and management of renewable energy projects are planned in a sustainable manner to help minimise any negative impacts. This is an important issue which must be addressed in the present research.

2.5 Transition Towards Hydro Energy

Hydropower is a renewable energy technology that harnesses the power of moving water to generate electricity. It has been used for centuries, dating back to ancient civilisations such as the Greeks, Romans and Chinese, however, it was not until the 19th century that hydropower began to be used on a larger scale to generate electricity (Breeze, 2018). In recent years, there has been a significant increase in hydropower as a key source of supplying renewable energy due to its low

carbon emissions and reliability. Hydropower can be divided into two categories; conventional hydropower and pumped-storage hydropower (PSH). Conventional hydropower involves the use of dams and turbines to generate electricity from the natural flow of water (Kong et al., 2017). PSH involves the use of two reservoirs at different elevations to store and generate electricity during times of peak demand (Kong et al., 2017). PSH schemes are often favoured due to their lifetime expectancy, typically between fifty to one hundred years, their fast response time, and efficiency (Harby et al., 2013). PSH take an average of ten years to construct, and can then work on daily, weekly, or seasonal cycles to generate energy (Harby et al., 2013). PSH generally use pre-existing lakes as reservoirs, however, in some cases artificial reservoirs are built (Harby et al., 2013). PSH play a critical role in the security and stability of power grids as they provide rapid response, frequency modulation, and arguably most importantly, black start capability (Ming et al., 2010). Black start capability refers to the ability of a power generating module or facility to recover and restart its operations following a complete shutdown, without relying on any external electrical energy supply (Ming et al., 2010).

2.6 Advantages of Hydropower

Today, hydropower is the largest source of renewable energy in the world, accounting for approximately 20 percent of power generation worldwide (Liu et al., 2013). Furthermore, according to the International Energy Agency (2009), electricity demand will grow at an annual rate of 2.5 percent until 2030. Liu et al. (2013) contends that compared to other renewable energy sources and traditional fossil fuels, there are several advantages associated with hydropower. First, hydropower resources are widely available around the world (Liu et al., 2013). Hydropower is argued by many to be the most accessible and obtainable choice of sustainable energy sources (Siciliano et al., 2015). Hydropower is particularly important in developing countries as it meets a significant portion of the electricity demand in these areas. Furthermore, large dams have reemerged as a tool to reduce energy poverty in developing countries (Siciliano et al., 2015). In Southeast Asia, 72 new hydropower projects have been planned in Laos, more than 50 in Cambodia, and at least another 6 in Myanmar and Thailand (Siciliano et al., 2015). This is extremely important because access to modern energy services is relatively poor in Southeast Asia when comparing to other parts of the world, therefore, hydropower developments are a key priority in these areas. This

showcases the importance of hydropower infrastructure given today's environmental and social climate (Berga, 2016).

Other key advantages of hydropower include its low operating cost and long lifespan, the fuel (water) is not subject to fluctuation of market conditions, it provides the flexibility of electricity production and supply, and finally, it improves the living conditions of surrounding areas (Liu et al., 2013). However, there are many social, cultural, and environmental impacts of hydropower developments which must be emphasised to ensure they are not overlooked.

2.7 Environmental Impacts of Hydropower

Despite hydropower dams increasing in popularity, there is still controversial opinions and apprehension surrounding their implementation due to their impact on social, cultural and environmental impacts. Environmental impacts in this setting relate to fragmentation of river systems, vegetation, and land; implications for soil health, wetlands and surrounding ecosystems; water quality; implications for species and their habitats; and changes to geomorphology (Liu et al., 2013). Due to hydropower stations commonly being situated in ecological reserves, there are often a large range of plant and animal species residing in these area (Kong et al., 2017). Therefore, the construction of such stations have inevitable effects on the environment (Kong et al., 2017).

2.8 Social Impacts of Hydropower

With regards to social impacts, Supriyasilp (2009) argues that some of the most critical impacts are displacement, resettlement, changes in livelihood, poor compensation, and the loss of access to land and water. The introduction of new infrastructure can disrupt established social networks, alter community dynamics, and lead to changes in quality of life (Mouratidis, 2021). Sovacool and Griffiths (2020) emphasise that social tensions arise in many countries, predominately due to hydropower projects. These projects are often planned to increase energy in urban areas, rather than the rural location they are situated in. Therefore, this highlights a lack consideration for the communities in which the hydropower project is situated in (Sovacool & Griffiths, 2020). Magee (2006) expands on this idea and describes this phenomenon as the "power-shed." This emphasises the fact that large hydropower dams produce most benefits in urban environments, far away from

the hydropower dam itself (Magee, 2006). This becomes problematic when there are negative impacts observed on communities local to the hydropower scheme, while urban communities commonly reap the benefits of these schemes.

The construction of hydropower schemes has also been associated with a phenomenon known as the "boom and bust" (Van Assche et al., 2016). Within the context of infrastructure development, such as LSH plants, a boom and bust denotes the initial period of economic expansion followed by a subsequent decline or stagnation once the project reaches completion. This often occurs in small cities or townships (Van Assche et al., 2016). Van Assche et al. (2016) underscores the significance of drawing lessons from past case examples, emphasising the need for long-term planning, economic diversification, and sustainable development strategies to alleviate the adverse effects associated with these cycles. Moreover, large-scale projects can lead to increased social demands, particularly on healthcare facilities and services, requiring additional resources and planning to meet the needs of the growing population (Calderon & Servén, 2004).

2.9 Cultural Impacts of Hydropower

Cultural impacts of hydropower infrastructure are another critical concern and has often resulted in opposition from affected Indigenous communities. Supriyasilp (2009) argues that Indigenous oppositions to large-scale developments such as PSH has the potential to create significant points of conflict. Therefore, it is important to take this into consideration when selecting a site for hydropower infrastructure to be built on (Supriyasilp, 2009). Around the world, many Indigenous people and small local communities live on or near the land that will be used for hydropower development. Displacement and migration are often the result of such developments (Fujikura, 2021). Small communities often lose their local infrastructure and the connection with place aesthetically and emotionally, and therefore, migrate to other rural areas or into the urban cities (Fujikura, 2021). In Cambodia, hydropower development is a priority as it not only increases accessibility to electricity, but also promotes national development. There have been many observed cases in Cambodia where there has been poor consideration of residents, their opinions, and livelihoods when hydropower schemes are implemented (Supriyasilp et al., 2009). This has been mainly caused by a divergence between national and local interests (Supriyasilp et al., 2009). According to Huang et al. (2017), construction of large infrastructure projects can bring about

notable environmental and social consequences. This means that such projects are often based in rural areas near rural communities. The development of remote regions through infrastructure initiatives, such as large hydropower projects, may lead to the diminishing of their distinctive characteristics and degrade the connection between communities and their environment (Huang et al., 2017). This is important to consider when conducting additional research into such schemes as many proposed hydropower sites are located close to several small communities. Therefore, much of the literature states that enabling the voices and opinions of small communities to be heard, and listened to, is fundamental in ensuring similar concerns and unfair proceedings are avoided.

2.10 Connection to Place

Acknowledging communities' connection to place is important for understanding why communities may perceive certain impacts of large-scale infrastructure projects to be more significant than others. Connection to place can have a great influence on people's acceptance of large-scale projects (Vorkinn & Riese, 2001). As found by Vorkinn & Riese (2001), connection to place could explain more of the difference in attitudes towards large-scale projects than could the sociodemographic principles. It is important to understand the community members' connection to place to comprehend why they have different viewpoints concerning the LOBP, whether these viewpoints are positive or negative. People may develop negative perceptions toward large-scale infrastructure projects, as they may feel that it could threaten their connection to place (Manzo & Perkins, 2016). Van Veelan & Haggett (2017), state that the response and acceptance of communities toward large-scale infrastructure projects are influenced by the unique connection to place held by individuals. As individuals have unique connections to place, it is common for conflict or differing views in relation to such large projects (Van Veelan & Haggett, 2017). Connection to place will be an important consideration in this research and will help to form a deeper understanding of why the community perceives certain impacts to be more significant than others.

2.11 Global Case Studies

2.11.1 China

As China seeks to reach its carbon neutrality targets, it has embarked on producing and using renewable energy sources, and this continues to grow. Today, China's hydropower resources are the richest in the world, with most PSH distributed throughout the eastern regions (Kong et al., 2017). Consequently, this has created an uneven distribution of PSH in southwestern and northwestern regions, therefore having a larger effect on their respective communities. At the end of 2010 there were 23 PSH in China (Kong et al., 2017). Two of China's main PSH projects include Huizhou and one of the world's largest hydropower reservoirs, Guangzhou (Kong et al., 2017). The Guangzhou project now has a total installed capacity of 2.3 million kilowatts and is argued to have reached the most advanced level of a single-stage reversible pump-turbine in the world (Ming et al., 2010). An aerial image of The Guangzhou Project is shown in Figure 5 below. Lyu et al. (2022) states that while China is continuing to build advanced and important PSH infrastructure it has created many concerns. Notably, social issues, issues with resource utilisation, lack of ecological restoration, and increased population resettlement.



Figure 5: Guangzhou Pumped Storage Station (Source: Kong et al., 2017)

As awareness grows surrounding the impacts PSH can have on the environment, the requirements to protect the environment and ecology when site selection takes place have significantly increased. China has showcased strong implementation of this through many of its current projects, however, still endures many obstacles. Lyu et al. (2022) argues that due to the added need of protection for endangered species, as well as soil and water conservation, negative effects on the economic feasibility of such projects are observed as there is a pronounced increase in cost. This is a negative implication as the low cost of such projects was previously identified as a key driver of PSH, as established earlier in this review. China also has concerns with expropriation and the resettlement of many communities in the area, due to land often being flooded for the construction of PSH reservoirs to occur. As Ming et al. (2010) explains, to minimise these effects, and to maintain social order and stability, the Chinese national policy gives priority to these people and works closely alongside them when changes are made.

Ming et al. (2010), argue that the construction of PSH plants should not increase the economic burden to consumers, nor increase electricity prices. Additionally, they believe that although it is a large investment, it can significantly support and stimulate economic growth locally and nationally. This showcases the idea that many countries who are implementing PSH schemes are also interested in the additional economic benefits for the country, alongside the environmental and energy advantages. This perhaps is a concern as it is important that any monopolisation of hydropower infrastructure does not become a priority over genuine environmental, social, and cultural benefits. However, Kong et al. (2017) argues that in many cases there is a lack of unified planning and PSH is likely to cause great waste of social resources which could be more beneficial elsewhere.

Ennis et al. (2013) stated that the presence of infrastructure and housing in large-scale projects can pose challenges related to housing affordability and availability. Without proper management, infrastructure development can exacerbate housing shortages, drive up prices, and have detrimental effects on the local workforce (Ennis et al., 2013). However, according to Wang (2012), as seen in China, infrastructure development holds the potential to facilitate community enhancement and revitalisation. It can contribute to economic growth, job creation, and the wellbeing of the community if the benefits are effectively harnessed (Wang, 2012). A literature review conducted by Ali et al. (2021), found that rural development in the form of economic

growth was one of the top-ranked socio-economic impacts of the PSH projects. Chandy et al. (2012) found through the examination of socioeconomic impacts, that LSH projects see the immigration of skilled workers resulting in a long-term increase of skilled labour in the surrounding areas.

2.11.2 Germany

A case study from Germany's Atdorf Hydropower Reservoir showcased that even years after construction, some dams may be further enlarged to increase storage capacity. An aerial image of Germany's Atdorf Hydropower Reservoir is shown in Figure 6 below. PSH projects are long lasting energy solutions, they can require expansion or alterations which add costs, time, and money to the project (Harby et al., 2013). This also requires the need to redress all potential concerns which encompass social, cultural, economic, and environmental factors to ensure that any changes do not further disrupt these elements. Tellefsen et al. (2020), analysed the Atdorf hydropower reservoir and found that there are a range of impacts relating to the construction of power houses, water tunnels, access roads, and the operation of downstream rivers and lakes. They argue that the creation of new dams and reservoirs implies serious interference with nature, in particular the modification of natural stream flow regimes and aquatic ecosystems (Tellefsen et al., 2020).



Figure 6: Germany's Atdorf hydropower reservoir (Source: Tellefsen et al., 2020)

The creation of this PSH resulted in flooding areas of land. The effects of this included resettlement of people and the loss of biodiversity. Today there is state-of-the-art PSH infrastructure being implemented, and it is important to acknowledge the previously explained concerns and lessons from Germany's Atdorf Hydropower Reservoir when undertaking these projects. Additional factors need to be considered, particularly when considering access to construction sites and the transportation of the infrastructure itself. When construction began for the Atdorf hydropower reservoir they poorly factored in these requirements and this resulted in extra time taken to excavate and deposit rock masses (Tellefsen et al., 2020). Some literature provides evidence that the state of infrastructure plays a vital role in shaping public perceptions and attitudes. Mell (2010) argues that inadequate infrastructure can impede economic development, hinder accessibility, and disrupt social connectivity. Moreover, Tilt et al. (2009) asserts that deficient road conditions can result in higher transportation costs and pose potential safety risks.

2.11.3 Norway

In Norway, the electricity supply is remarkably dominated by hydropower (99 percent) (Harby et al., 2013). As of 2012, Norway has 1250 hydropower stations, accumulating to a combined total of 130,000 GWh (Lillesund et al., 2017). This is primarily due to the need to store energy as water from periods of high inflow to periods with low inflow, such as in the winter period when the demand for energy is highest. This highlights how PSH schemes are extremely useful in areas that experience seasonal variation. In Norway, water is stored during the periods of high rainfall and at times of low electricity demand during the spring and summer. This stored electricity is then used in winter when there is high demand (Lillesund et al., 2017). A typical Norwegian PSH is shown in Figure 7 below. Harby et al. (2013) argues there is potential for Norway to further balance fluctuations in power generation with the wider European power grid. This would however require the expansion of existing infrastructure. The concept of extending pre-existing hydropower stations has been proposed for the use of pumped storage without having to construct new man-made lakes or reservoirs (Harby et al., 2013). This may be something other countries could look towards doing, rather than building new hydropower infrastructure and ultimately saving time, money, and minimising social and environmental impacts associated with constructing an entirely new hydropower scheme.



Figure 7: Norway Pumped Hydropower Dam (Source: Harby et al., 2013)

2.12 New Zealand Case Studies

2.12.1 The Waitaki Hydro Scheme

The Waitaki Hydro Scheme was the first LSH scheme to exist in New Zealand. The scheme was initiated in 1904 when Mr. P S Hay, an employee in the Public Works Department, realised the Waitaki Valley's potential as a source of electricity generation. Further construction was deemed required at the time because the Lake Coleridge power station was unable to satisfy the South Island's growing need for electricity. However, it wasn't until the 1920s that a project of this magnitude could be started (Meridian Energy, 2023). The Waitaki Hydro Scheme was the first major dam to ever be built in the South Island of New Zealand and played a large role in early hydropower development in the country (Meridian Energy, 2023). An overview of the Waitaki Hydro Scheme is shown in Figure 8 below.

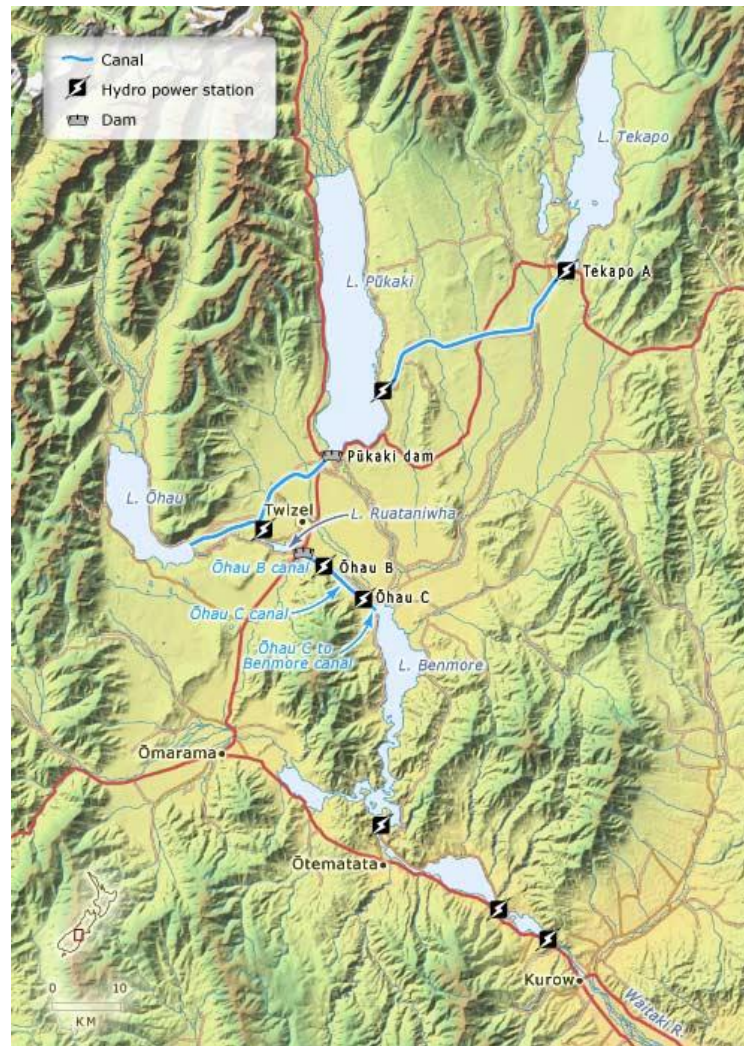


Figure 8: Overview of the Waitaki Hydro Scheme (Source: Martin (2010))

The Waitaki Hydro Scheme began with the construction of Benmore dam and the high voltage direct current link, pioneering the goal of a unified power transmission system for New Zealand. Construction of the Upper Waitaki Hydro Scheme began in 1968 in response to an increasing need for power, with the final station being commissioned in 1985 (Meridian Energy, 2023). The overall Waitaki Hydro Scheme is made up of eight power stations, with inflow being taken from Lake Tekapo, flowing through a canal into Lake Pukaki (Places New Zealand, 2023). Water from the Ohau power station as well as water from another canal connected to Lake Ohau supply the generator as the water passes into Lake Ruataniwha (Meridian Energy, 2023). The Ohau B and C generators are located on a canal linking Lake Ruataniwha to Lake Benmore, supplying the power stations in the lower part of the chain (Places New Zealand, 2023). Water passing through each station is discharged back into the Waitaki river, forming a storage lake for the next station in the chain. The annual system output of the Waitaki Hydro Scheme is 7,640 GWh (Places New Zealand, 2023). In this example, Lake Ruataniwha is very similar to what is being proposed at Lake Onslow, being a storage battery. The lake itself does not generate electricity, but instead provides surety of water which flows down the canals into Lake Benmore for electricity generation (Places New Zealand, 2023).

Otematata township, located at the eastern end of the scheme, was developed in the 1950s to house the workforce required to build the various dams and power stations. During this time, the population of Otematata increased to over 4,000 people in 1963 (Meridian Energy, 2023). In the late 1960s, the Ministry of Works staff transferred to Twizel, and this became the new residential base for workers of the Waitaki Hydro Scheme. Twizel's population then boomed for a short while, then dwindled to just over 1,000 people after the majority of the Waitaki development was completed in the mid-1980s (Meridian Energy, 2023). Otematata and Twizel are now both self-sustaining towns, largely focused on tourism, with travellers drawn to their rich history and natural beauty (Meridian Energy, 2023).

The Waitaki Hydro Scheme led the way for future sustainable electricity generation projects in New Zealand. Depending on inflows, the scheme generates approximately between 20 and 25 percent of New Zealand's annual electricity, with Lake Tekapo and Lake Pukaki providing around 65 percent of the nation's hydroelectric storage (Ministry for the Environment, 2005). This storage is critical during dry years in the South Island and set the scene for the proposed Lake Onslow

hydro scheme which is subject to this research. The Waitaki Hydro Scheme displayed the operational flexibility of hydroelectricity, proving it as a reliable source to match peak electricity demands (Ministry for the Environment, 2005). Overall, the Waitaki Hydro Scheme was revolutionary for hydropower in New Zealand, and it is important to draw from its learned lessons and experiences when addressing the LOBP.

2.12.2 Manapouri Hydro Station

Lake Manapouri is the largest hydropower station in New Zealand and is located on the edge of Lake Manapouri's West Arm in the Fiordland National Park (Meridian Energy, 2023). The hydropower station is underground, and the producing units are housed in a cavern 200 metres beneath the surface of Lake Manapouri (Meridian Energy, 2023). The original construction of the project took 1,800 workers eight years to complete and included power stations, access tunnels, and generating units, reaching completion in 1971. At its maximum, it can produce up to 0.8 MWh which can power on average around 619,000 homes (Meridian Energy, 2023). The first tailrace tunnel constructed had a diameter of nine metres, a length of ten kilometres, and a concrete interior, operating as a 'drill and blast' structure which releases water into Deep Cove in Doubtful Sound. Shortly after its construction, engineers determined that a second tunnel was needed to expand the generating capacity, successfully being completed in 2002 (WSP, n.d.). The second tunnel provided power for an additional 64,000 homes, making it an overwhelming success (WSP, n.d.).

The construction of the Manapouri hydro station was no easy task, as it faced opposition from various groups. When the initial plans for the hydro station were proposed, it was intended to raise Lake Manapouri's lake level by over 30 metres. In doing so, it would converge with Lake Te Anau, forming a massive super-lake with tremendous hydroelectric potential. Unfortunately, a project of this magnitude would have caused the beech forests and wooded islands of Lake Manapouri to vanish underneath the water, which is why many locals and other New Zealanders nationwide opposed the project (Meridian Energy, 2023). This opposition was largely spearheaded by local farmers and the Forest and Bird Society, with protests and public talks becoming known as the 'Save Manapouri' movement. From this, the Guardians of Lakes Manapouri and Te Anau were formed from among those who had spearheaded the campaign. The concept of the Guardians was to reduce the influence of governmental bureaucracy and extend political processes into the public

arena (Mark et al., 2009). Further, the government vowed to not raise Lake Manapouri water levels in the construction of the hydro scheme, reducing power capacity but overall favouring the avoidance of potential negative environmental impacts (Engineering New Zealand, n.d.). This was a compromise between preserving the natural lake system as well as realising its hydroelectric potential.

It is anticipated that there will be some opposition to the Lake Onslow pumped hydro scheme due to personal beliefs or various environmental, social, or cultural reasons. However, the Lake Manapouri hydro station shows that success can be achieved when adequate public consultation is taken into consideration. Without the work of the community and other environmental activists, Lake Manapouri likely would have been raised those 30 metres, proving detrimental to the natural lake system. If Lake Onslow can follow a similar consultation and public participation framework, then it is much more likely that Lake Onslow's environmental characteristics can be protected in the construction of a hydro scheme (Warne, 2018).

2.13 Moving Forward

Supriyasilp et al. (2009) express that the main criteria when considering a hydropower project development should consist of six key aspects; electricity generation, engineering, economics, socioeconomics, environment, and stakeholder involvement. They argue that through using these six criteria, a deeper understanding of decision-making processes is enabled which promotes the role of participants in decision-making (Supriyasilp et al., 2009). Whether it is these specific six steps or a variation of other factors, it is clearly critical to ensure explicit, rational, and efficient decisions are made which are inclusive of communication and civil negotiation. Today's current understanding and acceptance of hydropower schemes is changing and becoming increasingly accepted and further sought after. This is important as acceptance of people, particularly those living in the affected area, is paramount (Supriyasilp et al., 2009). As has been discussed, hydropower projects have been questioned, and in many cases around the world have not been able to go ahead due to limited research and communication concerning those who live within close proximity. Therefore, ensuring the inclusion of aspects other than technical conditions will be necessary moving into the future of hydropower projects.

2.14 Conclusion

In summary, the significance of renewable energy sources, particularly hydropower, has increased over the past century as a means to embrace more sustainable approaches to energy supply while addressing the challenges posed by climate change. Insights gained from case studies both abroad and within the local context underscore significant themes related to social, cultural, economic, environmental, and infrastructure impacts. These cases have had varied results and outcomes; however, these findings will be invaluable in the present research as they provide a basis in which it can be built upon.

3 Context

3.1 Research Location

The proposed LOBP is located to the north-east of the Clutha River in the Teviot Valley of Central Otago (MBIE, 2023). Lake Onslow is a manmade lake which is situated east of Roxburgh and south of Alexandra. It was formed in 1888 when the Roxburgh Mining Company constructed a 5.5m high rock dam on the Upper Teviot River, and flooded an area named the Dismal Swamp. The lake resulting from this was coined as Lake Onslow (Fish and Game, 2023). The area of Lake Onslow itself is 380 hectares and the catchment size is 12,600 hectares (Land, Air, Water Aotearoa, 2018). However, there has been some tussock to pasture conversion in the lake's immediate catchment over previous years (Majeed, 2019). Middle Swamp, Boundary Creek Fen, and Fortification Creek Wetland lie to the south of Lake Onslow and have been identified by the Otago Regional Council as Regionally Significant Wetland in Schedule 9 of the Regional Plan: Water.

Lake Onslow in relation to the surrounding environment and proposed expansion of Lake Onslow (shows by the dashed line) is shown in Figure 9 and Figure 10 below.

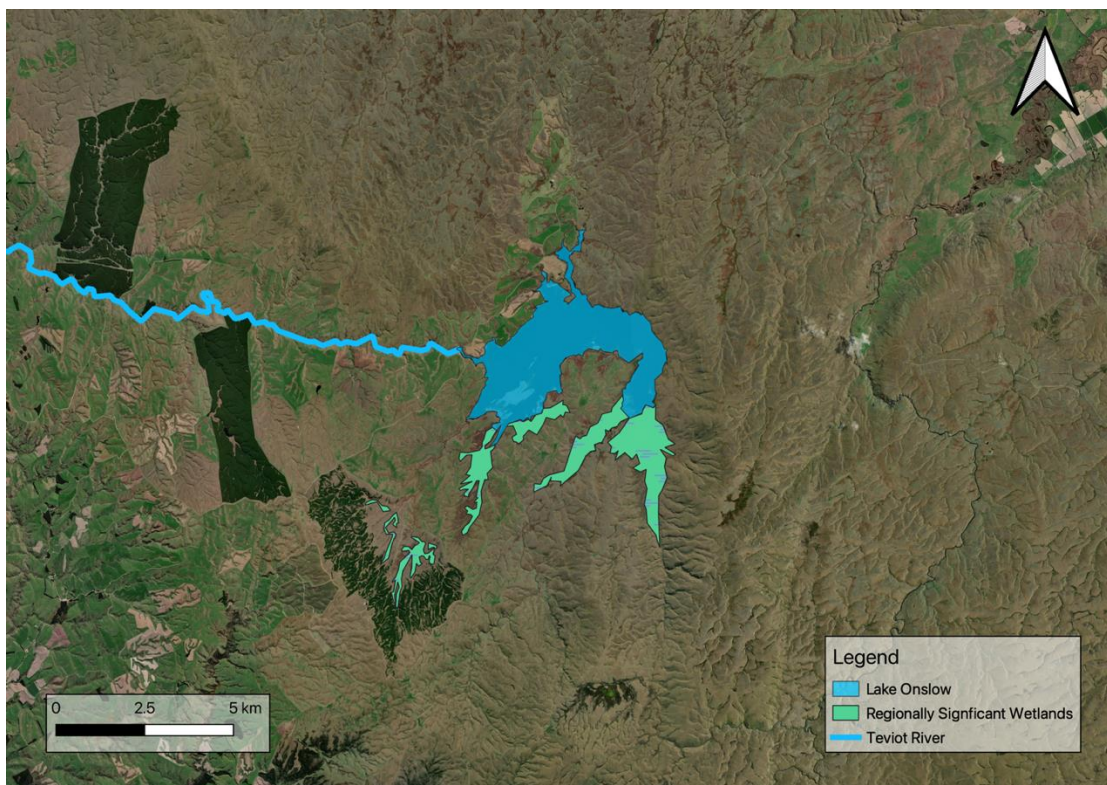


Figure 9: Lake Onslow in relation to the Surrounding Landscape

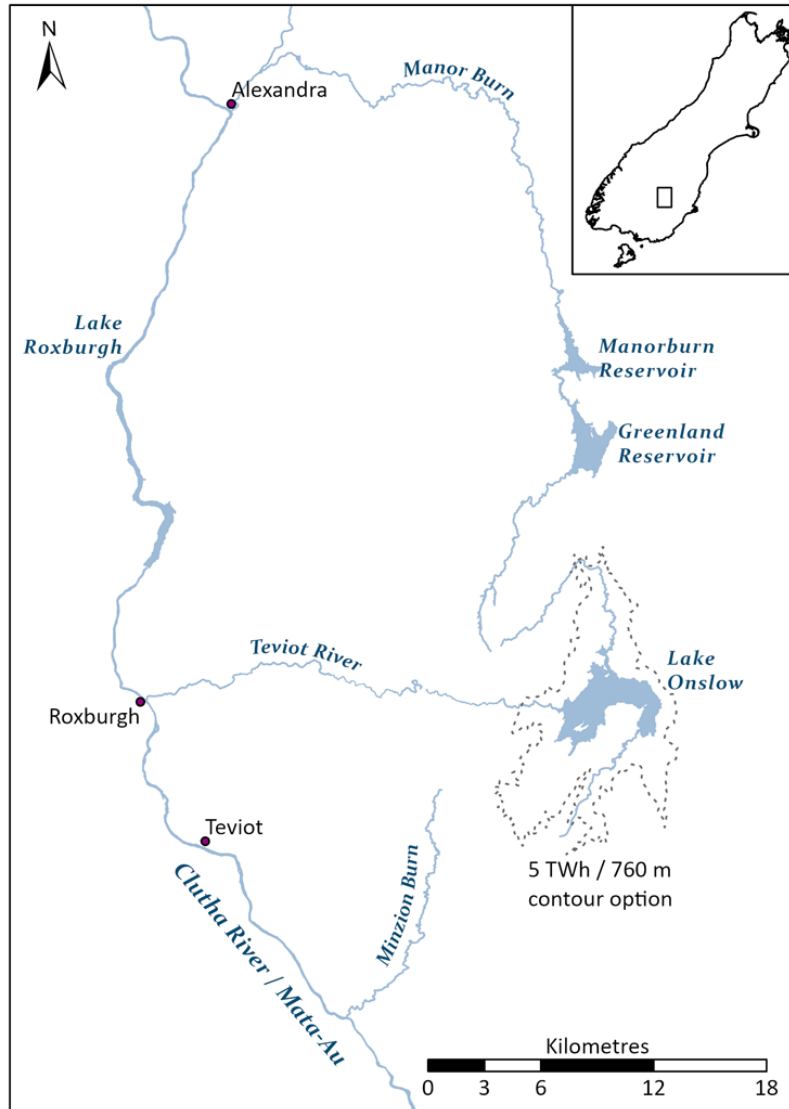


Figure 10: Lake Onslow and the Proposed Expansion of the Lake (Source: MBIE, 2023)

Lake Onslow was initially constructed as a water source for irrigation and gold mining, but it began functioning as an irrigation power system in 1924 (Fish and Game, 2023). Due to its altitude and the surrounding open countryside, Lake Onslow can also be very exposed and desolate in adverse weather (NZ Fishing, 2023). The two most popular access routes to Lake Onslow are from Miller’s Flat and Roxburgh East. Most of the access routes are private roads which are made available for public use by landowner permission. There is a boat ramp located on the west side of the lake near a cluster of privately owned fishing huts (NZ Fishing, 2023). These huts are shown in Figure 11.



Figure 11: Huts at Lake Onslow (Source: KI 6)

A large population of fish can be found in Lake Onslow's five major tributaries, each of which provides ideal breeding sites (NZ Fishing, 2023). Brown trout and galaxias are abundant in Lake Onslow due to excellent spawning habitats in the major tributaries and adjacent wetlands (Fish and Game, 2023). Due to the abundance of fish, Lake Onslow is known for brown trout fishing (Fish and Game, 2023). The population is self-sustaining, with fish averaging between 1 and 1.5kg, but can reach up to 3kg or more (NZ Fishing, 2023). Lake Onslow also boasts several recreational activities such as water sports, biking, sightseeing, and more. While the lake itself is quite isolated, it is only one hour from Miller's Flat and two and a half hours from Queenstown, making it an ideal location for recreational getaways.

3.2 Geography and Climate

Otago has one of the most varied climates in all New Zealand. The region is in a westerly wind belt, and exposed coastal areas frequently experience powerful winds whereas inland areas have weaker winds. Winter is generally the least windy season, as well as the driest in many areas (NIWA, 2015). Over the Teviot River watershed, rainfall varies spatially, with Lake Onslow situated halfway between a wetter zone in the higher uplands to the south and a drier area to the north (Bardsley et al., 2022). Lake Onslow is located in Central Otago, which is the driest region in all of New Zealand and receives less than 400mm of rainfall annually due to its inland location (NIWA, 2015). While the soils are fertile in this region, pasture and crop growth is limited by the low annual rainfall (Willingham, 2008). However, the agriculture, horticulture, and viticulture industries are strong and thriving in the region of Central Otago (CODC, 2023). It is also the only region in the country which experiences a near continental climate, experiencing the hottest summers and the coldest winters (New Zealand Tourism Guide, 2022).

3.3 Land Use and Economy

Central Otago is made up of a variety of economic industries which all contribute to the annual gross domestic product (GDP) and economic output of the district. Among broad industries, agriculture, forestry, and fishing was the largest industry in Central Otago in 2022, accounting for 20.1 percent followed by construction at 16.3 percent (CODC, 2022). Electricity, gas, water, and waste services was the most productive industry in Central Otago in 2022 according to GDP per employee followed by rental, hiring, and real estate services (CODC, 2022). The Central Otago District's population increased by 2.8 percent from 2021 to 2022, indicating a strong regional economy with plentiful job opportunities (CODC, 2022).

3.4 Demographics and Infrastructure

The research location encompasses the Teviot Valley communities of Roxburgh, Millers Flat, and Ettrick. Lake Onslow in relation to the surrounding communities is shown on Figure 12 below.

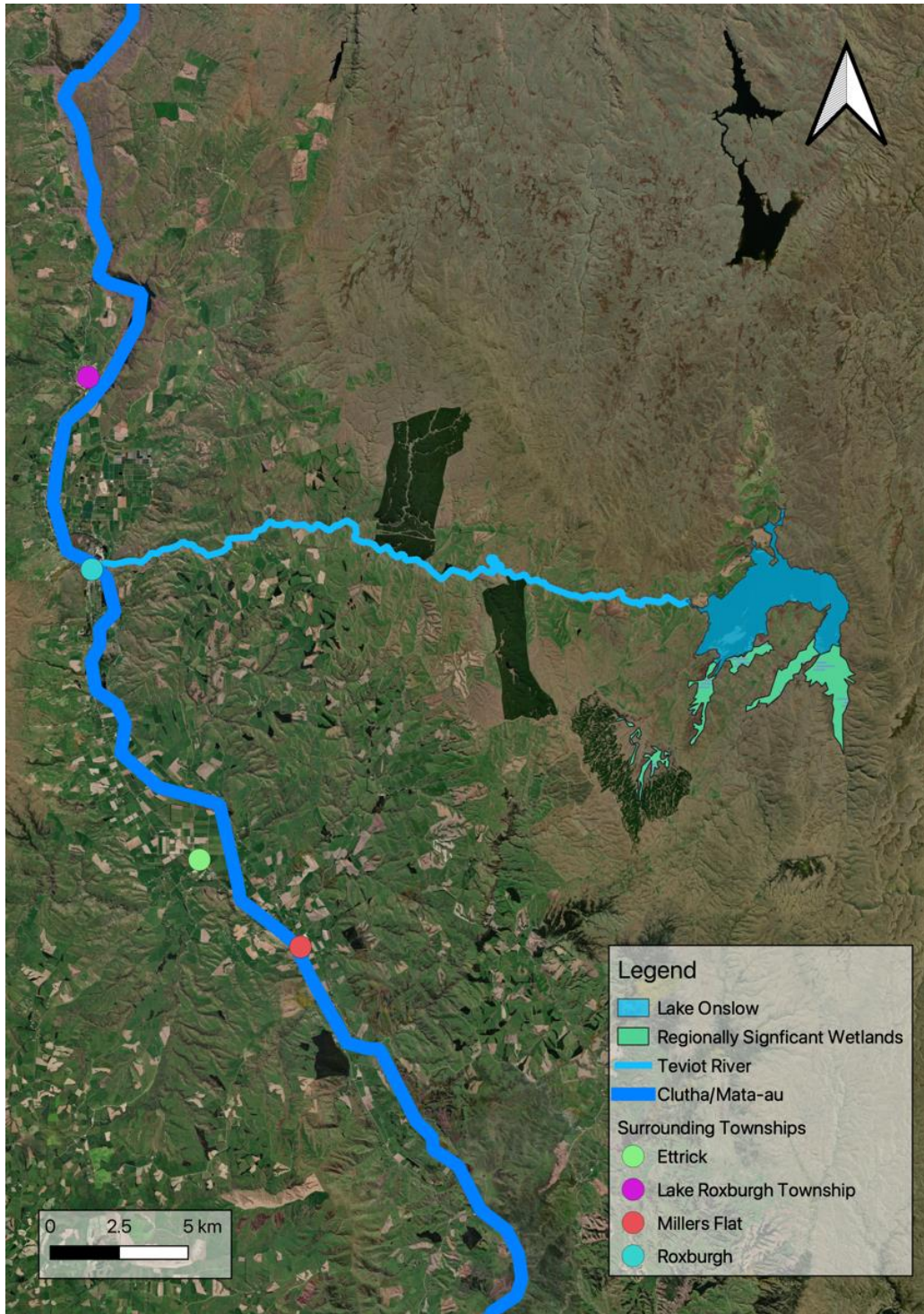


Figure 12: Lake Onslow in relation to surrounding communities

In 2018, the population of the Teviot Valley was 1,779 with a median age of 50 years old, and the current rate of population growth is low (Stats NZ, 2018; Walker & Gonzalez, 2022). While population growth is low, there was an increase between 2013 and 2021 and this resulted in an increase in housing stock (Walker & Gonzalez, 2022). With 27 percent of the population over the age of 65, this sees a number of people moving away from the area each year for improved access to healthcare and assisted living facilities (Walker & Gonzalez, 2022). Seasonal work is a prominent characteristic of the economy in the Teviot Valley, largely attributed to the agricultural and horticultural sector present within the area (Walker & Gonzalez, 2022). According to Walker & Gonzalez (2022) the seasonal nature of employment within the Teviot Valley makes it difficult for the area to attract and retain a permanent population.

Much of the Teviot Valley's housing stock is made up of old homes, with the average home being approximately 66 years old (Walker & Gonzalez, 2022). A report prepared by Sygrove & Guy (2022), analysed the CODC maps to understand the area of undeveloped land within the Teviot Valley. The report found that there is approximately 254.9ha of undeveloped land capacity within the Teviot Valley (Sygrove & Guy, 2022) demonstrating the potential for community growth in the area.

Roxburgh and Lake Roxburgh have a reticulated water supply and wastewater services, while Etrick and Miller's Flat currently have no reticulated water supply and wastewater services (Sygrove & Guy, 2022). However, there is a private water scheme supplying some homes with water in Etrick (Sygrove & Guy, 2022). While there is a school, healthcare services, a library, rest home, grocery stores and more, it is common for people within the Teviot Valley to travel to other towns including Alexandra to access services (*Roxburgh and the Teviot Valley: Community Plan*, 2006). A number of local services have been closed throughout the Teviot Valley, and this has seen the departure of a number of professionals (*Roxburgh and the Teviot Valley: Community Plan*, 2006).

3.5 History of Energy in New Zealand and Central Otago

Historically, most of New Zealand's renewable electricity generation has come from hydropower generated in the South Island (Kelly, 2011). According to Kelly (2011), New Zealand's climate and topography creates favourable conditions for the construction of hydropower infrastructure.

The Clutha River flows through Central Otago and the Teviot Valley, with its water supply originating from three glacial lakes, Wakatipu, Wanaka, and Hāwea (Calvert, 1975).

Most of New Zealand's hydropower infrastructure was constructed between the 1940s and 1980s, and this infrastructure was able to generate approximately 60 percent of the country's total electricity supply (Kelly, 2011). The Roxburgh Dam, located north of the town of Roxburgh, is one of New Zealand's earliest hydropower projects which was constructed between 1949 and 1956. The Clyde Dam in Central Otago is located on the Clutha River. The construction of the Clyde Dam began in 1980 as part of New Zealand's 'Think Big' program which encompassed a number of large-scale energy resource development schemes (Sewell, 1987). The dam was constructed due to concerns about the country's future electricity generation, and the Clutha River was one of the most favourable hydropower sites as most of the North Island's hydropower potential had been harnessed (Sewell, 1987). Due to favourable landscape characteristics and conditions, Central Otago is no stranger to renewable electricity generation.

3.6 Lake Onslow Pumped Hydro Scheme

PSH is a type of hydroelectric energy storage which is a system made up of two water reservoirs that sit at different elevations. This system can produce electricity as water flows from one reservoir to the other, passing through a turbine (US Department of Energy, 2023). The network requires electricity to pump water back into the upper reservoir when there is excess power, and has the ability to store energy and release it when necessary (US Department of Energy, 2023). This makes it comparable to a large battery (US Department of Energy, 2023).

The NZ Battery Project was established to investigate New Zealand's dry year problem. It operates under the assumption that storing energy which can be converted to electricity could provide a solution to the nation's shortage of hydropower during dry years (MBIE, 2023). The LOBP is expected to provide between 3 and 8.5 Terawatt hours and is estimated to have a construction time of between 7 and 9 years (MBIE, 2023). It is currently estimated that up to 2,500 workers would be required over the course of construction, including specialist plant operators, construction workers, site and supervising engineers, trade people, drivers, and administrative staff (MBIE, 2023). This high number of workers as well as the variety of disciplines shows the need for a large

and temporary workforce which will undoubtedly have effects on the surrounding community which will need to be acknowledged.

The LOBP is comprised of three phases: the feasibility study, a detailed business case, and implementation. Phase 1 took place from December 2020 to December 2022, and evaluated the viability of pumped hydropower schemes of different sizes at Lake Onslow. It included a detailed analysis into the nature of New Zealand's dry year problem, technological options to address the dry year problem, potential environmental impacts of the pumped hydro scheme, power system impacts of long-term storage, consenting pathways, stakeholder and iwi engagement, and geotechnical work (MBIE, 2023). Phase 2 will include a progress report on all options, a detailed business case, and a final investment decision. The estimated timeframe for Phase 2 is approximately July 2023. Phase 3 consists of the implementation of preferred option or options and is estimated to be determined between 2027 and 2028 (MBIE, 2023).

4 Policy Analysis

4.1 Introduction

There are many regulations, policies, and rules at all national, regional and district levels in which the LOBP will need to be consistent with. This is in order to achieve the purpose of the Resource Management Act 1991 (RMA). The LOBP is currently considered under the RMA therefore, must meet the purpose of the act. Additionally, it is well known that a reform of the RMA is currently underway whereby it will be replaced by new legislation. Namely the Spatial Planning, Natural and Built Environment, and Climate Adaptation Acts. While the Natural and Built Environment Bill and Spatial Planning Bills were introduced to parliament in late 2022, the Climate Change Adaptation bill is expected in late 2023 (Ministry for the Environment, 2022). The timeline of this reform in addition with the current indicative timeline for the LOBP suggest that objectives from both the RMA and new legislation will need to be met. Therefore, until the LOBP is complete, changing legislation will need to be understood, considered, and implemented if possible.

The following assessment looks at current legislative framework and how the LOBP fits against said framework. This chapter seeks to analyse the place that the LOBP may have in the current legislative framework. The hierarchy of documents assessed in this chapter can be found in the Figure 14 below.

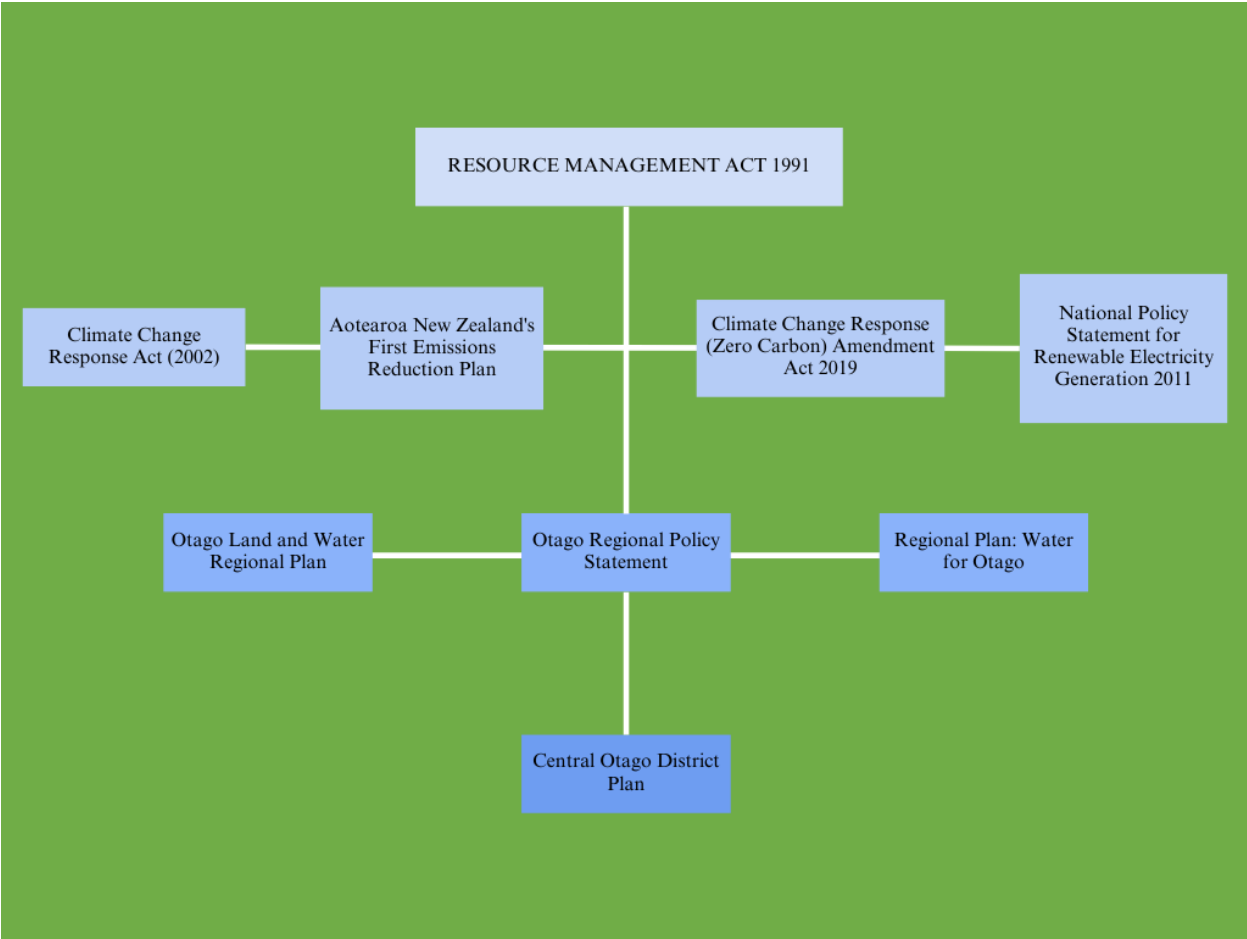


Figure 14: Key Planning Documents relevant to the Lake Onslow Battery Project

4.2 National Planning Documents

4.2.1 Resource Management Act 1991

The Resource Management Act 1991 (RMA) is an overarching piece of legislation which governs resource management in New Zealand. At the time of implementation, the RMA was considered a more radical way of resource management (Warner & Baker-Galloway, 2015). The RMA was also described as multi-dimensional as it seeks to sustain the natural environment and enable people and communities to “provide for the social, economic, and cultural wellbeing and for their health and safety” (Warner & Baker-Galloway, 2015).

Section 5(1) of the RMA sets out the purpose; “... *to promote the sustainable management of natural and physical resources.*” Section 5(2) sets out the definition of “sustainable management”. This has been tabulated below. As displayed in Table 1, comments have been provided against each aspect of sustainable management to provide an overview of how the LOBP may fit into section 5(2) of the RMA.

Table 1: Assessment of the LOBP against the RMA

Provision	Detail	Assessment
Section 5(2)	<i>In this 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—</i>	
5(2)(a)	<i>sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and</i>	The LOBP seeks to store a significant amount of water to ensure the reliable generation of electricity during dry periods of weather. It is expected that the potential of water used in this scheme will be maintained to meet the needs of future generations. At this stage, it seems that the LOBP will be generally consistent with section 5(2)(a).
5(2)(b)	<i>safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and</i>	It is well known that in order for the LOBP to occur, significant flooding must be undertaken on the surrounding land. The flooded areas include Regionally Significant Wetlands. The flooding will have adverse effects on the life-supporting capacity of the surrounding water, soil, and ecosystems. At this stage, it seems that the LOBP is inconsistent with section 5(2)(b).
5(2)(c)	<i>avoiding, remedying, or mitigating any adverse effects of activities on the environment.</i>	The effects that the LOBP will have on the surrounding environment are significant, with many effects expected to be adverse. Given the scale of the

		indicative effects, it is unlikely that effects could be avoided, remedied, or mitigated. At this stage, it seems that the LOBP is inconsistent with section 5(2)(c).
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The importance of the RMA in relation to the LOBP is shown by the multidimensional and interacting nature of the environmental, social, economic, and cultural impacts, all of which must be considered and managed throughout the progression of the LOBP. Specific aforementioned impacts are emphasised in Part 2, Section 7 of the act;

(7) In achieving the purpose of this Act, all persons exercising functions and powers under it, in relation to managing the use, development, and protection of natural and physical resources, shall have particular regard to—

- (a) kaitiakitanga:*
 - (aa) the ethic of stewardship:*
 - (b) the efficient use and development of natural and physical resources:*
 - (ba) the efficiency of the end use of energy:*
 - (c) the maintenance and enhancement of amenity values:*
 - (d) intrinsic values of ecosystems:*
 - (e) [Repealed]*
 - (f) maintenance and enhancement of the quality of the environment:*
 - (g) any finite characteristics of natural and physical resources:*
 - (h) the protection of the habitat of trout and salmon:*
 - (i) the effects of climate change:*
 - (j) the benefits to be derived from the use and development of renewable energy.*

Due to the scale of this project, it is likely that all parts of Section 7 require thorough consideration. It is highly likely that many issues would be encountered if regard were to be given to all required sections, therefore making the LOBP very difficult to implement. For example, 7(a) Kaitiakitanga, may be particularly affected as a result of the LOBP going ahead due to the immense loss the rich cultural heritage and ecological value Lake Onslow holds. Overall, based on the commonly known

information relating to the LOBP, it seems highly unlikely that the purpose of the RMA will be met throughout construction or at the completion of the LOBP.

While the RMA is the overarching document governing resource management in New Zealand, it is also accompanied by various other regulations, policy documents, and planning instruments (Warner & Backer-Galloway, 2015). The following sections of this Chapter will identify key planning documents which relate to the LOBP at National, Regional and District levels. These documents have been created in order to achieve the purpose of the RMA. While this research does not specifically focus on the policy and consenting of the LOBP, it is important to acknowledge and understand the key documents which may have initiated and/or enable the LOBP to be undertaken.

4.2.2 Climate Change Response Act (2002)

The Climate Change Response Act (CCRA) was introduced in 2002 and enables New Zealand to meet international climate change obligations (Environment Guide, 2018). The act is administered by the Minister for the Environment and is a pivotal piece of legislation regarding New Zealand's preparedness for the anticipated national and international challenges regarding climate change. The CCRA is important in the present context as the primary goal of the LOBP is to address climate change related issues. As a result of this act, there have also been other regulations created which relate to water, emissions, greenhouse gasses, fossil fuels, forestry, agriculture, and industrial activities. A recent amendment of the CCRA has seen clear and stable climate change policies implemented in New Zealand. (Ministry for Environment, 2021). This amendment is explained below.

4.2.2.1 Climate Change Response (Zero Carbon) Amendment Act 2019

The Climate Change Response (Zero Carbon) Amendment Act 2019 (CC-ZC) came into effect on 13 November 2019. The overarching purpose of this amendment is to enable New Zealand to better prepare for and adapt to the effects of climate change. With the effects of Climate Change becoming more observable (Ministry for the Environment, 2021), this act is arguably more important than ever. The Ministry for the Environment (2021) explain the four key elements included in the amendment:

1. *Create new and reduced greenhouse emission targets for New Zealand.*
2. *Create and establish emission budgets which lead towards the long-term targets.*
3. *Require policies to be developed and implemented by the government relating to climate change adaptation and mitigation.*
4. *Establish a Climate Change Commission.*

This is relevant to the LOBP as it addresses the issue of dry years, which ultimately is an effect of climate change. The LOBP provides a form of resilience being a ‘sustainable battery’ which can be used when required therefore, also providing certainty of energy supply.

The purpose of the CCRA was amended throughout the amendment process. Policies 4(aa)(i) and 4(aa)(ii) of the Zero Carbon Amendment Act were added, and these are shown below;

(4)(aa) provide a framework by which New Zealand can develop and implement clear and stable climate change policies that—

- (i) contribute to the global effort under the Paris Agreement to limit the global average temperature increase to 1.5° Celsius above pre-industrial levels; and*
- (ii) allow New Zealand to prepare for, and adapt to, the effects of climate change:*

The inclusion of Section 4 (aa)(i) and (ii) provided relevant direction that New Zealand required in order to prepare for, and adapt to, the effects of climate change. As a result of the complexity of regulation in New Zealand, the inclusion of Section 4(aa) means that projects such as the LOBP can be encouraged. However, if they do not meet the purpose for the RMA it is unlikely they will go ahead. While the CCRA was a ground-breaking piece of legislation at the time of implementation in 2002, there has been a lot of lived and observed impacts relating to climate change since then. The aforementioned amendment has therefore, enabled the CCRA to continue to be relevant and enable projects such as the LOBP be initiated.

4.2.3 National Policy Statement for Renewable Electricity Generation 2011

The National Policy Statement for Renewable Electricity Generation 2011 (NPS-REG) was implemented on 13 May 2011. The purpose of this NPS was to provide local authorities clarity on electricity infrastructure as it contains a specific focus on regional and district plans, and policy making. The preamble of the NPS-REG recognises the social and environmental effects which can

occur as a result of renewable energy developments; - these are often adverse on a local scale, and positive on a national scale. The NPS-REG therefore highlights the importance of identifying the social and environmental effects regarding an activity such as the LOBP. This document enables planning frameworks around New Zealand to have consistent and clear direction, therefore, ensuring that renewable electricity generation and the associated infrastructure can be adequately planned for (Ministry for the Environment, 2021). Notably, this NPS applies to renewable electricity generation projects regardless of their size (Ministry for the Environment, 2021).

The NPS-REG provides various objectives and policies which enable renewable electricity to be generated under the RMA. The preamble of the NPS-REG recognises that Aotearoa was forecast to become more reliant on renewable electricity, identifying two main barriers for NZ to meet the forecast demand. The first being that New Zealand is too reliant on energy sources which produce greenhouse gas emissions, next it was recognised that New Zealand was not able to deliver energy which was clean, secure, and affordable and treated the environment responsibly. Accordingly, this NPS sought to address these challenges through introducing policies which enable said barriers to be overcome.

Overall, the NPS-REG recognises the importance of the LOBP in the current context. Furthermore, it establishes the need to enable local, regional, and national authorities to prepare infrastructure to support such electricity generation schemes before they are required.

4.2.4 Aotearoa New Zealand's First Emissions Reduction Plan

In May 2022, Aotearoa released their first Emission Reduction Plan (ERP). The ERP recognised the urgency of reducing emissions to prevent the climate crisis from worsening. This will be achieved by meeting certain targets by 2050 with the goal of also creating a productive, sustainable, and inclusive economy (Ministry for the Environment, 2022). Chapter 11 of the ERP relates to Energy and Industry stating that: *“By 2050, our energy system is highly renewable, sustainable and efficient, and supports a low-emissions and high-wage economy. Energy is accessible and affordable and supports the wellbeing of all New Zealanders. Energy supply is secure, reliable and resilient, including in the face of global shocks.”* This plan also acknowledges that just over one quarter of all greenhouse gas emissions come from the energy and industry sectors. This plan creates viable pathways for the energy and industry sectors to become less reliant

on high greenhouse emission sources of fuel, therefore providing a viable pathway for the LOBP to be proposed. By creating more reliable renewable energy sources such as the LOBP, there will be less reliance on alternative, resource intensive means of electricity generation (fossil fuels, coal, gas). Especially throughout dry years when there is less water available for electricity generation.

The LOBP is directly relevant to Chapter 11 as each aspect of the LOBP relates to the overarching purpose in relation to Energy and Industry- the purpose of the LOBP is to provide secure, reliable, and resilient energy. This is yet another plan which enable feasibility conversations for projects such as the LOBP to be initiated.

4.3 Regional Planning Documents

4.3.1 Otago Regional Policy Statements

Currently, the Otago Regional Council (ORC) has various Regional Policy Statements which are at different levels of implementation; the Partially Operative Regional Policy Statement 2019, the Proposed Otago Regional Policy Statement 2021 (non-freshwater parts), and the Freshwater Planning Instrument Parts of the Proposed Otago Regional Policy Statement 2021. Therefore, it is difficult to predict how the LOBP will sit within the Otago regulatory framework.

However, the purpose of the Otago Regional Policy Statement (ORPS) is to provide a policy framework which provides direction specific to the Otago Region regarding resource management. This further emphasises the importance of ensuring that the LOBP aligns with the direction of Otago's Regional Policy Statements.

Chapters of the Partially Operative Regional Policy Statement 2019 provides insight into some aspects which the LOBP will need to align with. For example,

Chapter 1- Resource Management in Otago is Integrated (Economic, social and cultural wellbeing for people and the communities is promoted)

The LOBP provides an opportunity for the Teviot Valley, and wider Otago Region to create a large scale, comprehensive scheme which provides for economic, social, and cultural wellbeing for people in the community. However, the legacy of a project such as Lake Onslow is still largely unknown as no similar projects have been completed in recent times. Furthermore, it is unclear

exactly what is exactly proposed as part of the LOBP, therefore difficult to understand the true potential impacts.

Chapter 2- Kāi Tahu Values and Interests are recognised and Kaitiakitaka is expressed

Given the scale of the LOBP and significant effects it is expected to have on cultural values, it is highly unlikely that the LOBP will align with Chapter 2 of the OPRS. Because of this, it is highly unlikely that Kaitiakitaka will be expressed.

Chapter 3- Otago has high quality natural resources and ecosystems

The LOBP proposes to raise the water level of Lake Onslow which will consequently flood and destroy Regionally Significant Wetlands, as explained in Chapter 3 of this report. These wetlands holds high quality natural resources and ecosystems. It is highly likely that the LOBP is inconsistent with Chapter 3 of the ORPS.

Chapter 4- Communities' in Otago are resilient, safe and healthy

The LOBP provides an opportunity for community growth. In turn, this provides the opportunity for the “boom and bust” effect as explained in Chapter 2. Again, given the uncertainty as to how exactly Lake Onslow will develop, it is difficult to understand whether it will create community resilience or community vulnerability.

Chapter 5- People are able to use and enjoy Otago's natural and built environment

The natural environment which surrounds Lake Onslow is a significant area given the recreational and ecological values it holds. By raising the level of Lake Onslow, there will be significant impacts on the natural environment and people's ability to utilize it. Therefore, it is unlikely that the LOBP will align with Chapter 5 of the ORPS.

4.3.2 Otago Land and Water Regional Plan

The Otago Regional Council is currently in the process of creating a new Land and Water Regional Plan. It is unclear how the taking or use of water, or land use in Otago will be managed in this plan. Therefore, it is difficult to understand how the LOBP will fit in to or impact current water users in the surrounding areas. Taking and using water, and the use of land for constructing the

facility is central to the LOBP. Therefore, the new Land and Water plan may have a large impact on the LOBP viability as a whole.

4.3.3 Regional Plan: Water for Otago

The Regional Plan: Water for Otago is the plan which is currently operative, and was written with an overarching aim to ensure that Otago's waterways remain healthy while also sustaining economic use of land. This plan recognises that how we treat our waterways and water now will determine how Otago can and will develop in the future. Importantly, this needs to be undertaken in a way that the opportunities and needs of Otago's future communities can be met.

Over time, there have been various amendments to the plan which have ensured that the previously mentioned points may be achieved. There are 6 key chapters of the plan which are relevant to the LOBP;

Chapter 4- Kai Tahu Ki Otago Water Perspective

Chapter 5- Natural and Human Use Values of Lakes and Rivers

Chapter 6- Water Quantity

Chapter 7- Water Quality

Chapter 8- The Beds and margins of Lakes and Rivers

Chapter 10- Wetlands

While it is not the purpose of this sections to explore the objectives, policies, and rules of each of these chapters, it is important to understand the complexity and extent of the chapters that will need to be considered in relation to the proposal. Due to the magnitude of this project, it would require a significant assessment to understand how the LOBP may fit into Otago regional planning documents. However, this chapter accepts that the LOBP is generally inconsistent with the Regional Plan for Water: Otago.

4.4 District Planning Documents

4.4.1 Central Otago District Plan

The Central Otago District (CODC) Plan is comprised of various sections, all of which have the overarching goal of assisting the council to carry out the functions of the RMA. Section 1.1.1 of the CODC Plan explains that the documents is the “means by which the effects of using, developing and protecting the district’s natural and physical resources will be managed in the future.” Throughout this chapter, the documents which are relevant to the LOBP itself have been discussed. While most direct aspects of the LOBP have been addressed in relation to higher level legislation and policy, it appears that the CODC Plan may be relevant in more indirect or highly localised ways. Various sections of the plans describe the different areas which can be found in the Central Otago Region. Most of the Teviot Valley is recognised within the plan as a Rural Resource Area. However, the small townships such as Roxburgh, Ettrick, and Millers Flat also contain Residential Resource areas. The Central Otago District Plan is important in the context such as the LOBP as it may result in change having to occur with the plan itself as a result of the LOBP being undertaken. An example of this would be in relation to Section 16 of the Central Otago District Plan, which decides the allotment sizes of land when it is being subdivided.

As previously explained, given the scale of the LOBP, it is outside of the scope of this research to assess the proposal against the Central Otago District Plan. However, it is highly likely that the infrastructure and development required to support the LOBP will rely heavily on the CODC Plan being changed and adjusted to accommodate and allow such development to occur.

4.5 Chapter summary

This chapter has addressed the legislative framework in which the LOBP must be assessed against in order to occur. To summarise, there is legislation which enables or encourages projects such as the LOBP. This includes the Climate Change Response Act (2002), the Climate Change Response (Zero Carbon) Amendment Act 2019, National Policy Statement for Renewable Energy Generation, and New Zealand’s First Emission Reduction Plan. Ultimately, these have enabled conversations to be initiated regarding the LOBP, and therefore, investigations to be pursued.

Conversely, there is legislation which may discourage the LOBP from occurring, specifically the RMA. As explained earlier in this chapter and based on the known information, it is highly unlikely that the LOBP will meet the purpose and principles of the RMA. Furthermore, it is highly unlikely that matters in Section 7 of the RMA could be given particular regard due to the scale and magnitude of expected effects of the LOBP.

5 Methodology

5.1 Introduction

The aim of this project is to consider the potential impacts of the LOBP on communities in the Teviot Valley, including infrastructure needed to support the LOBP. In achieving this aim, both primary and secondary methods were used. Primary methods included site visits, collecting qualitative data through KI interviews and an online survey. Secondary methods included a review of existing academic literature and a policy review of current legislative documents and relevant planning frameworks. This chapter will discuss these methods in further detail, including how they contributed to answering the research aim and objectives.

5.2 Aim and Research Questions

5.2.1 Research Aim and Questions

This research aims to provide the CODC with a report that identifies the social, cultural, economic, environmental, and infrastructural impacts of the LOBP. This project also aims to investigate the level of understanding that the Teviot Valley community have about any impacts which have been identified. Three research questions were created to guide the research process:

1. What are the primary social, cultural, economic, and environmental impacts of the Lake Onslow Battery Project as perceived by the Teviot Valley community?
2. What are the opportunities and limitations of the required infrastructure associated with the Lake Onslow Battery Project in the short-term and long-term?
3. What is the community's perception of the Lake Onslow Battery Project in terms of consultation adequacy and desired outcomes for the future?

5.3 Research Design

The research design is comprised of a mixed-methods approach using both qualitative and quantitative methods (see Figure 15) to investigate the level of understanding that the Teviot Valley community have about the potential impacts, or any concerns that the community have in

relation to the LOBP. Mixed-method research designs can be used to provide a more comprehensive understanding of the research questions at hand (Wilson, 2016). The qualitative and quantitative data can complement each other to provide deeper and more meaningful answers (Wilson, 2016). Qualitative methods were used to gather data on the community’s perception of key impacts related to the LOBP. Quantitative methods were used to gather data on the community’s key concerns, the perceived greatest impacts, key opportunities, and reasons for supporting or opposing the LOBP. Most research methods have inherent biases and therefore, adopting a mixed-methods approach can increase the validity of research (Wilson, 2016).

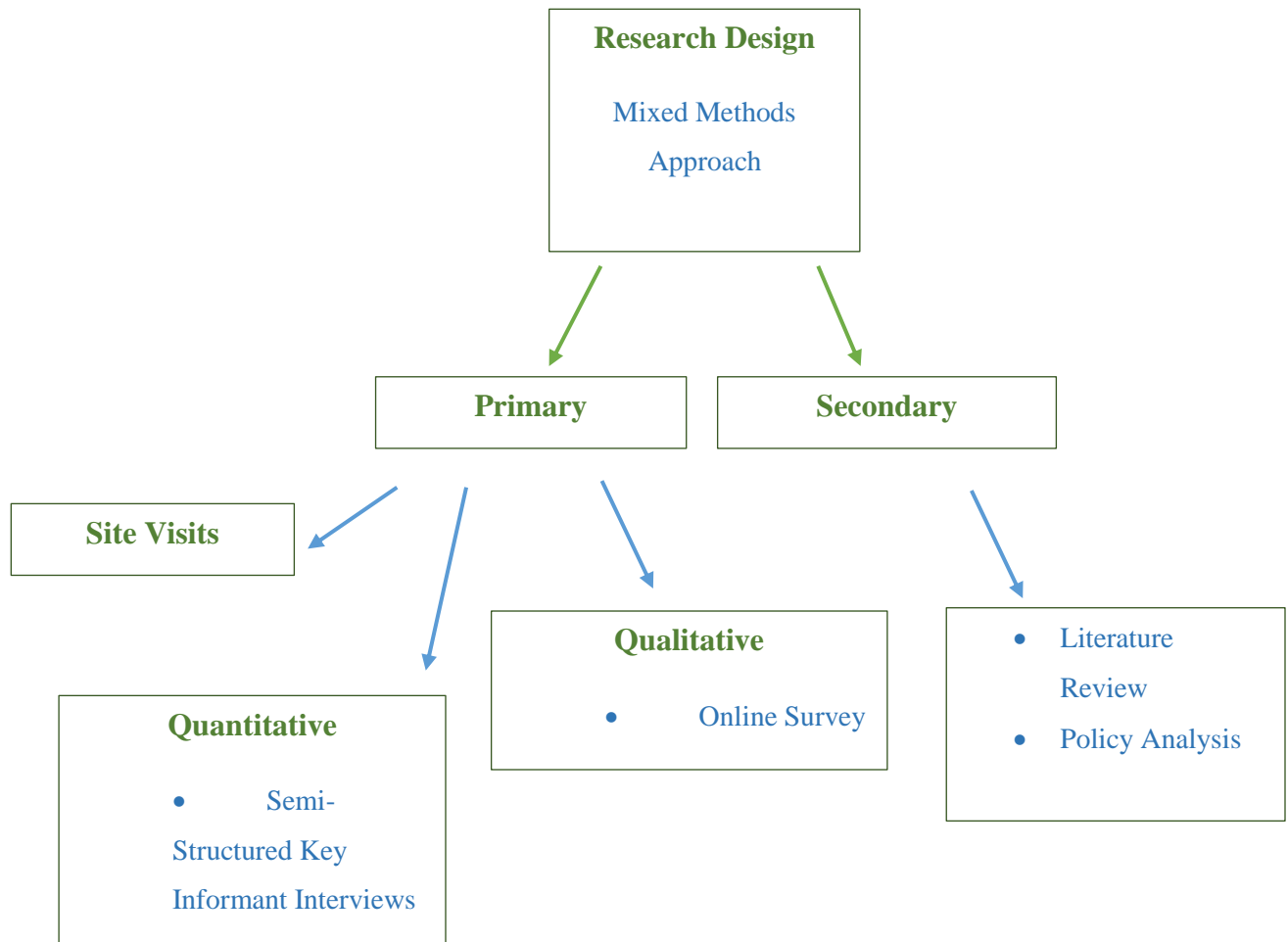


Figure 15: Mixed-Method Approach

5.4 Primary Methods

5.4.1 Site Visits

Site visits were carried out between the 1st and 5th of May 2023. Locations of interest included Lake Onslow, the Maniototo and the small communities within the Teviot Valley such as Roxburgh, Ettrick, and Miller's Flat. Site visits were carried out to allow the researchers to understand the context of the research and communities likely to be impacted by the LOBP. Site visits of the local communities were also valuable for identifying existing local infrastructure and potential opportunities for growth. The researchers were particularly interested in visualising the extent to which the LOBP would alter the natural environment at Lake Onslow. The site visits complimented the interview and survey responses.

5.4.2 Semi-Structured Key Informant Interviews

Semi-structured interviews were carried out to identify some of the community's key perspectives and concerns in relation to the LOBP. Semi-structured interviews were chosen as a primary method for this research due to their advantages in forming a comprehensive understanding of KI perspectives and concerns. This type of interview method allows the researcher to have focus on a particular theme while having the ability to further explore ideas and themes that may arise throughout the interview (Bradley et al., 2007). According to Bradley et al. (2007), semi-structured interviews are one of the best data collection methods for when the researcher wants to learn about the unique perspectives of the KIs. For this research, investigating these unique perspectives of the Teviot Valley community will be critical in gaining an understanding of key concerns in order to tailor future impact assessments. The interviews provided qualitative answers to the research questions.

KIs were identified through known contacts, community Facebook groups, and desktop research. KIs were recruited via phone number, email, and Facebook Messenger. Selected KIs were made up of Teviot Valley community members, local landowners, community board members, experts, and councillors. Those who were happy to be interviewed were contacted to organise a time and meeting location.

KI interviews were carried out between the 1st and 5th of May 2023. Before undertaking the interview, KIs were asked to read the interview information sheet and consent to partaking in the interview by providing a written name and signature. The information sheet detailed the aim and research questions of the project, and the role of the KI within the research process. Interviews were semi-structured in nature, there was a set of pre-prepared questions tailored to the particular role of the KI. The semi-structured nature of these interviews allowed the researcher to adjust the direction of the interview depending on any strong opinions held by the KI. The interview structure allowed the KI to feel relaxed and comfortable speaking about issues that may be of key concern and importance to them. Each interview had at least two researchers present. Generally, one researcher asked the questions and ensured good interview flow, while the other researcher took notes and took an audio recording. Each interview was recorded using a Dictaphone, which were then transcribed and coded for further analysis.

There were eleven KIs that participated in this research. This group of KIs were made up of community members from within the Teviot Valley and surrounding areas. A list of KIs and their roles are shown in Table 2 below.

Table 2: Key Informants and Their Roles

Key Informant (KI)	Role
1	Community member
2	Community board member
3	Community board member
4	Community group
5	Business owner
6	Community member
7	Councillor
8	Landowner
9	Engineer
10	Community member
11	Community group

5.4.3 Online Survey

Online surveys offer a more convenient opportunity for gathering qualitative and quantitative data, with greater reach and flexibility (Evans & Mathur, 2005). Online surveys are a time-efficient method for collecting large amounts of data with low time and cost expenses (Evans & Mathur, 2005). Online surveys are more technically innovative than paper surveys, providing more creative and complex options for answering questions (Evans & Mathur, 2005). This style of survey can provide the researcher with answers more directly related to the topic of interest and allow the participant to share more unique and personal views.

An online survey was created to gather qualitative and quantitative data on the perspectives of the local community regarding the LOBP. The online survey was created in the week prior to field week using Qualtrics. The online survey was distributed via Facebook groups and emailed to known contacts. Survey responses were also gathered between the 1st and 5th May 2023, in person around the local community in the Teviot Valley, and some across the Maniototo. Participants were asked about: their awareness of the LOBP; what they know about the LOBP; opinions on the potential environment; social, cultural, economic, and infrastructure impacts; potential benefits and opportunities that could open up as a result of the LOBP; and whether they feel they have been provided adequate information. The online survey was created with both closed and open-ended questions to allow participants to discuss particular aspects of the LOBP that they were interested in sharing. The online survey was open between the 1st and 16th of May, 2023. There was a total of nineteen survey responses. The responses were collated and summarised for further discussion.

5.5 Secondary Methods

5.5.1 Literature Review

Prior to gathering data, a literature review was undertaken to better understand the subject and determine what is known and what is unknown about the impacts of the LOBP. Secondary analysis is the re-examination of data with the goal of addressing the original research question with new statistical techniques or addressing new questions with previously collected data. In the research and evaluation process, secondary analysis is a crucial component (Glass, 1976), making it easier for the researchers to identify important arguments and themes that were prevalent in the literature. This in turn helped to influence the research's objectives, directing the process in a suitable

direction. This was accomplished by consulting numerous peer-reviewed academic journal articles, published books, and reputable government documents. By examining and identifying previous themes and controversies across a range of literature, it made it possible to develop and clarify the research scope as well as determining key themes relating to the LOBP.

5.5.2 Policy Analysis

Planning and policy documents provide a dependable source of publicly available secondary data that can give researchers undertaking qualitative research a contextual understanding of the environment in which their findings are presented. To comprehend the existing planning framework that oversees the LOBP and wider Teviot Valley, this research utilised a review of the pertinent national, regional and district policy documents and plans. The scope of this policy analysis was narrowed down to the context of the RMA, Acts relating to climate change and emission reductions, regional planning documents, and district planning documents.

5.6 Positionality

The positionality of the researchers has an impact on how the findings are interpreted and understood in research, especially in studies conducted using qualitative analyses (Wilson & Darling, 2021; Parson, 2019). The researchers undertaking this study are five postgraduate students within the Master of Planning Programme at the University of Otago. All five students come from a range of geographic and educational backgrounds and aim to become planners at the conclusion of their master's degrees. The planning programme at the University of Otago entails both environmental and social aspects. Consequently, the positionality of the researchers is influenced by a desire for positive environmental and social outcomes.

Throughout this research, it was the objective of the researchers to remain neutral during the study. Regardless of this, it is important to understand that there are numerous factors that may have an impact on the method and results. Prior to this study, all the researchers had undertaken qualitative research. Therefore, are aware of the ethical requirements and degree of reflexivity. The researchers were also mindful of the potential impact that preconceived notions resulting from exposure to media relating to the LOBP may have had. This project has had a lot of media coverage

over numerous years. This may have created unconscious bias in researchers and influenced interactions with KIs. To counteract this, researchers approached this study with an open, neutral mind and paid close attention to what KIs had to say regarding their thoughts on the LOBP.

5.7 Ethical Considerations

It is important to consider ethical aspects of research throughout the whole research process (David & Resnik, 2015). When recruiting KIs throughout data collection and analyses, and presenting findings, every effort was made to ensure the anonymity of participants was maintained. This ensured that the privacy and wellbeing of the participants was not affected as a result of taking part in this research. Furthermore, participants were given the opportunity to withdraw from this research at any time before the 30th May 2023.

Ethics approval was obtained for this research from the University of Otago Human Ethics Committee prior to any KIs taking part in this research. Given this research is social in nature, consideration was given to the thoughts and feelings of participants while making the online survey and the semi-structured interview questions. Each participant was provided with an information sheet and consent form prior to the research being undertaken. This outlined the project and outlined their right to withdraw from the research without any disadvantage to themselves. Overall, ethical obligations of this research as required by the University of Otago Human Ethics Committee have been understood and carried out by the researchers.

5.8 Limitations

Utilising a single method approach in isolation has inherent advantages and weaknesses. Therefore, employing a mixed-method paradigm allows researchers to explore issues from different perspectives, enhancing the understanding of the study group (Hageman, 2008). By incorporating a variety of techniques, it aids in alleviating concerns about potential biases. The primary data collected throughout this research project was transcribed and systematically compiled into dominant themes presented in results and discussion. These enabled the researchers to answer the research objectives and overall brief. Importantly, it is crucial to acknowledge any

limitations or biases that may contribute to an unfair representation or misinterpretation of the target demographic. The following limitations should be noted:

5.8.1 Demographics of Participants

The KI interviews primarily involved individuals ages between 45 to 75 years, while the average age for survey questionnaire participants was over 50 years old. Consequently, the interview and survey participants did not encompass all age groups in the Central Otago region, and this may have potentially led to an unbalanced representation of the area and the region in its entirety. Additionally, the study pertains to the diversity of ethnicity, backgrounds and participant location. The majority of the participants were of New Zealand European descent, which can be attributed to the research's rural emphasis.

5.8.2 Online Survey Reach

The primary method of distributing the online survey to residents of the wider Central Otago region was through sharing the link in community Facebook groups. Although this approach allowed for a large outreach within and beyond the area, the reach of participants was limited to those associated with group members of the Facebook page. Additionally, many of the residents in the Teviot Valley and wider Central Otago area consist of a largely retired population, therefore, may not be active members and users of Facebook community groups. Since this research aimed to encompass the entire Central Otago region, this uneven distribution of data may introduce bias towards those who are members of these Facebook groups.

5.8.3 Value in more Expert Interviews

Despite conducting interviews with numerous KIs relevant to the topic, more interviews with regards to the potential implementation of the Lake Onslow Hydro Battery project, particularly in the feasibility of incorporating long-term solutions and plans for the Teviot Valley community and residents, and with environmental and infrastructure experts, would have been valuable.

5.9 Conclusion

This chapter has discussed the mixed-methods approach using both qualitative and quantitative methods to carry out the research. This mixed-methods approach was used with the hopes of increasing the validity of the research. Primary methods in this research included site visits,

collecting qualitative data through KI interviews and an online survey. Secondary methods included a literature review and a policy review of current legislative documents and relevant planning frameworks. The results of the research will be presented in the next chapter and then discussed in the following chapter, using key themes and research questions to guide the structure.

6 Results

6.1 Introduction

The research aims to answer three research questions in relation to the social, environmental, cultural, economic, and infrastructure impacts on the Teviot Valley community as a result of the LOBP. The methods chosen to answer these questions have given insight into the community's perceptions of potential impacts, key concerns, and views on potential opportunities in regard to the LOBP. This chapter will present the findings from the online survey and KI interviews. Firstly, this chapter will look at the Teviot Valley community's connection to place and their current understanding of the LOBP, and the level of consultation and engagement they have had with MBIE and other relevant authorities. Secondly, this chapter will present the perceived positive and negative social and cultural impacts of the LOBP. Thirdly, this chapter will present the potential environmental and economic impacts. Finally, this chapter will present the impacts on infrastructure within the Teviot Valley.

6.2 Connection to Place

This section will present the findings from the surveys and interviews in relation to respondents and KIs connection to the Teviot Valley and Lake Onslow environment. It will be important to establish an understanding of their connection to the environment, and what values they associate with the environment to inform future discussion.

Of all the survey respondents, 36.9 percent lived within the Teviot Valley, from either Millers Flat, Roxburgh, or Ettrick. This is shown in Figure 16 below. Understanding where respondents resided will help to inform future discussion. It is interesting to note that some respondents resided far from the Teviot Valley as some responses were gathered from Christchurch and Australia.

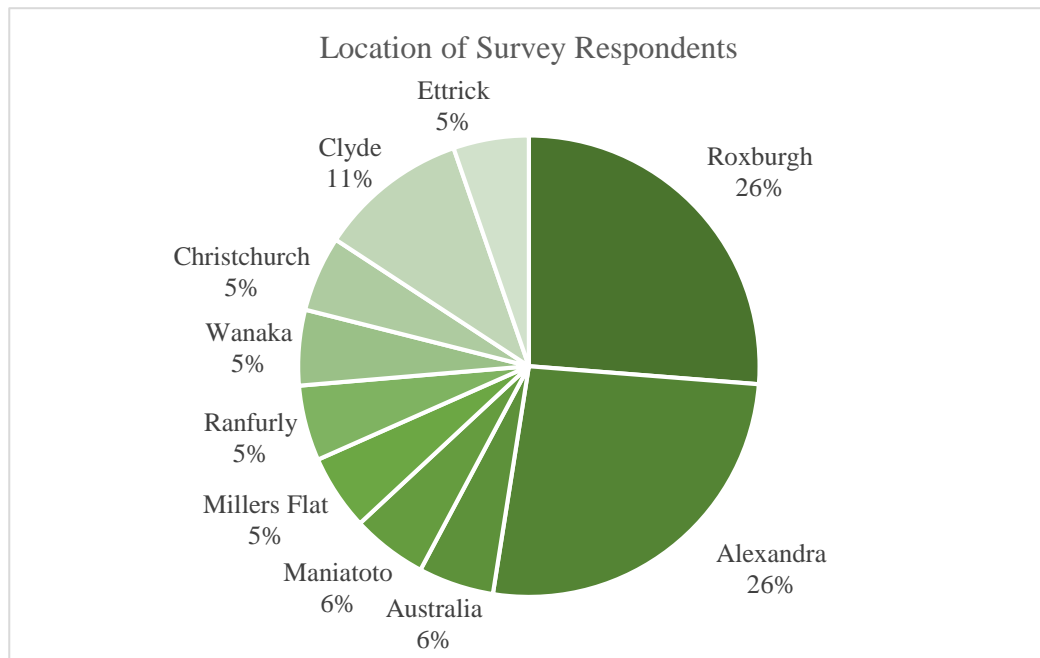


Figure 16: Survey Respondents – Place of Residence

It was evident from survey respondents and KIs, that community members have long and deep connections with Lake Onslow and the Teviot Valley, with some KIs having lived in the Teviot Valley for 50 years. These deep connections are demonstrated by the following quote;

“I’ve been here 50 years, so my entire lifetime and me with my family of course, I grew up across the road here, 6 generations. So yeah, we have a long-standing connection with the Teviot valley for sure..... my dad spent years mustering that country all around Onslow, you know the connection with it is huge, you can’t really describe it.” – KI 1

KI’s strong connections have come from years of holidaying at Lake Onslow, time spent fishing, farming, and mustering on nearby land. KIs identified several reasons why they valued the Teviot Valley and Lake Onslow environment. Some of these reasons include access to Lake Onslow for recreation, the visual amenity, the tranquillity and peacefulness of the environment, and accessing

the surrounding land for rural activities. The following quotes sum up these values encompassed by Lake Onslow and Teviot Valley environments;

“We have got everything at our backdoor - we have the river, Lake Onslow for fishing, the dam, so we have amazing access to all of that stuff, especially for raising children we have lots of recreational stuff. The farming and the horticulture is hugely valuable to us growing up in this area, it is the backbone of our community.” – KI 1

“I think you find a common theme is we like the tranquillity and the peacefulness of the valley. Yeah, it's like being in the 70s, you know, it's just really chilled out, not much happening” – KI 2

It is clear that survey respondents and KIs have positive associations and connections to the Teviot Valley and Lake Onslow environments, there are some concerns that the LOBP may negatively impact people's connections to these environments. Some KIs stated that they are worried about the potential loss of peace, tranquillity, and recreation, which are all important values to them. The following quote illustrates these concerns;

“We will never have the same community again - it's going to change it immensely because it's such a large project” – KI 1

Respondents and KIs were concerned that the LOBP will have localised negative impacts on the Teviot Valley where the community has strong connections, and that the general population of New Zealand will benefit without any consequences. This was reflected through comments which in effect, raised concerns that the local community would be greatly impacted by the LOBP but for the betterment of areas of high energy demand in New Zealand, such as Auckland.

6.3 Current Understanding and Consultation

This section will present the findings from the research relating to the current understanding and consultation associated with the LOBP. These findings are from an online survey and KI interviews. The research question that these findings aim to answer is: *What are the community’s perceptions of the Lake Onslow Battery Project in terms of consultation adequacy and desired outcomes for the future?*

6.3.1 Consultation

Of all the survey respondents, 13 first heard about the LOBP from the news, media, or social media, while only two respondents heard about the LOBP through MBIE. This is shown in Figure 17 below.

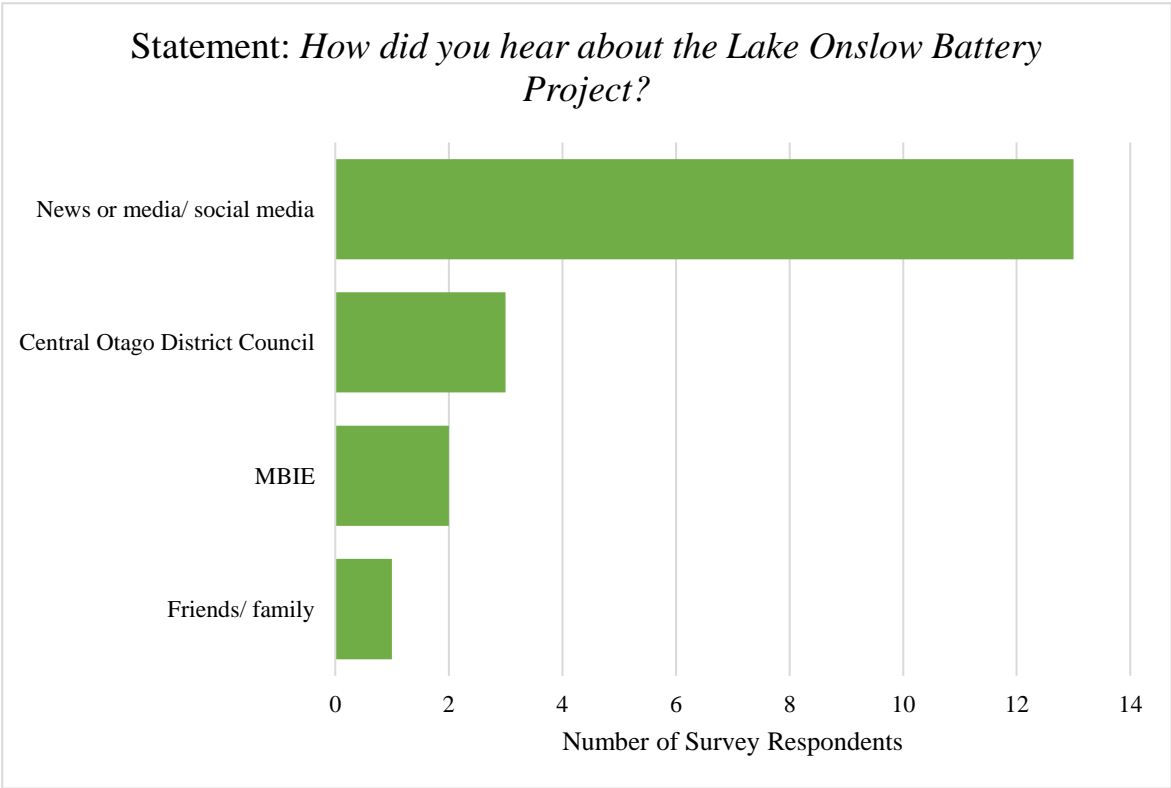


Figure 17: Means in which survey respondents heard about the LOBP

The results of this survey are also heavily shown in findings from the KI interviews, with the majority of community members and leaders also hearing about the LOBP in the news or media before MBIE. KI 8 stated;

“We found out about the LOBP through the media, and the other landowners were never contacted until I got mad and started sending emails off and actually, in the end, wrote to the minister.” – KI 8

This quote expresses the frustrations felt by many community members, including KI 8, who felt that MBIE’s communication is “reactive” and often only comes when the community have instigated them.

A common theme in KI interviews is that community members feel that MBIE and the CODC has been limited as to what they can share with the community, and in turn, this has created a sense of uncertainty. KIs have communicated that while they understand that MBIE and the CODC may not have all the answers to their questions, the lack of information has led to a lack of knowledge and little understanding as to what the potential impacts might be for themselves, their community, and Lake Onslow. These feelings of uncertainty have led to many community members sharing a negative view of the LOBP. A community member, KI 4, reiterates this point;

“Yes, but they’re limited to what they can tell us as well; if you read a report in the paper or something that’s come out later, then obviously there’s been changes and further discussion, but I feel we’re behind.” – KI 4

Findings from KI interviews also found that some community members felt they couldn’t trust the information that they had been told due to incorrect information being spread at the beginning of the LOBP. KI 8 and 4 stated;

“They gave us incorrect information at the start, so there’s just absolute distrust, I suppose.” – KI 8

“I don’t trust the government to do what they’ve said in the initial plan. It’ll get used as a power station; we’re not dumb.” – KI 4

6.3.2 Current Understanding

Findings show that both community members and community leaders had varying conceptions of the LOBP. However, the majority of community members and leaders held the common understanding that the LOBP was in stage two of development. The following quotes demonstrate this understanding, as stated by several KIs;

“What I understand is that stage two is now underway, which is the detailed planning of it and architectural design and engineering design of the of the different options, but it does appear so that the battery project is more than Lake Onslow.” – KI 2

“My understanding is that we are onto stage 2, the feasibility. I have been to the meetings held here, that MBIE have held... one in Millers flat last year and the second one they held at a weekend which was great.” – KI 1

“The government made the announcement that it will continue and we’ve had radio silence. So no one’s been in touch with us. Officially, we believe it’s going on to phase two, but we have no idea what that means for us.” – KI 8

When asked about their current understanding, community members felt that due to a lack of communication, they were uncertain about what was happening with the LOBP. KI 8 stated;

“We have no clear idea of what’s going to happen in the future for our farm, which is terrible.” – KI 8

Some KIs chose to discuss their current understanding of the possible outcomes of the LOBP. KI 4 stated;

“Personally, I think it could mean a lot of positivity for the community if it is done well. It could bring more tourism or jobs, but that has to be managed and it has to be guaranteed.” – KI 4

Some community members also felt that the LOBP wouldn’t go ahead, with KI 1 stating;

“So, for me I come away from those meetings thinking that this could either go ahead or it won’t. I think it’s probably very 50/50 whereas a lot of people thought it was full steam ahead.” – KI 1

6.4 Social Impacts

This section displays findings which specifically relates to the social impacts as perceived by the Teviot Valley community. Therefore, this section seeks to answer the research question: *What are the primary social, cultural, economic, and environmental impacts of the Lake Onslow Battery Project as perceived by the Teviot Valley community?*

6.4.1 Key Informant Interviews: Positive Impacts

Community growth was identified by KIs as a key positive social implication of the LOBP. Given the scale of this project, it was recognised that community expansion would be required in order to support the LOBP. Interestingly, many KIs said that community growth would only be positive on the basis that said growth was undertaken ‘correctly’. While KIs were largely unsure how the community growth should occur in order to be ‘correct’, it was recognised that the growth of the community would result in outcomes such as larger schools and medical facilities in the Teviot

Valley. It was these outcomes which were identified as positive. However, the community growth required for these facilities to be viable was a key issue for KIs.

KIs also identified that because of community growth, there would be more employment opportunities in the Teviot Valley which would be a positive implication of the LOBP. Possible jobs suggested by KIs were builders, architects, engineers, and labourers. Therefore, more housing would also be required to accommodate these workers. KI 3 explained that when more housing is required, there is even more demand for the aforementioned jobs, further increasing the size of the community. This process was identified as an ongoing cycle which would ultimately result in continuous community growth.

An expert furthered this idea, suggesting that as the community size increases to enable large projects such as the LOBP, the sense of community also increases. However, the community expansion must be undertaken correctly. The following quote reiterates this point;

“ I think that in itself, [LOBP] can add value to the local community. The challenge, again, as always, to make sure that it's done alongside the community acknowledging and respecting how that community operated previously, and then how it's going to integrate with the community long-term, you know, the fundamental aspects of any project like this. – KI 9

While a key positive social outcome was identified as community growth if undertaken correctly, many KIs were unable to elaborate on what ‘undertaken correctly’ meant to them. However, one recurring theme, particularly from older participants who had moved to Teviot Valley to retire, said that they would not like the current relaxed, quiet lifestyle to change. Therefore, many older participants only perceived community growth as positive if the lifestyle they signed up for remained the same.

Positive social impacts were not only limited to the Teviot Valley. One KI explained that if a road were constructed from the Maniototo Basin, the positive social impacts by way of community growth would not be limited to the Teviot Valley. Patearoa, a small town approximately 40km north-east of Lake Onslow, is a key area where KI 3 thought community growth could occur. This

was largely perceived as positive as community growth in Patearoa would allow for more business and financial activity in the area.

6.4.2 Key Informant Interviews: Negative Impacts

Findings show that while KIs recognise the positive social impacts that the LOBP has to offer, these are far outweighed by negative social impacts. Specifically, the long-term negative impacts the community will be required to face if the LOBP were to go ahead. KI 7, a community member, stated that;

“I appreciate this scheme may bring some employment benefits to our community, but this will be short-term. The devastation and irreversible aquatic and environmental repercussions will be long-term.” – KI 7

KIs constantly communicated their concern that the community will change. The concept of change was mostly viewed negatively. Although it was not explicitly stated, the concept of ‘change’ appeared to be factors such as increased traffic, changes to community groups associated with Lake Onslow (i.e. the Anglers Club), changes to recreation at Lake Onslow, and changes relating to the general community. Increased drug use and crime as a result of community growth was another worry that was shared. This was perceived as particularly negative as current community members believe that the community is largely free of drugs and crime.

Interestingly, many of the older KIs who had retired to the area were negative towards social change. KI 1, a community leader, provided insight stating that;

“They came here for this and this is the package, and they don’t want anything to change. They don’t want our roads busier, don’t want loads of people moving into our community we don’t know anything about, they have just said this is not what we signed up for.” – KI 1

This quote provides an overview of social norms and expectations for the Teviot Valley as it explains that any change to the status quo is seen as negative change, and therefore has negative social impacts on the community. Any change to the current community was said to put the small community feeling at risk. KI 5 identified that while most ‘old people’ don’t want to see change, the reality is that some ‘old people’ also want to see growth.

As previously mentioned, community groups, such as the Teviot Anglers Club, would be impacted by the LOBP. The Teviot Anglers Club has between 170-250 members and is made up of people from Canterbury, Otago, Southland, the North Island, and some from Australia. Lake Onslow is a significant and popular location for the members as the membership entails the use of a hut on Lake Onslow. The LOBP may have significant social impacts on this club as it is unclear what the future of the club is if the LOBP goes ahead. The hut available for members of the club on Lake Onslow would be removed as part of the LOBP. Furthermore, KIs explained that it was not clear whether fishing would be allowed on the new lake at all.

Not only is Lake Onslow used for fishing, but is also used by recreational boaters, hunters, four-wheel drivers, and canoeists. There are a number of huts on Lake Onslow which are owned by members living in the Teviot Valley, other areas of New Zealand, and internationally. A number of KIs either owned a hut or were aware of these huts, and stated they hold great social and community value. These huts are currently used to take part in recreational activities on Lake Onslow. A KI who owns a hut explained that their hut was routinely fully booked each year for family and close friends to use each weekend. Therefore, the loss of the huts would result in the loss of social and community value. Given that public access provisions to the new lake that would be created by the LOBP are largely unknown, the aforementioned groups are all at risk of loss due to the proposed development.

6.4.3 Online survey

This section focusses on results from the online survey relating to the positive and negative social impacts of the LOBP. Findings from the online survey demonstrate the KIs are largely divided on what they think about the LOBP. Regardless of the low response rate of the survey, it indicated the participants could see both the positives and negatives of the LOBP. This is demonstrated in Figure 18 below.

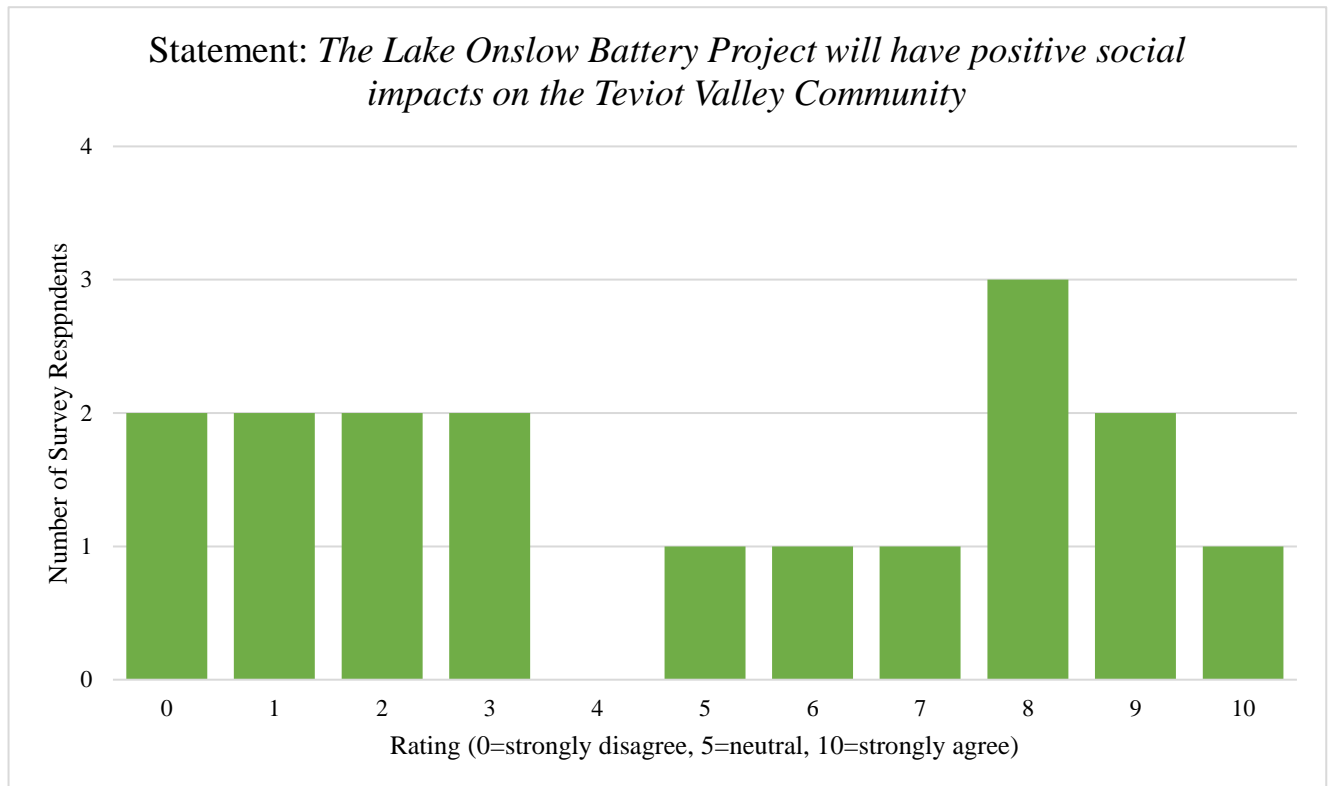


Figure 18: Online survey results relating to the Social Impacts of the LOBP

6.4.4 Common Themes

There are several common themes which have emerged as a result of the interviews and survey in terms of social impacts of LOBP. While the survey suggested that many participants could see both the positive and negative aspects of the LOBP, interviews provided more in-depth accounts. The main positive social impacts identified by KIs were that if done correctly, community expansion could be an effect of the LOBP which would greatly benefit the community. In turn, community expansion would also increase job opportunities in the Teviot Valley. It was also identified that positive impacts were not limited to the Teviot Valley. KIs though that positive impacts would also reach communities around the Teviot Valley also.

The main negative social impact were identified by key informants to greatly outweigh the aforementioned positive social impacts. The main negative impacts identified by KIs were that the LOBP would change day to day lives of community members and recreational opportunities of

Lake Onslow would decrease. Interestingly, people who have retired to the Teviot Valley were generally more negative towards the LOBP.

6.5 Cultural Impacts

6.5.1 Key Informant Interviews

There were few cultural impacts identified by all KIs. However, there is one key finding from KI 11, who stated that Lake Onslow is key area of cultural significance. Not only was this due to the cultural sites, but also the loss of indigenous species that would occur as a result of the LOBP.

KI 11 referenced multiple cultural sites which surround Lake Onslow. These include historic Māori ovens which are all very old, however they were unable to elaborate more on this. While it is recognised that a loss of indigenous species is a key environmental concern which is explained later in this chapter, this was also identified as a cultural impact. The current plans for the LOBP mean that a wetland will be flooded. The key cultural impact that KI 11 associated with this was the loss of instream life, namely Galaxiid.

6.5.2 Online Survey

The above findings are reiterated in the online survey results. While there was a relatively low response rate in this survey, many participants identified that the LOBP would not benefit the Teviot Valley. These findings are shown in Figure 19 below;

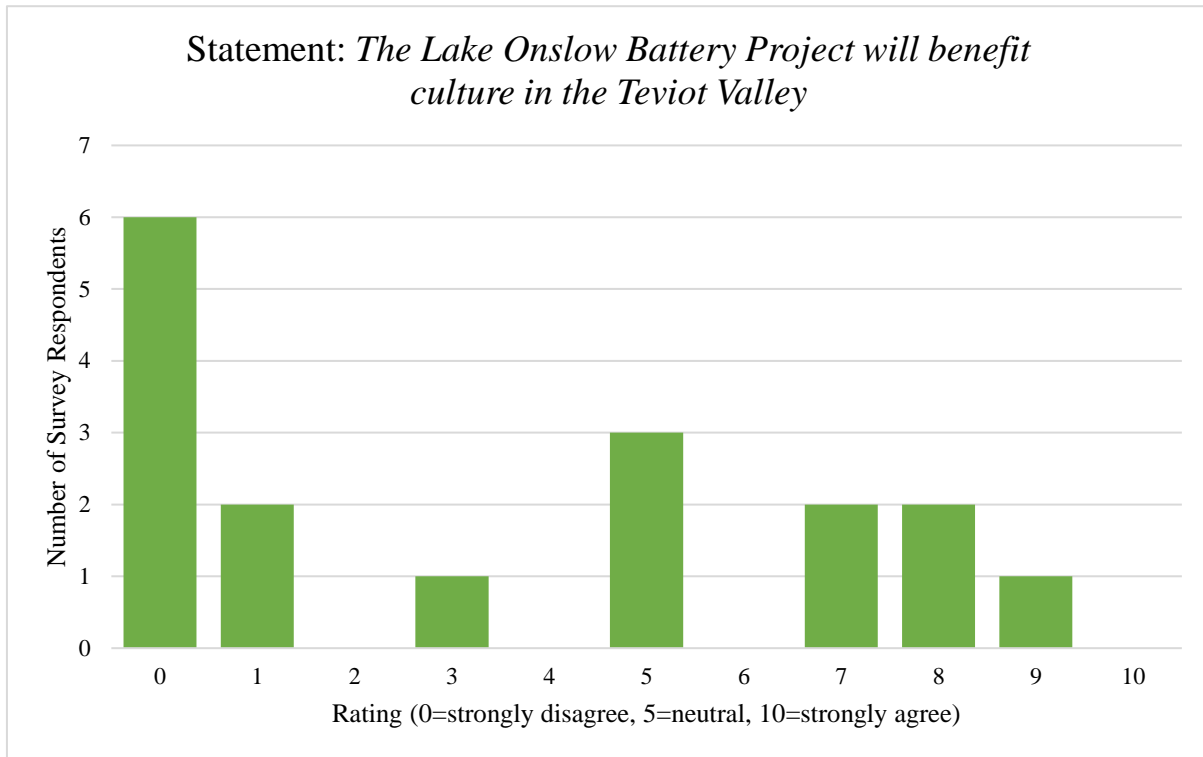


Figure 19: Online survey results relating to impacts on culture in the Teviot Valley

6.5.3 Common Themes

Overall, while KIs did not identify many cultural impacts, those which were identified were thought to be largely negative to Māori culture if the LOBP were to go ahead. Namely the loss of Māori historical sites, wetlands, and galaxiid.

6.6 Environmental Impacts

This section will discuss the environmental impacts of the LOBP on the Teviot Valley. The findings in this section aim to answer the following research question: *What are the primary social, cultural, economic, and environmental impacts of the Lake Onslow Battery Project as perceived by the Teviot Valley community?* These results are informed by the online survey and KI interviews.

6.6.1 Key Informant Interviews: Positive Impacts

When speaking with the KIs, it became clear that almost all of the discussion surrounding environmental impacts was largely negative. The only positive impacts which related to environmental impacts of the LOBP related to the scientific nature of the LOBP and why this was the best option to go ahead for the greater good of New Zealand’s sustainable energy future. KI 9 shares their knowledge of renewable energy and their reasoning as to why the LOBP is a feasible option. They explain;

“The reason that hydropower is a better option than solar and potentially wind has to do with what we call firm capacity. So having an energy storage system, which in this case is water, which can then be put through turbines to generate means that you’ve got it there when you need it.” – KI 9

KI 9 also shared that while renewable energy is important to a sustainable future, the storage of energy created through these different avenues is the challenge that New Zealand is currently facing. Without a way to store energy for use during times when solar, wind, and hydro are unavailable, communities can fall back on the stored energy to sustain themselves. KI 9’s final remark on the LOBP shows just how much they believe that hydropower could be the ticket to New Zealand’s fully renewable future. They state;

“Solar and wind do contribute to a renewable future, but it’s the storage of their energy output that will contain to remain the challenge, whereas Lake Onslow itself is a storage facility. That is the purpose of it.” – KI 9

6.6.2 Key Informant Interviews: Negative Impacts

The KIs that were interviewed as part of this project were very vocal about the environmental impacts of the LOBP. The results from these interviews show that one of the biggest things that the community is aware of in relation to the LOBP are the environmental impacts it could have on Lake Onslow and the surrounding areas. KI 1 explained their concern about the sheer magnitude of the LOBP and how that could affect the environment. They stated;

“That’s my biggest concern is the environmental impact. I think a project of this scale is so huge, it is irreversible and it is going to change our community forever, especially because of the size.” – KI 1

Other KIs discussed the potential impacts on fish species that are currently present in Lake Onslow, and that the go ahead of the LOBP would mean an enormous alternation of the current ecosystem. KI 8 described their current knowledge of the ecosystem and species that exist within the lake. They feel that the health of the ecosystem is strong, and that the LOBP would disrupt the harmony of the natural environment of Lake Onslow. They explain;

“Those Teviot Galaxias fish have been living out there quite happily with the environment, the wetlands, and everything. Everything’s all out there and it’s still fine. It’s all working away really nicely.” – KI 8

KI 8 as well as various other KIs are clear of their understanding of the Lake Onslow environment, and they do not want to see that destroyed or altered to a point of no return from something like the LOBP. Other KIs shared their concerns about erosion from the raising and lowering of the lake, the overall pollution from the LOBP, and how the flooding of the land will affect the ecosystem within the Teviot Valley. KI 7 explains;

“The proposal to raise the lake to the level which is being sought will be a disaster for the ecology, angling, and all other uses of the lake. Lake Onslow currently provides ideal habitat for trout. All freshwater species are and will be affected by all current level variations. Drowning the tributaries and operating the lake with a greater level of variation will destroy the trout habitat and create ongoing hazards for anglers.” – KI 7

Residents shared their desire for new spawning areas if the LOBP does go ahead as without these new areas, the rich trout ecosystem will cease to exist, drastically altering the environment for the foreseeable future.

6.6.3 Online Survey

The online survey reflected a variety of views regarding the potential effects of the LOBP on the natural environment. When asked if survey respondents felt that the LOBP would positively benefit the Lake Onslow and wider Teviot Valley environment, the responses were quite divided as shown in Figure 20. Ten respondents rated the environmental impacts below a five, and seven respondents rated the environmental impacts above a five. Aside from this question, many respondents shared their concerns about the environmental impacts of the LOBP in the short response questions in the survey. One respondent stated;

“The environmental impact of raising Lake Onslow will be huge, especially the impact on indigenous species.”

Other respondents shared that they believe the LOBP would lead to a loss of ecosystems, destruction of nature, and overall environmental degradation. Beyond just the effects of the LOBP on the natural environment, respondents explained that they feel a connection to Lake Onslow, and that the LOBP would disrupt the natural landscape as well as the peace and quiet that the area currently provides for the community.

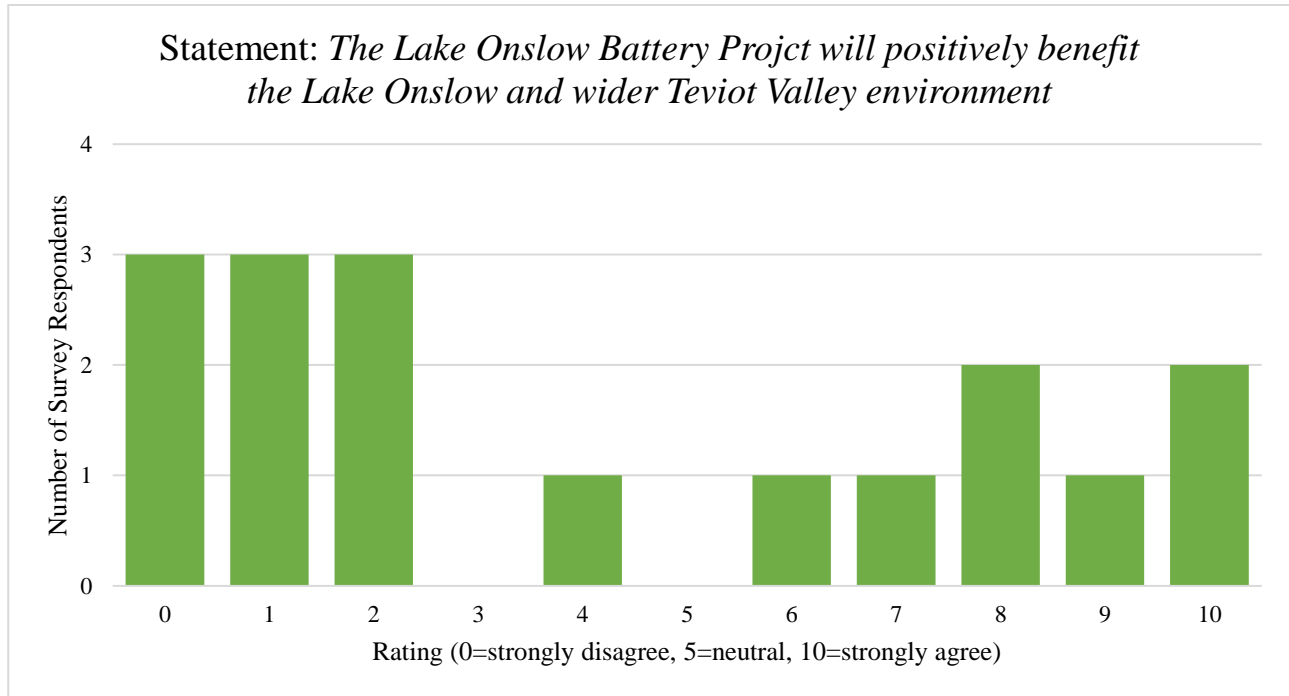


Figure 20: Online Survey results relating to impacts on the environment in the Teviot Valley

6.6.4 Common Themes

There are several common themes which emerged as a result of the interviews and survey in terms of environmental impacts of the LOBP. One theme is that respondents raised a greater number of negative environmental impacts than positive ones. While the survey was more divided in terms of positive and negative environmental impacts, KIs who discussed the environmental impacts of the LOBP were almost entirely negative. The only positive environmental impacts discussed in the interviews had to relate to the overall sustainability of hydropower and how that could help New Zealand achieve a more sustainable energy future, not related to the LOBP specifically. Another common theme was that community members are concerned that the negative environmental impacts that would arise as a result of the LOBP would be long-term, whereas the benefits would likely be short-term. Things such as the permanent alteration of the ecosystem, a change in the habitat which would affect fish spawning, and erosion would all be long-term issues for short-term gain within the community. The final theme that has caused concern within the community is how all these aforementioned impacts will affect the quality of life for residents in

Teviot Valley. Whether that be health, accessibility, or job security, many residents fear that the environmental impacts resulting from the LOBP could change their lives for the worse.

6.7 Economic Impacts

This section will discuss the economic impacts of the LOBP on the Teviot Valley. The findings in this section aim to answer the following research question: *What are the primary social, cultural, economic, and environmental impacts of the Lake Onslow Battery Project as perceived by the Teviot Valley community?* These results are informed by the online survey and KI interviews.

6.7.1 Key Informant Interviews: Positive Impacts

It is clear from the interviews that many of the community and expert KIs do believe that the LOBP has the potential to provide positive economic benefits to the Teviot Valley community. KI 3 highlights the opportunity for increased economic talent and skills, stating;

“So with more skills training, all of a sudden there’s massive opportunities.” –

KI 3

This quote showcases that community leaders and members alike believe that the LOBP could bring a variety of new skills to the area, supporting and growing their economy for future generations. As the demographics provided from the survey as well as the general ages of the KIs that were interviewed, the Teviot Valley has an ageing population which could be a factor as to why the feedback received reflected the want for new workers and opportunities. Along with new skill sets, many KIs also discussed the importance of job security and the quality of living for the community. KI 9 discusses the positive economic impacts in terms of employment opportunities. They quote;

“It’s going to create jobs in the area and hopefully with that brings benefits to the local community in terms of local spend and the local economy and

supporting infrastructure through housing, as well as just general living requirements.” – KI 9

KI 9 is an expert interviewee, meaning that they have a sophisticated knowledge on the LOBP and its potential impacts on the Teviot Valley. They also maintain an outsider perspective, removing bias as the impacts will not directly affect them as they do not normally reside within the Teviot Valley area. Their acknowledgement of an increase in jobs and local spending aligns with the quote from KI 3 above, indicating that the community and experts alike can agree that the LOBP could bring economic benefits to the Teviot Valley. Their mention of housing and living requirements aligned with the types of economic growth and monetary increase that could occur in the community as a result of the LOBP going ahead.

6.7.2 Key Informant Interviews: Negative Impacts

While there are clear supporters of the LOBP in term of economic benefits, there are also many individuals who argue that the negative impacts outweigh the positives. One argument for why the LOBP could have negative economic impacts has to do with the risk of going ahead with such a large project as well as the cost that goes along with it. KI 1 explains;

“I think there are better options out there and it’s not putting all this risk on a dry year storage dam, I think they need to be looking at other alternatives for energy.” – KI 1

Many of the KIs questioned the reasoning for building PSH rather than other types of renewable energy such as wind or solar. This lack of knowledge and understanding leads to scepticism about the LOBP and makes it difficult for the community to see the economic benefits. Another concern about the LOBP is that costs within the community will increase, having an overall negative effect on those within the community. KI 2 explains this further by saying;

“It will cost more to get things done. There’ll be more competition for services, more people wanting stuff done. So costs will go up for us.” – KI 2

While the price of services going up is one potential concern, the increase of housing costs is another worry that members of the community have. The Teviot Valley wants to see the benefits directly reflected within their community, and not simply exported elsewhere. While the LOBP could have high economic benefits for New Zealand as a whole, many residents are unconvinced that these benefits will be accurately distributed amongst the people whose lives it is actually affecting.

6.7.3 Online Survey

The online survey reflected many contrasting views concerning the economic impacts of the LOBP. Figure 21 below illustrates that the community is quite divided on whether the LOBP will be good for New Zealand as a country in the views of the Teviot Valley community on a scale of one to 10. Most respondents were on either the high or low end of the spectrum, indicating that they either strongly agree or strongly disagree with the statement. In total, nine respondents scored the statement a four and under, and ten respondents scored the statement a six and above. Only one participant indicated a five, placing them at a neutral position in terms of agreement with the statement. Figure 22 shows a survey question which asked respondents to indicate if they believe that the LOBP will economically benefit the Teviot Valley community. These results reflected a largely overwhelming agreement with the statement, with only five respondents scoring the question a four and under, and the remaining twelve respondents scoring it a five and above.

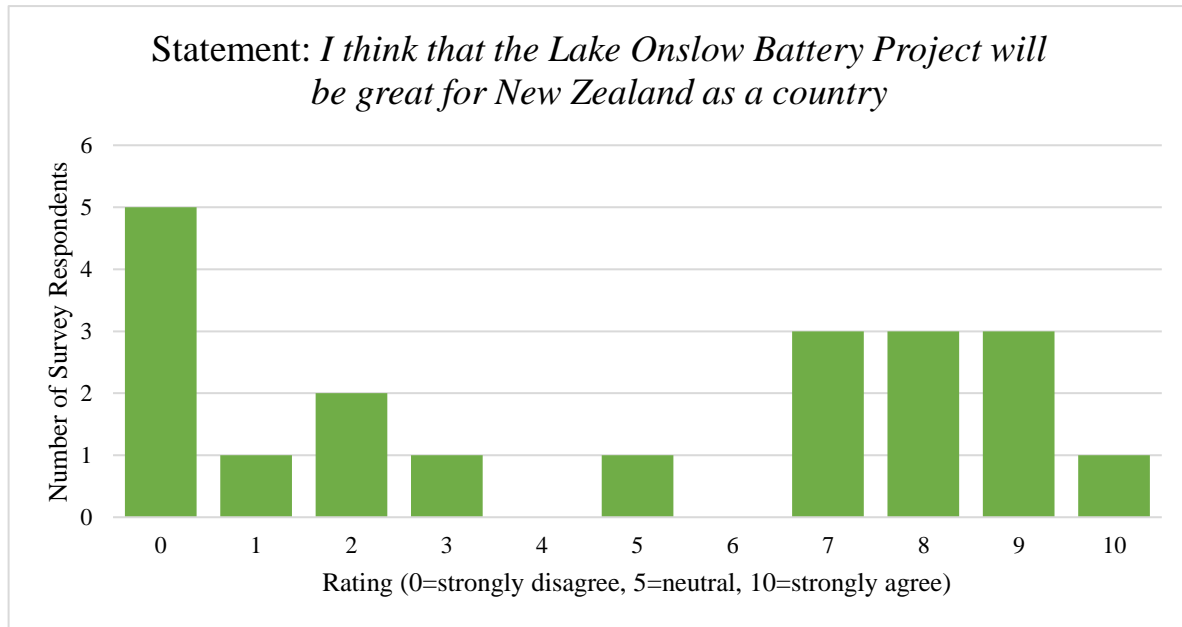


Figure 21: Online Survey results relating to the benefit of the Lake Onslow Battery Project on New Zealand as a country

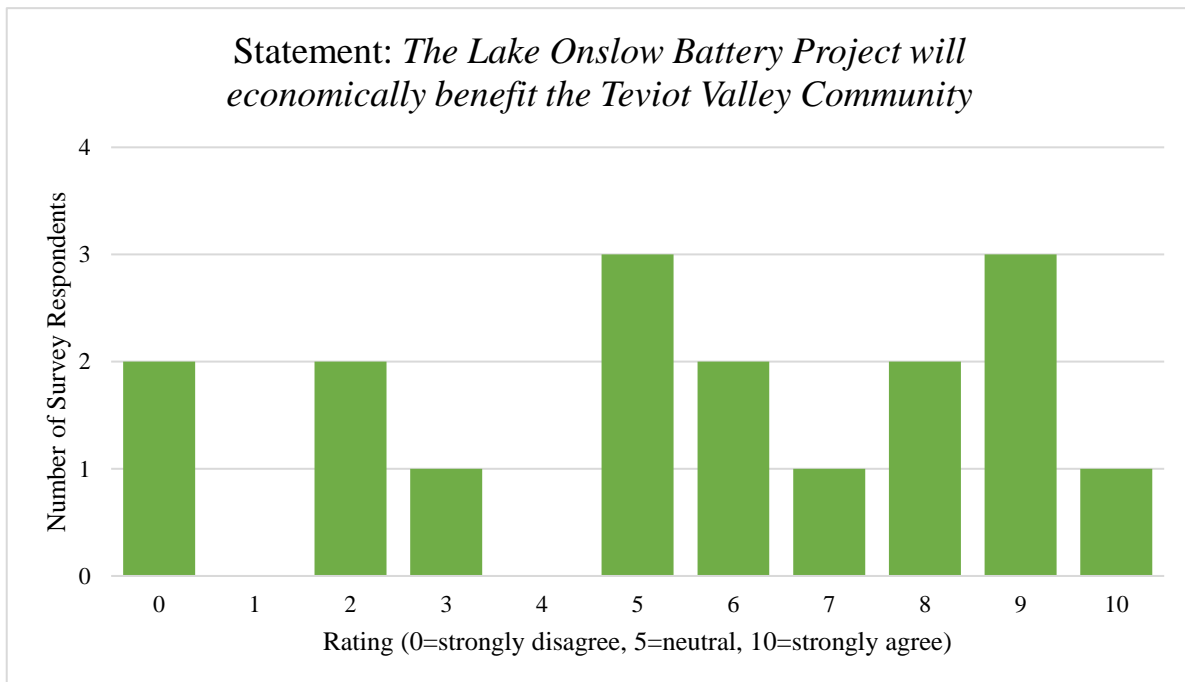


Figure 22: Online Survey results relating to the economic benefit of the Lake Onslow Battery Project on the Teviot Valley

6.7.4 Common Themes

In terms of the economic effects of the LOBP, a number of recurring themes emerged from the interviews and survey. One theme is that whether an individual supports or opposes the LOBP through an economic lens depends on whether or not the LOBP will directly affect them and their land. It became clear through the interviews that most KIs who opposed the LOBP would be adversely affected through its implementation, and were not convinced that MBIE would adequately accommodate their losses. Another theme is that residents are concerned that the economic benefits that would result from the LOBP would be filtered around the entire country, leaving the Teviot Valley and those who are most directly affected at a disadvantage. Residents of the Teviot Valley believe that because the LOBP is occurring in their own backyard, they should receive a large portion of the economic benefits. A final theme is that residents want to ensure that economic gain does not outweigh the importance of their quality of life. The LOBP would create more jobs, a larger population, and more infrastructure, but not all residents desire this type of growth. Results from the interviews and survey show that while they are supportive of economic development, maintaining their current quality of life is of the utmost importance for many residents.

6.8 Infrastructure

This section presents the results of the current study, focusing on existing infrastructure, potential changes to infrastructure and opportunities for additional infrastructure for the Teviot Valley from the LOBP. The findings in this section address the following research question: *What are the opportunities and limitations of the required infrastructure associated with the Lake Onslow Battery Project in the short-term and long-term?* The data used in this section is obtained from KI interviews and the online survey.

6.8.1 Key Informant Interviews: Concerns

Results from the semi-structured interviews showcased concern about the already existing infrastructure in the Teviot Valley. In particular, KIs expressed their concern about the access road to Lake Onslow and the repairs that would be required if the LOBP were to go ahead. This is demonstrated by the following quotes;

“One of the big things out there that people will first say and it's already been said, the winding gravel road, away out there needs to be widened and fixed.”

– KI 5

“The road is a big issue up here at the moment, it's already in a bad state of repair” – KI 8

Many KIs expressed were concerned about the large amount of work, time, and money that would need to be put into the narrow road for it to be accessible by big trucks and other large construction vehicles. Currently this road is used by farmers, fishermen, holiday goers, local residents, and other recreational lake users, many of whom have expressed ongoing issues with the current road. Additionally, repairing and re-inventing this road was mentioned various times by KIs and was a reoccurring theme throughout the data. Another response which speaks to the notion of existing infrastructure can be seen below;

“The Lake differs from the other local reservoirs as it does not have cell phone coverage and has a greater sense of isolation. The transmission lines are the only major obvious built structure” – KI 7

This statement underscores the remote setting of Lake Onslow and its existing reputation as a serene and tranquil location. It draws attention to the limited existing infrastructure at the lake, thereby emphasizing the significant scale of infrastructure required for the LOBP. This raises inquiries about the feasibility of implementing such extensive infrastructure in this area and raises concerns about the potential impact on the overall sense of connection to the place. Increased infrastructure has the potential to transform the environment from its current isolated state, potentially altering the cherished and isolated nature of the location.

During the interviews with KI, a recurring topic discussed was the long-term impacts arising from significant alterations to the existing infrastructure of the Teviot Valley. Numerous community

members expressed apprehension about the potential occurrence of a 'boom and bust' scenario following the completion of the LOBP. The subsequent quotes exemplify these concerns;

“I mean they are talking about all the employees in order to build this project so our infrastructure is going to change, our population is going to grow, we are talking boom and bust like we saw with the Roxburgh hydro dam, Twizel, Cromwell. Even though they are saying that won't happen again it is still going to change our community.” – KI 1

“I think that's what people worry about is the boom and bust thing, because I think we've sort of seen it a little bit in Cromwell.” – KI 8

These quotes not only highlight the increasing worry about abandoned infrastructure in the Teviot Valley but also underscore the significance of drawing lessons from other towns and regions that have undergone similar projects. It is crucial to analyse the LSH projects and the accompanying extensive infrastructure, including the dam, housing, buildings, schools, commercial areas, and other necessary community spaces. This analysis will play a vital role in addressing the concerns effectively.

Further remarks regarding potential alterations to infrastructure revolve around the desire of community members and leaders to preserve the existing small-town community they cherish in the Teviot Valley. Many individuals choose to reside in the area precisely because of the close-knit, unhurried lifestyle, and the sense of safety that comes with it. They express concerns that an influx of people and a growing population would significantly transform the community, especially in terms of the peace and tranquillity they value.

“We want that small community feeling and want to feel safe, want to be able to drive from A to B and not be impacted by a big project with big trucks rattling past your driveway and building bigger roads, bridges, accommodation.” – KI 1

KI 8 expressed concerns about the potential challenges of accommodating the large number of workers and additional individuals, fearing that the town would be overwhelmed. The immense magnitude of the LOBP and the accompanying infrastructure needed to sustain it were major points of apprehension for the community. Furthermore, KI 8 also highlighted the access road to Lake Onslow as a significant concern, emphasizing the necessity for substantial reconstruction.

“Well, I think it's going to swamp, you know, that many workers, it's going to be bigger than Twizel, where you going to put the people? And then the road up there, it would need a major upgrade.” – KI 8

Furthermore, certain KIs expressed worries regarding accommodation. A community leader acknowledged it as a potential issue but also saw it as an opportunity for creating new infrastructure and utilizing unused buildings.

*“Rental accommodation is going to be a real problem. A real problem.”
– KI 2*

*“The effects will be building and the effects will be a lot more people, whatever people bring, brings congestion and we might even end up with traffic lights.
The Township will grow because of all the supporting commercial requirements. So that'll be a great thing. A lot of the commercial buildings are getting a bit unused in town, so that'll be a great thing. A lot more housing will be needed.” – KI 2*

Additional concerns regarding housing and accommodation infrastructure revolved around apprehensions of rising housing and rental prices. Landowners, who depend on affordable worker accommodation for their farming staff, expressed worries that the current housing situation would become unaffordable, thereby impacting their business and livelihoods.

“If they're going to be employing people and they're going to be paying really good money for housing, does that mean that we can't attract workers or that some of the tradespeople around here because housing is not available.”

– KI 8

The impacts of altering infrastructure extended beyond housing and accommodation, as concerns regarding healthcare and medical facilities were raised during the interviews. One community member expressed worry that the impacts would not only affect the Teviot Valley but also put additional strain on the already busy and pressured hospital in Dunedin. This highlights the extensive scale of infrastructure necessary for the successful implementation of the LOBP.

“We listened enough now and then that the struggle that is for people to come to Dunedin to the hospital imagine another 2000 people up there with their families.” - KI 6

6.8.2 Key Informant Interviews: Opportunities

Despite the significant concerns raised about the potential increase in infrastructure within the Teviot Valley, many community members held a positive outlook, perceiving it as a promising opportunity for the community. Numerous community members and leaders expressed enthusiasm for the prospect of revitalising unused and unsafe buildings, as well as creating and upgrading shared community spaces, which would contribute to the overall character and atmosphere of the Teviot Valley. Additionally, it was emphasised that this could generate social and economic opportunities within nearby townships. The following quotes capture these key ideas;

“Community groups might say, so can you please help us, with you know? The tennis courts, or something like that.” – KI 5

“It would be great to see some of the properties in Roxburgh that have been sitting there idle at the moment because I gather some of them aren't

earthquake proofed and then can be useful buildings in the community, it would be wonderful to see those things developed and some character kept in Roxburgh because there is a lot of character here already and it would be wonderful to build on it and then it would become more of a draw for tourists because we're in a brilliant position with the cycle trail and everything else and Roxburgh already has a lot of good things going for it but I think there could be more.” – KI 4

Lastly, opportunities for infrastructure were intricately tied to the compensation of individuals affected by the LOBP and the broader Teviot Valley community. Some residents and community leaders believed that the most significant infrastructure opportunities would stem from compensation, with one member underscoring the importance of "playing their cards right." It is crucial to ensure that new infrastructure in the Teviot Valley can be effectively utilised after the LOBP is complete, especially for tourism prospects within the region.

“When it's all finished and operating, there won't be much left, so we want to be compensated and make sure that it's something tangible and can be helpful to afterwards, like a much more attractive Roxburgh, with more buildings and facilities and stuff we can house tourists in.” – KI 4

“I thought now if these fishermen play their cards right. They could get toilets out there because there's nothing. There's just a lot of collection of huts. And amazingly, that's just sat. They could get a big building. Electricity all these things and it was only a few months after I thought it and said it that I could see just wee things in the paper quoted from Fish and Game. And you could see they were starting to think like that, we can click this ticket and it's logical.” – KI 5

6.8.3 Online Survey Results

From the survey responses there was a range of different perspectives as to whether the LOBP would create positive impacts on infrastructure. Five participants either disagreed or strongly disagreed, while a further three participants remained neutral neither agreeing nor disagreeing. Finally, eight participants agreed or strongly agreed that if the LOBP goes ahead, it would create positive impacts for the Teviot Valley.

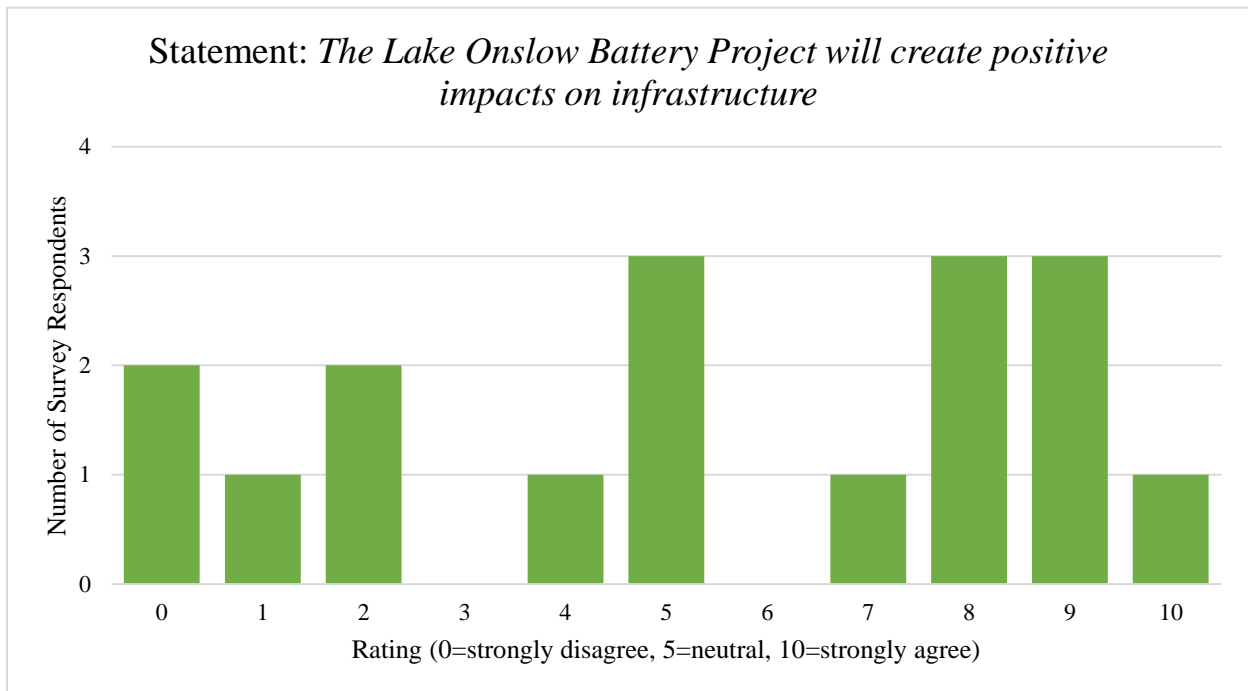


Figure 23: Responses to survey statement 'The Lake Onslow Battery Project will create positive impacts on infrastructure'

According to the findings of this survey question, which will be elaborated on later in this chapter, it is clear that respondents hold divergent views on whether the LOBP will have positive effects on future infrastructure in the Teviot Valley and Lake Onslow areas. These infrastructure-related results hold significance as they reaffirm the community's major concerns and opportunities pertaining to social, cultural, environmental, and economic aspects. Moreover, they highlight the existence of differing opinions and perspectives regarding the overall LOBP.

6.8.4 Common Themes

In summary, several key themes emerged during the analysis, including the assessment of existing infrastructure and its current condition, the necessity for infrastructure modifications, concerns regarding potential changes to infrastructure, and the potential opportunities that the LOBP could offer to the current infrastructure in the Teviot Valley. While some community members acknowledged the potential benefits, their concerns and reservations outweighed the positives. On the other hand, experts and community leaders had a more optimistic perspective but remained realistic about the changes and consequences associated with the extensive infrastructure required at Lake Onslow and throughout the wider Teviot Valley. While there are diverse perspectives and opinions regarding the impacts of the necessary infrastructure for the LOBP, there is a general consensus among residents, community leaders, and experts that the scale of changes and new infrastructure required will be substantial.

6.9 Desired Community Outcomes

KIs were asked in interviews if they had any desired outcomes should the LOBP go ahead. Ensuring the LOBP would be a sustainable asset for the Teviot Valley community in the future was one of the strongest themes that came across during KI interviews. As has been previously discussed, the community was concerned that the LOBP may bring negative impacts to their quality of life and want to be sure that this is recognised by MBIE and the CODC. The community feels that some form of compensation or investment in infrastructure and community initiatives would be a good way of giving back to the community.

There were several ideas raised by KIs from a mini golf course in the Teviot Valley, to ensuring the LOBP would become a sustainable asset for the Teviot Valley community in the future. Some of the key desires raised included: more and earlier information; ensuring the natural ecosystems were safeguarded; a new local community body with an ongoing revenue stream; community playgrounds; minor school upgrades; rabbit fencing around certain areas within the Teviot Valley; and upgrades to local infrastructure.

6.10 Conclusion

It is evident from this chapter that there are a range of different perspectives on potential impacts arising from the LOBP. These impacts range from social and cultural, to economic and infrastructure impacts. Figure 24 below provides a summary of key theme and perspectives as they arose from the interviews and survey.

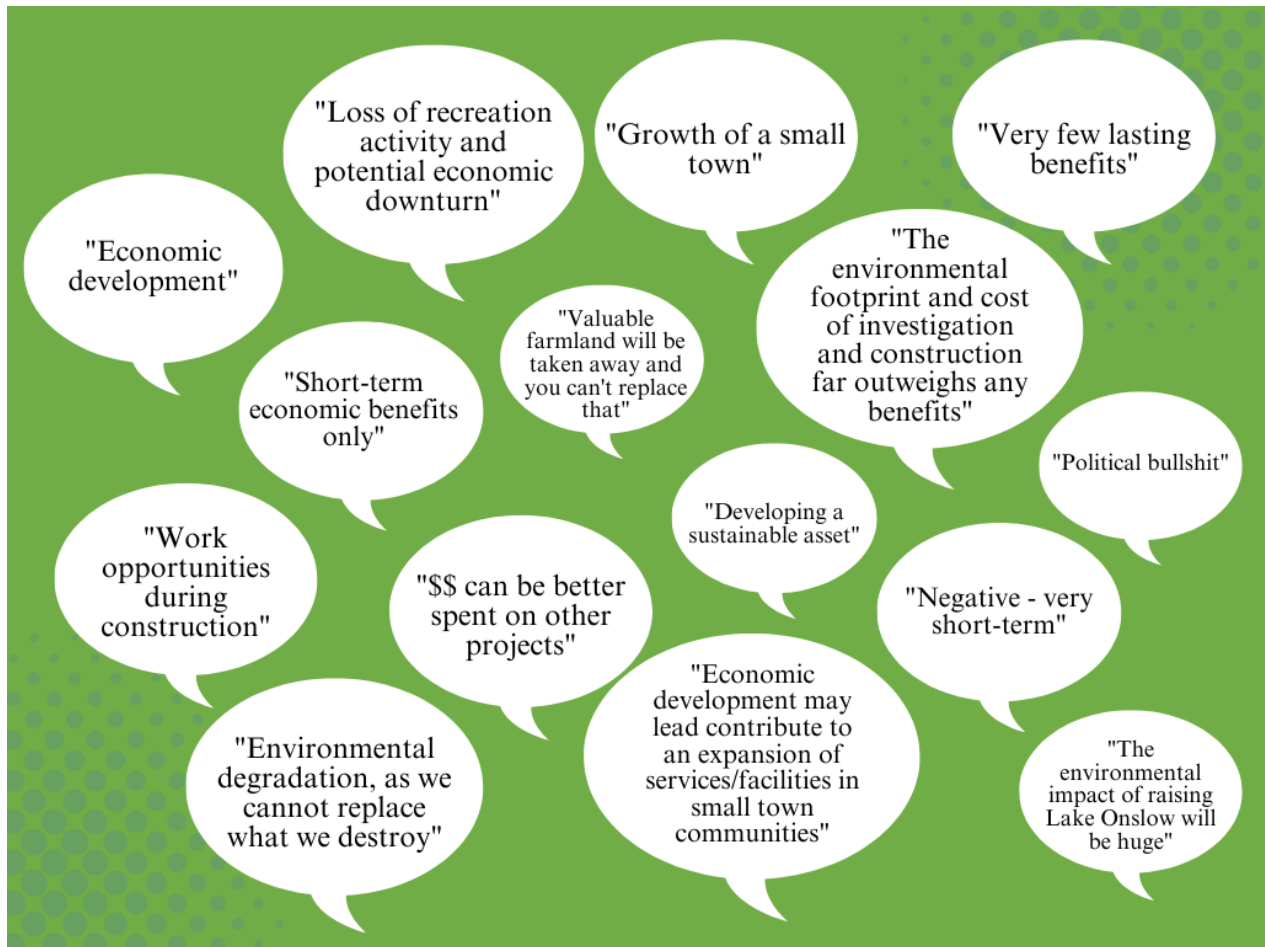


Figure 24: Key Quotes from Online Survey

7 Discussion

This chapter will synthesise the findings of this research across a range of methods, in which final recommendations can be made. Three research questions were developed to consider the potential impacts of the LOBP on the Teviot Valley community. These research questions are as follows:

1. What are the primary, social, cultural, economic, and environmental impacts of the Lake Onslow Battery Project as perceived by the Teviot Valley community?
2. What are the opportunities and limitations of the required infrastructure associated with the Lake Onslow Battery Project in the short-term and long-term?
3. What is the community's perception of the Lake Onslow Battery Project in terms of consultation adequacy and desired outcomes for the future?

The following chapter will be structured according to these three research questions. This discussion will be informed by all methods used for this research including, site-visits, semi-structured KI interviews, an online survey, a literature review, and a policy analysis.

7.1 What are the primary, social, cultural, economic, and environmental impacts of the Lake Onslow Battery Project as perceived by the Teviot Valley community?

This section of the chapter aims to understand what the key impacts of the LOBP are as perceived by the Teviot Valley community. The results indicate that the LOBP could yield a range of potential impacts, both positive and negative impacts, which could be both short and/or long-term in nature. The following section will discuss said effects and be structured by the community members' connection to place, and the primary social, cultural, economic, and environmental impacts.

7.1.1 Connection to Place

It was interesting to note from the results that not all survey respondents resided within the Teviot Valley, as previously shown in Figure 16. The survey link was posted online, and participation was voluntary which indicates that participants from outside the study area may have been interested in, or connected to, the Teviot Valley and Lake Onslow in some way. Initially, the

researchers were focused solely on the potential impacts within Teviot Valley, but from the survey results and KI interviews it was understood that potential impacts would extend beyond just the communities within the Teviot Valley.

As discussed in Chapter Two, an understanding of people's connection to place can play a critical role in the planning process (Manzo & Perkins, 2016). As discussed by Manzo and Perkins (2016), an understanding of people's connection to place can help to understand community perceptions and values. In the context of this research, comprehending what community members value about their community or environment will help to understand why it is that certain impacts are perceived to be more significant than others. The results show a common theme; - KIs value the Teviot Valley for its tranquillity, peacefulness, and natural beauty. Some KIs are concerned that the LOBP could impact their peace and quiet, something that is a common value within the Teviot Valley. Some KIs connections to the Lake Onslow environment have stemmed from the recreational opportunities that Lake Onslow offers, including boating, fishing, and huts for holidays.

Connection to place can have a great influence on people's acceptance of large-scale projects, as found by Vorkinn and Riese (2001). It is evident from the results, community members' connection to the Teviot Valley and Lake Onslow environment has shaped their perceptions of the potential primary impacts of the LOBP. As found by Vorkinn & Riese (2001), connection to place could explain more of the difference in attitudes towards the LOBP than could the sociodemographic principles. It is important to understand the community members' connection to place to comprehend why they have different viewpoints concerning the LOBP, whether these viewpoints are positive or negative.

It is evident from the results, community members' connection to the Teviot Valley and Lake Onslow environment has shaped their perceptions of the potential primary impacts of the LOBP. As discussed in Chapter Two, it is important to consider people's connection to place when considering the impacts of large-scale infrastructure projects (Vorkinn & Riese, 2001). The results found that several KIs have had long-standing connections with the Teviot Valley and Lake Onslow environment with some KIs having lived there for over 50 years. These KIs are concerned that such a large infrastructure project will impact their values associated with their community and environment. Manzo and Perkins (2016) explain that community members may feel that their connection to a place may be threatened by large infrastructure projects. The results showed that

some KIs are concerned that should the LOBP go ahead, their values associated with the community and environment will never be the same again. This was demonstrated in a strong statement from KI 1: “*we will never have the same community again*”. It was also noted a couple of times during interviews that KIs are concerned that it is the community members, who have strong connections to the Teviot Valley, that will experience more significant and immediate impacts than the rest of New Zealand that will largely benefit from the LOBP.

As discussed previously in Chapter Two, such concerns regarding loss of community or community values could disrupt community members’ connection to place (Manzo & Perkins, 2016). Recognising and addressing what impacts could cause the greatest disruptions to the community’s connection to place, and working to mitigate these impacts could help to increase public acceptance of the LOBP. Therefore, if the LOBP were to go ahead it will be important to unpack and understand the connections and values that community members associate with the Teviot Valley and Lake Onslow environment.

7.1.2 Social Impacts

Chapter Two established that social issues are a key concern associated with the construction of PSH schemes (Lyu et al., 2022). Furthermore, hydropower schemes are known to have more disproportionality effect on a local scale as opposed to effects on a national scale (Supriyasilp et al., 2009). Findings from the present research were consistent with the aforementioned comments, showing that while KIs recognised that the LOBP could have positive social impacts for communities in the Teviot Valley, they can also have large negative social impacts. Community members identified these negative impacts to affect the Teviot Valley disproportionately as opposed to New Zealand as a whole.

As shown in Chapter 6, nearly all the KIs expressed some level of concern regarding the detrimental social effects that the LOBP would have on the on both the immediate and wider community. These negative social impacts were typically linked to ‘change’ in the immediate and wider community.

When KIs were discussing ‘change’ this generally related to increased traffic, the expansion of small towns in the Teviot Valley, and general disruption to the peaceful lifestyle that the Teviot Valley is known to offer. This therefore resulted in ‘change’ often being associated with negative social impacts. However, ‘change’ was also perceived as a positive social impact, often when the KI was describing the same situation. For example, one KI would explain that a negative social impact of ‘change’ would be community growth resulting in increased crime rates, while others associated a positive social impact of ‘change’ being community growth resulting in increased job availability. However, a common theme throughout the results was the majority of the social impacts associated with community change were perceived negatively.

As explained in the results, many of the older KIs who had retired to the area were especially negative towards the change. This is because they had often moved or retired to the Teviot Valley for the lifestyle that it offered, or the values that were already established. The LOBP would change this. KIs identified that change was a large catalyst in creating negative social outcomes.

Overall, the findings of this research show that the LOBP has put the status quo of the Teviot Valley at risk of significant change. Without the LOBP even taking place, the prospect of the LOBP was reported to bring a large amount of unease to members of the Teviot Valley, or even create tension. Because of the uncertainty the LOBP, members of the Teviot Valley are unsure how the valley will look in both the near and far future. This evidence demonstrates that regardless of whether it goes ahead or not, the LOBP is having negative social impacts on the Teviot Valley.

Regardless of the social impacts, Chapter 6 indicated that KIs were willing to support the LOBP if it were to go ahead. However, this was predominantly on the term that future generations would benefit from the LOBP. This manifested in the results as KIs would also often refer to not what they could personally gain, but what their community and future communities could gain if they were willing to put up with said impacts. While many of the retired residents recognised that realistically, they might not be around when the LOBP is complete, they noted that change may be tolerable if there were long-term benefits for both the immediate and wider community that would outlive the KI themselves.

Interestingly, older residents in the area believed that they were in an advantageous position as this is not the first-time hydropower scheme had been proposed, or even contrasted in their lifetime. KIs reported that they had observed and lived the construction of all Lake Roxburgh, Clyde,

Waitaki Dam Hydro Scheme, and Lake Manapouri Dams. Therefore, they were able to see both the negative social impacts of such projects but also the positive social impacts or opportunities. Sovacool and Griffiths (2020), explained the long-term economic benefits that have been observed with hydropower schemes. This resonated with the community as long-term, community focused economic benefit was a key social impact they wanted to see. Therefore, there would be both vast short and long-term social impacts observed. These were reported to be a result of community clubs being funded, education and training being more easily available in the community, community facilities being created, and even recreational facilities being created for the community.

Supriyasilp et al. (2009) also explains how locals can be disproportionately impacted when comparing effects on a local scale to a national scale. This was recognised throughout the results where KIs identified that both New Zealand as a nation and local community/region would benefit from the LOBP. However, members of the Teviot Valley were extremely concerned that they were the only members facing the negative social consequences of the LOBP, and these would outweigh the positive social consequences.

Figure 25 below illustrates how the benefits (e.g., social, environmental, economic) of the LOBP compared to the negative social impacts on the community. Note that there are no negative social impacts on the nation.

Figure 25 has been created based on information provided in the results and demonstrates that while there many benefits on a national level, there are also a great amount of negative social impacts on the immediate and wider communities. While it was recognised that there are possible immediate and wider community benefits, these are vastly outweighed by the negative social impacts on both the immediate and wider communities.

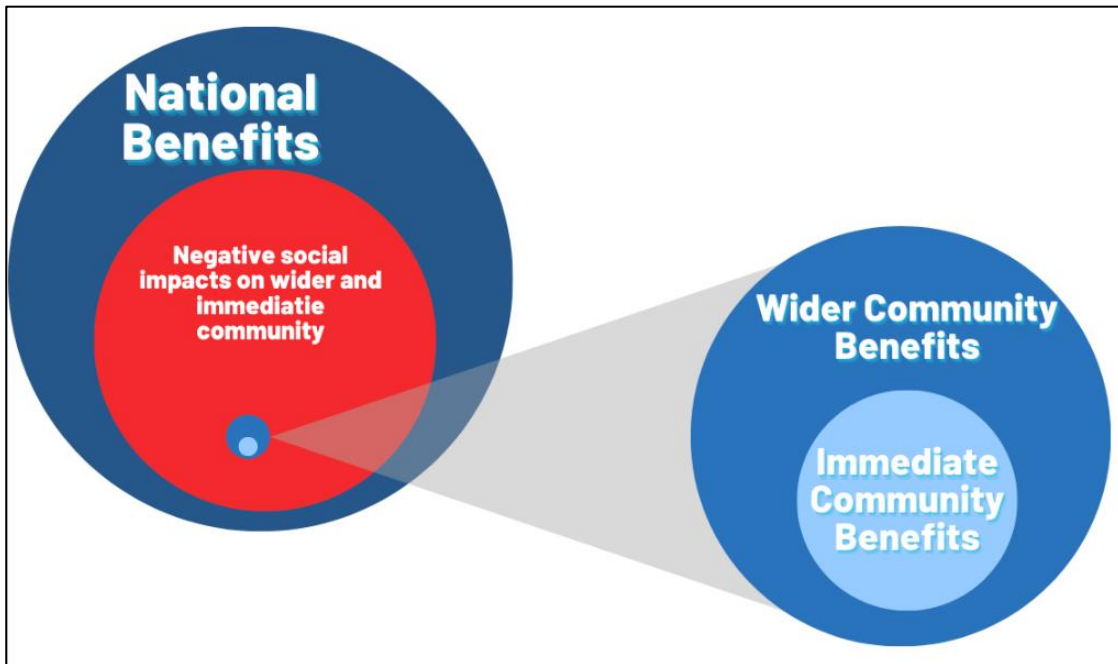


Figure 25: National benefits of the LOBP in relation to localised benefits

7.1.3 Cultural Impacts

The literature established that among other factors, cultural impacts of hydropower developments need to be emphasised, so they are not overlooked (Liu et al., 2013). Although there were questions throughout data collection relating to anticipated cultural impacts as a result of the LOBP, there were very few cultural impacts identified by KIs or survey participants. While there were few impacts on culture specifically identified, it is imperative to note that concerns which were raised have high significance to Māori Culture. Notably, the historic sites mentioned by KI 11. Therefore, results from this research do not represent the true cultural impacts that may be observed.

One single KI recognised the vast cultural impacts that the LOBP will have on Māori culture in the Teviot Valley. Interestingly, there are no cultural values identified for Lake Onslow by the Kāi Tahu ki Otago- Natural Resource Management Plan 2005, the Otago Regional Council Planning Maps, or the Central Otago District Council Planning maps. This does not align with the strong cultural presence indicated by the aforementioned KI, however, does align with the previously mentioned findings from Liu et al. (2013). This thereby suggests that cultural values of the LOBP have not yet been ascertained or recognised in any planning documents. Therefore, before such values can be considered, this must occur.

However, what the results do show is that there is better community awareness of environmental effects which have deep ties to Māori culture, rather than cultural values themselves. For example, while it was identified by a KI specifically as an environmental impact, the loss of habitat for Teviot Flathead Galaxias, a species of significant cultural value to Māori, is a very important cultural impact. Natural inland wetlands are also of great cultural value to Māori people. Loss of such areas was also identified by a KI directly as an environmental effect of the LOBP. Regardless of how the KI recognised or categorised the effect (ie. As an environmental effect rather than cultural), loss of wetland as a result of the LOBP will still have a large effect on Māori culture.

Overall, this shows that whether the community realise it or not, they have identified features important to them which are innately important to Māori culture thereby indicating some form of cultural disconnection.

This could also be explained by the demographic make-up of the Teviot Valley. Information from the 2018 census shows that 87 percent of members in the Teviot Valley identified as European and 21.5 percent identified as Māori or of Māori descent. (Stats NZ, 2018). This is vastly different to the rest of New Zealand where 70.2 percent identified as European, and 35 percent identified as Māori or being of Māori descent as there is significantly less Māori representation in the Teviot Valley. Therefore, the results of our research have no adequacy reflected a Māori worldview.

Again, this is important as Lie et al. (2013) explains that the cultural impacts of hydropower developments need to be emphasised, so they are not overlooked. The findings of this research shows that the community is not emphasising the cultural impacts, and the cultural impacts are not known. Therefore, it is likely that cultural impacts of the LOBP are being and will continue to be overlooked.

7.1.4 Economic Impacts

It was apparent from survey results and KI interviews, that there are contrasting perceptions amongst community members concerning potential economic impacts because of the LOBP. As discussed in Chapter Six, survey respondents were divided when they were asked if they believed that the LOBP would be great for New Zealand as a country. The results showed that people had different perceptions concerning the potential benefits or impacts of the LOBP. As discussed in

Chapter Two, it is common for there to be differing views regarding the potential economic impacts of large-scale infrastructure projects.

The results have revealed that KIs perceive one of the greatest economic impacts to be the potential for an increase in talent and skills in the Teviot Valley. This was perceived as a positive impact by KI 3 who stated that the LOBP could create an increase in training for skilled professions. An increase in skilled training could create economic opportunities within the Teviot Valley. Overseas, large overseas infrastructure projects have provided opportunities for increased skills training in project-affected areas, creating local opportunities for skilled and technical jobs (Chandy et al., 2012). From the results, some KIs felt positively towards the prospects of new skills and talent within the community.

Another positive economic impact that arose from the results was the potential for an increase in job opportunities and local spending. This is supported by a quote from an expert KI (KI 9) who stated that the LOBP would create local jobs that could increase local spending. Large infrastructure and developmental projects, like the LOBP, have the potential to create numerous jobs during the construction and operation of the PSH Project. As discussed in Chapter Two, rural development and revenue generation were the top-ranked socio-economic impacts of pumped hydro projects in a literature review of studies looking at pumped hydro energy (Ali et al., 2021). The creation of jobs, local spending, and economic growth go hand in hand. However, while this may be perceived as a positive impact by some it is important to note that there may be opposition toward job creation and local economic growth. This may be due to other social factors such as changes to community groups and change to the status quo as has been discussed in the previous section. Ali et al. (2012) state that is common for there to be opposition for social and political reasons in such large-scale infrastructure projects.

While positive economic impacts have been discussed, it is apparent from the results that KIs informants perceive there to be negative economic impacts from the LOBP too. A primary argument that arose from surveys and interviews was that the LOBP is costly, and there is concern that the great costs may outweigh the benefits. KIs and survey respondents stated that “there are better options out there”, “the cost to the country outweighs the benefits”, “Money can be better spent on other projects”, “very expensive energy”, “cost of investigation and construction far outweigh any benefits”. A common debate arises for such large infrastructure projects, and this is

whether the benefits of investment outweigh the costs involved (Ansar et al., 2014; Lehr et al., 2012). The Teviot Valley community is concerned that economic benefits will not be directly reflected or distributed within the community, or that financial benefits will be distributed throughout the community but will not benefit community. For example, financial benefits associated with this project may be absorbed by local communities but get put toward road repairs due to increased traffic, or to cover costs due to the loss of agricultural land and fishing resources (de Faria et al., 2017). The Teviot Valley community would like to see the LOBP become a sustainable asset for the community, where money can go towards growth in the community and their desired outcomes. De Faria et al. (2017), stated that for large infrastructure projects, more effective mechanisms are needed for ensuring long-term development and economic growth in impacted communities. Such mechanisms could include compensation to landowners and community members, policy programs to ensure sustainable future growth, and taxation measures for the dam owners (de Faria et al., 2017).

Another primary economic impact, perceived as a negative impact by KIs and survey respondents, is the potential for an increase in rental costs, house prices, and service costs within the Teviot Valley. For Teviot Valley community members these potential impacts are of great concern, especially for a community that values maintaining their current quality of life. There is some evidence that other renewable energy projects have caused an increase in rental and house prices in the short-term and long-term (Shoeib et al., 2021; Ennis et al., 2013). However, evidence of this comes from towns with populations between 5,000 and 15,000 which is significantly greater than the Teviot Valley so there is no certainty that an increase in rental prices would occur (Shoeib et al., 2021). As discussed earlier, several KIs have lived within the Teviot Valley for a great number of years and an increase in prices could cause great disruption to their way of life.

The potential for economic benefits of the LOBP to be distributed around New Zealand was perceived to be a negative economic impact and was a common theme during KI interviews. As stated by Allan et al. (2011), the economic benefit to the local community is a critical factor in determining public acceptance towards a large-scale infrastructure project like the LOBP. Providing an overview of the potential economic benefits of the LOBP to the community will be important in gaining community acceptance (Allan et al., 2011). Not only is it crucial to acknowledge potential economic benefits, but it is equally important to understand the

community's desired outcomes should the LOBP go ahead. A discussion of the desired outcomes sought by the Teviot Valley Community will be discussed later in this chapter. The analysis conducted by Allan et al. (2011), suggests that local revenue-sharing arrangements should be implemented for such large-scale infrastructure projects. Such arrangements could ensure that community members will benefit from larger portions of the economic benefits generated because of the LOBP, where local communities will be most burdened by the LOBP. KIs are concerned that the Teviot Valley community will experience the most significant impacts in terms of disruptions, loss of recreation amenities, and environmental degradation, while the rest of the country will benefit from the electricity and potential money flows from the Teviot Valley. Due to these concerns, Teviot Valley community members want to be assured that they will receive economic benefits in the long-term.

While the community has perceived some of the potential economic impacts of the LOBP to be negative, it is important to note that the community largely still acknowledges the potential for the LOBP to result in some positive economic impacts. Three of the community's primary concerns largely lie with the potential for economic growth to change their current quality of life, increase local house and service prices, or for the economic benefits to be distributed unfairly leaving them disadvantaged. The primary positive economic impacts as perceived by community members are the potential for an increase in community skills and talent, as well as an increase in job opportunities and local spending.

7.1.5 Environmental Impacts

The survey results and KI interviews provided valuable insights regarding the environmental impacts of the LOBP on the Teviot Valley community. The online survey revealed a range of views about the potential effects of the LOBP on the natural environment. The question asking respondents if they believed the LOBP would have positive benefits yielded a split response, with some respondents perceiving positive environmental impacts and others expressing concerns. However, when examining the short response questions in the survey, it becomes evident that most respondents are generally quite worried about the environmental impacts of the LOBP. This reflects the historic discourse of other large-scale projects in New Zealand, notably the case of the Manapouri hydropower station. The Manapouri power station faced extensive opposition due to

the environmental impacts which ended up sparking the environmental movement in New Zealand (Meridian Energy, n.d.). The results of the present research indicate that a similar level of opposition may occur. Furthermore, people are generally more knowledgeable about environmental impacts of large infrastructure projects than they were back when the Manapouri power station was being proposed. This means that with the LOBP being similar to the Manapouri Power Station in terms of scale, the environmental impacts and potential backlash will likely be of a similar scale, if not worse, given the increased levels of knowledge about such impacts. This is supported by the results gathered during this project.

One common concern raised by respondents was the significant impact on indigenous species, indicating a deep concern for the preservation of the local biodiversity. Other respondents shared their belief that the LOBP would lead to a loss of ecosystems, destruction of nature, and overall environmental degradation. These concerns reflect a strong desire to protect the natural environment and the wildlife that inhabit it. Furthermore, respondents emphasised their connection to Lake Onslow and the surrounding natural landscape. Connection to place has been explored earlier in this section. KIs expressed concerns that the LOBP would disrupt the current harmony and tranquillity of the area, affecting the community's overall wellbeing. The literature references the biophysical and environmental impacts of hydropower which includes fragmentation of river systems vegetation and land; soil health and wetland impacts; declining water quality; changes to geomorphology; and permanent ecosystem alterations (Liu et al., 2013). This sentiment directly relates to the potential impacts of the LOBP and highlights the importance of the natural environment to the local residents and their desire to maintain the existing natural landscape as a source of solace.

The KI interviews predominantly expressed negative sentiments towards the environmental impacts of the LOBP. While the survey showed a mixed response, the KIs consistently raised concerns about the LOBP's potential consequences for Lake Onslow and its surrounding areas. The KIs emphasised the irreversible nature of the LOBP due to its significant scale, heightening concerns about the long-term impact on the environment. Their concerns were not limited to the immediate effects of the LOBP but extended to the potential alteration of the ecosystem and loss of indigenous fish species. For instance, KI 8 shared their extensive knowledge of the ecosystem species within Lake Onslow, highlighting the current health of the ecosystem and the potential

disruption that would be caused by the LOBP. This concern resonated with other KIs who shared worries about the effects of fluctuating lake levels, including erosion, pollution, and the overall impact on the Teviot Valley ecosystem. KI 7 specifically mentioned the adverse consequences for trout habitat and angling activities, emphasising the potential destruction of trout habitat and spawning areas required to sustain the population.

The interviews illustrated a positive perception of hydropower and storage in a general sense. KIs recognised the importance of renewable energy and considered the LOBP as a feasible option due to its potential for storing energy. They highlighted the advantage of hydropower in providing firm capacity and the ability to sustain communities during times when other renewable sources are unavailable. For example, KI 9 continuously vouched for hydro storage as being a sustainable and long-term solution for New Zealand's dry year problem. In terms of overall sustainability and environmental preservation, it can be inferred that Lake Onslow could be a very positive step in New Zealand transitioning to renewable energy, supporting overall sustainability goals. This is supported by the literature review as Damle (2014) explained that over 75 percent of global greenhouse gas emissions are caused by fossil fuels (Damle, 2014). As a result, steps must be taken to lessen these emissions through the implementation of more sustainable types of energy generation. The Teviot Valley community generally recognises this fact but wants to ensure that nationwide environmental benefits don't come at the cost of the ecosystems and environment present at Lake Onslow.

The analysis of the survey and interview results reveals several key themes. Firstly, the larger number of negative environmental impacts compared to positive ones indicates a substantial level of concern among community members regarding the potential environmental consequences of the LOBP. While the survey responses showed some divergence, the KIs overwhelmingly voiced negative sentiments which shows that the community is very concerned about the environmental impacts, and the various unknowns surrounding what those impacts could be. The results also highlighted the community's recognition of the asymmetry between negative long-term environmental impacts and expected short-term benefits. Concerns were raised about irreversible alterations to the ecosystem, changes in fish spawning habitats, erosion, and other long-term issues. This suggests that the community wants to see the prioritisation of sustainable and long-term solutions over immediate gains. The survey and interviews also showcased the community's

apprehension about how the LOBP's environmental impacts may impact residents' quality of life. Worries such as health, accessibility, and job security were frequently mentioned, indicating a broader understanding among community members of the potential adverse effects on their wellbeing resulting from the environmental impacts.

7.1.6 Conclusion

This section demonstrates the various impacts that may occur as a result of the implementation of the LOBP and illustrates the Teviot Valley's perception of these impacts as well as their relative importance to the future of their community. The social and cultural impacts of the LOBP have a large crossover with connection to place, showing that the perhaps unintended and future consequences of the LOBP will alter the Teviot Valley community just as much as the more immediate impacts such as economic and environmental impacts. It was evident from the results that the LOBP will produce a range of both positive and negative impacts within the Teviot Valley. Whether impacts were perceived as positive or negative could be attributed to people's connection to place or how directly they were impacted by the various impacts of the LOBP itself. For instance, those whose land will be more directly impacted tended to be more negative about the LOBP when compared to people who wouldn't be as directly affected. There are concerns amongst the community about how the LOBP will put stress on existing infrastructure, therefore, has been perceived as a key impact of the LOBP. Other concerns in the community lay with the potential for national benefits to outweigh local benefits and increase local prices, although it was acknowledged that the LOBP could increase job opportunities and local spending. The community perceived the potential environmental impacts as almost entirely negative, due to the loss of important wetlands and erosion from raising the lake level. The wide extent of potential impacts addressed within this section highlights the magnitude of the proposed LOBP, and its effects on the environment and Teviot Valley community.

7.2 What are the opportunities and limitations of the required infrastructure associated with the Lake Onslow Battery Project in the short-term and long-term?

This section aims to explore the impacts as perceived by the Teviot Valley community relating to infrastructure required for the LOBP to go ahead. The findings reveal that the LOBP will have repercussions on the existing infrastructure of the Teviot Valley and will necessitate the implementation of additional infrastructure to adequately support such a large-scale project. Moreover, the results underscore concerns regarding feasibility and long-term suitability. Conversely, community members in the Teviot Valley view this as an opportunity for tourism, growth and to improve the current infrastructure.

This section is organised around the key concerns of the community members; the current state of infrastructure, the viability of additional infrastructure, long-term consequences on infrastructure, the preservation of small-town communities, housing and accommodation, and potential opportunities for new infrastructure.

7.2.1 Infrastructure

Based on the survey results and KI interviews, it became evident that community members held differing opinions regarding the infrastructure effects resulting from the LOBP. Chapter Six and Figure 23 provided an overview of this division among survey respondents when asked about their beliefs regarding the positive impacts of the LOBP on infrastructure. These findings illustrate the varying perceptions regarding the potential benefits and/or consequences of the LOBP, and the impacts on future infrastructure associated with LOBP in the Teviot Valley. These results carry significant importance, as they reaffirm the primary concerns and opportunities of the community regarding social, cultural, environmental, and economic aspects. Furthermore, they highlight the existence of contrasting viewpoints and perspectives concerning the overall LOBP.

The findings highlight that community members have expressed major concerns regarding the current state of infrastructure. KI 5 and KI 8 revealed significant apprehensions specifically related to the condition of the access road leading to Lake Onslow. Participants emphasized the necessity for widening and repairing the road to accommodate the transportation of heavy trucks and construction vehicles. This concern was shared by a diverse range of stakeholders, including

farmers, fishermen, holiday goers, and residents of the Teviot Valley. The recurring emphasis on the road's repair and improvement demonstrates the critical need to address the existing infrastructure limitations. Chapter 2 supports the idea that infrastructure conditions play a crucial role in shaping public perceptions and attitudes. Mell (2010) demonstrates that poor infrastructure can hinder economic development, accessibility, and social connectivity. Furthermore, Tilt et al. (2009) expresses that inadequate road conditions can lead to increased transportation costs and potential safety hazards. Addressing the concerns raised by KIs regarding the access road is crucial for ensuring the successful implementation of the LOBP. Failing to take appropriate measures could not only impede the progress of the LOBP but also have far-reaching consequences for the community as a whole.

Tellefsen et al. (2020), expressed how insufficient consideration of requirements during the construction of the Atdorf hydropower reservoir led to delays in excavating and depositing rock masses. Therefore, taking proactive steps to improve the road's condition will contribute to enhancing economic opportunities, facilitating transportation efficiency, and ensuring the safety of individuals and goods. Therefore, a comprehensive plan that includes widening and repairing the access road should be devised and implemented. This plan should consider the perspectives of various stakeholders and ensure that their concerns are adequately addressed. By doing so, the community can pave the way for the successful realisation of the LOBP while also addressing broader infrastructure needs and promoting sustainable development.

Additionally, feasibility of extensive infrastructure in relation to the LOBP was addressed. KI interviews highlighted the remote and isolated nature of Lake Onslow, emphasising the limited existing infrastructure. This remoteness contributes to the lake's serene and tranquil reputation, and there are concerns that extensive infrastructure development associated with the LOBP could alter the character and isolation of its location. The impacts of increasing infrastructure in terms of its impact on the sense of connection to the place were raised. Huang et al. (2017), argue that infrastructure development can have significant environmental and social impacts, leading to changes in the perception and identity of a place. The transformation of remote areas through infrastructure projects may result in a loss of their unique qualities and alter the relationship between communities and their surroundings (Huang et al., 2017). The concerns expressed by KIs about the potential changes to the isolated nature of Lake Onslow reflect a desire to maintain the

character and authenticity of the place. This raises an important point for critical consideration. While addressing infrastructure limitations is necessary for the successful implementation of the LOBP, it is crucial to balance this with preserving the unique qualities and sense of place that Lake Onslow offers. As explained in Section 6.2, many residents of the Teviot Valley have a strong connection to Lake Onslow for various reasons. This means that it is imperative to approach infrastructure development in a manner that minimises negative impacts and safeguards the intrinsic values associated with the area. A comprehensive and thoughtful approach is required, taking into account the concerns expressed by stakeholders regarding the potential alteration of the location's character. This includes conducting environmental impact assessments, engaging with local communities, and implementing measures to mitigate any adverse effects on the landscape, biodiversity, and cultural heritage. By incorporating these considerations into the planning processes, it is possible to strike a balance between infrastructure development and the preservation of Lake Onslow's distinct qualities which, as previously explained, are so important to members of the Teviot Valley.

Interviews also revealed concerns about the potential long-term consequences of significant alterations to the existing infrastructure in the Teviot Valley. Participants referred to the "boom and bust" scenario experienced by other towns and regions that have undergone similar large-scale projects, as can be observed in Chapter Six from KI 1 and 8. The apprehension about abandoned infrastructure and the need to draw lessons from past experiences were highlighted. The concept of "boom and bust" in relation to infrastructure development refers to the initial economic growth followed by a subsequent decline or stagnation once the LOBP is complete (Assche et al., 2016). Furthermore, Assche et al. (2016) highlight lessons from previous cases that emphasise the importance of considering long-term planning, diversification of the local economy, and sustainable development strategies to mitigate the negative impacts associated with such cycles. This indicates a thoughtful consideration of the potential risks and challenges that could arise from significant alterations to the infrastructure. The apprehension of abandoned infrastructure also sheds light on the importance of sustainable development and long-term planning. Therefore, it is crucial for stakeholders involved in infrastructure development to prioritise long-term planning, diversification of the local economy, and sustainable development strategies. By doing so, they can effectively mitigate the negative impacts associated with the recurrent nature of large-scale projects. It is worth exploring how the Teviot Valley can develop a comprehensive plan that not

only focuses on immediate economic growth but also considers the long-term impacts and potential risks associated with altering infrastructure. By integrating sustainable practices and diversifying the local economy, the region can potentially minimise the likelihood of experiencing a "boom and bust" scenario.

Another concern that arose from the results was the preservation of small-town communities. Interviews revealed a strong desire among community members and leaders to preserve the close-knit, unhurried lifestyle and the sense of safety in the Teviot Valley. Concerns were expressed by KI 1, who stated that there would be a potential transformation of the community due to an influx of people and a growing population. Additionally, this would have an impact on peace, tranquillity, and the cherished small-town community. Mouratidis (2021), indicates that infrastructure development can have profound effects on local communities and their social fabric. Additionally, the introduction of new infrastructure can disrupt established social networks, alter community dynamics, and lead to changes in the perceived quality of life (Mouratidis, 2021). Preserving the existing community values and the desired small-town atmosphere should be taken into consideration when planning and implementing infrastructure projects, such as the LOBP. To strike a balance between development and preservation, community engagement and participation should play a central role. Involving community members and leaders in the decision-making process can help ensure that their voices are heard, and their concerns are taken into consideration (Supriyasilp et al., 2009). This collaborative approach can lead to the development of infrastructure projects that align with the values and aspirations of the community, while also fostering a sense of ownership and pride. Furthermore, it is crucial to explore strategies that can mitigate the potential negative impacts on small-town communities. This could involve implementing measures to manage population growth, such as appropriate zoning regulations and controlled development. It may also require the provision of resources and support for community initiatives that promote social cohesion and preserve the unique character of the Teviot Valley.

KIs highlighted concerns relating to housing and accommodation infrastructure. There were worries about rising housing and rental prices, potential unavailability of affordable housing for workers, and the impact on farming businesses that rely on affordable worker accommodation. KI 9 suggested solutions to these potential issues including providing appropriate accommodation at an affordable level was seen as crucial for integrating workers into the community and alleviating

concerns. Ennis et al. (2013) expressed that infrastructure and housing indicates that large-scale projects can create challenges in terms of affordability and availability of housing. If not properly managed, infrastructure development can exacerbate housing shortages, increase prices, and negatively impact the local workforce (Ennis et al., 2013). Balancing the accommodation needs of the LOBP and the local community while considering long-term affordability is essential for fostering social sustainability. Moreover, the consequences of modifying infrastructure extended beyond housing and accommodation, as the interviews also raised concerns about healthcare and medical facilities. KI 6 expressed concerns regarding the broader impact of the LOBP on the Teviot Valley. KI 6 specifically highlighted the potential strain on Dunedin hospital and emphasised how this would contribute to increased pressure on its resources. This offers us a more comprehensive understanding of the extensive influence LOBP will have on infrastructure, extending beyond its immediate location, and the potential effects it may have if not comprehensively addressed. The impact of infrastructure development on healthcare services is a relevant concern that has been studied in various contexts. Large-scale projects can lead to increased demands on healthcare facilities and services, requiring additional resources and planning to meet the needs of the growing population (Calderon & Servén, 2004). Anticipating and adequately addressing healthcare infrastructure requirements is crucial for ensuring the wellbeing of the community during and after project implementation. It is important to recognise that the impact of infrastructure development on healthcare extends beyond physical facilities alone. Adequate staffing specialised medical services, and access to healthcare professionals are all factors that need to be considered to maintain the quality and accessibility of healthcare services. Furthermore, collaboration and communication between infrastructure planners and healthcare stakeholders are essential to address these concerns effectively. Engaging healthcare professionals, hospitals, and local health authorities in the decision-making process can help identify potential challenges and develop strategies to meet the evolving healthcare needs of the community.

In addition to the raised concerns, the interviews also unveiled an optimistic perspective shared by numerous community members regarding the prospective infrastructure opportunities that could arise from the LOBP. The revitalisation of unused buildings, creation of shared community spaces, and the economic and social benefits were seen as potential positive outcomes. Moreover, the idea of providing compensation to affected individuals and communities was viewed as a chance to improve infrastructure and boost tourism potential in the Teviot Valley. KI 4 emphasised the

significance of compensating for the incurred losses, but also recognised this as an opportunity to develop new areas and enhance the overall quality of the townships. The aim was to create an appealing environment that would serve as an encouragement for future endeavours. Wang (2012) suggests that infrastructure development can provide opportunities for community enhancement and revitalisation. It can contribute to economic growth, job creation, and community wellbeing if the benefits are effectively harnessed (Wang, 2012). Ensuring that compensation leads to tangible and valuable infrastructure improvements aligns with the principle of equitable and sustainable development. The optimistic perspective shared by community members regarding the potential infrastructure opportunities stemming from the LOBP project presents a contrasting viewpoint to the raised concerns. It is important to ensure that compensation leads to valuable infrastructure improvements aligns with the principles of equitable and sustainable development. However, it is essential to carefully consider the potential trade-offs and unintended consequences of such development to ensure long-term benefits for the community as a whole.

7.2.2 Conclusion

In conclusion, results of this research highlighted several common themes and concerns regarding the existing infrastructure and the potential opportunities and limitations of said infrastructure. Overall, this section discusses; the need to address infrastructure needs and limitations in relation to LOBP, the need to carefully consider the impacts of infrastructure required for the LOBP while maintaining the intrinsic values, and the need to ensure the unique characteristics of the community are preserved when creating new infrastructure.

This section has explained also explained the opportunities of the required infrastructure, which included both long- and short-term economic gains, an increase in the quality of townships within the Teviot valley, enhancement of transport efficiency, and enhancement of communities in the Teviot Valley. These points align with existing literature on infrastructure development, emphasising the importance of sustainability, community involvement, and long-term planning. Understanding these perspectives is crucial for effectively managing the infrastructure requirements of the LOBP while considering the social, economic, and environmental impacts for the Teviot Valley and its residents.

7.3 What is the community's perception of the Lake Onslow Battery Project in terms of consultation adequacy and desired outcomes for the future?

This section of the chapter aims to understand the community's current understanding of the LOBP and what consultation has occurred thus far. As well as this, it will discuss the desired outcomes of the Teviot Valley community.

7.3.1 Current Understanding and Consultation

Results from the survey and KI interviews show that the majority of community members held some understanding of the LOBP, what phase the LOBP was in, and what work had already been undertaken by MBIE. Results from interviews found that many community members held the understanding that stage 2 of the LOBP was underway. Interviews also found that many community members had attended meetings held in the Teviot Valley by MBIE. This further contributes to the current understanding held by community members. Mayeda (2020) emphasises the significance of offering meaningful opportunities for public participation and feedback during the decision-making process to help mitigate adverse impacts as well as enhance social acceptance of hydropower initiatives.

Some KIs discussed their current understanding of the possible outcomes of the LOBP. KI 4 felt that the LOBP would bring tourism and job opportunities to the community, while other KIs felt that the LOBP wouldn't go ahead. The results also showed that there is a common theme of uncertainty amongst community members in the Teviot Valley. Many community members felt that due to lack of information from MBIE and other parties, they were uncertain about what the LOBP would mean for their community presently and for future generations. This feeling of uncertainty has also stemmed from community members feeling like MBIE limited what they can share with the community. Survey results also showed that the majority of participants did not feel satisfied with the information that they had been provided with about the LOBP. To address local populations' concerns about a lack of awareness about hydropower, free access to information, communication, and education regarding large-scale development projects is required. Many studies conclude that project communication should be enhanced to promote greater public comprehension of the technology since a lack of openness by decision-makers has led to community rejection (Mayeda et al., 2020). As well as this, the results showed that some

community members felt they couldn't trust the information given to them due to supposedly incorrect information relayed to the community when the LOBP was in the first stages of development. KI 8 stated that there was 'absolute distrust' due to this.

The survey results showed that of the 21 participants, 13 first heard about the LOBP through news and media or social media. The interviews also found that most community members and leaders heard about the LOBP through news media or social media. This could have contributed to the lack of understanding and possible misinformation in the beginning stages of the LOBP. The results from the survey also showed that most of the survey respondents were 'aware' of the LOBP, with only four participants stating they were 'somewhat aware.' This reaffirms that the community are aware of the LOBP and therefore, have been consulted by either news or media, MBIE, or the CODC. Results from the survey also show that the majority of survey respondents felt like they had not been adequately consulted or had their opinions listened to. This could further the need for more MBIE meetings in the Teviot Valley but also in the wider community to address uncertainty and provide an opportunity for community members to express their thoughts or concerns.

7.3.2 Community Desired Outcomes

Results from the KI interviews showed social, environmental, and infrastructure outcomes sought by the Teviot Valley community. A key theme in the interviews was the desire for more information. Some community members felt that they were unable to make decisions about desired outcomes for the community without further information about the LOBP. Community members felt that more information was key to being able to understand how the LOBP might impact the community. Some community members also acknowledged that the LOBP could take years to complete, by which time the community may have different needs. KI 11 and other community members want to have a potential for future community members to make that decision.

A key theme amongst KI interviews was the desire for a younger demographic in the area. Overall, community members wanted to see growth in the Teviot Valley community. OECD (2012) explains that renewable energy projects can have a positive impact on the demographics of rural areas. KI interviews uncovered some desired environmental outcomes by the community. Many community members wanted to safeguard the ecosystems and environment of Lake Onslow, making sure that nationwide environmental advantages are not achieved at its expense.

Another key theme that arose from interviews was that the community wanted to feel as though they are appreciated for having to put up with potential disruptions. The community has some desires, small initiatives, and projects that they would like to receive from MBIE, local council, and the rest of New Zealand for having to endure potential disruptions. As discussed within Chapter Six some of the key desires raised by the Teviot Valley communities were the establishment of a local community body, ensuring the LOBP is a long-term asset for the community, upgrades in existing local infrastructure, and investments towards community initiatives. As previously discussed, the community would like to preserve their current way of life and have any adverse effects avoided or mitigated, fulfilling some of the communities' key desires would help them to think more positively toward the LOBP.

7.3.3 Conclusion

The results from the survey and key informant (KI) interviews indicate that the majority of community members in the Teviot Valley have some understanding of the Lake Onslow Battery Project (LOBP), its current phase, and the work undertaken by the MBIE. The survey results also revealed that participants were not satisfied with the information they had been given about the LOBP, leading to feelings of mistrust. The survey and KI interviews highlighted that news and media, including social media, played a significant role in community members' awareness of the LOBP. However, this source of information may have contributed to initial misunderstandings and misinformation. Additionally, the majority of respondents felt that they had not been adequately consulted or had their opinions heard, emphasising the need for more meetings and opportunities for community members to express their thoughts and concerns.

Regarding community desired outcomes, the interviews showed that community members sought more information to make informed decisions about the project's impact. They also expressed a desire for the LOBP to benefit the younger demographic and contribute to the growth of the Teviot Valley community. Environmental considerations were important to community members, particularly in safeguarding the ecosystems and environment of Lake Onslow. Furthermore, the community wanted to feel appreciated for enduring potential disruptions caused by the LOBP and expressed specific desires such as the establishment of a local community body, ensuring the project's long-term benefits, upgrading local infrastructure, and receiving investments for

community initiatives. Overall, the findings suggest a need for improved communication, transparency, and public participation in the LOBP decision-making process to address community members' concerns, enhance understanding, and promote social acceptance of the project.

8 Recommendations

The following section states the recommendations developed based on the results and discussions in this report.

8.1 Recommendation One: Direct communication and consultation with the community (i.e., early information system, greater meeting accessibility)

One reoccurring theme throughout KI interviews and the online survey was that respondents desired more direct and clearer communication regarding the progress of LOBP. As discussed in Section 7.3.1, many community members expressed that due to the lack of information from MBIE and other parties, they were apprehensive and uncertain about what the LOBP would mean for them personally as well as the wider community. The results and discussion section identified that some landowners were not consulted about the LOBP prior to media coverage. In order to move forward, a new and innovative way to consult affected parties will be of the utmost importance.

To address this lack of communication between decision makers and community members, it is recommended that the CODC needs to establish an all-access platform or stream of information that provides Teviot Valley community members with early access to information. This would give community members the most up to date information regarding the LOBP and how the proposed steps will affect them personally. This information system could be a regular email that alerts all community members of what is currently happening with the LOBP, or website run by the CODC which updates community members about how the LOBP is progressing and how that in turn will affect them and their land, for example.

While there is a page on the MBIE website which details information about Lake Onslow and a brief background of the proposal, community members in the Teviot Valley should have a direct source of information from MBIE and the CODC. This would ensure that the Teviot Valley Community would be the first to be informed about progress which may affect them. This would give the community the opportunity to raise questions or concerns about particular proposals from MBIE and make them feel as if they have a voice in how this project will affect their community.

8.2 Recommendation Two: More localised research

Another issue that was prevalent throughout the results and discussion was that most of the research surrounding the LOBP was high level which gave a very general overview of the LOBP and how it would affect the surrounding environment and communities. Most information was very vague, therefore, the community expressed persistent uncertainties as to how their community as they know it will change if the LOBP is to go ahead.

More focussed, localised research would be of greater benefit to both the Teviot Valley and MBIE. In turn, MBIE would have a greater understanding of how the Teviot Valley would be impacted by the LOBP, and the support they would need for the LOBP to be successful as well as supported by local communities. This relationship is reciprocal, as the local communities will also benefit because of the more localised research. This research could aid in decreasing uncertainties amongst the community regarding potential impacts.

Overall, it is recommended that more localised research will be of great benefit to the Teviot Valley community as their desires and needs will be better understood by both MBIE and the CODC.

8.3 Recommendation Three: Support a new community-led body

As discussed in this research, the establishment of a community-led body to facilitate the ongoing consultation between the local community, MBIE, and the CODC could be of great benefit. This community-led body would ideally receive funding from MBIE to employ one or several full-time professional staff from the community to provide legal, planning, and economic advice. This person/s should be independent of both MBIE and CODC, and work for the betterment of communities in the Teviot Valley. The primary purpose of this community body would be to bridge the disconnect and lack of knowledge between local communities of the Teviot Valley, decision makers, and MBIE. This community-led body would be ongoing, functioning long after the completion of LOBP, with regular meetings, formal powers, and a focus on positive, long-term community outcomes. For this local community body to carry out its intended duties, funding will initially be required from MBIE with support from local council. Therefore, it is recommended that CODC work with the local community to establish a community-led body and a funding stream to support said body.

8.4 Recommendation Four: Ensure the Lake Onslow Battery Project will be a long-term, sustainable asset with balanced national and community benefits

It is evident from the results that the community would look more positively toward the LOBP if it were to become an ongoing, sustainable asset for the community. Among KIs, there was key concern that the LOBP could lead to a “boom and bust” scenario without forward planning. Through the establishment of a local community body and an ongoing revenue stream, as previously discussed in Recommendation Three, money could go toward the wants and needs of the local communities in the future. Such ideas which arose from the results were a community gymnasium, mini golf, or investing in accommodation blocks. Therefore, it is recommended that ensuring positive and long-term benefits in the Teviot Valley communities are a priority in the project planning.

One concern that community members consistently expressed related to the disproportionate negative effects of LOBP in comparison to the national benefits. When looking at the LOBP from a national perspective, it seems that environmentally and economically it could be a great success as it enables New Zealand to transition towards a more sustainable era of energy generation and storage. However, residents in the Teviot Valley were concerned that negative effects of the LOBP were isolated to local communities and the positive benefits will only be felt on a national scale. To ensure positive impacts of the LOBP are felt on a local scale as well as a national scale, residents and/or community groups in the Teviot Valley should receive generous benefits from the LOBP. This could be monetary compensation, new or upgraded community facilities, or other long-term positive environmental, social, economic, and cultural benefits. If residents can be assured that they are not being overlooked and their voices and lives matter and are being heard, it is likely that their support of the LOBP as well as MBIE will improve.

8.5 Recommendation Five: Invest and plan for upgrades to local infrastructure and community initiatives

From this research, it is evident that the population of the Teviot Valley will increase as a result of the LOBP. Therefore, creating pressure on existing infrastructure and services, which is a concern to Teviot Valley community members. Therefore, the community would like to see an investment

in local infrastructure such as roading, sewerage, housing of various qualities and size, health services, footpaths, emergency services, and security. These could all be facilitated by a prompt and understanding approach to resource consent processing by the CODC. This would make it easier to achieve such projects. Whilst making necessary investments and improvements in infrastructure, it is important to the community that their way of life is preserved. Therefore, it is recommended that the CODC look toward upgrading existing infrastructure and services within the Teviot Valley and engaging the community throughout the entire process.

It is inevitable that communities within the Teviot Valley will experience some disruptions as a result of the LOBP. From the results, it is clear the community wants to feel supported and appreciated throughout the constructing and operation phases of the LOBP. During interviews, KIs raised several small initiatives and projects that could be funded and implemented by MBIE as a way of saying ‘thank you’ to the local communities. Such ideas that were raised included playgrounds, mini golf course, school upgrades, and rabbit fencing.

The research demonstrates the importance to understand community values to determine what impacts of the LOBP the community will perceive to be the most significant. For example, there could be investment in recreation opportunities such as walking and biking trails, as the recreation value of the valley was made apparent in this research. Therefore, it is recommended that both the CODC and MBIE work in collaboration with the communities of the Teviot Valley to fund and implement small initiatives and projects as directed by the desires of the community.

9 Conclusion

The LOBP will have wide impacts for the Teviot Valley community. With various case studies both nationally and internationally showcasing the benefits of hydropower, it is clear why a similar project has been proposed at Lake Onslow to contribute to New Zealand's move towards a more sustainable future. However, the social, cultural, economic, and environmental impacts that the LOBP would have on the Teviot Valley cannot be ignored, and the community's perceptions are vital to the success of such a large project. This research aimed to identify these various impacts, as well as understand the short-term and long-term opportunities and limitations while taking the community's expectations of the project into consideration.

Through a mixed methods approach, this research demonstrated that positive and negative perceptions of the LOBP were largely dependent on people's connection to the Teviot Valley and how they would directly be affected by the project. However, the lack of consultation provided by MBIE to the community creates uncertainty as to the magnitude of these impacts and how exactly the Teviot Valley would change with the go ahead of the LOBP. While some community members were very positive about the potential social and economic impacts of the project, the environmental and cultural impacts tended to be negative. This is a result of the loss of land and ecosystems that would occur from the rising lake levels and apparent favouring of national benefits over community benefits. The Teviot Valley community consistently expressed their desire for long-term benefits and improved consultation regarding the LOBP moving forward, and security knowing that their quality of life would be maintained with its implementation.

After analysing the results from this study, five key recommendations were created. To summarise, these recommendations suggest;

1. More direct communication and consultation with the community.
2. More localised research based on the impacts of the LOBP specific to the Teviot Valley.
3. A community-led body should be created in the Teviot Valley to ensure the values and aspirations of the communities are communicated and recognised.
4. Ensure that the LOBP will have long-term positive impacts on communities in the Teviot Valley.

5. Invest in infrastructure and initiatives which benefit the Teviot Valley community.

This research has highlighted the importance of direct community consultation as local knowledge and perceptions will be crucial to the LOBP moving forward. While different individuals understandably have differing opinions on the social, cultural, economic, and environmental impacts of the LOBP, giving the Teviot Valley community a more elevated voice in decisions in the future will help to ensure a successful progression of the project. By investigating the above recommendations to better understand and address the impacts of the LOBP, the CODC can create a more cohesive community that supports long-term sustainability locally and nationally.

10 References

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11 Appendices

11.1 Appendix A- Questions used for KI Interviews

The following questions are for all interviews:

General:

1. Are you happy to be recorded for transcribing purposes?
2. What area do you live in?
 - a. How long have you lived there?
 - b. What is your occupation?
 - c. What is the thing you like best about the area that you live?
3. What is your connection to Lake Onslow/the proposed Lake Onslow Battery Project?
4. What is your current understanding of the Lake Onslow Battery Project?

Awareness:

5. Have you heard about the Lake Onslow Battery Project?
 - a. If yes, what have you heard?
 - b. What is your current understanding of the project?

Environmental Implications:

6. Can you think of any potential implications (positive or negative) that the project might have on the environment? What might these be?
 - a. If no, prompt with key words such as rivers, fishing, wetlands?

Social/Economic/Cultural Implications:

7. Can you think of any potential implications (positive or negative) that the project might have on the community? What might these be?
 - i. Do you think it will have positive or negative implications on the immediate community (place where KI from)? Why?
 - ii. Do you think it will have positive or negative implications on the wider community (wider area where KI from)? Why?
8. Do you feel that the community needs time to prepare to accommodate for the LOBP?

Infrastructure

9. Can you think of any implications (both positive and negative) of the project itself?
10. Can you think of any implications (both positive and negative) of constructing surrounding infrastructure associated with the project (workers' accommodation, roading, healthcare, schools etc.).
11. Based off the implications you have just mentioned, do you think that this project will be feasible in the long-term?

The following questions will be asked for these specific Key Informants:

Community members:

- What are your personal views on the Lake Onslow Battery Project?
- Do you believe this project will benefit the Teviot Valley community?

- Have you been consulted by the MBIE regarding the project?
- To what extent do you believe you personally will be impacted by the Lake Onslow Battery Project?
- What support (if any) would you like to see from the council in relation to the impacts of the Lake Onslow Battery project?

Community groups:

- What are your groups views on the project?
- What support (if any) would you like to see from the council in relation to the impacts (if any) of the Lake Onslow Battery project?
- How will the Lake Onslow Battery Project impact your group, and your group's affiliation with Lake Onslow and the surrounding?
- Have you been consulted by the MBIE regarding the project?

For planners/council:

- To what extent has the council been consulted or involved in the Lake Onslow Battery Project feasibility study?
- Has the council conducted any feasibility or impact assessment of their own in regard to the Lake Onslow Battery Project?
- To what extent has growth occurred in the Teviot Valley in the past and to what extent do you think further growth will occur in this area as a result of the project?
- If the Lake Onslow Battery Project were to go ahead, how might the council plan for the required infrastructure e.g., workers' accommodation, schools, healthcare?
- How will the project shape growth plans and strategies in the district?

MBIE: (hard to write questions as they will be subject to the information in the feasibility study reports)

- What infrastructure will be required for the construction of the project?
- How has the Teviot Valley community been consulted and engaged within the feasibility study?
- What do you think is the general community response in regard to the project?

Experts:

- How do you believe the project will impact the wetlands and the surrounding environment present at Lake Onslow? (Water quality, downstream, in-stream life, other wildlife?)
- In your opinion, how could the MBIE or local council mitigate (name some effects) the potential adverse effects of the project on___?

11.2 Appendix B- Online Survey

1. Do you consent to participating in this survey and for use of your answers in our research?

- Yes
- No

2. What community do you live in?

- Ettrick
- Roxburgh
- Miller's Flat
- Other (please specify)

3. What is your age?

- 18 – 25
- 26 – 35
- 36 – 46
- 47 – 55
- 56 – 65
- 66+

4. What group do you identify with?

- Community member
- Planner/council member
- Ministry of Business, Employment and Innovation
- Community group
- Experts e.g., ecologists etc.
- Catchment Group

5. What is your occupation?

- (Short response)

6. How aware are you of the Lake Onslow Battery Project?

- Not aware at all
- Somewhat aware
- Very aware

7. How do you feel about the following statements?

a) I support the Lake Onslow Project

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

b) With the existing infrastructure in place, do you believe the Teviot Valley community could support the project?

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

8. How did you hear about the Lake Onslow project?

- MBIE
- Central Otago District Council
- News or media/social media
- Friends/family

9. Do you feel satisfied with the information that you've been provided with about the project?

- Yes
- Somewhat
- No

10. How do you feel this project will benefit or detriment the Teviot Valley Community?

- Strongly beneficial
- Beneficial
- No change
- Detrimental
- Strongly detrimental

11. What do you deem to be some of the potential impacts arising from the project? (economic, social, environmental, cultural). Choose all options that apply.

- Economic impacts
- Social impacts
- Environmental Impacts
- Cultural Impacts
- I don't know
- I haven't thought about it
- Other

12. Please provide any comments on the above answer (only if economic, social, environmental, or cultural impact option chosen).

- (Short response)

How would you rate your understanding of the infrastructure requirements regarding the project? (1-5 Likert, strong understanding, poor understanding). Anything higher than 2 gets a following "explain your understanding".

- (Short response)

What is your affiliation to Lake Onslow and are there any particular values that you associate with Lake Onslow?

- (Short response)

11.3 Appendix C- Ethics Form

Reporting Sheet for use ONLY for proposals considered at departmental level



Form Updated: November 2021

UNIVERSITY OF OTAGO HUMAN ETHICS COMMITTEE APPLICATION FORM: CATEGORY B

(Departmental Approval)

Please ensure you are using the latest application form available from:
<http://www.otago.ac.nz/council/committees/committees/HumanEthicsCommittees.html>

- University of Otago staff member responsible for project:**
Thompson-Fawcett, Michelle, Professor
- Department/School:**
School of Geography - Master of Planning
- Contact details of staff member responsible (always include your email address):**
michelle.thompson-fawcett@otago.ac.nz
- Title of project:**
Lake Onslow Hydro Project- Community and Infrastructure Impacts
- Indicate type of project and names of other investigators and students:**

Staff Research Names

Student Research Names

Level of Study (e.g. PhD, Masters, Hons)

Reporting Sheet for use ONLY for proposals considered at departmental level

External Research/ Names

Collaboration

Institute/Company

6. When will recruitment and data collection commence?

1/05/2023

When will data collection be completed?

31/05/2023

7. Brief description in lay terms of the aim of the project, and outline of the research questions that will be answered (approx. 200 words):

New Zealand has a long-term goal of 100% renewable electricity generation by 2030. The Ministry of Business, Employment and Innovation has proposed a pumped hydro scheme for the generation of hydropower. Water will be transported and stored in an upper reservoir (Lake Onslow) when there is a surplus of renewable energy generation and electricity demand is low.

The aim of this project is to consider the potential impacts of large scale pumped hydro scheme on the communities in the Teviot Valley, including infrastructure needed to support the project.

The overarching research questions are as follows:

Research Question 1: What are the opportunities and limitations of the required infrastructure in the short-term and long-term?

Research Question 2: What are the key social, cultural, economic, and environmental impacts of the Lake Onslow Battery Project?

Research Question 3: What is the current community understanding of the previously identified key social, cultural, economic, and environmental impacts of the project?

Research Question 4: How might other large infrastructure projects inform the mitigation of potentially adverse effects arising from the Lake Onslow Battery Project?

8. Brief description of the method

This research will deploy both quantitative and qualitative methods via a mixed-methods approach. The methods we require ethical approval for are the questionnaire survey and the semi-structured interviews. The focus and scope of our research will draw on the Teviot Valley community, specifically the impacts of the Lake Onslow Battery Project.

Survey Questionnaire with the local community

A questionnaire survey has been created to target our specific demographic of interest – the Teviot Valley community, key stakeholders, local actors, landowners, district planners, experts, and anyone who deems themselves relevant to the Lake Onslow Battery Project. Due to the current circumstance of COVID 19 in New Zealand, all participant recruiting, and data gathering will have an option to be taken place online. Recruitment will take place via email, through online Facebook pages and groups, or in person. When considering our target population, we will only recruit people of the age of 18 or above. Therefore, no data will be collected from anyone outside this age bracket. No personally identifying information will be requested.

The questions will consist of multi-choice and open-ended short answer questions. A copy of the survey is attached as *Appendix A*. Before a participant is surveyed, they will be given an information sheet about the research which includes the disclosure that only those 18 years of age and above are permitted to participate.

Data from the survey will be stored on personal, password-protected laptops, including online platforms such as Google shared drives, Dropbox, and SharePoint that only have access to the researchers named in this application.

Semi-structured Interviews with key stakeholders

Semi-structured interviews will occur with critical stakeholders such as local actors, district planners, landowners, and local government bodies relevant to the Lake Onslow Battery Project. Broad categories of questions and prompts can be seen in *Appendix B*.

Before an interview commences, researchers will ensure that participants accept and feel comfortable sharing their ideas with the interviewer. Informed consent will be gained before an interview commences. Obtaining informed consent will involve presenting the participant with an information sheet, allowing them time to read it and discuss key points with the researcher and then ensuring they sign a consent form. The Information Sheet will include:

- Details about the project.
- The reason for the interview.
- Participation criteria.
- Expectations within the interview.
- The level of participation required.
- Data use.

Participants will be informed that their information may be used in the students' reports and presentations. Having read and understood the information sheet, participants will be asked to sign the consent form. They will be instructed that they are not obligated to answer any questions or lines of questions that make them uncomfortable. It will be made clear to participants that if they feel uncomfortable with participating, they can discontinue at any point in time. They will be reassured that there will be no disadvantage to themselves if they choose to do so.

9. Disclose and discuss any potential problems and how they will be managed:

While this is a low-risk research project in terms of personal and physical safety, measures will be put in place to ensure the anonymity (unless they prefer otherwise) and protection of any involved participants. Extra care will be taken when addressing sensitive topics, and participants will be given the option to refuse to answer any questions in both the survey and interviews with no disadvantage to themselves.

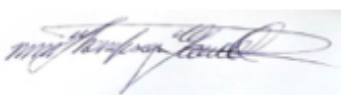
Key informant interviews and focus groups will be scheduled in advance. Due to the nature of the research, it is unlikely that interviewees will be exposed to any harm or discomfort. No research is being taken undertaken involving vulnerable participants. However, steps to ensure that any risk of discomfort will be minimised. This includes establishing informed and uncoerced consent prior to the interview through the presentation of a detailed information sheet and consent form. Participants will also be informed prior to the interview beginning – both through the consent form and verbally – that if at any point they become uncomfortable, they may refuse to answer a question or terminate the interview.

Questions in the interview will also be open-ended, so informants can easily avoid uncomfortable subjects. This method of research allows participants to end the process at any time.

The online questionnaire survey will take approximately 10-15 minutes to complete. Should participants agree, they will have to read an information page at the beginning of the questionnaire, and completion of the survey will be taken as consent. No personally identifying information will be requested in this research. If any participants include any personally identifying information by mistake, the researchers will remove it.

Data from the survey and interviews will be stored on personal, password-protected laptops, including online platforms such as Google shared drives, Dropbox, and SharePoint that only have access to the researchers named in this application. The findings from the research will be presented in the report, and presentation requirements for PLAN435/535, and results will be shared with relevant stakeholders at the Central Otago District Council. However, care will be taken so that participant anonymity is maintained if so desired and there is no negative impact on participants of this research.

Reporting Sheet for use ONLY for proposals considered at departmental level



***Applicant's Signature:**

Name (please print): Michelle Thompson-Fawcett

Date: 18 April 2023

ACTION TAKEN

- Approved by HOD Approved by Departmental Ethics Committee
 Referred to UO Human Ethics Committee

Signature of **Head of Department: *Douglas Hill*

Name of HOD (please print): Assoc. Prof. Douglas Hill (on deputation) ..

Date: 30/04/2023

****Where the Head of Department is also the Applicant, then an appropriate senior staff member must sign on behalf of the Department or School.**

Departmental approval: *I have read this application and believe it to be valid research and ethically sound. I approve the research design. The research proposed in this application is compatible with the University of Otago policies and I give my approval and consent for the application to be forwarded to the University of Otago Human Ethics Committee (to be reported to the next meeting).*

IMPORTANT NOTE: As soon as this proposal has been considered and approved at departmental level, the completed form, together with copies of any Information Sheet, Consent Form, recruitment advertisement for participants, and survey or questionnaires should be **emailed as one complete fully-signed PDF to HECapplications@otago.ac.nz**

11.4 Appendix D- Information Sheet for Interview Participants



Lake Onslow Hydro Project- Community and Infrastructure Impacts

INFORMATION SHEET FOR INTERVIEW PARTICIPANTS

Thank you for showing an interest in this project. Please read this information sheet carefully before deciding whether or not to participate. If you decide to participate, we thank you. If you decide not to take part, there will be no disadvantage to you, and we thank you for considering our request.

What is the Aim of the Project?

This project aims to identify the social, cultural, economic, environmental, and infrastructural impacts of the Lake Onslow Battery Project. This project also aims to learn of the community's current understanding of these potential impacts. This project is being undertaken as part of the requirements for the Master of Planning programme at the University of Otago.

What Types of Participants are being sought?

The researchers would like to speak to community members within the Teviot Valley, planners/councillors, relevant stakeholders (MBIE representatives), community groups, and experts. The researchers will recruit participants via email, websites and Facebook. We are aiming to interview 10 community members; however, this number might be reduced due to time constraints and feasibility.

What will Participants be asked to do?

Should you agree to take part in this project, you will be asked to answer a series of open-ended questions relating to your experience, opinions and perceptions of the Lake Onslow Battery Project. Interviews will take no longer than 1.5 hours with the ability to conclude whenever the participant wishes to do so.

If at any stage you feel uncomfortable, you may choose to decline to answer any question or withdraw from the interview. The information gathered from the research will be made available to participants upon request. Please be aware that you may decide not to take part in the project without any disadvantage to yourself.

What data will be collected and what use will be made of it?

Interviews will be audio-recorded and transcribed for use in our research. Only the researcher and supervisor will have access to the identifiable data. The data collected will be securely stored in such a way that only those mentioned below will be able to gain access to it. Any personal information held on the participants may be destroyed at the completion of the research even though the data derived from the research will, in most cases, be kept for much longer or possibly indefinitely. You have the right to withdraw either part or all of the information provided before 30th May 2023. This information will then be used to inform the results and discussion chapters of the final report along with academic and local contextual studies. Quotations from key informant interviews may be used in the results and discussion chapters of the final research report.

The results of the project will be presented in a report, but every attempt will be made to preserve your anonymity. On the Consent Form you will be asked to create an identifying title (e.g., Teviot Valley Community Member) to be used in the final report. Please be aware that should you wish, we will make every attempt to preserve your anonymity. However, with your consent, there are some cases where it would be preferable to attribute contributions made to individual participants using a pseudonym. It is up to you which of these options you would prefer.

Upon your request, the results will be made available to you through email. If you are hesitant or uncomfortable about answering any question, you are reminded of your right to decline to answer, and that you may withdraw from the project at any stage without disadvantage to yourself of any kind. Participants can request that a copy of their transcribed interview be sent to them for approval. Any section of information may be withdrawn from the transcribed data.

This project involves an open-ended questioning technique. The general line of questioning will regard your understanding of the potential impacts in relation to the Lake Onslow Battery Project. Although the School of Geography is aware of the general areas to be explored in the interview, the Committee has not been able to review the precise questions to be used. In the event that any line of questioning makes you feel uncomfortable, you are reminded of your right to decline to answer any particular question(s).

Can Participants change their mind and withdraw from the project?

If you feel uncomfortable or change your mind about participating in this research, you may withdraw from the project before its completion and without any disadvantage to yourself before the 30th May.

What if Participants have any questions?

If you have any questions about our project, either now or in the future, please feel free to contact either:

Caroline Cech

and

Prof Michelle Thompson-Fawcett

Department of Geography

School of Geography

University Telephone Number

+64 3 479 8762

Email: cecca075@student.otago.ac.nz

michelle.thompson-fawcett@otago.ac.nz

This study has been approved by the Department stated above. However, if you have any concerns about the ethical conduct of the research you may contact the University of Otago Human Ethics Committee through the Human Ethics Committee Administrator (ph +643 479 8256 or email gary.witte@otago.ac.nz). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.

11.5 Appendix E- Consent Form for Interviews



Lake Onslow Hydro Project- Community and Infrastructure Impacts

INFORMATION SHEET FOR SURVEY PARTICIPANTS

Thank you for showing an interest in this project. Please read this information sheet carefully before deciding whether or not to participate. If you decide to participate, we thank you. If you decide not to take part, there will be no disadvantage to you, and we thank you for considering our request.

What is the Aim of the Project?

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What Types of Participants are being sought?

The researchers wish to survey community members within the Teviot Valley, planners/councillors, relevant stakeholders (MBIE representatives), community groups, and experts. The researchers will recruit participants via email, websites, and Facebook.

What will Participants be asked to do?

Should you agree to take part in this project, you will be asked to take part in a 10-15 minute survey with questions relating to your experience, opinions, and perceptions of the Lake Onslow Battery Project. If at any stage you feel uncomfortable, you may choose to decline to answer any question or withdraw from the survey.

What data will be collected and what use will be made of it?

Survey responses will be coded and analysed for use in our research. Only the researchers and supervisor will have access to the identifiable data. The data collected will be stored securely.

The information will be used to inform the results and discussion chapters of the final report along with academic and local contextual studies. Quotations from short answer questions may be used. The results from this survey will be presented in a report, and every attempt will be made to preserve anonymity.

Can Participants change their mind and withdraw from the project?

If you feel uncomfortable or change your mind about participating in this research, you may withdraw from the project before its completion and without any disadvantage to yourself before the 30th May.

What if Participants have any questions?

If you have any questions about our project, either now or in the future, please feel free to contact either:

Caroline Cech	and	Prof Michelle Thompson-Fawcett
Department of Geography		School of Geography
University Telephone Number		+64 3 479 8762
Email: cecca075@student.otago.ac.nz		michelle.thompson-fawcett@otago.ac.nz

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11.6 Appendix F- Information Sheet for Survey Participants



Lake Onslow Hydro Project- Community and Infrastructure Impacts

INFORMATION SHEET FOR SURVEY PARTICIPANTS

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The information will be used to inform the results and discussion chapters of the final report along with academic and local contextual studies. Quotations from short answer questions may be used. The results from this survey will be presented in a report, and every attempt will be made to preserve anonymity.

Can Participants change their mind and withdraw from the project?

If you feel uncomfortable or change your mind about participating in this research, you may withdraw from the project before its completion and without any disadvantage to yourself before the 30th May.

What if Participants have any questions?

If you have any questions about our project, either now or in the future, please feel free to contact either:

Caroline Cech	and	Prof Michelle Thompson-Fawcett
Department of Geography		School of Geography
University Telephone Number		+64 3 479 8762
Email: cecca075@student.otago.ac.nz		michelle.thompson-fawcett@otago.ac.nz

This study has been approved by the Department stated above. However, if you have any concerns about the ethical conduct of the research you may contact the University of Otago Human Ethics Committee through the Human Ethics Committee Administrator (ph +643 479 8256 or email gary.witte@otago.ac.nz). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.