# Economic impact assessment of the Rangiuru business park

**NZIER report to Quayside Holdings Limited**

April 2021

## About NZIER

NZIER is a specialist consulting firm that uses applied economic research and analysis to provide a wide range of strategic advice.

We undertake and make freely available economic research aimed at promoting a better understanding of New Zealand's important economic challenges.

Our long-established Quarterly Survey of Business Opinion (QSBO) and Quarterly Predictions are available to members of NZIER.

We pride ourselves on our reputation for independence and delivering quality analysis in the right form and at the right time. We ensure quality through teamwork on individual projects, critical review at internal seminars, and by peer review.

NZIER was established in 1958.

## Authorship

# Key points

NZIER was commissioned by Quayside Holdings to use its computable general equilibrium (CGE) model of the New Zealand economy at the territorial local authority level to estimate the wider economic impact of an investment in a new business park in the Western Bay of Plenty district.

## Development of a business park can increase economic activity across the sectors

Our objective is to estimate the impact of the investment to the development of the Western Bay of Plenty district. We estimate this impact by comparing the economy with and without the investment. To model these economic impacts, we distinguish between the construction phase and the operational phase of the business park.

Local businesses and households would benefit from investment in construction of this infrastructure by providing labour and other inputs. In addition, when new businesses start to operate in the park, the rest of the economy can benefit through improved productivity of the industries located in the park.

## Construction phase

For this stage, we model the changes in the economy resulting from the construction of the business park. During this phase, the business park is being built and developed; therefore, the economic benefit of the park is shown by how much the construction sector activity can boost activity in the district's economy across the sectors. There are four stages of construction, each representing the different amount of investment on different types of infrastructure (e.g. roads) in the Western Bay of Plenty district and the Rangiuru business park.

- Stage 1: total investment of $121.2 million

- Stage 2: total investment of $34.1 million

- Stage 3: total investment of $92.6 million

- Stage 4: total investment $42.8 million.

## The economic benefit for the Western Bay of Plenty district ranges between $16.33 million to $55.35 million during each stage of construction

Investment in the region boosts construction activity and leads to increased profitability in the sector. These impacts lead to an increase in household income, which leads to increased household spending which in turn generates demand in the other sectors of the Western Bay of Plenty economy.

However, the construction of the business park in the Western Bay of Plenty district results in resources being pulled from other regions in New Zealand. This transfer of resources to the Western Bay of Plenty district results in them being used less productively, so the net impact of the construction on the overall New Zealand economy is negative.

**Figure 1 Changes in regional and national GDP during the construction phase**

$ millions
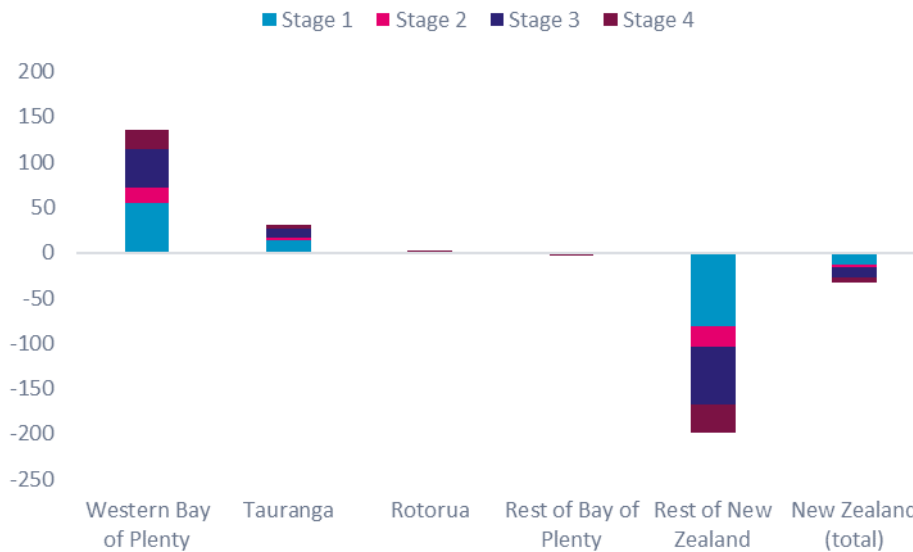


Source: NZIER

## Operational phase

We also model the impacts of the business park once it has been constructed and begins operating. A business park pulls businesses together, and this clustering leads to higher productivity as a result of innovation and competitiveness through input sharing, knowledge spill overs and labour pooling. These are known as agglomeration benefits.

The business park leads to an increase in employment density, which results in improved productivity in the different industries. We model the flow-on effects of these productivity gains across industries at the regional and national levels. We model two scenarios, based on different expectations of the number of new job opportunities available in the business park:

- **Scenario 2a:** 3,000 workers move to the business park.

- **Scenario 2b**: 4,000 workers move to the business park.

We used the estimated change in employment density to determine the agglomeration benefits. We then model the productivity gains arising from these agglomeration benefits to capture the wider impact on the economy.

## The economic benefit for the Western Bay of Plenty district ranges between $ 19.9 to $25.98 million a year once it is operational

At the national level, the New Zealand economy is up to $11.48 million larger compared to not having the Rangiuru business park in the economy, based on our expectations of 4,000 workers moving to the business park under scenario 2b.

Increased productivity in industries located in the Western Bay of Plenty district means higher profit for those industries, which in turn leads to increased household income through higher wages. Higher household income encourages some workers to move to the Western Bay of Plenty district, thus increasing activity in the area.

**Figure 2 Changes in regional and national GDP at the operational phase – scenario 2a and scenario 2b**

$ millions



Source: NZIER

# Contents

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# 1 Scope and objectives

Quayside Holdings has commissioned NZIER to estimate the wider economic impact of developing the Rangiuru business park (the business park) in the Western Bay of Plenty district.

We used our regional computable general equilibrium (CGE) model to capture the direct and flow-on impacts of the new business park. A business park increases activity through firstly the construction of it, and once in operation through bringing workers into the area which leads to productivity gains and increased spending.

These impacts filter through the regional and national economies and include the contribution to gross domestic product (GDP), household consumption and employment. We model these wider economic impacts of the investment for the:

- construction phase and
- operational phase.

# 2 Business parks: Infrastructure for economic growth

Business parks provide important infrastructure for businesses to facilitate and accelerate the provision of goods and services. They are usually located near main roads/ports – this proximity lowers transport costs and improves accessibility for businesses.

The geographical concentration of industries and workers also results in productivity gains – known as agglomeration benefits.

Marshall (1890) laid out the foundation of the theory of agglomeration in economics. He identified three main reasons (or 'agglomeration forces') that explain why firms from the same industry have the tendency to cluster in the same geographical area:

- input sharing
- knowledge spill-overs
- labour pooling.

These factors bring innovation and competitiveness to firms located in the same geographical location, resulting in productivity gains for the industries located in the business park.

## 2.1 Rangiuru business park

The business park is a shovel-ready project that has strong regional stakeholder support. In addition to the estimated 750 construction jobs required to construct the business park,

there is the potential for 3,000 to 4,000 new jobs in the business park once it is operating at full capacity.[1]

# 3    Modelling approach

We used our regional computable CGE model of the New Zealand economy to estimate the economic impacts of the Rangiuru business park to the Western Bay of Plenty district.

## 3.1    Our regional CGE model

NZIER's TERM-NZ[2] model is our multiregional bottom-up CGE model of the New Zealand economy, and captures the complex and multidirectional flows between the various actors of the national economy and how they interact with the rest of the world. More technical details about our CGE model are described in Appendix A.

We estimate the impact of the business park on the Western Bay of Plenty district economy through comparing the economy with and without the business park (known as the 'business as usual' scenario). The difference between the two scenarios represents the net impacts of the business park during the construction and operational phases. These impacts include changes to GDP, employment, wages, and household consumption.

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[1]    Estimates from *Rangiuru Business Park Community Service Area Economic Overview*, prepared by Property Economics Ltd., November 2016.

[2]    TERM-NZ stands for "The Enormous Regional Model" of the New Zealand economy. It was developed at NZIER based on the original Australian TERM model created by Professor Mark Horridge of the Centre of Policy Studies, Victoria University-Melbourne, Australia. http://www.copsmodels.com/term.htm. NZIER maintains close connections with the Centre, ensuring that our modelling techniques reflect international best-practice.

**Figure 3 Overall approach of EIA of Rangiuru business park**
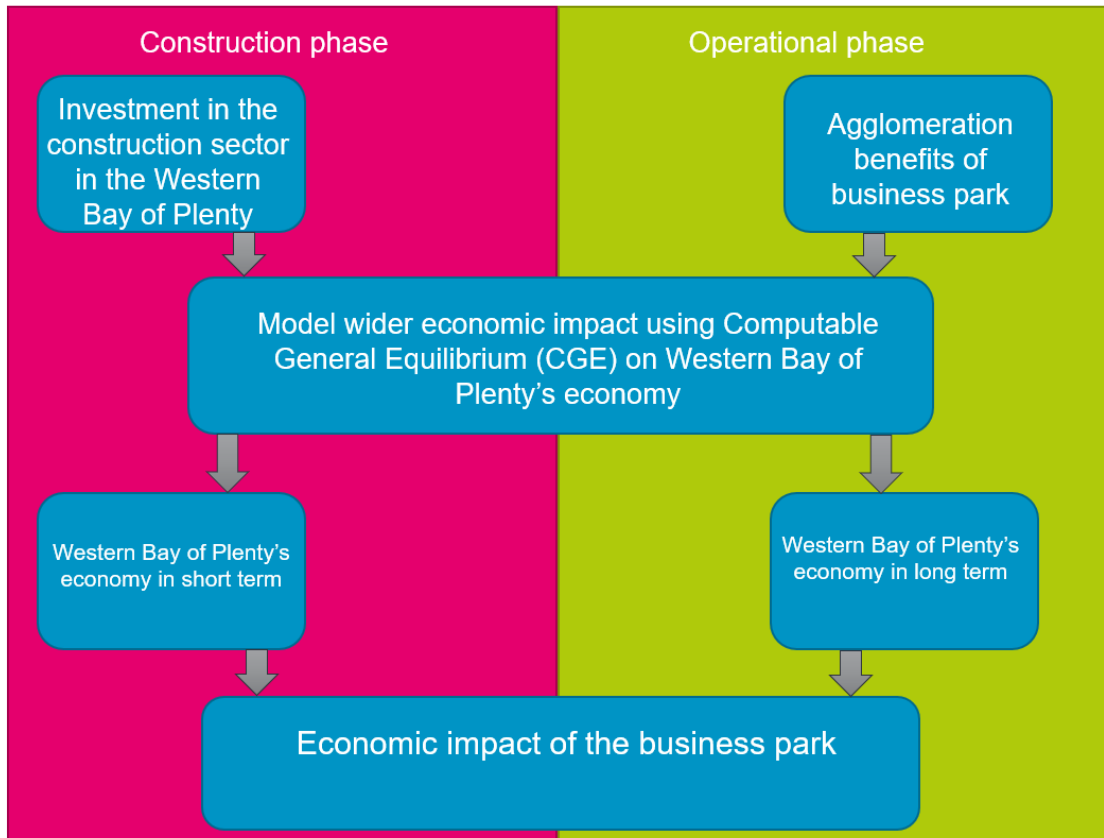


Source: NZIER

We first determine the direct impact of the investment on the construction sector and resulting productivity gains. The estimates of these direct impacts form the inputs into our CGE modelling in order for us to estimate the flow-on impacts across the sectors of the Western Bay of Plenty district.

We model the impacts for 1) the construction phase, and 2) the operational phase. Therefore, we designed two scenarios separately to reflect the impact of these phases.

## 3.2 Estimating the 'shocks' as inputs into our CGE modelling

### Scenario 1 – Construction phase

We model the impacts of the business park during the construction phase. During this phase, the business park is being built and developed. We model how the change in construction sector activity flows through to other sectors of the district's economy.

To shock our model, we increase the investment in relevant construction sectors in the Western Bay of Plenty district with the information provided by Quayside Holdings.

### Table 1 High level costs and expected timeframes
$ millions

|  | Short term (1-5) | | Long term (10+) | |
| --- | --- | --- | --- | --- |
|  | Stage 1 | Stage 2 | Stage 3 | Stage 4 |
| Roads | 50 | 4 | 22 | 4 |
| Three waters | 50 | 9 | 31 | 9 |
| Reserves | 0.2 | 0.1 | 0.6 | 0.8 |
| Power/Comms/Gas | 3 | 1 | 2 | 2 |
| Earthworks | 18 | 20 | 37 | 27 |

Source: Quayside Holdings Ltd

For the construction phase, we made the following assumptions:

- We assume an upward-sloping labour curve in each region (extra workers could come from either the underemployed or other regions/districts).

- Rates of return adjust to maintain fixed capital.

- National real wage is fixed, and aggregate employment adjusts.

- Consumption is fixed instead of the ratio between trade balance and GDP.

- Real consumption follows wage income – higher wages encourages households to spend.

- Real government expenditure is exogenous.

Figure 4 summarises the expected chain of economic effects from the business park's activities at the local and regional levels during the construction phase.

Note that we expect some negative economic impacts on other regions/sectors of the New Zealand economy as a result of the investment during the construction phase of the business park. This reflects the effects of the investment drawing in resources to construct the business park from other sectors/regions in the economy, which prior to the investment were being used more productively. However, this impact is only during the construction phase, and hence temporary.

**Figure 4 Economic effects from the development of the business park – construction phase**
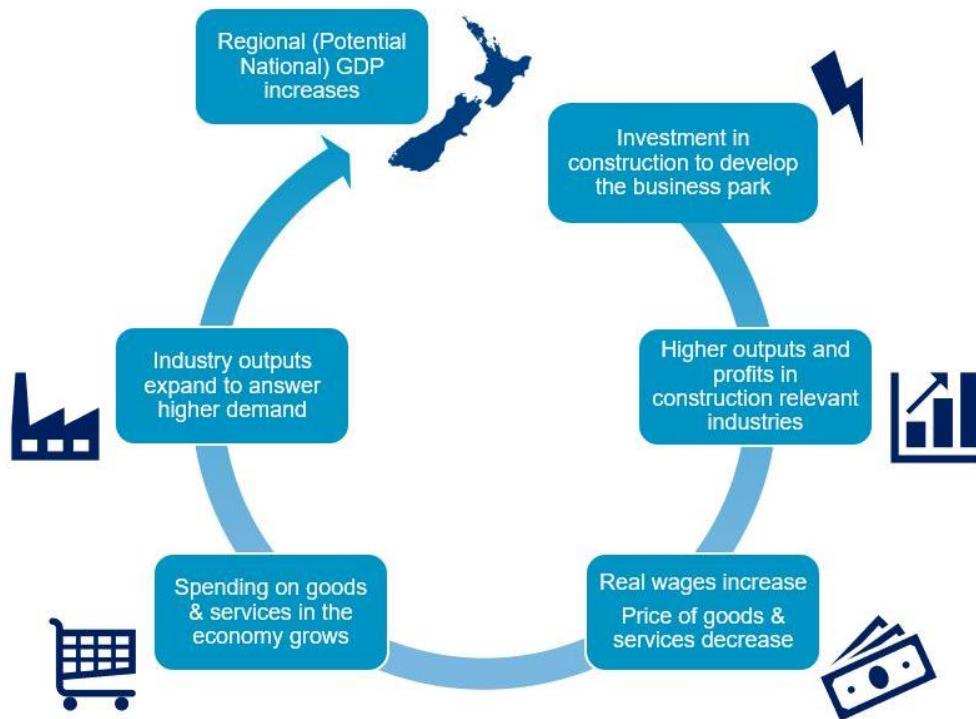


Source: NZIER

## Scenario 2 – Operational phase

In this scenario, we model the impacts of the business park once it is operational. An operational business park draws workers in, with the increase in employment density in turn leading to improved productivity of different industries in the business park. We input these productivity gains into our CGE model to estimate the flow-on effects across the other industries at the regional and national levels.

The following diagram shows the process that captures the economy-wide impacts of agglomeration benefits as a result of the business park bringing workers together.

**Figure 5 Modelling the agglomeration benefits of the business park**



Source: NZIER

We use Maŕe and Graham's (2009) methodology of the relationship between density and industries' productivity in New Zealand to estimate agglomeration benefits of the business park attracting 3,000 (scenario 2a) to 4,000 (scenario 2b) more workers to the area.

We estimate the agglomeration benefits by constructing a measure of effective density for each industry sector. Then, we compare how a relocation of 3,000 to 4,000 employees to the business park increases the effective density of the market and from this determine the productivity gains for each industry.[3]

Figure 6 shows how 4,000 extra workers increases the effective employment density of wholesale trade within the Tauranga/Western Bay of Plenty district.

**Figure 6 Change in effective employment density in scenario 2b – wholesale trade**
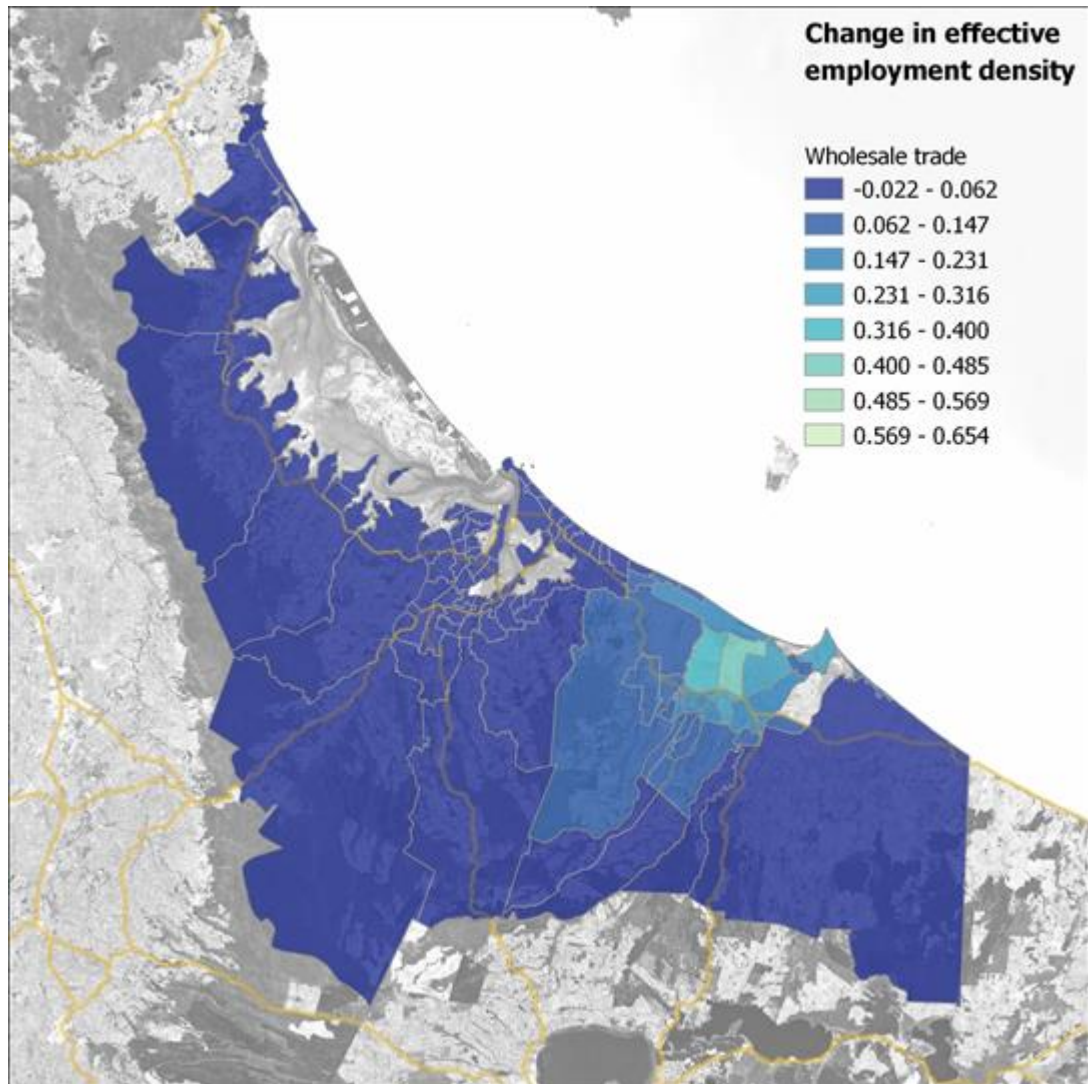


Source: NZIER, LINZ, NZTA

New workers are attracted to the Western Bay of Plenty district in the relevant industries because of the infrastructure provided by the business park. To find out which relevant

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[3] To measure the effective density, we use a decay function to assign higher weights to the jobs available in closer proximity to a suburb. The formula for ED is as follows: $ED_i = \frac{E_i}{(\sqrt{A_i/\pi})^\alpha} + \sum_j^{i \neq j} \left( \frac{E_j}{(d_{ij})^\alpha} \right)$

industries are affected by the business park, we looked at the Western Bay of Plenty district council plan[4] and assumed industries are similar to those in the Tauriko business park.

### Table 2 Productivity shocks for operational phase
% change

| Industry groups | Scenario 2a – 3,000 workers | Scenario 2b – 4,000 workers |
| --- | --- | --- |
| Agriculture, Forestry and Fishing | 0.047% | 0.061% |
| Mining | 0.888% | 0.888% |
| Manufacturing | 0.917% | 1.203% |
| Electricity, Gas, Water and Waste Services | 1.532% | 1.686% |
| Construction | 0.864% | 1.153% |
| Wholesale Trade | 2.918% | 3.676% |
| Retail Trade | 0.561% | 0.709% |
| Accommodation and Food Services | 0.219% | 0.284% |
| Transport, Postal and Warehousing | 1.215% | 1.532% |
| Information Media and Telecommunications | 2.789% | 3.178% |
| Financial and Insurance Services | -0.134% | -0.114% |
| Rental, Hiring and Real Estate Services | 0.021% | 0.070% |
| Professional, Scientific and Technical Services | 0.113% | 0.177% |
| Administrative and Support Services | 0.266% | 0.336% |
| Public Administration and Safety | 1.045% | 1.045% |
| Education and Training | 0.153% | 0.183% |
| Health Care and Social Assistance | 0.141% | 0.150% |
| Arts and Recreation Services | 0.082% | 0.123% |
| Other Services | 0.003% | 0.004% |

Source: NZIER

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[4]   https://www.westernbay.govt.nz/repository/libraries/id:25p4fe6mo17q9stw0v5w/hierarchy/property-rates-building/district-plan/operative-district-plan-2012/2017-07%20Section%2021.pdf

During the operational phase, we made the following assumptions:

- Total employment is fixed but perfectly mobile across industries and/or districts/regions as workers look for better opportunities (expressed in term of real wages).

- Capital stocks adjust to maintain fixed rates of return. We assume that capital is mobile between industries and regions. This mobility can happen in the form of machinery and equipment being physically moved or capital in one district/region and/or industry being able to depreciate without being replaced while investment builds up the capital stock of another district/region and/or industry.

- Fixed investment/capital ratios.

- Aggregate employment is fixed, and the real wage adjusts.

- Ratio between trade balance and GDP (in nominal terms) is fixed instead of real household consumption.

- Real government expenditure moves with real household consumption.

Figure 7 shows the expected chain of economic effects from the business park activities at the local and regional levels during the operational stage.

## Figure 7 Economic effects from the development of Rangiuru business park – operational phase
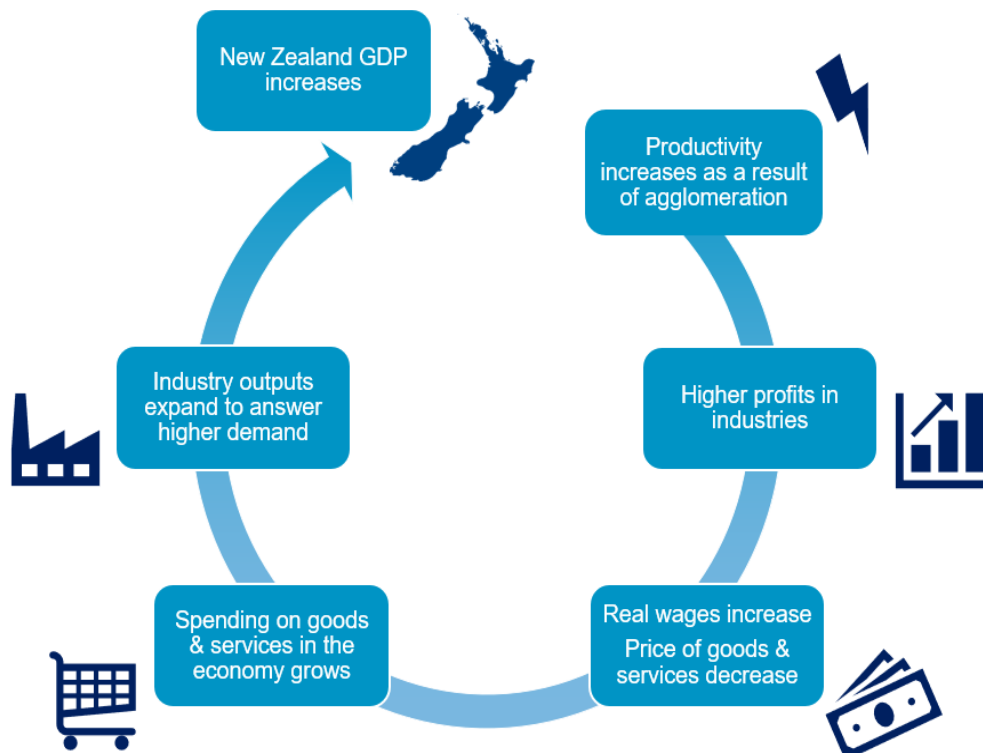


Source: NZIER

# 4 Our results

Our CGE modelling produces show a range of outcomes as a result of the direct impacts we input into the model. We present the main results for a range of economic indicators, industries, and districts.

All the modelled economic outcomes are compared to the status quo in which there is no business park in the economy, and are reported as percentage change or in dollar values. The difference between the economy with and without the business park represents the net economic benefit of the business park.

## 4.1 Construction phase

During this stage, we expect investments in heavy construction to draw resources (e.g. workers, machinery) from the rest of the country to the Western Bay of Plenty district. Therefore, while there is an increase in the economic output in the Western Bay of Plenty district, this movement of resources results in a reduction in output in some other regions given resources were put to their most productive use prior to the construction.

We run four stages in this phase. Using the information provided in Table 1, we shock investment in the Western Bay of Plenty district:

• Stage 1: total investment of $121.2 million

• Stage 2: total investment of $34.1 million

• Stage 3: total investment of $92.6 million

• Stage 4: total investment $42.8 million.

### 4.1.1 National economic indicators during the construction phase

The national impact of the construction of the business park for the New Zealand economy is slightly negative. This is because prior to the construction, resources are assumed to be allocated to where they are most productive. The construction of the business park induces a movement of resources to the Western Bay of Plenty district, so while it increases activity in this district, given resources are not being used as productively, the net effect on the whole New Zealand economy is negative.

Note that we show the increase in imports that result from both the construction and operation of the business park as a negative figure in our tables and charts to reflect the fact that import is a negative contribution to GDP i.e. Total GDP = consumption+ investment + government spending + export – import.

## Table 3 National economic indicators during the construction phase

$ millions

|  | Stage 1 | Stage 2 | Stage 3 | Stage 4 |
|---|---|---|---|---|
| Household consumption | -7.44 | -2.04 | -6.24 | -3.04 |
| Investment | -2.66 | -1.04 | -2.60 | -1.50 |
| Government Spending | -1.67 | 0.33 | -1.11 | 0.02 |
| Exports | 45.62 | 13.00 | 35.24 | 17.40 |
| Imports | -46.76 | -13.79 | -36.12 | -18.16 |
| Total GDP | -12.91 | -3.54 | -10.83 | -5.28 |

Total GDP = consumption+ investment + government spending + export - import

Source: NZIER

### 4.1.2 Regional GDP impacts during the construction phase

Table 4 shows the impact of the construction phase on GDP for each region. These effects are not a permanent effect on the regional economies and are the result of the construction shifting resources across the regions. While the Western Bay of Plenty district and adjoining regions gain from this construction, the effect on rest of the economy is negative.

## Table 4 Regional impact on GDP during the construction phase

$ millions

|  | Western Bay of Plenty | Tauranga | Rotorua | Rest of Bay of Plenty | Rest of New Zealand | New Zealand (total) |
|---|---|---|---|---|---|---|
| Stage 1 | 55.36 | 13.10 | 0.22 | -0.61 | -80.96 | -12.91 |
| Stage 2 | 16.33 | 3.60 | 0.07 | -0.18 | -23.35 | -3.54 |
| Stage 3 | 42.64 | 9.83 | 0.16 | -0.49 | -62.97 | -10.83 |
| Stage 4 | 21.42 | 4.75 | 0.08 | -0.25 | -31.29 | -5.29 |

Source: NZIER

Table 5 shows the impact of the construction phase on household consumption. Household consumption is a reasonable proxy for consumers' wellbeing. As a result of more money in the Western Bay of Plenty district, the higher household incomes encourage households to spend more. This leads to increased household consumption in the district during this phase.

## Table 5 Regional impact on household consumption during the construction phase

$ millions

| | Western Bay of Plenty | Tauranga | Rotorua | Rest of Bay of Plenty | Rest of New Zealand | New Zealand (total) |
|---|---|---|---|---|---|---|
| Stage 1 | 25.87 | 7.05 | 0.23 | -0.24 | -40.34 | -7.44 |
| Stage 2 | 7.92 | 1.94 | 0.07 | -0.08 | -11.88 | -2.04 |
| Stage 3 | 20.14 | 5.29 | 0.17 | -0.20 | -31.63 | -6.24 |
| Stage 4 | 10.32 | 2.56 | 0.08 | -0.10 | -15.90 | -3.04 |

Source: NZIER

Table 6 shows the impact of the construction phase on employment at the regional level. Employment will increase in the Western Bay of Plenty District and Tauranga, but these workers are coming from other parts of the country, therefore, the impact for other regions is slightly negative.[5]

## Table 6 Regional employment impact during the construction phase

Employee count

| | Western Bay of Plenty | Tauranga | Rotorua | Rest of Bay of Plenty | Rest of New Zealand |
|---|---|---|---|---|---|
| Stage 1 | 114 | 34 | 0 | 0 | -117 |
| Stage 2 | 35 | 7 | 0 | 0 | 0 |
| Stage 3 | 90 | 27 | 0 | 0 | -110 |
| Stage 4 | 46 | 13 | 0 | 0 | 0 |

Source: NZIER

## 4.2 Operational phase

We run two simulations for the operational phase, based on different assumptions for how many workers are attracted to the business park.

- **Scenario 2a:** 3,000 workers move to the business park.
- **Scenario 2b**: 4,000 workers move to the business park.

### 4.2.1 National impacts from the operational phase

Table 7 shows our estimates of the net impact on the New Zealand economy under the two simulations based on the different number of workers attracted to the business park. In both simulations the overall impact of the business park on the New Zealand economy during the operational phase is positive. Workers attracted to the business park lead to productivity gains across industries in the area, with the increased output having a flow-on impact to the other New Zealand regions.

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[5]   CGE models only show employment because the economy is assumed at full capacity, therefore there is no unemployment.

Note that in our CGE modelling the assumption is that national employment remains unchanged – the business park leads to workers moving between the sectors and regions. The increase in total output represents resources being used more productively as a result of the business park.

The increase in productivity across the sectors leads to increased revenue for firms, which they pass on to their workers in the form of higher wages. The increase in household income that results from higher wages encourages households to spend more, with this increased spending concentrated in the district. We proxy this increase in household consumption for consumers' wellbeing.

Nominal investment for the whole of New Zealand declines. This reflects the movement of resources to the Western Bay of Plenty district, which leads to a fall in prices outside of the district and hence a decline in nominal investment.

## Table 7 National GDP at the operational phase

$ millions

| | Scenario 2a | Scenario 2b |
|---|---|---|
| Household consumption | 4.96 | 6.62 |
| Investment | -2.45 | -3.26 |
| Government spending | -0.14 | 0.09 |
| Exports | 32.54 | 42.38 |
| Imports | -26.30 | -34.36 |
| **Total** | 8.61 | 11.48 |

Total GDP= consumption+ investment + government spending + export - import

Source: NZIER

### 4.2.2 Regional impacts from the operational phase

The following diagram and table show the changes in GDP if 3,000 workers are attracted to the business park (scenario 2a). Results for scenario 2b are presented in Appendix B.

As expected, GDP increases the most in the Western Bay of Plenty district. Some other regions face a decline in GDP, reflecting the movement of resources as a result of the business park. The overall impact on GDP is positive for the whole of New Zealand under both scenarios.

## Figure 8 GDP, operational phase – scenario 2a
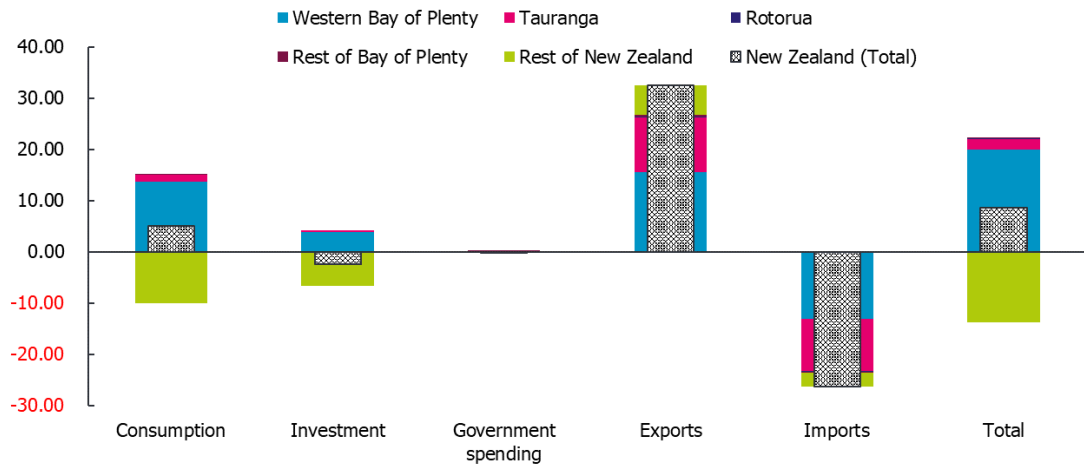
$ millions



Total GDP = consumption+ investment + government spending + export - import

Source: NZIER

## Table 8 Regional GDP changes in the operational phase under scenario 2a

$ millions

|  | Western Bay of Plenty | Tauranga | Rotorua | Rest of Bay of Plenty | Rest of New Zealand | New Zealand (Total) |
|---|---|---|---|---|---|---|
| Household consumption | 13.71 | 1.28 | -0.02 | 0.04 | -10.05 | 4.96 |
| Investment | 3.88 | 0.25 | -0.04 | -0.03 | -6.52 | -2.45 |
| Government spending | -0.05 | 0.05 | 0.01 | 0.01 | -0.16 | -0.14 |
| Exports | 15.53 | 10.70 | 0.25 | 0.32 | 5.74 | 32.54 |
| Imports | -13.17 | -10.10 | -0.13 | -0.14 | -2.74 | -26.30 |
| **Total** | **19.90** | **2.17** | **0.07** | **0.19** | **-13.73** | **8.61** |

Total GDP = consumption+ investment + government spending + export - import

Source: NZIER

Table 9 shows the employment impacts for both scenarios at the regional and national levels.

**Table 9 Regional employment impacts during the operational phase**

% change

| Employment | Western Bay of Plenty | Tauranga | Rotorua | Rest of Bay of Plenty | Rest of New Zealand |
|---|---|---|---|---|---|
| Scenario 2a | 0.72 | 0.02 | 0 | 0 | -0.01 |
| Scenario 2b | 0.94 | 0.02 | 0 | 0 | -0.01 |

Source: NZIER

### 4.2.3 Industry output

Most industries located in the Western Bay of Plenty district will experience increased output as a result of the business park, as well as increased household spending (on accommodation, food and beverages, retail, real estate) due to higher wages and employment. These effects lead to a rise in real GDP, employment, and household consumption within the Western Bay of Plenty district.

Industries in some other regions are negatively affected, reflecting the movement of resources (labour and capital) towards the Western Bay of Plenty district. However, the net overall impact of the business park on the New Zealand economy is positive.

**Table 10 Change in the industry output – selected industries under scenario 2a**

$ thousands

| | Western Bay of Plenty | Tauranga | Rotorua | Rest of Bay of Plenty | Rest of New Zealand |
|---|---|---|---|---|---|
| Horticulture | 270 | 100 | 0 | 200 | 100 |
| Forestry | 700 | 0 | 400 | 300 | -500 |
| Fishing | 0 | 0 | 0 | 0 | -100 |
| Fruit processing | 25,100 | -900 | -100 | -100 | -12,400 |
| Construction | 13,200 | -1,500 | -700 | -600 | -68,100 |
| Wholesale trade | 21,700 | -4,100 | -900 | -500 | -29,600 |
| Retail trade | 15,400 | 2,200 | 0 | 100 | -6,900 |
| Accommodation, Food and Beverage | 7,700 | 1,400 | 200 | 100 | -6,500 |

Source: NZIER

# 5 References

Maŕe, David and Graham, Daniel J. 2009. Agglomeration elasticities in New Zealand. NZ Transport Agency Research Report 376.

Marshall, A. 1890. *Principles of Economics*. Macmillan: London, UK.

Property Economics Ltd. 2016. Rangiuru Business Park Community Service Area Economic Overview.

# Appendix A TERM-NZ

We used our NZ-TERM ('The Enormous Regional Model') CGE model of the New Zealand economy and its regions for this economic impact analysis.

TERM-NZ contains information on 149 industries, 149 commodities and 88 districts. The 88 districts include 67 territorial authorities across New Zealand plus, within Auckland, 21 local community boards. As far as we know, our model is the only one in New Zealand with this degree of granularity. We usually run TERM-NZ with an aggregated version of the database to speed-up the model computation and because it is not technically possible to run the model with such a large database in its full dimensions. For this study, we have aggregated the model's database to 5 geographical areas[6] and 51 industries.

NZIER's TERM-NZ has been built in consultation with CGE experts at the Centre of Policy Studies (COPS) which is now based at Victoria University, Melbourne. COPS is well-regarded internationally and recognised as a world leader in CGE modelling. For more details, see their website.

TERM-NZ is a bottom-up regional CGE model which treats each region as a separate economy. All regions are linked via inter-regional trade in commodities and movements in labour and capital. The model captures the various inter-linkages between sectors, as well as their links to households (via the labour market), the government sector, capital markets and the global economy (via imports and exports). Key features of the model are:

- Each industry produces a single commodity.

- Production inputs are intermediate commodities (domestic and imported) and primary factors (labour, land and capital). Industry demand for factors of production follows the same structure for all regions in the model.

- The demand for primary factors and the choice between imported and domestic commodities are determined by Constant Elasticity of Substitution (CES) production nests. This means an increase in the price of one input shifts sourcing towards another input.

- Intermediate goods, primary factors and other costs are combined using a Leontief production function. This means the proportion of production inputs is held constant for all levels of output. Therefore, an industry cannot substitute capital or labour instead of land for their production.

- The production mix of each industry is dependent on the relative prices of each commodity. The proportion of output exported or consumed domestically is also dependent on relative prices.

- Within each region, any changes to the economy have multiple direct and indirect (flow-on) impacts, including beyond the sectors initially affected. So, for example, changes to the Queenstown economy due to changes in investment patterns will flow on to other regions.

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[6]    These 5 geographical areas include: Tauranga, Rotorua, West Bay of Plenty, Rest of Bay of Plenty and Rest of New Zealand.

- Price changes (e.g. wage increases, shifts in the exchange rate) as a result of a change to the regional economy in one sector also affect all other sectors, both within the region and across the rest of the country.

## A visual representation of TERM-NZ is shown in Figure 9

It highlights the complex and multidirectional relationships between the various parts of each regional economy and how they interact with other New Zealand regions and rest of the world.

### Figure 9 NZIER's TERM-NZ CGE model

Circular flow between all agents and activities at TLA level in the economy
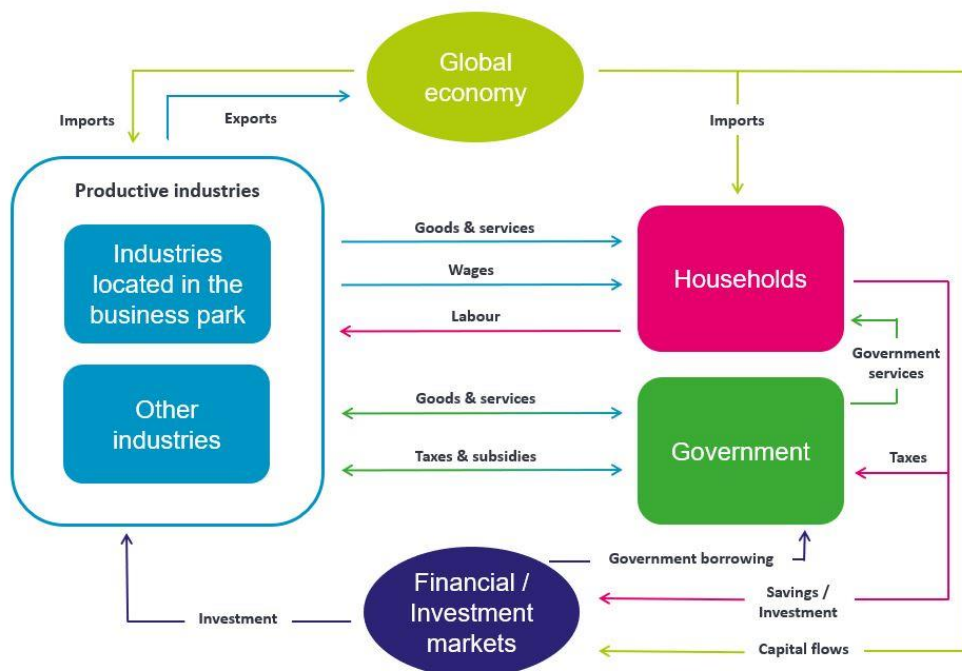


Source: NZIER

# Appendix B Additional results from the CGE modelling

## Figure 10 GDP, operational phase – scenario 2b
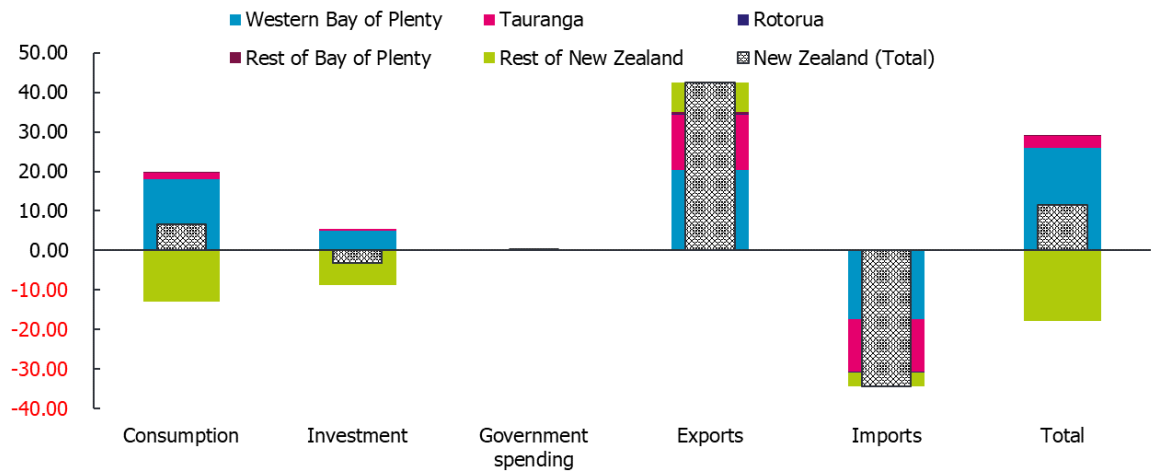
$ millions



Total GDP = consumption+ investment + government spending + export - import

Source: NZIER

## Table 11 National GDP (expenditure) during the construction phase

$ millions

|  | Stage 1 | Stage 2 | Stage 3 | Stage 4 |
|---|---|---|---|---|
| Household consumption | -7.44 | -2.04 | -6.24 | -3.04 |
| Investment | -2.66 | -1.04 | -2.60 | -1.50 |
| Government spending | -1.67 | 0.33 | -1.11 | 0.02 |
| Exports | 45.62 | 13.00 | 35.24 | 17.40 |
| Imports | -46.76 | -13.79 | -36.12 | -18.16 |
| **Total** | **-12.91** | **-3.54** | **-10.83** | **-5.28** |

Total GDP = consumption+ investment + government spending + export - import

Source: NZIER

## Table 12 National GDP (income) during the construction phase

$ millions

|  | Stage 1 | Stage 2 | Stage 3 | Stage 4 |
|---|---|---|---|---|
| Return of land | -1.60 | -0.51 | -1.25 | -0.66 |
| Wages | -6.51 | -1.61 | -5.19 | -2.40 |
| Return on capital | -3.37 | -1.04 | -3.20 | -1.66 |
| Production Tax | -0.46 | -0.13 | -0.38 | -0.19 |
| Commodity tax | -0.96 | -0.26 | -0.80 | -0.39 |
| **Total** | **-12.91** | **-3.54** | **-10.83** | **-5.29** |

Source: NZIER

## Table 13 National GDP (income) at the operational phase

$ millions

|  | Scenario 2a | Scenario 2b |
|---|---|---|
| Return of land | 0.61 | 0.77 |
| Wages | 3.74 | 5.00 |
| Return on capital | 3.56 | 4.76 |
| Production tax | 0.22 | 0.30 |
| Commodity tax | 0.48 | 0.65 |
| **Total** | **8.61** | **11.48** |

Source: NZIER

## Table 14 Regional GDP changes (income), operational phase – scenario 2a

$ millions

|  | Western Bay of Plenty | Tauranga | Rotorua | Rest of Bay of Plenty | Rest of New Zealand | New Zealand |
|---|---|---|---|---|---|---|
| Return on land | 0.62 | 0.01 | 0.03 | 0.02 | -0.07 | 0.61 |
| Wages | 9.92 | 0.96 | -0.01 | 0.03 | -7.16 | 3.74 |
| Return on capital | 7.21 | 0.84 | 0.04 | 0.13 | -4.66 | 3.56 |
| Production tax | 0.71 | 0.05 | 0.00 | 0.00 | -0.53 | 0.22 |
| Commodity tax | 1.45 | 0.32 | 0.01 | 0.01 | -1.30 | 0.48 |
| **Total** | **19.90** | **2.17** | **0.07** | **0.19** | **-13.73** | **8.61** |

Source: NZIER

## Table 15 Regional GDP changes (expenditure), operational phase – scenario 2b
$ millions

| | Western Bay of Plenty | Tauranga | Rotorua | Rest of Bay of Plenty | Rest of New Zealand | New Zealand |
|---|---|---|---|---|---|---|
| Household consumption | 17.91 | 1.68 | -0.02 | 0.05 | -13.00 | 6.62 |
| Investment | 5.04 | 0.32 | -0.05 | -0.05 | -8.52 | -3.26 |
| Government spending | 0.09 | 0.10 | 0.01 | 0.01 | -0.12 | 0.09 |
| Exports | 20.32 | 13.96 | 0.33 | 0.41 | 7.38 | 42.38 |
| Imports | -17.37 | -13.18 | -0.17 | -0.18 | -3.46 | -34.36 |
| **Total** | **25.99** | **2.88** | **0.09** | **0.25** | **-17.72** | **11.48** |

Total GDP = consumption+ investment + government spending + export - import

Source: NZIER

## Table 16 Regional GDP changes (income), operational phase – scenario 2b
$ millions

| | Western Bay of Plenty | Tauranga | Rotorua | Rest of Bay of Plenty | Rest of New Zealand | New Zealand |
|---|---|---|---|---|---|---|
| Return on land | 0.81 | 0.01 | 0.04 | 0.03 | -0.11 | 0.77 |
| Wages | 12.96 | 1.26 | -0.01 | 0.04 | -9.24 | 5.00 |
| Return on capital | 9.41 | 1.13 | 0.05 | 0.16 | -5.99 | 4.76 |
| Production tax | 0.92 | 0.06 | 0.00 | 0.00 | -0.69 | 0.30 |
| Commodity tax | 1.89 | 0.42 | 0.01 | 0.01 | -1.68 | 0.65 |
| **Total** | **25.99** | **2.88** | **0.09** | **0.25** | **-17.72** | **11.48** |

Source: NZIER

## Table 17 Western Bay of Plenty – industry output – operational phase
$ thousands

| Industry | Scenario 2a | Scenario2b |
|---|---|---|
| Horticulture | 270 | 343 |
| Dairy Cattle | 383 | 502 |
| Sheep Beef | 968 | 1275 |
| Other Livestock | 158 | 205 |
| Forestry | 73 | 96 |
| Fishing | 0 | 0 |
| Agriculture Services | 457 | 610 |
| Coal Oil Gas | 0 | 0 |
| Mining Exploration | -4 | -6 |

| Industry | Scenario 2a | Scenario2b |
|---|---|---|
| Meat Manufacturing | 5031 | 6626 |
| Seafood Processing | 63 | 83 |
| Dairy Production | 331 | 435 |
| Fruit Production | 2508 | 3303 |
| Beverage and Tobacco Manufacturing | 688 | 909 |
| Textiles | 183 | 240 |
| Clothing | 24 | 32 |
| Wood Manufacturing | 3742 | 4915 |
| Pulp and Paper Manufacturing | 914 | 1192 |
| Printing | 39 | 52 |
| Petroleum Manufacturing | 0 | 0 |
| Basic Chemical Manufacturing | 22 | 28 |
| Fertilizer Manufacturing | 705 | 928 |
| Pharmaceutical Manufacturing | 1019 | 1340 |
| Rubber Manufacturing | 122 | 161 |
| Metal Manufacturing | 639 | 841 |
| Transport Equipment Manufacturing | 173 | 228 |
| Electrical Equipment Manufacturing | 544 | 717 |
| Machinery Manufacturing | 558 | 736 |
| Other Manufacturing | 159 | 208 |
| Electricity Generation and Transmission | 0 | 0 |
| Gas and Water Supply | 108 | 157 |
| Wastewater and Sewerage services | -91 | -62 |
| Construction | 1325 | 1635 |
| Wholesale | 2166 | 2807 |
| Retail | 1540 | 2013 |
| Accommodation, food and beverages | 773 | 1008 |
| Road Transport | 208 | 279 |
| Rail Transport | 0 | 0 |
| Other Transport | -4 | -5 |
| Air Transport | 61 | 78 |
| Transportation Storage | 823 | 1053 |
| Media and Telecom | 1 | 2 |
| Finance and Insurance services | 228 | 306 |
| Property services | 5479 | 7147 |
| Business services | 970 | 1282 |
| Local government | -293 | -273 |
| Central government | 268 | 243 |
| Education and hospitals | 530 | 690 |
| Sports and recreation services | 54 | 70 |
| Other services | 451 | 590 |
| Tourism | 879 | 1142 |

Source: NZIER