

# Measuring the Economic Impact of the Pūhoro STEM Academy- Extension to Tertiary Education

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## Executive Summary

This report builds on a previous report produced in November 2018. The first report considered the economic value the Pūhoro Academy was producing through helping Māori students to achieve NCEA standards with an emphasis on STEM subjects, this second report investigates the potential economic benefit which could be generated through extending the Pūhoro Academy to tertiary education. This report repeats some contextual information provided in the first report, however, the analysis is based on the **potential economic value from increased tertiary education at a bachelor's degree level.**

The Pūhoro Academy partners with a selection of secondary schools to operate a STEM (science, technology, engineering and mathematics) Academy to increase Māori student engagement in STEM programmes. Pūhoro seeks to support secondary schools to prepare their Māori science students for transfer to tertiary study and from there into employment. The Academy has had significant success in improving Māori educational performance rates:

- Ninety-eight percent of Pūhoro Year 11 students passed at least one science achievement standard.
- Ninety-two percent of the 2016 Pūhoro student cohort continued in the Year 12 Pūhoro programme and participated in science courses at NCEA level 2.
- In 2017, 92% of Pūhoro Year 12 students achieved at least one science external achievement standard.

Due to the limited data available and the relatively short time the programme has been operating for, the Cost Benefit Analysis (CBA) presented here takes a conservative approach to estimating the value of the Academy to the students over their working life. In addition to the primary CBA, three different versions of the CBA are provided, each based on different assumptions from highly conservative to less conservative, in order to test the sensitivity of the primary analysis.

The CBA considers in the counterfactual that there is a cohort of Pūhoro students who would not have been expected to enter and achieve Level 7 tertiary qualifications in the absence of the Academy. It is this cohort, representing the difference between the average Māori school leaver entering and completing a Level 7 degree programme and the potential Pūhoro Academy Level 7 degree programme entry and achievement rates, that represent the potential economic benefits of the Academy at a tertiary level.

As the CBA is estimating potential future economic benefits, there is a degree of uncertainty in quantifying the economic benefits. The CBA establishes a base scenario which considers only the impact of the Pūhoro Academy in increasing tertiary enrolments, as well as two additional scenarios, which consider changes in achievement rates, and increase in potential future earnings.

Based on information on tertiary enrolments provided by tertiary institutions, only 13% of Māori school leavers entered a bachelor's level degree programme in 2017<sup>1</sup>. In contrast, 87% of Pūhoro Academy students intended to enter a bachelor's level degree programme in 2019, an increase of 74%.

Based on this increase in enrolments and accounting for average pass rates the cost benefit analysis reported in sections 4.2 and 4.3 suggests that the net potential economic benefits of the Pūhoro Academy are **\$13,380,000**. The return on investment is calculated at approximately 10:1.

The following table below summarises four different CBA scenarios over a forty-year working career. In all cases the Pūhoro Academy covers its costs by a factor of 2.8 to 9.5 times

<i>CBA Scenarios</i>	Base Scenario	Sensitivity Testing		
		44% enrolment	32% pass rate	44% enrolment with 32% pass rate
<b>40-Year NPV \$m</b>				
Total marginal impact	14.95	8.79	7.47	4.4
Total cost of initiative	1.57	1.57	1.57	1.57
Net economic benefits	13.38	7.22	4.8	2.83
Average net economic benefit per cohort member (40y)	\$159,238	\$85,980	\$70,279	\$33,651
CBA Ratio	9.5	5.6	4.8	2.8

The Pūhoro Academy covers its costs under even the most conservative scenarios tested. The analysis provides an illustration of the power of a successful intervention in a young person's life.

<sup>1</sup> <https://www.educationcounts.govt.nz/statistics/indicators/data/education-and-learning-outcomes/3688>

The analysis also highlights the significant benefits that are possible through tertiary education. Through potentially increasing tertiary enrolments, the Pūhoro Academy could deliver economic benefits well above its costs. These benefits will be realised by students obtaining qualifications that they would not have been likely to obtain in the absence of the Pūhoro Academy. The analysis assumes that the Pūhoro Academy is extended into a tertiary environment, so that students are able to receive the same level of support they had throughout high school.

It is likely that the benefits considered in this analysis will ripple out through whānau, both in the present and in the future. The AgriBusiness Group has not attempted to quantify these ripple effects, which reinforce the conclusion that considerable value is being created through this initiative. However, the potential scale of these effects is briefly explored in the discussion.

Additionally, the sometimes-conservative assumptions used throughout the report are likely underestimate the direct economic impacts that Pūhoro may have on its students. If the Academy were to continue to support students through tertiary education, significant economic benefits could be achieved. Further, the focus on STEM subjects is likely to amplify these benefits. While this study focuses on the potential financial benefits to the Pūhoro students from completing a tertiary qualification, there are also significant socio-economic benefits for the wider society that can also be generated. These benefits can not be quantified to the same degree as can the private benefits, despite this limitation, we explore the extent of social service costs that may be avoided through higher education as well as touching in the other significant social benefits in terms of health, education, whanau relationships, and intergenerational wealth creation that may be supported through the activities of the Pūhoro Academy.

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# 1 Introduction

In September 2018 The AgriBusiness Group was subcontracted by ESR to perform a cost benefit analysis (CBA) of Massey University's Pūhoro STEM Academy. The AgriBusiness Group provided an analysis of its economic impact, taking into account guidelines published by the New Zealand Treasury. The first report presented the details of The AgriBusiness Group's analysis. The proposal for the CBA stated that:

*The focus of the CBA will be on quantifying the lifetime earnings of an individual based on their potential educational achievement.*

The first report focused on the potential benefits the Pūhoro Academy was generating by assisting students through higher school qualifications. In February 2019 The AgriBusiness Group was subcontracted by ESR to perform a second cost benefit analysis (CBA) of Massey University's Pūhoro STEM Academy, this time considering the potential economic impact of extending the Pūhoro Academy into tertiary education at a bachelor's degree level. The proposal for the second CBA stated that:

*The study will involve multiple cost benefit analyses (CBA) to determine the potential economic and social impact of extending the Pūhoro STEM Academy programme to tertiary study. It will build on the previous study which focused on the secondary school impact of the Pūhoro Academy.*

This report builds off and extends the first analysis which demonstrated that through helping students to achieve NCEA standards the Pūhoro Academy was generating a positive economic impact. This analysis is extended to show that there are potential economic benefits that could be realised through assisting this same cohort of students through to higher levels of education in STEM fields if the Pūhoro Academy were to be extended into a tertiary environment.

## 1.1 Structure of the report

This report presents the results from The AgriBusiness Group's analysis. Chapter 2 describes the Pūhoro Academy and provides some background information on the participants, it also highlights limitations in the data available on which the Academy was assessed. Chapter 3 describes the way in which the cost benefit analysis was designed and the data that were used. This description has been

written for a general audience. It focuses on the ability of the Pūhoro Academy to improve Māori tertiary achievement rates above the national Māori average. It also describes the way in which the economic impacts of the Pūhoro Academy were quantified. Chapter 4 presents the results of the analysis. The net present value as at 11 February 2019 of potential economic benefits from tertiary qualification achievement by Pūhoro cohort of students is estimated to be above **\$14,950,000**. A total cost of approximately **\$1,570,000** was ascribed to the cohort over 7 years. Thus, the analysis finds that Pūhoro has the potential to return around 10 times its cost in economic benefits.



## 2 The Pūhoro Academy

As noted in the introduction, the Pūhoro Academy has been selected for analysis because it specifically aims to invest in the economic potential of its participants through educational development, which can be expected to produce lifetime benefits. This chapter describes this initiative. Section 2.1 draws on Pūhoro reports to introduce the initiative. Section 2.2 provides some descriptive data about the participants in the programme. Section 2.3 summarises the outcomes achieved by the participants as at February 2019.

### 2.1 The Pūhoro Academy Overview

The Pūhoro programme is best described by the 2017 Pūhoro Annual Report:

In January 2016, NASA Aerospace Engineer and Pūhoro Ambassador, Mana Vautier (Te Arawa, Tūhourangi, Ngāti Kahungunu), together with Astronaut Col. Rick Searfoss officially launched Massey University's Pūhoro STEM Academy. Since then, Pūhoro has grown in strength to now offer places for more than 450 Māori students across four regions.

Pūhoro ... is an exciting transformative programme aimed at advancing Māori leadership and capability to deliver a world class science community. The programme works directly with secondary school students and their whanau across the country. It provides students and whanau with mentoring, tutoring, wānanga (experiential learning/field trips) within culturally appropriate settings to help them navigate career pathways into science and technology related industries.

Pūhoro commences with a three-year programme (Years 11 – 13) within secondary school. The Pūhoro Academy partners with a selection of secondary schools from the Manawatū, Bay of Plenty and South Auckland regions to operate a STEM (science, technology, engineering and mathematics) Academy to increase Māori student engagement in STEM programmes. Pūhoro seeks to support secondary schools to prepare their Māori science students for transfer to tertiary study and from there into employment.

All students selected to be a part of Pūhoro are required to participate in and sit a minimum of three of the required external science achievement standards at National Certificate of Educational

Achievement (NCEA) Level 1, 2 and 3. They are also required to attend Pūhoro at wānanga at Massey University each term. The Academy has many aspects to engage with students including career mentoring, study noho, wānanga, tutorials, expo's, study/exam workshops, and kaihautū mentoring.

## 2.2 The Participants in Pūhoro

The Pūhoro Academy is recently established, and data on the success of the participants are still limited. However, Pūhoro staff have stated that in 2016, 75% of students were not on an academic pathway (and therefore did not intend to enrol in external science achievement standards). The AgriBusiness Group was provided the following table of information on the Pūhoro students' numbers and pass rates for the past three years (Table 1.)

**Table 1. Information on NCEA achievement of Pūhoro students**

	Pūhoro Student Numbers	Pūhoro Pass Rates (%)	National Pass Rate (%)
2016	97 (Y11)	98%	82% (Y11)
2017	110 (Y11) 80 (Y12)	92%(Y11), not available(Y12)	78% (Y11), 79% (Y12)
2018	160 (Y11) 93 (Y12)	No data available	No data available

*Data provided by the Business Development Manager and the Business Manager – Pūhoro Academy Programmes.*

Students enter the Academy in Y11 so that the benefits from participation are potentially enjoyed for a working life of four decades. This observation is a significant aspect of the cost benefit analysis in Chapter 4.

## 2.3 Outcomes achieved by the participants

The Pūhoro Academy has had significant success in improving Māori educational performance rates, some key achievements include:

- Ninety-eight percent of Pūhoro Year 11 students passed at least one science achievement standard (this includes internal achievement standards). This is a significant achievement for Pūhoro students resulting in an increase of Māori student achievement in science subjects.
- Ninety-two percent of the 2016 Pūhoro student cohort continued in the Year 12 Pūhoro programme and participated in science courses at NCEA level 2. While improving Māori

participation in STEM subjects, the Pūhoro program is also significantly enhancing overall Māori NCEA pass rates.

- The 2017 Year 11 cohort had a wide range of career aspirations. Many of the students identified engineering, marine biology and physiotherapy as aspirations.
- According to Pūhoro informational resources, Pūhoro students achieved a high-level of merit and excellence endorsements for individual external achievement standards.
- In 2017, 92% of Pūhoro Year 12 students achieved at least one science external achievement standard.
- Of the 97 Year 13 Pūhoro students who left school in 2018, 87% intend to enter tertiary studies at a bachelor's degree level. This is a 74% increase over the national Māori average.

### 3 Economic Benefits of Pūhoro

The purpose of this chapter is to explain the mechanisms by which the Pūhoro Academy produces economic benefits. Section 3.1 brings together the data from Chapter 2 on the previous and current situations of the participants. Section 3.2 presents the income data used in the cost benefit analysis of the following section.

#### 3.1 Impact of the Pūhoro Academy

The analysis is based on the 97 Y13 cohort from 2018 who have now completed High School. These students are the original Pūhoro Academy cohort and have spent up to three years in the academy. Table 2 below provides an overview of the 97 students upon which the economic benefits are estimated.

**Table 2. Improvements in pass rates from the Pūhoro intervention**

Year	Pūhoro Students (n)	Pūhoro students moving to tertiary study at degree level	Pūhoro students moving directly to employment	Pūhoro students unsure	Average Māori students moving to tertiary study at degree level)	Average Māori students perusing no further study	Pūhoro Intervention increase in tertiary enrolments
2018	97*	87% (n84)	9% (n9)	4% (n4)	13%**	49%**	74% increase

\*Data on Pūhoro provided by the Business Development Manager and the Business Manager – Pūhoro Academy Programmes.

\*\* <https://www.educationcounts.govt.nz/statistics/indicators/data/education-and-learning-outcomes/3688>

The following assumptions have been made about the Pūhoro students.

- The students included in the model represent the difference between the national average bachelor’s degree qualification entrance rates for Māori Y13 NCEA students and the Pūhoro student’s bachelor’s degree entrance rates. Students that are in the Pūhoro Academy but would have been assumed to have entered a bachelor’s degree qualification without the

Pūhoro intervention are not included. This may underestimate the impact of Pūhoro, as the students brought into the program are likely to gain exposure to knowledge in STEM fields which could provide significant future benefits.

- It is assumed that students who are unsure or are moving straight to employment will gain no economic benefit from their participation in the Pūhoro Tertiary Academy.

The analysis is therefore based on the cohort of 84 students who intend to enter tertiary studies at a bachelor's degree level. As it is too early to determine the future pass rates of these students, the most recent (2017) data on national bachelor's degree pass rates are used<sup>2</sup>. However, based on the success of Pūhoro for Y11 students, the Pūhoro programme has been estimated to have increased pass rates for its students by 30% above the national average for Māori students undertaking the same level of qualification in the same year.

The economic benefits of the students' educational achievements will only be realised in the future. Thus, the analysis will determine the *potential* economic benefits on the assumption that those currently engaged in the Pūhoro Tertiary Academy.

### 3.2 The income data used in the analysis

The New Zealand Treasury (2019) provides a spreadsheet model for social cost benefit analysis along with other resources offering guidance for analysts using this tool. This CBAX model incorporates a list of publicly available New Zealand data that organisations can use to value the impacts of an intervention such as the Pūhoro programme. The Impacts Database of the Treasury's CBAX model includes impacts on marginal annual income data categorised by qualification level rebased to 2019 values. The impacts database is highly generic in estimating the value of educational achievements, providing only one level of impact for tertiary degree achievement.

To more accurately estimate the economic impacts, we have conducted a more detailed analysis of the potential economic opportunities from different fields of study. As the Pūhoro Academy focuses on STEM achievement, this is an important distinction. From the cohort, 74 students indicated their intended future profession they will study towards, these professions were then mapped to the relevant bachelor's degree required to enter the profession. It is important to note that some

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<sup>2</sup> <https://www.educationcounts.govt.nz/statistics/indicators/data/education-and-learning-outcomes/3672>

professions indicated e.g. doctor, require multiple qualifications, as the analysis is done at a bachelor's degree level only, the CBA estimates only the future economic benefit of the bachelor's degree component of a profession's pathway. For a doctor this means estimating the future economic impact of achieving a Bachelor of Health Sciences. This is a conservative approach that will likely underestimate future earning potential. The following economic impacts (Table 3) are attributed to the Pūhoro programme to different degrees based on the number of students intending to enrol in these courses.

**Table 3. CBAX impacts used to determine economic benefits**

<b>Degree</b>	<b>Provider</b>	<b>Marginal value p.a. (rebased to 2019)</b>	<b>Students (n)</b>
Bachelor of Engineering	University of Waikato	\$29,233	5
Bachelor of Architectural Studies	Otago Polytechnic	\$27,101	3
Bachelor of Commerce	University of Auckland	\$29,748	2
Bachelor of Teaching	University of Otago	\$28,083	6
Bachelor of Veterinary Technology	Massey University	\$52,667	2
Bachelor of Laws	Auckland University of Technology	\$35,922	2
Bachelor of Agriculture	Lincoln University	\$29,979	1
Bachelor of Health Sciences	University of Auckland	\$24,505	10
Bachelor of Science	Auckland University of Technology	\$37,216	13
Bachelor of Computer and Information Sciences	Auckland University of Technology	\$36,943	4
Bachelor of Arts	Auckland University of Technology	\$17,662	1
Bachelor of Aviation	Massey University	\$79,631	1
Bachelor of Exercise and Sport Science	Universal College of Learning (UCOL)	\$23,500	6
Bachelor of Medical Laboratory Science	Auckland University of Technology	\$37,216	5
Bachelor of Physiotherapy	University of Otago	\$31,196	9
Bachelor of Science	Massey University	\$37,216	4
<i>Treasury generic (course unknown)</i>	<i>Generic</i>	\$21,105	10

Careers NZ<sup>3</sup> is used to provide an estimate for the earning potential for each degree three years out from graduation. This is an early career salary and will likely underestimate the lifetime earnings of graduates. Age influences earning potential. Statistics NZ was used to determine the impact of age on earnings as shown in Figure 1 below.

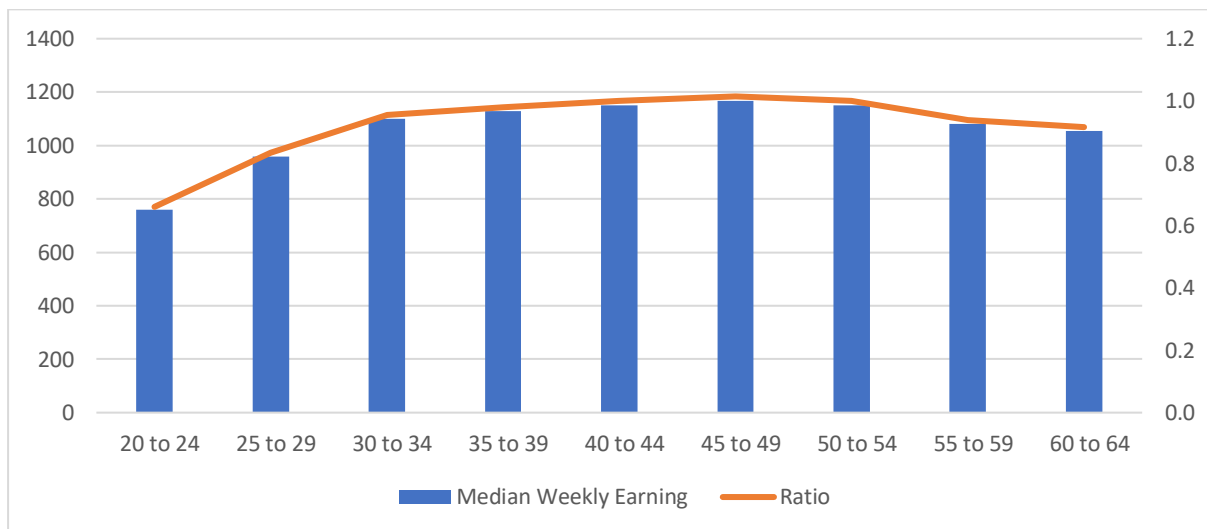


Figure 1. The impact of age on earning potential.

The ratio of earnings was used to adjust the projected earnings figures by 1.4x higher to reflect the increase in salary that occurs with age while compensating for a late career decrease. The CBA uses a marginal rate for income. Statistics NZ data was used to derive the average median earnings for people with an upper high school qualification. In 2018, across all age groups, this was found to be \$39,318. The marginal value rates used in the CBA are therefore calculated as follows:

$$(\text{Average salary for qualification 3 years after graduation} - \$39,318) * 1.4$$

<sup>3</sup> <https://www.careers.govt.nz/>

## 4 Results of the Cost Benefit Analysis

This chapter uses resources provided by Treasury (2015, 2018) and information provided by Statistics New Zealand and Careers New Zealand to undertake a consistent and systematic cost benefit analysis of the Pūhoro Academy, using information available at February 2019. The analysis also takes direction from Dalziel et al. (2017) *Measuring the Economic Impact of Whānau Ora Programmes: He Toki ki te Mahi Case Study*, which estimates the economic benefits of a Māori trade skills training programme.

It begins in section 4.1 by describing the counterfactual; that is, the assumed outcomes in the absence of the Pūhoro Academy. Section 4.2 presents a detailed account of how the potential economic benefits of the initiative have been calculated, including an explanation of the ‘discount rate’ used. Section 4.3 then presents the estimated economic costs. Section 4.4 reports the results of a sensitivity analysis, examining the impact of changing key assumptions in the cost benefit analysis. Section 4.5 considers the impact of the programme beyond what is quantified in the analysis.

### 4.1 The counterfactual

The Guide to Social Cost Benefit Analysis explains that the counterfactual is the situation that would exist if a policy does not go ahead (Treasury, 2015, p. 9). In the absence of the Pūhoro Academy, it is expected that 13% of Māori students would enter tertiary studies at a bachelor’s degree level. Based on information provided by Pūhoro, 87% of Pūhoro Academy Y13 graduates intend to enter tertiary studies at a bachelor’s degree level. This accounts for 84 of the 97 students in the cohort. In the absence of Pūhoro, 13 students would have been expected to move onto tertiary studies. The analysis assumes that economic benefits will accrue to 87% (71) of the students. That is, the 84 students entering tertiary study minus 13% (11) students who would have been expected to enter tertiary studies without the Pūhoro intervention.

Consequently, the assumed counterfactual is that in the absence of Pūhoro, 87% of the tertiary studies cohort would gain no additional economic benefit from their participation in the Pūhoro programme but would return to their likely previous career path of a person with a higher secondary school qualification. The counterfactual is therefore the difference between average bachelor’s degree enrolment and achievement for Māori students, and bachelor’s degree enrolment and achievement for Pūhoro students.



While we have been provided data on intended enrolments and academic fields of enrolment, the CBA is being conducted on the *proposed* extension of Pūhoro into tertiary education. Therefore, the CBA assumes that the Pūhoro cohort enrolls in the indicated fields and achieves qualifications at the national average rate.

To keep the analysis conservative, it is assumed that students who are not expected to pass a qualification level will get no future benefit from higher educational achievements. A national average pass rate of 64% is applied to all qualifications. Additionally, the economic impact for each degree field is quantified using average earnings three years after graduation. This salary level is often significantly lower than professionals in these fields will earn as they progress in their careers.

## 4.2 The estimated potential economic benefits

The 97 students analysed in this chapter can be grouped into four categories of participants, all of which contribute to the estimated potential economic benefits. To reiterate, the analysis only includes students who would not have been expected to enter tertiary studies at a degree level in the absence of the Pūhoro programme.

- 9% of students moving into employment will receive no economic benefit from the Pūhoro tertiary extension.
- Of the 84 remaining students, 13% would have been expected to enter a degree programme in the absence of Pūhoro, this 13% is discounted across all economic impacts.
- From the remaining 87% of the cohort entering university to study at a bachelor's degree level, 64% are expected to pass their qualifications.

The potential economic benefits come from the remaining 45 students who are on a higher income path due to the qualifications they are expected to obtain as a result of the Pūhoro intervention. Students who are not expected to pass or would have been expected to pass in the absence of the Pūhoro programme are not included in the analysis. Based on their age group (Y13 students), it is possible to calculate for the remaining years of their working life the marginal income benefits assumed in the counterfactual.

The bachelor's degree programmes considered are either 3 or four years in duration. Because the intervention is targeting young people, the economic benefits continue for a long time, up to 40

years. Hence the total benefits to a participant are substantial. Second, larger gains come from successful completion of higher levels of qualifications. In addition, Pūhoro is targeting STEM qualifications which tend to attract larger salaries than other fields. Pūhoro is not currently operating in a tertiary environment, therefore there are no data on degree completion rates. This is why the analysis refers to the initiative's *potential* economic benefits.

This report follows Dalziel et al. (2017 p.20) in the selection of an appropriate discount rate, they state:

To calculate the total net present value of these benefits, it is necessary to determine a suitable discount rate, acknowledging “that most people would prefer receiving a dollar today over receiving a dollar in a year’s time” (Treasury, 2015, p. 34). This preference is linked to interest rates earned on savings, and so the discount rate is set to reflect current interest rates and the risks of social investment of this nature. The discount rate recommended by [Treasury (2018)] is 6 per cent, which is the rate used in this study.

Based on these assumptions, the total net present value of the potential economic benefits at 11 February 2019 is calculated by The AgriBusiness Group to be above **\$14,950,000**.

#### 4.3 The estimated economic costs

Information on costs for the programme was limited to a single budget sheet for 2017. This was used to derive a cost of \$2982 per student per annum. These costs are based on operating the Pūhoro Academy in a High School environment. The analysis provided here considers the potential of continuing Pūhoro in a Tertiary environment. As no estimates of likely costs have been provided for the tertiary scenario, the same high school costs are used. It is assumed that the costs will remain similar as the services provided are expected to be similar.

Due to the high pass rates (between 95-98%) achieved by Pūhoro at a high school level the analysis takes a conservative approach in assuming that the costs for each student in the cohort will remain throughout the 3-4 years of study. This may overestimate costs as some students will drop out of the programme or the qualification.

All the fixed costs are assigned to the current cohort of participants, although it is hoped that the initiative will continue to operate with new entrants as time proceeds. This represents another

conservative assumption in the analysis. Marginal costs would likely decrease as new students come into the academy.

The costs based on the 2017 costs of \$2982 per student per annum and then adjusted based in the CBAX model to reflect the appropriate years adjustment factor (Table 4).

**Table 4. Estimated costs of the Pūhoro Academy cohort for over seven years**

Year	2016	2017	2018	2019	2020	2021	2022 (4-year degree students)
Total Costs (inflation adjusted)	\$289,254	\$294,256	\$298,375	\$302,789	\$308,086	\$314,265	\$70,762

Based on the assumptions made above, the total net present value of the economic costs associated with participants at 11 February 2019 is calculated to be \$1,570,000.

This cost is well below the estimated net present value of potential economic benefits in Section 4.2 (above \$14 million). Thus, the Pūhoro initiative is producing potential economic benefits beyond its costs.

#### 4.4 Sensitivity analysis

The cost benefit analysis reported in sections 4.2 and 4.3 suggest that the net potential economic benefits of the Pūhoro Academy is **\$14,950,000 - \$1,570,000 = \$13,380,000**.

The final step in a cost benefit analysis is to reflect on whether the assumptions in the analysis have unintentionally incorporated an ‘optimism bias’, leading to overestimation of future benefits or underestimation of costs (Treasury, 2015, p. 31). The alternative is to consider pessimistic scenarios to understand the sensitivity of the result to key assumptions (Dalziel et al. 2017).

It was assumed that the Pūhoro Academy can increase bachelor’s degree level enrolments for its students by 74% based on students stated intentions. Table 5 below considers three additional scenarios – in the first - only half the students who have stated their intention to enrol, actually enrol, in the second - only 32% of the cohort pass their qualifications (half the national average), in the third - only half the students who have stated their intention to enrol, actually enrol and only 32% of these pass.

**Table 5. Sensitivity analysis of three scenarios of Pūhoro’s impact**

	Base Scenario	44% enrolment	32% pass rate	44% enrolment with 32% pass rate
	<b>40-Year NPV \$m</b>			
Total marginal impact	14.95	8.79	7.47	4.4
Total cost of initiative	1.57	1.57	1.57	1.57
Net economic benefits	13.38	7.22	4.8	2.83
Average net economic benefit per cohort member (40y)	\$159,238	\$85,980	\$70,279	\$33,651
CBA Ratio	9.5	5.6	4.8	2.8

Table 5 shows that in all cases the Pūhoro Academy covers its costs by a factor of 2.8 to 5.6 times. We suggested in the first CBA of the Pūhoro Academy that large economic impacts could be possible through tertiary study. As the Pūhoro Academy has not been operating long enough to follow students through a tertiary study path, there is significant uncertainty in quantifying their potential impacts.

Due to the high lifetime benefits that are possible through higher educational achievement, the Pūhoro academy covers its costs under all scenarios considered and provides a significant economic benefit under the primary scenario. Hence the fundamental conclusion of the analysis, that the Pūhoro Academy is likely to continue generating a positive economic impact is robust.

The stated intentions of the Pūhoro Academy students suggest that the Academy has had a significant impact on their future educational pathways. The analysis has assumed that these students will continue to receive support from the Pūhoro Academy throughout their tertiary studies. However, even in the absence of this support, it is likely that these students have been put on an educational pathway they are unlikely to have followed without the support of Pūhoro.

## 5 Additional Discussion – further benefits of education

The CBA provided in this report has focused on the private benefits to the individual students involved with the Pūhoro Academy, however, there are likely to be significant and widespread social benefits which would be generated. Quantifying social benefits is complex and the data that are available do not provide a complete picture of the widespread social benefits of education. However, financial data tends to be more easily obtainable. The financial data that is available focuses on costs rather than benefits, while the avoidance of costs can be a significant benefit, it provides a narrow window into the benefits of education.

The Treasury (2017) has considered the potential service costs that at-risk children may attract. These costs include income support payments, costs associated with serving sentences administered by the Department of Corrections, and costs associated with the services provided by CYF in childhood. In 2016 dollars, projected costs are less than \$50,000 per person for children and youth who are not considered to be at risk, while they are at least \$180,000 and as much as \$410,000 for different risk groups by the age of 35 (Treasury, 2017). There are four key indicators of risk, the more indicators that a child has, the more they are likely to require additional services. Having a mother with no formal qualifications is one of the four indicators<sup>4</sup> which emphasises the important role of education in intergenerational wellbeing. A child exposed to just one risk indicator is expected to require an additional \$65,000 in services by the age of 35. This cost increases exponentially with additional risk factors.

In a recent data science presentation<sup>5</sup>, data from a cohort of all people born in New Zealand in 1990 were used to measure the cost of services eight years out from high school completion. From the cohort, the top 16% required more funding than the remaining 84%. These 16% represent people in the most disadvantaged socio-economic position. The top 1% required \$160million in services over the 8 years after completing high school. The majority of these people did not have NCEA Level 2. While a lack of NCEA Level 2 cannot be described as causing the need for more services, it is an important associated factor. The ripple effects from low educational achievement can be vast and last a life time. A report from Whitehead & Walker (forthcoming) demonstrates that a parent's aspirations for their children's educational achievement is one of the main variables that can predict

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<sup>4</sup> The other three are: being mostly supported by benefits since birth; having a CYF finding of abuse or neglect; and having a parent with a prison or community sentence.

<sup>5</sup> <https://www.youtube.com/watch?v=sB6Ww9-WMGw>

whether their child will go on to own a home. In turn, home ownership has been shown to have significant health and wellbeing benefits for families and helps to create intergenerational wealth.

A significant body of research exists which describes the non-market benefits of education. For example, Wolfe & Haveman (2002) describe:

- a likely positive link between one's own schooling and the schooling received by one's children;
- a likely positive association between one's own schooling and the health status of one's family members; a likely positive relationship between one's own education and
- one's own health status; a likely positive relationship between one's own education and the efficiency of choices made, such as consumer choices (the efficiency of which contributes to a well-being similar to the contribution of money income);
- a relationship between one's own schooling and fertility choices (for example, decisions of one's female teenage children regarding nonmarital childbearing); and
- a relationship between schooling in one's neighbourhood and youth decisions regarding their level of schooling, nonmarital childbearing, and participation in criminal activities.

Higher levels of education can be assumed to bring higher levels of benefits. We do not try to quantify these benefits here as robust data are not available. However, the Pūhoro Academy is generating significant social benefits in terms of health, education, whanau relationships, wealth creation and the avoidance of social service costs. These benefits have intergenerational impacts that extend far beyond and individuals' lifetime. A parent's level of qualifications and their expectations for their children's educational achievement have both been shown to generate significant future impacts for their children. Through a small intervention in a child's educational pathway, the Pūhoro Academy has the potential to generate significant financial and wider socio-economic benefits.

## 6 Conclusion

The cost benefit analysis of the Pūhoro Academy reported in sections 4.2 and 4.3 calculates that the potential economic benefits outweigh the economic costs by a factor of around 10 to 1. The analysis is an illustration of the power of a successful intervention in a young person's life; in this case, the initiative has the potential to increase the lifetime earnings of a group of 71 Māori students. For those students who go on to complete a bachelor's degree, the Pūhoro Academy is assumed to have a significant impact on their lifetime. The sensitivity analysis reveals that even under the most conservative assumptions, potential economic benefits outweigh the economic costs by a factor above 2.8 to 1.

The sensitivity analysis in section 4.4 indicates that the results from the cost benefit analysis are robust. The Pūhoro Academy is delivering economic benefits above its costs. These benefits are being realised by students obtaining qualifications that they would not have been likely to obtain in the absence of the Pūhoro Academy. It is likely that the benefits considered in this analysis will ripple out through whānau, both in the present and in the future. Section 4.5 discussed some of these benefits at a high level. The AgriBusiness Group has not attempted to quantify these ripple effects, which reinforce the conclusion that considerable value is being created through this initiative. Additionally, the sometimes highly conservative assumptions used throughout the report likely underestimate the direct economic impacts that Pūhoro has on its students. If the Academy were to continue to support students through tertiary education, significant economic benefits could be achieved. Further, the focus on STEM subjects is likely to amplify these benefits, creating significant benefits to the individual, helping Māori build intergenerational wealth, and generating wide spread socio-economic value.

## 7 References

- Dalziel, Paul, Caroline Saunders and Meike Guenther (2017). Measuring the Economic Impact of Whānau Ora Programmes: He Toki ki te Mahi Case Study. AERU Research Report No. 343, prepared for Ihi Research and Development. Lincoln University: Agribusiness and Economics Research Unit.
- NZAQ (2018a). Annual Report on NCEA and New Zealand Scholarship Data and Statistics (2017) - May 2018. Wellington. New Zealand Qualifications Authority
- NZAQ (2018b). Quarterly Report 1 January – 31 March 2018. Wellington. New Zealand Qualifications Authority
- Treasury (2015). Guide to Social Cost Benefit Analysis. Wellington. The Treasury.
- Treasury (2017). Insights – Informing policies and services for at-risk children and youth. Wellington. The Treasury.
- Treasury (2018). CBAX Tool User Guidance. Wellington. The Treasury.
- Whitehead J and Walker G (forthcoming). Ngā kaihanga, ngā noho, ngā tangata – exploring the factors affecting Māori home ownership. Report prepared for the Building Better Homes Towns and Cities National Science Challenge.
- Wolfe, B. L., & Haveman, R. H. (2002). Social and nonmarket benefits from education in an advanced economy. Symposium conducted at the meeting of the Conference series-federal reserve bank of Boston.