A Genuine Progress Indicator
for the Auckland region

Summary Report

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Executive Summary

Introduction

The Genuine Progress Indicator (GPI) is a concept that is becoming increasingly popular world-wide as a measure of human welfare. Over the last decade the GPI has been promoted internationally as an alternative to the Gross Domestic Product (GDP) measure. Unlike GDP, the GPI incorporates aspects of the non-market economy, separating welfare-enhancing benefits from welfare-detracting costs, correcting for the unequal distribution of income, and distinguishing between sustainable and unsustainable forms of consumption (Talbert et al. 2007).

This report presents the findings of a study conducted by the New Zealand Centre of Ecological Economics (NZCEE) and Market Economics Ltd (MEL) on the GPI for the Auckland region.

The Auckland region GPI began with a valuation of total personal consumption expenditure in the region. A total of eighteen additional socio-economic and environmental components of welfare were then included, with each component representing either an addition to, or subtraction from, the region’s total personal consumption expenditure. The study covers the period from 1990 to 2006.

Comparisons in this report with the soon-to-be-released national GPI study (prepared by NZCEE and MEL) are based on the latest (at time of publication of this report) draft versions of the national socio-economic and environmental GPI technical reports. These reports are however, subject to ongoing review and the final national results may differ from those reported in this study.

All dollar figures in this report are NZ$\textsubscript{2006} dollars unless stated otherwise.

Headline results

Over the study period, the Auckland region GPI grew from $28 billion to $47 billion, an annual average rate of 3.1 percent. This can be compared to the region’s GDP which grew at an annual average rate of 2.5 percent. Over the same period, the national GPI rose from $93 billion in 1990 to $131 billion in 2006, an annual average rate of 2.2 percent, while national GDP grew at an annual average rate of 3.1 percent.

In 1990 the Auckland region GPI amounted to 75.8 percent of Auckland region GDP, while in 2006 it amounted to 83.0 percent.

When the Auckland region GPI is expressed in per capita terms the results are relatively static over the study period – rising only 12.7 percent (or an annual average growth rate of 0.8 percent). By comparison, the national GPI per capita increased by 15.4 percent or an annual average of 0.9 percent.

The level of socio-economic benefits that are accounted for in the GPI climbed by $23,489 million, or a rise of 70.4 percent. The socio-economic costs and the environment costs also increased, by $5,057 million (139.4 percent) and $338 million (27.1 percent) respectively – a total of $5,395 million for the two cost components.

Overall, the net increase in the Auckland region GPI for the study period is estimated to be $18,094 million.

All dollar figures in this report are NZ$\textsubscript{2006} dollars unless stated otherwise.
Component results

Personal consumption is the major contributor, accounting for $14,488 million or 61.7 percent of the total socio-economic benefits increase over the study period. This was followed by the value of household and community work at $3,731 million (15.9 percent) and non-defensive public consumption at $3,623 million (15.4 percent). Lastly, the value of services of public capital added $1,647 million (7.0 percent) over the study period.

The most significant components of the socio-economic costs were income inequality which accounts for $3,615 million, or 71.5 percent of the increase in total socio-economic costs over the study period. The cost of commuting makes up $788 million (15.6 percent), the cost of overwork $520 million (10.3 percent), and the remaining socio-economic cost components together account for $133.4 million (2.6 percent) of the increase.

In terms of the increase in total environmental costs over the study period, the most significant contributions came from: climate change at $109 million (32.3 percent of total environmental costs); noise pollution at $80 million (23.6 percent), loss and damage to terrestrial ecosystem at $69 million (20.3 percent) and the loss of soils at $67 million (19.9 percent). Negligible contributions, to the sum of approximately $13.1 million (3.9 percent), where made by the loss of air quality, loss of non-renewable resources, and land degradation components. It is worth noting that in the case of the loss of air quality component there was a net benefit of $22 million over the study period.

Outstanding issues

This study represents a unique first step in creating a GPI for the Auckland region.

It is one of the first fully evaluated GPls to be developed within the New Zealand context. Moreover, it is among only a few sub-national GPls to be developed globally. It builds on past efforts aimed at improving measurement of national well-being or genuine progress.

There are a number of outstanding theoretical, methodological and empirical issues with the Auckland region GPI which are beyond the scope of the current study, but which future work may address.
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All dollar figures in this report are NZS_{2006} dollars unless stated otherwise.
Introduction

The Genuine Progress Indicator (GPI) was first developed in 1995 by the non-profit organisation, Redefining Progress. Like its forerunner, the Index of Sustainable Economic Welfare (ISEW), the GPI is promoted on the grounds that it attempts to undertake a more holistic measure of welfare than GDP. It incorporates aspects of the non-market economy, separating welfare-enhancing benefits from welfare-detracting costs, correcting for the unequal distribution of income, and distinguishing between sustainable and unsustainable forms of consumption (Talbert et al. 2007). Among the nations for which a GPI has been developed are the United States, the United Kingdom, Germany, Australia, China and India.

In January 2009, the Auckland Regional Council (ARC) contracted the New Zealand Centre of Ecological Economics (NZCEE) and Market Economics Ltd (MEL) to develop a GPI for the Auckland region covering the period 1990 to 2006. This work builds on NZCEE and MEL’s national GPI project which has been funded by the Foundation of Research, Science and Technology under the ‘Sustainable Pathways’ programme (contract number MAUX0306).

The starting point for the valuation of the Auckland region GPI was total Personal Consumption expenditure for the Auckland region. A total of twenty additional socio-economic and environmental components of welfare were then taken into consideration, with every component representing either, an addition to, or subtraction from, the total personal consumption expenditure (Figure 1). Of the twenty components considered for inclusion, a total of eighteen have been included in the Auckland region GPI – the loss of wetlands and ozone depletion components were excluded.

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1 These methodologies have been independently peer reviewed by leading international GPI practitioners.

All dollar figures in this report are NZS\textsubscript{2006} dollars unless stated otherwise.
Table 1 provides a brief description of each component of the Auckland region GPI. The table is divided into three sections that cover the socio-economic benefits, socio-economic costs and environmental costs. Both component descriptions and brief methodologies are provided. This has been necessary as often components are only partially valued due to data paucity and/or lack of appropriate valuation techniques.

For a full account of the valuation methods employed in developing the Auckland region GPI please refer to McDonald et al (2009).

This report

There are two key outputs of the Auckland region GPI study:

- this summary report that outlines the major findings and trends in the Auckland region GPI; and
- a technical report that describes in detail the data and methods used to estimate the Auckland region GPI (McDonald et al (2009)).

In this summary report, the key findings, trends and causal mechanisms underpinning the GPI components are discussed. The report is divided into three sections:

- headline results;
- socio-economic component results; and
- environmental component results.
Matters for further consideration are also presented at the end of the report, and the Appendix includes brief discussion on several theoretical, methodological and empirical matters.

Comparisons in this report with the soon-to-be-released national GPI study (prepared by NZCEE and MEL) are based on the latest (i.e. at the time of publication) draft versions of the national socio-economic and environmental GPI technical reports. These reports are subject to ongoing review and the final national results may differ from those reported in this study.

All dollar figures in this report are NZ$\textsubscript{2006} dollars unless stated otherwise.
Table 1: Components of the Auckland region GPI – valuation methods applied

<table>
<thead>
<tr>
<th>Component</th>
<th>What is valued</th>
<th>Brief description of valuation method applied</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Personal consumption</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ Personal consumption</td>
<td>All household outlays on consumer goods and services along with expenditure</td>
<td>Auckland region consumption per capita multiplied by resident population.</td>
</tr>
<tr>
<td></td>
<td>on non-capital items by private non-profit organisations serving households.</td>
<td></td>
</tr>
<tr>
<td>- Income distribution</td>
<td>Income distribution between different income quintile groups.</td>
<td>An Income Distribution Index generated from Gini coefficients.</td>
</tr>
<tr>
<td>+ Weighted personal consumption</td>
<td>Personal consumption adjusted for income inequality.</td>
<td>Derived by dividing personal consumption by the Income Distribution Index and then multiplying by 100.</td>
</tr>
<tr>
<td><strong>Socio-economic benefits</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ Public consumption (non-defensive)</td>
<td>The value of goods and services provided by the government for the consumption</td>
<td>Public sector consumption by category (as derived from regional input-output tables) multiplied by an assumed</td>
</tr>
<tr>
<td></td>
<td>by the community.</td>
<td>non-defensive proportion.</td>
</tr>
<tr>
<td>+ Household and community work</td>
<td>Non-leisure time spent on household and community work.</td>
<td>Time spent on household and community work by age-sex cohort multiplied by the median wage rate for housekeepers.</td>
</tr>
<tr>
<td>+ Services of public capital</td>
<td>Non-market services rendered by government-owned capital stocks.</td>
<td>Estimated as the depreciation of capital stocks (including non-defensive and non-market services) plus the</td>
</tr>
<tr>
<td></td>
<td></td>
<td>opportunity cost of government investment funds.</td>
</tr>
<tr>
<td><strong>Socio-economic costs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Cost of unemployment</td>
<td>The involuntary leisure time that unemployment brings.</td>
<td>Total unemployed hours multiplied by the average hourly wage rate.</td>
</tr>
<tr>
<td>- Cost of underemployment</td>
<td>The involuntary leisure time that underemployment brings.</td>
<td>Total underemployed hours (part-time employees looking for full time work) multiplied by the average hourly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>wage rate.</td>
</tr>
<tr>
<td>- Cost of overwork</td>
<td>The loss of leisure time from overwork.</td>
<td>Total hours overworked multiplied by the average wage rate.</td>
</tr>
<tr>
<td>- Cost of private defensive expenditure on health</td>
<td>Resident household private defensive expenditure on health.</td>
<td>Total private expenditure on health multiplied by an assumed defensive proportion.</td>
</tr>
<tr>
<td>- Cost of commuting to work</td>
<td>The direct costs (i.e. vehicle purchases, maintenance, bus and train fares,</td>
<td>Direct costs are calculated for both private and public components of commuting to work. Time costs are</td>
</tr>
<tr>
<td></td>
<td>etc) and time costs of commuting to work.</td>
<td>estimated as total hours spent on commuting by employed people multiplied by a cost per hour.</td>
</tr>
<tr>
<td>- Cost of crime</td>
<td>Private sector property loss, property damage and preventative expenditure</td>
<td>Total offences multiplied by a cost per offence.</td>
</tr>
<tr>
<td></td>
<td>including associated administration costs borne by insurance companies.</td>
<td></td>
</tr>
</tbody>
</table>

All dollar figures in this report are NZ$2006 dollars unless stated otherwise.
### Component | What is valued | Brief description of valuation method applied
--- | --- | ---
**Environmental costs** |  |  |
- Loss and damage to terrestrial ecosystems | Losses resulting from invasive pests and weeds and indigenous forest change. | Calculated as the loss and damage to terrestrial ecosystems by 1) pest-related annual expenditure as taken from central government estimates, 2) biodiversity loss from milling old growth native forest valued on the basis of sawn timber extracted.
- Loss of soils | Loss of fertile soil to the built environment and erosion of agricultural land. | Agriculture erosion is the estimated as the tonnes of soil lost annually multiplied by a cost per hectare. Hectares of agricultural land lost to urban expansion have been valued on the basis of ecosystem services loss.
- Loss of air quality | Increases in mortality rate, hospital admissions and emergency department visits, school absences, lost of work days and restricted activity days. | Calculated by weighing the cost of loss of life years and reduced activity days for 2001 by an air pollution index (PM10).
- Pollution from solid waste | Waste to landfill and contaminated sites. | Estimated costs for remediation of contaminated sites in the Auckland region and the tonnes of waste going to landfill.
- Climate change | The cost of long-term environmental damage resulting from all greenhouse gas emissions (i.e. agriculture, forestry, industry and energy). | Calculated by multiplying annual greenhouse gas emissions by an estimate of the marginal social cost of emitting an additional tonne of carbon dioxide into the atmosphere.
- Loss of water quality | Turbidity etc. | The cost of water quality remediation - management of wetland ponds and riparian planting from stormwater treatment.
- Loss of non-renewable resources | The consumption of income-generating capital and results in running down capital to generate sustainable income. | The cost of aggregate and rock extraction, using the El Serafy method.
- Noise pollution | Unwanted or offensive sounds coming from a variety of sources. | The increase in the number of vehicle kilometres travelled has been used to approximate the loss of amenity from noise exposure.
- Loss of wetlands | Change in wetland areas. | No valuation undertaken as no definitive change recorded in the study period.
- Ozone depletion | | Ozone depletion in the Auckland region is not measured as the ozone depleting emissions are negligible.

**Notes:**

1. Only a brief description is provided in this table. Please refer to the technical report (McDonald et al, 2009) for full details.
2. Defensive expenditures are defined by Leipert (1989, p.28) as “expenditure … made to eliminate, mitigate, neutralize, or anticipate and avoid damages and deterioration that industrial society’s process of growth has caused to living, working, and environmental conditions.”

All dollar figures in this report are NZ$2006 dollars unless stated otherwise.
Headline Results

When regional GPI is compared to regional GDP over the study period, there are two notable findings:

- the Auckland region GPI is lower than regional GDP; and
- the Auckland GPI tracks closely with regional GDP.

A more in depth analysis of these findings reveals several underlying changes:

- the plateau in both indicators during the early 1990s is a lag effect largely attributable to a period of relatively slow economic growth and recession following the central and local government reforms of 1984 to 1993; and
- while both the Auckland region GPI and GDP experienced some recovery following the reforms, the two indices have slowly diverged since the millennium.

Comparisons of GPI and GDP

Over the study period 1990 to 2006, the Auckland region GPI grew from $28 billion to $47 billion – representing an annual average rate of 3.1 percent. Over the same period the national GPI grew from $93 billion to $131 billion, a rise of 2.2 percent. (By comparison, national GDP grew at an annual average rate of 3.1 percent).

Growth in the Auckland region GPI and GDP for the study period are shown in Figure 2.

The Auckland region’s per capita GPI has been relatively static over the past 17 years; rising by only 12.7 percent, or an average annual growth rate of 0.8 percent. By comparison, the national GPI per capita grew by 15.4 percent, or an annual average rate of 0.9 percent.

Auckland regional per capita GDP rose 2.9 percent (0.2 percent per annum) over the same period, while national GDP per capita rose 35 percent (1.9 percent per annum).

These results are summarised in Table 2 below.

Table 2: Summary GPI and GDP annual average percentage growth, 1990 -2006

<table>
<thead>
<tr>
<th></th>
<th>Auckland region</th>
<th>New Zealand</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPI</td>
<td>3.1</td>
<td>2.2</td>
</tr>
<tr>
<td>GPI per capita</td>
<td>0.8</td>
<td>0.9</td>
</tr>
<tr>
<td>GDP</td>
<td>2.5</td>
<td>3.1</td>
</tr>
<tr>
<td>GDP per capita</td>
<td>0.2</td>
<td>1.9</td>
</tr>
</tbody>
</table>
In 1990 the Auckland region GPI amounted to 75.8 percent of Auckland region GDP, while in 2006 it amounted to 83.0 percent. By comparison, the national GPI in 1990 amounted to 94.2 percent of national GDP, while in 2006 it amounted to 80.9 percent.

Summary of net contributions by components

Overall, the net increase in the Auckland region GPI for the study period, from 1990 to 2006, is estimated to be $18,094 million. The level of socio-economic benefits climbed by $23,489 million, or an overall rise of 70.4 percent. The socio-economic costs and the environment costs increased respectively by $5,057 million (139.4 percent) and $338 million (27.1 percent) - $5,395 million in total.

Personal consumption was the major contributor to socio-economic benefits during the study period, accounting for $14,488 million or 61.7 percent of the total socio-economic benefits increase. This was followed by the value of household and community work at $3,731 million (15.9 percent) and non-defensive public consumption at $3,623 million (15.4 percent). Lastly, the value of services of public capital added $1,647 million (7.0 percent).

The most significant components of the socio-economic costs were income inequality; which account for $3,615 million, or 71.5 percent of the total increase in socio-economic costs. The cost of commuting made up $788 million (15.6 percent), the cost of overwork $520 million (10.3 percent), while the remaining socio-economic cost components together account for $133.4 million (2.6 percent).

In terms of the increase in total environmental costs over the study period, the most significant contributions came from: climate change at $109 million (32.3 percent of total environmental costs); noise pollution at $80 million (23.6 percent), loss and damage to terrestrial ecosystem at $69 million (20.3 percent) and the loss of soils at $67 million (19.9 percent). Negligible contributions, to the sum of approximately $13.1 million (3.9 percent), where made by the loss of air quality, loss of non-renewable resources, and land degradation components. It is worth noting that in the case of the loss of air quality there was a net benefit of $22 million over the study period.

Figure 3 provides a summary of the net contributions by socio-economic and environmental components over the study period 1990 to 2006 as measured in $2006 terms. The top box shows the net period changes by the major categories, namely socio-economic benefits, socio-economic costs, and environmental costs. The bottom three figures, in turn, provide a breakdown of each major category into its constituent components.

Further on, Table 2 provides a comprehensive year-by-year valuation of each component of the Auckland region GPI including cumulative impacts and net change over the entire study.
All dollar figures in this report are NZ$2006 dollars unless stated otherwise.
Table 3: Annual change by GPI component, Auckland region 1990 - 2006

<table>
<thead>
<tr>
<th>Year</th>
<th>Personal Consumption ($ million)</th>
<th>Socio-Economic Benefits ($ million)</th>
<th>Socio-Economic Costs ($ million)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Personal consumption</td>
<td>Income Distribution Index</td>
<td>Personal Consumption adjusted by Income Distribution</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Public Consumption Expenditure (Non-Defensive)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Value of Household and Community Work</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Services of Public Capital</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cost of Unemployment</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cost of Under employment</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cost of Overwork</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Private Defensive Expenditure on Health</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cost of Commuting</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cost of Crime</td>
</tr>
<tr>
<td></td>
<td>1990</td>
<td>18,220</td>
<td>103</td>
</tr>
<tr>
<td></td>
<td>1991</td>
<td>18,072</td>
<td>106</td>
</tr>
<tr>
<td></td>
<td>1992</td>
<td>18,279</td>
<td>106</td>
</tr>
<tr>
<td></td>
<td>1993</td>
<td>18,881</td>
<td>109</td>
</tr>
<tr>
<td></td>
<td>1994</td>
<td>20,371</td>
<td>111</td>
</tr>
<tr>
<td></td>
<td>1995</td>
<td>21,486</td>
<td>111</td>
</tr>
<tr>
<td></td>
<td>1996</td>
<td>23,051</td>
<td>112</td>
</tr>
<tr>
<td></td>
<td>1997</td>
<td>24,115</td>
<td>113</td>
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<tr>
<td></td>
<td>1998</td>
<td>25,838</td>
<td>110</td>
</tr>
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<td>1999</td>
<td>26,583</td>
<td>112</td>
</tr>
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<td>2000</td>
<td>27,956</td>
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<tr>
<td></td>
<td>2001</td>
<td>27,851</td>
<td>114</td>
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<td></td>
<td>2002</td>
<td>29,049</td>
<td>115</td>
</tr>
<tr>
<td></td>
<td>2003</td>
<td>30,928</td>
<td>115</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>33,805</td>
<td>115</td>
</tr>
<tr>
<td></td>
<td>2005</td>
<td>33,446</td>
<td>115</td>
</tr>
<tr>
<td></td>
<td>2006</td>
<td>32,708</td>
<td>115</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>430,639</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1990-2006</td>
<td>14,488</td>
<td></td>
</tr>
</tbody>
</table>

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All dollar figures in this report are NZ$\text{2006}$ dollars unless stated otherwise.
Socio-Economic Components

The section is split into four parts:

- personal consumption adjusted for income inequality (or weighted personal consumption);
- public sector benefits resulting from non-defensive public consumption and services of public capital;
- labour market costs relating to unemployment, underemployment and overwork; and
- other socio-economic benefits and costs including the value of household and community work, private defensive expenditure on health, costs of commuting, and costs of crime.

Personal consumption

It is important to note that at any particular point in time, the total level of personal consumption in the Auckland region (Figure 4) and the degree of income inequality (Figure 5) are the consequences of many interrelated and complex factors. Rather than considering the effects of individual policy changes and other events during the period in isolation, it is more helpful to review the overall context upon which the levels of consumption in each period were determined. This discussion is also of relevance when interpreting the results obtained in other socio-economic categories of the GPI.

Figure 4: Personal consumption expenditure, Auckland region 1990 - 2006
Total personal consumption expenditure is estimated to have increased from $18.2 billion in 1990 to $32.7 billion in 2006, a rise of 79.5 percent. This mirrors population growth, at an annual average rate of 2.4 percent. On a per capita basis, personal consumption expenditure rose steadily by 23.7 percent over the study period, an average annual growth rate of 1.3 percent.

The relatively static trend in personal consumption expenditure in the early 1990s was largely the result of a lag effect from the period of slow economic growth and recession following the central and local government reforms that occurred from 1984 to 1991. The economic atmosphere at the beginning of the 1990s was characterised by further economic deregulation, privatisation of state owned enterprises (e.g. tele-communications, energy provision), public sector reform and removal of barriers to overseas investment (Evans et al., 1996). These reforms included across-the-board benefit cuts, abolition of family benefits in favour of a more targeted family support, cuts in health subsidies and increases in medicine prescription charges, introduction of market rents for public housing, higher levies on petrol, alcohol and tobacco, introduction of ACC levies, and the introduction of tertiary student fees (Bell and Elliott, 1993).

Declining levels of unemployment, with corresponding higher levels of disposable income, were a strong influence on the levels of personal consumption during the rest of the study period, as was a generally strong level of business confidence. Both of these factors were to some degree negatively influenced during a downturn in tourist activity associated with the Asian crisis in 1998.

In the late 1990s other factors influencing personal consumption included international immigration and increased purchasing power associated with low levels of inflation and periods of appreciation in the New Zealand dollar. Globalisation, the process of deepening and changing links throughout the world economy, has also had profound impacts on the consumption patterns of Auckland residents. Among the many dimensions of globalisation impacting on personal consumption during this period were the significant investments undertaken in shopping centres and malls by a mixture of New Zealand and overseas companies, closer economic relations (CER) with Australia, and the large growth in trade with China – particularly in respect to imports of low cost apparel, clothing and footwear.

On the negative side, the degree of income inequality in the Auckland region also increased substantially over the study period, with a larger proportion of total household income going to the top quintile of households (refer also to OECD (2008) for national result).
In 1992, the top 20 percent of the households in the Auckland region accounted for 50 percent of total regional income. By 2004, this situation had changed with the top 20 percent of households accounting for 56 percent of total regional income. By comparison, the bottom 20 percent of households in 2004 accounted for only 3 percent of total regional income.

The widening income gap has emerged partly from the effects of the economic reforms, but also from other influences, which have not been felt evenly through the population. During the study period the Auckland region economy also underwent significant structural changes. Importantly, there was a steady loss of jobs in the manufacturing sector, and to a lesser extent the primary sector, and a marked shift towards more of a service economy. Thus, while there was a marked deterioration in the labour market position and employment opportunities for many of the lower skilled 'working class' during the period, there was, for example, also some increase in demand and remuneration levels for a relatively small number of jobs in the corporate, financial and producer services. Not surprisingly these shifts, in the composition of employment opportunities, had disparate implications for different social and geographic groups. Overall, the increasing income disparity during the period is evidence of rising social and economic polarisation.

Once personal consumption is adjusted for income inequality (referred to as weighted personal consumption) a much lower growth rate of 61.7 percent over the study period is recorded; from an estimated $17.6 billion in 1990 to $28.5 billion in 2006. This equates to 3.0 percent annual average growth over the study period. By comparison, national personal consumption expenditure adjusted for income inequality grew from $59.5 billion in 1990 to $86.4 billion in 2006; or 2.4 percent annual average over the period.

**Public consumption (non-defensive) and services of public capital**

The governmental fiscal, monetary and exchange rate reforms of the late 1980s and early 1990s not only affected personal consumption expenditure, but also to some degree, non-defensive public consumption (Figure 6) and expenditure on government services of public capital (Figure 7).

In particular, a hiatus in local and central government expenditure followed the 1987 and 1991 share market crashes. This was accentuated in the case of local government consumption expenditure by the local government reform of the late 1980s that resulted in the amalgamation of numerous borough and county councils within the region into seven territorial local authorities and one regional council.

**Figure 6: Public consumption (non-defensive), Auckland region 1990-2006**
Prior to 1994, non-defensive public consumption expenditure is estimated to have increased by around only $221 million, or an annual average rate of 1.1 percent. The economic reforms of 1984 to 1991 were marked by the introduction of numerous measures to curb growth in public consumption. The public sector itself underwent drastic restructuring with the idea of promoting efficiency and productivity. Other reforms affecting public consumption included increases in tertiary student fees, increases in medicine prescription charges and restructuring of public housing and health funding (Statistics New Zealand, 1993; Bell and Elliott, 1993; Evans et al., 1996).

For the rest of the study period, the level of non-defensive public consumption grew significantly faster than before, estimated at an annual average rate of 4.0 percent (compared with 3.0 percent nationally). A more buoyant economy entailing greater public revenues was one of the many influences during this period. It can also be noted that despite the earlier government reforms of the health sector, health spending continued to increase substantially, both in real and per capita terms. Another major contribution to public consumption is expenditure on education. During the period government expenditure on education grew both in absolute terms and as a percentage of total government expenses.

Consistent with the numerous measures put in place to curb growth in government expenditure, the early years of the study period saw a slight drop in the level of services derived from public capital. Over time, a number of government owned assets, for example New Zealand Rail, were sold to help meet fiscal deficits (Statistics New Zealand, 1990, 1991, 1995). Partly as a result of these sales, services derived from public capital declined markedly by 3.6 percent (compared with 1.9 percent nationally), from $2,520 million in 1990 to $2,430 million in 1994. From the mid 1990s however, the services of public capital rose dramatically from an estimated value of $2,505 million in 1995 to $4,168 million in 2006. This represents an annual average increase of 4.7 percent. By comparison, national level expenditure on services of public capital has grown from $8.5 billion in 1995 to $12.7 billion in 2006; or an annual average increase of 3.7 percent.

**Labour market costs: unemployment, under-employment and overwork**

The labour market experienced enormous change throughout the time of this study (Figures 8, 9 and 10). Key reasons for the changes observed in these categories include the period of intense restructuring during the economic reforms, followed by a subsequent period of economic recovery.
The major economic reforms of the 1980s and 1990s had some far-reaching consequences for New Zealand’s labour market. Numerous policies were implemented in the 1980s which focused upon deregulating the private sector and exposing the domestic economy to market forces. During the 1990s, further reforms were implemented including across-the-board benefit cuts, and the enactment of the Employment Contracts Act 1991. Following the latter measure, New Zealand saw the abolishment of compulsory trade unionism, sharp declines in
union memberships, and a strong shift from collective to individual employer-employee agreements (Britton et al., 1992).

The lagged impacts from policies and economic conditions in the reform period saw the number of unemployed in the Auckland region rise sharply during the early period, reaching a peak in 1991, where the official number of unemployed in the Auckland region was recorded as 55,900 people (Statistics New Zealand, 2009). This is clearly shown in Figure 8 where the cost of unemployment moved from $158 million in 1990 to $251 million in 1992; or an increase of 58.3 percent for the period. By comparison the national cost of unemployment moved from $643 million in 1990 to $842 million in 1992.

Similarly, the number of underemployed also rose sharply around 1991, as is reflected in the estimated costs of underemployment at $115 million (Figure 9). One of the reasons for the growth in underemployment was the rapid growth in part-time employment, particularly in service sector industries such as retail trade, restaurants and hotels. The number of people in other forms of contingent employment, i.e. casual, contract, temporary and intermittent employment, also increased significantly during the period (Le Heron and Pawson, 1996).

The regional economy went through a short period of recovery from 1993, expanding by 2.4 percent during 1995-1996. A corresponding decline in the costs of both unemployment and underemployment is estimated for these years. The cost of unemployment is estimated to have fallen from $253 million in 1991 to $97 million in 1996 and the cost of underemployment dropped below $90 million. The impacts of the Employment Contract Act and other reforms continued to be observed including a decline in real wages, increased levels of productivity, and a reduction in the cost of hiring.

Although there was a fall in unemployment and underemployment costs during 1995–1996, this was followed by another three to four year period of growth in both components. A notable event during this period was the Asian economic crisis of 1998. It can also be noted that while the official unemployment rate had once again fallen to below five percent in 2001 (Statistics New Zealand, 2009), the total estimated cost of unemployment remained above $104 million, largely due to a greater population and thus higher absolute numbers of unemployed people.

The cost of underemployment peaked during the years 1998 and 1999 averaging at $150 million and then continued to recover for the remaining study years to $61 million in 2006. At the national level, the cost of underemployment ranged from $334 in 1990 to $647 million in 1999. As at December 2006 the national level cost of underemployment had levelled off to $412 million.

The cost of overwork (Figure 10) is estimated to have grown rapidly at an annual average rate of 6 percent for the first half of the study period, from approximately $747 million in 1990 to $1,176 million in 1997. This trend is set against a backdrop of strong growth in part-time employment, coupled with declining working conditions and rates of pay in depressed sectors, particularly manufacturing (Britton et al., 1992; Le Heron and Pawson, 1996). Such conditions are likely to have encouraged workers to take on additional hours in order to maintain previous take-home levels, as evidenced by the substantial rise in multiple job holders during this period (Statistics New Zealand, 1993). At the same time, strong growth was experienced in service sector employment, with associated skill shortages in areas such as information technology, telecommunications and finance (Le Heron and Pawson, 1996). These trends are also reflected in the national study where the cost of overwork grew from $2.3 billion in 1990 to $3.3 billion in 1997.

The cost of overwork in the Auckland region is relatively static over the second half of the study period with the annual average growth rate at 0.2 percent (1.4 percent nationally). There appears to be some negative correlation between the estimated cost of overwork for the post reform period and the estimated costs of unemployment for the same period. Additionally, there seems to have been some shift towards more flexible working conditions during this period (Career Services, 2006).
Other socio-economic components

The trends over time for the remaining socio-economic categories namely, household and community work, private defensive expenditure on health, cost of commuting and cost of crime are presented respectively in Figures 11, 12, 13 and 14. While the matters addressed in these categories vary quite substantially, they are all relate to various societal factors and influences on human welfare.

Figure 11: Value of household and community work, Auckland region 1990-2006

Figure 12: Private defensive expenditure on health, Auckland region 1990-2006
The value of household and community work (Figure 11) generally increased over time, with an annual average growth rate of 2.6 percent. There was however a temporary slump in the total value of these activities around the period 2001–2002. This corresponds with a fall in the real wage rate.

Acceleration in the rate of population growth was an important factor contributing towards growth in the value of household and community work, especially for the latter years of the period. The ageing of the Auckland regional population, in particular an increase in the number of retired persons who spend time on community and household activities, is also considered to have had a noticeable effect.

Overall, the value of household and community work in the Auckland region rose from $7,439 million in 1990 to $11,170 million in 2006. This represents 50.2 percent growth over the period. By comparison, the value of household and community work for the nation rose from $23.9 billion in 1990 to $31.7 billion in 2006, a rise of 32.6 percent for the period.

Private defensive expenditure on health (Figure 12) continued to increase during the entire period from an estimated value of $67 million in 1990 to $112 billion in 2006, or a rise of 67.4
percent. These trends are also reflective of the national situation where private defensive expenditure on health increased from $192 million in 1990 to $322 million in 2006.

As previously described, the economic reform period was characterised by the introduction of numerous measures to help curb growth in government expenditure. In particular, there were a number of reforms implemented in the early 1990s with respect to the health sector. These included reductions in health subsidies, increases in prescription charges and doctor fees, and the implementation of separate funding and providers for the public health system (Statistics New Zealand 1993, 1999; Evans et al., 1996). In addition, an ageing population, as well as technology advances and a higher demand for alternative and ancillary clinical health services (e.g. physiotherapy), were important factors leading to additional private health expenditure.

From 1990 to 1994, the cost of commuting remained relatively static, with upper and lower values of $926 million and $981 million, respectively (Figure 13). By comparison the national equivalents for the same years were $2.10 billion and $2.19 billion.

The labour market recovery until 1998 had a significant influence on the regional cost of commuting, shown as a sharp increase at an average growth rate of 8.5 percent (and 8.0 percent nationally). The cost of commuting grew steadily for the period 1998 to 2000. This is said to be a reflection of the emergence of increasingly dissimilar urban environments and communities, coupled with a more specialised and pluralistic labour market (Le Heron and Pawson, 1996). Particularly important events during the period were the privatisation of public transport, and dismantling of the import licensing regime for motor vehicles and tariff reductions (NZIER, 1998). The real price of motor vehicles fell significantly over the period as the number of imported motor vehicles, particularly second-hand motor vehicles, increased dramatically – effectively putting more cars on the roads and increasing traffic congestion. In the new century, the total cost of commuting increased dramatically at an annual average rate of 4.5 percent (and 4.7 percent nationally). In the case of the Auckland region, the cost of commuting has also risen sharply as a result of increasing levels of cross-commuting.

The growth in crime costs (Figure 14) over the early period was sharp, with an estimated annual average growth rate of 2.2 percent. During the entire study period, the total estimated cost of crime fluctuated between $1,051–1,248 million. A more buoyant economy, characterised by turbulent social and economic conditions, including high unemployment levels is likely to have been an instrumental factor in this trend.
Environmental Components

This section is split into three parts:

- a short discussion on why natural capital adjustments must be incorporated within the GPI;
- a discussion on why ozone depletion and loss of wetlands environmental components, which are often in other GPI studies, have been excluded from the Auckland region study; and
- an analysis of the key trends and patterns evident in each environmental component valued in the Auckland region GPI. This includes: loss and damage to terrestrial ecosystems, loss of soils, loss of air quality, land degradation, climate change, loss of water quality, loss of non-renewable resources, and noise pollution.

Natural capital adjustments

Just as the goods and services that are measured to provide an approximate value for GDP are generated from the store of man-made capital aggregated over time, the environment provides goods and services that we benefit from as a result of the stock of natural capital. New Zealanders have benefited from the plentiful natural capital in this country, but as has happened elsewhere in the world, a point has been reached where natural capital resources have become increasingly scarce. This scarcity is a combination of reduced natural capital and increased demand for the services provided by that capital. For many of the environmental components valued in this report the losses incurred are a result of past decisions.

At some point in time, the marginal benefit gained from depleting (drawing down on) natural capital became less than the margin cost incurred as a result of the loss of ecosystem services provided by that natural capital. This cross-over has been described by Daly (2005) as a transition from an ‘empty’ world to a ‘full’ world. Evidence of this transition can be seen in such situations as:

- the inability of the environment to assimilate the wastes produced by human activity, resulting in water pollution and the build up of greenhouse gases in the atmosphere;
- the lack of native timber available for use as it has been harvested at a rate exceeding natural regeneration; and
- the replacement of ecosystem services such as flood and storm protection, previously provided by wetlands, by grey, more vulnerable infrastructure.

It is difficult, if not impossible, to determine when these cross-overs occurred. The national GPI used 1970 as this cross-over point, and for consistency has also been used here. The use of 1970 can be considered to provide conservative estimates of costs.
Exclusions

Ozone depletion

Most international GPI studies include the costs of ozone depletion because it represents a long-term environmental impact of economic activity with consequences for human health.

Because of its southern location, New Zealand is vulnerable to increased solar ultraviolet radiation, the main consequence of ozone depletion. The hole in the ozone layer currently covers a substantial area over Antarctica, and modelling studies by the National Institute of Water and Atmospheric Research (NIWA) have confirmed that the Antarctic ozone hole is a major contributor to the lower summer ozone levels measured over New Zealand (Ajtić and Connor, 2004).

While it is known that ozone depletion has an impact on the well-being of New Zealanders (death from melanoma alone was estimated at more than $200 million in 2006), the GPI only measures the impact of economic activity in New Zealand. In 1986, before restrictions were introduced under the Montreal Protocol (UNEP, 1987), New Zealand’s total emissions of ozone-depleting gases (mostly CFCs) was 2,100 tonnes, or less than 0.002 percent of global emissions (McCulloch et al., 1994). If the total cost of ozone depletion was measured in terms of health effects in New Zealand (estimated at $200 million in 2006), emissions generated in New Zealand would only be responsible for only $0.4 million. The Auckland region’s share would at most be $0.13 million.

The costs associated with ozone depletion generated in the Auckland region are therefore considered negligible and are excluded from this study.

Loss of wetlands

The national GPI study includes the cost of loss of wetlands. Based on soil type, it is estimated there were 57,851 ha of wetlands in the Auckland region before settlement – now just 2,639 ha remain (Aussel et al., 2008). The vast majority of wetlands have been drained or modified for coastal land reclamation, farmland, flood control, road construction, and the creation of hydro-electricity reservoirs. Although most of the loss occurred between 1920 and 1980, loss was still occurring up to 1997 (Ministry for the Environment, 1997, p.7.37). Wetland conversion across the country was encouraged by the government with rural banking and finance corporation funding improvement loans, livestock incentive schemes and land encouragement loans (National Water and Soil Conservation Organisation, 1983). While the end of government subsidies for flood control and drainage schemes in the mid-1980s stopped wholesale drainage and infilling, conversions associated with dairying and urbanisation were still taking place in the 1990s.

The draft report ‘Assessment of Change in Wetlands in the Auckland region: 1980s to 2006’ (Denyer, 2008) is the most informative recent review of wetlands in the Auckland region. This study used the 20-year-old WERI (Wetlands of Representative and Ecological Importance) dataset as a baseline to determine the extent to which the WERI wetlands are still present in the region. The analysis found that almost all the WERI wetlands are still present, but provided no information on their condition in terms of weeds and pests or if there had been any reduction in scale. Approximately 1.0 percent (2 wetlands) appear to have been completely or substantially drained and cleared.

This loss is compensated by the new wetlands in the region that have been restored or created. There is a possibility that wetlands not included in the WERI database (<1 ha), have been drained or reduced in size, but no data are available to quantify the exact magnitude of this contribution. The ‘no overall change’ assessment is corroborated by the LCDB1 and LCDB2 databases, which indicate wetland area between 1996-97 and 2000-01 in the Auckland region remains the same.
For these reasons the costs associated with losses of wetlands in the Auckland region have not been included in this study.

Component summaries

Results for the Auckland region GPI environmental components are presented below.

Loss and damage to terrestrial ecosystems

This category is divided into two parts: loss of indigenous forest ecosystems and cost of pests and weeds.

Loss of indigenous forest ecosystems

Forests provide not only ecosystem services such as climate regulation, erosion control, soil formation, waste treatment (removal of excess nutrients), and biological control, but also recreational, cultural, and existence value.

The loss of old-growth forest in the Auckland region is long term and has impacted on its native flora, fauna and people. The flows of services provided by forests are lost for every subsequent year after the loss – not just in the year of loss. To estimate the annual cost for 1990–2006, costs have been aggregated from 1970 onwards.

Cost of pests and weeds

Economic activity, including settlement, in New Zealand has resulted in the introduction of a large number of species that are destroying native flora and fauna. Significant defensive costs are paid annually not to eradicate pests and weeds, but to keep them under control. The annual cost of this expense is money that could be spent on providing services to improve the well-being of people in the Auckland region, if keeping pests and weeds at bay was not necessary. To determine the real cost of progress in the Auckland region the GPI therefore deducts this expenditure.

For the period 1990–2006 the total cost of loss and damage to terrestrial ecosystems has been estimated at $1,264 million, or 6.4 percent per annum since 1990 (Figure 15). It is not possible to directly compare these results with the national level due to differences in both the data sets employed and the methods followed.

Figure 15: Loss and damage to terrestrial ecosystem, Auckland region 1990-2006

All dollar figures in this report are NZS_{2006} dollars unless stated otherwise.
Loss of soils

Agricultural soils are built up over hundreds of years, supporting terrestrial biodiversity as well as providing humans and other species with food. As such, they are a valuable natural capital asset that must be maintained. Soils are lost in the Auckland region as a result of expansion of built-up areas and erosion. As with the loss of indigenous forest ecosystems, the flows of services provided by soils are lost for every subsequent year after the loss – not just in the year of loss. Soil loss has therefore been estimated from 1970 onward.

Soil loss from expansion of urban areas has been measured using estimates for the annual increase (hectares) in urban area in the Auckland region. To calculate the per hectare cost of this loss, a study to quantify the economic value of ecosystem services associated with highly modified arable landscapes in Canterbury, New Zealand by Sandhu et al. (2007) was used. That study estimated the total economic value to be between $\text{2005}1,792/\text{ha/yr}$ and $\text{2005}20,254/\text{ha/yr}$ for conventional farmland. We have used the average of these bounds, which is $\text{2005}11,023/\text{ha/yr}$ or $\text{2005}11,290/\text{ha/yr}$. The ecosystem services valued included: biological control of pests, soil formation, mineralisation of plant nutrients, pollination, services provided by shelter belts and hedges, hydrological flows, aesthetics, carbon accumulation, nitrogen fixation, soil fertility, food, and raw materials (Sandhu et al., 2007).

Erosion costs for the Auckland region from 1970 to 2006 have been determined using land-use type and erosion rates as estimated in ‘Predicting sediment loss under proposed development in the Waiau catchment’ (Auckland Regional Council, 2003). Erosion costs are based on the estimated annual economic cost of erosion and sedimentation in New Zealand in 1998 as calculated by Krausse et al. (2001, p.38). This estimate ($\text{1998}126.7$ million) covers the “total impact regardless of erosion cause or type” (Krausse et al., 2001, p.14). As this erosion cost is the result of tectonic activity and various land use, the $\text{1998}126.7$ million figure has been reduced accordingly so that just anthropogenic impacts are valued. It was estimated 209 million tonnes of soil were lost in 1998 (Krausse et al., 2001), and for the calculations we have assumed 1998 was a typical year. Erosion related to agricultural land use accounted for 36 percent (75 million tonnes) of the total soil loss in 1998. Using this fraction, erosion from agricultural land has been calculated at $\text{1998}1.15$ or $\text{2006}1.37$ per tonne. Erosion costs resulting from subdivision account for off-property impacts only, therefore, lost production costs are excluded. Subdivision costs have been estimated at $\text{1998}0.55$ or $\text{2006}0.65$ per tonne of erosion.

For the period 1990–2006, the total cost of loss of soils has been estimated at $1,113$ million (Figure 16). This represents a total growth rate of 7.0 percent per annum in soil loss over the entire study period.

Figure 16: Loss of soils, Auckland region 1990-2006
Loss of air quality

Urban air pollution causes both premature deaths and lesser health effects that lead to days of restricted activity. The cost of air pollution for the Auckland region between 1990 and 2006 has been based on the number of premature deaths and restricted-activity dates per year attributable to air pollution in New Zealand, as calculated by the HAPINZ study completed in 2007 for the Health Research Council of New Zealand (Fisher et al., 2007).

PM$_{10}$ data for 1994–2005 (ARC Air Quality Data CD, May 2006) were used to calculate an index to show the trend in air pollution in the Auckland region, and this trend was assumed to be present between 1990 and 2006. The number of deaths from PM$_{10}$ in the region in 1996 was estimated at 436 (with a range of 284–619) per annum (Fisher et al., 2007, Table 5-2). The cost of deaths and restricted-activity days was estimated for each year based on Fisher et al. (2007) figures for the economic impact of air pollution and adjusted (to avoid double counting) for the GPI.

For the period 1990–2006 the total cost of air pollution has been estimated as $2,976 million (Figure 17). Notably, costs associated with the loss of air quality have reduced since their peak in 1996 by $24 million to $159 million in 2006, or 13.0 percent.

Cost of land degradation

The real costs associated with solid waste and contaminant generation from both households and businesses as a result of economic activity are often not experienced until a later period in time. The GPI allocates solid waste and contamination of land to the period of time the pollution was most likely generated. Waste to landfills and the estimated cost of cleaning up contaminated sites in New Zealand are used as proxies for this cost. Providing pesticides, herbicides and timber treatment to the forestry, farming and horticulture sectors has left large clean-up costs as well as damage to the health of people and the environment. An unwanted legacy has been left behind not only by businesses, such as old gasworks, petrol stations and drycleaners, but also by households. While standards have improved since the implementation of the Resource Management Act (1991) many municipal solid waste sites were not managed to a high standard, and as a result pollution from these sites still remains.

Auckland region municipal solid waste data for 1990–2006 for the year ending June was obtained from the ARC. To be consistent with other data these have been converted to year ending December.

A small amount of waste dumped in the Auckland region comes from outside the region (estimated as 2 percent from data provided). This amount has not been removed from the total tonnage as the Auckland region has to assimilate the environmental impact associated
with this. Since 2005-06 the Auckland region has been disposing of some solid waste in the Environment Waikato area. This amount is excluded from the total as Environmental Waikato benefits from this economic activity so therefore assumes responsibility for the environmental impact. The full cost of disposing of waste into landfills was based on costs at Kate Valley (Parliamentary Commissioner for the Environment, 2006). A 1992 study that calculated the cost of cleaning up high- and moderate/slight-risk sites in the Auckland region at $1992392 million (Worley Consultants Limited, 1992) was used to estimate and proportion over time the costs associated with contaminated sites.

For the period 1990–2006 the total cost of land degradation (Figure 18) has been estimated at $1,917 million. The cost of land degradation grew from $87 million in 1990 to a peak in 2004 of $147 million; this represents an average growth rate of 3.8 percent per annum.

**Figure 18: Cost of land degradation, Auckland region 1990-2006**

![Graph showing cost of land degradation from 1990 to 2006](image)

**Climate change**

Increased fossil fuel use, industrial activity, deforestation and farming have led to a global rise in carbon dioxide in the atmosphere. As a result of the greater concentration of greenhouse gases (GHGs) in the atmosphere, the Earth has begun to warm up and its climate is changing.

The GHG emissions for the Auckland region have been estimated for each year from 1990 to 2006 based on data in the New Zealand Greenhouse Gas Inventory 1990–2006 (Ministry for the Environment, 2008), MED’s Energy Greenhouse Gas reports (MED, 2008), EECA’s Energy Database (EECA, 2004), and other sources.

The valuation of environmental damage from GHG emissions is calculated using the marginal social cost per tonne of CO$_2$-equivalent emitted into the atmosphere. The marginal social cost reflects “the total (discounted) value of all future damage arising from that tonne of emissions” (Neumayer, 2000, p. 354). Therefore, GHG emissions are not accumulated over time.

The value of $200544 per tonne of carbon dioxide was used based on the Stern Review marginal social cost of carbon of US$200530 per tonne for a 450 parts per million (ppm) CO$_2$-e goal (Stern, 2006, p.304). At an average 2005 exchange rate of NZ$20050.70 to US$20051.00, this equates to $200542.6 for 450ppm CO$_2$-e. This value is similar to the December 2005 EU Emissions Trading Scheme price, which was about €20 per tonne (Point Carbon, 2006, p.42). There are, however, numerous prices for carbon as tradable instruments have different risks and volume volatility and operate in a range of global markets. The social cost of carbon may rise over time due to increases in marginal damage costs; it is also possible the price of carbon may decrease as a result of policy implemented to reduce carbon emissions. An
international price per tonne of carbon is used, given that climate change is an externality of global proportions and the marginal damage from an extra tonne of GHG is the same regardless of where it comes from.

For the period 1990–2006 the total cost of GHG emissions has been estimated at $5,951 million (Figure 19). Between 1990 and 1999 the cost of climate change grew at a relatively slow rate of 1.3 percent per annum. Nevertheless, between 1999 and 2003 the CO$_2$-e emissions generated in the region increased rapidly. This trend is reflected in the respective cost increase from $329 million to $421 million (compared with $1.82 billion to $2.42 billion nationally). A key reason for this cost increase was the complete removal of import tariffs on motor vehicles and relatively cheap costs per litre of petrol/diesel at the pump. The growth rate since 2004 is higher than in the early period, at an annual average of 1.7 percent.

**Figure 19: Climate change, Auckland region 1990-2006**

![](image)

**Loss of water quality**

The availability of clean water is fundamental to every aspect of life and its quality is of prime importance to anyone intending to drink water, swim, eat fish, provide water for livestock and food processing, or base their business on tourism. The calculation for change in water quality used in the GPI has been based on remedial action, which reflects the cost of righting or offsetting damage realised at a particular point in time. This does not truly reflect the real cost of damage, as it makes no allowance for damage to the ecology of the waterways over the period. It also does not reflect the cumulative effects of damage over time, or the fact that thresholds may be breached and recovery may need to take place over extended timeframes, if recovery is possible at all.

Water quality data from 2000–2007 for the Auckland region indicates that water quality is most unsatisfactory in urban and peri-urban areas. The annual cost of loss of water quality for the Auckland region has been based on the 2004 PricewaterhouseCoopers, which estimated the cost of undertaking action to remediate poor water quality in the Auckland region as $9,208 million over a 20-year period (Infrastructure Auckland and PricewaterhouseCoopers, 2004). This cost includes $6,661 million for capital expenditure and $2,547 million for operating and maintenance (Infrastructure Auckland and PricewaterhouseCoopers, 2004, p.39). The proposed remediation mechanisms include riparian planting on natural stormwater flow pathways and construction and retrofitting of receiving stormwater ponds.

For the GPI this total cost of $9,208 million is allocated equally to each of 20 years giving a figure of $498 million per year. Thus, for the period 1990–2006 the total cost of loss of water quality has been estimated at $8,463 million.
Loss of non-renewable resources

Underpinning the ideology of the GPI is the need to maintain the asset base from which we generate a sustainable economic income. Non-renewable mineral resource depletion represents the consumption of income-generating capital and results in running down natural capital to boost current market-based economic income. The Auckland region does not have large quantities of non-renewable resources and relies instead on imports from overseas and other parts of New Zealand. Rock, gravel and sand (aggregate) makes up most of the volume of minerals extracted in the region. As population and economic growth increases so does the demand for aggregate. Transport is a major component of aggregate costs so having a local supply is cost effective. However, the concentrated urban nature of the Auckland region makes it difficult to develop resources with environmental effects acceptable to those living nearby (Barker et al., 2006). As a result, demand has increased at the same time as urban development has restricted the establishment of new quarries. Supply is therefore not the limiting factors, for instance, 630 million cubic metres of basalt are available in the Auckland urban area, but planning restrictions prevent production (Barker et al., 2006).

The monetary cost associated with the use of non-renewable resources is generally calculated from the percentage of total profit that would need to be put aside and reinvested to ensure a similar level of income can be generated after the resource has been depleted (El Serafy, 1989).

The Auckland region extracts mostly rock, sand, and gravel for building, reclamation work, and roads. These resources are readily available from elsewhere in New Zealand (and even renewable in some parts of the country). Depletion of local reserves will require bringing rock, sand and gravel from further afield, so allowance is made for additional future transport costs. Assuming the profit margin for the extraction industry in the region is 20 percent (a generous amount), using the principles propounded by El Serafy, we have put aside 5 percent of this to be invested to return an income that covers increased future transport costs to compensate for resource depletion.

For the period 1990–2006 the total cost of non-renewable loss has been estimated at $18.3 million (Figure 20).

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Figure 20: Loss of non-renewable resources, Auckland region 1990-2006

All dollar figures in this report are NZS\textsubscript{2006} dollars unless stated otherwise.
Noise pollution

Noise pollution refers to unwanted or offensive sounds from a variety of sources including: industry, activities such as lawn mowing, recreational events, people communicating, animals, etc. It is both a health and an environmental issue. One of the main sources of noise that unreasonably intrudes into our daily activities is traffic, especially from heavy vehicles (Hamilton and Denniss, 2000). Traffic noise, according to an OECD (1995) report, has the following negative impacts:

- productivity losses due to poor concentration, communication difficulties or fatigue due to insufficient rest;
- health care costs to rectify loss of sleep, hearing problems or stress;
- lowered property values; and
- reduction in psychological well-being.

As no data are available to calculate absolute noise levels or change in intensity, annual fuel sales in the Auckland region have been used as a proxy. Given that most people in New Zealand live in urban areas and that car ownership levels are high, a significant proportion of the population experience noise associated with traffic. In 1996, the Ministry of Transport studied environmental externalities associated with motor vehicle use and estimated that the total annual social cost of noise pollution from vehicles was between $230 million and $2,650 million, with the best estimate being $290 million per year (Ministry of Transport, 1996, p.38). The total social cost is defined as private costs plus externalities. According to the research, the $290 million figure was derived from a pilot study of road traffic exposure in an Auckland suburb with a range of road networks. The Auckland region proportion of the $290 million was $124 million, which converts to $153 million.

The amount of $124 million was divided by the litres of fuel consumed in 1995-96 to reach a cost for noise pollution per million litres of fuel consumed. Variation in the volume of noise each year has been allowed for by multiplying this cost by annual fuel consumption.

For the period 1990–2006 the total cost of noise pollution (Figure 21) has been estimated at $2,696 million. Overall, the cost of noise pollution has risen at an annual average growth rate of 3.3 percent.

Figure 21: Noise pollution, Auckland region 1990-2006

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2 Fuel use is also associated with stationary motors which are in this study considered to produce the same levels of noise pollution as non-stationary motors used in vehicles.
Matters for Further Consideration

This study represents a unique first step in creating a GPI for the Auckland region. The study is unique in that it is among the first fully evaluated Genuine Progress Indicators to be developed within the New Zealand context. Moreover, it is among only a few sub-national GPIs to be developed globally. It is the opinion of the authors that the Auckland region GPI is also unique in that it represents a more meaningful indicator of well-being or ‘genuine progress’ than regional GDP since it does not arbitrarily place a zero value to the goods/services derived from social and ecological capital – which are essential ingredients in the well-being of any society (Cobb et al., 1995). At this point it is worth noting that the contribution presented in this report is grounded in the detailed, meticulous and comprehensive work undertaken as part of the national GPI study. It also builds on past efforts aimed at improving measurement of national well-being or genuine progress.

Despite the level of detailed analysis that has gone into creating this report, it is hoped that the study will constitute only the first, early step towards the establishment of ongoing work in measuring and monitoring the genuine progress of the Auckland region. As the work in this area progresses, it is envisaged that the methods used to develop the GPI will be further developed and refined. In these regards Appendix A provides a short summary of some of the theoretical, methodological and empirical matters associated with the calculation of the GPI which, although beyond the scope of the current study to resolve, might be given further consideration in future work.
References


Health Research Council of New Zealand, Ministry for the Environment, Ministry of Transport Wellington.


All dollar figures in this report are NZ$2006 dollars unless stated otherwise.
Appendix A: Theoretical, Methodological and Empirical Matters for Further Consideration

Theoretical considerations

Selection of components for inclusion

There are currently no international standards specifying the method in which a GPI is to be calculated (unlike the calculation of GDP). This means that the types of socio-economic and environmental benefits or costs included in any particular GPI calculation are, to a large degree, left to the discretion of the persons undertaking the study. This somewhat arbitrary nature of the GPI is perhaps its most fundamental theoretical issue. For example, studies in other countries have included additional socio-economic components such as the cost of gambling. The GPI could also include issues such as the cost of alcoholism, drug abuse, child abuse, money laundering and fraud etc as separate categories from the cost of crime.

It can be noted further that the comparison of GPIs between countries is complicated by variances in social problems experienced, and also variances over time. For example, internet crime was unheard of prior to the 1990s.

Further debate will be beneficial in regards to what are the appropriate components to include in the Auckland GPI. Moreover, a key focus of this discussion should be on what Aucklanders conceive to be the key determinants of their welfare.

Definition of system boundaries

System boundaries create further complications in the calculation of a GPI as some issues (e.g. internet crime and fraud) may be experienced by a victim in New Zealand, yet committed by a person based overseas. The system boundary issue is perhaps the most problematic in regards to the calculation of the environmental components of the GPI. For example, New Zealand does not produce or consume a high volume of ozone-depleting substances, but as a nation we are more exposed to the impact of damage to the ozone layer than most other countries. Similar arguments can be made concerning the potential consequences of climate change where the impacts of burning fossil fuels in other nations may have a profound impact on our climate. In the calculation of future GPIs, further consideration could be given to the most appropriate system boundaries for the study.

Definition of defensive expenditures

Another factor which could have an important impact on the Auckland regional GPI valuation is the definition given to ‘defensive expenditures’. Commentators, such as Hamilton and Denniss (2000), note that the definition of what constitutes a defensive expenditure, or the degree to which an activity is considered defensive, is largely an arbitrary decision. Often only anecdotal or ad hoc information exists for setting the degree to which a component is defensive. Moreover, in those cases where anecdotal or ad hoc information do not exist, then the analyst implementing the component is left to make a judgement or assumption.
Monetary valuation of non-market externalities

Assigning a monetary value to many social and environmental goods and services is often problematic. Frequently, as is the case in this study, value is dependent upon implied or imputed benefits/costs. The benefits derived from ecosystem services such as climate regulation, for example, cannot be adequately captured in economic markets due to the intangible nature of the services provided. In this case, economists typically rely on non-market valuation techniques such as willingness-to-pay, hedonic pricing, and travel cost methods. Unfortunately, there are many well known limitations associated with the application of these methods (see, for example, Khan (1995) for further details). It is also worth noting that many commentators argue that it is inappropriate to place economic values on social and environmental goods and services that are ‘invaluable’. It is, however, the opinion of the authors that without valuations many of the components included in this study would remain unaccounted for, or at least undervalued, in Auckland region’s welfare.

Selection of an appropriate base year

The selection of an appropriate base year from which to conduct the valuation from is critical in determining the quantum of several GPI components. The valuation of components such as the loss and damage to terrestrial ecosystems and loss of soils rely on accurately determining the point in time when the marginal benefits gained from depleting (or drawing down) an environmental good/service become less than the marginal costs incurred as a result of the loss of that resource. This is a difficult task fraught with difficulties such as lag effects, cumulative effects and compounding data paucity.

Methodological considerations

Partial or incomplete valuation of components

Assumptions made in estimating the GPI are open to debate (Neumayer, 2000; Lawn, 2003; Constanza et al., 2004). The cost of unemployment and underemployment, for example, is determined using an average wage rate per hour. This is likely to be an overestimate as a vast majority of the unemployed, and underemployed, are unskilled. Incomplete valuation such as the omission of the psychological costs associated with unemployment mean that components are of only partially, rather than fully, accounted for. While full cost accounting of all sub-components of a component is not possible, it is however important that all major sub-components are evaluated. The key barriers to full cost accounting are difficulties associated with measurement and insufficient data (see below).

Lack of standardised valuation methodologies

The comparability of different GPI studies is often limited because, as described above, currently no international standardised valuation method exists. This means that in calculating a GPI, the researcher must decide both which items will be incorporated in the index, and which valuation methods are best to employ. These decisions are typically made on the basis of data availability. It should, however, be noted that here are currently efforts underway to standardise core components of the GPI across nations – refer, for example, to Lawn and Clarke (2008).
Empirical considerations

Paucity of regional data

The paucity of regional data is a significant obstacle to rigorous GPI calculations. It is recommended that a regional database of information sources pertaining to each socio-economic and environmental component be created. This database would record not only bottom up primary data for improving the construction of the GPI, but importantly also information on the causal mechanisms responsible for change in components. It is, however, acknowledged that in comparison, the System of National Accounts from which the GDP indicator is extracted developed over a period of 70 year plus years, with definitions and accounting procedures evolving along the way. Under ideal circumstances, information for development of component accounts would be based on regularly collected data. Furthermore, the development of regional GPIs would be a nationwide exercise supported by statistical data sources from Statistics New Zealand.

Data accuracy and certainty

To aid in interpreting the accuracy of the findings, standard statistical errors could be added where possible to component valuations with a sensitivity analysis undertaken to allow for feasible ranges of values. Alternatively, a Monte Carlo analysis could be undertaken to provide certainty bounds for component valuations and for the overall aggregate indicator.