

Proposed Waipaoa River (Gisborne)
Flood Control Scheme Upgrade

*A Community Economic Benefit-Cost
Assessment
of Upgrading Options*

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Executive Summary

- This report provides a detailed benefit-cost analysis from a Gisborne district perspective, of the currently proposed three different options for upgrading the flood control system along the Waipaoa River.
- The summarised results of the analysis are indicated in the table below.

Table A: Waipaoa River Flood Protection Upgrading Options- Benefits and Costs at the Gisborne District Level

Benefit/Cost Factor	Value (\$M)		
	1:100	1:150	1:200
(i) Direct Benefits:			
(a) Construction Period Value-Added/GDP Direct Impact	0.42	0.61	0.73
(b) Annual Operation/Maintenance- Value Added/GDP Direct Impact	0.46	0.49	0.50
(c) Direct cost savings in damage to flood protection scheme	1.00	1.75	2.50
(d) 'Savings' in direct production losses- Direct Value Added/GDP Impact	1.65	2.80	4.10
(e) 'Savings' in property damage costs	2.10	2.80	3.50
(ii) Total Direct Benefits	5.63	8.45	11.33
(iii) Indirect Benefits:			
(a) Construction Period Value-Added/GDP Flow-On Impacts	0.43	0.62	0.75
(b) Annual Operation/Maintenance Value-Added/GDP Flow On Impacts	0.29	0.31	0.32
(c) 'Savings' in production losses- Value Added/GDP Flow-on Impacts	1.49	2.88	4.36
(d) Pastoral lease income for GDC	0.10	0.10	0.10
(iv) Total Indirect Benefits	2.31	3.91	5.53
(v) Total Direct and Indirect Benefits	7.94	12.36	16.86
(vi) Direct Costs	1.50	2.06	2.43

- The key elements covered in the analysis were:
 - The direct, indirect and intangible community economic benefits of the upgrading options
 - The direct benefits addressed in the report were the direct economic impact gains from the construction and operation of the upgrading options, the 'savings' in damage costs resulting from the flood events scenarios and the economic impacts of the 'savings' in production losses through upgraded flood protection
 - The indirect benefits assessed also covered the same aspects as above
 - The direct total costs for the construction and operation/maintenance of the three upgrading options
- The overall benefit-cost results based on the figures in the above table are as follows:
 - 1:100 year protection 5.3
 - 1:150 year protection 6.0
 - 1:200 year protection 6.9
- All three upgrading options therefore produce significantly positive district-level economic returns, with the 1:200 year level of protection providing the highest level of return.

1.0 Introduction

- 1.1 Gisborne District Council is currently giving consideration to the matter of options for the future upgrading of the flood protection scheme for the Waipaoa River in the district.
- 1.2 As part of the background analysis and information gathering for the study, the Council has requested a suitably detailed assessment of the anticipated economic benefits and costs for the Gisborne area as a whole, of the different upgrading options for the scheme.
- 1.3 The current flood protection scheme is considered to provide a 'one in seventy year' level of protection, although there is some doubt as to whether this is now the case. The main options for upgrading the current system are a 1:100 year level of flood protection, 1:150 year and 1:200 year protection.
- 1.4 The categories of economic benefit and cost associated with the upgrading of the flood protection system on the Waipaoa River which are covered in the analysis in the report are as follows:

(i) Benefits

- (a) In broad terms, the direct, indirect and intangible benefits for the district of the different upgrading options.

And specifically:

- (b) The direct and indirect economic impact gains for the district resulting from the 'construction' expenditure associated with the upgrading work.
- (c) The direct and indirect economic impact gains for the district resulting from the annual operational and maintenance work undertaken on the flood protection scheme.
- (d) The (direct benefit) savings in flood damage and response/recovery costs associated with the flood protection scheme and its different upgrading options.
- (e) The indirect district-wide benefits arising from flood protection, such as reduced business disruption losses and traffic delay costs, insurance and other savings, and land use benefits.
- (f) The intangible economic community benefits of flood protection in the areas of community safety, local economic and business development, and quality of life.

(ii) Direct Costs

- (a) The construction or development costs associated with the different upgrading options
- (b) Annual flood protection operating and maintenance costs for the different upgrading options

- 1.5 Gisborne District Council has specifically requested a comparative assessment of the district economic benefits and costs associated with the main options for the different levels of flood protection, and the net 'payoff' or return for the district, in relation to the different options. The report's response to this request is as follows:

- (i) Where suitable robust Gisborne-specific information is available for such an assessment to be made, the appropriate benefits and costs are quantified in the report.
 - (ii) Where Gisborne-based information is unavailable, detailed reference to other relevant New Zealand 'case studies' is made in the report. This information should be viewed as indicative only, as major flooding events around the country have their own unique characteristics which are not directly transferable from area to area or from situation to situation. In terms of the benefit-cost framework used in the report, this type of information can only be quantified in general or broad terms.
 - (iii) In the situation where no hard information on particular benefit factors is available locally or nationally, nevertheless, suitable reference is still made in the report to these factors.
- 1.6 At the end of the analysis, a short tabular assessment of the various economic benefits and costs of the different flood protection upgrading options, is provided.
- 1.7 It is emphasised that the focus of the report is on the district-wide **economic** benefits and costs of the different upgrading options, rather than on a strictly narrow financial benefit-cost assessment of the options. The objective of the report is therefore to identify and quantify where possible the range of community based economic benefits and costs of the upgrading options.
- 1.8 The range of information sources used for preparing the report include:
- A base consultancy report prepared for the Gisborne District Council in September 2009 entitled 'Waipaoa River Flood Control Scheme Review' (prepared by Peacock DH Ltd and John Philpott & Associates Ltd).
 - Consultation in January 2010 with staff from the Gisborne District Council and with some community/business representatives. Direct discussions were also held with Messrs Peacock & Philpott (noted above).
 - A review of specialist studies on the impacts of recent major floods in New Zealand (eg the Cyclone Bola – Gisborne/Hawke's Bay, Whakatane, Thames-Coromandel, Manawatu and Waikato regions).
 - Appropriate flood protection and recovery financial and mapping information provided by the Gisborne District Council.
 - Statistics New Zealand and HortResearch data on economic and business activity in the Gisborne region.
 - Economic impact modelling results provided by Dr Warren Hughes, economic impact modelling consultant, Auckland.

Further detailed reference to these information sources is provided in the main body of the report.

2.0 Direct Benefits

2.1 This section of the report identifies the considered main direct economic benefits of the proposed options for upgrading the Waipaoa River flood protection system. These benefits for the purpose of this report include:

- The direct economic impact gains generated in the district by the expenditure associated with the new construction/upgrading work on the flood protection system and with the annual operational/ maintenance work on the system.
- Savings in a range of flood damage and response costs.

2.2 **Construction and Operational Activity Economic Impact Gains** – Table 1 on Page 4 indicates the direct (and indirect and total) economic impact gains for the Gisborne district arising from the construction/ development stage for the 1:100, 1:150 and 1:200 year upgrading options for the Waipaoa River flood protection scheme and the annual operational and maintenance expenditure programme for each option (including the current 1:70 scheme). It is noted that the impact gains from the construction stage relate to the whole period for the actual upgrading work. The gains do not extend beyond the construction period. In terms of the operational and maintenance work with the flood protection scheme, these have been identified only on an annual basis. The calculation of the economic impacts was undertaken by Dr Hughes, using a 112-industry economic impact model of the Gisborne economy. The necessary base financial expenditure data for the impact modelling process was provided by Gisborne District Council drainage staff. (A copy of Dr Hughes' economic academic and work record, and his economic impact results are attached as Appendices to the report).

2.3 Nature of Economic Impact Assessment

2.3.1 Economic impact assessment is concerned with identifying the total multiplier or flow-on impacts of a new development (e.g. facility, industry/business or visitor event) in a particular geographical economy (local, regional or national). The impacts include the initial direct expenditure impact and the indirect and induced (flow-on) impacts. The indirect impacts include the impact of spending activity on backward-linked or supplier industries providing inputs to the main expenditure activity and forward-linked industries using any goods or services produced by the new development being considered (forward linkage impacts are not covered in the analysis in the report but an example would be the pastoral farmers who graze their stock on or near stopbanks). Induced impacts relate to the impact of a development on the consumption spending activity of employees directly involved in the establishment and operation of the development and those associated with supplier or backward-linked industries. The multipliers covering the indirect and induced impacts are referred to as Type II multipliers and are used in this report's analysis.

2.3.2 The measures traditionally used for economic impact assessment are **Gross Output** (the total value of economic impacts generated including imports), **Net Household Income** (the total value of household income generated by a new development net of taxation and various forms of saving), **Employment** (in Jobs or Labour-Years) and **Value Added/GDP** (the true level of additional economic activity generated within a particular area after removing import payments flowing out of the area).

2.3.3 The base assumptions of economic impact assessment modelling should be noted – constant levels of productivity, linear production relationships and near-full capacity utilisation. The use of these

assumptions means that the results of the modelling process should be viewed with due caution, in light of prevailing economic and industry conditions in the subject area.

2.3.4 For the purposes of this economic impact assessment, Dr Hughes used a March 2009 year input-output model of the Taupo district economy. The model is based on the latest national input-output table of March 2004. The 112-industry models provide better economic impact estimates for smaller areas such as Gisborne district, than do less detailed models that are based on broader industry sectors. It is emphasised that the multipliers referred to earlier in Section 2.3.1 are generated by the economic impact modelling process itself and are specific to the Gisborne district. They are not national or general regional multipliers applied to the Gisborne area.

Table 1: Gisborne Area Economic Impacts of the Construction and Annual Operation/Maintenance of the Proposed Waipaoa River Flood Protection Upgrading Options

Economic Impact Variables	Construction Stage				Annual Operation/Maintenance			
	1:70	1:100	1:150	1:200	1:70	1:100	1:150	1:200
Direct Expenditure (\$M)	-	16.9	24.3	29.2	0.21	0.32	0.36	0.39
Gross Output (\$M)	-	36.9	53.0	63.7	0.65	0.85	0.93	0.99
- Direct	-	16.9	24.3	29.2	0.47	0.58	0.62	0.65
- Indirect	-	20.0	28.7	34.5	0.18	0.27	0.31	0.34
Net Household Income (\$M)	-	5.3	7.6	9.1	0.45	0.51	0.53	0.55
- Direct	-	2.8	4.0	4.8	0.26	0.26	0.26	0.26
- Indirect	-	2.5	3.6	4.3	0.19	0.25	0.27	0.29
Employment (#)	-	157	226	271	12	13	14	14
- Direct	-	86	124	149	8	8	8	8
- Indirect	-	71	102	122	4	5	6	6
Value Added/GDP (\$M)	-	12.2	17.6	21.1	0.65	0.75	0.80	0.82
- Direct	-	6.0	8.7	10.4	0.40	0.46	0.49	0.50
- Indirect	-	6.2	8.9	10.7	0.25	0.29	0.31	0.32

2.4 In terms of direct benefits, the key points to note from the table are as follows:

- (i) The true increase in direct economic activity/Value Added in the Gisborne district resulting from the construction period for the three different upgrading/expenditure options ranges from \$6 million for the 1:100 year option to \$10.4 million for the 1:200 year option.
- (ii) The additional direct net household income generated in the district as a result of the capital expenditure activity ranges from \$2.8 million for the 1:100 option to \$4.8 million for the 1:200 option.
- (iii) The direct employment/jobs impact of the different upgrading options ranges from 86 for the 1:100 option to 149 for the 1:200 option.

2.5 **Savings in Direct Flood Damage Costs** – the potential costs of major flooding include the costs of repairing damage to the flood protection scheme itself, industry/production direct losses, the cost of repairs to damaged structures (e.g. roading, bridges, communications and utilities) and damage to buildings (e.g. houses and commercial/rural premises).

2.5.1 *Flood Protection Scheme*

- 2.5.1.1 Major river flooding is capable of causing significant damage to flood protection schemes themselves. The range of damage can include heavy siltation of river channels, damage to bank protection work, breaches of stopbanks and damage to key river tributaries. The level of damage is likely to increase more than proportionately with increasing flood severities.
- 2.5.1.2 The repair costs for the damage to flood protection schemes caused by the 1:100 flood events in the Waikato/Coromandel area in mid 2002 have been estimated at in excess of \$0.5 million at that time. The significant 1:40 flood events in the Gisborne region in 2005 resulted in a \$150,000 repair bill for the Gisborne District Council; this cost was lower than that which would have been expected due to the major flood protection improvement works undertaken (at a total cost of around \$3 million including scheme repair costs) following Cyclone Bola in March 1988.
- 2.5.1.3 Peacock DH Ltd has advised that for a flood of average duration, the value of flood damage for a 1:100 year flood is likely to be in the order of \$1 million, \$1.75 million for a 1:150 year flood and \$2.5 million for a 1:200 year flood.

2.5.2 *Production Losses*

- 2.5.2.1 Appropriate flood protection along the Waipaoa River will make a very important contribution to minimising rural production losses from flooding in the Poverty Bay Flats area.
- 2.5.2.2 This area comprises an estimated 10,000 hectares of high-class primary industries production land. The largest producing sectors in the area are horticulture and fruit/grape growing, followed by a small amount of pastoral farming. Latest (Year 2007) information provided by HortResearch on regional horticultural production in New Zealand indicates the land areas for the Gisborne district as detailed in the table below. The Poverty Bay Flats area accounts for almost three-quarters of total horticultural and fruit production in the Gisborne district.

Table 2: Total Gisborne District Land Area (Ha) in Horticultural and Fruit Production as at June 2007

Crop	Land Area (Ha)	% of New Zealand
Peas/Beans	276+	3.7
Squash	2,773	35.7
Sweetcorn	1,798	29.0
Other Vegetables	60+	1.0
Other Outdoor Crops	201	5.2
Apples	190	2.1
Grapes	1,812	6.1
Kiwifruit	284	2.1
Avocados	58	1.4
Citrus Fruit	1,003	54.7
Other Fruit	108	2.7
TOTAL	8,563+	7.3

As the table indicates, the leading crops in the district in terms of land area are, in order, squash, grapes, sweetcorn and citrus fruit. The district's leading national contributions are in citrus fruit, squash and sweetcorn.

On the basis of the above figures, horticultural and fruit production accounts for approximately 70% of total land-use in the Poverty Bay Flats area. The other forms of economic activity in the area include pastoral farming, rural production services, commodity processing and some manufacturing activity.

2.5.2.3 **Table 3** details the current estimated total annual revenue earned by the identified different main production sectors located on the general Poverty Bay Flats area. The district-level data in the table has been sourced from Dr Hughes' industry input-output model for the Gisborne economy. The 'Poverty Bay Flats' shares of the district industry revenue totals are based on Statistics New Zealand's Business Demography Census Area Unit industry employment statistics for the Flats area in comparison to the industry totals for the whole district.

Table 3: Poverty Bay Flats Industry Total Revenue/Turnover Estimates 2009

Industry	Total Revenue (\$M)		
	Poverty Bay Flats	Gisborne District	Poverty Bay Flats % of Gisborne
Horticulture	31.7	48.6	65.2
Fruit/Grapes	23.7	26.4	89.6
Pastoral Farming	60.1	600.6	10.0
Meat Processing	101.1	101.1	100.0
Other Processing	10.0	200.2	5.0
Wood Manufacturing	51.3	61.1	84.0
Other Manufacturing	3.8	75.8	5.0
TOTAL	281.7	1,113.8	25.3

The table indicates that the Poverty Bay Flats area had a total production revenue return of almost \$282 million or approximately one-quarter of total district-wide revenue, in 2009.

2.5.2.4 The 'McDermott Miller Strategies' economic consultancy report prepared for the Gisborne District Council in January 2009, concerning an economic development strategy for the district, makes a number of points which are pertinent to consideration of flood protection upgrading options for the area. The points include:

- The priority sectors for future development in the Gisborne area are meat and wool production and processing, **wood processing, horticultural production and processing, viticulture** and tourism.
- The growth of **horticultural exports** will have strong benefits across the regional economy.
- Renewed growth of **wine production** will produce strong employment benefits for the Gisborne economy.
- Output from the district's horticultural production and processing sector is forecast to increase noticeably over the five-year period to Year 2012.

A number of the above priority sectors are located in the Poverty Bay Flats area. It is important that there is, amongst a number of factors, a high level of flood protection in the area in order that the full potential of the priority sectors can be realised, to the maximum benefit of the Gisborne economy.

2.5.2.5 **Production Losses – Other Flood Events** – as a brief background to the analysis in the next section on the direct production losses in the Gisborne area in relation to different levels of flood severity, this section indicates the value of production losses for other major flood events in New Zealand since Cyclone Bola in 1988.

The flooding from Cyclone Bola affected an estimated 3,600 hectares of farming and horticultural land in the Gisborne/East coast area. The damage included 3,000 tonnes of grapes, 1,300 tonnes of squash, 7,000 tonnes of sweetcorn and 13,500 tonnes of tomatoes. A number of pastoral farmers in the area lost up to 30% of their grazing land. Large quantities of sediment from eroding hillsides which was dumped into the floodwaters was subsequently swept onto and smothered pastoral land, orchards and crops ready for harvesting. The value of direct horticultural and farming losses from Bola was estimated at \$90 million, including several million dollars of local-market vegetable production.

The major flooding in the eastern Bay of Plenty in 2004 resulted in significant damage to pastoral and horticultural farming enterprises in the area. In excess of 450 farms were affected by the flooding. Post the event, Central Government established an agricultural recovery programme to assist the farming sector. The budget for the programme included \$6.3 million in 2004/05 allocated to the cost of restoring uninsurable damaged property. This covered silt removal, re-grassing of pastures, rebuilding of boundary fences and re-establishing essential access, races, water supply and drainage. Restoration of lost crops was also covered. New-start grants were made available to farmers and orchardists forced off their properties by the flooding.

The major central-lower North Island flooding (a 1:100 year flood event) in February 2004 resulted in rural production sector lost income and damage costs estimated at close to \$160 million. The immediate cost of restoring the damage was estimated at \$70 million and the balance of \$90 million for ongoing production losses over the following two years. The latter figure included \$10 million for destroyed crops. Over 2,000 farm properties were damaged to varying degrees by the flooding.

The two significant flood events that 'hit' the Gisborne area in 2005 resulted in an estimated 1,784 hectares of total crop losses. The total farm-gate value of the losses following the second (November 2005) flooding was estimated at \$8.4 million. The main crops affected were squash, maize and sweetcorn, which together accounted for over 90% of the total area of crop losses.

2.5.2.6 **Direct Gisborne Losses** – this section estimates the direct economic impact losses that could occur in the wider Gisborne area as a result of the different levels of major flooding event (i.e. 1:100, 1:150 and 1:200 years) on the Waipaoa River. The methodology used for quantifying the losses was as follows:

- (i) A midway short to long-term duration flood with a 6 hour peak flow and occurring at a significant adverse impact period of the production year was assumed.
- (ii) Base modelling of the geographical 'hazard area' of impact of a 1:100 and 1:200 year flood event was then undertaken (this was carried out for the purposes of the report by Peacock DH Ltd, in consultation with modelling staff at the Hawke's Bay Regional Council).
- (iii) The results of (ii) above indicated that approximately 35% of the Poverty Bay Flats rural production area would be at risk with a 1:100 flood event, 50% for a 1:150 event and 60% for a 1:200 year flood event.
- (iv) A further adjustment was then made in order to account for an estimate of the total value of primary industry production that would be lost for the different flood event levels. The estimated losses were based on discussion with agricultural specialists in the Gisborne area.

- (v) The value of the total production losses for the agricultural and processing/manufacturing industries located on the Poverty Bay Flats area were calculated and then run through Dr Hughes' economic impact model for the Gisborne district. The modelling process identifies the direct and flow-on impacts in the district of the production losses, in the case of the three different flood event scenarios.

Table 4 indicates the direct (and indirect) economic impacts in the district of the estimated production losses.

Table 4: Gisborne District Economic Impacts of Agricultural and Processing/Manufacturing Production Losses Resulting From Major Flooding Events On The Poverty Bay Flats

Economic Impacts	Flood Events		
	1:100	1:150	1:200
Total Value of Production Loss (\$M)	56.4	103.7	158.9
Production Loss % of Total PBF Industry Revenue	20.0	37.0	56.4
GDP/Value Added Impact (\$M)			
- Direct	23.6	40.0	58.5
- Indirect	21.3	41.1	62.3
- TOTAL	44.9	81.1	120.8
Employment Impact (#)			
- Direct	486	661	906
- Indirect	243	457	687
- TOTAL	729	1,118	1,593

The points to note from Table 4 are as follows:

- The total value of lost production on the Poverty Bay Flats area ranges from \$56.4 million (20% of total agricultural and processing/manufacturing production in the area) for a 1:100 year flood event to \$159 million (56%) for a 1:200 year flood event.
- The district-wide direct GDP impact of the total production losses are \$24 million for a 1:100 flood, \$40 million for a 1:150 flood and \$58.5 million for a 1:200 year flood.
- The district-wide direct employment impacts of the total production losses are 486 full/part-time persons for a 1:100 flood, 661 persons for a 1:150 flood and 906 persons for a 1:200 flood event.
- The total (reduced) direct net household income impacts for the different flood events are \$10.9 million for a 1:100 flood, \$18.2 million for a 1:150 flood and \$26.8 million for a 1:200 flood.

2.5.3 *Cost of Repairs to Flood Damage*

2.5.3.1 This excludes the cost of flood damage to the flood protection scheme itself, which was addressed earlier in Section 2.5.1.

2.5.3.2 The range of structures liable to be damaged by major flooding includes residential dwellings; farm, commercial, business and other buildings; roads and bridges; and utility services.

2.5.3.3 In order to attempt to quantify the total damage costs likely to be associated with major flood events occurring in the Waipaoa River, it is instructive to look at the costs arising from flooding of the river in 2005. Two significant floods occurred in that year, in October and November. The Labour Weekend

flooding has been described as a 1:40 year event and was in fact the second highest on record for the Te Karaka and Waipaoa river flood control schemes. The range of damage resulting from the flooding included several road 'dropouts', railing damage on bridges, major siltation, slippages, power outages and 40 road closures. The later November 2005 flooding has been described as a 1:10 year event. Over 2002-2005, emergency repairs to the Gisborne district's roading network averaged about \$2 million annually; during 2005/06, the repair bill exceeded \$6.9 million (this includes though repair work outside of the Poverty Bay Flats area). Insurance Council of New Zealand information indicates that the total value of the insurance claims made in relation to the Labour Weekend flooding in the Gisborne area in 2005 was \$0.74 million.

Cyclone Bola which struck the Gisborne/East Coast region (primarily) in March 1988 has been described as a 1:70 year event, although there has been considerable debate since about the accuracy of this description. Government assistance towards damage costs from the Cyclone totalled approximately \$48 million, covering damage to catchment works, water supply, Gisborne railway bridge and road repairs throughout the whole Gisborne/East Coast region. The Insurance Council of New Zealand has identified the total value of insurance claims made in relation to the damage caused by Bola at approximately \$61 million (in 2007 dollar terms). Based on an analysis undertaken in 2004 by the NZ Institute of Economic Research into the economic impacts of the June 2002 major 1:100 year flooding in the Coromandel area, the level of uninsured damage with Bola is estimated at about 25% of the above figure or some \$15 million. The Institute's analysis also indicates a total direct damage cost for the Coromandel flooding of approximately \$13 million.

An analysis of Insurance Council flood damage event-related insurance claims since 1968, adjusted to Year 2007 dollars, indicates that the large majority of the claims had a combined value below the \$5 million mark. This was followed by claims in the \$5m-\$9m range. At the other end of the scale, there were four claims totals in excess of \$50 million. Ministry of Environment information for flood damage costs in New Zealand indicates that after taking into account flood damage claims made to the Earthquake Commission, total damages for a flood event are approximately 1.5 times the value of insurance claims. This suggests that the total property damage cost for the Labour Weekend 2005 major flooding in the vicinity of the Waipaoa River was in the order of \$1.5 million, after also taking into account uninsured flood damage.

Thus, an estimate for the total cost of the property related damage resulting from the 2005 Labour Weekend 1:40 year flooding is \$7-8 million (including an estimate of \$5.5 million for road repair work).

Property damage estimates for the Waipaoa River catchment area for the 1:100, 1:150 and 1:200 year flood events have been conservatively calculated by this report at \$30 million, \$40 million and \$50 million respectively, based on the total damage costs (estimated \$160 million) for Cyclone Bola (which impacted the whole Gisborne-East Coast district). The Waipaoa River catchment's share of the district total for the 1:100 year flood is based on the catchment's share of the district totals for a number of demographic and economic indicators. The damage figures for the other two flood levels are based on the level of increase for the damage to the flood protection scheme itself (as indicated in Section 2.5.1.3) and the evidence of another major flood event analysis in the country.

3.0 Indirect Benefits

3.1 The indirect economic benefits of higher levels of flood protection along the Waipaoa River include:

- The indirect flow-on economic impacts from the construction work associated with the flood protection upgrading options and also the annual operational/maintenance work associated with the options.
- The avoidance of the adverse flow-on economic impacts in the district resulting from the direct production losses.
- A range of other indirect benefits, as discussed later in this section.

3.2 Flow-On Economic Impacts

3.2.1 **Table 1** on Page 4 indicates that the indirect economic impact gains for the Gisborne district from the flood control scheme upgrading work are as follows:

- Additional GDP/economic activity in the district ranging from \$6.2 million for the 1:100 upgrading option to \$10.7 million for the 1:200 option.
- Additional employment generated in the district ranging from 71 for the 1:100 option to 122 for the 1:200 option.
- Additional net household income generated in the district ranging from \$2.5 million for the 1:100 option to \$4.3 million for the 1:200 option.

3.2.2 With regard to the annual operation and maintenance of the flood protection scheme, the indirect economic impact flow-ons are:

- A Value Added/GDP impact of \$0.25 million for the current 1:70 scheme, \$0.29 million for the 1:100 scheme, \$0.31 million for the 1:150 scheme and \$0.32 million for the 1:200 upgrading option.
- An indirect employment impact ranging from 4 for the present scheme to 6 for the 1:200 scheme.
- Additional flow-on net household income impacts ranging from \$0.19 million for the current 1:70 flood protection scheme to \$0.29 million for the 1:200 scheme.

3.2.3 With regard to production losses resulting from major flooding events the avoided indirect flow-on economic impact losses are as follows:

- *Value Added/GDP* – \$21.3 million for a 1:100 flood event, \$41.1 million for a 1:150 event and \$62.3 million for a 1:200 flood event.
- *Employment* – 243 for a 1:100 flood, 457 for a 1:150 flood and 687 for a 1:200 flood
- *Net Household Income* – \$8.8 million for a 1:100 flood, \$17.0 million for a 1:150 flood and \$25.9 million for a 1:200 flood event.
- The results for Value Added and Employment are also detailed in Table 4 on Page 8.

3.2.4 **Other Indirect Benefits** – other indirect economic benefits for the Gisborne district arising from flood protection upgrading along the Waipaoa River should include:

- (i) Avoided or reduced business disruption losses. This aspect has been primarily covered earlier in Sections 2.5.2 and 2.5.3 (production losses and repairs to damaged business assets). However, there are likely to be additional costs to businesses arising from a major flood event,

such as time delays in restoring business operations following flooding, employment disruption and roading/transport issues.

- (ii) Avoidance of increased insurance payments such as insurance excesses, possible loss of 'no claims' bonus and increased insurance premiums.
- (iii) Income received by the Gisborne District Council from the lease of land contained within the flood protection scheme, currently in the order of \$100,000 per annum, continues and is able to make a significant contribution to the annual costs of maintaining the flood control system.
- (iv) Upgrading of the flood control system should contribute to maintaining and possibly increasing property values in the catchment area of the flood protection scheme.
- (v) Increasing levels of flood protection along the Waipaoa River will help considerably to reinforce the key agricultural and processing/manufacturing importance of the Poverty Bay Flats area, within the wider district economy. It should also provide enterprises operating in the area with increased business and investment confidence. The important GDP and employment contribution of the area to the Gisborne district will be maintained and possibly improved on.
- (vi) It should be noted that the Waipaoa River flood protection scheme is currently 'protecting' floodplain economic assets with a current capital valuation in excess of \$1 billion. It is also protecting other valuable economic resources and infrastructures in the district.

4.0 Intangible Economic Benefits

4.1 The intangible economic benefits for the Gisborne district resulting from higher levels of flood protection for the Waipaoa River include as follows:

- The reduced risk of significant flooding impacts and resulting increased business confidence of firms operating in the Poverty Bay Flats area should have positive flow-on effects for the district's business community generally.
- Along with other important local business operation factors, the upgrading of flood protection should provide a valuable incentive for existing businesses operating in the Flats area or servicing these firms from another Gisborne location to remain in the district and for new businesses enterprises to be attracted to the Flats area or wider district
- The upgrading of flood protection in the district should contribute to an improvement in the overall quality of life of the Gisborne community

5.0 Costs of Flood Protection

5.1 The main direct costs of upgrading the flood protection system for the Waipaoa River are:

- The total construction/upgrading costs associated with each upgrading option
- The total operational and maintenance costs associated with each upgrading option

5.2 With regard to the first factor, the costs for each option are 1:100 (\$16.9 million); 1:150 (\$24.3 million) and 1:200 (\$29.2 million).

- 5.3 With regard to the second factor, the costs for each option are 1:100 (\$320,000); 1:150 (\$360,000) and 1:200 (\$390,000).
- 5.4 A further indirect cost related factor to note is the likely rating impact within the Gisborne district of any proposed upgrading of the flood protection scheme on the river. As with all Council services, the identification of direct and indirect beneficiaries of an upgraded scheme will need to be carried out in order to determine the most appropriate funding policy for the scheme's development and operation.

6.0 Overall Benefit-Cost Outcomes

- 6.1 Table 5 below draws on the information provided in the previous sections of the report and summarises the value of the benefits and costs, where they have been quantified, for the three different flood protection upgrading options. It should be noted that the figures are provided on an annualised basis, using a 7% cost of capital and assuming a 1:100 year flood event scenario.

Table 5: Waipaoa River Flood Protection Upgrading Options- Benefits and Costs at the Gisborne District Level

Benefit/Cost Factor	Value (\$M)		
	1:100	1:150	1:200
(vii) Direct Benefits:			
(f) Construction Period Value-Added/GDP Direct Impact	0.42	0.61	0.73
(g) Annual Operation/Maintenance- Value Added/GDP Direct Impact	0.46	0.49	0.50
(h) Direct cost savings in damage to flood protection scheme	1.00	1.75	2.50
(i) 'Savings' in direct production losses- Direct Value Added/GDP Impact	1.65	2.80	4.10
(j) 'Savings' in property damage costs	2.10	2.80	3.50
(viii) Total Direct Benefits	5.63	8.45	11.33
(ix) Indirect Benefits:			
(e) Construction Period Value-Added/GDP Flow-On Impacts	0.43	0.62	0.75
(f) Annual Operation/Maintenance Value-Added/GDP Flow On Impacts	0.29	0.31	0.32
(g) 'Savings' in production losses- Value Added/GDP Flow-on Impacts	1.49	2.88	4.36
(h) Pastoral lease income for GDC	0.10	0.10	0.10
(x) Total Indirect Benefits	2.31	3.91	5.53
(xi) Total Direct and Indirect Benefits	7.94	12.36	16.86
(xii) Direct Costs	1.50	2.06	2.43

- 6.2 The benefit-cost ratios for the different upgrading options are therefore as follows:

- 1:100 year protection 5.3
- 1:150 year protection 6.0
- 1:200 year protection 6.9.

- 6.3 All three upgrading options therefore produce significantly positive district-level economic returns, with the 1:200 year level of protection providing the highest level of return.

APPENDIX 1:

Dr WARREN R HUGHES - AUTHOR PROFILE

The author is Cambridge, NZ born and a graduate of the University of Auckland and Indiana University in the USA, where he completed his doctorate in Business Economics and Public Policy in 1970.

Since that time, he has taught in the areas of econometrics, forecasting, financial economics and managerial strategy at The University of New South Wales in Sydney (1970 – 1978) and most recently at The University of Waikato (1978 – 2007). At various times, he has taught in MBA programmes at the University of Florida in Gainesville and in the Graduate School of Management at the University of California at Irvine. At the present time, he works as an independent economic consultant.

The author has published extensively, mainly as single-authored articles in international journals such as *Decision Sciences*, *Theory and Decision*, *The Journal of Business*, *Mathematical & Computer Modelling*, *Environment & Planning*, *Australian Journal of Management*, *Forest Science*, *Australasian Journal of Regional Studies* and, most recently, *OMEGA*, the international journal of management science. Other articles on theoretical and applied economics have been published by the author in *NZ Economic Papers* and Australia's *Economic Record*. He is a member of the Advisory Board for the Wiley journal *Managerial and Decision Economics* and maintains a continuing interest in the latest developments in economic theory as it relates to management and business. The author has developed a particular expertise in the area of impact and regional analysis. He is the Editor/Manager of the *Regional Economic Bulletin*, which focuses on topical issues relevant to the business and wider communities, mainly but not exclusively, in the Waikato and Bay of Plenty regions. The *Bulletin* is a complimentary publication of the Department of Economics at The University of Waikato.

The author has acted as a consulting economist for *Alpha Aviation Limited*, *Environment Waikato*, *Carter Holt Harvey Limited*, *Norske Skog Tasman Limited*, *Port of Tauranga Limited*, *Port of Napier*, *Feltex Carpets Limited*, *NZ Refining Company Limited*, *Zespri International*, *Waikato Innovation Park*, *Property Council of NZ*, *Creative Napier*, *Katolyst*, *Priority One BOP*, *Vision Manawatu*, *Enterprise Franklin*, *Venture Taranaki*, various District Councils in the Waikato, Bay of Plenty, Hawke's Bay and other regions and for events such as Tauranga's *Montana Jazz Festival*, Hamilton's *Balloons Over Waikato* and Napier's *Art Deco Weekend*.

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APPENDIX 2

A: Gisborne Flood Upgrading-Construction Impacts For Development Period

Prepared by Dr Warren Hughes, Economic Impact Consultant, Auckland

Economic Impact Measure	Current Flood Protection Scheme			
	1:70	1:100 Scheme	1:150 Scheme	1:200 Scheme
Cost \$M		16.9	24.3	29.2
Labour Requirement		40400 Man Days	62400	76400
Economic Impacts from modelling:		(=1.88 years)	(=2 years)	(=2.12 years)
Total Revenue		36.85	52.99	63.68
a) Direct Impact		16.90	24.30	29.20
b) Indirect Impact		19.95	28.69	34.48
Net Household Income		5.28	7.59	9.12
a) Direct Impact		2.78	4.00	4.80
b) Indirect Impact		2.50	3.59	4.32
Total Employment		157	226	271
a) Direct Impact		86	124	149
b) Indirect Impact		71	102	122
Total Value Added		12.22	17.57	21.12
a) Direct Impact		6.03	8.67	10.42
b) Indirect Impact		6.19	8.90	10.70

B: Annual Operational Impacts

Economic Impact Measure	Current Flood Protection Scheme			
	1:70	1:100 Scheme	1:150 Scheme	1:200 Scheme
Annual Operating Cost \$M	0.208	0.316	0.360	0.389
Total operational staff	8	8	8	8
Economic Impacts From Modelling				
Total Revenue	0.65	0.85	0.93	0.99
a) Direct Impact	0.47	0.58	0.62	0.65
b) Indirect Impact	0.18	0.27	0.31	0.34
Net Household Income	0.45	0.51	0.53	0.55
a) Direct Impact	0.26	0.26	0.26	0.26
b) Indirect Impact	0.19	0.25	0.27	0.29
Total Employment	12	13	14	14
a) Direct Impact	8	8	8	8
b) Indirect Impact	4	5	6	6
Total Value Added	0.65	0.75	0.80	0.82
a) Direct Impact	0.40	0.46	0.49	0.50
b) Indirect Impact	0.25	0.29	0.31	0.32

APPENDIX 3

Poverty Bay Flats, Gisborne-District Economic Impacts of Production Losses due to Flooding

Analysis by Dr Warren Hughes, Economic Impact Consultant, Auckland

PBFA= Poverty Bay Flats Area

SECTOR	Gisborne RC 2008/2009		1:200 Year Flood	
	Total Revenue \$ millions	PBFA %	Annual Loss %	PBFA Revenue Loss \$m
Other Horticulture	48.57	0.6517	1.0000	31.65
Other Fruit	26.44	0.8956	0.5995	14.20
Sheep & Beef	600.64	0.1001	0.5000	30.06
Wood Manufacturing	61.14	0.8400	0.4964	25.49
Meat Processing	101.13	1.0000	0.5000	50.57
Other Processing	200.15	0.0499	0.5000	4.99
Other Manufacturing	75.81	0.0499	0.5000	1.89
	1113.88			158.86

Gisborne RC Flood Losses

Economic Impacts

	Revenue \$ m	Income \$ m	Employment Persons	GDP \$ m
Direct Losses as above	158.86	26.84	906	58.48
Flow-on losses within region	179.48	25.86	687	62.31
Total Loss Gisborne RC	338.34	52.70	1593	120.79

SECTOR	Gisborne RC 2009		1:150 Year Flood	
	Revenue \$ millions	PBFA %	Annual Loss %	PBFA Revenue Loss \$m
Other Horticulture	48.57	0.6517	0.7471	23.65
Other Fruit	26.44	0.8956	0.5000	11.84
Sheep & Beef	600.64	0.1001	0.3000	18.04
Wood Manufacturing	61.14	0.8400	0.3017	15.49
Meat Processing	101.13	1.0000	0.3008	30.42
Other Processing	200.15	0.0499	0.3000	3.00
Other Manufacturing	75.81	0.0499	0.3333	1.26
	1113.88			103.70

Gisborne RC Flood Losses**Economic Impacts**

	Revenue \$ m	Income \$ m	Employment Persons	GDP \$ m
Direct Losses as above	103.70	18.23	661	40.00
Flow-on losses within region	118.33	16.99	457	41.08
Total Loss Gisborne RC	222.03	35.22	1118	81.08

SECTOR	Gisborne RC 2009 Revenue \$ millions	PBFA %	1:100 Year Flood	
			Annual Loss %	PBFA Revenue Loss \$m
Other Horticulture	48.57	0.6517	0.4918	15.57
Other Fruit	26.44	0.8956	0.5000	11.84
Sheep & Beef	600.64	0.1001	0.2000	12.02
Wood Manufacturing	61.14	0.8400	0.0988	5.07
Meat Processing	101.13	1.0000	0.1047	10.59
Other Processing	200.15	0.0499	0.0714	0.71
Other Manufacturing	75.81	0.0499	0.1666	0.63
	1113.88			56.44

Gisborne RC Flood Losses**Economic Impacts**

	Revenue \$ m	Income \$ m	Employment Persons	GDP \$ m
Direct Losses as above	56.44	10.90	486	23.60
Flow-on losses within region	60.69	8.75	243	21.34
Total Loss Gisborne RC	117.13	19.65	729	44.94