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Private Bag 3038
Waikato Mail Centre
Hamilton 3240, NZ

waikatoregion.govt.nz
0800 800 401

Dear Janice Carter

Proposed Waikato District Plan – Evidence for Defended Areas and 1D/2D mapping used for the Flood Plain Management Area.

1 Rick Liefing Background

My Name is Rick Liefing, I am Team Leader of Regional Resilience in the Integrated Catchment Management (ICM) Directorate of Waikato Regional Council (WRC). I have a Master of Science degree from Waikato University (1998) and have been working in the natural hazards field for over 20 years. I have been working for WRC since 2013, firstly as Senior Regional Hazards Advisor, then team leader from 2016. The Regional Resilience team provides information on flood hazard and performance of flood protection assets.

I have been a primary contact and provider of information on flood hazards, including defended areas to WDC. I have also been a key information provider to the Waikato Regional Policy Statement (WRPS) practice note on Natural Hazards, which includes residual risk.

I have been asked to provide evidence for the Defended Areas layer in the Proposed Waikato District Plan (PWDP).

1.1 Defended areas

Defended areas are areas of residual risk. Residual risk is defined in the (Waikato Regional Policy Statement) WRPS as the risk associated with existing natural hazard structural defences such as stopbanks and seawalls, including the risk of a failure of defence or of a 'greater than design event' occurring.

The Defended Areas identified in the Proposed Waikato District Plan (PWDP) are areas that have protection from a 1% AEP (Annual Exceedance Probability) river flood event, due to a WRC managed stopbank. That is, the stopbank providing protection is designed to mitigate a 1% AEP flood event of a specific water course. Another way to define Defended Areas is identifying areas that could be impacted by a stopbank breach.

Private stopbanks, not managed by WRC, are not included.

The Defended Areas layer in the PWDP has been provided to Waikato District Council (WDC) by WRC. The layer is also available on the Waikato Regional Hazards Portal¹, along with Defended Areas of a lesser protection. Defended areas for the PWDP were determined two ways, depending on location and protection provided for stopbanks within or outside the Huntly urban area. Description of the methodologies will be discussed in later sections.

1.1.1 Areas likely to be impacted by a stopbank breach.

To identify potential impacts from a specific stopbank breach location would require bespoke hydraulic modelling and assessment, relative to a specific property/area. As a breach in a stopbank could occur anywhere along the stopbank reach, modelling all possible locations is not deemed feasible. There is currently no methodology available to undertake such modelling effectively and efficiently for all properties and stopbank breach scenarios.

Therefore, a simple, consistent and tiered approach was taken for identifying Defended Areas and management land use in the PWDP. The Defended Area layers is an initial identification of areas likely to be protected by a WRC stopbank from a 1% AEP flood event. Further specific assessment of the impacts from a stopbank breach on a property is intended to be undertaken, were required. The requirement for further assessment is to ensure residual risk is minimised due to any change in land use within the defended area.

1.1.1.1 WRC Lower Waikato Waipa Control Scheme

WRC manage an extensive network of stopbanks, spillways, flood gates and pumpstations within the Lower Waikato Flood Protection Scheme. Funding for these schemes is from targeted rates for properties that benefit from the protection. The amount of direct benefit and therefore rates allocated is based on the level of protection provided by a WRC flood protection asset with a weighting allocated to the direct benefit area, resulting in differential ratings across the scheme. Direct benefit areas that receive 1 % AEP design standard protection are weighted 90 to 100.

Note that for the Huntly area, a different process was undertaken, explained further below.

More detailed information on the differential rating process is provided in WRC report 'Lower Waikato Waipa Control Scheme Land Classification and Direct Benefit Analysis for Differential Rating Purposes – 2001' in Appendix 1.

1.1.1.2 WRC Stopbanks or defended areas outside the Huntly urban area

For all stopbanks or defended areas outside of the Huntly Urban area, the defended area was defined using the existing Direct Benefit Rating layers (GIS_ALL.RACS_RATE_WAIKWAIP_DIR_BENEFIT; under "RACS – Rating Scheme – Waikato-Waipā – GIS Layer"). The layer is a spatial representation of the direct benefit areas described above and in Appendix 1.

As mentioned above, only the direct benefit areas receiving a 1 % AEP design standard protection (Weighting 90 to 100) were used to define the Defended Areas layer (outside Huntly urban area). The areas were also assessed/reviewed by WRC experts to ensure correct benefit areas were used. Therefore, all properties that are receiving a direct benefit from a 1% AEP flood protection scheme are identified as being defended in the PWDP.

¹ [Waikato Regional Hazards Portal | Waikato Regional Council](#)

1.1.1.3 Stopbanks or defended areas within the Huntly urban area

For stopbanks or defended areas within the Huntly urban area, a different methodology was used to attribute direct benefit across properties within the Huntly urban area. Essentially the rating cost was spread across all Huntly urban properties, whether the property was getting a direct benefit or not. For instance, where a property is sufficiently elevated and above a likely stopbank breach overflow path, the property is still classified as receiving a benefit as the protection allows continued access and services. Therefore, the Defended Area layer in the PWDP would not include elevated areas above a possible flow path due to stop bank breach.

For the Huntly urban area, the defended area was identified as ground levels below the respective 1% AEP design flood level of the WRC stopbank reach. Ground levels below the 1% AEP design flood level is a simple representation of a possible overland flow path of a stop bank breach. Ground levels were based on the 2007/2008 WRC LiDAR dataset. Areas that were likely to be 'disconnected' from a possible overland flow path were removed.

1.1.1.4 Defended area overview

The methodologies above provide a simple and consistent approach to identifying Defended Areas. The above methodologies to identify the defended areas are deemed appropriate to satisfy the relevant policies of the WRPS so that residual risk is minimised. The methodologies also provide consistency with previous methods to determine areas that are protected and provide Direct Benefit from WRC stopbank with a 1% AEP design standard. A property deemed to be defended from a 1% AEP river flood event provides added security of reduced flood risk to the property owner.

The Defended Areas are intended to provide an initial identification of residual risk and where land use change is proposed, further assessment will be required to better ascertain the risk of a stopbank breach to the specific property.

1.2 Mapping of 1D model flood extents

WRC supplied the flood extents (GIS layer) used by WDC in the PWDP within the 'Flood Plain Management Area' layer. The layer supplied to WDC is the same as the 'Waipa and Waikato 1% AEP flood extent' layer in the WRC Waikato Regional Hazards Portal².

The flood extents for the layer were derived from a 1D (1 dimensional) model of the main channels representing the Waipa and Waikato rivers and Mangawara Stream. A 1D model simply provides a single water level at regular intervals along the main channel. To represent the 1D water levels into a spatial format, such as a map, the 1D water levels can be extrapolated over a surface.

For the PWDP flood layers, there needs to be a clear distinction between the 1D and 2D (2 dimensional) model datasets. Therefore, to avoid confusion with the 2D flood modelling undertaken by DHI (Greg Whyte's evidence), the following table provides a simple comparison.

Component	1D Waipa and Waikato 1% AEP flood extent (WRC)	2D Horotiu to Ohinewai (DHI)
Water levels	Y	Y
Water velocity	N	Y

² [Waikato Regional Hazards Portal | Waikato Regional Council](#)

Hazard Classification	N	Y
Climate Change	N	Y

Table 1 Simple Comparison of Models used in the PWDP

The 1D model flood extent is interpolated from a Mike 11 1D model onto a LiDAR derived topography using WaterRide flood analysis software. The 1D flood extent is created by extrapolating the 1% AEP 1D flood level model (2009 TOPNET Design 1958 - 0.2) over the adjacent floodplain to create a flood extent. The 1D model does not include allowance for the projected effects of climate change on rainfall and sea levels. The model also only relates to the main channel of the Waikato and Waipa Rivers and Mangawara Stream with many other tributaries and some overbank areas not included.

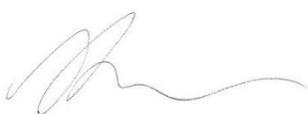
The 2009 TOPNET model was used to inform the performance of WRC managed stopbanks along the main channel of the Waikato River. The performance assessment (Scheme review) is regularly undertaken approximately every 10 years. The same 1% AEP model data and flood extent methodology for the Waipa river was also used in the Waipa District Plan.

The 1D flood extent maps do not show ponding/flooding outside of the main channel extents. Information is correct as of 16 November 2016 with further review undertaken by WRC prior to supply to WDC for the PWDP. Some manual amendments were made to the flood extents to remove inaccuracies/errors due to the extrapolation process.

1.2.1 Mapping of 1D/2D flood extents overview

The 1D mapping of the current 1% AEP flood extent provides a good representation of potential flood hazards to inform the provisions associated with the Flood Plain Management Area in the PWDP. That is, identifying areas that are at current risk from a 1% AEP flood event, with further detailed assessment including the projected impacts of climate change would be required for any further development in these areas.

Yours faithfully



Rick Liefing
Team Leader, Regional Resilience, Integrated Catchment Management Directorate, Waikato Regional Council.

Appendix 1

Lower Waikato Waipa Control Scheme Land Classification and Direct Benefit Analysis for Differential Rating Purposes

Lower Waikato Waipa Control Scheme

Land Classification and Direct Benefit Analysis for Differential Rating Purposes

Prepared by:

D R Campbell

M G Adams

For:

Environment Waikato

PO Box 4010

HAMILTON EAST

Discussion Draft September 2001

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In February 1998, Boyes Campbell & Associates, Registered Valuers and Property Consultants, Whakatane, in association with M G Adams, Registered Valuer and Farm Management Consultant of Pukekohe, were appointed as Consultant Classifiers, part of the team reclassifying land and implementing a new differential rating system for the Lower Waikato/ Waipa Control Scheme (LWWCS).

2 The Consultants' Brief, and the Terms of Reference

The Consultant's Brief and Terms of Reference are attached as Appendix 1. In summary, the requirement is to classify benefit for:

- a) Section A Urban Works in the former Huntly Borough area - 357 hectares.
- b) Section B Works in the former Counties of Waikato, Raglan and Franklin - 33,222 hectares.
- c) Section D Works in the former Taupiri Drainage and River Board area - 6,258 hectares.
- d) The Main Channel Works
- e) The Community Works

The areas stated are effectively the 1958 flood plain, which was considered to obtain direct benefits. The rating base of LWWCS was confined to those areas obtaining direct benefits, a restriction applied by the Waikato Valley Authority Act, now repealed.

At the time the project was initiated, it was proposed that the Classification Review would include indirect benefits and contribution/exacerbation effects.

Amended Instructions

The Brief has been amended, over a period of time, but formally as at February 2001, to the effect that only direct benefits are taken into account in this project.

Indirect benefits and contributory/exacerbatory effects are to be taken into account under rating mechanisms within the wider ambit of Project Watershed.

3 Legislation

3.1 The Rating Powers Act 1988 and Amendments

Classification is intended to provide the basis for differential rating, under Section 41 of the Rating Powers Act 1988.

Section 41 sets out the matters which are to be taken into account for direct and indirect benefits, including the extent to which the characteristics or the use of any property or actions of the occupier are likely to contribute to or alleviate the need for the work or service provided.

Section 81 of the Rating Powers Act sets out the criteria for determining types or groups of property for differential rating purposes.

3.2 The Local Government Amendment Act

The Local Government Amendment Act No.3, in particular Section 122F, addresses the principles of community based funding, beneficiary contributions, and contributory/exacerbator contributions.

3.3 The Resource Management Act 1991 and Amendments

Section 30 of the Act sets out the functions of Regional Councils under the Act. In particular, Sub-section (1)(c)(iv) focuses on avoiding or mitigating natural hazards.

Section 30 is directly linked to Section 5 which is the purpose of the Act.

The construction and maintenance of flood control Schemes is clearly a responsibility of Regional Councils in achieving the purpose of the Act.

3.4 Project Watershed Rating Mechanisms

The combination of rating mechanisms for Project Watershed, including the differential rating system described in this report, are intended to meet the requirements of the legislation. Environment Waikato has obtained legal advice which supports the proposed range of rating mechanisms, and this project and report on direct benefits is prepared on that basis.

4 Scheme Description

4.1 Catchment Description

The Waikato River is New Zealand's longest, and has a total catchment area of some 14,250 square kilometres. This includes its largest tributary, the Waipa River, which has a catchment of some 3050 square kilometres, extending from South of Te Kuiti to join the Waikato River at Ngaruawahia.

The Lower Waikato means that area which extends from Ngaruawahia to the Waikato River mouth, with a flood plain of approximately 36,400 hectares originally dominated by lakes and wetlands. A considerable area had been developed for agricultural production, but optimum production was severely limited by regular flooding.

The flood plain consists mainly of alluvial or peat-based flats. With very little fall through the river system, the slow flowing Waikato River remained high for a considerable period, and left behind extensive long term flooding or ponding, taking weeks to drain.

The Mangawara River catchment is included, with a current rateable area within LWWCS of some 6,250 hectares. Most of the Mangawara part of the Scheme is affected not by flooding of the Waikato/Waipā Rivers, but by flooding from its own catchment, with relatively explosive run-off from the hill country. Relatively swiftly flowing streams caused flooding over a considerable area of alluvial, peat, and clay based flats, with, in most cases, flood waters soon receding, in contrast to the much longer lived flooding in the lower Waikato.

4.2 Lower Waikato/Waipā Control Scheme

Although subject to periodic severe flooding throughout the period of development, it was the series of floods of the 1950s which triggered the development of a comprehensive flood control Scheme. The Waikato Valley Authority was created in 1956. Scheme works began in 1961, and were generally completed in 1983.

The underlying concept of the Scheme was to provide 1 percent annual event probability (AEP), or "100 year" protection to the flood plains wherever possible by constructing stopbanking, undertaking channel improvement works, and constructing control structures, along with floodpumps and floodgates.

It was not possible to protect all of the flood plain, and decisions were generally made on a cost/benefit analysis.

The result was that some 21,500 hectares achieved a high standard of protection from the Scheme, mainly to 1 percent AEP, but with 2 percent AEP in the Mangawara area, and a lesser standard in a number of generally quite small compartments.

A further 18,000 hectares approximately were thought to obtain a more limited benefit from the Scheme, largely as a result of improved day-to-day drainage resulting from lowering of the Waikato River level through channel training and deepening.

The protected flood plain of the lower Waikato is not joined together, but consists of several compartments of varying size. Each compartment effectively has its own local catchment, and in most cases the Scheme provides a considerable measure of protection from the effects of local catchment rainfall.

This protection takes the form of stopbanking, and in most cases it includes pump stations and floodgates. These pump stations and floodgates have, since the Scheme was constructed, been maintained by local drainage Schemes. However, they are now being brought within LWWCS funding.

5 Process of Classification

The initial stages of work involved familiarisation with Scheme assets, through field inspections with Environment Waikato staff and with some key landowner representatives, and individual personal inspections.

In the early stages, a number of meetings were arranged, attended by farmer representatives, Environment Waikato staff, and the classifiers to explain the re-classification process and intent, and provide the opportunity for farmers to express any matters they thought the classifiers should take into account.

The main points for discussion were:

- a) That the intent of the classification was to provide a more equitable basis for rating than the existing classification.
- b) That indirect benefit would be taken into account.
- c) That contributory factors would be taken into account.
- d) That in line with the above, the wider catchment would make a contribution to the rating base.

There were few on-farm matters put forward by property owners, but several wider issues became apparent, such as:

- a) A contribution from the wider catchment was considered equitable.
- b) The lack of contribution from providers of utilities and conservation land was considered inequitable.
- c) Many farmers with a lower standard of protection would be willing to pay for greater protection - how much they would be prepared to pay was not researched.
- d) The Aka Aka / Otaua farmers preferred to retain their independent control of drainage and hard flood protection defences, but recognise the need for management and funding for Main Channel Works.
- e) The issue of the unprotected lands within the flood plain is a major and perhaps disproportionate issue. This appeared to be based largely on -
 - i) frequency of flooding before and after construction of the Scheme
 - ii) increased reliance on the unprotected areas for Scheme ponding
 - iii) effect on the Waikato River Channel with and without sand dredging.

Almost all meetings and discussions undertaken by the classifiers, in public forums or on a personal level, have been with property owners within the existing rating base of the LWWCS. It will be necessary for Environment Waikato to extend consultation into those areas which will be part of the new overall rating base. It will also be necessary to convey to the ratepayers within the existing rating base that indirect benefit and contributory effects will be accounted for, but not within this differential rating system.

The initial familiarisation procedures were just the start of an in-depth analysis aimed at understanding not only the design and protection standards of the Scheme, but importantly, the

effect of these on the various land compartments of the protected and unprotected flood plains and adjacent lands of the lower Waikato.

The classifiers have studied considerable background information to gain an understanding of the Scheme and a bibliography of study material is attached.

Field inspections and discussions with farmers have added to familiarisation, so a sufficient part of the flood plain was inspected to enable a reasoned classification to be prepared. The project does not envisage that all properties can be inspected.

The major flood event of July 1998 served to focus the attention of today's farmers, and the community generally, on the need for the flood protection works and the benefits derived from them.

The classifiers spent quite some time during and after the flood observing flood effects and talking to landowners.

6 Direct Benefits

The classification is essentially an analysis of the benefits that the Scheme provides to the land, property and communities within the rateable area of the Scheme.

Matters to be taken into account when assessing direct benefits, as set out in the Rating Powers Act, are as follows:

- i. the likelihood, frequency, depth and severity of flooding and erosion; and
- ii. the likelihood, frequency and extent of damage to land and improvements to the land; and
- iii. the improvement of drainage; and
- iv. the need for water management generally - the actual and potential uses of the land, the advantages accruing from the works concerned and the responsibility for their care and maintenance. “

The direct benefits of flood control schemes are clearly identified and easily understood, and in the LWWCS, accrue to a significant extent on the protected flood plain, and to a limited extent on the unprotected flood plain.

6.1 Economic Benefits

The LWWCS has had a major and direct effect on the Regional economy arising from:

6.1.1 Land Development

Thousands of hectares have been cleared of willow and other vegetation, cleared of stumps, grassed, fertilised and drained where necessary.

Land which was previously virtually unproductive is now in a variety of productive land uses.

6.1.2 Dairying

Much of the land, alluvial and peat/alluvial in origin, has a high productive potential of up to 800 - 1000 kgs milk solids/ha, producing under current dairy farming economics a return of \$4000 - \$5000/ha Gross Income per annum. While some of this land, such as Aka Aka/Otaua, was in production at the inception of the Scheme, it is recognised that the maintenance of the Scheme assets is necessary to safeguard this productivity.

6.1.3 Cropping

The pressure for good quality cropping land, especially in the Franklin District, has led to a transition from dairy farming to cropping on many of the high quality soil areas protected by the Scheme. Crops initially were predominantly maize for grain and cucurbits. The trend is now for increasing areas in main crop potatoes and onions, both for local and export markets. Returns are approximately twice that of dairy farming.

While the main cropping areas have been in the Franklin District, many cropping companies are now extending into the Waikato Region and it is expected that more or the protected land under LWWCS will be used for this purpose.

6.1.4 Horticulture

Some niche areas are used for more intensive horticultural use including berry cropping, orchards, cut flowers and greenhouses.

6.1.5 Pastoral

Some areas remain in less intensive use such as sheep and beef farming. However farming economics are likely to lead to land being used more intensively to achieve it's full productive potential.

The productive factor is considered important in achieving equity in the Classification process.

6.2 Land Value

Perhaps the best measure of the benefits provided by the Scheme to the individual ratepayer is the increase in asset value, especially Land Value.

Examples of typical Land Values/ha are as follows:

Unprotected land in willow	\$1,000/ha
Protected land in willow	\$3,000 - \$4,000/ha
Protected land in pasture	\$10,000 - \$14,000/ha
Protected land suitable for cropping	\$12,000 - \$17,000/ha

With costs of development at \$2,000 - \$3,000/ha, the added Land Value for dairy quality land of around \$7,000 - \$10,000/ha is substantial, especially when related to a capitalised maintenance rate per hectare.

The flow-on effect of Land Value extends to those lands in the indirect benefit areas and to the local communities.

6.3 Drainage Benefit

Drainage benefits are derived from pump stations and floodgates, which are not currently funded by LWWCS but by local drainage Schemes.

These drainage benefits are now taken into account in the LWWCS Classification and Differential Rating System.

The local drainage district benefits relate to draining of local catchment water by floodgates and flood pumps.

In the absence of the Scheme, in any flood, regardless of size, beyond the area actually flooded will be a significant area where drainage would be significantly prevented by the presence of flood waters lower down, and this is a direct benefit from the LWWCS funded Scheme component.

7 Local Protection Works (Section B and Section D)

The local protection works comprise the greater part of the structural works in the lower Waikato (formerly Section B) and the Mangawara (formerly Section D) catchments. The works consist of stopbanking, stream clearing and diversion, along with pump stations and floodgates.

8 Section A Works

These are the urban works providing protection for the Boroughs of Huntly, Otorohanga and Te Kuiti. Only Huntly has been brought within the scope of the current project. Assets maintained by the Scheme are confined to stopbanking, along with a limited area with limited benefits from the Waahi outlet. This classification covers all benefits of the Scheme, including floodgate and pump station outlets.

9 Main Channel Works

Because the Waikato River channel was less able to deal with a flood, the Scheme was designed to provide for willow clearance, removal and future containment of shoaling, improvement of branch channel entrances, partial removal of islands and trimming of main and secondary channels, and improved alignment of and widening of the channel where appropriate. More extensive channel training works for the Mercer to Rangiriri reach were included as part of the Tongariro Offset Works, with the aim of offsetting the effect of the extra water diverted into the Waikato River from the Tongariro power development.

Most of the improvement to channel capacity has been obtained by commercial sand dredging operations which has also provided a sand royalty to assist in maintaining the Scheme.

The Aka Aka /Otaua area has one of the few major main channel works structural improvements - the Holmes Canal and the buffer bank.

10 Community Works

Community Works are those parts of the Scheme which were designed to provide benefit to more than one of the original counties which made up the Lower Waikato area. The works were generally those designed to control natural ponding of floodwater in the lower Waikato system, and to reduce peak discharges in the lower Waikato River.

It is obvious that the design of the Scheme called for a significant loss of floodwater ponding storage by protecting large areas of the former flood plain with stopbanks.

The residual ponding areas include several small to medium sized lakes - Whangape, Rotongaro, Waahi, Kimihia and Hakanoa, along with the unprotected flood plains, and two large areas, Lake Waikare and the Whangamarino Swamp.

The Community Works were centred on Lake Waikare and the Whangamarino Swamp.

There is a design spillway at Rangiriri across the highway and into Lake Waikare, which is designed to accommodate the excess discharge above an approximately 50 year event, diverting

this to storage in Lake Waikare. There is a control structure from Lake Waikare into the northern outlet canal which discharges to a tributary of the Whangamarino River.

There is a control structure on the outlet from the Whangamarino wetland to the Waikato River, which is closed when the Waikato River starts to backflow in to the wetland. The flood water from the extensive catchment of the Whangamarino River and its tributaries is stored in the wetland.

Once the Waikato River falls sufficiently, and the Whangamarino River gates are opened, the Lake Waikare gates are opened to allow dispersal of the stored floodwaters.

11 Tongariro Off-Set Works

When power development in the Tongariro river catchment was undertaken, the headwaters of the Wanganui and Rangitikei Rivers were in part diverted to Lake Taupo, and from there to the Waikato River.

Certain works were undertaken to off-set the likely effect, and consisted of main channel works to off-set the effect of increased normal to moderate winter flows, upgrading pump stations and floodgates, and strengthening of stopbanks. Improved flood management procedures for the Waikato Hydro system were agreed.

Due to the control mechanisms in place, high flood discharges are not increased.

12 The Classification Model

12.1 Physical Measurable Parameters

Environment Waikato prefers a model of Scheme benefit which has specific physical measurable parameters.

However, the classifiers have stated from the outset that the classification model can be developed only to a certain level on specific physical measurable parameters. Considerable judgement, both objective and subjective, is required throughout the classification process. Land classification has long been regarded as being as much an art as a science. Having said that, measurable parameters have been defined wherever possible.

Separate classifications are required for each of Section B and Section D Local Protection Works; Huntly Section A Urban Works; Main Channel Works; and Community Works.

A significant addition to the LWWCS funded area is the Aka Aka /Otaua area, which had flood protection in place at the time of the 1958 flood, but where these pre-existing assets, along with the improvements undertaken as part of LWWCS, now come within the ambit of Scheme maintenance. This area will be separately funded.

12.2 Direct Benefit Areas

The classification covers the land of the flood plain and adjacent land obtaining direct benefits. Essentially, it is the flood plain of the lower Waikato as identified in 1958, plus the Mangawara flood plain and the Aka Aka / Otaua area. It includes areas which, although not covered in flood water in 1958, without the Scheme would be surrounded by or significantly affected by floodwater. It also includes areas beyond the 1958 flood line which obtain a direct benefit from the Scheme, such as areas of peat land which have sunk with development and would now flood without the Scheme, and areas which obtain a direct drainage benefit from the Scheme.

The flood plain mainly consists of easily identifiable, essentially separate geographical areas or compartments. These generally correspond with the compartments set out in the Asset Management Plan Maps, and for clarity, we have in most cases adopted name identification from the Asset Management Plan.

Within each compartment the following have been taken into account:

- a) The design protection standard as set out in the Asset Management Plan and associated documentation.
- b) Where the current level of protection varies from the design standard, this has not been taken into account. Environment Waikato has clearly stated that the design standards as set out in the Asset Management Plan will be achieved, and are to be the basis for classification. In a number of cases the original stopbank protection has been topped up by local farmers. While this in some cases may not be to design engineering standard, the effect has been to improve the level of protection. The classification will relate only to the LWWCS design standard.
- c) The relative reliance of the land, by compartment and within compartments, on the Scheme assets.
- d) The quality of the land - productivity.

- e) The use of the land.
- f) The frequency and depth of flooding, and extent of damage, in the absence of the Scheme.
- g) Other matters necessary to ensure equity.

Each of the compartments has, to a greater or lesser degree, characteristics which make it different from other compartments, because of the various elements which make up the benefit obtained from the Scheme. This does not mean however that the overall classification of a compartment will necessarily be different from the classification of all other compartments.

There is also variation within compartments, even in such basic matters as the design protection standard, for example, Mangatawhiri, Meremere and Mangawara.

Because of the diversity of funding agencies for the maintenance of LWWCS, it is necessary to provide the separate classifications as detailed in Section 1.1. While the separate costs associated with the various works are separately identified, in total, the design of the Scheme overall is based on a high level of integration between each and all of the works. For example, the aim and the effect of Community Works and Main Channel Works was to significantly reduce the height of stopbanking required, on the basis of cost, and on the basis of some areas of poor foundation material below Rangiriri.

The Community Works are geographically associated with Lake Waikare and the Whangamarino Swamp, and these areas effectively provide the greater part of the residual ponding area in the Lower Waikato, below Huntly. However, the farmed areas immediately associated with the Community Works, being the land surrounding Lake Waikare, and the land around the Whangamarino Swamp, in fact have a lower total standard of protection than some other parts of the Scheme.

Taking these factors into account, the Classification has been prepared on the basis that:

- a) compartments may obtain their total overall Scheme benefits from varying proportions of the several works, and
- b) the design of the Scheme relies upon the integration of the several works.

12.3 Unprotected Areas

Large areas within the existing and proposed rating base have no stopbanking, and are still subject to periodic flooding. Direct benefits are mainly those associated with improvement to drainage and flooding obtained by the lowering of the Waikato River bed levels and normal flow water levels.

The recently completed investigation by a consultant engaged by Environment Waikato indicates that, in general terms, Main Channel Works and sand dredging have lowered the bed level and thus the water level of the river quite substantially.

Nevertheless, there is a perception amongst a number of landowners, based largely on anecdotal evidence, that some areas which could formerly be grazed for an extended period each year can now be grazed for shorter periods, or not at all.

Large areas of the unprotected flood plain remain in an undeveloped or essentially undeveloped state, with some limited grazing undertaken in many areas. This appears to be little different

from the situation before construction of the Scheme, and indicates that the improvement resulting from the Scheme works has not been enough to encourage capital expenditure on the development of these areas.

The Classification is based upon generally marginal Main Channel benefits, on the assumption, supported by observation, that the current use of the land, i.e. developed, semi-developed, or undeveloped, is an appropriate measure of the level of benefits.

12.4 Local Catchment Influences

There are some instances where the full benefit has not been obtained from the Scheme assets due to internal catchment flooding, and where economic considerations preclude private flood pumping or private stopbanking. The lesser land use potential in these areas is recognised.

For example, there may be stopbanking on the river, but none on the ponding body, often a lake, and when the ponding body outlet to the river is closed or impeded, flooding or ponding occurs on productive farmland around the margins of the ponding body. Specific examples are described within the compartment descriptions later in the report.

13 Class Descriptions

Most properties within the differential rating area will be paying rates based on three separate classifications for three separate works areas:

- i) Local Protection Works - Section B, D, or A.
- ii) Main Channel Works.
- iii) Community Works.

The various areas get their flood protection and drainage improvements from different proportions of each of the three works. Local protection works are to be funded separately within a number of different local compartments. For example, the Mangatawhiri protected area would be rated under the following cost centres:

- i. Main Channel Works
- ii. Community Works
- iii. Local Protection Works - Mangatawhiri

13.1 Local Protection Works - Lower Waikato - (Section B)

All classes from Section B1 to Section B5 are serviced by flood pumps.

The class ranking for each separately identifiable compartment is abbreviated as per the map legend. For clarity, note the following:

- a. LPSECB1 (etc) refers to the Section B or Local Protection Works.
- b. MCH1 (etc) refers to the Main Channel Works Classes.
- c. CWK1 (etc) refers to Community Works Classes.

LPSECB1

This class includes compartments which were highly susceptible to frequent flooding pre-Scheme, where the primary protection is provided by the Section B stopbanking, flood pumps and floodgates, with a moderate to low reliance on Main Channel Works and Community Works. The design standard of protection is 1 percent AEP.

Weighting is 100.

LPSECB2

This class contains compartments which were subject to frequent flooding pre-Scheme, as in B1 above, and where there is a moderate to high level of dependence on either Main Channel and/or Community Works. The design standard of protection is 1 percent AEP.

Weighting is 95.

LPSECB3

This class is subject to flooding and protected to 1 percent AEP standard. It contains a relative diversity of land types, including land of slightly higher elevation than the preceding two classes. It also includes areas of highly productive land, highly subject to frequent flooding, and protected to 5-10 percent AEP standard, but with no significant flooding problems in 1998.

Weighting is 90.

LPSECB4

Most of the compartments are protected by 5-10 percent AEP standard. There is a generally moderate reliance on Main Channel Works and Community Works. This class comprises a significant number of compartments scattered along the lower to middle reaches of the LWWCS maintenance area. All of the land was subject to frequent flooding pre-Scheme.

Weighting is 85.

LPSECB5

This consists of compartments, specifically Meremere Main and Bell Road, where the protection standard is compromised by flooding from the internal catchment.

Weighting is 70.

LPSECB6

These are compartments without flood pumps, but with a good standard of overall protection from stopbanking, floodgates, Main Channel works and Community Works.

Weighting is 55.

LPSECB7

This class contains a diversity of compartments which are not pumped. Some have a theoretically high standard of protection, but are compromised by lake flooding issues, i.e. Waikare, and South of Rotongaro. Other compartments have a lesser design standard of protection.

Weighting is 45.

LPSECB8

This class contains a diversity of compartments, where a high to moderately high normal standard of protection has significant compromising factors, e.g. Rangiriri Spillway; a lower standard of protection with some compromising factors, such as slightly more elevated land.

Weighting is 40.

LPSECB9

This class comprises the drainage areas at Waikokowhai, where the drainage outlet is pumped.

Weighting is 30.

LPSECB10

This is land deriving protection from the Waahi floodgate.

Weighting is 25.

LPSECB11

This is land in the more elevated parts of the Waikare plain.

Weighting is 20.

LPSECB12

This is land in the un-pumped drainage valleys south of Lake Rotongaro, and at Lake Waahi.
Weighting is 10.

13.2 Aka Aka Drainage

LPG1/A

Represents the majority of the drainage area being that which relies solely on gravity outlets to the Waikato River. It extends from west of the eastern drain through to the northern and western foothills. It relies on gravity outlets at Mawhitiwhiti, Aka Aka, Ten Foot, Awaroa, Otaua and Hills drains.

LPPG1/A

Comprises a relatively small area in the eastern sector of the district, which relies on both gravity and pumping drainage with outlet at eastern drain.

LPP1/A

A pumped compartment at the eastern end of the district based on the Mangawhero Scheme Pumps.

LPP2/A

A pumped compartment adjacent to the stop banks in the central part of the district. Based on the Muir Scheme Pumps.

LPP3/A

A pumped compartment at the western end of the district adjacent to Hoods Landing. Based on Hoods Landing Scheme Pumps.

13.3 Main Channel

MCH1

This class comprises a significant proportion of the Aka Aka/Otaua compartment, which obtains benefits from the only built Main Channel asset - the Holmes Canal/Buffer Bank. The compartment also has high Section B protection, with low Community Works benefit which does however recognise the integral Scheme design.

Weighting is 100.

MCH2

This class contains a diversity of land which is considered to obtain moderately high benefits from Main Channel Works, and which has a high standard of overall protection, i.e. 1 percent AEP.

Weighting is 70.

MCH3

This class contains a diversity of land which is considered to obtain a moderate to high level of Main Channel benefits, and where the overall standard of protection ranges from 5-10 percent AEP to 1 percent AEP.

Weighting is 60.

MCH4

This class contains a diversity of land, mainly with 5-10 percent AEP standard of protection, and with some land with 1 percent AEP standard but compromised by factors such as internal catchment flooding.

Weighting is 50.

MCH5

This comprises compartments in the Delta area where limited Main Channel Works are possible, but where the standard of protection is 1 percent AEP, along with an area at Mangatawhiri where the overall protection standard is 14 percent AEP.

Weighting is 40.

MCH6

This class comprises land in the Delta area, similar to MCH5, but with factors which compromise production potential.

Weighting is 30.

MCH7

This class obtains a low level of benefit from Main Channel Works, and a similarly low level of benefit from Section B Works and Community Works. It includes elevated peat dome land near Lake Waikare, and land adjacent to Lake Waahi

Weighting is 25.

MCH8

This class is situated generally above the level of pre-Scheme river flooding, but where Main Channel Works improve drainage outlet conditions.

Weighting is 20.

MCH9A

This is unprotected land - land without stopbanking, where there is a marginal Main Channel Works benefit resulting from lower mean water levels. The land is generally in pasture, and able to be grazed for a significant part of the year.

Weighting is 15.

MCH9B

This is unprotected land, generally with rough grazing available for a few months each year over at least part of the area.

Weighting is 10.

MCH9C

This is unprotected land, mainly undeveloped, with minimal grazing available.

Weighting is 5.

13.4 Community Works

CWK1

This class comprises land with an overall protection standard of 1 percent AEP, which is considered to obtain the greatest benefit from Community Works, but integral with Section B and Main Channel Works, on which it has a moderately high level of dependence. The land is situated adjacent to Lakes Waikare and/or the Whangamarino swamp.

Weighting is 100.

CWK2

This class has a high level of dependence on the Community Works for flood protection, but is compromised by rising lake levels, along with areas adjacent to the river in the Huntly/Ohinewai area with a high level of reliance on Community Works ponding. It contains land adjacent to Lake Waikare.

Weighting is 80.

CWK3

This land has a high level of dependence on the Community Works, and with 1 percent AEP for protection nominally, but is compromised by internal flooding or other productive limitation. It is mainly land adjacent to the Whangamarino swamp, and includes an area adjacent to the Waikato River with reliance upon Community Works ponding capacity, having 5-10 percent AEP protection.

Weighting is 70.

CWK4

This class contains a diversity of land with a moderate level of dependence on Community Works, along with a moderate level of dependence on Main Channel and Section B Works, and generally with an overall standard of protection of 5-10 percent AEP.

Weighting is 60.

CWK5

This class contains a diversity of land, which obtains moderate benefits from the Community Works, along with, generally, moderate levels of benefit from Section B and Main Channel Works. The land is mainly along the Waikato River, with an area at Mangatawhiri, a slightly elevated area south of Lake Rotongaro, and the Rangiriri Spillway area.

Weighting is 50.

CWK6

This land obtains a relatively low level of benefit from Community Works, but where the overall standard of protection is generally high, i.e. 1 percent AEP, and where the integral nature of the Scheme design needs to be taken into account. It is mainly land in the Delta area and an area at Mangatawhiri with 14 percent AEP protection, with a higher reliance on Community Works than the balance of the class, but with an overall low standard of protection. There is an area of elevated land on a peat dome near Lake Waikare.

Weighting is 40.

CWK7

This land has a limited standard of overall protection provided by the Waahi outlet to the Waikato River, where levels are in part dependent upon the ponding capacity of the Community Works. It is the area adjacent to Lake Waahi

Weighting is 35.

CWK8

This class contains areas above the pre-Scheme flooding level of the river or lakes, but which obtains benefits through improved drainage outlet conditions, which are in part dependent upon Community Works. A low level of benefit is assessed.

Weighting is 10.

13.5 Local Protection Works - Mangawara (Section D) (Mangawara)

LPSECD1

This area has the highest level of protection in Section D. It is a relatively small area at Orini, where ground levels are low. It is bisected by the Orini Canal (Mangawara River), with Sludge creek to the north, and with what may be an old Tauhei stream meander to the south. Soils are mainly alluvial, with some peat towards the southern side.

There is a floodpump, but this has seldom, if ever, been operated, with gravity outlets sufficient for evacuation of such internal ponding as occurs post-Scheme.

Weighting is 100.

LPSECD2

This area has a lesser level of protection. It comprises land throughout the system, which obtains a significant level of benefit from the Scheme, within the context of the economic benefits as set out in the general section. It includes both peat land, and areas of alluvial soil.

Geographical locations include adjacent to the Mangawara, adjacent to the Paranui, and stopbanked sections of the Tauhei.

Weighting is 80.

LPSECD3

This is land spread throughout the Scheme area. It includes more elevated land with a lesser likelihood of flooding, and/or in some cases, areas where flood protection is compromised by sub-catchment influences, and/or spillways such as those of the Southees' and Smith's at Hoe-o-Tainui.

It includes a quite substantial area south/south-west of Hoe-o-Tainui where the Mangawara River flows at a level considerably above the Paranui Drain which lies at the valley floor. In times of flood, pre-Scheme, the Mangawara River broke its bank and flowed down through this country to the Paranui Drain.

It includes areas adjacent to stream works such as small strips along the un-stopbanked parts of the Tauhei Stream, and the un-stopbanked reaches of the Mangawara above Hoe-o-Tainui.

Weighting is 70.

LPSECD4

This consists of more elevated land, much of it on peat domes, where the major benefit presently is the protection of outlet structures (floodgates). In due course, it is likely that peat shrinkage and possibly climate change will create a greater dependence on the Scheme than presently prevails.

Weighting is 60.

LPSECD5

This consists of more elevated parts of the plain above foreseeable river flood level and including peat domes but where there is high reliance upon drainage Schemes with floodgated outlets through the LWWCS stopbanking.

Weighting is 50.

LPSECD6

This is the balance of the mainly flat land contained within the several drainage Schemes which rely upon the floodgated outlets to the Mangawara River.

Weighting is 35.

LPSECD7

This is a relatively small area of land which comprises the stopbanking and associated berms to the Mangawara River and its tributaries, and where there is a limited level of benefit derived from Mangawara and tributary channel works.

Weighting is 5.

13.6 Mangawara Main Channel Works and Community Works

The benefits from these works in the Mangawara (Section D) area are directly in proportion to the level of benefits from the Section D Works themselves. So the class descriptions above apply for both Main Channel Works and Community Works.

13.7 Huntly Local Protection Works

LPH1

The Huntly direct benefit area has been classified largely using the Huntly Flood Hazard Management Report and the associated mapping, which identifies land as high risk from flooding, and land with relatively low risk of flooding. The land in this class is low lying land considered to be at high risk from flooding.

Weighting is 1.

LPH2

See LPH1. The land in this class is land considered to be at relatively low risk of flooding from the Waikato River.

Weighting is 0.6.

LPH3

This land derives significant indirect benefits from the Scheme, and these will be accounted for elsewhere within the Project Watershed funding systems. This is more elevated land, and land on the hill within the Huntly urban area, which is considered to be outside of any area likely to be flooded from the Waikato River.

Weighting is 1.

13.8 Huntly Community Works

The same class boundaries are used as for the Local Protection Works.

The Huntly proportion of total community works rates has been calculated by Environment Waikato.

Although the community works are located some distance downstream from Huntly, they are part of the integrity of the Scheme design, and contribute to enabling Huntly to discharge flood water into the Waikato River.

13.9 Huntly Main Channel Works

The same class boundaries are used as for the Local Protection Works. The Huntly proportion of total community works rates has been calculated by Environment Waikato. Although the community works are some distance downstream from Huntly, they are part of the whole scheme design, and help Huntly to discharge flood water into the Waikato River.

The Huntly proportion of total Main Channel works rates has been calculated by Environment Waikato. Huntly benefits from Main Channel Works by a lowering of water levels and drainage, as well as lower stopbank costs.

14 Description of Direct Benefit Compartments

Each geographical area of the flood plain, or compartment, is ranked according to the standard of protection obtained from the Scheme by Local Protection Works, Main Channel Works and Community Works.

These compartment descriptions will, in some cases, refer to both peat and alluvial soils in the same compartment. Where the alluvial soils are commonly used for a higher and better use - cash cropping/market gardening, the land may be placed in a separate higher class.

However, where the dominant land use is dairy farming on either soil, no separate class is assessed.

Although in most cases production from the alluvial soils is better than from the peat, the extra production is balanced by the fact that the peat shrinks over time and therefore has an increasing reliance on the Scheme.

Some compartments consist of a rising plain, where the upper reaches are less susceptible to flooding than the lower reaches, and in some cases benefits are largely from drainage. Although these more elevated areas are generally classified separately, the following descriptions and classes relate to the areas most dependent upon the Scheme assets. Refer to the maps to identify the elevated areas where separately classified.

14.1 Huntly North / Kimihia: (Classes: LPSECB1/3/8; MCH2/3; CWK2.)

This is the area north of Huntly, on the right bank of the river, extending towards Fosters Landing with Lake Kimihia to the east.

Pre-Scheme, flooding would have occurred regularly in the lower lying areas, parts of which were in limited production, or undeveloped. The more elevated flats were in production prior to Scheme works, being generally fertile and free draining. These now receive protection from the larger floods, and the whole area has protection to 100 year standard.

Protection Standard

1 percent AEP stopbank, with 2,325 metres of primary stopbank, floodgate and a pump station.

Productivity

The land is used for dairy farming and drystock grazing, with production ranging from fair to average.

Without the Scheme

Production on the more elevated areas would continue, but could be compromised by higher general water tables, and would be significantly compromised by larger flood events.

In the lower lying areas reversion to something like pre-Scheme conditions would occur over time, with limited summer grazing.

Main Channel Works

The compartment gets a common level of benefits from the main channel works, which generally provide lower outlets for everyday drainage, and increased channel capacity in times of flood.

Community Works

Kimihia is well upstream from the community works. However flood flows from the Kimihia catchment affect the Waikato River flow as a whole. Although this could be seen as adding to flooding on lower Waikato River flood plains, we consider that the matter is best dealt with as a direct benefit from the overall Scheme design.

July 1998 Flood

The area sustained flooding, due apparently to the breach of a private stopbank, although anecdotally the floodgate from the stream outlet from Lake Kimihia to the Waikato River was defective at the time.

14.2 Ohinewai / Waikare: (Classes: LPSECB3/7/8/11; MCH3/4; CWK2/4.)

This is a large and relatively diverse compartment, approximately two thirds of which was marginally farmed prior to Scheme construction, with the balance being swampland, mainly around the margins of Lake Waikare.

There are areas of more elevated land, particularly in the vicinity of Ohinewai itself, and east of Ohinewai south of the Tahuna Road, where a peat swamp rises in a north to south direction.

The main flood plain to the south and west of Lake Waikare contains variable soils, part alluvial, and part peat.

Protection Standard

Nominally, the area is protected to a 1 percent AEP standard by stopbanking on the right bank of the Waikato River. There are however compromising from the Community Works.

The Rangiriri spillway, which reduces the effective stopbank value to approximately 2 percent AEP. Although the water which crosses the spillway directly ponds on only a relatively small area of land, the spilled water enters Lake Waikare, which is one of the design flood storage areas remaining within the LWWCS area.

The outlet gate at the northern end of Lake Waikare to the canal into the Whangamarino swamp is closed during a high rainfall event when the Whangamarino Gate is closed or the Waikato River spills over the Rangiriri Spillway. Lake levels rise from a combination of spillway water, and local catchment rain. Opening of the outlet is controlled by the Waikato River level at the Whangamarino swamp outlet, so no water is released from Lake Waikare until water is flowing from the Whangamarino swamp to the Waikato River. This can lead to extended periods of ponding on farmland around Lake Waikare, as evidenced in July 1998. The situation could have been made much worse by internal catchment rain and/or higher spillway flows as the lake could have risen another 1.5 metres to design level.

This is a difficult situation for Waikare farmers. Unlike many other compartments which are able to pump internal ponding into the river or a tributary outlet, the Waikare farmers have no pumping outlet unless they construct their own stopbanks around the margins of Lake Waikare. Some of them have done this for all or part of their properties, but some were ineffective and some only just effective in the July 1998 event. There are apparently Resource Management impediments to constructing further stopbanking or upgrading existing private stopbanking.

The controlled inlet to Lake Waikare on the Waikato River - the Te Onetea Stream, the Rangiriri Spillway, and the Waikare outlet gate and the canal are all Community Works. While the nett effect of the spillway and the controlled inlet provide a lesser level of protection than an uninterrupted stopbank would, the community works do give some benefit. The outlet to Lake Waikare is man-made, which lowers the mean lake level. Land which was not able to be farmed around the margins of the lake because of high wet period lake levels is now productive farmland.

Defences include 8,024 metres of main stopbank, exclusive of the spillway stopbank, five pump stations and six gravity outlet floodgates.

Stream clearing is undertaken on 1,450 metres of the Te Onetea Stream.

The Rangiriri spillway embankment is 1,840 metres long. Stream clearing is undertaken on the Rangiriri Stream over 900 metres, and Te Onetea Stream channel works are undertaken over 750 metres. There is a control gate on the Te Onetea Stream.

Productivity

The land is used mainly for dairy farming , with average to good production.

Without the Scheme

Most of the compartment would, without the Scheme, be regularly flooded, severely affecting dairy farming, with a quite rapid reversion to low productivity, and much of the area available only for summer grazing.

Before the Scheme, some farmers had built their own stopbanks adjacent to the lake, with limited benefit.

Farming has led to peat subsidence, with some areas around the lake stopbanked by the farmers after the Scheme. These areas would be severely affected without the Scheme if lake levels reverted to those before the Scheme.

Main Channel Works

Part of the compartment, mostly situated closest to the river, obtains an average level of benefits from Main Channel Works, providing lower drainage outlets for everyday drainage, and increased channel capacity in floods. The rest of the compartment drains firstly to Lake Waikare. The level of Lake Waikare is controlled by the Community Works, but in due course, drainage water is routed from the lake through the outlet canal to the Whangamarino River and then to the Waikato River between Mercer and Meremere.

So, while in an everyday sense the land around Lake Waikare does not rely on the Main Channel Works next to the compartment, there is an obligation to contribute to the maintenance of Main Channel Works due to the integral design of the Scheme, and the effect of water from the Lake Waikare area on downstream compartments.

Community Works

Part of the actual community works are located towards the northern end of this compartment, where the Te Onetea Stream channel works, Rangiriri Stream clearing works and the Rangiriri Spillway embankment are located. These works are integral with the control structure radial gates at the northern outlet.

The Te Onetea stream was previously the main outlet from Lake Waikare. The Te Onetea control structure prevents floodwater from the Waikato River flowing back into Lake Waikare.

The northern outlet control gate is designed to maintain Lake Waikare water levels for ecological purposes, but at the same time maintaining the lake at a lower level than before the Scheme.

The Rangiriri Spillway operates in a severe flood event, such as occurred in July 1998. The operation of the spillway in conjunction with the closing of the outlet gate affects water tables and creates flooding or ponding around the margins of the lake.

The northern outlet gate remains shut until Whangamarino floodwater can flow out to the Waikato River.

The purpose of the spillway / community works here is in part to maximise flood storage in Lake Waikare to benefit downstream compartments.

While the community works clearly provide quite significant benefits to this compartment, the net effect of the community works, plus stopbanking and main channel works, is to provide an overall standard of protection below that enjoyed by otherwise quite comparable compartments, for example Huntly West.

July 1998 Flood

Flooding occurred in a number of places next to Lake Waikare. Some of these were areas with private stopbanking, where the stopbanks were breached, while other areas had no private stopbanking.

The area directly affected by the operation of the Rangiriri Spillway sustained flooding or ponding.

Essentially, the Scheme performed to design in this compartment, and flooding or ponding is expected in an event of this size.

Some farmers believe that the water level of Lake Waikare could have been better controlled, and brought to a lower level early in the flood event, and/or maintained at a lower level before the flood. This may however have put added pressure on the Whangamarino compartments.

14.3 Waikare Northern Foreshore: (Classes: LPSECB6/7; MCH4; CWK1.)

This compartment lies between Lake Waikare and the Te Kauwhata/Waerenga Road. Pre-scheme it was pussy willow infested virgin swamp, and is a relatively small compartment of approximately 250 hectares.

The compartment is some distance from the Waikato River, and flooding pre-scheme was caused by floodwater backing up through the Whangamarino River, the swamp from the Waikato River, and also by water spilling from Lake Waikare during floods, and/or as a result of high local catchment rainfall.

Protection Standard

1 percent AEP: A man made canal links Lake Waikare with the Pungarehu Stream north of the Waerenga Road.

There are 1,754 metres of canal stopbank, along with a 73m spillway, and one floodgate. The spillway operates only if there is an event above design.

Productivity

The land is used mainly for dairy farming with average to good production. It contains alluvial silts with potential for cropping.

Without Scheme Effects

As result of frequent flooding and high water tables from naturally higher lake levels, the land was not suitable for farming, and without the Scheme could revert to that state.

Main Channel Works

Everyday drainage and floodwaters reach the Waikato River through the Whangamarino River, and the compartment does not directly rely on the Main Channel Works.

However, the Scheme design is integral, and the effect on downstream compartments must be taken into account. The Northern Foreshore compartment is considered to, in effect, get standard or average benefits from Main Channel Works.

Community Works

The community works northern outlet canal passes through this compartment.

Before the Scheme, floodwaters spilled uncontrolled from Lake Waikare, and floodwater backed up through the Whangamarino swamp from the Waikato River.

Anecdotally, some over-drainage of the flats adjacent to the canal occurs during drier periods. The compartment clearly gets the greater part of its overall benefit from the community works.

July 1998 Flood

The Scheme worked as designed in this compartment, with no flooding or ponding.

14.4 Swan Road / Vrsaljkos: (Classes: LPSECB2; MCH2; CWK1.)

In total this is quite a substantial compartment of more than 600 hectares which, before the Scheme, was predominantly virgin peat swamp. It is mainly particularly low lying when you consider the level of the Whangamarino swamp and the Waikato River. Prior to the protection works flooding was caused by floodwater backing up the Whangamarino River and Swamp from the Waikato River, and by water spilling from Lake Waikare, fed from the Waikato River in flood, and from the local catchment. A man-made canal links Lake Waikare and the Pungarehu Stream, a small tributary of the Whangamarino River. The canal has been stopbanked, and there is a stopbank between areas of high ground along the northern end of the developed flood plain next to the swamp. Both Swan Road and Vrsaljkos have pumped outlets.

Although the Whangamarino swamp is a designated ponding area for LWWCS, it ponds water only from its own catchment, unless an extreme (above design) event results in overflow from Lake Waikare. A controlled outlet from the swamp near the Whangamarino River confluence prevents Waikato River flood waters flowing into the swamp.

A complicating factor for the area surrounding Whangamarino is the Whangamarino weir, which is designed to increase the water level in the swamp for conservation purposes. A new weir has recently been constructed, replacing one which was washed out.

Factors about the operation of the weir in reducing ponding capacity, and higher water tables affecting the frequency of ponding, or production on farmland next to the swamp were the subject of a resource consent application under the Resource Management Act. This consent was granted, and any adverse effects are subject to separate compensation. The classification has been prepared as though the weir exists, to reflect the actual water level.

Protection Standard

There are 3,612 metres of stopbank in the Swan Road area, plus a pump station and floodgate. Vrsaljkos has 2,000 metres of stopbank, and a pump station/floodgate.

The design standard is 1 percent AEP. Farmers say there was minimal freeboard on the stopbanking for a period during the July 1998 flood. There are internal drainage problems

related to ground levels and minimal fall through the peat plain, but these are not river scheme matters.

Productivity

Part of the land, at the southern end, consists of high quality alluvial soil suited to cropping, and there is some cropping taking place. The greater part of the land is peat, used mainly for dairying and dry stock farming. In the Vrsaljkos area there is a small area of essentially undeveloped peat land with heavy stumps

Without the Scheme

Production would be reduced to minimal levels within a short period of time.

Without the Scheme, flooding would be frequent, with inundation most of the year, particularly for the winter months, and high water tables throughout the year.

Main Channel Works

Everyday drainage and floodwaters reach the Whangamarino River.

Community Works

The man-made canal of the community works meets the natural Pungarehu Stream, a tributary of the Whangamarino River. The Whangamarino radial gates control structure prevents Waikato River floodwater from entering the Whangamarino catchment. Consequently although the Whangamarino swamp is one of the very large residual ponding areas in the lower Waikato system, it stores only its own catchment floodwater.

Viewed in isolation, the level of benefits to this area from the community works is high, although from an integral design viewpoint, the overall standard of protection is no better than in other generally well protected compartments e.g. Huntly West.

July 1998 Flood

The Scheme met design expectations in this compartment, although anecdotally very limited freeboard was available towards the northern end of the Swan Road compartment.

14.5 Lake Waahi: (Classes: LPSECB10/12; MCH7; CWK7.)

This is a relatively small compartment, with no Scheme floodbanking, but with a floodgate installed near the Waikato River confluence to prevent Waikato floodwaters flowing in. Channel vegetation control is undertaken over 1,900 metres, and there is a weir to maintain summer water levels.

Lake Waahi has a significant local catchment, and in the absence of the floodgate, the relatively limited areas of flood plain around the margins of Lake Waahi would flood regularly.

However in general terms the area is still subject to water table problems, and to inundation from local catchment flood flows.

Productivity

The more substantial properties are used for dairy farming with average to good production.

Without the Scheme

Without the floodgate, drainage would be affected, particularly on the un-stopbanked areas and frequent flooding would occur.

Main Channel Works

The capacity of the main channel at the Waahi Stream floodgated outlet is critical to the everyday level of Lake Waahi in providing the admittedly limited benefit to the Lake Waahi compartment.

The flood period channel capacity is important in enabling Lake Waahi levels to be controlled as far as possible.

July 1998 Flood

The Scheme met expectations for this compartment. A substantial private stopbank was breached in July 1998, flooding a considerable area of good land. The landowner has since reinstated the bank to an improved standard.

14.6 Furniss / Waikokowhai / Deroles: (Classes: LPSECB4/7/9; MCH4; CWK4.)

These small compartments are at the southern end of Lake Whangape, between the end of Furniss Road and the lake.

Stopbanking on the margins of the Waikokowhai Stream and the lake provides protection against the rising levels in Lake Whangape caused by water backing up the Whangape Stream from the Waikato River during times of flood, and by run-off from the local catchment. Prior to the Scheme, the greater part of the area is understood to have been virgin swamp.

Protection Standard

The design protection standard is given as 5 percent - 10 percent AEP. However, the stopbanks withheld the July 1998 flood, although some sandbagging was undertaken. Some topping up of the banks has since been undertaken by the Scheme.

The combined compartments have a total of 5,967 square metres of primary stopbanks, and each compartment has a pump station, with no gravity outlet.

Productivity

The land is used for dairy farming, with fair to good production.

Without the Scheme

Flooding would be regular, and high water tables would see the land revert to essentially swamp conditions, with some summer grazing.

The productive capacity of land would become minimal.

Main Channel Works

Lake Whangape has an uncontrolled outlet to the Waikato River, so levels fluctuate in relation to levels in the Waikato River. Accordingly, the compartment is considered to have a common level of reliance on main channel works.

Community Works

The compartment is well removed geographically from the community works. However the outlet of the Whangape Stream to the Waikato River is below the Rangiriri Spillway to Lake Waikare, so flood levels at the Whangape outlet are reduced in a large flood. Therefore the compartment gets a direct benefit from the community works.

July 1998 Flood

As indicated under 'Protection Standard', the stopbanks withheld the flood, albeit with some sandbagging.

14.7 Rotongaro: (Classes: LPSECB7/8/12; MCH3/4; CWK4/5.)

This consists of the flood plain South and South-west of Lake Rotongaro. The rest of Lake Rotongaro is surrounded by a rim of low hills, and to this extent the compartment is separate from the adjoining Huntly West/Whangape flood plain.

The outlet to Lake Rotongaro is through Lake Rotongaroiti, and thence to the Rotongaro Canal, with a floodgated outlet maintained by LWWCS to the Whangape Stream at a point between Lake Whangape and the confluence of the Whangape Stream with the Waikato River.

The floodgate prevents water backing up through the Whangape Stream from the Waikato River in floods, through Lake Rotongaroiti into Lake Rotongara, thence flooding the compartment plain.

There is a considerable local catchment and in heavy rain, a considerable area closest to the margins of the lake is flooded quite regularly. There may be issues of maintenance of the canal and channel.

The standard of protection is indicated as being 1 percent AEP, but this is compromised by local catchment floodwater regularly having an insufficient outlet through the scheme assets such as the Rotongaro canal.

Productivity

The area consists mainly of peat soils, used for dairy farming with fair to good production.

Without the Scheme

Before the Scheme, it is understood marginal production was obtained from the land. Without protection, the land at intermediate levels would be subject to regular flooding and/or water table problems, and the lower areas would revert to swamp vegetation.

The plain rises quite steadily to the south-west, and the more elevated areas would be able to sustain production at a reasonable level, although drainage would be compromised.

Main Channel Works

The level of Lake Rotongaro is dependent on Waikato River levels and their effect on the closing and opening of the Rotongaro floodgated outlet. Accordingly, the compartment is considered to have an above average level of reliance on main channel works.

Community Works

This compartment is somewhat removed geographically from the community works, except that the outlet through the Whangape Stream to the Waikato River is below the Rangiriri Spillway to Lake Waikare, so flood levels at the Whangape outlet are reduced in a large flood event. The compartment gets a nett benefit from the community works.

July 1998 Flood

In general terms, the Scheme met design expectations. Some flooding/ponding occurred around the margins of the lake on the lower lying areas, as a result of the inability to evacuate local catchment floodwater until the Waikato dropped sufficiently at Rangiriri.

14.8 Huntly West (Huntly, Whangape, Rangiriri LB, excluding Rotongaro): (Classes: LPSECB1/7; MCH2; CWK2.)

This is a large compartment situated on the left bank of the Waikato River, between Huntly and Rangiriri. Soils consist of alluvium and extensive areas of peat. Much of the peat lies at a low level compared to low flow levels of the Waikato River. The alluvial soils are generally higher ground, and there are some small rather more elevated areas within the middle of the flood plain. The latter would, however, be surrounded by floodwater without the Scheme, and get a high level of benefit.

There is a relatively small area between the un-stopbanked left bank of the Rotongaro Canal, and the Rotongaro - Rangiriri Road, which gets less protection.

Before the Scheme, the northern end of the compartment - some 1100 hectares - was virgin swamp, while the rest was in marginal sheep and beef production.

The Rotongaro canal contains 5,774 metres of secondary stopbanking, 4,300 metres of channel clearing, and a further 3,100 metres of channel clearing in the Whangape Stream. There is a spillway in the canal right bank just north of the Glen Murray Road. This provides for a controlled overflow if design conditions are exceeded for internal catchment flood flows.

As well, there is the protection provided by the Rotongaro canal stopbanks. Stopbanking extends along the entire bank of the Waikato River, with secondary stopbanking next to the north-eastern arm of Lake Whangape. Secondary stopbanking along the Rotongaro canal provides protection from internal catchment floodwater, including the catchment south of Lake Rotongaro.

Protection Standard

1 percent AEP: Protection consists of 20,554 metres of primary stopbanking, eight pump stations without gravity outlets, and four floodgates other than the Rotongaro canal gate.

Productivity

Most of the land is used for dairy farming, but with significant dry-stock farming. Generally, production is average to good, with some fair.

Without the Scheme

Flooding without the Scheme would be regular over most of the compartment, with flooding of much of the peat area for most of the year.

The area would revert to either swamp, in the case of the peat areas, or a marginally farmed situation, with no protection either from the Waikato River, or from significant internal catchment flooding.

Main Channel Works

The Waikato River channel extends along the entire eastern margin of the compartment, with 13 pumped or gravity outlets. The compartment as a whole has a common level of reliance on the benefits of providing lowered everyday drainage outlet conditions, and improved flood channel capacity.

Community Works

Most of this compartment discharges to the Waikato River upstream of the Rangiriri Spillway. The northern end discharges at or below the spillway.

However, floodwaters throughout the reach are reduced by the operation of the spillway. Without the spillway stopbanks would have to be higher to hold more water within the channel.

Although to some extent part of this catchment could increase the need for community works, we consider that the matter is best dealt with as a direct benefit from the overall Scheme design.

July 1998 Flood

Generally, the Scheme met design expectations. In places the Waikato River stopbank was threatened by a combination of water pressure, stopbank foundations, piping and boiling, requiring sandbagging. At the northern end of the compartment, a sandbag dam was constructed on the inside of the stopbank to create toe-loading back pressure to prevent a breach of the stopbank.

14.9 Aka Aka / Otatau: Area - 4900 ha. (Classes: LPSECB1; MCH1/5; CWK6.)

The Aka Aka/Otatau Compartment is the largest in the Scheme, including 3990 hectares of alluvial and peat lands used mostly for dairy farming. It is a major dairy farming locality. The Scheme Assets protect the land from the Waikato River while internal catchment water is drained by gravity and some pumping. An integral part of the Scheme is the Holmes Canal which is treated as main channel works. This creates a buffer between the main outlet of catchment water and the River.

The drainage and flood control Scheme has been administered by the local Aka Aka/Otatau Drainage Board for many years. This has subsequently become a sub committee of Environment Waikato.

The significance of the area is recognised in the context of its estimated productivity of around

3.5m kg milk solids p.a. with a gross revenue of around \$17.5m. p.a.

Protection Standard

1 percent AEP comprising 14,349 metres of primary stopbank, 11 flood gates with gravity outlet and five pump stations.

Frequency

Levels indicate that there is very little variation in level throughout the Compartment. Variation is approximately 800mm from south-west to north-east. In effect without protection the total area would be flooded very frequently and would revert to its original cover of wetland with limited productivity.

Productivity

Overall productivity of the compartment is very high with dairy farming the highest and best use with a productive potential of 850 kg - 1000 kgs of milk solids per hectare.

Soil types vary from silt loam on sand through silt loam on clay through peaty alluvium on clay and some small areas of deep peat.

The area is efficiently drained, with a network of gravity and pumping stations to main evacuation canals.

Some limited cropping is carried out and there is scope for increased cropping. This includes mainly summer crops - maize, sweet corn, cucurbits, crown pumpkin and late onions. The land would also be suitable for some more intensive horticultural uses including orchard, cutflowers and bulb production.

Effects

The effects of flooding would arguably be the most disastrous in the Scheme, as the flood plain is totally exposed to flooding to a depth of up to two metres in a major flood. This would destroy many expensive improvements. The highest risk would be to the residential component as there are many houses in the flood plain and there would be considerable risk to life.

Main Channel Works

The Aka Aka/Otaua Compartment benefits from:

1. Main Channel works both upstream and in the Delta area. These works are aimed at keeping main channels clear to increase both low flow and flood capacities. Channel works from the Tuakau bridge area downstream encourage the river flow to keep Delta channels open as it is not practicable to dredge in this area.
2. The maintenance of the Holmes Canal and Buffer Bank. This preserves the outlet for gravity drainage from a large part of the compartment via the Eastern Main Drain. It also assists in flood protection, due to the hydrological action of the Buffer Bank.

Community Works

While the direct benefit from community works is more difficult to measure because of the distance from the works themselves, there is benefit from reducing the flow at Rangiriri from

66,500 cusecs to 55,600 cusecs at the Mangatawhiri River, thereby reducing the water to be managed in high flood through the Delta area.

July 1998 Flood

The 1998 Flood presented no challenge to the stopbanks and there was little internal ponding. In short, the local Scheme appears to be operating efficiently both from within and without.

Local farmers emphasise the vulnerability of the banks in times which may not be during a major flood. These times coincide with high tide at Port Waikato and high south-westerly winds. This has been observed to be correct.

Drainage Benefits

Drainage benefits on the Aka Aka/Otaua compartment arise from a network of drainage systems in three main categories:

1. Pumped compartments.
2. Pump plus gravity.
3. Gravity.

Pumped Compartments - There are three compartments, Mangawhero, Muir and Hoods Landing. These are relatively small compartments which rely on flood pumps. They are low lying areas close to the river where it would be difficult to rely on gravity drainage.

Pump plus Gravity - This relates to the eastern drain pump which also connects to the gravity system evacuating through Mawhitiwhiti drain. The area of benefit is the eastern sector extending to the foothills.

Gravity - This applies to approximately 85 percent of the total area. It includes a number of major waterways and main drains, which link to floodgates and drain by gravity at low tide. The main waterways are Mawhitiwhiti, Aka Aka, Tenfoot, Awaroa, Otaua and Hills drain.

Many farms have internal pumping systems to pump into main drains but these are privately operated.

The major waterways are stopbanked and designed to retain run-off from the hill catchment area. Overall the drainage system is very effective in draining surplus water, maintaining water table levels, and supporting the highly productive dairy farming industry in the Aka Aka/Otaua area.

14.10 Meremere West: Area - 154.4 ha. (Classes: LPSECB4; MCH3; CWK4.)

Meremere West Compartment consists of 150 hectares of land protected by a long stopbank on its western side. It is within 300 metres of State Highway 1 at its northern end. It is used for drystock and dairy grazing.

Protection Standard

Protection is 5 percent - 10 percent AEP provided by 4341 metres of primary stopbank and two pump stations with no gravity outlet. It has a high proportion of assets compared with the area protected.

Frequency

Without protection the land would be subject to very frequent flooding. As it is silt land it could be cleared, grassed and grazed to a low intensity, subject to flooding.

Ponding would not be as lengthy as Meremere Main.

Effects

Flooding would destroy productive improvements. There are no homes within the flood plain, although there are some improvements related to the dirt track racing at the northern end.

Main Channel Works

The compartment benefits from channel works in the Waikato River especially in the Rangiriri to Mercer section. This preserves the river capacity both at low flow and flood level.

Community Works

The compartment benefits from the Community Works by a reduced flood flow from 66,500 cusecs to 55,500 cusecs past the Rangiriri spillway.

July 1998 Flood

The stopbank was over topped in two places during the 1998 floods. Over topping combined with subsurface seepage caused extensive flooding and some scouring. The stopbank was breached in two places to release the flood water. It has since been repaired and upgraded.

14.11 Rangiriri North: Area - 105.9 ha. (Classes: LPSECB4; MCH3; CWK3.)

This is a relatively small compartment compared to the size of the asset and is next to and immediately to the north of the Rangiriri Bridge. It is used for drystock grazing and there are some orchards.

Protection Standard

5 percent - 10 percent AEP provided by 2412 metres of primary stopbank and one pump station with no gravity outlet.

Frequency

Without protection the compartment would flood frequently. As for the Churchill East compartment the eastern sectors, which are lower lying, would revert to wetlands and those close to the river could be cleared and grazed on a low intensity basis.

Productivity

This is also similar to Churchill East - high quality silt loam close to the river and peat on the eastern sector. The dominant soil is the silt loam which has a high potential for dairy farming although this is restricted by the size of the compartment. It also has potential for cropping, although seepage could limit this in some areas.

Effects

The effects of flooding in this compartment would be serious both for the productive improvements and also for residents in the southern sector.

Main Channel Works

The compartment receives benefit from channel works in the main river, especially in the Rangiriri to Mercer reach. Channel Works are particularly important as the stopbanks are below 1 percent AEP and the effects of over topping would be severe.

Low flow channel capacity is important for pumping head drainage, and channel capacity for major flood is even more important.

Community Works

The Community Works are especially important to this Compartment being immediately downstream of the Rangiriri spillway where the major flood flow is reduced from 66,500 cusecs to 55,500 cusecs. This increases the integrity of the stop banks and permits a reduction in size.

July 1998 Flood

The defence performed well in the 1998 flood apart from some seepage along the length of the stopbank. One area of ponding occurred.

14.12 Ohairoa: Main Road Tuakau - Area: 45.0 ha. (Classes: LPSECB4; MCH4; CWK5.)

This is a small compartment immediately upstream of the Tuakau River Bridge. It is protected from internal catchment waters on the west and east and from the River on the northern side. It is similar to the Ticks compartment in having a high level of Asset development compared to the area and productivity of the land.

Protection Standard

5 percent - 10 percent AEP comprising 2470 metres of primary stopbank with one pump station with gravity outlet and one flood gate with gravity outlet. In addition the Scheme provides for 800 metres of channel diversion, 500 metres of channel vegetation control and one gravity outlet flood gate.

Flooding in this compartment continues to occur by way of internal catchment flooding. This arises from catchment water out flanking the western channel and entering the compartment in the southern sector. This event occurs quite frequently. Remedial work has recently been carried out but this does not appear to be engineered.

Internal flooding in particular has lowered the productivity of the compartment.

Productivity

It is used for drystock grazing. Pastures have been severely affected by flooding and have not been renewed.

With attention to both internal flooding and topping up of stopbank productivity would be substantially increased. The land has been cropped in the past. It is not big enough to be used as a dairy farm.

Frequency

Without protection the land would flood very frequently and would have a cover of willow and alder and be used only for summer grazing.

Effects

Flooding would remove all productive improvements. There is a major infrastructure effect in that flooding occurs at the corner of Murray Road and Main Road and this would be accentuated. There is no residential component.

Main Channel Works

The compartment benefits from works in the river channel which preserve flood flow capacity, and control low river flow water levels.

This has a beneficial effect on drainage and flood protection.

Community Works

These benefit the compartment by reducing the design flood from 65,000 cusecs at Rangiriri floodway to 56,000 cusecs downstream of the Mangatawhiri River.

July 1998 Flood

The stopbank was over-topped in the 1998 flood. This is reported to have been 30 metre length in the north-western section by approximately 250mm and a 40 metre length on the north-eastern section by a similar amount. Remedial measures were abandoned and the compartment was totally flooded.

14.13 Onewhero East, Port Waikato Road: Area - 92.9 ha. (Classes: LPSECB4; MCH4; CWK5.)

The Onewhero East compartment comprises a relatively large area of high quality soil protected from the river on the northern side and from internal catchment on the western side. It is the last compartment before the Tuakau Bridge and as such is very strategic to the local infrastructure.

It is used for cropping and dry stock grazing, with crops grown in recent years including maize, cucurbits, potatoes, onions and green crops.

Because of its soil type and location the compartment is one of the most productive in the Scheme. This is however compromised by a lower than desirable protection standard.

Protection Standard

5 percent - 10 percent AEP comprising 2635 metres of primary stopbank, one pump station with gravity outlet and one flood gate with gravity outlet. The stopbank has been raised by private landowners.

Frequency

The compartment would flood very frequently without protection, would have a cover of willow and alder and be suitable only for summer grazing.

Levels taken indicate that the compartment is near flat with a rise of about a metre only from north-west to south-east.

Productivity

Soil type is high quality river silt with some small areas of peaty alluvium. An internal drainage system links to the flood pumps and flood gate and this creates a soil environment suitable for cropping. Crops grown have included maize, cucurbits, potatoes, onions and green crops. Potential yields are high reflecting the high quality soil and high moisture holding capacity.

Alternative land use would be as a dairy farm.

Effects

These would be major in their effect on productive improvements and possible crops. There is no residential component.

Main Channel Works

The compartment benefits from main channel works carried out in the Delta area with view to preserving the flood capacity of all channels. The ability to preserve channels is limited because dredging is impractical. Channel works upstream also help in keeping the flow of the river sufficient to flush the Delta to prevent silting.

Community Works

These benefit the compartment in the context of the overall Scheme design. The community works reduce the design flood from 65,000 cusecs at Rangiriri floodway to 56,000 cusecs downstream of the Mangatawhiri River.

July 1998 Flood

The stopbank required some emergency topping in 1998 flood, but held. A temporary extension was required along Port Waikato Road where flood waters threatened to out flank the main stopbank. This was a very strategic protection measure as flooding would have taken both compartments and cut off the Port Waikato Road for a considerable time. It would also have threatened houses and lives.

14.14 Onewhero West, Port Waikato Road: Area - 153.0 ha. (Classes: LPSECB4; MCH4; CWK5.)

This is a relatively large compartment of good alluvial quality soils a kilometre west of the Tuakau River Bridge. It is protected on two sides from internal catchment water and on the northern side from the River. It is used for drystock grazing and has been partially cropped.

Because of its soil type and location, the compartment is potentially one of the most productive in the Scheme. This however is compromised by a lower than desirable protection standard.

Protection Standard

5 percent - 10 percent AEP comprising 3880 metres of primary stopbank with one flood gate with gravity outlet and one pump station with gravity outlet. The stopbanks have been topped privately by land owners. Classification relates only to design standards under the LWWCS.

Frequency

The compartment would flood very frequently without protection. Cover would be willow and alder and it would be suitable for summer grazing only.

The compartment is near level throughout with a rise of approximately a metre from river to south and east. The dwelling and other buildings would be at risk in a moderate event.

Productivity

Soil is mostly high quality river silt with some small areas of peaty alluvium. An internal drainage system links to the flood pump. This is required to pump some catchment water from south of Port Waikato Road and it is regarded as a design deficiency by the landowner. Most of the catchment water can flow to the river through the internal canal between the east and west compartments.

Although the compartment is large enough to be a dairy farm it is used for drystock grazing and has in the past been partially cropped. Its highest and best uses are either dairy farming or cropping. It has potential for in excess of 800 kgs of milk solids per hectare and is capable of growing crops, including cucurbits, maize with main crop potatoes, late onions and green crops.

Main Channel Works

The compartment benefits from main channel works carried out in the Delta area with view to preserving the flood capacity of all channels. The ability to preserve channels is limited because dredging is impractical. Channel works upstream also help in keeping the flow of the river sufficient to flush the Delta to prevent silting.

Community Works

These benefit the compartment in the context of the overall Scheme Design. The community works reduce the design flood from 65,000 cusecs at Rangiriri floodway to 56,000 cusecs downstream of the Mangatawhiri River.

July 1998 Flood

The stopbank came close to being over topped in the 1998 flood. Sand bagging and dumping of loose top soil on low areas was needed.

14.15 Waller-Comins: Area - 26.9 ha. (Classes: LPSECB4; MCH3; CWK3.)

This compartment is next to the Whangamarino Outlet and is protected by stopbank from the Whangamarino River. It is a small compartment used with adjoining land for dairy farming.

Protection Standard

This is 1 percent AEP derived from 469 metres of primary stopbank from the Whangamarino River and one pump station with gravity outlet. There is some internal flooding from catchment water when the flood gate is closed.

The compartment benefits from stream clearing in the Whangamarino River Channel.

Frequency

Without flood protection the compartment would be prone to frequent flood events arising from moderate river levels at Mercer and back flow into Whangamarino swamp lands. This would be worsened by catchment rainfall in the Mangatangi River catchment area. The compartment would be wetlands similar to the Whangamarino swamp.

Productivity

The land is of dairy quality and is complementary to adjoining high ground. It has a potential of around 700 - 800kgs of milk solids per hectare. Its size lessens its productive significance.

Effects

Flooding would remove productive improvements and create ponding over an extended area. If the Whangamarino gates were closed and stop bank failed this ponding could be for a very long time resulting in requirement for regrassing.

Main Channel Works

The compartment benefits from channel works, which maintain channel capacity both at low flow and flood capacity. Works increase low flow channel capacity and reduce the incidence of Whangamarino gate closure and hence provide a drainage benefit while maintaining flood capacity also delays gate closure.

Community Works

The compartment is within the community works enclosure, so it gets direct benefit from the works from the closure of the Whangamarino gates nearby when flood levels rise. This prevents back flow of the Waikato River into the Whangamarino River which then is a self contained ponding area within its own catchment. As gates are closed well before the River reaches major flood proportions, the community works have a significant affect on frequency of flooding on the Compartment. This has benefits based from drainage and flood protection.

July 1998 Flood

The 1998 flood event report indicates that, although the defence performed adequately there were some signs of minor seepage.

14.16 Ticks, Port Waikato Rd, Te Kohanga: Area - 23 ha. (Classes: LPSECB1; MCH6; CWK6.)

This is one of the smaller compartments in the Scheme and is next to the Waikato River Delta approximately eight kilometres from the river mouth. The area is river margin swamp lands infested with alder and willow and the compartment has in effect been carved from this environment. It is protected on three sides by stopbanks and has pumping capacity. The

protection and drainage standard combined with the alluvial soil makes it potentially highly productive. Present use is mixed drystock and horse and pig grazing. The compartment is not large enough and has no back up land to make it effective as a dairy unit. It could, however, be used more effectively with improved pastures and increased stock carrying capacity.

Protection Standard

1 percent AEP. The protection consists of 1616 metres of primary stopbank with one flood gate and one pumping station. This is arguably the most asset intensive compartment in the Scheme compared to the area protected.

Frequency

Without flood protection the land would flood very frequently, apart from a narrow strip next to the road. Land on either side remains in cover of willows and alder and is suitable only for summer grazing.

Productivity

The soil is high quality river silt. It is used for mixed drystock grazing. Internal drainage does not appear to be to the standard which the facilities potentially provide. The drainage restricts current land use. This is considered to be more a question of management rather than any deficiency in the design standards.

The land is too small to fully reach its productive potential, which would be dairy farming.

The land has potential for cropping, including cucurbits, maize, potatoes and onions.

Effects

Effects on productivity would be high. There is no residential component as the house is on adjacent high ground.

Main Channel Works

The compartment benefits from main channel works carried out in the Delta area with view to preserving the flood capacity of all channels. The ability to preserve channels is limited because dredging is impractical. Channel works upstream also help in keeping the flow of the river sufficient to flush the Delta to prevent silting.

Community Works

These benefit the compartment in the context of the overall Scheme Design. The community works reduce the design flood from 65,000 cusecs at Rangiriri floodway to 56,000 cusecs downstream of the Mangatawhiri River.

July 1998 Flood

The flood protection was not challenged in 1998 and there was reportedly at least 400mm of freeboard at the flood peak.

14.17 Miller-Farlane: Area - 28.6 ha. (Classes: LPSECB4; MCH3; CWK5.)

This compartment is adjacent to State Highway 1 north of Pokeno. It is protected from the Mangatawhiri River close to the confluence with the Waikato River at Pokeno.

It is a small compartment of predominantly peat soils used for dairying and horticulture.

Protection Standard

5 percent - 10 percent AEP comprising 545 metres of primary stopbank protecting from the Mangatawhiri River, one pump station with gravity outlet, and one pump station with no gravity outlet (Submersible).

There are no deficiencies recorded in the 1998 Asset Review, although it is noted that stopbank level was lowered temporarily as part of upgrading State Highway 1 adjacent.

Stream clearing in the Mangatawhiri River Channel benefits the compartment.

Frequency

Without protection the area would be permanent wetlands and willow with very low productivity.

Productivity

Soil type is predominantly shallow peat over alluvium. It has an internal drainage network linking to the pump station, which copes with internal catchment run-off. This also has gravity outlet to the Mangatawhiri River.

The sector south of Miller Road is partly used for a blueberry enterprise including full netting cover. The area north of Miller Road is used for a dairy farm in conjunction with adjacent high ground. It is complementary to the high ground and productivity there would be reduced to drystock without the protected area.

Effects

Effects of flooding would be major, especially on the high value blueberry improvements. There is no residential component within the flood level.

Main Channel Works

The compartment receives drainage and flood protection benefits from channel works in the main river.

The river channels are improved, both for low flow and flood, resulting in benefits to drainage and flood protection. The gravity outlet is to the Mangatawhiri River which is close to the confluence with the Waikato River.

Community Works

The compartment benefits from the community works, with lower flood levels through the Mercer section when the Rangiriri spillway is activated. The reduction from 66,500 cusecs to 55,500 cusecs has a significant effect on the Mangatawhiri River levels and standard of stopbank protection in the area.

Local anecdotal evidence suggests that the closing of the Whangamarino gates may cause more frequent flooding nearby. This does not affect the protected areas but may have some effect on unprotected areas.

July 1988 Flood

The stopbank was challenged in the 1998 flood and required some sand banking at this low area where road works had taken place.

14.18 Mangatawhiri 1: Area - 155.6 ha. (Classes: LPSECB4/7/8; MCH5; CWK6.)

The Mangatawhiri Scheme in general has four compartments. The Scheme design provides for stopbanking on the main channel of the Mangatawhiri Stream and several side streams. Compartment 1 encloses Lake Mangamate ponding area, which is designed to reduce the 5 percent risk flood peak.

Historically most extensive flooding in the area was triggered with storms of eight hour duration and consequent flow of 280 cumecs at the State Highway 2 bridge coinciding with high river levels at Mercer.

Protection Standard

This comprises two main areas:

- a) Mangatawhiri River consisting of 555 metres of primary stopbank on left bank and 1076 metres of primary stopbank on the right bank.
- b) This encloses the Lake Mangamate ponding area and consists of 809 metres of primary stopbank on the left bank of the Pouarauroa Stream and 900 metres along the right bank. There is a spillway into the ponding area and two flood gates with gravity outlet.

Compartment 1 is designed for 14 percent AEP (seven year) and a 170 cumec flood protection, which in turn is designed to reduce flooding to 5 percent AEP on the downstream compartments.

The 1994 review of design standards identified several deficiencies within the compartment, mainly related to crest widths and levels.

Stream clearing in the Mangatawhiri River Channel benefits the compartment.

Frequency

Without the protection the compartment would flood frequently estimated at two to three year event with the Lake itself reverting to marsh land, and surrounding land having willow cover suitable for summer grazing.

Productivity

Soil type is good quality river silt with some areas of peat within the ponding area. Present cover is pasture and the land is used as part of a dairy farm. It has the potential to produce in excess of 700 kgs of milk solids per hectare. As there is no pumping system areas of the land are subject to impeded drainage with runoff from the hills to the north.

Effects

Flooding would remove productive improvements such as fencing. Flooding would be of lengthy duration owing to the ponding area. There is no residential component on the compartment.

Main Channel Works

The Mangatawhiri Scheme as a whole benefits from channel works protecting the flood capacity of the river. This is especially significant in the Mercer area where river levels affect the confluence of the Mangatawhiri River with Waikato River, and have a ripple effect through the Mangatawhiri River to State Highway 2. Serious flooding in the Mangatawhiri Compartments usually coincides with high river levels at Mercer and a high concentration of rainfall in the Mangatawhiri River catchment. As rainfall cannot be controlled the channel works become especially significant.

Sand dredging at Mercer is significant in that there is a conflict between anecdotal evidence of local landowners claiming a build up of sand affecting river channels, and river cross section work which indicates a general lowering in channel levels. Classification assumes that design standards throughout the river channel are met.

Community Works

The Mangatawhiri Scheme benefits from community works by lowering peak flood flows from 66,500 cusecs to 55,500 cusecs. This is important in its effect at the Mangatawhiri River confluence and upstream effects. Without the community works the stopbank protection along the Mangatawhiri River would need to be raised.

July 1998 Flood

The report on the July 1998 flood event prepared by Tonkin and Taylor states that the Compartment 1 stopbank on the Mangatawhiri River was not threatened by flooding and there were no areas of concern. The Pouaraureroa River stopbanks were also not threatened and the Mangamate ponding area was not activated. This is presumably due to lack of rainfall in the Mangatawhiri catchment with the main flooding being from the Mercer or River end.

14.19 Mangatawhiri 2: Area - 200.0 ha. (Classes: LPSECB3; MCH4; CWK4.)

Compartment 2 consists of an area of high quality alluvial soil protected on the northern and western side by stopbanks to the Mangatawhiri River and by State Highway 2. Land close to State Highway 2 is more elevated than land to the west and the predominant land use is dairying and some cropping.

Protection Standard

5 percent AEP provided by 2100 metres of primary stopbank on the Mangatawhiri River, one pump station with gravity outlet and one pump station with no gravity outlet. The compartment is indirectly protected by the Mangamate ponding area in Compartment 1. This prevents the topping of the northern stopbank in all but the most serious events. If this stopbank is topped, water can flow across State Highway 2 into the compartment. This is a rare event and the last occurred in 1985.

Stream clearing in the Mangatawhiri River Channel benefits the compartment.

The 1994 Asset Review of the Scheme indicated there were a few locations where the bank was marginally below design crest level. It is believed these have been topped up since.

Frequency

Without protection, the compartment would flood reasonably frequently although this would be mainly in the south-western sector where it is more low lying and prone to intrusion from high levels of the main river at Mercer. It is assumed that this area would be in swamp and willows and the area close to State Highway 2 would be cleared and used reasonably productively.

Levels taken indicate approximately five metres above sea level on the lower flats of the compartment, six to seven metres on the medium levels, and seven to eight metres close to State Highway 2. Design flood levels are 8.2 metres at bridge and 7 metres 2.5 kilometres downstream.

Productivity

Most of the compartment is used for dairy farming. It is high quality silt loam soil type with some peat in the western sectors. Dairy farming productivity is assessed at in excess of 800 kilograms of milk solids per hectare. An area of approximately 20 hectares close to State Highway 2 bridges has been cropped for several years, including crops of maize, sweet corn and onions. This cropping area could be extended through most of the dairy land if required. The land to the north of State Highway 2 has also been cropped.

Effects

Effects of flooding in this compartment would be extremely serious as there is a high level of productive development including fencing, water supply, buildings and crops. The fertiliser depot within the compartment is on artificially elevated land and is assumed to be above flood level. Two houses within the compartment would be at risk although they are at around eight metre level.

Main Channel Works

The Mangatawhiri Scheme as a whole benefits from channel works protecting the flood capacity of the river. This is especially significant in the Mercer area where river levels affect the confluence of the Mangatawhiri River with Waikato River and have a ripple effect through the Mangatawhiri River to State Highway 2. Serious flooding in the Mangatawhiri Compartments usually coincides with high river levels at Mercer and a high concentration of rainfall in the Mangatawhiri River catchment. As rainfall cannot be controlled the channel works become especially significant.

The sand dredging issue at Mercer is significant in that there is a conflict between anecdotal evidence of local landowners, claiming a build up of sand effecting river channels, and river cross section work which indicates a general lowering in channel levels. Classification assumes that design standards throughout the river channel are met.

Community Works

The Mangatawhiri Scheme benefits from community works by lowering peak flood flows from 66,500 cusecs to 55,500 cusecs. This is important in its effect at the Mangatawhiri River confluence and upstream effects. Without the community works the stopbank protection along the Mangatawhiri River would need to be raised.

July 1998 Flood

The defence performed adequately in the 1998 flood.

14.20 Mangatawhiri 3: Area - 520.0 ha. (Classes: LPSECB4; MCH4; CWK5.)

Compartment 3 is a large area of predominantly peat land protected on the northern side by the stopbank to the Mangatawhiri River. From there it extends through several arms into the surrounding high ground to the south. Its access points are to Koheroa Road by side roads, and it is predominantly used for dairy farming.

Protection Standard

5 percent AEP provided by 3443 metres of primary stopbank on the Mangatawhiri River, and two pump stations with no gravity outlet.

The internal drainage is linked to the pumping stations and there can be some internal catchment ponding after heavy rain.

The 1994 Asset Review identified some areas where the stopbank was not to design standard. It is understood this has since been corrected.

Stream clearing in the Mangatawhiri River channel benefits the compartment.

Frequency

Without protection the land would be flooded very frequently and would have a cover of swamp land willow and stumps, flooding would be made worse by peat shrinkage.

Productivity

The land is a mix of peat and some river silt. Since the Scheme was constructed the land has been cleared and stumped and is now used for dairy farming. It has a reasonable productive potential of 700 - 800 kilograms of milk solids per hectare. It has cropping potential although this would be confined to summer production including maize, cucurbits, and late onions.

Effects

Total effects of flooding would be substantial. It would remove productive improvements and would result in an extended period of ponding, with disastrous effects on productivity. Land would need to be regrassed and productive improvements reinstated.

Main Channel Works

The Mangatawhiri Scheme as a whole benefits from channel works protecting the flood capacity of the river. This is especially significant in the Mercer area where river levels affect the confluence of the Mangatawhiri River with Waikato River and have a ripple effect through the Mangatawhiri River to State Highway 2.

Serious flooding in the Mangatawhiri compartments usually coincides with high river levels at Mercer and a high concentration of rainfall in the Mangatawhiri River catchment. As rainfall cannot be controlled the channel works become especially significant.

The sand dredging issue at Mercer is significant, in that there is a conflict between anecdotal evidence of local landowners claiming a build up of sand effecting river channels, and river cross section work which indicates a general lowering in channel levels. Classification assumes that design standards throughout the river channel are met.

Community Works

The Mangatawhiri Scheme benefits from community works by lowering of peak flood flows from 66,500 cusecs to 55,500 cusecs. This factor can be considered important in its effect at the Mangatawhiri River confluence and upstream effects. Without the community works the stopbank protection along the Mangatawhiri River would need to be raised.

July 1998 Flood

The stopbank was not challenged in the 1998 flood.

14.21 Mangatawhiri 4: Area - 412.9 ha. (Classes: LPSECB3; MCH4; CWK4.)

Compartment 4 includes a large area of river silt and peat extending for several kilometres from the State Highway 2 Bridge to the west. It has access from several side roads from State Highway 2 to the north and is used predominantly for cropping.

Protection Standard

5 percent AEP provided by a number of sectors:

- a) 4990 metres of primary stopbank and one pump station with no gravity outlet.
- b) Contour drain with 3800 metres of channelled diversion and 3310 metres of secondary stopbank.
- c) A contour drain detention dam with spillway, culverts and flood gate with gravity outlet and control structure weir. The contour drain is designed to divert water from a sub catchment to the north past Compartment 4. There is a spillway and ponding area designed to divert at the 10 percent flood level.

Stream clearing in the Mangatawhiri River channel benefits the compartment.

The 1994 Asset Review identified some stopbank deficiencies and these have since been corrected.

Frequency

Without protection, the compartment would flood very frequently both from the Mangatawhiri River and from the contour drain catchment area. The lower lying areas close to the river would be swamp, willow and stumps, and some areas close to the highway which are more elevated would be cleared and in reasonable grazing.

Productivity

This is one of the more productive compartments in the total Scheme, almost totally market gardening. It has been cropped for a number of years with maize predominant. Maize, a high demand crop, illustrates the strength and naturally fertility of the soil. This is predominantly silt loam in the eastern sectors which have been subject to continuous cropping. More recent

developments in the western sector involve peat soils, which have been cleared and stumped. These are also now cropped with crops including maize, sweetcorn, cucurbits and onions.

Alternative land use would be large scale dairying.

Effects

Effects of flooding in this compartment would be severe, varying according to the season and especially disastrous if crops were destroyed.

Ponding could be expected to be substantial especially in the western sectors where levels are lower. Levels on the peat areas are around three metres above sea level whereas the higher levels close to State Highway 2 are around 5 - 6 metres. The design flood level for main stopbank is at 8.2 metres at State Highway 2 Bridge and 6.8 metres, 4.5 kilometres downstream.

Ponding would be likely for a substantial time.

Main Channel Works

The Mangatawhiri area as a whole benefits from channel works protecting the flood capacity of the River. This is especially significant in the Mercer area where River levels affect the confluence of the Mangatawhiri River with Waikato River and have a ripple effect through the Mangatawhiri River to State Highway 2. Serious flooding in the Mangatawhiri Compartments usually coincides with high river levels at Mercer and a high concentration of rainfall in the Mangatawhiri River catchment. As rainfall cannot be modified the channel works become especially significant.

Sand dredging at Mercer is significant in that there is a conflict between anecdotal evidence of local land owners claiming a build up of sand affecting river channels, and river cross section work which indicates a general lowering in channel levels. Classification assumes that design standards throughout the river channel are met.

Community Works

The Mangatawhiri Scheme benefits from community works by lowering peak flood flows from 66,500 cusecs to 55,500 cusecs. This factor can be considered important in its effect at the Mangatawhiri River confluence and upstream effects. Without the community works the stop bank protection along the Mangatawhiri River would need to be raised.

July 1998 Flood

The stopbank and contour drain performed adequately in the 1998 flood with no threat to the defences.

14.22 Parish Polder: Area - 185.2 ha. (Classes: LPSECB4; MCH3; CWK3.)

This is a moderately sized compartment with a high level of Scheme asset in relation to the area protected. It is used for drystock grazing and has a complementary benefit to adjoining high ground. It has side road access to State Highway 1 1 kilometre to the west and is close to the Whangamarino gates.

Protection Standard

This is 1 percent AEP derived from 1528 metres of primary stopbank on the Whangamarino River section and 1590 metres on the Maramarua River section. There is one pump station with no

gravity outlet. The design crest level of the stopbank is 6.37 metres and internal ground level 3.02 metres. Various asset performance reviews indicate deficiencies in the pumping system and seepage problems within the stopbank. Submissions to the Whangamarino weir application in 1995 claimed that the weir would raise water table levels in the compartment, due to increased seepage. It is claimed that this will limit potential land productivity.

There is a high cost of pumping internal catchment water against the head in this compartment.

The compartment benefits from stream clearing in the Whangamarino River channel.

Frequency

Without protection the land would revert to swamp land similar to the adjacent Whangamarino swamp.

Productivity

Soil type is silt loam. Owing to seepage and internal drainage problems cropping is a limited option and the highest and best use is dairy farming. The land is at present used for drystock grazing.

Effects

Effects of a flood would be major, removing productive improvement. Ponding would be substantial for a long period of time until river levels receded to approximately 3.4 metres.

Main Channel Works

The compartment benefits from channel works from maintenance of channel capacity both at low flow and flood capacity. Low flow works increase channel capacity and reduce the incidence of Whangamarino gate closure, benefiting drainage, while maintenance of flood capacity also delays gate closure.

Community Works

The compartment is within the community works enclosure, and gets direct benefit from the works. This arises from the closure of the nearby Whangamarino gates in times of rising flood levels. This prevents back flow of the Waikato River into the Whangamarino River which then is a self contained ponding area within its own catchment. As gates are closed well before the river reaches major flood proportions, the community works significantly affect the frequency of flooding on the compartment.

Effect of Whangamarino Weir

Environment Waikato has calculated that there will be a relatively small loss of storage in the available ponding area within the Whangamarino wetland, and there is some conflict of opinion as to how this will affect the overall effectiveness of the Community Works. There may also be an adverse effect on drainage on fringe land such as the subject Compartment. Actual effects will be revealed in time, but in the meantime the classification has been prepared on the basis that adverse effects will be minimal in this compartment.

July 1998 Flood

The 1998 flood challenged the stopbank to the extent that peak flood at the Whangamarino gates was 6.11 metres external and 5.7 metres internal. Gates were opened at 5.4 metres. While

sufficient free board existed on stopbanks this may have been challenged had there been more significant rainfall in the Mangatangi catchment while gates were closed.

14.23 Bell Road: Area - 164.1 ha. (Classes: LPSECB5; MCH4; CWK3.)

This consists of a medium sized compartment of alluvial soil type formed by the flood plain of the Maramarua River. It is to the west of State Highway 2 at Maramarua and lies between the road and the Whangamarino swamp.

Protection Standard

1 percent AEP comprising 1602 metres of primary stopbank, one pump station with gravity outlet and one gravity outlet flood gate. The flood defences protect both from the rise in water levels of the Whangamarino wetlands to the west and also encroachment from the Maramarua River in the south. While the major flood protection is to 1 percent AEP level, the overall protection is considerably less owing to Indirect flooding from behind the defences from the Maramarua River. This flows into the compartment from the south-east and is in effect trapped by the stopbanks and requires pumping.

The compartment benefits from channel works in the Maramarua and Whangamarino Rivers.

Indirect flooding has taken place up to three times in a year, while on other occasions there is no flooding for two to three years. There is considerable economic loss as the land - high quality alluvial - is used for dairy farming and cropping.

Despite the high level of primary stopbank protection the deficiencies within the compartment are taken into account in the classification assessment. It is noted that no long term solution to the problem has been identified or actioned.

Frequency

Without protection the area would be permanent wetland although with more summer grazing potential than most of the Whangamarino swamp land of which it forms part.

Productivity

The compartment is highly productive, based on good quality alluvial soils. Part is used for dairy farming with a reasonable productive level under average management of in excess of 750 kg of milk solids per hectare.

Much of the area has been used for maize cropping for a number of years.

Effects

The effects of flooding could be severe. The level of the Whangamarino swamp land could create a long term flood water problem together with damage from the Maramarua River itself.

Main Channel Works

The compartment benefits from channel works arising from maintenance of the main river channel which affects the frequency with which the Whangamarino flood gates are closed and hence levels in the Whangamarino swamp.

Community Works

The compartment is within the Community Works enclosure and as such gets direct benefit from the works. When the Whangamarino gates are closed in times of rising flood levels, back flow of the Waikato River into the Whangamarino River and through to the Maramarua River is prevented. The Whangamarino swamp land then becomes the ponding area for the compartment. As gates are closed well before the river reaches major flood proportions, the Community Works have a significant effect on frequency of flooding of the compartment.

Effect of Whangamarino Weir

Environment Waikato has calculated that there will be a relatively small loss of storage in the available ponding area within the Whangamarino wetland, and there is some conflict of opinion as to how this will affect the overall effectiveness of the Community Works. There may also be an adverse effect on drainage on fringe land. Actual effects will be revealed in time, but in the meantime the classification has been prepared on the basis that adverse effects will be minimal in this compartment.

July 1998 Flood

There was extensive flooding in the 1998 flood event and flood water took some weeks to remove .

14.24 Motukaraka: Area - 1461.5 ha. (Classes: LPSECB2/3; MCH2; CWK1.)

This is a large compartment of 1538 hectares of peat land extending from close to the Parish Polder Compartment through to State Highway 2 at Mangatawhiri. It has several points of access from Koheroa Road, State Highway 2 and Bell Road. It is used for large scale dairy farming and has been used for market gardening cropping in the past.

Protection Standard

1 percent AEP comprising 2130 metres of primary stopbank protecting from back up flow from Maramarua River and Whangamarino swamp. There are three pump stations with no gravity outlets.

The compartment benefits from stream clearing in the channels of the Maramarua and Whangamarino Rivers.

The compartment is linked to the effectiveness of the Waikare/Whangamarino community works and relies heavily on the Whangamarino ponding area to retain internal water levels below design crest levels of 6.82 metres. Minimum internal ground levels are 2 - 2.5 metres.

Internal catchment water is pumped mainly by way of the stopbanked Kopuera Stream which links to the main pumping system in the western sector.

As for the other compartments within the Whangamarino Scheme, the defences could be challenged if the Whangamarino gates were closed for a long time and there was extensive rainfall in the Mangatangi catchment.

Frequency

Without protection the area would be permanent wetland similar to Whangamarino. Information on previous levels taken in 1970, 1981 and 1985 indicates that the peat lands are

subject to considerable shrinkage. Minimum levels are now 1.74 metres with an average over the peat land of around 2.2 metres. This rises to 2 - 5 metres on the perimeter of high ground areas.

The majority of the flat land is below low river level at Mercer.

Productivity

The compartment is one of the most highly productive in the Scheme with peat soils which are suitable both for high quality pastoral production and cropping. The upper end of the protected land is complementary to high ground comprising one of the largest dairy farms in the Auckland/Waikato Region milking up to 3000 cows.

The western end is also now a large scale dairy farm and was a pioneer large scale cropping area in the 1980s and could return to this use.

Effects

Effects of flooding on this compartment would be disastrous for productivity and risk to life. It has a high level of asset development and includes several buildings and some residential component within the flood plain. Most houses however, are located on adjacent high ground.

The major effect would be the length of time the land would be ponded as most is below normal river level and peak flood would see much of it under four metres of water. It is also linked to the Whangamarino swamp land which would also have to recede.

Having a predominant land use of large scale dairying there could be very severe effect on dairy farming requiring dairy herds to be moved, possibly in full milk production.

Main Channel Works

The compartment benefits from channel works arising from maintenance of channel capacity, both at low flow and flood capacity. Low flow works increase channel capacity and reduce the times the Whangamarino gate is closed, providing a drainage benefit while maintaining flood capacity also delays gate closure.

Community Works

The compartment is within the community works enclosure and gets direct benefit from the works. This arises from the closure of the nearby Whangamarino gates in times of rising flood levels. This prevents back flow of the Waikato River into the Whangamarino River which then is a self contained ponding area within its own catchment. As gates are closed well before the river reaches major flood proportions, the community works have a significant effect in providing flood protection and drainage benefits.

July 1998 Flood

The defences were not challenged in the 1998 flood with a peak flood level of 5.5 metres. Some areas of seepage were noted.

14.25 Churchill East: Area - 717.0 ha. (Classes: LPSECB3; MCH3; CWK3.)

This is a large compartment to the west of State Highway 1 between Meremere and Te Kauwhata. It has predominantly silt loam soils blending to peat in the eastern sector and is used for dairy farming.

Protection Standard

5 percent - 10 percent AEP provided by 4811 metres of primary stopbank, three pump stations with no gravity outlet and one flood gate with gravity outlet. There is a two stage pumping system to remove internal catchment water.

Owing to the size of the catchment and shrinkage of the peat there can be some ponding after heavy rain in the upper compartment.

Without protection the land would be subject to frequent flooding. The silt loam areas close to the river would clear quickly and ponding would be confined to the upper catchment areas where peat is at a level 1.5 - 2 metres below the front silt loam land. This land would revert to wetlands while the silt land would be cleared and farmed on a low intensity basis subject to flooding.

Productivity

The compartment is one of the more productive in the total Scheme and is recognised as a premium dairy farming area based on high quality silt loam soils on sand, giving free draining in winter and good summer growth. The upper compartment peat lands have some impeded drainage and lower productivity.

Highest and best pastoral use is dairy farming with a potential of in excess of 800 kgs of milk solids per hectare on the silt loam and 650 kgs per hectare on the peat.

The silt loam land has cropping potential for such crops as maize, cucurbits, potatoes and onions.

Effects

Effects on this compartment would be particularly serious as it would eliminate productive improvements and also put several homes and life at risk.

Main Channel Works

The compartment receives benefit from channel works in the main river, especially in the Rangiriri to Mercer reach. Channel Works are particularly important as the stopbanks are below 1 percent AEP and the effects of over topping would be severe.

Low flow channel capacity is important from drainage aspects especially owing to the length of the stopbank and preserving gravity outlets, and channel capacity for major flood is even more important.

Community Works

The Community Works are especially important to this compartment being immediately downstream of the Rangiriri spillway where the major flood flow is reduced from 66,500 cusecs to 55,500 cusecs. This increases the integrity of the stopbanks and permits a reduction in size.

July 1998 Flood

The Waikato Regional Flood event report states that the defence performed well except for some minor ponding and seepage.

14.26 Meremere Main: Area - 505.9 ha. (Classes: LPSECB5; MCH3; CWK5.)

Meremere Main is a moderately large compartment west of State Highway 1 at Meremere. It comprises predominantly peat land protected by a small length of high grade stopbank.

The compartment has a serious problem within internal flooding, which may result in substantial areas flooded more than once a year. The problem arises from the large catchment, which delivers catchment water through a central drain to the pumping system. The pumping system has been found to be inadequate in times of intense rainfall. Investigations found that remedies are largely uneconomic. This ranges from installing pumps of greater capacity to construction of a ponding system in the upper catchment area. Both alternatives are estimated to cost around \$400,000 which is unlikely to be economic.

Protection Standard

1 percent AEP Flood protection provided by 467 metres of primary stopbank and a pump station with no gravity outlet. While flood protection is 1 percent AEP the compartment is frequently internally flooded. This is a major limitation to land use.

While the major flood protection is indeed 1 percent AEP, classification takes into account that the benefit of this protection can not be fully used while the internal flooding persists.

Frequency

Without protection the compartment would flood very frequently and would be a wetland area providing summer grazing only.

Productivity

Soil type is peat loam, which is yet to be stumped in some areas. A central drain giving access to the pumping station is partially stopbanked and provides an outlet for internal drainage with flood gate protection. Shrinkage of the peat and an ineffective pump prevents drainage through large areas of the compartment, restricting land use. Land south of Hampton Downs Road, east of State Highway 1, and west of the main drain has been cleared and is in reasonable pasture. Land between the main drain and State Highway 1 is in the process of development and is predominantly in poor rush infested pasture with drainage problems.

Land west of the main drain is used for dairy farming and the other cleared areas for sheep and beef grazing.

The dairy land is complementary to adjoining high ground and improves overall land use and productivity.

Effects

Flooding would remove productive improvements. There is no residential component within the flood plain.

Ponding would be reasonably lengthy until the river levels return to approximately three metres which is the basic level of the peat land.

Main Channel Works

The compartment benefits from channel works in the Waikato River, especially in the Rangiriri to Mercer section. This preserves the river capacity both at low flow and flood level.

Community Works

The compartment benefits from the Community Works, with high flood flow reduced from 66,500 cusecs to 55,500 cusecs past the Rangiriri spillway.

July 1998 Flood

The flood defence performed adequately in the 1998 flood.

14.27 Whisky Flats, Port Waikato Road: Area - 30.3 ha. (Classes: LPSECB6; MCH6; CWK6.)

This is a small compartment midway between Tuakau Bridge and Port Waikato. It was previously part of the flood plain of the river with a cover of virgin swamp, willow and Alder. It is protected from the river by stopbanking and an internal stopbank provides outflow from the hill country catchment to the south. This divides the compartment into two sections.

Soil is alluvium and some peat and the land is used for dairy farming along with adjacent high ground.

Protection Standard

1 percent AEP. The compartment consists of two sectors western and eastern. The western has 1143 metres of primary stopbank and one flood gate and the eastern has 1270 metres of primary stopbank and one flood gate.

Frequency

The compartment would flood very frequently without protection. It would have a cover of willows and alder and be regarded as not economic to clear. It would provide summer grazing only.

Productivity

Soil type is good quality river silt with some peat, and the land is used for dairy farming in conjunction with adjoining land. It has potential for cropping if farmed in its own right. Present land use is assessed at 750 - 800 kg/M/S/ha under average management.

Effects

Flooding would have a substantial effect on productivity due to the extended time the flood waters would be retained. There is a house on the flood plain.

Main Channel Works

The compartment benefits from main channel works carried out in the Delta area with view to preserving the flood capacity of all channels. The ability to preserve channels is limited because dredging is impractical. Channel works upstream also help in keeping the flow of the river sufficient to flush the Delta to prevent silting.

Community Works

These are of benefit to the compartment in the context of the overall Scheme design. The community works reduce the design flood from 65,000 cusecs at Rangiriri floodway to 56,000 cusecs downstream of the Mangatawhiri River.

July 1998 Flood

In the 1998 flood the western compartment was not challenged. The Eastern compartment was flooded because the flood gate was missing. This was a deficiency of internal and external management rather than a deficiency in the design standard.

14.28 Horseshoe, Port Waikato Road: Area - 99.1 ha. (Classes: LPSECB2; MCH6; CWK6.)

Horseshoe compartment is a horseshoe shaped piece of peat and alluvial land fronted on the north side by the river and on other sides by a volcanic tuff escarpment. It has private access from Port Waikato Road close to Te Kohanga settlement. It is presently part of a dairy farm. A main central drain gives access to a pump and there is no gravity outlet. There are some small areas of seepage on the inside of the stopbank and parts of the main compartment are poorly drained. Some land is humped and hollowed.

Protection Standard

1 percent AEP. There are 765 metres of primary stopbank and one pump station.

Frequency

The compartment would flood very frequently without protection. It would remain in willows and alder and provide summer grazing only.

Productivity

The soil type is peaty alluvium with dairy farming the highest and best pastoral use associated with adjoining land, or cropping if farmed independently. Present land use is assessed at 700 kgs M/S/ha under average management.

Effects

There would be major effects without protection in that the land would revert to river swamp land. There is no residential component on the land.

Main Channel Works

The compartment benefits from main channel works carried out in the Delta area to preserve the flood capacity of all channels. The ability to preserve channels is limited because dredging is

impractical. Channel works upstream also help in keeping the flow of the river sufficient to flush the Delta to prevent silting.

Community Works

These benefit the compartment in the context of the overall Scheme Design. The community works reduce the design flood from 65,000 cusecs at Rangiriri floodway to 56,000 cusecs downstream of the Mangatawhiri River.

July 1998 Flood

The defence performed adequately during the July 1998 flood with a freeboard of 0.5 metre observed at peak flood.

14.29 Te Kohanga West - Major: Area - 29.6 ha. (Classes: LPSECB1; MCH5; CWK6.)

Te Kohanga major western and eastern compartments are divided by a natural water course allowing drainage of natural run-off water from the hills to the south.

The western portion includes stopbanks protecting both from the internal water course and the river to the north. It is used for dairy farming.

The compartment forms part of the natural flood plain of the river and has an alluvial soil type. Without protection the land would have a similar cover as outside the stopbanks - virgin swamp with alder and willow infestation with some limited summer grazing potential.

Protection Standard

1 percent AEP comprising 1660 metres of primary stopbank, one pump station and no gravity outlet. The pump station evacuates run-off water from the volcanic cone to the west through a central open drain.

Frequency

The compartment would flood very frequently without protection and would have a cover of willow and alder and the use of summer grazing only.

Productivity

Soil type is high quality river silt with some areas of peat with dairy farming the highest and best pastoral use capable of in excess of 800 kgs of milk solids per hectare. The land would be suitable for market gardening cropping if not used for dairy farming.

Effects

Flooding effects without protection would be major, including dairy farming assets reverting to low productivity. The assets include a house.

Main Channel Works

The compartment benefits from main channel works carried out in the Delta area to preserve the flood capacity of all channels. The ability to preserve channels is limited because dredging is

impractical. Channel works upstream also help in keeping the flow of the river sufficient to flush the Delta to prevent silting.

Community Works

These are of benefit to the compartment in the context of the overall Scheme Design. The community works reduce the design flood from 65,000 cusecs at Rangiriri floodway to 56,000 cusecs downstream of the Mangatawhiri River.

July 1998 Flood

The protection performed adequately during the July 1998 flood.

14.30 Te Kohanga East - Major: Area - 551.1 ha. (Classes: LPSECB1; MCH5; CWK6.)

This is the largest and most productive of the Te Kohanga Valley compartments. It is protected from the river on the western and northern sides. It is used for dairy farming.

The compartment forms part of the general alluvial flood plain next to the river, and is at a similar level to the Aka Aka Plains on the northern side of the river. Without protection the land would be virgin swamp with willow and alder infestation and with the productivity limited to summer grazing.

With the combination of flood protection, internal drainage capability and soil type the land has a very high productive potential under dairy farming use.

Protection Standard

1 percent AEP comprising 6328 hectares of primary stopbank, two pump stations with no gravity outlet, one pump station with gravity outlet, and one gravity outlet flood gate.

Productivity

Soil type is predominantly peaty alluvium. Highest and best pastoral use is dairy farming with a potential of in excess of 800 kgs of milk solids per hectare.

An internal drainage system including open drains and humps and hollows links to the pump stations. Alternative land use would be market gardening with potential crops being cucurbits, maize, green crops and main crop potatoes and late onions.

Effects

The direct effects of flooding without protection would be major, causing the destruction of internal farming assets and seriously affecting the local economy.

Residential components are on high ground.

Main Channel Works

The compartment benefits from main channel works carried out in the Delta area to preserve the flood capacity of all channels. The ability to preserve channels is limited because dredging is impractical. Channel works upstream also help in keeping the flow of the river sufficient to flush the Delta to prevent silting.

Community Works

These benefit the compartment in the context of the overall Scheme Design. The community works reduce the design flood from 65,000 cusecs at Rangiriri floodway to 56,000 cusecs downstream of the Mangatawhiri River.

July 1998 Flood

The protection performed adequately in the 1998 flood with approximately 500mm of freeboard observed at peak flood level.

14.31 Te Kohanga - Minor: Area - 120.4 ha. Classes: LPSECB4; MCH6; CWK6.)

This is a small compartment at the end of Frost Road. Although it has similar soil type and productivity potential to Te Kohanga Major it has not been provided with as high a standard of protection presumably due to unsuitable foundation conditions. It is used for cropping and drystock grazing.

The compartment forms part of the main flood plain of the river and without protection would be virgin swamp land with willow and alder infestation. Productivity would be limited summer grazing.

Protection Standard

5 percent - 10 percent AEP comprising 2475 metres of primary stopbank and one pump station with gravity outlet.

In the event of the stopbank being topped, flooding would be confined to this compartment as it is restricted by a 1 percent AEP stopbank on its southern boundary between Te Kohanga major eastern compartment.

Classification recognises that this event is inevitable at some stage with the present protection standard.

Frequency

Without protection the land would be flooded very frequently and would have a cover of willow and alder and used for summer grazing only.

Productivity

Soil type is a mix of river silt with some patches of peaty alluvium away from the river banks. Internal drainage is linked to the pump station and there are some areas which could be improved.

Highest and best pastoral use would be for dairy farming and the land is at present used for a mix of cropping and drystock grazing. Cropping includes market gardening crops on adjoining high ground. Full potential may not be realised while risk of flooding exists.

Effects

Effects would be long term and major. There is no residential component.

Main Channel Works

The compartment benefits from main channel works carried out in the Delta area to preserve the flood capacity of all channels. The ability to preserve channels is limited because dredging is impractical. Channel works upstream also help in keeping the flow of the river sufficient to flush the Delta to prevent silting.

Community Works

These are of benefit to the compartment in the context of the overall Scheme design. The community works reduce the design flood from 65,000 cusecs at Rangiriri floodway to 56,000 cusecs downstream of the Mangatawhiri River.

July 1998 Flood

The stopbank was very nearly topped in the 1998 flood and temporary topping was carried out by excavating soil from the inside berm of the existing bank at the critical peak flood level time.

14.32 Orton: Area - 223.6 ha. (Classes: LPSECB4/5/6; MCH3; CWK3.)

This is a relatively isolated compartment on the western banks of the river midway between Mercer and Rangiriri. It includes an area of flat to gently undulating alluvial land adjacent to the river backed by a peat valley extending 800 metres to the west. A stopbank protects from river intrusion and internal run-off is pumped. The area generally is one of traditional sheep and beef farming and a number of lifestyle lots. There is no substantial dairying or cropping within 10 kilometres to north or south.

Protection Standard

5 percent - 10 percent AEP consisting of 1627 metres of primary stopbank and one pump station with gravity outlet. Internal canals and drains link to the pump. In periods of high rainfall, the time lag from the upper valley to the pumping station is such that extensive ponding occurs in the upper Valley due to a choking effect close to the pumps in the waist of the valley.

There are areas of seepage along the stopbank.

Frequency

The compartment would flood very frequently without protection. Cover would be virgin swamp with infestation of willow and alder and peat sedges and the land would be suitable for summer grazing only.

Levels taken indicate that most is within one metre height difference with the exception of a small area of two metre difference where there is a hay shed. The total area would have been under two to three metres of water in the 1998 flood without the stopbank.

Productivity

Soil type is a mix of river silt on sand, river silt on clay, and peat. The variability of soil type makes for difficulty of drainage and this in turn is variable.

Present land use is drystock grazing. Highest and best use would be dairy farming but the land is not in sufficient size titles for this. It would have a potential productivity of 650 - 700 kgs of milk solids per hectare. Under drystock grazing carrying capacity is estimated at 15 stock units per hectare.

Part of the river silt on sand land at higher elevation would be suitable for cropping although the area in available titles is limited.

Effects

Overall effects of flooding would be severe on productive improvements. There is also a small holding with a house within the compartment and this would be at risk, including danger to life.

Main Channel Works

The Compartment benefits from main channel works in that it has gravity outlet. Main channel works also assist ground water and drainage levels and flood capacity of the River. Assuming that economics do not make it feasible to raise the stopbanks to 1 percent standard, the main channel works are especially important in controlling flood levels.

Community Works

The Rangiriri spillway community works immediately benefit this compartment in reducing design flood levels from 65,000 cusecs to 55,000 cusecs plus extending the protection standard of the stopbanks.

July 1998 Flood

The stopbank held in the 1998 flood, although it required sand bagging at the point where the road crosses the stopbank and lowered the crest by approximately 400mm. Several seepage areas developed.

14.33 Orton - Minor: Area - 1.3 ha. (Classes: LPSECB8; MCH4; CWK5.)

This consists of a very small area to the south of Orton major. In theory it has a protection standard similar to Orton major but this is compromised by the lack of a flood gate. The raised road which forms the stopbank has a small culvert which is insufficient to allow evacuation of run-off water and so there is internal flooding. There appears to be limited direct benefit from the Scheme assets.

Main channel works and community works benefits are similar to Orton Major.

14.34 Tuakau West/East: Area - West 153.0 ha. East 92.9 ha. (Classes: LPSECB4; MCH4; CWK5.)

The Tuakau compartment consists of a west and an east compartment divided by the canal evacuating catchment run-off to the river. The west compartment is the more developed of the two and they are used for cropping and grazing. Part of the east compartment has recently obtained consent for a hard fill operation. The compartments have direct access to the southern fringe of the Pukekohe/Tuakau volcanic plateau and are serviced by both Tuakau and Pukekohe.

Protection Standard

5 percent - 10 percent AEP. Stopbanks have been topped privately. The compartment consists of 4343 metres of primary stopbank on the western compartment and 2593 metres of primary stopbank on the eastern compartment. There is one pump station with gravity outlet and one gravity pipeline outlet.

Frequency

Without protection the area would flood very frequently and would have a cover of willow and alder, and would be suitable for summer grazing only.

Productivity

Soil type is high quality river silt with some small areas of peat. There is internal drainage system linking to the flood pump. There are some areas of seepage in the western compartment and some areas of impeded drainage in the eastern compartment. This area is largely where the hard fill enterprise is to be located.

Most of the land is high quality cropping land and has been used for this purpose. Crops grown include maize, cucurbits, potatoes and late onions.

Effects

Effects of flooding would be major in destroying productive assets and possible effects on consents required for the hard fill operation.

Main Channel Works

The compartment benefits from main channel works, which have lowered the flow levels. Benefits are both from drainage and from flood protection.

Community Works

These are of benefit to the compartment in the context of the overall Scheme design. The community works reduce the design flood from 65,000 cusecs at Rangiriri floodway to 56,000 cusecs downstream of the Mangatawhiri River.

July 1998 Flood

The main stopbanks were not challenged in the 1998 flood. However the internal stopbanks were close to over topping and temporary emergency measures were adopted including laying of telegraph poles on stopbank tops.

After the flood prolonged internal flooding was observed. This was related more to management of the flood pumps than to any design deficiency.

14.35 Mercer West: Area - 350 ha. Classes: LPSECB7/B8; MCH3/4; CWK4/6.)

This compartment includes three flood protection basins: downstream, upstream, and Morrison Road. There is a total of 350 ha. Protected - 145 ha. Morrison Road, 103 ha downstream, and 101 ha upstream. These works are currently in the process of construction.

The hill catchments total 1215 ha including 975 ha Morrison Road, 100 ha downstream, and 140 ha upstream.

Soil type in the downstream and upstream compartments is predominantly deep river silt and large areas of the land, although unprotected, have been used for highly productive land uses, including maize cropping and dairy farming.

The Morrisons Road compartment is in general at a lower level than the downstream and upstream compartments and subject to more frequent and longer lasting flooding. Soil type is a mix of alluvium and peat, and part of the reason for frequent flooding is due to shrinkage of drained peat areas.

The Morrison Road area itself is used for drystock and some dairying.

Protection Standard

The river stopbank is designed for a 1135 cubic metre flood with 600 mm freeboard and a 10 year return period.

The return stopbank within the Morrison Road compartment is designed for internal drainage protection and is on a 10 year return basis with no freeboard.

Flood gates are located in all compartments with one in the downstream compartment, one in the Morrison Road compartment and two in the upstream compartment. They are designed to drain a 24 hour, 10 year return storm within three days after the river has receded. Floodgates are set at summer low flow levels.

Compared with other protection standards in the area it can be reasonably assumed that the 1998 flood would not have breached the defences. However it would have been a considerable time before floodgates would have been effective which would have had a relatively serious internal effect on the lower lying Morrison Road compartment. In this respect, although the protection standard is similar for all three compartments, the overall effectiveness of that protection is lower on the Morrison Road area because of an internal flooding problem.

Frequency

Without protection the downstream and upstream compartments would be relatively frequently flooded in parts although the more elevated areas with higher silt deposits may be flood free for up to five years.

The lower lying Morrison Road area would be subject to more frequent flooding coinciding with river levels of between 3.4 and 3.6 metres at Mercer.

Effects

Effects of flooding would be greater on the Morrison Road area where flooding in the past has meant re-fencing areas and regrassing after prolonged ponding.

The effects on the downstream and upstream compartments are less, because of the more rapid draining of flood water.

Main Channel Works

The compartment overall receives a high benefit from channel works. This preserves the river capacity both at low flow and flood level and protects the design integrity of the proposed stopbanks.

Community Works

The compartment benefits from the community works which reduce higher flow from 60,500 cusecs to 55,500 cusecs past the Rangiriri spillway.

14.36 Unprotected Areas: (Classes: MCH9A, 9B, 9C, 9D.)

These are areas which are not protected by stopbanking, but which obtain some benefit from the Scheme works, mainly from channel works, whereby the control of river levels creates a nett benefit to the land.

These areas are scattered throughout the lower Waikato flood plain, but mainly along the left bank of the river between Lake Whangape and Te Kohanga, the Whangamarino swamp, and on the right bank of the river in the Tuakau area.

14.37 Mangawara (Section D): (Classes: LPSECD1 to 7; MCH1 to 7; CWK1 to 7.)

General

The Mangawara or Section D compartment is different from most of the balance of LWWCS in that it has little direct link to Waikato River flooding. Although the lower unprotected reaches get ponding from the Waikato River, and some small protected areas were affected by the Waikato River without the Scheme, most is protected from flooding generated in the Mangawara and Tauhei River catchments. The Scheme here has a quite complex system of stopbanking and associated flood flow channels along the Mangawara River, the Paranui Canal and part of the Tauhei Stream, including a diversion of the latter.

It has a nominated design standard of 2 percent AEP, although most may have a higher actual protection standard. There are some areas of lesser protection standards, including spillway ponding or flow areas.

Historically, flooding occurred quite regularly as a result of intensive rainfall within the catchment, with very quick runoff from the clay hills. Unlike the lower Waikato area, there is a steady fall between the headwaters of the streams and rivers, and the lower end of the Mangawara River, so flood waters are quite quickly drained, including most of any ponding which occurs at the margins of the protected areas.

The Mangawara part of the Scheme, some 6,250 hectares in total, has some 70 kilometres of stopbanks, and numerous floodgates which are maintained by the adjoining local drainage Schemes.

Channel and stream works are undertaken on the Mangawara River, Tauhei Stream and Paranui Drain, and there are detention dams at Orakei, Waiiti and Tauhei.

The Mangawara area is in distinct contrast to the balance of the Lower Waikato / Waipa Scheme. While most of the compartments in the latter were in a marginal grazing to virgin swamp

condition before the Scheme, the Mangawara area was largely farmed much as it is today. Areas of development since the Scheme was constructed are mainly elevated peat dome country which presently, and in the meantime at least, has limited reliance on the Scheme.

Flooding was, in most areas of significant nuisance value rather than being a dire threat to farm economics.

An estimate contained in the 1982 economic report indicated that total production in the Mangawara area was depressed by perhaps two percent because of flooding, and that half of this was in a small area at Orini.

This is not to say that the flood protection works have not been worthwhile. Few, if any, farmers would wish to see the Scheme abandoned, with a consequent reversion to the quite frequent flooding of the past and the associated problems.

Proper maintenance of this Scheme has assumed significant importance in areas which may have had little difficulty with flooding pre-Scheme, but which now have a confined stopbanked flood channel passing through or next to their properties.

Productivity

Land use throughout the Mangawara catchment is dominated by dairy farming. There are some limited areas of cash cropping/arable use, very limited sheep/cattle farming, and one particularly large cattle drystock operation, but which is fully capable of supporting dairy pasture with appropriate inputs.

Main Channel and Community Works

Main Channel Works refers to work in the channel of the Waikato River, not the Mangawara river and its tributaries. They are part of the Section D or Local Protection Works.

The Main Channel Works and the Community Works are part of the overall Scheme design - the Scheme could not have been constructed in its present form without including and maintaining the Main Channel Works and the Community Works.

Insofar as the Mangawara Flood Protection Scheme is concerned, the works could not have been constructed, certainly in their present form, without the Main Channel Works and Community Works, because of unacceptable downstream effects. The main detrimental effect is the loss of ponding areas caused by the construction of stopbanks to protect them, directly increasing flood flows into the Waikato River.

It is a direct benefit to the Mangawara area to be able to discharge flood water into the Waikato River in an unfettered way, partly as a result of the construction of the Main Channel and Community Works.

It has been necessary to make a judgement about the proportion of the Main Channel and Community Works rates which should be met by the Mangawara area.

The Mangawara includes approximately 38 percent of the total protected area of the LWWCS, and approximately 55 percent of the area obtaining direct benefit drainage into the system.

It is clear that a contribution towards Main Channel and Community Works of this magnitude would be too high.

A proportional contribution of 15 percent of the maintenance costs of each of Main Channel Works, and Community Works has been adopted. This is the proportion of the direct benefit allocation of costs for these works, which represents only approximately (40-50 percent) of the actual total maintenance costs.

July 1998 Flood

The flood event in the Mangawara was not particularly large, and the Waikato flood had little effect except for some areas closest to the confluence.

Flooding and ponding did occur through the system, in most cases as a result of spillways operating according to design. Some localised areas sustained flooding due to local catchment influences, or water caught behind stopbanks until the Mangawara went down enough to allow floodgates to open.

There are some specific problems towards the bottom end of the catchment on two or three properties, where Scheme improvements could be made. One of these properties is in part at a level where it is unlikely that improvements can be made within the context of the Scheme itself without also incorporating private flood pumping.

14.38 Huntly (Section A)

Huntly is the major urban area where there are LWWCS protection works. A relatively small part of the town obtains direct benefits, with most of the developed urban area being on elevated ground well above flood level, and although getting a substantial level of indirect benefits, no direct benefits can be attributed.

Stopbanked areas east of the river are mainly in the Huntly South area, with some limited protection at Huntly North.

The Huntly urban area has been classified for differential rating on a capital value basis as instructed by Environment Waikato. The justification for this is that Capital Value may provide a more realistic basis for measuring flood protection benefits to residential and commercial/industrial property because it more closely reflects the value of assets at risk.

A new stopbank has been constructed in the Parry Street area at Huntly West after flooding problems there in 1998.

It is noted that the stopbank at Huntly College has been upgraded since 1998, but this stopbank is a private work, not funded by LWWCS.

Main Channel Works provide benefits to land served by floodgated outlets or land immediately next to the river, in addition to the stopbanked areas.

Community Works are considered to provide a benefit in that in the design of the Scheme downstream effects must be considered. It benefits the Huntly area to be able to have Scheme improvements constructed because downstream flooding effects are lessened by the Community Works.

The Huntly Flood Management Plan of 1992 and associated documentation provides an assessment of the high risk and low risk floodable areas of Huntly, and this information has been used in assessing two classes, Huntly 1 being the high risk area, and Huntly 2 being the low risk area.

14.39 Other Urban Areas and Rural/Residential Properties and Smallholdings

Along the Waikato River, and in the Mangawara, are a number of small townships and settlements get direct benefits from flood protection from LWWCS. In addition, throughout the direct benefit area there are numerous scattered residential properties, along with small rural properties.

These urban areas and small rural properties are included in the land area system, in common with the adjacent rural areas, and within the same land class.

However, to recognise the added benefit to urban and small properties over and above that of the general rural benefit, an additional component could be included.

There are two alternatives:

- a) to use the site component system, which will capture all such properties, or
- b) to use mapping to identify the urban areas, which will capture only the urban areas.

15 Site Components

The land area system of benefit analysis/classification has had, on the face of it, a problem in assigning a fully equitable rate to the smaller rural properties, and to urban settlements.

Since the empowering legislation for benefit analysis came into being, land classifiers had been seeking to address this matter.

It has become clear that Section 81(4) of the Rating Powers Act provides the basis for dealing with the matter, where it states that: "..... the Local Authority may, place any part or parts of the separately rateable property into different types or groups of property from any other part or parts of that separately rateable property".

Therefore, a part of any property can be classified in a different way to the rest of that property - a site area can be taken out and assigned a higher class and a higher rate than the rest of the property.

This recognises the higher level of benefits for part of any property likely to be used as a site for a house or a substantial building.

The site component can be assessed for all properties within all compartments protected to a standard equal to or greater than two percent AEP, whether or not dwellings or buildings are constructed thereon. The Scheme has provided the benefits in allowing for potential sites as well as built sites. This would avoid the need to make use of property use data bases which may be expensive to maintain.

The site component would be based on the first 1,000 square metres for rural properties, and properties in urban settlements. Properties of less than 1,000 square metres would for these purposes attract the same rate as a property of 1,000 square metres.

The site component system is a differential one, i.e. it is highest where benefits are higher, and reduced according to lower benefits.

The location of the site would not be shown on any map. On any given property which lies within two or more classes, it would be defined as being located on the least floodable land.

If any property includes land outside the direct benefit area, it is assumed that any site on that property would be located on the indirect benefit area, and no site component would be assessed.

No distinction would be drawn on the amount of rate between residential properties and commercial/industrial properties. This is a matter which has been the subject of considerable debate over the years, but to set a differential between the property uses would require use of the QuotableValue/District Council Land Use Data Base. This is almost certainly not 100 percent accurate at present, and future maintenance may be questionable.

At this stage no site component has been included in the proposed rating system.

16 Rating Incidence

The rating base is particularly confined, including only those areas obtaining direct benefits from the flood control Scheme. Normally, this would result in a very high rate for scheme ratepayers. However, there are a number of factors which reduce the rate. Project Watershed provides for contributions from uniform rates on capital value across the subcatchment, the total catchment and the Region. Sand royalties and land rentals will also be used to reduce rates.

Implementing the new differential rating system based on the new classification will reduce the rate in the direct benefit area compared with the combined Rural Local Protection, Main Channel and Community Works rates as set out in the Asset Management Plan.

Presently, the Main Channel and Community Works are not funded from the Scheme rate, and this may result in changes to rating incidence in areas not currently rated under the Scheme.

The LWWCS has the advantage of Government funding for the Main Channel Works, and from hydro electric generation companies for Tongariro Offset Works until the year 2003. Under Project Watershed an alternative means of sourcing funding from the hydro electric power generation companies will be sought to reflect the effects these companies have in terms of flood protection and river management. This is in contrast to virtually all other river control Schemes in New Zealand, for which any Government contribution was withdrawn in 1987.

It should be noted that the published rate in the Asset Management Plan for LWWCS for Section B includes only that part of Local Protection Works (Section B) within the Waikato District. The Franklin District area is administered and funded by the Franklin District Council, and the Mangawara area is funded mainly by the adjacent drainage Schemes, with only the loan repayment portion funded by the LWWCS Scheme rate.

Under the present rating system, most of the Scheme rates are borne by the direct benefit area - the area flooded in 1958. Contributions towards Scheme maintenance come from land rentals, a general rate, sand royalties, and hydro power companies.

Under the combination of systems proposed for Project Watershed, the rate will be raised by several separate and different rating systems. The first of these is the direct benefit area which is the subject of this classification, and for which a differential rate based on land area will be introduced. Preliminary indications are that something like 40 percent-50 percent of the cost of the Scheme will be funded from differential rates over the direct benefit area.

Part of the rate requirement will be assigned on the basis of indirect benefits from the Scheme, and it is proposed that this will be raised by a rate in the dollar on the capital value of properties throughout the Waikato/Waipā catchment, including the direct benefit area.

The third mechanism will account for contributory/exacerbatory effects from the whole of the catchment, including the direct benefit area. This will be raised in conjunction with additional rates required for middle and upper catchment soil conservation works. The presently proposed amount of LWWCS rates to be raised in this manner is 10 percent.

A fourth component will include a contribution from general rates across the whole Region to reflect wider benefits of the Scheme to the Region.

A proportion of rates will be raised from utilities on the basis of benefit, and from power companies on the basis of contributory effects. Environment Waikato currently has no power under legislation to rate Transit NZ or TranzRail and recovery of a portion of costs from these utilities will only be possible by agreement or by change in legislation.

Revenue from land leases, mainly in the areas of stopbanks, will be applied to reduce rates, mainly in Local Protection Works and Community Works areas.

Local Protection areas will be required to contribute to Main Channel and Community Works for the first time. This is not a result of the new classification or differential rating system. Rates to fund these works would have been introduced in any case, but the introduction of the rate has been deferred pending this new Classification / Benefit Analysis to enable an equitable basis of rates distribution and incidence.

The requirement for Main Channel and Community Works funding to be made from the Scheme rate introduces a significant number of new Scheme ratepayers with properties on the flood plain. These are the areas where the Local Protection Works are funded and maintained by agencies other than Environment Waikato - the Aka Aka / Otaua area, which manages its own affairs in conjunction with Environment Waikato, and the rest of the former Franklin County Council flood plain, where the Franklin District Council currently maintains and funds the Works on behalf of the Scheme beneficiaries.

These areas will pay an LWWCS Scheme rate for the first time. However, this would have been the case, whether or not a new classification / differential rating system was put in place, and in general terms the Scheme rate resulting from the new combined rating systems will be significantly lower than it would otherwise have been.

Of a total rates requirement of some \$1.98 million, the preliminary draft funding policy proposes that approximately (42.5 percent), or approximately (\$840,000), will be raised by this direct benefit differential rate.

So property owners can determine what their actual change in rating incidence will be, it will be necessary to factor in their indirect benefit rate, and the contributory/ exacerbatory rate.

The Mangawara area (Section D), was apparently classified separately from, and by a different classifier, to the rest of the Scheme, and the existing classification appears to be particularly complicated with numerous anomalies. The new classification inevitably results in significant changes in the current theoretical rate relativity between properties.

However, in practice, the existing classification has been used in the Mangawara area only for the purposes of loan repayment, and the Scheme has been maintained until now by the drainage districts within and around the Mangawara Scheme area. Given that these drainage Schemes encompass a rather wider area than the existing direct benefit Mangawara portion of LWWCS, there has effectively been a substantial wider catchment rates contribution to Section D maintenance.

The situation is further complicated by two other matters. The first is that a considerable contribution to the drainage Schemes, and LWWCS maintenance, has been made by areas which get no direct benefit from the Scheme, and only get indirect benefits. This includes all of the hill country included within the drainage Scheme areas.

These areas will now make no contribution towards the direct benefit part of Scheme costs, and their contributions from indirect benefit and contributory effects may not make up the difference.

Rating will also be altered because of the nature of the drainage Scheme classifications, where the highest benefit levels have been judged to be those areas immediately next to the Board drains, rather than having consideration for the actual drainage requirement of the land. This current classification by contrast assesses relative benefits from the Scheme works.

The Mangawara area (Section D) is required to contribute to Main Channel Works and Community Works maintenance funding for the first time. Although these works are not contained within the Mangawara area, the area obtains benefit from those works in that the effects of increased discharge to the Waikato River resulting from the construction of the Section D Scheme works is lessened by the downstream Main Channel Works and Community Works.

17 Land Area Differential Rating

Section 40 of the Rating Powers Act states that a Catchment Board may make and levy separate rates.

This rate may be made and levied as a uniform rate, or on a differential basis, (a). on the land value or capital value of every rateable property, or (b). on the area system.

The current differential rating system in the LWWCS is the land area system, and Environment Waikato has proposed that the new differential rating system should be the land area system (with the exception of the Huntly urban area). These are the reasons for adopting this system:

Section 84(1)(c)(iii) of the Rating Powers Act requires that the Special Order introducing the differential rating system shall include a statement specifying, among other things, "that the proposed system of differential rating has the objective of establishing and preserving, as far as practicable, a stated relationship between the total proceeds of rates received from any type or group or combination of types or groups of property and any other type or group or combination of types or groups of property, if such is the case".

The adoption of a land area system ensures that a stated relationship is maintained where required.

There could now be an added complication to using capital value or land value systems - the devolving of the maintenance of rating rolls to District Councils. In a catchment such as the Waikato with numerous Councils, it is by no means certain that either capital values or land values will be maintained as they are at present through all districts. Even if they are maintained, the problem remains of establishing the relativity between land values assessed at different times for different Councils. This has often, of itself, created anomalies in the past, and certainly no improvement can be anticipated in future.

The land value system has, in the past, been very useful, where at first there was an undeveloped or semi-developed catchment, where land values increased with time as a result of Scheme works. They paid a higher rate as the land came into production, and the rate could then be afforded.

With most Schemes now having existed for 20-30 years or more, most of those areas capable of being developed have been developed, and there is no economic need to have a rate based on land value. It is appropriate that any areas which today remain undeveloped, but which could be developed as a result of Scheme works, should pay the full rate as assessed on a land area basis.

Capital value differential rating is generally inappropriate in rural areas. Improvements with very high levels of value are not commonly constructed on the actual flood plain. Considerable distortion between the effective rate per hectare, and the benefit obtained, can result from the use of capital value system.

The classifiers confirm their opinion that the land area basis should be adopted for the current classification of direct benefits in the rural areas of the Scheme.

18 Compliance With Local Government Amendment Act No.3 Section 122F

This section deals with the principle relating to the funding of expenditure needs.

The classification and proposed system of differential rating complies with Sub-section (a) in that the rates are recovered on an annual basis and by instalment, for a benefit which is effectively to be maintained in perpetuity.

Sub-section (b) is complied with, in that the rating mechanisms under the Rating Powers Act 1988 are used.

Sub-section (c) is complied with as a result of the use of the rating mechanisms under the Rating Powers Act 1988.

Sub-section (d) which requires the allocation of any expenditure to control negative effects is to be complied with under an alternative rating mechanism within Project Watershed.

It appears certain that there will be submissions on this matter, at the time of the Special Order process if not earlier, and Environment Waikato will then have the responsibility placed upon each local authority by Section 122I (4).

"(a) to make judgements about fairness and equity; and

(b) to make judgements concerning the extent to which any provision of Sections 122F to 122H of this Act is relevant to any particular case, -

which judgements may reflect the complexity and inherent subjectivity of any benefit allocation for specified outputs and the complexity of the economic, social and political assessments required in the exercise of political judgement concerning rating".

The Section 122F requirement to identify and allocate costs needs some further analysis.

The Asset Management Plan identifies costs associated with the Section B Works, the Main Channel Works, Community Works, Section D Works, and Section A Works. The Section D Works allocation in the Asset Management Plan, however, only identifies the costs associated with loan repayment, with Scheme maintenance costs funded by local drainage Schemes. This is not a problem, because the actual maintenance costs have been separately extracted.

The separate costs of pumps and floodgates which are funded by drainage Schemes are identified.

The matters set out above establish, at least in general terms, where the various costs of the Scheme maintenance lie. It is now necessary to establish whether any further identification and allocation is necessary.

As between separate compartments, there may be varying amounts of physical works providing a similar standard of protection. For example, some compartments have relatively short lengths of stopbanking protecting quite a large area, while conversely some areas have relatively extensive stopbanking protecting a relatively small area.

However, the Scheme is essentially a community Scheme, and compartments cannot within the design and maintenance context be considered as separate. The compartment with limited

stopbanking would have no protection at all if it were not for the implementation of the Scheme as a whole. There is no need therefore to undertake any additional identification or allocation of costs based upon any narrow definition of where Scheme maintenance costs lie. Where areas have been identified for funding as separate entities, or cost centres, this has largely been due to the current complexity of administrative arrangements and the range of different agencies involved.

The Local Government Act requires, among other things, that benefit be taken into account in the allocation of costs. This concept is central to the classification and the differential rating system. The Asset Management Plan contains a cost/benefit analysis, which shows a benefit cost ratio that is very high in the urban areas of the Scheme, satisfactorily high in the lower Waikato rural area, but only marginally satisfactory in the Mangawara area. In general terms, it appears that indirect benefits have not been taken into account in the analysis.

Cost/benefit analysis at the broader level is taken into account in the classification so that equity is achieved within the classification and differential rating system as a whole. In summary, the classifiers' opinion is that the classification and proposed differential rating system, by its very nature and intent, satisfactorily addresses all matters required by the Local Government Act but limited to the consideration of direct benefits only.

19 Compliance with the Rating Powers Act

The relevant section in so far as the classification is concerned is Section 41, relating to the Rating Powers of Catchment Boards. This classification and proposed differential rating system complies with Section 41 in respect of direct benefits only.

The Local Government Amendment Act No.3 of Section 122H(a) provides for combination of funding mechanisms. The classifiers have accepted legal opinion obtained by Environment Waikato to confirm that the "Board" has taken account of the requirements of Section 41(1)(b) of the Rating Powers Act by the proposed initiation of separate and possibly different rating mechanisms to deal equitably with indirect benefits and contribution/exacerbation effects.

20 Application of the Classification

The classification has been prepared on the basis that compartments throughout the LWWCS system which derive similar benefits from the works are placed in the same class. Ordinarily, this would mean that properties in those compartments would all pay the same rate towards the several works.

However, because of historical matters in respect of funding agencies and agencies having responsibility for maintenance, Environment Waikato has adopted several cost centres, thereby subdividing the LWWCS into areas which are to meet the costs of works in their own area.

Consequently, Environment Waikato will provide detail in respect of those cost centres, and the resultant rating incidence, on a cost centre by cost centre basis.

D R CAMPBELL

M G ADAMS

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Appendix 1: The Consultants' Brief and Terms of Reference

1 Background

Environment Waikato is undertaking Project Watershed which is aimed at reviewing services provided by Environment Waikato within the Waikato River Catchment and implementing a comprehensive funding system for them.

The Lower Waikato Waipa Control Scheme is a flood protection Scheme that protects low-lying floodable land in the Lower Waikato Valley floodplain against flooding. The Scheme is one of the major services provided by Environment Waikato within the Waikato River Catchment. The Asset Management Plan for the Scheme identifies the levels of service provided and the overall cost of these. The Scheme however, currently lacks a comprehensive funding system, and one of the key components of Project Watershed involves development of such a system. Classification of land for benefit from the Scheme is one of the key components of funding system development. This brief sets out requirements for development of a direct benefit classification system.

A more detailed description of the Scheme and the benefit it provides is contained in the Asset Management Plan. The specific areas of the Scheme which are covered by this brief include:

- The Section A Works in the former Huntly Borough area.
- The Section B Works in the former Counties of Waikato, Raglan and Franklin
- The Section D works in the former Taupiri Drainage and River Board area.
- The Main Channel Works
- The Community Works

The Scheme was implemented under the auspices of the former Waikato Valley Authority, but direct responsibility for construction of much of the works lay with the Counties in whose areas the works lay. Current administration of the Scheme is fragmented between Environment Waikato and the District Council successors to the former Counties.

For this reason it is proposed that the classification be subdivided into components as per the bullet points above to clearly identify the source of benefit and to allow different agencies to rate based on benefit for the works maintained by them.

The current classification is area based and classifies land on benefit only. No provision is made for wider catchment contributions to flood problems or erosion/sedimentation. Also, no provision is made within the current classification for indirect benefits. The work covered by this brief excludes contributory effects and indirect benefits.

2 Conditions of Engagement

Conditions of Engagement for the purpose of this contract shall be as per the Institute of Professional Engineers New Zealand (IPENZ) short form agreement for consultant engagement.

Special conditions, in addition to those set out in the document outlined above shall be as follows:

1. Copyright of all reports and documents prepared by the contractor under the terms of this brief shall transfer to Environment Waikato, with acknowledgement of the individuals participating in preparing the document and their employer.
2. Electronic copies of all reports and documents prepared by the contractor under the terms of the contract shall be provided to Environment Waikato in *Microsoft Word* format.
3. Documents shall be issued as per Environment Waikato's standard formatting guidelines.

3 Goal and Objectives

3.1 Project Goal

To undertake a classification of land for direct benefits from the Lower Waikato Waipa Control Scheme to assist in providing an equitable and efficient means of funding the private benefit portion of the costs of maintaining the Scheme for the future.

3.2 Objectives

1. To implement a revised benefit classification for the following elements of the Lower Waikato Waipa Control Scheme by June 2001:
 - a) The Section A Works in the former Huntly Borough area.
 - b) The Section B Works in the former Counties of Waikato, Raglan and Franklin
 - c) The Section D works in the former Taupiri Drainage and River Board area.
 - d) The Main Channel Works
 - e) The Community Works

To ensure that the classification adopted allows for separate identification of direct benefits for the different elements of the Scheme as in 1 (a) – 1 (e) above.

4 Outputs

The primary general output from the project will be a new classification that identifies direct benefit received from each of the Scheme components as a function of geographical location.

5 Scope of Project

The project is confined to assessment of direct benefits to land from the Lower Waikato Waipa Control Scheme, however it is being undertaken as part of a wider project considering service and funding issues for the whole Waikato River Catchment.

6 Classification Requirements

Benefit classification for the Scheme will be broken down in to a number of different components to identify separately, benefits derived from specific elements of works.

The following components for the revised classification are proposed:

6.1 Section A

Works in the former Huntly Borough. This area is not currently classified. An initial classification was completed in 1966 but never adopted. The approximate benefit area is 357 ha within an urban environment.

6.2 Section B

The Section B works classification will include benefit from works in the former Counties of Waikato, Raglan and Franklin. The current classification lumps together Main Channel and Community Works benefits, however it is intended that the benefits from the latter two parts of the scheme will be identified separately under the new classification. The approximate benefit area is as follows:

- existing classified area: 28,232 ha
- currently unclassified (Aka Aka Drainage area) 4,990 ha
- TOTAL 33,222 ha

6.3 Section D

These are the works in the former Taupiri Drainage and River Board area. The current classification lumps together Main Channel and Community Works benefits, however it is intended that the benefits from the latter two parts of the scheme will be identified separately under the new classification. The currently classified benefit area is 6,258 ha.

6.4 The Main Channel Works

The Waikato River Main Channel Works primarily provide benefit to the Section B area of the Scheme, i.e. a total area of 33,222 ha. Benefit from these works is currently not separately classified.

6.5 The Community Works

The Scheme Community Works primarily provide benefit to the Section B area of the Scheme, i.e. a total area of 33,222 ha. Benefit from these works is currently not separately classified.

6.6 Exclusions

Indirect benefits and contributory/exacerbator effects are specifically excluded from the work to be undertaken under this brief. These will be addressed as a separate item of work under Project Watershed.

7 Role of Consultant

Specific tasks that the Consultant shall undertake are as follows:

1. Undertake an overview assessment of the Scheme, and the basis of the current classification.
2. Consider and report on the appropriateness of the existing classification for the ongoing management and maintenance of the Scheme as required by the Asset Management Plan.
3. Develop and report on an appropriate model for the distribution of direct benefits from the Scheme.
4. Review and revise the outputs from the benefit classification model to ensure that an equitable and efficient benefit classification system is arrived at. Classification experience will be required to interpret the physical geographic and technical data to allow for underlying inaccuracies etc. in the data used. A report detailing the proposed classification system will be submitted.
5. Participate in consultation with Scheme ratepayers and Council committee's etc. in regard to the work undertaken under this brief, prior to and during the special order process under the Rating Powers Act.

8 Standard of Service

8.1 Time

The key time constraint is determined by Project Watershed, which aims to have a complete funding system in place for services with the Waikato River Catchment by 30 June 2002. To meet this deadline it is necessary for the classifiers report, and draft differential rating system to be completed by 30 June 2001. There will be additional requirements after 30 June 2001 for participation in consultation and making amendments where required.

8.2 Cost

Consultancy costs will be paid on a time and disbursements basis.

8.3 Quality

All work undertaken by the Consultant shall be undertaken in a workmanlike and professional manner. The consultant shall provide with monthly invoices a written report summarising all activities undertaken during the invoicing period.

All items of significant work shall be reported on to an acceptable standard.

Sufficient documentation of work, processes results and recommendations etc. will be provided to ensure that the classification of direct benefits, as part of the Project Watershed rating mechanisms, is defensible in terms of the statutory requirements of the Rating Powers Act and the Local Government Act.

Signed:

for Boyes Campbell and Associates

Signed:

for Environment Waikato

Date:

Appendix 2: Classification Ratios

Lower Waikato					
Local Protection		Main Channel		Community Works	
LPSECB1	100	MCH1	100	CWK1	100
LPSECB2	95	MCH2	70	CWK2	80
LPSECB3	90	MCH3	60	CWK3	70
LPSECB4	85	MCH4	50	CWK4	60
LPSECB5	70	MCH5	40	CWK5	50
LPSECB6	55	MCH6	30	CWK6	40
LPSECB7	45	MCH7	25	CWK7	10
LPSECB8	40	MCH8	20	CWK8	7
LPSECB9	30	MCH9A	15		
LPSECB10	25	MCH9B	10		
LPSECB11	20	MCH9C	5		
LPSECB12	10	MCH9D	0		
Aka Aka Drainage Outlets					
LPG1/A	6				
LPPG1/A	20				
LPP1/A	26				
LPP2/A	50				
LPP3/A	100				

Huntly					
Local Protection		Main Channel		Community Works	
LPH1	100	MCHH1	100	CWH1	100
LPH2	60	MCHH2	60	CWH2	60

Mangawara					
Local Protection		Main Channel		Community Works	
LPSECD1	100	MMCH1	100	CWSECD1	100
LPSECD2	80	MMCH2	80	CWSECD2	80
LPSECD3	70	MMCH3	70	CWSECD3	70
LPSECD4	60	MMCH4	60	CWSECD4	60
LPSECD5	50	MMCH5	50	CWSECD5	50
LPSECD6	35	MMCH6	35	CWSECD6	35
LPSECD7	5	MMCH7	5	CWSECD7	5