



GISBORNE DISTRICT COUNCIL

EP1112

GDC 92/117

9 March 1992

THE CHIEF EXECUTIVE

COMMITTEE: POLICY & RESOURCES

SUBJECT: FLOOD HAZARD PLANNING

1. INTRODUCTION:

During 1990 and 1991 the Council's Engineering and Works Department has conducted an extensive study into flood hazards for various parts of the Gisborne District. This report considers the Poverty Bay Flats only. Other areas will be dealt with in subsequent reports.

The information derived has been useful for two purposes:-

- (a) To enable improvements to be designed to flood protection measures in various areas and to assess the impact of those improvements.
- (b) To enable Council to determine what land use restrictions are required in areas liable to flooding and unable to be completely protected.

2. SUMMARY

- (a) Land on the Poverty Bay Flats is partially protected from flooding by the Waipaoa Flood Control Scheme (WFCS).
- (b) Certain improvements to the WFCS are intended.
- (c) The design for the improved WFCS assumes that beyond a certain level of discharge overflows will occur. The first discharge occurs at 5,000 cumecs, other discharges will occur beyond 5,300 cumecs. The location of these overflows is carefully selected to minimise the overall impact on the Poverty Bay Flats and minimise the chance of severe damage to the WFCS itself.
- (d) Land use planning should recognise and allow for the effects of these discharges.
- (e) There is a greater likelihood of major flood events in the future than in the past. The main reasons for this are global warming and aggradation of the Waipaoa River system. Uncertainties about both these make it unwise to attempt to predict the sizes and frequency future flooding events from past experiences and records.

- (f) It is recommended that for the purposes of land use restrictions, a design flood of 5,830 cumecs should be adopted for the Waipaoa River, together with the July 1985 floodspread for the Poverty Bay Flats.

3. FLOOD PROTECTION

Land on the Poverty Bay Flats Flood Plan is protected by the Waipaoa Flood Control Scheme (WFCS) which is a system of stopbanks and channel improvements on the Waipaoa River and some tributaries. This protection is described as "partial" for two reasons.

- (a) The WFCS offers control and protection up to a certain condition but in events creating a river discharge beyond the scheme capacity the system would be overtopped. In such events water ponds in and flows across the Poverty Bay Flats. The location and severity of such ponding and flows are able to be assessed and allowed for and will generally follow similar patterns for similar events. Such overtopping occurred in March 1988 during Cyclone Bola.
- (b) The Waipaoa River is the dominant element on the Poverty Bay Flats Flood Plan but there are numerous other important drainage features such as the Taruheru and Waimata River system, the Te Arai River, the Whakaahu (Ngatapa and Patutahi), the Muhunga Stream (Ormond) and the Whatatuna and Pipiwakao drains (Manutuke Area). In major storms these are capable of creating significant overland flooding without any input from the Waipaoa at all. For example, major floods occurred in the Taruheru and Waimata and their tributaries in 1977 and 1985. In events where the Waipaoa was virtually unaffected. Significant floods occurred on the Poverty Bay Flats in 1985 on both sides of the Waipaoa which were in some cases more severe than occurred in Bola.

During Bola overland flows from the Waipaoa River joined with flood waters from the other rivers and streams.

4. WFCS IMPROVEMENTS

Council have recently resolved to carry out improvements to the Scheme. Mostly in the form of minor stopbank raising in the Ormond and Kaiteratahi vicinity. When complete these will generally have the effect of containing a flood discharge equal to that experienced during Bola in most locations.

Resource Consent is currently being sought for this work. These improvements will not contain any discharge greater than Bola and overflows would then occur but their impact would be less than if no improvements were to take place. The improvements will have no effect on flooding created by the other rivers, streams and drains independently from the Waipaoa.

5. PLANNING AND BUILDING RESTRICTIONS

Council has a legal and moral obligation to protect people and property to the maximum extent possible against the effects of flooding. These requirements are set out in

the Local Government Act 1974, the Building Act 1991 and the Resource Management Act 1991. The considerable levels of investment on the Poverty Bay Flats Flood plain also creates a social and economic imperative for Council to pursue flood protection.

Protection may be by direct physical means such as already described or by planning and building restrictions or by a combination of both. The regulatory approach attempts to ensure that buildings and other investment take place only in suitable areas or are made safe.

For example, in the worst affected areas buildings may not be permitted at all while in other areas it may be sufficient to provide raised floor levels and strengthened foundations. This planning approach can be effectively used to back up and support the physical flood control schemes and to provide an extra measure of safety in the event of flood discharges greater than the capacity of the physical control systems.

6. RETURN PERIODS

Floods are often described in terms of their "return period" such as "hundred year floods". This refers to the average frequency of an event occurring over a very long period of time. However, the terminology is frequently misunderstood. In particular it gives no guarantee that, once the hundred year flood has occurred, it will not occur again for another century. For example, Southland experienced three so called hundred year floods in the early 1980s.

Attempts have been made to assign a return period for the Cyclone Bola event but estimates vary from about ninety to four hundred years. This is because:-

- (a) The flow was not able to be completely accurately measured.
- (b) There is insufficient knowledge of the history of flooding in the Waipaoa to place this event in the historical context. Only fifty years of measured records exist. It is possible to calculate return periods by statistical measures from these records but the result is more of a statistical calculation than a reliable prediction. In reality it is generally recognised that to accurately calculate the hundred year event three hundred years of records are required by which time several such events may have occurred.

Two other factors significantly hamper the attempt to predict a standard such as the hundred year flood. These are:-

- (a) Climate Change
- (b) Aggradation of the river system.

Climate Change, or the so called "green house effect" is the effect caused by the gradual increase in the earths atmospheric temperature. Although the concept is still controversial and the green house effect is not totally proven, the vast majority of scientific opinion holds that the atmosphere is gradually warming and this will have significant effects on the climate.

A possible consequence of climate change is an increase in the frequency of tropical cyclonic storms reaching New Zealand, as well as an increase in the quantity of moisture carried by a column of air (due to temperature increase). Such storms would form part of a different statistical population to storms earlier this century. Therefore, attempts to assign a return period to Bola-based on-past records may be quite unreliable and misleading for the future.

Aggradation of the Waipaoa River System is caused by erosion in the waters bringing considerable quantities of silt down the bed of the river. As the bed of the river aggrades, the capacity of the WFCS is reduced. The rate of aggradation is monitored by Council and has proved to be extremely variable over time. It is entirely possible that the benefits of the forthcoming stopbanks raising may be lost to aggradation within about twenty five years because of this effect but this period could be longer or shorter. Afforestation of the eroding hinterland may eventually reduce to manageable proportions such aggradation but cannot control the considerable amount of material already in the river system.

7. SIGNIFICANCE OF RETURN PERIODS

The "hundred year return period" has traditionally been used as a yard stick when considering protection against flooding, either by direct means such as stopbanks or planning restrictions or both. There is no legal significance to this measure but it has been accepted as a realistic economic criteria justifying expenditure by central government.

The "hundred year flood" is a traditional measure for urban protection and rural protection schemes are often much less eg. 30 - 50 years, depending on circumstances and potential for development.

The confusion that often results have led to this measure being increasingly disfavoured around the world. The measure tends to give unreliable indications of the period between floods, is extremely difficult to assess and predict accurately and is subject to uncertainty in the future. In addition, most buildings constructed of modern materials are likely to last considerably in excess of a hundred years and, once erected and sites developed, there would often be an expectation and an economic necessity to replace buildings on the same site.

8. SELECTION OF A FLOOD STANDARD FOR GISBORNE AND THE POVERTY BAY FLATS

The options open to the Gisborne District Council to discharge its obligations to protect its citizens against the effects of flooding are as follows:-

- (a) Physical control measures.
- (b) Planning and Building Restrictions.
- (c) Civil Defence and floodwarning.

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Traditionally the Council has relied upon a combination of all three and it is recommended that this continue. Physical flood control measures cannot be relied upon as the only solution. Whatever is put in place will have a certain capacity. To increase that capacity to a point of complete safety would be economically impossible for this district. The Council is proceeding with flood control work and afforestation of the hinterland but it does not have the financial capacity to totally solve the problem by these means - even if it were physically possible. Most of the Council's efforts have from necessity been directed to the Waipaoa but major effort would also be required on the Taruheru and Waimata Rivers in particular and any control effected on the Taruheru to protect the Poverty Bay Flats would have to take into account the impact on Gisborne City downstream.

The Council's floodwarning telemetry provides early warning, Civil Defence plans include evacuating homes at risk. This option will be vigorously pursued but would never be more than a reactive mechanism. Civil Defence will do all it can to ensure effected owners are safely and timely evacuated but this cannot be guaranteed to be effective every time and in addition will do little or nothing to prevent economic damage to properties. Even if lives are saved, there can be an enormous economic impact from floods.

Planning restrictions are the third part of the equation. Under this option buildings are not permitted at all in the most vulnerable locations and measures such as raised floor levels and strengthened foundations are required in other areas. A recent example of a planning measure was in setting the boundaries of the new rural R zone. This zone is designed to encourage life style dwelling on the Poverty Bay Flats and therefore the area in this zoning was carefully checked to be free of significant flood risk.

When imposing planning restrictions these must be done by reference to some "standard" or "design flood". The Council must make an assumption that beyond a certain point flooding or damage from it is so unlikely as to mean that restrictions cannot reasonably be imposed. As there is always a theoretical possibility of the design being exceeded, that design standard should be conservative and cautiously thought out.

If the standard selected is too low then it will be exceeded relatively frequently and damage on flooding will be frequent and unacceptable. Council could be held liable for such damage.

9. DIFFERENT FLOOD STANDARDS FOR DIFFERENT PURPOSES

It is critical to the understanding of this report to understand that it is possible and may be necessary to adopt different flood standards for different purposes.

The purposes are river control, planning and civil defence.

9.1 RIVER CONTROL

Council has adopted a proposal to raise stopbanks so that in general the Waipaoa will contain a discharge equal to Cyclone Bola (5300 cumecs at Kanakanaia) at most locations. At one location the system will contain 5000 cumecs and at others in excess of 5300 cumecs. This has been necessary to make the optimum economically possible improvements. It represents an improvement up to 5000 cumecs at every part of the system. It was not possible to design equal protection to a level beyond 5300 cumecs in every part of the system.

The improvements are therefore designed to fully contain a flood up to 5000 cumecs. This design is not made on the basis that this is the largest flood that could ever be expected. The design accepts that greater floods are possible and that overtopping will then occur. The design attempts to ensure that if such overtopping occurs then it will occur in the most suitable possible location. The location selected are in general where the downstream impacts would be least or where the least damage might occur to the stopbank itself. For example, at Ford Road the stopbank is very low and should it be washed out here far less water would be released than if higher banks were damaged or lost.

These comments are included not to attempt to justify the improvements which is a separate exercise but to explain the philosophy behind them and the implications of them for land use planning.

9.2 LAND USE PLANNING

The WFCS therefore is designed on the basis that floods may occur beyond its design capacity and that this would result in discharges to the Poverty Bay Flats. Planning (and Civil Defence) measures must then deal with the consequences of those overflows.

It is the considered opinion of staff in Environment and Planning and Engineering and Works Department that a standard greater than the discharge of Cyclone Bola should be adopted. The significant uncertainties about future climate, aggradation and the lack of long historical records leads to the conclusion that it would be unwise to consider that Cyclone Bola would be the worst event ever foreseeable.

History has proven that in this district and in New Zealand as a whole, communities have tended to look at the last known floods and add a margin over that. For many years in this district the 1948 flood was the reference. After 1985 that flood became something of a standard for the Poverty Bay Flats until Bola in 1988. This piecemeal approach has resulted in new or near new houses being flooded in 1985 and 1988. It is time for a more considered approach than merely adding a margin to the most severe known flood to date.

9.3 CIVIL DEFENCE

There is no requirement to adopt any standard for Civil Defence purposes. Rather, Civil Defence should be aware of, and have contingency plans for a whole range of events.

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These plans will be based on the floodspread information and rainfall warning systems now available, and will enable Civil Defence to decide such matters as who should be evacuated, when, to where and by what routes.

10. STOPBANK FAILURE

Collapse of stopbanks is considered unlikely but cannot be disregarded. To guard against this it will be recommended that all dwellings should be at least 600 mm above ground level on piles or earth pads. This will protect dwellings not immediately adjacent to the stopbanks and also give a margin against localised drainage failures.

11. COMPARISON OF ALTERNATIVES

Alternatives standards which could be considered are 5,300 cumecs ("Bola"), 5,830 cumecs ("Bola + 10%") and 6,225 cumecs or ("Bola + 17.5%"). (The latter has been included to demonstrate the effects of a really big flood and because mapping for it exists, as it is very similar to the discharge from "Bola + 10%" prior to stopbank raising).

The following table shows the area of land affected by flooding for three possible flooding scenarios.

		AREAS INUNDATED (HECTARES)		
ZONE	DESCRIPTION	5,300 (Bola)	5,830 (Bola + 10%)	6,225 (Bola + 17.5%)
Zone 2	High Hazard Areas	205	205	270
Zone 3	Flood Ponding Areas (depth > 1 metre)	445	1,058	1,574
Zone 4	Areas Liable To Flooding	5,790	5,178	4,662
Zone 5	Flood Fringe Areas	Nil	614	1,614
TOTAL		6,440	7,055	8,120

NB: DISCHARGE These scenarios assume the discharge at Kanakanaia at the volumes stated for approximately 36 hours in the case of Bola, appropriately adjusted for the other cases.

11.1 5,300 CUMECS (BOLA)

If this were the design standard then land use restrictions relating to the Waipaoa River would be needed only at locations on both banks just downstream from the

Kaiteratahi Bridge, as at all other points there would be no effects from the Waipaoa (assuming the banks are raised as currently proposed). As noted, over time this level of protection will diminish due to aggradation and will eventually approach the situation which occurred during Bola itself, as the aggradation eliminates the benefit of the stopbank raising. Under this option, restrictions would still be needed in relation to the other rivers, drains and streams.

11.2 5,830 CUMECS (BOLA + 10%)

Under this option, no more land is classified as "High Hazard" than for the "Bola" option. These are areas in which building would not be permitted at all. The area of land in Zones 3, 4 and 5 do increase, by a total of 615 hectares. These are the areas in which raised or possibly strengthened foundations may be required. The additional cost direct to the community of adopting Bola + 10% is the additional cost of such foundations. This is additional height only, as it will be recommended that all dwellings on the Poverty Bay Flats be situated on piles or earth pads.

11.3 6,225 CUMECS (BOLA + 17.5%)

Under this option an extra 65 hectares of land would be classified high hazard, and an extra 1,000 hectares of land would be subject to foundation requirements compared to "Bola + 10%" or an extra 1,615 hectares compared to "Bola".

11.4 ASSESSMENT

The differences between these three options are comparatively minor on the ground. As houses are built or replaced there will be small additional costs to owners. Property valuations could be expected to rise and insurance premiums could in some cases reduce, once properties are properly protected and risks accurately described. Council can adopt a high level of future protection without a major cost to the community.

12. ATTACHED REPORTS

Attached to this report are background reports on the issue prepared by the Engineering and Works Department. These are included for additional explanation and information and should be read with some care because many of the calculations in the July 1991 technical report have been superseded by the decision to raise the stopbanks and because those reports referred to details of land use restrictions which are not being put forward for approval at this time.

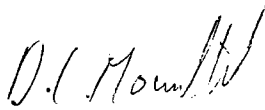
The purpose of this report is to have Council adopt a standard as a starting point for land use restrictions. The details of such restrictions will then be worked out and recommended to the Council in the form of District Scheme Changes.

RECOMMENDATION

THAT For the purpose of planning and building measures relating to flood protection on the Poverty Bay Flats, the Council adopt a design flood of at least "Bola + 10%" together with the 1985 floodspread on the Poverty Bay flats, as described in Report No. EW 3453, 1991.

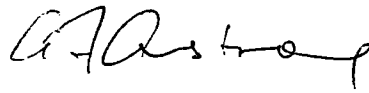
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