Accepted for the award of
Master of Arts
on 14 July 1978

UNIVERSITY OF QUEENSLAND

LIBRARY

The persons whose signatures appear below have consulted this thesis by MACEY, SUSAN M. and are aware that it is available for study only and that no quotations, or substantive information not otherwise available, may be published therefrom without the consent of the author.

NAME	DATE	NAME	DATE
A/m Maggart	3-10-83		
K Yeomans	14-10-83		
C. Goodyer	30-9-85		
L Goodyer	8-10-85		
J. RAWLINS	8-8-86		
S. MITCHELL	1-4-87		
S. MITCHELL	5-5-87		
B. Powell	27/5/87		
B. Powell	29/5/87		
S. Pl	5/6/87		

PERCEPTION OF FLOOD HAZARD AND ADJUSTMENT IN BRISBANE

by

Susan M. Macey.

A thesis submitted in fulfilment

of the requirements for the degree of

Master of Arts

Department of Geography,

University of Queensland.

January, 1978.

STATEMENT OF ORIGINALITY

Except where acknowledgements in the form of references have been made, this dissertation represents original research carried out by the author. It has not been submitted to any other University or previously to the University of Queensland.

Susan Macey

(Susan Macey)

ACKNOWLEDGEMENTS

I would like to thank my supervisor, Dr. A. Auliciems for his valuable advice and criticism throughout, and also Prof. J.H. Holmes for his initial guidance and stimulation of my interest in the study topic.

My thanks must go to Mr. E.E. Savage for his assistance in cartographic matters; the cartographic staff of the Newcastle University Department of Geography for reproduction work; Dr. G. McDonald and Dr. P. Sharma for their guidance in statistical methods; the staff of the Queensland University Computer Centre for their advice on data processing; and Barbara, Jan, Lyn and Noeline for their excellent typing.

Appreciation is expressed for information and assistance provided by the Public Relations Section of the Brisbane City Council and staff of the Oxley Memorial Library. I would especially like to thank Mr. Debie of the BCC Works Department for assistance in obtaining maps of flood extent.

I am also very grateful to my students in the 1974 Resource Management course at the University of Queensland who undertook some of the interviewing and to Brisbane's flood plain occupants for their time and cooperation in making this thesis possible.

Lastly, I would like to express my great appreciation to my family and friends for their enduring support.

ABSTRACT

This thesis examines factors which influence Brisbane flood plain occupants' perception and evaluation of the flood hazard. It also looks at their evaluation of the effectiveness of public and private adjustments and the variables affecting their adoption decision.

As the basis for analysis, three hypotheses are set up. Hypothesis 1 relates to the factors associated with variations in hazard perception and evaluation, those under consideration being perceived frequency and magnitude of the natural event, knowledge and experience of the flood hazard and expectation of future flooding. The second hypothesis pertains to the choice of adjustment, stating that this is a function of evaluation of the hazard, awareness of the choices open and evaluation of alternatives. In the third, it is hypothesized that there exist rational explanations for the persistence of human occupance in hazard areas.

Information obtained from a personally administered questionnaire forms the main data base. The sample was selected by a systematic technique in which every tenth residential unit which had experienced some degree of flooding in January, 1974 is included. In all, 647 interviews were obtained from either the household head or spouse. The bulk of statistical analysis is carried out using packaged computer programmes, crosstabulation and chi-squared being the main methods used.

Basically, findings suggest the hypotheses may be accepted as stated, though some refinement can be made regarding the characteristics of the variables involved. In the first hypothesis, hazard evaluation

varies directly with expected flood frequency. However, it appears that responses can more appropriately be classified in terms of certainty and uncertainty. While hazard evaluation varies directly with height of flood waters in the dwelling, a more important distinction exists between those who experienced flooding in their dwelling and those who did not. Both recency and amount of personal experience, knowledge of previous floods, and expectation of future flooding are also significantly related to hazard evaluation.

In examining the second hypothesis, again relationships appear more complex than originally anticipated. Significant relationships are established between the adoption of private adjustments and a number of factors including perceived frequency and magnitude of flooding, future flood expectation, hazard evaluation and experience. Perception of public adjustments is significantly related to the first three, but not to the last two.

While the overall range of public adjustments perceived is relatively broad, individual respondents knowledge is more restricted. Information, warning and evacuation measures are generally given the highest ranking by respondents, followed by zoning regulations. In the main, technical adjustments are ranked below these in effectiveness. However, they are the government action most frequently sought.

Amount of experience and adoption of adjustments at the time of the flood are significantly related. Little difference exists in the type of adjustment adopted since the flood, suggesting a common pool of knowledge has developed. Few occupants have adopted major adjustments. Most appear to place their reliance on last minute emergency measures for protection. Relocation is a favoured alternative but often precluded

from consideration by economic and social constraints. The situation of increased public confidence being generated by a knowledge of public mitigation work does not appear to be operative in the present study.

In the final analysis, one factor, information, stands out for its role in both perception of the hazard and response to it. Its direct role in the adoption decision appears to be of particular importance. As an adjustment, the provision of information is the one most sought and also appears to have the most potential in influencing the adoption of other adjustments.

On the basis of these observations, three planning proposals are made. These are:

(1) the extension of information provision

(2) the improvement of flood forecasting, warning services and evacuation plans, and

(3) the development of positive preventive measures such as zoning regulations to induce development away from the flood plain.

Finally, three avenues for future research are proposed including the examination of the information and warning component of hazard perception and the adoption decision, a study through time of one community to gauge the effect of information flows and third, benefit-cost analysis at the level of the individual flood plain occupant.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

C H A P T E R 1

INTRODUCTION

1.1 Introduction and Justification for Research

This thesis is concerned with the interaction between man and one aspect of the environment in which he or she lives. It seeks to understand how people respond to flood events, and to explore the differences that exist in that response. Further, it attempts to describe and explain this response for one particular area by analysing the attitudes expressed and actions taken by flood plain occupants. In this respect it is essentially a case study employing similar objectives to those outlined by Kates (1962) and Natural Hazard Research (1970). The approach adopted here is that of a behavioural geographer and is concerned with investigating the ways in which people perceive and evaluate elements of their environment and how they act on the basis of their evaluation.

The area selected for analysis forms part of the Brisbane River flood plain and is wholly encompassed by the Brisbane metropolitan area. Within this area, the study is limited to the response of residential occupants whose property was affected by flood waters in the Australia Day flood, January 1974. The data on which the ensuing analysis is based was gained by personal interviewing of a selected sample of these occupants.

The study was prompted by two main concerns. Firstly, it was prompted by a concern over the seeming lack of awareness of flood potential and alternative adjustments to flooding among flood plain occupants in Brisbane. Secondly, concern was with the apparent disregard by residents and local authorities alike of the evidence presented by Brisbane's flood history - a disregard shown by the continued encroachment of development into areas that have experienced previous flooding.

It is hoped from this study some insight may be gained into how flood plain occupants view their environment and the processes by which they cope with the hazard they face. By looking at factors involved in the formulation of their attitudes and decisions, the results may help illuminate some aspects of the decision process in resource management and lead to a better understanding of human response to environmental stress. Therefore, while this study is problem oriented, the implications for planning policy are clearly evident.

1.2 Organization of Study

To set this study in wider perspective, Chapter 2 will be devoted to a review of the concepts and methodological advancement of behavioural geography and more specifically of natural hazards research. In the latter, attention will be given to examining the present level of development in the field and the major themes and hypotheses put forward by previous researchers, particularly those relating to flood hazard.

Various aspects of the study area are discussed in Chapter 3 and the problem to be researched set in perspective. The methods used in the data collection and processing phase, including a review of questionnaire design, sampling procedure and statistical techniques adopted are discussed in Chapter 4.

Chapters 5 to 7 form the substantive report which is closely aligned in organization to the hypotheses outlined in Chapter 2. Elements in the perception and evaluation of hazard are the basis of discussion in Chapter 5. The influence on hazard evaluation of such variables as perceived frequency, experience, knowledge and information, expectation of future flooding and flood interpretation is examined. Chapter 6 looks at awareness of the range of choice of public and private

adjustments and the evaluation of their effectiveness. Finally Chapter 7 considers the adoption of adjustments and examines factors involved in the adjustment decision process, particularly where this involves persistence of occupance on the flood plain.

In the concluding chapter (Chapter 8), the objectives and themes of the study are restated and a synopsis of findings provided, along with some recommendations for future Brisbane flood plain management and planning. Problems encountered in the present research are also discussed and some suggestions for further research offered.

C H A P T E R 2

REVIEW OF LITERATURE

It is intended, in the following review, to give an indication of the extent of geographical research into the problems of flood plain occupance by outlining the major objectives of present research on natural hazards, in particular, as they apply to flood hazard. Firstly, however, an attempt will be made to set natural hazards research in the broader context of behavioural geography since many of the concepts and terms employed in the latter are directly relevant to this study.

2.1 Behavioural Geography (Man-Environment Relations)

A recent trend in geography has been the development of the 'behavioural revolution'. The basic schema for analysis is no longer environment/spatial behaviour but environment/man/spatial behaviour in which man becomes a significant intervening variable. This represents a fundamental change in the conceptual approach to understanding human spatial behaviour and is characterized by a more realistic view of man in combination with the use of quantitative methods. Rather than the normative behaviour of 'economic' man, the approach behavioural geographers have adopted is typified by a normative-behavioural dichotomy (for example, Downs' schema (1970), pp. 84-89; and Studer's model (1970), p. 59) more synonymous with the real world situation, and in which concern is with understanding why certain activities take place rather than what pattern they produce in space.

Yet, as Saarinen (1969) points out, there remains a lack of well developed methodology - partly as a result of the recency of inquiry and partly because of the type of behaviour investigated. Since a person's conscious and purposive response to his milieu are explicable only in terms of psychological events, identified by such words as perception, reaction, attitude, choice, decision etc. (Sprout, 1965),

measurement instruments which are fundamentally different from those normally employed by geographers are required. In large part, these have been borrowed from the fields of psychology and sociology. Thus the new emphasis has come to represent a trend towards more psychological geography characterized by a strong infusion of behavioural science technique and terminology. Evidence of this can be found in geographers' changing concept of environment.

2.1.1 Environment

All behaviour occurs within the total environment, that is, "the aggregate of external conditions that influence the life of an individual or population" (Detwyler, et al., 1972, p.6). In conceptual terms, the environment may be thought of as having a 'nested' structure (Sonnenfeld, 1972) in which each level influences and is influenced by each other level. At the broadest level is the geographical environment encompassing all that is external to the organism. Included within it is the operational environment or the environment in which man operates. This level consists of those portions of the world which impinge on man. That portion of the operational environment of which man is aware is the perceptual environment in which awareness may be derived from learning and experience or from physical sensitivity to environmental stimuli. That is, the perceptual environment has both sensory and symbolic dimensions. Finally, the behavioural environment is that part of the perceptual environment which elicits a behavioural response or towards which behaviour is directed. To quote Sonnenfeld (1972, p.245),

> "in its objective dimensions the behavioural environment exists as a complex subset of the broader geographical environment, but in its subjective perceived dimensions it also exists as the individual's psychological environment, a mental projection of a kind which, conditioned as it is by personality and culture, may only in part be congruent with the real world."

Perception studies have therefore come to play an increasingly important role in geographic inquiry and nowhere more importantly than in the field of natural hazards perception where research has been concerned with the persistence of settlement in hazardous areas and the ways in which man has attempted to adapt to the hazard. By concentrating on the cognitive understanding man has of his environment and the way in which this knowledge is stored and organized in the mind, these studies may give a more realistic image of the world as men see it.

2.1.2 Perception and attitudes

Because of its interdisciplinary nature, the subject matter of perception studies has variously been called environmental psychology, environmental perception, human ecology, man-environment relations, to name only a few (Saarinen, 1969, p.3). The term, perception, has as a result, taken on many varied meanings. Some clarification of the meaning of the term as used in this study is therefore needed before proceeding.

Drawing from the great complexity of perception terminology, the part which has particular relevance for geographers, and especially those engaged in natural hazard research is *social perception*. In the simplest terms, social perception is concerned with "the effects of social and cultural factors on man's cognitive structuring of his physical and social environment" (Saarinen, 1969, p.5). Thus it depends on more than the stimulus present, that is the hazard, and the capabilities of the sense organs. Social perception also varies with the individual's past history and present attitude acting through values, needs, memories, moods, social circumstances and expectations which provide a 'cultural lens' or 'filter' so that the image received is a selective one resulting from the subconscious interaction of the real

world with all these elements. For example, an individual's perception of a flood will vary not only with the physical characteristics of the flood event, but also with his past experience of flooding, expectation of future flooding etc, all of which work to modify the image he holds.

Unlike perceptions, *attitudes* are more stable, involving some commitment of opinion, and less subject to change with the immediate past experience and present state of the perceiver, though like perceptions, attitudes develop in part as a result of past experience and learning (Schiff, 1970).

By definition, an attitude is "an organized set of feelings and beliefs which will influence an individual's behaviour" (Schiff, 1970, p.6). According to Upshaw (1968, p.60), the three components which together make up an attitude are

(1) affective - consisting of an individual's positive and negative feelings;

(2) cognitive - including the individual's evaluative beliefs;

and (3) behavioural - denoting the individual's actions.

It has been found that people tend to keep their affective and cognitive systems internally consistent (Campbell, 1950; Schiff, 1970). While the interrelationships are by no means simple, these two components can be said to predispose an individual to react (behave) in a certain way toward the object of these affects and cognitions. Here two properties of attitudes which have served most in analysis are

(1) direction - referring to whether feelings, beliefs and behavioural tendencies are positive or negative;

and (2) magnitude - showing the degree of favourableness or unfavourableness (Scott, 1969, pp.206-208).

Thus an attitude is often defined as a tendency to react favourably or unfavourably toward a designated class of stimuli. When so defined,

'attitudes cannot be directly observed, but must be inferred from overt behaviour, both verbal and nonverbal" (Guilford, 1959, p.48).

It is in the scope of the reaction or behaviour that a major difference occurs between perceptions and attitudes, the former being more limited in the behavioural component and needing the physical presence of the stimulus/stimuli set. However the two are closely interrelated in that perceptions may give rise to attitudes and attitudes affect the perceptual discrimination of the individual in formulating his images of an object or stimulus (Schiff, 1970).

2.1.3 Evaluative approach and decision making

As noted by Downs (1970, p.70) one of the "principal underpinnings" of the perception approach is that spatial behaviour is a function of the image where it represents man's link with his environment. In behavioural geography, the evaluative approach best exemplifies the practical application of this concept in that it is primarily concerned with the evaluation of the environment via spatial images and seeks to relate the evaluation to decision making, and therefore to behaviour. An implicit assumption in this approach is that the perceived world is one of the fundamental criteria or bases used in making a decision. Concern is with the perception of factors in the environment which people consider important and the way they employ them in decision making activities, that is, the way structural components of the image are assigned weightings. In terms of decision theory, this focus on the image is "the utility of various environmental states and the probability of their occurrence" (Downs, 1970, p.80). Here Downs (1970), attributes the principal work to studies on the perception of natural hazards, in particular measuring the probabilities that people attach to the occurrence of potentially dangerous environmental phenomena.

2.2 Natural Hazard Research - Outline

Natural hazard research provides a theme for the integration of many disciplinary interests and geographers have made basic developmental contributions. The geographic tradition of hazard research can be traced back over half a century in the United States, to the work of Harlan Barrows (1923) whose observations on the concept of human adjustment to environment "provide the philosophical basis for this field of inquiry" (Mitchell, 1974, p.312). However, it was not until 1945 that geographic hazard research received its main impetus from the work of Gilbert White and his colleagues in the Chicago School. White's pioneering study (1945) provides a general typology of human adjustment to floods and focused on physical factors involved in such adjustments. From this point, steady progress has been made in examining the fundamental relation between man and his environment. Indeed, Brookfield (1969) attributes the real empirical starting point of environmental perception to the work of White, Burton, Kates and their collaborators on the hazards of flood damage in North America, which "specifically introduced the question of human adjustment to floods and perception of the flood hazard as an element in this adjustment" (Brookfield, 1969, p.60). Subsequently, more behavioural variables have been emphasized, for example, in investigations of attitudes towards flood hazard (Roder, 1961), perception of hazards in nature (Burton and Kates, 1964) and in analysis of the role of perception in structuring decisions made by resource managers in hazard risk areas (Kates, 1962; White, 1964).

2.2.1 Natural hazard definition

In the simplest terms, natural hazards may be described as "those elements in the physical environment harmful to man and caused by forces extraneous to him" (Burton and Kates, 1964, p.413). However

this definition ignores the fact that a natural hazard of any sort is a function both of the physical event itself and of the prevailing state of the human use system of affected areas that are provided, through adjustments, with a certain capacity to absorb these events. Stated another way, "no natural hazard exists apart from human adjustments to it. It always involves human initiative" (White, 1974b, p.73). White (1974b) further states that floods would not be hazards if man were not tempted to occupy flood plains, by which occupance he establishes damage potential and may well change the flood regimen itself. To paraphrase Kates (1970), a natural hazard may be defined as an aspect of the interaction of man and nature arising from the common process in which men seek in nature that which is perceived as useful and attempt to buffer that which is perceived as harmful to man.

2.3 Themes in Natural Hazard Research

The present state of global understanding of natural hazard phenomena may be stated as "a series of linked, succinct but complex hypotheses as to the nature of natural hazard, adjustments to it, and the choice thereof made by the human occupants of hazard areas" (Kates, 1970, p.2). In this, according to Burton, Kates and White (1968), the following five principal areas of investigation have emerged:

(1) assessing the extent of human occupance of hazard zones;

(2) identifying the full range of possible human adjustments to hazard;

(3) studying human perception and estimation of hazard;

(4) describing the process of adopting hazard adjustments;

and (5) estimating the optimum set of adjustments and its social consequences.

The focus of research in the present study resides in the third and fourth of these areas as applied to the analysis of flood hazard, and follows a recurrent theme running through much of the natural hazard research. This theme explores behavioural aspects of human response, especially human perception both of the physical events themselves and of the choices open. The reasoning behind this approach has been aptly summarized by Hewitt and Burton in the following way -

> "Insofar as we regard the perceptual framework as influencing how people and society behave, we cannot expect to grasp the human ecology of hazards without exploring that framework ... nearly all significant events in man's adjustment to environment involve mental processing of environmental information."
> (Hewitt and Burton, 1971, p.147)

2.3.1 Human perception and evaluation of hazard

A combination of three main factors has been found to account, in considerable measure, for variations in an individual's perception and estimation of a specific natural hazard. As listed by Kates (1971), these are the way in which characteristics of the natural event are perceived or interpreted, the nature of personal encounters with the hazard and factors of individual personality.

Firstly, *characteristics of the natural event* which appear to be most significant are magnitude, duration, frequency and temporal spacing. White et al. (1958) found that the longer time since the most recent large flood, the more weight rationalization had in reducing or distorting public perception of the flood hazard and that the longer the flood to peak interval of major floods, the less keen was the interest in dealing with the flood hazard. Frequency, or more particularly perceived frequency, has been found to be a common component in overall hazard evaluation by a number of researchers, among them Roder (1961), Burton (1962) and Kates (1962). In the last instance, Kates puts forward

the idea of a certainty-uncertainty scale as an aid to understanding hazard behaviour. He explains,

> "the way men view the risks and opportunities of their uncertain environment plays a significant role in their decisions as to resource management. The certainty of flood occurrence, as it differs from place to place, appears to underlie this diversity of perception and to influence the way men attempt to order their activities to reduce the threat of natural hazard." (Kates, 1962, p.1)

Kates bases this scale on perceived frequency of flood events which, he states, "may vary from the best technical estimates because of the mixed effects of personal experience, the traumatic shock of catastrophic events, the perceived effectiveness of real or imagined protection works and the like" (Kates, 1963, p.222). By plotting a number of cases on the scale, Kates (1962) found that three classes of response emerged. These coincided with uncertainty, intermediate certainty and certainty. In each class, a certain amount of behavioural uniformity can be distinguished; for example, where the events in question are frequent or certain, there is little variation among respondents in their perception. The same holds true where the event is infrequent or uncertain, for here the failure to perceive a significant hazard is widely shared. It is in the situation of moderate or intermediate frequency that one expects to find considerable variation among flood plain occupants. This is in keeping with White's observation (1961b) that there exist particular flood frequencies that are sensitivity or turning points for human adjustment to floods. However, Kates (1962) cautions that though results to date suggest that in the aggregate there is an ordered relationship, a considerable number of observations will be needed before one might conclude that men on flood plains perceive and respond to key changes in frequency and to define these points of change with more precision and objectivity.

Secondly, *the nature of personal encounter with a hazard* (that is experience) may be defined as the element of information that describes knowledge based on personal observation or contact. It implies physical presence only and not that the respondent's dwelling was necessarily damaged or even inundated. A further distinction may also be made between onsite experience at the respondent's present location and offsite, either at another location on the same flood plain or elsewhere. Recency, frequency and intensity of the experience appear to be the most critical elements. Results of Burton's study (1961) on the Little Calumet River in the United States suggest a relationship between degree or intensity of past flood experience and the attitudes of flood plain residents to future flooding such that, if this experience had been only of minor flooding respondent's 'optimism' would be tempered to 'neutralism', while in the event of severe flood experience the trend to 'pessimism' became much more pronounced even though large scale protection works were under construction. From this, Burton concluded that it may be expected that major floods play a significant role in changing the attitudes of flood plain residents and thus discourage encroachment, but that invasion of the flood plain would be expected to persist in the face of minor flooding. That is, one would expect that, when personally experienced, a flood would be more meaningful and lead to heightened perception.

However the relationship between experience and perception of the environment or a willingness to deal with it is not a simple or clear one. As Burton and Kates (1964) point out the effect of experience as a determinant of hazard perception is blurred firstly by the fact that there exists a pronounced ability to share in the common experience and newcomers often take on the shared or dominant perception

of the community and secondly, given a unique or cyclic interpretation of natural events, the experience of an event often tends to allay future anxiety. Kates (1962, p.132) terms this latter effect the "prison of experience" which he relates to Simon's (1957) concept of satisficing or bounded rational behaviour. In the former case, knowledge other than that acquired by personal experience is shown to play an important role in hazard perception.

Knowledge, ranging from rudimentary awareness of flood events to a detailed knowledge of the areas flood history, and experience together form the basis of each respondent's flood hazard information. Such information or lack of it is known to be related to some perceived probability distribution of flood hazard (Kates, 1962, p.45). Kates has amalgamated knowledge and experience in what he terms a "scale of flood awareness", but points out that the possession of flood hazard information however widely it is distributed, does not necessarily imply a personal awareness of flood hazard in the sense of a danger to person or property, or even expectancy of a flood in the future. Similarly, it is not sufficient to conclude a respondent has 'experienced' a hazard because he or she physically experienced a flood event. Rather, as Burton, Kates and Snead (1969) point out, it requires the recognition of the flood as such by the respondent and not all necessarily accept the common appraisal. A precise understanding of the way respondents evaluate flood hazard requires more than the simple specification of their knowledge and experience.

Kates (1962) found the simplest and most reliable estimate of hazard evaluation to be the respondent's *expectation of future flooding*. In his study, expectation of future flood was associated with amount of flood information, as measured on a knowledge-experience scale.

However, the link between experience and expectation is an apparently complex one in which "the high awareness of past experience is diluted considerably in the expectation component of perception" (Burton, Kates, Mather and Snead, 1965, p.573). It seems likely that between common knowledge or experience of a flood event, and the expectation of other similar future events a process of interpretation takes place.

Interpretation describes that process whereby information is referred to an individual's underlying perception of the state of nature passing through a series of psychological and physical filters which transform it into a unique personal evaluation in this case, of flood hazard (Kates, 1962, p.49). Kates' (1962) findings in La Folette suggest that respondents interpret information with reference to both a deterministic (implying the existence of some pattern or cycle) and indeterministic perception of the state of nature and that there is an extremely high consistency between interpretation and the simple hazard evaluation measured by future flood expectancy.

The third set of factors involved in perceptual variation are those of *individual personality*. Such factors as "fate control, differential views of nature and tolerance of dissonance-creating information" (Kates, 1971, p.441) form an integral part of the interpretation process and therefore of an individual's perception. Where an individual's interpretation or appraisal deviates from objective facts, Lazarus (1966) suggests an answer for the variation can be found in the discovery of psychological dispositions within the individual. For example, Kates (1962, p.45) found in La Follette that people behave as if they have some "underlying perception of the state of nature" which aids in their interpretation process. However, Burton and Kates (1964) question how much of the divergence can be ascribed to

fundamental views of nature and suggest that much more of the divergence is explicable in terms of basic attitudes towards uncertainty. Another personality trait, 'risk-taking propensity', has not according to Kates (1971) been shown to be a consistent trait and, like other variables of personality, has proved operationally difficult to measure. Thus, while geographers recognize the import of personality traits on perception and response, research on the relationship between them is still at an early stage.

Other factors which in varying degrees have been shown to affect a respondent's perception and evaluation of hazard include dominant resource use, perception of protection works, life cycle stage and esteem for neighbourhood. The relationship between perception of hazard and resource use was first demonstrated in United States flood hazard studies. Burton and Kates (1964) reporting on their respective studies in 1962 of agricultural and urban flood plain users, suggest a greater hazard sensitivity in terms of awareness exists among agricultural land users.[1] A similar disparity in hazard perception has been noted between different types of urban users; for example, Kates (1962) and others have found commercial managers to be more perceptive of risk than residential managers. With regard to the effect of protection, it is generally acknowledged that property managers tend to underestimate the flood hazard and overestimate the benefits of technological change (White, et al., 1958). However the role of protective works is poorly understood. Hewitt and Burton (1971) note the increased public confidence generated by flood-control works, either real or imagined

---

[1] Though the frequency of hazard that encourages certain responses on the part of resource uses was found by Kates (1963) to be approximately equal for both urban and agricultural land users.

as a key element in the process of encroachment on flood plains while Burton (1961) and Roder (1961) found little or no association between appraisal of the flood hazard and knowledge of protective structures.

Stages of family development have generally been overlooked as a variable in disaster research, yet general studies of communities in disaster evidence that the family affects disaster behaviour (Hill and Hansen, 1962). Marks and Fritz (1954, pp.426-28) have shown that, compared to persons without dependents, men with homes and dependents both prepared better and acted more rationally in all stages of disaster.

Socio-economic status has generally been found to have no significant relation to perception and evaluation of hazard (Burton, 1961; Roder, 1961; van Arsdol et al. (1964). Some correlation has however been found in the abovementioned studies between perception and elements of socio-economic status such as age, homeownership, income and education, but these elements may generally be linked to experience and information factors.

2.3.2 The decision process and adoption of adjustments

Although the importance of perception is widely acknowledged, comparatively little is known about other factors which influence the process of adjustment adoption. White (1945, pp. 48-49) states

> "the degree to which any one factor bears a significant relationship to a given adjustment is influenced in large measure by accidents of human disposition, reason and technology so that no hard and fast generalizations can be made with respect to their quantitative importance."

In analysing the behaviour and decision-making process of resource managers therefore, the ideal of the completely optimizing man has proven of little use as a model because it fails to take sufficient account of differences in perception of the hazard, decision criteria and the effect

of social guides to permit a reasonably accurate description of what and how people decide to cope with flood hazard (White, 1966b). A better approximation of the process involved has been found in the model of bounded rationality (Simon, 1957). In Kates'(1971) most recent version, the formulation portrays adjustments as the products of a three stage filtering process involving

(1) the respondent's perception of hazard;

(2) his or her awareness of possible adjustments;

and (3) his evaluation of these adjustments in terms of their suitability for the environmental setting, technical feasibility, economic efficiency and conformance with social guides.

Rarely are individuals unaware of the existence of possible floods. But, before any process of adjustment can be effected, the flood event must be perceived as sufficiently threatening by the respondent to warrant action. This threshold, below which he neither seeks nor evaluates adjustments is a function of the way in which the respondent perceives natural events, his personal hazard experience and specific personality characteristics. Therefore limits may vary greatly. In simple terms, the significance of the threat may be equated with the amount of actual or anticipated loss suffered. The expectation of bearing a loss may in turn be related back to the location of a place on a certainty-uncertainty scale (Kates, 1962, p.107). Once the loss threshold is reached the appraisal of adjustments may begin.

In the main, awareness of adjustments, including their number and type, and the quality of this knowledge is a "function of the casual access to communication networks and, to a lesser degree, of motivation to search for new modes of adjustment" (Kates, 1971, p.441). In the first instance, variations in awareness might be accounted for by factors

controlling access to information which can be approximated by socio-economic indicators of age, education, income, travel, role responsibility and training, while intensity of personal experience or role-related responsibility might provide motivation for knowledge of adjustments when encouraged by positive views of 'fate control' and efficacy of action. It has been found that those who have lived longest on the flood plain and therefore would be expected to have more knowledge or experience of flood events are more aware of alternatives and those most recently flooded perceive emergency action more acutely (White, 1964). This bears out Kates' observation (1962) that floods need to be experienced not only in magnitude, but in frequency as well. Without repeated experience, the process whereby managers evolve emergency measures of coping with floods does not take place and without frequent experiences, learned adjustments atrophy with time. Kates (1962) also notes that limited experience may lead to a loss of motivation to seek further for alternatives.

In the third stage of the decision process referred to above, the range of theoretical choices known to the respondent are evaluated according to a number of criteria which Kates (1971, p.441) lists as follows: environmental fit involving the conformity of the adjustment to an appraisal of site or situation for certain activities; technical feasibility involving an assessment as to the efficacy of the adjustment, the availability of skills, tools, and materials, and the indivisibility of the activity from related processes; economic gain involving an estimation of anticipated costs and gains in the light of the perceived time horizon, the ratio of reserves to anticipated loss and the degree to which the choice is required; social conformity[1] involving judgment

---

[1] Along with individual awareness, White (1961b) considers social constraints to be the most important aspects reducing the range of theoretical choices open to managers.

of the degree of conflict or conformity with law, tradition or expected mores of behaviour. Variation in the importance of these criteria appears to be related both to the perception of the hazard and the role training and responsibility of the decision maker. However, thus far, ramifications of these factors have not been thoroughly investigated in the context of hazard research. From what is known, it is clear that such constraints can severely limit the practicability of adopting perceived adjustments (Mitchell, 1974). The process by which decisions or choices are made in selecting an adjustment can therefore range from intuitive acceptance to highly sophisticated computation.

The *frequency of adoption of adjustments and the variation in adoption* between individual managers appear to be most strongly related to hazard frequency and the expectation of future flooding (Kates, 1962; Burton, Kates and Snead, 1969). Indication levels of adoption appear to respond to greater certainty and to shrink as uncertainty increases; that is, a large number of adoptions are made by a high proportion of the population where the probability of a hazard occurrence is high and where the perceived frequency is equated with positive certainty, while in areas of low probability and negative certainty few adoptions are made and only by a small proportion of the population. In areas of uncertainty, a wide variation occurs in the adoption of adjustments by people in similar circumstances and in the proportion making any particular adjustment. Age, education, socio-economic status and experience have been found to exert little influence on these adoption decisions (Kates, 1962; Burton, Kates and White, 1968). Exceptions to this general rule do however exist when uncommon adjustment adopters are considered separately; for example, it has been found that a significantly larger proportion of those who adopt uncommon adjustments have experienced heavy damage and possess higher incomes (Burton, Kates and Snead, 1969).

2.4 Formulation of Hypotheses

2.4.1 Hypotheses in natural hazard research

In summary, the observations and hypotheses made in natural hazard research so far may be grouped into two broad areas: perception and evaluation of the hazard, and the process of adoption of adjustments. Factors that have been found to have a significant relationship with the first include characteristics of the natural event including frequency (Roder, 1961; Kates, 1962) and magnitude (Burton, 1961), experience (Burton, 1961; Kates, 1962), knowledge (Burton and Kates, 1964) and expectation of future flooding (Kates, 1962). In the second area, evaluation of the hazard, awareness of choices open and evaluation of the alternatives appear to be the main variables (Natural Hazard Research, 1970; White, 1961b and 1974b) forming what Kates (1971) portrays as a three stage filtering process. Explanation for persistence on the flood plain has been one specific focus in adjustment evaluation (Roder, 1961; Natural Hazard Research, 1970; White, 1974b).

Because of the nature of the variables involved each situation is different. Natural Hazard Research (1971, p.1) points out the importance of observing a natural hazard in a local area "so as to provide a basis for comparative analysis of man's adjustment to hazard situations in a variety of cultural and physical conditions." By this means, common trends may be established and generalizations made which will aid in theory building. The case study therefore provides a useful tool for data collection and analysis as well as an important basis for planning. To date, the bulk of research has taken this form, looking at one or more of the above hypotheses in relation to a specific hazard and site.

2.4.2 Hypotheses in this study

The hypotheses to be tested in this thesis follow the guidelines set out in Natural Hazard Research (1970) and Kates (1971). They were specifically chosen to enable comparability with other research, therefore aiding in the formation of general theory, and are as follows:

Hypothesis 1: Variation in hazard perception and evaluation is associated with

(1) perceived frequency and magnitude of the natural event;

(2) recency and amount of personal experience;

(3) knowledge of previous flooding; and

(4) expectation of future flooding.

It is expected that those who perceive a higher frequency and magnitude of flooding have more flood experience and knowledge or hold a positive expectation of future flooding will exhibit a greater sensitivity to the hazard.

Hypothesis 2: Choice of adjustment is a function of:

(1) evaluation of the hazard;

(2) awareness of the choices open; and

(3) an evaluation of alternatives.

It is expected that those who perceive a more serious hazard will be more likely to seek out and adopt adjustments than those who perceive a lesser one; those who adopt adjustments will have a greater awareness of the range of alternatives open; the type of adjustments made will be related to experience onsite and expectation of future flooding.

Hypothesis 3: There are rational explanations for the persistence of human occupance in areas of higher risk. These explanations will be

related to a manager's perception of the hazard, evaluation of alternative adjustments and the consequences of their adoption. It is expected that reasons for continued occupance will include a superior economic value of remaining onsite, lack of satisfactory alternative opportunities and a positive rating of the effectiveness of protection works.

CHAPTER 3

THE STUDY AREA

To serve as a basis for further discussion, a brief description of the physical setting, nature of flooding and flood history of the area, plus characteristics of the January 1974 flood will be given in this chapter.

3.1 Physical Setting[1]

The Brisbane River rises in the Brisbane and Cooyar Ranges. Flowing in a generally SSE direction from its source, the river skirts the western flank of the D'Aguilar Range till it reaches a point just north of Ipswich where it turns to flow in a north-east direction to its mouth in Moreton Bay (see Fig. 1). The city of Brisbane has been built on both banks of the Brisbane River with the central city area approximately 16 kilometres (10 miles) from the river's mouth. The river is fed by a number of tributaries, the principal ones being the Stanley and Bremer Rivers and Lockyer Creek in the middle reaches, and Moggill, Oxley, Norman, Bulimba and Enoggera-Breakfast Creeks in the lower reaches within the metropolitan area. The rainfall catchment for the Brisbane River comprises approximately 13,559 square kilometres.

The D'Aguilar Range terminates in long ranges of hills which penetrate into the northern suburbs of Brisbane. The intervening valleys are characteristically deep and steep sided. In these valleys flow a series of major creeks (for example, Enoggera-Breakfast Creek and Kedron Brook) with catchment areas up to 80 square kilometres (31 square miles). With the exception of Kedron Brook which discharges directly into Moreton Bay, these creeks join the Brisbane River. South of the river, the topography is generally flat to rolling and is drained by a number of

---

[1] Information for sections 1 & 2 was obtained mainly from Director of Meteorology Report (1974) and Cameron and Morris (1974).

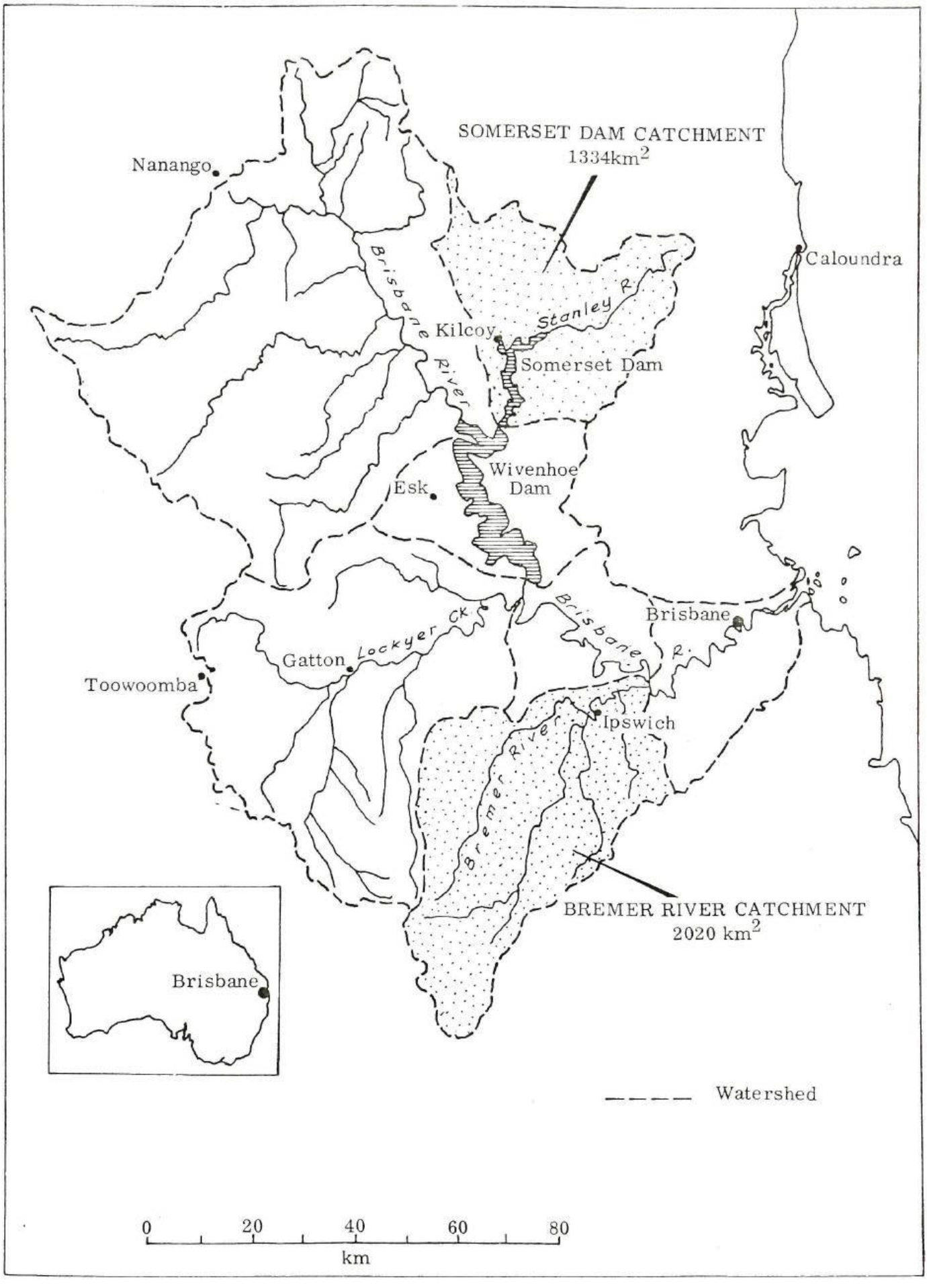

Figure 1: Catchment Areas of the Brisbane River and its Tributaries

creeks including Moggill, Oxley, Norman and Bulimba Creeks which flow north into the Brisbane River. These creeks generally have larger catchments than those to the north of the river and have much flatter profiles and wider flood plains. Hence, river storage modifies downstream discharge to a greater degree in these creeks than happens in the northern creeks.

3.2 Nature of Flooding

Four types of flooding occur in the Brisbane valley. *Flash flooding* is experienced in most creeks in the Brisbane metropolitan area as a result of their characteristically rapid response to excessive rainfall. Usually, flash flooding is experienced in a number of creeks simultaneously and is associated with major synoptic weather systems that have produced continuous rain over at least 24 hours. Oxley Creek which has a much flatter catchment has a much slower response time to intense rainfall and hence is less susceptible to flash flooding. *River flooding* occurs on a much longer time scale than creek and flash flooding. For major flooding in Brisbane, the peak usually occurs within two to three days of the river first reaching flood level. Under non-flood conditions, the Brisbane River is tidal almost to Mt. Crosby. With increasing flood discharge however, the tidal variation is progressively reduced. The Brisbane River also exhibits a flood gradient or slope on flood waters through the Brisbane metropolitan area such that water rises by different amounts in different suburbs. For example, a rise of 5.5 metres at the Brisbane Port Office could mean a rise of more than 14 metres at Jindalee, a fact that was not commonly known at the time of the 1974 flood. *Backwater flooding*, resulting from the impediment to creek waters entering the river when the latter is in flood, is observed near the mouths of the Brisbane metropolitan creeks, especially

those upstream from the Central Business District (CBD). Those creeks which flow into Moreton Bay or the Brisbane River downstream of the CBD experience maximum flood levels in all but small areas around the confluence with the river due to run-off from their own catchments. Those creeks which flow into the river upstream of the CBD experience maximum flood levels over considerable lengths of their courses due to backwater from flooding in the river as well as local run-off. Oxley Creek, where the direction of discharge is against the flow of the river (that is the creek mouth faces upstream in the Brisbane River), is particularly susceptible to backwater flooding from the Brisbane River. A combination of *storm surges and tidal effects* may also lead to flooding in low lying areas, especially around Breakfast Creek. It has been noted (Director of Meteorology, 1974) that spring tide levels are only about 0.2 metres below flood level in some of these areas and so it only requires a very small surge to produce flooding.

There are some small fixed crest dams (for example Moogerah Dam and Enoggera Reservoir) in the Brisbane Valley that automatically mitigate floods to a minor extent. However, the major mitigation of flooding is achieved by Somerset Dam located on the Stanley River approximately six kilometres above its confluence with the Brisbane River. Though it only accounts for ten percent of the total Brisbane catchment, the Stanley catchment plays an important part in Brisbane flooding. Orographic rainfall in this area is a major contributor to most Brisbane River floods. Up to 25 percent of the total volume of many floods have originated above Somerset Dam and thus could be regulated. The dam itself is a combined flood mitigation and water supply structure. It was commissioned for water supply in 1943, for partial flood mitigation in 1950 and full flood mitigation in 1956. A larger capacity dual purpose

dam is proposed at Wivenhoe on the middle reach of the Brisbane River above Lowood and is expected to be completed around 1981.

3.3 Flood History and Settlement Development

The historic record of flooding in Brisbane and some characteristics of floods are outlined in Table 3.1. The first recorded flood occurred in 1841. The largest on record was that of February 5, 1893 when three major floods occurred within the space of a fortnight.[1] Prior to 1900, flooding occurred at one to eight year intervals. Since 1900, flood producing rainfall has been much less frequent[2] and the interval between floods has become much longer (Fig. 2). Furthermore, dredging and other changes to the hydraulic character of the channel, together with the effect of Somerset Dam have reduced most floods in Brisbane in recent years and have eliminated smaller floods (Director of Meteorology, 1974). The monthly frequency of floods exceeding 2.74 metres (9 feet) at the Brisbane Port Office is given in Table 3.2. This shows that flooding is most common in the usual wet season months of January, February and March, and rare from July to December.

During the twentieth century, there has been increasing development of river and creek bank areas. Except in 1931, the first 66 years of this century were relatively flood free and pressure increased to develop low lying land which had previously been avoided. During the 1920's and 1930's, much of the flood plain of Breakfast Creek was built up. Though the 1931 flood prevented complete development and there are large numbers of football parks and other playing fields

---

1 Aboriginal legends and geological evidence testify to larger floods occurring before western settlement (D. Rose, *Courier Mail*, 4 Feb., 1974).

2 According to the report by the Director of Meteorology (1974).

TABLE 3.1: Flood History of Brisbane *

Date	Flood Depth at Port Office +	Comments
14-17 Jan. 1841	9.58m (est.)	
9 June, 1843	3.91m	Relatively minor flood
10 Jan. 1844	8.18m	Very little information, except flood severe in Ipswich
11-16 April, 1852	4.06m	Heavy flood in Brisbane and Ipswich
19-20 May, 1857	4.42m	Flooding result of six weeks heavy rain rather than sudden heavy rainfall. "Brisbane Courier" story of rowing boats in 'Frog's Hollow' adjacent to C.B.D. St. Lucia area submerged (but unpopulated at time).
16 Feb. 1863	4.47m	All low lying areas flooded. 40 foot rise in river at Oxley. Road to Ipswich impassible. Wharves badly affected.
20 Mar. 1864	4.93m	South Brisbane, 'Frog's Hollow' and parts of Fortitude Valley heavily inundated. Oxley Creek flooded to Coopers Plains.
27 Oct. 1866	-	Storm caused flooding of low lying suburbs and unroofed buildings.
10-12 Dec. 1866	-	Creeks and water courses overflow. South Brisbane severely flooded.
2 April, 1867	3.61m	Original Victoria Bridge destroyed.
10 Mar. 1870	4.04m	Flooding in inner city. Exceptionally heavy rain.
18 June, 1873	3.84m	
1 Mar. 1875	3.76m	2 drownings. Ipswich-Oxley rail link subsidence.
16 Oct. 1879	3.61m	Oxley and South Brisbane extensive flooding. Low lying suburbs flooded.
23 Jan. 1887	4.93m	Worst flooding since 1841. River rose suddenly. Current 6 knots in city. Several lives lost. Kedron Brook area severely damaged. Bowen Bridge washed away.
20 July, 1889	4.9m	Heavy rains caused flooding in low lying suburbs.
13 Mar. 1890	6.48m b)	Business suspended in city. No gas available in city. Brisbane cut off from telegraph communications
5 Feb. 1893	9.51m c)	Heavy rain in headwaters of Brisbane River. Houses, ships and bridges swept away. Telegraph and rail communications disrupted north and west. Two ships left aground in Botanic Gardens and one on Eagle Farm flats.
12 Feb. 1893	3.3m c)	Second flood of the year.
19 Feb. 1893	9.24m	Debris clogging river at Indooroopilly Bridge acted as barrier to flow. Another steel span of Indooroopilly Bridge swept away. Grounded ships carried back into river. 190 patients admitted to hospital up to 24th in consequence of floods.
12 June, 1893	4.78m	
14 Feb. 1896	3.15m	Cyclonic rain. Two piles of Victoria Bridge snapped under weight of estimated three acres of debris
29 Feb. 1896	3.00m	Recurrence of cyclonic influence. Strong fresh in river.
13 Jan. 1898	6.17m	First time Government Flood Warning Service tried out - two days notice given allowing removal of goods - no serious damage or loss of life.
9 Mar. 1898	4.42m	Brisbane Chamber of Commerce and local authority representatives met and discussed possible methods of flood mitigation including training walls and straightening. Dredging only action carried out.
15 Mar. 1908	4.5m	Wharves submerged at Russell and Stanley Sts. South Brisbane flooded. Breakfast Creek up. Ithaca Creek flooded above 1893 level. Stones Corner near Norman Bridge submerged. Auchenflower, Rosalie, Milton, Rocklea and Lang Park inundated. First flood photos in "Brisbane Courier".
4 Feb. 1924	-	Low lying areas inundated including Zillmere - creek flooding only.
28 Jan. 1927	2.85m	First flood in river since 1908. Talk of Stanley River dam.
22 Feb. 1928	2.82m	Extraordinary fresh in river. Low lying areas submerged and erosion a problem.
21 April, 1928		Pinkenba, Stones Corner and New Farm Park flooded after heavy rains.
24 Jan. 1929	3.00m	Only slight fresh recorded in river.
7 Feb. 1931	4.47m	Overflow at Enoggera Reservoir because of rain over catchment-leads to flooding in Swan Hill.
6 Mar. 1931	-	Enoggera Reservoir overflows causing serious erosion problem downstream. Many low lying suburbs inundated.
22 Feb. 1934	-	Breakfast, Ithaca, Ekebin, Oxley and Norman Creeks flood. Large tracts of Milton and Swan Hill submerged.
9-21 Jan. 1938	-	Enoggera Reservoir overflows. Cyclonic weather. Flooding of Somerset Dam hinders progress of construction.
2 Mar. 1950	?	Heavy rain in upper Brisbane catchment. Creeks flood low lying areas.
2 Feb. 1951	?	Somerset Dam considered dominant factor in holding back flood waters. Enoggera and Oxley Creeks flood.
1953		Map published in "Courier Mail" by Queensland government showing flooded area with 9.2m (30 ft.) level at the Port Office.
11 Dec. 1954	?	Fresh in Brisbane River.
30 Mar. 1955	3.51m	Moderate flood in lower Brisbane catchment from Cyclone Bertha (little rain in Stanley catchment). Sherwood, Chelmer, Graceville, St. Lucia, Milton, Fairfield, New Farm and East Brisbane flooded by backwater. Flood fund set up.
13 Jan. 1956	2.9m	
12 June, 1967	?	Serious local flooding from Cyclone Dinah.(d) Heaviest falls in metropolitan area. Intense local rain leads to creek flooding, plus backwater flooding from river. Erosion a problem.
14 Jan. 1968	3.12m	Breakfast Creek floods Northey Street, Windsor.
24 Oct. 1970	-	Flash flooding in Kedron Brook and Enoggera Creek.
Feb. 1971	2.62m	Local flooding.
2 April, 1972	-	Creek flooding from Cyclone Emily.
6-10 July, 1973	-	Metropolitan creek flooding after long rainfall.
25-29 Jan. 1974	6.2m	Australia Day flood. Friday, 25th - major flooding in all Brisbane creeks. Saturday - backwater raises creek level.

Sources: a) "Brisbane Courier" b) Pugh's Almanac, 1891. c) Pugh's Almanac, 1894.
d) Brisbane Weather Bureau records.
Occurrence of flooding established by reference to a) except where indicated.

+ Metre heights were obtained from the Bureau of Meteorology, Brisbane.

* Information for this table was compiled from a search of past editions of the Courier series of Newspapers (variously called *The Brisbane Courier*, *The Brisbane Courier Mail*, and the *Courier Mail*) which has been continuously published since 1846 and Pugh's Almanac, an annual publication since 1859.

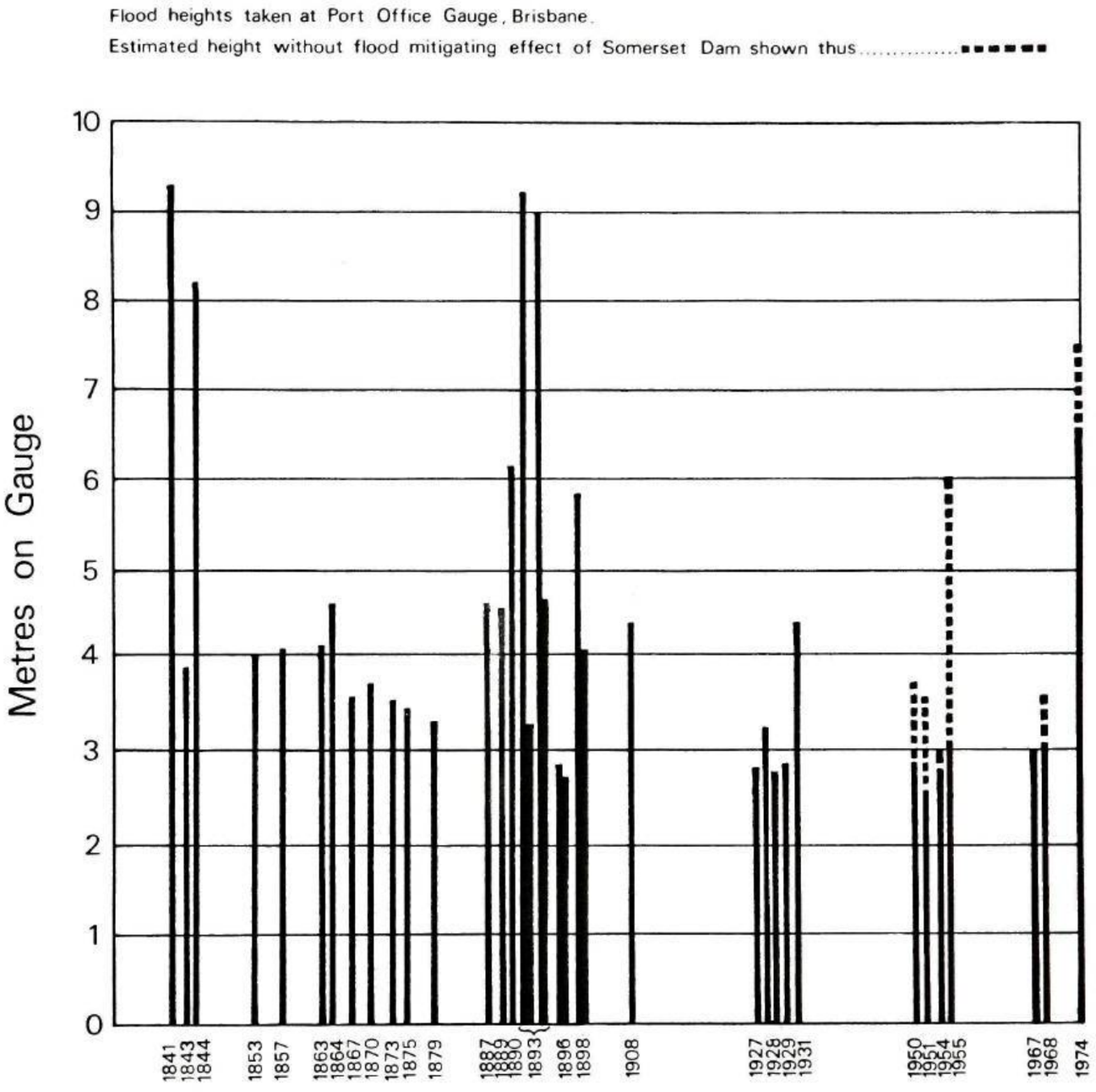

Figure 2: Brisbane River Flood Heights 1841-1974.
(After Ward, 1974)

TABLE 3.2: Occurrence of floods exceeding 2.74 m at the Brisbane Port Office between 1841 and 1974*

Month	Number	Month	Number	Month	Number
Jan	10	May	1	Sep	0
Feb	9	June	3	Oct	1
Mar	7	July	1	Nov	0
Apr	4	Aug	1	Dec	0

* The Port Office heights quoted refer to metric heights above Port Office datum. Port datum is equivalent to Brisbane City Council datum in imperial units. Future floods will be referenced to a new Brisbane City gauge, on Australian Height datum, which is 1.15 m lower.

(Source: Director of Meteorology, 1974, p.8)

occupying the lowest part of the plain damages in this area remain high.[1] Since the early 1950's there has been large scale development of Kedron Brook catchment. Parts of Moggill, Witton, Bulimba and Oxley Creeks have also been developed both for residential and industrial purposes. Heavy creek flooding since 1967 has consequently resulted in a great deal of damage to private property and public utilities along the metropolitan creeks. Within the last fifteen years, residential development has taken place along the river banks themselves, for example in the Jindalee and Yeronga West areas.

3.4 The January, 1974 Flood

This flood was unusual in many ways (Cameron and Morris, 1974). High intensity rainfall was maintained over a long period. There were three

---

[1] Damage in the Enoggera-Breakfast Creek catchment has been estimated to exceed $3,500,000 in the 1974 flood and the total damage since 1967 approaches $10,000,000 (Cameron and Morris, 1974, p.191).

distinct peaks, twelve and eighteen hours apart. Intensities recorded at many stations during the Friday night peak were among the highest recorded for long duration storms.[1] The main rain mechanism responsible for the Brisbane Valley floods was first evident on January 21 as a low pressure in a 'monsoonal' trough situated to the north of Brisbane (Director of Meteorology, 1974). This system gradually deepened, moving south east and eventually intensifying to become cyclone 'Wanda' which recurved onto a south-westerly track and crossed the coast near Double Island Point. 'Wanda' played a major role in the generation of the flood because it provided initial rain which saturated the catchment basin and it also forced the trough south-east to Brisbane. Here the trough persisted for several days resulting in several periods of intense rainfall. In addition, a larger stationary anti-cyclone over the Tasman Sea was influential in effectively stopping the normal eastward progression of the weather system across southern Australia which according to the Director of Meteorology Report (1974) would have resulted in weather clearing.

Total rainfall in the Brisbane metropolitan area for the five day period (24-29 January) was 500-900 mm (20-35 inches) and exceeded 300 mm over all but the extreme western parts of the Brisbane River catchment area. The flood commenced with heavy rain over the Stanley River catchment late on Thursday, 24th. By 3 p.m. on Friday, 25th, rain had saturated all the Bremer catchment and by 9 p.m. that night, significant run-off had commenced in both the upper Brisbane River and Lockyer Creek. By 9 a.m. Saturday, 26th, there was major flooding in these three. On the 25th and 26th January, the river flood was still

---

[1] During January 1974, 872 mm were registered on 26 rain days - the highest on record not only for January, but for any month except that of the last great flood (February, 1893) when 1026 mm fell on 25 rain days, and only the second occasion on which a 24-hour total in January at the Bureau of Meteorology has exceeded the average monthly rainfall. (Director of Meteorology, 1974, p.26)

being generated in the Brisbane valley, but in the metropolitan area, the three periods of intense rainfall referred to earlier resulted in three separate floods in the metropolitan creeks. Many people returned to their homes and began cleaning up only to be flooded again shortly after. Oxley Creek, because of the large flat nature of its catchment was an exception in that it experienced a single flood which reached record levels. Rainfall over creek catchments on the south side of the Brisbane River east from Oxley Creek was not as heavy as to the north. Consequently, flooding in these creeks (notably Norman and Bulimba Creeks) did not reach record levels.

Due to the heavy rain which fell over most of the Brisbane valley, principally during the period between 3 p.m. Saturday and 3 p.m. Sunday, the river rose steadily during the 27th and 28th attaining a peak of 6.6 metres at the Port Office on the high tide at 2.15 a.m. on Tuesday, 29th January. After this, the floods slowly receded, but the Port Office reading did not fall below 3.0 metres until Thursday, 31st January.

The degree of inundation and the severity of damage varied greatly. Most suburbs had not experienced previous flooding since they were settled, the main exceptions being those areas near major creeks, for example; Wilston, Windsor, parts of Chelmer, Graceville and Oxley, and areas bordering Kedron Brook. Chelmer, Fairfield, Toowong and Windsor were the only suburbs to show significant damage from mud while the Brisbane Corso in Yeronga was one of the areas which suffered the worst from turbulence resulting in brick walls being demolished and whole houses shifted.

3.5 The Problem in Perspective

The January 1974 flood forcibly brought home to many people the awareness that they were living on a flood plain. Though many areas of Brisbane, particularly along the metropolitan creeks are well known locally for their susceptibility to periodic flooding, the extent of the 1974 flood far exceeded that of any other flood occurrence in this century. Not since 1893 had a flood of comparable magnitude affected Brisbane (see Fig. 2). The 1974 disaster once again focused public attention on the problem of flooding and generated policies and commitments among government agencies.

Since 1970, a number of reports relating to flood mitigation have been prepared for the Queensland Co-ordinator General's Department. The report by Shepherd (1971) was concerned with riverine flood mitigation particularly as this would be effected by a dam on the middle reach of the Brisbane River. Subsequently, the proposal for a dam at Wivenhoe (see Fig. 1) was accepted. At the time interviewing was carried out, this project was still in the planning stage.

Other reports have been focused on mitigation in three major metropolitan creek systems: Oxley Creek (Bornhorst and Ward, 1973), Breakfast and Enoggera Creeks (Cameron, McNamara and Partners, 1973) and Kedron Brook (Munro, Johnson and Associates, 1973). In the main, their recommendations are confined to technical measures including channel work, retention basins, dredging, levees and the expansion of the capacity of Enoggera Reservoir. Cameron, McNamara and Partners (1973) also suggest that a simple flood plain information brochure be prepared and made available to the public. All three recommend the instigation of some form of zoning regulations to limit or prohibit building in areas subject to flooding.

Some clarification of jurisdiction over watercourses was achieved in March, 1974 by the passing of the City of Brisbane (Flood Mitigation Works Approval) Act 1952-74. This Act gives the Brisbane City Council authority to carry out mitigation work on the river as well as the creeks (including tidal and non-tidal sections).

It is anticipated that mitigation work proposed in the three reports on creek flooding will be carried out by the Brisbane City Council which would also contribute 20 percent of the cost, with the remaining 80 percent being split equally between the Federal and State Governments. While many of the recommendations have been accepted in principle, government approval for their implementation was still pending at the end of 1974.

C H A P T E R 4

METHODS AND TECHNIQUES

4.1 Delimitation of Study Area

The boundary of the study area (Fig. 3) was set firstly by the Brisbane metropolitan boundary, and secondly by the January 1974 flood limit (as defined below). All properties that fell totally or partially within these limits formed part of the study area irrespective of the degree of inundation. Within this study area, sampling was confined to residential premises, including split residences but excluding multiple dwellings such as flats and home units. Premises were also excluded from selection where residential use was combined with another major function, for example retailing or professional services. These guidelines were set down in keeping with the stated objectives of the study - to analyse the response of residential flood-plain occupants to flooding.

4.2 Pre-Interview Preparations

Before interviewing could commence, the aerial extent of the January flood had to be plotted to allow field investigations and recording of the sampled population. At the time this was undertaken, the only source of reference as to the area inundated was a flood map of Brisbane and suburbs.[1] To enable easier distinction between properties that were flooded and those that were not, the boundary of the 1974 flood was transcribed from this map (scale - 1:15840) onto four chain maps (1:3168). Where areas were not shown on the flood map, for example Kedron Brook, the upper reaches of Oxley Creek and the section of the Brisbane River above the Centenary Bridge, the flood line was copied from Brisbane City Council four chain survey maps of the 1974 flood and, in the case

---

[1] This map was compiled under the direction of the Queensland Surveyor General from data obtained from field inspection by the Survey Office field staff and supplemented from aerial photographs flown on the 29th and 30th January, 1974 plus information made available from the Brisbane City Council.

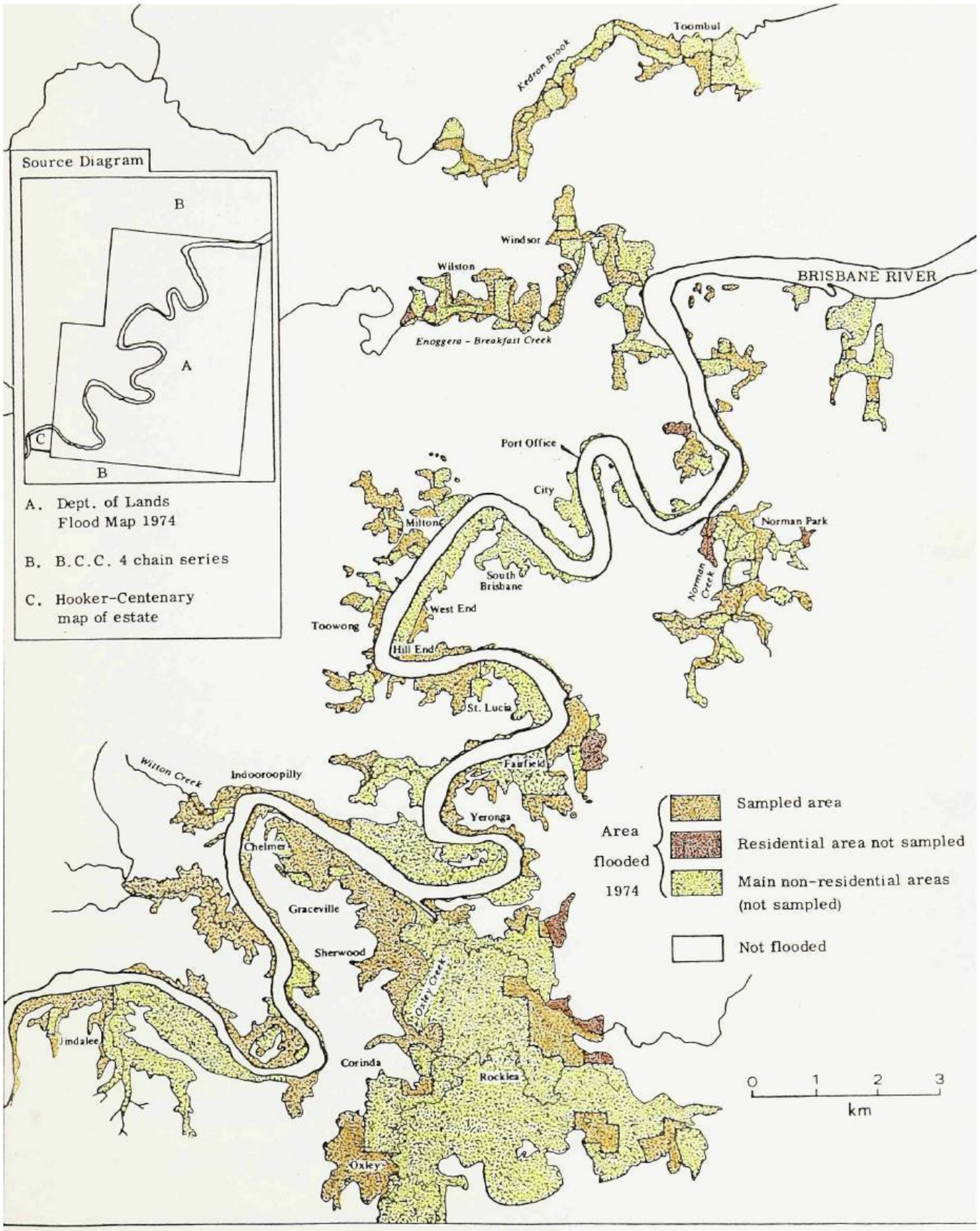

Figure 3: Delimitation of Study Area

of the suburb of Jindalee from a map provided by the developer, Hooker Centenary Pty Ltd. Comparison was also made between this flood map and the air photo mosaic to check for any inconsistencies that may have resulted. The field map thus formed was found to be a reasonably accurate representation of the area flooded in January and only minor alterations had to be made in the field, based on information given by residents.

Fourteen second and third year geography students from the 1974 Resource Management course at the University of Queensland undertook to assist in the field work of administering the questionnaire. To ensure the necessary uniformity in questionnaire administration and sampling required for a meaningful and statistically reliable set of responses, they were instructed at considerable length on the research objectives, interview techniques, comprehension and interpretation of the questionnaire and the strict sampling procedure to be followed.

4.3 Sampling Procedure

The exact size of the population to be sampled was unknown. Estimates of the total number of properties affected by the flood varied from 12,700 (Director of Meteorology, 1974) to 13,700 (Chapman et al., 1974). In the area delimited for study, approximately 5030 applications[1] for flood relief were received by the Brisbane Lord Mayor's Fund. However not all who had flood water on their property would have applied for relief. A further estimate of 8000 flood-affected properties was derived from an examination of the four chain maps and air photo of the study area. Taking this as the best indication and given the time and resources

---

[1] Information provided in personal communication with the Public Relations Section, Brisbane City Council, January, 1976.

available for interviewing, a 10 percent sample size was selected.[1]

To draw the sample, a systematic location sampling procedure was chosen both because of its ease in application and in order to gain an even spread over the population. The procedure was to choose the first household unit at random and thereafter sample every tenth unit along the street. Where possible, a route at right angles to the flood source was followed to ensure a more representative sample in terms of degree of flooding. Only the household head or spouse was interviewed. At least three recalls were made at varying hours and days of the week before a replacement was used. Where this was necessary, the first house in the next group of ten was chosen and thereafter the predetermined sample was resumed. In all, 42 replacements were required, seven to replace houses found empty, 12 where householders refused to be interviewed and 23 where repeated calls failed to contact the occupants. By this method 647 interviews were obtained, 282 being completed by the author and 365 by the fourteen students. On average, each interview took 45 minutes, but time taken ranged from 30 minutes to 2½ hours.

Interviewing took 12 weeks in all. Work commenced on the 30th August, 1974 and was completed by the 15th November, 1974, except for

---

[1] This gives a sample more than twice that recommended by Krejcie and Morgan (1970) using the formula

$$s = X^2NP(1 - P) \div d^2(N - 1) + X^2P(1 - P)$$

s = required sample size

X^2 = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841)

N = population size

P = the population proportion (assumed to be .50 since this would provide the maximum sample size)

d = the degree of accuracy expressed as a proportion (.05)

33 interviews administered in the second week of December. At the termination of field work a number of small areas containing approximately 300-400 houses in all remained to be sampled. These areas are randomly distributed in the study area as a whole and were not the result of any conscious intention (see Fig. 3). While completion of the sample would have been desirable, interviewing over the Christmas-New Year period was impracticable and it was felt that interviewing in January may have introduced an undefinable bias. This was felt partly because the anniversary of the 1974 flood was so near and partly because newspaper reports on flooding and flood mitigation became more numerous at this time.

4.4 The Questionnaire

The method most widely and successfully used in disaster field studies has been the personal interview. Its superiority to mailed questionnaires, or those left with the respondent for completion, in terms of return rate, quality and quantity of information obtained has been attested to by a number of writers (Killian, 1956; Kates, 1962; Ericksen, 1967). In this study, personal interview based on a standard questionnaire (Appendix 1) formed the basic tool for gathering data.

With a view to comparability, wherever possible, questions were constructed with content similar to those used in previously applied interview schedules (for example, those of Roder, 1961; Kates, 1962 and Ericksen, 1967). Before sampling proper began, a short pilot study was carried out to judge the suitability of the questions used. This pilot study consisted of the administration of ten interviews at random and a further 28 interviews conducted in the suburb of Jindalee under field conditions. Small changes were made after the first ten interviews,

mainly in clarifying wording and instructions for the correct administration of the questions. Since no changes were made after the remaining 28 interviews, the latter were subsequently included in the sample.

4.4.1 Question content

The questionnaire was designed to provide information in five general areas:

Section 1: Respondent's flood history - questions here were aimed at assessing the degree of flooding suffered in the January 1974 flood (in terms of depth and duration of flooding and losses suffered), respondent's previous experience of flooding both onsite and elsewhere, previous residence location and reasons for the move, length of residence in present location.

Section 2: Perception and evaluation of the flood hazard - questions in this section sought to probe attitudes to and evaluation of flood hazard. Questions ranged in form from basically information-seeking questions on respondent's knowledge of previous flooding in the vicinity, to opinion-seeking questions to assess the respondent's perception of frequency, seriousness of flood hazard, expectation of future flooding, preparedness for a flood etc.

Section 3: Perception and evaluation of adjustments - two categories of adjustments were examined in this section. Firstly information was sought on respondent's knowledge of public adjustments and evaluation of their relative effectiveness. Respondent's perception of the role of government and other bodies in flood mitigation, was also sought. Secondly, a series of questions pertaining to the perception and evaluation of private adjustments (both short- and long-term) were posed.

Section 4: Adoption of adjustments - here respondents were asked to rank both public and private adjustments in terms of prospective adoption on a five point scale (see Section 4.4.2). Facts on the type of adjustments, made at the time of the January flood and since, were also elicited.

Section 5: Socio-economic, demographic and dwelling characteristics - questions here sought information on age, sex, marital status, occupation and level of schooling of each member of the household as well as on family income, home-ownership and dwelling characteristics; for example, age, structure design (that is, elevated or not) and building material.

4.4.2 Question type

Basically, two types of questions were used:

(a) fixed-alternative or constrained response questions; and (b) open-ended questions.

In the former, use was made of scaled items. A five-point Likert-type scale (for example, Q.12, 13, 29) and a shorter three-point scale (Q.24 and 25) were the main forms used. Where possible, questions were pre-coded in a fixed-answer form to enable greater ease and speed in interviewing and facilitate statistical analysis.

Some questions were purposely left open-ended to allow respondents to freely express their opinions and attitudes without the restrictions imposed by alternative choices not necessarily representative of their viewpoint. Often these questions were very simple in construction, for example: "other, please specify" or "Why do you think this?", but produced a broad array of answers requiring tabulation and careful coding to facilitate meaningful interpretation.

4.4.3 Scaling techniques

Since attitude scales play an important role in this research, a further word is needed here on their use and applicability. The objective in using a scale was to measure differences in degree of response which would be comparable for any single item in the scale and for individual respondents with respect to all other respondents in the same sample population.

A modified Likert scale was used in several instances to gauge respondents' attitudes, perceptions and evaluations. It was chosen for its ease of construction and because it has the advantage of providing more precise information than smaller scales while retaining the quality of statistical manageability. A limitation however, was the ordinal nature of the data derived which imposed restrictions on the statistical techniques appropriate to its handling.

Reliability of Likert scales also tends to be good and, partly because of the greater range of answers permitted to respondents, is often higher than that of corresponding Thurstone scales (Oppenheim, 1966). This was found to be of particular importance in questions gauging effectiveness and adoption trends for public and private adjustments (Q. 35, 37 and 42). Here the scales were weighted to give three positive rankings ("definitely effective", "probably effective", "possibly effective"), and one negative as follows:

definitely effective	1
probably effective	2
possibly effective	3
uncertain	4
reject this action	5

instead of the customary even distribution. In these scales, the sixth alternative. "unaware of action", did not form part of the scale but was used separately.

In other applications of the Likert scale, the even distribution of positive and negative responses was maintained, excepting a value of 3 was interpreted as 'fair' or 'average', whereas on the original Likert scale it denotes 'undecided'.[1] This overcomes a major drawback of the original scale in not having a neutral point to serve as a guideline of where middle range scores alter from mildly positive to mildly negative (Moser and Kalton, 1971; Upshaw, 1968).

4.5 Data Analysis

4.5.1 Data organization

An essential and time consuming prerequisite for statistical analysis was the organization of the data that had been gathered. As mentioned earlier, many of the responses had been purposely precoded on the questionnaire in anticipation of later analysis by computer. Precategorization in fixed-alternative type questions meant a considerable amount of time saving when data had to be transcribed onto punch cards in preparation for computer processing. Although, in cases where an 'other, please specify' category was included, a wide variety of additional responses often had to be added to the pre-determined coding system. Responses given in an absolute numeric form (for example, depth of flood water in the house, length of residence, number of floods experienced, etc.) were directly transcribed for processing.

In the case of open-ended questions, responses first had to be categorized, and then coded before processing could commence. This was done by means of listing all possible alternatives given by respondents, along with the frequency of each, and sorting them into classes. These classes were then numbered as part of a single variable, for example,

---

[1] In the present study an 'undecided' response was noted separately.

responses to the second part of Q.16 and Q.18, or alternatively, as happened in Q.40, 42 and 44, each class became a single variable and was recorded as being 'mentioned' or 'not mentioned'.

In this way, 278 variables were entered on six data cards for each case or interview.

4.5.2 Statistical techniques

In a number of cases, the nature of the variables made the use of correlation procedures impossible. In these instances the most effective way of determining if any relation existed was to use cross-tabulation. Basically, this method gives a joint frequency distribution of cases according to two or more classificatory variables. By examining the percentage frequencies in each cell, the relationship between the variables can be established and its significance tested using the chi-squared test. This method was used to test the significance of variations in response patterns between different groupings of the population, and to test the significance of relationships between two variables. The accepted level of significance is 0.05 and in all cases, the chi-squared values and probability levels are shown below the relevant tables.

The majority of statistical analysis was carried out by computer using package programmes set out in *Statistical Package for the Social Sciences* (Nie, Bent and Hull, 1970). This manual was designed to provide the social scientist with a comprehensive unified package enabling him to perform a variety of data analysis procedures simply and conveniently. The initial preparation that is required is justified by the fact that a number of statistical procedures can be carried out simultaneously for each set of data. Another feature of this package which proved most useful, is the array of data modification procedures available in it.

C H A P T E R 5

ELEMENTS IN THE PERCEPTION AND EVALUATION OF FLOOD HAZARD

5.1 Hazard Evaluation

In Chapter 2 it was hypothesized that variations in a flood plain occupant's perception and evaluation of flood hazard are associated with perceived frequency and magnitude of the natural event, recency and amount of personal experience, knowledge of previous flooding and expectation of future flooding.

The measure used for hazard evaluation was derived in response to Question 29 where respondents were asked to rank flooding as a hazard to them on a five point scale. The categories in the scale and response frequency in each are set out in Table 5.1.

TABLE 5.1: Ranking of Hazard Evaluation*

	Respondents	
Evaluation Rank	No.	%
1. Not at all	51	7.9
2. Minor	208	32.2
3. Average	82	12.7
4. Moderate	86	13.3
5. Serious	216	33.4
Not stated	4	0.6
TOTAL	647	100.0

* Q.29. On a five point scale, how would you rank flooding as a hazard to you?

5.2 Characteristics of the Natural Event

5.2.1 Perceived frequency

As already mentioned (Section 2.3.1), a number of researchers,

among them Roder (1961), Burton (1962) and Kates (1962), have found perceived frequency to be a common component in overall flood hazard evaluation. In each case it was found that respondents were reluctant to make an estimate of how often their property would be affected by flooding. The same was found to be true in the present study when Question 4 was posed to ascertain Brisbane flood plain occupants' appreciation of flood frequency as it directly related to them. As can be seen in Table 5.2, all but three of the respondents gave an answer. However only 367 (56.7%) gave a definite frequency estimate, bearing out the observation that individuals are not as able or willing to make complex probability computations as some decision-making analysts assume (Slovic, Kunreuther and White, 1974). It should be noted therefore that

TABLE 5.2: Expected Frequency Response*

	Respondents	
Frequency	No.	%
Estimate in years	367	56.7
Never/rarely expect a flood	57	8.9
Expect flood perhaps any time	49	7.6
Uncertain	171	26.4
Not stated	3	0.5
TOTAL	647	100.0

*Q.14. How often do you expect the people in this dwelling will be directly affected by a flood?

the usefulness of the data in this section may be limited firstly because of respondents' reluctance to make estimates and secondly by some respondents' apparent neglect of temporal trends in making their estimate.

Though a comparison may have proved interesting, it was not intended to compare respondents' and official estimates.[1] Rather it was intended to examine how a respondent's own estimate affected his evaluation of other variables.

Where a definite frequency estimate was made, four intervals stand out in terms of frequency of mention (see Table 5.3). These are expectations of one flood in one year or less, one in 50 years, one in 80 years and one in 100 years. In the first instance, the majority of respondents appeared to base their answers on personal experience,[2] while the estimate of a one in 80 year interval closely corresponds with the occurrence of the 1893 flood which a number of respondents explicitly mentioned when making their estimate. However, only 49 respondents (7.6%) appeared to have a correct understanding of the interpretation of predicted flood frequencies expressing the view that flooding could occur at any time.[3]

---

[1] In such an event, the gauging of the 'correctness' of respondents' estimates would be an extremely difficult task. Analysis would be complicated by the fact that flood frequency varies greatly within the study area and official estimates that have been made are open to question because of the relatively short history of recorded events on which they are based (Fig. 3.2).

[2] Eighty percent of these respondents knew of or had experienced previous flooding onsite. For the latter, the mean time since the last flood experience was 1.6 years, two-thirds having experienced a flood onsite one year or less before the January flood. The mean number of onsite floods experienced by this group was 10.65.

[3] The reciprocal of the recurrence interval defines the probability of the event occurring in any one year. If the predicted flood recurrence interval is 100 years for a flood of a given magnitude, the quantitative probability of that flood occurring in any one year is 1/100 or 0.01, and the probability of it not occurring is 0.99. The probability of a 100-year flood not occurring in any given number of years (N years) is 0.99^N; thus the probability of at least one 100-year flood occurring in N-year is $1-0.99^N$. For N equal to 10 years, this means that the chance of a 100-year flood occurring at least once during the next 10 years is $1-0.99^{10}$, or 0.096 (after Schaake, 1972).

TABLE 5.3: Expected Flood Frequency Estimates*

Frequency Estimate	Respondents No.	%	
Expect a flood perhaps any time	49	7.57	
1 in < 1 year	15	2.32	7.73+
1 year	35	5.41	
2 years	19	2.94	
3 years	3	.46	
5 years	21	3.25	
6 years	1	.15	
7 years	4	.62	
10 years	18	2.78	
20 years	19	2.94	
22 years	1	.15	
25 years	2	.31	
30 years	7	1.08	
40 years	13	2.01	
50 years	78	12.06+	
55 years	1	.15	
70 years	6	.93	
75 years	1	.15	
80 years	26	4.02+	
83 years	1	.15	
100 years	85	13.14+	
200 years	11	1.70	
Never/rarely expect a flood	57	8.81	
Uncertain	171	26.43	
Not stated	3	.46	
TOTAL:	647	100.00	

*Q.14. How often do you expect the people in this dwelling will be directly affected by a flood?

+ Four most frequently mentioned flood frequency estimates.

In looking at perceived flood frequency, a number of classes were used for analysis in preference to raw data because of the nature and range of responses (Table 5.3). The first class consists of those giving a definite flood frequency estimate, the second those who expressed uncertainty as to flood frequency (including those who expressed the view that a flood could occur at any time) and the third category of those who never or rarely expect another flood.

Following from Kates' observations (1962), it was anticipated that an inverse relationship would exist between certainty as expressed in the respondent's flood frequency response and his flood hazard evaluation such that greater certainty would be correlated with a lower hazard evaluation and vice versa. When hazard evaluation was cross-tabulated with perceived flood frequency using the classes described above a significant relationship was found to exist (Table 5.4) in which

TABLE 5.4: Hazard Evaluation* x Perceived Flood Frequency+

Perceived frequency	Hazard Evaluation (Ranking)					
	Not at all 1	Minor 2	Average 3	Moderate 4	Serious 5	ROW TOTAL
Estimate in years	25 (6.8)a [49.0]b	111 (30.3) [53.6]	50 (13.7) [61.0]	59 (16.1) [70.2]	121 (33.1) [56.0]	366 57.2
Uncertain/perhaps any time	11 (5.1) [21.6]	73 (33.6) [35.3]	27 (12.4) [32.9]	22 (10.1) [26.2]	84 (38.7) [38.9]	217 33.9
Never/rarely expect another flood	15 (26.3) [29.4]	23 (40.4) [11.1]	5 (8.8) [6.1]	3 (5.3) [3.6]	11 (19.3) [5.1]	57 8.9
COLUMN TOTAL	51 8.0	207 32.3	82 12.8	84 13.1	216 33.8	640 100.0

χ^2 = 41.44 df 8 p < 0.001 n = 640

a. Percentage of row total
b. Percentage of column total

*Q.29. On a five point scale, how would you rank flooding as a hazard to you?

+Q.14. How often do you expect the people in this dwelling will be directly affected by a flood?

those expressing negative certainty (that is, the 'never/rarely expect another flood' response group) exhibited the lowest hazard evaluation. A closer inspection of the data revealed a significant difference between this group and the other two (Tables 5.5A and B) in hazard evaluation, bearing out Kates' observations (1962). No significant difference was found in the response pattern of those in the 'estimate' or 'uncertain' classes.

It was also anticipated that the longer the perceived frequency interval between floods, the less likely was the respondent's hazard evaluation to be high and vice versa. To test this, only absolute estimates (that is one flood expected in x years) and the 'never/rarely' class data were used. Employing natural break points in the data (obtained by visual inspection of Table 5.3) and ensuring sufficient class size required for valid statistical treatment, the range of frequency estimates was divided into three classes with the 'never/rarely' group forming a fourth class as the upper extreme in frequency estimation.[1] The results of this analysis are set out in Table 5.6 and show that hazard evaluation does, as expected, vary directly with increased frequency expectation.

5.2.2 Magnitude

Magnitude here is taken to be the degree of flooding experienced onsite in the 1974 flood. To simplify analysis, three broad magnitude classes were used. The first class included those respondents who experienced flooding only in the yard. Class two consists of those who experienced some degree of flooding in the house itself, but excludes those whose dwelling was totally submerged. The latter constitute the

---

[1] 'Never' and 'rarely' responses were classified together as in both cases, on probing from the interviewer, respondents were unable to estimate any time interval. All either put flooding beyond any time limit or entirely out of the realm of possibility.

TABLE 5.5: Hazard Evaluation* x Perceived Flood Frequency+

A. Comparing 'estimate' and 'never/rarely' categories.

Perceived frequency	Hazard Evaluation (Ranking) Not at all 1	Minor 2	Average 3	Moderate 4	Serious 5	ROW TOTAL
Estimate in years	25 (6.8) [62.5]	111 (30.3) [82.8]	50 (13.7) [90.9]	59 (16.1) [95.2]	121 (33.1) [91.7]	366 86.5
Never/rarely expect another flood	15 (26.3) [37.5]	23 (40.4) [17.2]	5 (8.8) [9.1]	3 (5.3) [4.8]	11 (19.3) [8.3]	57 13.5
COLUMN TOTAL	40 9.5	134 31.7	55 13.0	62 14.7	132 31.2	423 100.0

$\chi^2_{df\ 4} = 29.23$ $p < 0.001$ $n = 423$

B. Comparing 'uncertain' and 'never/rarely' categories.

Perceived frequency	Hazard Evaluation (Ranking) Not at all 1	Minor 2	Average 3	Moderate 4	Serious 5	ROW TOTAL
Uncertain/ perhaps any time	11 (5.1) [42.3]	73 (33.6) [76.0]	27 (12.4) [84.4]	22 (10.1) [88.0]	84 (38.7) [88.4]	217 79.2
Never/rarely expect another flood	15 (26.3) [57.7]	23 (40.4) [24.0]	5 (8.8) [15.6]	3 (5.3) [12.0]	11 (19.3) [11.6]	57 20.8
COLUMN TOTAL	26 9.5	96 35.0	32 11.7	25 9.1	95 34.7	274 100.0

$\chi^2_{df\ 4} = 28.66$ $p < 0.001$ $n = 274$

* Q.29. (as for Table 5.4)

\+ Q.14. (as for Table 5.4)

TABLE 5.6: Hazard Evaluation* x Perceived Flood Frequency+ Estimate

Frequency Estimate	Hazard Evaluation (Ranking)					
	Not at all 1	Minor 2	Average 3	Moderate 4	Serious 5	ROW TOTAL
1 - 19 years	4 (3.5) [10.0]	21 (18.3) [15.7]	14 (12.2) [25.5]	25 (21.7) [40.3]	51 (44.3) [38.6]	115 27.2
20 - 69 years	8 (6.6) [20.0]	39 (32.2) [29.1]	17 (14.0) [30.9]	20 (16.5) [32.3]	37 (30.6) [28.0]	121 28.6
70 - 200 years	13 (10.0) [32.5]	51 (39.2) [38.1]	19 (14.6) [34.5]	14 (10.8) [22.6]	33 (25.4) [25.0]	130 30.7
Never/rarely expect another flood	15 (26.3) [37.5]	23 (40.4) [17.2]	5 (8.8) [9.1]	3 (5.3) [4.8]	11 (19.3) [8.3]	57 13.5
COLUMN TOTAL	40 9.5	134 31.7	55 13.0	62 14.7	132 31.2	423 100.0

$\chi^2_{df\ 12} = 53.38$ $p < 0.001$ $n = 423$

* Q.29. (as for Table 5.4)

\+ Q.14. (as for Table 5.4)

third class. In the case of double storey dwellings, a distinction was made between those where the main living area was affected to a minor or major degree and those where it was not at all affected. The latter were included in the 'yard only' class and the others in class two.

The crosstabulation results shown in Table 5.7 support Hypothesis 1.1 (Section 2.4.2): that variation in hazard evaluation is associated with magnitude of flooding.

TABLE 5.7: Hazard Evaluation* x Degree of Flooding+

Degree of Flooding	Hazard Evaluation (Ranking)					
	Not at all 1	Minor 2	Average 3	Moderate 4	Serious 5	ROW TOTAL
Yard only affected	19 (7.9) [37.3]	103 (42.7) [51.0]	39 (16.2) [48.1]	29 (12.0) [33.7]	51 (21.2) [23.6]	241 37.9
Dwelling partly submerged	22 (8.1) [43.1]	70 (25.8) [34.7]	31 (11.4) [38.3]	43 (15.9) [50.0]	105 (38.7) [48.6]	271 42.6
Dwelling fully submerged	10 (8.1) [19.6]	29 (23.4) [14.4]	11 (8.9) [13.6]	14 (11.3) [16.3]	60 (48.4) [27.8]	124 19.5
COLUMN TOTAL	51 8.0	202 31.8	81 12.7	86 13.5	216 34.0	636 100.0

$\chi^2_{df\ 8} = 41.96$ $p < 0.001$ $n = 636$

* Q.29. On a five point scale, how would you rank flooding as a hazard to you?

\+ Q.1. To what depth did the January flood water enter your home?

From this table it can be seen that respondents' evaluation of the seriousness of flood hazard varies directly with the magnitude of flooding experienced, an increase in magnitude corresponding with an increase in the hazard ranking. However, the variation is much more distinct between those flooded only in the yard and those whose dwelling was partly or fully submerged (Table 5.8), there being no significant difference between the latter in their hazard evaluation (Table 5.9).

5.3 Effect of Experience

As previously stated, experience is taken to be that element of information which presumes practical knowledge of a flood event. In the present sample, the number of floods experienced ranged from zero

TABLE 5.8: Hazard Evaluation* x Degree of Flooding+ -- comparing 'yard only' and 'part-' or 'fully-submerged' categories

Degree of Flooding	Hazard Evaluation (Ranking) Not at all 1	Minor 2	Average 3	Moderate 4	Serious 5	ROW TOTAL
Yard only affected	19 (7.9) [37.3]	103 (42.7) [51.0]	39 (16.2) [48.1]	29 (12.0) [33.7]	51 (21.2) [23.6]	241 37.9
Dwelling partly/fully submerged	32 (8.1) [62.7]	99 (25.1) [49.0]	42 (10.6) [51.9]	57 (14.4) [66.3]	165 (41.8) [76.4]	395 62.1
COLUMN TOTAL	51 8.0	202 31.8	81 12.7	86 13.5	216 34.0	636 100.0

$\chi^2_{df\ 4} = 37.71$ $p < 0.001$ $n = 636$

* Q.29. (as for Table 5.7)

\+ Q.1. (as for Table 5.7)

TABLE 5.9: Hazard Evaluation* x Degree of Flooding+ -- comparing 'partly' and 'fully' submerged categories

Degree of Flooding	Hazard Evaluation (Ranking) Not at all 1	Minor 2	Average 3	Moderate 4	Serious 5	ROW TOTAL
Dwelling partly submerged	22 (8.1) [68.8]	70 (25.8) [70.7]	31 (11.4) [73.8]	43 (15.9) [75.4]	105 (38.7) [63.6]	271 68.6
Dwelling fully submerged	10 (8.1) [21.2]	29 (23.4) [29.3]	11 (8.9) [26.2]	14 (11.3) [24.6]	60 (48.4) [36.4]	124 31.4
COLUMN TOTAL	32 8.1	99 25.1	42 10.6	57 14.4	165 41.8	395 100.0

$\chi^2_{df\ 4} = 3.86$ p not significant $n = 395$

* Q.29. (as for Table 5.7) + Q.1. (as for Table 5.7)

to fifty. The majority of respondents, however, had no experience of flooding prior to the January 1974 flood. Looking at Table 5.10, it can be seen that for 65% of respondents, the January flood was their first ever, while for 79% it was the first flood they had experienced in their present dwelling.[1] In comparing their previous flood experience to the January flood, 188 (86%) of those who had experienced flooding previously described the other occasions as "not as bad", 19 (9%) could remember experiencing a worse flood, while the remaining 10 (5%) described their previous experience as the same.

TABLE 5.10: Previous Flood Experience

No. of Floods Experienced	Respondents					
	Experience onsite+		Experience elsewhere¢		Total Experience*	
	No.	%	No.	%	No.	%
0	510	78.8	559	86.4	422	65.2
1	39	6.0	26	4.0	65	10.0
2	25	3.9	20	3.1	45	7.0
3	25	3.9	16	2.5	41	6.3
4 or more	48	7.4	26	4.0	74	11.5
TOTAL	647	100.0	647	100.0	647	100.0

* Q.6. How many floods had you experienced before the January flood 1974?

\+ Q.7. How many of these affected your present dwelling?

¢ Calculated from responses to Q.6 and Q.7.

---

[1] It should be noted that a significant relationship exists between onsite experience and source of flooding. As would be expected from a knowledge of flooding in Brisbane (Section 3.3), nearly three-quarters of those who had previously experienced flooding onsite were subject to flooding from a creek. The experience of these respondents was also more recent than for those flooded from the river.

5.3.1 Recency of experience

For the population under analysis, experience of the January 1974 flood was universal. Recency of flood experience is therefore based on the last flood experience prior to the January flood, whether onsite or elsewhere. Those with no experience prior to January are excluded from the analysis.

For those who had experienced flooding previously, the mean time prior to January, 1974 since the last flood experience was 9.63 years and ranged from a minimum of one month to a maximum of 60 years.[1] (For full range, see Appendix 2). Again because of the wide range it was necessary to form categories. Three intervals were chosen as the most appropriate: one to twelve months, thirteen months to five years, and more than five years.

A relationship, significant at the 0.027 level was found to exist between recency of flood experience and respondents evaluation of the hazard (Table 5.11). It appears from this table that the more recent a respondent's flood experience the more likely he/she is to evaluate the hazard as more serious. However, in further testing it was revealed that, up to five years, no significant difference existed in hazard evaluation, but that a significant difference was present between those who had experienced flooding in the last five years and those whose last flood experience was more than five years ago (Table 5.12). It would seem then that the effect of experience on hazard evaluation in the present case does not vary directly with time.

---

[1] Respondents were asked to calculate all figures back from the January, 1974 flood; for example, for a flood experienced in late February, 1973, the time since that flood would be given as eleven months.

TABLE 5.11: Hazard Evaluation* x Recency of Experience+

Recency	Hazard Evaluation: Not at all /Minor 1 & 2	Average 3	Moderate 4	Serious 5	ROW TOTAL
1 Year or Less	10 (20.8) [14.3]	6 (12.5) [20.7]	7 (14.6) [19.4]	25 (52.1) [31.3]	48 22.3
13 months - 5 years	22 (28.2) [31.4]	8 (10.3) [27.6]	15 (19.2) [41.7]	33 (42.3) [41.3]	78 36.3
More than 5 years	38 (42.7) [54.3]	15 (16.9) [51.7]	14 (15.7) [38.9]	22 (24.7) [27.5]	89 41.4
COLUMN TOTAL	70 32.6	29 13.5	36 16.7	80 37.2	215 100.0

χ^2 = 14.28 df 6 $p < 0.03$ n = 215

* Q.29. On a five point scale, how would you rank flooding as a hazard to you?

+ Q. 9. How long before the January flood was your last flood experience?

TABLE 5.12: Hazard Evaluation* x Recency of Experience+ -- comparing '5 years or less' to 'more than 5 years ago' experience

Recency	Hazard Evaluation: Not at all 1	Minor 2	Average 3	Moderate 4	Serious 5	ROW TOTAL
≤ 5 years	5 (4.0) [45.5]	27 (21.4) [45.8]	14 (11.1) [48.3]	22 (17.5) [61.1]	58 (46.0) [72.5]	126 58.6
> 5 years	6 (6.7) [54.5]	32 (36.0) [54.2]	15 (16.9) [51.7]	14 (15.7) [38.9]	22 (24.7) [27.5]	89 41.4
COLUMN TOTAL	11 5.1	59 27.4	29 13.5	36 16.7	80 37.2	215 100.0

χ^2 = 12.53 df 4 $p < 0.02$ n = 215

* Q.29. (as for Table 5.11) + Q.9. (as for Table 5.11)

5.3.2 Amount of experience

Because of the limited number of respondents who had experienced previous flooding (Table 5.10), a simple dichotomous division was made between respondents with experience onsite and those without. Using this form, a significant relationship was found between hazard evaluation and onsite experience. Table 5.13 shows this relationship in which those with experience can be seen to be more sensitive to the flood hazard and evaluate it as more serious than those with no experience.

TABLE 5.13: Hazard Evaluation* x Experience Onsite+

Experience Onsite	Hazard Evaluation (Ranking)					
	Not at all 1	Minor 2	Average 3	Moderate 4	Serious 5	ROW TOTAL
None	47 (9.3) [92.2]	176 (34.7) [84.6]	65 (12.8) [79.3]	64 (12.6) [74.4]	155 (30.6) [71.8]	507 78.8
1 or more	4 (2.9) [7.8]	32 (23.5) [15.4]	17 (12.5) [20.7]	22 (16.2) [25.6]	61 (44.9) [28.2]	136 21.2
COLUMN TOTAL	51 7.9	208 32.3	82 12.8	86 13.4	216 33.6	643 100.0

$\chi^2_{df\ 4} = 17.09$ $p < 0.002$ $n = 643$

*Q.29. On a five point scale, how would you rank flooding as a hazard to you?

+Q. 7. How many of these (i.e. floods) affected your present dwelling?

5.4 Information

5.4.1 Range of information

Apart from personal experience, news reports from the metropolitan newspapers, radio and television are the predominant agents in the dissemination of information on flooding (96.3% of all respondents recorded

seeing some form of news report, while 85.3% gave it as their sole source, Table 5.14). Prior to the January 1974 flood these items consisted mainly of reporting the occurrence of flood events. In the aftermath of the flood, more attention has been focused on the publication of plans and procedures for actions to be taken by public authorities and floodplain occupants in time of flooding.

Other sources of information include suburban newspapers, the flood map (1974) and a number of symposia - three of which were run by the University of Queensland for the public and one held by the Australian Institute of Engineers (Queensland Division) (1974). Both the Department of Lands' flood map (1974) and symposia received coverage in the major newspapers, the former being reproduced in both the *Sunday Sun* and *The Sunday Mail* (24th February, 1974). However very few of those interviewed said they had personally seen any official reports or been to a symposium.

TABLE 5.14: Information Source*

Respondents	Source					
	News reports only	Official Reports	Other	All Types	None	Total
Number	551	43	31	7	15	647
%	85.3	6.6	4.8	1.1	2.3	100.0

*Q.33. What reports have you seen on flooding?

Further to these, two respondents cited the January report of the Director of Meteorology (1974) and five cited flood mitigation committee reports as information sources. All of the latter were references by Jindalee residents to a report by Swannell and Isaacs (1974).

On testing, no significant relationship[1] was found between hazard evaluation or future flood expectation and information source, that is news reports versus official or other forms. Though this result may show the true situation, it is also possible that the lack of variation in hazard evaluation and expectation by information source reflects the development of a pool of common knowledge, particularly aided by the newspaper coverage of symposia and other material, so that information from these sources may be presumed to have a more universal distribution than the figures in Table 5.14 would suggest.

5.4.2 Knowledge

At the time of the interview, over half of the respondents (52.4%) had no knowledge of previous floods in their neighbourhood (Table 5.15). When asked if they were aware before the January flood of the likelihood of flood waters affecting their property, the negative response increased to 67.1%. A further 101 respondents (15.6%) said though they were aware of the possibility of being flooded their information had been inadequate (Table 5.16). Generally, those who had experienced previous onsite flooding had more knowledge (several being able to relate a history of flooding in their area in detail), while only one third (33.9%) of those who had no personal experience of flooding onsite prior to January knew of previous flooding in their area.

In examining the relationship between knowledge of previous flooding and hazard evaluation, it can be seen from Table 5.17 that those with knowledge rank the hazard significantly higher than those with none.

---

[1] As stated in Section 4.5.3, the accepted level of significance is 0.05.

TABLE 5.15: Knowledge of Previous Flooding in Neighbourhood*

Respondents	No. of Floods Known Of				
	0	1	2	3 or more	Total
Number	339	119	65	124	647
%	52.4	18.4	10.0	19.2	100.0

*Q.8. Including those floods you actually experienced, how many floods do you know of entering this neighbourhood?

TABLE 5.16: Awareness of Flood Likelihood on Property Before January*

Respondents	Awareness					
	Aware of Possibility			Not Aware	Don't Know/Not Stated	Total
	Adequate information	Inadequate information	Uncertain			
Number	84	101	11	434	17	647
%	12.9	15.6	1.7	67.1	2.6	100.0
	30.2%					

*Q.15. Before the January 1974 flood, were you aware of the likelihood of flood waters affecting this property?

TABLE 5.17: Hazard Evaluation* x Knowledge of Flooding+

Knowledge	Hazard Evaluation (Ranking)					
	Not at all 1	Minor 2	Average 3	Moderate 4	Serious 5	ROW TOTAL
None	35 (10.4) [68.6]	116 (34.5) [55.8]	48 (14.3) [58.5]	37 (11.0) [43.0]	100 (29.8) [46.3]	336 52.3
Knowledge of one or more floods	16 (5.2) [31.4]	92 (30.0) [44.2]	34 (11.1) [41.5]	49 (16.0) [57.0]	116 (37.8) [53.7]	307 47.7
COLUMN TOTAL	51 7.9	208 32.3	82 12.8	86 13.4	216 33.6	643 100.0

$\chi^2_{df\ 4} = 13.82$ $p < 0.01$ $n = 643$

* Q.29. On a five point scale, how would you rank flooding as a hazard to you?

+ Q.8. Including those floods you actually experienced, how many floods do you know of entering this neighbourhood?

Employing Kates' concept of a "scale of flood awareness" (1962, p.45), a test of the related effect of the two information components, knowledge and experience was also carried out. The results in Table 5.18 show a relationship (significant beyond 0.003) such that, as an individual's knowledge and experience increase so does his/her evaluation of the seriousness of the flood hazard.

TABLE 5.18: Hazard Evaluation* x Knowledge-Experience Scale+

Information	Hazard Evaluation: Not at all / Minor 1 & 2	Average 3	Moderate 4	Serious 5	ROW TOTAL
No knowledge, no experience	150 (44.9) [57.9]	48 (14.4) [58.5]	37 (11.1) [43.0]	99 (29.6) [45.8]	334 51.9
Knowledge, no experience	73 (42.2) [28.2]	17 (9.8) [20.7]	27 (15.6) [31.4]	56 (32.4) [25.9]	173 26.9
One onsite experience	16 (41.0) [6.2]	5 (12.8) [6.1]	4 (10.3) [4.7]	14 (35.9) [6.5]	39 6.1
2 or more experiences onsite	20 (20.6) [7.7]	12 (12.4) [14.6]	18 (18.6) [20.9]	47 (48.5) [21.8]	97 15.1
COLUMN TOTAL	259 40.3	82 12.8	86 13.4	216 33.6	643 100.0

$\chi^2_{df\ 9} = 25.37$ $p < 0.003$ $n = 643$

*Q.29. (as for Table 5.17)

+Calculated from response to Q.8 (as for Table 5.17) and
Q.7. How many of these (i.e. floods) affected your present dwelling?

5.4.3 Interpretation of flood events

Interpretation is that process whereby information is referred to an individual's underlying perception of the state of nature passing

through a series of psychological and physical filters which transform it into a unique personal evaluation (Kates, 1962). This evaluation has been found by Kates (1962) to be related to both a deterministic (implying some pattern or cycle) and indeterministic perception of the state of nature.

In the present study, a majority of respondents interpreted floods in a deterministic manner, that is as part of a cycle, though 40 percent of this group were uncertain of the trend in time (Table 5.19). Only 17 respondents (2.6%) saw floods as decreasing in frequency.

TABLE 5.19: Interpretation of Flood Occurrence*

Interpretation Class	Respondents		
	No.	%	
(1) Believe floods occur in cycles			
a) decreasing in time	17	2.6	51.6%
b) constant in time	97	15.0	
c) increasing in time	85	13.1	
d) trend uncertain	135	20.9	
(2) Flood result of special set of characteristics, unpredictable	39	6.0	
(3) Personally don't expect another flood on own property	28	4.3	
(4) Flood unique	144	22.3	
(5) Other	4	0.6	
(6) No opinion	98	15.2	
TOTAL	647	100.0	

* Q.19. In general, how would you describe the occurrence of floods?

Nearly one quarter of those sampled believed the 1974 flood to be a unique occurrence. A further twenty-eight respondents indicated that they believed themselves to be excluded from the possibility of experiencing another flood. The three main reasons given for this were age, a feeling of optimism on the respondent's part or a belief that future flooding would be rare or of a smaller magnitude than that experienced in January 1974. Only two of these respondents had experienced previous onsite flooding, the lowest number of any of the interpretation classes (Table 5.20).

The relationship between flood interpretation and hazard evaluation was not significant[1] at the 0.05 level set down as acceptable in this study. However, following Kates' example (1962) and using future flood expectation as a hazard evaluation measure, a significant relationship was found (Table 5.21). It is interesting to note, of the 144 respondents who classified flooding as a unique occurrence, 30 (21%) expected to experience another flood while in their present location and 40 (28%) gave a flood frequency estimate of 55 years or less, suggesting that their interpretation response was based on their perception of the 1974 flood and was related to magnitude of flooding experienced in that flood rather than the occurrence of floods over time. Only 26 (18%) of these respondents expressed the opinion that their dwelling would never be affected by flooding again when asked to make a frequency estimate.

Thirty-nine respondents were unwilling to classify flooding as either cyclic or unique. These respondents described the occurrence

---

1 $\chi^2_{df\ 24} = 34.84$ $p < 0.07$ $n = 541$

TABLE 5.20: Interpretation of Flood Occurrence* x Experience Onsite+

Interpretation class	Experience: None	Experience: 1 or more	ROW TOTAL
(1) Believe floods occur in cycles			
a) decreasing in time	12 (70.6) [2.8]	5 (29.4) [4.2]	17 3.1
b) constant in time	75 (77.3) [17.6]	22 (22.7) [18.6]	97 17.8
c) increasing in time	57 (67.1) [13.3]	28 (32.9) [23.7]	85 15.6
d) trend uncertain	106 (78.5) [24.8]	29 (21.5) [24.6]	135 24.8
(2) Result of set of characteristics	29 (74.4) [6.8]	10 (25.6) [8.5]	39 7.2
(3) Personally excluded	26 (92.9) [6.1]	2 (7.1) [1.7]	28 5.1
(4) Flood unique	122 (84.7) [28.6]	22 (15.3) [18.6]	144 26.4
COLUMN TOTAL	427 78.3	118 21.7	545 100.0

$\chi^2_{df\ 6} = 14.34$ $p < 0.03$ $n = 545$

* Q.19. (as for Table 5.19)

+ Q.7. How many of these (i.e. floods) affected your present dwelling?

TABLE 5.21: Interpretation of Flood Occurrence* x Expectation of Future Flood+

Interpretation class	Expectation: Positive	Negative	Uncertain	ROW TOTAL
(1) Believe floods occur in cycles				
a) decreasing in time	7 (41.2) [4.4]	5 (29.4) [2.3]	5 (29.4) [3.1]	17 3.1
b) constant in time	30 (30.9) [18.8]	45 (46.4) [20.5]	22 (22.7) [13.5]	97 17.9
c) increasing in time	34 (40.0) [21.3]	27 (31.8) [12.3]	24 (28.2) [14.7]	85 15.7
d) trend uncertain	50 (37.0) [31.3]	35 (25.9) [15.9]	50 (37.0) [30.7]	135 24.9
(2) Result of set of characteristics	9 (23.7) [5.6]	14 (36.8) [6.4]	15 (39.5) [9.2]	38 7.0
(3) Flood unique/personally excluded **	30 (17.5) [18.8]	94 (55.0) [42.7]	47 (27.5) [28.8]	171 31.5
COLUMN TOTAL	160 29.5	220 40.5	163 30.0	543 100.0

$\chi^2_{df\ 12} = 39.90$ $p < 0.001$ $n = 543$

* Q.19. (as for Table 5.19)

\+ Q.18. Do you think there will be another flood while you are living here?

** None who felt personally excluded gave a positive future flood expectation.

of floods as the result of a special set of characteristics, for example heavy and prolonged rainfall, high tides etc. occurring simultaneously. This group also showed the greatest uncertainty in both expectation of future flooding and estimating flood frequency (39.5% and 53% respectively giving 'uncertain' as a response).

5.5 Expectation of Future Flooding

Kates (1962) found an individual's expectation of future flooding to be a simple and reliable indication of his or her hazard evaluation. In this study, a simple measure of future expectation was gained in response to Question 18: "Do you think there will be another flood while you are living here?" Of the 647 respondents in the sample, only 180 (27.8%) expected to experience another flood, 213 respondents (32.9%) expressed uncertainty while 254 (39.3%) denied the possibility of experiencing another flood.

5.5.1 Reasons for future flood expectation

Reasons for these expectations were also sought and can be summarized as follows. Reasons most often mentioned for a positive expectation ranged from feelings that it was a possibility, some going so far as to say it was "inevitable", to the more specific effect of previous onsite experience and the lack of mitigation work (Table 5.22). In making forecasts of future flood potential Kates (1962, p.88) observes that individuals "are strongly conditioned by their immediate past and limit their extrapolation to simplified constructs, seeing the future as a mirror of that past." Only one-fifth of respondents citing onsite experience in the present study held a negative expectation. Thus it appears, in this instance, that experience has not come to be the "prison" Kates speaks of (1962, p.32) (see Section 2.3.1). A smaller number of respondents (1.5%) saw development of the flood plain as the

TABLE 5.22: Future Flood Expectation* x Reason

Reason	Expectation						
	Positive		Negative		Uncertain		Total
	No.	%+	No.	%+	No.	%+	No.
Possibility, law of averages	36	60.0	4	6.7	20	33.3	60
Onsite experience	30	71.4	9	21.4	3	7.1	42
Mitigation sufficient/ insufficient	-	-	10	100.0	-	-	10
	28	100.0	-	-	-	-	28
Frequency	22	38.6	32	56.1	3	5.3	57
Development on flood plain	10	90.9	-	-	1	9.1	11
Inevitable/feeling	10	100.0	-	-	-	-	10
Increasing frequency	8	100.0	-	-	-	-	8
Changing weather pattern	7	70.0	2	20.0	1	10.0	10
Expert opinion	6	66.7	2	22.2	1	11.1	9
Dependent on weather	3	30.0	-	-	7	70.0	10
Floods unpredictable	3	6.5	1	2.2	42	91.3	46
Flood unique, rare, not of similar magnitude	1	1.8	53	94.6	2	3.6	56
Age	-	-	15	88.2	2	11.8	17
Move before	-	-	42	85.7	7	14.3	49
Optimistic, hopeful	-	-	54	84.4	10	15.6	64
Other	2		2		3		7
Don't know/Not stated							153
TOTAL							647

\+ Row percentage.

* Q.18. Do you think there will be another flood while you are living here? Why?

reason for possible future flooding in their area. Twenty-two respondents gave frequency of flooding as the reason they expected to be flooded in the future. However, the majority of respondents who mentioned frequency held a negative future flood expectation.

Main reasons for a negative expectation included feelings of optimism or hopefulness, an intention to move and the view of flooding as unique, rare or of a smaller magnitude in the future. In the first instance, respondents were unable to give a more objective reason for their expectation when questioned further.

By far the most common reason for uncertainty was the belief in the unpredictability of floods. One-third of those who described future flooding as a possibility were unwilling to commit themselves to a positive or negative expectation while 10 respondents stated they were 'uncertain' but 'optimistic'. One hundred and fifty-three respondents gave no reason for their expectation.

5.5.2 Expectation and hazard evaluation

The hypothesized relation between flood hazard evaluation and future flood expectation (Section 2.4.2) was found to be significant. It would appear from Table 5.23 that those in the 'positive' and 'uncertain' groups hold a similar view of the flood hazard - generally viewing it as of above average seriousness - while those in the 'negative' group more often gave it a low ranking. This conclusion was borne out by further analysis in which it was found that those with both positive and uncertain expectations did indeed differ significantly in their hazard evaluation from those with a negative expectation (Table 5.24A and B) while no significant difference existed between them.

TABLE 5.23: Hazard Evaluation* x Future Flood Expectation+

Expectation	Hazard Evaluation (Ranking) Not at all 1	Minor 2	Average 3	Moderate 4	Serious 5	ROW TOTAL
Positive	8 (4.5) [15.7]	45 (25.1) [21.7]	26 (14.5) [31.7]	25 (14.0) [29.4]	75 (41.9) [34.9]	179 28.0
Negative	30 (11.9) [58.8]	102 (40.3) [49.3]	30 (11.9) [36.6]	25 (9.9) [29.4]	66 (26.1) [30.7]	253 39.5
Uncertain	13 (6.3) [25.5]	60 (28.8) [29.0]	26 (12.5) [31.7]	35 (16.8) [41.2]	74 (35.6) [34.4]	208 32.5
COLUMN TOTAL	51 8.0	207 32.3	82 12.8	85 13.3	215 33.6	640 100.0

$\chi^2_{df\ 8} = 29.96$ $p < 0.001$ $n = 640$

* Q.29. On a five point scale, how would you rank flooding as a hazard to you?

\+ Q.18. Do you think there will be another flood while you are living here?

TABLE 5.24: Hazard Evaluation* x Future Flood Expectation+

A. Comparing 'positive' and 'negative' expectation.

Expectation	Hazard Evaluation: Not at all 1	Minor 2	Average 3	Moderate 4	Serious 5	ROW TOTAL
Positive	8 (4.5) [21.0]	45 (25.1) [30.6]	26 (14.5) [46.4]	25 (14.0) [50.0]	75 (41.9) [53.2]	179 41.4
Negative	30 (11.9) [79.0]	102 (40.3) [69.4]	30 (11.9) [53.6]	25 (9.9) [50.0]	66 (26.1) [46.8]	253 58.6
COLUMN TOTAL	38 8.8	147 34.0	56 13.0	50 11.6	141 32.6	432 100.0

$\chi^2_{df\ 4} = 23.72$ $p < 0.001$ $n = 432$

B. Comparing 'uncertain' and 'negative' expectation.

Expectation	Hazard Evaluation: Not at all 1	Minor 2	Average 3	Moderate 4	Serious 5	ROW TOTAL
Uncertain	13 (6.3) [30.2]	60 (28.8) [37.0]	26 (12.5) [46.4]	35 (16.8) [58.3]	74 (35.6) [52.9]	208 45.1
Negative	30 (11.9) [69.8]	102 (40.3) [63.0]	30 (11.9) [53.6]	25 (9.9) [41.7]	66 (26.1) [47.1]	253 54.9
COLUMN TOTAL	43 9.3	162 35.1	56 12.2	60 13.0	140 30.4	461 100.0

$\chi^2_{df\ 4} = 15.78$ $p < 0.005$ $n = 461$

*Q.29. (as for Table 5.23)

+Q.18. (as for Table 5.23)

5.5.3 Expectation and information

Because expectation of future flooding is based on the personalized perceptions of past events, preconceived concepts of uniqueness or repetitiveness in the state of nature and notions regarding man's relationship with 'Nature' (Kates, 1962, pp. 66-72), it is logical to suppose that the greater the knowledge and experience of flooding held by the respondent, the greater will be his/her expectation of a future flood.

In his study, Kates (1962) found that expectation of future flooding was associated with the amount of information as measured on a knowledge-experience scale, such that, as an individual moved up the scale, his likelihood of an affirmative future flood expectation increased. This was also found to be the case in the present study (Table 5.25).

5.6 Influence of Other Variables

5.6.1 Knowledge and evaluation of protective works

No significant relationship was found between knowledge of public adjustments (as evidenced by the number mentioned in response to Question 35) and hazard evaluation. This supports conclusions by Roder (1961) and Burton (1961) who were unable to discern a direct relationship between these variables. Knowledge of more public protection works and mitigation measures did not, as one might expect, decrease the seriousness with which individuals viewed the hazard. Nor was the effectiveness ranking of public adjustments found to bear any apparent relation to hazard evaluation.

TABLE 5.25: Future Flood Expectation* x Information+

Information	Expectation			ROW TOTAL
	Positive	Negative	Uncertain	
No knowledge, no experience	60 (17.9) [33.3]	158 (47.2) [62.2]	117 (34.9) [55.7]	335 52.0
Knowledge, no experience	46 (26.6) [25.6]	74 (42.8) [29.1]	53 (30.6) [25.2]	173 26.9
One onsite experience	12 (30.8) [6.7]	9 (23.1) [3.5]	18 (46.2) [8.6]	39 6.1
2 or more experiences onsite	62 (63.9) [34.4]	13 (13.4) [5.1]	22 (22.7) [10.5]	97 15.1
COLUMN TOTAL	180 28.0	254 39.4	210 32.6	644 100.0

χ^2 = 87.96 df 6 $p < 0.001$ n = 644

* Q.18. Do you think there will be another flood while you are living here?

\+ Calculated from response to Q.8: Including those floods you actually experienced, how many floods do you know of entering this neighbourhood? and

Q.7. How many of these (i.e. floods) affected your present dwelling? (as for Table 5.18).

Fifty-eight percent of all respondents saw Wivenhoe Dam as a positive factor in flood control, either eliminating or reducing the hazard (Table 5.26). Nearly one-quarter (155) of those sampled were uncertain as to its effect while nearly all the rest felt it would have no effect. Less than one percent voiced the opinion that the dam's construction would increase flooding.

This factor does not seem to affect respondents' hazard evaluation in that evaluation was not found to significantly differ with variation

TABLE 5.26: Perception of the Effect of Wivenhoe Dam on Flooding*

Effect	Respondents No.	%	
Eliminate	18	2.78	58%
Reduce	357	55.18	
No effect	112	17.31	
Increase	5	0.77	
Uncertain	155	23.96	
TOTAL	647	100.00	

* Q.46. Do you think the Wivenhoe Dam will be effective in reducing or eliminating the flood hazard on your property?

in perception of the dam's effectiveness. But a significant relationship was found between the dam's effectiveness and expectation of future flooding such that those with a positive view of the dam's effectiveness were less likely to expect future flooding (Table 5.27).

As a positive factor in the decision to stay in the present location, knowledge of Wivenhoe Dam was found to be related to hazard evaluation at the 0.05 significance level (Table 5.28). However, in the light of the many variables which enter into any location decision, this relationship cannot be taken as an accurate measure of the importance of Wivenhoe Dam on hazard evaluation.

5.6.2 Life cycle stage

Respondents were divided into six classes after Johnston's (1971) categories for life cycle stage. (For resulting distribution see Appendix 2.) Though it was thought that some correlation would exist, following from the fact that general studies of communities in

TABLE 5.27: Perception of the Effect of Wivenhoe Dam on Flooding* x Expectation of Future Flooding+

Effect	Expectation: Positive	Negative	Uncertain	ROW TOTAL
Eliminate** or reduce flooding	94 (25.2) [63.9]	163 (43.7) [84.9]	116 (31.1) [79.5]	373 76.9
No effect	53 (47.3) [36.1]	29 (25.9) [15.1]	30 (26.8) [20.5]	112 23.1
COLUMN TOTAL	147 30.3	192 39.6	146 30.1	485 100.0

$\chi^2_{df\ 2} = 21.34$ $p < 0.001$ $n = 485$

*Q.46. (as for Table 5.26)

+Q.18. Do you think there will be another flood while you are living here?

**None in this group held a positive expectation.

TABLE 5.28: Hazard Evaluation* x Effect of Knowledge of Wivenhoe Dam on Decision to Stay+

Knowledge effect	Hazard Evaluation (Ranking): Not at all 1	Minor 2	Average 3	Moderate 4	Serious 5	ROW TOTAL
Positive	13 (10.5) [28.9]	41 (33.1) [22.4]	17 (13.7) [23.0]	23 (18.5) [31.5]	30 (24.2) [15.2]	124 21.7
Negative	32 (7.1) [71.1]	142 (31.7) [77.6]	57 (12.7) [77.0]	50 (11.2) [68.5]	167 (37.3) [84.8]	448 78.3
COLUMN TOTAL	45 7.9	186 32.0	74 12.9	73 12.8	197 34.4	572 100.0

$\chi^2_{df\ 4} = 10.49$ $p < 0.05$ $n = 572$

*Q.29. On a five point scale, how would you rank flooding as a hazard to you?

+Q.47. *Either:* you said in Q.20 you would not locate here again if you knew as much about the floods as you know now. Does knowledge of the new Wivenhoe Dam change your views?

or: you said in Q.20 that you would still locate here. Do you feel more strongly about this now that the Wivenhoe Dam is planned?

disaster evidence that the family affects disaster behaviour (Hill and Hansen, 1962), no clear relationship was found between life cyle stage and hazard evaluation or future flood expectation in this study.

5.6.3 Other factors

Similarly, testing failed to yield any significant relationship between neighbourhood rating, family income or home-ownership and hazard evaluation or future flood expectation.

5.7 Summary

A series of crosstabulations and chi-squares were carried out to test the first hypothesis: that variation in hazard perception and evaluation is associated with characteristics of the natural event, personal experience, knowledge of previous flooding and expectation of future flooding.

The two characteristics of the natural event under study, perceived frequency and magnitude, were found to be significantly related to hazard evaluation as measured on a five-point attitude scale. Two measures of perceived frequency response were used in the analysis, one using categories, the other using absolute frequency data. In the former, the response pattern of the 'uncertain' group was not found to differ significantly from those giving a frequency estimate in hazard evaluation. However, both were found to differ significantly in this regard from those who 'never/rarely' expect another flood. When absolute frequency estimates were employed, the shorter the perceived recurrence interval, the greater was the seriousness attached to the hazard.

Using three magnitude classes, hazard evaluation was found to increase directly with degree of flooding on a respondent's property,

those suffering the greatest inundation giving the highest evaluation. Whether or not the living area of the dwelling was affected appeared to be the critical factor here rather than variation in depth.

Personal experience was also found to be positively associated with hazard evaluation. Here both the possession of previous flood experience and its recency were examined. It was found that those with previous onsite experience gave a higher evaluation as did those with more recent experience. Those with less recent or no previous experience rated the hazard as of lesser, though still above average seriousness. Similarly, the possession of knowledge of previous floods (whether personally experienced or not) significantly increased hazard evaluation. When knowledge and experience were combined into a 'scale of flood awareness' after Kates' example (1962) and crosstabulated with hazard evaluation, a direct relationship was found, such that more knowledge and experience led to a higher hazard evaluation.

The hypothesized relationship between flood hazard evaluation and future flood expectation also proved significant. Those with a positive expectation perceived a more serious hazard than those with a negative expectation. Those uncertain of future flood possibilities were more akin in their response to those with a positive expectation while both differed significantly from those with a negative expectation in their evaluation. Future flood expectation was also significantly related to information as measured on the 'scale of flood awareness' (Kates, 1962) and flood interpretation.

Of the other factors thought to be related to variation in hazard evaluation, including knowledge and evaluation of protective works, life cycle stage, neighbourhood rating, income and home-ownership, only the

effect of knowledge of Wivenhoe Dam on the location decision was found to be significant. While no direct relationship was established between hazard evaluation and the perceived effect of Wivenhoe Dam on flooding, a correlation was found between the latter and future flood expectation such that a positive view of the dam's effectiveness was more frequently correlated with a negative future flood expectation.

CHAPTER 6

AWARENESS AND EVALUATION OF ADJUSTMENTS

In Chapter 2, the hypothesis was put forward that choice of adjustment was a function of evaluation of the hazard, awareness of the choices open and an evaluation of the alternatives. The task here is to investigate the range of public and private adjustments, the perception of this range and the evaluation of it in terms of effectiveness and adoption.

A respondent's perception of an alternative is usually thought of as ranging in intensity from awareness, interest and evaluation of its use through to adoption. In this appraisal, perception of an alternative was satisfied when a respondent expressed knowledge of an alternative use. The adoption of an alternative was acknowledged whether or not its usage was temporary or permanent, partial or complete.

6.1 Awareness of Public Adjustments

The first step in investigating respondents' perception of alternative public adjustments was to examine the extent of knowledge of alternatives. Here respondents were asked if they knew of anything being done to reduce flood damage: Q.35 (whether or not they considered it an effective measure). As can be seen from Table 6.1, the overall range of adjustments perceived by respondents as a whole is relatively large. However less than a quarter of all respondents knew of more than one public adjustment, while nearly 46% (297) said they did not know of anything being done to reduce flood damage (Table 6.2), despite the fact that each of the adjustments listed is present in some measure in the Brisbane catchment and a number have received repeated mention in the media.

The most commonly perceived adjustments were reservoir and dam construction (34.5%), followed by dredging (17.0%), a result which could

TABLE 6.1: Knowledge of Existing Public Adjustments*

Adjustment	Respondents		Rank by frequency of mention
	No.	% of total	
Dredging	110	17.0	2
Channel improvement	49	7.6	6
Levees, flood gates, storm channels	42	6.5	7
Reservoir and dam construction	223	34.5	1
Erosion control works	12	1.9	10
Zoning regulations	26	4.0	8
Investigations & surveys - government	64	9.9	3
- other	13	2.0	9
Citizen action groups	56	8.7	5
Civil Defence work#	62	9.6	4
Flood warning devices and signs	6	0.9	11
Mitigation schemes	5	0.8	12
Others	5	0.8	

*Q.35. Do you know of anything being done to reduce flood damage?

#This organization has since been renamed the Queensland State Emergency Service with expanded membership, funding and facilities.

TABLE 6.2: Number of Public Adjustments Known Of*

No. of adjustments+	Respondents	
	No.	%
0	297	45.9
1	199	30.8
2	73	11.3
3	31	4.8
4	24	3.7
5 or more	23	3.6
TOTAL	647	100.0

+ Mean = 1.0 Mode = 0

*Q.35. Do you know of anything being done to reduce flood damage?

be expected given the wide public discussion of these two measures at the time of the flood and in subsequent press coverage in both metropolitan and local newspapers. In the majority of cases, when more than one adjustment was known of, reservoir and dam construction or dredging received first mention.

It could be argued that, despite respondents being counselled by the interviewers that the perceived effectiveness of an adjustment was not to be a consideration, this factor would bias response, such that, if an adjustment was considered ineffective it was not mentioned as a measure to reduce flood damage. This bias only appears to have been operative in the case of dredging, channel improvement, and reservoir and dam construction where those who perceived the adjustment ranked it significantly higher in effectiveness than those who did not mention it (see for example Table 6.3). Further evidence for this bias is provided by a comparison of knowledge of various adjustments and the source of flooding. Dredging and channel improvement, two measures particularly related to mitigation of creek flooding were reported by a significantly greater proportion of those flooded from a creek, while reservoirs and dam construction, more associated with river flood control, were reported by a significantly greater proportion of those flooded from the river (Table 6.4). In each case the relationship was significant beyond the 0.001 probability level. These three were the only adjustments related to flood type in this manner.

Though Civil Defence work ranked fourth in frequency of mention (Table 6.1), considering the large role it played during and after the January flood, only a small proportion of respondents (9.6%) mentioned knowing of it. Again, some explanation for this may be found in the image people have of Civil Defence as an emergency evacuation and rescue service

TABLE 6.3: Perception of Dredging as a Public Adjustment x Effectiveness Ranking[+]

Adjustment perceived	Effectiveness Ranking: Definitely Effective 1	Probably Effective 2	Possibly Effective 3	Uncertain 4	Reject 5	ROW TOTAL
No	145 (32.4) [77.5]	96 (21.4) [74.4]	69 (15.4) [76.7]	54 (12.1) [93.1]	84 (18.8) [93.3]	448 80.9
Yes	42 (39.6) [22.5]	33 (31.1) [25.6]	21 (19.8) [23.3]	4 (3.8) [6.9]	6 (5.7) [6.7]	106 19.1
COLUMN TOTAL	187 33.8	129 23.3	90 16.2	58 10.5	90 16.2	554 100.0

$\chi^2_{df\ 4} = 20.48$ $p < 0.001$ $n = 554$

[+]Q.35. Do you know of anything being done to reduce flood damage? How would you rank the effectiveness of each of these?

TABLE 6.4: Knowledge of Selected Adjustments[+] by Flood Source

Adjustment	% Stating Knowledge by Flood Source: River (n=350)	Creek (n=297)
Dredging	11.7 (41)	23.2 (69)
Channel improvement	2.9 (10)	13.1 (39)
Reservoir and dam construction	41.7 (146)	25.9 (77)

[+]Q.35. Do you know of anything being done to reduce flood damage?

'once the damage has been done', rather than a measure to minimize the effect of disaster on the community, though it fills both roles.

6.2 Evaluation of Public Adjustments

6.2.1 Effectiveness ranking

The perceived effectiveness ranking of each of the public adjustments mentioned is set out in Table 6.5. Paradoxically, the measure perceived as the most effective was Civil Defence. The role played by this mainly voluntary organization was generally highly praised by respondents. The relatively high evaluation of this measure, as opposed to technological adjustments designed to reduce flooding as such, would seem to indicate respondents were giving a retrospective evaluation of the effectiveness of this organization in fulfilling its particular role.

The opposite appears true for zoning regulations, the adjustment deemed 'definitely effective' by the second largest number of respondents. Here the main comment was that regulations were very effective where they had been put into effect, but that stronger regulations needed to be formulated and the area where restrictions were in force needed to be extended.[1] Many respondents saw zoning as the ultimate means of solving the problem of flood losses.

---

[1] Under the City of Brisbane Town Planning Act, 1964-1971 and the City of Brisbane Ordinances, 1972, Chapter 8, Part 8, the Brisbane City Council has the power to require information on drainage and flood levels to be supplied where land is proposed for subdivision, and to declare Drainage Problem Areas. In the latter, filling may be required before permission for residential development is granted. However the Council is reluctant to do so after development has taken place and there is no check required on the consequences of such filling for other areas or on private managers filling their own property. Further, building applications are at present being approved with the specification of a minimum floor level for any habitable area as a recommendation only, not a requirement (see Appendix 3).

TABLE 6.5: Effectiveness Ranking of Public Adjustments*

Adjustment+	Ranking: Definitely Effective 1		Probably Effective 2		Possibly Effective 3		Uncertain 4		Reject 5		No.of Cases
	No.	%#	No.	%#	No.	%#	No.	%#	No.	%#	
Dredging	187	33.8	129	23.3	90	16.2	58	10.5	90	16.2	554
Channel improvement	168	32.4	133	25.6	80	15.4	79	15.2	59	11.4	519
Levees, flood gates & storm channels	115	21.5	98	18.3	117	21.8	104	19.4	102	19.0	536
Reservoir & dam construction	180	31.5	137	24.0	117	20.5	89	15.6	49	8.6	572
Erosion control works	87	17.3	119	23.7	78	15.5	148	29.4	71	14.1	503
Zoning regulations	287	55.1	93	17.9	45	8.6	55	10.6	41	7.9	521
Investigations & surveys - government	85	16.3	121	23.2	142	27.3	104	20.0	69	13.2	521
- other	68	13.4	119	23.5	140	27.6	113	22.3	67	13.2	507
Citizen action groups	107	20.6	135	26.0	131	25.2	82	15.8	65	12.5	520
Civil Defence work	305	58.8	110	21.2	54	10.4	34	6.6	16	3.1	519
Flood warning devices & signs	1	12.5	4	50.0	2	25.0	1	12.5	-	-	8
Mitigation schemes & others	2	33.3	2	33.3	-	-	1	16.7	1	16.7	6

*Q.35. How would you rank the effectiveness of each of these?

+Respondents were asked to give a ranking for all ten adjustments listed plus any others they mentioned (shown below dotted line).

#All percentages based on number of cases (i.e. responses) for each adjustment.

Technological adjustments including channel improvement, reservoir and dam construction, and dredging were perceived to be the next most effective measures. Following on from the earlier finding of a significant relation between knowledge of these adjustments and source of flooding (Table 6.4), tests were carried out to see whether a relationship also existed between flood source and the effectiveness ranking. As before, source of flooding was found to have a significant effect, with those flooded from a creek ranking channel improvement and dredging higher in effectiveness and those flooded from the river giving reservoir and dam construction a higher effectiveness ranking.[1]

Erosion control work gained the lowest effectiveness score. It was also the adjustment about which most uncertainty was shown, an indication of respondents' general lack of knowledge about the role of this adjustment in flood mitigation.

The highest rejection score was recorded for levees, flood gates and storm channels. A partial explanation for this may be found in the comment by some respondents that they were flooded by a backup of water in storm channels and also suffered subsequent minor flooding as a result of debris clogging storm drains, thus preventing the run-off of water. In general, levees did not bring the same degree of criticism and a number of respondents commented that they would have ranked levees higher had they been listed separately.

6.2.2 Adoption ranking

In order to identify the theoretical range of public adjustments perceived, respondents were asked to suggest ways in which they would reduce flood damage given a position of 'strong authority', that is putting themselves in a position to propose and implement public policies (Question 37). The range of adjustments perceived is shown in Table 6.6.

---

[1] Flood source x dredging $\chi^2_{df\ 4} = 38.45$ $p < 0.001$ $n=554$
x channel improvement $\chi^2_{df\ 4} = 17.97$ $p < 0.002$ $n=519$
x reservoir & dam construction $\chi^2_{df\ 4} = 18.24$ $p < 0.002$ $n=572$

TABLE 6.6: Public Adjustments Respondents Would Adopt*

Adjustment	Respondents		Rank by Frequency of Mention
	No.	% of Total	
Dredging	149	23.0	2
Channel improvement	81	12.5	6
Levees, flood gates & storm channels	51	7.9	8
Reservoir & dam construction	111	17.2	5
Limit, control or prohibit building in flood zone	133	20.6	3
Provide flood information to public	113	17.5	4
Install better warning system & evacuation plan	158	24.4	1
Establish permanent relief fund	56	8.7	7
Provide flood insurance scheme	46	7.1	9
Establish expert investigation and mitigation control body	24	3.7	10
Stop reclamation & infilling	12	1.9	11
Improve drainage	12	1.9	11
Establish emergency services, centres & communications	12	1.9	11
Proper administration of dam	8	1.2	15
Others	12	1.9	

*Q.37. Given a position of 'strong authority' what would you have done about the flood situation?

The major concern was with immediate emergency measures. Just under a quarter (24.4%) said they would install a better warning system and evacuation plan which they thought were lacking in the 1974 flood. This was followed by dredging, mentioned by 23% of respondents and zoning regulations third (20.6%). Providing flood information to the public and reservoir and dam construction were each mentioned by approximately a sixth of all respondents.

Other measures suggested by respondents included a permanent relief fund, a flood insurance scheme, levees and a central flood investigation and mitigation control body. Adjustments which received minor attention were a cessation of reclamation and infilling, improved drainage, the establishment of emergency service and communications centres, and proper administration of dams in the catchment. Erosion control was suggested by only one respondent.

Again, while the overall theoretical range of adjustments perceived by all respondents is relatively broad, the range of choice perceived by the individual is more restricted, for example less than 20% of respondents mentioned more than two adjustments (Table 6.7). It is felt that this figure would have been lower still if respondents had not earlier been asked to rank a number of adjustments for effectiveness.

TABLE 6.7: Number of Adjustments Suggested for Adoption by Respondents*

No. of Adjustments+	Respondents	
	No.	%
0	199	30.8
1	203	31.4
2	121	18.7
3	52	8.0
4	35	5.4
5 or more	37	5.7
TOTAL	647	100.0

+Mean = 1.5 Mode = 1.00

*Q.37. Given a position of 'strong authority' what would you have done about the flood situation?

When respondents were asked to rank each adjustment on a five-point adoption scale, results confirmed the earlier concern with information, warning and evacuation measures (Table 6.8). Provision of flood information to the public and installation of a better warning system and evacuation plan were the most frequently mentioned for definite adoption. Zoning regulations to restrict building in the flood zone maintained third position, an indication that flood-plain occupants would be willing to accept this measure despite City Council concern to the contrary.

Though a flood insurance scheme and permanent relief fund were each initially mentioned by less than ten percent of all respondents (Table 6.6), approximately 80 percent of respondents ranking these adjustments for adoption gave them a positive score (that is, 'possibly', 'probably' or 'definitely' adopt ranking).

Overall, technical adjustments such as dredging, channel improvement, levees, flood gates and storm channels ranked lowest for adoption. The only exception was reservoir and dam construction. Here the proportion of adopters was approximately equal to that for zoning regulations, though the general level of the ranking was lower. As was the case in effectiveness ranking, levees, flood gates and storm channels received the highest rejection score though they would still be adopted by the majority.

Comparing respondents' effectiveness and adoption rankings (Tables 6.5 and 6.6), there appears to be a high level of consistency in the relative ordering of adjustments that appear in both. Informational, warning and emergency services head the list followed by zoning regulations, then technical measures. A number of writers, among them Heron (1972),

TABLE 6.8: Adoption Ranking of Public Adjustments*

Adjustments+	Ranking										No.of Cases
	Definitely Adopt 1		Probably Adopt 2		Possibly Adopt 3		Uncertain 4		Reject 5		
	No.	%#	No.	%#	No.	%#	No.	%#	No.	%#	
Dredging	288	47.8	111	18.4	53	8.8	85	14.1	65	10.8	602
Channel improvement	268	46.0	108	18.5	55	9.4	93	16.0	59	10.1	583
Levees, flood gates & storm channels	180	30.4	125	21.1	74	12.5	116	19.6	97	16.4	592
Reservoir & dam construction	298	48.0	135	22.2	73	12.0	68	11.2	40	6.6	608
Limit, control or prohibit building in flood zone	392	64.4	67	11.0	41	6.7	61	10.0	48	7.9	609
Provide flood information to public	490	79.9	52	8.5	14	2.3	40	6.5	17	2.8	613
Install better warning system & evacuation plan	424	68.1	77	12.4	32	5.1	52	8.3	38	6.1	623
Establish permanent relief fund	333	55.1	103	17.1	45	7.5	65	10.8	58	9.6	604
Provide flood insurance scheme	372	61.7	92	15.3	29	4.8	66	10.9	44	7.3	603
Establish expert investigation & mitigation control body	24	100.0	-	-	-	-	-	-	-	-	24
Stop reclamation & infilling	12	100.0	-	-	-	-	-	-	-	-	12
Improve drainage	12	100.0	-	-	-	-	-	-	-	-	12
Establish emergency services, centres & communications	12	100.0	-	-	-	-	-	-	-	-	12
Proper administration of dam	8	100.0	-	-	-	-	-	-	-	-	8
Other	12	100.0	-	-	-	-	-	-	-	-	12

* Q.37. How would you rank these in terms of adopting each of them?

+ Respondents were asked to rank all nine adjustments listed plus any others they mentioned (shown below dotted line).

All percentages based on number of cases (i.e. responses) for each adjustment.

Hewitt and Burton (1971), and White et al. (1958), speak of the confidence inspired in hazard zone occupants by technical adjustments. Here it appears that given adequate warning, respondents place more value on their own ability to instigate damage reducing measures than on the effectiveness of technical adjustments.

This would particularly appear to be true in the light of the measure most frequently mentioned for adoption, the provision of flood information to the public (Table 6.8). This item was not mentioned on the list of those measures known to exist (Table 6.1). Access to information on previous flood levels did exist at the time of the January flood and subsequent newspaper and symposia reports, for example the Australian Institute of Engineers symposium (1974), have included information on flood levels, public and private adjustments etc. However, respondents clearly felt insufficient information was available to them at the time of the interview, that is at least six months after the January flood. In this regard their perception of the need for action corresponds with that of a number of workers in the field (White, 1960; Ericksen, 1967 and 1971) who give provision of information to the public a high priority. Recommendations from the Symposium on Natural Hazards in Australia (1976) include one for the diffusion of simple brochures ("How to cope with hazard X") to all households together with educational programmes which it is suggested should be renewed sufficiently often to maintain public awareness of the risk in their particular localities. Some remedy has been effected in that brochures have been produced and distributed by the State Disaster Relief Organization (no date) and jointly by the Natural Disasters Organization, State Emergency Service and Bureau of Meteorology (no date). A series of 18 1:10000 flood maps of the Brisbane and Ipswich areas (Queensland Surveyor General's

Department, 1976) have also been made available for purchase by the public. On the reverse of each map are instructions to residents on how to act when floodwaters reach their properties, what information will be broadcast and what steps the State Emergency Service will take. But the effect of these measures is yet to be tested. As Burton and Kates (1964, p.440) point out, "to expect radical changes in the pattern of human adjustments to floods simply by providing detailed and precise flood hazard information is unduly optimistic."

6.3 Perceived Government Role in Flood Mitigation

Three main questions were posed to determine respondents' perception of the role of government authorities in flood mitigation. These related to

(1) who respondents considered responsible for providing flood information in their locality (Question 32);

(2) who should be responsible for action to reduce flood losses given people were adequately informed of flood possibilities and the extent of likely damage (Question 34);

and (3) what action, if any, respondents thought the government could take to reduce flood damages (Question 36).

6.3.1 Responsibility for flood information

By far the authority perceived to be the most responsible for providing flood information was the Brisbane City Council (BCC) (Table 6.9). Over 40 percent of the respondents in the sample saw the BCC as wholly responsible for this task, while approximately another 11 percent saw it as the joint task of the BCC and either the State Government or the real estate agent. A further 10 percent saw it as the State Government's responsibility alone while just over 15 percent felt it was up to the

TABLE 6.9: Source Perceived Responsible for Providing Flood Information+

Source	Respondents No.	%	
State Government	65	10.1	58.8
Brisbane City Council	271	41.9	
State Govt. & BCC*	44	6.8	
Land Developer	26	4.0	
Real Estate Agent	101	15.6	
Person selling	28	4.3	
Person buying	45	7.0	
BCC & Real Estate Agent*	26	4.0	
Other	18	2.8	
Don't know/Not stated	23	3.6	
TOTAL	647	100.0	

* Respondents in these categories were unable to distinguish between the two sources and saw both sources as equally or jointly responsible.

\+ Q.32 Who do you think should be the most responsible for providing residents with information about whether their land is subject to flooding?

real estate agent to inform potential buyers. A small percentage (4.3%) saw it as the task of the individual person selling the property, though more (7.0%) felt it was up to the person buying to find out for himself. Others mentioned included the police department and the Civil Defence.

From this breakdown, it can be seen that most respondents feel it to be the responsibility of some governmental authority, mainly at the local level, to provide flood information. Those nominating real estate agents felt there should be laws binding them with this responsibility, so once again this would reflect some government initiative.

6.3.2 Responsibility for mitigation

Given that people were adequately informed about flood possibilities and the extent of likely damage, almost half of those questioned saw the onus to be on the individual to effect action to reduce flood losses (Table 6.10). This supports the conclusion earlier

TABLE 6.10: Perceived Responsibility for Mitigation[+]

Body	Respondents No.	%	
Individual	322	49.8	
State Government	97	15.0	
Brisbane City Council (BCC)	89	13.8	35.5
BCC & State Govt.*	43	6.7	
State Govt. & Individual*	8	1.2	
Insurance	7	1.1	
Individual, State Govt. & BCC*	2	0.3	
Other	34	5.3	
Don't know/Not stated	45	7.0	
TOTAL	647	100.0	

* Respondents in these categories saw each one as of equal importance.

[+] Q.34. Given that people were adequately informed about flood possibilities and the extent of likely damage, on whom do you think most responsibility rests for action that would reduce flood losses?

regarding the importance of the provision of flood information and its positive effect on the confidence of respondents in their ability to implement damage reducing measures (Section 6.2.2). Of course, this is not to imply that respondents do not desire government action to be taken simultaneously. Further, the impression was gained during the interviews that a number of respondents were excluding those already living in flood

prone areas and were basing their response on the premise that if a person moved into an area that had been flooded knowing the risk, then that individual should be responsible for his or her own protection. The exclusion of present occupants seemed to be based on the reasoning that they were not aware of the flood risk before the January flood. Therefore it was not their 'fault' they were in the situation and they should not therefore be expected to bear the responsibility for mitigation.

Approximately one-third saw it as the responsibility of the State Government, the BCC or a combination of the two to institute mitigation work. Whereas more people saw the provision of flood information to be the responsibility of the BCC (Table 6.9), here the response was almost equally divided between the two with a slightly larger number nominating the State Government. This may denote the greater perceived capacity of the State Government to deal with flood mitigation work, having more authority, finance and resources at its command. For those nominating the BCC, the same reason may be presumed to underlie their choice.

6.3.3 Desired government action

Over three-quarters of those sampled thought some government action was possible (Table 6.11). Given the response in the previous

TABLE 6.11: Perceived Need for Government Action[+]

Government action needed	Respondents	
	No.	%
Yes	498	77.0
No	72	11.1
Don't know	77	11.9
TOTAL	647	100.0

[+] Q.36. Is there anything the government can do to prevent or reduce damages from floods?

section, it follows that respondents hold a separate view of the actions that an individual can take and those that should and must of necessity be carried out at the community level. This is supported by a check of the government actions sought (Table 6.12). The three most frequently sought adjustments in descending order were dredging, reservoir and dam construction, and zoning regulations, all needing implementation at least at the community level. Only after these came the provision of flood information to the public and more efficient evacuation and flood emergency services, the two adjustments most respondents said they would implement themselves given the authority and in which they could play a role.

6.4 Range of Practical Alternatives for Private Adjustments

Private adjustments range from elementary-standby preparations to relocation with corresponding variations in effectiveness and cost. In almost all instances, the practical range of adjustments is more limited than the theoretical range while the perceived range of practical alternatives may be even further limited. Here, the patterns and types of adjustments adopted will be considered.

6.4.1 Private adjustments at the time of the flood

Actions taken by respondents in the January flood are summarized in Table 6.13. From this table, it can be seen that the most common adjustment was the elevation or emoval of possessions, adopted by 75.9 percent of all respondents. However, the degree of adoption in this category varied from a hasty last minute attempt to raise or remove possessions to the total removal of all goods accomplished by five respondents, and three going so far as the removal of fittings, including doors, carpets etc. A further 35 said they knew of this alternative but

TABLE 6.12: Government Action Sought

Action	Frequency of mention+ No.	%	1st** Preference %#	2nd** Preference %##
Dredging	207	32.0	22.7	14.9
Channel improvement	122	18.9	3.1	17.1
Levees, flood gates & storm channels	97	15.0	2.5	11.0
Reservoir & dam construction	191	29.5	21.1	14.0
Limit, control or prohibit building in flood zone	181	28.0	14.5	12.7
Provide flood information to public	121	18.7	4.5	6.6
Prepare or plan (more) efficient evacuation & flood emergency services	103	15.9	7.2	5.3
Erect flood height & warning signs	61	9.4	1.6	3.1
Establish permanent relief fund	74	11.4	3.1	3.5
Provide government sponsored flood insurance	64	9.9	1.4	2.6
Erosion control work	21	3.2	1.4	3.1
Proper administration of dam	4	0.6	0.2	0.4
Expert investigation	16	2.5	2.9	0.4
Finance mitigation	9	1.4	1.0	0.9
Compensation for private adjustments	10	1.5	1.2	0.9
Drainage improvement	26	4.0	4.1	2.2
Other - specified	28	4.3	4.3	1.3
- unspecified	15	2.3	3.1	-

n = 488 ## n = 228

+Q.36A. Is there anything the government can do to prevent or reduce damages from floods?

** Q.36B What would be your preference for the government to place greatest emphasis on in the next few years?

TABLE 6.13: Private Adjustments Respondents have taken or would take in Future

Action	1 Action taken in January flood		2 Other adjustments known of/ considered		3 Action next time (if different)		4 Different action if flood expected	
	No.	%*	No.	%*	No.	%*	No.	%*
Do nothing	111	17.2	-	-	12	1.9	408	63.1
Standby preparations	9	1.4	13	2.1	28	4.3	143	22.1
Keep water out	13	2.0	27	4.2	13	2.0	-	-
Let water run through	47	7.3	24	3.8	15	2.3	-	-
Rely on previous structural changes	18	2.8	-	-	4	0.6	4	0.6
Rely on insurance	4	0.6	-	-	11	1.7	3	0.5
Elevate or remove possessions	493	76.1	35	5.5	189	29.2	7	1.1
Flood proof house	-	-	-	-	3	0.5	8	1.2
More preparation, move earlier	-	-	-	-	81	12.5	24	3.7
Relief/organization work	-	-	-	-	2	0.3	2	0.3
Other	-	-	-	-	3	0.5	8	1.2
Move	-	-	-	-	-	-	34	5.3
Not applicable	26	4.0	-	-	12	1.9	-	-

COLUMN 1 Q.39 (1) When the January flood came, what action did you take to prevent or reduce damages?
2 (2) Were there any others you considered or knew of?
3 (3) Next time would you do anything different than you did last time?
4 (4) If a warning were to be given that a flood is coming this summer, would you do anything different?

* All percentages based on total number of respondents, 647.

did not have time to act, though generally few respondents knew of any adjustments other than those actually implemented (see column 2, Table 6.13).

Failure to act also resulted from a lack of perceived need to do so until too late. Table 6.14 clearly shows the extent of respondents inability to perceive the threat of flood waters entering their dwelling until the event. The inaccuracy of respondents' perception in these

TABLE 6.14: Perception of Immediate Flood Threat[+]

	Respondents	
Perceived threat	No.	%
Yes	65	10.0
No	320	49.5
Uncertain	19	2.5
Not applicable	243	38.0
TOTAL	647	100.0

[+]Q.17. Did you ever really think you were going to be flooded before the water came into your home?

instances can be gauged more closely through a comparison of actions taken in January and the degree of flooding experienced (Table 6.15). More than one-fifth (21.1%) of those whose dwelling was totally submerged took no action to prevent or reduce losses while approximately one-seventh (14.0%) of those who experienced partial flooding of their dwelling similarly took no action. The higher action rate for the latter group may be linked with the greater flood knowledge and experience of this group (see Table 6.16). A direct link was also found between knowledge-experience and action, the proportion of those making some adjustments generally increasing as knowledge and experience increased (Table 6.17).

TABLE 6.15: Private Adjustments made during January Flood* x Degree of Flooding+

No. of adjustments	Degree of flooding: Yard only affected	Dwelling partly submerged	Dwelling fully submerged	ROW TOTAL
None	53 (46.9) [22.5]	36 (31.9) [14.0]	24 (21.2) [21.1]	113 18.6
One or more	183 (37.0) [77.5]	222 (44.8) [86.0]	90 (18.2) [78.9]	495 81.4
COLUMN TOTAL	236 38.8	258 42.4	114 18.8	608 100.0

$\chi^2_{df\ 2} = 6.46$ $p < 0.04$ $n = 608$

*Q.39. When the January flood came, what action did you take to prevent or reduce damages?

+Q.1. To what depth did the January flood waters enter your home?

TABLE 6.16: Knowledge-Experience Scale* x Degree of Flooding+

Information	Degree of flooding: Yard only affected	Dwelling partly submerged	Dwelling fully submerged	ROW TOTAL
No knowledge, no experience	119 (36.0) [49.0]	136 (41.1) [50.0]	76 (23.0) [60.8]	331 51.7
Knowledge, no experience	49 (28.5) [20.2]	87 (50.6) [32.0]	36 (20.9) [28.8]	172 26.9
One onsite experience	21 (53.8) [8.6]	10 (25.6) [3.7]	8 (20.5) [6.4]	39 6.1
2 or more experiences onsite	54 (55.1) [22.2]	39 (39.8) [14.3]	5 (5.1) [4.0]	98 15.3
COLUMN TOTAL	243 38.0	272 42.5	125 19.5	640 100.0

$\chi^2_{df\ 6} = 32.80$ $p < 0.001$ $n = 640$

* Calculated from response to Q.7 and Q.8.

+Q.1. To what depth did the January flood waters enter your home?

TABLE 6.17: Private Adjustments made during January Flood* x Knowledge-Experience Scale+

No. of Adjustments	Information: No Knowledge, no experience	Knowledge, no experience	One onsite experience	2 or more experiences onsite	ROW TOTAL
None	76 (66.7) [24.1]	24 (21.1) [14.5]	2 (1.8) [5.1]	12 (10.5) [12.5]	114 18.5
One or more	239 (47.7) [75.9]	141 (28.1) [85.5]	37 (7.4) [94.9]	84 (16.8) [87.5]	501 81.5
COLUMN TOTAL	315 51.2	165 26.8	39 6.3	96 15.6	615 100.0

$\chi^2_{df\ 3} = 15.22$ $p < 0.002$ $n = 615$

*Q.39. When the January flood came, what action did you take to prevent or reduce damage?

+Calculated from response to Q.7 and Q.8.

Two reasons may be postulated for the decrease in the proportion of those with two or more experiences onsite taking action. Firstly, it may be a reflection of the experience being less recent and therefore less effective (see Section 5.3.1), or, more probably, it may reflect the "prison" effect of experience as Kates (1962, p.132) terms it. In the present case it is probable that the experiencing of several minor floods where the degree of damage did not warrant action has led to the development of complacency.

The effect of the January flood experience on knowledge of adjustments can be seen by comparing columns one and three of Table 6.13. Still the most popular alternative should another flood occur was the elevation or removal of possessions. Of the 189 respondents who would take this action, 134 said they would remove all goods. Given only five

respondents were able to accomplish this in the January flood, the response here would seem to imply a confidence on the part of the respondents in their ability to act which may or may not be backed by preparation. Eighty-one respondents (12.5%) explicitly stated they would be more prepared or move earlier. Less than two percent of respondents would take no action by choice in the next flood.

Making the next flood more knowable by placing it in the specific context of "this summer",[1] had the effect of polarizing responses (Table 6.13, column 4). The majority of respondents (63.1%) would take no immediate action while just over one-fifth (22.1%) would make standby preparations. At the other extreme, 34 respondents (5.3%) said they would move if a warning was given that a flood was coming this summer. Few respondents would take the opportunity to implement flood proofing or other more permanent damage reducing measures. Clearly, response to this question would depend greatly on the credibility and significance the respondent attached to it. In the first instance, insufficient conviction that a flood would occur or the discounting of such a possibility would most probably result in no action being mentioned. Similarly, a number of respondents may feel action was unwarranted in the light of previous experience. The time interval (see fn. 1) could be a third factor contributing to respondents' inaction. With regard to major adjustments, it is likely that those able and most motivated to implement them had already done so at the time of the interview. Given the cost involved, relocation was seen as a more effective action.

---

[1] For the majority of respondents this would put the impending flood approximately two to four months in the future. This time variation was not found to have any significant effect on response.

Many respondents expressed the desire to move, but feasibility limited the number choosing this adjustment as a serious alternative.

6.4.2 Private adjustments adopted since the January flood

Nearly four-fifths of all respondents (504) had taken no action since the flood to avert or reduce future damage (Table 6.18). If those

TABLE 6.18: Private Action or Adjustments Adopted Since January Flood+

Adjustment	Respondents	
	No.	%*
Volunteer work	8	1.2
Civil Defence work	2	0.3
Discussion/agitation at meeting	36	5.6
Insurance	9	1.4
Standby preparations	17	2.6
Improved drainage	8	1.2
Flood proofing measures (including special building materials)	50	7.7
Elevate house	19	2.9
Restump	9	1.4
Other	21	3.3
None	504	77.9

* n = 647

+ Q.40. Have you done anything since the flood about averting the danger or reducing the damage by flooding?

in the first three categories, that is those whose actions are not directly related to damage reduction on their own property are included, this number is increased to 528 (81.6%).[1] Considering only 121 respondents (18.7%) suffered no direct loss of property and therefore

[1] Note some respondents have taken more than one action, so this figure is not directly calculable from the table.

had little to gain in material terms from implementing adjustments, the number adopting adjustments would appear to be low. While a significant relationship existed between losses suffered and adoption of adjustments, such that increased losses corresponded to a greater adoption rate (Table 6.19), the implication remains that nearly 60 percent are willing to accept the risk and bear the loss. However, the decision to adopt adjustments is not a simple outcome of the amount of loss. A number of factors affecting both the decision to seek and to adopt adjustments will be discussed more fully in following sections.

The most frequently made adjustment was flood proofing (Table 6.18). This included a variety of measures including the use of building material resistent or impervious to water damage in walls, cupboards etc., bricking up openings and the installation of easily removable fittings. Nineteen respondents (2.9%) had raised or were in the process of elevating their dwelling. The relatively small adoption rate for this adjustment and also for flood insurance may be attributed in part to the greater expense incurred in their adoption.

Given that 22.1% of respondents had previously stated that they would implement standby preparations if warned of an impending flood, the number of respondents who had adopted this adjustment also seems low. This may be taken as an indication that, in the majority of cases, for standby preparations to be implemented, the flood threat has to be perceived as imminent.

6.4.3 Adoption of adjustments for a one in ten year flood frequency

Speaking about prospective purchasers of property near the Brisbane River, Cossins in Australian Institute of Engineers (1974, p.144) notes "advice on the probability of flooding to different levels was

TABLE 6.19: Private Adjustment Type Adopted since January Flood* x Losses in January+

#Losses	Adjustment Type: None	Minor (1&2)	Major (3,4&5)	ROW TOTAL
$ 0	112 (92.6) [23.9]	6 (5.0) [10.7]	3 (2.5) [3.7]	121 19.9
$ 1 - 500	89 (80.2) [19.0]	8 (7.2) [14.3]	14 (12.6) [17.1]	111 18.3
$ 501 - 1000	44 (74.6) [9.4]	7 (11.9) [12.5]	8 (13.6) [9.8]	59 9.7
$ 1001 - 2000	42 (75.0) [9.0]	6 (10.7) [10.7]	8 (14.3) [9.8]	56 9.2
$ 2001 - 4000	67 (74.4) [14.3]	7 (7.8) [12.5]	16 (17.8) [19.5]	90 14.8
$ 4001 - 6000	56 (77.8) [11.9]	6 (8.3) [10.7]	10 (13.9) [12.2]	72 11.9
> $6001	59 (60.2) [12.6]	16 (16.3) [28.6]	23 (23.5) [28.0]	98 16.1
COLUMN TOTAL	469 77.3	56 9.2	82 13.5	607 100.0

$\chi^2_{df\ 12} = 36.15$ $p < 0.001$ $n = 607$

* Q.40. (as for Table 6.18)

\+ Q.50. With regard to this property, what would you estimate the value of your damages at?

\# For fuller breakdown of losses, the percentage of losses covered by relief aid and the amount spent on private adjustments adopted since January, see Appendix 2.

received as 'bad' news and it was always clear from the tenor of conversation that most people quickly convinced themselves that a one in ten risk of flooding would be personally acceptable." It would appear from Table 6.20 that in the present study, the majority of respondents are unwilling to accept the risk of a one in ten year flood.

The adjustment with the highest adoption score and also the lowest rejection rate was relocation. Given a one in ten year flood probability approximately half of those sampled would 'definitely adopt' this alternative. The second most popular adjustment was to make private evacuation plans. Approximately 40 percent of all respondents would 'definitely adopt' this action, though an almost equal number of respondents would reject it. Presumably, most of the latter would come from those opting to relocate, therefore having no reason to make evacuation plans. Though ranking third in frequency of mention for 'definite adoption', loss bearing was rejected by over half of all respondents. Ninety percent of those who would adopt this alternative stated they would also adopt other adjustments, in particular making their own evacuation plans. The remaining three major adjustments, relating to flood proofing, structural changes and insurance, were the least likely to be adopted. As previously noted, the high rejection for flood insurance may in part be attributed to the high premium rates incurred, and it would appear that respondents are even less willing to make alterations which may involve substantial cost and effort while providing uncertain protection.

6.5 Summary

While the overall range of public adjustments known of was relatively broad, individual respondents' knowledge was much more restricted, nearly half not knowing of any existing public adjustments.

TABLE 6.20: Adoption Ranking of Adjustments Given a 1 in 10 year Expected Flood Frequency*

Adjustment	Ranking										No.of Cases
	Definitely Adopt 1		Probably Adopt 2		Possibly Adopt 3		Uncertain 4		Reject 5		
	No.	%#	No.	%#	No.	%#	No.	%#	No.	%#	
Bear the loss	196	30.3	50	7.7	34	5.3	27	4.2	340	52.6	647
Take out/increase insurance	95	15.0	36	5.7	32	5.1	27	4.3	442	69.9	632
Relocate	325	50.5	27	14.2	40	6.2	24	3.7	228	35.4	644
Make structural changes	36	5.6	10	1.5	23	3.6	38	5.9	538	83.4	645
Flood proof house	21	3.4	13	2.1	16	2.6	39	6.4	521	85.4	610
Make own evacuation plan	267	41.5	62	9.6	29	4.5	16	2.5	269	41.8	643
Join action group	2	100.0	-	-	-	-					2
Rely on insurance	1	50.0	-	-	1	50.0					2
Other	-	-	1	50.0	1	50.0					2

* Q.42. If you were told you could expect flooding once every 10 years, what action would you take? How would you rank adopting each one?

All percentages based on number of cases (i.e. responses) for each adjustment.

Measures most commonly mentioned included reservoir and dam construction and dredging. Generally, however, technical adjustments were ranked below warning and emergency services (Civil Defence) and zoning regulations in terms of effectiveness.

When asked what public adjustments they would adopt, given the power, the one most respondents would 'definitely adopt' was provision of flood information to the public, followed by warning, evacuation and zoning measures. Here, respondents' perception of the need for the provision of information corresponds with that of a number of workers in the field. Technical adjustments were the least favoured for adoption.

In the main, the provision of flood information to the public was seen as the responsibility of the Brisbane City Council (BCC) or the BCC in conjunction with the State Government or real estate agent. Less than one-tenth saw the onus as on the potential buyer to obtain information. If an individual had adequate knowledge, however, almost half of those surveyed saw it as the responsibility of that individual to implement flood protection measures. This emphasizes the need for the provision of flood information, not only to overcome the lack perceived by respondents, but also to provide a better basis for the adjustment decisions of flood-plain residents. Some remedy has been effected in the form of brochures distributed by State and federal bodies, but their effect is yet to be tested. Still, over one-third felt it was the responsibility of the State Government, the BCC or both to provide protection. This may reflect the greater perceived capacity of these authorities to implement mitigation work.

More than three-quarters of all respondents felt some government action was possible. The most frequently sought adjustments were

technical ones, followed by zoning regulations, all of which require action at the community level. Less frequently sought were the provision of flood information, evacuation and emergency measures which the individual could personally adopt. In the light of respondents' earlier adoption ranking placing information and warning first, it would appear that respondents hold a separate view of the actions that an individual can take; for example, obtaining information and preparing evacuation plans, and those that should and must of necessity be carried out at the community level; for example, technical measures.

In the private sector, the most common adjustment at the time of the flood was the elevation or removal of possessions. Within this category there existed a wide range of actions reflecting the time available, and depending on the perceived need to act and the accuracy of that perception.

Experience in the January flood does not appear to have led to an increase in knowledge of possible adjustments. The majority of respondents would still rely on elevation or removal of possessions, though the emphasis would be more on removal next time.

In making the flood knowable by asking respondents what they would do if they could expect a flood "this summer", the majority stated they would take no immediate action while, at the other extreme, just over five percent stated they would relocate. Few would take the opportunity to implement flood proofing or more permanent damage reducing measures onsite.

Nearly four-fifths of all respondents have made no adjustments since the flood. Eliminating those who suffered no direct losses in

January and therefore would have little to gain from adopting adjustments, it would appear that nearly 60 percent of respondents are still willing to accept the risk of bearing losses.

The most frequently adopted adjustment was flood proofing which included a variety of measures ranging from special choice of building materials to bricking up openings below expected flood level. Less than three percent had elevated their dwelling and only nine had taken out flood insurance, a reflection in part of the expense involved. Standby preparations had been adopted by only 17 respondents. In the light of previous responses this also would appear low but may be taken as an indication that, in the majority of cases, for standby preparations to be implemented, the flood has to be perceived as an imminent threat.

When the hypothetical situation of a flood probability of once in every ten years was set, just over half of all respondents expressed their unwillingness to accept loss bearing as an alternative, while 90 percent of those who would expressed the intention of also adopting other measures, particularly the making of their own evacuation plans. Approximately half of those questioned would definitely relocate. Flood proofing, structural changes and flood insurance recorded the lowest adoption score and the highest rejection.

It would appear from the above that the range of practical alternatives perceived by the individual flood-plain manager is limited, most placing their reliance on "last minute" emergency measures such as the elevation or removal of possessions. Less than one-eighth have implemented any long term protection measures. Given the threat of future flooding most would choose to bear the loss or relocate rather than outlay what could amount to considerable expense on adjustments with uncertain return in protection.

C H A P T E R 7

FACTORS AFFECTING CHOICE OF ADJUSTMENT

The intention in this chapter is to look into those factors which affect the decision to adopt adjustments and evaluation of the outcome. It has already been seen that perception of the hazard and awareness of adjustments varies greatly within the study area. Here, the third stage of the decision process, evaluation of adjustments is examined in the light of these factors. A simple analysis of the relationship between preparedness and various adjustment measures is also undertaken. Finally, a closer examination is made of one particular adjustment, relocation.

7.1 Perception of the Hazard and Personal Experience

It was noted earlier (Section 2.3.2) that before any process of adjustment can be effected, the flood event must be perceived as sufficiently threatening by the resource manager to warrant action. It was suggested that this threshold, below which a respondent neither seeks nor evaluates adjustments is a function in part of the respondent's perception of the natural event and his or her personal experience.

7.1.1 Hazard evaluation

From an examination of the role of perception of the hazard in the choice of adjustment, it appears in this study that awareness and evaluation of public adjustments are not affected by this measure. But some association can be seen between hazard evaluation and private adjustments. Four public adjustment measures were tested - knowledge of public adjustments as evidenced by the number mentioned in response to Question 35, the view respondents held of the need for flood control plus the number of government actions sought (Question 36), and the number of public adjustments respondents stated they would adopt (Question 37). None were found to be significantly related to hazard evaluation.

When private adjustments were considered a significant relationship was established between the decision to adopt private adjustments and hazard evaluation (Table 7.1). However, it was

TABLE 7.1: Hazard Evaluation* x Private Adjustment Adoption+ since January

Adoption	Hazard Evaluation: Not at all 1	Minor 2	Average 3	Moderate 4	Serious 5	ROW TOTAL
No adjustments made	42 (8.4) [82.4]	174 (34.8) [83.7]	61 (12.2) [74.4]	74 (14.8) [86.0]	149 (29.8) [69.0]	500 77.8
One or more adjustments made	9 (6.3) [17.6]	34 (23.8) [16.3]	21 (14.7) [25.6]	12 (8.4) [14.0]	67 (46.9) [31.0]	143 22.2
COLUMN TOTAL	51 7.9	208 32.3	82 12.8	86 13.4	216 33.6	643 100.0

$\chi^2_{df\ 4} = 18.38$ $p < 0.001$ $n = 643$

* Q.29. On a five-point scale, how would you rank flooding as a hazard to you?

\+ Q.40. Have you done anything since the flood about averting the danger or reducing the damage by flooding?

impossible given the small number of adopters (just over one-fifth of all respondents) to test if a relationship existed between hazard evaluation and the type of adjustment chosen beyond a simple division between minor (standby preparations etc.) and major adjustments (flood proofing measures and structural changes). Using this simple criteria, no significant relationship was detected.

7.1.2 Future flood expectation

Using future flood expectation as a measure of respondents' perception of the natural event, a higher level of correspondence was found for both public and private adjustment measures. All but the

first of the public adjustment measures listed above were significantly related to future flood expectation. As would be expected, the majority of respondents who saw no need for government action expressed a negative future expectation (Table 7.2). With regard to the number of government actions sought, those holding a positive expectation differed

TABLE 7.2: Future Flood Expectation* x Perceived Need for Government Action+

Govt. action needed	Expectation: Positive	Negative	Uncertain	ROW TOTAL
Yes	152 (30.7) [93.3]	186 (37.6) [83.4]	157 (31.7) [86.7]	495 87.3
No	11 (15.3) [6.7]	37 (51.4) [16.6]	24 (33.3) [13.3]	72 12.7
COLUMN TOTAL	163 28.7	223 39.3	181 31.9	567 100.0

$\chi^2_{df\ 2} = 8.31$ $p < 0.02$ $n = 567$

* Q.181 Do you think there will be another flood while you are living here?

\+ Q.36. Is there anything the government can do to prevent or reduce damages from floods?

significantly from those in both the 'negative' and 'uncertain' groups (Table 7.3). The respective mean number of actions sought were 2.4 (positive expectation), 1.8 (negative) and 2.1 (uncertain). When respondents were given power to act, a similar trend was evidenced (Table 7.4). Here respondents with a positive expectation would themselves be more likely to adopt a greater number of public adjustments (mean number 1.8). The majority of those in the negative group would adopt one adjustment or none at all (mean number 1.2). Those uncertain

TABLE 7.3: Future Flood Expectation* x Number of Government Actions Sought+

Expectation	Number of Actions 0	1	2	3 or more	ROW TOTAL
Positive	28 (15.6) [18.5]	43 (23.9) [23.9]	44 (24.4) [35.5]	65 (36.1) [34.4]	180 28.0
Others	123 (26.5) [81.5]	137 (29.5) [76.1]	80 (17.2) [64.5]	124 (26.7) [65.6]	464 72.0
COLUMN TOTAL	151 23.4	180 28.0	124 19.3	189 29.3	644 100.0

$\chi^2_{df\ 3} = 15.50$ $p < 0.005$ $n = 644$

*Q.18. (as for Table 7.2) +Q.36. (as for Table 7.2)

TABLE 7.4: Future Flood Expectation* x Respondents' Public Adjustment Adoption

No. of Adjustments	Expectation Positive	Negative	Uncertain	ROW TOTAL
0	43 (21.6) [23.9]	88 (44.2) [34.6]	68 (34.2) [32.4]	199 30.9
1	55 (27.1) [30.6]	89 (43.8) [35.0]	59 (29.1) [28.1]	203 31.5
2	40 (33.3) [22.2]	46 (38.3) [18.1]	34 (28.3) [16.2]	120 18.6
3 or more	42 (34.4) [23.3]	31 (25.4) [12.2]	49 (40.2) [23.3]	122 18.9
COLUMN TOTAL	180 28.0	254 39.4	210 32.6	644 100.0

$\chi^2_{df\ 6} = 18.01$ $p = 0.006$ $n = 644$

*Q.18. Do you think there will be another flood while you are living here?

+Q.37. Given a position of "strong authority" what would you have done about the flood situation?

of future flooding show a response pattern closer to the 'positive' group with a mean of 1.6, and testing showed no significant difference between these two groups.

The full set of private adjustments made by those in each expectation group is shown in Table 7.5, while the relationship between

TABLE 7.5: Future Flood Expectation* x Type of Private Adjustment Adopted since January+

Adjustment	Expectation					
	Positive		Negative		Uncertain	
	No.	%	No.	%	No.	%
None	128	71.1	209	82.3	165	78.6
1. Civil Defence, volunteer work meetings	10	5.6	3	1.2	11	5.2
2. Standby preparations, drainage, other	9	5.0	19	7.5	8	3.8
3. Insurance	0	0.0	5	2.0	3	1.4
4. Flood-proofing, restumping	20	11.1	15	5.9	20	9.5
5. Structural changes to dwelling	13	7.2	3	1.2	3	1.4
TOTAL	180	100.0	254	100.0	210	100.0

* Q.18. (as for Table 7.4)

\+ Q.40. Have you done anything since the flood about averting the danger or reducing the damage by flooding?

future flood expectation and adoption of private adjustments is set out in Tables 7.6 and 7.7. Findings here support evidence in other studies (Kates, 1962; Burton, Kates and Snead, 1969) where the frequency of adoption of adjustments and the variation in adoption between individual managers is strongly related to expectation of future flooding. Here, the difference in adoption rate and type of adjustment chosen is most

TABLE 7.6: Future Flood Expectation* x Private Adjustment Adoption since January+

Adoption	Expectation			
	Positive	Negative	Uncertain	Row Total
No adjustments made	128 (25.5) [71.1]	209 (41.6) [82.3]	165 (32.9) [78.6]	502 78.0
One or more adjustments made	52 (36.6) [28.9]	45 (31.7) [17.7]	45 (31.7) [21.4]	142 22.0
COLUMN TOTAL	180 28.0	254 39.4	210 32.6	644 100.0

$\chi^2_{df\ 2} = 7.72$ $p < 0.025$ $n = 644$

* Q.18. Do you think there will be another flood while you are living here?

\+ Q.40. Have you done anything since the flood about averting the danger or reducing the damage by flooding?

TABLE 7.7: Future Flood Expectation* x Private Adjustment Type Adopted since January+

Expectation	Adjustment Type#			
	None	Minor 1 - 3	Major 4 & 5	ROW TOTAL
Positive	128 (71.1) [38.0]	19 (10.6) [41.3]	33 (18.3) [64.7]	180 41.5
Negative	209 (82.3) [62.0]	27 (10.6) [58.7]	18 (7.1) [35.3]	254 58.5
COLUMN TOTAL	337 77.6	46 10.6	51 11.8	434 100.0

$\chi^2_{df\ 2} = 13.03$ $p < 0.005$ $n = 434$

*Q.18. (as for Table 7.6)

\+Q.40. (as for Table 7.6)

#For full set see Table 7.5.

marked between the 'positive' and 'negative' expectation groups. As would be expected, the group with the greatest proportion of adopters is that expressing a positive future flood expectation. Nearly three-fifths of the adopters in this group have made or are in the process of making major adjustments including flood proofing or structural changes to the dwelling. A smaller proportion of those in the negative group have made adjustments and nearly half of these have been of a minor nature. It is interesting to note that none of the eight respondents who took out flood insurance after the flood expect future flooding (three were uncertain and five held a negative expectation). Given the existence of the required motivation as evidenced by the implementation of other major adjustments, the absence of this adjustment among those with a positive expectation may reflect its general unavailability to those at greater risk. It may also reflect a distinction between 'active' and 'passive' adjustment measures, those with a positive expectation being more inclined to take 'active' measures such as flood proofing or structural changes designed to reduce losses at the source rather than a 'passive' adjustment such as insurance. (Respondents' family income was not significantly related to either future flood expectation or private adjustment type adopted and therefore can be ruled out as a factor.)

7.1.3 Magnitude of flooding and expected flood frequency

Other variables in the perception of the hazard that may be expected to bear on the choice of adjustment are expected flood frequency and magnitude of flooding. Kates (1962) states that floods need to be experienced not only in magnitude, but in frequency as well. He links frequency with motivation to seek adjustment alternatives and to the continuance of those already learned. Other studies, notably that

of Burton, Kates and Snead (1969) rank hazard frequency along with expectation of future flooding as major factors in the frequency of adoption of adjustments and the variation in adoption between managers.

In the January flood the degree of flooding made no significant difference to the type of action adopted at the time, conceivably because the majority of residents were equally uncertain as to the level flood waters would reach. A distinction can however be drawn between magnitude classes in the type of adjustment made since the January flood. No significant difference was found to exist between those whose dwelling was partly flooded and those fully submerged, or by the depth of flood water entering the dwelling. A difference, however, appears to occur between respondents when flood waters entered the living area of the dwelling. Table 7.8 shows the variation in private adjustments adopted using the two divisions.

TABLE 7.8: Degree of Flooding* x Private Adjustment Type Adopted since January+

Degree of flooding	Adjustment Type: None	Minor 1 - 3	Major 4 & 5	ROW TOTAL
Yard only affected	206 (84.8) [41.3]	20 (8.2) [29.9]	17 (7.0) [23.0]	243 38.0
Dwelling partly/fully submerged	293 (73.8) [58.7]	47 (11.8) [70.1]	57 (14.4) [77.0]	397 62.0
COLUMN TOTAL	499 78.0	67 10.5	74 11.6	640 100.0

$\chi^2_{df\ 2} = 11.27$ $p < 0.005$ $n = 640$

* Q.1. To what depth did the January flood water enter your home?

\+ Q.40. Have you done anything since the flood about averting the danger or reducing the damage by flooding?

A similar division was found in the knowledge of public adjustments respondents possessed. Those whose dwelling was partly or fully submerged generally possessed knowledge of more public adjustments (Table 7.9). However, testing failed to find any

TABLE 7.9: Degree of Flooding* x Number of Public Adjustments Known of+

Degree of flooding	Number of Adjustments 0	1	2	3 or more	ROW TOTAL	Mean Number
Yard only affected	124 (51.0) [42.0]	77 (31.7) [39.3]	22 (9.1) [30.1]	20 (8.2) [26.3]	243 38.0	0.8
Dwelling partly or fully submerged	171 (43.1) [58.0]	119 (30.0) [60.7]	51 (12.8) [69.9]	56 (14.1) [73.7]	397 62.0	1.7
COLUMN TOTAL	295 46.1	196 30.6	73 11.4	76 11.9	640 100.0	

$\chi^2_{df\ 3} = 8.50$ $p < 0.05$ $n = 640$

*Q.1. (as for Table 7.8)

+Q.35. Do you know of anything being done to reduce flood damage?

significant relationship between degree of flooding and the other public adjustment measures. It would seem reasonable to expect that those suffering a greater depth of inundation would desire more government action (Question 36) and themselves implement a greater number of public adjustments if given the power (Question 37). This was not found to be the case.

One possible reason for the lack of association between magnitude of flooding and these measures may be found in the relationship between magnitude and experience. In the study area, frequency of experience

varies inversely with magnitude. Those suffering the worst inundation are flooded only infrequently while at the other end of the scale, inundation may be minimal though more frequent. Thus frequency of experience may be thought of as a compensating factor for severity of flooding.

In the two instances where public adjustment measures were related to expected flood frequency, the outcome may be attributed to the degree of certainty inherent in responses. In the first case, those who felt a flood could occur at any time differed significantly from all other groups[1] in the number of public adjustments known of (Table 7.10). The former's range of knowledge was smaller than that of the other groups in keeping with Kates' findings (1962) where uncertainty was equated with little variation among respondents.

TABLE 7.10: Perceived Flood Frequency* x Number of Public Adjustments Known of+

Perceived frequency	Number of Adjustments 0	1	2	3 or more	ROW TOTAL	Mean Number
Perhaps anytime	18 (36.7) [6.1]	24 (49.0) [12.1]	6 (12.2) [8.2]	1 (2.0) [1.3]	49 7.6	1.25
Other	276 (46.4) [93.9]	175 (29.4) [87.9]	67 (11.3) [91.8]	77 (12.9) [98.7]	595 92.4	1.63
COLUMN TOTAL	294 45.7	199 30.9	73 11.3	78 12.1	644 100.0	

$\chi^2_{df\ 3} = 11.20$ $p < 0.02$ $n = 644$

* Q.14. How often do you expect the people in this dwelling will be directly affected by a flood?

\+ Q.35. Do you know of anything being done to reduce flood damage?

[1] No significant difference was found amongst these, that is 'don't know', 'never/rarely' and those giving an estimate in years.

A slightly different pattern was observed in the relationship between expected frequency and the number of government actions sought (Table 7.11). Again, the response of those who were of the opinion a flood could be expected any time was relatively narrow (mean number 1.6). But the response of those in the 'don't know' and 'never/rarely' groups was not significantly different from that of this group, while all were significantly different from the group making an estimate.

TABLE 7.11: Perceived Flood Frequency* x Number of Government Actions Sought+

Perceived frequency	Number of Actions: 0	1	2	3 or more	ROW TOTAL	Mean Number
Estimate in years	77 (21.0) [51.0]	82 (22.3) [45.8]	76 (20.7) [61.3]	132 (36.0) [69.5]	367 57.0	2.17
Other	74 (26.7) [49.0]	97 (35.0) [54.2]	48 (17.3) [38.7]	58 (20.9) [30.5]	277 43.0	1.73
COLUMN TOTAL	151 23.4	179 27.8	124 19.3	190 29.5	644 100.0	

$\chi^2_{df\ 3} = 24.36$ $p < 0.001$ $n = 644$

* Q.14. (as for Table 7.10)

\+ Q.36. Is there anything the government can do to prevent or reduce damages from floods?

The lower mean for those in the 'don't know' category may again be equated with the effect of uncertainty, while those 'never' or 'rarely' expecting another flood would have little reason to seek government action.

The effect of perceived flood frequency can also be seen in the adoption of private adjustments since January (Table 7.12). Again

TABLE 7.12: Perceived Flood Frequency* x Private Adjustment Adopted since January+

Perceived Frequency	Adoption: No Adjustments made	Adoption: One or more Adjustments made	ROW TOTAL
Perhaps any time/ don't know	160 (72.7) [32.8]	60 (27.3) [42.6]	220 35.0
Estimate in years/ never-rarely	328 (80.2) [67.2]	81 (19.8) [57.4]	409 65.0
COLUMN TOTAL	488 77.6	141 22.4	629 100.0

$\chi^2_{df\ 1} = 4.59$ $p < 0.05$ $n = 629$

*Q.14. (as for Table 7.10)

+Q.40. Have you done anything since the flood about averting the danger or reducing the damage by flooding?

certainty appears to be the operative factor. Those uncertain of flood frequency differ significantly from those making an estimate or those who 'never/rarely' expect a flood. The latter two may be equated with certainty, either positive or negative. While this result would be expected given that certainty in the present instance may be equated with complacency, it should also be recognized that uncertainty here reflects a more realistic appraisal of the situation, and one that would rationally lead to higher motivation to adopt adjustments.

7.1.4 Personal experience

Personal experience onsite was found to significantly affect an individual's private adjustment decision process, though the same was not found to be true for any of the public adjustment measures tested. In the January flood the percentage of those with no experience who took no action was double that of those with experience, while a greater

proportion of the latter group instigated emergency actions such as elevating or removing goods (Table 7.13). This supports the relationship

TABLE 7.13: Experience Onsite* x Private Adjustments Adopted in the January Flood+

Experience	Adjustment: None	Standby preparations only	Elevation or removal of goods	ROW TOTAL
None	100 (20.8) [87.7]	6 (1.3) [75.0]	374 (77.9) [75.9]	480 78.0
1 or more	14 (10.4) [12.3]	2 (1.5) [25.0]	119 (88.1) [24.1]	135 22.0
COLUMN TOTAL	114 18.5	8 1.3	493 80.2	615 100.0

$\chi^2_{df\ 2} = 7.64$ $p < 0.025$ $n = 615$

*Q. 7. How many of these (i.e. floods) affected your present dwelling?

+Q.39. When the January flood came, what action did you take to prevent or reduce damages?

found between onsite experience and the respondent's view of his state of preparedness at the time of the January flood, those with experience, in general, feeling they were better prepared (Table 7.14). An analysis of the relationship between experience and respondents' present state of preparedness reveals much less of a difference in preparedness between the two groups, though those with experience are still better prepared (Table 7.15). The lessening of the difference may be attributed to respondents' sharing in the common pool of flood knowledge developed after the January flood. This sharing may also contribute to the similarity in private adjustment adoption.

TABLE 7.14: Experience Onsite* x State of Preparedness for January Flood+

Experience	Preparedness ranking: Not at all 1	Poor 2	Fair 3	Good 4	Very well 5	ROW TOTAL
None	374 (75.4) [88.6]	45 (9.1) [70.3]	34 (6.9) [50.0]	21 (4.2) [53.8]	22 (4.4) [56.4]	496 78.5
1 or more	48 (35.3) [11.4]	19 (14.0) [29.7]	34 (25.0) [50.0]	18 (13.2) [46.2]	17 (12.5) [43.6]	136 21.5
COLUMN TOTAL	422 66.8	64 10.1	68 10.8	39 6.2	39 6.2	632 100.0

$\chi^2_{df\ 4} = 86.17$ $p < 0.001$ $n = 632$

* Q. 7. (as for Table 7.13)

\+ Q.12. How would you rank your preparedness for the January flood on a five point scale?

TABLE 7.15: Experience Onsite* x State of Present Preparedness+

Experience	Preparedness ranking: Not at all 1	Poor 2	Fair 3	Good 4	Very well 5	ROW TOTAL
None	123 (24.2) [87.2]	65 (12.8) [73.9]	142 (27.9) [76.3]	106 (20.8) [80.3]	73 (14.3) [73.7]	509 78.8
1 or more	18 (13.1) [12.8]	23 (16.8) [26.1]	44 (32.1) [23.7]	26 (19.0) [19.7]	26 (19.0) [26.3]	137 21.2
COLUMN TOTAL	141 21.8	88 13.6	186 28.8	132 20.4	99 15.3	646 100.0

$\chi^2_{df\ 4} = 9.65$ $p < 0.05$ $n = 646$

* Q. 7. (as for Table 7.13)

\+ Q.13. How would you rank your present preparedness for a flood?

Except in the case of structural changes and flood insurance, little variation exists in the type of private adjustment adopted since January for those with experience and those without (Table 7.16).

TABLE 7.16: Experience Onsite* x Type of Private Adjustment Adopted since January+

Adjustment	Experience: None No.	%	1 or more No.	%
None	400	78.4	104	75.9
1. Civil Defence, volunteer work, meetings	19	3.7	5	3.6
2. Standby preparations, drainage, other	30	5.9	6	4.4
3. Insurance	7	1.4	1	0.7
4. Flood-proofing, restumping	46	9.0	10	7.3
5. Structural changes to dwelling	8	1.6	11	8.0
TOTAL	510	100.0	137	100.0

* Q. 7. (as for Table 7.13)

+ Q.40. Have you done anything since the flood about averting the danger or reducing the damage by flooding?

Only a slightly higher proportion of those with experience have adopted any form of private adjustment while an approximately equal proportion of each group have undertaken minor adjustment measures. The greater proportion of those with previous flood experience onsite implementing structural changes would seem a natural outcome of weighing the cumulative cost of flood loss experienced against the cost involved in making this adjustment. As with future flood expectation (Section 7.1.2) the idea of 'active' versus 'passive' adjustments could also be expected to play a role here and could account for the disparity in the adoption of insurance as an adjustment. But again, part of the difference may be attributed to the difficulty of obtaining cover.

Looking at emergency measures, White (1964) observed that those most recently flooded perceived these more acutely. In the present study, recency was not found to be a significant factor in the type of adjustment made at the time of the January flood. Nor was it found to be related to the number or type of adjustments made since the flood.

7.2 Evaluation of Preparedness

The term adjustment generally implies some physical action on the part of the respondent. However, a respondent's mental attitude to the flood hazard may be just as, if not more important, as it affects his predisposition to seek, evaluate and adopt adjustments.

The change in a respondent's state of preparedness between the time of the January flood and the interview was considered the most appropriate as a measure of 'mental adjustment'. In the event, this variable was not found to be significantly related to flood hazard evaluation or expectation of future flooding but was related to magnitude of flooding in January and the amount of onsite experience (Tables 7.17 and 7.18). An explanation for this may be that the former are attitudinal measures that change with time reflecting present attitudes and situation. The latter, magnitude and experience, on the other hand are fixed measures of which a respondent's change in preparedness would be an outcome.

As a state of mind, a respondent's evaluation of his/her preparedness may be considered both a result of knowledge of flood mitigation measures (public and private) reflecting the respondent's evaluation of their effectiveness, and a determinant in the decision to seek and implement adjustments. The degree to which preparedness

TABLE 7.17: Change in Preparedness* x Degree of Flooding+

Change in preparedness	Degree of flooding: Yard only affected	Dwelling partly submerged	Dwelling fully submerged	ROW TOTAL
None/negative#	125 (49.6) [51.4]	95 (37.7) [34.9]	32 (12.7) [25.6]	252 39.4
Positive	118 (30.4) [48.6]	177 (45.6) [65.1]	93 (24.0) [74.4]	388 60.6
COLUMN TOTAL	243 38.0	272 42.5	125 19.5	640 100.0

$\chi^2_{df\ 2} = 27.01$ $p < 0.001$ $n = 640$

* Calculated from Q.12. How would you rank your preparedness for the January flood on a 5 point scale? and
Q.13. How would you rank your present preparedness for a flood?

\+ Q. 1. To what depth did the January flood water enter your home?

\# This response was calculated for 17 respondents, representing 6.7% of this class or 2.6% of the total, 647.

TABLE 7.18: Change in Preparedness* x Experience Onsite+

Change in preparedness	Experience: None	1	2 or more	ROW TOTAL
None/negative	177 (69.6) [34.7]	17 (6.7) [43.6]	60 (23.6) [61.2]	254 39.3
Positive	333 (84.7) [65.3]	22 (5.6) [56.4]	38 (9.7) [38.8]	393 60.7
COLUMN TOTAL	510 78.8	39 6.0	98 15.1	647 100.0

$\chi^2_{df\ 2} = 24.57$ $p < 0.001$ $n = 647$

* (as for Table 7.17)

\+ Q. 7. How many of these (i.e. floods) affected your present dwelling?

plays a part in each of these cannot, however, be separated out as the two are interrelated and may function simultaneously.

Respondents' present state of preparedness was first cross-tabulated with the number of public adjustments known of. It was anticipated that a greater knowledge of public adjustments would correspond with a respondent feeling better prepared. This is borne out in Table 7.19 where the state of preparedness can be seen to increase directly with the number of public adjustments known of.

TABLE 7.19: State of Present Preparedness* x Number of Public Adjustments Known of+

Number of adjustments	Preparedness Ranking: Not at all 1	Poor 2	Fair 3	Good 4	Very well 5	ROW TOTAL
0	80 (27.0) [56.7]	31 (10.5) [35.2]	96 (32.4) [51.6]	50 (16.9) [37.9]	39 (13.2) [39.4]	296 45.8
1	44 (22.1) [31.2]	37 (18.6) [42.0]	46 (23.1) [24.7]	43 (21.6) [32.6]	29 (14.6) [29.3]	199 30.8
2	7 (9.6) [5.0]	9 (12.3) [10.2]	28 (38.4) [15.1]	18 (24.7) [13.6]	11 (15.1) [11.1]	73 11.3
3 or more	10 (12.8) [7.1]	11 (14.1) [12.5]	16 (20.5) [8.6]	21 (26.9) [15.9]	20 (25.6) [20.2]	78 12.1
COLUMN TOTAL	141 21.8	88 13.6	186 28.8	132 20.4	99 15.3	646 100.0

$\chi^2_{df\ 12} = 35.80$ $p < 0.001$ $n = 646$

* Q.13. How would you rank your present preparedness for a flood?

\+ Q.35. Do you know of anything being done to reduce flood damage?

A weaker, but still significant relationship exists between present preparedness and the number of government actions sought. Again, the general trend was for state of preparedness to increase with the number of government actions sought (Table 7.20). This response would seem out of keeping if a respondent's evaluation of his own preparedness is taken as a reflection of his evaluation of existing public adjustment measures, and the desire for more government actions seen as a reflection of the perceived inadequacy of existing measures.

TABLE 7.20: State of Present Preparedness* x Number of Government Actions Sought+

Number of actions	Preparedness Ranking					ROW TOTAL
	Not at all 1	Poor 2	Fair 3	Good 4	Very well 5	
0	47 (31.1) [33.3]	21 (13.9) [23.9]	39 (25.8) [21.0]	25 (16.6) [18.9]	19 (12.6) [19.2]	151 23.4
1	41 (22.8) [29.1]	29 (16.1) [33.0]	50 (27.8) [26.9]	32 (17.8) [24.2]	28 (15.6) [28.3]	180 27.9
2	21 (17.1) [14.9]	20 (16.3) [22.7]	39 (31.7) [21.0]	29 (23.6) [22.0]	14 (11.4) [14.1]	123 19.0
3 or more	32 (16.7) [22.7]	18 (9.4) [20.5]	58 (30.2) [31.2]	46 (24.0) [34.8]	38 (19.8) [38.4]	192 29.7
COLUMN TOTAL	141 21.8	88 13.6	186 28.8	132 20.4	99 15.3	646 100.0

$\chi^2_{df\ 12} = 22.68$ $p < 0.03$ $n = 646$

* Q.13. (as for Table 7.19)

\+ Q.36. Is there anything the government can do to prevent or reduce damages from floods?

However, it may simply illustrate a greater knowledge of adjustments that could be implemented among those better prepared (as Table 7.19

illustrates). The relationship between preparedness and the number of public adjustments respondents would adopt was not significant beyond the 0.5 level, but a similar trend was evident in that an increase in preparedness corresponded to an increase in the number of adjustments mentioned for adoption.

An analysis of the relationship between preparedness and the adoption of private adjustments since January revealed a significant and direct relationship between the two (Table 7.21).

TABLE 7.21: State of Present Preparedness* x Private Adjustment Adoption since January+

Adoption	Preparedness Ranking					ROW TOTAL
	Not at all 1	Poor 2	Fair 3	Good 4	Very well 5	
No adjustments made	128 (25.4) [90.8]	69 (13.7) [78.4]	147 (29.2) [79.0]	93 (18.5) [70.5]	66 (13.1) [66.7]	503 77.9
One or more adjustments made	13 (9.1) [9.2]	19 (13.2) [21.6]	39 (27.3) [21.0]	39 (27.3) [29.5]	33 (23.1) [33.3]	143 22.1
COLUMN TOTAL	141 21.8	88 13.6	186 28.8	132 20.4	99 15.3	646 100.0

$\chi^2_{df\ 4} = 25.22$ $p < 0.001$ $n = 646$

* Q.13. (as for Table 7.19)

\+ Q.40. Have you done anything since the flood about averting the danger or reducing the damage by flooding?

Though a number of respondents making no adjustment felt well prepared and some making adjustments expressed the opinion they were 'poorly' or 'not at all' prepared, the general trend was for greater preparedness to correspond with the implementation of adjustments. The type of adjustment adopted was not significantly related to preparedness.

The fact that preparedness involves mental and well as physical considerations is borne out by an examination of Table 7.22. Keeping in mind that only seventeen respondents recorded a negative change and that lack of change need not correspond to poor preparedness, a greater proportion of those making adjustments recorded a positive change. At the same time, more than half of those making no adjustment also recorded a positive change in their preparedness since January.

TABLE 7.22: Change in Preparedness* x Private Adjustment Type Adopted since January+

Change in preparedness	Adjustment Type None	Minor 1 - 3	Major 4 & 5	ROW TOTAL
None/negative	213 (83.9) [42.3]	19 (7.5) [27.9]	22 (8.7) [29.3]	254 39.3
Positive	291 (74.0) [57.7]	49 (12.5) [72.1]	53 (13.5) [70.7]	393 60.7
COLUMN TOTAL	504 77.9	68 10.5	75 11.6	647 100.0

$\chi^2_{df\ 2} = 8.66$ $p < 0.02$ $n = 647$

* (as for Table 7.17)

\+ Q.40. Have you done anything since the flood about averting the danger or reducing the damage by flooding?

The effect of preparedness on predisposition to the adoption of adjustments is evidenced in Table 7.23. If a warning were given that a flood were coming the following summer, the proportion of the positive change group who would act was more than double that of those recording a 'negative' or 'no change'.

TABLE 7.23: Change in Preparedness* x Planned Action if Warning Given+

Change in preparedness	Action: None	Onsite Adjustment	Move	ROW TOTAL
None/negative	191 (78.0) [46.8]	43 (17.6) [23.2]	11 (4.5) [32.4]	245 39.1
Positive	217 (56.8) [53.2]	142 (37.2) [76.8]	23 (6.0) [67.6]	382 60.9
COLUMN TOTAL	408 65.1	185 29.5	34 5.4	627 100.0

$\chi^2_{df\ 2} = 30.39$ $p < 0.001$ $n = 627$

* (as for Table 7.17)

\+ Q.39 (4) If a warning were given that a flood is coming this summer, would you do anything different?

To further check respondents' perception of their preparedness and their evaluation of any private adjustments adopted, three further questions were posed. Firstly, respondents were asked if they felt their property was safe enough or whether they intended adopting other adjustments (Question 41). The association between this response and the adoption of private adjustments is set out in Table 7.24. Several points emerge from an analysis of this table. Sixty percent of respondents felt they were safe enough, though for only one-fifth could this evaluation be associated with the implementation of one or more adjustments. Of those who had made adjustments, over half felt these satisfactorily assured protection. Of those who did not feel this, seven percent planned further action. Around forty percent did not feel fully safe, but planned no further action. In all, four percent of the total number of respondents planned improvements.

TABLE 7.24: Perception of Present Safety* x Adoption of Private Adjustments since January+

Adoption	Perceived Safety: Safe Enough	Will improve	Not fully safe, but no adjustment planned	ROW TOTAL
No adjustments made	300 (62.2) [80.4]	16 (3.3) [61.5]	166 (34.4) [74.4]	482 77.5
One or more adjustments made	73 (52.1) [19.6]	10 (7.1) [38.5]	57 (40.7) [25.6]	140 22.5
COLUMN TOTAL	373 60.0	26 4.2	223 35.8	622 100.0

$\chi^2_{df\ 2} = 6.83$ $p < 0.05$ $n = 622$

*Q.41. Do you feel your property is safe enough now, or do you intend to adopt further adjustments?

+Q.40. Have you done anything since the flood about averting the danger or reducing the damage by flooding?

The other two questions (Q.44 and 45) concerned the type and extent of damage expected should flooding occur again. Response concerning the expected effect of a future flood varied widely from no effect, through minor inconvenience to impairment of health and structural damage to the dwelling (Table 7.25). By far the most frequent effect cited was not material loss, but anxiety. Though often mentioned in conjunction with another effect, the anxiety reaction seemed to be the one that remained uppermost in respondents' minds and weighed most heavily in their consideration of future flood effects. It is evident that interviewees varied in their evaluation of what constituted an "effect". For example, though restriction of activity would have been experienced by the majority of respondents, it was cited by only 120.

TABLE 7.25: Expected Effect of Future Flood*

Effect	Respondents No.	Respondents %#
Structural damage	181	28.0
Contents damage	248	38.3
Other property damage	45	7.0
Activity restricted	120	18.5
Anxiety	382	59.0
Inconvenience	26	4.0
Clean-up	56	8.7
Physical health affected	17	2.6
Mental health affected	17	2.6
Hardship	1	0.2
Other	12	1.9
No effect	75	11.6

* Q.44. If this area is affected by a flood again, in what way do you think it would affect your household?

n = 647

A similar situation can be seen in looking at the response of those who expect 'no effect'. The majority of respondents in this group based their judgment on their experience in January and previous floods (Table 7.26). Presumably, should flooding occur in their area, the property of these respondents would again be subject to some degree of flooding and would therefore require some clean-up, cited by 56 respondents as an expected effect (Table 7.25). It appears though, that for these respondents, the effort would be inconsequential.

In terms of the level of damage expected, more than half expected less or no damage next time. Knowledge of public adjustments was not found to be significant in relation to the level expected, further supporting earlier evidence (Section 6.2.2) that respondents do not place all their reliance on public adjustments for damage reduction.

TABLE 7.26: Reason for Expecting Future Flood to Have No Effect*

Reason	Respondents	
	No.	%
Yard only flooded in Jan.1974	26	34.7
Past experience	24	32.0
Do not expect another flood	8	10.7
Raised house	2	2.7
Move before	2	2.7
Other	6	8.0
Not stated	7	9.3
TOTAL	75	100.0

*Q.44. If this area is affected by a flood again, in what way do you think it would affect your household?
If "no effect": Why do you think this?

Expected future flood damage level was related to the adoption of private adjustments (Table 7.27). Those expecting less damage have the highest adoption rate and the greatest proportion adopting major adjustments. Those expecting no damage recorded the lowest adoption rate reflecting the response in Table 7.26 where expected lack of future damage was related to a low threat perception rather than obviation through the instigation of adjustment measures. The degree of damage expected does not appear to be the operative factor. Rather it was found that those expecting any damage whether less, the same or more, differed significantly from those expecting none.

A comparison of future flood damage expectation and present safety evaluation revealed a similar situation. No significant difference existed in the response of those expecting different levels of damage in the level of safety they felt. The 'safe' response varied from 45 percent for those expecting more damage to 60 percent for those expecting the same level, in comparison with nearly 90 percent for those expecting no damage (Table 7.28).

TABLE 7.27: Expected Damage Level of a Future Flood* x Private Adjustment Type Adopted since January+

Adjustment type	Expected damage level: Less	Same	More	No damage	ROW TOTAL
None	181 (39.9) [70.4]	157 (34.6) [82.2]	49 (10.8) [73.1]	67 (14.8) [94.4]	454 77.5
Minor 1 - 3	27 (43.5) [10.5]	22 (35.5) [11.5]	11 (17.7) [16.4]	2 (3.2) [2.8]	62 10.6
Major 4 & 5	49 (70.0) [19.1]	12 (17.1) [6.3]	7 (10.0) [10.4]	2 (2.9) [2.8]	70 11.9
COLUMN TOTAL	257 43.9	191 32.6	67 11.4	71 12.1	586 100.0

$\chi^2_{df\ 6} = 32.45$ $p < 0.001$ $n = 586$

* Q.45. Do you expect damages to be less, more or about the same as before, should flooding occur again?

\+ Q.40. Have you done anything since the flood about averting the danger or reducing the damage by flooding?

TABLE 7.28: Expectation of Damage in a Future Flood* x Perception of Present Safety+

Damage expectation	Perceived safety: Safe enough	Will improve	Not fully safe but no adjustment planned	ROW TOTAL
No damage expected	59 (86.8) [16.9]	1 (1.5) [4.3]	8 (11.8) [4.1]	68 12.0
Some damage expected	291 (58.1) [83.1]	22 (4.4) [95.7]	188 (37.5) [95.9]	501 88.0
COLUMN TOTAL	350 61.5	23 4.0	196 34.4	569 100.0

$\chi^2_{df\ 2} = 20.80$ $p < 0.001$ $n = 569$

* Q.45. (as for Table 7.27)

\+ Q.41. Do you feel your property is safe enough now, or do you intend to adopt further adjustments?

7.3 The Decision to Relocate

For floodplain residents the ultimate adjustment to the threat of flood is relocation. Yet continued occupance of flood-prone areas appears the rule. Some explanation for this is sought in the present section, to test the third hypothesis (Section 2.4.2).

Over four-fifths of all respondents planned to remain in their present location (Table 7.29). For those considering or likely to move,

TABLE 7.29: Present Moving Plans*

	Respondents	
	No.	%
Definitely stay	539	83.3
Considering moving	31	4.8
Probably move	18	2.8
Definitely move	44	6.8
Not stated	15	2.3
TOTAL	647	100.0

* Q.23. As of the present, what are your moving plans?

the importance of the January flood and the possibility of future flooding in that decision was sought. For the majority, flooding was found to play some role in their decision (Table 7.30).

TABLE 7.30: Importance of Flooding in Decision to Move

	Importance						
	Not at all		Somewhat		Very		TOTAL
	No.	%	No.	%	No.	%	
January flood*	24	26.9	25	27.2	43	46.7	92
Future flood possibility**	24	27.0	22	24.7	43	48.3	89

* Q.24. How important would you say the effect of the January floods was on that decision (i.e. to move)?

**Q.25. How important is the possibility of a future flood on that decision (i.e. to move)?

More respondents considered moving immediately after the January flood, but, as Table 7.31 shows, this was only an initial reaction in some instances and was rejected by others. Approximately two-thirds did not

TABLE 7.31: Consideration of Relocation in January*

	Respondents	
	No.	%
Seriously considered moving	87	13.4
Considered moving but only at first	56	8.7
Considered moving, but rejected idea	74	11.4
Did not consider moving	410	63.3
Not stated	20	3.1
TOTAL	647	100.0

* Q.21. Did you consider shifting after the January flood?

consider moving. But when respondents were asked if they would still choose their present location knowing what they know now about flooding, 309 (47.7%) said they would not (Table 7.32). Reasons for not moving

TABLE 7.32: Choice of Present Location Given Knowledge of Flooding*

	Respondents	
Choice	No.	%
Would choose present location	312	48.2
Would not choose present location	309	47.7
Don't know/not stated	26	4.0
TOTAL	647	100.0

* Q.20. Knowing what you know now about flooding, would you choose to locate here again?

in these circumstances varied, but the dominant one was economic. Over half cited the cost of moving as the major deterrent, while another 15 percent cited the difficulty of selling and getting value for their property (Table 7.33). What could be termed social reasons, for example "like it here" and "nowhere else to go" were next in importance. This supports the suggestion by Roder (1961) and Ericksen (1967) that social and economic factors are stronger forces in affecting decisions on

TABLE 7.33: Reasons for Not Moving*

Reason	Respondents			
	Major reason		Secondary reason	
	No.	%	No.	%
Costs too high	156	57.1	9	17.6
Problem selling/getting value	42	15.4	6	11.8
Like it here	32	11.7	25	49.0
Nowhere else to go	16	5.9	2	3.9
Never thought of moving	7	2.6	1	2.0
Investment in property	4	1.5	-	-
Age	3	1.1	3	5.9
Other	13	4.8	5	9.8
TOTAL	273	100.0	51	100.0

* Q.20. (If you would not choose to locate here again) Why don't you move?

changing land-use than is the fear of flood hazard, evidenced in Tables 7.34 and 7.35.

Given free choice, 55 percent of respondents would stay in their present location. Of those who would choose to move, 55 respondents nominated the same suburb and a further 19, a neighbouring flood-free suburb (Table 7.36). While the flood-free nature of the location was the major consideration, the prominent influence of location considerations is also evident (Table 7.37).

TABLE 7.34: Hazard Evaluation* x Choice of Present Location Given Knowledge of Flooding+

Choice	Hazard Evaluation					ROW TOTAL
	Not at all 1	Minor 2	Average 3	Moderate 4	Serious 5	
Would choose present location	39 (12.6) [81.3]	124 (40.1) [62.0]	46 (14.9) [59.0]	39 (12.6) [47.6]	61 (19.7) [29.2]	309 50.1
Wound not choose present location	9 (2.9) [18.8]	76 (24.7) [38.0]	32 (10.4) [41.0]	43 (14.0) [52.4]	148 (48.1) [70.8]	308 49.9
COLUMN TOTAL	48 7.8	200 32.4	78 12.6	82 13.3	209 33.9	617 100.0

$\chi^2_{df\ 4} = 69.19$ $p < 0.001$ $n = 617$

*Q.29. On a five-point scale how would you rank flooding as a hazard to you?

+Q.20. (as for Table 7.32)

TABLE 7.35: Future Flood Expectation* x Choice of Present Location Given Knowledge of Flooding+

Choice	Expectation			ROW TOTAL
	Positive	Negative	Uncertain	
Would choose present location	68 (21.8) [39.3]	143 (45.8) [57.4]	101 (32.4) [51.3]	312 50.4
Would not choose present location	105 (34.2) [60.7]	106 (34.5) [42.6]	96 (31.3) [48.7]	307 49.6
COLUMN TOTAL	173 27.9	249 40.2	197 31.8	619 100.0

$\chi^2_{df\ 2} = 13.50$ $p < 0.002$ $n = 619$

* Q.18. Do you think there will be another flood while you are living here?

+ Q.20. (as for Table 7.32).

TABLE 7.36: Relocation Area Given Free Choice*

Area	Respondents No.	%
Same suburb - flood free	55	21.2
Neighbouring - flood free suburb	19	7.3
Other Brisbane - flood free	57	21.9
Unspecified - flood free	78	30.0
Other	41	15.8
Don't know	10	3.8
TOTAL	260	100.0

* Q.22. If 'would move', where would you like to live, given free choice?

TABLE 7.37: Reasons for Relocation Area Choice*

Reason	Respondents 1st Reason No.	%	2nd Reason No.	%	3rd Reason No.	%
Flood free	125	52.7	8	8.8	3	8.1
Location - work related	12	5.1	5	5.5	1	2.7
- non work related	51	21.5	13	14.3	8	21.6
Social considerations	12	5.1	14	15.4	1	2.7
Environmental quality	11	4.6	11	12.1	8	21.6
Convenience	10	4.2	12	13.2	3	8.1
Facilities offered	7	3.0	5	5.5	5	13.5
House related factors	6	2.5	7	7.7	4	10.8
Aesthetic quality	3	1.3	16	17.6	4	10.8
TOTAL	237	100.0	91	100.0	37	100.0

* Q.22. What are your reasons for choosing that area (to relocate), in order of importance?

Consistent with earlier response patterns (Section 6.2.2 and 7.2) the desire to move or stay was not significantly related to either knowledge of existing public adjustments or the perceived effectiveness of Wivenhoe Dam.

7.4 Summary

The adoption of private adjustments was found to be significantly related to flood hazard evaluation, expectation of future flooding, degree of flooding and expected flood frequency. In the latter case, uncertainty was related to a greater adoption rate. With regard to magnitude of flooding, whether or not flood waters entered the living area of the dwelling was found to be the operative factor affecting adjustment adoption. In future flood expectation, a positive expectation was related to a higher frequency of adoption, especially of major adjustments, supporting the findings of Kates (1962) and Burton, Kates and Snead (1969). Onsite experience was a significant factor in the action taken in the January flood - those with previous experience being more prepared and proportionally taking more action. Since January, the gap in level of preparedness has narrowed and, except for the adoption of structural changes, no significant difference was evident in the private adjustments adopted. This would suggest a sharing of common knowledge amongst floodplain residents in the period since the flood. Recency of experience was not found to be a factor in the adoption decision.

The situation of increased public confidence being generated by a knowledge of flood control works noted by Heron (1972) and Hewitt and Burton (1971) among others, does not appear to be operative in the present study, in that the level of flood damage expected in the future was not significantly related to knowledge of public adjustments.

However, respondents' level of preparedness did increase with the adoption of private adjustment measures. It is also suggested that level of preparedness incorporates some degree of mental adjustment to flood hazard, the evidence for this being that more than half of those showing a positive change in preparedness had not undertaken any physical adjustments. The importance of the mental component is further stressed in the expected effect of future flood. The most frequent effect, cited by approximately 60 percent of all respondents, was anxiety.

Relocation as the ultimate adjustment to the flood hazard would be adopted by approximately 45 percent of all respondents, given free choice. At the time of the study, four-fifths intended staying in their present location. Cost of moving and obtaining value for their property were cited as the primary deterrents to moving with social considerations next in importance. These findings support the suggestion by Roder (1961) and Ericksen (1967) that social and economic factors are stronger forces than fear of flooding regarding land use change. They also serve to substantiate the third hypothesis (Section 2.4.2): that there are rational explanations for the persistence of human occupance in areas of higher risk.

C H A P T E R 8

CONCLUSION

8.1 Restatement of Research Objectives

The stated aim of this research was to investigate how residential managers respond to flood events and to explore the differences that exist in that response. The approach was behavioural. Perceptions and attitudes toward flood hazard and toward adjustments, both public and private, made in response to it were examined with the view to gaining some insight into how flood plain occupants view their environment and the processes by which they cope with the hazard they face.

8.2 Conclusions

Looking at the results obtained from the analysis of the three hypotheses set down for study at the end of the second chapter (see Sections 5.7, 6.5 and 7.4), one factor stands out for its role in both perception of the hazard and response to it. That factor is information. In support of findings elsewhere (Burton, 1961; Kates, 1962 and 1971), evidence in the present study shows a direct relationship between knowledge (or awareness) and experience, the two components of information, and both hazard evaluation (Section 5.3 and 5.4.2) and expectation of future flooding (Section 5.5.3). The latter, in turn, are significantly related to the perception and adoption of adjustments by flood plain occupants (Section 7.1).

However, it is the direct role of information in the adoption process that is of particular importance. Its pervasive influence as a variable affecting the perception, evaluation and adoption of adjustments is evidenced throughout the study. Failure to act in the January flood was related to respondents' failure to accurately perceive the flood risk and lack of awareness of alternative adjustments. As found in other studies (Burton, 1961; Roder, 1961; White, 1961b; Kates, 1962), those with knowledge

or experience of flooding were more likely to act and also adopted a greater number of adjustments (Section 6.4.1). The similarity in private adjustment adoption since the January flood and the lessening of difference in the state of preparedness between those with previous experience and those without suggests that a common pool of knowledge has developed (Section 7.1.4). This is consistent with Ericksen's findings (1967) in New Zealand. Two conclusions may be drawn from this. Firstly, information can replace the necessity for personal experience as a motivation to implement adjustments, and second, a flood plain occupant's state of preparedness may be increased by the input of information. Ericksen (1967 and 1971) speaks of the input of information as a 'short-circuiting' of the decision-making process, but laments that "there too often exists an impediment to the free flow of information from the technical expert to the ordinary flood plain occupant: information which would not only sharpen perception of the flood hazard and methods of adjustment, but also increase the level of adjustment adoptability" (Ericksen, 1971, p.108).

As an adjustment in itself, the provision of information was the one most frequently mentioned by respondents as the adjustment they would adopt given the authority. It was followed by the suggestion of installation of a better warning system and evacuation plan. This also carries the implication of better information provision (Section 6.2.2).

It should be noted that, out of keeping with other studies (Ericksen, 1967; Heron, 1972), technical adjustments were, in the main, least favoured in ranking for effectiveness and adoption. This is not to say respondents do not consider the provision of technical adjustments such as dredging, reservoirs and dams as important. In fact, these measures overshadowed the provision of information and warning services in government actions sought (Section 6.3.3). Flood plain occupants'

ranking of their present preparedness was also significantly related to their knowledge of public adjustments (Section 7.2). Rather then, it appears that a distinction exists in respondents' minds between those public adjustments which lie solely in the public domain and those that can be implemented at the individual or household level. Many technical adjustments by their nature must be implemented at the community level, while the obtaining of information and, to a certain extent, warning measures fall into the list of those adjustments that an individual can make.[1] This adds to Kates' observation (1962) that many alternatives have both individual and community variations which distinguish the major responsibility or capability for effecting them.

Further the conclusion may be drawn that respondents take for granted the implementation of technical adjustments as an accepted part of the government's role, their extension being a safeguard for the community against the occurrence of flooding. However in the actual situation when flooding is inevitable, it would appear that the factors most important to the resident are those that will aid him in reducing the immediate damage to his property, namely knowledge of the likely risk and ways of combating it. Three things support this conclusion: the reliance of respondents on emergency measures (both in January and presumably in future floods, since few had implemented any adjustment measures - Section 6.4); the high effectiveness ranking of Civil Defence work in the January flood (Section 6.2.1); and the preference for information and warning measures as the public adjustments most respondents would themselves adopt given the authority (Section 6.2.2).

---

[1] While most respondents saw provision of information as the responsibility of the BCC or State Government (Section 6.3.1), provision here may be interpreted in the narrower sense as meaning the source from which information would be freely obtainable.

The provision of information becomes particularly important in the context of perceived responsibility for the implementation of flood mitigation work. In his study on the Fraser River, Sewell (1969) notes the correlation between lack of a clear definition as to who is responsible for dealing with flood problems, and inaction. In concluding he states, "flood plain dwellers will assume that the Government is dealing with the matter, while government agencies assume that it is beyond their terms of reference" (Sewell 1969, p.450). Given that people were adequately informed about the flood possibility and the extent of likely damage, approximately half of those questioned in the present study saw the onus as on the individual to effect action to reduce flood losses (Section 6.3.2). The impression was gained by the author that, in a number of cases, this response referred only to intending occupants, not those already on the flood plain. Nevertheless, it may be presumed that public liability and spending could be cut if adequate provision of information and warning measures were made.

In this connection, a further note should be made on the type of private adjustment adopted. On the whole, respondents were reluctant to adopt major or costly adjustments, except where protection was guaranteed as in relocation (Section 6.4). However this was often precluded from serious consideration because of economic or social constraints. Here, as in other studies, (Ericksen, 1967; Sewell, 1969) it was found that most respondents place their reliance on emergency measures for protection. The bulk of adjustments made at the time of the January flood were of this kind, while flood proofing, the adjustment most frequently adopted since January, generally involves a combination of structural changes and emergency action. Emergency measures may greatly reduce the impact of floods if, as White (1945) points out there are accurate, timely forecasts of flood occurrence and height, if efficient plans for emergency action have been prepared, and if the persons affected know the plans sufficiently to act promptly. Key elements therefore, in emergency action are the

provision of information about the likelihood and the potential effects of floods, and the development of a flood-forecasting and warning system. In turn, their success hinges on the flood plain occupant being able to interpret the information and being able to select the appropriate action.

In the light of these results, continued loss appears inevitable as long as flood plain occupance is allowed to continue. Given accurate knowledge of the flood hazard, it is unlikely that all individuals will be dissuaded from moving on to the flood plain, while those already present are often hampered in their desire to move by economic and other constraints. A possible solution to these problems may be provided by the implementation of zoning regulations. The effectiveness of flood plain regulations as a flood loss prevention measure was noted in White's (1945) study of adjustments and their importance as an integral part of town planning reemphasized by Murphy (1958). Despite apparent public authority fears to the contrary, the present analysis revealed a general willingness on the part of flood plain occupants to accept zoning regulations. This adjustment ranked second only to Civil Defence work in respondents' evaluation of its effectiveness and third below the provision of information and warning measures in adjustments respondents would themselves adopt given the authority (Section 6.2). Many respondents expressed the opinion that zoning regulations were definitely effective when and where they were implemented, but felt that stronger regulations were needed and the area where restrictions were in force should be extended.

Overseas experience (Kates, 1962; White, 1964b; Ericksen, 1967) as well as that in Australia, shows that, in the present circumstances, social guides in the form of information, regulations and investment affecting flood plain occupance tend to encourage further encroachment upon the flood plain. At the same time, they lead to heavier expenditures

for flood control. The latter is generally characterized by an excessive reliance on technology in the form of large-scale structural works which engenders a false sense of safety among flood plain occupants and often proves ineffective in the face of an infrequent event such as that which occurred in Brisbane in January 1974. Over the last decade, the integrated approach to flood loss reduction has gained in favour. As outlined by White (1970), this approach essentially involves canvassing all possible means of managing flood losses in arriving at public plans for dealing with floods in a river basin or watershed.

It is with these considerations and the findings of the present study in mind that the following planning proposals[1] are made:

(1) The provision of information to flood plain occupants should be extended. In particular information about the characteristics, likelihood and potential effects of flooding is needed together with a comprehensive outline of both public and private adjustments. Attention should be paid to the mode of communication so as to achieve maximum spread and acceptance. It is not sufficient to assume formal organizations and their members have credibility in the eyes of the community and that

---

[1] Public adjustment measures which have been made since the January 1974 flood include:

(1) an improved data network with more automation of observations and the introduction of a radio telemetry system.
(2) the reorganization under new legislation of the emergency services (formerly the Civil Defence) including the setting up of the State Emergency Service with greater manpower and facilities.
(3) the compilation of 18 1:10000 flood maps of the Brisbane and Ipswich areas (Queensland Surveyor General's Department, 1976) which are available for purchase by the public.
(4) the production and distribution of flood information brochures by the State Disaster Relief Organization and jointly by the Natural Disasters Organization, State Emergency Service and Bureau of Meteorology.
(5) the implementation of a number of technical adjustments including construction of a reservoir, dredging and acquisition of land along suburban creeks to allow widening, deepening and straightening.

therefore information will be received. Similarly, if care is not taken, it may reach only those who already know or be beyond the understanding of those for whom it is intended.

(2) More attention needs to be paid to flood forecasting, warning services and evacuation planning. These measures can only be effective if clearly understood and accepted by the public. It is suggested therefore, that continuing education and publicity programmes are needed to maintain public awareness of the hazard and the means of responding to it.

(3) Positive preventive measures in the form of community guidance and incentives to induce development away from the flood plain could be implemented along with zoning and building regulations to limit new development on the flood plain. A wide variety of measures including statutes, ordinances, subdivision regulations, building codes, government purchase of property and subsidized relocation should be considered to obtain the most suitable combination.

To overcome the entrenched attitudes and biases built up over years of flood plain occupance would seem an almost impossible task in the light of evidence presented by the history of such settlement. While the difficulties of reaching such an objective are recognized it is felt these measures would go some way towards creating greater awareness and a more efficient and widespread use of adjustments by individuals.

8.3 Final Considerations and Further Research Needs

In any study of perceptions, attitudes and opinions, the variables, by their nature, impose difficulties of measurement and interpretation. Because of the interrelationships that exist, the nature and limits of

individual variables are not always precisely determinable, while the form of the data necessarily imposes limits on the type of analysis that can be carried out. Conclusions drawn here are the result of the study of one area at one point in time. Care should therefore be taken in any generalization to a wider context. Within these bounds, and recognizing that differences will exist in community characteristics, the above observed relationships and proposals may have practical application elsewhere.

Considerable scope still remains for further research. While contributions in any area of behavioural study would be profitable for the development of greater understanding, the following three suggestions are made as avenues that deserve more immediate attention.

Firstly, the information and warning components of hazard evaluation and their effect on flood plain occupants' response could profitably be examined. Particular attention should be given to the range of information and warning now available, the actual distribution of each form and the channels by which they are distributed.

As an adjunct to this, a study could be made through time of the same community to determine the resultant effect of information flows and decay in recency of experience on perception and evaluation of the hazard, future flood expectation, knowledge of adjustments and their adoption.

Third, closer analysis is needed of flood plain occupants' benefit-cost analysis taking into account social as well as economic factors. To date, such analyses have been confined to the community level (White, 1973), and, particularly in the Australian context, have only taken economic factors into consideration, for example the three studies commissioned by the Queensland Coordinator General's Department on Brisbane creek flooding

(Bornhorst and Ward, 1973; Cameron, McNamara and Partners, 1973; Munro, Johnson and Associates, 1973). It is proposed that the benefit-cost analysis, employed at the level of the individual manager be explored to more precisely determine the factors that enter into his or her adoption decision and the relative importance of each in the final choice of adjustment. All of these avenues hold potential importance for planners. Through their investigation a greater understanding of man's decision-making process and its outcome could be achieved.

BIBLIOGRAPHY

AND REFERENCES CITED*

Anastasi, Anne (1961) Psychological Testing, 2nd edition, New York: Macmillan.

* van Arsdol, M.D., Sabagh, G. and Alexander, F. (1964) "Reality and the Perception of Environmental Hazards", Journal of Health and Human Behaviour, Vol. 5, pp. 144-53.

Australian Association of Social Workers (Queensland Branch) (1974), Social and Psychological Consequences of Natural Disaster. Proceedings of a Symposium sponsored by the University of Queensland, Brisbane.

* Australian Institute of Engineers (Queensland Division) (1974), January 1974 Floods Moreton Region. Proceedings of Symposium, Brisbane.

Australian Institute of Engineers (Queensland Division) (1976), Proceedings of the Symposium on Flood Plain Management, Brisbane.

Baker, G.W. and Chapman, D.W. (eds.) (1962), Man and Society in Disaster, New York: Basic Books.

* Barrows, H.H. (1923), "Geography as Human Ecology", Annals of the Association of American Geographers, Vol. 13, pp. 1-14.

Barton, A.H. (1963), Social Organization Under Stress: A Sociological Review of Disaster Studies. Disaster Study Number 17, Washington: National Academy of Sciences-National Research Council.

Beyer, J.L. (1974) "Global Summary of Human Response to Natural Hazards: Floods", in White, G.F. (ed.) (1974a) Natural Hazards: Local, National, Global. New York: Oxford University Press, pp. 265 - 274.

* Bornhorst, and Ward, (1973) Report on an Investigation of Flooding and Flood Mitigation Proposals in Oxley Creek. Prepared for Co-ordinator General's Department, Brisbane, Queensland.

* Brookfield, H.C. (1969) "On the environment as perceived" in Board, C., Chorley, R.J., Haggett, P. and Stoddart, D.R. (eds.) (1969) Progress in Geography. International reviews of current research, Vol. 1, London: Edward Arnold, pp. 51-80.

Brown, L.A. and Moore, E.G. (1970) "The Intra-Urban Migration Process: a Perspective", Geografiska Annaler, Vol. 52B, pp. 1-13.

* Burton, Ian (1961) "Invasion and Escape on the Little Calumet" in White, G.F. (ed.) (1961a), Papers on Flood Problems. Dept. of Geography, Research Paper No. 70, University of Chicago, Chicago, pp. 84-92.

* Burton, Ian (1962) Types of Agricultural Occupance of Flood Plains in the United States. Dept. of Geography, Research Paper No. 75, University of Chicago, Chicago.

Burton, Ian (1965) "Flood-Damage Reduction in Canada", Geographical Bulletin, Vol.7, pp. 161-185.

Burton, Ian (1971) "The Social Role of Attitude and Perception Studies" in Sewell, W.R.D. and Burton, I. (eds.) (1971) Perceptions and Attitudes in Resources Management, Resource Paper No.2, Policy Research and Co-ordination Branch, Dept. of Energy, Mines and Resources, Ottawa, pp. 1-6.

* Burton, Ian and Kates, R.W. (1964) "The Perception of Natural Hazards in Resource Management", Natural Resources Journal, Vol. 3, pp. 412-441.

* Burton, I., Kates, R.W., Mather, J.R. and Snead, R.E. (1965) The Shores of Megalopolis : Coastal Occupance and Human Adjustment to Flood Hazard, New Jersey: Elmer.

* Burton, I., Kates, R.W. and Snead, R.E. (1969) The Human Ecology of Coastal Flood Hazard in Megalopolis. Dept. of Geography, Research Paper No. 115, University of Chicago, Chicago.

* Burton, I., Kates, R.W. and White, G.F. (1968) The Human Ecology of Extreme Geophysical Events. Natural Hazard Research Working Paper No.1, Dept. of Geography, University of Toronto, Toronto.

* Cameron, I.G., McNamara and Partners (1973) Report on Flooding in the Catchment of Breakfast and Enoggera Creeks. Prepared for the Co-ordinator General's Department, Brisbane, Queensland.

* Cameron, I.G. and Morris, K. (1974) The 1974 Australia Day Weekend Flooding in Brisbane Metropolitan Creeks. Paper presented to Water Engineering Symposium, Brisbane.

* Campbell, D.T. (1950) "The indirect assessment of social attitudes." Psychology Bulletin, Vol.47, pp. 15-38.

Campbell, D.T. (1963) "Social Attitudes and Other Acquired Behavioural Dispositions" in Koch, S. (ed.) (1963) Psychology: a Study of a Science. New York: McGraw-Hill, Vol. 6, pp. 94-172.

* Chapman, J., Davis, M. and Elliot, N. (1974) Australia Day Washout. Unpublished report, Dept. of Social Work, University of Queensland, Brisbane.

Cossins, G. (1975) "An Engineering Emergency: The 1974 Floods", Journal of the Institute of Engineers, Australia, Vol.47, Nos. 7-8, pp. 20-23.

Congalton, A.A. (1969) Status and Prestige in Australia. Melbourne: Cheshire Publishing.

* Detwyler, T.R., Marcus, M.G. and others (1972) Urbanization and Environment. The Physical Geography of the City. Belmont California: Duxbury.

Department of Science, Bureau of Meteorology Queensland Regional Office (1976), Flood Warning System, Brisbane River Valley, December 1974. Paper presented at Natural Hazard Symposium, Australian Academy of Science, Canberra, May 1976.

* Director of Meteorology (1974) Report on Brisbane Floods January, 1974 Australian Government Publishing Service, Canberra.

Douglas, Ian (1976) Flooding in Australia. Paper presented at Natural Hazard Symposium, Australian Academy of Science, Canberra, May 1976.

Douglas, Ian and Yeates, G. (1976) Provisional Summary of Official Attitudes and Responses to Flooding 1945-1974. Paper presented at Natural Hazard Symposium, Australian Academy of Science, Canberra, May 1976.

* Downs, R.M. (1970) "Geographic Space Perception: past approaches and future prospects" in Board, C., Chorley, R.J., Haggett, P. and Stoddart, D.R. (eds.) (1970) Progress in Geography, Vol.2, London: Edward Arnold, pp. 65-108.

English, H.B. and English, A.C. (1958) A Comprehensive Dictionary of Psychological and Psychoanalytical Terms, London: Longmans.

* Ericksen, Neil J. (1967) Perception and Adoption of Alternative Measures for Reducing Flood Damages in Opotiki. M.A. Thesis, University of Canterbury, Christchurch.

* Ericksen, Neil J. (1971) "Human Adjustment to Floods in New Zealand". New Zealand Geographer, Vol.27, pp. 105-129.

Ericksen, Neil J. (1974) "Flood information, expectation and protection on the Opotiki floodplain, New Zealand" in White, G.F. (ed.) (1974a) Natural Hazards: Local, National, Global. New York: Oxford University Press, pp. 60-70.

Ericksen, Neil J. (1976) The Dynamics in Human Adjustments to Floods. Paper presented at Natural Hazard Symposium, Australian Academy of Science, Canberra, May 1976.

Firey, Walter (1960) Man, Mind and Land: a Theory of Resource Use. Illinois: Free Press of Glencoe.

Forsythe, G.A. (1975) "An Assessment of the Role of Insurance and Structural Measures in Flood Mitigation Planning", Review of Marketing and Agricultural Economics, Vol.43, No.2, pp. 65-87.

Fritz, C.E. and Marks, E.S. (1954) "The NORC studies of human behaviour in disaster", Journal of Social Issues, Vol.10, pp. 26-41.

Golant, S. and Burton, I. (1969a) Avoidance-Response to the Risk Environment. Natural Hazard Research, Dept. of Geography Working Paper No.6, University of Toronto, Toronto.

Golant, S. and Burton, I. (1969b) The meaning of a hazard-application of a semantic differential. Natural Hazard Research, Dept. of Geography, Working Paper No.7, University of Toronto, Toronto.

Guilford, J.P. (1954) Psychometric Methods, Second edition, New York: McGraw-Hill.

* Guilford, J.P. (1959) Personality. New York: McGraw-Hill.

* Heron, K. (1972) Perception of Erosion Hazard and Choice of Adjustment on the Gold Coast, Queensland. B.A. (Hons.) Thesis, University of Queensland, Brisbane.

* Hewitt, K. and Burton, I. (1971) The hazardousness of a place: a regional ecology of damaging events. University of Toronto Press, Toronto.

* Hill, R. and Hansen, D.A. (1962) "Families in Disaster" in Baker, G.W. and Chapman, D.W. (eds.) (1962) Man and Society in Disaster. New York: Basic Books, pp. 185-221.

Hoyt, W.G. and Langbein, W.B. (1955) Floods. New Jersey: Princeton University Press.

Hunter Valley Research Foundation (1963) Flood Plain Information for the Hunter Valley, New South Wales. Newcastle, New South Wales.

* Johnston, R.J. (1971) Urban Residential Patterns: an Introductory Review, London: Bell.

* Kates, R.W. (1962) Hazard and Choice Perception in Flood Plain Management, Dept. of Geography, Research Paper No. 78, University of Chicago, Chicago.

* Kates, R.W. (1963) "Perceptual Regions and Regional Perception in Flood Plain Management," Papers and Proceedings of the Regional Science Association, Vol. 11, pp. 217-227.

* Kates, R.W. (1970) Goals for National Studies of Hazard: Background for a Comparative Study of Agricultural Drought in Australia and Tanzania, Feb. 1970. Paper presented at a Natural Hazard Research Seminar on Comparative Study of Agricultural Drought: Australia and Tanzania, at Clark University, Worcester, Mass., 3-4 April, 1970.

* Kates, R.W. (1971) "Natural Hazard in Human Ecological Perspective: Hypotheses and Models", Economic Geography, Vol.47, pp.438-451

Kates, R.W. and White, G.F. (1961) "Flood Hazard Evaluation" in White, G.F. (ed.) (1961a) Papers on Flood Problems. Dept. of Geography, Research Paper No.70, University of Chicago, Chicago, pp. 135-147.

* Killian, L.M. (1956) An Introduction to Methodological Problems of Field Studies in Disasters, Disaster Study No.8, Committee on Disaster Studies, Washington D.C.

Kollmorgen, W.M. (1953) "Settlement Control Beats Flood Control", Economic Geography, Vol.29, pp. 208-215.

* Krejcie, R.V. and Morgan, D.W. (1970) "Determining Sample Size for Research Activities", Educational and Psychological Measurement, Vol.30, pp. 607-610.

* Lazarus, R.S. (1966) Psychological Stress and the Coping Process, New York: McGraw Hill.

Lee, D.H.K. (1966) "The Role of Attitude in Response to Environmental Stress", Journal of Social Issues, Vol.22, pp. 83-91.

Leopold, L.B. and Maddock, T. (1954) The Flood Control Controversy. Big Dams, Little Dams and Land Management, New York: Ronald Press

Lowenthal, D. (ed.) (1967) Environmental Perception and Behaviour. Dept. of Geography, Research Paper No. 109, University of Chicago, Chicago.

* Marks, E.S. and Fritz, C.E. (1954) Human reactions in disaster situations. Unpublished report, National Opinion Research Centre, University of Chicago, Chicago.

* Mitchell, J.K. (1974) "Natural Hazard Research" in Manners, I.R. and Mikesell, M.W. (eds) (1974) Perspectives on Environment. A.A.G. Commission on College Geography Publication No. 13, Washington D.C., pp. 311-341.

Moore, E.G. (1972) Residential Mobility in the City. A.A.G. Resource Paper No. 13, Washington, D.C.

* Moser, C.A. and Kalton, G. (1971) Survey Methods in Social Investigation. London: Heinemann.

* Munro, Johnson,and Associates (1973) An investigation of methods of mitigating flood damage caused by Kedron Brook, Brisbane. Prepared for the Co-ordinator General's Department, Brisbane, Queensland.

Murison, H.S. and Woolard, D.S. (1974) Flood Facts 74, Dept. of Architecture, University of Queensland, Brisbane.

* Murphy, F.C. (1958) Regulating Flood-Plain Development, Dept. of Geography, Research Paper No. 56, University of Chicago, Chicago.

* Natural Hazard Research (1970) Suggestions for Comparative Field Observations on Natural Hazards. Working Paper No.16, Revised edition Oct. 20, Dept. of Geography, University of Toronto, Toronto.

Natural Hazard Research (1971) Collaborative Research on Natural Hazards, Progress Report. Dept. of Geography, University of Toronto, Toronto.

* Nie, N.H., Bent, D.H. and Hull, C.H. (1970) Statistical Package for the Social Sciences, New York: McGraw Hill.

Nunnally, J.C. (1967) Psychometric Theory. New York: McGraw Hill.

Nunnally, J.C. (1970) Introduction to Psychological Measurement. New York: McGraw-Hill.

* Oppenheim, A.N. (1966) Questionnaire Design and Attitude Measurement. London: Heinemann.

O'Riordan, T. (1974) "The New Zealand natural hazard insurance scheme: application to North America" in White, G.F. (ed.) (1974a) Natural Hazards: Local, National, Global. New York: Oxford University Press, pp. 217-219.

Pilgrim, D.H. and Askew, A.J. (1974) The Case for Flood-Plain Mapping in Australia. Water Research Foundation of Australia Report No.43, University of New South Wales, Sydney.

Queensland Disaster Welfare Committee (1974) Report from the Elmes Road Flood and Community Advisory Centre - Rocklea, June, 1974, Brisbane.

* Roder, W. (1961) "Attitudes and Knowledge on the Topeka Flood Plain" in White, G.F. (ed.) (1961a) Papers on Flood Problems, Dept. of Geography, Research Paper No.70, University of Chicago, Chicago, pp. 62-83.

Russell, C.S. (1970) "Losses from Natural Hazards" Land Economics, Vol.46, pp. 383-393.

* Saarinen, T.F. (1969) Perception of the Environment. A.A.G. Commission on College Geography, Resource Paper No.5, Washington D.C.

Saarinen, T.F. (1971) "Research Approaches and Questionnaire Design" in Sewell, W.R.D. and Burton, I. (eds) (1971) Perception and Attitudes in Resource Management. Resource Paper No.2, Policy Research and Co-ordination Branch, Dept. of Energy, Mines and Resources, Ottawa, pp. 13-25.

Saarinen, T.F. (1974) "Environmental Perception" in Manners, I.R. and Mikesell, M.W. (eds) (1974) Perspectives on Environment. A.A.G. Commission on College Geography, Publication No.13, Washington D.C. pp 252-289.

* Schaake, J.C. (1972) "Water and the City" in Detwyler, T.R., Marcus, M.G. and others (1972) Urbanization and Environment. The Physical Geography of the City, Belmont, Calif: Duxbury, pp.97-133.

* Schiff, Myra R. (1970) Some Theoretical Aspects of Attitudes and Perception. Natural Hazard Research, Working Paper No.15, Dept. of Geography, University of Toronto, Toronto.

* Scott, W.A. (1969) "Attitude Measurement" in Lindzey, G. and Aronson, E (eds) (1969) The Handbook of Social Psychology. Second edition, Reading, Mass: Addison-Wesley, Vol.2, pp.204-273.

* Sewell, W.R.D. (1969) "Human Response to Floods" in Chorley, R.J. (ed.) (1969) Water, Earth and Man, London: Methuen, pp. 431-451.

* Shepherd, E.M. (1971) Future Brisbane Water Supply and Flood Mitigation Report on Proposed Dam on the Brisbane River at Middle Creek or Alternatively Wivenhoe and Flood Mitigation for Brisbane and Ipswich, Brisbane: Co-ordinator General's Department.

Shields, A.J. (1976) The Brisbane Floods of January, 1974. Paper presented at Natural Hazard Symposium, Australian Academy of Science, Canberra, May, 1976.

* Simon, H.A. (1957) Models of Man, Social and Rational. New York: Wiley.

Sims, J. and Saarinen, T.F. (1969) "Coping with Environmental Threat: Great Plains Farmers and the Sudden Storm", Annals of the Association of American Geographers, Vol.59, pp.677-686.

* Slovic, P., Kunreuther, H. and White, G.F. (1974) "Decision processes, rationality and adjustment to natural hazards" in White, G.F. (ed) (1974a) Natural Hazards: Local, National, Global. New York: Oxford University Press, pp.187-205.

Snowy Mountains Engineering Corporation (1975) Brisbane River Flood Investigation. Final Report. Prepared for the Australian Cities Commission, Brisbane.

* Sonnenfeld, J. (1972) "Geography, Perception and the Behavioural Environment" in English, P.W. and Mayfield, R.C. (eds) (1972) Man, Space and Environment. Concepts in Contemporary Human Geography. New York: Oxford University Press, pp.244-251

Sonnenfeld, J. (1973) "Personality and Behaviour in Environment" in Albaum, M. (ed.) (1973) Geography and Contemporary Issues New York: Wiley, pp.410-416.

* Sprout, H. and M. (1965) The Ecological Perspective on Human Affairs. New Jersey: Princeton University Press.

Strom, H.G. (1962) River Improvement and Drainage in Australia and New Zealand. State Rivers and Water Supply Commission, Victoria.

* Studer, R.G. (1970) "The Dynamics of Behaviour - Contingent Physical Systems" in Proshansky, H.M., Ittleson, W.H. and Rivlin, L.G. (eds) (1970) Environmental Psychology: Man and His Physical Setting. New York: Holt, Rinehart and Winston, pp.56-76.

* Swannell, P. and Isaacs, L.T. (1974) An Assessment of the Consequences of the 1974 Flood in the Jindalee Area. Unpublished mimeo, University of Queensland, Brisbane.

Tennessee Valley Authority (1967) Flood Damage Prevention. An Indexed Bibliography. Fifth edition, Knoxville, Tennessee.

* Upshaw, H.S. (1968) "Attitude Measurement" in Blalock, H.M. and Blalock, A.B. (eds) (1968) Methodology in Social Research, New York: McGraw-Hill, pp.60-111.

Vaughn, C.K. (1971) Notes on Insurance Against Loss from Natural Hazards. Natural Hazards Research Working Paper No.21, Dept. of Geography, University of Toronto, Toronto.

Vogel, H.D. (1960) "New Approach to Local Flood Problems" Journal of the Hydraulics Division Proceedings of the American Society of Civil Engineers, Vol.86 (2336)(No.HY1), pp.53-61.

* Ward, J.K.G., (1974) "Hydrology of the Floods" in Australian Institute of Engineers (1974) January 1974 Floods Moreton Region. Proceedings of Symposium, Brisbane, pp.39-55.

* White, G.F. (1945) Human Adjustment to Floods. A Geographical Approach to the Flood Problem in the United States. Dept. of Geography, Research Paper No.29, University of Chicago, Chicago.

* White, G.F. (1960) "Strategic Aspects of Urban Flood Plain Occupance" Journal of the Hydraulics Division Proceedings of the American Society of Civil Engineers, Vol.86 (2376)(No.HY2), pp.89-102.

White, G.F. (ed.) (1961a) Papers on Flood Problems, Dept. of Geography, Research Paper No.70, University of Chicago, Chicago.

* White, G.F. (1961b) "The Choice of Use in Resource Management" Natural Resources Journal, Vol.1, pp.23-40.

* White, G.F. (1964) Choice of Adjustment to Floods, Dept. of Geography, Research Paper No.93, University of Chicago, Chicago.

White, G.F. (1966a) "Formation and Role of Public Attitudes" in Jarrett, H. (ed.)(1966) Environmental Quality in a Growing Economy. Baltimore: John Hopkins Press, pp.105-127.

* White, G.F. (1966b) "Optimal Flood Damage Management: Retrospect and Prospect" in Kneese, A.V. and Smith, S.C. (eds)(1966) Water Research. Baltimore: John Hopkins Press, pp.251-269.

* White, G.F. (1970) "Flood-Loss Reduction: the Integrated Approach" Journal of Soil and Water Conservation, Vol.25, pp.172-176.

* White, G.F. (1973) "Natural Hazard Research" in Chorley, R. (ed.) (1973) Directions in Geography. London: Methuen, pp.193-216.

White, G.F. (ed.) (1974a) Natural Hazards: Local, National, Global. New York: Oxford University Press.

* White, G.F. (1974b) "Comparative field observations on natural hazards" in Pécsi, M. and Probáld, F. (eds) (1974) Man and Environment Akadémiai Kiadó, Budapest, pp.73-79.

* White, G.F., Calef, W.C., Hudson, J.W., Mayer, H.M., Sheaffer, J.R. and Volk, D.J. (1958) Changes in Urban Occupance of Flood Plains in the United States, Dept. of Geography, Research Paper No.57, University of Chicago, Chicago.

Williamson, T.J. (1975) Housing in Flood Prone Areas. Dept. of Housing and Construction, Housing Research Branch Special Publication No.1, First edition, Melbourne.

Wolman, M.G. (1963) "Aspects of Flood Problems" Geographical Review, Vol.53, pp.462-464.

Wolpert, J. (1965) "Behavioural Aspects of the Decision to Migrate" Papers and Proceedings of the Regional Science Association, Vol.15, pp.159-169.

Wolpert, J. (1966) "Migration as an Adjustment to Environmental Stress", Journal of Social Issues, Vol.22, pp.92-102.

OTHER REFERENCE MATERIAL CITED

Pamphlets

Natural Disasters Organization, State Emergency Service, Bureau of Meteorology (no date) "Alternatives to an Ark: The ABC and D of your next Flood."

State Disaster Relief Organization (no date) "Your Guide for a Brisbane River Flood Emergency".

Recommendations from Symposium on Natural Hazards in Australia 26-29 May, 1976.

Legislation

City of Brisbane (Flood Mitigation Works Approval) Act 1952-1974

City of Brisbane Town Planning Act, 1964-1971

City of Brisbane Ordinances, 1972, Chapter 8, Part 8.

Maps

Flood Map of Brisbane and Suburbs (1974) Survey Office, Dept. of Lands, Brisbane.

Series of 18 flood maps of the Brisbane and Ipswich areas (1976), Survey Office, Dept. of Lands, Brisbane.

Miscellaneous

Brisbane *Courier Mail*, 1841-1976.

Pugh's Almanac, 1891 and 1894.

Sunday Mail, Brisbane Edition, 1974-76.

Sunday Sun, Brisbane Edition, 1974-76.

A P P E N D I X 1

THE QUESTIONNAIRE

UNIVERSITY OF QUEENSLAND

DEPARTMENT OF GEOGRAPHY

Date .....
Interview No. .....
Area .....
Respondent, M,F,M&F .....
Interviewer .....

1. To what depth did the January flood water enter your home? ..... feet
or

   (1) fully submerged

   (2) yard only affected (probe percentage area covered .....%) (If '2', go to question 3)

   (3) not flooded (If '3' Stop interview)

   If multi-storey ask: To what extent was the main living area (i.e. living room, bedrooms) affected?

   (1) Major (2) Minor (3) Not at all

2. How long were the flood waters in your home?

   (1) less than 1 day

   (2) 1 - 2 days

   (3) 2 - 3 days

   (4) 3 - 4 days

   (5) Other (specify) .....

   (6) Don't know

3. When you first moved into this house, how important was the reason "to escape the possibility of being flooded"?

   (1) Major reason

   (2) Minor reason

   (3) Of no importance

   (0) Not stated

4. How long have you lived in this house? ..... years

5. Where was your previous place of residence?

   Suburb ..... City ..... Area .....

6. How many floods had you experienced before the January flood 1974? .....
   (If '0' go to question 12)

7. How many of these affected your present dwelling? .....

8. Including those floods you actually experienced, how many floods do you know of entering this neighbourhood? .....

9. How long before the January flood was your last flood experience?
   ..... yrs ..... mths

10. Were the other occasions the same as January, worse than this or not as bad?
    (1) Same (2) Worse (3) Not as bad

11. Do you think your experience of flooding made you better or less well prepared in the January flood?
    (1) Better (2) Same (3) Less well (4) Don't know

12. How would you rank your preparedness for the January flood on a 5 point scale?
    (1) Not at all (2) Poor (3) Fair (4) Good (5) Very well

13. How would you rank your present preparedness for a flood? On the same scale
    (1) Not at all (2) Poor (3) Fair (4) Good (5) Very well

14. How often do you expect the people in this dwelling will be directly affected by a flood?
    (1) More than once a year
    (2) Once every year
    (3) Once every 2 years
    (4) Once every 5 years
    (5) Once every 10 years
    (6) Once every 20 years
    (7) Once every 50 years
    (8) Once every 100 years
    (9) Once every 200 years
    (10) Other (specify) .....

15. Before the January 1974 flood, were you aware of the likelihood of flood waters affecting this property?
    (1) Yes (2) No (0) Don't know
    If 'yes' ask: Was this information adequate?
    (1) Yes (2) No (0) Don't know

16. Did you consider the possibility of being flooded before you decided to live here?

(1) Yes (2) No

If a riverfront resident: Why did you choose to live here on the river in preference to any other site?

.....
.....
.....

17. Did you ever really think you were going to be flooded before the water came into your home?

(1) Yes (2) No (3) Don't know (0) Not applicable

18. Do you think there will be another flood while you are living here?

(1) Yes (2) No (3) Uncertain

Why? .....
.....

19. In general, how would you describe the occurrence of floods?

(1) No opinion

(2) Believe floods occur in cycles - decreasing in time

(3) _____ - constant in time

(4) _____ - increasing in time

(5) _____ - trend uncertain

(6) Personally, don't expect to experience flood on own property again

(7) Flood unique

(8) Other (specify) _____

20. Knowing what you know now about flooding, would you choose to locate here again?

(1) Yes (2) No (0) Don't know

If "no": Why don't you move?

(1) Never thought about it

(2) No place else to go

(3) Costs too high

(4) Like it here

(5) Other (specify) .....

(6) Don't know

21. Did you consider shifting after the January flood?

    (1) Seriously considered it

    (2) Yes, but only at first

    (3) Yes, but rejected idea

    (4) No, did not consider it

    (0) Not stated

22. If you had your choice, would you move or stay here?

    (1) Move (2) Stay (3) Uncertain

    If "move": Where would you like to live, given free choice?

    (1) Same suburb (2) Other (specify) .....

    : What are your reasons for choosing that area, in order of importance?

    (1) .....

    (2) .....

    (3) .....

    (4) .....

23. As of the present, what are your moving plans?

    (1) Definitely stay (If '1', go to question 26)

    (2) Considering moving

    (3) Probably move

    (4) Definitely move

    (0) Don't know (If '0', go to question 26)

24. How important would you say the effect of the January floods was on that decision?

    (1) Not at all important

    (2) Somewhat

    (3) Very important

    (4) Don't know

25. How important is the possibility of a future flood on that decision?

    (1) Not at all important

    (2) Somewhat

    (3) Very

26. In general, how would you rate the neighbourhood right around here as a place to live; very good, good, fair, poor or very poor?

(1) V.Poor (2) Poor (3) Fair (4) Good (5) V.Good

27. What do you see as the main advantages of living in this area? (List)

( ) .....
( ) .....
( ) .....
( ) .....
( ) .....

How would you rank these in order of importance (Rank 1st to 4th or 5th)

28. What do you see as the main disadvantages? (Do not read list. Add any others mentioned)

( ) Lack of facilities
( ) Heavy traffic
( ) Noise pollution
( ) Other environmental problems (specify) .....
( ) Air pollution
( ) Flooding
( ) Other (specify) .....
.....
.....

Again, could you rank these for importance? (Rank 1st to 4th or 5th

29. On a five point scale, how would you rank flooding as a hazard to you.

(1) Not at all (2) Minor (3) Average (4) Moderate (5) Serious

30. If not mentioned in Q.28:

How would you rank the flood hazard in comparison with the other disadvantages you have mentioned? (e.g. 1st, 5th, etc. or not at all)

.....

31. Is this location as desirable now as it was before the flood?

(1) Yes (2) No (3) Uncertain

32. Who do you think should be most responsible for providing residents with information about whether their land is subject to flooding? (Do not read list. If more than one mentioned, ask to rank from most to least responsible)

(1) State Government

(2) Brisbane City Council

(3) Land Developer

(4) Real Estate Agent

(5) Other (specify) .....

33. What reports have you seen on flooding?

(1) News reports only

(2) Official reports (including symposiums)

(3) Other (specify) .....

(4) None

34. Given that the people were adequately informed about flood possibilities and the extent of likely damage, on whom do you think most responsibility rests for action that would reduce flood losses?

(1) Individual (2) State Govt. (3) B.C.C.

(4) Other specify ..... (0) Don't know

35. Do you know of anything being done to reduce flood damage? (Tick those mentioned.)

( ) Dredging

( ) Channel improvement

( ) Levees, flood gates and storm channels

( ) Reservoir and dam construction

( ) Erosion control works

( ) Zoning regulations

( ) Investigations and surveys - government

( ) - other

( ) Citizen action groups

( ) Civil Defence work

( ) Other (specify) .....

.....

How would you rank the effectiveness of each of these? (Include all items above.)

Code - 1 - definitely effective; 2 - probably effective; 3 - possibly effective; 4 - uncertain; 5 - reject; 6 - unaware.

36. Is there anything the government can do to prevent or reduce damages from floods?

(1) Yes (2) No (0) Don't know

If "yes": specify

( ) Dredging

( ) Channel improvement

( ) Levees, flood gates and storm channels

( ) Reservoir and dam construction

( ) Limit, control or prohibit building in flood zone

( ) Provide flood information to public

( ) Prepare or plan (more) efficient evacuation and flood emergency services

( ) Erect flood height and warning signs

( ) Establish permanent relief fund

( ) Provide govt. sponsored flood insurance

( ) Other (specify) .....

( ) .....

What would be your preference for the government to place greatest emphasis on in the next few years? (Rank if more than one.)

.....

37. Given a position of "strong authority" what would you have done about the flood situation? (Tick those mentioned.)

( ) Dredging

( ) Channel improvement

( ) Levees, flood gates, and storm channels

( ) Reservoir and dam construction

( ) Limit, control or prohibit building in flood zone

( ) Provide flood information to public

( ) Install better warning system and evacuation plan

( ) Establish permanent relief fund

( ) Provide flood insurance scheme

( ) Other (specify) .....

.....

Code -

1-definitel adopt

2-probably adopt

3-possibly adopt but dubious

4-uncertair

5-reject th actior

6-unaware c actior

How would you rank these in terms of adopting each of them? (All items above to be scored.)

38. Would you be willing to pay increased taxes for those you have noted as most useful?

(1) Yes (2) No

39. When the January flood came, what action did you take to prevent or reduce damages? (No matter whether action (column 1) successful.)

List of Adjustments	1 Mentioned by Respondent	2 When Asked	3 Different Next Time Yes	3 Different Next Time No	4 Warning Given
Did nothing	.....				
Standby preparations (sandbags, etc.)	.....				
Kept water out of house (blocked doors, etc.)	.....				
Let water run through	.....				
Elevated or removed possessions	.....				
Relied on previous structural changes to house(elevated)	.....				
Relied on insurance compensation	.....				
Flood-proofed house	.....				
Other (specify).....	.....				
.....	.....				
.....	.....				

(2) Were there any others you considered, or knew of? (List and tick in Column 2)

(3) Next time would you do anything different than you did last time? (Colume 3)

(4) If a warning were to be given that a flood is coming this summer, would you do anything different? (Column 4)

40. Have you done anything since the flood about averting the danger or reducing the damage by flooding?

(0) None

(1) Volunteer work

(2) Civil defence

(3) Structural changes to house

(4) Install flood proofing measures

(5) Discussion at meeting

(6) Agitation at meeting or in news

(7) Other (specify) .....

40. (cont'd)

If "3": What structural changes have you made to your home?

(1) Raised old house to higher level

(2) Built present house above known present flood levels

(3) Other flood proofing measures to keep water out

(4) Other (specify) .....

41. Do you feel that your property is safe enough now, or do you intend to adopt further adjustments?

(1) Safe enough

(2) Will improve

(3) Not fully safe, but no adjustments planned

(0) Don't know

42. If you were told that you could expect flooding once every 10 years, what action would you take? (Tick those mentioned.)

( ) Bear the loss

( ) Take out (Increase) flood insurance

( ) Relocate on flood-free land

( ) Make structural changes to house

( ) Flood proof home

( ) Make own evacuation plans

( ) Other (specify) .....

Code -
1- Definitely adopt
2- Probably adopt
3- Possibly adopt
4- Uncertain
5- Reject this action
6- Unaware of action

How would you rank adopting each one? (All items above to be scored.)

43. What do you think the effect of the flood has been on property values in this area?

(1) Caused permanent fall

(2) Caused temporary fall

(3) Caused rise

(4) No effect

44. If this area is affected by a flood again, in what way do you think it would affect your household?

(1) Structural damage

(2) Contents damage

(3) Other property

(4) Activity

(5) Anxiety

(6) Other (specify) .....

(7) No effects

If "no effect": Why do you think this? .....

45. Do you expect damages to be less, more or about the same as before, should flooding occur again?

(1) Less (2) More (3) Same (4) No damages (0) Don't know

46. Do you think that the Wivenhoe Dam will be effective in reducing or eliminating the flood hazard on your property?

(1) Eliminate (2) Reduce (3) Increase hazard (4) No effect
(0) Don't know

47. Either You said in Q.20 you would not locate here again if you knew as much about the floods as you know now. Does knowledge of the new Wivenhoe Dam change your views?

(1) Yes (2) No (0) Don't know

OR You said in Q.20 that you would still locate here. Do you feel more strongly about this now that the Wivenhoe Dam is planned?

(1) Yes (2) No (0) Don't know

48. Did you or your husband/wife play any role during the January floods outside of your immediate household?

H	W	
(1)	(1)	Immediate unit only
(2)	(2)	Helped relatives or friends (probe suburb.....)
(3)	(3)	Civil Defence worker
(4)	(4)	Other aid organization work
(5)	(5)	Police/army
(6)	(6)	Other official capacity (specify) .....
(7)	(7)	Other (specify) .....

If other than '1': Did this have an effect on your own family's preparations?

(1) No effect
(2) Negative effect
(3) Good effect
(0) Don't know

49. On a five point scale, how would you rate this community's capacity to cater for the needs that arose during the flood?

(1) Very Poor (2) Poor (3) Average (4) Good (5) Very Good

50. With regard to this property, what would you estimate the value of your damages at? $.....

51. How much have you spent on adjustments? $ .....

52. What would you estimate the total cost of the flood to you at (including clean up, damages and adjustments, etc.)? $ .....

53. Do you expect to bear any further losses due to floods?

(1) Yes (2) No (3) Uncertain

54. What percentage of your flood losses was covered by relief aid? .....%

55. Is this property covered by flood insurance?

(1) Yes - war service (4) Not obtainable

(2) Yes - other (5) Don't know

(3) No

If "yes": Did the possibility of flood losses prompt you to take out the insurance?

(1) It was only/major reason (2) One of several reasons

(3) Other reasons most important

56. Has your source of income been affected by the flood?

(0) No

(1) Minor negative effect

(2) Moderate negative effect

(3) Substantial negative effect

(4) Positive effect

57. Do you own any other properties that were affected by the January flood waters?

(1) Yes (2) No

If "yes": What would you estimate the losses to you from this source at? $ .....

Now, just a few general questions.

58. What is the age of this dwelling? ..... years

Do you own or are you renting this dwelling?

(1) Own/Buying (3) Renting - long term

(2) Renting - short term (4) Other (specify) .....

59. Is this block of land used only for residential purposes?

(1) Residential - single unit

(2) Residential - split unit

(3) Residential and workshop

(4) Other (specify) .....

60. In to which group would the total net income for you and your family fall for last year (before deductions)?

(1) below $2,000

(2) $2,000 - 3,999

(3) $4,000 - 5,999

(4) $6,000 - 7,999

(5) $8,000 - 9,999

(6) $10,000 - $12,000

(7) $12,000 +

61. Finally, a few questions about you and the other members of this household.

Relation to Head	Age	Sex	Marital Status	Occupation	Level of Educ.	Present in Jan.flood
Head						
Spouse						

To be completed by interviewer -

Has the exterior of the dwelling been cleaned? (1) Yes
(2) No

Has the yard been cleaned up? (1) Yes (2) No

House classification
(1) Low set, single storey
(2) Low set, two storey
(3) High set, single storey
(4) High set, two storey
(5) Low set, short stilts
(6) Low set, one storey stilts
(7) Other (specify) .....

Exterior wall material
(1) Wood
(2) Brick
(3) Stucco
(4) Fibro
(5) Other (specify) .....

A P P E N D I X 2

SELECTED SAMPLE CHARACTERISTICS

TABLE 1: Length of Time since Last Flood Experience*

Time (in years)	Respondents	
	No.	%
0	431	66.6
<1	23	3.6
1	25	3.9
>1 - 1½	5	0.8
2	54	8.3
2½	1	0.2
3	5	0.8
4	4	0.6
4½	2	0.3
5	7	1.1
6	1	0.2
7	12	1.9
7½	12	1.9
8	4	0.6
9	1	0.2
10	2	0.3
10½- 15	6	0.9
16 - 20	19	2.9
21 - 30	16	2.5
>30	17	2.6
TOTAL	647	100.0

* Q.9. How long before the January flood was your last flood experience?

TABLE 2: Life Cycle Stage*

Stage	Respondents No.	%
Pre child	10	1.5
Child bearing	84	13.0
Child rearing	125	19.3
Child launching	152	23.5
Past child	186	28.7
Later life/widowhood	76	11.7
Non family unit	11	1.7
Not ascertained	3	0.5
TOTAL	647	100.0

* After Johnston (1971)

TABLE 3: Value of Losses in January Flood*

Value	Respondents No.	%
0	121	18.7
$ 1 - 500	111	17.2
501 - 1000	59	9.1
1001 - 2000	56	8.7
2001 - 3000	53	8.2
3001 - 4000	37	5.7
4001 - 5000	42	6.5
5001 - 6000	30	4.6
6001 - 10000	69	10.7
10001 - 15000	24	3.7
15001 - 20000	2	0.3
20001 - 30000	3	0.5
Not stated	40	6.2
TOTAL	647	100.0

* Q.50 With regard to this property, what would you estimate the value of your damages at?

TABLE 4: Percentages of Losses covered by Relief Aid*

Percentage	Respondents	
	No.	%
0	292	45.1
1 - 9	21	3.2
10 - 19	39	6.0
20 - 29	45	7.0
30 - 39	29	4.5
40 - 49	19	2.9
50 - 59	60	9.3
60 - 69	27	4.2
70 - 79	32	4.9
80 - 89	17	2.6
90 - 99	16	2.5
100	50	7.7
TOTAL	647	100.0

* Q.54. What percentage of your losses was covered by relief aid?

TABLE 5: Amount spent on Private Adjustments Adopted since January*

Cost	Respondents	
	No.	%
0	597	92.3
$ 20 - 100	6	0.9
101 - 200	3	0.5
300 - 400	6	0.9
500	3	0.5
600	1	0.2
700	1	0.2
800	2	0.3
1000	5	0.8
1100 - 2000	8	1.2
2100 - 3000	3	0.5
3100 - 4000	7	1.1
4500	1	0.2
5000	3	0.5
10000	1	0.2
TOTAL	647	100.0

* 0.51. How much have you spent on adjustments?

A P P E N D I X 3

COPY OF TEXT OF LETTER ISSUED BY THE DEPARTMENT OF HEALTH, PARKS AND BUILDING, BRISBANE CITY COUNCIL TO APPROVE BUILDING APPLICATION

Dear

I refer to your letter of the contents of which have been noted.

Brisbane City Council is concerned that owners of land which was affected by the 1974 flood should as far as possible be aware of the fact that their land was affected by this flood prior to granting any approval to build upon their land and that future purchasers of any dwellings erected thereon should have the opportunity of ascertaining that the land was so affected.

In view of this the Council has decided that where any building approval is granted in respect of any such land relevant information will be noted upon Council records and will be available to prospective purchasers upon request.

It is further advised that when granting any building approval in respect of land affected by the 1974 flood the Council will in future, recommend a level below which the floor of any habitable area of the dwelling should not be constructed. In making this recommendation the Council is in no way representing that should a further flood occur, the dwelling would not be affected and in fact it is pointed out that should a further flood similar to that of 1974 occur prior to the construction of the proposed Wivenhoe Dam, information in the possession of the Council suggests that this dwelling could very well be affected. It is hoped, however, that once the proposed Wivenhoe Dam is constructed this may not be the case if the recommended level is adhered to.

It is further pointed out that in granting building approval in such cases, the construction of the approved dwelling is entirely at the risk of the owner and the Council cannot be held responsible for any damage which may in the future occur as a result of flooding.

I now therefore wish to advise that Building Application No. is approved with a recommendation that the floor level of any habitable area should be not less than R.L. (B.C.C.) Datum), and any part of the dwelling below this level to be constructed out of flood resistant material such as concrete block, brickwork or poured concrete.

Yours faithfully,

(C.F. Sharp)
MANAGER.