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CHAPTER IV

THE PERCEPTION OF STORM HAZARD ON THE SHORES OF MEGALOPOLIS

Robert W. Kates

The outer shore of Megalopolis consists of 1300 miles of sand bar, bluff, and
al marsh. On the twenty percent of this frontage that is developed, air photos reveal
r 125,000 man-made structures within ten feet of sea level. The people who live
work in these structures share a common orientation to the ocean, and are in turn
ject to a set of natural hazards posed by the onshore movement of wind and water
ered by the impressive energy of atmosphere and ocean.

The degree to which these hazards are recognized by those who locate adjacent
he shore is the subject of this paper. It is part of a long-term inquiry into the rela-
between man and the more hazardous aspects of the natural environment.[1] But it
es also from a pragmatic concern with the rising toll of storm damages and with
sequent public pressure for increased protection, relief, and insurance against
e and associated wind damage.[2] And this research report is part of a larger study
ed specifically at understanding the processes of growth and development in areas
ect to coastal inundation and within easy reach of Megalopolitan population centers.[3]

[1] The most recent general statement is in Ian Burton and Robert W. Kates
ception of Natural Hazards in Resource Management," Natural Resources Journal,
964), pp. 412-441.

[2] Ian Burton and Robert W. Kates, "The Flood Plain and the Seashore: A
arative Analysis of Hazard Zone Occupance," Geographical Review, LIV (1964),
6.

[3] Ian Burton, Robert W. Kates, John R. Mather, and Rodman E. Snead, The
of Megalopolis: Coastal Occupance and Human Adjustment to Flood Hazard,
ations in Climatology, XVII, No. 3 (Elmer, New Jersey: C.W. Thornthwaite
iates, 1965). Pp. 435-603.

Fifteen sites along the coast from North Carolina to New Hampshire were chosen for intensive study (Figure IV-1). These sites are diverse in settlement, in regional location, and in subjection to natural hazard. They include urbanized areas with a coastal orientation, small settlements and fishing ports, seasonally occupied recreational areas, and coastal areas devoid of permanent human occupance.

At each site, excluding the empty shore, a non-random sample of permanent residents, seasonal home owners, and commercial managers was selected for interviews; in all, 371 usable interviews were obtained. All respondents were potentially subject to some hazard of tidal inundation from coastal storms, but fifteen percent had ground-floor elevations higher than the previously recorded maxima of flooding. In content, the interviews were designed to explore existing hypotheses of human adjustment to natural hazard and to delineate individual hazard perceptions.[4]

Our present understanding of human adjustment to hazardous natural environments has been derived mainly from flood plains, but these observations are reinforced by other research, notably that of anthropologists.[5] Their studies suggest that adjustments to natural hazards are common in most societies and at all levels of technological skill. However, the level of adjustment is often sub-optimal--that is, fewer and weaker steps are taken than are required to minimize the effects of the natural hazard, while permitting maximum use of resources associated with that hazard.

The causes of sub-optimal behavior are complex and manifold. Natural hazards include a variety of extreme or rare geophysical events. They are not easily amenable to the prevailing calculus of risk based on relative frequency, and it is difficult, even with technical-scientific expertise, to specify an optimal set of adjustments. Even were such specifications theoretically feasible, to make use of them would require a range of information beyond the capacity of the ordinary individual residing or working within a hazard area. Finally, the pattern of decision-making that leads to sub-optimal choice seems to be inherent in the human condition.

We are, in Simon's terms, either satisficers, content with sub-optimal solutions, or, as the traditionalists suggest, born optimizers, saddled with ignorance and

[4] The portion of the interview schedule dealing with tidal flood hazard is reproduced as Appendix: "Tidal Flood Hazard Questionnaire."

[5] See Burton and Kates, "Perception of Natural Hazards in Resource Management, for a summary of some relevant studies.

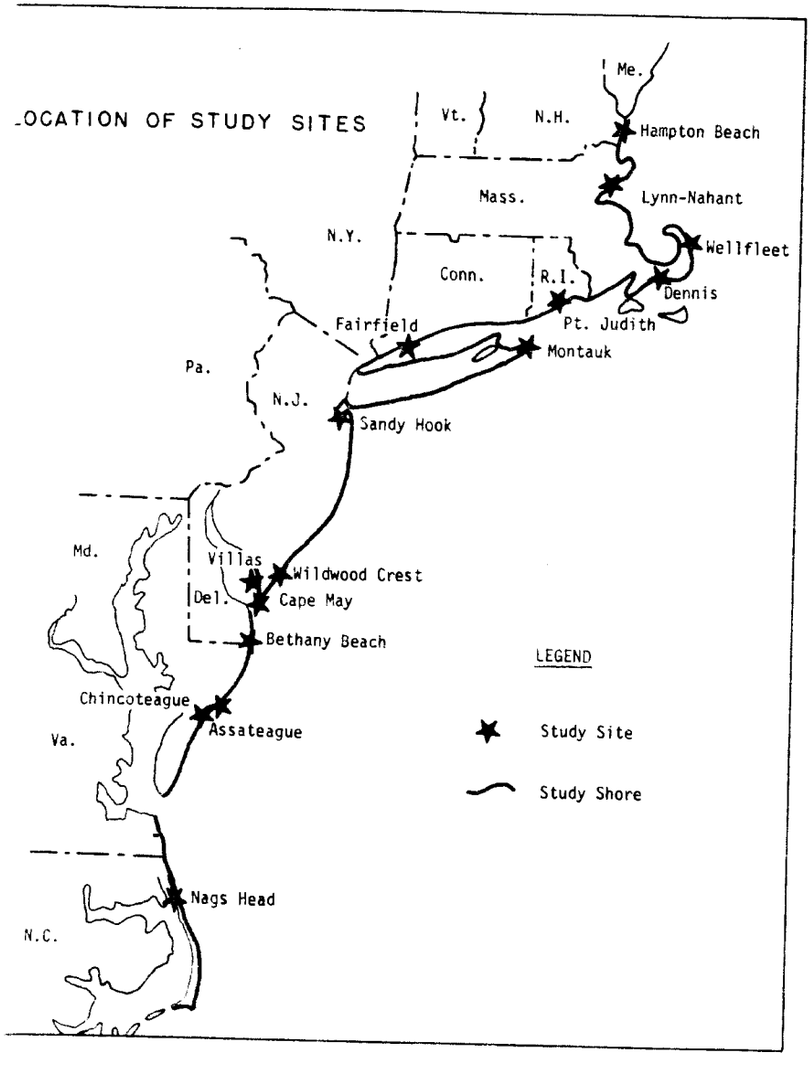

Fig. IV-1

ill fortune.[6] We aspire to, but never reach, the ideal response. A choice between these models of man may always elude us, but we can at least study how men elect to order their uncertain environments. Ignorance and ill fortune can be operationally defined in terms of individual experience of hazard, and the extent of damage suffered. We can inquire what men do or would do about hazard and compare their responses with some technical standard of what men could do. We can compare variations in behavior and perception between areas of different magnitudes of hazard and uncertainty, and between natural hazards of different types. Our coastal data illustrate one such set of relations--that between past and present storm experience and anticipations of the future course of events.

This relation is fundamental to the study of decision-making. In technical terms, future expectation is the specification of a set of outcomes. Based on these perceived sets of outcomes, actions may or may not be taken to reduce damage. How are these outcomes formulated, on what are they based, and whence do they derive?

The specification of storm hazard cannot come solely from scientific and technical knowledge. Even in this area we are woefully inadequate. Climatology, meteorology, oceanography, and coastal geomorphology all seek to define significant elements of the land-sea interface. There is no shortage of description, but meaningful measurements--meaningful in terms of human occupance--are lacking.

We can be certain that major damage-causing storms will affect the area under study in the future. But we cannot state with precision the type of storm to be feared, the frequency of its recurrence, the degree of its magnitude, the likely area of run-up. We can record the past experience of others, but despite the long familiarity of man and sea, our information is rudimentary. The most destructive storm of the recent past, that of March 6-7, 1962, was born off Florida, passed northward to devastate the mid-Atlantic coast over a fetch of upwards of a thousand miles--and then, without warning, under clear skies and with a calm sea, sent swells a thousand miles south to batter the Florida coast again.[7]

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[6] H.A. Simon, Models of Man: Social and Rational (New York: John Wiley, 1957). For a discussion of decision-making models, see Robert W. Kates, Hazard and Choice Perception in Flood Plain Management, Department of Geography Research Paper No. 78, University of Chicago (Chicago: University of Chicago Press, 1962), pp. 12-28.

[7] U.S. House of Representatives, Improvement of Storm Forecasting Procedures, Hearing before the Subcommittee on Oceanography of the Committee on Merchant and Marine Fisheries, 87th Cong., 2nd Sess., April 4, 1962.

Or consider frequency. A Laboratory of Climatology survey has identified lasses of storms significant for human occupance from 1935-64 by twenty-five-mile ectors from 1935 to 1964. Over our study area, there averaged three storms per wenty-five miles in the first decade, six storms in the second decade, and seventeen n the third decade.[8] Has there been a phenomenal rise in storm occurrence, or is the ncrease the result of improved reporting of storms, or of more intensive occupance of ow-lying areas--lending new significance to storms that would earlier have passed nnoticed?

It is against this background of the common occurrence of coastal storms, ombined with great temporal and spatial uncertainty about their specific character- tics, that the knowledge and experience of residents should be viewed.

Almost all our respondents had some knowledge of storm hazard. (Table IV-1). nly three evinced ignorance that storms occur along their stretch of coast. Two-thirds f our respondents recalled being aware of the hazard when they first settled there, and nety percent had experienced a storm during their period of occupance. Fifty percent ad suffered some water damage and many more had suffered wind damage. Conscious rception of at least some degree of natural hazard is generally more widespread than pular accounts suggest, but an exceptionally high proportion of coastal dwellers dis- ay such awareness. Comparable studies on riverine flood plains reveal far less owledge of hazard.

This reflects the distinctive locational orientation of our coastal respondents. contrast to flood-plain dwellers and to inhabitants of zones of high seismic activity, r example, coast dwellers do not just happen to be where they are. It is the adjacent a that attracted them to their location, as over half of them suggested in response to open-ended question. The coastal dweller, attracted to the sea for recreation or mmerce, becomes keenly aware of its varied states. Even the seasonal visitor, who ually sees the sea only in its more placid moods, seems to share this heightened areness. On the coast, the daily variation of tide reminds us of the sea's potential changing its level. And the use of boats, beaches, and water sports, with their sitivity to weather, provides additional familiarity with phenomena and so contributes his awareness.

But this appreciation of the force of storm and tide does not carry over into a listic assessment of the future. As Table IV-2 shows, despite the fact that ninety

[8] Burton et al., The Shores of Megalopolis, pp. 546-549.

TABLE IV-1

INFORMATION AND FUTURE EXPECTATIONS OF COASTAL RESPONDENTS

Present Hazard Information	Expectation of Future Hazards (% of respondents)				Total
	No storms or damage expected	Storms and damage uncertain	Storms expected but no or uncertain damage	Storms and damage expected	
No knowledge	0.8	-	-	-	0.8
Knowledge	2.2	2.4	4.3	0.8	9.7
One experience	6.5	5.7	8.4	9.4	30.0
Two or more experiences	4.6	8.7	22.7	23.0	59.0
Total	14.1	16.8	35.4	33.2	99.5
(Number of Respondents)	(52)	(62)	(131)	(123)	(368)

percent of our respondents experienced storms, only two-thirds expect storms in the future. And although half of them suffered some damage in the past, only a third expect a future storm to entail damage for themselves.

Expectations of future outcomes cannot be understood on the basis of simple awareness of the past; such expectations arise out of a process called interpretation. Our knowledge and experience of real events in the world is personalized and distorted by preconceived concepts of uniqueness and repetitiveness. These concepts are presented in Table IV-2, which classifies respondents on the basis of their replies to structured and unstructured questions about storms. From these verbal clues, we somewhat subjectively derive our categories of interpretation.

Most respondents interpret storms as repetitive events, and many of them feel that the repetition is in some fashion constant: "Just the process of nature in this area for storms to come every year"; "We get storms, with serious ones at about ten year intervals." For others, storms are increasing, owing either to the action of man--"They are shooting those rockets up on Wallop's Island"--or to a perceived migration of hurricane tracks--"They are running up the coast." The spatial pattern may be reversed; some perceive it as "the cycle goes from North Carolina to Florida." These respondents

TABLE IV-2

INTERPRETATION AND FUTURE EXPECTATIONS OF COASTAL RESPONDENTS

Present Interpretation of Hazards	Expectation of Future Hazards (% of respondents)				Total
	No storms or damage expected	Storms and damage uncertain	Storms expected but no or uncertain damage	Storms and damage expected	
I Respondents do not share in the common knowledge of storms	0.9	-	-	-	0.9
II Respondents share in the common knowledge of storms but:					
a) Deny the common image of storms	2.1	0.3	0.6	0.3	3.3
b) Think storms are unique	5.3	4.0	-	-	9.8
c) Think storms are repetitive and also think:					
1. They are personally excluded	3.7	0.9	0.3	-	4.9
2. Storms are decreasing in time or space	1.2	-	1.5	0.3	3.0
3. Storm trend can not be ascertained	-	2.7	16.2	12.8	31.7
4. Storms are constant in time or space	0.6	0.9	20.1	21.6	43.2
5. Storms are increasing in time or space	-	-	0.3	2.4	2.7
Total	14.3	8.8	39.0	37.4	99.5
(Number of Respondents)	(47)	(29)	(128)	(123)	(327)

all see storms as decreasing in frequency or intensity.

For a fair number of other respondents, storms are either unique or unknowable: "The 1962 storm was a freak"; "Nature is too unpredictable." And for a very few, hazard is denigrated or even wished away by semantic magic: "We never have any bad storms"; "We might have a couple of hurricanes, but not a storm." The coastal resident who interprets a storm as a freak, unique event, gains no sense of direction from his experience; his future expectations are based on uncertainty and on a desire to deny hazard.

But quite different interpretations of the course of nature may lead to similar expectations. Some respondents who view the repetition of storms as an ordered event derive comfort from their supposed cyclical frequency: "We get storms once in ninety years, we're not due for another." If a major storm occurs and an individual escapes serious damage, the net impact frequently reinforces feelings of security. Storms might be expected in the future, but they will not affect me. Similarly, elderly retired couples, although aware of storm hazard, may feel secure from them. Storms seem to them to be spaced far enough apart to assure them of security during their few remaining years.

These interpretations, garnered from the spoken clues of the world inside peoples' heads, help to explain the gap between actual experience and future expectation. They help to answer the puzzling question as to why people continue to place themselves in areas of high natural hazard. They show how common experiences are individually interpreted so as to enhance the security of expectations. They suggest something of the way men think about natural phenomena.

Most hazards are apparently random phenomena. Members of the technical-scientific community have by training been prepared to accept a high degree of uncertainty in their scientific work, if not in their private lives. They strive to order the unknowns of natural phenomena, but are prepared to accept the unexplained and to await tomorrow's knowledge.

Our respondents, intelligent and articulate lay people, react to uncertainty in a fundamentally different way. They react to the random occurrence of storms by making events knowable, finding order where none exists, identifying cycles on the basis of the sketchiest of knowledge or folk insight, and, in general, striving to reduce the uncertainty of the threat of hazard. Or conversely, they deny all knowability, resign themselves to the uniqueness of natural phenomena, throw up their hands in impotent despair and assign their fates to a higher power.

Each of these types of explanation has its exponents, but seventy five percent of

the responses of coastal residents fall in one of two categories of interpretation. We had expected to find that the less a hazard was understood, the greater would be the range of interpretations, and that where common knowledge was ambiguous or obscure, the distortion of that knowledge--measured by the variance of interpretation--would increase. Evidence from flood plains suggested that variations of all sorts--in experience, in interpretation, in future flood expectations, and in the perception and adoption of hazard-reducing actions--were greatest where floods occurred often enough to be common but not so often as to make their occurrence certain.[9] The range of individual perceptions fell off in areas of frequent floods or very infrequent floods, where the absence or the occurrence of events seemed immediately and overwhelmingly explicable.

The coastal data reinforce this notion. The left sides of Figure IV-2 show the range of response to four kinds of questions asked in 216 interviews of flood plain dwellers resident where floods occurred on an average of four in every ten years.[10] The right sides show the responses of 371 coastal residents where damage-producing storms occurred on an average of nine in every ten years. By comparison with the flood plain dwellers, range of response among coastal residents is narrow on all counts.

Space does not permit a discussion of how the perception of hazard is translated into behavior designed to reduce damage from storms. But the public policy implications of our study are clear and straightforward. With the exception of a few villages inhabited by retired couples or impoverished fishermen, who in any event are well aware of coastal hazard, coastal users are relatively well educated and well-to-do.[11] They have come to the shore to partake of the attractions found at the interface of land and sea or to serve those who are so attracted. They are, by and large, knowing and well-informed about the general nature of the hazard they face; and as to the details, they are little worse off than the technical-scientific community. A high proportion of coastal dwellers take minimal steps to reduce their hazard, but many of them elect to live at considerable risk rather than reduce their seaward amenities by conservation

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[9] Kates, Hazard and Choice Perception, pp. 83-96.

[10] These data are summarized in Robert W. Kates, "Perceptual Regions and Regional Perception in Flood Plain Management," Papers and Proceedings of the Regional Science Association, II (1963), p. 220.

[11] Among the respondents, 43 percent had some college education and 22 percent had annual incomes in excess of $15,000. These compare with percentages of 16.5 and 17.2, respectively, for the U.S. population.

measures. Some, for example, have opposed the construction of seawalls; others have knowingly leveled dunes in order to improve views and accessibility to beaches.[12] In such a situation, government action to protect beach-front property could be taken only through considerably extending the concept of the welfare state. However, given the long tradition of policy-by-crisis in resource management,[13] it is quite conceivable that some such development and commitment might occur, owing to the pressures, human and natural, that the shores of Megalopolis inevitably face. A more desirable alternative would be an increased effort by government to improve scientific understanding of physical processes, to share such knowledge with the users of the shore, and to encourage patterns of land use that minimize damage.

On the facade of the University of Wyoming is emblazoned the slogan, "Strive, the Conquest of Nature is Won--Not Given". The awesome power of the sea leads to the reflection that the conquest of nature is neither won nor given except in the minds of men.

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[12] Fairfield, Connecticut, the North Shore of Long Island, and Narragansett Bay Rhode Island, provide instances of such anti-conservation action.

[13] The basic statement on the relation between crisis and flood plain management is in Henry C. Hart, "Crisis, Community, and Consent in Water Politics," Law and Contemporary Problems, XXII (1957), pp. 510-537.

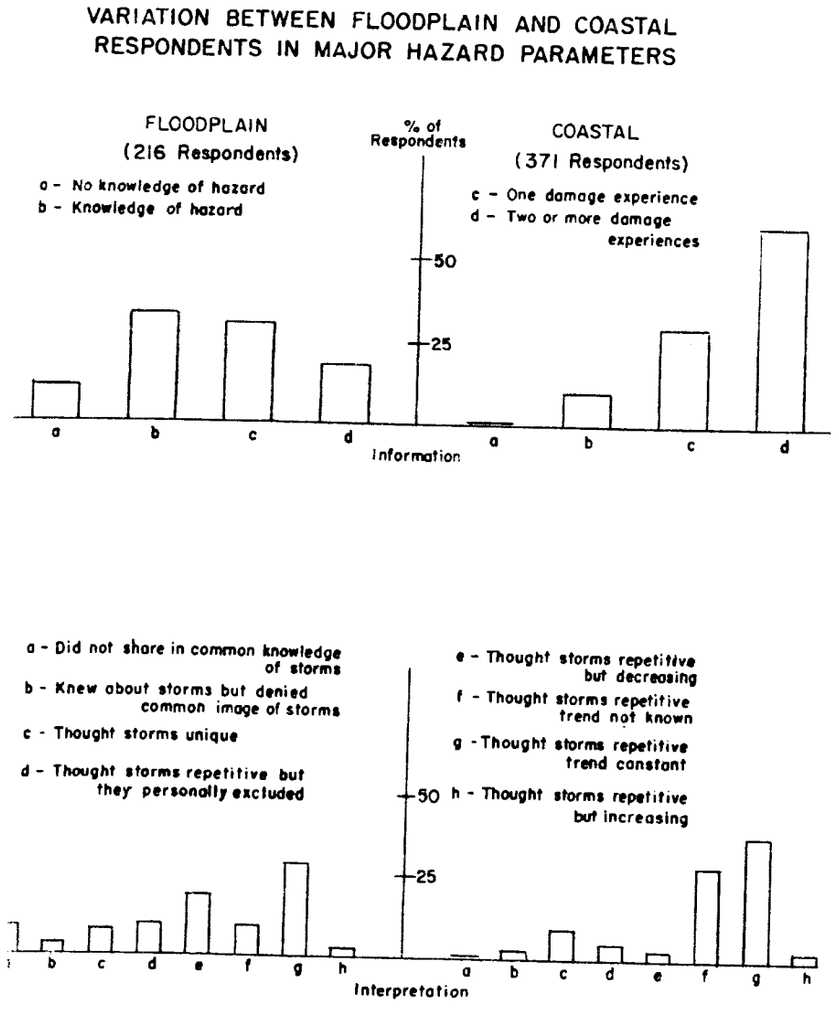

Fig. IV-2

Variation Between Floodplain and Coastal Respondents in Major Hazard Parameters

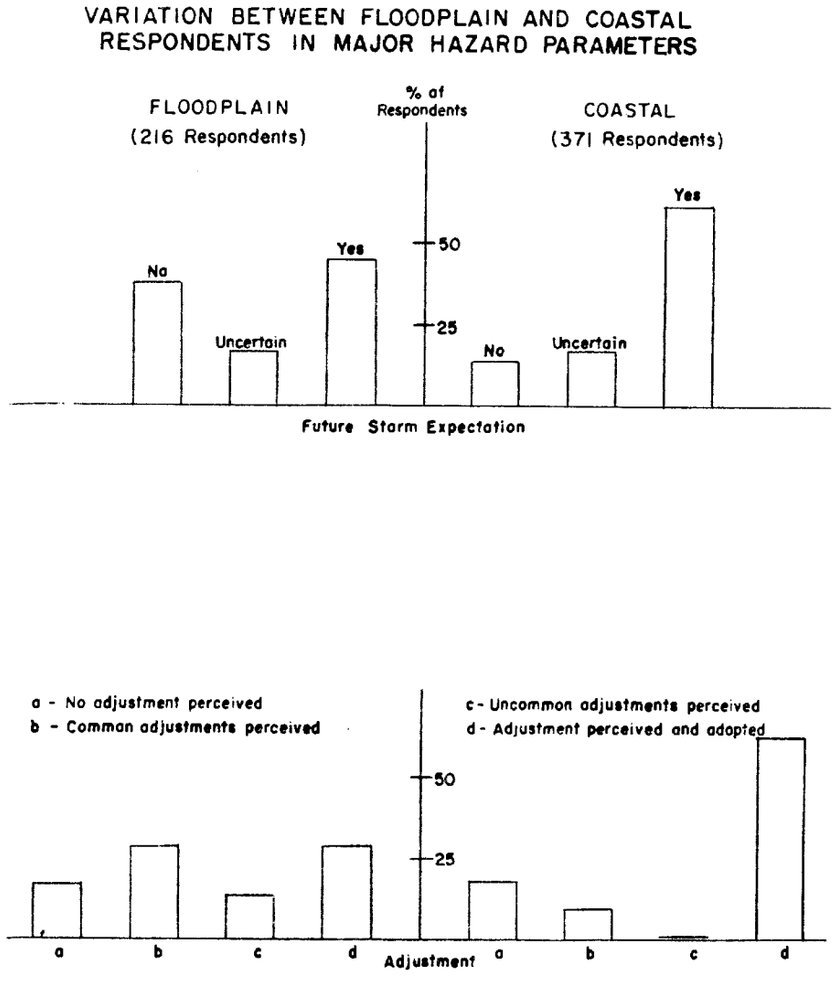

Fig. IV-2 (Cont'd)

Variation Between Floodplain and Coastal Respondents in Major Hazard Parameters

APPENDIX
TIDAL FLOOD HAZARD
QUESTIONNAIRE SITE NO.

SCHEDULE NO.

1. Do you have any bad storms or hurricanes along this part of the coast?

YES NO UNCERTAIN EXPLAIN UNCERTAINTY

IF NO, PASS DIRECTLY TO F 6.

2. Have you had any bad storms or hurricanes while you have (been in Business) (lived) here?

YES NO UNCERTAIN EXPLAIN UNCERTAINTY

PROBE: WHEN, YEARS, DESCRIPTION

IF NO, PASS DIRECTLY TO F 4.

3. Did you have any damage in the storm of _____ or _____?

SPECIFY STORM _____

4. Do you know how high the water gets along the shore in the worst storm or hurricane that you know about?

EXACT STATEMENT _____

PROBE IF NECESSARY AND CONVERT TO NEAREST FOOT ABOVE SEA LEVEL

SITE NO.

SCHEDULE NO.

F 5. How about where we are now standing? How high would the water get here?

EXACT STATEMENT _____

PROBE IF NECESSARY AND CONVERT TO NEAREST FOOT ABOVE SEA LEVEL

F 6. Do you think that you will have, or there will be, a bad storm or hurricane while you are (in business) or (living) here?

YES NO UNCERTAIN

PROBE, WHY? _____

IF NO, PASS ON TO F 8.

F 7. Do you think you might suffer damage?

YES NO UNCERTAIN

PROBE, WHY? _____

F 8. Do you know of anything being done to reduce damage from storms or hurricanes?

SEA WALLS _____

GROINS OR JETTIES _____

PROTECTIVE DUNES _____

OTHER _____

IMPROVED WARNING _____

LAND-USE REGULATIONS _____

BUILDING CODES _____

INVESTIGATIONS BY LOCAL OR FEDERAL GOV'T _____

SITE NO.

SCHEDULE NO.

F 9. Have you ever done anything personally to get action to reduce danger from storms or hurricanes?

YES NO UNCERTAIN

PROBE: WHAT? _____

_____

_____

F 10. Do you know of anything that you might do personally with this property or your belongings to reduce damages, either before or during a storm?

YES NO UNCERTAIN

PROBE: IF RESPONDENT SUGGESTS KNOWLEDGE, PROBE FOR ADOPTION, AND CODE ANSWERS 1 FOR KNOWLEDGE, AND 3 FOR ADOPTION. IF ACTION APPEARS SOLELY DESIGNED FOR WIND ACTION, NOTE THAT AS WELL.

REQUIRING NO PRIOR ACTION:

DISCONNECT UTILITIES & MOTORS _____

KEEP WATER OUT _____

HELP WATER THROUGH _____

_____

ELEVATION & REMOVAL _____

_____

PERSONAL SAFETY _____

REQUIRING PRIOR ACTION:

STAND-BY PREPARATIONS _____

_____

STRUCTURAL CHANGE _____

ELEVATION & REMOVAL _____

_____

REORGANIZATION _____

DO NOTHING _____

OTHER _____

11. Did you know anything about the storm problems when you decided to move here?

YES NO UNCERTAIN

PROBE: IF YES. Did it bother you at the time?

_____

_____

_____

PROBE: IF NO. Knowing what you now know about storms, would you (move) (start) (locate) here again?

_____

_____

_____

CHAPTER V

THE VIEW FROM THE ROAD[1]

Donald Appleyard, Kevin Lynch, and John R. Myer

This paper deals with the esthetics of urban highways: the way they look to the driver and his passengers, and what this implies for their design. The authors became interested in the subject out of a concern with the visual formlessness of American cities and an intuition that the new expressway might be one of the best means of re-establishing coherence and order on the metropolitan scale. Also, the highway offers a good example of a design issue that is typical of the city: the problem of designing visual sequences for the observer in motion.

Ugly roads are often taken to be a price of civilization, like sewers or police. The boring, chaotic, disoriented landscape, which seems to be the natural habitat for the American automobile, is tolerated with resignation by the highway user. Even those who are alarmed by the ugliness of the roadways emphasize the repression of vice: roads should melt into the landscape; billboards should be controlled; the scars of construction should be disguised by planting. There is little discussion of turning the highway experience to any positive account.

Yet roadwatching can be a delight. There are many journeys that are enjoyable in themselves: walking, horse-back riding, boating, rides in amusement parks, or on open bus tops. There are even a few roads in this country on which driving a car is a pleasure.

In an affluent society it is possible to choose to build roads in which motion,

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[1]This paper, which incorporates the substance of Kevin Lynch's presentation at the A.A.G. symposium on Environmental Perception and Behavior, is extracted from the book of the same title published by the M. I. T. Press for the M. I. T.-Harvard Joint Center for Urban Studies, Cambridge, Mass., 1964. It was first published in the Highway Research Record, No. 2, "Community Values as Affected by Transportation," Highway Research Board Publication 1065, 1963, pp. 21-30.