What determines vulnerability to floods; a case study in Georgetown, Guyana

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SUMMARY: *This paper describes how a high proportion of Greater Georgetown's inhabitants are subjected to regular floods and examines also the vulnerability of households to flooding and flood impacts in four of the city's 49 wards. It demonstrates the importance of incorporating social and economic assets together with physical resources as key "dynamic pressures"[1] in assessments of household and neighbourhood vulnerability to environmental stress. It also identifies households and communities as active agents in the management of vulnerability and examines the potential of such organizations for reducing vulnerability based upon economic poverty.*

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I. INTRODUCTION

FOLLOWING SOME INTRODUCTORY comments, human vulnerability to flood hazard in Greater Georgetown will be assessed with reference to four key household pressures: access to secure housing, adequate health care/education, household economic resources and community based organization. The character of flood hazard in Greater Georgetown will then be described, drawing upon recent work by the Guyana Water Authority (GUYWA).[2] Methodological issues in the selection and investigation of the four local study areas will then be discussed, field data describing neighbourhood and household levels of access to the four key assets will be investigated and experiences of vulnerability and hazard from within the study areas will be compared.

City-scale risk and vulnerability in Greater Georgetown have received some attention and it is the aim of this research to provide empirical data to describe the impacts of a hazardous living environment upon households in four socio-economically differentiated case study neighbourhoods. A hazard theory approach is taken whereby household assets are identified and generalized to produce comparative descriptions of neighbourhood vulnerabilities to flooding and flood impacts at the household level.[3] Those forces or "dynamic pressures" which are thought to underlie identified vulnerabilities to both flooding

1. Blaikie, P., T. Cannon, I. Davis and B. Wisner (1994), *At Risk: Natural Hazards, People's Vulnerability and Disasters*, Routledge:London.

2. The Guyana Water Authority commissioned a review of sewerage and water services in Greater Georgetown in 1993 and 1994. The work was undertaken by Sir William Halcrow and Partners Ltd., in association with Design and Construction Services Ltd. and Wessex Water International. This paper has drawn information from Part 1, Vol.5, "Environmental"; Part 3, Vol.1, "Sewerage system"; Part 4, Vol.1, "Primary drainage system"; project memorandum PM/GMP/09, "Review of potable water quality";

technical note TN/GMP/09, "Household surveys".

3. See reference 1.

4. Wratten, E. (1995), "Conceptualising urban poverty", *Environment and Urbanization* 7:1, pages 11-36; also Chambers, (1989), "Vulnerability, coping and policy", *Journal of International Development* 20:2, pages 1-7.

5. World Bank (1993), *Guyana: Public Sector Review*, World Bank:Washington DC; also Ferguson, T. (1995), *Structural Adjustment and Good Governance: the Case of Guyana*, Public Affairs Consulting Enterprise:Georgetown; and Thomas, C.Y. (1993), "Lessons from experience: Structural adjustment and poverty in Guyana", *Social and Economic Studies* 42:4, pages 133-184.

6. PAHO/WHO (1993), *Health in the Americas; Guyana*, PAHO/WHO:Washington DC; also Ministry of Health (1995), *Draft National Health Plan of Guyana*, Government of Guyana: Georgetown.

7. Kemp, S. (1993), *A Statistical Analysis of Georgetown Rainfall, A Proportionate Approach*, Ministry of Agriculture: Georgetown; also Simon, K. (1994), *Observed Climate Trends in Guyana*, paper presented at the Climate Change Conference, Georgetown, Guyana.

and to flood impacts in Georgetown will also be explored. A discussion of environmental hazard and underlying conditions of vulnerability is of particular relevance to Georgetown, where flood risk is likely to increase as a consequence of global environmental change.

Vulnerability is a concept often used to describe a household's position relative to poverty and economic stress;[4] here, a broader view extends vulnerability to incorporate stress from environmental as well as human sources. Vulnerability is determined by a household's resource characteristics (economic, political, social, demographic, psychological and environmental) and, in this case, their appropriateness in reducing the likelihood of living space being flooded and the scale and distribution of impacts should flooding occur.

Local experience is influenced by larger, macro-scale processes; in this case, Guyana's economic crises of the late 1970s and 1980s, economic restructuring of the 1990s and underlying international pressures are key causes of local vulnerability. An on-going scarcity of both finance and skills associated with these periods severely restricted the functioning of state and municipal agencies and resulted in an effective abdication of their responsibilities for the maintenance of physical and social infrastructures.[5] In Greater Georgetown, this became manifest in the deterioration of drinking water, sewerage, drainage and garbage disposal services which contributed to a worsening of urban environmental quality. In addition, the undermining of health services and the extension of poverty have increased households' vulnerability to flood impacts from environmental stress. This is demonstrated by high infant mortality rates, estimated to be 70 per 1,000 in under one-year olds and 73 per 1,000 in children under five years old. Intestinal infectious diseases, which can be associated with Georgetown's deteriorated environmental quality, account for about 25 per cent of recorded infant deaths.[6] Though improvements in donor/government relations since 1988 have renewed the inflow of external capital and allowed some limited institutional strengthening, environmental stress, poverty and vulnerability remain extremely high.

Greater Georgetown is Guyana's capital and principal urban centre (with a population of 151,679 according to the Population and Housing Census, 1991). Risk from coastal, riverine and rainfall flooding stems from Georgetown's coastal plain location at the mouth of the Demerara river. Surface water drainage is hampered by underlying, impervious clay soils and a resultant flat topography and elevation at about or below mean high water level. The city is currently protected from riverine and coastal flooding by defensive walls but regularly experiences widespread flooding following biannual, seasonal rains.

No recent change in annual rainfall patterns have been observed[7] and this increase has therefore largely been associated with a range of human processes. Impervious areas within Georgetown increased by 50 per cent between 1963 and 1993 raising the volume of run-off channelled through Georgetown's drainage system. At the same time, drainage capacity has been reduced due to the infilling of drains, inadequate maintenance

of existing drainage, the use of drains for informal refuse disposal and the use of drainage reserves for informal housing and peti-agriculture. Since 1989, uncontrolled urban expansion into unserviced areas has similarly increased city vulnerability to flooding from high rainfall events. A rise in sea levels will further reduce the efficiency of the city's gravity drainage,[8] and may induce a rise in groundwater level.

II. CITY LEVEL HUMAN VULNERABILITY

FLOODING IN GEORGETOWN is superimposed upon pre-existing land uses, thus all social groups resident in the city may be at risk from flooding regardless of economic or social position. The following discussion integrates available secondary data to assess the extent to which housing and urban services, health care, poverty and community organization shape vulnerability to flooding and flood impacts at the city level.

a. Access to Secure Housing

Secure housing has become unaffordable for all but high-income groups.[9] Indeed, the housing sector is generally recognized as being in a state of crisis.[10] Total housing need in Greater Georgetown has not been identified although it has been estimated that an immediate housing need for around 10,000 units (30 per cent of contemporary stock) exists. The inability of the private and public sectors to provide housing is demonstrated in the low figure of 438 private, new-build housing units for Greater Georgetown between 1984 and 1994; neither has there been significant public funded housing construction since the 1970s.[11]

The housing shortfall is likely to increase vulnerability to flood events amongst three specific social groups. First, as mentioned above, many households have chosen (been forced) to live in squatter sites where no formal physical or social infrastructure is available and tenure is insecure. Second, the low values of rentals obtained relative to maintenance costs has meant that households in the public and private rental sectors (50 per cent of households in Greater Georgetown[12] may suffer from especially poor physical environments. Third, housing demand has encouraged houseowners to sub-divide properties[13] leading to the creation of vulnerable "bottom houses".[14]

b. Access to Adequate Health Care/Education

The national health care system has been severely restricted through high levels of inefficiency, the fragmented organization of the sector, a lack of coordination between the agencies responsible for health, financial scarcity and a lack of skilled staff.[15] The ineffectiveness of health care and education in Guyana is demonstrated by a national health profile which is dominated by conditions (respiratory infection, hypertension, diabetes, mellitus, enteritis/diarrhoea, worm infestation and

8. Comacho, R.F. (1993), *The Implications for Climate Change and Sea-level Rise on the Coastlands of Guyana*, Comacho Associates: Devizes, UK; also Swedeplan (1995), "Sea-level rise", technical note in *Shorezone Management Plan*, Swedeplan:Stockholm, Sweden.

9. Central Housing and Planning Agency (1996), *Housing and Urban Development in Guyana*, CHPA:Georgetown.

10. Rodney, D. (1993), "Aspects of urban poverty", *Transition* 20-21, Institute of Development Studies, University of Guyana: Georgetown.

11. Central Housing and Planning Agency (1993), *Government of Guyana Housing Policy*, CHPA:Georgetown.

12. Bureau of Statistics (1993), *Population and Housing Census, 1991*, Bureau of Statistics:Georgetown.

13. IDB (1994), *Building Consensus for Social and Economic Reconstruction: Report of the IDB Pilot Mission on Socio-Economic Reform in the Co-operative Republic of Guyana*, IDB: Washington DC.

14. Traditionally, Guyanese houses are raised on stilts of between two and four metres. The space under the house may be used as a kitchen, for recreation, as a workshop or store. A particular feature of housing in Greater Georgetown is the conversion of this space into a "bottom house" which is often occupied by young married couples (and young children) or elderly family members or is rented out.

15. See Ferguson (1995), reference 5.

malaria) the number of which could be substantially reduced by basic improvements in the health sector. Affordability, adequacy of service and the low priority placed on health education are major constraints on health care delivery. Because physical accessibility is not a major constraint in Greater Georgetown, access is considered to be closely related to economic and social status.

c. Access to Economic Resources

The widespread existence of poverty in Guyana is extensively acknowledged. SIMAP, for example, in 1992 estimated that 75 per cent of the population could be classified as poor. Only 13 per cent of households have a monthly income above G$40,000 (UK£160, 1993) with 70 per cent of households having a monthly income below G$25,000 (UK£100, 1993). However, estimating the extent of poverty, or the effect of recent structural adjustment policies (SAPs), is problematic.[16] Historically, poverty has been less severe in Georgetown than in rural areas. However, SAPs have impacted hardest upon urban based public sector employees; in 1990 the "overwhelming majority of public servants had incomes.... well below subsistence levels."[17] The IDB[18] identified children, the aged and women (particularly heads of households) as being especially vulnerable to poverty on the Guyanese coast.[19] Although various poverty amelioration projects have been undertaken to reduce the burden of SAPs on the poor and economically vulnerable, they have been unable to target the most needy groups because of a continuing paucity of data.[20]

Economic resources can be used directly to ameliorate flood impacts through household insurance cover or investment in flood proofing of dwellings. Indirectly, access to household economic resources influences vulnerability through access to associated household resources; access to health care has already been identified and much work has identified links between poverty and ill-health.[21]

d. Access to Social Resources: Community Based Organizations

There has been little evidence of community based organizations (CBOs) or developmental non-governmental organizations (NGOs) in Guyana or Greater Georgetown until very recently. Indeed, an ongoing Central Housing and Planning Agency (CHPA)/UNDP participatory infrastructure rehabilitation programme targeting low-income, inner-city neighbourhoods has encountered only limited community support. The need to foster community development is demonstrated by the high priority given to the re-introduction of community development and strengthening of NGOs by donors, ministries[22] and presidential opinion.[23] A lack of organization at the community level reveals a weakness in Georgetown's mix of managing institutions which is likely to have contributed to the undermining of environmental infrastructure and will reduce the effectiveness of infrastructural rehabilitation.[24]

16. World Bank (1992), *Guyana: From Economic Recovery to Sustained Growth*, World Bank:Washington DC.

17. See Ferguson (1995), reference 5.

18. See reference 13.

19. See reference 13.

20. See Thomas (1993), reference 5.

21. Cairncross, S., J.E. Hardoy and D. Satterthwaite (editors) (1990), *The Poor Die Young*, Earthscan:London; also, Stephens, C. (1996), "Healthy cities or unhealthy islands? The health and social implications of urban inequality", *Environment and Urbanization* Vol.8, No.2, pages 9-30.

22. See reference 9.

23. Jagan, C.B. (1993), "Opening address", *Transition* 20-21, Institute of Development Studies, University of Guyana.

24. See Cairncross et al. (1990), reference 21; also Arrossi, S., F. Bombarolo, J. Hardoy, D. Mitlin, L.P. Coscio and D. Satterthwaite (1994), *Funding Community Initiatives*, Earthscan:London.

III. PREVIOUS FLOOD HAZARD RESEARCH IN GREATER GEORGETOWN

PREVIOUS DATA ON flood hazard in Greater Georgetown is limited to a single 477 household survey conducted by Halcrow Ltd.[25] It was estimated that 48,000 people experienced regular flooding and a further 48,000 experienced occasional flooding within their homes. Twenty-five out of 49 city wards were described as being at high risk from flooding (see Figure 1). Several floods may occur each year, 21 floods were recorded by the press between January 1990 and June 1996.[26] For the "most recent flood" Halcrow recorded depths rarely exceeding 0.05 metres (maximum recorded depth is three metres) and duration rarely exceeding eight hours. Reported flood events may appear to run into one another if precipitation from consecutive rainfalls exceeds the capacity of infrastructure to drain the land. It was argued that this is why 36 per cent of recorded household flood duration lasts one to two days and 6 per cent three to four days. During 1993, 31 per cent of those households in Greater Georgetown affected by flooding experienced damage to property or loss of time from work or school and 15 per cent reported diarrhoea or gastric illness.

25. Sir William Halcrow and Partners, Ltd. (1994), "Household surveys", technical note TN/GMP/09, Georgetown Water and Sewerage Master Plan, Sir William Halcrow and Partners, Ltd.:Swindon.

26. Stabroek News, January 1, 1990 to June 31, 1996. Over this period of time, the Stabroek News was the only national, independent daily newspaper.

IV. METHOD

TO ALLOW QUALITATIVE comparison, four case study sites were selected from 25 wards and self-help settlements within Greater Georgetown previously identified as being of "high flood risk" (see Figure 1). The 1991 census was used to select four wards differentiated by sewerage infrastructure, location and employment profile (see Table 1). Within each ward an area of around 200 households was randomly chosen from an ordinance survey map for field surveys.

Table 1: Sample Characteristics

Ward Character	Ward Name	Household Sample
Sewer/inner-city/non-professional	Wortmanville	62
Septic tank/suburban/non-professional	West Ruimveldt	63
Septic tank/suburban/professional	Bel Air Park	47
Pit latrine/self-help settlement/ non-professional	West Sophia	60

Sources: 1991 Population and Housing Census; Georgetown Water and Sewerage Master Plan, III, 1, 1994

The size and number of samples was limited by the number of research workers available and the necessity to conduct surveys in a two-week period commencing seven days after the flood event. This timing was needed to keep respondent memory bias to a minimum whilst allowing a sufficient period for the identification of rapid onset health impacts. A "one-in-three"

Figure 1. Wards at Risk from Flooding in Greater Georgetown

random sample frame was adhered to in the field. In this way, samples were not designed to be truly representative of complete wards but of local neighbourhoods within wards.

The questionnaire sought to obtain a household socio-economic and demographic profile, an infrastructural asset profile, past experience and perceptions of flood hazard and household vulnerability, household adjustments and hazard management mechanisms, and recent flood impact upon property and household members. It was supported by preliminary site observation, informal discussions with residents and a post-survey validity check through in-depth interviews conducted with 15 per cent of respondents. In-depth interviews were also designed to provide deeper, qualitative data on personal experiences of vulnerability, risk and flood impact.

V. RESULTS AND ANALYSIS

BECAUSE OF THE necessarily small sample sizes used, only qualitative and descriptive analysis has been possible. For each neighbourhood socio-economic and infrastructural profiles are given, followed by descriptions of the roles played by each dynamic pressure in the production of vulnerability and the impacts of a flood on Sunday, 12 November, 1995. This flood followed 153 millimetres of rainfall, the highest recorded volume of rainfall over a 24-hour period in November since 1974.[27] Detailed data on neighbourhood characteristics can be found in Tables 7-12, see Annex 1.

27. Hydro-meteorological Office, Ministry of Agriculture.

a. West Ruimveldt: a Low-income, Suburban Neighbourhood

Rental (43 per cent) and owner-occupation (42 per cent) dominated in the neighbourhood studied in West Ruimveldt. Overcrowding was common and access to economic assets very low (median monthly household income was G$20,000-G$29,999); a high proportion (70 per cent) of households also included at least one infant or aged member, thus implying health vulnerability. Residents were not served by the municipal sewerage system and had built septic tanks (69 per cent) or pit latrines (29 per cent); a primary drainage canal was also used by squatters to dispose of household waste and sewage. Some 29 per cent of septic tanks were overflowing at the time of interviewing. Drinking water was obtained from pipes (92 per cent; leaks reported in 8 per cent) with 35 per cent of households not treating water before consumption. Garbage was burnt.

The major landlord here was the Government of Guyana (GoG). Government houses were not raised, thus the proportion of houses raised above possible flood water levels was low (19 per cent). Whilst rental payments for such properties were around 10 per cent of market rates, government maintenance had been ineffective since the early 1980s. *De facto* property maintenance and improvement was carried out illegally by tenants. Between January and July 1996, the CHPA planned to offer all state

housing in West Ruimveldt for sale to sitting tenants at subsidized rates. For those residents able to afford to purchase, this should provide an impetus for improved maintenance. Other residents will remain tenants of the state.

Although no community wide organizations existed and *ad hoc* maintenance of drainage infrastructure was uncommon (18 per cent) a local church group coordinated the construction of a raised public walkway in 1995. Congregation and residents' labour, and congregation money, was used. The group reported having been refused assistance from the Social Impact Amelioration Programme (SIMAP), a key QUANGO funding community sponsored projects, because it was not recognized as a CBO. No GoG or municipal maintenance of housing or drainage infrastructure has been reported since the early 1980s, consequently all primary, secondary and tertiary drains were classified as "poor-very poor".[28] (Box 1 provides an example to highlight the inadequacies and conflicts between state, community and self-help management options for households in West Ruimveldt). Motivation for future self/community action (20 per cent/3 per cent) and faith in municipal agents (7 per cent) appeared low, with 68 per cent of respondents not being able to suggest a realistic means of improving local drainage.

All respondents had experienced at least one flood on their property prior to the 12 November flood. Drainage was ranked as the municipal service where an improvement would most benefit the household. Some 27 per cent of households considered that previous flooding had adversely affected household health and respondents also recorded relatively high stress lev-

28. Sir William Halcrow and Partners, Ltd. (1994), *Primary Drainage System, Georgetown Water and Sewerage Master Plan*, Sir William Halcrow and Partners, Ltd.: Swindon.

Box 1: Ina Campbell's Household - Navigating Household, Community and State Housing Maintenance and Flood Management Options

In 1985, Ina and her three adolescent children were forcibly evicted from their previous property and allocated a government flat. Although the property was built around 1965, Ina was not aware of any maintenance provided by the state. The property first flooded in 1988 and it now floods whenever it rains heavily.

Although Ina did not report any direct economic losses through flooding, her children had suffered frequently from respiratory tract infections, including one diagnosed case of pneumonia. Ina also suffered from arthritis.

In attempting to manage flooding, Ina first sought assistance from the state landlord in 1990. Because of a scarcity of capital, assistance was not available and Ina was warned against making alterations without permission from the state landlord. Ina subsequently tried to organize community action to clean drains but found no serious commitment or interest amongst her neighbours, most of whom also frequently experienced flooding. Finally, Ina acted on her own behalf, and against formal tenancy regulations, by using concrete to raise the ground floor inside her house by ten centimetres (in 1992), and building an eight centimetre block in front of the front door and an eight centimetre high path in the yard (in 1994). These alterations provided some protection but were not sufficient to make the house secure from all flooding; nor did these measures reduce flood hazard in the local environment.

els (see Table 8); 58 per cent stated being "worried every time it rains [heavily]". A comparatively high proportion (65 per cent) of those households identifying flood events as a source of health problems used a formal medical practitioner.

Residents of West Ruimveldt appeared to be very vulnerable to flood risk. Housing, though affordable, had not been maintained by the GoG landlord for many years. Similarly, drainage infrastructure had been neglected by municipal authorities for more than a decade. Poor housing and infrastructure maintenance was compounded by low household incomes and minimal community organization.

On 12 November, some 89 per cent of yards (mean depth, 20 centimetres; duration, 35 hours) and 22 per cent of dwellings (mean depth, 7 centimetres; duration, 24 hours) flooded. Ill-health (diarrhoea, vomiting, skin irritation, eye infection, respiratory infection) within one week of the flood was reported by 24 per cent of households. Reported event stress was high, with 54 per cent of respondents recalling feelings of anger and 38 per cent feeling frightened during the flood. A high proportion of households with student members reported forced absenteeism (43 per cent) of at least one day whilst absenteeism amongst workers was low (3 per cent of households). The incidence of damaged yards (16 per cent), damage to property (10 per cent) and estimated direct economic losses (G$1,000 -70,000) was variable but low. Reported severity was bi-modal with residents tending to report this flood as having either low or very high severity.

b. Wortmanville: a Low-income, Inner-city Ward

The neighbourhood studied in Wortmanville was dominated by low-income households with a relatively high proportion of households renting (61 per cent) and living in vulnerable "bottom houses" (50 per cent) (see Box 2 for an account of vulnerability produced by denied access to secure housing). Overcrowding was common and the occurrence of households which included an infant (47 per cent) or an aged member (23 per cent) was comparatively high.

Wortmanville's residents were served by Georgetown's municipal sewerage system and overflowing from yard sewers was a major health concern for residents (44 per cent). Drinking water was obtained from pipes (91 per cent), some of which leaked (13 per cent, observed) allowing contamination by flood waters. Some 31 per cent of residents drank untreated water. Household garbage was collected by the municipality (90 per cent).

All drains were severely silted to a depth of 5-15 centimetres and many were overgrown by weeds or blocked by garbage. No CBO involved in environmental works was identified, however, municipal workers had recently cleared some drain parapets. Some 21 per cent of households were involved in *ad hoc* tertiary drain clearance. In addition to household maintenance of municipal drains, 31 per cent of households had invested in raising the level of their yard to prevent the encroachment of flood waters. Motivation for future self/community action (24 per

Box 2: Wendy Stewart's Household - Made Vulnerable though Unaffordable Secure Housing

Wendy was a resident of Wortmanville, where she had lived in a derelict and abandoned "bottom house" with her nine children for ten years. There were three other households (a total of 46 people) in the same yard, living in two abandoned houses. The yard was extremely unsanitary and flooded with every heavy rain. Flood waters frequently entered Wendy's house and her children suffered from diarrhoea, shortness of breath (possibly asthma) and colds. She used the Georgetown Public Hospital when any of the children were seriously ill.

Wendy said that her biggest problem was finding affordable accommodation. Not only were private rents exclusive but many landlords refused to rent to families with young children. In response to this, over the last five years, Wendy had twice cleared land with the intention of establishing a squatter dwelling. In both instances, she was forced off the land through intimidation from other, competing squatters. She felt that there was no option but to continue living in her "bottom house".

cent/3 per cent) and faith in municipal agents (2 per cent) appeared low, with 71 per cent of respondents being unable to suggest a realistic means of improving local drainage in the short term.

All respondents had experienced at least one flood on their property prior to the 12 November flood. Drainage was ranked as the municipal service where an improvement would most benefit the household. Only 16 per cent of households considered that previous flooding had adversely affected household health although respondents recorded high levels of stress levels (see Table 8); 59 per cent stated being "worried every time it rains [heavily]". A comparatively low proportion (33 per cent) of those households identifying flood events as a source of health problems used a formal health practitioner.

As in all case study wards, Wortmanville's drainage infrastructure was in a very poor state of repair. In this case, this was despite recent drain-cleaning work by the city council which highlights the inadequacy of the present maintenance regime. Vulnerability to the health impacts of floods was increased because of the decayed municipal sewerage system which contaminates flood waters. Human vulnerability to flood events in Wortmanville was variable but generally very high. Wortmanville is dominated by low-income households living in private rental accommodation with a high proportion of "bottom house" dwellings which were especially vulnerable to flood impact. The lack of community involvement in local environmental management further increased vulnerability to flood hazard.

On 12 November, some 97 per cent of yards (mean depth, 17 centimetres; duration, 30 hours) and 24 per cent of dwellings (mean depth, 11 centimetres; duration, 15 hours) were under water. Ill-health, within one week of the flood, was reported by 20 per cent of households. Reported event stress was high with 58 per cent of respondents feeling angry and 23 per cent feeling frightened. A high proportion of households with student members reported forced absenteeism (37 per cent) of at least one

day whilst absenteeism amongst workers was low (6 per cent of households). The incidence of damaged yards (24 per cent), of damage to property (10 per cent) and estimated direct economic losses (G$300 - 3,000) was generally low. However, the majority of respondents reckoned that this flood was not severe when compared to past flood experience.

c. West Sophia: a Low/Mixed Income, Peripheral, Squatter Site

West Sophia is one of the most established sections of a rapidly expanding peripheral squatter zone; it was first settled in 1986.[29] All household characteristics in Sophia are extremely varied. Whilst squatting "ownership" dominates (95 per cent), a rental sector does exist (5 per cent). Access to economic resources was generally very low (median monthly household income was G$20,000 - 29,999) although there was a wide variation. Overcrowding was common, with a high proportion of households with infant members (68 per cent) or infant/aged members (75 per cent) suggesting potential health vulnerability. Household sewerage was disposed of by pit latrines (100 per cent) which, although not overflowing at the time of interview, regularly did so under flood conditions. Drinking water was obtained (98 per cent) from two public pipes both located at one extreme end of the site. A high proportion of residents (37 per cent) drank untreated water. Household garbage was burnt (90 per cent).

Because of the high infant and aged population, the prevalence of pit latrines and the use of untreated drinking water, vulnerability to the health impacts of flooding was high. However, the ability of self-help builders to construct dwellings responding to contemporary environmental conditions meant that a very high proportion of dwellings were raised (90 per cent), thus reducing the likelihood of flood waters entering living spaces.

There were very few secondary and tertiary drains on the site. However, the West Sophia Developers Group had, since 1991, coordinated regular drain-digging and maintenance, and bridge construction works. This CBO was reasonably well supported by members (38 per cent). In addition, informal support between residents was frequently observed and remarked upon as an advantage of life in West Sophia. Because the site lacked legality, no applications had been made for support from SIMAP for assistance in community based work. Motivation for future individual self-help (22 per cent) and faith in municipal agents (13 per cent) appeared low, with 41 per cent of respondents not being able to suggest a realistic means of improving local drainage. Interest in community self-help was, however, high (24 per cent).

West Sophia did not flood on 12 November. It is unlikely that this was solely due to local topography, indeed, coastal land is usually lower than that further inland (all other case study sites). In addition, the Liliendaal pump which allows high water drainage of eastern Georgetown was out of service during this flood.

29. Pelling, M. (1992), "A review of self-help housing strategies employed by lower-income groups in Greater Georgetown, Guyana", occasional paper, Department of Geography, University of Guyana.

Thus, it is possible that community action had contributed to a reduction in this neighbourhood's vulnerability to flood hazard.

Consistent with the observed lower vulnerability to flood risk, drainage was only ranked as the second municipal service where an improvement would most benefit the household. Only 3 per cent of households considered that previous flooding had adversely affected household health, a very low proportion given the site's high vulnerability. Respondents also recorded very low stress levels (see Table 8); 30 per cent stated being "worried every time it rains [heavily]".

Whilst West Sophia was largely populated by low-income households, vulnerability to flood hazard had been greatly reduced by both individual and community based action. Self-help construction had led to very few "bottom house" dwellings and a community organization had coordinated drain digging and maintenance. Failure to gain support from CBO funding agencies or to complete the government regularization process (five years after applying) had, however, undermined much of the potential offered by community based action in local drainage management. Despite successfully reducing vulnerability to flooding, vulnerability to health and economic impacts of floods remained high as living conditions were overcrowded, unsanitary and household incomes generally very low.

d. Bel Air Park: a Mixed/High Income, Suburban Ward

Bel Air Park was dominated by high-income households (median monthly household income was greater than G$40,000) with a roughly equal proportion of households owning (43 per cent) and renting (42 per cent) property. Some 60 per cent of dwellings were raised, greater than in either West Ruimveldt or Wortmanville. Overcrowding was very uncommon and household composition suggested comparatively low vulnerability to the health impacts of flooding (50 per cent of households had either an infant or aged member). Household sewerage was disposed of by septic tank (96 per cent) with a relatively low proportion of tanks observed overflowing (20 per cent). Drinking water was obtained from pipes (70 per cent), few of which leaked (3 per cent, observed), or purchased as purified water (30 per cent). Only 17 per cent of residents drank untreated, piped water. Household garbage was collected by the municipality (89 per cent).

All drains were silted and many were overgrown, including primary drains. A CBO, the Bel Air Park Residents Association, had coordinated the clearance of secondary drains serving around one-third of Bel Air Park, in 1995. However, no further works were planned and the group was poorly supported (4 per cent) with many residents lacking faith in the effectiveness of community action (Box 3 highlights this problem). In addition, few examples of informal support between neighbours in tackling environmental problems were observed or discussed. Whilst community organization was poor in Bel Air Park, the highest proportion of individual responses to flood hazard (49 per cent) were identified here and the greatest investments made (74 per

cent of raised yards used concrete). Motivation for future self/community action (28 per cent/2 per cent) and faith in municipal agents (9 per cent) appeared low, with 61 per cent of respondents not being able to suggest a realistic means of improving local drainage.

All respondents had experienced at least one flood on their property prior to the 12 November flood and drainage was ranked as the municipal service where an improvement would most benefit the household. Only 15 per cent of households considered that previous flooding had adversely affected household health, with respondents recording relatively low stress levels (see Table 8); 35 per cent stated being "worried every time it rains [heavily]". A comparatively high proportion (50 per cent) of those households identifying flood events as a source of health problems used a formal health practitioner.

Box 3: The Fernandes Household - Ineffective Community Representation and Economic Loss

Robert Fernandes lived with his sister and two aged relatives in a two-storey house, which they had occupied for ten years. Robert worked as a shipping agent earning around G$30,000 per month; because the house was owned by Robert's brother, who was based in New York, USA, no rent was paid.

Robert had never attended a residents association meeting and considered that such a group of "big men" would neither listen to, nor act upon, any input he might have to offer. Robert's brother had attended occasional meetings when he was in Guyana but no improvements in the immediate environment had been noted.

Although no health impacts from flooding had been reported, the ground floor of the house had been abandoned since 1989 because of regular flooding and was now only used as a rough workshop and store. The opportunity of using or renting this space to raise income had therefore been lost. In addition, Robert had ended his hobby/small business of breeding Doberman dogs since a flood in 1995 in which four young dogs died.

Residents of Bel Air Park demonstrated the greatest individual ability to reduce household vulnerabilities. Residents were generally high-income and had access to purified drinking water, had well-maintained septic tanks and had the greatest proportion of raised yards and the smallest proportion of "bottom houses" encountered. Although flood risk in this ward was high, individual household vulnerability to flooding and its impacts appeared to be low (see below). Vulnerability had been lowered further by the activities of a CBO.

On 12 November, some 89 per cent of yards (mean depth, 18 centimetres; duration, 34 hours) and 38 per cent of dwellings (mean depth, 15 centimetres; duration, 32 hours) were under water in Bel Air Park. Despite this, ill-health within one week of the flood was reported by only 15 per cent of households. Reported event stress was also low, 45 per cent of respondents feeling angry and 17 per cent feeling frightened. A low propor-

tion of households with student members reported forced absenteeism (12 per cent), although absenteeism amongst workers was comparatively high (11 per cent of households). The incidence of damaged yards (38 per cent), damaged property (14 per cent) and estimated direct economic losses (G$2,000 - 200,000) was generally high (Box 3 provides an example of economic loss). The majority of respondents reckoned that this flood was quite severe when compared to past flood experience.

e. Housing Tenure and Household Income

Housing tenure and household income were believed to have played particularly important roles in the production and experience of household vulnerability to flood hazard and impact in Georgetown. Because these variables could be compared between wards, they have undergone additional descriptive analysis. The West Sophia sample was excluded from total values in Tables 2-6 because respondents did not report experiencing flooding and because dwelling tenure was complex and uncertain.

Table 2: Dwelling Ownership and Yard Modification

Neighbourhood	% of all households occupied by owner households and with raised yards*	% of all households occupied by non-owner households and with raised yards*
West Ruimveldt	32	35
Wortmanville	53	21
Bel Air Park	78	27
Total (excluding Sophia)	49	27

* 60% of all households had raised yards

Table 3: Yard Modification and Flood Experience

Neighbourhood	% of all ground floor dwellings experiencing a house flood and with raised yards*	% of all ground floor dwellings experiencing a house flood and without raised yards*
West Ruimveldt	27	21
Wortmanville	66	27
Bel Air Park	44	75
Total (excluding Sophia)	40	30

* 60% of all households had raised yards

Tables 2 and 3 show that owner-occupier households were more likely than non-owner households to have responded to flood hazard by raising yard levels and that such adaptation may provide some security to dwellings from flood hazard. Bel Air Park fits this trend most closely, with 78 per cent of owner-occupied households having raised yards compared to only 27 per cent of non-owner households; of ground floor dwellings

with raised yards, 44 per cent experienced a flood on 12 November compared to 75 per cent of dwellings without raised yards. However, Table 4 suggests that, in many cases, yard-raising was not a sufficient enough adaptation to completely safeguard dwellings from flooding. Combining samples shows that 40 per cent of ground floor dwellings with raised yards and 30 per cent of ground floor dwellings without raised yards experienced flooding within their dwellings on 12 November 1995. However, yard-raising does appear to have contributed to household security. Indeed, in flood events of lesser magnitude, which have a greater incidence in Georgetown, the amount of security provided by yard-raising may be increased. The high incidence of yard-raising amongst (especially owner-occupier) households reiterates the active character of households as agents in the production of vulnerability/security.

Table 4 shows that households with monthly incomes greater than G$30,000 (17 per cent of all households in Guyana are less likely to have experienced flooding than households with

Table 4: Income and Flood Experience Amongst All Dwellings

Neighbourhood	% of all households with monthly income <G$30,000 experiencing a house flood	% of all households with a monthly income >G$30,000 experiencing a house flood
West Ruimveldt	23	18
Wortmanville	29	20
Bel Air Park	44	27
Total (excluding Sophia)	40	28

Table 5: Raised Living Space and Monthly Household Income

Neighbourhood	% of all raised dwellings with households having > G$30,000 monthly income	% of all raised dwellings with households having < G$30,000 monthly income
West Ruimveldt	66	34
Wortmanville	52	48
Bel Air Park	42	58
West Sophia	72	28
Total	60	40

Table 6: Income and Flood Experience Amongst Ground Floor Dwellings

Neighbourhood	% of ground floor dwellings experiencing a house flood with a monthly income <G$30,000	% of ground floor dwellings experiencing a house flood with a monthly income >G$30,000
West Ruimveldt	57	43
Wortmanville	44	56
Bel Air Park	57	43
Total (excluding Sophia)	52	48

lower monthly incomes. Forty per cent of all households with a monthly income lower than G$30,000 experienced a house flood compared to 28 per cent of all households with a monthly income greater than G$30,000. This appears to be due to the fact that households with greater financial resources have greater access to dwellings with living space raised above ground level. This was observed in both formal and informal sector samples and is supported by data in Table 5 which show that 60 per cent of all raised dwellings house households with monthly incomes greater than G$30,000. Table 6, which controls for dwelling height, suggests that income itself has little impact on vulnerability for households unable to access raised living space; 48 per cent of all ground floor dwellings experiencing a house flood had incomes greater than G$30,000.

VI. CONCLUSION

WITHIN THE CITY, flooding was rooted in environmental fluctuations (rainfall, tidal phase, sea-level rise and possible groundwater level rise) and institutional weaknesses (public agencies were under-resourced, civic association independent of political parties had been deterred and consequently community participation was rare and the potential offered by private entrepreneurs had not been fully explored). Household experiences of flooding and its impacts were influenced by household assets profiles including the agency of household members. Because flooding was imposed upon a largely pre-existing urban structure, all social classes and urban environments had become potentially vulnerable to flood hazard and its impacts.

The neighbourhoods showing the highest levels of household vulnerability were characterized by low household incomes, poor housing quality, little community organization and were encountered in both suburban and inner-city wards. Children appeared to be particularly vulnerable to flood impacts through forced school absenteeism and health vulnerability.

In the high income ward, Bel Air Park, vulnerability was recorded but here, households had been able to manage vulnerabilities to some extent through the transfer of flood impacts from health to economic investment and loss. Recent self-help construction in West Sophia had allowed households to respond to contemporary environmental conditions and so reduce individual vulnerabilities. Such flexibility was not encountered in formal housing areas where dwelling form and drainage infrastructure were more fixed and responsibility for living environments was less clear, being shared between house owners, landlords, tenants and municipal authorities.

As highlighted by the Wortmanville case study, access to secure housing is influenced both by economic and social assets. There was a recognized need in Greater Georgetown to develop land for private sector construction for mid-income housing, provide “sites only” for new self-help construction and the rapid regularization of established squatter sites for low-income hous-

ing, to improve the service offered by Government of Guyana rented properties and review the operation of the private rental sector. The CHPA, with assistance from the IDB and UNDP, is currently initiating a range of policies that, if successfully implemented, will begin to address these issues. Once this has taken place, a reduction in the number of households living in overcrowded or unsuitable accommodation or in vulnerable rental accommodation could occur.

Good health was closely linked to the income of household heads and child carers. However, reported use of formal health services was not so clearly linked to income, with two low-income wards showing the greatest and least utilization of formal health services. Such variation itself suggests that health services were ineffective at targeting vulnerable groups. Greater support for Georgetown's environmental health and education unit and primary health care centres would improve the ability of households to protect themselves from environmental health risks.

West Sophia was an example of a neighbourhood where relatively successful environmental management by individual households and a functioning CBO appeared to have reduced the risk of flooding. This was important in a community which had very poor sewerage and garbage disposal provision and a high number of households with infant members. It was, however, unclear whether such action would be a permanent or temporary feature of this community.

Although not common in Georgetown, CBOs had successfully taken some responsibility for drainage maintenance and local environmental improvement from the public sector. As public services continue to be inadequate and private services limited and inaccessible to the majority, community initiatives could provide an opportunity for neighbourhoods to escape the "prisoners dilemma" and improve local quality of life. There was much scope for expanding the activities of these organizations through developing financial, technical and organizational resources and by speeding up the granting of land titles. There was very little practical support for community development within Greater Georgetown; the major agency supporting community sponsored development projects (SIMAP) had been deterred from operating within the urban limits because of an IDB funded Urban Rehabilitation Programme, although this had not moved beyond the planning stage since 1993, and the upgrading of squatter settlements had been regarded as an area exclusively for governmental funding.

The agency demonstrated by households and community groups needs to be recognized in future environmental planning strategies (it may be that the high level of individual household agency did not signify a preferred adaptation by households but rather a lack of available community based options). A review of institutional relationships between NGO funding agencies, government, CBOs, the communities that they represent and the private sector is urgently needed as a background for the promotion of projects to facilitate community development and participation in the rehabilitation of Greater

Georgetown's infrastructure. This is essential both for the provision and sustainability of physical infrastructure and flood hazard management. In addition, there is a great need for reliable, basic data on the nature of poverty in Greater Georgetown and on the impacts of SAPs and amelioration programmes. Lack of such reliable data, and data on housing and health care, will reduce the effectiveness of any contemporary vulnerability reduction strategies.

Table 7: Summarized Socio-economic and Demographic Profiles for Households by Case Study Ward

Characteristic	West Ruimveldt	Wortmanville	West Sophia	Bel Air Park
% households with aged (>65 years) and infant (<5 years) members	aged 24% infant 60% both 13 % either 70%	aged 23% infant 47% both 13 % either 56%	aged 5% infant 68% both 0 % either 75%	aged 26% infant 28% both 4% either 50%
Number of living rooms	Mean 3.3 (STD 1.7)	Mean 3.8 (STD1.5)	Mean 2.55 (STD 0.8)	Mean 4.0 (STD1.2)
Household size	Mean 7.2 (STD 3.7)	Mean 5.6 (STD 2.9)	Mean 5.1 (STD 2.2)	Mean 3.4 (STD 1.8)
Household density: rooms/membership	Mean 0.6 (STD0.4) range 0.125 - 2	Mean 0.9 (STD 0.6) range 0.2 - 4	Mean 0.6 (STD 0.3) range 0.2 - 1.5	Mean 1.7 (STD 1.4) range 0.3 - 6
Marital status of head	Married/c.law/ visiting: 62%	Married/c.law/ visiting: 56%	Married/c.law/ visiting: 68%	Married/c.law/ visiting: 47%
Length of residence	Mean 19 years (STD 13.6) range 1 - 45 years	Mean 12 years (STD 11.3) range 1 - 49 years	Mean 4 years (STD 1.5) range 1 - 8years	Mean 15 years (STD 12.5) range 1 - 45 years
Stated income	Median G$20,000-29,999	Median G$30,000-39,999	Median G$20,000 - 29,000	Median >G$40,000
Cooking fuel	kero 74% gas 24% coal 2%	kero 52% gas 47% electricity 2%	kero 82% gas 18%	kero 23% gas 72% electricity 5%
Television in house (% of households with TV)	64% (1, 93%; 2, 5%; 3, 2%)	86% (1, 98%; 2, 2%)	63% (1, 100%)	85% (1, 75%; 2, 23%; 3, 2%)
Access to remittances	10%	11%	7%	13%
Access to rents	0%	5%	0%	6%
House ownership	own 42% rent 43% rent free 10% squat 5%	own 24% rent free 15% rent 61%	squat "own" 95% squat "rent" 5%	own 43% rent free 15% rent 42%
Stated household head	female 41% male 45% joint 14%	female 50% male 50% joint 0%	female 43% male 47% joint 10%	female 39% male 52% joint 9%

All values are for positive responses and for all households unless otherwise stated.

Table 8: Summarized Drainage and Associated Infrastructure Profiles for Households by Case Study Ward

Characteristic	West Ruimveldt	Wortmanville	West Sophia	Bel Air Park
Sanitation	Sewer 0% Septic Tank 69% Pit Latrine 29% Trench 2%	Sewer 92% Septic Tank 8%	Pit Latrine 100%	Septic Tank 96% Pit Latrine 2% None 2%
Drinking water source	house pipe 3%, yard pipe 60%, neighbour's pipe 19%, public pipe 13%, bottled 5%,	house pipe 19%, yard pipe 63%, neighbour's pipe 8%, bottled 6%, rain 3%,	public pipe 98%, neighbour 2%	house pipe 57%, yard pipe 11%, neighbour's pipe 2%, bottled 30%
Tank/sewer presently overflowing	23%	44%	N.A.	20%
Last maintenance of tank	Mean 1.46 years	N.A.	N.A.	Mean 2.6 years
Observed leak in drinking water pipe	8%	13%	N.A.	3%
Duration of leak	>3weeks, <5 years: 100%	>2 weeks, <1 year: 100%	N.A.	> 2 weeks, <2 months: 100%
Treatment for household drinking water	65%	69%	63%	83%
Treatment for infants (<5years) drinking water	76%	83%	80%	92%
Living areas raised above ground level	19%	50%	90%	60%
Household rubbish disposal	collected 35% burnt 47% buried 8% thrown in yard 5% thrown in ditch 5%	collected 90% burnt 7% thrown in yard 3%	burnt 90% buried 5% thrown in yard 2% thrown in ditch 3%	collected 89% burnt 11%

All values are for positive responses and for all households unless otherwise stated.

Table 9: Summarized Household Adjustments and Management Responses to Flood Hazard by Case Study Ward

Characteristic	West Ruimveldt	Wortmanville	West Sophia	Bel Air Park
Community work	18%	21%	38%	4%
Household drain maintenance	<1 week 33%, 1w-1m 27%, >1m 15% unknown 25%	<1week 16%, 1w-1m 21%, >1m 34% unknown 29%	<1week 2%, 1w-1m 7%, >1m 7% never 84%	<1week 22%, 1w-1m 22%, >1m 30%, unknown 26%
Labour used in latest drain maintenance	Self/family/friends 90%, workmen 10%	Self/family/friends 23%, council 70%, workmen 7%	Self/family/ friends 70%, community group 30%	Self/family/ friends 26%, council 10%, workmen 65%
Cost of latest drain maintenance	G$ 0 (90%) G$ 500 - 3,000 (10%) mean cost G$ 1,050	G$0 (88%) G$ 300 - 3,000 (12%) mean cost G$ 1,040	G$ 0 (100%) mean cost G$0	G$ 0 (34%) G$ 200 - 12,000 (66%) mean cost G$2,097
Insured for flood losses	0%	2%	0%	4%
Considered moving house	19%	35%	20%	30%
Reason for staying	small housing market 70% cost 20% home here 10%	small housing market 77% cost 18% home here 5%	small housing market 92% home here 8%	small housing market 64% cost 14% home here 22%
Invest in yard raising	32%	31%	56%	49%
Material used	concrete 45% rubbish 10% mud/dirt 35% sand 10%	concrete 27% sawdust 6% mud/dirt 36% sand 27%	dirt/mud 85% sawdust 3% sand 9% coconut 3%	concrete 74% dirt/mud 9% sand 13% coconut husk 4%
Cost of materials and labour	6 cases: G$0 14 cases: G$ 2,000 - 45,000 mean cost: G$11,650	5 cases: G$ 0 8 cases: G$ 500-75,000 mean cost: G$13,192	18 cases: G$0 12 cases: G$ 1,000-15,000 mean cost: G$5,458	2 cases: G$0 17 cases: G$1,000 - 500,000 mean cost: G$73,895

All values are for positive responses and for all households unless otherwise stated..

Table 10: Summarized Impact of November 12th Flood on Households by Case Study Ward

Character	West Ruimveldt	Wortmanville	West Sophia	Bel Air Park
Yard flood on November 12th	89%	97%		89%
Depth	Mean 20cm (STD 17.78cm) range 2cm - 1m	Mean 17cm (STD 14.98cm) range 2cm - 1m		Mean 18cm (STD 10.16cm) range 2cm-75cm
Duration	Mean 35hr (STD 29hr) range 2hr - 7days	Mean 30.4hr (STD 38h) range 1h-12days		Mean 34hr (STD 19.8hr) range 3hr-4 days
Pit latrines overflowing	25% (of pit latrines)	NA		50% (of pit latrines)
Damage in yard	16% (of flooded yards)	2% (of flooded yards)		22% (of flooded yards)
House flood on Nov. 12th	22%	24%		38%
Depth	Mean 7cm (STD 4cm) range 2cm - 50cm	Mean 11cm (STD 4.06cm) range 7cm - 20cm		Mean 15cm (STD 12.19cm) range 5cm -45cm
Duration	Mean 24hr (STD 20hr) range 2hr - 3days	Mean 15 hr (STD 15.5hr) range 1hr - 2days		Mean 32hr (STD 20.3hr) range 3hr - 3days
Time for repairs/ cleaning	59%	76%		83%
Direct economic loss	10%	10%		14%
Time lost from work	3%	6%		11%
Time lost from school	43% (of households with students)	37% (of households with students)		12% (of households with students)
Angry during flood	54%	58%		45%
Frightened during flood	38%	23%		17%
Estimated economic loss	6 cases: G$1,000 - 70,000	7 cases: G$300-3,000		6 cases: G$2,000-200,000
Health problem in week following flood	24%	20%		15%
Severity: 0-not severe 6-very severe	0: 19% 1: 22% 2: 10% 3: 14% 4: 6% 5: 3% 6: 25%	0: 10% 1: 23% 2: 18% 3: 11% 4: 18% 5: 5% 6: 15%		0: 15% 1: 10% 2: 17% 3: 11% 4: 13% 5: 15% 6: 19%

All values are for positive responses and for all households unless otherwise stated.

Table 11: Summarized Household Flood Experience and Perception by Case Study Ward

Characteristic	West Ruimveldt	Wortmanville	West Sophia	Bel Air Park
Previous flood experience	100%	100%	100%	100%
Main cause of flooding	drain maintenance: 81% low land: 13% other: 6%	drain maintenance: 79% low land: 17% other: 4%	drain maintenance: 60% low land: 38% other: 2%	drain maintenance: 77% low land: 17% other: 6%
Ranked need for improvement in local service provision (every respondent ranked each service 1-4)	Drainage (213) Electricity (194) Rubbish (131) Police(88) max. 258	Drainage (201) Electricity (166) Rubbish (158) Police(95) max. 248	Electricity (225) Drainage (177) Rubbish (114) Police(96) max. 240	Drainage (160) Electricity (131) Rubbish (104) Police(65) max. 184
Perceived increase in annual flood frequency	87%	84%	17%	81%
Perceived health impacts from past flooding	27%	16%	3%	15%
Consider flood risk when moving here	3%	10%	_	11%
Most effective base for future infrastructure improvement	individual self-help: 20% community self-help: 3% council/government: 7% God 2% nothing 68%	individual self-help: 24% community self-help: 3% council/government: 2% nothing 71%	individual self-help: 22% community self-help: 24% council/government: 13% nothing 41%	individual self-help: 28% community self-help: 2% council/government: 9% nothing 61%
Stress indicators (positive responses) (see Table 7)	a: 40% b: 21% c: 39% d: 42% e: 37% f: 55% g: 58%	a: 21% b: 21% c: 41% d: 46% e: 39% f: 43% g: 59%	a: 14% b: 9% c: 21% d : 16% e: 28% f: 16% g: 30%	a: 17% b: 17% c: 35% d: 17% e: 33% f: 33% g: 35%

All values are for positive responses and for all households unless otherwise stated.

Table 12: Stress Indicators by Case Study Ward

		% Agreement			
Character	**Statement**	**West Ruimveldt**	**Wortmanville**	**West Sophia**	**Bel Air Park**
a	We stay up all night when it rains	40%	21%	14%	17%
b	If we go away, we arrange with neighbours how they can contact us in case of a flood	21%	21%	9%	17%
c	When it rains we check the level of water in the trench	39%	41%	21%	35%
d	We don't like to leave the house when it rains heavily and water levels in the trench are high	42%	46%	16%	17%
e	When we go away from the house for a few days we move important things above possible flood water levels	37%	39%	28%	33%
f	We are too worried to sleep at night when it rains heavily	55%	43%	16%	33%
g	We are worried every time it rains	58%	59%	30%	35%