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# THE 1974 GRAND RIVER FLOOD

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On Friday, May 17, 1974, communities along the Grand River in Southwestern Ontario were hit by the worst flash flooding in twenty years. Most seriously affected were sections of the cities of Cambridge, Kitchener and Brantford. With a scarcely developed disaster subculture, an incomplete flood control system, and a new regional municipal governmental system which was still undergoing assorted growing pains, problems in communication, co-ordination and coping were to be expected. This paper will examine these problems in relation to the political, environmental and organizational conditions within which the flood response was formulated and carried out.

## General Background

### The Area

Situated between London and Toronto are the cities of Guelph, Brantford, Cambridge, and Kitchener-Waterloo. In its second full year of existence, Cambridge represents an amalgamation of three cities -- Galt, Preston and Hespeler. In addition, Cambridge is linked to Kitchener-Waterloo via the agency of regional government. A relatively loose, but sometimes controversial arrangement, regional government is most apparent on a day-to-day basis in the regionalization of the area police forces. While Guelph and Brantford are outside the regional government structure, they are linked to Cambridge and Kitchener-Waterloo through the Grand River Conservation Authority (GRCA), a public agency responsible to the 400,000 people who live in 71 municipalities in the river valley. The Authority's functions are mainly related to flood control, pollution abatement and recreational activities throughout its area of jurisdiction. Structurally, then, municipal level authority in the flood area is segmentalized among local, regional and conservation area officials.

### The Watershed and its Control Structure

The Grand River watershed occupies the central part of the peninsula-shaped section of Southwestern Ontario. With a total drainage area of 2,614 square miles, the watershed has an overall north-south length of 118 miles and an average width of 22 miles. Generally, the Grand River and its tributaries flow from north to south. The upper part of the watershed is high tableland, once largely swamp, but now drained for agricultural purposes. The stream gradients here are high, the lateral slopes steep, and the soil poorly drained till. These physical features result in a high rate of runoff whenever adverse climatic conditions prevail.

Spring floods occur because the high land of the upper Grand is subject to low winter temperatures and heavy snowfalls (usually 120 to 130 inches, with a recorded high of 154 inches). Summer floods are potentially more severe, but occur less frequently than spring floods. They are caused chiefly by inland hurricanes and heavy thunderstorms. Most of the flood damage occurs in the central part of the watershed which contains all of the cities and most of the towns and villages.

The river valleys of the Grand River and its tributaries are, with few exceptions, horseshoe-shaped and do not flare out into extensive flats, a feature which would reduce flood flows by providing natural storage reservoirs. The banks average from 50 to 75 feet in height, with extremes of less than 40 feet to more than 125 feet. The width between bank crests varies from about 1,500 feet to 3,000 feet.[1]

Extensive clearing of the watershed of trees for agricultural and general urban development has created two general problems on the Grand River: (1) more severe spring flooding from increased runoff, and (2) decreased river levels in the summer (the average flow past Doon in the mid-1930's was 40 cfs). Since the turn of the century individuals and groups have encouraged the installation of control structures to deal with these two problems. Up to the present, three major control structures have been built and are operational in the watershed. These present works, the Shand and Luther Dams on the Grand River and Conestoga Dam on the Conestoga River provide less than half the impounding capacity necessary for water conservation and flood protection purposes. The drainage area controlled by these major works covers 528 square miles or approximately 20 per cent of the watershed.

No works are located on the Nith, Speed, Eramosa or Irvine Rivers. This is far from being a complete flood control mechanism in the Grand River watershed. The existing system, together with the proposed Montrose, Everton, Ayr, Guelph and Hespeler Dams and reservoirs would provide substantial flood control along the Grand and its major tributaries, but many valley communities face local flood threats from smaller streams and from headwaters above the reservoirs.

All reservoirs are operated within their extreme limits, with no provision for operational storage. Records show that the spring runoff period occurs between March 25 and April 5. The heaviest runoff from the upper reaches is generally during the last week in March. The multi-purpose reservoirs are lowered to their minimum flood season levels by mid-February and are allowed to fill slowly until late March, as the probability of the occurrence of large floods decreases, and then more rapidly until early April. The drawdown and filling dates are adjusted to prevailing snow and weather conditions.

Regulated discharge is started when the natural flow in the channel becomes inadequate for pollution control and municipal water supply. After the reservoirs are filled, their flood control value becomes negligible for a short period. This is necessary to provide maximum possible storage for the other major benefit -- low flow augmentation for pollution abatement. The three reservoirs were primarily designed for flood protection, but the studies by the Ontario Water Resources Commission (<u>The Grand River and Pollution, 1957 to 1963</u>) indicate that the augmentation of stream flow during drought has become increasingly necessary. A certain minimum flow of fresh water is mandatory to provide dilution of polluted materials which are discharged from industrial and municipal sewer outfalls and sewage treatment plants. Pollution is a serious problem in the Kitchener-Waterloo-Guelph-Cambridge-Brantford area because of the relatively intensive urban development and high growth rate, and because the city of Brantford draws its domestic water supply directly out of the river.[2]

## The Weather

The basic weather conditions leading to the flood were as follows:[3] The month of May was extremely wet, and above average rainfall had thoroughly saturated the watershed. The streams were high, creating a high runoff ratio for any amount of rainfall. The reservoirs had been filled for purposes of summer flow augmentation, as usual, and the abnormal rainfall had filled them to above their normal May levels. Thus an unusually large amount of water (for May) was being discharged before the flood. On May 16 the weather forecasting system predicted "up to one inch of rain" over southwestern Ontario. The GRCA verified this report and calculated that the system, in its existing condition, could handle this safely; consequently no major changes were made at the dams. By 6:00 p.m. that day, 0.3 inches of rain had fallen and the rain was announced to be over. A 2.5 to 3.5 inch rainfall came after this, thus precipitating the first flood on record for the month of May.

## The Warning Phase

Reports of heavy rain, rapidly increasing inflows into the reservoirs and rising stream gauges from GRCA staff on duty gave cause for concern, and by 10:30 that evening a warning for moderate to severe flooding was issued to representatives of Cambridge and Brantford, as well as the Waterloo Region EMO Planning Officer. The EMO official was requested to take action to warn residents of towns and villages affected, as well as those who lived along the low-lying areas adjacent to the river. Calls to the relevant police departments were made and the various communities were alerted. At this time firm predictions were not yet available and only moderate to severe flooding could be predicted.

By 9:00 a.m., May 17, predictive calculations had been made (based on estimates of rainfall calculated from water level increases) and the GRCA sent messages to Cambridge, Paris, Brantford and the Haldimand-Norfolk Region EMO predicting flows equal or greater than Hurricane Hazel by 6:00 p.m. in Cambridge (Galt) and by 12:00 p.m. at Brantford. All contacted parties were requested to call back for detailed information. Two regional police officers at approximately 10:00 a.m. began a door-to-door warning of the threatened area in Cambridge although they were unable to say how high the water would be. By 2:00 p.m., when the flood peak had reached Doon, the GRCA calculated that the crest would be 17½ feet above normal (flooding begins at 12 feet) when it hit the Galt section of Cambridge at 6:00 p.m. (It peaked at 7:00 p.m. at 17.8 feet above normal). The GRCA spent the next 36 hours updating information, monitoring phone calls and regulating their control structures. The flood crest passed Bridgeport at approximately 9:00 a.m., May 17; Galt at 7:00 p.m., and Brantford at 12:00 p.m.

## Factors Causing Flooding

> "Disasters...often bring out the best in individuals. Ability to endure suffering, desire to help others, and acts of courage and generosity come forth in times of crisis. But disasters can also evoke the worst in persons -- a relentless search for scapegoats to blame for destruction and loss of life.
>
> This tendency to seek the cause in a who -- rather than a what -- is common after airplane crashes, fires, cave-ins, and other catastrophes not naturally caused."[4]

Floods on rivers without control structures are usually accepted as "acts of God" by the victims since the calamity is seen to be naturally caused. However, if a river has control structures, the possibility is created that the flooding could have been artificially caused, and thus the dams and/or those who manage them are often perceived as responsible for the flooding that occurs.[5] For example, the Mactaquac Dam on the St. John River in New Brunswick was viewed by many citizens as responsible for the 1973 flooding. Consultation with the engineers, however, showed that inflows into the headpond were being immediately discharged through the dam, and that the natural flooding levels were not being affected by the structure.

The 1974 Grand River Flood created a similar problem. Many bitter flood victims viewed the control structures and/or those who operated them as responsible for their losses. Consequently, one major thrust of this study was to attempt to understand the effects of the control structures on the flood levels.

The major storm center was situated over the north-central section of the watershed. As a result most of the rain fell below the Luther and Shand Dams. Therefore, most of the water ran into the Conestoga and Irvine Rivers and not the Grand River. The Shand and the Conestoga Dams were nearly full given the time of the year (pollution dilution waters were being stored in the structures) as well as the heavy rain experienced before the storm. Even in this condition, the structures were able to store some water, and as a result the actual peak flow at Galt was 17.8 feet as opposed to the estimated peak flow of 19.5 feet without the dams. It is estimated that if the dams had been empty and could have held back all the inflow that the peak at Galt would have been 16.2 feet (flooding begins at 12 feet). From this it seems clear that, although the control structures were not able to reduce the flooding levels as completely as they would have had they been less full, they did not increase the flooding peak and further were instrumental in reducing it by an estimated two feet.

It seems that one of the major causes of the flooding was the 17,000 cfs flow from the Irvine River which has no control structures built on it. A dam for the Irvine River has been proposed ever since 1912 at West Montrose, but to date no structure has been built. It has been argued that such a dam on the Irvine River would: (1) provide extra storage space for stream augmentation supply thus allowing the lowering of water levels at both the Shand and Conestoga Dams and increasing their flood protection all year round, and (2) help regulate the flow of flood waters on the Irvine River. For this particular flood, it was speculated that if the Conestoga and Shand Dams would have been lower, the GRCA could have lowered the peak flow at Galt to 16.2 feet. A dam on the Irvine River would have further reduced this 16.2-foot flow considerably (a firm figure is not yet available) and as a GRCA official said, "I think it probably would have eliminated the flooding in downtown Galt."

In conclusion, it can be said that the highly saturated ground conditions created high runoff ratios within the watershed; both the Conestoga and Shand Dams held their normal high level of water for this time of year, thus reducing their flood control capabilities; and a massive thunderstorm dropped 2.5 to 3.5 inches of rain in a very short period of time. Thus while the existing control structures were not able to contribute as much to flood control as they may have at a different time of year, it seems that the lack of such control structures was a major factor contributing to the flooding. If present studies are correct, the proposed West Montrose Dam would allow for a major modification of the use of existing structures, thus greatly increasing their flood control function as well as reducing the conflict of purpose under which these structures now operate for a short period of time each spring.

## The Response to the Flood

The response to the Grand River flood was essentially an ad hoc operation. None of the municipalities involved had an official flood plan, although ironically a Brantford plan was awaiting municipal approval and a plan for the Waterloo Region was presented to Regional Council on the Thursday following the flood.

In the Galt section of Cambridge, the area which had the greatest extent of damage, high level city officials were not only involved in policy decisions and coordinating activities, but were also heavily involved in operational level tasks, ranging from alerting the Ontario Government to the scope of the flooding damage to answering social service inquiry calls. Such operational activities as the latter tended to put an undue burden on these higher level city officials. Under a disaster plan with a clearly defined set of tasks, these operational activities would have been delegated to personnel at a lower level in the organization, thus leaving higher level officials free to deal with coordination and the overall response to the flood.

Many Galt residents, unaware of, or simply not comprehending, the gravity of the flood threat, remained in their homes or offices until the river began to inundate the downtown area. Consequently, many were trapped by the rampaging waters and had to climb to the second story or roof of the buildings in which they were trapped. Most were rescued by front-end loaders; one of these vehicles was city owned and operated by a municipal employee, while two others were privately owned and operated. City firemen answered 60 alarms during the peak of the flood period, ranging from fires due to short circuited wires to requests for help with flooded basements. Along with private boat owners and local two way radio operators, firemen were heavily involved in search and rescue operations.

Lack of disaster contingency plans can lead to loss of valuable time and require extra effort to resolve relatively simple problems. For example, in the recent flood, a ham radio operator was trapped in a tree for ten hours after his boat overturned. The Cambridge mayor and the local EMO official initiated a telephone search for a helicopter equipped with floodlights and hoist and capable of making a night rescue. This search for a helicopter ranged over southern Ontario to as far away as the northeastern United States and northern Ontario. An army helicopter from Camp Petawawa (northwest of Ottawa) and a private helicopter from Maple, Ontario (near Toronto) were finally secured with the private aircraft making the rescue. Clearly, with a more developed set of contingency plans, operations such as this could have been arranged more quickly and efficiently.

A shelter was made available for displaced Cambridge families in a local arena but only six persons took advantage of this. The arena remained open throughout the weekend, however, and by the next week had been designated as a depot for furniture and other larger items donated by local citizens. Such a limited use of a designated shelter by those who have been displaced appears common in a situation where only a section of a city has been affected by the disaster, and where flood victims can stay with friends, relatives or others with whom they are personally acquainted.

The Cambridge cleanup operations were organized by the Mennonite Disaster Service, whose 500 volunteers came from as far away as Virginia. This group was universally praised by city residents and officials both for its hard work and for its ability to organize quickly and efficiently. In operations of this type, the Mennonite Disaster Service offers to either work under another local group, or organize the cleanup themselves. This dual option can be seen as a highly perceptive attempt to adapt to local conditions.

In Brantford, the emergency response was generally reported as well handled. Aware of what had happened in the Cambridge and Kitchener areas, Brantford officials were able to advise residents of areas close to the river to be prepared to evacuate and to warn all Brantfordians to be prepared to shut off all services in their homes in the event of severe flooding. In addition, city works department employees sandbagged some areas which were likely to be threatened.

The major emergency in Brantford arose when a canal dike unexpectedly burst, flooding the water treatment plant and thereby contaminating city drinking water. The Public Utilities Commission coped with this promptly, using a diesel-powered pump to flush out the system and continue pumping services. Arrangements were also made to provide drinkable water to residents by placing tank trucks at five strategic locations. These water-tank trucks were borrowed from fire departments and private firms and were filled with water from township sources and the nearby city of Paris. Additional water trucks were also available at Camp Borden, a nearby army base.

Because of its central downtown location and its radio facilities the Brantford EMO quarters functioned as an emergency operating centre during part of the emergency. A major meeting of civic officials and other flood workers was held there on Saturday morning resulting in a state of emergency being declared due to flooding of the water treatment plant.

It was reported that the Brant County Health Unit was not formally notified of the danger. The reason for this is unclear. However, it turned out that the staff learned informally of the danger and were thus able to respond.

In the Bridgeport area of Kitchener, 100 homes on the east side of the Grand River were seriously flooded. Rescue workers conducted a house-to-house search and evacuated those stranded by boat, raft and front-end loader. As in Cambridge, fire department personnel were instrumental in carrying out search-and-rescue operations. The local EMO official in Kitchener engaged chiefly in warning activities via telephoning, although he did appear to intermittently function as an official information source about the flooding to out-of-town media. Unlike Cambridge and Brantford, however, the flood emergency in Kitchener-Waterloo had a more localized impact, and thus never attained the status of a community-wide disaster.

## Analysis of the Overall Warning Process

Disasters create strains on communities which create a need for special plans to deal with the response to them. Disaster situations also help bring into clearer focus weaknesses in community structure. Every community learns more about itself under stress conditions. The purpose of this section of this paper is to analyze some of the problems which arose as a result of the flooding. These problems can be divided into two types, social-psychological and structural.

## Social-Psychological Problems

### Perception of the Warning Message

An article in the Cambridge Daily Reporter contained the following:

> "/ A city lawyer 7 questioned what messages were sent. 'I'm sure the conversations would be meaningful, but... / the city engineer 7 might have placed a different interpretation on the warning,' he said. 'I am sure if he had been made aware of the real danger, that there might have been a different result.'"[6]

Warning is a communicative process. Williams sees the following steps involved in disaster warning:[7]

1) Detection and measurement or estimation of changes in the environment which could result in a danger of one sort or another.

2) Collation and evaluation of incoming information about environmental changes.

3) Decisions as to who should be warned, about what danger, and in what way.

4) Transmission of a warning message, or messages, to those whom it has been decided to warn.

5) Interpretation of the warning messages by the recipients and action by the recipients.

6) Feedback of information about the interpretation and actions of recipients to the issuers of warning messages.

7) New warnings, if possible and desirable, corrected in terms of responses to the first warning messages.

Anderson has conceived of disaster warning as a communicative process.[8] He has noted that, "Disaster warning conceived of in such a manner helps to explain the interdependence of the various activities which comprise it. Thus, we become aware of the possibility that an inadequacy, or breakdown, in a certain part of the disaster-warning process may result in the failure of the system as a whole." An analysis of the Grand River Flood response suggests that there may have been problems in parts 5 and 6 of the warning process.

Paraphrased contents of the messages issued to the municipalities are contained in Appendix A to this paper. In themselves, they appear to be quite clear in their meaning. However, two factors seem to have been operating which may have affected the interpretation of their meaning. (1) The communities along the Grand River have often experienced minor flooding over the years and tend to interpret the threat of flooding in terms of past bench marks. Thus when warned of flooding in Bridgeport and Galt, many citizens tended to interpret this information as an indication of minor flooding. This particular psychological mechanism and its dangers have been observed in many other DRC studies. (2) The last major flood on the Grand River was 20 years ago. Since that time there has been a turnover of personnel in organizations as well as of residents along the river banks. Many citizens, then, had no first-hand experience upon which to conceptualize the possible dangers of serious flooding and thus tended to underestimate the content of warnings.

This is a particularly common type of problem in communities which face a disaster agent only infrequently. Similar problems will probably occur again unless steps are taken to ensure that the warning messages are made understandable not only to those familiar with the river and its habits but also to those who have little experience upon which they can base their actions. An indication of water levels may not be adequate here. Rather, an indication of the area and depth of flooding at common landmarks should be made a part of the content of warnings to give receivers a more concrete image of what to expect. In environments which seldom experience flooding, an extra effort should be made to ensure that the warnings have been properly interpreted and that an awareness of what should be done to limit loss of life and property damage has been created. Failure to create this awareness can lead to failure of the warning process.

The overall warning process faces other pitfalls which tend to undermine its effectiveness. The "cry-wolf" problem can tend to undercut the credibility of warnings if projected threats lead to action and no disaster threat materializes. This problem would be particularly significant for Bridgeport, since accurate predictions about flooding magnitude are not generally available because major tributaries empty into the Grand River just above this community. Thus warnings may be seen as necessary in the interest of safety, but will tend to be inaccurate since basic data is not yet available to reliably compute the flow and stage forecast. This problem should, however, pose no major threat for warnings to Cambridge, Paris and Brantford since a lapse of nine hours or greater occurs before peak flows reach them after passing Bridgeport. Based on the effects of flood waters at Bridgeport, highly reliable predictions can be made for Cambridge and initial warnings can be upgraded or downgraded allowing an adequate period of emergency response if necessary. The fact that the magnitude of the Bridgeport flooding was not interpreted generally as a cue to serious flooding in Cambridge during this recent flood is a further indication of the lack of experience with flooding in this area. Calculations projecting expected flows for Cambridge from experienced flows at Bridgeport might be useful information for the interpretation of disaster warnings in the future.

Other Misperceptions

The flood control function of the dams in the watershed generally only comes into public view sporadically whenever flooding threatens the area. The pollution dilution and flow augmentation functions of the dams rarely come into public awareness. The major and minor dams in the watershed generally are viewed as recreation areas and much of the public views them to exist for this purpose. It is not surprising, therefore, that many citizens in the area saw the flooding as a result of conflicting recreation and flood control interests. The GRCA takes an active part in maintaining the flood plain and the areas around the dams as recreational facilities. It is indeed one of the benefits derived from their existence. But, it seems clear that the recreational benefits of the dams are secondary and that, as mentioned earlier in this paper, the major conflict of purpose revolves around flood control and pollution dilution functions. Thus much of the public criticism of GRCA based on the view that flood protection was jeopardized to maintain recreational facilities is largely a misperception.

Another major perceptual problem constantly plagues the area. Since major flooding occurs only occasionally on these rivers, there has been a constant pressure by private citizens and organizations to build on the flood plain. The GRCA has continually sought to keep such building from occurring but the public generally sees this concern as unwarranted. Transportation no longer depends on river traffic in this watershed and thus there is no vital need to be situated near the river. The public conception that the flood plain is safe is understandable (due to the generally placid nature of this river), but the property damage created (even if only every twenty years) hardly seems to justify any advantages gained from the use of this land. This is a consistent problem found in countless other DRC studies; some people have even built homes inside the mainline levies on the Mississippi River. As urban growth continues in the watershed the runoff ratios will increase further and the flood plains will become even more dangerous sites for major real estate. The public misperception will continue and thus so should the resistance to building in the flood plain.

## Structural Problems

### Amalgamation and Regional Government

The governmental structure in the impacted area has recently been converted into a regional governmental structure. While no major problems developed from this change, some disorganizing effects were created. For example, an overall interlocking disaster plan for the region had been developed but had not yet been approved by the regional council. While resources were found for coping with problems as they arose, the channels for requests were sometimes new and tended to slow the response. The recent amalgamation of Galt, Hespeler and Preston also tended to obscure who should deal with the various disaster-generated tasks. While it is clear that the rational elaboration and streamlining of the disaster-response system should receive lower priority for a new governmental structure in favour of reorganizing normal, day-to-day governmental activities (especially in a relatively disaster-free environment), it is also clear that the amalgamation and change to regional government will not be complete until the disaster-response system has been reviewed and modified. A critical review of the past flood response in the near future would help clarify where problems exist and lead to possible solutions.

### Weather Information

As was mentioned previously, one inch of rain was projected for the area on May 16. Between 2.6 and 3.6 inches eventually fell. Based on this sizeable discrepancy, major thrust of our study was to review the weather information system for the Grand River watershed, especially as it referred to the northern and central sections of the watershed.

The weather forecasting station for this area is located 65 to 70 miles east of it in Toronto. Prevailing weather patterns move from the southwest and northwest, over this area and then generally toward Toronto. It is therefore questionable as to whether the weather station in Toronto is capable of detecting storm systems and/or predicting precipitation from them at a 70 mile distance. A GRCA official was of the opinion that radar at the Toronto Weather Office was not always able to pick up storms in the Grand River area and that a closer station would be advisable.

As the situation now stands, the GRCA does not have the facilities to record the rainfall in the watershed. There are neither a sufficient number of rain gauges nor is there enough staff to read them. GRCA does not feel that a meteorological team of its own is justifiable nor the best use of such a team. At present, GRCA predicts rainfall on the basis of increases in river flows. Thus they have no way to estimate flow increases since base-line precipitation data is not independently available and is now derived from its effect on river levels. The availability of accurate precipitation data would not allow for the adjustment of reservoir levels, since this adjustment takes a longer period of time, but it would greatly increase the precision and speed with which flooding estimates could be given. This would be especially true for Bridgeport which, under the present structure, can not be warned as to the stage and flow of flood waters. This would also allow for better and earlier estimates of flow and stage of flood waters for Cambridge as well as allowing for more accurate estimates on inflows from tributaries which enter the Grand River below Bridgeport, especially the Speed and the Nith Rivers.

It seems clear that more accurate weather information is necessary for this area. A weather station in the watershed would not only be of service to the GRCA and the over 400,000 residents of the area, but it would also provide data for storm systems moving over this area toward the Hamilton and Toronto areas.

Control Structures on the Grand River and its Tributaries

As was stated earlier, the system of dams now existing in the watershed controls only approximately 20 percent of the watershed. It seems clear that the construction of the West Montrose dam would better control the Irvine River in flood stage and would reduce the conflict of flood protection and pollution dilution for the other two structures. This would potentially reduce the May high water "Russian roulette" which threatens the area each spring when the reservoirs are filled to near capacity. It is important to note, however, that the storage at the West Montrose dam may also be allocated for drinking water for the Kitchener-Waterloo area. Water used for this purpose would again necessitate the maintenance of higher levels at the Shand and Conestoga Dams for pollution dilution use. If this were the case, then other proposed dams would be necessary to make up the required storage necessary to maintain headwater for pollution dilution while still allowing for low enough levels on all structures to maintain their flood control abilities.

It should also be noted that modifications of the river channel in Cambridge have great effects on river levels especially at flood stage. A GRCA official stated, "A higher water level resulted from one company which did some construction after 1954 which included a parking lot, [thereby] changing the river channel."[9] If this is the case, then further modifications of this channel would have serious consequences for flood levels in Cambridge.

## Conclusions

The 1974 Grand River flooding clearly demonstrated what can occur when an area lacking any type of disaster subculture is suddenly faced with an emergency situation.

The Grand River Conservation Authority, the agency most closely attuned to the danger of flooding, had for years advocated a more complete system of dams to control flooding throughout the watershed. Senior levels of government, however, did not fully recognize this need, and indeed appear to have been more sensitive to pressures from environmentalist groups in setting their dam building priorities. The Authority seems to have been fully cognizant of what could occur as a result of the deficit control structures. Indeed, in 1969 its chairman, in a speech before the Kitchener-Waterloo Kiwanis Club, predicted an event similar to the 1974 flooding.

The area citizens appeared no more attuned to the dangers of widespread flooding than did the various levels of government. Few seemed to believe that the river could actually rise as high as it did, and when disaster struck, many were bitter, claiming that they were not warned. This is a marked contrast to areas where a constant threat has sensitized residents to closely monitor weather situations, and to evacuate when conditions appear to be worsening.

With disasters so infrequent in the area, there existed no strong emergency planning organization, as, for example, exists in the province of Manitoba. In both Kitchener and Brantford, the local EMO organization consisted of one man, and as the Kitchener official pointed out in the flood aftermath, EMO was neither an "organization" nor was it even listed properly in the area telephone book. Clearly, EMO in these areas must be strengthened to an effective level, or else its functions should be transferred elsewhere in the municipal government structure. Especially in Kitchener, there was evidence that EMO was expected by municipal officials and by the public at large to do much which a lone man could not carry out with limited resources and no personnel support. In particular, the Workman's Compensation Rules which leave EMO open to be sued by injured volunteers unless a formal disaster has been declared, appear to be a major deterrent to the effective mobilization of manpower resources by EMO at the time of a disaster.

The experience of the Waterloo region and in particular Cambridge would indicate that the adoption of a coordinated disaster plan must accompany such changes as amalgamation or regionalization, rather than being assigned a lower priority and presented at a later point in time. In particular, we found evidence of considerable confusion over the proper communications procedures between city officials and the regional and provincial police forces. Such procedures should be clearly specified in any future flood fighting plan which is presented.

Finally, there is the question of compensation for flood victims. Almost none of the affected businesses or residences which were damaged had insurance, nor could those who wished to buy it do so. At the same time, provincial laws do not specifically provide for any direct grants or aid or low cost loans to disaster victims. The formula used by the Ontario Government is one of matching voluntary local contributions to an official local disaster fund, dollar to dollar. Clearly, such provisions are geared to a predominantly disaster free environment and tend to appear to local residents and businesses with considerable losses as a band aid solution to serious wounds. It would appear fruitful, therefore, for a tri-level discussion to be initiated in Ontario with the aim of working out more satisfactory methods of assisting stricken citizens in coping financially with an event such as the 1974 Grand River flood.

FOOTNOTES

1. The above information was taken from a Grand River Conservation Authority "Brief on Flood Control and Water Conservation for the Grand River Watershed" presented to the government of Ontario in August, 1966, pp. 14-15.

2. The above material was obtained from: (1) 1966 "Brief on Flood Control"; (2) "Resource Management Plan, Grand River Watershed," 1966; and (3) "1967 Annual Report," Grand River Conservation Authority.

3. For more detailed information on the weather facts see the "Grand River Conservation Authority Report on Flood Event" attached as Appendix A to this paper.

4. Thomas Drabek and E. L. Quarantelli, "Scapegoats, Villians and Disasters," in Trans-action (March 1967): 12.

5. See an article by Rue Bucher, "Blame and Hostility in Disaster," in American Journal of Sociology 62, no. 5 (March 1957): 467-475. She suggests that the placing of blame involves both the possibility of recurrence and a moral judgment. The assessment of responsibility does not necessarily lead to blaming behaviour.

6. Cambridge Daily Reporter, "City Lawyer Critical of GRCA Flood Action," May 23, 1974, p. 3.

7. Harry B. Williams, "Human Factors in Warning-and-Response Systems," in The Threat of Impending Disaster: Contributions to the Psychology of Stress, ed. by George H. Grosser et al. (Cambridge, Mass.: The MIT Press, 1964).

8. William A. Anderson, "Disaster Warning and Communication Processes in Two Communities," The Journal of Communication 19 (June 1969): 93-94.

9. Cambridge Daily Reporter, May 18, 1974, p. 1.

# APPENDIX I

## GRAND RIVER CONSERVATION AUTHORITY

## REPORT ON FLOOD EVENT, MAY 16-19, 1974

### Weather Facts

The month of May was extremely wet. Total precipitation up to the 15th of the month at the Shand Dam was 3.04 inches and it was 3.50 inches at the Conestogo Dam. The mean rainfall from 1960-1973 at these stations for the entire month of May is 2.90 inches and 2.64 inches. In the four days preceeding this storm, there was 1.34 inches at Shand and 2.00 inches at Conestogo. Due to this precipitation, the basin was saturated and runoff ratios were high for any amount of rainfall. Also, the reservoirs behind the dams were slightly above normal levels as the runoff was being routed past the dam.

On the night of May 16/17, an intense storm system moved across the basin from the northwest. The following rainfall amounts were recorded:

| | |
|---|---|
| Shand | 2.66 inches |
| Conestogo | 2.38 inches |
| Luther | 1.18 inches |
| Laurel Creek | 2.40 inches |
| Rockwood | 2.38 inches |

It has been estimated by the University of Guelph that a storm of this intensity in May has a return period in excess of 100 years and is approaching the Maximum Probable Storm.

### River Facts

The following peak flows were recorded:

| | | |
|---|---|---|
| Grand River | West Montrose | 25,260 cfs at 0700, 17 May 74 |
| | Doon | 50,000 cfs at 1430, 17 May 74 |
| | Galt | 51,010 cfs at 1900, 17 May 74 |
| | Brantford | 61,850 cfs at 2359, 17 May 74 |
| | York | 52,000 cfs at 1600, 18 May 74 |
| Nith River | Canning | 9,500 cfs at 1500, 18 May 74 |
| Speed River | Eramosa | 1,500 cfs at 0600, 18 May 74 |
| | Guelph | 5,900 cfs at 1400, 17 May 74 |
| | Beaverdale | 4,900 cfs at 1800, 17 May 74 |
| Conestogo River | St. Jacobs | off scale |
| Irvine River | Salem | 17,000 cfs at 0600, 17 May 74 |

Note: Due to the severity of this flood, which exceeded all records, these flows are all estimates based on extending available stage-discharge curves.

The flows at the dams were:

| | Maximum Inflow | Maximum Discharge |
|---|---|---|
| Shand | 11,592 cfs at 2245, 16 May | 9,980 cfs at 0100, 17 May |
| Conestogo | 16,533 cfs at 0300, 17 May | 15,200 cfs at 0400, 17 May |

The effect of the dams is apparent from the following:

| | Galt | Brantford |
|---|---|---|
| Actual Peak Flow | 51,010 cfs (Height 17.8') | 61,850 cfs (Height 18.1') |
| Peak flow without Dams | 62,544 cfs (Height 19.5') | 73,384 cfs (Height 20.2') |
| Uncontrolled flow (i.e. flow if dam outflow was zero) | 43,910 cfs (Height 16.2') | 54,750 cfs (Height 17.1') |

## Authority Action

On May 16, unofficial word was received from an Executive member of the Authority that he had heard that "up to 1 inch of rain" could be expected over southwestern Ontario on the evening of May 16th. Phone calls to the Waterloo-Wellington Office and to the Conservation Authorities Branch in Toronto substantiated this. However, as it was felt that the system could handle this quite safely, no changes were made at the dams. With their afternoon reports at 1600, the dams reported approximately 0.3 inches of rain had fallen. On the local 6:00 p.m. newscast, the weather forecaster announced that the rain was over. The 2.5 to 3 inch rainfall came after this.

Notification was first given to the Manager of Water Resources Engineering at 2030 by the operator at Laurel Creek Dam who reported 1.55 inches of rain and local flooding in Waterloo. This flooding proved to be caused by storm sewer and culvert capacity. At the same time, a report came from Wellesley that the small dam there was in danger of failure. Authority staff were dispatched at once. It was raining heavily and when the dams reported at approximately 2100 hours, they advised rapidly increasing inflows. At this point, the Manager of Water Resources Engineering left his home for Central Control. Due to weather, a normally half-hour trip took almost an hour. Upon reaching the office, and noting the rising rates of the stream gauges, Mr. Stevens notified the following to advise as indicated:

Mr. Ron Middleton, City Engineer, Brantford
and
Mr. John Gandier, City Engineer, Cambridge

Message: (paraphrased) Expect moderate to severe flooding to occur along Grand River on Friday, 18 May. Firm predictions not yet available but will be provided in morning.

Time: approximately 2215-2230

Mr. Bert Camp, Emergency Message Co-Ordinator, Waterloo Region

Message: (paraphrased) Moderate to severe flooding in morning along Grand and Conestogo Rivers. Warn low-lying areas and rural hamlets. Authority to keep in touch.

Time: 2245

Mr. Camp was contacted five times during the late evening and early morning requesting warnings for West Montrose, St. Jacobs, Hawkesville, Bridgeport, Conestogo and New Hamburg. He was also advised that Cambridge had also been advised. Mr. Stevens also contaced the Duty Forecaster at Toronto International Airport on two occasions to monitor the storm.

The early morning hours were spent in the above phone calls, and in controlling the water control system. Until 4:00 a.m. the Central Control was manned by the Assistant General Manager and the Manager of Water Resources Engineering. Operators were on duty at Luther, Shand, Conestogo, Woolwich, Wellington Street (Guelph) and Laurel Creek. Several staff members were also mobile around the watershed checking various small dams. By 0500, the situation appeared to be under the best control possible and predictive calculations were made for Galt and Brantford. These were ready by approximately 0630. Due to the high flows predicted, the Manager of Water Resources Engineering held them for examination by the Assistant General Manager on his return. It was felt that there was adequate time for this as Mr. Kao was expected shortly after 0800, and the Cambridge peak was not expected until 1800. Upon his arrival, Mr. Kao examined the figures and shortly after 0900, proceeded to contact Cambridge, Paris and Brantford. The general message was to expect flows equal or greater than Hurricane Hazel by 1800 hours at Galt and 2400 at Brantford. Contact was also made with the Emergency Measures Co-Ordinator of Haldimand-Norfolk Region.

0900 hours - Warnings issued to:
(all parties requested to call back for detailed information)

Cambridge (Galt) 0915 hours
Mr. Gandier and Mr. Dandoni not available - warning given to Mr. Thompson - expect five foot rise during the afternoon (16.7')

Paris 0923 hours
Mr. Myerscough - no answer - warning given to Mr. Ough - expect 8 to 9 foot rise during the afternoon

Brantford 0920 hours
Mr. Middleton - not available - warning given to his secretary - expect 7 to 8 foot rise later in the evening (16.6')

Haldimand-Norfolk Region around 10:00 a.m.
Mr. Roberts - expect high water after midnight until early hours on Sunday

2:00 p.m. - Flood Bulletin - related to all parties calling in:

| Location | Time Predicted | Level Predicted |
|---|---|---|
| Doon | May 17 - 1400 hours | 18.8' |
| Cambridge-Galt | 1800 hours | 17.5' |
| Brantford | May 18 - 000 hours | 18.0' |
| Caledonia | 1200 hours) | |
| York | 1800 hours) | Hurricane |
| Cayuga | May 19 - 000 hours) | Hazel |
| Dunnville | 0600 hours) | or higher |

The rest of Friday was spent monitoring phone calls from press, officials and citizens; radio reports from staff; and in regulating the closing of the dams. The flood crest passed Galt at 1900.

Shortly thereafter, the telephone service went out at the Authority office. This has led to many complaints that the Authority was not on duty during the peak of the flood. Staff was definitely on duty at all hours from 0800 Thursday to approximately 1730 Saturday. After the phones went out, contact was established by radio to Brant Conservation Area and from there by telephone to the city administration in Brantford. This was considered most important as the flood crest had not yet reached that city. The crest passed Brantford at midnight. Authority staff continued to monitor the flood as it passed downstream. Contact was maintained with Haldimand-Norfolk E.M.O. The flood passed from Brantford to Lake Erie.

At the request of the City of Cambridge, two Authority crews assisted in the clean-up operations on Saturday and Sunday. Intensive analysis of this extreme flood event is being carried out and the effectiveness of our system is being re-evaluated.

Respectfully submitted,

(signed)

I. Kao,
Assistant General Manager

C. W. Stevens
Manager, Water Resources Engineering.
GRAND RIVER CONSERVATION AUTHORITY

May 22, 1974