

## **AVOIDING FLOOD DISASTERS: TWO IMPORTANT CONSIDERATIONS FOR PLANNERS**

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### **Abstract**

Urban and rural communities continue to experience increasing frequency and severity of flood disasters. Governments are being forced to deal with rapidly escalating costs for remediation. Loss of life and negative health effects are increasing. Planners influence directly the location, form and nature of land use development. They also influence the policy and standards that control actual site development engineering and required safety practices. While there are many areas where planners should direct more attention toward reducing the potential for disasters, two of immediate importance are reduction of storm water discharges from all new development, and the environmental management of farming operations. These are discussed with reference to some Canadian examples.

### **1.0 Introduction**

Floods continue to increase in frequency and severity. Newkirk (1999, 2000, 2001) discusses the general increase in the number and severity of serious natural disasters, and observes that there is a long history of costly flood disasters shared by Canada, the United States, Australia, United Kingdom, and many other countries. Areas hitherto rarely flooded now are beginning to experience increased flooding risks – in part due to structural changes to watercourses and increases in upstream storm water discharges. Nelson (2001) provides a useful discussion of the evolution of response to flood disasters emphasizing the need for a new Civics approach to developing flood-related policy. In Canada, floods are one of the most costly disasters to governments and the insurance industry. This should have stimulated planning initiatives by many levels of government to complete studies, mapping, and the implementation of policies that would reduce the property, life and financial risks associated with damage, disease, and loss of life due to flood water quantity and

quality. Governments in North America and Europe seem to have been preoccupied with mainly reactive and structural adaptation approaches that focus on downstream flood-prone lands. This is not to say that governments have totally ignored investments and policy development required to reduce the effects of some major disasters. Rather, government action emphasis seems to have been overly focused on large regional projects or more general policies ignoring potentially important actions at the local level, which could contribute to reducing flood impacts.

Land use changes in the upper portion of watersheds (Newkirk, 2000) contribute to increased downstream flooding; much of the impact is related to development practices. This is the result of government giving more heed to the property rights of upstream landowners and developers than the impacts of civil risks downstream. Newkirk (1995, 1996, 1997, 1999b) shows that alterations of local land development practices can significantly reduce the output of storm water and improve its quality. He suggested that local planners should use existing planning instruments (eg., Official Plans, Site Plans, Zoning Bylaws) to require land development and land use to include mitigation to reduce storm water discharge and to improve the quality of any resulting flows. Yet, for more than the last century, the major government flood adaptation expenditures have been made primarily by federal and provincial levels and primary emphasis has been on insurance, downstream remedial physical structures and upstream storage structures. This approach has been of only mixed success (Nelson, 2001; de Loe, 2000; Hunt, 1999, Platt, 1999, White, 1945.)

Some Canadian provinces (e.g. Ontario) have developed some useful policies and agencies to help mitigate against floods, but many other provincial governments have not given effective flood mitigation high priority. To complicate the matter, the Federal Government that had initiated a nation flood program in 1975, has effectively withdrawn. De Loe, (2000, 356) observes "A national leader since April 1975, when the federal-provincial Flood Damage Reduction Program (FDRP) was launched, the federal government has now, for all intents and purposes, left the field of flood damage reduction to the provinces while it reconsiders its role in water management in Canada." "One of the main achievements of the FDRP has been contributing to the entrenchment of non-structural solutions in the range of choice for floodplain management in Canada." "Watt (1995) suggests that the withdrawal of the federal government from floodplain management eventually will lead to a spiral of increasing damages and disaster assistance." (De Loe, 2000, 356) It is therefore increasingly important for local government jurisdictions to initiate steps to help reduce the risks of flooding.

This paper, in recognizing that flood management continues to be in a state of flux particularly at senior government levels, recommends two straightforward actions that planners working for local governments can take to reduce some of the pressures that increase flooding impacts. These actions are within local government legal mandates, involve relatively modest expenses and do not require funding from higher levels of government.

## **2.0 Floods – Whose Risk and Rights should be managed?**

Planners have a responsibility for “the planning of the scientific, aesthetic and orderly disposition of land, resources, facilities, and services, with a view to securing physical, economic and social efficiency, a sound environment, health and well-being.” (Ontario Professional Planners Institute, 1995, J-1) Clearly this requires the planners to minimize the exposure of citizens to risk. “Risk is ... the potential for harm resulting from conditions beyond human control, such as natural disasters, disease or accidents.” (Kobayashi and Ray, 2000, 402) This appears to be a standard concept of direct physical risk. A narrow view of a planner’s responsibility for flood policy might be to ensure that use of flood prone areas is restricted and physical structures are in place to protect individuals and commerce that are located there. However some of the risk to which citizens in flood prone areas are exposed may be characterized as Civil Risk – and this required a broader perspective from planners.

Kobayashi and Ray define as follows: “Civil risk is ... a failure of human rights brought about by institutional means and creating disadvantages ...” (Kobayashi and Ray, 2000, 402) The critical point here is that citizens may be exposed to Civil Risk as a consequence of decisions that institutions are making in other places or locations. They argue that the crux of the issue relates to the ascendancy of property rights over civil rights and the difficult policy environment that this creates. “‘Urban landscapes are fundamentally constructed around rights of ownership rather than citizenship and risk’ (Zukin, 1991) ... Furthermore, class differentiation came about because the rights of property were given priority over other forms of rights.” (Kobayashi and Ray, 2000, 405) “Social groups are differentially situated, face differential risks as a function of access to knowledge [and property ownership], and use a variety of strategies to attain and use knowledge in their quests to attain social justice and transform oppressive built landscapes. This diversity occurs within the ordinary landscapes of everyday life and is “responsible for the ongoing restructuring of urban areas. (Laws 1994, 8)” in Kobayashi and Ray, (2000, 405) Thus policy makers need to give serious consideration to the impact on downstream community civil risk when upstream property rights are not sufficiently constrained by “best practices” to reduce storm water discharges and to avoid pollution.

Planners should be take a broader view of flood policy than just that directly required for flood prone areas; it is clear that land use changes in the flood-free upper watershed areas are major contributors to increased downstream flooding (Newkirk, 2000). Yet most scholarly research and government agency attention remains focussed on flood effected areas. (See for example the focus of work by Hunt (1999), Pratt (1999) and flood hazard discussion by the Federal Emergency Management Agency (1997, 136-147.))

In addition to increasing storm water discharge and water pollution, upper watershed changes can have a significant negative impacts on ground water resources used to provide citizens with potable water. For example, in 2000 the water system failure in Walkerton Ontario resulted directly in the death of 7 individuals, severe illness of over 2,000 citizens (some of whom may have to remain under health treatment for the

balance of their lives), and significant economic hardship to the community. The E. Coli contamination at Walkerton was introduced to the water supply through a minor surface water flood that washed animal waste from nearby farms into a municipal water supply well. While the current judicial review of the events in Walkerton has tended to focus on procedures related to testing the water supply, staff behavior, administration and monitoring, the role of private and public testing laboratories and government agencies, the fact remains that better planning and engineering could have ensured that the wells upon which Walkerton depended were not at risk of flooding and that animal waste on nearby farms was effectively contained and treated.

The larger issue is that storm water control regulations and regulations to control the location and size of animal husbandry operations restrict land owners or developers property rights. Property owners are often very insistent that their property rights are respected and not curtailed. Normally they are unaware of or uninterested in any “spin off” civil risks experienced by others. Thus property owners will ignore the civil risks created by their actions or operations unless required to do so by law or regulation. Historically, governments have been cautious about limiting property rights. Perhaps it is this ascendancy of property rights over civil risk considerations that leave governments reluctant or unwilling to force citizens to restrict their use of flood hazard lands (Day 1999) – in spite of repeated and costly flood damage. The U.S. National Flood Insurance Program (NFIP) is plagued by repeated claims for individual properties or areas. (Platt 1999) Lawrence and Nelson (1999) review the lack of effective government policy and institutional action to deal with the impacts of recurring Lake Erie<sup>1</sup> floods in spite of many potentially useful assessments and policy studies. It is local land use change decisions in both downstream and upstream areas that effect the degree of civil risk from floods faced by citizens, and, thus it is planners who have the responsibility of reducing both direct and civil risk of floods.

### **3.0 Problems in Balancing Civil and Property Rights, Flood Policy, and Development**

Governance fragmentation, excessive drainage, the trend to artificial landscapes, high density development design, the private sector and property rights as driving force in development, encroachment of urban development into rural lands, and the development of intensive animal husbandry farming all create challenges to implementing effective flood mitigation policies that respect civil and environmental rights. Newkirk (2000) observes that fragmentation between many competing institutions, governments and possibly states makes it a daunting task to develop overall coordinated policy strategies for most watersheds. For example the Grand River Watershed in Southern Ontario Canada; drains a watershed of 6,965 square kilometres along a watercourse of 300 kilometres with population of 787,000 in

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<sup>1</sup> Lake Erie is one of the Great Lakes of North America. The international boundary between Canada and the United States passes through its centre. It and the other Great Lakes are studied and managed by the International Joint Commission (IJC) cooperatively established by Canada and the United States.

mixed rural and urban settlements (Boyd et al. 1999). This modest sized watershed is divided into areas administered by 58 local and regional governments and agencies with some overlap in jurisdictional spatial boundaries, and some watershed parts are administered by authorities whose geographic area of responsibility extend significantly outside the boarder of the watershed. This is not an unusual governance structure for a watershed. It is understandable that it is difficult to manage the following forces that effect watershed flood performance:

*Excessive drainage:* most local municipalities require all development site plans to ensure that surface storm water is removed quickly. Rural governments have access to drainage laws that allow the government to force property owners to fund drainage projects for agricultural “improvement” purposes leading to the elimination of wetlands, channeling of small creeks and streams, and installation of tile drainage across extensive tracts of land. Excessive upstream drainage can have substantial downstream impact on floods but these local drainage decisions mostly are made without consideration of the civil impact on the whole watershed..

*Artificial landscapes:* have very high runoff coefficients greatly increasing the storm water runoff from a site; they discharge rainwater very quickly. These are highly manicured parks and gardens, drained damp areas and wetlands, and “low maintenance” landscapes (where a site has an underlay of impervious plastic over which is placed stone or gravel; any vegetation is placed in pots or planters). In some cases artificial turf is installed over an impervious concrete or asphalt base. These kinds of landscapes are becoming an increasing part of new commercial, industrial and residential developments designed and implemented at the local level.

*High-density development design:* In North America there is a marked increase in residential development density. (See Figure 1.)



Figure 1: A New High Density Residential Development

There are obvious environmental and economic benefits (e.g. reduced consumption of land, lower cost per unit for municipal services); but there is also a significant decrease in the average site's ability to absorb rainfall unless suitable storm water retention is built into developments. It is clear in the figure that most of the land is covered with roof, roadway or driveway. All sites are well drained and no provision was made at the bottom of the grade to retain rainwater – it is just sent off down the storm water disposal system into the nearest watercourse. Large homes with driveways on very small lots means that in some modern developments, well over 85% of the total land surface is rendered impervious. Beyond the obvious impact of increasing storm water discharges, the reduced infiltration has serious effects that reduce ground water tables.

*The private sector and property rights as driving force in development:* It is private developers who assemble land parcels, initiate, plan and finance land development projects. They attempt to minimize development costs in response to the market demand of the soon-to-be new property owners for large but inexpensive homes. Since profit considerations are key, developers pay little attention to how their work changes surface runoff volumes and impacts unless required by regulation. Normally, the only consideration of storm water aspects of development design is whether or not the storm water flows generated can be adequately discharged outside the community. Citizens complain if water is left standing after a rainfall event. Thus, the development of most residential subdivisions substantially increases the amount of impervious land in a watershed. A quick review will show that much of this kind of development in watersheds tends to be in the upstream tributary areas where, previous to development, there were stands of vegetation to help absorb or delay storm runoff. The development of new high density urban areas with very decreased ability to absorb rainwater and increased capability to dump storm water rapidly into the watercourses of the watershed will continue to increase the risk of downstream flooding.

*Encroachment of urban development into rural lands:* It is easier and more profitable for developers to convert agricultural land to new developments than redevelop older urban land. (See Figure 2) The consequence of such development is a transfer of land that had ability to absorb rainfall to land that is far more impervious. Often these developments rely upon private surface wells for potable water and septic beds for sewerage processing. Such development without adequate storm water considerations can alter nearby farm drainage as well. Some possible consequences beyond the impact on watershed storm water performance include: potable water wells contaminated by farm runoff and increased farm runoff and pollution of nearby streams



Figure 2: Typical Urban Development in Rural Lands

*Development of Intensive Animal Husbandry (Factory Farms):* This is a rapidly developing rural problem that is raising concern both in North America and Europe. In the literature they are often called Concentrated Animal Feeding Operations (CAFO's). These involve compounds contain a very large numbers of animals being raised primarily for slaughter. It is argued by some individuals that such operations are not farms – rather they are a form of a factory located under a general rural operations umbrella. Large buildings and storage areas contain thousands of animals. The processing involves inputs of weaned animals, feedstock, water, antibiotics and meat enhancement chemicals. Sometimes animals are not suitably contained and wander into local streams causing a concern for pollution. The outputs involve a “finished” animal ready for market and production wastes. It is the latter that have raised the largest concern. Waste output includes large volumes of urea, ammonia, feces and other chemicals that are seen to be causing air and land pollution, methane and other greenhouse gases. Most operations store large quantities of liquid manure in sewerage lagoons for processing (aging) and eventual spreading on farm fields. It is not clear that sufficient is known about the volumes of sewerage effluent that a farm is capable of receiving before there are serious problems with pollution of ground water, wells and watercourses. The safety of these operations is vulnerable to extreme rainfall events. Sewage lagoons begin to fill and overflow. Very serious problems developed in North Carolina when hurricanes saturated the land and flooded the farm sewage lagoons. This created major public health concerns from seriously contaminated floodwaters. Beyond the obvious concerns about pollution in extreme weather events, there is a general concern that these CAFO's do not have sufficient sewage treatment capability to neutralize the waste. The amount of waste needing treatment can be prodigious. For example a 50,000 acre hog farm in Utah produces



2.5 million hogs a year. The potential waste output of this farm has been claimed to be larger than the City of Los Angeles (U.S. Senate Committee on Agriculture - minority staff report, 1997) Further views on CAFO's used for intensive hog production may be found at <http://www.hogwatch.org/,2000/> or <http://www.web.net/men/gallonhog.htm/>

Growth of large scale CAFO's operations is rapid. In most cases a farmer can add facilities for animal husbandry to a farm without seeking special approval. Many local municipalities do not have legislation in place to require permits for such operations or to set and enforce standards regarding sewage treatment.

It would be unwise to assume that these problems are limited only to large scale farm operations. Many small farms do not yet practice suitable manure management or keep livestock from polluting watercourses. (See Figures 3 and 4)



Figure 3: Family Farm Open Grazing with No Manure Storage

In Figure 3 it is easily seen that there is poorly organized manure storage and the worn earth shows that cattle are allowed to wander down to and into the stream at their will. This farm is located on a main tributary of a significant river in the watershed.

Figure 4 shows a pleasant pastoral theme of cattle grazing with full access to the near by stream. This stream has significant pollution problems. Fishers are advised not to take any fish from the stream. Both of these Figures demonstrate that even family farm operations need to be required to change their livestock management practices





Figure 4: Family Farm Open Meadow Grazing with Stream Access

#### **4.0 Two Planning Initiatives For Local Municipalities To Mitigate Against Floods**

Local municipalities can begin to assist with mitigation against floods and environmental impact of development. They can take important steps on their own to help reduce storm water runoff from development and to reduce pollution from agricultural operations. In both of the initiatives recommended below, the costs to the municipality are minor – simply related to implementing, monitoring, and enforcing local regulations to require property owners to act in a manner that respects the civil rights of all residents of the watershed.

##### 4.1 Require All New Site Development to Include Storm Water Retention

Planners should develop site plan approval regulations that require all new developments to minimize any increase in flows of storm water from the site. Newkirk (2000) shows how increased storm water output associated with development in the headwater areas of watersheds leads to stiffening watershed hydrological characteristics. This in turn increases inherent systems instability that results in more frequent and more damaging floods. This could lead to an increased tendency for flash floods. There is extensive literature regarding storm water detention and retention systems and stream and pond buffering systems. In addition, natural vegetation planting approaches on individual property parcels can reduce storm water output. Planners need to develop a civics-based (see Nelson, 2001) public information campaign to encourage interest and support of this kind of a broader based approach.



Figure 5: A Local Constructed Storm Water Detention Pond

Figures 5, and 6 show a storm water detention system that was recently built as part of a “for profit” residential property development of previously vacant college grounds undertaken by a Catholic religious order. The fathers instructed the development planner to ensure the new development did not discharge undue amounts of storm water. The figures clearly show the nature of the constructed detention pond. Before the development was started the pond did not exist; the land was at the same elevation of the surrounding lands. This shows the new pond area after 2 weeks of very wet weather; most of the year it will be dry. It is clear that this kind of facility can become an attractive “natural” site and serve as an amenity for the area.

The pond outflow is shown in Figure 6 to the left side. It has been designed with a two level discharge. The lower discharge as designed to allow water to flow out slowly. This will delay the discharge of storm water surge in normal rainfall events, and will encourage water to infiltrate into the ground. Infiltration is important in this regional area since the whole metropolitan area of 750,000 people relies on wells for potable water. The higher level discharge is designed with much higher flow capacity to prevent local flooding during major rainfall events. This was a relatively small land development project; but this example shows that on-site storm water detention can fit in nicely. Planners need to make this kind of approach a normal component of all development projects. The municipality has the means to make this happen because it is the authority for granting development approval.



Figure 6: Constructed Storm Water Detention Pond and Discharge

#### 4.2 Require All Animal Husbandry Operations to Properly Manage and Dispose of Waste

Rural Planners have the responsibility to ensure a safe and healthy environment for all of the citizens. New policy initiatives need to be developed to properly manage CAFO's and to set and monitor standards for farm sewerage processing. It is important that regulations for small farm animal husbandry operations also be developed and monitored. There is no doubt that proper management of manure will cost the farmer some one-time capital set up costs. Municipalities can encourage this by extending design assistance, construction grants and special financing arrangements. In Ontario, Canada, the Region of Waterloo provides this kind of support to farmers because it is aware of the need to protect its ground water resources that supply a metropolitan region with 750,000 population. Figure 7 shows how a local family farm made use of this program to improve its manure management.



Figure 7: A Family Farm With Concrete Animal Waste Management Facilities

Regional encouragement and assistance has also led to CAFO's improving their animal waste management. A careful look at the large beef feedlot operation shown in Figure 8 reveals extensive use of concrete animal waste management systems. Both of these show a commitment of the Regional government to protect the Civic rights of its citizens through subsidies to encourage sound environmental practices by farmers.



**Figure 8: A Large Feedlot for Beef with Concrete Waste Management**

## **5.0 Conclusion**

We have observed the continuing tendency of researchers and government policy to focus on managing flood prone areas. It is clear that structural adaptations have



delivered only mixed results. There is an increasing need to take broader based civics based approaches to ensure that a focus on property rights does not any longer diminish the civil rights of citizens to have safe and healthy environments. Higher levels of government appear to be challenged to make effective improvements toward reducing flood risks and improving storm water quality. There are a number of forces operating at the independent local areas that compromise flood reduction strategies. Planners at the local level must manage these forces. Two particular areas where local administrations can make progress are requiring on site management of storm water, and developing better management of farm animal husbandry operations. Such initiatives are within local government mandates and are relatively inexpensive for municipalities to implement. However, they require planners and politicians to begin to give citizen civil rights ascendancy over some portion of private property rights. These initiatives will test the political will of professionals and politicians.

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