Canadian Water Resources Journal

ISSN: 0701-1784 (Print) 1918-1817 (Online) Journal homepage: https://www.tandfonline.com/loi/tcwr20

Drought Contingency Planning and Implementation at the Local Level in Ontario

Jennifer L. Durley , Rob de Loë & Reid Kreutzwiser

To cite this article: Jennifer L. Durley , Rob de Loë & Reid Kreutzwiser (2003) Drought Contingency Planning and Implementation at the Local Level in Ontario , Canadian Water Resources Journal, 28:1, 21-52, DOI: 10.4296/cwrj2801021

To link to this article: https://doi.org/10.4296/cwrj2801021

Published online: 23 Jan 2013.

Submit your article to this journal

Article views: 514

View related articles

Citing articles: 1 View citing articles

Full Terms & Conditions of access and use can be found at
https://www.tandfonline.com/action/journalInformation?journalCode=tcwr20

Drought Contingency Planning and Implementation at the Local Level in Ontario

Submitted October 2002; accepted January 2003
Written comments on this paper will be accepted until September 2003

Jennifer L. Durley[1], Rob de Loë[2] and Reid Kreutzwiser[3]

ABSTRACT

Responsibilities for water management in Ontario are shared among the federal, provincial and local levels of government. Recently, the local level (which includes municipalities and conservation authorities) has been assigned significantly more responsibilities. For example, the provincial government's Ontario Low Water Response plan (OLWR) assigns key responsibilities to municipalities and conservation authorities. However, it is not clear that all local level agencies are capable of assuming these greater responsibilities. This paper reports findings from a study that used the community capacity literature to evaluate the role of the local level in drought contingency planning and implementation in two Ontario watersheds. The Big Creek watershed is dominated by agriculture, while the upper Credit River watershed faces great pressure from urban development. Both watersheds are dependent upon groundwater and have experienced reduced water supply during recent drought episodes. Based on an investigation into the roles, responsibilities and communication patterns among government agencies and non-government organizations in each watershed, it was concluded that watershed communities do have the capacity to create and implement a drought contingency plan. However, they require considerable assistance from the provincial government, especially in terms of regulating water withdrawals during periods of drought.

RÉSUMÉ

Les responsabilités de la gestion de l'eau dans la province de l'Ontario, Canada, sont partagées entre les niveaux fédéral, provincial, et paliers du gouvernement. Le niveau local (qui inclut des municipalités et des autorités de conservation) a été assigné sensiblement a plus de responsabilités ces dernières années. Par exemple,

[1] Ph.D. Candidate, [2]Associate Professor and Canada Research Chair in Rural Water Management, and [3]Professor, Department of Geography, University of Guelph, Guelph, ON

le gouvernement provincial Ontario Low Water Response (OLWR) assigne les responsabilités principales aux municipalités et aux autorités de conservation. Cependant, il n'a pas été déterminé si les agences de niveau local sont capables de prendre cette augmentation de responsabilités. Cet article rapporte des résultats d'une étude qui a employé la littérature de capacité de la communauté pour évaluer le rôle du niveau local de sécheresse, la planification d'urgence et l'exécution dans deux lignes de partage de l'Ontario. La ligne de partage *Big Creek* est dominée par l'agriculture, alors que la ligne de partage *upper Credit River* fait face à la grande pression du développement urbain. Les deux lignes de partage dépendent des eaux souterraines et ont l'approvisionnement en eau réduit pendant les états récents de sécheresse. Une recherche basée sur les rôles, les responsabilités et les modèles de communication entre les organismes gouvernementaux et des organismes non gouvernementaux dans chaque ligne de partage, on a conclu que les communautés de ligne de partage pourraient avoir la capacité de créer et mettre en application un plan d'urgence de sécheresse. Cependant, ils exigent une aide considérable du gouvernement provincial, particulièrement en terme de régulation de l'eau pendant des périodes de sécheresse.

INTRODUCTION

Ontario has an abundant supply of freshwater within its boundaries. There are more than 225,000 lakes and numerous groundwater aquifers. Additionally, Ontario borders on four of the five Great Lakes, which together contain over 20 percent of the world's surface freshwater supply (McCulloch and Muldoon, 1999). However, even with this vast supply of freshwater, Ontario's water is not always available in adequate quantities for human uses. This is especially true for approximately 2.8 million Ontario residents who rely on groundwater (Singer *et al.*, 1997). Ontario residents who depend on groundwater can experience local–scale water quantity problems, such as the drought–like conditions that southwestern and eastern Ontario experienced during the summers of 1999, 2001 and 2002. Droughts in Ontario, while not as harmful as those in other parts of Canada, can be locally significant. Gabriel and Kreutzwiser (1993) documented Ontario drought episodes and their impacts from 1960 to 1989 and reported that after the 1988 drought, farmers received $55 million in crop insurance payouts and livestock producers received $15 million in federal government assistance. Impacts on water supplies have also been felt across the province.

In addition to drought occurrence and its associated impacts in Ontario, federal and provincial government fragmentation and policy overlap complicate local–scale water quantity issues. Responsibility for water resources in Ontario is shared among numerous provincial government departments. Within the provincial government, the Ontario Ministry of Natural Resources (OMNR) and the Ontario Ministry of the Environment (OMOE) have jurisdiction over different areas of water management. Agencies at the local level, notably municipalities and conservation authorities, also share responsibility. Within Ontario there is no single policy or

government body that oversees and coordinates water management (Carlise and Smith, 1989; Kreutzwiser, 1998; McCulloch and Muldoon, 1999). The result is an accumulation of specific policies and programs aimed at alleviating various water–related problems instead of an integrated approach to water management emphasizing collaboration (McCulloch and Muldoon, 1999; O'Connor, 2002).

In their analysis of Canadian water management, Mitchell and Shrubsole (1994) noted that emphasis has been given to decentralization and delegation of responsibilities. They reported that "There has been growing acceptance that the 'traditional' methods of resource and environmental management, dominated by top–down, centralized, expert–driven, technical and financial considerations are no longer capable of dealing with increasingly complex 'metaproblems' or 'messes'" (Mitchell and Shrubsole, 1994). In a report prepared for the Executive Resources Group, Beak International Incorporated (2001) also noted that watershed planning in Ontario continues to experience the trends noted by Mitchell and Shrubsole. Thus, water managers see public participation moving beyond an advisory role to an active decision–making role in water management (Mitchell and Shrubsole, 1994; Griffin, 1999; Walesh, 1999; Beak International Inc., 2001).

With people becoming increasingly motivated to have shared or delegated power, water managers should develop a process that shares responsibility and maintains accountability (Mitchell and Shrubsole, 1994; Walesh, 1999). However, to ensure an effective process, water managers need to build effective communication channels for information dissemination (Dorcey, 1997). Reflecting these concerns, attention has recently been directed toward local government management of water resources during drought conditions (OMNR *et al.,* 2001).

Drought Contingency Planning and Ontario Low Water Response

The term drought can have many different definitions: meteorological, hydrological and agricultural. Ontario droughts tend to consist of dry spells with a subsequent reduction in streamflow, groundwater and reservoir levels and runoff, which result in water allocation problems.

Drought contingency planning represents the preparedness and mitigation measures taken by government, industry, citizens and others prior to a drought (Wilhite, 1996). Drought planning is a dynamic process that takes into consideration socioeconomic, agricultural, technological and political trends (Wilhite, 1996). Successful drought plans should include assessment tools such as drought criteria or triggers (Palmer Drought Severity Index values); water conservation and drought contingency planning legislation and policy; water allocation or supply methods such as water taking permits; public education and conflict resolution; and development of emergency response procedures (Shepherd, 1998; Wilhite *et al.,* 2000). Ontario's drought guidelines follow this format to some extent, with emphasis on a local response to low water due to drought conditions. For example, the Ontario drought guidelines include a definition of drought, drought–trigger criteria and a drought–response framework.

In response to the drought-like conditions experienced in Ontario in 1998 and 1999, and in recognition of climate change, the province of Ontario created a set of guidelines for responding to low water conditions. Ontario Low Water Response (OMNR *et al.*, 2001) is designed to ensure provincial drought preparedness and to support and aid in the co-ordination of a local (watershed) response to drought. The guidelines provide measures to quantify drought in terms of precipitation levels and streamflow thresholds. Three drought levels have been defined and described in the guidelines: Level I (warning), Level II (water conservation), and Level III (water use restrictions). Precipitation levels and streamflow thresholds act as indicators to identify each level of drought. For example, a Level I drought is identified when precipitation is less than 80 percent of a three month average, and monthly streamflow is less than 70 percent of the lowest average summer month flow.

Under the guidelines, the province provides overall direction and co-ordinates policies, science and information systems and emergency support. The local role is collecting information, interpreting policy, developing programs and responding to emergencies through the creation and implementation of water response teams (WRT). At the local level, the guidelines recommend the formation of watershed-based WRTs to coordinate local activities. Membership on WRTs includes provincial, municipal and conservation authority staff as well as representatives of local interest groups and water users in the watershed. Conservation authorities have been identified as the lead agency for arranging and hosting the WRT meetings and activities. However, decision-making power and responsibility is shared amongst the members of the WRT, with the exception of provincial representatives who are not part of the decision-making process. Only at a Level III drought does the province become involved in the decision-making process. For example, when a Level III drought is declared, the OMOE enforces water-taking restrictions through the Permit to Take Water program (PTTW) (OMNR *et al.*, 2001).

Under Section 34 of the *Ontario Water Resources Act*, any water-taking from a well, lake, stream or storage pond in excess of 50,000 litres per day requires a Permit to Take Water. Users who do not require a permit are those taking less than 50,000 litres per day, those taking water for domestic purposes or livestock watering, or firefighting. Restrictions may be imposed by the OMOE when water shortages occur. Penalties for non-compliance with the act and its regulations can range from cancellation of a permit, to a $305 Provincial Offences ticket, and ultimately to court with additional fines of $20,000 (OMOE, 2000).

Because the provincial drought guidelines are relatively new, this study did not attempt to evaluate their success or failure during the 2001 drought. Instead, we explored the assumption in the guidelines that a watershed community, consisting of government agencies, non-government organizations and citizens, has the capacity to plan for and implement a drought contingency plan. As part of the capacity evaluation, we also explored issues surrounding the devolution of power and authority of a water response team to the province at a Level III drought. This discussion relates to capacity building for locally-led drought contingency planning because the roles and responsibilities of the WRT are not clear when a watershed enters a Level III drought condition, thereby potentially hindering capacity. Thus,

the focus of the research was on conceptualizing and evaluating local capacity to conduct drought contingency planning at a watershed scale.

Ideally, drought contingency planning should not be pursued in isolation from other land and water management activities. Therefore, in this work local capacity for drought contingency planning is evaluated in the context of an integrated approach to water management. Integrated water management, which is broadly defined to include government agency and non–government organization collaboration and partnerships, represents a bottom–up approach to drought contingency planning.

Integrated Water Management

Integrated water management (IWM) may have different definitions and applications. From a natural resource management perspective, IWM considers human–environment interactions, interdisciplinary management and sustainable development (Cohourn, 1999). Others view IWM in terms of structural or engineering approaches to water management (Shirai, 1990). In this paper, integration in the water management sector is based on a collaborative or partnership approach at a watershed scale. Michaels (2001) suggests that "successful collaborative watershed management programs emphasize active stakeholder engagement, employ integrated solutions, recognize the authority of multiple agencies and jurisdictions, and build on the expertise and resources across sectors." Consistent with Michaels' attributes of collaborative watershed management, key characteristics of IWM have been defined for this research. These defining characteristics highlight the components that form the foundation of IWM at a watershed scale, and contain elements of a multistakeholder approach, interagency and interdepartmental collaboration and partnerships, as well as participation and education.

Integrated water management should be based on a watershed approach. Watersheds offer an approach to land and water resources management that takes into consideration interactions between the natural environment (e.g., land and water) and societal considerations (e.g., economic and political systems, values). A multistakeholder approach allows all stakeholders with a vested interest in water management in the watershed to be part of the decision–making process. This is a key element of an integrated approach because it allows for the sharing of ideas, information and resources within the watershed. IWM also entertains collaboration among all levels of government and between all jurisdictions within the watershed boundary. Watersheds cross jurisdictional boundaries and this requires communication between governments and communities to achieve integration. Thus, interdepartmental and interagency collaboration are one means of achieving IWM. Incorporating the human dimension and defining roles and responsibilities is also a key characteristic of IWM. Attempts should be made in the watershed to educate all stakeholders about their individual and collective responsibility about water conservation and drought response. These defining characteristics are reflected in the dimensions of community capacity building to conduct drought contingency planning as presented later in this paper.

Given the degree of recognition of the role agencies and organizations play in implementing IWM in a watershed, it is appropriate to assess the ability or capacity of government agencies and non–governmental organizations to manage water resources in an integrated fashion. It is fair to assess, for example, if communities, composed of agencies, organizations and citizens, possess the capacity (e.g., community resources) to manage water resources in an integrated fashion.

Local (Watershed) Capacity Building

Gates (1999) noted that the context of local problem–solving is changing. He summarized the stimuli for assessing watershed capacity for decision–making and problem–solving, and noted the following trends:

- the challenges and problems society faces are increasingly becoming the responsibility of local and regional communities;
- there are, and in all likelihood will continue to be, fewer and fewer public dollars available to deal with critical issues that face society; and
- power has become more widely and thinly distributed within the community.

In light of these trends, it is inappropriate to assume that all local communities will be able to develop effective local responses to drought (de Loë *et al.*, 2002). Variability in local capacity for water management is thus a key emerging theme, and attention in the water sector is turning to strategies for building capacity (United States Environmental Protection Agency, 1998; Litke and Day, 1998; Franks, 1999).

Capacity building refers to strengthening the competency of people, groups or agencies to solve their problems (Dugan, 1993). Many applications to local capacity building have been reported in the literature. McGuire *et al.* (1994) studied development capacity of non–metropolitan communities based on their economic and governmental performance. Grindle and Hilderbrand (1995) examined capacity building as a method to improve public sector performance in developing countries. Murray and Dunn (1995) studied capacity building in terms of rural development in the United States, where considerable weight was given to the contribution of leadership in small communities as an indicator of capacity.

In the present research, McGuire *et al.'s* (1994) dimensions of capacity building have been categorized under the broad sub–titles of community and citizen participation, and community structure and arrangements. Within this broad structure, specific elements (e.g., human and financial resources) are derived from previous work by Walter–Honadle (1986). Based on these models, the drought literature (Wilhite, 1996; Knutson *et al.*, 1998; Shepherd, 1998; White and Karssies, 1999; Wilhite *et al.*, 2000) and the characteristics of integrated water management defined for this work, specific dimensions and pertinent watershed capacity building indicators are presented in Table 1.

Table 1. Local Capacity Building Indicators for Drought Contingency Planning.

Local Capacity Building Dimensions	Local Capacity Building Indicators
Citizen and Community Participation	**Tools and Approaches** Mechanisms for direct community input Mechanisms for conflict resolution
Community Structure and Arrangements	**Roles and Responsibilities** Vertical Linkages Horizontal Linkages Interdepartmental and interagency collaboration and project–oriented involvement **Resources** Human Resources Financial Resources

Community and Citizen Participation—Tools and Approaches

Measuring the presence and successful implementation of the tools and approaches used for community and citizen participation is necessary for determining local capacity to conduct drought contingency planning. How to include the public in drought contingency planning is also an important component of watershed capacity building and is included as an indicator under the banner of mechanisms for direct community input. Effective public involvement has the following characteristics: two–way communication; involvement early and throughout the entire planning process; deliberation involving informal and personal processes; and representation of all interests (Blahna and Yonts–Shepard, 1989; Rich *et al.*, 1995; Dorcey, 1997; Wallace *et al.*, 1997; Walesh, 1999).

Mechanisms for conflict resolution are an indicator of this capacity building dimension because attempts to coordinate water quantity management may initiate conflict between the individuals or groups involved. Conflict may also arise between water users competing for the resource, especially in times of low water supply, because water scarcity often increases demand. Frederickson and Lovrich (2001) suggest that constructive conflict management at the community or watershed level is characterized "by the norms of interpersonal trust, active listening, open self–revealing communication and due respect for the values and interests of others." The role of government agencies in locally–led initiatives should be to convene a discussion, not control it (Gates, 1999). In this respect, government agencies should facilitate discussion and allow the watershed community to resolve its problems.

McGuire *et al.* (1994) have noted "an important component of high–capacity communities is well–developed horizontal and vertical linkages." Horizontal linkages represent linkages of a community with other communities, either through formal inter–community partnerships or based on a "project–specific know–how" relationship (McGuire *et al.*, 1994). Vertical linkages are the relationships and linkages between communities and upper tier levels of government.

Vertical and horizontal linkages can be evaluated based on the way in which government agencies and non–government organizations are arranged. A community with adequate horizontal linkages may be described as having multi–community ties, either formally through project–based partnerships with nearby communities or organizations, or informally by seeking out advice and resources from other communities involved in similar projects (McGuire *et al.*, 1994). A watershed community with adequate vertical linkages seeks funding and builds relationships with senior level government. Consulting with senior level government has the benefit of increasing communication and connections, which may help the watershed community obtain financial assistance for projects or at least increase its awareness about possible funding opportunities. Relationships with senior government can also aid a watershed community in conflict management. Communities can approach senior level government for guidance in the event of conflicts between water users.

Another indicator of capacity, related to roles and responsibilities in a watershed, involves measuring interdepartmental and interagency collaboration, and project–oriented involvement by stakeholders. A coordinated approach requires that those involved in the decision–making process take an approach that:

(a) considers the scope of environmental and human systems,

(b) examines interconnections,

(c) identifies common goals, and

(d) selectively identifies the key elements on which to focus attention (Margerum and Born, 1995).

Based on his involvement in the Fraser Basin Management Board and Program, Dorcey (1997) suggested key factors that facilitate or constrain collaborative approaches that bring together many stakeholders. He found that a fair representation of stakeholders was necessary to avoid conflict later in the project. Ensuring representation also adds to the diversity of knowledge and experience allowing an informed decision–making process. However, a lack of common knowledge and differing perspectives can make communication difficult. Therefore, Dorcey suggests that the project team reaches a consensus at the start of the project.

Community Structure and Arrangements—Resources

The availability and training of staff to conduct drought contingency planning is another indicator of the watershed community's capacity to manage water resources in times of low water levels. In the context of drought preparedness, Wilhite (1996) has defined human resources as the labour needed to develop water resources, process citizen complaints, provide technical assistance and direct citizens to available services. In addition to addressing key roles in drought contingency planning, responsibility for the necessary tasks to be completed in the project planning and implementation stages must also be addressed. For example, what tasks are needed to accomplish each recommended action? Who is accountable for each task? When is each task to be accomplished? (OMNR and OMEE, 1993).

Financial resources are also a key indicator of local capacity to conduct drought contingency planning. In terms of watershed management the OMNR and OMEE (1993) stated, "there cannot be a simple, generic funding formula in place." They suggest that all stakeholders involved in plan development and implementation need to be innovative in securing new and various funding sources. Opportunities for partnership funding are enhanced due to the interdisciplinary nature of watershed planning.

Given the response framework, the roles and responsibilities presented in the provincial guidelines, and based on watershed capacity dimensions and indicators, two Ontario watersheds were evaluated to determine their ability to conduct and implement drought contingency planning on a watershed scale.

METHODOLOGY

Comparisons between case study areas are made to highlight generalizations about an underlying commonality regarding a policy, process, program, or decision (Yin, 1994). Case study comparisons can also broaden the research to include many different entities, from provincial agencies to non–government organizations. Therefore, a comparative case study approach was used for this research because of its ability to draw together and compare provincial, municipal and local agencies and organizations in Ontario.

Data sources included official plans, community profiles, watershed studies, annual reports and focused interviews. Government documents and reports formed the primary source of document analysis with some supporting documentation from non–government organizations. The most important use of documents in case study research is to corroborate and augment evidence from other sources. For example, if the documentary evidence is contradictory rather than corroboratory, the case study investigator has specific reason to inquire further into the topic (Yin, 1994).

Provincial, municipal and non–government organization documents were analyzed. For example, provisions for water resources management and specifically water quantity management, environmental management, public consultation, partnerships and provisions for emergency measures were analyzed in municipal official plans. Similarly, consideration of mandates, goals and visions, as well as

education and volunteer opportunities for water management projects, was the focus of the analysis for non–government organization documents. The presence and/or absence of these documents was considered along with examples of their implementation and use. Using focused interviews and analysis of project reports, the research investigated if planning documents, watershed plans and other documents reflected water management, public consultation and collaboration.

A preliminary list of potential interview subjects was obtained from Credit Valley Conservation Authority, Long Point Region Conservation Authority and the Ministry of the Environment. Additional interview subjects were identified during the focused interviews and from agency and organization websites. Interviewees included provincial ministry staff (5), conservation authority staff (4), municipal government staff (8) and members of non–government organizations with a vested interest in water management (12). For consistency between the two watersheds, an attempt was made to select interviewees with comparable positions. For example, at the municipal level, directors of water works were interviewed, and presidents or leaders of non–government organizations were interviewed.

Case study comparisons of the watersheds were then used to analyze similarities and differences between the watersheds based on the evaluation framework. Under each dimension of capacity, each capacity indicator was accompanied by an underlying evaluative question. These questions were used to guide the focused interviews and for the evaluation of the two case study watersheds (Table 2).

The Big Creek and upper Credit River watersheds were chosen to evaluate watershed capacity to conduct drought contingency planning in rural Ontario (Figure 1). These watersheds were chosen because they contain a large rural population, they are groundwater dependent, and competition between water users is high, an indication of high stress for water. Budgets levels of conservation authorities range from $30,942,600 to $355,900 (Canadian dollars) and the number of staff ranges from 205 to 3, thereby placing the case study watersheds in the upper range for financial resources and staff numbers when compared to other conservation authorities in the province (Ivey, 2000).

Big Creek Watershed

The Big Creek watershed is located in southwestern Ontario on the north shore of Lake Erie (Figure 2). Draining a large portion of the Norfolk Sand Plain, The Big Creek watershed encompasses about 723 km^2 of land in Brant (106 km^2), Norfolk (536 km^2) and Oxford (81 km^2) counties (Gamsby and Mannerow Ltd. *et al.*, 2002). Land use is mainly rural/agricultural in nature. The water resources are used for crop irrigation, private and municipal wells, aquaculture, and sewage assimilation. Cold water discharge from the shallow water table aquifers of the Norfolk Sand Plain has also created ideal habitat for brook trout in the headwater areas of the Big Creek tributaries.

The population of the watershed was approximately 19,000 in 1996, and the economy is predominately supported by agriculture. It is estimated that approximately

Table 2. Evaluative Framework Example with Accompanying Data Sources.

	Types and Numbers of Data Sources Used to Answer the Capacity Building Indicator Question		
Example Question	**Interviews**	**Official Plans (Regional, County, Municipal)**	**Watershed Plans/ Water Budgets**
Vertical Linkages Are the roles and responsibilities of all organizations involved in water resources management and drought contingency planning clearly defined?	All 29 interviewees provided insight. However, interviews with provincial government staff (5), conservation authority staff (4), and municipal government staff (8) provided the most information.	8 Official Plans Big Creek Watershed – Oxford County – Brant County Upper Credit River Watershed – Region of Peel – Town of Orangeville – Wellington County – Dufferin County – Town of Erin – Town of Caledon	3 Watershed Plans – Credit River watershed 4 Subwatershed Plans – Subwatersheds 15, 16, 18 and 19 in the upper Credit River watershed 2 Water Budget Proposals – Big Creek watershed – Credit River watershed 1 Water Budget Report – Big Creek watershed 1 Groundwater Report – Town of Erin, upper Credit River watershed

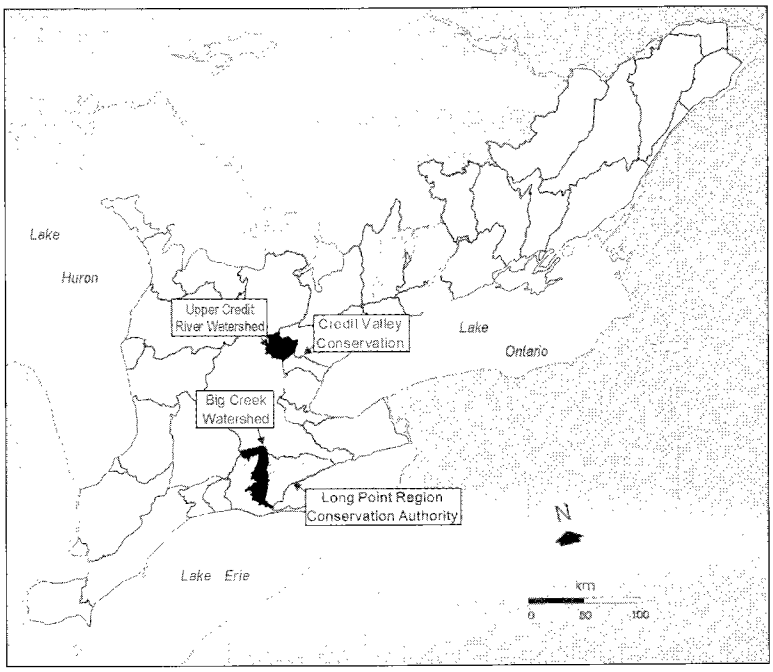

Figure 1. Geographical Location of Study Watersheds and Conservation Authorities.

7,500 ha of land are in tobacco production, and about 1.3 percent of the total land available for tobacco is being used for ginseng farming. In addition, vegetable farming occupies 726 ha of available agricultural land (Gamsby and Mannerow Ltd. *et al.*, 2002). In terms of climate, the watershed has experienced irregular climatic patterns characterized by warm temperatures and erratic precipitation. Irrigation, commercial aquaculture and rural domestic uses account for the largest proportion of water consumption, followed by municipal use in Delhi. Due to the high demand for water and recent low water conditions, conflicts have arisen over the allocation of water between the agricultural community and other users (Gamsby and Mannerow Ltd. *et al.*, 2002).

Upper Credit River Watershed

The Credit River watershed is located west of the City of Toronto (Figure 3) and drains into Lake Ontario. The Credit River watershed covers approximately 1000 km^2 with the southern portion characterized as urban, while the upper or northern portion is predominately rural. The upper or northern part of the watershed consists of subwatersheds 15 through 19 including the headwaters of the river and its tributaries near the Town of Orangeville. Subwatersheds 15 and 17 are

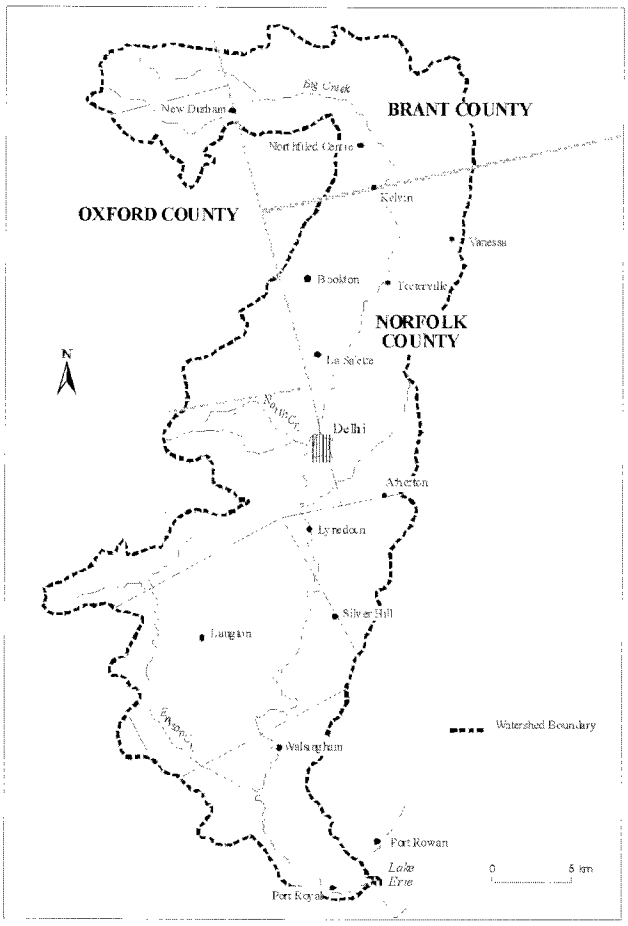

Figure 2. Big Creek Watershed.

flanked by the Region of Peel and County of Wellington, subwatersheds 16 and 18 fall within the Region of Peel, and subwatershed 19 falls between the Region of Peel and Dufferin County.

The population of the upper Credit River watershed was approximately 70,000 in 1996. Land use throughout the upper portion of the watershed is characterized by agriculture, natural areas including wetlands, and aggregate mines. Urban centres include the towns of Orangeville, Caledon and Erin. According to Ivey *et al.* (2001) "Development pressures in the towns of Orangeville and Caledon, existing hydrological variability, and possible future increases in the incidence and duration of droughts will make balancing human and ecological water needs increasingly difficult."

At the commencement of this study, neither watershed had a drought contingency plan or a water response team in place. However, during the summer of 2001 the Big Creek watershed initiated a WRT because the watershed entered a Level I drought

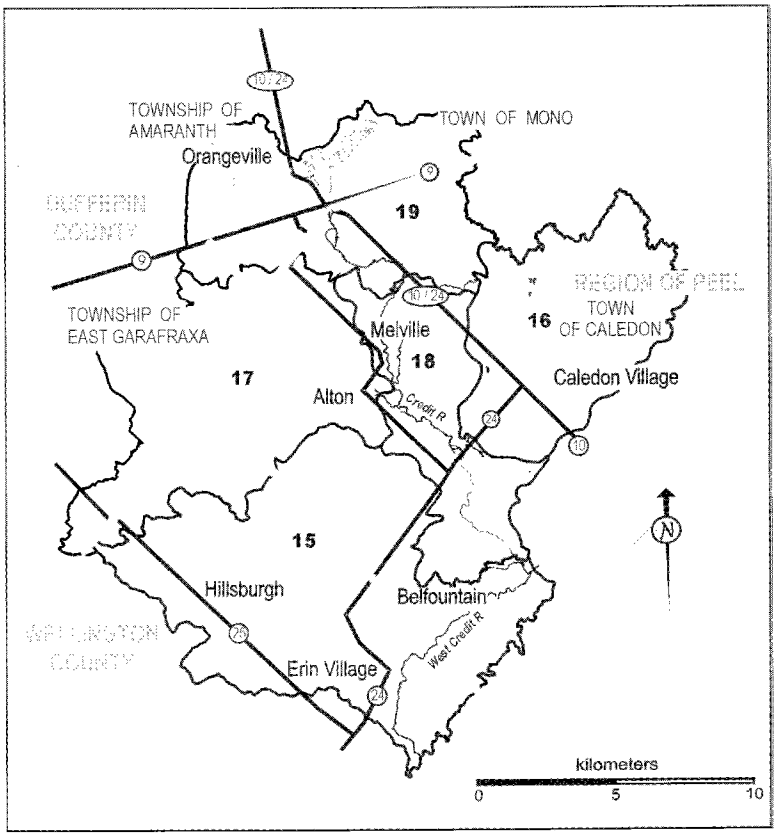

Figure 3. Upper Credit River Watershed.

as defined in the Ontario drought guidelines. The upper Credit River watershed did not experience drought conditions and therefore did not establish a water response team during the study period.

RESULTS AND DISCUSSION: DROUGHT CONTINGENCY PLANNING AND IMPLEMENTATION AT THE WATERSHED LEVEL

Using the capacity dimensions and indicators in Table 1, we present an evaluation of the capacity of the study watersheds to conduct drought contingency planning.

Community and Citizen Participation—Tools and Approaches

Evaluating citizen participation mechanisms provided an indication of the level of community involvement. Contributing to the measurement of this capacity

building indicator is the identification of pertinent interest groups in the watershed, solicitation of community priorities and concerns through public meetings and open houses, regular public reviews of plan documents, and the means used by the agency or organization to educate the public (Blahana and Yonts–Shepard, 1989; Born and Sonzogni, 1995; Margerum and Born, 1995; Griffin, 1999). As illustrated in Table 3, it was found that both watersheds have the necessary measures and procedures in place to effectively solicit and communicate with agencies, organizations and citizens. Conservation authorities and municipalities were the primary agencies involved in the promotion and facilitation of citizen involvement via education programs and open houses, with non–government organizations playing a supporting role.

Table 3. Community and Citizen Participation: Tools and Approaches.

Indicator	Big Creek Watershed	Upper Credit River Watershed
Strategy for conflict resolution	✓	✓
Conflict management personnel	✓	
Conflict management training		
Community awareness regarding drought and water allocation	✓✓	✓
Opportunities for agencies, organizations and citizens to identify water conservation and drought concerns	✓✓	✓
Establishment of public education programs pertaining to drought response		
Development of an education strategy and materials for drought response and water allocation issues	✓	✓
Implementation of drought response and water conservation education programs	✓✓	✓
Ongoing public consultation	✓	✓

✓ = indication of capacity ✓✓ = very strong indication of capacity.

The Long Point Region Conservation Authority (LPRCA) has jurisdiction over the Big Creek watershed. In 2000, as part of the water management activities in the watershed, the LPRCA and associated consultants initiated a water basin management study and a water budget study for the Big Creek watershed. Citizen involvement has been a large component of this study. The public has been provided with the study findings through newspaper articles, advertisements at public centres and quarterly public meetings (Gamsby and Mannerow, 2000; Oliver, 2002). Government agency and non–government organizations are also included in these studies as part of a steering committee set up for these projects, thereby promoting a two–way communication process and representation of various interests in the watershed (Gamsby and Mannerow Ltd., 2000). In addition, the LPRCA keeps the public informed about water quantity conditions through its Water Level Bulletin, which is available on its website or at the LPRCA office (Oliver, 2001; <http://www.lprca.on.ca/>).

Another resource for informing and educating the public was produced by the Norfolk Field Naturalists (2002). This publication explains the impacts of drought conditions, highlights the programs in the watershed that help to mitigate the impacts of drought, and provides contact information for each program. This publication is sent to all members of the Ontario Federation of Agriculture in Norfolk County and is available on the Norfolk Field Naturalists' website (Reid, 2001; <http://www.kwic.com/nfn/index.htm>).

Numerous mechanisms exist at the county level to keep the public informed about water resources issues. For example, Norfolk County makes a water conservation pamphlet available in its office (D'Hondt, 2002). Oxford County, which represents only a small portion of the watershed, hosts an annual Children's Groundwater Festival. In 2001, approximately 3,200 grade school children from Oxford County participated in 46 interactive water activities focusing on water conservation, water protection, water technology and water ecology (Oxford County, 2001). An on–line geographic information system, the "Groundwater Navigator", has also been created by Oxford County to provide the public with water–related data (<http://lris.county.oxford.on.ca/maps/groundwater/>). Public consultation was a major component of Oxford County's Groundwater Protection Study (Golder Associates, 2001). Serving as the "foundation for community education and awareness programs", the public consultation portion of the study consisted of a telephone survey, a household survey, focus group sessions and an internet questionnaire to solicit public opinion pertaining to water protection and conservation in Oxford County. Additional educational programs and materials in Norfolk County, the major part of the watershed, would increase the capacity of the watershed community to educate its citizens.

Non–government organizations in the Big Creek watershed also involve the public. At the provincial level, Ducks Unlimited is developing a public conservation program to protect and restore wetland habitats. Under this program, landowners receive incentives to ensure the sustainable use of their land by encouraging the

adoption of conservation farming, land development and forestry practices (Ducks Unlimited, ND). Locally, Ducks Unlimited hosted the Soil and Water Improvement Program for the Environment (SWIPE) workshop in December 2001. More than 25 farmers heard eight speakers from the conservation community discuss the various programs and projects offered in the watershed (McLachlin, 2002). Ducks Unlimited has also signed a long–term agreement with the Vanden Bussche Irrigation Learning Centre, located in Delhi Township, to help teach farmers and other landowners about water conservation and management. In 2001, over a three–day period 600 farmers attended the first annual open house and education event. Ducks Unlimited hopes to include topics such as water quality, wetlands and surface water conservation and management as part of the educational topics at the Irrigation Learning Centre (McLachlin, 2002).

The upper Credit River watershed falls within the jurisdiction of Credit Valley Conservation (CVC). To highlight water quantity management and concerns, the CVC hosted a Water Users' Workshop in 1999. All known holders of Permits to Take Water were invited to participate and approximately 30 permit holders attended, with representation from all sectors except for the bottled water industry (Barron, 1999). The CVC also maintains a watershed information centre, which contains information about the watershed, stewardship and restoration issues which can be accessed via phone, fax, email or in person at the CVC office (CVC, 1996; 2000). In addition, public meetings are common practice during the preparation of watershed and subwatershed plans, allowing water managers to respond to public concerns (Beak Consultants, Ltd. *et al.,* 1992; Aquafor Beech Ltd. *et al.,* 1997; CVC, 1997; CVC *et al.* 1997).

Municipal efforts to involve and educate the public in water quantity management are noteworthy in the upper Credit River watershed. The Regional Municipality of Peel, has incorporated public participation into its Official Plan by recognizing the importance of public input in the decision–making process (Regional Municipality of Peel, 2001) providing opportunities for the public to comment on new or existing policies or programs. There also are provisions for the investigation of more effective ways to consult with the public on planning matters (Regional Municipality of Peel, 2001). Like Oxford County, the Region of Peel also hosts an annual Children's Water Festival, designed to give students a practical learning experience about water issues in the environment, water quality, distribution, conservation and usage (Regional Municipality of Peel, 2002). It is anticipated that the Festival will attract approximately 5,000 grade school students in 2002 and a public day event is also planned for the 2002 Peel Children's Water Festival, to heighten awareness about water conservation (Regional Municipality of Peel, 2002).

The Town of Erin (Figure 3) has launched a citizen involvement campaign related to its *Groundwater Management and Protection Study,* a collaborative effort with the *West Credit Subwatershed Study* (Town of Erin, 2000). Public interest in the study has been high with attendance numbers at public meetings greater than the staff had anticipated (Hass, 2001). Thus, groundwater management efforts in the

Town of Erin show evidence of a two–way communication process with the public involved in decision–making. The Town of Orangeville has initiated a *WaterCare* program and associated pamphlet which is distributed to households and contains information about the source of Orangeville's water supply (groundwater), By–law No. 22–99, which regulates lawn and garden watering, and tips for lawn and garden watering (Town of Orangeville, ND).

Non–government organizations also contribute to citizen participation and education in the upper Credit River watershed. The Greg Clark Chapter of Trout Unlimited is very active, and part of its purpose is to educate the public about the importance of conservation and wise use of coldwater resources, fish species and habitat. Ontario Streams, another non–government organization that is currently active in the watershed, builds public awareness about stream health and rehabilitation through stream stewardship activities.

Although educational materials are promoted by agencies and organizations in the watershed, the Children's Groundwater Festival is the main mechanism for educating the public. Thus, agencies and organizations in the upper Credit River watershed may benefit from hosting additional water conservation education programs.

Agencies and organizations in both the Big Creek and the upper Credit River watersheds have the mechanisms in place to inform the public about water conservation and water quantity issues. However, because of the water conservation projects and programs developed in the Big Creek watershed, agencies, organizations and citizens have more opportunities to identify water conservation and drought concerns (Table 3). Similarly, due to the creation and implementation of a WRT in 2001, the Big Creek watershed has been more successful in terms of implementing a community–wide response to drought. The Big Creek watershed WRT was created without first measuring the watershed's capacity to develop a drought response. However, the WRT was successful because the watershed had already established a strong foundation for addressing low water concerns through its numerous water conservation programs. Table 3 also illustrates that the Big Creek watershed has developed an education strategy for drought response and water allocation issues similar to those in the upper Credit River watershed. Both communities have the capacity to involve and educate citizens about low water or drought conditions, which is a necessary component of an integrated, collaborative drought response under the Ontario drought guidelines, and in the capacity building indicators for this work.

The presence of conflict management mechanisms was also evaluated based on the identification and use of conflict resolution processes in official documents and through interviews with provincial, municipal and conservation authority staff. Municipal governments and the conservation authorities in both watersheds indicated that they have received complaints regarding low water levels. However, they do not have staff trained in conflict management. For example, staff members do not attend workshops or conferences that deal specifically with conflict management. In most cases, these local agencies refer such complaints to the OMOE because, under the

Ontario Water Resources Act, the OMOE has the authority to manage and resolve conflicts. Both watersheds have a strategy in place to resolve potential water–related conflicts (Table 3). However, since the watersheds rely on outside help from the province, neither watershed has trained agency staff to manage conflicts.

The Big Creek watershed has a volunteer group, the Irrigation Advisory Committee, formed to manage water takings on the North and South Creek tributaries of Big Creek. This group of farmers manages water takings to reduce conflict during low water supply and has been successful in doing so (Reid, 2001). Therefore, as indicated in Table 3, the Big Creek watershed is moving toward increasing its capacity to manage water quantity conflicts. Unlike the Big Creek watershed, the upper Credit River watershed does not have a volunteer group in place to deal with water–taking conflicts.

Under the broad capacity building dimension of community and citizen participation, the upper Credit River and Big Creek watersheds have the capacity to involve and educate the public on an ongoing basis about drought and water conservation. What makes the Big Creek watershed superior in some areas is its attention to water allocation and conservation programs throughout the watershed, involving all levels of government and non–government organizations. These programs were developed due to the ongoing water shortages and subsequent demand during dry periods.

Community Structure and Arrangements—Roles and Responsibilities

Evaluating the way in which agencies and organizations are structured, and the way in which they communicate, indicates their ability to share information and collaborate on drought contingency planning. For example, agencies and organizations in the watershed have strong vertical linkages when internal communications flow in multiple directions (USAID, 2000). Also, in light of the partnership focus of this capacity building indicator, an agency or organization has strong horizontal linkages if it has a well developed network of strategic partnerships with other organizations within and outside of the watershed community. The evaluation results indicate that the Big Creek watershed has greater capacity in this dimension (Table 4). This is a result of the numerous water quantity projects that have been initiated and implemented by non–government organizations, the LPRCA, and provincial agencies, through input and financial assistance.

Table 4. Community Structure and Arrangements—Roles and Responsibilities.

Indicator	Big Creek Watershed	Upper Credit River Watershed
Identification of special interest groups in the watershed with an interest in drought response	✓	✓
Coordination of public information programs pertaining to drought response	✓	
Horizontal linkages (local agency and organization links with other communities and groups)	✓	✓
Vertical linkages (local agency links with senior government)	✓✓	
Opportunities for agencies, organizations and citizens to participate in water conservation and drought management activities	✓	✓

✓ = indication of capacity ✓✓ = very strong indication of capacity

There are at least seven water quantity–related projects formally established in the Big Creek watershed. These projects include the Norfolk Water Supply Enhancement Project (NWSEP), which has provincial, municipal, conservation authority and non–government organization support. This project aims to help farmers improve water conservation, lessen pressure on local streams and creeks and improve storage of water for dry–season use (NWSEP, 2001). The Irrigation Advisory Committee, separate from the NWSEP, is a local farmer initiative formed under the Norfolk Federation of Agriculture whereby farmers monitor and self–regulate water takings from streams (Reid, 2001; Norfolk Field Naturalists, 2002). The Wetland Drain Restoration Project has numerous partners, and uses drains from agricultural fields as retention and absorption areas for water (Norfolk Field Naturalists, 2002). It is common for agency and organization representatives to be involved with more than one of these projects, thereby facilitating the sharing of information and resources. The success of these projects in the Big Creek watershed indicates that this watershed community has the capacity to communicate effectively and form partnerships among government agencies and non–government organizations, thereby strengthening horizontal and vertical linkages in the watershed.

During the summer of 2001, the LPRCA initiated a water response team (WRT) under *Ontario Low Water Response* (OMNR *et al.*, 2001). The membership, which

consisted of the Steering Committee for the Big Creek Water Basin Management Study, included representation from provincial ministries, municipalities, LPRCA, agricultural interest groups, and environmental and angling groups. In terms of the roles, responsibilities and response framework outlined in the provincial drought guidelines, the WRT accomplished its tasks as it moved from a Level I drought to a Level II advisory. However, the WRT was not sure of the protocol if faced with a Level III drought due to the lack of authority assigned to the WRT. Thus, in the event of a Level III drought, the OMOE would have had to intervene and fine those individuals who did not comply with any assigned water restrictions (Oliver, 2001). This is a critical issue when evaluating the capacity to conduct drought contingency planning because a watershed may have the capacity to implement the provincial drought guidelines, but when the WRT lacks the authority to implement the guidelines, it may withdraw from the response process due to confused issues pertaining to protocol (Oliver, 2001). This finding suggests that in order to maintain strong vertical linkages between senior government and watershed communities, senior government should clearly define roles and responsibilities for a Level III drought. In addition, senior government agencies should establish effective communication patterns to enhance this indicator of capacity.

Credit Valley Conservation has also collaborated with numerous partners including government ministries, municipalities, other conservation authorities, universities, non–government organizations and citizens (CVC, 1996; 2000). For example, CVC (2000) boasts that "Community groups and volunteers play a vital role in helping us to reach our goals. In the past three years [1997–2000] more than 30 groups have worked with us. More than 2,140 individuals have donated 13,700 hours of volunteer time." Trout Unlimited, the Izzak Walton Fly Fishing Club and the Dufferin Northern Field Anglers and Hunters, for example, have all indicated that they have worked collaboratively with the CVC on various stream and river rehabilitation projects (Clarence, 2001; Kuehnbaum, 2001; Warrien, 2001). The Upper Credit River Rehabilitation Initiative is an example of a partnership between agencies and organizations in the upper Credit River watershed to improve water quality and water flow in the upper reaches of the Credit River. This initiative, ongoing since 1999, is a collaborative effort between the Greg Clark Chapter of Trout Unlimited Canada, the Izaak Walton Flyfishing Club, Ontario Streams, the Upper Credit Trout Club, Credit Valley Conservation Authority and the Ontario Ministry of Natural Resources.

Provincial ministry and municipal collaboration is also a key component of watershed and subwatershed planning. The Regional Municipality of Peel has indicated its interest in collaborating with other levels of government and conservation authorities in its Official Plan. For example, the Official Plan states that it is the policy of Regional Council to "promote and participate in watershed plans and subwatershed plans within Peel Region" (Regional Municipality of Peel, 2001). Similarly, the Town of Caledon has acknowledged the importance of forming partnerships with agencies and organizations to coordinate environmental policies and programs (Town of Caledon, 2000). Partnerships and collaboration are evident in the upper Credit River watershed as illustrated in the formation of steering

committees for each watershed and subwatershed project (Beak Consultants, Ltd. *et al.*, 1992; Aquafor Beech Ltd. *et al.*, 1997; CVC, 1997; CVC *et al.*, 1997). As part of its water budget study, CVC has collaborated with the Grand River Conservation Authority, evidence of its ability to form horizontal linkages with other agencies (CVC, ND).

As indicated in Table 4, agencies and organizations in the Big Creek and the upper Credit River watersheds have the horizontal linkages in place to collaborate with other communities and groups on water quantity projects. As illustrated by the numerous projects in the Big Creek and the upper Credit River watersheds, there are already established partnerships for water–related projects. Although agencies in the upper Credit River watershed have shown that they have the ability to form partnerships in the upper Credit River watershed, the nature of the programs does not relate directly to low water or drought preparedness and management as shown in Table 4.

The identification of special interest groups or non–government organization involvement in the watersheds indicates that responsibility and decision–making fosters a bottom–up approach, which is a key aspect of integrated water management (Table 4). The creation of a WRT in the Big Creek watershed also indicates that this watershed community has the capacity to share information and resources in the event of a drought while allowing for organizations and citizens to participate in water conservation and drought management activities. However, support for drought response and collaboration may be compromised at a Level III drought when the Ministry of the Environment is required to monitor and regulate Permits to Take Water, which hinders vertical linkages with the provincial government. Except for Level III droughts, the OMOE's role on the WRT is only an advisory one and the power of the WRT disappears when the watershed enters a Level III drought. This has been highlighted as a major problem by WRTs in the province because of the confusion between roles and responsibilities during a Level III drought (OMNR, 2001).

Under the broad capacity building dimension of community structure and arrangements—roles and responsibilities, the case study watersheds have adequate horizontal and vertical linkages. Clearly established linkages between communities and upper–tier government can help the watershed community obtain resources, information and financial assistance. While the Big Creek watershed has generated more support for and participation in drought response, the upper Credit watershed has, to a lesser extent, mandated and formed partnerships for water quantity projects. However, once a watershed reaches a Level III drought under the Ontario drought guidelines, it has to rely on the OMOE to regulate water takings. This procedure restricts the ability of a WRT to manage drought actions, thereby hindering an integrated or collaborative approach to drought planning because under the existing Ontario drought guidelines information flows in only one direction at a Level III drought condition.

Community Structure and Arrangements—Resources

A drought contingency plan is a useful document only if the agency has well–trained staff and community support to implement the plan objectives. The human resources capacity indicator was evaluated based on the quality and quantity of staff and citizen support the agency or organization has to conduct drought contingency planning. If the agency or organization has a plan in place but no money to implement the plan, the practical value of the plan is minimal. This indicator was evaluated based on financial support that both the agencies and organizations in the watershed contribute to plan development and implementation.

The evaluation of human resources indicated that both watersheds have trained staff at the provincial, municipal and conservation authority levels. Interviews indicated that background education and training are appropriate for the positions held. The number of trained staff in water–related employment at the local government level averaged from two to five. In addition, it was determined through interviews with non–government organizations that there is a strong contingent of non–government organization interest and support for drought contingency planning in both watersheds. This was confirmed based on the number of water project partnerships and volunteer support in the watersheds.

Local support for drought contingency planning is especially evident in the Big Creek watershed, since stakeholders in this area have already formed and implemented a WRT. Non–government membership in the WRT included representatives from Ontario Flue–Cured Tobacco Marketing Board, Norfolk Federation of Agriculture, Delhi District Anglers Association for example. Several non–government organizations in the upper Credit River watershed participated in a workshop on understanding low water conditions in the watershed as well as the provincial drought guidelines. Attendees from non–government organizations included Trout Unlimited, Concerned Citizens Coalition and the Upper Credit Field Naturalists (Ivey *et al.*, 2001).

In terms of financial resources, the upper Credit River watershed has access to more financial resources for drought contingency planning than the Big Creek watershed because the Regional Municipality of Peel falls within the boundaries of the former watershed, and the regional government has a substantial operating budget compared to county level governments in the Big Creek watershed. Table 5 provides only a relative indication of the financial resources of the two watersheds, because the budgets of the local organizations vary somewhat from year–to–year.

The upper Credit River watershed also obtains funds for water resources projects from the Credit Valley Conservation Authority, which had an annual revenue of $3,102,600 in 1999 (CVC, 2000); approximately $333,500 derived from government grants, and $1,929,000 from municipal levees in the Credit River watershed. The Big Creek watershed does not have a regional government within its boundaries, and draws most of its financial resources from Norfolk County. The Big Creek watershed also obtains revenue for water resources projects from the Long Point Region Conservation Authority, which had a total annual revenue

of $2,086,000 in 2000 (LPRCA, 2000); $161,260 from government grants, and $440,420 from municipal levees for the Long Point Region watershed.

Table 5. Annual budgets of municipalities and conservation authorities in the study areas.

	Big Creek Watershed	Upper Credit River Watershed
Regional Municipality	—	$471,051,000[1]
County Government	$152,993,000[2]	$55,038,000[3]
Local (Township) Government	$9,772,000[4]	$38,149,000[5]
Conservation Authority	$2,086,034[6]	$3,102,593[7]

[1] Includes the Regional Municipality of Peel (1997 data).
[2] Includes the former County of Haldimand–Norfolk, County of Oxford and County of Brant (1997 data).
[3] Includes Wellington and Dufferin Counties (1997 data).
[4] Includes Norfolk Township and Delhi Township (1997 data).
[5] Includes the Town of Caledon, Town of Orangeville and the recently amalgamated Erin Township and Village of Erin (1997 data).
[6] 2000 annual financial data.
[7] 1999 annual financial data.

Local non–government organizations in each watershed indicated that they do not have the financial resources to contribute to drought contingency planning. Non–government organizations mainly generate revenue from membership fees and fundraising events to support projects and other events sponsored by the organizations. However, local groups have indicated that they can provide "in–kind" contributions such as volunteer members to participate in WRT activities.

Under the broad capacity building dimension, community structure and arrangements—resources, each watershed has the ability to attract human and financial resources to conduct drought contingency planning. Based on the evaluation of annual reports and focused interviews, both watersheds have the capacity and willingness to contribute human and financial resources for drought contingency planning. In addition to the potential funds available from its respective regional, county and local governments, each watershed may obtain additional funds from the provincial government once a WRT has been formed.

CONCLUSION

Drought does occur in Ontario. In response to recent drought episodes, the provincial government established a set of guidelines which assume a local or watershed drought response framework. These guidelines promote a coordinated approach among provincial ministries, conservation authorities, municipalities and non–government organizations in the form of a water response team with the conservation authority as the lead agency. However, the capacity of agencies and organizations to respond to drought and educate and communicate with the public in the watershed has not been evaluated. This research evaluated these aspects of capacity in the Big Creek and upper Credit River watersheds to determine if the respective watershed communities have the capacity to conduct drought contingency planning.

It was concluded that the two watershed communities have the capacity to create and implement a drought contingency plan which fosters integration and collaboration. Based on our research, a coordinated or partnership approach to drought contingency planning on a watershed scale is possible due to the numerous horizontal and vertical linkages and established partnerships in the watersheds. Many of the water resources projects in each watershed are already being completed in cooperation with regional governments, municipalities and conservation authorities. Evidence also suggests that non–government organizations have participated in many projects and processes in the study watersheds, and will continue to provide "in kind" contributions to drought contingency planning efforts. This finding suggests that for watersheds to successfully conduct drought contingency planning, adequate linkages and partnerships among senior and local governments and non–government organizations are required.

Partnerships, linkages and the necessary human and financial resources are fundamental to a watershed's capacity to conduct drought contingency planning. However, a watershed community requires capacity in each of these areas in order to successfully create and implement a drought contingency plan. For example, even though the upper Credit River watershed has access to more financial resources than the Big Creek watershed, overall the Big Creek watershed is in a better position to respond to drought conditions because of its numerous linkages and partnerships. Funding, resources and volunteer support for drought planning are obtained from the province, three county governments, one town government, numerous non–government organizations and the conservation authority.

Ways of keeping the public informed at all stages of a drought, and the ability to resolve conflicts between water users are also necessary components of the watershed community's capacity to respond to drought. Both watersheds showed evidence of their capacity to keep the public informed. However, the upper Credit River watershed lacked dispute resolution mechanisms and staff trained in conflict management. Both watersheds relied on provincial ministries to resolve conflicts, mainly because they lacked the authority and power to do so under the *Ontario Water Resources Act*. Thus, our research indicated that watershed communities often require assistance from the provincial government with the exception of the locally–based efforts of the Irrigation Advisory Committee in the Big Creek watershed.

In terms of the capacity focus of this research, the provincial drought guidelines foster a sense of local ownership for drought response. Conflicting roles and responsibilities between provincial agency staff and the members of the WRT can hinder an effective drought response at the local level during a Level III drought. Ontario watershed communities need to establish roles and responsibilities in the watershed prior to the formation of a WRT, or the drought response effort may be ineffective and experience conflict over roles and responsibilities.

In light of these research findings, it appears that the study watershed communities have the capacity to conduct drought contingency planning. Key elements of a successful drought response include multi–community, interagency, interdepartmental ties and partnerships, the mechanisms to educate and consult with the public and access to trained staff and financial resources. Unfortunately, these may not be universally available in Ontario so there is concern for communities in other less capable watersheds.

ACKNOWLEDGEMENTS

This research was funded by the Ontario Ministry of Agriculture, Food and Rural Affairs through its research program at the University of Guelph, and by the Social Sciences and Humanities Research Council. The authors gratefully acknowledge the support received from the officials and members of the Big Creek watershed and upper Credit River watershed.

REFERENCES

Aquafor Beech Ltd., Terraqua Investigations Ltd., Beak International Inc., Triton Engineering Services Ltd. and Walker, Nott, Dragicevic Associates Ltd. 1997. *Environmental Planning for the Credit River Headwaters Subwatershed No. 19.* Technical Document. Reference Number 6516.30.

Barron, V. 1999. *Water Report Update.* Report to the Chairman and Members of the Board of Directors of Credit Valley Conservation. Credit Valley Conservation, Meadowvale, Ontario.

Beak Consultants Ltd., Aquafor Engineering Ltd., and Donald G. Weatherbe Associates Inc. 1992. *Credit River Water Management Strategy—Phase II.* Prepared for Credit Valley Conservation Authority.

Beak International Inc. 2001. *A Review of Watershed Experience.* Prepared for the Executive Resource Group, Brampton, ON.

Blahana, D.J. and S. Yonts–Shepard. 1989. "Involvement in Resource Planning: Toward Bridging the Gap between Policy and Implementation." *Society and Natural Resources,* 2(3): 209–227.

Born S.M. and W.C. Sonzogni. 1995. "Integrated Environmental Management: Strengthening the Conceptualization." *Environmental Management,* 19(2): 167–181.

Carlisle, T.J. and L.G. Smith. 1989. "Examining the Potential for a Negotiated Approach to Water Management in Ontario: The Fanshawe Reservoir Enlargement Project." *Canadian Water Resources Journal,* 14(4): 16–34.

Clarence, B. 2001. Dufferin Northern Peel Anglers and Hunters. Personal Communication. Orangeville, ON. July 14, 2001.

Cohoum, J. 1999. "Integrated Watershed Management on the Truckee River in Nevada." *Journal American Water Resources Association,* 35(3): 623–632.

Credit Valley Conservation. No Date. *Developing a Framework for Sustainable Water Management on a Watershed Basis.* Credit Valley Conservation, Meadowvale, ON.

Credit Valley Conservation Authority, Environmental Water Resources Group, Ortech Corporation, Terraqua Investigations Ltd., and Water Systems Analysts. 1997. *Caledon Creek and Credit River Subwatershed Study—Characterization Report.* Draft. Prepared for the Region of Peel and the Town of Caledon.

Credit Valley Conservation Authority. 1997. *West Credit Subwatershed Study—Draft Phase I Report.* Meadowvale, ON: Credit Valley Conservation Authority.

Credit Valley Conservation Authority. 1999. *Financial Statements of Credit Valley Conservation Authority.* Meadowvale, ON: Credit Valley Conservation Authority.

Credit Valley Conservation. 1996. *Facing Change: A Business Plan for Watershed Management.* Credit Valley Conservation, Meadowvale, ON.

Credit Valley Conservation. 2000. *Sustainable Water Management. Credit Valley Conservation,* Meadowvale, ON.

de Loë, R., S. Di Giantomasso and R. Kreutzwiser. 2002. "Local Capacity for Groundwater Protection in Ontario." *Environmental Management,* 29: 217–233.

d' Hondt, E. 2002. County of Norfolk. Personal Communication. Guelph, Ontario. February 22, 2002.

Dorcey, A.H.J. 1997. "Collaborating Towards Sustainability Together: The Fraser Basin Management Board and Program." In *Practicing Sustainable Water Management: Canadian and International Experiences.* D. Shrubsole and B. Mitchell (Eds), 167–199, Canadian Water Resources Association, Cambridge, ON.

Ducks Unlimited Canada. No Date. *A Conservation Vision for the Future: Ontario's Changing Landscapes.* Pamphlet, Ducks Unlimited, Ontario, Canada.

Dugan, S. 1993. "Reflections on Helping I: Sustainable Development, Capacity Building and Participation." *International Journal of Public Administration,* 16 (11): 1705–1713.

Franks, T. 1999. "Capacity Building and Institutional Development: Reflections on Water." *Public Administration and Development,* 19: 51–61.

Fredericksen, P.J. and N.P. Lovrich. 2001. "Sustaining Community Through Collaboration: The Value of Conflict Management Training for Community Leaders." In *Creating Sustainable Community Programs: Examples of Collaborative Public Administration.* M.R. Daniels (Ed), 58–71, Prager, Westport, CT.

Gabriel, A.O. and R.D. Kreutzwiser. 1993. "Drought Hazard in Ontario: A Review of Impacts, 1960–1989, and Management Implications." *Canadian Water Resources Journal,* 18 (2): 117–132.

Gamsby and Mannerow Ltd. 2000. *Proposal to Undertake a Water Basin Management Study for the Long Point Region Conservation Authority, Big Creek Watershed.* Gamsby and Mannerow, Guelph, ON.

Gamsby and Mannerow Ltd., Applegate Groundwater Consultants, Waterloo Hydrogeologic Inc. and Harold Schroeter and Associates. 2002. *Big Creek Basin Water Budget Study.* Draft. Prepared for Long Point Region Conservation Authority.

Gates, C. 1999. "Community Governance." *Futures,* 31: 519–525.

Golder Associates. 2001. *County of Oxford Groundwater Protection Study, Phase II.* Prepared for Oxford County.

Griffin, C.B. 1999. "Watershed Councils: An Emerging Form of Public Participation in Natural Resource Management." *Journal of the American Water Resources Association,* 35 (3): 505–518.

Grindle, M.S. and M.E. Hilderbrand. 1995. "Building Sustainable Capacity in the Public Sector: What can be Done?" *Public Administration and Development,* 15: 441–463.

Hass, Lisa. 2001. Town Manager, Town of Erin, Personal Communication. August 27, 2001.

Ivey, J., J. Smithers, R. deLoë and R. Kreutzwiser. 2001. *Strengthening Rural Community Capacity for Adaptation to Low Water Levels.* Rural Water Management Group, Department of Geography, University of Guelph, ON.

Ivey, J. 2000. *Evaluating the Groundwater Management Capacity of Conservation Authorities.* Unpublished M.A. Thesis, Department of Geography, University of Guelph, Guelph, ON.

Knutson, C., M. Hayes and T. Phillips. 1998. *How to Reduce Drought Risk.* Preparedness and Mitigation Working Group, Western Drought Coordination Council. National Drought Mitigation Centre, NE.

Kreutzwiser, R. 1998. "Water Resources Management: The Changing Landscape in Ontario." In *Coping with the World Around Us: Changing Approaches to Land Use, Resources and Environment.* R.D. Needham (Ed), 135–148, Department of Geography Publication Series, No. 50, University of Waterloo, Department of Geography, ON.

Kuehnbaum, B. 2001. Izzak Wlaton Fly Fishing Club. Personal Communication. Meadowvale, ON. August 27, 2001.

Litke, S. and J.C. Day. 1998. "Building Local Capacity for Stewardship and Sustainability: The Role of Community–Based Watershed Management in Chilliwack, British Columbia." *Environments,* 25(2–3): 91–109.

Long Point Region Conservation Authority. 2000. *2000 Annual Report.* Long Point Region Conservation Authority, Simcoe, ON.

Long Point Region Conservation Authority. 2002. *Long Point Region Conservation Authority Homepage.* < http://www.lprca.on.ca/>. Date Visited: 20–06–02.

Margerum, R.D. and S.M. Born. 1995. "Integrated Environmental Management: Moving from Theory to Practice." *Journal of Environmental Planning and Management,* 38(3): 371–391.

McCulloch, P. and P. Muldoon. 1999. *A Sustainable Water Strategy for Ontario.* Canadian Environmental Law Association, The Environmental Agenda for Ontario Project, Toronto, ON.

McGuire, M., B. Rubin, R. Agranoff and C. Richards. 1994. "Building Development Capacity in Nonmetropolitan Communities." *Public Administration Review,* 54(5): 426–433.

McLaughlin, D. *Conservation Programs Leader.* Ducks Unlimited Canada, Ontario. Guelph, ON. February 7, 2002.

Michaels, S. 2001. "Making Collaborative Watershed Management Work: The Confluence of State and Regional Initiatives." *Environmental Management,* 27(1): 27–35.

Mitchell, B. and D. Shrubsole. 1994. *Canadian Water Management: Visions for Sustainability.* Canadian Water Resources Association, Cambridge, ON.

Murray, M. and L. Dunn. 1995. "Capacity Building for Rural Development in the United States." *Journal of Rural Studies,* 11(1): 89–97.

Norfolk Field Naturalists. 2002. Water—Every Drop Has Many Uses. Norfolk Field Naturalists, Simcoe, ON.

Norfolk Field Naturalists. 2002. *Norfolk Field Naturalists Homepage.* <http://www.kwic.com/nfn/index.htm>. Date Visited: 20–06–02.

Norfolk Water Supply Enhancement Project. 2001. *Guidelines for the Water Supply Enhancement Project.* NWSEP, Simcoe, ON.

O'Connor, D.R. 2002. *Report of the Walkerton Inquiry: Part Two, A Strategy for Safe Drinking Water.* Ontario Ministry of the Attorney General, Queen's Printer for Ontario, Toronto, ON.

Oliver, J. 2001. Director, Long Point Region Conservation Authority. Personal Communication. Simcoe, ON. August 7, 2001.

Oliver, J. 2002. Director, Long Point Region Conservation Authority. Personal Communication. Simcoe, ON. April 22, 2002.

Oliver, J. 2001. "Experiences—Local Water Response Team Overviews." Presented at the Ontario Low Water Response—2001 Debriefing, Grand River Conservation Authority, Cambridge, ON, November 22, 2001.

Ontario Ministry of the Environment. 2000. *In Brief: Review Process for Permits to Take Water.* Queen's Printer for Ontario, ON.

Ontario Ministry of Environment and Energy and Ontario Ministry of Natural Resources. 1993. *Subwatershed Planning.* Queen's Printer for Ontario, ON.

Ontario Ministry of Natural Resources. 2001. *Ontario Low Water Response (2001) Debriefing Summary.* Ministry of Natural Resources Water Resources Section, Peterborough, ON.

Ontario Ministry of Natural Resources, Ontario Ministry of the Environment, Ontario Ministry of Agriculture, Food and Rural Affairs, Ontario Ministry of Municipal Affairs and Housing, Ontario Ministry of Economic Development and Trade, Association of Municipalities of Ontario, Conservation Ontario. 2001. *Ontario Low Water Response.* Queen's Printer for Ontario, ON.

Oxford County. 2001. *Oxford Children's Groundwater Festival, May 28—June 1, 2001.* Pamphlet. Oxford County, ON.

Oxford Country. 2002. *County of Oxford, Where Communities Connect.* <http://www.county.oxford.on.ca/>. Date Visited: 20–06–02.

Regional Municipality of Peel. 2001. *Official Plan, Office Consolidation.* Planning Department, Region of Peel, Brampton, ON.

Regional Municipality of Peel. 2002. *5,000 Students Expected at Seventh Annual Peel Children's Water Festival.* News Release. Region of Peel, Brampton, ON.

Reid, D. 2001. Stewardship Coordinator, Norfolk Land Stewardship Council. Personal Communication. Simcoe, ON. July 10, 2001.

Rich, R.C., M. Edelstein, W.K. Hallman and A.H. Wandersman. 1995. "Citizen Participation and Empowerment: The Case of Local Environmental Hazards." *Journal of Community Psychology,* 23: 657–676.

Shepherd, Anne. 1998. "Effectiveness of Plans." *Journal of Water Resources Planning and Management,* Sept/Oct: 246–251.

Shirai, Y. 1990. "Institutional Arrangements for Japanese Water Resources." In *Integrated Water Management,* B. Mitchell (Ed.), 149–171. Belhaven Press, London.

Singer, S.N., C.K. Cheng and M.G. Scafe. 1997. *The Hydrology of Southern Ontario.* Ministry of Environment and Energy, ON.

Town of Caledon. 2000. *Official Plan.* Town of Caledon, ON.

Town of Erin. 2000. *Groundwater Management and Protection Study in Co–operation with the West Credit Subwatershed Study, Notice of Public Open House.* Town of Erin, Erin, ON.

Town of Orangeville. No Date. *WaterCare: A Program to Promote Smart Use of Orangeville's Water Source.* Orangeville, ON.

Town of Orangeville. *A By–law to Regulate the Use of Water for Lawn and Garden Watering Within the Town of Orangeville.* By–law #22–99. The Corporation of the Town of Orangeville.

USAID. 2000. *Measuring Institutional Capacity. Recent Practices in Monitoring and Evaluation TIPS.* No. 15. USAID Centre for Development Information and Evaluation.

U.S. Environmental Protection Agency. 1998. *Information for States on Implementing the Capacity Development Provisions of the Safe Drinking Water Act Amendments of 1996.* United States Environmental Protection Agency, Office of Water.

Walesh, S.G. 1999. "DAD is Out, POP is In." *Journal of the American Water Resources Association,* 35(3): 535–544.

Wallace, M., L.E. Woo and S. Boudreau. 1997. "Involving the Public: Learning from Watershed Planning in Ontario." In *Practicing Sustainable Water Management: Canadian and International Experiences.* D.A. Shrubsole and B. Mitchell (Eds), 115–132. Canadian Water Resources Association, Cambridge, ON.

Walter–Honadle, B. 1986. "Defining and Doing Capacity Building: Perspectives and Experiences." In *Perspectives on Management Capacity Building,* B. Walter Honadle and A.M. Howitt (Eds.), 9–23. State University of New York Press, Albany.

Warrian, M. 2001. Executive Director, Ontario. Trout Unlimited Canada. Personal Communication. Meadowvale, ON. August 27, 2001.

White, D. and L. Karssies. 1999. "Australia's National Drought Policy: Aims, Analyses and Implementation." *Water International,* 24(1): 2–9.

Wilhite, D.A. 1987. "The Role of Government in Planning for Drought: Where do We Go from Here?" In *Planning for Drought—Toward a Reduction of Societal Vulnerability,* D.A. Wilhite, W.E. Easterling and D.A. Wood (Eds.), 425–444. Westview Press, London.

Wilhite, D.A. 1996. "A Methodology for Drought Preparedness." *Natural Hazards,* 13: 229–252.

Wilhite, D.A., M.J. Hayes, C. Knutson and K.H. Smith. 2000. "Planning for Drought: Moving From Crisis to Risk Management." *Journal of the American Water Resources Association,* 36(4): 697–710.

Yin, R.K. 1994. *Case Study Research: Design and Methods.* Sage Publications Inc., London.