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Sustainable Groundwater Allocation in the Great Lakes Basin

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ABSTRACT *Outdated groundwater allocation policies have resulted in unrestrained abstraction of groundwater in the Great Lakes Basin. Continuing on this course will lead to more frequent conflicts and further degradation of the Basin's ecosystem. Alternative approaches must focus on achieving sustainable groundwater allocation. The authors present two alternative institutions, local collaborative planning for groundwater allocation, and a regional watershed board. Collaborative institutions responsible for local groundwater planning should be established according to practical geographical units, have access to sound scientific information, utilize adaptive management and engage in open deliberation. The regional watershed board should establish a comprehensive and unified inventory of all groundwater resources in the Basin, designate critical groundwater areas, monitor groundwater management by respective jurisdictions, and make recommendations on best practices.*

Introduction

Groundwater is an integral component of a dynamic hydrological system that is the lifeblood for the remarkable natural diversity of the Great Lakes region. It is also an increasingly important resource exploited for a wide variety of purposes including drinking water, irrigation and manufacturing processes. Despite the increasing demand for groundwater, there have been no significant changes in groundwater allocation policies in the Basin since 19th century. Unrestrained groundwater withdrawals, encouraged by outdated allocation policies, are placing hidden pressures on the hydrological systems of the Basin. Water tables are declining, streams and wetlands are drying up, well interference incidents are increasing and groundwater divides are shifting (Grannemann *et al.*, 2000; USGS, 2005). These physical effects are resulting in social conflicts, economic costs and environmental degradation.

The failures of contemporary institutional approaches in allocating groundwater resources in the Great Lakes Basin indicate that new approaches should be identified, deliberated and implemented in order to discover an institutional structure that can address the complexity of this critical resource and ensure its long-term protection within the Basin. The aim of this paper is to introduce two such approaches, one which could address

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the local problems of groundwater pumping and the other which could help alleviate regional consequences. Before considering these alternatives, the paper provides illustrations of the groundwater conflicts that are becoming increasingly prevalent in the Basin and the institutional failures that are contributing to these conflicts.

Groundwater Conflicts in the Great Lakes Basin

In the Great Lakes Basin, many of the conflicts arising from groundwater withdrawals are occurring at a local level. For example, in Saginaw, Michigan, groundwater abstractions by farmers are causing domestic wells to dry up (Hoard & Westjohn, 2001) and similar impacts are being felt in Monroe County as a result of quarry dewatering (Nicholas *et al.*, 2001). High-profile conflicts have also erupted between local communities and water bottling companies in Ontario (Hoffman & Mitchell, 1995) and Michigan (*Michigan Citizens et al. v. Nestle Waters,* Mecosta County Cir. Ct. No. 01-14563-CE, 2003). The Michigan dispute served to highlight the detrimental impacts that groundwater pumping can have on local environments. The judge in this case found that groundwater flow was integral to the viability of local streams, wetlands and lakes, and that intensive groundwater pumping would significantly lower the levels of these water bodies, resulting in serious consequences for aquatic and plant species. As well, conflicts between the agricultural and municipal sectors over access to groundwater, which became increasingly common during the previous century, are expected to intensify as the demand for groundwater by both sectors continues to rise (Grannemann *et al.*, 2000).

In addition to local conflicts, large-scale groundwater withdrawals from deeper aquifers are having regional impacts. For example, in 1973, it was estimated that Wisconsin was losing US$1.4 million of accessible water per year to Illinois as a result of groundwater pumping of a deep aquifer in the Chicago region (Fetter, 1981), and despite a US Supreme Court decree requiring Illinois to reduce its groundwater withdrawals (*Wisconsin v. Illinois et al.*, 1980 449 US 48; 101 S. Ct. 557; 66 L. Ed. 2d 253), groundwater levels continue to decline in some parts of the Chicago region (Grannemann *et al.*, 2000). Recent studies have also indicated that groundwater pumping of deep aquifers by communities just outside the Basin is diverting water and potentially affecting the levels of the Great Lakes (USGS, 2005). These impacts raise the possibility of further regional conflicts, and even international disputes over groundwater pumping.

Institutional Failures

Contemporary institutions are failing to deal with the complex problems that surround the increasing demand for groundwater and two institutional failures appear to be particularly prevalent at this time. The first failure is the inability of allocation laws and policies to account for the varied and divergent interests in the use of groundwater. In particular, the interests of the environment, local communities and future generations are systematically undervalued. The second failure is the lack of institutional capacity to account for regional, cross-border impacts of groundwater pumping.

Table 1 shows the number of Basin governments that have asserted control over the allocation of groundwater resources. Noticeably, more than half of the governments within the Great Lakes Basin do not exercise control and are still relying on the common law to determine the rules on which allocation is based. Common law systems are designed for

Table 1. Government control over ground water withdrawals

Jurisdiction	Government control	Applicable legislation/ regulation	Trigger level for control litres (mgd)
Illinois	No		
Indiana	No		
Michigan	No		
Minnesota	Yes	Minnesota Statutes 103G.271	38 000 (10 000)
New York	No		
Ohio	No		
Ontario	Yes	Ontario Water Resources Act, Section 34 (1990)	50 000 (13 000)
Pennsylvania	No		
Québec	Yes	Groundwater Catchment Regulation (2002)	75 000 (19 500)
Wisconsin	Yes	Groundwater Protection Act, Wisconsin Act 310 (2003)	380 000 (100 000)

conflict resolution and are incapable of providing the long-term planning necessary to protect natural resources (Charles & VanderZwaag, 1998). Moreover, courts, which are bound by precedent and generally slow to respond to scientific progress, are still heavily influenced by the 19th century idea that groundwater should be treated as part of the landowner's property (*Acton v. Blundell* (1843) 152 E.R. 1223 Ex Ch.). Consequently, these common law systems continue to give greater weight to traditional private property rights than they give to societal and community concerns.

Experience with government allocation has also proven disappointing. In 1961, Ontario established a centralized permit to take water programme under the Ontario Water Resources Act. Despite having 40 years to perfect the delivery of this programme, the province still issues permits to virtually anyone who asks for one (McCulloch & Muldoon, 1999; ECO, 2001; O'Connor, 2002a; Kreutzwiser *et al.*, 2004). The ineffectiveness of permit programmes in the Basin can be attributed to a more general challenge presented by the political process. Governments tend to be reactive, often responding to environmental problems only after they have reached a state of crisis. Perceiving that citizens are mostly concerned with economic gain and material progress, governing institutions have shown reluctance to invest in properly protecting natural resources from excessive use because this investment produces no obvious short-term material benefit (de Geus, 2001; Eckersley, 2004). As a result, governments tend to give priority to the interests (and the Ministries that represent those interests) that can deliver the most obvious short-term material benefits. In the context of groundwater, this means that industrial or commercial development, agricultural expansion, and strategies for municipal growth have taken priority over environmental and other societal concerns, including those of future generations. The recent 'Big Pipe' controversy in Ontario is a good example of these underlying preferences. A permit to withdraw groundwater was approved for a sewer pipeline project that will service new residential sub-divisions on the outskirts of Toronto. However, the massive withdrawals of groundwater required by the project could have serious detrimental impacts on one of the Basin's most important ecological and

environmentally sensitive areas, the Oak Ridges Moraine, which also happens to be a critical aquifer recharge area (Gorrie, 2004; Swainson, 2004). Consequently, discovering an institutional structure that can empower environmental and community interests and the interests of future generations, which are currently undervalued, is a key to overcoming the institutional failures surrounding groundwater allocation.

The second institutional failure relates to the inability of any of the current institutions to deal with the regional impacts of groundwater pumping, in particular, those impacts that cross one or more political borders. The Basin spans more than 1200 km from west to east and contains parts of two countries and 10 jurisdictions (eight states and two provinces). The groundwater system underlying the Basin is estimated to be more than 4168 km^3 (1000 mi^3) and unfortunately this system does not obey political boundaries (Grannemann, 2000). Each provincial or state jurisdiction has (with some limited exceptions) the constitutional responsibility to allocate the groundwater resources within its own boundaries and each has established its own set of laws on which such allocation is based. However, international agreements, and the creation of legitimate international legal institutions, require the cooperation of the two federal governments. Herein lies the problem. No single state or province has the jurisdiction to require another state or province to adopt allocation laws that prevent cross-boundary groundwater impacts. Two or more US states can seek an agreement between themselves (called an interstate agreement) to address cross-boundary issues but this cannot be binding on the Canadian provinces. Furthermore, although an International Joint Commission has been in existence since the Boundary Waters Treaty of 1909, it currently has no formal powers to address problems relating to groundwater. As the intensity of groundwater pumping with the Basin continues to escalate, it is critical that an international institution is given the mandate to ensure the prevention and resolution of regional-scale conflicts within the Basin.

Institutional Alternatives

The following two alternatives are not the only institutional alternatives that exist and indeed there are many aspects of these two approaches that could be different to the way they are presented here. However, both alternatives are intended to be practical suggestions that have their roots in institutional approaches already in existence in some form in the Basin. The aim of presenting these alternatives is to help stimulate institutional imagination and experimentation so that new institutions can be formulated to more effectively allocate groundwater.

Collaborative Planning for Groundwater Allocation

The first step towards improved decision making for groundwater allocation is for all governments to assert control over groundwater resources, enabling a transfer from private rights (allocated under the common law) to public property (allocated by government). The central thesis of this section is to highlight the possibility of a second step, the vesting of planning authority in a decentralized collaborative institution. The basic goals of this institution would be to establish a detailed understanding of the aquifers in its jurisdiction and to identify priorities of groundwater use. These priorities would be determined through collaborative fact-finding and consensus-building that would involve the various stakeholders in the groundwater resources of that institution's jurisdiction. Critically, the

priorities would be binding on the centralized government. Therefore, rather than establishing its own priorities for groundwater use, the centralized government would only be responsible for providing the necessary administrative support, through government regulation, to give rise to the vision and priorities established by the collaborative plan.

Key components. Collaborative institutions can take many forms and their success is dependent on numerous case-specific factors beyond the scope of this paper. However, in terms of groundwater allocation in the Great Lakes Basin, it is possible to identify four key components upon which the effectiveness of planning for groundwater allocation would depend. These four components are: collaboration, jurisdiction, scientific knowledge and adaptive management.

The collaborative decision-making model envisages the establishment of forums in which various voices of a community have the opportunity to present their views and challenge the views of others (Cohen, 1989). In the case of groundwater, these voices might include (but would not be limited to): environmental groups, citizens, aboriginal leaders, farmers, industry and representatives of municipal and state/provincial governments. If the forum is established appropriately, the parties representing various interests come to the Table with equal standing, are open to change and transformation, and the various representatives are able to educate each other through a process of unconstrained dialogue. This provides a crucial opportunity for representatives of environmental interests to increase the community's collective understanding of its relationship with their natural environment (Connelly & Smith, 2003; Eckersley, 2004). In a recent article, the normative importance of collaboration in water resources management and its potential to more effectively realize our democratic ideals and civic culture have been highlighted (Priscoli, 2004). In an evaluation of various US watershed-based initiatives, Born & Genskow (2000) presented conclusions that appear to support the assertions made by Priscoli (2004). They found that positive outcomes correlated most strongly to two things, first, the participants' increased understanding of complex interconnections between natural systems and socio-economic activities, and second, the resolution of differences through joint fact finding and consensus-building.

The openness of institutions engaged in this form of collaboration has other benefits. It makes them more adaptable to changing circumstances, the importance of which is highlighted below. As well, the increased transparency and accountability derived from stakeholder involvement reduces suspicion exhibited by the public towards centralized decision making and citizens are more likely to adopt a sense of ownership over decisions on which they had input (NRC, 1999). This increases the likelihood of compliance with those decisions, which has been confirmed by Burchi & Nanni (2001), who have studied the experiences of other regions (including Australia and France) utilizing watershed planning for allocation.

In order to account for diverse community interests, collaboration needs to occur at a localized level, but what geographical unit should identify the jurisdictional boundaries of the institution: political or hydrological? An obvious observation of political units is that they are rarely delineated according to hydrological boundaries. This fact complicates the attainment of knowledge with respect to the hydrological relationships within that unit (such as groundwater and surface water or groundwater and wetlands) because the interactions may be occurring outside that unit's jurisdiction. Although a fully integrated approach to water resource management is currently unrealistic, framing water

management institutions according to political boundaries precludes even the possibility of many forms of operational integration. It also means that the consequences of groundwater pumping can go undetected because those consequences are experienced beyond the borders of that political unit. As a result, the costs arising from those consequences (social, economic and environmental) may be unjustly borne by an external political unit.

Two problems will still arise even if the collaborative institution is established according to a local hydrological unit. The first problem relates to scale. Groundwater pumping of deeper regional aquifers can cause impacts on a much larger scale than the locally defined geographical unit, whether it is political or hydrological. This is the reason for the discussion of the second alternative institution below. The second problem relates to the type of hydrological unit. The boundaries (or divides) of watersheds and groundwater catchment areas generally relate to one another (particularly at a local watershed and localized/shallow groundwater level) but they do not always coincide. In particular, groundwater pumping can shift the groundwater divide without affecting the surface water divide (USGS, 2005). Usually, the watershed boundaries will be known before the groundwater divides have been identified and from a practical perspective this might be the only unit on which to initially base the institution. As scientific knowledge becomes available, the boundaries can either be adjusted to account for groundwater divides, or the different units can actively cooperate, to ensure that there are no hidden impacts of groundwater pumping.

Despite these two problems, by establishing the collaborative planning institution according to hydrological boundaries, the institution's potential for addressing the local consequences of pumping within its own jurisdiction is greatly increased, while the costs borne by the external geographical units should be substantially decreased. Further, in order to better meet the multi-faceted costs of groundwater pumping, the hydrological unit also provides the opportunity for integration. Integrated Water Resource Management (IWRM) is not a new idea but it has gained in popularity in the last few decades (Global Watershed Partnership, 2000). However, the meaning and practical importance of this idea have been rightly questioned. A single, comprehensive approach to water resource management as visualized by IWRM may not even exist, and second, it may not apply to all situations (Biswas, 2004).

The authors support this criticism, but suggest that a good solution is not to abandon the idea of integration altogether but to experiment with certain forms of integration. Rather like the concept of adaptive management, it must be accepted that a certain amount of experimentation is necessary if we are to meet the complexities surrounding our use of water resources. Depending on history, culture and institutional genealogy, some forms of integration may work and others may not. By building on what works, and revisiting what does not, it is possible to escape from the institutional fetishism that currently threatens the future of global water resources. For example, the authors believe that integrating the allocation of groundwater and surface water is both practical and necessary. It is necessary because the two are interchangeable, being part of a continuous and dynamic process in which groundwater becomes surface water and vice versa. The distinction is therefore artificial and to allocate them separately denies this singular relationship (Winter *et al.*, 1998; Ivey *et al.*, 2002). It is practical because modern science makes it possible to identify these interactions and institutions are capable of designing tools that take into account both groundwater and surface water in allocation decisions. For instance, buffer zones (restricted permit areas) can be established around surface water bodies sensitive to the effects of decreased groundwater flow.

The authors also point to the potential of integrating source water protection (water quality) with surface and groundwater allocation (water quantity), a possibility currently being explored in Ontario and which is discussed in more depth below. Further, the very idea of collaborative groundwater planning implies a vertical integration between local and provincial/state institutions, and a horizontal integration between various stakeholders' interests, including municipalities, farmers, industry, citizens and environmental advocates. Other possibilities of integration may include demand management approaches and conservation. In fact, collaborative institutions should greatly enhance the operational potential of integration because the various interests in groundwater use are already sitting around the Table as opposed to being unequally divided by the traditional jurisdictional boundaries of government agencies (Priscoli, 2004) or, as in the case of court-based decision making, being muted by the legal procedural rules of standing.

Science is a critical component in the allocation planning process. Since many problems of groundwater pumping are underground and not readily apparent, scientific understanding is the only medium through which planners can visualize these problems. Without accurate scientific information, one can only guess the extent of the groundwater resource to be managed and its role in the ecosystem. There are currently major scientific gaps in the understanding of groundwater resources in the Great Lakes Basin (Grannemann, 2000; IJC, 2000). In light of these gaps, the IJC has urged the governments of the Basin to immediately take steps to enhance groundwater research in order to better understand the role of groundwater (IJC, 2000). Improving scientific understanding of groundwater hydrology in the Basin would directly impact the effectiveness of collaborative planning for groundwater allocation.

However, a lack of scientific knowledge should not lead to complete paralysis in the planning process. There are inherent uncertainties in planning for groundwater allocations because of the complex interdependencies between human activities, aquifers and groundwater dependent ecosystems. Instead of leaving the management of natural resource problems until all the scientific information is known, planning institutions can adopt an adaptive management approach (Karkkainen, 2001; NRC, 1996). Adaptive management accepts that there are things we do not know about a given situation but actively encourages the attainment of new knowledge to progressively update the planning process. It incorporates a precautionary approach by avoiding decisions that involve too much risk or uncertainty, and by revisiting planning decisions as new information becomes available (NRC, 1996). In adaptive management, the role of science shifts from providing certain, objective measurements, to clarifying what we do not know and offering a suite of narrative descriptions that communicate to planners what might unfold (NRC, 1996, 1999; Bavington, 2002; McCarthy, 2003). Hence, scientific knowledge allows the planning institution to make educated trade-offs between different approaches to specific problems but it is the planners' common values that are the basis for those trade-offs, not science (Bosch *et al.*, 2003).

An emerging concept. In the Great Lakes Basin, there are signs that the concept of collaborative planning for water allocation is already emerging. Both Minnesota and Ontario utilize collaborative allocation planning during times of drought or water stress, and recent proposals in Ontario would make collaborative allocation planning an aspect of a comprehensive source protection strategy.

Under Minnesota's water allocation legislation, the commissioner is expected to establish 'water appropriation and use management plans' for certain water-stressed areas (Minn. R. §6115.0810). To assist with the plan, the commissioner is required to establish a planning team that consists of representatives of the government, water users, as well as any other interested government or citizen group. This team then provides input on the preparation of the plan, which under the legislation must include an evaluation of prevailing hydrological conditions and the dependability of scientific information, the identification of future water use and concerns relating to this use, water conservation options and the relationship between the plan and other water resource programmes such as water quality and land use management. The Department of Natural Resources has highlighted some of the benefits of this approach such as local participation in plan development and implementation, improved resource monitoring and earlier reinstatement of suspended appropriations (Minnesota DNR, 2005).

Following water use conflicts in 1999, Ontario developed the Ontario Low Water Response Plan (OLWRP) (MNR *et al.*, 2003). The OLWRP is implemented under existing legislation, such as the Municipal Act, the Lakes and Rivers Improvement Act and the Ontario Water Resources Act. The province is responsible for collecting and analysing information on water levels across the province, while Watershed Response Teams (WRT) are responsible for identifying actions needed to manage low water conditions and coordinating the implementation of these actions. The WRTs are based on watershed boundaries and are required to include staff from provincial, municipal and conservation authorities, representatives of local interests, and users (including agriculture, industry and business, recreation, resource management, and First Nations). Each member of the WRT is given equal opportunity for input, sharing information and being accountable. The OLWRP defines three levels of low water conditions. The first level focuses on voluntary conservation measures to alleviate demand pressures. During the second level, the WRT can add restrictions to new permit approvals, enforce water restrictions by-laws and consider restricting existing permit holders. At the third level, WRTs establish priorities for water users through a consensus building process. The Ministry of the Environment can then restrict existing permit holders according to these priorities. At this level, water allocations are stringently enforced.

Ontario is also considering linking permit takings to collaborative source protection planning. Following the Walkerton tragedy of May 2000, in which seven people died from drinking contaminated groundwater, a comprehensive inquiry into Ontario's drinking water management was undertaken. In the Report of the Walkerton Inquiry, the commissioner makes a number of recommendations for reform of the current water management process in Ontario (O'Connor, 2002b). One of the key recommendations is source protection planning. Source protection plans are described by the report as comprehensive preventative measures that implement a systematic land-use management approach to prevent the release of pollutants into drinking water sources.

With respect to the institutional approach to groundwater allocation, the report makes three significant recommendations. First, it recommends that Conservation Authorities, which are bodies already in existence and defined according to watershed boundaries, be responsible for overseeing the source protection plans. Since aquifers sometimes straddle watershed boundaries, the report states that Conservation Authorities should ensure that source protection plans are co-ordinated between watersheds so that these groundwater systems are not overlooked. Second, the report recognizes the importance of effective representation of local community interests. It therefore recommends that Conservation

Authorities, which consist solely of representatives from municipalities, should establish collaborative committees to develop the draft source protection plans. These committees should consist of representatives of municipalities, various provincial ministries, non-governmental organizations, other affected groups including First Nations, and representatives from federal agencies. Third, the report recommends that the source protection committee should develop operational limits concerning acceptable levels of water withdrawals. Significantly, the report strongly asserts that these limits should be binding on the Ministry of the Environment when it considers applications for permits to take water. In addition, if demands for water exceed available supply, the report advocates reallocation through a process of local negotiations rather than a unilateral decision imposed by the Ministry of the Environment.

So far, the draft legislation and formal recommendations for implementation have followed the recommendations of the Walkerton Report (Implementation Committee, 2004; MOE, 2004). If this approach is adopted and proves successful, Ontario's source protection legislation could be a potential model for other jurisdictions in the Great Lakes Basin and elsewhere in the world.

Implementing collaborative groundwater allocations plans. In order to implement collaborative allocation plans, governments could utilize a number of regulatory tools, most of which are already in use in some form or another in the Basin. For instance, governments could ensure that permit thresholds were at a level that would take account of all withdrawals with the capacity to interfere with other wells or cause detrimental impacts to the environment. In the Great Lakes Basin, the best practice is Minnesota's threshold of 37 850 litres (10 000 gallons) (Minn. Stat. 103G.271).

Attaching time limits to permits would be an important corollary to the adaptive management component of the allocation plans. Time limits would provide users with security of use for a defined period but allow permits to be amended or denied on renewal to account for decreased water availability or increased competition. In Ontario, permits tend to be issued for between 5 and 10 years. Cumulative impacts of groundwater pumping could be mitigated by attaching well-spacing requirements to the issuance of permits. In addition, buffer zones could be designated next to sensitive surface water bodies. For example, Wisconsin's new Groundwater Protection Act creates groundwater protection areas, which are areas within 1200 ft of an outstanding water resource or any trout stream (Wisconsin Act 310, 2003). The Act requires the Department of Natural Resources to undertake an environmental review of any proposals for high capacity wells in these areas. Similar provisions exist in Minnesota's legislation (Minn. Stat. 103.315, subd. 5). Permitting programmes could also encourage the conservation of groundwater resources by requiring applicants to demonstrate that they are using water efficiently before a permit is issued. This is a requirement that has been successfully incorporated into allocation decisions in the Southwest Florida Water Management District and has been a consideration in the issuance of some permits in Ontario (Brandes *et al.*, 2005).

Great Lakes Watershed Board

For the reasons given above, local scale planning cannot be relied upon to address the regional-scale impacts that can arise from pumping deeper aquifers. Therefore, a regional institution should be granted authority to ensure that the regional and international impacts of groundwater pumping are properly addressed.

Despite the omission of groundwater in the Boundary Waters Treaty (1909), the authors assert that the International Joint Commission (IJC) has the institutional potential to successfully address regional groundwater issues within the Great Lakes Basin. This potential comes from: the IJC's reputation for independence and impartiality (LeMarquand, 1993; Clamen, 2002); the IJC's capacity to build consensus through joint fact finding (LeMarquand, 1993, Duda & LaRoche, 1997); its ability to access the 'invisible college' of scientific expertise (Colborn *et al.*, 1990); its active encouragement of input from stakeholders through web-based consultation and public meetings and hearings (Clamen, 2002); and perhaps most importantly, its flexibility, which allows it to adapt and evolve to deal with contemporary problems (LeMarquand, 1993; Clamen, 2002). If the IJC is to fulfil its potential with respect to groundwater issues it is this flexibility that must again be engaged, as it was when the IJC was asked to address water quality issues.

Although the Boundary Waters Treaty does not grant the IJC powers to properly address water quality, the federal governments of Canada and the US created these powers through the use of long-term references (pursuant to Article X of the Boundary Waters Treaty). These references, better known as the Great Lakes Water Quality Agreements of 1972 and 1978, have provided the IJC with a broad mandate to tackle water quality problems. This mandate includes collecting information on the quality of boundary waters, submitting recommendations on appropriate actions, and monitoring and assessing the progress of the two countries in achieving the agreement objectives. To assist the IJC with these responsibilities, the agreements created two Boards: the Great Lakes Water Quality Board (the principal advisor to the Commission) and the Great Lakes Science Advisory Board (essentially a scientific research institution).

Therefore, although the Boundary Waters Treaty is silent on groundwater, the IJC could still achieve the necessary authority over groundwater resources through another long-term reference. In fact, this is an approach that has been suggested by the IJC itself. In a report to the Canadian and US federal governments, the IJC recommended the creation of 'International Watershed Boards' from coast to coast that could then adopt a basin-wide ecosystem approach akin to that adopted under the 1978 Great Lakes Water Quality Agreement (IJC, 1997). These Boards would have powers relating to all water-related issues within shared basins, including the quality and quantity of surface and groundwaters. With respect to the responsibilities of a Great Lakes Watershed Board (GLWB) as they relate to groundwater, the authors suggest the following:

- *Comprehensive Inventory and Database of Withdrawals*: The GLWB could coordinate with government agencies and scientific experts from both countries to establish a comprehensive and unified inventory of all groundwater resources in the Basin, including detailed mapping of major aquifers, information pertaining to the quantity and quality of storage, water levels, recharge rates, direction of flow and interaction with surface waters. The GLWB could also coordinate with all levels of government to maintain a regularly updated database of all groundwater withdrawals in the Basin.
- *Critical Groundwater Areas:* The IJC could be given the authority to designate 'critical groundwater areas'. These would be areas where groundwater withdrawals already exist, or are threatening to impair the quality or quantity of boundary waters. The IJC's authority to designate critical groundwater areas would be exercised in a similar way to the identification of the areas of concern under the Great Lakes Water Quality Agreement. A similar provision in the Bellagio Draft Treaty, a model groundwater treaty established by international water law experts, could also provide guidance (Hayton & Utton, 1989). Once designated, a regional groundwater management council, comprised representatives of various stakeholders with interests in the aquifer, could be formed and given the responsibility of devising a detailed recovery plan that would include proposed rules for the allocation and reallocation of groundwater.
- *Monitoring and Recommendations:* The GLWB could also be given the responsibility of monitoring the efforts of the jurisdictions within the Basin with respect to groundwater management (including groundwater allocation laws) and making recommendations on best practices. This is a role the IJC has performed in the Great Lakes Water Quality Agreements.

The IJC has shown itself to be a very flexible organization when given the opportunity. It is this flexibility that makes it particularly suited to dealing with the complexity of contemporary problems such as groundwater pumping. However, as was identified in the IJC report, it must be entrusted with that authority by the respective federal governments (IJC, 1997). Unfortunately, contemporary concerns relating to loss of sovereignty over water resources have left the federal governments reluctant to further expand the IJC's mandate (LeMarquand, 1993; Toope & Brunnee, 1998). As a result, and motivated by the fear of losing water resources to other regions, the Great Lakes states and provinces have taken matters into their own hands through Annex 2001, a recent supplement to the Great Lakes Charter (1985) (CGLG, 2005).

A detailed comparative analysis of the two regional institutional approaches is beyond the scope of this paper, but the authors advocate for the Great Lakes Watershed Board on the following grounds. The Annex 2001 framework is a regional agreement that would bind the states through an interstate compact but would only be binding in good faith on the two provinces. It is not an international treaty and therefore cannot create international responsibilities, but if approved, it will significantly overlap the institutional framework established by the Boundary Waters Treaty and potentially undermine the IJC's future role and effectiveness (Council of Canadians, 2005; Nikiforuk, 2004; Shyrbman, 2004). While the regional cooperation that has given rise to Annex 2001 is admirable, the framework is not designed to encourage sustainable groundwater allocation within the Basin. As a result of pressure applied by strong agricultural and industrial lobbies (CGLI, 2003), the draft agreements impose no significant limits on groundwater or surface water use within the Basin, as evident in the excessively high permit levels proposed. The only provisions with substance are those preventing long-distance diversions of water out of the Basin. The lack of political independence, which is inherent in the institutional design of Annex 2001, and the lack of international legitimacy, are the primary (although not the only) reasons that the Great Lakes Watershed Board would be a more suitable institution for overseeing the regional management of groundwater resources.

Conclusion

The Great Lakes governments and communities can no longer ignore the importance of groundwater to the Basin. Common law allocation must be replaced with policies based on a concept of sustainability that engages communities in an ethical discourse and results in

a legacy for future generations. Collaborative planning institutions present an opportunity to stimulate this discourse and bring about, at least at a local level, sustainable groundwater allocation. To address regional and international impacts of groundwater pumping in the Basin, the International Joint Commission (IJC) should be specifically assigned a mandate to address groundwater issues in the Basin. This mandate could be exercised through a Great Lakes Watershed Board (GLWB), which would be responsible for preventing and resolving regional disputes over groundwater use.

As competition for water resources in the Great Lakes Basin increases, provincial, state, and federal governments have reached a critical juncture in their water management strategies. The myth of water abundance has been dispelled by social conflicts, economic costs and environmental degradation, but groundwater allocation is still situated in the 19th century. For governments to restrict themselves to current institutional structures is to effectively admit that they lack the institutional ingenuity to respond to the complexities of contemporary resource problems. Governments must consider alternative institutional approaches and provide citizens with a forum to fashion a more sustainable future.

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