

Institutions and Transboundary Governance Capacity in the Great Lakes Basin: The Case of Irrigation Water-Takings

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This article examines the institutions governing irrigation water-takings in the Great Lakes Basin in an effort to get some idea of the transboundary governance capacity in this area. Examining the capacity of the institutions governing irrigation water-takings is especially interesting given that most water-taking institutions in the basin were created without irrigation specifically in mind. Accordingly, one might reasonably expect there to be limited governance capacity with respect to irrigation, but this is not the case. The introduction of the *Great Lakes-St. Lawrence River Basin Water Resources Compact* in 2008 has resulted in an impressive level of transboundary governance capacity, scoring well on the four institutional indicators of capacity used in this special issue.

Keywords: Irrigation; Institutions; Transboundary; Governance capacity; Great Lakes

1. Introduction

While the other cases in this special issue address pressing water governance concerns in the Great Lakes Basin, irrigation water-takings are more of a looming concern. Conflicts over irrigation water-takings in the Great Lakes have, thus far, been relatively few in number, mostly low profile, and predominantly localized in nature. The notable exception was the conflict over the Mud Creek Irrigation District in the early 1990s which put Michigan at odds with a number of state and provincial governments, and starkly demonstrated the weaknesses of the Great Lakes Charter. Based on this experience and a number of prevailing trends – particularly the onset of climate change – there is reason to believe that irrigation water-takings will become an increasing governance challenge. As farmers adapt to a warmer climate with more erratic precipitation patterns, irrigation is likely to play a bigger role in basin agriculture and irrigation demands on Great Lakes waters are likely to increase. Irrigation is already one of the largest consumptive users of water in the Great Lakes Basin, and there is preliminary evidence that irrigation water demands are already increasing. Given the environmental damage wrought by excessive irrigation water-takings in places like central Asia, China, Australia, and the American southwest, irrigation

water-takings are deserving of attention in the Great Lakes Basin as well. This article examines the institutional arrangements governing irrigation water-takings in the Great Lakes Basin in an effort to get some idea of the transboundary governance capacity in this area. Examining the capacity of the institutions governing irrigation water-takings is especially interesting given that most water-taking institutions in the basin were created to address other water governance issues, without irrigation specifically in mind. Accordingly, one might reasonably expect there to be limited governance capacity in this area, but this is not the case. The introduction of the *Great Lakes-St. Lawrence River Basin Water Resources Compact* in 2008 has created an impressive level of transboundary governance capacity, scoring well on the four institutional indicators of capacity used in this special issue.

The article proceeds below in three sections. The first section provides some background on irrigation agriculture in the Great Lakes Basin, the demands irrigation places on basin waters, and the trajectory of irrigation demands in the context of climate change. The second section outlines the institutions governing irrigation water-takings in the Great Lakes Basin, starting with the transboundary institutions and then proceeding to the state/provincial institutions of Michigan and Ontario, the two largest irrigating jurisdictions in the basin. Finally, in the third section, these institutions are critically evaluated using the four institutional indicators associated with Transboundary Governance Capacity (TGC) used in this issue: nature of compliance mechanisms, functional intensity, stability and resilience, and degree of legitimacy.

2. Water, Irrigation and Climate Change in the Great Lakes Basin

Though often overshadowed by the region's industrial and services sectors, agriculture is an essential and broad-based economic activity in the Great Lakes Basin. The region's deep, fertile soils and temperate climate combine to make the southern part of the basin an agricultural 'sweetpot'. Altogether, in the six Great Lakes states and Ontario, agriculture involves about 114 million acres (45.6 million hectares) of land and about \$150 billion in production (Kling et al., 2003, p. 61).

Unlike many parts of the world – and even many parts of North America – rain-fed agriculture is the norm in the Great Lakes Basin. The basin's climate is such that farmers can usually rely on spring and summer rains to provide the water necessary for their crops. Prolonged droughts and dramatic floods have been relatively rare in the basin, at least thus far. A substantial amount of irrigation is present in the Great Lakes Basin, but only as a supplement to rain-fed agriculture. Irrigation is generally used to ensure that drought-sensitive crops get appropriate amounts of water at crucial times, but most farmers still rely on precipitation as the primary means of watering their crops (Annin, 2006, p. 155). The large-scale irrigation systems prevalent in the western US and Canada, involving massive dams, diversions, and canal systems, are not present in the Great Lakes Basin. Instead, most irrigation is small-scale in nature, with farmers using pump and sprinkler systems to irrigate from local streams and groundwater sources. No irrigation water comes from inter-basin diversions or dam storages, and very little of it is pumped directly from the Great Lakes.

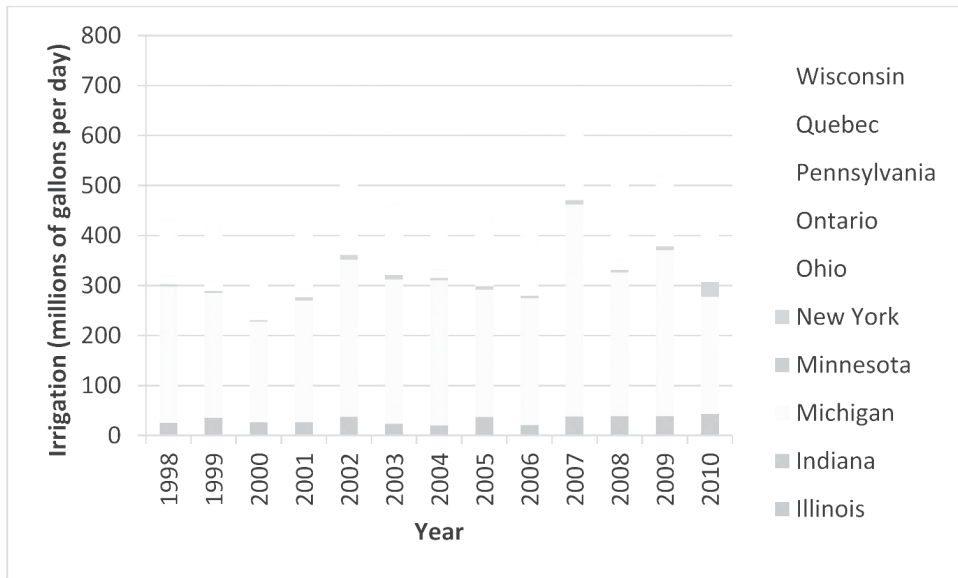


Figure 1: Irrigation Water Use in the Great Lakes Basin by Jurisdiction

Source: Great Lakes Commission, Great Lakes Regional Water Use Database, available at: <http://glc.org/wateruse/database/>

Based on water use data collected by the Great Lakes Commission,¹ a number of trends are noteworthy in Great Lakes irrigation. As is evident in Figure 1, irrigation is much more prevalent in some jurisdictions than others: Michigan is by far the largest irrigator in the Great Lakes Basin, both in terms of acres irrigated and water used, with Ontario a distant second. Together, Michigan and Ontario account for over three-quarters of the basin's irrigation in most years and, for this reason, they will receive special focus in this study. Michigan's status as the largest irrigator is explained by a combination of factors. According to rainfall records, Michigan is ". . . the driest state east of the Mississippi River during the critical growing months of July and August" (Michigan Department of Agriculture and Rural Development, 2012, p. 13). Moreover, it is the only jurisdiction whose territory lies entirely within the Great Lakes Basin, so that all of its irrigation draws from Great Lakes water. Irrigation in Michigan is concentrated in the southwestern part of the state, particularly in the area around Kalamazoo, and is used primarily to grow corn, soybeans, vegetables, potatoes, and nursery crops (Michigan Department of Environmental Quality, 2006, p. 3). Ontario also draws just about all of its irrigation water from the Great Lakes Basin, as most of its arable land coincides with the basin's hydrological boundaries. Irrigation in Ontario is concentrated in the southern part of the province particularly in the Niagara Peninsula, the

¹The Great Lakes Commission data is the best water use data available on irrigation water use in the basin. However, the data has a number of limitations, as outlined by the Commission at: www.glc.org/wateruse/database/metadata_new.html. None of these limitations detract significantly from the purposes for which the data are used in this article.

Norfolk Sand Plain, the Essex Region, and the southern shores of Lake Simcoe, where it is used to grow a wide variety of fruit and vegetable crops, and, to a lesser extent, field crops (De Loe, Kreutzweiser, & Ivey, 2001, p. 37; Statistics Canada, 2011, p. 27).

Also evident in Figure 1, there seems to be a trend toward overall irrigation growth in the basin. Data are only available since 1998, so some caution must be exercised, but a modest upward trend is noticeable in Figure 1. Moreover, if one compares years with comparable summer run-off levels as shown in Figure 2 – such as a comparison of 1998 and 2007 or 1999 and 2009 – increases in irrigation water use are evident, suggesting that more irrigation is being conducted over time, when run-off levels are held constant. Figure 2 also illustrates the tendency in the Great Lakes Basin to use more water for irrigation when run-off levels are low in July and August. This speaks to the fact that irrigation is used as a supplement to rain-fed agriculture, and that water demand is higher during dry years when natural water supplies are lower.

Depending on the year, irrigation is currently the second or third largest consumptive water use in the Great Lakes Basin, accounting for 16–25 percent of water consumption; however, it has the potential to have a much larger impact on the basin with the onset of climate change.² Most climate change studies predict a warmer and wetter climate, on average, for the Great Lakes Basin. Such a climate could actually benefit basin agriculture by creating a longer growing season in northern areas, creating some opportunities for double-cropping

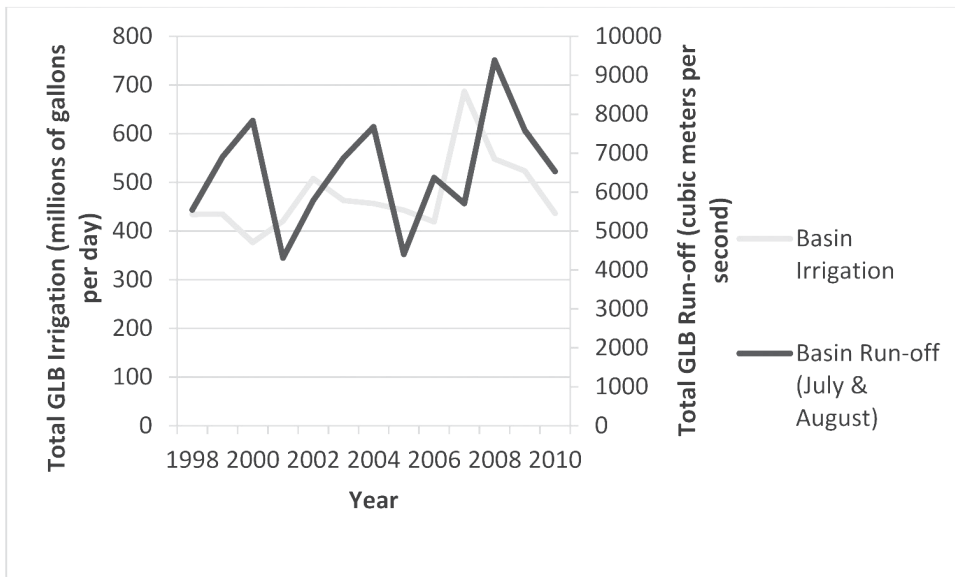


Figure 2: Irrigation Water Use and Run-off in the Great Lakes Basin

Source: Irrigation data from: Great Lakes Commission, Great Lakes Regional Water Use Database, available at: <http://glc.org/wateruse/database/>. Run-off data from: National Ocean and Atmospheric Administration, Great Lakes Environmental Research Laboratory, available at: http://www.glerl.noaa.gov/ftp/publications/tech_reports/glerl-083/UpdatedFiles/

²The water use data is based on an analysis of water use data in the Great Lakes Commission's *Annual Report of the Great Lakes Regional Water Use Database* for the years 2006 to 2010, inclusive.

in southern areas, and by increasing crop yields through CO₂ fertilization. However, this warmer and wetter average climate is also expected to be more variable than the current climate with more intensive precipitation episodes and drier, more frequent summer low flows (Mortsch, Alden, & Scherago, 2003, pp. 66–67). This climatic variability could be a real problem for basin farmers who, as noted above, have mostly relied on relatively dependable spring and summer rainfalls to water their crops. Increased use of irrigation would be one means of coping with increased climatic variability, providing farmers with dependable water in the face of erratic rainfalls. More than one report on the potential impacts of climate change on the Great Lakes Basin have noted this fact and have predicted increased use of irrigation as one of the likely outcomes resulting from climate change (Mortsch, Alden, & Scherago, 2003, p. 69; Penney, 2012, p. 34). So, it is reasonable to expect that irrigation will remain at least as prevalent as it is now in terms of Great Lakes water use, and will most likely become even more prevalent as farmers adapt to a changing climate.

Irrigation has the potential to preserve and enhance Great Lakes agriculture in the context of climate change, but it also has the potential to deplete local water sources and create intractable conflicts between competing water uses. Irrigation can be a voracious consumer of water, involving large water takings with little return flow (Postel, 1999). In places throughout the western US and Canada where large-scale irrigation has existed for decades, water use conflicts between irrigation and other human water uses are endemic, as are conflicts between irrigators and environmentalists who have clashing worldviews on the nature and purpose of water resources. All of these conflicts require careful balancing and management on the part of state regulators who are usually caught in the middle and pressurized by all sides. Instances of conflict between irrigation and other water uses have been evident in the Great Lakes Basin, including intergovernmental conflict over Michigan's Mud Creek Irrigation District, and local conflicts over irrigation water-takings in southern Michigan and southern Ontario. However, it is likely that these conflicts will become even more common as irrigation water demand increases.

Since most of the institutions governing water-takings in the Great Lakes Basin were not established with irrigation specifically in mind, it is reasonable to question how much capacity they have to deal with increasing irrigation water demands. However, thus far, no examinations of transboundary governance capacity with respect to Great Lakes irrigation have been undertaken. This article endeavours to do so, using the approach mapped out by VanNijnatten, Johns, Friedman and Krantz in the introductory article to this special issue. This approach starts with an examination of the institutions governing irrigation water-takings in the Great Lakes Basin, at both the transboundary and domestic levels.

3. Institutions Governing Irrigation Water-Takings in the Great Lakes Basin

3.1. Transboundary-Binational Institutions

Any examination of governance capacity at the transboundary level must begin with the *Boundary Waters Treaty* (BWT). Signed in 1909, the BWT has provided the institutional foundation for the cooperative management of waters shared between the US and Canada. Accordingly, one might expect that the BWT and the International Joint

Commission (IJC) would play a central role in any water-takings conflicts arising from increased irrigation in the Great Lakes Basin and that, given the treaty's long and relatively successful track record, this would translate into considerable governance capacity at the transboundary level. A closer examination, however, reveals that the BWT has little practical relevance when it comes to irrigation water-takings in the Basin.

With respect to water-takings, the most important feature of the BWT is Article III pertaining to the approval of diversions from boundary waters. Article III requires that any new, large diversions from shared boundary waters receive approval from both national governments and the IJC before being undertaken. While Article III has worked well in governing water uses pertaining to navigation and hydro-electricity generation in the Great Lakes Basin, its scope is limited in such ways that it has little capacity to govern irrigation water-takings in the basin (Heinmiller, 2008).

The first limitation of Article III is its application only to boundary waters, those water bodies through which the Canada-US boundary directly runs. This means that it has application in Lakes Superior, Huron, Erie, and Ontario and in their connecting rivers, but it has no application in Lake Michigan or any of the Great Lakes' tributary rivers or connected ground water sources (Hall, 2006, p. 417). However, it is the latter group of water sources that are predominantly utilized by Great Lakes irrigators, simply because they are more accessible, meaning that Article III has no application to most irrigation water-takings based simply on the location of the water withdrawals.

The other limitation of Article III pertains to the size of water withdrawals. Article III only applies when a diversion from a boundary water would "... materially affect the level or flow of the boundary waters on the other side [of the boundary]" (Boundary Waters Treaty, 1909). Given the enormous size of the Great Lakes, it would take a massive irrigation diversion to have any noticeable effect on water levels or flows on the other side of the border, a diversion so large as to be highly improbable (Hall, 2006, p. 417).³ The threat from increased irrigation is not from single massive diversions but from a multitude of smaller water-takings that could have substantial cumulative impacts. Accordingly, even in boundary waters, Article III seems to have little application to irrigation water-takings in the Great Lakes Basin.

In fairness to Article III and its architects, it was probably not designed with irrigation governance in mind. At the time the BWT was negotiated, the only Canada-US border region experiencing irrigation development was the Prairie region, where international conflict over the shared St. Mary and Milk Rivers was rife. The treaty framers addressed this conflict by negotiating an apportionment of these two rivers, giving each country a quantified share of each river. The apportionment was enshrined in Article VI of the BWT and the IJC was tasked with monitoring and administering its implementation (Heinmiller, 2008, pp. 1502–1507). Because irrigation-related water scarcity was not a

³This statement refers to diversions for irrigation within the basin. It is possible to envision massive inter-basin diversions for irrigation in other places, such as the American southwest, but this is beyond the scope of this paper.

present or anticipated source of conflict in the Great Lakes Basin, a comparable apportionment arrangement was not negotiated for this basin, and diversions for irrigation purposes in the Great Lakes fell under Article III by default rather than by design.

3.2. *Transboundary-Subnational Institutions*

With the BWT of little practical relevance to irrigation governance in the Great Lakes Basin, the transboundary institutions of most relevance have been those created by the Great Lakes states and provinces, beginning with the Great Lakes Charter in 1985. The Charter created an intergovernmental 'Prior Notice and Consultation Process' for the review of all diversions from non-boundary waters in excess of 19 million liters per day and intended for a consumptive use. Initiation of the process was made the responsibility of the permitting jurisdiction and all basin governments were to be given a chance to comment and object to prospective water-takings, although the final decision remained with the permitting government. Other commitments were made to undertake reforms in the monitoring and regulation of smaller water-takings, but the Prior Notice and Consultation Process was the centerpiece of the Charter. Significantly, the Great Lakes Charter was a political handshake agreement between governments rather than a legally binding compact, so compliance with this institution depended on the commitment and goodwill of the signatory governments (Heinmiller, 2007, p. 660).

The only instance in which the Great Lakes Charter was called into force was in Michigan's 1993 proposal to create the Mud Creek Irrigation District. In 1992, a group of farmers in Huron County, Michigan secured federal funding for the construction of a new irrigation project, planning to withdraw 23–32 million litres of water per day from Lake Huron via a small tributary known as Mud Creek. As this diversion exceeded the threshold for the Charter's Prior Notice and Consultation Process, Michigan's governor notified the other Great Lakes governors and premiers of Michigan's intent to build the project, and held a one-day consultation meeting in an effort to address their concerns about the project. Despite the outright objection of Indiana and the reservations expressed by a number of other states and provinces, the Charter left the ultimate decision in Michigan's hands and they decided to let the project proceed. By most accounts, the Prior Notice and Consultation Process was little more than an information exchange and the Charter had little substantive impact in regulating the Mud Creek Irrigation Project, other than alerting the other Great Lakes governments to its existence (Anin, 2006, pp. 154–171; Heinmiller, 2007, pp. 667–668). This not only underscores the negligible governance capacity created by the Great Lakes Charter, but also illustrates the potential for irrigation water-takings to result in significant intergovernmental conflict in the Great Lakes Basin.

Disillusionment with the Great Lakes Charter and the perception of continued threats to Great Lakes water prompted renewed efforts by the governors and premiers to build governance capacity at the transboundary level. In June 2001, they negotiated an amendment to the Great Lakes Charter known as the Charter Annex – which committed them to work toward a binding basin-wide agreement to preserve and protect the basin's water for

the use and benefit of its citizens. A new round of negotiations was undertaken, resulting in the signing of the *Great Lakes-St. Lawrence River Basin Sustainable Water Resources Agreement* (the Agreement) and its companion *Great Lakes-St. Lawrence River Basin Water Resources Compact* (the Compact) in December, 2005 (Council of Great Lakes Governors n.d.). The two documents are substantively similar, but the Compact makes use of the US constitution's interstate compact mechanism to create an institution in which state compliance can be enforced through the courts.⁴ Lacking a comparable compact mechanism under the Canadian constitution and unable to join the US compact under the American constitution, the Agreement commits Ontario and Quebec to the same water conservation measures as their US counterparts but in a political handshake agreement (Hall, 2006). At the transboundary level, it is the Agreement/Compact that is of most relevance in regulating irrigation water-takings in the Great Lakes Basin.

One of the central features of the Agreement/Compact is the Great Lakes governments' commitment to a "decision-making standard" for regulating water withdrawals within the basin. The Agreement/Compact requires signatory governments to establish volumetric threshold levels for regulation of water withdrawals and to apply the decision-making standard to all new or increased water withdrawals above the threshold. The precise level of the regulatory threshold is undefined in the Agreement/Compact, but each government must define it so that overall water uses are reasonable, so that overall water withdrawals do not result in significant adverse impacts, and so that the objectives of the Agreement/Compact are achieved. Should any government fail to establish a regulatory threshold within five years, a threshold of 100,000 gallons per day automatically takes effect, providing some indication of what the framers had in mind as a reasonable threshold (Hall, 2006, p. 440).⁵ The overall intent is to cast a wider regulatory net for water withdrawals across the basin, one that would catch many new or increased water-takings for irrigation, making them subject to the provisions of the decision-making standard.

In terms of scope, the decision-making standard applies to all new or increased water withdrawals from any water source in the basin, including the lakes themselves, lake tributaries, and even ground water. The inclusion of all the basin's surface and ground water sources under a single regulatory umbrella is unprecedented in the Great Lakes Basin and, according to Hall, ". . . is a long overdue advancement in water law" (Hall, 2006, p. 435). It also means that all prospective sources of future irrigation water are covered by the Agreement/Compact, again reinforcing the relevance of the decision-making standard in the regulation of future irrigation growth. The decision-making standard does not apply to existing water withdrawals – their regulation is left to the

⁴In order for the compact to take effect (and become legally binding) it had to be passed into law in all eight US states and the federal Congress. This happened in surprisingly rapid fashion starting with Minnesota in February 2007 and ending with the federal Congress in October 2008.

⁵The signatory governments are also required to create water resource inventories that document all available water resources and all water withdrawals of 100,000 gallons per day or greater. So, again, the 100,000 gallons per day threshold seems to be what the Agreement/Compact's framers had in mind as an appropriate regulatory threshold.

discretion of the respective states/provinces – but the Agreement/Compact does commit the states/provinces to implement water conservation programs for all water users, including existing uses (Hall, 2006, p. 436).

Substantively, the decision-making standard establishes five principles that states/provinces must adhere to in evaluating proposed new or increased withdrawals from basin waters. The first four principles are based on concerns with source water protection and past experiences with transboundary regulation of water-takings in the basin, while the fifth principle has its roots in common law riparian rights and the reasonable use doctrine (Hall, 2006, p. 435). Stated concisely, the five principles of the decision-making standard include:

1. That all water withdrawals will be returned to the source watershed, less an allowance for consumptive use.
2. That all water withdrawals, individually or cumulative, will not have a significant adverse impact on source watersheds.
3. That all water withdrawals will make use of environmentally sound and economically feasible water conservation measures.
4. That all water withdrawals will comply with all applicable municipal, state, and federal laws as well as all relevant interstate and international agreements.
5. That all water withdrawals will make reasonable use of the water based on a number of defined criteria such as: the efficiency of the proposed use; the efficiency of existing uses; the balance between economic development, social development and environmental protection; the capability of a source to supply water; the adverse impacts on other uses; and, any potential restoration of degraded sources (Great Lakes-St. Lawrence River Basin Sustainable Waters Agreement, 2005, p. 11).

Even a cursory reading of these principles suggests that they set the bar pretty high in terms of standards for new or increased water withdrawals. For prospective irrigators, these principles place the burden on them to show that their withdrawals will not have significant adverse impacts on water sources, that they make use of sound conservation practices, that they adhere to all relevant laws, and that they are reasonable in all specified senses of the term. This does not make irrigation expansion impossible by any means, but it does lay out a precautionary approach to irrigation expansion that guards against environmental degradation, wasteful water use practices, and impairments of existing uses.

Beyond the decision-making standard, the Agreement/Compact also institutes a general ban on diversions of Great Lakes water, both between Great Lakes sub-basins and outside of the Great Lakes Basin at large. There are, however, some exceptions to this ban for communities and counties that straddle the Great Lakes Basin divide and have historically relied on Great Lakes water (Great Lakes-St. Lawrence River Basin Sustainable Waters Agreement, 2005). These provisions are important in their own right, and were quite contentious in the negotiation of the Agreement/Compact, but they are not pertinent to irrigation expansion in the Great Lakes Basin; thus, they are not discussed here.

3.3. State/Provincial Institutions: Michigan and Ontario

Since, on both sides of the border, it is the states and provinces which have primary constitutional responsibility for regulating water-takings, governance capacity at this level is crucial to overall transboundary governance. In this regard, this section focuses on Michigan and Ontario, as these jurisdictions are not only the largest irrigators in the Great Lakes Basin, their ‘regulated riparian’ institutions are also typical of the institutions governing irrigation water-takings in the other Great Lakes jurisdictions.

Regulated riparian regimes typically draw a distinction between small and large water-takings, each being governed by a different set of rules. For small water-takings, common law riparian rights apply, so that water entitlements are tied to land ownership and anyone owning land that abuts or overlies a water source has a right to the ‘reasonable use’ (discussed further below) of that water source (Hall, Michigan Water Law Summary). In contrast, large water-takings are regulated by statutory laws, such as *Michigan Public Act 185* and the *Ontario Water Resources Act*, and riparian landowners planning a large water-taking must obtain a government permit to do so.⁶ Thus, whether irrigation water-takings are regulated by government depends on whether they constitute large water-takings, so the threshold between small and large water-takings is quite important.

This threshold is set by statute and varies by jurisdiction, though the recent Compact/Agreement has facilitated greater uniformity in this area. In Michigan, the permitting threshold is 2 million gpd (approx. 7.6 million Lpd) over any 30-day period. This is quite a high threshold, especially compared to Ontario where the permitting threshold is only 50,000 Lpd (approx. 13,000 gpd) over any 30-day period. However, in compliance with the Compact/Agreement, Michigan also requires landowners wanting to withdraw more than 100,000 gpd (approx. 379,000 Lpd) to register their withdrawals with the state’s Department of Environmental Quality. Since the process for registering such withdrawals is quite rigorous, and registrations can be rejected by the state if they are projected to have an “adverse resource impact,” the effective regulatory threshold for water withdrawals in Michigan is much closer to Ontario’s than at first glance (Hamilton & Seelbach, 2010). Nevertheless, with its lower permitting threshold, Ontario still casts a wider net in regulating irrigation water-takings than does Michigan.

In both jurisdictions, permitting (and registration) of large water-takings is the purview of environment departments – the Michigan Department of Environmental Quality (MDEQ) and Ontario Ministry of the Environment (OME), respectively – and new applications are reviewed for their potential impact on the environment and existing water users. These review processes are critical to governance with respect to irrigation water-takings, so it is worth exploring them in some detail.

In Michigan, permit applications and registrations are categorized based on their risk of adverse environmental impact, using an impressive tool known as the Water Withdrawal Assessment Process. As of 2009, riparian land owners undertaking a new large

⁶It is important to note that only riparian landowners – with riparian water rights – can apply for large water-taking permits.

water-taking can access this tool online (at <http://www.miwwat.org>), input key data related to their water-taking, and the tool will evaluate the proposed water-taking and its risk of adverse resource impact. The tool is based on a sophisticated model with data on all of Michigan's approximately 5,000 Water Management Areas. Water-takings are assessed based on their projected impact on the health of streams and fish populations, and are categorized into one of four ". . . management zones representing increasing levels of risk to the environment" (Hamilton & Seelbach, 2010, p. 536). Lowest risk withdrawals are permitted and highest risk withdrawals (causing "adverse resource impact") are prohibited. Middle risk withdrawals are subject to a "site specific review" by MDEQ officials to determine how withdrawal impacts may be minimized and whether the water-taking should be allowed to proceed (Hamilton & Seelbach, 2010). Overall, the Water Withdrawal Assessment Process seems to provide Michigan regulators with considerable regulatory reach; that is, provided that most irrigation water-takings in the state breach the 100,000 gpd threshold, thereby activating this process.

Ontario also reviews all proposed new water-takings for their environmental impact, though its system is not as sophisticated as Michigan's and there are some gaps in it with respect to irrigation. Under the Permit to Take Water Program, "[w]ater taking applicants are required to classify their applications into one of three categories, based on the proposed water-taking's anticipated risk to existing users and the environment" (Ontario Ministry of the Environment, 2007). Water-takings in the lowest risk category are usually permitted while those in the two higher risk categories are subject to more detailed scrutiny by OME officials. Most water-taking permit applications must be posted on the OME's Environmental Registry for public comment, but irrigation uses are specifically exempted from this requirement (Ontario Ministry of the Environment, 2007). OME has also classified all tertiary watersheds in the province as low, medium, or high use based on their average annual flow conditions and their summer low flow conditions. In designated high-use watersheds – all of which are located in the irrigation areas of the Niagara Region and the Norfolk Sand Plain – the OME must refuse new or expanded permits for designated commercial water uses. However, again, irrigation uses are exempt from this prohibition. Overall, with its low 50,000 Lpd permitting threshold, Ontario's Permit to Take Water Program is likely to cover most irrigation water-takings in the province, and these water-takings will be reviewed for their environmental impact, suggesting considerable governance capacity. Yet, the irrigation exemption in high use watersheds seems to undercut this capacity precisely in the areas where it is needed most.

4. Institutional Indicators of Transboundary Governance Capacity

4.1. Compliance

On balance, the institutions governing irrigation water-takings feature an impressive level of compliance. This is especially true at the transboundary level where compliance is often the Achilles heel of transboundary institutions. This was the case, for instance, with

the Great Lakes Charter. When Michigan approved the water-taking permit for the Mud Creek Irrigation District, other Great Lakes governments objected to the approval, but the Great Lakes Charter provided no means of enforcing Michigan's compliance. The same mistake was not repeated with the formation of the *Great Lakes-St. Lawrence River Basin Sustainable Water Resources Compact* which, as a formal interstate compact under the US constitution, is legally binding on the partner governments and enforceable through the courts, at least in the American portion of the basin. The companion Agreement that includes the Canadian provinces is not legally binding or judicially enforceable, but the states and provinces have committed to work together toward the implementation of the Agreement.

One of the clearest signs of this commitment is in the work of the two transboundary organizations associated with the Agreement/Compact, the Great Lakes-St. Lawrence Water Resources Regional Body (the Regional Body, for short), and the Great Lakes-St. Lawrence River Basin Water Resources Council (the Council, for short). The Regional Body was created in 2005 through the conclusion of the Agreement and is comprised of representatives from all of the Great Lakes states and provinces. The Council was created in 2008 when the Compact came into force and involves representatives from the Great Lakes states only. Both transboundary organizations are very important for achieving compliance with the Agreement/Compact and have put in place strong compliance mechanisms. In implementing the decision-making standard, for instance, the state governments are required to make yearly reports to the Council and, should any state fail to implement the decision-making standard, the Council or any disgruntled state can undertake court action to force compliance (Hall, 2006, p. 444). The Regional Body also monitors compliance and provides input to the Council, thereby involving the provinces in compliance efforts; however, due to the non-binding nature of the Agreement, the Body does not have enforcement power in itself (Hall, 2006, p. 447).

Overall, at the transboundary level, the Agreement/Compact not only outlines a basin-wide precautionary approach to irrigation expansion, but ensures that this approach is enforceable, at least on the US side of the Basin. Given the constitutional impossibility of linking the states and provinces in a binding transboundary compact, the Regional Body's compliance mechanisms – with the combination of third-party adjudication and clear reporting requirements – put in place a strong framework for cross-national compliance.

While this special issue focuses on the *nature* of compliance mechanisms associated with transboundary institutions, as opposed to actual domestic compliance with transboundary objectives, in this case a brief discussion of state/provincial compliance on the ground does shed additional light on the nature of the transboundary institutions in place. In both Michigan and Ontario, institutional compliance is generally strong, with a couple of notable caveats. Small irrigation water-takings are governed by common law and its 'reasonable use' limitations, which are consistently recognized and enforced by the courts. Large irrigation water-takings are governed by governments' statutory permitting/registration systems, and are enforced by state/provincial environment departments. One limitation of these enforcement mechanisms is that they are predominantly complaint-based: the

courts do not enforce reasonable use limitations unless someone brings suit, and environment departments typically do not investigate permitting violations unless they receive a complaint or a tip. So, the enforcement of limitations on irrigation water-takings is mostly reactive rather than proactive, creating some potential for unregulated water-takings to escape notice.

4.2. *Functional Intensity*

The institutions governing irrigation water-takings also score well in terms of functional intensity, falling squarely in the ‘harmonization’ category on the functional intensity spectrum introduced in the framework paper in this special issue. The focal point of harmonization is the Compact/Agreement which requires Great Lakes governments to: 1) establish a regulatory threshold for large water-takings; and, 2) apply the decision-making standard in evaluating large water-takings. Both the regulatory threshold and the decision-making standard are expressed as sets of principles. These principles, such as the five principles of the decision-making standard outlined earlier in the article, are meant to harmonize state/provincial water-taking policies around common transboundary policy objectives. This helps to affect a substantial amount of transboundary collaboration as governments reorient their policies around common objectives, but falls just short of complete transboundary integration, as would be achieved, for instance, through the creation of a single transboundary regulator.

Harmonization has helped to bring greater consistency to state/provincial policies governing large water-takings by bringing the traditional policy laggards closer to the traditional policy leaders. Some jurisdictions, such as Minnesota and Ontario, have long had relatively strict policies regarding large water-takings and, because their existing policies already complied with the Compact/Agreement’s principles, their policies have changed relatively little. Other jurisdictions, however, were more lax in regulating large water-takings and they have been engaged in a flurry of legislative and administrative reforms since the Compact/Agreement’s introduction. Michigan, for instance, passed significant new water legislation in 2008 and undertook the implementation of its landmark Water Withdrawal Assessment Process shortly thereafter.

As Figure 3 shows, the large water-taking regulations of the Great Lakes states/provinces are far from uniform. However, all governments are now regulating large water-takings, and regulating them at levels no less than those required by Compact/Agreement principles. In this way, the Compact/Agreement principles have served as a floor for the regulation of large water-takings, filling regulatory holes that existed in some jurisdictions prior to the Compact/Agreement, and bringing greater regulatory standardization throughout the Basin. Much of the remaining policy divergence is accounted for by jurisdictions, such as Minnesota, Ontario, Québec, and New York, whose policies go beyond the standards required by the Compact/Agreement. So, although there is not regulatory uniformity, most of the divergence is positive in nature and does not detract from the harmonization created by the Agreement/Compact. In short, there is now much greater

State/Province	Regulation of Large Water-Takings
Illinois	Illinois' diversion of Lake Michigan water is limited to about 2.068 billion gpd (by Supreme Court decree).
Indiana	Permits required for withdrawals of more than 1 million gpd. Exceptions: the permitting threshold for withdrawals from salmonid streams is 100,000 gpd, and the permitting threshold for withdrawals from Lake Michigan is 5 million gpd.
Michigan	Permits required for withdrawals of 2 million gpd or more. Registration required for withdrawals of 100,000 gpd or more. Exceptions: permits required for withdrawals of 1 million gpd or more if a potential adverse resource impact is detected during the registration process.
Minnesota	Permits required for withdrawals of more than 10,000 gpd, withdrawals of more than 1 million gallons per year, and consumptive uses of more than 2 million gpd.
New York	Permits required for systems with a capacity to withdraw 100,000 gallons or more per day.
Ohio	Permits required for withdrawals of more than 1 million gpd. Exceptions: the permitting threshold for withdrawals from Lake Erie is 2.5 million gpd, and the permitting threshold for withdrawals from designated rivers is 100,000 gpd.
Ontario	Permits required for withdrawals of 50,000 Lpd (13,000 gpd) or more.
Pennsylvania	Permits required for withdrawals of 100,000 gpd or more and consumptive uses of 5 million gpd or more.
Quebec	Permits required for withdrawals of 75,000 Lpd (19, 500 gpd) or more.
Wisconsin	Permits required for withdrawals of 100,000 gpd or more. Additional permit required for withdrawals of 1 million gpd or more.

Figure 3. Regulatory Regimes for New or Increased Large Water-Takings (Anderson, 2012)

functional intensity than existed in the Great Lakes Charter days and this has contributed quite positively to transboundary capacity to govern large water-takings.

4.3. *Stability and Resilience*

Assessing the stability and resilience of the transboundary institution governing irrigation water-takings is quite speculative given that the Compact came into effect barely five years ago. Simply not enough time has passed in order to gauge adequately how this transboundary institution facilitates or impedes learning and adaptation. There are design elements of the Compact/Agreement, however, that are cause for optimism. One of these is the creation of the Council and the Regional Body, transboundary organizations with a lot of potential to facilitate information sharing and policy learning across basin governments. For instance, the Compact/Agreement requires that the state/provincial governments develop water resources inventories with information on both water supplies and water withdrawals within their respective portions of the basin, and that this information be collected by the Council and Regional Body to form a basin-wide water resources inventory (Hall, 2006, p. 441). In December 2013, these organizations used this information to complete the first-ever transboundary Cumulative Impact Assessment, examining “. . . the impacts resulting from all water withdrawals, diversions and consumptive uses from the largest source of surface fresh water on the planet—the Great Lakes-St. Lawrence River Basin”

(Great Lakes Compact Council, 2013) The inclusion of groundwater in the Compact/Agreement is also cause for optimism, as this should facilitate treatment of the basin's water resources in a more holistic and systemic manner than it has in the past. Nevertheless, as cautioned above, the Compact/Agreement is so new that, as yet, the capacity of these institutional elements to facilitate learning, adaptation, and resilience is largely untested.

Since the state/provincial institutions have a longer pedigree, some firmer conclusions can be drawn about their resilience. A key aspect of resilience with respect to irrigation is the ability to adapt and cope with periodic water shortages. As precipitation patterns become more variable in the changing climate, summer droughts and low flow periods are likely to become more common and more intense. Irrigation water demands usually increase during dry spells just as natural water supplies are dwindling, creating intense water use rivalries among irrigators and between irrigators and other water users. Accordingly whether the regulated riparian regimes can cope with recurring periods of acute water scarcity is an important part of overall transboundary resilience capacity.

In all regulated riparian regimes, including Michigan and Ontario, the courts have potentially important roles to play in managing periodic water shortages. Water-takings of all sizes (from both surface and groundwater) are subject to the limitations of the 'reasonable use' doctrine of the common law, with the courts determining what constitutes reasonable use in any given situation. Determining reasonable use often means prioritizing between different water uses, and this is where there is some uncertainty. Courts have typically prioritized domestic uses ahead of irrigation uses, and have traditionally treated competing irrigation uses as correlative rights that are equal in priority, requiring proportionate cutbacks in water use during water shortages. However, this is not a certainty (Gregg, 2002; Hall, n.d.). This uncertainty, combined with the reactive, expensive, and slow manner with which courts often deal with water disputes, means that they are not ideal for managing acute water shortages and are questionable in terms of their contribution to resilience.

Alternatively, some jurisdictions have developed drought management plans such as Ontario's Low Water Response Plan. The Plan distinguishes between three levels of drought/low water emergencies. During a Level I drought, the least severe of the three drought levels, the OME can encourage water users to undertake voluntary conservation measures. In a Level II drought, a Low Water Committee (comprised of relevant government officials) and local Water Response Teams (comprised of relevant local stakeholders) are created. These bodies are tasked to distinguish between 'essential,' 'important' and 'non-essential' uses in affected areas. In a Level III drought, regulators can impose 20% reductions in water-takings, presumably affecting only 'essential' and 'important' uses since 'non-essential' uses will already have been deprived of water at the Level II stage. (Ontario Ministry of Natural Resources et al., 2010). The Ontario Low Water Response Plan establishes a set of procedures for coping with water shortages and prioritizing water uses. By giving stakeholders a key role in determining priority uses during shortages, it should create buy-in from the most drought-affected groups, providing legitimacy to drought management efforts and contributing positively to the resilience of the regime.

Michigan has no comparable drought management plan but it does have a program for assessing proposed water-takings that seems to contribute to the potential resilience of the regime. The Water Withdrawal Assessment Process uses detailed and localized data on water supplies, streamflows, fish stocks and other environmental factors as well as sophisticated modelling to determine the potential impacts of proposed water-takings. When potential adverse impacts are detected, state regulators work with local water users to develop plans to mitigate these impacts, if possible. As water conditions change – due to the onset of climate change, increased water demands, or both – this program should be sensitive and responsive to these changes, facilitating learning and adaptation in water use and providing considerable resilience. Most other states/provinces do not have as sophisticated a system for evaluating large water-takings as the Water Withdrawal Assessment Process, and it will be interesting to see whether this program lives up to its resilience potential and, if so, whether other jurisdictions adopt it.

Finally, in terms of budget stability, both the Ontario Ministry of the Environment (OME) and the Michigan Department of Environmental Quality (MDEQ) have fared surprisingly well despite the economic turmoil of the past decade, suggesting continued governance capacity in both jurisdictions. In Ontario, between 2003 and 2013, the OME's annual budget increased by a substantial margin, from \$265.8 million to \$327 million, plus another \$159.3 million for the affiliated Ontario Clean Water Agency (Government of Ontario, 2003, 2013). This increased spending, and the creation of the Ontario Clean Water Agency, is a legacy of the Walkerton e-coli contamination in 2000 that tragically killed seven people, an incident that underscored the importance of effective water governance for the people and government of Ontario. In Michigan, the MDEQ's budget has held relatively steady over the past decade, from \$401.5 million in 2003 to \$432 million in 2013 (Government of Michigan, 2003, 2013). However, considering Michigan's recent economic decline and the fiscal austerity measures undertaken by its elected officials during this period, the MDEQ fared quite well. In fact, looking forward, the MDEQ may be in a better position than the OME: Michigan erased its budget deficit in 2013, while Ontario was still burdened with a nearly \$12 billion deficit, suggesting that OME's budget, and perhaps its governance capacity, are under fiscal threat for the foreseeable future.

4.4. Legitimacy

The institutions governing irrigation water-takings are somewhat uneven in terms of legitimacy, with a high level of self-defined legitimacy but only a moderate level of externally-defined legitimacy.

At the transboundary level, there is a high level of self-defined legitimacy, mostly due to the unusually rigorous process used to create the Compact/Agreement. This institution was the product of nearly a decade of intergovernmental negotiation; the negotiations were based on intergovernmental consensus and the Compact, in particular, went through a difficult ratification process involving all of the state legislatures and the federal Congress. The bar was set so high and the approval process was so rigorous, that only

an institution with a high degree of legitimacy amongst its signatory governments could be created. However, in terms of externally-defined legitimacy, the Compact/Agreement scores somewhat lower. In this sense, legitimacy derives from the extensive stakeholder and public consultations that were undertaken during the negotiation process, and from the small assortment of stakeholder groups that interacts regularly with the Council and Regional Body. However, most of the on-the-ground water users subject to the authority of the Compact/Agreement's provisions are only vaguely aware of its existence, and have no direct means of participating in its processes or holding it accountable. So, for everyday water users, such as irrigators, the legitimacy of the Compact/Agreement is questionable.

The same might be said of state/provincial institutions, many of which offer little participatory role for water users and are not directly accountable to them. There are some exceptions, such as Ontario's Low Water Response Plan which provides for stakeholder participation in the designation of priority water users when drought conditions occur. On the whole, the institutions governing irrigation water-takings may not have as much legitimacy as they could have, but they have enough legitimacy to govern without widespread protest or defection by key water stakeholders.

5. Conclusion

Overall, based on the same institutional indicators used to analyze the other cases, a relatively high level of transboundary governance capacity exists for the governance of irrigation water-takings in the Great Lakes Basin. Since the Compact/Agreement came into effect in 2008, the institutions governing large water-takings have become broadly enforceable and exhibit a considerable degree of functional intensity. Compared to the Great Lakes Charter, the Compact/Agreement also seems to have greater capacity for learning, adaptation, and resilience, though these conclusions are only preliminary given the relatively short time the new regime has existed. The Compact/Agreement also seems to have a considerable level of legitimacy, though this legitimacy is probably higher amongst the governments that created it than for the everyday water users who are ultimately subject to its provisions.

That the institutions governing irrigation water-takings have such a relatively high level of transboundary governance capacity is a bit counterintuitive. After all, as remarked at the outset of this article, irrigation water-takings are more of a looming water governance concern than a pressing water governance concern. Without a pressing sense of urgency, why has a high level of transboundary governance capacity developed around this issue?

The answer mostly lies in the way that irrigation water-takings have been bound with other water withdrawal and diversion issues. The governance of irrigation water-takings may not have had much sense of urgency, but the governance of inter-basin diversions has, given that some Great Lakes governments became very concerned about losing Great Lakes water to communities on the outer fringes of the Basin. These inter-basin diversion

fears emerged in the mid-1990s, around the same time that the weakness of the Great Lakes Charter in regulating within-basin consumptive water uses – such as irrigation – became evident during the Mud Creek Irrigation District conflict. The two issues were bound together by reform-minded political actors and, ultimately, were both included in the Compact/Agreement. So, the transboundary governance capacity that has developed for irrigation water-takings was built mostly on the coattails of efforts to build transboundary governance capacity for inter-basin diversions. In other words, fortuitous political circumstances significantly aided the development of transboundary governance capacity for irrigation water-takings, circumstances that most other water governance issues in the Great Lakes Basin have not yet enjoyed.

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