North American Transnational Groundwater Issues: Cooperation and Conflict

M.E. Campana[1], A.M. Neir[2], and G.T. Klise[3]

(1) Department of Geosciences, Oregon State University, 104 Wilkinson Hall, Corvallis, OR 97331-5506 USA, email: aquadoc@oregonstate.edu
(2) Golder Associates, Inc., 18300 NE Union Hill Road, Suite 200, Redmond, WA 98052 USA, email: aneir@golder.com
(3) Sandia National Laboratories, P.O. Box 5800, MS 0735, Albuquerque, NM 87185-0735, USA, email: gklise@sandia.gov

ABSTRACT

Transnational groundwater issues among Canada, the USA, and Mexico are being addressed using existing institutions and *ad hoc* approaches. The International Boundary and Water Commission (IBWC; USA-Mexico) and the International Joint Commission (IJC; USA-Canada) were originally established to consider surface water but have been adapted to consider groundwater. The North American Free Trade Agreement (NAFTA), implemented in 1994, may prove to be applicable to groundwater. Case studies illustrate specific examples and the issue of groundwater in the Great Lakes basin illustrates a more general situation. Examples of cooperation include the Abbotsford-Sumas aquifer (USA-Canada) and the Santa Cruz basin (Mexico-USA). A task force was created for the Abbotsford-Sumas aquifer to address water quality issues impacting both Canada and the USA. Mexico and the USA funded a study to address water quality problems in the Santa Cruz basin on the USA-Mexico border. NAFTA creates some interesting predicaments; the Hermosillo aquifer in the Mexican state of Sonora is a prime example. Although it is not a transnational aquifer, it supplies water for agricultural products that are in high demand in the USA due to the easing of trade restrictions. This increased demand has created internal conflict over the rights to and use of the water in the aquifer. An exception to bilateral transnational cooperation is the case of the Sierra Blanca nuclear waste facility in Texas. The USA's desire to site this facility relatively close to the border strained relations between Mexico and the USA. The IBWC, IJC, and individual stakeholder groups illustrate that transnational groundwater management is generally functioning well in North America. Although disagreements do exist, cooperation among countries is the general rule. The unknown is NAFTA's approach to groundwater as an economic good, which interjects yet another consideration into transnational groundwater management in North America.

Key words: transnational, North America, groundwater, management, cooperation

1. INTRODUCTION: INTERNATIONAL LAWS AND INSTITUTIONS

1.1 USA-Canada: The Boundary Waters Treaty of 1909 and the International Joint Commission

Transboundary water conflicts between the USA and Canada can occur all along the 8,000-kilometer border (Carroll, 1986). Rules concerning transboundary waters were created almost one hundred years ago with the signing of the Boundary Waters Treaty (BWT) of 1909. This treaty created the International Joint Commission (IJC) in Article IV, which is involved in administrative, quasi-judicial, arbitral, and investigative aspects of conflicts (Carroll, 1983). This mature governmental process includes scientific investigations into one country's impact on the water in another country and illustrates the results of an effective interface between government and science. However, this government-science interface is not always appropriately balanced; the IJC's power is limited to the role the governments want it to play—both governments must agree to request the IJC's intervention (Carroll, 1983). This can lead to an unbalanced interface when one country's stakeholders fail to persuade its government to bring the issue to the IJC for resolution; the government processes are more powerful than the societal processes.

The absence of groundwater from the treaty and the IJC's jurisdiction is a real issue. However, as Everts (1991) explains, both countries can agree to address groundwater issues. This has been done on a smaller scale, province to state, for the Abbotsford-Sumas aquifer underlying Washington, USA, and British Columbia, Canada (Campana *et al.,* 2007).

1.2 Mexico-USA: International Boundary and Water Commission

The USA and Mexico share an international border of 3,110 kilometers with river boundaries comprising around 66% of the border. The Rio Grande/Rio Bravo borders the USA state of Texas and

the Mexican states of Chihuahua, Coahuila, Nuevo Leon, and Tamaulipas for 2,020 kilometers. The Colorado River separates Arizona, USA, and Sonora, Mexico, for 27 kilometers. The international border between both countries was first established by the Treaty of Guadalupe Hidalgo in 1848, just prior to the end of the Mexican War.

The first border water issues dealt with the location of the international boundary. The Convention of November 12, 1884 was adopted to help deal with the ever-changing international boundary as a result of meandering by the Rio Grande and Colorado River (IBWC, 1884). Five years later, the International Boundary Commission was created in 1889 (changed to the International Boundary and Water Commission (IBWC) in 1944) to specifically deal with boundary and water issues (IBWC, 2005). The IBWC is also a mature governmental process that incorporates both scientific and societal processes into its decisions and actions.

Water use for irrigation was important to both countries and controversies surfaced in the late 1800s and early 1900s about the equitable distribution of water. The Convention of May 21, 1906 was the first treaty regarding water quantity and stated that the U.S. must deliver 74 million cubic meters (MCM) per year to Mexico via the Rio Grande (IBWC, 1906). The 1944 Treaty was more comprehensive and described specific actions that each country must take to reduce water sharing conflicts (IBWC, 1944). Water quality issues were addressed through the passage of "Minutes" or legally binding agreements between both countries. Specifically, water quality minutes addressed salinity from irrigation return flows and wastewater treatment plants on both sides of the border (IBWC 2005a; IBWC, 2005b).

1.3 North American Free Trade Agreement (NAFTA)

In 1994, the North American Free Trade Agreement (NAFTA) was adopted by Canada, Mexico, and the USA as a way of cooperating on trade issues. This agreement essentially removed tariffs to facilitate increased trading which would lead to greater economic opportunities for all three countries.

The parts of Mexico that stood to benefit the most from NAFTA are the states that border the USA Any USA or Canadian corporation could open a factory on the Mexican side and benefit financially from cheaper labor costs. 'Maquiladoras' (foreign-owned manufacturing facilities) had already been operating in Mexico since the 1960s, but they were required to take manufacturing wastes back into the country of origin. After the passage of NAFTA, the wastes could remain in Mexico. Given the differing environmental standards, many believed that the border area would become a dumping ground for USA companies who wanted a cheaper way to dispose of manufacturing wastes. However, the adoption of treaties and subsequent 'Minutes' have attempted to regulate these practices. This is an example using the government-science interface to restrain the economic emphasis of NAFTA.

2, NORTH AMERICAN TRANSNATIONAL GROUNDWATER: CASE STUDIES

2.1 Abbotsford-Sumas Aquifer

The Abbotsford-Sumas aquifer, in the Fraser River Basin, underlies British Columbia (Canada) and Washington State (USA); its water flows southward from Canada to the USA (fig. 1). The aquifer is unconfined and provides water for over 115,000 people (Mitchell *et al.,* 2003; Cox and Liebscher, 1999). The current concern is the high concentration of nitrate in the aquifer from agricultural practices in both British Columbia and Washington (Washington State Dept. of Ecology, 2003; Mitchell *et al.,* 2003). The presence of the Abbotsford-Sumas Aquifer International Task Force demonstrates the presence of cooperation (A-S Task Force, n.d.). This task force is the product of the 1992 Environmental Cooperation Agreement between the province and state and was created specifically to address aquifer transboundary problems (A-S Task Force, n.d.). The agreement covers the broad area of "groundwater protection" which can be expanded to include future issues.

An example of small-scale cooperation surrounding the protection of the aquifer is British Columbia's proposal to reclaim a gravel pit and transform it into Aldergrove Lake Regional Park, which would use biosolids and biosolids compost to re-vegetate the area (Van Ham *et al.,* 2000). The public on both sides of the border was concerned about the effects that biosolids would have on the aquifer's water quality in general and specifically for regions of the aquifer that people rely on for their drinking water (Van Ham *et al.,* 2000). In order to allay people's fears, open meetings were held and stakeholders (elected officials, Abbotsford-Sumas Aquifer International Task Force, residents within a one-kilometer radius of the park, and local and U.S. interest groups) were informed about the

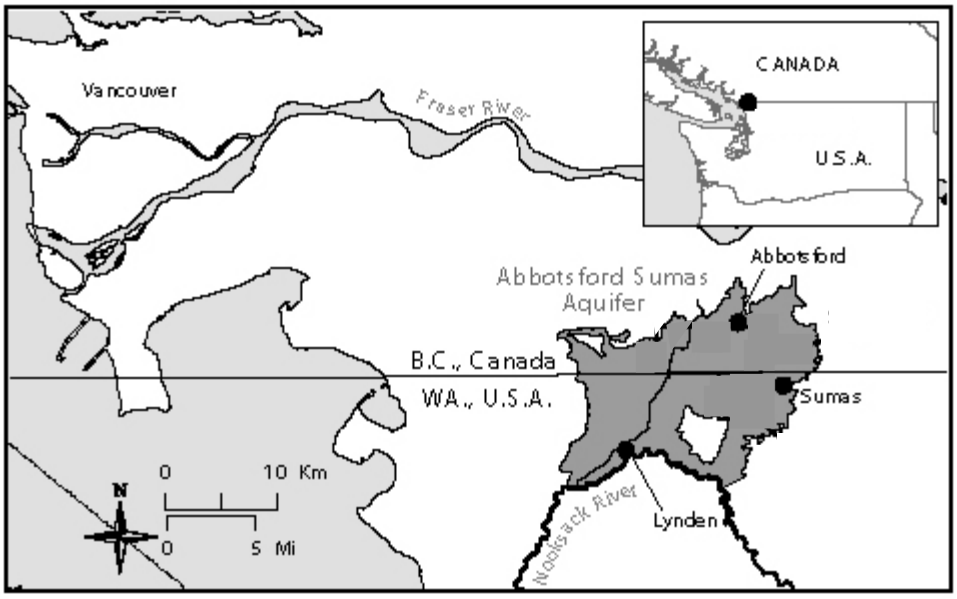

Figure 1. Abbotsford-Sumas aquifer, USA-Canada border.

project (Van Ham *et al.,* 2000). The project, which was shown to potentially improve the aquifer's water quality, was approved and demonstrates how open cooperation from the beginning of a project led to success. This open cooperation included governmental (the task force), societal (the initial concern and subsequent meetings), and scientific (the study on the impact of biosolids on the aquifer's water quality) elements. In this case, the elements were balanced—everyone was satisfied with the outcome and no element was used in isolation or at the expense of another element.

2.2 Santa Cruz River Basin

The border cities of Nogales, Arizona (USA) and Nogales, Sonora (Mexico) were the subject of a study completed by the Binational Technical Committee, headed by the Border Environment Cooperation Commission (BECC). This group, comprised of local, state and federal water agencies, developed a plan to mitigate wastewater runoff originating in Mexico and flowing into the U.S. (BECC, 2004). The purpose of this project is to fix existing leaky wastewater pipes on the Mexican side, which will in turn improve water quality in the Nogales Wash that flows into the USA. These actions used both government and scientific processes.

The project was jointly funded by the U.S. Environmental Protection Agency (EPA) and the Mexican government, and is an example of cooperation between both countries in response to deteriorating water quality on both sides of the border, and public health issues that arose due to the presence of untreated wastewater. This area was also the subject of the first binational groundwater quality monitoring project between the two countries and set the stage fixing the wastewater leaks in Nogales, Sonora (Castaneda, 1998).

Other aspects of this project will eventually bring more water to those on the Sonoran side by increasing groundwater pumping (Walker and Pavlakovich-Kochi, 2003). However, some in Arizona are worried that growing water use on the Sonoran side will lower water tables on the Arizona side, increasing pumping costs (Walker and Pavlakovich-Kochi, 2003). The direction of water flow in the transboundary aquifer is from south to north, with those in Sonora having the ability to use water first before it flows across the international border. This places those in Nogales, Arizona, vulnerable to the increasing population in Nogales, Sonora, especially since there is no agreement on the apportionment of groundwater. While governmental processes exist, an agreement would create more specific governmental processes in managing the transboundary groundwater in the Santa Cruz River basin. In addition, concerns by citizens on groundwater use may result in future societal processes playing a role in the management and instigating scientific studies on the impact of groundwater use by each country on the water table levels. This basin has all the factors required to create a trialogue (government, science, and society), but only two are currently in use.

2.3 Hermosillo Aquifer

The Hermosillo aquifer is located in the state of Sonora, Mexico (fig. 2) and does not straddle the USA-Mexico border. However, its use for agricultural production as a result of NAFTA has caused local conflict due to competing demands. This region typically grew crops for local consumption;

however, after the removal of trade barriers, many higher-valued fruits and vegetables replaced traditional crops and are primarily shipped to the USA for consumption. The change in what was produced led to the consolidation of many farms in the region with larger farms controlling most of the acreage. The resulting shift in agricultural production has placed a strain on the coastal aquifer with sea-water intrusion threatening many wellfields (Rodriguez, 2002; Steinich *et. al.,* 1998). At the same time, the municipal government has decided to expand its industrial sector and needs water to do so. The government proposed pumping salt-water from coastal wells and desalting the water; however, this has created tension with the growers who hold the current monopoly over the coastal aquifer.

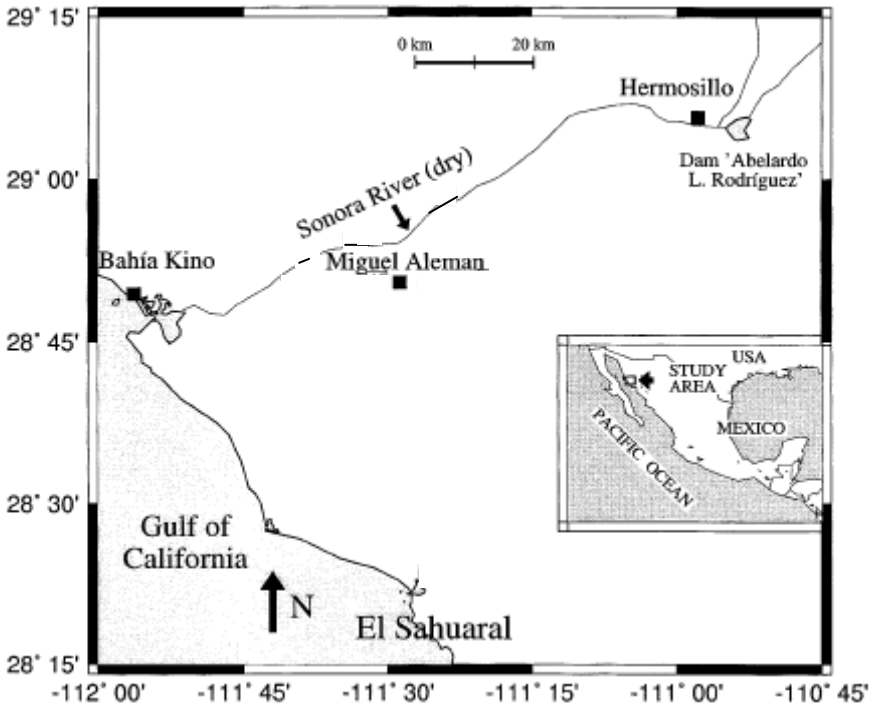

Fig. 2. Map of the Hermosillo basin (Steinich *et al.,*1998). Reprinted with permission.

This example shows the relationship among government, science, and society and how the decision will affect the different areas. This tension, as a partial result of trade between the USA and Mexico, leaves the aquifer vulnerable to over-exploitation and is a direct result of economic growth in the Hermosillo Valley. Any expansion can further reduce groundwater quality by drawing in more sea water. The government will have to decide if the value of new industry outweighs existing agricultural exports, and it may be that a switch to a different industry has a positive effect on the aquifer but might bring in less money to the region. The government knows the scientific and potential societal impacts of its decisions and must determine how to manage the aquifer in a "sustainable" manner so that the entire region does not suffer.

2.4 Sierra Blanca Low-Level Nuclear Waste Site

The issue of nuclear waste storage facility siting in the USA has created a great deal of tension between the USA and Mexico. In 1991, the state of Texas determined that a low-level nuclear waste repository would be built near the town of Sierra Blanca, approximately 25 kilometers north of the USA-Mexico border. Both USA and Mexican citizens heavily opposed this repository because it was to be located close to the international border in one of the most seismically active areas in Texas, right above an aquifer that discharges to the Rio Grande/Rio Bravo (Boren, 1997).

Those within Mexico who opposed the repository used the 1983 La Paz agreement as an argument against it. They interpret the treaty as banning the siting of new pollution-generating facilities. The U.S. Environmental Protection Agency (EPA) interpreted the agreement as requiring 'consultation and notification' (Boren, 1997). In the end, the facility was not built in Sierra Blanca due to a lack of

research into the geologic hazards and a lack of planning to understand the socioeconomic impacts to the surrounding community.

2.5 Great Lakes Basin

No treatment of transboundary groundwater in North America is complete without at least some mention of the Great Lakes, which straddle the USA - Canada border. Although the Great Lakes represent the largest reservoir of liquid fresh surface water in the Western Hemisphere – almost 23,000 km^3 (Galloway and Pentland, 2005) – little attention is paid to the groundwater resources of the region, whose volume is approximately equal to that of Lake Michigan, 4168 km^3 (Grannemann *et al.,* 2000). Despite the large amount of groundwater in storage, groundwater provides only about 5% of the total water use in the basin and relatively little is known of the quality and quantity of groundwater in the Great Lakes region. However, evidence indicates that groundwater is an important component of the water balance of the Great Lakes, either directly as seepage into the lakes or indirectly as baseflow of streams which discharge into the lakes (Holtschlag and Nicholas, 1998; Grannemann *et al.,* 2000). Baseflow contributions to streams entering the lakes range from a low of under 20% on the Canadian side to about 42% to both Lakes Ontario and Huron. Low contributions in Canada are the result of less permeable groundwater reservoirs (Holtschlag and Nicholas, 1998). Lake level changes can effect changes in the groundwater flow into/out of the lakes.

As discussed in Section 1.1, the Boundary Waters Treaty is silent on the issue of groundwater, although there is a way the IJC can consider groundwater (Everts, 1991). Certainly, the groundwater resources of the Great Lakes basin will come under increasing scrutiny as the competition for water becomes more intense among the basin riparians – two Canadian provinces and eight USA states. Climate change may also affect water availability. In the case of water transfers outside the basin, all the aforementioned provinces and states must concur. Not only will there be quantity issues, but also water quality and ecosystem health issues. Galloway and Pentland (2005) suggested that, by 2050, a variety of issues – climate change, unfettered diversions, overuse, pollution - could mount to the point that the social and economic fabric of the region would be adversely affected. The problems may be daunting, but the potential for solving them exists.

3. CONCLUSIONS

The adaptability of institutions such as the IBWC and the IJC and their ability to resolve bilateral disputes and promote cooperation between the countries is demonstrated in the examples of cooperation and conflict. Cooperation is demonstrated by the voluntary use of the institutional entities available to each country such that effective management of transnational groundwater resources is accomplished. Institutions like the IJC and IBWC, while not specifically established to consider groundwater, have managed to function properly whenever groundwater is an issue, thus effecting transnational groundwater management, if on an *ad hoc* basis (see also Neir and Campana, 2007; Campana *et al.*, 2007) There is no predetermined process that clearly defines the role of government, science, and society in transnational groundwater management; however, at least two of these three elements are usually used in making decisions and agreements. NAFTA has also shown that it, too, can affect groundwater, although in the USA NAFTA's approach to groundwater as an economic good may jeopardize the use of scientific processes. Groundwater needs more attention, and attempts to "fit" groundwater into existing surface water compacts and agreements should be eschewed.

4. REFERENCES

Abbotsford-Sumas Aquifer International Task Force (A-S Task Force) (n.d.) http://wlapwww.gov.bc.ca/wat/aquifers/absumas.html

Border Environment Cooperation Commission (BECC) (2004) *Wastewater Collection System Rehabilitation for Nogales, Sonora.* http://www.cocef.org/aproyectos/ExcomNogalesSonWW2004_07ing.pdf

Boren, R. (1997) Waste on the Way? *Borderlines* 37(5) No. 7. http://www.americaspolicy.org/borderlines/1997/bl37/bl37wast_body.html

Campana, M.E., Neir, A.M., Klise,G.T. (2007). Dynamics of transboundary ground water management: lessons from North America. *In* A.R. Turton, J. Hattingh, G.A. Maree, D.J. Roux, M. Claassen, and W.F. Strydom, (eds.), *Governance as a Trialogue: Government*

Society-Science in Transition. Water Resources Development and Management Series, Berlin: Springer-Verlag, pp. 167-196.

Carroll J.E. (1983) *Environmental Diplomacy: An Examination and a Prospective of Canadian-U.S. Transboundary Environmental Relations.* University of Michigan Press, Ann Arbor, Michigan

Carroll, J.E. (1986) Water Resources Management as an Issue in Environmental Diplomacy. *Natural Resources Journal* 26(2):206-220.

Castaneda, M. (1998) Binational Water Quality Monitoring Activities along the Arizona-Sonora BorderRegion In: *Proceedings of the NWQMC National Monitoring Conference – Monitoring: Critical Foundations to Protect our Waters.* 7-9 July 1998, Reno, Nevada. http://www.nwqmc.org/98proceedings/Papers/34-CAST.html

Cox SE, Liebscher H (1999) *Ground-Water Quality Data from the Abbotsford-Sumas Aquifer of Southwestern British Columbia and Northwestern Washington State, February 1997.* U.S. Geological Survey Open-File Report No. 99-244.

Everts T.M. (1991) *Canadian/American Transboundary Groundwater Issues: The Forgotten Resource*. Thesis/Dissertation, University of Oregon.

Galloway G., Pentland R. (2005) Securing the Future of Ground Water Resources in the Great Lakes Basin. *Ground Water* 43(5):737-743.

Grannemann N., Hunt R, Nicholas J, Reilly T, Winter T (2000). *The Importance of Ground Water in the Great Lakes Region.* U.S. Geological Survey Water Resources Investigation Report No. 00-4008.

Holtschlag D., Nicholas J., (1998) *Indirect Ground Water Discharge to the Great Lakes.* U.S. Geological Survey Open-File Report 99-529.

International Boundary and Water Commission (IBWC) (1884) Convention between the U.S. and Mexico. http://www.ibwc.state.gov/Files/TREATY_OF_1884.pdf

International Boundary and Water Commission (IBWC) (1906) Convention between the U.S. and Mexico.http://www.ibwc.state.gov/Files/1906Conv.pdf

International Boundary and Water Commission (IBWC) (1944) Treaty between the U.S. and Mexico. http://www.ibwc.state.gov/html/treaties.html

International Boundary and Water Commission (IBWC) (2005) History. http://www.ibwc.state.gov/html/about_us.html

International Boundary and Water Commission (IBWC) (2005a) Minutes 1-179. http://www.ibwc.state.gov/html/index.htm

International Boundary and Water Commission (IBWC) (2005b) Minutes 180-311. http://www.ibwc.state.gov/html/body_minutes.htm

Mitchell RJ, Babcock RS, Gelinas S, Nanus L, Stasney DE (2003) Nitrate Distributions and Source Identification in Abbotsford Sumas Aquifer, Northwestern Washington State. *Journal of Environmental Quality* 32(3):789-800.

Neir, A, M., Campana, M.E. (2007). The peaceful resolution of US-Mexico transboundary water disputes. *Economics for Peace and Security Journal* 2(2): 35-41

Rodriguez, J. (2002) *Aquifers and Free Trade; A Hermosillo Coast Case Study.* Red Fronteriza de Salud y Ambiente, A. C. and Texas Center for Policy Studies. http://www.texascenter.org/publications/sonora-english.pdf

Steinich B., Escolero O., Marín, L.E. (1998) Salt-water Intrusion and Nitrate Contamination in the Valley of Hermosillo and El Sahuaral Coastal Aquifers, Sonora, Mexico. *Hydrogeology Journal* 6(4):518-526.

Van Ham M,, Lee, K., McLean, B. (2000) *Pit to Park: Gravel Mine Reclamation Using Biosolids.* http://www.gvrd.bc.ca/nutrifor/pdfs/PittoPark.pdf

Walker M.P., Pavlakovich-Kochi, V. (2003) The State of the Arizona Border Region: Shared Pollution, Shared Solutions. In: *"Border Institute V" The State of the Border and the Health of its Citizens: Multinational Indicators of Progress*, 1990-2020. 28-30 April 2003. Rio Rico, AZ. http://www.scerp.org/bi/BIV/AZSon.pdf

Washington State Dept. of Ecology (2003) *Transboundary Water: Feasibility of Conducting Negotiations with Other States and Canada on Water Bodies Shared with Washington.* http://www.ecy.wa.gov/pubs/0311009.pdf