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GROUNDWATER LAW, ABSTRACTION, AND RESPONDING TO CLIMATE CHANGE

ASSESSING RECENT LAW REFORMS IN BRITISH COLUMBIA AND ENGLAND

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Groundwater Law, Abstraction, and Responding to Climate Change – assessing recent law reforms in British Columbia, Canada and England

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Abstract

In 2014, British Columbia enacted the Water Sustainability Act, a comprehensive overhaul of its ground and surface water regimes. Meanwhile, in England more piecemeal changes have been made to existing groundwater laws and policies. Through developing a framework from groundwater governance and climate change adaptation literature this paper analyses the effectiveness of these reforms, which have been carried out through different methods and from different starting points. The paper goes on to considers how new processes and technologies, such as hydraulic fracturing (fracking), bring fresh challenges in aligning progress in groundwater law reforms with the wider policy framework.

Keywords: Groundwater, Climate Change, Abstraction, Fracking, Adaptation, Water Sustainability Act

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Introduction

Climate change poses a significant threat to groundwater management around the world. The Intergovernmental Panel on Climate Change (IPCC) (2014, p. 237) has emphasised that climate change will lead to more extreme events, such as droughts and floods, at more frequent intervals. Perhaps most significantly, in relation to groundwater, recharge will become increasingly variable and uncertain. As groundwater recharge is impacted, this can lead to a situation of greater scarcity of water in specific locales, as the seasons are more extreme and demand for water also increases. Even without precise knowledge on the localised impacts, climate change will require a radical rethink of the assumptions upon which regulations have been made (Craig, 2010). Whilst groundwater issues are immediately critical in countries such as India, as well as arid climates such as Australia and California, other traditionally 'wetter' countries such as Canada and England are also feeling the impacts of climate change on groundwater resources.

In this paper, I analyse the effectiveness of law and policy reforms to groundwater abstraction and management in British Columbia, Canada and England in light of climate change. In particular, I examine British Columbia's new Water Sustainability Act in depth, with reforms in England providing a comparison.

Groundwater and Climate Challenges in British Columbia and England

The relationship between groundwater and climate change in both British Columbia and England is complex and uncertain. There is an overall paucity of research on the relationship, both globally and in the two jurisdictions relevant to this paper (Allen, 2009; Jackson, Bloomfield, & Mackay, 2015; Pike et al., 2012). Furthermore, the interactions between groundwater, climate variability, and ecological changes are complex. They can depend on aquifer geography, geology, and geometry. The physical aquifer conditions therefore matter greatly and can limit generalised accounts. Nevertheless, the limited research to date in British Columbia and England has identified a number of challenges. These challenges are of course geographically and regionally unique.

Temperature changes and seasonal climate variability will impact groundwater recharge. In BC, interior regions of the province will be particularly sensitive to climate variability, impacting environmental flow and groundwater recharge (Allen, 2009). Similarly, in England, whilst there is limited research showing systematic changes, there is some evidence of "multi-annual to decadal coherence" of groundwater levels and large-scale climate indices (Jackson, Bloomfield, & Mackay, 2015). Research in England has often focussed on particular sensitive regions. For example, Holman and Tarwick (2011) have observed the impacts of climate change in East Anglia, noting risks of short summer recharge.

A higher occurrence of extreme events, due to climate change, such as heavy rainfall can have an effect on groundwater recharge. Because groundwater is unable to quickly absorb heavy rainfall, there can be greater run-off and flooding. These impacts are difficult to quantify accurately for hydrologists, however they pose a challenge in both jurisdictions (Allen, 2009; Jackson, Bloomfield & Mackay, 2015). Extended periods of drought are also a climate risk in specific locales in England and BC. Additionally, a greater demand for groundwater due to factors related to a changing climate and a higher demand for water, from longer growing season and hotter drier summers, will increase demand and use of groundwater where surface water is not enough (Allen, 2009).

It is worth noting that there is an on-going challenge for law and policy frameworks in how they understand and incorporate climate and water security risks (Forsyth, 2012; Zeitoun et al., 2016). The many uncertainties and complexities of how socio-ecological systems work are often difficult to translate into simplified policy frameworks (Zeitoun et al., 2016). These points are out of the scope of this paper to explore, but is an area of further research and thought. Nevertheless, the trends observed and research to date fits into broader trends worldwide for an assessment of groundwater governance, in light of a changing climate (FAO,2016; Mechlem, 2016).

Why British Columbia and England?

There are a number of reasons why this paper considers groundwater reforms in these two particular jurisdictions. First, both jurisdictions have been active in making reforms in how they regulate groundwater. These recent reforms are thus the focus of the discussion in this paper, as opposed to being a thorough primer on groundwater law in each jurisdiction. Second, both jurisdictions are commonwealth legal systems representing a shared method of decision-making and water governance. England, of

course, represents the source of 'colonial water law' (Simms, Harris, Joe & Bakker, 2016, p. 6) and the modern riparian doctrine, which many jurisdictions have used as a starting point for regulating groundwater. Nevertheless, whilst BC has inherited a commonwealth legal system and a colonial water governance system, it has also adopted elements from North American water law such as 'rule of capture' or 'first in time, first in right' (FITFIR) in allocation. The FITFIR system gives priority in allocation to those who hold the most senior licence during times of scarcity.

Third, though there is a shared history between BC and England in water governance and legal systems, the two jurisdictions are at very different stages of groundwater regulation. In BC, the government is only just beginning to licence groundwater use. The Water Sustainability Act (WSA), which received royal assent in 2014 and came into force in 2016, represents a large overhaul and consolidation of the water management and allocation regime in the province. On the other hand, in England, groundwater over-abstraction has brought about a recognised environmental and social problem, particularly in areas such as the South-East of England where there is higher demand and relatively less rainfall (Environment Agency, 2013). Thirty-five per cent of groundwater bodies are at risk of not achieving the EU Water Framework Directive's 'good' groundwater quantitative status, which measures the balance between abstraction, recharge and available groundwater.[i] The government has proposed groundwater abstraction reforms to address the impacts of climate change. For BC, the WSA brings in broad changes to groundwater regulation for the 21st century. This provides an opportunity for BC to detach itself from previous eras where there has been a paucity of groundwater regulation. On the other hand, England's regulatory reforms have been done in a more piecemeal manner, providing a contrasting way that groundwater law reform has occurred. Thus the two jurisdictions provide an illustration of the benefits and challenges of reforming groundwater management, from different starting points.

Fourth, both jurisdictions have promoted new technologies and sought sources of energy that exert profound impacts on groundwater. In this paper, I discuss technological advances in relation to hydraulic fracturing ('fracking') for shale gas. BC provides a jurisdiction with a well-developed fracking industry; however, as will be explored, without well-developed or scientifically based regulatory oversight. This provides potential lessons for England in its governance of fracking in relation to water. Both jurisdictions also highlight the issues of (in)coherence between energy and water policies.

Finally, whilst this is an examination of two commonwealth jurisdictions and their responses to, and in light of, climate change, it is important to point out that the two countries are different with respect to scale, geography, and geology. Nevertheless, in both jurisdictions groundwater has an important role for social, economic and environmental reasons. In England, groundwater plays a particularly important role in the southeast of the country (Environment Agency, 2013). In BC, despite the relative abundance of surface water, groundwater is an important source of drinking water and in some areas is the only viable source of water supply (Wei & Allen, 2004). This paper aims to contribute towards a more global discussion on groundwater law and climate change through an examination of the recent groundwater law and policy reforms in both contexts, highlight some insights offered by comparative analysis.

In the next section, I examine how groundwater law and policy can, in general, respond to climate change. The discussion below will then be used as a framework to examine BC's Water Sustainability Act and groundwater abstraction reforms in England.

Responding to Climate Change and the Role of Groundwater Law

Groundwater Law in Context

In both jurisdictions, groundwater has taken a secondary role to surface water in water law and policy. This is consistent with trends around the world. As Mechlem (2012, p. 5) notes " historically water legislation has focused on surface water resources, among other reasons because the state of groundwater is unseen, the resource is ubiquitous and aquifer systems respond over time creating less immediate regulatory pressures. Groundwater legislation has lagged behind. In many countries it remains fragmented, incoherent or simply ignored."

Groundwater Law and Governance in Light of Climate Change

The impacts of climate change on water management and specifically on groundwater management has become an increasingly important issue in water law scholarship (Dellapenna, 2010; Keessen & van Rijswick, 2012; Mechlem, 2016). Water law scholarship has often used climate change adaptation literature as a framework to argue that particular procedural and substantive concepts must be built into water law (Keessen & van Rijswick, 2012). The broader issues with groundwater globally have also seen a rise in groundwater governance literature, focusing on building principles and actions necessary to manage groundwater in a sustainable and equitable way. Law plays a central role in groundwater governance through embedding some of its principles into legislative and regulatory regimes (FAO, 2016). For the purposes of this paper, I identify six salient aspects that arise from both water law, climate change adaptation, and groundwater governance literature which may be used to assess recent groundwater law reforms in BC and England.

Firstly, flexibility in water law enables a system to cope with sudden changes in circumstances. Flexibility in water allocation is also important to ensure that water can be reallocated to more valuable uses, both from a societal and ecological perspective (Miller et al., 1997). On the other hand, the rule of law demands certainty and water users also have historically demanded certainty in their rights. Flexibility also means being able to adapt and change course on the basis of new information acquired (Keessen & van Rijswick, 2012). This also means building in mechanisms to allow regulators to adjust groundwater use rights depending on availability of water, where possible without compensation, and termination on the basis of environmental damage (FAO, 2016, p. 51). The historical inability of groundwater law to be flexible, through groundwater being tied to land property rights, is a major reason for multiple water crises today.

Secondly, participation in information sharing and decision-making is a widely recognised element in effective water governance. To enable regulators to make informed decisions, through regulations that are flexible as described above, comprehensive information is critical. Along with data gathering by the government, local knowledge and public participation are key elements of gaining such comprehensive information. Participation is a broad area in the governance of natural resources and generally, effective public participation in groundwater governance

helps ensure legitimacy of decision making and better planning for groundwater goals (Mollenkamp & Kasten, 2009). Nevertheless, for participation to be effective, it requires the continued involvement of the government, in terms of facilitation, financial and institutional support (FAO, 2016).

Thirdly, an effective legal framework is required to deliver groundwater objectives (Keessen & van Rijswick, 2012). Various factors can contribute to an effective legal framework. The key point however is that legal frameworks operate in a way to facilitate climate change mitigation and adaptation, rather than hamper it. This means effective enforcement of laws through responsive and well-resourced regulators. As the Global Framework for Action to Achieve the Vision on Groundwater Governance states, no matter how strong laws and regulations are on paper, "it is their acceptance, implementation, administration, and enforcement that eventually make the difference" (FAO, 2016, p. 52). Accordingly, "the capacity of government officials, of local users and of potential polluters to internalize the prescriptions and directions of the law is critical to the ultimate effectiveness of governance arrangements, and must be carefully nurtured" (FAO, 2016, p. 52).

Fourth, it is vitally important for groundwater law to recognise the connection between surface water and groundwater systems, as well as between groundwater and environmental flow. Historically, surface water and groundwater have been considered separately. Environmental flows describe the timing and amount of water to be retained in lakes, rivers, streams, and estuaries to sustain seasonal patterns of high and low water levels needed for natural functions, processes and resilience to persist (Kendy, Apse, and Blann, 2012). As surface water and groundwater are interconnected, environmental flows have impacts on groundwater.

The relationships between abstractions, groundwater level and river flow are often complex. There is a long lag-time in groundwater systems; hence often by the time a policy response is made, the impacts on groundwater systems would already be felt (Dyson, Bergkamp, & Scanlon, 2003, p. 29). This also emphasises the need for flexibility in regulation and an effective legal regime. Modifications to environmental flows through human activity affect the functioning of aquifers. Thus, allocation and utilisation of water from competing uses must consider environmental flows to ensure the sustainability of aquifers. Climate variability means that careful planning and decision-making around environmental flows, as well as conceptually linking groundwater and surface water to ensure that laws and regulations are in line with ecological baselines.

Fifth, protection of groundwater quality is essential. The impacts of climate change, such as temperature changes in water can have negative effects on water quality. Furthermore, floods, droughts and other impacts also increase the risk water pollution. Water pollution also has a direct link to water quantity, as a reduction in one affects the other. Protecting water quality requires monitoring, as well as other legislative tools such as setting quality targets in relation to various water uses, classifications of water bodies, reducing and regulating abstraction, prohibitions and limitations on emissions of certain substances, permitting of wastewater discharges, as well as land-use rules to control 'non-point' sources of pollution (Mechlem, 2016, p. 11). Along with groundwater law, broader criminal, civil, and administrative law can play an important role in regulating the protection of groundwater quality.

Finally, it is essential that linkages are made between groundwater and other areas of law and policy. Groundwater is physically connected to a wide range of human activities and the historical division of groundwater from society has been a major cause of current water crises. There is an urgent identified need for law and policy in different sectors to align under common principles of climate change adaptation and groundwater governance (FAO, 2016). In this paper, I will discuss this final point in relation to the link between new technologies, energy and water. I will explore how BC and England's water laws and policy reforms align with corresponding fracking policies. Energy and water policies have historically been looked at in isolation and this lack of attention is problematic as a constraint to one is intrinsically linked to the other (King, Stillwell, Twomey and Webber, 2013).

With the above discussions and framework in mind, I now examine the reforms through the Water Sustainability Act in British Columbia, as well as recent law reforms to groundwater abstraction and management in England.

Recent Reforms in British Columbia

Background

In 2014, after a four-year process that included a thorough consultation, discussion papers, policy proposals, and a proposed legislative framework, the provincial legislature in BC passed the Water Sustainability Act (WSA). The WSA is a major overhaul of the water regime in the province. The drivers for reform were population growth, increased water demand, changes in land use, and climate change (British Columbia Ministry of Environment, 2010).

For the first time in its history, groundwater users in BC must now obtain a license and must pay fees, with the exception of individual household wells, which will not be licensed or charged (WSA, s 6). Under the WSA, groundwater licences will be issued to all existing and new users of non-domestic water. Licenses are attached to land and a limited number of activities qualify for licenses (WSA, s 9). Licence holders may use water for conservation, industrial, domestic, irrigation, land improvement, mineral water extraction, mining, oil and gas, power, storage and waterwork construction purposes. Licensed users must make "beneficial use" of the water, but if they fail to do so for three consecutive years their license may be cancelled (WSA, s 30). Those using groundwater for domestic purposes do not need to apply for a licence, however, there is flexibility in the WSA to allow for licensing for domestic users, through area-based regulations, which could be important in zones of significant water shortages (WSA, s 136).

Groundwater rights, licences, fees and allocation

As stated earlier, WSA maintains an allocation priority based on FITFIR, which has operated to date. This means that if there is a conflict in water use, especially in a situation of water scarcity, the oldest rights are protected first over junior rights. Existing groundwater users have a three-year transition period to seek a licence based on their historic date of first use and their on-going use of groundwater for non-domestic purposes (domestic use is exempt from requiring a licence).[ii] Accordingly, existing well users have until 2019 to submit evidence of their historic use of groundwater to gain senior licence priority. Applications after this date will be treated as 'new' licences.

From a climate change perspective the upholding of FITFIR is problematic because it is a priority allocation based solely on being the first to extract. Such a method of allocation is based on principles of politics and power, on who is 'first', rather than being in line with any sustainability or equity consideration (Singh, 1991). The BC Government estimates that there are about 20,000 existing groundwater wells that supply groundwater for non-domestic uses (Government of British Columbia, 2015a). The regularisation of these wells, which could mean up to 20,000 new licences, all with senior rights based on historical first use, and assessing the cumulative impacts of these existing groundwater uses (as well as future uses) on both ground and surface water systems will be a major challenge.

In issuing groundwater licences for existing and new uses, the regulator must consider impacts on environmental flows. However, interestingly, this was initially not included in the regulations (Government of British Columbia, 2015a, p. 4). There is very little else in the WSA and associated regulation that guides the terms and conditions that may be applied to meet such a challenge. The risk remains that such licences will be entrenched with seniority based on historical first use, rather than adequately considering impacts on future climatic stresses and demands.

However, two aspects of the WSA counteract some of the worst-case scenarios of FITFIR. Firstly, where there is a risk of an area falling below critical environmental flow thresholds, a temporary protection order can be issued to stop abstraction (WSA, s 86-88). Secondly, there is a "no compensation" provision in the WSA, according to which water rights holders are not entitled to any compensation if there is a change, restriction or prohibition on the exercise of the rights, or any imposition of new terms and condition on an approval (WSA, s 121). This is important because it reduces the substantial monetary concern that may affect a Government decision in altering a water right because of unsustainable abstraction. Therefore, whilst the FITFIR model is maintained, these flexibilities do allow the government room for manoeuvre depending on varying climate-related scenarios.

The fees and charges associated to groundwater licenses remain a concern. The charges and fees are relatively low for industrial users, highlighting again the importance of appropriate policy decisions to match the potential of the WSA to deliver good groundwater governance. This has raised a great deal of public concern (Woo, 2015). Undercharging industrial groundwater use would significantly undermine the effectiveness of the licencing regime in BC. In recent years there have been significant concerns about companies such as Nestle, extracting millions of litres of water for free, even during drought conditions (Woo, 2015). Whilst a discussion on the pricing of groundwater is beyond the scope of this paper, the important point is that adequate pricing is important to manage groundwater abstraction sustainably and ensure correct price signals are given to industry.[iii] This includes for example, regionally differentiated abstraction charges, such as how abstraction charges are in England, taking into account regional scarcity. The effectiveness of the licencing regime in BC would be significantly undermined by inappropriate charges, however, as the WSA is so recent, its verdict on delivering adaptive groundwater management will only be realised in time.

Participatory Governance and Consideration of Environmental Flows

Improving Information and Knowledge on Groundwater

Groundwater data in BC is currently extremely poor and has been found to be "insufficient to enable it to ensure the sustainability" of water resources (Office of the Auditor General of British Columbia, 2010, p. 2). The WSA makes efforts to improve this through increasing participation and transparency in the process of data collection. First, there are obligations on licence holders to submit quantitative and qualitative data (WSA, s 57 and s 15). Second, water users are required to provide additional detailed monitoring and reporting information in water scarce areas through WSP or area-based regulations (WSA, s 17). Data submission is not mandatory for domestic users, but they will be encouraged to register their wells. However, if a specific area becomes particularly water scarce, the regulator has the power to enact regulations which require domestic users to also provide such data (WSA, s136(1)). Hence, the WSA builds in the ability of the regulatory to be flexible to changing conditions. Overall, whilst information and data will remain a key gap in groundwater governance for BC for a while, the WSA makes significant strides to set up a framework to gather information. In the long term, data will be vital to making governance decisions in light of climate change.

In the next section, I will discuss briefly the background of groundwater abstraction and management system in England, and then discuss how recent reforms provide a contrasting comparison to the major overhaul of groundwater governance in BC.

Recent Reforms in England

Background

In England, the main aspects of the system for managing abstraction of water from aquifers were introduced through the Water Resources Act 1963. Most abstractors were given a licence to extract a fixed volume of groundwater, regardless of availability and with no assessment of environmental impacts. Licences were not issued on any scientific basis, as it was assumed that water was a free and plentiful resource. They were issued as the licence applications came in (Sowter & Howsam, 2008). Allocated volumes were based on amounts that had previously been abstracted and on the capacity of abstraction equipment.

Since 2000, reforms to the system have been driven by the EU Water Framework Directive, which has influenced an ecosystem-based approach and has transformed the way water institutions plan and manage groundwater. The Water Act 2003 brought into focus efficient and sustainable water use, time limitations on new abstraction licences, mechanisms to help licence trading, flexibilities in types of licences, and the de-regulation of licensed abstractions of less than $20m^3$ a day. Exemptions were also introduced for certain types of abstraction, which were seen to have no significant impact on water quality, and for certain geographical regions. Thus the regime in England represents a hybridised version of the regulated riparian regime (Dellapenna, 2010).

Under the current regime, applications for new licenses are assessed with reference to the amount of water available in a particular 'catchment', in accordance with the Catchment Abstraction Management Strategy established in 2001 (a strategy derived

from the European Water Framework Directive). All new licences since 2001 are time limited (mostly to 12 years). However, the licences are subject to renewal as long as they meet tests of environmental sustainability, and there is a continued justification of need for water, as well as efficient use of water. This system of abstraction is to be reformed through the proposed changes announced in 2016, as discussed below.

Groundwater abstraction reforms since 2011

In 2011, the Government released a white paper called *Water for Life* highlighting the issue of over-abstraction, water scarcity, growing demand and climate change, and calling for reform. Since then, the Water Act 2014 has introduced important, yet incomplete, reforms. In January 2016, further abstraction reforms were announced ("2016 Reforms"), which signalled an important shift in how groundwater abstraction would be regulated (DEFRA, 2016a).

Three important changes were enacted through the Water Act 2014: first, to place a primary duty of 'resilience' and efficient use of water upon the Office of Water Services (OFWAT), which is the body responsible for the economic regulation of water (i.e. pricing, investment and management of the privatised water industry in England); second, the Act introduced provisions relating to the bulk supply of water, to encourage water trading; and third, it provided for no compensation for water companies whose abstraction licenses are varied or revoked on environmental grounds. These changes can be linked to the Environment Agency's programme of 'restoring sustainable abstraction'. Meaningful reform, however, has been postponed till after 2020, with a legislative requirement that a report is tabled in Parliament by May 2019.

Under the 2016 Reforms, abstraction licences will be linked to the availability of water and flows, rather than being seasonal or time-limited. Licences will be based on a 'risk-based catchment approach', so that if water availability is limited it can trigger a review if certain thresholds are met. Importantly, all data will be available to the public, to enable abstractors to understand environmental risks and the likelihood of reviews being triggered. Other changes include the continued liberalisation of water trading by allowing 'pre-approved' trades, so that permit holders can trade water faster when availability is low. The 2016 Reforms are likely to be brought into law in the early 2020s, as part of the wider water abstraction reform.

The Government is considering bringing exempted abstractions into the licence control regime (DEFRA, 2016a). Currently, a number of abstractors are exempt from licence requirements, because their activities are seen as exerting little impact on water quality. This together with allowing exempted abstractors access unlimited water quantity despite water scarcity in given areas, such as areas in the South East of England (DEFRA, 2016b), has generated a situation where water abstraction is now leading to environmental damage. If brought in, these changes will impact surface water abstractors primarily (who are the majority of water users with exemptions, and will now have to get licences); it is nevertheless a move towards providing for a single system for all water abstractions. It would be in line with the BC regime, which provides one system for all abstractors (except domestic users), with flexibilities, reviews and other mechanisms built in to adapt to varying circumstances and environmental changes.

Effectiveness of changes

The 2016 Proposals also signal a strong move towards a more transparent system, which will strengthen the effectiveness of the law to adapt to climate change. The most significant move is the catchment review trigger system, discussed above. DEFRA has proposed that the Environment Agency (EA) will publish data and information on key indicators in catchments so that abstractors and others are aware of the state of their catchment water asset and of the likelihood that a review could be triggered (DEFRA, 2016a). Accordingly, the increased transparency will provide certainty for abstractors and flexibility for regulators.

The overall effectiveness of the proposed changes is contingent on a responsive regulator. Unlike a time-limited approach, reviews are now to be carried out in a more dynamic fashion. Other changes discussed above such as, the power to review and revoke abstraction licences for environmental damage, and the increase in abstractors brought under the licensing scheme, require a responsive and pro-active regulator. The law and policy being appropriate to adjust to a changing climate depend on this function. Accordingly, it is important to point out that whilst the Government has been slowly reforming the water abstraction system, it has also reduced funding for the department responsible for regulating water abstraction. According to some analysis, DEFRA has had the largest proportionate cuts of all government departments in real terms (Howard, 2015). Whilst I have focussed on legal reform in this paper, it is important to point out that reducing the capacity of the regulator is likely to have a significant impact on the effectiveness of those laws and policies. In effect, such wider policies have the effect of creating climate vulnerability.

Discussion

In BC, the WSA is a robust and progressive legislation for groundwater management. It exhibits most of the characteristics identified earlier in this paper for a legal framework that is able to respond to the challenges and uncertainties of a changing climate. A number of issues still remain, however. Foremost is how it balances ecological and social considerations with its FITFIR priority allocation system, particularly for historical uses that can apply for seniority till 2019. Terms and conditions of such licences, as well as careful consideration of cumulative effects on aquifers, will be important to ensure that the scope for reforming groundwater abstraction that the WSA has provided is not neglected.

On the other hand, in England robust reforms have essentially been postponed until 2019. The reforms that have happened to date have seen small changes consisting of the introduction of environmental principles into a water abstraction regime built more on property rights than anything else. The removal of compensation for licences that are deemed to carry out environmentally damaging activity is significant in trying to address this.

In both jurisdictions, the legal framework requires a responsive regulator. In BC, the challenges for a regulator are to use flexibility and water management tools that the WSA provide. In particular, the ability to have comprehensive water sustainability plans in sensitive areas, such as those in the inner BC, which is susceptible to drought (Natural Resource Canada, 2016) and northeastern BC where is greater shale gas exploration (Government of British Columbia, 2015b). Similarly, in England, enforcement will become an important element of groundwater management. The

proposals to have a dynamic review system are also a move, which shifts the licensing regime towards a regime based on principles of environmental integrity. However, reforms in England, given the long recognised issues of over-abstraction, seem to be moving a lot slower than what is required to keep up to climate change considerations.

Increasing transparency, and development of comprehensive information have become an important priority for both jurisdictions. In BC's case, developing this information is a 'catch-up' exercise. Whilst the government will publish a 5-year report on water in the province, transparent records that have trigger mechanisms to review licences for particular regions could generate a system that may be used in particularly sensitive areas in the future. These mechanisms could be development through the water sustainability plans. In England's case, the government has maintained information on groundwater for far longer, and it is now developing greater transparency, such as through publically available information linked to a dynamic review system. Much can be learned from both jurisdictions.

Coherence of Law & Policy Responses: Groundwater and Regulating Fracking

Why explore the role of fracking?

Whilst both jurisdictions have made the reforms discussed above, with an eye on climate change challenges, further issues come from a disjuncture between groundwater regulation and wider economic and energy governance. To explore an example of this, this section will discuss fracking and the regulation of fracking in light of groundwater use. The coherence of groundwater governance and laws and regulations that promote fracking is of vital importance in light of climate change, to ensure that efforts made to reform water law and policies, discussed above, are not undermined through unsustainable practices by the fracking industry. The purpose of this section is to illustrate the importance of such alignment. As mentioned earlier there is an urgent need for law and policy from different sectors to align under common principles of climate change adaptation and groundwater governance (FAO, 2016). Hence, this section illustrates the challenges that lie in aligning water legislation that is based on principles of good groundwater governance, with wider regulation of the energy industry.

Relationship between fracking, groundwater and climate change

The relationship between fracking, groundwater, and climate change is multi-dimensional. Shale gas has gained importance in recent years because it has been promoted as a 'transition fossil fuel' to reduce carbon emissions. As part of their commitments to reduce carbon emissions, governments have been looking towards new forms of energy. Renewable energy, the use of nuclear power, carbon capture and storage, and so-called 'transition' fossil fuels such as shale gas are among the methods countries are using to reduce their emissions. In the US in particular, shale gas exploration through fracking has caused an energy boom and has been seen as a powerful tool for reducing carb emissions. Both England and Canada have included shale gas as forming part of their current and future energy mix. However, the use of this new form of energy has been challenged on the grounds that fracking represents a risk to groundwater quality and quantity ("America's falling carbon-dioxide emissions", 2012). Fracking has thus formed part of the carbon mitigation rhetoric and policy choices of governments.

Fracking however poses an issue for both water quality and quantity. Fracking involves the extraction of oil and gas from 'shale' rock formations by injecting fluids into the earth at high pressure (Department of Energy and Climate Change, 2014). In relation to water quantity, estimates for how much a typical drilling operation uses can vary between 2 million and 8 millions gallons of water (Department of Energy and Climate Change, 2014; Flatt & Payne, 2014). Importantly, the vast majority of the water used is entirely removed from the hydraulic cycle because it either stays in the formation where it was injected or is introduced into a waste disposal well (Flatt & Payne, 2014; Cooley and Donnelly, 2012). The high volume of water removed has the potential to put considerable stress on water resources at a local level, especially in areas already under pressure (Wood et al., 2011). Aside from this, groundwater contamination is an identified risk in fracking, which has important public health ramifications (Department of Energy and Climate Change, 2014).

British Columbia: different rules for the fracking industry?

In BC, the Oil and Gas Commission (OGC), rather than the Ministry of Environment has an important role in regulating the fracking industry's water use. This is because the industry has widely used short-term water use approvals under section 8 of the Water Act 1996 (henceforth 'section 8 approval'). The OGC has delegated authority to administer the Water Act in relation to the oil and gas industry. Through this power, the OGC engaged in a practice of issuing section 8 approvals recurrently. Thus, the OGC effectively turned what is intended to be a short-term approval, into a medium and longer-term approval for industry through issuing consecutive short-term approvals. Environmental groups unsuccessfully challenged such recurrent issuing of section 8 approvals at the BC Supreme Court in 2014 (*Western Canada Wildnerness Committee v British Columbia (Oil and Gas Commission),* 2014 BCSC 1919). The WSA, which succeeds the Water Act, now clarifies that a short-term water use approval can be renewed up to a period of 24 months. Thus, the fracking industry will continue to use such approvals through the OGC.

The OGC was created in the late 1990s to specifically support the development of the extraction industry. The Ministry for Environment oversees groundwater management in the province more generally. Under the regulations to the Oil and Gas Activities Act 2008, the OGC must consider the 'government environmental objectives' regarding water, including not allowing the operating area to be located within an identified groundwater recharge area, or on top of an identified aquifer, unless there is no material adverse effect on the quantity, quality and the natural flow of water (Environment Protection Management Regulations (under the Oil and Gas Activities Act), clause 4). Users are also required to record the amount of water actually withdrawn under section 8 approvals as well as disclose chemicals that are used in the hydraulic fracturing process, and this information is now publically available (Campbell & Horne, 2011).

Whilst the considerations above do make some linkages between groundwater protection and fracking processes, a wider concern is that of coordination and harmonisation between the OGC and the Ministry of Environment. As the licencing regime for groundwater currently stands, a significant portion of groundwater use will remain regulated by the OGC through section 8 approvals. The OCG has suffered criticism over its effectiveness to enforce environmental regulations. Collection of

data necessary to make informed decisions remains a large gap for the OGC. Section 8 approvals also do not set any limits to the amount of water to be pumped per day, either absolute or relative, and guidelines on the subject are not provided in the Manual for the regulator (British Columbia Oil & Gas Commission, 2014).

There is an urgent need for the OGC to have strong guidelines based on basic principles of environmental law, rather than economic efficiency. As a single window system for the fracking industry, there is a considerable amount of power in a single authority to both promote oil and gas activity and to enforce environmental regulation and oversight. This is often criticised as an inherent institutional problem for OCG (Campbell & Horne, 2011). More specifically, there are harmonisation issues between having different regulators for groundwater dependent on the activities (Ernst & Young, 2015). This has seen, for example, a disjuncture between instances of "non-compliance", and enforcement – that is, despite numerous instances of "non-compliance" by the industry, enforcement levels remain relatively low (Hoekstra 2013).

England: fracking and greying groundwater governance

Fracking for shale gas in England is still in the exploratory phase. Shale gas exploration has been explicitly mentioned as part of the government's plans to decarbonise (Department of Energy and Climate Change, 2015b). Despite streamlining several functions in the permitting process for shale gas operation in the UK, groundwater permitting and licencing will still be through the Environment Agency. Therefore, fracking processes will be subject to the same environmental permitting regime for groundwater abstraction as other industry and users.

Recent reforms have raised concern around protection of sensitive groundwater aquifers from fracking. The Infrastructure Act 2015 brought in a range of reform for large-scale infrastructure projects, including fracking. Under the Infrastructure Act, an environmental safeguard is placed on fracking in preventing fracking in "protected groundwater source areas". However, this safeguard is unhelpfully vague as there isn't a definition of what such an area is. It is expected that a definition will be provided through follow up regulations. However, this was a political U-turn on an earlier proposal to prohibit fracking all-together within key 'groundwater source protection zones' (Friends of the Earth 2015). Groundwater source protection zones are legally defined as sources of groundwater that are close to drinking water, and thus have public health sensitivity to contamination.

Fracking and the challenges for groundwater governance

Aligning energy policies with groundwater governance needs is still an issue in BC and England. For BC, by enabling an authority other than that responsible for water resources - the OGC - to govern groundwater, the legal framework effectively reduces the ability of the Ministry for Environment to make use of the groundwater-related provisions of the WSA. There is an urgent need for governance of groundwater exploitation by the fracking industry to align with the principles of the WSA. In England, political decisions of Parliament have prevented certainty from an environmental point of view as regards fracking activities in sensitive groundwater areas. Overall, both jurisdictions show a disjuncture between the principles of good groundwater governance and climate change adaptation that should regulate groundwater decisions and the political and economic decisions of government.

Conclusions

The recent reforms in groundwater law BC and England have taken steps towards addressing the challenges of a variable and changing climate. The WSA in BC represents a progressive legislation that was long overdue in the province. Groundwater abstraction regulation in England, however, presents a number of innovations such as catchment based licencing, seasonal licences, and the proposed dynamic review systems, which could also be built into the WSA framework in the future.

In both jurisdictions, certain trends can be observed. Moving beyond historic groundwater rights that have been granted without regard to social or environmental considerations is a major challenge in both jurisdictions. Balancing the security of groundwater rights tenure with the challenges of climate variability will continue to be an issue in BC with a 'first in time, first in right' groundwater rights allocation. The various flexibilities and legislative tools that are in the WSA will thus be imperative in future climate and water scenarios.

In both jurisdictions, the importance of a responsive regulator has been highlighted. This will require proper financial support to enable the regulator to function effectively. Finally, in both jurisdictions, political decisions around energy and fracking have the potential to undermine the broader groundwater law and policy reforms. There is a need therefore for greater co-ordination to ensure the fracking sector does not exacerbate groundwater depletion and degradation. In light of policy responses to climate change, energy and water must be considered together.

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[i] For more information on EU Water Framework see: European Commission (2016).

[ii] A significant outstanding issue is of First Nations rights and the FITFIR system. This paper does not discuss this issue. However, indigenous peoples water rights have been a neglected by post-colonial governments. In BC, the Government has missed an opportunity to include this explicitly in the Water Sustainability Act. This will potentially create future legal and operational issues. See also: Brandes & Curran (2016).

[iii] For more on water pricing and sustainability see: Sjödi , Zaeska, & Joyce (2016) and Rogers, de Silva & Bhatia(2002).

[iv] For more information on indigenous water governance in BC and Canada see: Simms (2015) and Bradford, Ovsenek, & Bhardwaj (2016).

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