Approaches to Resolve Conflict and Support Collaborative Decision Making in Participatory Transboundary Watershed Management

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Abstract

Transboundary watersheds are often such large and complex systems that no one person can have complete knowledge of the hydrological, environmental, political, legal, economic, and social processes that interplay within them. With multiple jurisdictions using and maintaining the water system, no one individual or entity has the power to fully control how the system is governed. This means that when it comes to making decisions about how to manage watersheds, current best practice puts a lot of focus on collaborative processes that bring together a broad range of stakeholders with knowledge about distinct aspects of the watershed's systems alongside those with different responsibilities and powers to govern it. Bringing together diverse stakeholders, who view the watershed from a range of perspectives, has the potential to lead to either conflict or cooperation. The challenge for transboundary water resources management is to find the means to bring together diverse perspectives in a way that fosters communication, and not confrontation. The aim of the present work is to contribute to addressing this challenge.

The upper St Lawrence watershed is used as a case study to explore the themes of conflict and cooperation in transboundary watershed management. The study is broken down into two parts. The first looks to the recent past and presents a critical analysis of the stakeholder engagement and conflict resolution processes employed by the International Joint Commission during negotiations to change the management regime of the St Lawrence River. Audio recordings and transcriptions of public and technical hearings held by the IJC in 2013 were systematically analysed to assess the extent to which this process was able to achieve consensus in decision making, and understand the root causes of any residual conflict. It is found that the Shared Vision Planning process employed by the IJC had some significant successes, notably the success that has been achieved with regards to integration of First Nations and environmental concerns, but that the IJC's public outreach and participation efforts were not successful in reconciling the positions of all stakeholders. There is a distinct group of shoreline property owners in New York State who remain opposed to Plan 2014 because they perceive that they can only lose out from any regulation change. They are therefore unlikely to be motivated to engage productively in any planning dialogue. A solution would require that the problem be reframed so that this group has something to gain from a successful regulation plan resolution, which may involve bringing the prospect of compensation to the table.

The second part of the study looks to the future. Serious games have been touted as a novel tool with applicable value in supporting collaborative decision making. Seminal literature presenting a variety of distinctly different approaches to decision making was selected and reviewed to survey the breadth of decision making processes employed. Exploratory interviews were conducted with water resource managers across the St Lawrence region to explore whether a serious game might be useful in this particular context. It is found that several contextual factors make the St Lawrence region a potentially viable candidate for the development of a serious game to support decision-making. For decisions to be effective in the St Lawrence Region, it is often necessary to reach consensus amongst a wide range of stakeholders who hold a multiplicity of perspectives. A serious game could be developed that would help actors gain first-hand experience of the perspective and challenges facing other actors. This could help develop empathy that leads to an expanded problem definition and facilitates the identification of decision outcomes that can be supported by a wider range of actors.

A final general conclusion is reached that both Shared Vision Planning and Serious Games increase the likelihood that, when diverse perspectives are brought together, collaboration will prevail over conflict. In the case of Shared Vision Planning, this is achieved by identification and resolution of disputed causal associations through collaborative model building; in the case of Serious Games, it is achieved by expanding the experience and awareness of actors by allowing them to role play another perspective. It is suggested that the Serious Games approach may have the advantage of helping develop empathy, as games can be designed to allow players to experience the challenges faced by other stakeholders first-hand.

An estimated sixty percent of the world's freshwater supply resides in transboundary watersheds. With increasing stress on this supply due to pollution, failing infrastructure, climate change and population growth, it is now more urgent than ever to find effective processes and tools that resolve the tensions inherent in transboundary water resource management and facilitate effective collaboration.

Résumé

Les bassins hydrographiques transfrontaliers sont généralement des systèmes si volumineux et complexes que personne ne peut avoir une parfaite connaissance des processus hydrologique, environnemental, politique, juridique, économique et social intrinsèquement associés. Quand de multiples administrations utilisent et entretiennent le système hydrographique, aucune personne physique ou morale n'a le pouvoir de contrôler complètement la façon dont ils sont régis. Cela signifie que lorsqu'il est question de prendre des décisions quant à la gestion du bassin hydrographique, les meilleures pratiques actuelles insistent largement sur des processus collaboratifs qui rassemblent un large éventail d'intervenants ayant des connaissances sur des aspects particuliers des systèmes de bassin versant aux côtés de ceux ayant diverses responsabilités et pouvoirs pour les administrer. Le fait de rassembler divers intervenants qui ont des points de vue différents sur le bassin hydrographique est susceptible d'entraîner des conflits ou de la coopération. Pour la gestion des ressources hydriques transfrontalières, le défi consiste à trouver les moyens de rassembler les divers points de vue de manière à favoriser la communication et non la confrontation. Ces travaux ont pour objet de contribuer à relever ce défi.

Le bassin versant supérieur du fleuve Saint-Laurent est utilisé comme étude de cas pour étudier les thèmes de conflit et de coopération dans la gestion de bassins hydrographiques transfrontaliers. Cette étude est divisée en deux parties. La première se penche sur les dernières années et présente une analyse critique de l'engagement des intervenants et des processus de résolution de conflits employés par la Commission mixte internationale (CMI) lors des négociations visant à modifier le régime de gestion du Saint-Laurent. Les enregistrements sonores et les transcriptions des audiences publiques et techniques organisés par la CMI en 2013 ont été systématiquement analysés afin d'évaluer la capacité de ce processus à parvenir à un consensus dans la prise de décision et de comprendre les causes profondes des conflits résiduels. Nous observons que le processus de Planification de la vision commune mis en œuvre par la CMI a obtenu de remarquables succès, notamment celui réalisé en ce qui concerne l'intégration des Premières nations et les préoccupations environnementales, mais que les efforts déployés par la CMI pour sensibiliser le public et le faire participer n'ont pas réussi à concilier les positions de tous les intervenants. Un groupe distinct de propriétaires riverains dans l'État de New York reste opposé au Plan 2014, car ils jugent que tout changement de réglementation ne peut que leur être préjudiciable. Ils sont par conséquent peu susceptibles d'être motivés pour engager le moindre dialogue constructif sur la planification. Pour parvenir

à une solution, il faudrait que le problème soit recadré afin que ce groupe ait quelque chose à gagner d'une résolution de plan de régulation fructueuse ; éventuellement, mettre sur la table la perspective d'une indemnisation.

La deuxième partie de l'étude se tourne vers l'avenir. Des jeux sérieux ont été présentés comme nouveaux outils ayant une valeur applicable pour appuyer la prise de décisions concertées. Des publications fondamentales présentant plusieurs approches nettement distinctes en matière de prise de décision ont été choisies et examinées pour sonder l'étendue des processus décisionnels employés. Des entretiens exploratoires auprès des gestionnaires de ressources hydriques de toute la région du fleuve Saint-Laurent ont été effectués pour étudier l'utilité d'un jeu sérieux dans ce contexte particulier. Il s'avère que plusieurs facteurs contextuels font de la région du Saint-Laurent un candidat potentiellement viable pour le développement d'un jeu sérieux en vue de soutenir la prise de décisions. Pour que les décisions soient efficaces dans la région du fleuve Saint-Laurent, il est généralement nécessaire de parvenir à un consensus parmi un grand nombre d'intervenants des points de vue très différents. Un jeu sérieux peut être développé afin d'aider les acteurs à acquérir une expérience directe du point de vue des autres acteurs et des défis qu'ils rencontrent. Cela pourrait contribuer à développer de l'empathie pour permettre une définition élargie de la problématique et faciliter l'identification des décisions prises pouvant être soutenues par un grand nombre d'acteurs.

En conclusion générale, la Planification de la vision commune et les Jeux sérieux améliorent tous deux la probabilité que la collaboration l'emporte sur les conflits, lorsque différents points de vue sont réunis. Dans le cas de la Planification de la vision commune, ceci est obtenu par l'identification et la résolution d'associations causales contestées par le biais d'une construction de modèles en collaboration ; tandis que dans le cas des Jeux sérieux, ceci est réalisé en développant l'expérience et la sensibilisation des acteurs en leur permettant de jouer le rôle d'un autre point de vue. On suggère que l'approche des Jeux sérieux peut présenter l'avantage de contribuer à développer de l'empathie, du fait qu'ils peuvent être conçus pour permettre aux joueurs d'acquérir une expérience directe des défis relevés par d'autres intervenants.

Environ soixante pour cent des réserves d'eau douce mondiales proviennent des bassins hydrographiques transfrontaliers. Compte tenu de l'augmentation des contraintes exercées sur ces réserves en raison de la pollution, des infrastructures défaillantes, des changements climatiques et de la croissance démographique, il est désormais plus urgent que jamais d'établir des processus et des outils efficaces pour résoudre les tensions inhérentes à la gestion des ressources hydriques transfrontalières et de favoriser une bonne collaboration.

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Contributions

Chapters 3 and 4 of this thesis have been prepared for submission to peer-reviewed journals. Chapter 3 has been published in Water (MDPI). Research for this publication was conducted and the manuscript written by Alison Furber, building on an earlier paper drafted by Meetu Vijay. Murray Clamen contributed expert knowledge of the LOSLR context and the history and workings of the IJC, and contributed ideas and comment throughout development of the paper. The research was initiated, supervised and reviewed by Jan Adamowski and Wietske Medema.

Chapter 4 will soon be submitted for publication. The research for this paper was initiated by Wietske Medema and Jan Adamowski and the starting point for the research was the successful proposal written to SSHRC. Research for this paper was conducted and the manuscript written by Alison Furber, and reviewed by Wietske Medema and Jan Adamowski.

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Contents

Blind Men and the Elephant

A Poem by John Godfrey Saxe

It was six men of Indostan,
To learning much inclined,
Who went to see the Elephant
(Though all of them were blind),
That each by observation
Might satisfy his mind.

The *First* approach'd the Elephant,
And happening to fall
Against his broad and sturdy side,
At once began to bawl:
"God bless me! but the Elephant
Is very like a wall!"

The *Second*, feeling of the tusk,
Cried, -"Ho! what have we here
So very round and smooth and sharp?
To me 'tis mighty clear,
This wonder of an Elephant
Is very like a spear!"

The *Third* approach'd the animal,
And happening to take
The squirming trunk within his hands,
Thus boldly up and spake:
"I see," -quoth he- "the Elephant
Is very like a snake!"

The *Fourth* reached out an eager hand,
And felt about the knee:
"What most this wondrous beast is like
Is mighty plain," -quoth he,-
"'Tis clear enough the Elephant
Is very like a tree!"

The *Fifth*, who chanced to touch the ear,
Said- "E'en the blindest man
Can tell what this resembles most;
Deny the fact who can,
This marvel of an Elephant
Is very like a fan!"

The *Sixth* no sooner had begun
About the beast to grope,
Then, seizing on the swinging tail
That fell within his scope,
"I see," -quoth he,- "the Elephant
Is very like a rope!"

And so these men of Indostan
Disputed loud and long,
Each in his own opinion
Exceeding stiff and strong,
Though each was partly in the right,
And all were in the wrong!

1. Introduction

Transboundary watersheds are like the elephant in Saxe's poem. They are often such large and complex systems that no one person can have complete knowledge of the hydrological, environmental, political, legal, economic, and social processes that interplay within them (Vugteveen et al. 2014). With multiple jurisdictions using and maintaining the water system, no one individual or entity is able to fully control how the system is governed. This means that when it comes to making decisions about how to manage watersheds, current best practice puts a lot of focus on collaborative processes that bring together a broad range of stakeholders with knowledge about different aspects of the watershed's systems alongside those with different responsibilities and powers to govern it (Medema, Wals & Adamowski 2014; Akhmouch & Clavreul 2016; Paredes-Arquiola et al. 2014). As Reed (2008) puts it, "Although few of the claims that are made [regarding the benefits of participation] have been tested, there is evidence that stakeholder participation can enhance the quality of environmental decisions by considering more comprehensive information inputs".

The problem is that, like the blind men in Saxe's poem, the stakeholders engaged in these collaborative processes often struggle to see the system in its entirety. Each stakeholder views the watershed through the frame created by their values, beliefs, expectation, experiences and assumptions (Mostert et al., 2008). Like the blind men, stakeholders engaged in collaborative processes too often end up in conflict with one another (Elias 2012, Mitchell 2001, Stanghellini 2010), arguing about the nature of the watershed and the best way to manage it. Social divides are manifest in physical space through the creation of borders (Phare, 2013), which present challenges for water resource management. Political and hydrological boundaries often do not co-inside and a significant portion of the world's watersheds straddle the jurisdictional boundaries of two or more nations (Uitto and Duda, 2002). Unilateral management of these transboundary waters is often, "ineffective, inefficient, or simply impossible" (Raadgever et al., 2008). Pahl-Wostl et al. (2004), identify particular challenges for resource management in such transboundary contexts, including differing legal and regulatory frameworks, languages, economic conditions, political history and antecedents with public participation, and stakeholder organisations. Timmerman and Bernardini (2009) attribute the increased complexity of transboundary management to the fact that differences in water management regimes (i.e. the principles, rules and procedures of water management) are often greater

between countries than within them. Each of these factors has the potential to deepen perspective divides.

While transboundary watershed management has the potential to lead to conflict, it also has the potential to be a catalyst for great cooperation (Wolf 2007) if differences in perspective can be overcome. Overcoming these differences requires problems to be reframed from a local perspective to a basin-wide one (Mostert et al., 2008). This reframing process, when it occurs between multiple parties from different jurisdictions, can be thought of as transboundary social learning. In this way, social learning is an essential element of transboundary resource management. The challenge for transboundary water resources management is to find the means to bring together diverse perspectives in a way that fosters social learning and communication, rather than conflict.

The aim of the present work is to contribute to addressing this challenge. The upper St Lawrence watershed is used as a case study to explore the themes of conflict and cooperation in the management of complex systems, allowing the challenges and opportunities of transboundary management to be reified through real life examples. The Great Lakes-St Lawrence basin faces an intricate set of governance challenges. Jurisdiction is shared between two countries, several states and provinces, and numerous local governments (Bakker and Cook 2011), which leads to the involvement of a diverse range of stakeholders including the general public, industry, farmers, small business owners, and civil servants and politicians of various levels. The basin's complexity and size challenges attempts to understand its dynamics, while limited interactions and disagreements between stakeholders impede management actions (IJC, 2013). Such governance challenges require novel methods of encouraging dialogue, while facilitating learning and enabling systemic institutional change, so that decisions can be made from a position of shared knowledge and understanding.

The study is broken down into two parts. The first looks to the recent past and presents a critical analysis of the stakeholder engagement and conflict resolution processes employed by the International Joint Commission during negotiations to change the management regime of the St Lawrence River; a contentious issue in which divergent stakeholder perspectives threatened to thwart efforts to reach agreement on a way forwards, despite widespread acknowledgement of shortcomings of the existing regime. The Commission employed a state-of-the-art engagement process during the negotiations, known as Shared Vision Planning. The objectives of the first part of the study are to (a) Assess the extent to which agreement was reached by stakeholders in support of the resulting Plan 2014 (b) Examine available data for

evidence of the extent to which the Shared Vision Planning process enabled stakeholders to overcome potential conflict and reach agreement (c) Assess residual conflict and identify the root cause of this conflict. Consideration is also given to whether any opportunities exist to move the conflict further towards amicable resolution, and what lessons might be learnt more broadly.

The second part of the study looks to the future. Serious games have been touted as a novel tool with applicable value in supporting collaborative decision making (Medema et al., 2014). The changing nature of decision making processes is a key consideration of this phase of work. The overarching objective of the second part of the study is to explore the potential use of serious games to support transboundary decision-making processes in the St Lawrence region in the future. It has as its specific objectives: a) Elucidation of the mechanisms which make serious games beneficial for decision making in different contexts; b) Analysis of the St Lawrence context to explore whether the development of a serious game might be appropriate in this case; c) If a serious game might be appropriate for the St Lawrence, analysis to determine which of the potential mechanisms identified through the first objective are applicable in the case of the St Lawrence.

Each part of the study deals with a process or tool that, returning to the metaphor with which the chapter started, has the potential to help blind men reach agreement on the nature of an elephant and, consequently, how it might best be looked after. The first section aims to learn lessons from processes that have been employed in the past, while the second is more exploratory and future orientated. The conclusions chapter subsequently discusses the future of conflict management in participatory decision making in the region and explores whether Shared Vision Planning or Serious Games or both should be pursued as potentially fruitful tools.

An estimated sixty percent of the world's freshwater supply resides in transboundary watersheds (UN, 2008). With increasing stress on this supply due to pollution, failing infrastructure, climate change and population growth, it is now more urgent than ever to find effective processes and tools that resolve the tensions inherent in transboundary water resource management and facilitate effective collaboration (Norman, 2014). This study focuses on understanding how the differing perspectives of stakeholders across the St Lawrence Region might be brought together in a way that encourages collaboration and conflict, through the use of Shared Vision Planning and Serious Games. By analysing the underlying mechanisms that make this possible, however, findings are expected to have broader relevance.

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2. Literature Review

Researchers and practitioners in the water sector increasingly recognise that conflict management is an important aspect of water resources management (Elias 2012; Mitchell 2001; Stanghellini 2010). This Chapter beings by considering the key drivers that support participatory approaches to decision making in water resources management before the discussion turns to why participatory approaches, for all the benefit they bring, can result in conflict. Two approaches, Shared Vision Planning and Serious Games, are introduced as they may offer mechanisms to help avoid or resolve conflict in support of participation and collaboration. The bodies of literature concerning these two approaches are surveyed with the goal of gaining insight into the ways they achieve this, and gaps in the literature to which the present research may contribute.

2.1 The Importance of Participation in Water Resources Management

Participatory approaches to water resources planning are increasingly promoted as best practice (Carr 2015, Lockwood et al. 2010; Medema et al. 2014, Palmer et al. 2013), if not a legal requirement (Scolobig and Lilliestam, 2016). Participation is defined broadly, following Carr (2015), as involvement of the public, institutional decision makers, individuals, or representatives of groups with an interest in or ability to influence how a river is managed, in river management decision making processes.

There is a strong ethical dimension to water management. As noted by Priscoli (2004), 'Control of water is control of life'. Consequently, those who are affected by the management decisions taken regarding water must have the opportunity to participate in the decision-making process (Priscoli & Llamas, 2001). Liu et al. (2011) note that it is essential to ensure that the interests of all groups, particularly the poor and often under-represented groups, have a space to be heard through participation. This can be a challenge to achieve in some contexts. For example, the difficulty in engaging adequate representation of women in water resource management decision making in some patriarchal societies has been well reported (Figueiredo & Perkins, 2013; Harris, 2009; Singh, 2008). There is a body of literature looking at the challenges to participation by marginalised communities (Butler & Adamowski, 2015). Even in Western society, it can be difficult to reach some sectors of society. The Royal Geographical Society (Betterbee et al., 2012) of the United Kingdom, while reviewing the country's water resource management challenges, noted difficulties in achieving broad public

engagement and in "achieving a truly democratic process where all involved have an equal voice". Despite these challenges, participation in democratic governance structures is crucial, as it reflects the values of empowerment, creativity and open-access to government (Priscoli, ob cit.). This is even more important when decisions have high stakes and great uncertainty (Funtowicz and Ravetz, 1993).

Beyond the ethical argument, the need for widespread engagement and participation is also a practical issue. There is a need to harness a greater breadth of knowledge to support more effective decision-making (Medema, Wals & Adamowski, 2014; Akhmouch & Clavreul 2016; Paredes-Arquiola et al., 2014; Renner et al., 2013). Water resources problems are complicated, in that finding solutions to them often requires analysis and understanding of components of the underlying environmental, social, economic and political systems and how these components interact (e.g. Dubois 2011; Hecht & Fiksel 2015; Sullivan & Meigh 2007; Tundisi 2008). As such, no single individual can be expected to have complete knowledge of all relevant aspects necessary to solve these problems (Vugteveen et al. 2014). Reed (2008) notes that, "Although few of the claims that are made [regarding the benefits of participation] have been tested, there is evidence that stakeholder participation can enhance the quality of environmental decisions by considering more comprehensive information inputs".

Advocates of co-management approaches to governance promote the value of integrating the knowledge of actors working at different scales (see for example Armitage et al. 2011, Olsson, Folke & Berkes 2004). As explained by Berkes (2009), co-management can be thought of as a knowledge partnership, where the detailed, place-specific knowledge of local actors is combined with the high-level knowledge that comes with the broader perspective held by national or international actors, so that water management benefits from the knowledge of both these vantage points. There is also a significant body of literature that promotes the need to integrate knowledge from different, and sometimes incompatible, types of knowledge systems. Two 'ways of knowing' that are often brought into close contact in water resources management discourse in North America and Australasia are scientific and traditional knowledge (e.g. Escott, Beavis & Reeves 2015). Authors such as Mantyka-Pringle et al. (2017) provide specific evidence of instances in which combining traditional and scientific knowledge is able to bring about a better outcome than relying on either knowledge type individually. In the case they describe, scientific knowledge offered a snapshot of the spatial distribution of the health of a river and traditional knowledge contributed knowledge of the variation in health of a local stretch of the river over the long-term (ibid). Similarly, Woo et al. (2007) report how First Nations communities in the Northwest Territories in

Canada were able to vividly describe how the local environment had changed historically, with quotes such as, “There was much snow last winter. Only the backside of caribou was seen above the snow”. They go on to describe how this knowledge was combined with scientific knowledge to support environment and water management in the region.

A further argument that supports the view of participation as critical in water resources management is that collective decisions are more legitimate and therefore more implementable (Carr 2015). Beetham (1991) identified three dimensions of legitimacy – legality, justification and consent. Participation and consent are closely related as participation signifies either express or tacit consent, whereas a lack of participation indicates lack of consent (Orr et al. 2016). One argument for participation is that successfully engaging a range of actors to participate in decision-making equates to obtaining consent, and thereby increases the legitimacy of decisions. With perceived legitimacy and broad backing, decisions become more implementable (Carr 2015). Not everyone agrees with this argument, however. Arnesen (2017) undertook experiments to test the hypothesis that democracies are more legitimate because they allow citizens to participate in decision-making. He found that perceived legitimacy depended upon whether participants agreed with the final decision more than the degree of participation in the decision-making process.

2.2 The Challenge Presented by Participation

In its purest form, participation impacts on the distribution of power in decision making, resulting in the dispersal of power down to lower-level actors (Arnstein 1969). With power dispersed, the ability of local actors to bring about collective action becomes a key factor in the coherence of the regions water resources management. The amalgamation of the different knowledge and perspectives of local actors makes participation simultaneously so important but also so challenging (Lange, Siebert & Barkmann 2016). Priscoli (2004) summarised the prevailing attitude of local actors following early experiences of participation in the 1970s and 80s as, “Public participation got people talking and us listening to their needs, but we do not seem to come to closure and reach agreement”. As noted by Scolobig and Lilliestam (2016), “representing and translating the heterogeneity of stakeholders’ perspectives and dealing constructively with value-based issues in decision making is far from simple”. When divergent world views and knowledge are brought into close proximity, the potential for conflict is great (Lange, Siebert & Barkmann, ob cit.). A key challenge for water resources planning, therefore, is finding ways to conduct participatory processes that manage this risk of conflict, so that the fruits of collaborative-participation can be realized.

2.3 The nature of conflict in water resource management

Several theories have been put forth in the academic literature that offer insights into the nature of the perspective divides that can result in conflict. Priscoli (2003) describes five distinct root causes of conflict relevant to the water sector, the first of which is relationship-conflict. This is conflict caused by interpersonal relations and the personalities of actors involved. According to Priscoli (ibid), this type of conflict is rooted in, "poor communication, misperceptions, dueling egos, personality differences and stereotypes". Data-based conflicts may arise in situations where there is disagreement over the validity and relevance of technical and scientific data, upon which decision making and arguments are being founded. Value-based conflict occurs when there are fundamental differences over which values to apply to a situation, which values are at stake and which values should be given priority. In contrast, interest-based conflicts arise due to disagreement over the substantive allocation of resources, or when parties perceive that their needs and interests are not being met due to the procedures being employed, or because of a perception of a lack of fairness or respect. The final category of conflict is structural-conflict. He uses the example of contract negotiations set up to reward actors who behave competitively to protect the interests of their own organisations. In this environment, the structure of the negotiation is set up to favour conflict.

In contrast to Priscoli's theory, Plural Rationality Theory proposes that only four perspectives prevail during policy decision-making: hierarchy, individualism, egalitarianism, and fatalism (Scolobig and Lilliestam, 2016). The hierarchical perspective aligns with top-down approaches to decision making, believing in master-planning by government authorities supported by experts. The individualist perspective takes the view that de-regulation is the answer, believing market forces and freedom to innovate will ultimately lead to a stable solution. The egalitarian perspective is based on moralistic principals and leftist approaches to solving problems. Lastly, the fatalist perspective believes that little can be done to affect change. The approach individuals are likely to prefer when faced with a decision is greatly influenced by their rational perspective; the perspectives, while all rational (Scolobig and Lilliestam, ibid), are largely incompatible and this is a key source of conflict and tension for collaborative decision-making.

Whether the root cause of conflict is better described in terms Priscoli's dimensions of conflict or one of the four perspectives defined by plural rationality theory is likely to depend upon the specifics of the conflict in question. Both theories present a view of the divides in society that can result in conflict. Social divides are manifest in physical space through the

creation of borders (Phare, 2013), which present particular challenges for water resource management. Political and hydrological boundaries often do not correspond and a significant portion of the world's watersheds straddle the jurisdictional boundaries of two or more nations (Uitto and Duda, 2002). Unilateral management of these transboundary waters is often, "ineffective, inefficient, or simply impossible" (Raadgever et al., 2008). Pahl-Wostl et al. (2004) identify particular challenges for resource management in such transboundary contexts, including differing legal and regulatory frameworks, languages, economic conditions, political history and antecedents with public participation, and stakeholder organisations. Timmerman and Bernardini (2009) attribute the increased complexity of transboundary management to the fact that differences in water management regimes (i.e. the principles, rules and procedures of water management) are often greater between countries than within them. Each of these factors has the potential to deepen perspective divides, making conflict resolution approaches particularly pertinent for transboundary watershed management.

Overcoming these differences requires problems to be reframed from a local perspective to a basin-wide one (Mostert et al., 2008). This reframing process, when it occurs between multiple parties from different jurisdictions, can be thought of as transboundary social learning. In this way, social learning is an essential element of transboundary resource management.

2.4 Traditional approaches to conflict resolution in water resources management

Unfortunately, social learning processes to reframe water resources problems have not traditionally received much attention in the water resources management literature. Scolobig and Lilliestam (2016) assert that little focus is placed on processes for integrating a range of perspectives in much of the environmental decision-making literature. Take, for example, the recent book by Conroy and Peterson (2013), 'Decision Making in Natural Resource Management: A Structured Adaptive Approach'. The book epitomises a rational approach to decision making, emphasising the importance of the use of rigorous, repeatable methods, and proposes a structured framework for achieving this. The essential components of the process include clear problem definition, setting of objectives, specification of decision alternatives, and delineation of the temporal and spatial boundaries of the problem. For effective decision-making using this approach it is critical that the selected objectives are measurable and reflect the overarching goals related to management of the resources. The

crux of the decision-making process is the conceptualisation and quantification of the impact the decision options will have on the selected objectives. The book discusses dealing with uncertainty at length but, as the process is essentially based on deductive reasoning and rational choice, the more complete the decision maker's understanding of the underlying systems, the more likely the decision maker is to correctly identify the optimum decision option, and so uncertainty must be reduced as far as possible. To be incorporated in the decision-making process irreducible uncertainty must be quantified to a probability using statistical approaches.

When conflict has arisen during decision-making in the past, traditional positional-bargaining approaches to resolution have been employed. In traditional positional-bargaining "a series of positions (alternative solutions that meet particular interests or needs) are presented to other parties during negotiations to reach an agreement. The first position represents the maximum gains hoped for, or expected in the negotiations. Each subsequent position demands less of an opponent and results in fewer benefits for the person advocating it. Agreement is reached when the negotiators' positions converge and they reach an acceptable settlement range" (Priscoli, 2003, as quoted in Simon, 2007). If agreement cannot be reached by actors, the next step would be to take the issue to court, where adversarial proceedings can be heard and judicial remedies applied.

Game Theory has been used to explain why positional-bargaining conducted in this way often results in sub-optimal outcomes for all parties. Many water resources management problems fall under the domain of Cooperative Game Theory: that is, they can be characterized as 'games' in which the sum of benefits across actors can be increased through cooperation (i.e. they are not zero-sum games. Zero-sum games mean that for one actor to benefit another must suffer the cost; a situation which tends towards competition rather than collaboration) (Madani, 2010). For example, Madani (ibid) presents a common two-player game, analogous to some water resources conflicts, in which the best outcome for both players is achieved through collaboration. In the 'stag hunt' game, two hunters must decide in isolation whether to hunt together or individually. If both choose to hunt together, they will hunt for a stag (the most agreeable outcome for both players); if they both choose to hunt individually they will separately hunt for a hare (an okay outcome but not as agreeable as hunting a stag); if one chooses to hunt individually and the other together, the person choosing to hunt individually will hunt for a hare while the other will not be able to hunt at all.

Critically, players are denied the opportunity to communicate about their choices. This, combined with the problem that choosing to collaborate carries the risk that the other player will not choose to collaborate, puts the player at risk of achieving a worse outcome than if they choose not to collaborate and leads to a tendency of players not to collaborate. A nonsensical outcome, unless viewed through the lens of Game Theory. Madani (ibid) provides a range of examples of water resources conflicts which, like the games described above, culminate in a situation in which the behaviour of stakeholders is simultaneously completely rational (when viewed from each stakeholder's own individual perspective), and leads to outcomes which are worse for all parties involved. Like the game, lack of communication is often a key factor in the selection of lower risk, less optimum 'game' strategies.

To relate this back to the topic at hand, the problem with traditional positional-bargaining is that it does nothing to address any of the underlying causes of conflict. This forms a barrier to the communication and cooperation that is a prerequisite to stakeholders having the confidence and trust in other stakeholders to implement higher risk, win-win solutions. The challenge for water resources management is to find innovative approaches to conflict resolution that address the underlying causes of conflict, and which take negotiation processes beyond confrontational positional-bargaining to enable problem-solving dialogue in the hope of realizing win-win outcomes through collaboration.

2.5 Shared Vision Planning as an Alternative Dispute Resolution Approach

Alternative Dispute Resolution (ADR) has been advocated as an antidote to positional-bargaining that is able to overcome these shortcomings (Priscoli 2003). ADR is a broad term covering a suite of processes including mediation, interest-based bargaining, arbitration, negotiated rule-making, joint fact-finding, and consensus building. These methods have become increasingly important in addressing natural resource issues (Raines & Kubala 2011). The goal of ADR is "structuring the process to minimise the destructive elements and promote productive use of conflicts" (ibid). At the heart of ADR is the idea of centring dialogue on interests rather than positions. The approach encourages parties to educate one another about their needs and interests, which expands their problem definition, and hence ADR is essentially a form of social learning (Priscoli & Wolf 2009). This encourages creative problem solving to find solutions that can meet the interests of all involved, thus increasing the likelihood of finding win-win solutions (ibid).

One of the most efficient ways of resolving conflict is to identify potential conflict and prevent it before it happens. Shared Vision Planning (SVP) provides a structured approach to water resources management planning, which uses the principles of ADR to overcome the root causes of conflict as early as possible during decision-making. SVP was an approach to planning born out of a dispute in the Potomac River Basin (Hagen, 2011). The Potomac River serves large parts of Virginia and the Washington D.C. area; droughts in the 1960s brought to light the fact that suburban demand in the upper part of the Potomac's catchment had the potential to exceed the River's low flows under severe drought conditions, essentially cutting the flow of water into the D.C. Metropolitan area. In subsequent studies to solve D.C.'s water supply problem, Sheer et al. (1977) and Palmer et al. (1980; 1982) arrived at the conclusion that a new rule-set for the management of existing reservoirs in the region could solve the region's water supply problem until around 2030. The problem was that their solution required the water supply companies who managed the reservoirs to work collaboratively, trusting each other to be following the rule set (Hagen, ob cit.).

When the promising study results were presented to stakeholders in 1979 in the form of outputs from the optimisation models developed during the studies, it was found that, "no one could make sense of the big picture, and the models themselves were seen as 'black boxes' and so were not trusted" (James W. Haines, quoted in Hagen, ibid). The particular limitations of the optimisation model were identified as, "a lack of user understanding, and difficulty in translating value judgements into non-intuitive object functions" (Hagen, ibid). The decision was taken to move away from using an optimisation model and instead to develop a simulation model. The model developed was called PRISM, a title that reflected the ability of the model to 'disperse light' on the management problem and potential solutions, in contrast to the 'black box' of the previous optimisation model. The key strength of the simulation model foreseen by Palmer (1980) was that it allowed decision-makers to interact with the underlying model; changing key input parameters related to the problem at hand and experimenting to understand the outcome of different policy options. This moved the model purpose away from the goal of finding an optimal solution, but in any case, as Palmer noted (1980, in Hagen, 2011), "The absence of an effective way of teaching the users of the model its logic and structures is a major impediment for its use as an aid in decision making". Hagen (ibid) reports that the use of a simulation model was a turning point that opened the door for stakeholders to begin exploring collaborative management options.

The Shared Vision Planning process as set out by Palmer et al. (2013) requires a team be involved in each step of the decision-making process, from problem identification to plan

implementation. This team should be composed of stakeholders, decision-makers, and experts (Palmer et al. 2013). Collaborative modelling is used as a mechanism through which multiple understandings can be brought together to identify and resolve disputed causal effects and create consensus and transparency regarding the underlying system as a starting point for participative decision making (ibid). Falconi and Palmer (2017) argue that a collaborative model can act as a boundary object (Star and Griesemer 1989), i.e. an object that can act as a bridge between stakeholders with different perspectives by 'translating' different types of knowledge using a shared 'syntax'. As such, it promises a tangible means for effective conflict resolution in participatory approaches to water management.

SVP is one of a number of terms used to describe an approach, often but not exclusively applied to planning (Lorie 2010), that uses collaborative modelling to support participatory process (Langsdale et al. 2013). Table 2.1 sets out the key terms used for these approaches. The Shared Vision Planning community is an organised research group who have already undertaken reviews of progress and case studies in their field. One such example is the paper produced by the Shared Vision Planning Programme at the United States Army Corps of Engineers Institute for Water Resources, who commissioned a review of studies utilising what it referred to at the time as computer-aided dispute resolution approaches (CADRe). They overcame the issue of somewhat nebulous terminology by reviewing articles that have, 'characteristics of Shared Vision Planning' (Imwiko et al. 2007). The following paragraphs set out some of their key findings to paint a picture of the nature of early SVP work.

Of the papers reviewed by Imwiko et al. (2007), 65% used Shared Vision Planning for water-resources planning and management. The issues addressed included: water rights and allocation disputes, water-supply management options, evaluation of water-conservation alternatives, development of drought plans, and water utility master planning (ibid). The other 35% were used for environmental planning and management, ecosystem planning and management, landscape planning and management, and water-quality management. In environmental planning and management, Shared Vision Planning was found to be used primarily to demonstrate the feedback and interactions between human activities and environmental systems, with the overarching goal of finding ways to limit the negative impacts of human actions. Similarly, the use of Shared Vision Planning for ecosystem, landscape and water quality studies aimed to encourage better management decisions by understanding the interconnectedness of these systems with others.

Table 2.1: Terms for Methods that Combine Integrative Collaborative Modelling with Participatory Process (from Langsdale et al. 2013)

Term	Description	Definitional Work(s)
Collaborative Modelling for Decision Support (formally Computer-Aided Dispute Resolution, CADRe)	Named by a community of practice following their 2009 workshop sponsored by the U.S. Army Corps of Engineers, Sandia National Labs, the U.S. Environmental Protection Agency, and the U.S. Institute for Environmental Conflict Resolution; not a new methodology, but a term that includes all related approaches	Bourget, 2011
Shared Vision Planning	Method refined by U.S. Army Corps of Engineers that combines (1) traditional water resources planning, (2) structured public participation, and (3) an integrated computer model	Werick and Whipple, 1995; Hagen, 2011
Mediated Modelling	Model building is used as the basis for a mediation process with, rather than for, multiple stakeholders	van den Belt, 2004
Group Model Building	Quantitative or qualitative system dynamics models are used to enhance team learning, foster consensus, and create commitment. Applied to organization and resource management problems	Vennix, 1996
Computer-Aided Negotiation (CAN)	Defined as "a marriage between two fields: (1) computer modelling/simulation, and (2) dispute resolution." Shares roots with SVP through early work on the Potomac River Basin	McCrodden, 2011
Participatory Modelling; Participatory Integrated Assessment Modelling	Stakeholder involvement in integrated assessment has become an increasing focus since the late 1990s, particularly motivated by the Environmental Directive of the EU	Hare et al., 2003; Rotmans, 1998

In terms of the types of models employed during these studies to support the negotiation process, 60% were simulation models of which the majority were Systems Dynamics models. The authors observed that simulation models able to capture both physical and socioeconomic dimensions of the decision to be made, "appear to be becoming more prevalent as the analytical basis for describing and modelling complex systems" (ibid). They note that systems dynamics models are particularly useful due to their ability to capture the temporal and spatial dynamics of systems (ibid).

The success reported through the use of SVP was found to be high: 35% of the case studies reported that the Shared Vision Planning approach was able to produce a resolution to the

problem being faced and only 6% reported that it was not. A further 27% reported that the process partially solved the problem (a further 4% were still ongoing projects at the time of writing, so no outcome assessment was provided and 4% reported mixed results due to the inclusion of multiple case studies). Imwiko et al. (ibid) summarise their findings on the outcomes produced using Shared Vision Planning in the studies they reviewed by saying that, "In general these studies reported that the processes used helped provide clarification of the problem and offered meaningful recommendations regarding decisions and future work".

Imwiko et al. (ibid) did not go on to offer a summary analysis of the advantages or limitations of SVP identified during this early work, so Table 2.2 has been compiled to present a summary of the advantages of SVP. These advantages have been selected from both the annotations of papers by Imwiko et al. (ibid) and other later research publications.

Table 2.2: Advantages of Shared Vision Planning

Advantage of SVP	Reference(s)
Bringing stakeholders together / encouraging fruitful discussions	Huerta 2006, Lamb et al 1998
Helping participants develop common understanding	Huerta 2006, Jones & Seville 2002
Helping participants develop understanding of system's time-related behaviour	Huerta 2006
Allow participants to test policies / evaluate alternatives	Beall et al. 2006, Costanza & Matthias 1998, Huerta 2006, Palmer et al 2000, Stave 2003
Help to identify win-win solutions	Huerta 2006
Development of accessible / user-friendly models	Beall et al. 2006, Cohen 1997, Connor, Cartwright & Stephenson 2004, Costanza & Matthias 1998, Vanclay & Haggith 2003
Collaborative development of management goals and objectives	Kallis 2005, Stave 2002
Helping participants reach agreement	Carr, Loucks, and Blöschl 2013, Lamb et al. 1998, Palmer, Kutzing & Steinmann 2002
Revealing participants' interests and perspectives	Elias 2004, Lamb et al. 1998, Nandalal & Simonovic 2003
Helping with problem solving	Kallis 2005
Educating participants / Individual capacity building	Grayson, Dohan & Blake 1994, Kallis 2005, Palmer et al 2000
Revealing integrated system dynamics	Cohen 1997, Krywkow et al. 2006, van den Belt, Deutsch & Jansson 1998
Increased problem framing / inclusion of broader concerns in planning	Connor, Cartwright & Stephenson 2004, Krywkow et al. 2006, Vanclay & Haggith 2003
Gaining support for model	Elias 2004
Transparent process	Connor, Cartwright & Stephenson 2004
Direct economic benefits	Werick & Whipple 1994

Langsdale et al. (2013) set out the following eight principles of collaborative modelling in decision support:

1. Collaborative modelling is appropriate for complex, conflict-laden, decision-making processes where stakeholders are willing to work together.
2. All stakeholder representatives participate early and often to ensure that all their relevant interests are included.
3. Both the model and the process remain accessible and transparent to all participants.
4. Collaborative modelling builds trust and respect among parties.
5. The model supports the decision process by easily accommodating new information and quickly simulating alternatives.
6. The model addresses questions that are important to decision makers and stakeholders.
7. Parties share interests and clarify the facts before negotiating alternatives.
8. Collaborative modelling requires both modelling and facilitation skills.

2.6 Serious Games as a Potential Tool for Alternative Dispute Resolution

Shared Vision Planning was developed during the late eighties and early nineties, when computing was nowhere near as advanced as it is today. With recent developments in computing, some authors have begun exploring the potential role advanced Information and Communication Technology (ICT) might play in ADR approaches to conflict resolution. Medema et al. (2014), for example, argue that ICT offers innovative and promising solutions for enhancing social learning to overcome water governance challenges, which is critical in ADR approaches. Serious games, defined as games for a purpose other than pure entertainment that combine computer simulation with role-play as an integrated method for complex policy making (Zhou, 2014), have been identified as particularly promising to facilitate collaborative decision making (Medema et al., ob cit).

While intuitively, we all understand what constitutes a game and what does not, finding a single authoritative definition is not a simple task (for full discussion see Mayer et al., 2016). While an exact definition may be elusive, the approach taken here will be to identify the range of characteristics that lead to an activity resembling a game (following Wittgenstein, 1953, and a number of subsequent game scholars). Characteristics generally indicative of games include: fixed rules (Callois 1961, Juul 2005, Salen & Zimmerman 2003); variable outcomes (Juul 2005); scoring or assigning value to the outcome of the games (Juul 2005, Salen & Zimmerman 2003); negotiable outcomes requiring player effort and attachment to the outcome (Juul 2005); subjective representation of reality (Crawford 2003); and interaction between the player and

the game world (Crawford 2003). While it is not necessary for an activity to possess all these characteristics to be classified as a game, these features have been closely associated with games, and most activities identified as games possess some of these characteristics. A Serious Game is then simply taken to be a game with a purpose beyond that of pure entertainment (Abt, 1970).

Serious Games are a relatively new tool in water resources management and the mechanisms through which they are able to support collaboration over conflict have not yet been clearly mapped out. As Vegt et al. (2016) put it, "We know Serious Games can enhance collaboration but we don't know why" (see also Mayer et al., 2005; Apostolakis et al, 2016). Two studies stand out as providing experimental evidence of the ability and means by which Serious Games may be useful in ADR. Vegt et al. (ob. cit.) demonstrate how, by changing the rules of a game, the behaviour of players can be directed towards either conflict or collaboration. In their experiment, pairs of players are asked to play one of two versions of Breakout. The original game of Breakout involves a player moving a paddle along the bottom of the computer screen to bounce a ball towards bricks at the top of the screen and stop the ball touching the bottom of the screen. If the ball hits the bricks, they are destroyed and the player wins points; if the ball touches the bottom of the screen the player loses a life. Vegt et al. developed two scoring systems for a multi-player version of the game. In both games the payers are interdependent, i.e. the actions of one affect the other. In one version of the game, players compete to hit the ball, scoring points if they reach the ball and it hits bricks. In the other, players must take it in turns to hit the ball, both scoring points if they hit bricks. Through their experiment, Vegt et al. (ibid) demonstrated that they can influence players towards either competitive or collaborative behaviour by manipulating the, 'rules of the game'. They imply that this is the mechanism through which Serious Games may be able to enhance collaboration.

The game upon which Vegt et al. base their experiment is not controversial and this does raise the question of how applicable their findings might be in more entrenched conflict situations. Kampf and Stolero (2014) undertook an experiment to explore the use of Serious Games for peace education in the highly contentious Israel-Palestine conflict. Their rationale for the potential use of games to overcome entrenched conflict originates in Peace Education Theory. Peace Education Theory promotes education to achieve several goals for conflict resolution processes: facilitating parties to develop empathy for the perspectives of others, through which they may come to view opposing narratives as legitimate; encouraging parties to critically reflect on their own position, so that they come to recognise their own role in the conflict; and providing a forum where parties can develop a relationship by interacting in

non-violent activities (Salomon, 2011). The overarching goal of Peace Education is to reframe conflict narratives to resolve conflict through the promotion of trust and empathy, and the reduction of prejudice (Kampf and Stolero ob. cit.). Kampf and Stolero (ibid) experimentally tested the ability of a computerised simulation of the Israeli-Palestinian conflict to promote Peace Education in 185 Israeli undergraduate students of Jewish and Palestinian origin. They found Serious Games to be an effective tool of Peace Education, thus demonstrating the value of Serious Games even in more entrenched, contentious conflict situations.

While the studies of Vegt et al. (2016) and Kampf and Stolero (2014) demonstrate the potential for Serious Games to support conflict resolution within a gaming environment, the critical question arises as to whether the benefits gained within the gaming environment carry into the 'real world'. As explained by Juul (2005), computer games are half-real. Real players interact with each other according to real rules in a fictional world (ibid). For Juul it is this fictional world that differentiates computer games from their more abstract, tradition game counterparts. Players must choose whether to immerse themselves in this fictional world, believing it to be true, or maintain the fictional world as a mere representation of information about the rules of the game (ibid). The translation of meaning in a fictional world to meaning in the real world can be complex. Juul notes that the act of fighting another person's character in a fictional conflict in a computer gaming environment does not equate to a desire to attack that person in real life; conversely, it may in fact be a symbolic interaction representing an invitation to friendship. As Juul puts it, "Humans are not always literal in their interactions, and we cannot take human games at face value. Competitive games are social affairs, and much more so than the rarely played non-competitive games that have been proposed".

This is an interesting point, because, as noted by Mayer (2009), the use of Serious Games for water resources management is based on the assumption that, 'individual and social learning that emerges in the game can be transferred to the world outside the game'. For Mayer, this transfer is, 'negotiated and not immediate, thereby making a simulation game low in external risks and giving the players a sense of safety' (ibid). Mayer is concerned primarily with the application of Serious Gaming to public policy making, but his assertion that there is a lack of empirical evidence exploring how gaming experience impacts on the real world seems more broadly relevant. In his words, "we hardly seem to know what happens at the interface of public policy making and gaming". Savic et al. (2016) have recently reviewed Serious Game applications developed for the water sector. Their assessment is that most of those developed to date aim to address conflict among stakeholders facing complex problems

of river basin management. These games are, on the whole, largely simplified and require expert mediation (ibid). There seems to be a prevailing assumption that Serious Games are beneficial for resolving conflict surrounding water resources management, but a lack of understanding of the mechanisms to explain how, and why, they are useful. Questions around how accurately computer gaming environments need to represent reality for lessons learnt to translate into the real world, and how interactions within gaming environments are mapped to interactions in the real world, seem to remain unanswered.

2.7 Summary

This Chapter has argued that, while participatory approaches to decision making are necessary for both ethical and practical reasons, they can result in conflict. Two approaches that may be able to support participatory approaches by avoiding or resolving conflict are Shared Vision Planning and Serious Games. The two approaches have been introduced above in preparation for more detailed exploration of each approach in subsequent Chapters. In the case of Serious Games, in particular, several gaps in the literature were identified. Firstly, there is a lack of understanding of the mechanisms to explain how, and why, serious games are useful. Secondly, there are questions around the way in which learning that takes place within a game environment may translate into the real world.

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Linking Statement

The Shared Vision Planning approach employed during a process to formulate a new plan for regulating flows in Lake Ontario and the St Lawrence River has been evaluated as one which had many strengths and has found to be exemplary in many regards. The following chapter forms a foundation for the present study by taking a detailed look at this state-of-the-art engagement process. The chapter undertakes a detailed assessment of the effectiveness of the process used, and identifies some of its successes and limitations. A particular goal of the chapter is to identify the outstanding challenges for collaboration in the region, so that consideration can be given subsequently to whether Serious Games may offer any opportunities to address these.

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3. Shared Vision Planning

Conflict Management in Participatory Approaches to Water Management: A Case Study of Lake Ontario and the St. Lawrence River Regulation

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Abstract: The International Joint Commission (IJC) has been involved in a 14-year effort to formulate a new water regulation plan for the Lake Ontario St. Lawrence River ("LOSLR") area that balances the interests of a diverse group of stakeholders including shipping and navigation, hydropower, environment, recreational boating, municipal and domestic water supply, First Nations, and shoreline property owners. It has embraced the principles of collaborative and participatory management and, applying a Shared Visioning Planning (SVP) approach, has worked closely with stakeholders throughout all stages of this process; however, conflicts between competing stakeholders have delayed and complicated this effort. The overarching aim of this chapter is to consider the extent to which the SVP approach employed by the IJC was effective in managing conflict in the LOSLR context. Audio recordings and transcriptions of public and technical hearings held by the IJC in 2013 have been systematically analysed using stakeholder mapping and content analysis methods, to gain insight into the stakeholder universe interacting with the IJC on Plan 2014. The principal conclusions of this chapter are that (a) the Shared Vision Planning approach employed by the IJC had some significant successes in terms of conflict management—particularly notable is the success that has been achieved with regards to integration of First Nation concerns; (b) there is a distinct group of shoreline property owners, based in New York State, who remain opposed to Plan 2014—the IJC's public outreach and participation efforts have not been successful in reconciling their position with that of other stakeholders due to the fact that this stakeholder group perceive that they can only lose out from any regulation change and are therefore unlikely to be motivated to engage productively in any planning dialogue; and (c) a solution would require that the problem be reframed so that this stakeholder can see that they

do in fact have something to gain from a successful resolution, which may necessitate bringing the prospect of compensation to the table.

3.1 Conflict in Participatory Approaches

Participatory approaches to water resources planning are increasingly promoted as best practice (Carr 2015, Palmer et al. 2013). For the purposes of this chapter participation is defined broadly, following Carr (2015), as involvement of the public, institutional decision makers, individuals, or representatives of groups with an interest in or ability to influence how a river is managed, in river management decision making processes. Participation can take many guises; the classic framework used to characterize participation is Arnstein's (1969) ladder, which classifies participation processes based on the degree of power transferred from the process implementer to the participants. At one extreme, participation processes involve little transfer of decision making power to participants; these processes aim only to inform participants about, or perhaps even manipulate them into accepting, decisions that have already been taken. At the other extreme, participants are given real decision-making power, and are actively involved in the decision-making processes. In between these two extremes are participation processes in which participants are consulted on decisions but are not given final decision-making power.

Despite widespread acceptance of the concept, there has been some debate over the benefits participation brings and how it should be implemented in complex social-ecological settings (von Korff et al. 2012). To address the question of why participation is desirable, Carr (2015) explored the mechanisms through which participation impacts river basin management. She concluded that participation can lead to better quality decisions being taken and, if conducted correctly, can increase the legitimacy of decisions, facilitating their implementation. She argued that participation both mobilizes and develops human and social capital, and provides space for deliberation and consensus building. Webler and Tuler (Webler & Tuler 2001) surveyed the opinions of watershed planners and activists from across Massachusetts and identified four prominent views of what a 'good' participation process should be. For some participants in their study, a good participation process is credible and legitimate, and maintains popular acceptance for outcomes decided, while for others it is one that is able to produce technically competent outcomes. A third set of participants emphasized the importance of fairness and procedural justice, while a fourth saw good participation as involving a process that educates and promotes constructive discourse.

Whichever of these views are held by planners, there is broad consensus that water resources problems are complex and multi-disciplinary; decisions are affected by, and affect, a broad range of stakeholders and actors, each of whom has their own knowledge and perspective of different aspects of the system about which decisions are being taken (Davis et al. 2015). Participation is key to ensuring that the full breadth of existing knowledge is represented in the decision-making process. It is this amalgamation of different knowledge and perspectives that simultaneously makes participation so important but also so challenging (Lange, Siebert & Barkmann 2016). When divergent world views and knowledge are brought into close proximity, the potential for conflict is great (ibid). A key challenge for participatory water resources planning, therefore, is finding ways to conduct participatory processes that manage this risk of conflict, so that the fruits of participation can be realized.

Shared Vision Planning (SVP) is a highly structured approach to planning that incorporates meaningful participation into each stage of traditional multi-objective planning Palmer et al. 2013). First conceived for the National Drought Study (IWR 1994) by the U.S. Army Corps of Engineers, it requires a team be involved in each step of the decision-making process, from problem identification to plan implementation. This team should be composed of stakeholders (those able to affect, and affected by decisions taken), decision-makers, and experts (Palmer et al. 2013). Collaborative modelling is used as a mechanism through which multiple understandings can be brought together to identify and resolve disputed causal effects and create consensus and transparency regarding the underlying system as a starting point for participative decision making (ibid). As such, it promises a tangible mechanism for effective conflict resolution in participatory approaches to water management. This paper explores the ability of SVP to manage conflict in the case of regulation planning for Lake Ontario and the St. Lawrence River.

3.2 Background to the Lake Ontario St. Lawrence River Regulation

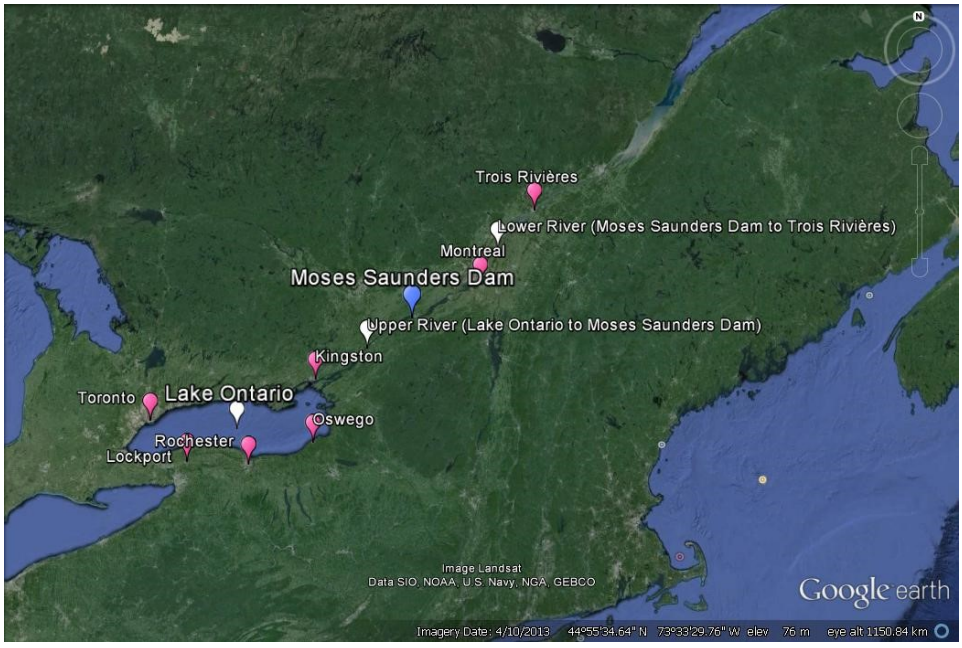
Researchers and practitioners in the water sector increasingly recognise that conflict management is an important aspect of water resources management (Mitchell 2001, Peltonen & Sairinen 2010, Stanghellini 2010, Elias 2012). Andrew (2003) identified a number of reasons that natural resource management is particularly prone to conflict: (1) the widespread use of natural resources by large, diverse, and geographically dispersed groups creates complex networks of people and entities with differing power and influence; (2) the problem is compounded by the fact that the interconnectedness of the natural environment means that the actions of one group can have an impact on other groups a great distance away (i.e., upstream/downstream effects); (3) the use of the resource can also have different meaning to

different people (i.e., economic livelihood for some; a way of life and cultural identity to others); (4) the diminishing supply of some natural resources may result in 'structural-scarcity' and unequal distribution.

Recognizing the potential for conflict, and the need to cooperate, in the management of waterways along their shared border, the United States and Great Britain (on behalf of Canada) entered into the Boundary Waters Treaty ("BWT") in 1909 and created the IJC. The joint Canada–USA staffed IJC and its various Boards has two basic responsibilities—to act on applications and issue orders if approved, and to conduct studies under formal references from the governments. The IJC is made up of six Commissioners, three appointed by the President of the USA and confirmed by the U.S. Senate, and three appointed by the Canadian Governor in Council, essentially the Prime Minister. The basic aim of the IJC and the BWT is to prevent and resolve disputes. Commissioners act not as representatives of their national government but in the common interest of the people of the basins the IJC works in.

In response to applications from both national governments, the IJC issued an Order of Approval in 1952 (and amended it in 1956) for the construction of the St. Lawrence River Hydropower Project. Figure 3.1 shows the location of the resulting Moses Saunders Dam in relation to Lake Ontario and the St. Lawrence River Drainage Basin.

Figure 3.1. Map of Lake Ontario and the St. Lawrence River.



Among the provisions contained in Article VIII of the BWT is a ranking of interests to be considered when devising regulation plans, set out as follows (IJC no date):

1 Uses for domestic and sanitary purposes;

2 Uses for navigation, including the service of canals for the purposes of navigation;

3 Uses for power and for irrigation purposes.

Plan 1958-D was the management plan formulated for regulation of the dam; it respected this order of precedence and since 1963, regulation of Lake Ontario water levels and outflows have occurred under this plan. Notably absent is any mention of the environment and certain special interests such as shoreline property owners and boaters, although the BWT does require the IJC to give all interested parties opportunities to be heard. Plan 1958-D was based on hydrologic conditions experienced from 1860 to 1954. Since that time, there have been changes to water flow patterns, climate conditions, and the composition of interested stakeholders and, as a result, this plan has become outdated (IJC 2006). As a consequence, the plan is frequently deviated from, following an unofficial plan referred to as Plan 1958-D with Deviations (Plan 1958-DD).

By 1993, the IJC was receiving numerous complaints, especially from environmental groups and recreational boaters, that the regulation plan was not meeting their needs and as a result the IJC recommended that the Order of Approval be amended to better reflect the current needs of the users and interests of the system (IJC 2006). Embracing a new spirit of participatory management, the IJC created the International Lake Ontario St. Lawrence River Study Board (the "Study Board") in 1999 and entrusted it to perform a comprehensive scientific and environmental analysis of water levels and flow regimes in the LOSLR system and mandated that this effort include public input (IJC 1999). A novel feature of the study process was the creation of a special group of stakeholders called the Public Interest Advisory Group (PIAG). The PIAG was an independent advisory group, made up of volunteers, who created a link between the general public and the Study Board. The Canadian and U.S. PIAG chairs were also members of the Study Board; they were tasked to provide advice to the board, feedback to the public, and input at all stages of the process (IJC 2006). Between 2000 and 2006, an extensive study was undertaken to combine scientific knowledge, modelling, and a plurality of viewpoints in the development of a new regulation plan. The Study Board assembled numerous public interest and technical committees to model the lake and river systems and a Shared Vision Planning approach was implemented to steer and integrate the results (IJC 2006, Langsdale et al. 2014).

A collaborative model was developed as part of the SVP approach. Technical work groups were tasked to undertake collaborative research and modelling of one aspect of the overall system. The task groups were: environmental; recreational boating and tourism; coastal processes; commercial navigation; hydroelectric power; and domestic, industrial, and

municipal water uses (IJC 2006). Stakeholders were assigned to Work Groups based on their interests and concerns. These individual group models were then integrated so that regulation plan options could be simulated and the consequences in terms of multiple objectives (which were also defined by the Work Groups) assessed (ibid). Based on extensive ecosystem and environmental modelling, three alternative plans were developed that incorporated the preferences of interested stakeholders (ibid). This was followed by a period of public consultation that resulted in the IJC choosing to back one of the plans, which was subsequently referred to as Plan 2007. Having selected Plan 2007, the IJC held more extensive public hearings on this option. During the hearings it transpired that the Plan was widely opposed; environmentalists thought that the plan failed to offer the environmental protection they sought, while other stakeholders saw no benefit in the plan for their concerns.

Following the Plan 2007 public hearings and almost complete opposition to that plan, the IJC created one formal Work Group to find a solution. This Work Group was chaired by the IJC and made up of governmental representatives. They used all the work of the Study Board and some of the technical experts and came up with Plan Bv7 (Plan B being one of the three options proposed by the Study Board). Plan Bv7 provided a wider range of flow levels that more closely matched natural flow patterns than the more tightly regulated levels found in the originally proposed Plan 2007 and Plan 1958-D (IJC 2014). Facing strong opposition from New York State South Shore property owners concerned about flooding, shoreline erosion, and damage to built structures, Plan Bv7 was further modified to address their concerns. The current regulation proposal, termed Plan 2014, has undergone several iterations and has, at the time of writing, been submitted to the governments of Canada and the United States for approval. The plan comprises both a new approach to the management of water levels and an adaptive management plan, which aims to overcome any data and modelling uncertainties and to allow for continued improvement in the future (IJC 2014). Plan 2014 underwent an extensive period of public comment during the summer of 2013; dozens of stakeholder groups and hundreds of individuals participated in these occasionally contentious proceedings. In addition to these in-person hearings held in six cities in Canada and the USA, many individuals have made their positions known in a variety of other forums—to their elected representatives, to the media, at town hall meetings, in published articles, and online. A summary of the timeline of events can be found in Table 3.1.

Table 3.1. Timeline of events.

Timeline	Event
1909	Boundary Waters Treaty signed
	International Joint Commission Created
1952	Order of Approval for the construction of the St. Lawrence River Hydropower Project
1954–1958	Construction of the Moses-Saunders Dam
1999	The International Lake Ontario St. Lawrence River Study Board Created
2000–2006	Lake Ontario St. Lawrence River Study Conducted
2007	Plan 2007 Backed by the IJC as the Preferred Regulation Option
2008	Plan 2007 Widely Opposed during Public Hearings
2013	Hearings on Plan 2014

A full description and analysis of the public participation process up to and including the 2008 public hearings can be found in Carr, Loucks, and Blöschl (2013). At this mid-point in the whole process, they concluded that there were some considerable strengths of the IJC's approach including good access to information and meetings, commitment to involving all potentially affected communities and interest groups resulting in broad representation, impartial facilitation, and inclusion of a wide variety of knowledge. They specifically compliment the PIAG, describing them as, "dynamic, dedicated, and well supported". The present chapter extends the work undertaken by Carr, Loucks, and Blöschl through an analysis of the 2013 hearings on Plan 2014, focusing on the extent to which the SVP approach employed by the IJC was effective in managing conflict during LOSLR regulation planning. To frame the research, the following research questions were posed:
(a) To what extent was agreement reached by stakeholders in support of Plan 2014? (b) What evidence is there that the resolution process enabled stakeholders to overcome potential conflict and reach agreement? (c) What residual conflict persists and what is the root cause of this conflict? Finally, consideration is given to whether any opportunities exist to move the conflict further towards amicable resolution, and what lessons might be learnt more broadly.

3.3 Methodological Approach

The study of environmental conflict is, essentially, the study of stakeholder conflict. One definition of "stakeholder" that has been widely cited in the non-profit and natural resources management literature was first proposed by Freeman more than 30 years ago as: "any group or individual that can affect or is affected by the achievement of the organization's objectives"

(Stanghellini 2010, Elias 2012, Freeman 1984). As such, this definition casts a broad net capturing actors, individuals, groups, and associations, whether formal or informal, holding different interests, perspectives, and viewpoints. In the current context, the IJC is confronted with the difficult task of balancing the competing demands of stakeholders and actors, some of whom hold strongly divergent views.

To determine the extent to which the IJC's planning process was effective at conflict management, a scheme was developed to identify, categorize and analyse the stakeholders interfacing with the IJC on the matter of Plan 2014. The IJC actively embraced the principles of collaborative and participatory management during the period of 14 years that a new water level regulation plan has been under consideration. A large number of stakeholder groups were engaged in various phases of the study. The IJC website provides copies of audio recordings and transcriptions of the public and technical hearings conducted during 2013. These data, which contain numerous statements made by a wide variety of actors and stakeholders, have been systematically analysed as part of the present work with the goal of gaining insight into the stakeholder universe interfacing with the IJC on Plan 2014.

The present analysis took the following steps, based on the methods and tools outlined by Freeman (1984), Mendelow (1991), Mitchell, Agle, and Wood (1997), Elias, Cavana, and Jackson (2002), and Elias (2012).

To assess the extent that agreement was reached by stakeholders in support of Plan 2014:

i. Stakeholders were identified and classified on a stakeholder chart;

ii. A snapshot of stakeholder positions at the time of the technical hearings was visualised through a stakeholder mapping exercise;

To explore the effectiveness with which the IJC's planning process enabled stakeholders to overcome potential conflict and reach agreement, it was necessary to first determine the potential for conflict. This was achieved by:

iii. Undertaking a content analysis to identify where stakeholders held potentially conflicting needs, values, beliefs, or expectations relevant to the resolution process;

The potential conflict was then compared to the final positions achieved through the resolution process to see if potential conflict had been effectively avoided.

Finally, to assess whether residual conflict persists and identify the root causes of this conflict:

iv. Content analysis of the statements made by stakeholder classes who remain opposed to Plan 2014 was undertaken with the goal of elucidating the root causes of opposition.

Each of the methods is described in more detail, prior to results being presented, in the subsequent section.

3.4 Results

3.4.1 Categorisation of Stakeholders into Classes

The first task undertaken during the stakeholder analysis was categorisation of stakeholders into classes. The challenge presented by the process of categorisation is to find an appropriate level of aggregation of stakeholders that allows the stakeholder universe to be simplified to a manageable number of groups and perspectives without over-generalising and losing potentially important detail about stakeholder interaction. The goal was to split the stakeholder universe into a limited number of coherent and logical classes along important dividing lines. At the beginning of the stakeholder analysis process it was not clear exactly where these lines could most appropriately be drawn, however. An initial best guess was made and stakeholders were roughly classed as belonging to one of the following groups: environmental concerns, shipping concerns, hydroelectricity concerns, fishing concerns, First Nations, and the general public. As the stakeholder analysis progressed by undertaking the steps described below, it became apparent that these classes did not capture some of the most important attributes of the dispute. Classes were therefore continually re-shuffled in an iterative process throughout the analysis.

For example, during the stakeholder mapping exercise the initial class ‘general public’ was found to be particularly incoherent and heterogeneous so additional effort was put into identifying dividing factors that diversify public opinion so that more homogenous sub-classes could be formed. During the first attempt at this process speakers were categorised geographically according to their state or province of origin. As the analysis proceeded, however, it became clear that geographic divisions could not adequately account for position differences. Opinion varied within the state of New York according to whether the speaker was a Lake Ontario riverside property owner or not. Conversely, the perspective held by those living adjacent to the St. Lawrence River did not appear to diverge depending upon whether the person lived in New York, Ontario, or Quebec. For this reason, the sub-categories used for the general public were ‘Riverine South Shore’, ‘Non-riverine South Shore’, and ‘St. Lawrence’. The perspective of those holding political office was kept separate from individuals speaking on behalf of themselves or small community groups.

In general, if no discernible differentiation could be found between two groups in terms of either position or rationale for that position (see following sections), the groups were merged

into one group. If differences were identified in position or rationale within a group, but no apparent logical divisor could be identified, the group remained as one group (albeit one less homogenous group). Table 3.2 shows the final classification of stakeholders into classes that aim to remain logical but as homogenous as possible.

3.4.2 Stakeholder Mapping

A key step in Freeman's analysis of stakeholders is the preparation of a high-level map of the universe of stakeholder classes (1984). In the LOSLR case study, stakeholders were analysed to identify their positioning in terms of the degree of support or opposition to the proposed Plan 2014. During the IJC's public and technical consultations in 2013, each speaker was permitted to speak for at least three minutes, longer if time permitted, and present their opinion on Plan 2014.

Each speaker's statement was examined for evidence to determine the speaker's position as either "strongly supportive", "supportive", "neutral", "opposed", or "strongly opposed". Many speakers explicitly stated their position as for or against Plan 2014, which simplified this task. The determination of whether a speaker was "supportive" or "strongly supportive" was made on the basis of whether the speaker also raised concerns about Plan 2014 during their speech. For example, one speaker said that their organization, "recognizes and supports the intent of Plan 2014" but also that they "have several concerns and recommendations". This speaker was therefore categorised as "supportive" rather than "strongly supportive". A distinction between "opposed" or "strongly opposed" was made on the basis of whether the speaker felt there was a need for a new plan but had strong enough concerns with the Plan to oppose it, or whether they felt that there was no need to make changes to the existing plan which they feel works adequately. A typical quote of a speaker who was determined to be "opposed" is, "we should not change the Plan until we have something that is more equal to all interests". This quote shows that the person is open to changing the regime but feels Plan 2014 is unfair and therefore their position is in opposition to it.

Table 3.2. Final classification of speakers participating in the 2013 public and technical consultations.

Environmental	Political South Shore	Riverine Public South Shore
• Large Environmental NGOs • The Nature Conservancy • World Wildlife Fund ("WWF") • Audubon Society • Ducks Unlimited • Nature Conservancy • Sierra Club • Local Environmental Groups • Upper St. Lawrence River Keeper • Save the River • Nature Quebec • Citizen's Campaign for the Environment ("CCE") • Royal Botanical Gardens • Hamilton Harbour Remedial Action • Thousand Island Land Trust • Goose Bay Reclamation Committee • Governmental Association • Conservation Authorities Ontario (CO) • Strategies Saint-Laurent • Zones d'Intervention Prioritaire (ZIP) committees	• Town/County Officials • Williamson, NY, USA • Wolcott, NY, USA • Sodus, NY, USA • Ontario, NY, USA • Huron, NY, USA • Greece, NY, USA • Monroe County, NY, USA • Niagara County, NY, USA • Orleans County, NY, USA • Wayne County, NY, USA • Oswego County, NY, USA • Cayuga County, NY, USA • Wilson, NY, USA • Olcott, NY, USA • Newfane, NY, USA • Somerset, NY, USA • Youngstown, NY, USA • Regional Alliances • Niagara/Orleans Regional Alliance • State/National representation • Congress men/women • Congressman Chris Collins • Senator Michael Nozzolio • Congresswoman Louise Slaughter • Senator Joe Roback • New York State Assembly	• Citizen Action Groups • Save Our Sodus • Lake Ontario Riparian Alliance • North Rainbow Shores Homeowner's Association • Grandview Beach Association (GBA) • Shore for All • Payne Beach Association • Baby Beach Association • Wilson Hill Association • Individuals who live in property adjacent to Lake Ontario's South Shore
Non-Riverine Public South Shore	**Public St. Lawrence**	**First Nations**
• Individuals who live in the counties along the South Shore of Lake Ontario but do not live directly on the shoreline	• Individuals living adjacent to the St. Lawrence in either Ontario, Quebec or New York	• St. Regis Mohawk Tribe (U.S.) • Mohawk Council of Akwesasne (Canadian)
Political St. Lawrence	**Shipping and Navigation**	**Fishing, Recreational Boating and Tourism**
• Officials from • Assembly (New York adjacent to St. Lawrence as far as Massena)	• The St. Lawrence Seaway Management Corporation (RSMC)	• Niagara Tourism and Convention Corporation • Tourism Department, Orleans County

• Jefferson County • St. Lawrence City • Clayton Town	• Shipping Federation of Canada (SFC) • Canadian Shipowners Association • Association of Canadian Port Authorities • Montreal Port Authority	• Classic Island Cruises, Clayton • Schermerhorn Boat Sales and Marina • Arnie's Marina • Grenadier Island Country Club • Fédération Québécoise des Chasseurs et Pêcheurs • Antique Classic Boat Society • Alexandria Bay Fishing Guides Association • Lake Ontario Fishing Coalition
Scientific Community	**Hydropower**	**Municipality and Domestic Water Supply**
• State University of New York (SUNY) • St. Lawrence River Institute of Environmental Sciences	• Hydro Quebec • New York Power Authority • Ontario Power Generation	• Water and Wastewater Treatment Plants within the Basin • Shore well users • Industrial water users

Despite efforts, made in the prior step, to classify stakeholders into coherent classes, some classes retained a degree of heterogeneity (when there was not further apparent logical basis on which to further divide a class) and therefore each aggregated stakeholder class was plotted relative to the range of positions that their sub-groups may hold. While there is undeniably a level of subjectivity to this approach, it is still a useful exercise as even a rough indication of position is useful to select stakeholders for more detailed exploration in the next step of the study.

Figure 3.2 shows results from the stakeholder mapping process, where stakeholder classes are mapped according to their position in terms of degree of support for Plan 2014. Evidence of the rationale behind the assignment of position of the stakeholders, excluding the general public, on the stakeholder map can be found in Table 3.3. Figure 3.3 looks specifically at the spread of opinion within the general public and their elected leaders, and the following section takes a closer look at the arguments of the Opposed South Shore public.

Figure 3.2. Final position of stakeholders on Plan 2014.

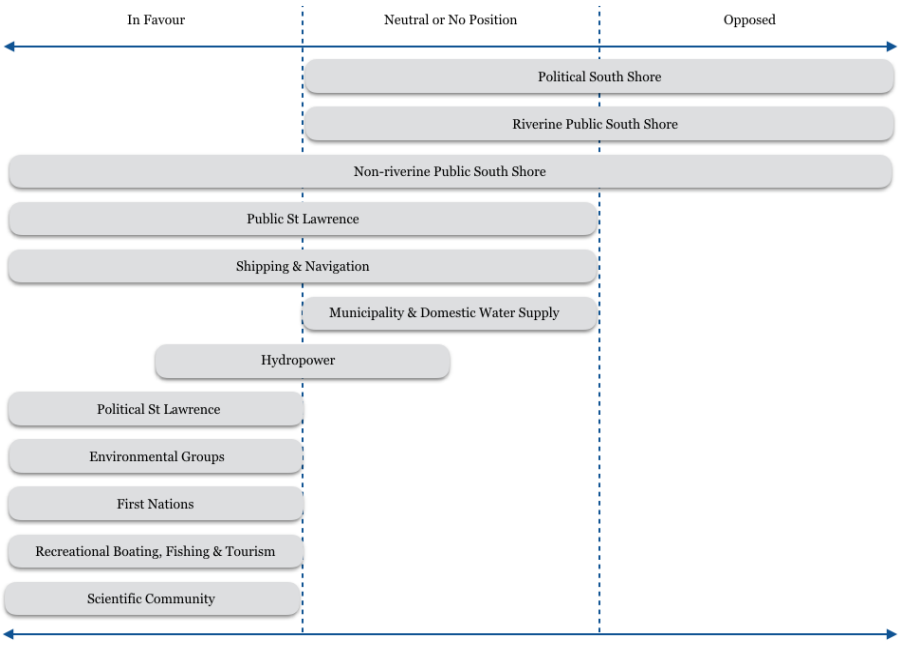


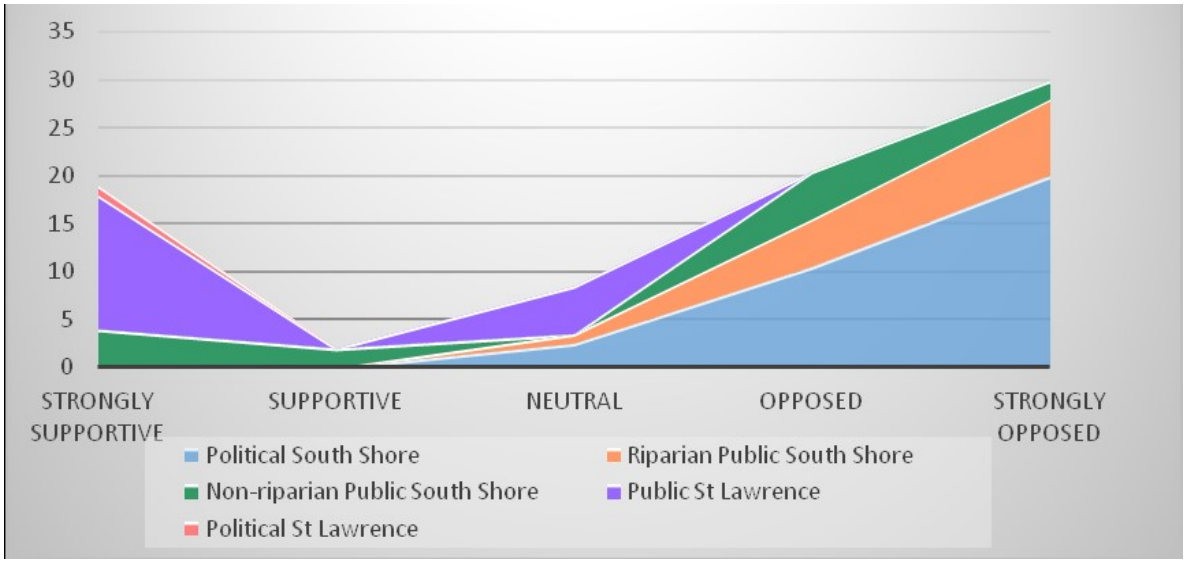
Table 3.3. Evidence of assigned position of stakeholders (excluding the general public) towards Plan 2014.

Organisation	Category	Position	Evidence
Mohawks of Akwesasne	First Nations	Strongly Supportive	"We strongly support the effort to mimic the natural flows of the River versus the Lake environment model that we have… I feel this Plan does give us the best approach forward… we fully support this new regulation Plan 2014"
Shipping Federation of Canada	Shipping	Supportive/ Strongly Supportive	"We fully support the IJC's effort through Plan 2014 to protect and enhance the environment" but they have some lingering concerns, "we're concerned with the possibility of continued low water…"
St. Lawrence Seaway Management Corporation (RSMC)	Shipping	Neutral	"The RSMC is not opposed to the prospect of refining the water management plan" but "given the above concerns, the implementation of the Plan in its current state will have significant negative impact to commercial navigation"
Canadian Shipowners Association	Shipping	Supportive	"the CSA recognizes and supports the intent of Plan 2014"… "we believe that Plan 2014 can be achieved and support both increased benefits to

			the environment and the economy through the efficient and predictable control of water levels but it still requires certain specific amendments"
Montreal Port Authority	Shipping	Supportive/ Strongly Supportive	"the proposal generally seems good to us"
Hydro Quebec	Hydro	Supportive	"so this was done partly in the plan but not necessarily as we would have liked", "the present Plan is progressively good… the Plan should be improved before it is implemented"
Conservation Ontario	Environment	Strongly supportive	"Conservation Authorities applaud the IJC for Plan 2014, proposing a more balanced approach to flow management that seeks to create more natural levels in the Lake and River while continuing to provide the basin's community with substantial benefits. It is a major step forward…" "In conclusion, Conservation Ontario and its members support the implementation of Plan 2014"
WWF Canada	Environment	Strongly supportive	"We feel that Plan 2014 really does have the potential to have a national and global impact… We're very pleased with plan 2014…"
Nature Conservancy	Environment	Strongly supportive	"I'm speaking today in support of Plan 2014"
Antique Classic Boat Society	Fishing, Recreational Boating & Tourism	Strongly Supportive	"I would definitely appreciate you accepting Plan 2014"
Lake Ontario Fishing Coalition	Fishing, Recreational Boating & Tourism	Strongly Supportive	"I really hope we can move forward with this"
Alexandria Bay Fishing Guides	Fishing, Recreational Boating & Tourism	Strongly Supportive	"I support Plan 2014 because I believe it will benefit the wetlands and the fish and the wildlife that live there"

Fédération Québécoise des Chasseurs et Pêcheurs	Fishing, Recreational Boating & Tourism	Strongly Supportive	"The Fédération Québécoise des Chasseurs et Pêcheurs is very happy with the main objectives of getting as close to a natural flow as possible. We strongly support this idea." If anything the speaker is suggesting that the plan should go further.
State University of New York	Scientific Community	Strongly Supportive	"I will point out every one of the damages that have been complained about happened under 1958DD. 1958DD never allows a low lake level to occur. I want to point out that low lake levels are really, really needed and critical"

Figure 3.3. 2013 position of the public on Plan 2014.



3.4.3 Content Analysis

The content of the available transcripts was analysed with the goal of understanding the perspectives of each type of stakeholder, to assess the potential for conflict as a first step to assessing the success or failure of the IJC's process. For each stakeholder class, consideration was given to what the stakeholder needs or wants (i.e., what their stake is), the argument they use to support their position, the underlying values and beliefs that form the basis of their position, and any expectations they hold regarding the resolution process. A summary of the needs or wants of key stakeholders is provided in Table 3.4 below.

Table 3.4. Needs or wants of key stakeholders.

Stakeholder	Needs/Wants
First Nations	Inclusion in decision making To be able to live off the environment both now and in the future
Shipping and Navigation	Predictability in water level Minimum water levels
Environmental Groups	Increased biodiversity and ecological integrity through protection of environmentally significant areas and enhanced aquatic and terrestrial habitat
Scientific Community	Increased biodiversity and ecological integrity through protection of environmentally significant areas and enhanced aquatic and terrestrial habitat
Hydropower	Consistent flow Predictable flow
Recreational Fishing, Boating and Tourism	Abundant fish, extended boating season through higher water levels at end of season (which also makes removing boats from the water easier) and beautiful environment to attract tourists
Municipal and Domestic Water Supply	Problems arise for water treatment plants at very low water levels if water becomes difficult to draw or requires additional treatment due to more concentrated pollutants, and for water and wastewater treatment plants at high water levels due to potential flood damage to facilities and shoreline protection structures
Opposed South Shore	Property security and protection from water damage and erosion Protection from emotional devastation caused by disasters Water Access Building regulation changes Consistent water levels

An important limitation of the approach that was used was that the data on which the analysis is based are statements made at the end of the resolution process. Ideally a content analysis would have been undertaken both before and after the process to identify perspective changes. One of the significant attributes of the IJC's process was the effort put into developing a shared understanding of the environmental, technical, and social dimensions of the dam management regime through the collaborative modelling process. It would have been very

interesting to see how lines of arguments, and the data upon which arguments were based, were changed by the shared visioning process. Despite this limitation, the content analysis revealed two features of the conflict with great potential to lead to conflict.

The potential for conflict between First Nations stakeholders and other stakeholders became evident through the content analysis process. The values of the Mohawks of Akwesasne stood in stark contrast to those of other stakeholders. The content analysis revealed a completely different worldview from that held by the other stakeholders. It was apparent that they had a structural concern that a process be employed that valued and included their way of knowing. In addition, previous relationship issues were referred to that highlighted the potential for conflict due to strained relations.

The potential for interest-based conflict was also particularly apparent. While the needs of some stakeholders were divergent but not necessarily mutually exclusive (for example, predictable water levels, high water levels during peak commercial times, and more variation in flow do not seem mutually exclusive), others simply seemed to conflict. The water regime cannot be simultaneously consistent in flow (as required by hydropower) and level (as required by shoreline property owners) and varied in flow and level (as required by environmental groups).

The final goal of this study was to identify the root causes of residual conflict. Having identified in preceding stages of the study that opposition to Plan 2014 persists among a subset of the public living along the South Shore and their local political leaders, content analysis of their statements was also used to identify complaints made by this group regarding Plan 2014. The outputs of this analysis are presented in Table 3.5.

Table 3.5. Complaints of the Opposed South Shore public.

There Is No Problem with the Current Management Regime:
"Why fix something that is not broken" (RK, Ontario NY)
Data Used in Shared Visioning Models Are Not Accurate:
"While this Plan reportedly reduces damages for home owners and recreational boaters, this remains an issue of great contention due to the fact that the data used remains old, outdated and inaccurate…At no time has the assessment value decreased and since this was a critical feature for the development of coastal damage projections, we believe it clearly documents the cost for coastal shoreline protection is significantly undervalued in this Plan" (DE, Niagara County)
"We feel that this plan does not show improvement to the environment due to its assumptions and out-dated data" (LC, Huron)

No Environmental Review Took Place:
"I don't see any environmental review. In New York State there's a thing called a 'seeker'; it's anytime you do anything with wetlands; it's an extremely detailed process which is justified, that you evaluate the environmental impact. I don't see anything like that in this Plan that I am aware of" (JH, Williamson)
Review Comments Were Not Adequately Addressed:
"The study had as part of it a funding mechanism to bring in the National Resource Council on the American side and the Royal Society of Canada on the Canadian side to Peer Review the environmental science... The Peer Review did not come out well for the environmental science. As a matter of fact, page 65 of the Peer Review says: "Do not use those models as a decision-making mechanism" (TM, Niagara County)
Lack of Emergency Response Maps:
"Last year the town of Greece…asked how any plan can be considered when there are no FEMA (Federal Emergency Management Act) risk maps detailing the effects of these proposals on our lakefront properties" (JA, Greece)
Outcomes Are Biased Towards Hydropower Production and/or Shipping Concerns:
"What does make sense however, after six years of reviewing the data released by the IJC, the biggest winner with Plan 2014 just like with the other proposed plans, might not be the environment at all; it's hydro power" (SL, Sodus)
"I read an article in yesterday's Buffalo News that talked about the hydro-electric plants during the peak demand times, they can make more electricity when the water levels are higher. The difference there results in millions of dollars. I don't believe that it's only just about the wetlands and the muskrats; I also believe that it also has to do with hydro-electric plants, the money that is involved and the shipping industry as well" (TH, South Shore)
"Hydro power gets I calculated four times the benefit than the environment…I would submit that the Plan is non-balanced in terms of impact, in terms of damage" (JH, Williamson)
"What I'm hearing, what the real issue is here, is that hydro power and shipping take priority over infrastructure concerns" (MR, Bailey Beach)
The Cost Is Unfairly Distributed:
"This Plan, as did previous, concentrates large disproportionate loss on five South Shore counties including Niagara" (DE, Niagara County)
"The International Joint Commission prefers Montreal interests over the South Shore's problems with flooding" (CS, Hamlin)

"I see that what we are doing here is creating damages for a very small group of people in a very localised area. When we started the study, one of the basic tenants of the study was that there would be no disproportionate losses; no one would gain from someone else's loss. Well that has not happened" (TM, Niagara County)
It's Unfair to 'Change the Rules of the Game':
"The Moses-Saunders Dam was built with the South Shore residents permission and the agreement included a 4-foot level for lows and highs…now the IJC wants a Plan that will let the waters go 5 times higher than the original plan, they don't want to hear from the South Shore and the problems that would incur" (CS, Hamlin)
"So for the past 40 years, homeowners, municipalities and private businesses have engineered and built marina and water treatment infrastructure to that roughly 4 foot like variation" (LS, Wilson)
"Our marina, our structures, everything we have was built according to the existing plan. If we deviate from that, you're going to devastate our community" (TH, Newfane)
"much commercial, residential and municipal development along the lakeshore; it was done based on the belief that to the best of human ability the lake would remain as promised in plan 1958 DD" (RK, Ontario NY)
There Is an Alternative Agenda to the Process:
"I had the pleasure of observing muskrats this year in my pond because I got a wetland in there that I can't touch; it's about a quarter of an acre. Guess what muskrats eat? Cattails, yes. Well, when they were done eating every bit of cattails and completely defoliating the entire pond, they're gone... It's a dichotomy that makes me question the agendas" (DC, South Shore)
Meetings Are Being Held in Secret/behind Closed Doors:
"We fast forward to 2013, and by the way this is rumors, but the neighborhood, IJC and other groups have had closed door meetings. Is this true?" (SD, Crescent Beach)
"As required by the [Boundary Waters] Treaty, the IJC is to involve the public in all of its activities, yet after B+ the meetings have been behind closed doors with input by environmental groups only" (LC, Huron)
Not All Data Are Being Shared with the Public:
"Also a rumor is there is a map and it shows how many homes will be affected; possible up to 2000. Rumor is this is not going to be presented to the public" (SD, Crescent Beach)
The Canadian and U.S. Governments Are Unable to Work Together Effectively:

"My concern is your triggering points and how they get triggered. I have people here from the United States and people from Canada. I know our Congress can't work together because they're Republicans and Democrats" (RK, Grandview)

3.5 Discussion

3.5.1 Extent of Agreement Reached

Figure 2 shows that the vast majority of stakeholders were supportive of Plan 2014 at the time of the public and technical consultations. With the exception of a group of a few hundred shoreline property owners based in New York State and their local political leaders, consensus was reached across the majority of stakeholders in support of Plan 2014.

3.5.2 Effectiveness of the IJC's Resolution Process

The challenge presented to the IJC to manage conflict over regulation of water levels in LOSLR was significant. The IJC process has achieved many successes. Clear examples can be found of stakeholders changing their position to back the proposed regulation changes. One such example can be found in the statement of JH, speaking on behalf of the Hamilton Harbour Remedial Action Plan. In his 2013 statement to the IJC he recalls, "I appeared before the International Joint Commission in this same room I believe and I had suggested that at that time the Commission not approve Plan 2007 … I'm very pleased to tell you that on behalf of our Remedial Action Plan Group … that we're very pleased to see the work that's gone on, and you have our support for Plan 2014". The commission then asked JH what the difference is between the 2007 Plan and Plan 2014 that led to this change in position. JH responded that Plan 2014 goes further to mimic the natural variation in the water level fluctuation that is so important for ensuring biodiversity in the region. This example is typical of many in the environmental community who wanted improved/greater water level fluctuations, and whose position was opposed to Plan 2007 and supportive of Plan 2014.

A further significant success of the IJC was the effectiveness with which they were able to achieve consensus between First Nation communities and the majority of stakeholders in support of Plan 2014. In the technical hearing in which First Nations participated, two major ongoing issues were identified by Chief Brian David that could have impacted greatly on the conflict resolution process implemented by the IJC. The first is regarding land claims being made in New York State and the Province of Quebec, along with the North Shore of Cornwall Island. The second relates to longstanding problems over the rights of First Nations individuals to travel freely within their territory without being restricted passage by the presence of

international borders. Against this backdrop, where relations must undoubtedly have been severely affected, obtaining the support of the First Nations communities was a victory.

The content analysis revealed that inclusion and influence over the decision-making process was important to the First Nations communities; “We have a concern that we know what’s going on and we have some influence over the decision making”. During the consultation process Henry Lickers, Director of the Mohawk Council of Akwesasne Department of the Environment and an important First Nation elder with great influence in the community who has been involved in the IJC’s process for many years, is quoted as saying, “We know that there are many other teachers in this world and we sit here today and listen to our problems that we have, but we know that we have the knowledge that came to us down the corridors of time from elders and ancestors that have preceded us and of us have those trusted elders that we have listened to in the past and hear their knowledge today and we will build on that knowledge that this will be a better place. And so I ask you to bring together your minds and think about those teachers of the world, and can we agree that they are important to us?” indicating a concern that the knowledge of the Mohawks be treated as equal to that of other types of knowledge. A major success of the IJC’s process is best explained by Mr. Lickers, who said that, “I think at that time a lot of the thinking from Akwesasne went forward in recommendations... I think we partly penned it, or actually had influence in the conception of it… This is a really impressive effort and I think that you’re trying to be sensitive and I really want to applaud you and thank you for this effort”

3.5.3 Root Causes of Residual Conflict

While the proportion of remaining opposition may be small, the impact of this group on the overall planning process has been significant to date. The content analysis of opposition statements identifies a number of unresolved concerns stated by the Opposed South Shore during the public hearings of 2013.

Comments made during the public hearings reveal issues in the relationship between the Opposed South Shore and the IJC. In particular, there seems to be a lack of trust by some in the IJC, which is apparent from concerns held by some of the public that the IJC had an alternative agenda, was holding secret meetings to which they were not invited or informed, and had data and graphs that they were not sharing. One speaker also questioned the ability of the U.S. and Canadian governments to work effectively together. The accuracy of the data used in the modelling process was refuted, calling into question the validity of the models and thereby the analysis of the likely impacts of management regime change. A particular concern

was expressed as to the valuation given to South Shore properties, which was felt to be outdated.

The IJC's process was directly criticized by some, who argued that an environmental review was lacking, or that a review had taken place but no effort had been made to respond to criticisms made during the review, and finally that no emergency risk maps had been produced. Many questioned the fairness of any effort to update or change dam management policy at all, given that decisions had been taken and structures built on the basis of previous policy decisions. The statement made by RK (Ontario, NY), "Why fix something that is not broken" was the most extreme of a variety of statements that revealed a lack of either understanding of, or valuing of, the local environment. A common theme amongst the Opposed South Shore was the belief that 'muskrat' (or other indicator species) concerns were not as valid as their own. Some used the argument that muskrats do not pay tax. The values held by these individuals are therefore at odds with a core value of many of the supporters of Plan 2014, which led directly to the goal of increased biodiversity.

Many of the statements make it clear that the speaker felt too much emphasis was placed on the interests of hydropower and shipping concerns, or larger downstream cities, at the expense of South Shore property owners. They disputed Plan 2014 on the basis that their interests are were not being adequately safeguarded.

The above summary reveals that the Opposed South Shore presented the IJC with a broad array of criticism in 2013, which disputed Plan 2014 on multiple fronts. Is it really the case that this stakeholder class believes that the IJC are engaged in secret meetings and are prepared to put their reputations on the line by basing their arguments on dubious data, to manipulate the process because they have an alternative agenda to serve hydroelectric and commercial shipping companies? It is thought more likely that there is, in fact, an alternative root cause of the conflict that has led to a resolution within the public to refute Plan 2014 by any means necessary.

This seems particularly true given the length to which the IJC went to conduct a process that had all the hallmarks of a participative and democratic process; Carr, Loucks, and Blöschl (2013) found little evidence of bias in the statements of the study board facilitators in their analysis of the participative process. The IJC put in place consultation and hearing processes that allowed all stakeholders to have a voice; the public had a direct link to the Study Board through the PIAG and individuals had ample opportunity to express their opinion through both three-minute speeches at the public consultations and via letters and online comment. By making recordings and transcripts of the public consultations freely available, the IJC sought

to increase the transparency of the process. The Opposed South Shore, in particular, were also represented by citizen action groups who were invited to participate in the technical working groups.

Some claims made by the Opposed South Shore, for example that no effort had been made to respond to criticisms made during the environmental review process, seem to have little connection with reality. The evidence of extensive environmental sampling and analysis is available for all to see and more time and money was spent on this aspect of the study than any other. If the root cause of the Opposed South Shore's position can be identified, perhaps it will be possible to gain insight into how the conflict can finally be resolved.

Consideration was given to whether distance from the problem-solving process was a factor in determining an individual's position with regards to Plan 2014. It is noteworthy that those individuals who were involved in the Technical Working Groups through citizen organisations remained in opposition to Plan 2014 when final positions were stated, as well as those not directly involved. This suggests that even full integration with the IJC's resolution process was insufficient to bring the strongly Opposed South Shore on board with the Plan. While the SVP process succeeded to align the positions of the vast majority of stakeholders, it failed to align the position of the general public.

It is posited that the Opposed South Shore property owners are (or at least perceive themselves to be) 'playing' a 'game' of a slightly different nature from the other stakeholders. Every stakeholder, except for the Opposed South Shore, has something to gain through the introduction of new water level regulations. Therefore, each of the other stakeholders is playing a collaborative game in which they want to achieve final agreement; the resolution process is about negotiating how much they can benefit. The Opposed South Shore, conversely, believes that they have nothing to gain from any new plan. Their objective is to keep water levels constant, which is in direct conflict with the principal objective of any new plan (i.e., to return water levels to a more natural and varied pattern). The Opposed South Shore, therefore, is playing a zero-sum game in which there is no hope of benefitting from new plans. The IJC itself has reinforced this position in the past. They stated that "the current Regulation Plan 1958-D with Deviations comes close to minimizing damages for Lake Ontario shoreline property owners" (2006); this implies that finding alternatives that bring benefits to this stakeholder group is highly unlikely. They explicitly acknowledge the zero-sum nature of the problem when they say that, "Changes to the criteria and existing operation plan are not possible without harm to some interests" and go on to justify this harm by saying that the, "majority of Board members do not consider these damages a disproportionate loss" (2006).

While the Opposed South Shore perceive themselves to be playing a zero-sum game, the benefits that can be brought by any collaborative process are arguably severely restricted. They have fairly limited power in comparison to the other stakeholders. Perhaps the only strategy which they feel to be available to them is to exert pressure on the IJC by standing in the way of any resolution process—a strategy which to date they have implemented highly successfully (as evidenced by the fact that the resolution process has now been going on for over 14 years).

3.5.4 Moving Forward

The positions of the stakeholders are now so well entrenched that reaching consensus appears an elusive goal. A solution to this impasse would require a significant re-framing of the problem such that the Opposed South Shore perceive themselves as having something to gain from committing to the resolution process, perhaps by bringing the possibility of compensation to the table. It should be noted, however, that taking a route involving compensation is not without difficulties of its own. For example, issues such as whether or not the owners of structures that have been developed during the time the studies and resolution process have been ongoing should be compensated are likely to be highly contentious. There is also the issue of whether compensation should be used to relocate those living in homes adjacent to Lake Ontario, or whether compensation would be for the rebuilding of damaged property following flood events. This could equally lead to a highly charged and politically contentious debate.

With every conflict there is a necessary compromise to be made between urgency and pressure to implement timely solutions, and a desire to ensure a democratic process is followed that encourages collective action. In the case of the LOSLR conflict, as with other conflicts, some may feel that the emphasis has been placed too firmly on achieving consensus at the expense of timeliness, whilst others may hold the opposite opinion. The fate of LOSLR now lies in the hands of the Governments of Canada and the United States of America, who must weigh up the increasing urgency and impatience to implement a new water regulation management plan against a desire to implement a solution that is supported by all stakeholders concerned. It is the authors' opinion (Furber et al.) that, as the environmental damage occurring due to the employment of Plan 1958-DD has now been demonstrated, the urgency to act outweighs the desirability of reaching full consensus. It is possible that the governments will concur with Plan 2014 for the greater good of both countries, and address shoreline property

owners separately. It is not clear, at this time, exactly how much political power these few hundred individuals have to influence international boundary decisions[1].

3.5.5 Broader Lessons

The successes of the IJC's approach suggest that SVP can be effective at managing potential conflict between stakeholders who have something to gain from participating meaningfully in the process. It is probable that any participatory approach will fail to completely eliminate conflict where gains to one interest can only be realized at the expense of another. In such cases, other mechanisms, such as the possibility of compensation, might usefully be brought to the table to complement the SVP approach.

3.6 Conclusions

It is concluded that while the Shared Vision Planning process employed by the IJC had some significant successes, notably the success that has been achieved with regards to integration of First Nations and environmental concerns, the IJC's public outreach and participation efforts have not been successful in reconciling the positions of all stakeholders. There is a distinct group of shoreline property owners in New York State who remain opposed to Plan 2014 because they perceive that they can only lose out from any regulation change. They are therefore unlikely to be motivated to engage productively in any planning dialogue. A solution would require that the problem be reframed so that this group has something to gain from a successful regulation plan resolution, which may involve bringing the prospect of compensation to the table. The fate of Plan 2014 now lies with the governments of Canada and the United States of America, who may choose to concur with the Plan for the overall public good of both countries and address shoreline property owners separately.

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[1] Plan 2014 had been approved since publication of this paper.

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Linking Statement

Chapter 3 undertook an analysis of the state-of-the-art Shared Vision Planning process used during the Lake Ontario and St Lawrence River conflict. The approach was found to have many strengths, achieving notable success in bringing stakeholder groups together and incorporating a broader range of perspectives into decision making process. With the exception of one small group of stakeholders, the process was able to overcome entrenched conflict and reach consensus on a management plan.

Serious Games have been touted as a novel tool with applicable value in supporting collaborative decision making. Chapter 4 goes on to look at the potential use of Serious Games, first in decision making generally and then in the St Lawrence River region more specifically. The mechanisms through which Serious Games may be able to contribute to decision making are analysed with a view to establishing if, and how, a game might benefit the region.

The conclusions chapter will subsequently discuss the future of conflict management in participatory decision making in the region and explore whether Shared Vision Planning or Serious Games or both should be pursued as potentially fruitful tools.

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4. Serious Games

Assessing the Benefits of Serious Games to support Sustainable Decision-Making for Transboundary Watershed Governance

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Abstract: The overarching objective of this paper is to consider the ways that serious games could be developed in the future to maximise potential benefits in the context of governance of complex transboundary water systems. A focus is placed on the use of serious games for decision making; as such the use of serious games for other purposes (e.g. games with a solely educational purpose), while interesting and useful, are outside the scope of this work. The Upper St Lawrence is used as a case study of a transboundary watershed to enable specific examples of the potential uses of serious games to be drawn. A review of the serious games and decision-making literature is undertaken to derive a theory framework for the way Serious Games may be able to support decision making in different contexts. Following this, exploratory interviews were conducted with water resource managers across the St Lawrence region to establish whether a serious game might be useful in this particular context. Three decision-making contexts were identified in which Serious Games may be a useful tool: decision making involving complex systems or significant uncertainty, decision making involving multiple stakeholders with divergent perspectives, and decision making under time constraints. It was found that several contextual factors make the St Lawrence region a potentially viable candidate for the development of a serious game to support decision-making.

4.1 Introduction

The Great Lakes-St Lawrence basin faces a complex set of governance challenges. Jurisdiction is shared between two countries, several states and provinces, and numerous local governments (Bakker and Cook 2011), which leads to the involvement of a diverse range of stakeholders including the general public, industry, farmers, small business owners, and civil

servants and politicians of various levels. The basin's complexity and size challenges attempts to understand its dynamics, while limited interactions and disagreements between stakeholders impede management actions (IJC 2013). Such governance challenges require novel methods of encouraging dialogue, while facilitating learning and enabling systemic institutional change, so that decisions can be made from a position of shared knowledge and understanding.

Advanced information and communication technologies (ICT) offer innovative and promising solutions for enhancing social learning and collaborations to overcome these water governance challenges (Medema et al. 2014). Serious games, defined as games for a purpose other than pure entertainment that combine computer simulation with role-play as an integrated method for complex policy making (Zhou 2014), are a particularly promising as they have the potential to trigger discussion and learning among stakeholders and therefore could facilitate decision making process (Medema et al. ob cit).

This paper considers the potential utility of a serious game for the St Lawrence Region. It has as its objectives: 1) Elucidation of the mechanisms which make serious games beneficial for decision making in different contexts; 2) Analysis of the St Lawrence context to explore whether the development of a serious game might be appropriate in this case 3) If a serious game might be appropriate for the St Lawrence, analysis to determine which of the potential mechanisms identified through the first objective are applicable in the case of the St Lawrence. Specifically, the following research questions will be addressed:

- What potential is there for serious games to support decision making in water resource management?
- What factors influence the decision-making processes currently used by water managers in the St Lawrence?
- What are the strengths of the region's approach to decision making?
- What are the challenges for decision making processes?
- What kind of decision making processes are likely to be most effective in the future?
- Would a serious game be useful to support decision making in the region?
- If as serious game would be useful, how would it be useful and what features might it have?

A review of the serious games and decision-making literature is undertaken to derive a theoretical framework by which to consider when and why serious games might be useful for decision making for water resources management. Subsequent sections will use this framework to investigate decision-making in the St Lawrence context to explore whether a serious game might be useful in this particular context.

4.2 Serious Games: Benefits and Mechanisms

This section aims to elucidate the mechanisms which make serious games beneficial for decision making in different contexts. To achieve this consideration is first given to the characteristics and potential benefits of serious games that might be of relevance. Following this, discussion turns to identification of the contexts in which serious games might be beneficially applied to support decision making process. The section ends by pulling together the ideas presented in the first two sections into a theory of contexts in which serious games are useful in decision making and the mechanism through which they are able to bring benefits.

While intuitively, we all understand what constitutes a game and what does not, finding a single authoritative definition is not a simple task (for full discussion see Mayer et al. 2016). While an exact definition may be elusive, the approach taken here will be to identify the range of characteristics that lead to an activity resembling a game (following Wittgenstein 1953, and a number of subsequent game scholars). Characteristics generally indicative of games include: fixed rules (Callois 1961, Juul 2005, Salen & Zimmerman 2003); variable outcomes (Juul 2005); scoring or assigning value to the outcome of the games (Juul 2005, Salen & Zimmerman 2003); negotiable outcomes requiring player effort and attachment to the outcome (Juul 2005); subjective representation of reality (Crawford 2003); and interaction between the player and the game world (Crawford 2003).

While it is not necessary for an activity to possess all these characteristics to be classified as a game, these features have been closely associated with games, and most activities identified as games possess some of these characteristics. The identification of these characteristics will serve as a handle with which to get to grips with the mechanisms by which games can be beneficial for decision-making as the discussion turns to the decision-making processes used in a range of contexts. A Serious Game is then simply taken to be a game with a purpose beyond that of pure entertainment (Abt 1970).

Serious games are a relatively new tool in water resources management and the mechanisms through which they are able to support collaboration over conflict have not yet been clearly mapped out. As Vegt et al. (2016) put it, “We know serious games can enhance collaboration but we don’t know why” (see also Mayer et al. 2005). Two studies stand out as providing experimental evidence of the ability and means by which serious games may be useful in ADR. Vegt et al. (ob. cit.) demonstrate how, by changing the rules of a game, the behaviour of players can be directed towards either conflict or collaboration. In their experiment, pairs of players are asked to play one of two versions of Breakout. The original

game of Breakout involves a player moving a paddle along the bottom of the computer screen to bounce a ball towards bricks at the top of the screen and stop the ball touching the bottom of the screen. If the ball hits the bricks, they are destroyed and the player wins points; if the ball touches the bottom of the screen the player loses a life. Vegt et al. developed two scoring systems for a multi-player version of the game. In both games the players are interdependent, i.e. the actions of one affect the other. In one version of the game, players compete to hit the ball, scoring points if they reach the ball and it hits bricks. In the other, players must take it in turns to hit the ball, both scoring points if they hit bricks. Through their experiment, Vegt et al. (ibid) demonstrated that they can influence players towards either competitive or collaborative behaviour by manipulating the, 'rules of the game'. They imply that this is the mechanism through which serious games may be able to enhance collaboration.

The game upon which Vegt et al. base their experiment is not controversial and this does raise the question of how applicable their findings might be in more entrenched conflict situations. Kampf and Stolero (2014) undertook an experiment to explore the use of serious games for peace education in the highly contentious Israel-Palestine conflict. Their rationale for the potential use of games to overcome entrenched conflict originates in Peace Education Theory. Peace Education Theory promotes education to achieve several goals for conflict resolution processes: facilitating parties to develop empathy for the perspectives of others, through which they may come to view opposing narratives as legitimate; encouraging parties to critically reflect on their own position, so that they come to recognise their own role in the conflict; and providing a forum where parties can develop a relationship by interacting in non-violent activities (Salomon 2011). The overarching goal of Peace Education is to reframe conflict narratives to resolve conflict through the promotion of trust and empathy, and the reduction of prejudice (Kampf and Stolero ob. cit.). Kampf and Stolero (ibid) experimentally tested the ability of a computerised simulation of the Israeli-Palestinian conflict to promote Peace Education in 185 Israeli undergraduate students of Jewish and Palestinian origin. They found serious games to be an effective tool of Peace Education, thus demonstrating the value of serious games even in more entrenched, contentious conflict situations.

While the studies of Vegt et al. (2016) and Kampf and Stolero (2014) demonstrate the potential for serious games to support conflict resolution within a gaming environment, the critical question arises as to whether the benefits gained within the gaming environment carry into the 'real world'. As explained by Juul (2005), computer games are half-real. Real players interact with each other according to real rules in a fictional world (ibid). For Juul it is this fictional world that differentiates computer games from their more abstract, tradition game

counterparts. Players must choose whether to immerse themselves in this fictional world, believing it to be true, or maintain the fictional world as a mere representation of information about the rules of the game (ibid). The translation of meaning in a fictional world to meaning in the real world can be complex. Juul notes that the act of fighting another person's character in a fictional conflict in a computer gaming environment does not equate to a desire to attack that person in real life; conversely, it may in fact be a symbolic interaction representing an invitation to friendship. As Juul puts it, "Humans are not always literal in their interactions, and we cannot take human games at face value. Competitive games are social affairs, and much more so than the rarely played non-competitive games that have been proposed".

This is an interesting point, because, as noted by Mayer (2009), the use of serious games for water resources management is based on the assumption that, 'individual and social learning that emerges in the game can be transferred to the world outside the game'. For Mayer, this transfer is, 'negotiated and not immediate, thereby making a simulation game low in external risks and giving the players a sense of safety' (ibid). Mayer is concerned primarily with the application of serious gaming to public policy making, but his assertion that there is a lack of empirical evidence exploring how gaming experience impacts on the real world seems more broadly relevant. In his words, "we hardly seem to know what happens at the interface of public policy making and gaming". Savic et al. (2016) have recently reviewed serious game applications developed for the water sector. Their assessment is that most of those developed to date, aim to address conflict among stakeholders facing complex problems of river basin management. These games are, on the whole, largely simplified and require expert mediation (ibid). There seems to be a prevailing assumption that serious games are beneficial for resolving conflict surrounding water resources management, but a lack of understanding of the mechanisms to explain how, and why, they are useful. Questions around how accurately computer gaming environments need to represent reality for lessons learnt to translate into the real world, and how interactions within gaming environments are mapped to interactions in the real world, seem to remain unanswered.

4.3 Decision-Making Process

The following paragraphs consider decision making processes with a view to ascertaining whether serious games, as characterized above, might be able to support these processes.

Traditional 'deductive reasoning and rational choice' approaches to decision making are still apparent within the natural resources literature. Take, for example, the recent book by Conroy and Peterson (2013), 'Decision Making in Natural Resource Management: A

Structured Adaptive Approach'. The book epitomises a rational approach to decision making, emphasising the importance of the use of rigorous, repeatable methods, and proposes a structured framework for achieving this. The essential components of the process include clear problem definition, setting of objectives, specification of decision alternatives, and delineation of the temporal and spatial boundaries of the problem. For effective decision making using this approach it is critical that the selected objectives are measurable and reflect the overarching goals related to management of the resources. The crux of the decision-making process is the conceptualisation and quantification of the impact the decision options will have on the selected objectives. The book discusses dealing with uncertainty at length but, as the process is essentially based on deductive reasoning and rational choice, the more complete the decision maker's understanding of the underlying systems, the more likely the decision maker is to correctly identify the optimum decision option and so uncertainty must be reduced as far as possible. To be incorporated in the decision-making process irreducible uncertainty must be quantified to a probability using statistical approaches.

The assumptions underlying this type of approach are well known and widely debated. The deductive reasoning and rational choice method arises from a positivist world view; the view that holds that a single reality exists out there that is independent of our experience of it. By applying the scientific method we can come to know the truths of that reality. As observers applying the scientific method we are capable of complete objectivity and as actors we are entirely rational and passive. In this mathematical and rational world, where is the place for serious games? What can they offer? It is argued here that there is little place for serious games when the world is viewed from this vantage point; they have no role to play in decision making. If the world can be so clearly mapped mathematically, then all that is left is to run the computer algorithms; with such a clear and complete understanding of the relationship and interaction of all relevant variables to a measurable objective function, any decision can be reduced to an optimisation problem with a single most favourable solution.

There are many decisions well suited to this positivist treatment. They are those that are simple enough that the causal influences of the underlying systems are identified and understood in their entirety; and uncontentious enough that there is agreement of the objective function upon which a decision is to be taken. The problem for water resource managers is that many decisions, and arguably the most important ones, are neither simple nor uncontested. Similar challenges have been faced in other fields of research. The field of operations research (OR), which has as it raison d'être the development of quantified approaches to decision making, had a crisis in the 1970s on the realisation that there were a very limited practical

applications for the deductive reasoning and rational choice theories it had previously espoused (Rosenhead and Mingers 2001). By the mid 1980s, authors such as Jackson and Keys (1984) had made significant progress towards resolving this crisis by encouraging the incorporation of a much wider range of methodologies into the OR decision making and problem solving repertoire. In their seminal paper, 'Towards a system of systems methodologies', they mapped methodologies to their most appropriate context. Traditional computational (i.e. deductive reasoning and rational choice) methods were constrained to contexts of low complexity with unitary decision makers.

If it is accepted that there is little need for a game in a purely deductive reasoning and rational choice decision making process, then we should turn our attention to those contexts in which this approach either cannot, or should not be applied. Generalising a little from the work of Jackson and Keys (1984), three broad contexts have been selected for further consideration here: 1. contexts in which a purely rational decision making process cannot be applied due to high levels of complexity and/or uncertainty; 2. contexts in which a purely rational decision making process cannot be applied due to time restraints on the decision making process; and 3. contexts in which it is inappropriate to apply a purely rational decision making process as the core assumptions of the positivist perspective do not hold true for significant dimensions of the decision making process (i.e where sociocultural and/or political factors are important). Each of these contexts is considered in turn below.

4.4.1 Decision Making under Time Constraints

Emergency situations are a typical example of when action is urgent and there is not enough time to fully analyse the consequences of every possible course of action. In a water resources context, emergencies might include responding to contamination events (e.g. oil spills) and flood response. How decision making happens under time constraints has been extensively studied by researchers such as Gary Klein (1999), who focuses much of his effort on studying particularly high-stakes decisions taken under time-stress by studying, for example, fire men and nurses. Klein pioneered a stream of research into 'naturalistic' decision making; of which the central idea is that experienced decision makers are able to pick up on subtle cues and identify good courses of action without consciously going through a rational decision making process. He calls this 'recognition-primed' decision making; it is a form of intuitive decision making employed widely by experienced professionals operating in these kinds of contexts.

Decision makers use pattern recognition to pick up on subtle cues to determine whether the situation is typical and whether it is meeting their expectations. Klein's research

participants often referred to the 'gut feeling' they had that something wasn't quite right in particular situations; when Klein probed further he was often able to identify a particular sequence of subtle cues that the decision makers were picking up on subconsciously. Klein gives the example of a fire in a one storey house; when firefighters arrived, all clues suggested a small fire that should be easily controlled by dousing with water. When the firefighters try this, however, the fire does not respond as expected and the water has little effect. Feeling something isn't right, the firefighters leave the building, and soon after the floor upon which they had been standing collapses. It turned out that there was a major fire in the basement of the building; a basement which the firemen did not know existed. On further questioning, it transpired that the decision maker had subconsciously noticed that the room in which they were standing was hotter than he would expect for a fire of the expected size, and quieter than it would usually be for the amount of heat being given off.

Klein's model integrates two major processes. In the first, decision makers size up a situation to determine whether the situation is typical, and like the majority of similar situations they have seen in the past, or not. If it is, they are able to call on a bank of knowledge including expectations of how the situation will develop, relevant cues they should look out for (i.e. by knowing what to look out for in particular situations they are able to filter information to pay attention to what is important while avoiding information overload), courses of action that are likely to be appropriate and can identify reasonable goals for the situation outcome. If everything indicates the situation is typical, typical actions and responses can be implemented directly. If the situation is atypical, or if the situation analysed initially as typical begins to violate the expectations of the decision maker, the decision maker will often spend more energy on diagnosis of the situation. The process followed here is one of, 'story building', i.e. the decision maker seeks the explanation of the situation that best matches what he/she is observing. This may have implications for whether the typical course of action is appropriate or not. If it is not, the decision maker is likely to begin mentally evaluating a range of possible courses of action. In this case the decision maker will think of a possible course of action and mentally simulate whether it will work. If it would it is implemented (usually without further consideration of alternative courses of action, a luxury not afforded to emergency responders), if not the course of action will be modified to work, if possible, or dropped so the decision maker can go on to think through alternatives until they identify a feasible option.

There is only one way to develop intuitive expertise, and that is through practice and experience. It is estimated that in order to become a chess master, and gain the intuition expertise that allows rapid recognition of the most promising move to make next, requires

recognition of around 50,000 to 100,000 patterns of play (Chase and Simon 1973) that is usually developed during the course of around ten years of serious, dedicated play (Kahneman and Klein 2009). Chess is a particularly challenging activity with which to gain intuition due to the sheer number of possible moves and strategies. Not all competencies require as long to gain intuitional expertise over but the process for gaining expertise always involves practice. According to Klein (1999), "If we can present many situations an hour, several hours a day, for days or weeks, we should be able to improve the trainee's ability to detect familiar patterns". Klein (ibid) also notes that, "A good simulation can sometimes provide more training value than direct experience. A good simulation lets you stop the action, back up to see what went on, and cram many trials together so a person can develop a sense of typicality". Box 1 lists the characteristics of the way experts learn as identified by Klein (1999).

Box 1: Characteristics of the way experts learn

They engage in deliberate practice, so that each opportunity for practice has a goal and evaluation criteria.
They compile an extensive experience bank.
They obtain feedback that is accurate, diagnostic, and reasonably timed.
They enrich their experiences by reviewing prior experiences to derive new insights and lessons from mistakes.

This seems a very obvious and natural use for serious games in water resources management decision making. Oil spills, for example, hopefully occur very infrequently over the career span of any one particular water resources decision maker. Yet we would like that, if an oil spill does occur, the decision maker will respond as an experienced professional. The question arises as to how decision makers are supposed to gain this experience when events are infrequent and not the ideal time to experiment and learn the most appropriate responses. Providing a safe arena for experimentation and learning, a serious game simulating potential emergencies faced by decision makers could have a lot to offer. A game brings the opportunity to expose a decision maker to a wide range of experiences that they might not otherwise be exposed to, in a relatively short space of time. In addition, game scenarios are repeatable, offering the decision maker an opportunity to test alternative responses, thus obtaining feedback that is diagnostic and reasonably timed. Games could also be recorded to aid the review of responses. To be useful in this context, games must be realistic enough in the cues the gamer received to ensure that feedback is accurate.

4.4.2 Decision Making with Complexity and Uncertainty

Complex systems are characterised by large numbers of objects or agents interacting with each other in non-trivial ways, such that the behaviour of the system exhibits emergent phenomena that would be difficult to deduce from the behaviour of individual objects (Johnson 2011). Complex systems are often adaptive, which means that they have the ability to mutate and change their behaviour based on experience (Smith and Johnson 2011). Feedback loops in the systems have a critical role to play in the production of adaptive and emergent behaviours, and mean that changes made to one part of the system can have far-reaching repercussions throughout the system. Balancing feedback loops work to maintain the system in its present equilibrium state, but if external influences (caused by a further feature of complex systems, the fact that they are characteristically open systems) pull the system too far from its equilibrium, then the objects within the system are able to self organise into an alternative equilibrium state in order to avoid the complete collapse of the system.

In theory, if a complex system could be fully understood, mathematically modelled and all relevant variables measured, there is no reason why it would not be possible to apply a deductive reasoning and rational choice approach to decision making to identify optimal measures for management of the system. Due to limited time, budget and/or scientific understanding, however, it is usually neither possible nor practical for the decision maker to obtain such a complete system model. For this reason, decision making for complex system management often goes hand in hand with high levels of uncertainty. Uncertainty can arise from different sources. Stochastic uncertainties, i.e. those with frequency based probabilities (Quade 1989), can be quantified using statistical approaches and incorporated into a deductive reasoning and rational choice approach. Other types of uncertainty, such as ambiguity regarding the identification of significant variables to incorporate into the decision making process or a lack of understanding of the causal links between variables, undermine the efficacy of employing such an approach (Lempert 2002). In addition, data of sufficient accuracy regarding the initial state of the system variables may be lacking and as the emergent behaviour of complex systems are sensitive to the initial system state, this can intensify the level of uncertainty.

Without the option of applying a deductive reasoning and rational choice approach, identifying a definitive optimum management approach becomes impossible and it becomes necessary to refine expectations and objectives for managing complex adaptive systems. There are several ways to refine goals and expectations to ensure they are more appropriate in such contexts. Instead of optimum solutions, one can pursue the more modest goal of identifying

robust solutions, i.e. those that are expected to perform well over a wide range of possible system states (as proposed by Rosenhead 1989 p186). Adaptability might also be a relevant goal; solutions with more flexibility to be refined in the future if not performing as desired are often preferable to those that are difficult to alter in high uncertainty contexts (ibid). Where decisions can be taken in incremental stages, management options remain open for longer and management approaches can be altered as the unknown future unfolds and more information becomes available. Where systems are highly complex and unpredictable, perhaps the best that can be strived for is enough understanding of the system dynamics that we are able to steer the system away from the states that are most dangerous.

The logical question then is, how might these more modest goals be achieved? How do we identify robust and adaptable solutions? Can we steer complex systems away from dangerous states? Without the possibility of applying deductive reasoning to decision-making process, the next best option is inductive reasoning. While the goal of deductive reasoning is to draw conclusions that must be true provided the premises upon which they are based are true, the goal of inductive reasoning is to draw conclusions that are probably true if the premises are true. Inductive reasoning is a process in which the decision maker searches for patterns within their observations upon which to draw general conclusions, and as such is about learning from experience. Resource managers often employ inductive reasoning processes either consciously or unconsciously; for example, each time they make a decision based on their own mental model of a system in question, or when they draw a comparison between the current problem and a problem they have seen in the past, they are doing so. How good these decisions are in the long run, will depend on how much experience the decision maker has, and how similar the experience to the question at hand. Two avenues for improving inductive reasoning processes in water resources management are proposed: 1) Increasing the experience of resource managers in managing the particular systems in question could improve their mental models of the system and lead to better decision making; 2) Inductive reasoning processes are widely applied in decision making, but usually informally; formalisation of the process to make more explicit the evidence upon which decisions are based and the degree of confidence in the general conclusions drawn could increase the legitimacy of the use of inductive reasoning and the decision produced.

Improving the (mental) models of resource managers: There are particular challenges for resource managers in developing and testing their mental models of the complex systems they manage. With so many factors influencing the state of the system in question, all simultaneously in flux, it is very difficult for managers to isolate and determine causal relations between different factors. The problem is compounded by time delays in action and response

that further obscure these associations. In the real world, managers are faced with a wide range of different types of decision; once a decision is taken there is no guarantee that a similar decision will be faced in the near future where a different course of action can be applied and the different response of the system noted. This presents a challenge for learning from experiences and assimilating lessons learned with existing understanding. It is proposed that herein lies a possible useful application of serious games in decision making processes for water resource management. Picking out some of the characteristics of games identified above, games offer a safe arena for experimentation, allowing the player to interact with the game world in a way that could support learning as necessary for inductive reasoning. A game could provide an arena in which water resources managers are able to develop and test a range of management measures and strategies based on an inductive reasoning approach. Bad decisions can be exposed in the gaming environment without serious real world consequences.

A potential problem with this approach immediately springs to mind. In order for the game player to test potential management approaches, and build a picture of the system's causal relations and response to those management approaches, the game world must, in some minimum critical respects, be an accurate reflection of the real world. Presumably, if data and understanding is lacking as required to employ a deductive reasoning and rational choice approach, this is likely to also be an issue for the development of such a gaming world.

Formalisation of the decision-making process: Serious games may have something to offer in terms of formalisation of decision-making process. If actions and consequences can be recorded and subsequently analysed, it may be possible to justify a decision on the basis of producing the most robust and/or adaptable outcomes; treating the serious game as a laboratory for experimentation. If the game is similar enough to the real world in salient features, the game environment could be a safe arena for experimentation, allowing a trial and error approach to the identification of robust and adaptable solutions. The results of the experimentation could be recorded and presented as evidence of the suitability of the decision made.

4.4.3 Subjectivity in Decision Making

The third context to be explored is when the assumptions of a positivist approach cannot be assumed to be true. As outlined above, the positivist approach holds that a world exists separate from our experience, that this world can be known through the application of the scientific method, and that humans are capable of rational and objective behaviour. To answer some questions that arise during decision making processes, it is appropriate to apply this perspective. For example, a water resources manager concerned about the health of a particular

river, may want to know how fish populations are varying with time as an indication of whether river health is stable or in decline. Applying a scientific approach to answering this type of question is very reasonable. Many questions confronting water resources managers, however, are of a much more subjective nature, relating to a murkier, socially constructed reality. For the manager concerned about the health of a particular river, such questions might include: What parameters are most important to stakeholders for assessing the health of the river? What does the river need to score in each of these parameters to be considered to be in 'good' health?

The problem is that, often, to find true solutions to water resources problems, it is necessary to engage a range of actors in the decision-making processes. One reason for this is that water resources problems are typically multidisciplinary, and no one individual has complete knowledge of all relevant aspects of the problem; decision making benefits from collaboration by a range of knowledge-holders (Akhmouch & Clavreul 2016). Another is that usually there is not a single person with the power to implement a decision unilaterally (ibid); to put a decision into effect, therefore, requires the agreement of a range of stakeholders. Each of these people may have a different opinion on subjective matters such as what parameters are most important, and what score might constitute 'good enough'. At the heart of the problem, lies the differing values, beliefs, expectations, experiences and assumptions that make up the perspective of the individuals involved in the decision making process. Each person has a different view of the problem being faced and therefore experiences, to a greater or lesser extent, a different reality from the others engaged in the process. When multiple decision makers have a different perception of reality, the deductive reasoning and rational choice approach is difficult to apply.

A typical way forwards in such cases is to abandon deductive-rational processes in favour of a negotiation process. Negotiation processes offer the advantage of not requiring a shared reality in order to reach an accord. In a negotiation, however, each participant strives for the best possible outcome for their interests using the leverage they have available to them. Not all participants are equal in a negotiation, more powerful participants are likely have more influence over the final outcome. It cannot be guaranteed that negotiated outcomes will be either fair or optimal (Druckman and Wagner 2017). Deductive-rational approaches, on the other hand, have the strong advantage of providing a transparent and more objective process (if objective functions are agreed upon) for identifying the best course of action. If a shared reality among decision makers could be agreed, use of the deductive-rational approach could lead to fairer outcomes.

Echterhoff, Higgins and Levine (2009) assert that shared reality is, 'a product of experiencing commonality with others' inner states about the world'. In other words, for two

people to have a shared reality, they need to be able to empathise with the situation of the other by drawing comparisons between their own experience and that of the other. It is posited that serious games, through their ability to expose players to a situation they might not encounter in their everyday life, might have the potential to help decision makers develop this empathy. A simulation - role playing game, where decision makers play the role of other actors, could allow decision makers to experience first-hand the challenges faced by the other party and develop the empathy necessary to achieve the shared reality permitting the use of the deductive reasoning and rational choice approach to decision making.

4.4.4 Summary of the Potential use of Serious Games in Water Resources Management Decision Making

The above sections set out to explore the potential benefits of serious games for decision making in water resources management, the mechanisms by which these benefits are brought about, and the contexts in which these mechanisms apply. Table 4.1 sets out a summary of ideas presented in the preceding discussion, as relating to these aims. The following section will consider the practical application of serious games in the context of the St Lawrence River.

Table 4.1: Summary table of benefits and mechanisms

Water resources management challenge	Potential benefit of serious games	Mechanism by which this is achieved	Context of Application
Unpredictability in the response of the system due to complex dynamics and emergent behaviours.	Identification of robust solutions.	Games as 'flight simulators' for learning to steer complex systems and 'game out' possible future scenarios.	Decision making when systems are complex and/or uncertainty is high
The need to reach consensus between diverse decision makers to implement decisions	More empathy of each decision maker for the perspectives of other decision makers leading to increased likelihood of agreement and implementation of decisions.	Expose decision maker to challenges facing other parties through role playing games	Multiple decision makers with divergent perspectives facing subjective decisions

Water resources management challenge	Potential benefit of serious games	Mechanism by which this is achieved	Context of Application
The need for decision makers to respond quickly and competently in emergency situations that arise infrequently (e.g. oil spills)	Helping decision makers develop an intuition for appropriate actions in emergency situations that increases the likelihood of an effective response.	Decision maker exposed to a broad range of repeatable experiences to help them recognise cues and develop intuition to quickly assess and respond in real world situations	Decision making under time constraints

4.4 Decision Making in the St Lawrence Context

Having identified broad theoretical contexts in which serious games might be beneficially applied to support decision making process in the previous section, this section looks more specifically at the potential for the development of a serious game for the St Lawrence region.

4.5 Methodological Approach

To analyse the St Lawrence context and explore whether a serious game might be useful in this particular context, exploratory interviews were conducted with water resource managers across the region. A list of the locations and organization type of each participant can be found in Table 4.2 below. Semi-structured, in-depth interviews (Robson 2016) were conducted with fourteen participants in total during the course of research, and informal unstructured interviews (Robson ibid) were conducted with a further four. Of the fourteen participants interviewed in-depth, seven work in Quebec, five in Ontario and two in the United States. All hold a role within a local, national or bi-national, governmental or non-governmental organization that takes decisions with implications for management of the St Lawrence River. Participants were asked questions broadly related to the nature of decisions they took with implications for the River system, their approach to decision making they employ, challenges and opportunities for collaborative decision making and the future threats they envisage for the region.

While the interviewer went into the interview with a list of topics to discuss, the interviews were intended to be exploratory and therefore great flexibility was afforded to the interviewer to follow interesting avenues of discussion and interviews often departed significantly from the pre-planned schedule.

Table 4.2: Characteristics of Interview Participants

Participant No	Location	Organisation
1	Vermont	Transboundary Non-Governmental Organisation
2	Ontario	Non-Governmental Organisation
3	Ontario	Bi-national Governance Committee
4	Quebec	Governmental Organisation
5	Quebec	Non-Governmental Organisation
6	Quebec	Non-Governmental Organisation
7	New York State	Non-Governmental Organisation
8	Ontario	Non-Governmental Organisation
9	Ontario	Non-profit Organisation with Governmental Mandate
10	Ontario	Non-profit Organisation with Governmental Mandate
11	Quebec	Non-Governmental Organisation
12	Quebec	Non-profit Organisation with Governmental Mandate
13	Quebec	Non-profit Organisation with Governmental Mandate
14	Quebec	Non-Governmental Organisation
15	Ontario	Non-Governmental Organisation
16	Quebec	Bi-national Governance Committee
17	Ontario	Bi-national Governance Committee
18	Ontario	Non-Governmental Organisation

4.5.1 Factors influencing the decision-making processes in the St Lawrence

While speaking with water resources managers across the region, two factors were identified that have implications for decision making process, and consequently the development of a game: the need to justify decisions subsequently to external parties (e.g. funding bodies), and, in the context of decision involving multiple stakeholders in conflict, the need to present the decision-making process as fair and unbiased.

Participant 6 held the view that regardless of the decision-making process employed, when it came to presenting the decision-making process externally, it is important to present

the decision as rational. This is particularly true when dealing with funding bodies and big institutions. Presenting the processes as rational is viewed as necessary to ensure the legitimacy of the final decision, making the decision justifiable and defensible. This participant explained why it is so important to be able to defend every decision made, saying, "I'm so used to working with so much red tape; everything has to be approved by everybody… I don't own the land, I don't take care of the land, I need to get the city's approved, I need to get the environmental approval". Interestingly, it was clear that this participant felt that it was the perception of rationality that was important; the participant went on to say that the final decision, "can come from an irrational perspective, but we have to present it to them in a rational way so that they can approve it". This quote implies a mutual understanding between those seeking approval and those able to grant it, that the employment of rational discourse is a socially constructed normality in this context.

The same participant made the point that rationality, due to its association with scientific objectiveness, could be usefully employed in decision-making contexts where conflict was a factor. Providing an example of a conflict in the region, this participant explained how different stakeholders each had a different idea about who was to blame and what the most appropriate solution was to a particularly sensitive issue at hand. In this example, a limited number of riverine property owners were suffering from sediment build up in front of their properties, which was leading to excessive plant growth, which in turn was restricting their river access and correspondingly their property value. The cause of the sediment accumulation was debated, with some suspecting modifications to a nearby public dock were either partially or fully to blame. Participant 6 described how, "nobody had the same perspective at all. We had to somehow peel the issues, peel away all the layers so that everybody understood all of the fundamental, scientific issues and data, nobody could refute it. Everybody knew what the true causes were, everybody knew what the potential solutions were and from there we had to determine where we wanted to go with that." The decision involved agreeing what action should be taken, and who should pay for it. In this example, a rational approach was used to define the problem and agree the basis upon which the decision was to be taken. Using rationality to overcome conflict regarding decisions makes a lot of sense in theory as emotions have no place in rational decision making; reducing decision making to rational logic, therefore, can take the emotional heat out of potential conflict situations.

The problem with this approach is that it is not always possible to eliminate all values and emotions from decision making processes. In the example above, rationalisation alone was able to resolve the conflict as value judgements did not seem to be a significant feature of the dispute. There was broad agreement between parties regarding what would constitute a

desirable solution (everyone agreed that there was a problem, that implementing the solution should be paid for by the party responsible for causing the problem etc.) The disagreement was regarding what was causing the problem and this could be resolved through scientific inquiry. Fortunately, the natural processes involved were well enough understood and occurring on a small enough scale that a full explanation could be found, and this explanation could be understood by everybody. When facing conflict over more complex issues, it can still be useful to increase understanding of the problem at hand but it is not possible to be fully objective in decision making. Values often have an important role to play, particularly in the selection of criteria upon which solution options will be evaluated. For example, in a previous study (Furber et al., 2016) it was found that despite the significant effort put into trying to achieve shared understanding of the consequences of water level fluctuations (or lack of them) on a range of social and ecological systems, this did not lead to full resolution of conflict. Despite effort to employ an objective and rational decision making process, values and emotions remained significant due to disagreement regarding the relative importance of environmental versus socioeconomic solution assessment criteria.

4.5.2 Strengths of the region's approach to decision making

Regardless of the external constraints on decision-makers across the region, the ability of local actors to find ways to implement their decisions was identified by some participants as a real strength of the region's decision-making process. As participant 8 put it, "It's not going to make anyone super happy at the really high levels, but people are starting to take back the decision making." This participant described the way that their organization was working with grant writers to win funds, when a few years ago local actors would sit back and watch the, "big guys" do it. Now this participant's organization is applying for some international grants so that projects can be truly international. Participant 1 spoke about the way that their organization had successfully received a large international grant that they were able to use on cross-border projects. For this participant, the advantages of local decision making included a more flexible approach to decision making, more local knowledge, and an increased ability to engage with diverse local actors on both sides of the border. Participant 7 described how their Non-governmental Organization had been able to influence regional decision making by engaging with Municipalities along the River and campaigning (successfully in one notable example) for the Municipalities to pass resolutions. With each Municipality passing the same or similar resolutions, it was possible to encourage a more united approach to water management issues.

The engagement of local actors brings the benefit of a wealth of local knowledge being fed into decision making process. The diversity of knowledge amongst local actors was clear during the interviews; with each interview, the authors gained a vantage point of the St Lawrence from a new perspective. Perspectives varied according to the participants' background (participants came from a range of political, scientific, and social science disciplines), their political jurisdiction, social and cultural affiliations, and primary language. It was apparent in some of the interviews that the local actors are themselves aware of, and highly value, the diversity of knowledge in the region. The value of First Nations' knowledge was spoken of on more than one occasion. Participant 8, for example, said, "I get a lot of good advice from my Mohawk colleagues, because they are very into the environment, they know what the issues are and I'm very fortunate to be in a Network that embraces that voice." Likewise, participant 18 spoke of the way their organization is incorporating First Nations knowledge into their planning approach. This participant gave the example of using a First Nations definition of landscape, which they described as more intuitive, with less emphasis on zoning or lines on a map. They also spoke of the way they were working to incorporate First Nations values into their planning, by placing their focus on the protection of traditional food sources (as contrasted to a more typical NGO discourse, which might talk in terms of endangered species etc.).

Diversity of knowledge is most useful in decision making when many perspectives are brought together and balanced through effective collaboration. Some participants reported examples of good collaboration, and high levels of engagement of influential individuals, occurring at the local level. Participant 8, while describing a meeting to collaborate on a local project, said, "I was thinking as I sat around the table while we were talking. I realised how well connected each individual is." Participant 5 spoke of how open the Non-Governmental Organisations across the region were to collaboration saying, "myself personally, I've never found the doors closed between the NGO community from the various regions". Participant 6 reported that there is a lot of interesting collaboration going on between sectors; lots of consultation and citizen participation occurs on issues, with people who run municipalities, industry actors etc. In one example, an organization on the Canadian side of the River had decided to apply for funding for a river clean-up project. Having successfully won funding, they decided that, to be a success, both sides of the river needed to be tackled and they decided to share the funding with their partners on the US side of the border. According to participant 8, who described the project, "it was a phenomenal experience; they had 100 children clean up and work on their side (US) in a sensitive wetland".

The participant contrasted the benefits of this local approach against the international approach to remediation of the river taken in the past. The participant described how different approaches, personalities and policies of the US and Canadian sides of the River had in the past led to decisions on each side of the River being taken in isolation. The participant cited the example that, while the US side of the river opted for a policy of dredging contaminated river-bed sediment from the tributaries of the St Lawrence in the Massena area in the 1990s, the Canadian side (facing the same problem) opted to leave the contaminated sediment in situ and allow natural sediment to form a cap over the contaminated sediment over time (the same example was also referred to by participants 9 and 10). The river clean-up project described above shows how local level actors can surpass some of the transboundary barriers to collaboration at the international level. Other participants also spoke of the way that the region is benefitting from the increasing role of local actors, and efforts to enhance local collaborative networks were identified through the interviews. Participant 15 spoke of an exciting initiative to enhance participation using 'Weavers', individuals selected from key organisations who are tasked to dedicate some of their working week to strengthening the regions network by creating and supporting new connections and collaborations.

4.5.3 Challenges for decision making processes

While many advantages of local actors' ability to implement decisions were identified, participant 3 raised the point that this also presents a challenge for decision making. This participant saw local actors' tendency to take a local perspective as a challenge for cohesive management of the watershed as a whole. The participant said, "I think that's where there's a bit of a disconnect and where there could be more emphasis to try to better engage municipalities and regional governments, to provide an opportunity for them to appreciate… how the actions of the municipalities and the regional governments really do drive Great Lakes and St Lawrence River water quality conditions…"

Similarly, while examples of effective transboundary collaboration were identified on a local scale, several participants identified transboundary collaboration on a regional scale as problematic. Participant 6 asserted that regionally, "There's no cross-border decision making… We know that a lot of the same issues are going on in different Municipalities along the River and they are all trying to deal with it alone, when often it's a regional problem". The participant gave an example of Lake St Francis, where water levels are consistent and this has led to a sediment accumulation problem in certain areas (always the same areas). This leads to mass growth of aquatic plants and then you get a few citizens who are effected as they can no longer access the water. According to this participant, this is happening in many localised

spots around the Lake. Collective solutions could increase the effectiveness of solutions, but because the affected areas are in multiple jurisdictions, no cohesive action is being taken. As explained by the same participant, often the problem is just identifying who to speak to; "We don't know who to talk to, we don't know who to get in touch with, or what exists". Participant 8 made a similar point regarding the challenge of knowing who to speak to; this participate explained that, "It's trying not to forget who is out there; that is a bit of a challenge… It's communication that is a challenge". Participant 5, when asked what collaborative structures are being used to facilitate transboundary water management, simply said, "Next to none". Participant 15 was engaged in a project to map the collaborative network in the region and they shared the opinion that transboundary collaboration was not occurring as effectively as it might. Their research suggested that there are good connections each side of the border, with less transboundary connections.

The challenge for local actors to collaborate on a regional scale to achieve cohesive policy and action is perhaps not surprising given the geographic size and complexity of the St Lawrence watershed. On a practical note, participants described the way that regional meetings have become a challenge in the area, with many stopping altogether following the terrorist attacks of the 11th of September 2001 in the United States. One participant described how, prior to 9/11, the U.S. and Canada had had a collaborative programme in place called Fast Line. Representative from both jurisdictions had met on an international island in the middle of the St Lawrence to discuss water resources management; an initiative that had led to projects occurring both sides of the border that mirrored one another. Since 9/11, however, border crossings have become more difficult and this initiative has subsequently stopped. Participant 3 explained how, in their experience, the larger the scale of planning efforts, the more challenging it becomes to engage the relevant stakeholders and the more difficult it is for individual stakeholders to relate their interests to the issues being discussed.

Patchwork regulations, policies and funding were also identified as further compounding the problem. Participant 6 spoke of issues related to shoreline regulations, discussing the resentment and confusion that have been caused in the past when their organization has tried to instigate environmentally friendly policies that obligate residents to undertake potentially more expensive measures to protect the shoreline, but their neighbours do not have to as they are the other side of the Municipality border and adjacent Municipalities do not require it. For this participant, implementing decisions was harder than it should have been due to the jurisdictional boundaries. Participant 2 provided an example of the different status of the American Eel in Ontario and Quebec to illustrate the challenge of patchwork regulations. For this participant, the status of the American Eel as endangered in Ontario but not Quebec leads

to disjointed management approaches. Restoration efforts are undertaken in Ontario but then the eels can swim downstream to Quebec where they can be caught by fisher people.

Given the scale and diversity of the watershed, it is perhaps not surprising that divisive issues were identified by Participant 7 as a major challenge for the region. This participant spoke of their relationship with another organization in the region, with a closely aligned perspective on all but one issue. The bad relationship between these two organisations following conflict on the one divisive and sensitive issue, however, has led to a situation where it is highly unlikely that these two organisations collaborate in the future.

Discussing decision making when issues are contentious, participant 1 asserted that there is a lack of political will to tackle the harder decisions. When asked whether the stakeholders possessed the political will to facilitate collaborative decision making, this participant said, "I'm going to be blunt. They are short on political will to make hard decisions. There's plenty of political will to make easy decision. They know the process of collaborative decision making and implementation and we're very good at doing it and following it up for things that don't challenge the political realities in a jurisdiction."

A number of other notable challenges were identified through the interviews. Participant 5 observed staff turnover in governmental jobs seemed to be greater today than it had been in the past. This participant explained, "The way I see Government evolving is not like it used to be. We used to have career people going in to Government. Now we have a new generation coming into Government this in not, I find, attached for really long". The same participant also found the short-term focus of politicians, a consequence of their four year term in power, to present a challenge for collaborative decision making. The influence of well financed, powerful players over regional water management was cited by Participant 6 as a big challenge. Hydro Quebec, for example, was reported to have given funds for a number of projects in the St Charles River area to local Municipalities in return for their signing a contract that prohibited them speaking up against the company or instillations for a 25-year period. There have subsequently been issues with water levels in the area, as water is diverted through the Beauharnois Canal to Hydro Quebec instillations. Unable to speak up, the Municipalities ability to manage the local environment and water level for access was severely hampered.

A final challenge identified by two participants is the need to engage young people across the region in water resources management. As Participant 9 put it, "I think one of our greatest challenges that we are trying to overcome, is not so much diversity in terms of ethnic background or European versus first nations, for example, but age. We tend to get a much older crowd coming out to our events. We really miss the kids and the younger generations.

In terms of engaging younger people in our work, that's an area of growth that we need to focus on". Participant 3 talked about the good-old-days of environmental activism in the 60s and 70s, lamenting the fact that people today, 'just don't seem as inclined to become engaged in issues related to the Lakes and the River".

4.5.4 Changing nature of decision making

One of the avenues explored during the exploratory interviews was the potential relevance of the IJC's International Watershed Initiative (IWI) to the St Lawrence River. The IWI is an idea developed by the IJC in recognition of the fact that there is a general trend towards more local management of international waterbodies and that this approach has much to offer (Clamen, 2013). Acknowledging this trend, the IWI is an IJC effort to adapt and remain relevant (ibid). The Initiative has been successfully applied in a number of other international waterbodies: the St. Croix River Watershed, Rainy-Lake of the Woods Watershed and the Red River Watershed. Participant 16 was invited to participate in the research as an expert in the work of the IJC, with knowledge of the St Lawrence Watershed. This participant was asked whether they felt the IWI might have something to offer the St Lawrence, and whether the IWI was being pursued for the region (as it was thought this could have significant consequences for decision making in the region in the near future if it was being pursued). In the opinion of participant 16, the IWI is an exemplary initiative, but the Great Lakes and St Lawrence watershed is one of the hardest to tackle with an IWI approach. This participant attributed the challenge of the region to the size, complexity, and number of Institutions present in the region. Participant 17, also an expert on the role of the IJC in the region, supported this view saying that the IWI in the Great Lakes is difficult due to the impact of the multiple Federal agreements at play in the region.

Participant 17 went on to discuss challenges associated with the implementation of the Great Lakes and St Lawrence River System Adaptive Management Plan. As in the case of the IWI, the Adaptive Management Plan saw an active role for local actors, who are more responsive to local conditions. The Adaptive Management Plan consisted of two key ideas: 1) A review/ evaluation of the impact of Plan 2014 on the River System, and 2) A plan to collaborate to address problems that cannot be solved through regulation alone by implementation of a Levels Advisory Board (LAB). As part of the LAB, adaptive management pilot projects occurring at a local level were proposed. While the first idea went ahead, the LAB never materialized and no pilot projects went ahead. The recommendation was made to the relevant Governments, but no formal response was received by the IJC. According to Participant 17, this was because the proposal touched on sensitive topics and not everyone in

the region was on the "same page" regarding the proposal. The participant does not expect to see any movement on this proposal in the near-term.

While these high-level management approaches may not have a great impact on the region in the near future, there was a notable feeling amongst water resources managers that the nature of decision making across the region was changing. One participant compared resource management in the region today to firefighting contrasting this against the past, which he described as, 'business-as-usual'. He said that, "We don't really know what is coming our way, it just seems like every year we are under threat by a new challenge… The only lesson you can take from it is to be adaptable. Not only with where the money is coming from, but also with the latest fire-fight of the day. You try to be proactive and deal with the long-term issues, but there is always going to be a fire-fighting aspect." The use of the term, 'fire-fighting' in reference to water resources management implies that decision makers across the region today perceive an increasing urgency in their decision-making process. This is interesting because, as discussed above, different forms of decision making process tend to be appropriate in different contexts. Urgency in decision making presents a challenge for employing a deductive reasoning and rational choice approach, and could signal the need for novel tools to be developed that support a more intuitive approach.

Climate change was often spoken about during the interviews, with the related issue of invasive species; a major cause of concern across the watershed. Some participants spoke of the way that, while in the past climate change seemed something distant, a concern of the UN, now the impacts were being were being felt in the region. Climate change was perceived to be a root cause of the changing nature of water management, from 'business-as-usual' to 'fire-fighting' the latest ecological threat. The point was made that, while the issues being experienced were new to water resources managers in the region, they were often well experienced in other parts of the continent or world. An obvious example is the spreading of invasive species; participants spoke of Emerald Ash Bore coming up from Michigan, ticks moving up from New York State, and wild parsnip coming in from elsewhere in Quebec. One of the key strengths of the regions decision making process, as highlighted above, is the wealth of knowledge about the local environment that can be employed in decision-making processes. Climate change moves the locus of relevant knowledge out of the watershed and necessitates knowledge sharing on a more global scale for effective decision making.

4.5.5 A serious game for the St Lawrence Region

Three situations were identified above where it might be beneficial to employ a serious game to support decision making processes: 1) When it is not possible to employ a deductive

reasoning and rational choice approach to decision making due to the complexity and uncertainty involved in the underlying system; 2) When it is not possible to employ a deductive reasoning and rational choice approach to decision making due to time constraints and urgency to act; and 3) When it is not possible to employ a deductive reasoning and rational choice approach to decision making because of subjectivity and different perspectives surrounding how to parameterize the decision making problem.

Speaking with managers across the St Lawrence Region has identified elements of each of the above situations as present in the St Lawrence decision-making context. The St Lawrence River system is certainly complex. While the interviews revealed that some problems are localized enough to be addressed using a deductive reasoning and rational choice approach, many other problems are not. Some decisions tackled in the region do need to be taken urgently. An obvious example is when an incident, such as a ship grounding, leads to contamination of the river. Decisions must be taken quickly about how to contain the contaminant and minimize environmental damage without undue risk to those tasked to contain the spillage. More subtly, the regions water resources mangers reported that the nature of decision making in the region is changing from 'business as usual' to 'fire-fighting'. This hints towards an increasing urgency in decision making in general, and implies a possible potential use for serious games to support decision makers take effective decisions more intuitively. Lastly, the diversity of perspectives of stakeholders in the region, whilst one of the greatest strengths for decision-making, present a challenge for deductive reasoning and rational choice approaches. With multiple jurisdictions in the region, the need to build consensus as to the best course of action is an unavoidable feature of decision making. Subjectivity in the decision making-process is inevitable. It is therefore postulated that there is potential for the use of a serious game to support decision making in the St Lawrence Region.

On the basis of the exploratory interviews with resource managers across the region, it may be beneficial if the game has the following features:

- The process through which any decisions are reached should be transparent as it is important that the decision can subsequently be justified to external bodies such as funding agencies;
- Where multiple stakeholders are engaged in a decision making process that is potentially contentious, it is important that the game is designed so that players recognize it as fair and unbiased;

- It is difficult for stakeholders from across the region to physically meet in one location; consideration should be given to whether it is necessary to meet in person or whether the game can be played remotely;
- A game that supports or enables knowledge sharing could be highly beneficial for the region. There is a wealth of knowledge within the region that could beneficially be shared between actors and the region could increasing benefit from access to knowledge outside the region;
- With the trend towards decentralization of decision making to lower levels, it would be useful to develop a game targeted to local level decision making;
- It would be beneficial if a game helped to engage younger volunteers;
- The region suffers from the presence of divisive issues; a game that helps to develop empathy for the perspective of a variety of actors in the region could be beneficial.

4.6 Conclusions

Several contextual factors make the St Lawrence region a viable candidate for the development of a serious game to support decision making. 1) Uncertainty is inherent in decision making processes in the St Lawrence region due to the complexity of underlying physical, social, environmental and political systems. In such a context, a serious game could be beneficially used to help managers identify robust solutions, using a gaming environment as a flight simulator (i.e. a safe environment) with which to test alternative management solutions. 2) For decisions to be effective in the St Lawrence Region it is often necessary to reach consensus amongst a wide range of stakeholders who hold a multiplicity of perspectives. A serious game could be developed that would help actors gain first-hand experience of the perspective and challenges facing other actors. This could help develop empathy that leads to an expanded problem definition and facilitates the identification of decision outcomes that can be supported by a wider range of actors. 3) The changing nature of decision making in the region, from that characterized as 'business-as-usual' to 'fire-fighting' the latest problem, suggests that decision-makers are experiencing an increasing urgency to act. This could see a greater role for intuitive decision-making processes, which may beneficially be supported by a serious game to expose decision-makers to a wide range of relevant experience quickly, thus enabling them to practice and refine their ability to respond appropriately. These context factors are not unique to the St Lawrence, and the same mechanisms could mean serious games could be applicable in a broad range of similar contexts.

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5. Summary and Conclusions

This thesis began with the assertion that transboundary watersheds are like elephants. Watersheds, like elephants, are large and complex; a range of actors with different knowledge must be brought together to fully understand them and consequently determine how they can best be looked after. The challenge is that when disparate actors with diverse perspectives are brought together, misunderstanding and conflict can result. This was the problem facing Saxe's blind men, who tried to understand the nature of an elephant while each touching only one part of it. The overarching question tackled in the preceding chapters was, how can actors with diverse perspectives be brought into collaborative planning processes in a way that fosters collaboration and not conflict? Specifically, two approaches, with potential use for facilitating the harmonious integration of diverse perspectives for watershed management, were explored in detail: Shared Vision Planning (SVP) and Serious Games (SGs). The St Lawrence River region was used as a case study to explore their previous (in the case of SVP) and potential (in the case of SG) application to support collaborative decision making.

Chapter 3 undertook a critical analysis of the stakeholder engagement and conflict resolution processes employed by the International Joint Commission during negotiations to change the management regime of Lake Ontario and the St Lawrence River; a contentious issue in which divergent stakeholder perspectives threatened to thwart efforts to reach agreement on a way forwards, despite widespread acknowledgement of shortcomings of the existing regime. The Commission employed a state-of-the-art SVP engagement process during the negotiations. The objectives of the first part of the study were to (a) Assess the extent to which agreement was reached by stakeholders in support of the resulting Plan 2014 (b) Examine available data for evidence that suggests the Shared Vision Planning process enabled stakeholders to overcome potential conflict and reach agreement (c) Assess residual conflict and identify the root cause of this conflict. Consideration was also given to whether any opportunities exist to move the conflict further towards amicable resolution, and what lessons might be learnt more broadly.

Exploration of the SVP process employed by the International Joint Commission in the case of Lake Ontario and the St Lawrence River led to the conclusion that SVP can usefully be employed to reduce conflict during participatory approaches to water management. A critical factor in the success of SVP is the use of collaborative modelling, as this is how multiple understandings are brought together and any disputed causal effects are identified and resolved.

It was found that the SVP had significant success in reconciling the perspectives of the majority of stakeholders. Several positive outcomes were thought to have arisen directly from the SVP approach employed. Clear examples were found of stakeholders changing their position to back the proposed regulation change. A further significant success of the process was identified as the effectiveness with which the process was able to achieve consensus between First Nation communities and the majority of stakeholders. Engagement process was found to be particularly important to this stakeholder group. Mr. Lickers, an influential member of the Mohawks of Akwesasne First Nation was quoted as saying about the process, "I think at that time a lot of the thinking from Akwesasne went forward in recommendations… I think we partly penned it, or actually had influence in the conception of it… This is a really impressive effort and I think that you're trying to be sensitive and I really want to applaud you and thank you for this effort". This quote expresses the importance of engagement process and clearly identifies the ability of Shared Vision Planning to incorporate a broad range of perspectives into the decision-making process.

There was, however, a distinct group of shoreline property owners, based in New York State, who remained opposed to the resulting management plan. The IJC's public outreach and participation efforts were not successful in reconciling their position with that of other stakeholders because this stakeholder group perceived that they could only lose out from any regulation change and are therefore unlikely to be motivated to engage productively in any planning dialogue. This stakeholder group perceived themselves to be playing a zero-sum game where any change bringing benefits to other stakeholder groups could only result in a loss for themselves. It was concluded that a solution would require that the problem be reframed so that this stakeholder group can see that they do in fact have something to gain from a successful resolution, which may necessitate bringing the prospect of compensation to the table.

The overarching objective of the second part of the study was to explore the potential use of Serious Games to support transboundary decision-making processes in the St Lawrence region in the future as Serious Games have been touted as a novel tool with applicable value in supporting collaborative decision making (Medema et al., 2014). It had as its specific objectives: a) Elucidation of the mechanisms which make Serious Games beneficial for decision making in different contexts; b) Analysis of the St Lawrence context to explore whether the development of a Serious Game might be appropriate in this case; c) If a Serious

Game might be appropriate for the St Lawrence, analysis to determine which of the potential mechanisms identified through the first objective are applicable in the case of the St Lawrence.

Three water resources management challenges were identified offering contexts in which Serious Games may offer benefits for decision making. The first challenge is unpredictability in the response of hydrological-socioeconomic systems due to the complex dynamics and emergent behaviours of these types of system. In this case Serious Games may be able to help through the identification of robust solutions, with the game helping the player learn to steer the complex system, allowing the player to 'game out' possible future scenarios. The relevant context of application for this would be decision making when systems are complex and/or uncertainty is high.

The second management challenge is the need to reach consensus between diverse decision makers to implement decisions, for which the context of application is one in which multiple decision makers with divergent perspectives face subjective decisions. In this case the potential benefit of the Serious Game is to help players develop more empathy for the perspectives of other stakeholders by exposing them to the challenges facing other parties. Finally, the third challenge identified was the need for decision makers to be able to respond quickly and competently in emergency situations such as oil spills; the context of application is any decision that must be made under time constraints. Here, Serious Games may be able to support decision makers by helping them develop intuition for appropriate actions in such situations. This could be achieved by using Serious Games to expose the player to a broad range of repeatable experiences to help them recognise cues of application in the real world.

In each of these contexts, Serious Games offer the opportunity to a player to live-out an event in a safe environment without 'real-world' consequences. In this way SGs are like flight simulators, allowing their pilots to practice and hone their skills, quickly gaining experience, in a way that is not always possible otherwise. Exploration of the potential future use of SGs in the International St Lawrence River led to the conclusion that all three of these challenges and contexts are relevant and make the region a viable candidate for a Serious Game.

5.1 Contribution to Knowledge

The first part of this research, exploring the use of Shared Vision Planning in the context of the Lake Ontario and St Lawrence River conflict, contributed a novel analysis of the ability of the approach to overcome conflict and support collaborative decision making. While there is widespread acknowledgement of the importance of diverse participation (Carr 2015,

Lockwood et al. 2010; Medema et al. 2014, Palmer et al. 2013), and the consequent need to resolve conflicts (Lange, Siebert & Barkmann 2016), engaging stakeholders is far from simple and debate still surrounds the best way for it to be achieved (Scolobig and Lilliestam, 2016). While the conflict in the St Lawrence Region has now been resolved (as Plan 2014 has now been passed), the above conclusions have widespread applicability to other similar dispute resolutions processes, both within the field of Water Resources Management and beyond.

The second part of this research explored the use of Serious Games for collaborative decision making. As a novel tool, this is an area requiring much further research. There seems to be a prevailing assumption that Serious Games are beneficial for resolving conflict surrounding water resources management, but a lack of understanding of the mechanisms of how and why they are beneficial. As Vegt et al. (2016) put it, "We know Serious Games can enhance collaboration but we don't know why". Chapter 4 contributes a theory of the ways that Serious Games might be useful for decision making in water resources management and demonstrated a need for such a tool within the St Lawrence River region. The conclusions of this chapter are expected to be widely applicable within both the field of water resources planning and Serious Games development.

5.2 Further Work

Shared Vision Planning to overcome conflict in collaborative decision making is a well-established approach. There is a coherent body of literature that supports its use and application. More case studies would benefit the field but its principles are well defined and set out. For this reason, the majority of further work proposed here relates to the much less mature field of Serious Games.

Chapter 5, looking at the benefits of Serious Games for decision making in water resources management, was exploratory in its nature and would benefit significantly from further work. In the case of the St Lawrence, there is a need to undertake more detailed and rigorous assessment of the identified uses for a Serious Game. In the first phase of interviews, the results of which were presented here, interview questions were open-ended and the nature of the questions changed from one interview to the next as ideas progressed. Now, with an idea of the challenges facing the region that may be supported by a Serious Game, it would be beneficial to undertake a wider and more structured approach to collecting the perspectives of actors and decision makers across the region. Additional case studies in other contexts would

also be beneficial to gain a more comprehensive understanding of the use of Serious Games in water resources decision making more generally.

At the same time, there is a need to undertake further research into the mechanisms by which Serious Games are able to support decision making. The mechanisms presented in Chapter 5 were based on a logical and theoretical argument which needs to be tested in practice. The field would benefit greatly from further analysis of the mechanisms through which Serious Games work, both in the field and under laboratory conditions. In this way, the theoretical arguments presented here can be tested. In order to achieve this, games need to be available with the relevant characteristics matched to desired outcomes. A number of Serious Games have already been, or are in the process of being, developed for application in water resources management. The present study has not focused on analysis of available games and there is still a need to systematically review available games in terms of their characteristics and potential use for decision making in water resources management. Once this work has been undertaken, it will be possible to test some of the theories presented here experimentally.

There are many more dimensions of Serious Games that must also be researched if they are to have a practical use in decision making. A big question still surrounds the way in which learning that takes place in a game environment is translated into real world knowledge. If a close enough mapping between virtual and real-world learning cannot be achieved, then there is little use for Serious Games within the field. It has been assumed, and seems intuitively likely, that learning in one context carries into the other, but it is vital that this assumption be rigorously tested. A further important question remains as to how acceptable actors and stakeholders will find the use of Serious Games, and whether they will be receptive to their use in practice. Practicalities such as whether they have the time and resources to engage in game play also remain unanswered.

5.3 Concluding Thoughts

Both Shared Vision Planning and Serious Games have been found to have either realised or potential benefits in the St Lawrence region context. In some ways, the two approaches seem similar, particularly with regards to the broader benefits they can bring. Both approaches provide a forum within which stakeholders with divergent views can interact, helping them to build the social capital and trust upon which collaboration is so reliant (Medema et al., 2014). Both have at the heart of their process a simulation model, that allows stakeholders to interact with ideas and policies in a safe environment (Crawford 2003). Whether this interaction is

termed experimentation (SVP) or play (SG) is of little consequence; the collaborative interaction encourages a process of social learning. In addition, the proponents of both approaches have paid considerable attention to how their methods can be made accessible to a wide range of stakeholders with different types of knowledge, allowing the diverse participation that is so essential for expanding problem framing and capturing knowledge as necessary to solve water resources management problems (Mostert et al., 2008).

The question remains as to which of these approaches might be more promising in the case of the St Lawrence Region. Shared Vision Planning has the advantage of being a well-established approach in the region and capacity for implementing the approach has already been developed. Is there any reason to consider an alternative approach, namely Serious Games? There is perhaps one advantage of Serious Games over that of Shared Vision Planning that becomes apparent when considering the mechanism by which each approach works to expand the problem framing of stakeholders from their own into a unified whole. In the case of Shared Vision Planning, stakeholders engage in the process of developing the simulation model, using the model as a boundary object to translate their perspective into a communal language. In this way, other parties gain exposure and understanding of the perspective in question. In contrast, Serious Games can offer their players the opportunity to experience the perspective of other players first hand. In this way, players may perhaps come not only to understand but also to empathise with the perspective of other stakeholders. Empathy is a stronger connection with the perspective of another than understanding and as such Serious Games may have something to offer the St Lawrence Region beyond that offered by Shared Vision Planning.

It is concluded that both SVP and SGs increase the likelihood that when diverse perspectives are brought together collaboration will prevail over conflict. In the case of SVP, this is achieved by identification and resolution of disputed causal associations through collaborative model building; in the case of SGs, it is achieved by expanding the experience and awareness of actors by allowing them to role play another perspective. SGs, beyond SVP, are able to offer their players an opportunity to experience management of the watershed from a first-hand perspective they cannot normally perceive. For this reason, it is concluded that Serious Games should be pursued as a potentially novel and exciting tool that can support collaborative decision making in the St Lawrence Region. Serious Games offer a virtual-reality tail to the blind man touching the elephant's trunk, so that he is able to get a better understanding of another part of the elephant. Having experienced the tail for himself, he might

realise the elephant is made of many parts and be more open to listening to the experiences of the elephant gained by the other blind men, so that he can increase his understanding of the elephant in its entirety.

5.3 References

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