# Participatory risk management approaches for water governance: insights from Australia and Bulgaria

Katherine A. Daniell*, Peter Coad, Irina Ribarova, Ian White, Nils Ferrand, Jean-Emmanuel Rougier, Natalie Jones, Albena Popova, Alexis Tsoukiàs, Stewart Burn, Pascal Perez

*Cemagref UMR G-EAU / Australian National University (Fenner School of Environment and Society)
361, rue J.F. Breton, BP 5095 - 34196 Montpellier Cedex 5, FRANCE

E-mail: katherine.daniell@gmail.com

**Abstract:** *Throughout the world, water management and planning issues are becoming increasingly difficult to handle, and there have been calls for more adapted approaches to aid the decision-making processes required for water planning and management. Participatory risk management approaches appear appropriate for such situations as they can be designed to increase collaboration and manage conflict, explicit uncertainties, and structure complexity in more understandable forms. This paper will outline some insights and lessons learnt from the design and implementation of two different participatory risk management processes for water governance: a values-based method based on the Australian and New Zealand Standard for Risk Management for the development of the Lower Hawkesbury Estuary Management Plan in Australia; and a participatory modelling approach to manage the risks of living with floods and droughts in the Iskar basin in Bulgaria. Both processes were designed and implemented with the aid of researchers, local managers, government representatives at various levels of jurisdiction, community stakeholders and external legislative, scientific or engineering experts. The Australian process consisted of three interactive stakeholder workshops with an average of 20 participants, held over a period of four months, as well as an external scientific and legislative review. The workshops focussed on establishing estuarine values, issues and current management practices; performing a risk assessment based on the stakeholder defined values (assets) and issues (risks); and formulating strategies to treat the highest prioritised risks as input to the estuary management "risk response" plan. The Bulgarian process in the region of Sofia was primarily driven from a research perspective. The participatory process was more elaborate in design than the Australian process with around 60 stakeholders divided into 6 groups taking part in a series of 15 workshops, individual interviews and evaluation exercises over a one year period. The process included cognitive mapping of the current management context and physical system, values, visions and preference elicitation for actions, strategy development and evaluation. Both cases provided insights into the value and constraints of participatory risk management approaches in different regulatory and political environments, as well as some important common issues including: impacts of last minute process changes; how to deal with divergent objectives in a multi-institutional organising team; and the unintended ethical issues that can arise when working in "real-world" management situations. Increasing awareness of the value and potential issues associated with participatory risk management approaches should aid their adoption and the subsequent improvement of water planning and management around the world.*

**Key words:** *participatory processes, risk management, water, Australia, Bulgaria*.

## 1. INTRODUCTION

In a changing, uncertain and complex world, water planning and management practices face enormous challenges. Increasing global populations, a multiplicity of managers and decision-makers, the depletion and degradation of water sources and their linked ecosystems have led to a variety of water "scarcity" issues and conflicts (Rijsberman, 2004). Drivers such as population growth, climate change, technological innovations and past water management choices including the construction of engineering structures and introduction of planning regulations are to some extent all caused by anthropogenic behaviour. They are also partially responsible for the increasing risk of damages and loss of life caused by "natural" hazards such as floods, droughts, storms, earthquakes and ecological shifts such as algal blooms or fish kills (Abramovitz, 2001; Kundzewicz and Takeuchi, 1999). The concept of *risk* in such cases can be considered as a function of: *hazard*; the probability of occurrence or *likelihood* of certain impacts resulting from a hazard event; and vulnerability defined as the magnitude of potential *consequences* or impacts resulting from an event's occurrence (Standards Australia, 2004a, 2004b, 2006; Dwyer et al. 2004). *Vulnerability* in this definition of risk is often considered as both a function of *susceptibility* or exposure to hazards and of *resilience*, which is defined as the adaptive capacity of systems to respond and cope in the face of hazard events (Kundzewicz and Schellnhuber, 2004; DIFD, 2004; Dwyer et al. 2004). Risk management should therefore treat not only the more technical event and impact probability aspects of these hazards, but also the building of adaptive capacity to cope with and become more resilient to such events.

In order to adapt to the uncertainty, complexity and conflict exhibited in an increasingly interconnected and globalised world, many "traditional" expert-based forms of water planning and management appear inadequate (Gleick, 2000). Likewise, "traditional" or "objective" forms of risk assessment (Klinke and Renn, 2002) are commonly inadequate. The pertinence of expert-created integrated water models designed to inform policy decisions, or quantitative risk analyses to determine levels of "acceptability", has been more broadly questioned due to the unrepresentative nature of these experts' values-based decisions (Fischer, 2000; Daniell and Daniell, 2006; Rayner, 2007). Apart from issues of capacity in representing a variety of world-views and values of concerned parties, it is unusual that one institution or individual possesses all the relevant knowledge and is in control of all the resources required to successfully make and implement decisions. Managers are therefore increasingly obliged to work in a participatory manner with other institutions, stakeholders, experts and the general public to create more acceptable models and plans, and to implement management actions (Loucks, 1998).

How these participatory processes can be more successfully carried out and aided to meet a range of objectives and challenges in the water sector is an important question. This paper demonstrates that "participatory risk management approaches" (Renn et al., 1995; McDaniels et al. 1999; Jaeger et al., 2001; Meinke et al. 2006), appear appropriate to address some of today's water governance challenges as they can be designed for multi-stakeholder and inter-institutional settings to increase collaboration, learning, and to manage conflict, explicit uncertainties, and structure complexity.

This paper will highlight a range of insights and lessons learnt from the design, implementation and comparison of two different participatory risk management processes for water governance. The first is a values-based method for the development of the Lower Hawkesbury Estuary Management Plan in Australia based on the Australian and New Zealand Standard for Risk Management. The second is a participatory modelling approach to manage the risks of living with floods and droughts in the Iskar basin in Bulgaria. Although undertaken in different cultural and social contexts, both processes were designed and implemented with the aid of researchers, local managers, government representatives at various levels of jurisdiction, community stakeholders and external legislative, scientific or engineering experts. The paper will begin by outlining the underlying methodologies and references drawn upon to design, adapt and inform the choice of specific participatory methods used in each case. An outline of the results and discussion of the two implemented processes and a number of outcomes will then presented, followed by a summary of the most important insights drawn from the processes.

## 2. METHODOLOGY

In order to aid multi-stakeholder or inter-institutional decision-making in the water sector, Daniell et al. (2006) proposed a methodological framework based on the concept of "participatory modelling" and employed a generalised decision aiding process from operational research (Tsoukiàs, 2007; Ostanello and Tsoukiàs, 1993). This general methodology, which was first developed and pre-tested for the European Integrated Project, "AquaStress" (Daniell and Ferrand, 2006), has been designed to allow a broad range of stakeholders to explicitly participate throughout the various stages of a decision-aiding process, as outlined in Figure 1: from defining the situation and formulating the problems requiring management, to developing and using an evaluation model to assess potential management alternatives before finally choosing and recommending the most desired courses of action.

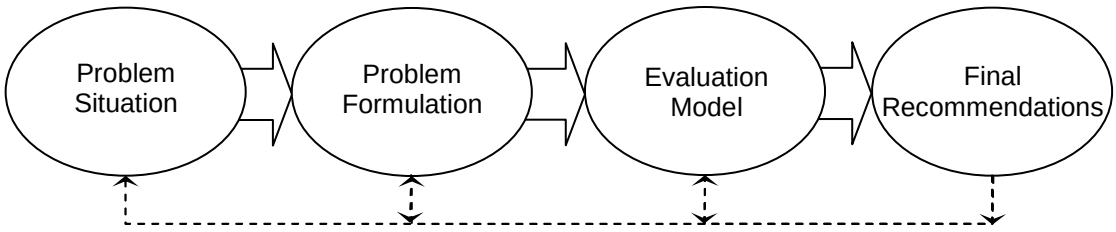


**Figure 1: Generalised decision aiding process model (adapted from Tsoukiàs, 2007)**

Following Tsoukiàs (2007), each of the phases or "constructions" outlined in the model of Figure 1 can be characterised by a number of elements that are to be elicited or developed through the process as follows:

- *Problem Situation* – sets of: actors; objectives; and resources.
- *Problem Formulation* – sets of: problem statements; potential actions; and points of view.
- *Evaluation Model* – sets of: alternatives to be evaluated; dimensions, attributes, or indicators and their corresponding scales under which the alternatives will be described and measured; preference criteria for alternative evaluation; an uncertainty structure; and operators that will allow the synthesis and manipulation of all of the above information to aid decision making.

- *Final Recommendations* – a set of final recommendations for decisions related to each of the problem statements with corresponding validity / legitimacy analyses such as sensitivity or robustness analyses and process and content evaluations.

The methodology based on this model, as outlined in Daniell et al. (2006), is also "participatory", as multiple stakeholders and institutions are involved throughout the process. It also encourages uncertainties to be made explicit and allows the complexity of the situations to be structured into a number of specific categories, in order to allow easier investigation and understanding by the stakeholders. One of the particular aspects of the methodology proposed in Daniell et al. (2006) and the underlying Tsoukiàs (2007) process model is that it is a conceptual framework that requires consideration of the specific context in which it is to be implemented. Different water planning and management contexts have their own particular aspects and needs which should influence the selection of methods to be used. The designed adaptations of this general methodology to the Australian and Bulgarian participatory risk management processes are outlined in the next subsections.

## 2.1. Methodological Adaptation to the Lower Hawkesbury Estuary Management Context

The Lower Hawkesbury Estuary lies on the northern fringe of the Sydney Metropolitan Area in Australia. Despite its proximity to the largest urban centre in the country, the peri-urban estuary and its surrounds remain an area of immense natural beauty and high ecological value with heavily forested catchments, steep cliff and gorges, deep waterways and secluded bays and beaches, which support high levels of biodiversity and a range of other values such as local culture, industries and recreation (BMT WBM, 2007). However, future drivers such as rapid population growth and climate change may have major negative impacts on the area if not managed successfully.

Currently on the Lower Hawkesbury River, only around fifty percent of the estuary and tributary creeks are covered by estuary management plans based on the NSW Estuary Management Program Guidelines (NSW Government, 1992), which is considered insufficient to successfully manage the whole area. The Hawkesbury Nepean River Estuary Scoping Study Report (Kimmerikong, 2005) recommended that to improve effectiveness, estuaries should be managed by a "whole-of-estuary" approach rather than management based on administrative local council area boundaries. A proposal to create and fund a regional "Lower Hawkesbury Estuary Management Plan" was put forward by the Hornsby Shire Council, one of the local Governments with jurisdiction over part of the area. The proposed Lower Hawkesbury Estuary Management Plan (LHEMP) is one of the first broader scale estuary management plans (EMPs) of its type to be implemented in Australia.

The LHEMP project has been designed to be participatory, and as such is conducted in close cooperation with the Gosford City Council, which also has jurisdiction over a large part of the proposed plan area, as well as with a large range of stakeholders, including service agency, industry, commercial, community association and residential representatives, and State Government representatives, who are also responsible for certain domains of estuarine management. Private consultants, BMT WBM and SJB Planning, were selected through a public tender process to run the project in collaboration with the Hornsby Shire Council and researchers from the Australian National University (ANU). These collaborators will be hereafter referred to in this paper as the "project team". The process for the plan creation outlined in the tender (HSC, 2006) was largely based on the methodology outlined in Daniell et al. (2006) and Daniell and Ferrand (2006), and was to include a series of stakeholder workshops and an external document review. This proposal was then redefined and negotiated within the project team, before and throughout the implementation, to meet a range of objectives as outlined in Daniell (2007a) and Coad et al. (2007). The final implemented process included three interactive stakeholder workshops based on stages of a generalised "participatory modelling process to aid decision making" (Daniell et al., 2006), the Tsoukias (2007) process model and the Australian and New Zealand Standard for Risk Management (AS/NZS 4360:2004), as well as an external scientific and legislative review. The principle elements of the process are outlined in Figure 2.

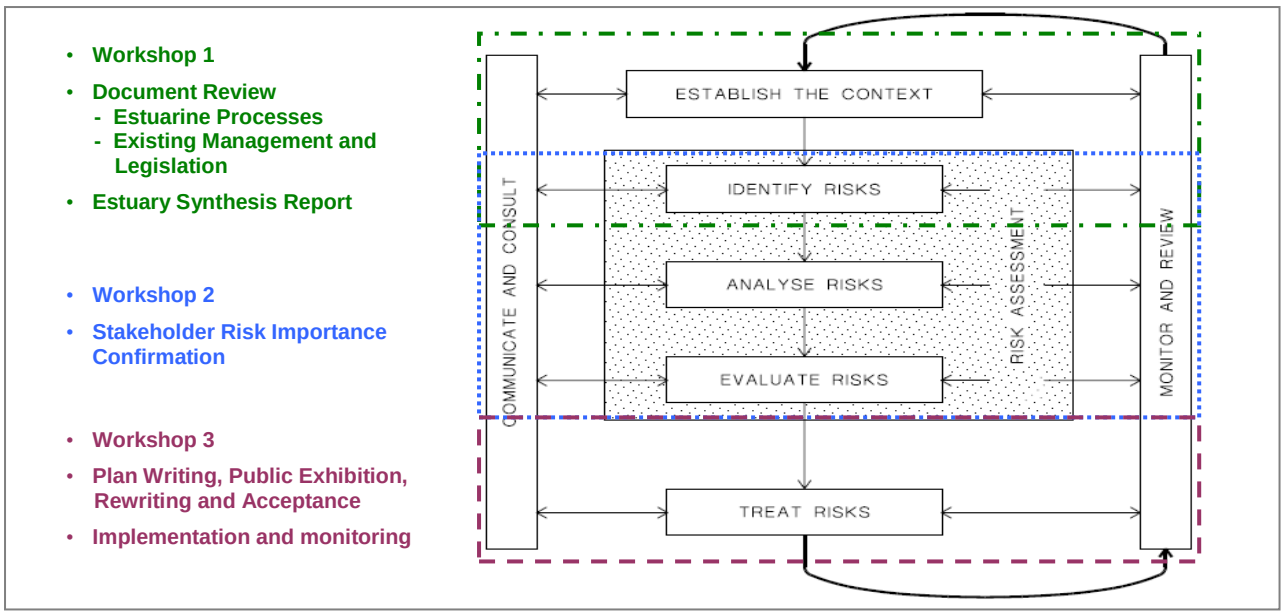


**Figure 2: LHEMP Participatory Risk Management Process (based on AS/NZS 4360:2004)**

To the authors' knowledge, this is the first time that the Australian and New Zealand Standard for Risk Management has been proposed for use in such a broad scale, inter-organisational and participatory process. Previous uses, especially in the water sector, have been run by one institution with the more specific objectives of operational management risks, and determining water quality risks or health risks (Billington, 2005; Everingham, 2005; SP AusNet 2006; Wild River and Healy, 2006).

## 2.2. Methodological Adaptation to the Iskar Flood and Drought Risk Management Context

Extreme climatic conditions such as large floods and extended drought periods have increasingly occurred over recent years in Bulgaria and the Upper Iskar Basin in the region of the nation's capital, Sofia, with many experts debating whether or not these "new" conditions are a consequence of global climate change (Knight et al. 2004; Kunzdewicz and Schellnhuber, 2004). Water management in such a context has presented many challenges, not just due to these "extreme events" or seemingly "natural hazards" but also due to the transitory nature of the country's social and political spheres following the fall of the Communist Regime in 1989 and the need to deal with its legacy of heavy industry, wide-spread pollution and infrastructural system issues (Hare, 2006). With its recent ascension into the European Union (EU), Bulgaria must now improve management of its water resources and resolve associated use conflicts between industrial, urban, agricultural, ecological and other human needs in line with EU legislation such as the Water Framework Directive. In order to aid the improved management of water in the Upper Iskar Basin, a number of initiatives were proposed as part of the Aquastress project (Ribarova et al., 2006). Only the participatory risk management process entitled "Living with Floods and Droughts" is outlined here.

Two of the largest issues for water management in the region appear to be a lack of institutional coordination and community capacity to cope with flood and drought events. It was therefore suggested that a process of "participatory modelling" could be proposed and tested as an intervention research exercise to aid the community and examine these and other issues (Ferrand et al. 2006; and Hare 2006). The "Living with Floods and Droughts" project was thus co-designed by a number of European researchers and more specific adaptations were made for the Bulgarian context in collaboration with Bulgarian researchers and local partners (to be referred to hereafter as the "project team"). The methodology for the participatory modelling process was based on Daniell and Ferrand, 2006, and the "SAS (System, Actors, Solutions) Integrated Model" (Ferrand et al., 2007), and was carried out in three general phases as outlined in Figure 3.

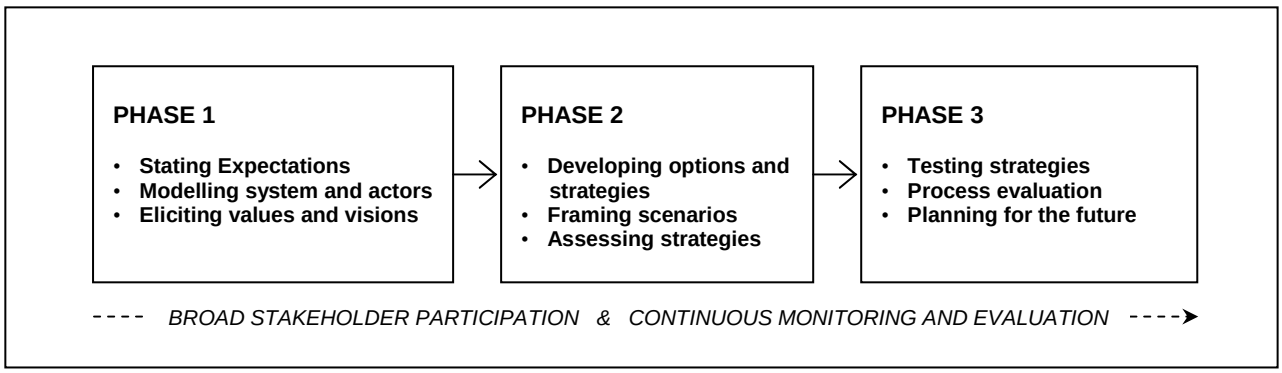


**Figure 3: Proposed Iskar Participatory Risk Management Process (based on Ferrand et al., 2006; and Hare, 2006)**

The participatory process was designed to include a wide range of regional stakeholders including: high level national policy makers, private company representatives, NGO representatives, municipal mayors and council workers, national experts, and citizens from the region, who would take part at different times in a series of interview and workshop exercises.

### 2.3. Comparison of the proposed methodologies

One of the specific differences in the two proposed processes was that the Australian project was a management-driven process with a specific output goal (the LHEMP plan) which is open to the inclusion of research suggestions and insights. The Bulgarian project was a research-driven process, with research objectives rather than entirely specified operational output goals, which had the potential to aid local stakeholders to improve the management of their water systems. Therefore, due to the important procedural difference, many more negotiations over the research agenda and process methodology were required in the Australian case as the estuary manager and consultants employed as project managers held the ultimate responsibilities over project outcomes and risks, including that the proposed participatory production of the plan could fail or generate conflict if inadequately carried out. This “responsibility” was one of the reasons behind using the Australian Risk Management Standard as a basis for the process, as it was considered that the outcomes would be more defendable to senior managers and funders of the plan.

In the Bulgarian case, although there were many discussions on how to design the process, many of the design choices were left to the European researchers, in part due to their funding of both the process and the participants, who were paid to cover their attendance costs at workshops. The specific choices of how methods were implemented were left to the Bulgarian local partners because of language difficulties. Unlike the Australian case, the adoption of a standard calculation approach to risk assessment such as that proposed in the Australian Risk Management Standard was not proposed for treating “risks”. Instead, it was proposed to draw upon a range of methods including scenario analyses, role playing games and multi-criteria assessment methods.

In both projects, specific methods and tools used in the participatory workshops and for analysis by the research teams were to be negotiated and selected within the project management teams as the processes progressed. It is also noted that, unlike the LHEMP project, the Tsoukiàs (2007) model was not specifically considered in the preliminary design phase of the Bulgarian process, but was rather introduced and considered in the later implementation stages of the process, as will be outlined further on in this paper.

## 3. PARTICIPATORY RISK MANAGEMENT PROCESSES AND OUTCOMES

This section will outline the processes that were implemented, based on the above methodological adaptations to the Australian and Bulgarian contexts. A number of content and process evaluation results will also be presented.

### 3.1. Lower Hawkesbury Estuary Management Planning Process

The estuary management planning process commenced in October 2006 with an initial meeting for the extended project team members. This was followed by another organisational meeting with the key project management team members to define and debate the methods and desired content of the three participatory workshops, as well as to discuss the stakeholders to be invited. Based on the theoretical and practical knowledge of the project team members in facilitating participatory processes to aid decision-making, a “values-based”, rather than an “alternatives-based” approach to decision making (Keeney, 1992) was adopted. This approach, used within the framework of the Australian and New Zealand Standard for Risk Management

(Figure 2), was aimed at firstly eliciting stakeholder values and common goals for estuary management that could be used as a base for later refining improved alternative actions for estuarine management, and secondly being used as the evaluation criteria for the risk assessment part of the process. The AS/NZS 4360:2004 framework has also been designed and explained with a "values-based" approach to decision-making implied, so it created a good fit with the Tsoukiàs (2007) decision aiding model (Figure 1) and methodology outlined in Daniell et al. (2006). The participatory risk management process and brief content explanations for the LHEMP creation are presented in Figure 4.

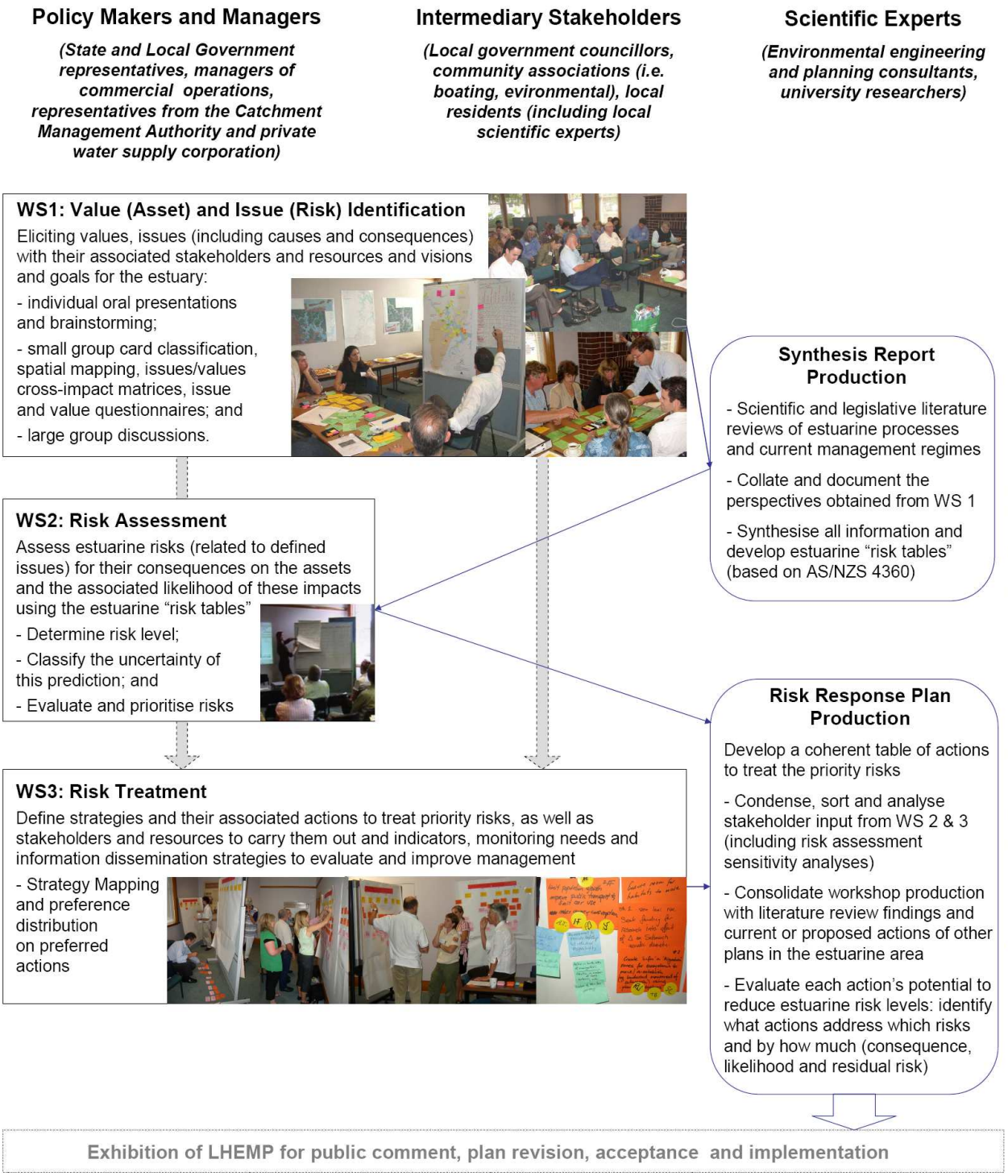


**Figure 4: Implemented LHEMP Participatory Risk Management Process**

The first stakeholder workshop, shown as WS1 in Figure 4, was held in November 2006 and attended by 30 participants from a wide range of stakeholder groups and state and local government departments. It was held in November 2006 and used to "establish the context" for the risk management approach. The second workshop (WS2 in Figure 4), held in February 2007 and attended by 19 participants, was then used to obtain policy makers' and managers' support for the stakeholder-defined values (assets) given in Table 1. It also

further identified the risks elicited in the first workshop and in an external document review; and then performed a “risk assessment” in order to prioritise a list of 16 estuarine risks to be subsequently addressed (BMT WBM, 2007 and Daniell 2007b). From these analyses, the priority of the risks was computed and presented as being “acceptable”, “tolerable”, or “intolerable”, and the participants given time to discuss the results. From this assessment, all risks were found to be tolerable or intolerable risks and were classified as requiring treatment. These risk priorities were also reviewed at a later date through a stakeholder email survey, sensitivity analysis and alternative calculations (Daniell 2007b; Coad et al., 2007). This work was carried out to analyse the validity and legitimacy of these priorities due to their status as a set of “final recommendations”, as outlined in the Tsoukiàs (2007) process model presented in Figure 1.

The third workshop was held soon after in March 2007 and attended by 17 participants representing a similar wide range of stakeholders to Workshop 1. This workshop developed strategies and actions for the treatment of all 16 risks, and identified monitoring needs, stakeholder responsibilities and stakeholder preferences related to the proposed strategies and actions. Individual brainstorming on cards of strategies and actions preceded the collective visual “strategy mapping” exercise for each risk, similar to Ackermann and Eden’s Oval Mapping Technique (2001) and preference distribution. Throughout this workshop over 900 elements were built into the 16 strategy maps. After the workshop, this information was then computerised using the Decision Explorer® software and exported to Excel to produce a preliminary Stakeholder-Based Action Table (Daniell, 2007b). This preliminary table was then considered and compared to existing management plans and regional strategies, and a final table of “risk-response” actions created. The final planned actions then underwent a secondary risk assessment based on the same stakeholder value list to determine their potential efficacy for treating the estuarine risks (Coad et al. 2007), and a final list of 32 priority actions, having the largest potential for reducing risks, were defined (BMT WBM, 2008). This secondary risk assessment process was carried out by the consultants in conjunction with the Estuary Management Group at Hornsby Shire Council, the results of which are currently under broader Council and stakeholder review before the Risk Response Plan is released for public comment.

As part of the participatory process, participant evaluation questionnaires consisting of approximately 15 open and closed questions were completed at the end of each workshop with a 50-70% response rate. These covered the stakeholder evaluation of the process and related to a variety of areas including: whether objectives were met; learning outcomes; what was useful; and what could be improved for future workshops or similar processes. External evaluations to further examine the context, objectives, process and results of the project were also carried out in person by researchers in collaboration with the project team, as well as with the aid of audio and video recordings of the workshops. A few of these results are presented later in this section, which will further analysed in the discussion. Further information on the evaluation results can be found in Daniell (2007a, 2007b) and Daniell et al. (2008).

### 3.2. Upper Iskar Basin Flood and Drought Risk Management Planning Process

The participatory modelling process was carried out from October 2006 to October 2007 to address the issue of “Living with Floods and Droughts” in the Upper Iskar River Basin of Bulgaria. Over 120 participants were involved in either the interview processes or workshops including: national ministers; policy makers; private company representatives; NGO representatives; municipal mayors and council workers; national experts; and citizens from Sofia, Samokov and Elin Pelin. The process participants and general content are presented in Figure 5.

The participatory modelling process used for risk management shown in Figure 5 was more elaborate in design than the Australian process, with around 60 stakeholders divided into 6 groups taking part in a series of 15 workshops, individual interviews and evaluation exercises over a one year period. The process included: cognitive mapping of the current management context and physical system, incorporating flood and risk drivers and impacts (see Hare (2007) and Ribarova et al. (2008) for further details); values, visions and game-based preference elicitation for actions; strategy development, evaluation and robustness analyses; as well as the production of an action plan for the Region of Elin Pelin. Participant voting on projects also took place and will be used to develop proposals to obtain Bulgarian structural funds in order to achieve the projects’ implementation. All of the preliminary workshops were carried out in the six separate groups (policy makers; national experts and organised stakeholders of Sofia; Sofia citizens; Elin Pelin mayors and organised stakeholders; Elin Pelin citizens; Samokov organised stakeholders and citizens). The last two workshops combined all 6 groups and involved approximately 35 participants each. The final development of projects for the action plan was created under five areas by “task forces” in the final workshop in order to ensure sufficient and concrete specification of required projects: three for preparedness planning (construction and infrastructure; education and capacity building; planning, management, decision infrastructure and monitoring); one for times of crisis (crisis management and action plan); and one for reconstruction after disasters (remediation and insurance). In total, 22 distinct projects were proposed.

Throughout the process, computer processing was used to digitalise the paper-based interview and workshop results and to perform translations from Bulgarian to English. The software used included the CmapTools (Novak and Cañas, 2006) for transferring and analysing the cognitive mapping outputs; Protégé (Gennari et al., 2002) for managing ontologies; Microsoft Excel for the assessment matrices, action plan projects and evaluation results; and Google Maps for spatialising the action plan projects. Further detail on the implemented process can be obtained from Ferrand et al. (2008).

Extensive evaluation including written questionnaires (65-100% return rates), facilitator and observer reports, and a number of interviews was carried out to assess the impacts and efficacy of the "participatory modelling" process. A few of these results are presented later in this section, which will further analysed in the discussion. Further information on the evaluation results can be found in Vassileva (2007).


**Figure 5: Implemented Iskar Participatory Risk Management Process**

### 3.3. Comparative notes and selected evaluation results

In both processes some of the "scientific experts" acted as facilitators for the workshops, with their role being to aid the other stakeholders to work together and create or elicit the desired information required for the next steps of the processes. At the beginning of the process, some of these experts had little or no experience in facilitation but most adapted quickly to the required role. However, depending on the professional and disciplinary backgrounds of the facilitators, neutrality vis-à-vis the content was variable, as in a few cases external observations of some facilitators who possessed high levels of knowledge about water management included that they occasionally presented their own views on the content or act as "gate-keepers" on which views would be given space in the collective visions. The ratio of facilitators to participants was typically no larger than 1:8 except for plenary and large group discussion sessions.

Unlike the Australian process where the members of the project team were unchanged during the design and implementation of the participation, the Bulgarian project team varied throughout the year and for specific workshops. This led to a number of last minute deviations from the original designed methodology, including changing its underlying objectives. For example, the decision-aiding model (Figure 1), which was introduced by a new project team member just prior to the workshop 4a series, had a number of subtle ramifications on the subsequent process design, including the use of previous elicited values (from WS2 and WS3) as evaluation criteria for the action plan projects. However, even though the Australian project team's membership remained constant, last-minute process changes, which included excluding the intermediate stakeholders from WS2 and in-workshop program changes suggested by participants, occurred (Daniell 2007b).

Another change that occurred was that in both processes multi-criteria analysis approaches had been suggested (considering mathematical-based matrix assessments based on solid decision aiding theory such as the ELECTRE, PROMETHEE and AHP methods (Roy, 1985; Brans and Vincke, 1985; Saaty, 1980)), yet were finally adapted in the participatory context to more rudimentary forms of matrix analysis. For example, this transpired during the value preference elicitation games and the options and project assessments in the Bulgarian case. This appeared to have occurred for a number of reasons including: to aid stakeholder comprehension; because the majority of the project team members had insufficient proficiency in the methods to make the underlying mathematical assumptions understandable to their colleagues and the participants; and due to a lack of time to gain and sort weighting or rank preferences. In the Australian case, a simple weighted average approach was used (which as stated in Bouyssou et al. (2000) may compromise the real "meaning" of the final numbers). Strangely enough, when this aspect was discussed with project team members and process participants, it incited little to no reaction. It appears that as long as the project team members are seen to have a legitimacy to manage the process and underlying mathematics, the final results will be accepted with a similar ambivalence, as long as obvious discrepancies between instinctive and calculated ranks can be logically argued. This insight is drawn in particular from the discussion and later acceptance of the low prioritised ranking of the "water quality" risk, which was instinctively labelled as of high or medium priority by all participants (refer to Daniell 2008 for further details). Lack of application in the Bulgarian case was more probably due to time constraints and doubts by some project team members of the usefulness and interest of such an approach.

In both of these proposed processes, the "evaluation model" artefacts of Tsoukiàs' (2007) framework (Figure 1) were not constructed as a separate phase but rather co-constructed along with the problem situation and problem formulation elements (i.e. criteria for assessment in the Australian case were developed directly from values elicited in the "problem situation" construction). The lists of common values elicited from participants and used in different manners in the two processes (as a part of the "evaluation models") are given in Table 1 and will be briefly discussed in the following section.

**Table 1: Comparative stated collective values underlying water management (in no particular order)**

| List of estuarine and surrounding community values - Australian process | List of river basin and surrounding community values – Bulgarian process |
|---|---|
| Scenic amenity and national significance | "To feel secure and healthy" (Enhanced well-being) |
| Sustainable economic industries | Sustainable economy |
| Improving water quality that supports multiple uses | Treated potable water and treated wastewater |
| Functional and sustainable ecosystems (including biodiversity) | Preserved ecosystems |
| Culture and heritage | Sustainable agriculture |
| Community value | "To share our lives" (Enhanced community capacity) |
| Largely undeveloped natural catchments and surrounding lands | Effective water supply |
| Effective governance | Effective management |
| Recreational opportunities | |

One of the other largest procedural differences was that the participants of the Bulgarian case built a range of individual and collective causal "situation" models and other linked factor cognitive maps of actors and their

current actions as part of the "problem situation" and "problem formulation" phases of the decision aiding process. In the Australian case, although a range of participative methods such as spatial mapping of issues and issue/value cross impact matrices were developed, such causal linkages were only elicited informally in speech or in written group questionnaires, and also defined in the synthesis report (BMT WBM, 2007) by the engineering consultants. Rather than using causal models for drawing influences on the estuarine system's behaviour, subjective collaborative decisions based on available and shared knowledge in the agency group (WS2) were elicited using the "Risk tables" as part of the "problem situation" and "problem formulation" phases (Tsoukiàs, 2007) of the Australian decision aiding process.

Another potentially important difference in the processes was that most of Australian participants were seasoned "participators" and appeared to have a marginally more jaundiced opinion about the possible positive outcomes of participation than did the Bulgarians who for a large part had never participated to a similar extent in "multi-level" participatory water management analysis and decision aiding processes before. For the Australians, this included being aware of more of the underlying constraints of the participation process design used. However, as can be seen from a selection of questionnaire responses given in Table 2, many more positive outcomes including participant learning and increased understanding were still achieved, even if the participants exhibited some cynicism due to their previous participation. The implications of these differences and elements of the qualitative evaluation responses will be further discussed in the following section.

**Table 2: Comparative evaluation - selected qualitative questionnaire responses**

| **Estuarine risk management process, Australia*** | **Flood and drought risk management process, Bulgaria** |
|---|---|
| ***What are the most important things you have learnt throughout the (workshop*) process?*** | |
| *"The multi-faceted nature of environmental issues"* (WS3) | *"The basic and most important issues and problems, which are connected to floods and droughts."* |
| *"There's lots to do - where will the $$ and political/management will come from?"* (WS3) | *"I learnt more about the role of the different institutions in the field of water management. Actually I understood that the region of Iskar basin is not ready yet to cope with these problems."* |
| *"There is no one right way to address identified risks. Collaboration is essential."* (WS3) | *"The most important thing I've learnt is that there are always 2 different points of view and they are equally important."* |
| *"Many different views (understandably). Has helped me to formulate and form up my own opinions."* (WS3) | *"I met different people during the Flood and Drought project with different points of view, opinions and ideas. These contacts and joint activities enriched my thorough vision and knowledge about the discussed problems."* |
| *"A range of challenges to the estuary exist and are ever evolving" (WS3)* | *"The floods can not be predicted but the risk and the bad impacts can certainly be prevented and the appropriate measures for their reduction can be undertaken in time."* |
| ***How did the (day's activities*) workshop process help you to work with and (relate to*) communicate with the other participants?*** | |
| *"Each workshop has increased my awareness of these processes + issues associated with presenting, managing such a process. Got to know and hear more from other participants"* (WS3) | *"In a very positive way. Every participant has the opportunity to enrich his knowledge about the problems being a member of a large group with different people. The motivation to work in the best possible way is quite bigger when you are a member of a team."* |
| *"Helps develop a team mentality"* (WS3) | *"By creating friendly and comradely relations in the team."* |
| *"Gained a better understanding of individual agency responsibilities and knowledge with regards to the estuary."* (WS2) | *"It helped me to understand better how the institutions with affiliation with water and water problems are functioning."* |
| *"Good open and honest discussion, effective facilitation."* (WS2) *"not <u>too</u> confrontational"* (WS1) | *"The joint work had very positive influence upon all the participants. The discussions were open and straightforward, without confrontations or conflicts."* |
| ***How do you think this process is helping to better manage (the estuary*) water in the Iskar basin? (If it is not, please also state why.)*** | |
| *"The process provides a focus for the estuary, brings all these parties together to at least discuss and endeavour to try and plan / improve the estuary" (WS3)* | *"Without any doubt this process is helping the improvement of the whole area. It is a golden chance to discuss and identify the problems, and based on this analysis the most appropriate and suitable actions and activities can be undertaken."* |
| *"Will only help if it doesn't end in a report that isn't widely communicated and adopted"* (WS3) | *"I really can not understand how the results from our work - strategies, plans, information data base, will be used later at a higher level - institutions and legislation."* |
| *"Getting different groups (government + community) talking together and operating under agreed framework"* (WS3) | *"The project provides an excellent opportunity to put all stakeholders in the region around the table - managers, common people, and experts."* |

The quantity and richness of information produced and collected throughout the two processes mean that it is only possible to present and discuss a small portion of results in this paper. Further results are outlined in Daniell et al. (2007a), BMT WBM (2007), Daniell et al. (2007b), Coad et al. (2007), Daniell et al. (2008), BMT WBM (2008), Hare (2007), Ribarova et al. (2008), Ferrand et al. (2008) and in a range of forthcoming papers.

## 4. DISCUSSION

This section will concentrate on formulating insights related to just a few key areas: 1) the importance of context 2) the value and constraints of designing and implementing participatory risk management approaches in different regulatory and political environments; 3) dealing with divergent objectives in a multi-institutional organising team; and 4) unintended ethical issues that can arise when working in "real-world" management situations.

### 4.1. The importance of context: the value and constraints of participatory risk management approaches in different regulatory and political environments

Australia has a long history of participation and participatory approaches in water and natural resources management. It also has common use and acceptance of risk management approaches to decision-making as evidenced by the existence of the Australian and New Zealand Standard for Risk Management, and its accompanying handbooks including one specifically designed for "Environmental Risk Management" (Standards Australia 2004a, 2004b, 2006). Even though some participatory water management processes in Australia may not be specifically designed on coherent spatial or administrative scales with carefully developed decision aiding methodological knowledge, there appears to be a common acceptance and a general capacity for Australians from many walks of life to manage or participate in them when required, often by state or national legislation, whether or not they agree with the underlying purposes. Such familiarity exhibited by many participants and managers with regard to participatory approaches, including those focussing on "risk" or "asset" management, could be mostly considered as a positive element of the Australian regulatory and political context. However, it also presents a range of challenges for process designers and implementers of participatory processes to attract and keep the participants' interest and to achieve useful and concrete outcomes during the time dedicated to collaborative activities. Creating innovative processes and publicising them appropriately is increasingly becoming a necessity in Australia if participation of the required individuals and organisations for achieving change is to be assured. In the LHEMP process, it is considered that the introduction of the use of the Risk Management Standard in a non-traditional domain such as regional scale estuarine management, and the participatory process with a workshop dedicated to just working with policy and managers, provided the necessary "drawcard" to help obtain agency and funding support of the LHEMP process and hopefully the resulting plan (Coad, 2007 – personal communication). Although presenting positive outcomes, these choices also had, and could have, other more negative ramifications such as alienating some members of the community or encouraging a return to "technocratic" and non-participatory management, an issue which is further discussed in Daniell (2007b).

Unlike current management systems in Australia, the Bulgarian water sector has long been characterised by technocratic management systems and the work of scientific experts. Since the fall of the country's Communist regime, the former rural community structures based on work and equipment sharing in villages have also been dismantled, leaving rural populations with fewer services and collective capacities. Until recently, there has also been little concern for environmental or social impacts of management decisions and infrastructural projects. Although there is some evidence that Bulgarians are active participators in some sectors of social community life (Letki, 2004), there are few, if any, prior examples of participatory multi-level inter-organisational water or risk management processes that have been carried out in the country. Early assessments in the AquaStress project by European researchers also highlighted that the Bulgarians they had met had little knowledge about participatory processes and their potential to aid the Upper Iskar basin's water management (Hare, 2006). Another interesting difference between the two countries' contexts was the familiarity with the concept of "risk". Early in the Bulgarian process, most attention focussed on issues of better dealing with "crises" of flood and drought, with relatively little consideration of the need for pre-emptive local community planning to reduce community vulnerability through capacity building. It was rather considered that it was the government's job to "protect" them from flood and drought events to reduce their susceptibility to such hazards. However, later in the process, sufficient learning appears to have taken place so that participants began to understand the concept of "risk" and the need to develop a more holistic response. This was evidenced by the 13 pre-emptive projects put forward in the action plan in the final workshop. Despite the previous lack of experience in managing or involvement in participatory water management processes before, the Bulgarians exhibited great proficiency in adapting and working effectively in them. Unlike in the Australian process, there was rather less cynicism surrounding the use of such a process and apparent sustained interest. Considering the high levels of acceptance and proficiency in participating in this process, it could be suggested that further participation initiatives in the

Bulgarian context may have a good chance of succeeding if the initiators have sufficient skills and legitimacy to coordinate such a process.

It was also interesting to note the similarities and differences in values elicited in the two processes, as shown in Table 1. In both countries, common values such as economic sustainability, ecosystem health, the importance of community and effective governance or management were made evident. However, a number of differences were also observed, the "effective water supply", "to feel secure and healthy" and "sustainable agriculture" category of the Bulgarian case being most worthy of note, as deficiencies of safe food and water in the recent past have caused Bulgarians enormous stress and suffering. Therefore, the important values linked to these basic requirements of life elicited from the Bulgarian participants are on quite a different level from the "scenic amenity" and "recreational opportunities" values outlined by the Australian participants.

Despite the obvious contextual and procedural differences of the two projects, there were still a number of close similarities in outcomes noted by participants in the evaluation questionnaires, as outlined in Table 2. This leads to partial support of the general assertion that carefully designed and implemented participatory risk management approaches are likely to aid learning, appreciation of common and divergent views on complex problems and support inter-organisational and multi-stakeholder coordination which could help to aid future water management outcomes.

### 4.2. Dealing with divergent objectives in multi-institutional organising teams

Broad-scale participatory management initiatives commonly require organising teams, rather than just one individual designer and implementer. Working in a team through such processes requires the consideration of a whole range of other issues that may not be often consciously considered by observers or participants of participatory processes. There is the possibility that different team members and participants may hold a variety of objectives for the process that are not necessarily shared or coherent, as well as a variety of different skills, resources, values and preferences that are likely to impact on how the final process is designed and implemented. Such a situation is likely to require continuous negotiation or other forms of decision-making such as consensus building or vetoing by more powerful project team members, which could include the client, funding institution or legally responsible project manager.

Throughout both the Australian and Bulgarian processes, divergences between project-team members became evident in a number of decision-making phases and were finally resolved or treated using a variety of different methods. In the Australian process, where each of the project team members had their own specific objectives for the process, more-or-less known from the beginning of the process due to their different roles, as well as a number of shared objectives, the dominant form of decision-making was negotiation. This was particularly evident for major process adaptation decisions, such as deciding to make Workshop 2 "agency" only. In this case, project team members held different viewpoints on how the process should have been carried out, and in the end the funder was required to end the negotiation by making the final decision. However, most other minor differences were resolved and commonly acceptable solutions constructed between the project team members in a more collaborative manner.

The Bulgarian process design and implementation also had a number of similarly challenging negotiations. However, due to the dominant research theme of the project and the fact that different groups of researchers were working together, rather than legally responsible project managers and funders, the majority of the process design was rather more collaborative due to a lack of "veto" power that could be effectively exerted without serious consequences. Despite the European researchers' process design intentions, the Bulgarian facilitators held the ultimate power to change the process. This occurred a number of times through the process, most often due to the facilitators' intuition that the suggested process would require modifications to achieve successful outcomes in the Bulgarian cultural context or that due to the facilitators' lack of specific skills, the implementation of certain process design elements was considered infeasible (Popova, 2008 – personal communication).

From these processes where there may be a variety of divergences between project-team members, it is suggested that greater reflection on the co-design and co-implementation processes is required. Increasing individual flexibility and encouraging creative thinking to propose alternative win-win solutions to suit the broadest possible range of objectives may prove particularly useful to ensure more successful project outcomes, rather than entering into heavy negotiations where more is likely to be lost than gained overall. Although this process of co-construction of the participatory process is in itself a participatory process, it is rarely run as such and could also potentially be improved by "best-practice" participatory meeting processes and support tools. This may include processes such as improving the transparency of reasoning presented throughout the co-construction activities and, for resultant decision outcomes, by publishing concise minutes of meetings.

### 4.3. Potential unintended ethical issues arising in "real-world" management situations

Although the idea that there are many ethical quandaries which may be encountered when embarking on participatory research programs is in no way new (i.e. Cahill et al., 2007; Sultana, 2007), it appears that in certain research and cultural contexts, there is still minimal reflection dedicated to them. In both the Australian and Bulgarian projects a number of different ethical issues requiring reflection arose, two of which will be further discussed here.

It is possible that research agendas may not be fully able to accommodate the local needs of involved communities, stakeholders and project managers before a participatory process is embarked upon. Such processes have the possibility to instil the hope in the minds of participants that the process has the potential to "make a difference" in the lives of the local inhabitants, even though such expectations may not have been intended by researchers running a "research project". Researchers are then put in a position where ethically they must reassess whether their own plans for obtaining certain pre-planned scientific research outcomes are more important than the newly found hopes of the participants. Such considerations were required in the Bulgarian case before the last workshop. After much discussion between the project team members and their institutional superiors, the process was changed to help the participants develop a flood risk action plan that could be used for a funding proposal for a sub-section of the Iskar basin; rather than completing the planned research program.

Grand plans for inclusive participation programs initially agreed upon in principle by project managers and researchers and communicated to participants may strike stumbling blocks when underlying managerial process objectives surface part-way through the process and require a reduction in planned numbers or types of participants. Such a situation could disempower omitted participants, resulting in a boycott of further participation initiatives or much larger impacts such as negative publicity, distrust of the organising institutions, and mistrust of any further participatory initiatives in the region. There are therefore ethical considerations when changing the structure of participation in the course of a process. Such a change occurred in the Australian process, but only a few of the possible negative consequences resulted due to the way in which the process changes were managed.

A range of other ethical issues need to be considered depending on cultural norms. Issues such as the preservation of participant anonymity, the use of photos, audio and video recordings, storage, distribution and publication of this information need to be critically examined within the cultural context. Cultural differences in ethics principles were quite noticeable between the Australian and Bulgarian processes. As an example, when the Bulgarian researchers were asked if the debriefing session could be audio recorded, as required by Australian university ethics procedures, they did not understand why anyone would ask such a question. The cultural differences surrounding ethics in participatory projects require careful attention when working in cross-cultural or even inter-disciplinary research teams to ensure that all involved in the process develop a mutual understanding and adhere to adequate and suitable ethical standards.

## 5. CONCLUSIONS

The underlying assumption here has been that participatory risk management approaches are required for improving water planning and management practices under the conditions of uncertainty, complexity, and conflict that are exhibited in the increasingly interconnected and globalised world of today. A range of insights and lessons learnt have been outlined from the design and implementation of two different participatory risk management processes for water planning and management: a values-based method based on the Australian and New Zealand Standard for Risk Management for the development of the Lower Hawkesbury Estuary Management Plan in Australia; and a participatory modelling approach to manage the risks of living with floods and droughts in the Iskar basin in Bulgaria. Both cases provided insights into the value and constraints of participatory risk management approaches in different regulatory and political environments, and more or less elaborate forms of process implementation. Some important common issues arose including: impacts of last minute process changes; how to deal with divergent objectives in a multi-institutional organising team; and the unintended ethical issues that can arise when carrying out research in "real-world" management situations. Research questions arising from this work include: determining to what extent different cultural and political contexts may prevent or enhance the possible future repetition and normalisation of participatory risk management approaches for the water sector; developing and examining procedural engineering for process design groups; determining the comparative efficacy of participatory processes of differing elaborateness; and investigating the use and need for reflexivity on ethics for participatory research and participatory process design. It is hoped that this paper has provided the basis for increasing awareness of the value and potential issues associated with participatory risk management approaches and thus should aid their adoption and the subsequent improvement of water planning and management in various contexts around the world.

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## REFERENCES

Abramovitz, J. N. (2001) *Averting Unnatural Disasters*. In: L. Starke (ed) *State of the World 2001,* Worldwatch Institute, New York: 123-142.

Ackermann, F., Eden, C. (2001) SODA and Mapping in Practice. In Rosenhead, J. and Mingers, J. (eds.) *Rational analysis for a problematic world revisited.* Wiley, Chichester: 43-60.

Billington, K. 2005, *River Murray Catchment Risk Assessment Project for Water Quality—Concepts and Method*, SA EPA, Australia.

BMT WBM (2007) *Lower Hawkesbury Estuary Synthesis Report*. Prepared for the Hornsby Shire Council, NSW, Australia.

BMT WBM (2008) Lower Hawkesbury Draft Estuary Management Plan, March 2008, Prepared for the Hornsby Shire Council, NSW, Australia.

Bouyssou, D., Marchant, T., Pirlot, M., Perney, P., Tsoukiàs, A. and Vinke, P. (2000) *Evaluation and Decision Models: A Critical Perspective*, Norwell, Massachusetts, USA, Kluwer Academic Publishers.

Brans, J.-P. and Vincke, P. (1985) *A preference ranking organisation method: the PROMETHEE method for multiple criteria decision-making*, Management Science, 31(6): 647-656.

Cahill, C., Sultana, F. and Pain, R. (2007) *Participatory Ethics: Politics, Practices, Institutions*, ACME: An International E-Journal for Critical Geographies, 6(3): 304-318.

Coad, P. (2007) *Personal Communication*, Monday 1st October 2007, Hornsby, NSW, Australia.

Coad, P., Haines, P., Daniell, K.A., Guise, K., Rollason, V. (2007) *Integration of Environmental Risk Assessment within Estuary Management Planning for the Lower Hawkesbury-Nepean River, New South Wales*, 16th NSW Coastal Conference, 7-9 Nov, Yamba NSW, Australia.

Daniell, K.A. (2007a) *Summary Report: Community Workshop 1 for the Lower Hawkesbury Estuary Management Plan*. Available as Appendix A in: BMT WBM (2007) Lower Hawkesbury Estuary Synthesis Report, prepared for the Hornsby Shire Council, NSW, Australia.

Daniell, K.A. (2007b) *Summary Report: Stakeholder Workshops 2 & 3 for the Lower Hawkesbury Estuary Management Plan*. Prepared for Hornsby Shire Council & BMT WBM, NSW, Australia.

Daniell, K.A., Ferrand, N. (2006) *Participatory Modelling for Water Resources Management and Planning*, Report D3.8.2, Aquastress IP, FP6, Europe.

Daniell, K.A., White, I., Ferrand, N., Tsoukiàs, A., Burn, S., Perez, P. (2006) *Towards an art and science of decision aiding for water management and planning: a participatory modelling process.* In: Proceedings of the 30th Hydrology & Water Resources Symposium, 4-7 Dec, Launceston, Australia.

Daniell, K.A., Coad, P., Ferrand, N., White, I., Jones, N., Guise, K., Marvell, C., Burn, S., Perez, P. (2008) *Participatory values-based risk management for the water sector.* In: Proceedings of the Water Down Under 2008 International Conference, 15-17 April, Adelaide, Australia.

Daniell, T.M., Daniell, K.A. (2006) *Human impacts, complexity, variability and non-homogeneity: four dilemmas for the water resources modeller*. In: *Climate Variability and Change - Hydrological Impacts*, IAHS Publication No. 308: 10-15.

DIFD (2004) *Disaster risk reduction: a development concern. UK, Department for International Development*, UK Government. [Online]: http://www.undp.org.cu/crmi/files/docs/dfid_ddrpolicy.pdf

Dwyer, A., Zoppou, C., Nielsen, O., Day, S. and Roberts, S. (2004) *Quantifying Social Vulnerability: A methodology for identifying those at risk to natural hazards, Record 2004/14*. Canberra Australia, Geoscience Australia. [Online]: http://www.ga.gov.au/servlet/BigObjFileManager?bigobjid=GA4267

Everingham, P. 2005, *Upper South East Water Quality Risk Management Strategy. South Australia*. Department of Water, Land and Biodiversity Conservation.

Ferrand,N., Hare, M. and Rougier J-E. (2006) *Iskar Test Site Option Description Living with Flood and Drought*. Methodological document to the Iskar Test Site, AquaStress IP, FP6, Europe.

Ferrand, N., Ribarova, I., Daniell, K., Rougier, J.-E., Popova, A., Vasileva, S., Abrami, G. (2007) *Supporting a multi-levels participatory modelling process for floods and droughts co-management*. Journées de la Modélisation au Cemagref, 26-27 November 2007, Clermont-Ferrand, France.

Fischer, F. (2000) *Citizens, experts, and the environment*, Durham, Duke University Press.

Gennari, J., Musen, M.A., Fergerson, R.W., Grosso, W.E., Crubezy, M., Eriksson, H. Noy, N.F., Tu,. S.W. (2002) *The Evolution of Protégé:*

*An Environment for Knowledge-Based Systems Development*. [Online]: http://smi.stanford.edu/smi-web/reports/SMI-2002-0943.pdf

Gleick, P. (2000) *The Changing Water Paradigm, A Look at Twenty-first Century Water Resources Development*, Water International, 25 (1): 127-138.

Hare, M. (2006) *Evaluation of process and next steps for the Iskar River Basin Test Site within the AquaStress project*, Seecon Report # Seecon09/2006. Osnabrück, Germany, Seecon Deutschland GmbH: 20.

Hare M. (2007) *Policy Makers' Interviews and Report on the 1st Policy Makers' Workshop of Case Study 3 of the Iskar River Basin Test Site within the AquaStress Project*, Seecon Report # Seecon01/2007, Osnabrück, Germany, Seecon Deutschland GmbH: 27.

HSC - Hornsby Shire Council (2006) *Q26/2006 Lower Hawkesbury Estuary Management Plan – Tender Document*, Water Catchments Team, Hornsby Shire Council, NSW, Australia.

Jaeger, C. C., Renn, O., Rosa, E. A. and Webler, T. (2001) *Risk, Uncertainty, and Rational Action,* London, Earthscan Publications Ltd.

Keeney, R.L. (1992) *Value-Focussed Thinking*, Harvard University Press, Cambridge, Massachusetts.

Kimmerikong (2005) *Hawkesbury-Nepean River Estuary Management – Scoping Study – Final Report*, Kimmerikong Pty Ltd Natural Resource Management, NSW, Australia. [Online]: http://www.hn.cma.nsw.gov.au/multiversions/2759/FileName/Scoping%20Study_HNEstuaryMan_Final%20Report_Nov05.pdf

Klinke, A., Renn, O. (2002) *A new approach to risk evaluation and management: risk-based, precaution-based, and discourse-based strategies*, Risk Analysis, 22 (6): 1071-1094.

Knight, C. G., Raev, I. and Staneva, M. P. (Eds.) (2004) *Drought in Bulgaria: a contempory analog for climate change*, Aldershot, UK, Ashgate Publishing Limited, 336.

Kundzewicz, Z.W., Takeuchi K. (1999) *Flood protection and management: quo vadimus?* Hydrological Sciences Journal, 44(3): 417-432

Kundzewicz, Z.W., Schellnhuber, H.-J. (2004) *Floods in the IPCC TAR perspective*, Natural Hazards, 31(1): 111-128.

Letki, N. 2004 "*Socialization for Participation? Trust, Membership, and Democratization in East-Central Europe*", Political Research Quarterly, 57(4): 665-679.

Loucks, D. P. (1998) *Watershed Planning: Changing Issues, Processes and Expectations*, Water Resources Update, Universities' Council on Water Resources, Illinois, Issue No.111, Spring, pp.38-45.

Meinke, H., Nelson, R., Kokic, P., Stone, R., Selvaraju, R., Baethgen, W. (2006) *Actionable climate knowledge: from analysis to synthesis*, Climate Research, 33:101-110.

McDaniels, T., Gregory, R. and Fields, D. (1999) *Democratizing Risk Management: Successful Public Involvement In An Electric Utility Water Management Decision*, Risk Analysis, 19(3): 491-504.

Novak, J.D., Cañas, A.J. (2006) *The Theory Underlying Concept Maps and How to Construct Them*, Technical Report IHMC CmapTools 2006-01, Florida Institute for Human and Machine Cognition. [Online]: http://cmap.ihmc.us/Publications/ResearchPapers/TheoryCmaps/TheoryUnderlyingConceptMaps.htm

NSW Government (1992) *Estuary Management Manual*, NSW Government, NSW, Australia.

Ostanello, A., Tsoukiàs, A. (1993) *An explicative model of 'public' interorganizational interactions*, European Journal of Operational Research, 70: 67-82.

Rayner, S. (2007) *The rise of risk and the decline of politics*, Environmental Hazards, 7(2): 165-172.

Renn, O., Webler, T. and Wiedemann, P. (Eds.) (1995) *Fairness and Competence in Citizen participation*. *Evaluating Models for Environmental Discourse*, Dordrecht, Kluwer.

Ribarova, I., Ninov, P.I., Daniell, K.A. Ferrand, N., Hare, M. (2008) *Integration of technical and non-technical approaches for flood identification*. In: Proceedings of the Water Down Under 2008 International Conference, 15-17 April, Adelaide, Australia.

Ribarova, I. Assimacopoulos, D., Balzarini, A., Ferrand, N., Rougier, J.-E., Hare, M., Inman, D., Ribarova, I., Tarnacki, K., Vamvakeridou-Lyroudia, L., de Vries, T. (2006) *AquaStress Case Study Iskar*: Report of the JWT. Presented to the PSG on the 29th of June, 2006, Brussels, Belgium.

Rijsberman, F.R. (2004) *Water Scarcity: Fact or Fiction?* In: "New directions for a diverse planet". Proceedings of the 4th International Crop Science Congress, 26 Sept-1 Oct 2004, Brisbane, Australia.

Roy, B. (1985) *Méthodologie multicritère d'aide à la décision*, Paris, Economica.

Saaty, T. L. (1980) *The Analytic Hierarchy Process*, McGraw-Hill.

SP AusNet 2006, Risk Management Framework. Online: *http://www.sp-ausnet.com.au/CA256FE40021EF93/Lookup/20060413RiskManagementFramework/$file/Risk%20Management%20Framework%20Version%201.0.pdf*

Standards Australia (2004a) *AS/NZS 4360:2004 Risk Management*. Standards Australia, Australia.

Standards Australia (2004b) HB 436:2004, *Risk Management Guidelines—Companion Handbook*

Standards Australia (2006) HB 203:2006, *Environmental risk management—Principles and processes*.

Sultana, F. (2007) *Reflexivity, Positionality and Participatory Ethics: Negotiating Fieldwork Dilemmas in International Research*, ACME: An International E-Journal for Critical Geographies, 6(3): 374-385.

Tsoukiàs, A. (2007) *On the concept of decision aiding process*, Annals of Operations Research, 154: 3-27.

Vasileva, S. (2007) *Technical evaluation report*, Aquastress IP, FP6, Europe.

White, I. (2007) *Personal Communication*, Saturday 6th October 2007, Canberra, ACT, Australia.

Wild River, S., Healy, S. (2006) *Guide to Environmental Risk Management*, CHH Aust. Ltd, Sydney.