Whisky is for drinking; Water is for fighting over.

A critical investigation of the decision to build the Broken Hill Pipeline.

Owen David Carr

Master Thesis Series in Environmental Studies and Sustainability Science,
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A thesis submitted in partial fulfillment of the requirements of Lund University International Master's Programme in Environmental Studies and Sustainability Science (30hp/credits)

LUCSUS
Lund University Centre for Sustainability Studies

LUND UNIVERSITY

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Submitted May 15, 2018

Supervisor: Murray Scown, LUCSUS, Lund University

Abstract:

Water is a necessity for human survival, and a lack of sufficient clean water can have severe negative impacts on human health, economic activity, food security and societal relations. Increasing demand on water resources around the globe often leads to conflicts between different water users who compete for available supplies. The Murray Darling Basin (MDB) in Australia is an area that faces many complex challenges relating to water management. The basin is located in the driest inhabited continent in the world, spans five separate states with diverse laws on water ownership, and supports multiple competing water users. Hence water governance in the basin is a contested issue that has caused many conflicts. Governance within the basin is guided by an overarching governing agency called the Murray Darling Basin Authority (MDBA), which is meant to coordinate the multiple actors, however in reality governance is a complicated layered system that often sees conflicts between competing groups. This thesis investigates a case study of one current conflict (the Broken Hill pipeline) to identify causes of the conflict and potential interventions for future sustainable water governance in the basin. The thesis draws on political ecology and the hydrosocial cycle to argue that water is shaped by a complex mix of social, political, economic and historical factors that need to be considered together. A qualitative approach is taken including document analysis of official planning and decision-making publications, combined with local stakeholder interviews. Major findings include, firstly, the planning and decision-making process only partially followed governance principles held by the MDBA. Secondly, complaints of local stakeholders highlighted multiple issues, of which only half would have been fully addressed if the all governance principles were followed. Complaints that are not addressed by current governance guidelines, and should be the focus for future sustainable pathways, were driven by issues of 1) a lack of recognition of different 'frames' of water; 2) no consideration of uneven power relations; 3) a lack of trust in the legitimacy of the current governance system. Thirdly, factors that were used to motivate the pipeline decision could be seen as drawing attention away from underlying drivers of water problems, favouring a quick-fix technical solution. Conclusions suggest that a more polycentric form of governance that facilitates co-management and social learning would help address many of the issues that were identified and could help facilitate a more sustainable pathway for future governance of the MDB.

Keywords: Hydrosocial cycle, MDBA, water governance, conflict, socio-ecological systems, sustainability.

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List of Abbreviations / Definitions

Aboriginal	= Indigenous people of Australia
CEMP	= Construction Environmental Management Plan
MDB	= Murray Darling Basin
MDBA	= Murray Darling Basin Authority
NSW	= New South Wales
NSW DPI	= New South Wales Department of Primary Industries
REF	= Review of Environmental Factors
RQ	= Research Question
SES	= Social Ecological System

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1) Introduction

Access to sufficient clean water is fundamental for human life. Good quality, fresh water is needed for drinking, food production, sanitation, recreational and cultural purposes (WHO, 2018), yet worldwide more than four billion people (nearly two thirds of the global population) experience water scarcity for at least one month per year (Mekonnen & Hoekstra, 2016). This is a major problem facing society and sustainable development, and hence water resources are recognised in the Sustainable Development Goals under Goal 6 'clean water and sanitation' (United Nations, 2017) as well as the planetary boundaries under 'freshwater use' (Steffen et al., 2015). Looking forwards, population growth and climate change are predicted to increase pressure on water resources, particularly competition between urban and rural areas and the different water users such as irrigation, industry, domestic use and the environment (Flörke, Schneider, & McDonald, 2018; Gosling & Arnell, 2016). This increasing competition and scarcity of water resources can impact society in many ways including increasing conflicts, impacting human health, decreasing economic activity and negatively affecting food security (Mianabadi, Mostert, & van de Giesen, 2015; Schewe et al., 2014). The cumulative effects of these factors are being seen all around the globe, which has led to the idea that we are facing a global water crisis (e.g. Guppy & Anderson, 2017; Watkins, 2006).

Although it is easy to think the global water crisis is occurring simply due to decreased water availability and increased demand, in reality the situation is much more complex. How water is governed can have a huge impact on availability, which has led many to call the crisis a 'crisis of governance' (e.g. Ambrus, 2013; OECD, 2011). Many scholars support this suggestion, criticising traditional technical/engineering focused water management, guided by scientific knowledge, instead suggesting that water management is a complex issue involving, human values and behaviour, power relations, and social and political structures (e.g. Linton & Budds, 2014; Swyngedouw, 2009). Governance is further complicated by the fact that in most cases there are multiple actors involved who need to co-ordinate on policy and planning, often with competing interests and different views around water. This regularly leads to conflicts between actors, especially when cross-boundary cooperation is required (Mianabadi et al., 2015).

Political ecology investigations highlight many of the above-mentioned complexities, including multiple actors, scales and conflicts, and call for new approaches to natural resource management, questioning common long held understandings and problem-solving strategies (Paulson et al., 2004). The hydrosocial cycle has been developed through work in political and argues that the previous

dominant paradigm of water as a 'natural resource' to be 'managed' by experts for economic development ignores important social and political aspects that must be considered (Linton, 2014; Swyngedouw, 2009). The core premise of the hydrosocial cycle suggests there is a need to see water flows as combined physical and social process that are inseparable from one another (Swyngedouw, 2006). It suggests water resource management is an inherently political issue infused with power struggles, that must be explicitly recognised. This new way to view water has emerged due to the failings of previous approaches, and will be essential to address many of the pressing problems that face water governance.

The Murray Darling Basin (MDB) in Australia is a large river basin that exemplifies many of the issues mentioned above. Located in the south-eastern section of the country, the basin spans four different states and one territory (Figure 1), is home to more than 2.1 million residents, and sustains a number of different industries that all compete for water resource (MDBA, n.d.-b, n.d.-d, n.d.-f). Water governance within the basin is a complicated issue that involves multiple actors from the commonwealth level right down to the local level (Dare & Evans, 2017). Coordination of the many different actors is provided by an overarching governance body called the Murray Darling Basin Authority (MDBA); which is a commonwealth level, independent statutory agency. The MDBA coordinates actors through the Murray Darling Basin Plan, which is a piece of legislation that "guides governments, regional authorities and communities to sustainably manage and use the waters of the Murray–Darling Basin" (MDBA, n.d.-g).

The complexity of management in the MDB has often led to conflicts between different actors within the basin. One particular example of this that is currently occurring, and is the topic of this thesis, is the conflict surrounding the decision to build the 'Broken Hill Pipeline'. Once operational the pipeline will pump water 270km from the town of Wentworth to the town of Broken Hill to ensure water security for the businesses and residents of Broken Hill (NSW DPI, 2017b). The decision to build the pipeline was made by the NSW state government, however many local residents, the opposition government and many organizational representative bodies in the region have publically spoken out against it. The Broken Hill City Council has called for a moratorium on the pipeline, there have been a number of public protests and a petition with over 13,000 signatures on it was presented to state government in February 2018 (Brewster, 2017; Ellicott, 2018; Hannam, 2018; Neales, 2018).

Figure 1. Shows the Murray Darling Basin in south east Australia. The basin is comprised of twenty-two sub catchments and spans four states and the ACT. Locations of the towns of Broken Hill and Wentworth are shown with red stars. Source: adapted from (MDBA, n.d.-b).

1.1 Aim and research questions

This thesis aims to investigate what aspects have led to the conflicts that have surrounded the decision to build the Broken Hill Pipeline through a hydrosocial cycle analysis. It investigates the planning and decision-making process that was adopted by the NSW state government and engages local stakeholders to get their perspective around what has caused the controversy. A key aim of the thesis

is to identify potential leverage points to change future governance approaches for more sustainable water management within the MDB. In particular, I ask three research questions:

RQ1. Did the decision-making process adopted by the NSW State Government comply with the core governance principles advocated for by the Murray Darling Basin Authority and what were the motivating reasons for the pipeline decision?

RQ2. Do local stakeholders agree the process occurred as officially published by the NSW state government and what have been their major complaints about the project?

RQ3. Based on the complaints identified in RQ2, what aspects should have been addressed by the Murray Darling Basin Authorities' core governance principles and what aspects need further consideration?

The structure of this thesis and the research questions is visualised in Figure 2. RQ1 takes a top down approach by looking at official documents of the planning and decision-making process behind the Broken Hill Pipeline, and compares these to the core governance principles supported by the MDBA. RQ2 takes a bottom up approach by engaging local stakeholders, finding out their concerns then relating them up to bigger governance structures. Finally, RQ3 has a future focus, looking for potential leverage points for sustainable pathways moving forwards.

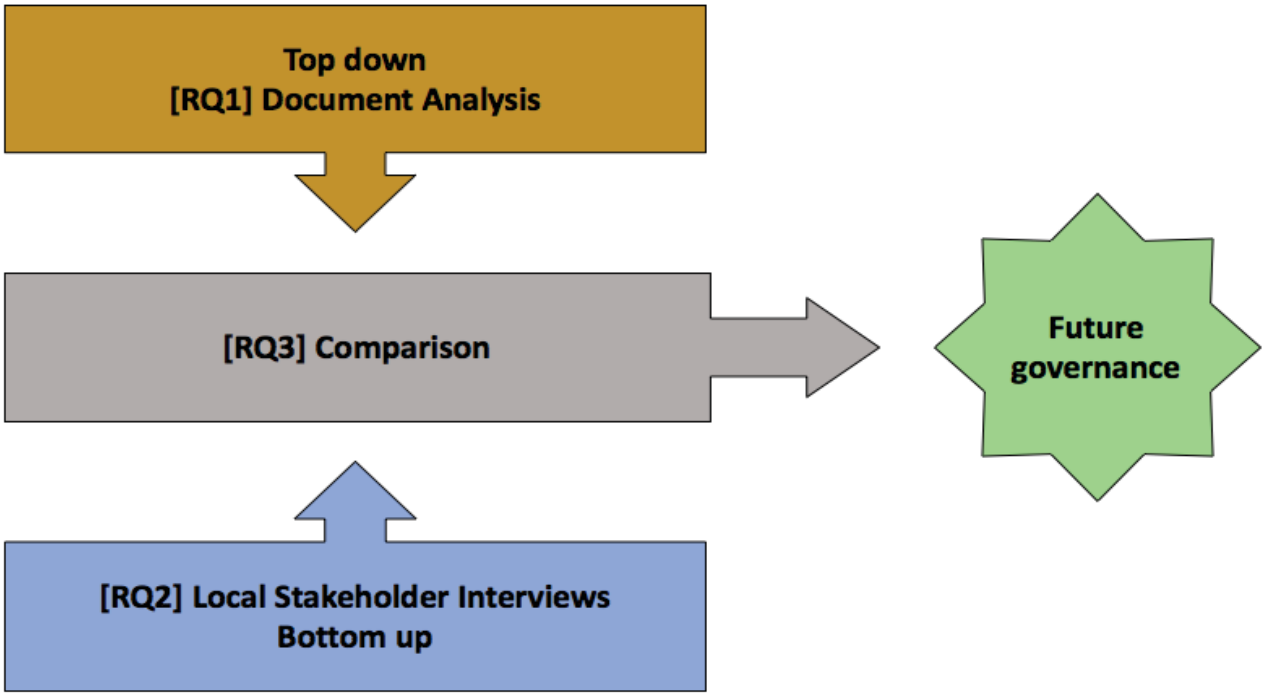

Figure 2. Visual representation of the research questions and the research process. Source: (own illustration, 2018).

2) Background information

2.1 The Murray Darling Basin

2.1.1 Geography

The MDB is the largest river basin in Australia which covers an area of more than 1 million square kilometres (around 14% of Australia's total land surface) in the south east of the country (Figure 1) (MDBA, n.d.-d). The basin spans four different states and one territory, and is made up of 22 major sub-basins, including Australia's three longest rivers (MDBA, n.d.-e). Around 2.1 million residents live within the basin, and water resources from the basin supply another 1.3 million people living outside the basin (MDBA, n.d.-f). The basin also contains almost 50 Aboriginal Nations who have lived in the region for more than 40,000 years and have significant spiritual, cultural, environmental and social connections to the land (MDBA, n.d.-a).

2.1.2 Climate

The size of the basin means the climate varies spatially. The northern section is classified as sub-tropical, the western section is semi-arid, and the southern section is largely temperate (MDBA, n.d.-c). The alpine region to the east of the basin accounts for only 5% of the land area yet contributes more than 50% of runoff to the basin (CSIRO, 2008). Evaporation rates in the basin are generally very high, and potential evapotranspiration averaged over the whole basin is 1'176mm/year (MDBA, n.d.-c). This means that 94% of the rainfall that falls in the basin is lost through evapotranspiration (MDBA, n.d.-c). Weather patterns are also highly variable from year to year, all of which make water availability an issue. Climate change in the MDB has also been predicted to increase evaporation rates across the whole basin and decreased rainfall in south eastern regions (CSIRO, 2008; Dunlop & Brown, 2008). The net result of this is a predicted 2% to 22% reduction in runoff for the southeast section of the basin (Dunlop & Brown, 2008). All of these factors are putting increasing pressure on water resources and competing water users.

2.1.3 Industry

Agriculture is one of the major economic activities in the basin which uses up substantial land and water resources. Grazing, dryland agriculture and irrigated agriculture take up around 84% of the total

land area, and irrigated agriculture alone uses more than 80% of the basins water resources (MDBA, n.d.-d). Farming in the basin accounts for 35-40% of the gross value of agriculture in Australia, and makes up around 15% of GDP of the basin (MDBA, n.d.-d). Mining and tourism are two other important industries in the basin, and numerous towns such as Broken Hill have been founded around mining activities.

2.1.4 Water management

Historical management

Water management in the MDB has gone through four main stages of development. Initially, water rights were largely tied to property rights and landholders could extract as much water as they liked as long as it did not impinge other riparian landholders (Settre & Wheeler, 2015). At this stage water was largely seen as a resource for individual use by landholders. Following federation of the states in 1901, water shifted to be seen more as a commodity and means of economic expansion and development (Settre & Wheeler, 2015). Individual states started building large infrastructure projects to advance regional development with little concern for other states (i.e. upstream and downstream users) which soon led to conflicts (Settre & Wheeler, 2015). The first multi-state water trading agreement was signed in 1915, however this had little effect. The third major shift did not appear until the late 1900's when concerns about the environment emerged. This led to the introduction of water markets as a management approach that allowed water to be allocated specifically for environmental purposes. This also saw decoupling of water licences from property right (Alston, Whittenbury, Western, & Gosling, 2016; Smith & Pritchard, 2014).

Current management

The most recent shift in governance has seen a shift to a more 'top down' water reform approach. In 2007 legislation was passed that required the formation of the MDBA, a commonwealth level, independent statutory agency, responsible for overseeing integrated and sustainable management of the basin (Alston et al., 2016). Although the MDBA can be seen as a top down governance body, it advocates for cooperation between member states and community engagement in decision-making, so in a sense it can also be viewed as a more diffuse or integrated form of governance (Alston et al., 2016). The MDBA is responsible for planning of the basins water resources, however it requires

involvement of state-level governments (who still legally have rights to water[1]) to both implement and fund action. This can become problematic as it gives states veto powers to undermine the formal agreed upon rules of water governance (Dare & Evans, 2017).

As the overarching governance organization, the MDBA sets the big picture goals for management of the basin through the 'MDB Plan'. In principle, the plan is designed to facilitate multipartisan agreement between the five basin state governments, regional water authorities and communities to work together in managing the basins water resources (MDBA, n.d.-g).

Each year the MDBA publishes an annual report outlining progress on the MDB Plan, and where efforts need to be focused moving forwards. Because the plan is flexible, and is open to revisions, annual reports provide the most up to date information on the current status of the plan. The annual reports measure performance against five strategic goals that are the focus of governance within the basin (MDBA, 2017). Table 1 shows these five strategic goals and the main aims of each goal from the 2016-17 annual report.

Although these strategic goals have been set by the MDBA, achieving these goals requires joint cooperation of the many different players who influence water management (Dare & Evans, 2017). These players include various stakeholders from a range of scales representing interests from the international arena right through to a regional and local level. Figure 3 gives an overview of the multiple players that influence the implementation of the MDB Plan. These organisations are all run and influenced by many different actors including bureaucrats, service professionals, political parties, private contractors, businessmen, community groups etc., many of whom have competing interests (Dare & Evans, 2017). This compartmentalization of responsibilities by different actors with different priorities makes water management a very complicated issue.

[1] Each state has different rules over water rights. In some states water rights are the personal property of the water user and in others they are owned by the state. In NSW (the state Broken Hill and Wentworth are located in) "All rights to the control, use and flow of waters in rivers, lakes, aquifers and water conserved by works under the control of the Minister and all water occurring naturally on or below the surface of the ground are vested by statute in the State. Basic rights are vested by statute and allow a person to take water for stock and domestic purposes." (Productivity Commission, 2003, p. 70)

Table 1. Shows the five strategic goals of the MDBA presented in their 2016-17 annual report. Source: data from (MDBA, 2017).

Strategic Goals	Aims
Goal 1: Lead the implementation of the Basin Plan to achieve a healthy working Basin	Implementing the Basin Plan will lead to a healthy working Basin and deliver: • Communities with sufficient and reliable water that is fit for a range of intended purposes, including domestic, recreational and cultural use. • Productive and resilient water-dependent industries and communities with confidence in their long-term future. • Healthy and resilient ecosystems with rivers and creeks regularly connected to their floodplains and ultimately the ocean.
Goal 2: Strengthen engagement with the community	Sustaining a healthy working Basin relies on effective engagement with the community to build relationships, identify common interests and local knowledge, implement policy, administer governance and manage the river system and its assets.
Goal 3: Evaluate and report the social, economic and environmental outcomes of Basin water reforms	Continued tracking the implementation and outcomes of Basin water reforms. Measuring the effect of the reforms is essential to understand whether intended outcomes are being achieved, identify problems as they arise and to adjust management practices (adaptive management). This transparent approach to monitoring and reporting is fundamental to gain community confidence in the implementation process and support the reforms in the future.
Goal 4: Operate the River Murray system efficiently for partner governments	The MDBA in partnership with Basin governments will ensure the efficient, cost effective and transparent governance and delivery of the joint programs, to safeguard the sustainable use of the Basin's water resources in a manner that protects the environment, as well as benefits the communities and industries that depend on it.
Goal 5: Improve the knowledge base to support sustainable water resource management	To support sustainable water resource management across the Basin, we recognise that knowledge, data and evidence is crucial in assisting with Basin Plan implementation and reviews, River Murray operations as well as informing policy and decision makers.

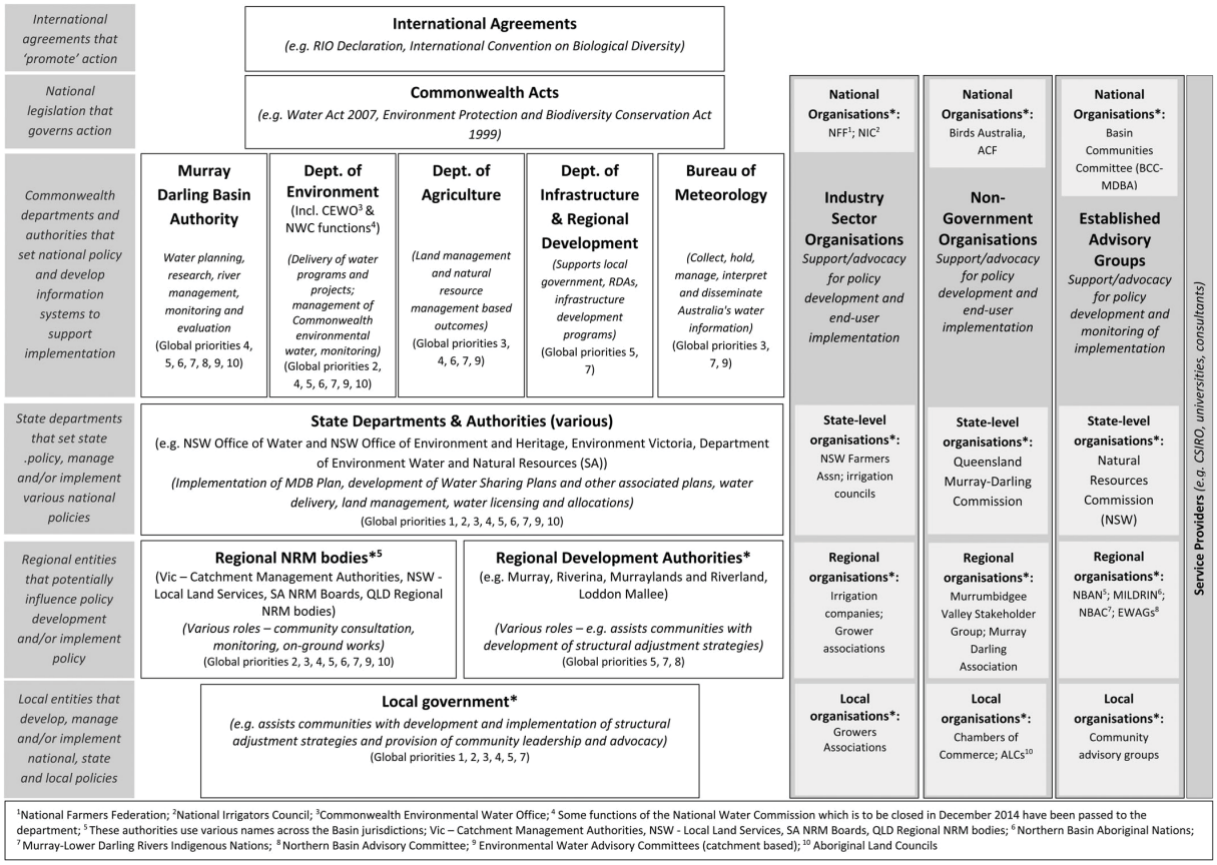

Figure 3. The multiple players that influence the implementation of the MDB Plan. Source: (Dare & Daniell, 2017).

2.2 Broken Hill

2.2.1 History and past water supply problems

The first sizable European settlement in Broken Hill was established in 1883; when what turned out to be the largest silver and lead ore body in the world was discovered (BHCC, n.d.). Its discovery spurred a massive influx of workers to the town and other subsequent nearby discoveries resulted in a mining boom in the region. By 1905 Broken Hill had a population of more than 30,000 people (the majority of whom worked in or were associated with the mines) (HO & DUAP, 1996). Since these times, the population of Broken Hill has fluctuated (largely in line with mining activity), peaking in the 1960's at around 33,000 but has steadily been decreasing since to its current population of around 17,000 (WRI, 2016).

The Region of Broken Hill has an arid climate with an average rainfall of only 260mm/year and a potential evaporation rate of 2,335mm/year (BOM, 2015a). Two local water storages, Stevens Creek Reservoir (completed in 1892) and Umberumbica reservoir (completed 1915) often ran dry when large

droughts hit the region and a number of times water had to be trained into Broken Hill, including an eight-month period in 1951/52 when more than 500 million litres of water was delivered by rail (*Flashback of Events in Broken Hill*, 2001). This resulted in the construction of the current water supply system, a pipeline from the Menindee Lakes (located on the Darling River) which was completed in 1952 and was supposed to be the end of Broken Hills water problems for good.

2.2.2 Current water supply problems

The Millennium Drought, which lasted between 1997 to 2010 (BOM, 2015b) saw record low rainfalls across much of southeast Australia (Figure 4). This period coincided with the lowest inflows in recorded history entering the Menindee Lakes (Broken Hill's main water supply) (Figure 5) and increased concerns about Broken Hill's future water security (NSW DPI, 2017a). Off the back of this and another dry period starting in 2013, a short-term emergency solution including a reverse osmosis plant and bore field development was approved in May 2015 which extended water supply in Broken Hill (at the time) until April 2019 without substantial rainfall (NSW DPI, 2017b). These solutions however were seen as short-term.

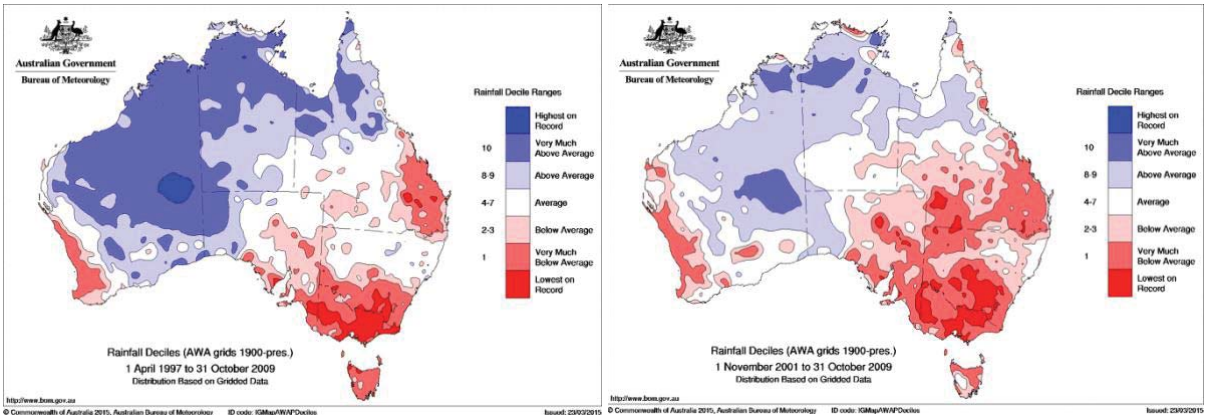

Figure 4a (left) & 4b (right). Show rainfall deciles (a) for the entire Millennium Drought from 1st April 1997 to October 2009 (b) for the worst period of the Millennium Drought from November 2001 to October 2009. As you can see much of south east Australia experienced below average rainfall especially in the MDB and Broken Hill region. Source: (BOM, 2015b).

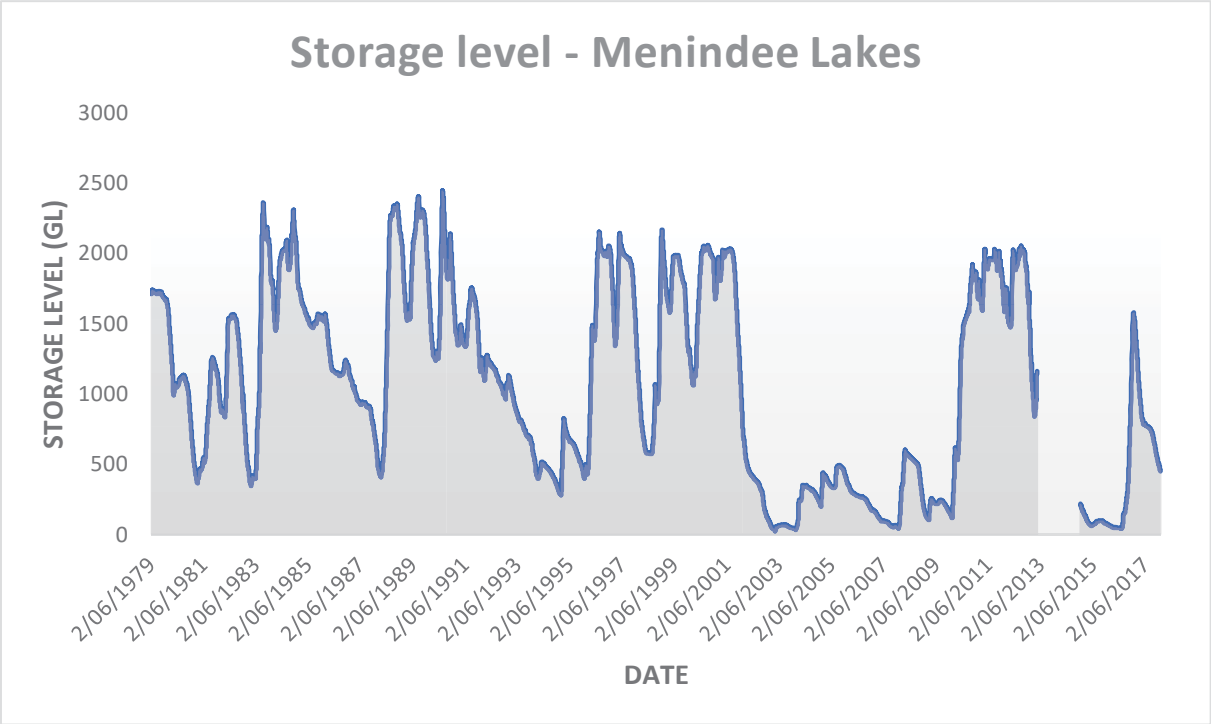

Figure 5. Menindee Lakes combined storage level in GL from 1979 to 2017. Data shows proplonged low levels between 2001 and 2009 during the worst period of the Millennium Drought. Data is missing from the 11/04/2013 to the 5/12/2014. Source: (own illustration, data from (MDBA, 2018)).

2.3 Decision to build the pipeline

The NSW Government decided it needed to do something to secure water resources for Broken Hill long-term (NSW DPI, 2017b). This decision was guided by recent drought conditions, that at the time of the proposal had been the longest on record, as well as long term climate data from the region (NSW DPI, 2017b). The data showed that over the past century Broken Hill has exceeded the NSW Government guideline targets for the amount of time spent in drought restrictions as well as the percentage of years drought restrictions have been in place by around 400% (NSW DPI, 2017b). This pushed the government to come up with a longer-term water supply solution. A long list of nineteen preliminary options was compiled, which was later reduced to four potential options that met regulatory threshold criteria. These four shortlisted options then underwent extensive expert analysis which resulted in the pipeline solution being chosen as the best option (NSW DPI, 2017b).

3) Theoretical approach

I use two theories to position this study: 1) political ecology and 2) the hydrosocial cycle, which are outlined in sections 3.1 and 3.2 respectively. These two theoretical approaches are very closely connected and are aimed at linking social and environmental problems to deal with real life complex problems such as the Broken Hill Pipeline case. My ontological position in this thesis is that of social-institutional constructivism, which is introduced and justified in section 3.3.

3.1 Political Ecology

Political ecology first emerged as an attempt to link the social and physical sciences to address environmental degradation, conflicts and problems (Paulson et al., 2004). Although different authors have provided different definitions of political ecology through time, almost all definitions centre around changes in socio-environmental systems, often with explicit consideration of power relations (Robbins, 2011). Political ecology differs from traditional apolitical views by arguing that environmental problems are always contextual and political in nature and cannot be thought of outside of this (Robbins, 2011). Because of this view, many have called for 'practical engagement with different stakeholders' to understand how socio-environmental problems are impacted by economic and political structures as well as discursive and cultural constructions of the environment (Paulson et al., 2004, p. 31).

Another strength of political ecology that aligns well with sustainability science and this thesis, is that it critically questions assumptions behind decision making (Forsyth, 2004). By doing this political ecology helps to uncover winners and losers, underlying motivations and tensions that subsequently arise (Forsyth, 2004). This is highlighted by Robbins (2011) in his 'five big themes' of political ecology, or, in other words, five areas where research in political ecology is often applied. One of these themes is the 'environmental conflict and exclusion thesis' that states "Increasing scarcities produced through resource enclosure or appropriation… [by certain actors] accelerate conflict between groups [...] Similarly, environmental problems become "socialized" when such groups secure control of collective resources at the expense of others…" (Robbins, 2011, p. 22). My thesis uses this claim to guide investigations into what has caused the conflict seen in Broken Hill surrounding the construction of the water pipeline.

Finally, from its early stages political ecology has been analytical, normative and applied in nature (Paulson et al., 2004), which aligns it well with sustainability science and this thesis.

3.2 The hydrosocial cycle

The hydrosocial cycle is a theoretical approach that has emerged from political ecology investigations, but is focused around water. Linton and Budds (2014) state "We propose the hydrosocial cycle as an analytical tool for investigating hydrosocial relations and as a broader framework for undertaking critical political ecologies of water" (p.170). For this reason, I have adopted the hydrosocial cycle to further guide my investigation of the Broken Hill Pipeline.

The central premise of the hydrosocial cycle is the idea that water circulation is always determined by combined social and physical process, which impact one another and cannot be thought of in isolation. As Swyngedouw (2009) states, water circulation is seen as "a hybridized socio-natural flow that fuses together nature and society in inseparable manners" (p.56). This is supported by research that has shown water use, water management and socio-political organizations as well as social change are all interlinked and influence one another (Norgaard, 1994 as cited in Swyngedouw, 2009).

A second core aspect of the hydrosocial cycle is the idea that "Hydraulic environments are socio-physical constructions that are actively and historically produced" (Swyngedouw, 2009, p. 56). This means hydrosocial analysis should consider both the current and past socio-technical and socio-ecological conditions that have led to current conditions.

Thirdly, hydrosocial analysis insists that power relations are an important aspect to investigate and are infused in water governance decisions (e.g. Linton & Budds, 2014; Swyngedouw, 2006, 2009). Swyngedouw (1999) shows how each individual techno-social system (including dams, canals, pipes etc., as well as the agents who operate them) displays how social power is distributed through society.

Finally, Linton and Budds (2014) have called for hydrosocial research to look at how different actors view water resources, and the discourses around what water should be used for (also commonly referred to as 'frames'). Frames determine how an actor gives sense to their physical and social worlds and are determined by factors including culture, social role and scientific training (Pahl-Wostl et al., 2007a).

Summing up, hydrosocial cycle investigations can be used to reveal the complex socio-environmental relationships (and infused power struggles) that often cause conflicts in water resource management. By examining these relationships, governance can address the underlying core drivers of conflicts, allowing for more sustainable future solutions.

3.3 Social-institutional constructivism

My ontological position of this thesis is what Robbins (2011) calls 'social-institutional-constructivism'. This form of constructivism is an approach often used in political ecology research that unlike 'radical' or 'hard' constructivism, does not discredit scientific knowledge or the idea of object reality, but rather acknowledges that social-biases can exist in scientific enquiry (Robbins, 2011). It argues that these social-biases explain why scientific facts are sometimes proved wrong. This view argues however, that over time through progressive scientific experimentation, social biases are removed from our understanding of nature, and science gets closer and closer to the objective reality (Robbins, 2011). In the case of Broken Hill, this ontological position accepts the strength of scientific investigation of water resources, such as hydrological modelling that has occurred as a part of the pipeline project, however it would not rely solely on this information as the absolute truth. The social-institutional constructivism position works well with a critical mode of inquiry, as it questions how 'factual' information is used for decision making and highlight the importance of social aspects that cannot be thought of separately but intimately related to natural science facts.

4) Contribution to Sustainability Science

Sustainability science is focused around the interactions between natural and social systems, and looks at how these interactions effect future sustainable pathways (e.g. Kates, 2011; Miller, 2013). It is focused on developing human systems that operate within environmental limits, and looks at how society can effectively guide socio-environmental systems (Kates, 2011; Kates et al., 2001). This thesis looks at a case study focusing on the interaction between the social system and natural water systems through a water resource management project in Broken Hill. More specifically, this thesis relates strongly to one of Kates (2011) seven major questions for future sustainability science research "How can society most effectively guide or manage human environment systems toward a sustainability transition?" (Kates, 2011, p. 19450).

This thesis is based around a problem-solving agenda which aims to produce knowledge, that could translate into action to address human needs, which is a core component of sustainability science (Clark, 2007; Miller, 2013). It takes a critical approach to sustainability science, questioning the decision and planning process that the NSW Government took in its choice to install a water pipeline to Broken Hill. As Jerneck et al. (2011) point out, critically questioning the conditions of unsustainability can open up the way for future sustainable pathways. Therefore, this thesis aims to provides background information that can be used and built upon in the future for effective governance strategies. Even though the case study is based in Broken Hill, knowledge from this thesis will be highly relevant for planning within the whole MDB, and may even be applicable in other similar situations around the world.

5) Methodology

5.1 Research design

This research project uses a qualitative research design, that is largely guided by a deductive approach (Bryman, 2012). A qualitative design was chosen as the project aims to understand a real-world complex situation that is intangible to investigate with purely quantitative data. The data sources I draw on for this investigation include both published government documents as well as interviews with local stakeholders. By using multiple data sources, I facilitate triangulation, which helps guard against single source bias (Patton, 1990) and is often used in qualitative research (Bowen, 2009). Secondly, as Atkinson and Coffey (2004) point out, documents construct a particular kind of 'document reality' through literary conventions, often presenting an 'organisational version of reality' that cannot always be taken as matter of fact. Therefore, by combining data sources I hope to avoid this bias.

5.1.1 Case study

This thesis uses a case study design, which Bryman (2012) describes as a "detailed and intensive analysis of a single case" (p.66). More specifically, I adopted what Creswell (2007) describes as a 'single instrumental case study' that focuses on an issue or concern and subsequently selects boundaries based on that issue. An instrumental design tries to find out theoretical explanations of a particular issues (Algozzine & Hancock, 2006), which in this thesis is a hydrosocial cycle explanation of the conflicts that surrounded the Broken Hill Pipeline. Hence boundaries for the case study were set to the pipeline project, and the major stakeholders affected by it (see section 5.1.3 for stakeholder identification). The case study also follows a descriptive approach, which attempts to describe a 'phenomenon within its context' (Algozzine & Hancock, 2006, p.33).

Although the Broken Hill pipeline is a single case study, many of the aspects looked at such as the governance structure and the rationale behind decision-making process are relevant to other cases. In particular information gained from this investigation will be applicable to other water infrastructure projects carried out within the entire Murray Darling Basin. The broader governance aspects will also be applicable to other cases on a larger scale. As Kingsford, Roux, McLoughlin, and Conallin (2017) point out, the need for effective management, particularly in intermittent water regimes, is increasing worldwide, however effective management is still lacking in many cases. Therefore, lessons learnt from this case study could have potential relevance at a much larger scale. As outlined by Creswell (2007),

a case study examines a specific example with the intent of examining a bigger issue, which in this thesis is effective water governance in water scarce regions.

5.1.2 Document analysis

A document analysis was performed to answer RQ1. Relevant documents were searched for on the NSW Department of Primary Industries (DPI), NSW Water and, general NSW Government websites. NSW DPI and NSW Water were the two government agencies responsible for delivering the project and the general NSW Government website covers broader media releases that were related to the pipeline project. The phrase "Broken Hill Pipeline" was entered into the search bar on each website on the 28th February 2018, and all results that related to the project were downloaded. In the end, 18 files were identified as relevant to the planning and decision-making surrounding the pipeline project, all of which were official NSW Government publications (Table 2). These documents were then analysed using content analysis methods based on Bryman (2012, pp. 288 - 308). Content analysis is a method that "seeks to quantify content in terms of predetermined categories and in a systematic and replicable manner" (Bryman, 2012, p. 289). In this case, documents were analysed to determine how the planning and decision-making process officially described by the NSW Government aligned with the MDBA core governance principles.

As mentioned previously MDBA annual reports provide the most up to date information regarding the basin plan development, and where current governance is focused against five strategic goals. Because many of the strategic goals are quite broad, and cover multiple aspects, I identified eight core governance principles that compose them, which are used as more concrete core governance principles throughout the rest of this thesis (Table 3). All documents in the document analysis were read in their entirety and relevant sections of the text were coded (i.e. highlighted) in different colours representing the eight core governance principles. A ninth category of '*other aspects that motivated the NSW decision to build the pipeline*' was also coded for. Following coding, the highlighted text was extracted and compiled into an excel spreadsheet for further analysis.

Table 2. Documents analysed and their relevance to the project.

Document Type	Document References	Relevance
Media releases	(Brennan, 2016; Catorall & Fowler, 2017; "Government shortlists water security options for Broken Hill," 2015; "Local business opportunities on pipeline project," 2017; McCarthy, 2014; "Rebuilding NSW: Broken Hill a high priority for water security funding," 2016; "River Murray to Broken Hill pipeline contract awarded," 2017)	Media releases were all officially published by the NSW Government and gave insights into the project from various politicians that may not have been documented in other reports.
Fact sheets	(NSW DPI, 2016a, 2016b, 2017a; NSW Governmnet, 2015; Water NSW, 2017a, 2017b, 2018)	Fact sheets included community updates and general information sheets published about the project. These were aimed at the general public and gave general information and updates throughout the process.
Multimedia	(NSW DPI, 2015)	This PowerPoint Presentation was presented at the initial planning stage before the pipeline had been decided on and shows aspects of the early planning stages.
Reports	(NSW DPI, 2017b; NSW Public Works Advisory, 2017; Warne, 2017)	These reports give much more detail about the project and cover many of the planning and decision-making processes. They cover aspects including public engagement strategies, identify all official partner organizations and give more detailed outlines and justifications for the planning and development of the project.

Table 3. Shows the five strategic goals of the MDBA and the core governance elements that compose them. The 'strategic goals' and 'aims' were taken directly from the MDBA 2016/17 annual report and the core governance principles are my personal interpretation, which is what the colours represent. Source: data from (MDBA, 2017).

Strategic Goals	Aims	Core Governance Principles
Goal 1: Lead the implementation of the Basin Plan to achieve a healthy working Basin	Implementing the Basin Plan will lead to a healthy working Basin and deliver: ☐ Communities with sufficient and reliable water that is fit for a range of intended purposes, including domestic, recreational and cultural use. ☐ Productive and resilient water-dependent industries and communities with confidence in their long-term future. ☐ Healthy and resilient ecosystems with rivers and creeks regularly connected to their floodplains and ultimately the ocean.	☐ Multiple water uses – domestic, recreational, industrial and cultural. ☐ Productive, Healthy and resilient communities and ecosystems long term.
Goal 2: Strengthen engagement with the community	Sustaining a healthy working Basin relies on effective engagement with the community to build relationships, identify common interests and local knowledge, implement policy, administer governance and manage the river system and its assets.	☐ Community engagement and use of local knowledge.
Goal 3: Evaluate and report the social, economic and environmental outcomes of Basin water reforms	Continued tracking the implementation and outcomes of Basin water reforms. Measuring the effect of the reforms is essential to understand whether intended outcomes are being achieved, identify problems as they arise and to adjust management practices (adaptive management). This transparent approach to monitoring and reporting is fundamental to gain community confidence in the implementation process and support the reforms in the future.	☐ Triple bottom line approach. ☐ Ongoing monitoring and adaptive management. ☐ Transparency in monitoring and reporting.
Goal 4: Operate the River Murray system efficiently for partner governments	The MDBA in partnership with Basin governments will ensure the efficient, cost effective and transparent governance and delivery of the joint programs, to safeguard the sustainable use of the Basin's water resources in a manner that protects the environment, as well as benefits the communities and industries that depend on it.	☐ Efficient, cost-effective, joint government and governance programs.
Goal 5: Improve the knowledge base to support sustainable water resource management	To support sustainable water resource management across the Basin, we recognise that knowledge, data and evidence is crucial in assisting with Basin Plan implementation and reviews, River Murray operations as well as informing policy and decision makers.	☐ Improving knowledge base.

5.1.3 Interviews

Stakeholder interviews were conducted in order to answer RQ2. Interviewees were selected through a purposeful sampling method described by Teddlie and Yu (2007, as cited in Bryman 2012) as 'sequential sampling'. This approach to sampling involves selecting an initial sample by the researcher based on the research questions, then adding to the sample as the investigation evolves (Bryman, 2012). In this case I initially identified key stakeholders as local government, indigenous, business, industry and local action groups. This was informed by background research about the project as well as a previously completed socio-economic profile of Broken Hill (see WRI, 2016). This list changed however, once I arrived at the study site and gained more local knowledge. The final stakeholder list included representatives from state government, local government, business, tourism, local resident overview, pastoralists, indigenous, local action groups and vocal supporters of the project. Individuals selected to represent each stakeholder group were chosen because it was felt their positions provided them with knowledge and experience to represent the general views of each group. Table 4 shows these different stakeholder groups, why they were chosen and the individuals who represented each group.

I conducted nine interviews with local stakeholders in Broken Hill, between the 9th and the 20th of February 2018, that lasted for between forty and ninety minutes. The interviews followed a semi-structured process to allow for a guided discussion, covering key aspects, but also giving scope and freedom to explore any topics of relevance that arose during the conversation. This flexibility allowed participants to guide the interview to aspects they found important or relevant that may have been missed by a more structured approach (Bryman, 2012). Appendix A shows the interview guide that was used.

During the interviews, I also used a number of visual aids, which have been shown to help elicit responses about certain aspects more clearly (McIntosh & Morse, 2015). This included showing participants a number of diagrams about the decision-making process, a scale of public participation and the current governance structures operating in the MDB (Appendix A). I often referred back to these diagrams throughout the interviews and asked interviewees to annotate them when appropriate.

All interviews were recorded and directly transcribed personally using the online transcription program Transcribe.wreally.com. The transcripts were then analysed using methods based off Burnard (1991). These methods are similar to those used in the document analysis involving coding and extraction, however categories for coding were not pre-defined by the research question. Instead open coding

was first used where the transcripts and any associated research notes were read through, and numerous headings written down to describe all the relevant material. These initial headings were then grouped by combining similar categories into a manageable number of higher level headings that could then be used for detailed coding and extraction (see Burnard (1991) for more detail). Extracted material was compiled into an excel spreadsheet.

For all interviews, the ethical guidelines outlined by Bryman (2012, pp. 135 - 147) were followed, which included not causing harm to participants, getting informed consent, not invading privacy and making sure not to deceive participants. I took measures including asking for consent to perform and record the interviews, explaining there would be no liability from any answers provided, allowing participants to skip any questions they did not feel comfortable answering and asking how they wanted to be identified in this thesis. Going one step further I chose to keep all participants anonymous (even if consent was given to use their name) and where participants may be identifiable from their position, I made sure they were happy to be represented through these titles.

Table 4. Shows the different stakeholder groups, the representatives that were selected from each group and the justification for their inclusion.

Stakeholder Group	Representative	ID	Justification
State government	Senior representative of local state Member for Parliament.	[SG]	Represents the State Government who have been advocate supporters of the project and are supposed to represent broader region interests.
Local government	Broken Hill mayor.	[LG]	The local mayor is supposed to represent the local community and be up to date on local sentiment.
Business	Local business advisor.	[B]	Representative of Business Enterprises Centre (a government affiliated, not for profit business advisory organization) who collaborate with many local businesses. The representative was also a chair person of Destination Broken Hill (tourism).
Tourism	Local tourism business operator.	[T]	Runs a local tourism business and also works at the tourist information office in town.
Local resident overview	Local ABC news reporter.	[LR]	Has been covering the pipeline project for the past 2 years, looking at all perspectives on the project.
Pastoralists	President of the Pastoralists' Association of West Darling.	[P]	The organization is the peak representative body for pastoralists who are the biggest land holders in the region.
Indigenous	Chairperson of the Murdi Paaki Regional Assembly.	[I]	Murdi Paaki Regional Assembly is a peak body that represents the interest of Aboriginal and Torres Strait Islander people in 16 communities across Western NSW.
Local action group	Founding member of two local action groups.	[AG]	Founding member or "Broken Hill / Menindee Lakes, We Want Action" and "Broken Hill Darling River Action Group" which are two of the biggest and most vocal groups opposing the pipeline construction.
Vocal supporter	Ex-mayor of Broken Hill and active supporter of the pipeline.	[S]	An active supporter of the pipeline who has close connections to the community as ex-mayor and claims that he knows of a number of supporters of the project that are afraid to speak up about it.

5.2 Limitations

Firstly, interviewees were taken from a range of different local stakeholder groups and were selected as representatives for larger circles of the community. Although I explained to interviewees I wanted the general view of the stakeholders they represented, it is hard to tell how well this was captured. It is unlikely that each stakeholder group identified would have homogenous views on the topic and individuals selected may not completely represent the bigger picture of their stakeholder group. I felt however, with the time and resources available, covering a larger variety of different stakeholders would give me a better understanding of the problems than trying to obtain multiple views from within the same stakeholder group. The relatively small sample size must be kept in mind when interpreting the results.

Secondly, due to the scope of this research, I was unable to extend my analysis to surrounding communities that may be affected by the pipeline decision. Wentworth, Menindee, Pooncarie, Sunset Strip and Wilcannia were also identified as communities that may be impacted by the decision to build the pipeline, however I was unable to visit and interview stakeholders from all of these sites.

Thirdly, the mining industry was identified through my background research as a potential stakeholder, however no representative of this group was willing to have an interview.

One other aspect that must be considered is that this thesis is investigating an ongoing project. Views gathered were current as of February 2018, however future processes may change. Further changes in the development of the pipeline may occur which could impact some of the views expressed and conclusions drawn in this thesis.

6) Results

6.1 RQ1

Did the decision-making process adopted by the NSW State Government comply with the core governance principles advocated for by the Murray Darling Basin Authority and what were the motivating reasons for the pipeline decision?

The document analysis revealed varying degrees with which the NSW Government covered the core governance principles of the MDBA in the decision to build the pipeline. Two of the principles were comprehensively covered, four were reasonably covered, and two were poorly covered (Figure 6). The rationales for these assertions are summarised in Table 5, and section 6.1.1 provides detailed evidence from the document analysis in support. Section 6.1.2 provides other factors that were used by the NSW Government to motivate the decision.

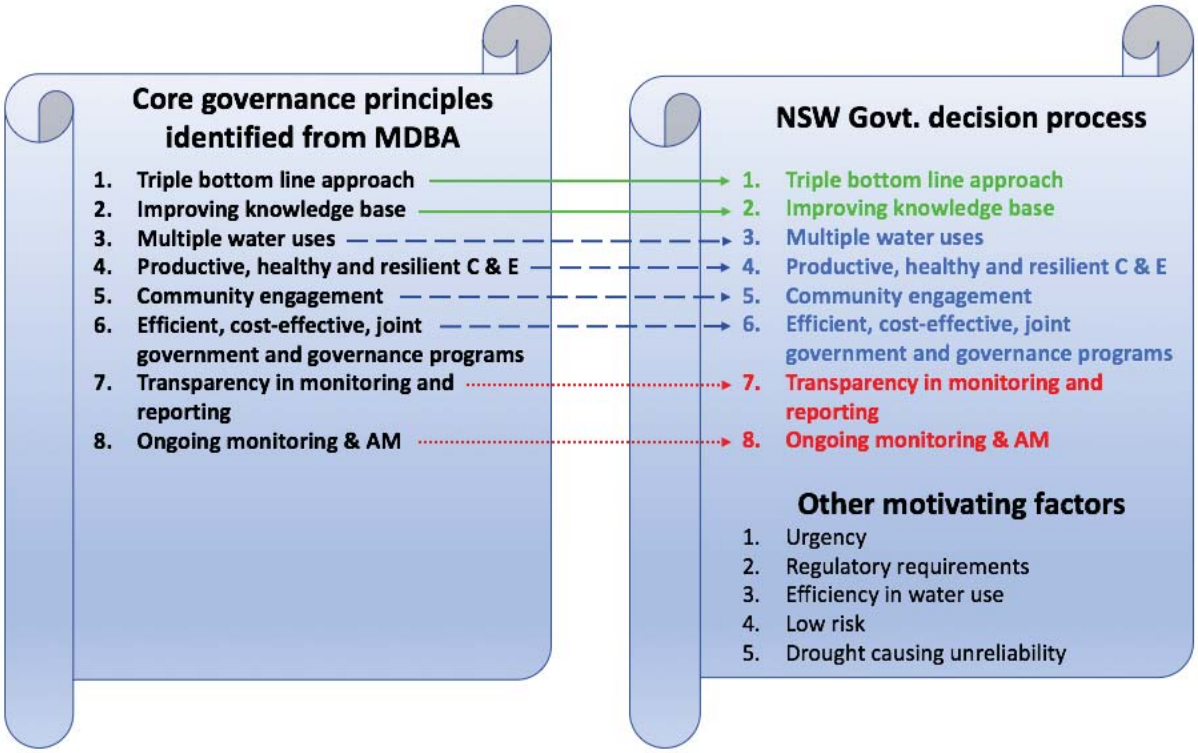

Figure 6. Comparison of the core governance principles identified from the MDBA's 2016-17 annual report with the process adopted by the NSW Government. The figure shows that all of the MDBA core governance principles were addressed by the NSW Government in the planning and decision-making process however to varying degrees. Green arrows show comprehensive coverage, Blue arrows show reasonable coverage but with some key aspects missing and Red arrows show limited coverage. Table 5 provides further explanation of the categorization. Other factors that the NSW Government used to motivate the decision are also shown. Source: (own illustration, 2018).

Table 5. Displays the eight core governance principles taken from the MDBA annual report and how well these were covered by the NSW Government in the decision to build the pipeline. Justifications for the level of coverage is also given.

Core governance principle	Level of coverage	Reasoning
1) Triple bottom line approach	Comprehensive coverage	The triple bottom line approach was a key selection criteria that led to the pipeline being chosen as the best option.
2) Improving knowledge base	Comprehensive coverage	Extensive expert analyses were conducted to inform the decision to build the pipeline including hydrologic, environmental and socio-economic analyses.
3) Multiple water uses – domestic, recreational, industrial and cultural	Reasonable coverage	Documents outlined consideration for domestic, recreational and industrial uses of water, however cultural use of water was not considered.
4) Productive, Healthy and resilient communities and ecosystems long term	Reasonable coverage	Healthy and resilient ecosystems were partly taken into account through the 'Review of Environmental Factors', however this was largely focused on the construction and operation impacts along the pipeline route. Larger considerations of the Darling River health were very limited. Healthy and resilient communities were initially considered quite extensively, however the project was re-scoped at a later stage to exclude the communities of Menindee and Sunset Strip.
5) Community engagement and use of local knowledge	Reasonable coverage	Community engagement was extensively documented with a number of different stakeholders. There was little evidence however of how this knowledge would be used to feedback into the project.
6) Efficient, cost-effective, joint government and governance programs.	Reasonable coverage	Efficient, cost effective joint programs was well documented, however there was little evidence of engagement with other governments regarding the pipeline decision.
7) Transparency in monitoring and reporting.	Limited coverage	Transparency was only mentioned once in reports relating to the evaluation process of the project. Information sharing (which could be interpreted as transparency) was mentioned only a couple of times in regard to community involvement. There was no mention of transparency in monitoring and reporting post construction of the pipeline.
8) Ongoing monitoring and adaptive management	Limited coverage	The only ongoing monitoring for the project is to be completed by the construction contractor, and this only relates to the impacts identified in the 'Review of Environmental Factors'. The NSW Government is not conducting any other monitoring of its own. Adaptability was minimal and limited to construction details of the pipeline and there was little mention of any flexibility moving forwards.

6.1.1 Evidence of coverage

Triple bottom line approach

A triple bottom line approach was mentioned numerous times, relating to the planning of the project. For example, "Some 19 project options were analysed against strict economic, environmental and social criteria […] [the consideration] involved extensive economic, social, environmental and technical analysis to ensure that only options that were feasible were taken forward." (NSW DPI, 2017a, pp. 1 - 2). Furthermore, the pipeline was reported to perform well on all measures "The recommended option also performs well on social, environmental and economic sustainability assessments." (NSW DPI, 2017b, p. 16).

Improving knowledge base

The decision to build the pipeline was based on a large amount of expert analysis including socio-economic profiling, hydrological security modelling, hydrogeological feasibility study, bore field design and construction cost estimates, geotechnical and water supply system option development and analysis, economic appraisal of options, market sounding and procurement options and water pricing impact analysis (NSW DPI, 2017b, p. 4; NSW Public Works Advisory, 2017, p. 222). Once the pipeline solution had been selected as the preferred option, environmental assessments and potential commercial opportunity assessments were also completed (NSW Public Works Advisory, 2017; Warne, 2017).

Multiple water uses – domestic, recreational, industrial and cultural

Multiple water uses were considered quite extensively in the planning process. The NSW Government commissioned a special report to investigate the potential opportunities to promote commercial activities along the length of the pipeline. Within this report multiple uses of water were considered including: 1) improved water security for Pooncarie (a small town between Wentworth and Broken Hill); 2) providing water for graziers along the pipeline; 3) horticulture development; 4) greenhouse development; 5) aquaculture development; 6) raw water for existing / new mining operations; 7) eco-tourism opportunities. "The proposed pipeline will be constructed […] with the aim of securing water for the recognised demand for domestic, industrial (including mining) and urban needs of the people of Broken Hill." (Warne, 2017, p. 5).

Recreational opportunities were also mentioned in relation to both Menindee Lakes and Broken Hill. “The pipeline project being delivered by WaterNSW has no impact on recreational access to the Menindee Lakes” (NSW DPI, 2017a, p. 3). It was claimed that recreation in Broken Hill would improve through benefits to sporting fields and household swimming pools (NSW Public Works Advisory, 2017, p. 226).

Limiting the full coverage of this governance principle, was the fact that cultural values of water were not taken into consideration. The documents showed that information about cultural significance was collected regarding the land on which the pipeline is to be built (NSW Public Works Advisory, 2017, p. 32); however, this was focused on construction impacts of the pipeline and there was no mention of water use for cultural activities, which is what the MDBA advocate for.

Productive, healthy and resilient communities and ecosystems long term

Healthy and resilient ecosystems were considered in the sense that the project conducted a Review of Environmental Factors (REF) to identify any potential impacts of the proposed pipeline construction. The review looked at potential impacts from sixteen different factors covering both the construction and operation of the pipeline and found that “Overall, potential impacts associated with the proposal are unlikely to be significant, of short duration and can be adequately managed by implementing the mitigation measures outlined in this REF” (NSW Public Works Advisory, 2017, p. vii). The review stated that “The operation of the River Murray to Broken Hill Pipeline Project is not expected to result in adverse impacts to the Menindee Lakes system [or] flows in the Darling River” (NSW Public Works Advisory, 2017, p. 165).

In terms of community benefits, documents had a large focus on the long-term sustainability of Broken Hill and the surrounding communities. “The government is determined to take the time to find acceptable, long term solutions that will provide a secure supply of fresh potable water to the families of Broken Hill and surrounding communities for decades to come.” (NSW Governmnet, 2015, p. 1). Key benefits of the project were identified to include positive economic impacts for the entire region (NSW Public Works Advisory, 2017, pp. 224 - 225), security for businesses in Broken Hill (Warne, 2017, p. 1), growth in the region, and communities with confidence in long term water supply (NSW Public Works Advisory, 2017, p. 60 & 260).

One limitation around this governance principle was that communities surrounding Broken Hill were excluded from consideration at a late stage in the project. “The Preferred Option was re-scoped to

exclude the surrounding communities of Menindee and Sunset Strip." (NSW DPI, 2017b, p. 5). There was also little mention about improving the health of the Darling River outside the quote above saying the project is "not expected to result in adverse impacts to […] flows in the Darling River" (NSW Public Works Advisory, 2017, p. 165).

Community engagement and use of local knowledge

Community engagement was a large part of the NSW Governments strategy and 12 out of the 18 documents, mentioned community engagement in some form.

> "A detailed Stakeholder Engagement Strategy has been developed for the project. The strategy has identified key stakeholders and provides for targeted, proactive stakeholder engagement, concentrated in the early stages prior to start of construction […] Targeted consultation was undertaken with a range of stakeholder groups over a 12-month period to evaluate the options and select the Preferred Option. During this period, nine stakeholders, including the community, business and government, were engaged through formal consultation forums, workshops, site visits, teleconferences and meetings." (NSW Public Works Advisory, 2017, p. 30 & 63).

Other community engagement strategies included a community information phone line and email, fifteen interviews with various stakeholders to understand the impacts of the project, establishment of a Local Representative Committee to facilitate information sharing and targeted aboriginal consultation (NSW Public Works Advisory, 2017, pp. 30 - 32).

While community engagement was well covered in the documents, feeding this information back into the decision-making process was rarely discussed, thus limiting the full adoption of this governance principle. Only two examples referring to using the community feedback were found including: "… a Stakeholder Engagement Strategy to guide the delivery of the preferred pipeline option." (NSW DPI, 2017b, p. 18) and "The committee will work to gain feedback to inform decisions on aspects of the project that affect the community" (NSW Public Works Advisory, 2017, p. 31). There was no mention of using community feedback in the selection process for the pipeline in the first place.

Efficient, cost-effective, joint government and governance programs

Efficient and cost-effective governance was highlighted multiple times e.g. "WaterNSW has been working hard to ensure that it delivers the lowest 'whole of life cost' solution that it can" (NSW DPI,

2017a, p. 5). 'Value for money' was also a performance criteria used to determine the preferred solution (NSW DPI, 2017b).

The goal of joint governance projects was also well adhered to as there were a number or different bodies included in the decision-making process.

> "Oversight for the Initiative was provided by a multi-agency Steering Committee, […] with representatives from the Department of Industry – Crown Lands and Water (the then DPI Water), NSW Treasury, Department of Premier and Cabinet (DPC), NSW Department of Planning and Environment (DPE) and Infrastructure NSW (as an Observer)." (NSW DPI, 2017b, p. 3).

Other agencies such as Essential water, local councils, Roads and Maritime Services, Office of Environment and Heritage as well as construction contractors and outside agencies providing reports were also involved (NSW Public Works Advisory, 2017).

The goal of joint government programs was poorly covered however and there was no mention of collaboration with other state governments outside of ongoing operations of the Menindee Lakes under the Murray Darling Basin Plan (Water NSW, 2017a, p. 2). There was no mention of collaboration in the planning and development of the pipeline.

Transparency in monitoring and reporting

The only specific mention of transparency found in the document analysis was in the following quote:

> "The NSW Government is committed to increasing the transparency of decision making in NSW. This summary brings together an extensive set of documentation into a more concise document to provide citizens of NSW with confidence that a robust evaluation process was undertaken to inform the investment." (NSW DPI, 2017b, p. 3).

It was mentioned a couple of times that information was shared during the selection and construction process "The community were kept informed throughout the selection process." (NSW DPI, 2017a, p. 2) and "The [local representative] committee will [meet regularly to] provide for ongoing information sharing on the delivery of the project." (Water NSW, 2017b, p. 2), which could be seen as transparency. There was no mention however of transparency regarding ongoing monitoring and reporting of the project post construction, which is a key premise of the MDBA and limits coverage of this governance principle.

Ongoing monitoring and adaptive management

The only mention of ongoing monitoring was found in the following quote; "The CEMP would also provide details on monitoring and verification for all identified mitigation measures." (NSW Public Works Advisory, 2017, p. 230). The Construction Environmental Management Plan (CEMP) has to be completed by the contracted construction company and only focuses on identified mitigation measures in the REF, hence the NSW Government has not committed itself to provide any other form of ongoing monitoring of the project.

In terms of adaptive management, it was mentioned that some design aspects of the project were altered due to findings of investigations "Further refinements to the project were also undertaken based on the findings of environmental and engineering investigations, and consultation with potentially affected stakeholders." (NSW Public Works Advisory, 2017, p. 67). No mention of ongoing or future adaptive management was found relating to the planning or operations of the pipeline. Also, the pipeline decision itself could be seen as contradictive to adaptive management that advocates for continually adjusting practices based on what is learned (Edalat & Abdi, 2017); however the pipeline will lock in current practices for the lifetime of its operation.

6.1.2 Motivating factors for the decision

Five main factors outside the core governance principles of the MDBA motivated the NSW Government's decision to build the pipeline including:

1) Urgency: the solution needed to be operational by the end of 2018
2) Need to meet requirements for:
    I. Peak daily consumption of 37.4 ML/day
    II. Water quality in line with Australian Drinking Water Guidelines
    III. Sufficient supply to meet NSW guidelines around water restrictions
3) More efficient supply than the current system
4) Lowest level of risk
5) Natural drought making current water supply unreliable

    (NSW DPI, 2017b)

6.2 RQ2

Do local stakeholders agree the process occurred as officially published by the NSW state government and what have been their major complaints about the project?

Local stakeholders held mixed opinions about how the planning and decision-making process actually occurred and if the documents published by the NSW Government were accurate or not. There were three different schools of thought ranging from largely in agreement, to partial agreement or lack of knowledge, to little or no agreement. Section 6.2.1 details interviewee responses in these three categories. Section 6.2.2 outlines key concerns that were raised by local stakeholders regarding the decision to build the pipeline. These concerns are characterised into six encompassing complaints that arose numerous times from different interviewees (Table 6). Detailed descriptions and quotations to support the complaints are provided.

6.2.1 Level of agreement with officially published process

Largely in agreement

Four of the nine interviewees were in complete or very high agreement with how the NSW Government officially described the process. This group included the **local news reporter [LR]**, the **indigenous representative [I]**, the **pro-pipeline supporter [S]** and the **state government representative [SG]**. These interviewees either agreed that every step occurred, or were largely in agreement with the process but may not have had complete awareness of one or two of the steps. Two of these interviewees (**[I]** and **[S]**) agreed that the process did occur as described, but expressed concerns about the openness and ease with which stakeholders could participate. The following section presents some of their comments and subtleties they expressed.

[LR]: When asked if she agreed with the published process said “yeah I was aware of all of that, yep and we covered that as the ABC online and the radio, so yeah I was aware of those.” When asked if she felt the general community were aware of the steps, she replied, “No they say that they haven't been, and that’s: one, maybe they haven't watch or listen to the news; and two, maybe they weren't consulted by the government you know as an individual... but I mean that definitely did happen because I reported them.”

[I]: “For me personally I have seen enough information around the Pipeline […] it's like everything Owen, if you have got an interest in something you will look it up and chase it up and find out a bit

more and you would notice a lot of people just accept what is in the news you know what I mean, what people are talking about in the pubs and clubs." This response suggests that the steps may have all happened, but the onus was on stakeholders to inform themselves and participate in the process.

[S] "I think all the stages took place, I was part of most of the stages I think they all took place. […] did New South Wales government and DPI and New South Wales Water release the information on the process and where they got the ideas from as well as they should have, probably not. I think that could have been a little bit more open". This view acknowledges that the process was conducted as described, but questions the openness of the process to the public.

[SG] Was also in agreement with the process, and when asked if all the steps occurred her response was simply "Yeah", later she went on to say "I think it was done properly… and it has been done over quite a period of time… so you know things, somethings have changed in there but um… yeah the opportunity has been there, everybody knows about it." Figure 7 was annotated by **[SG]**.

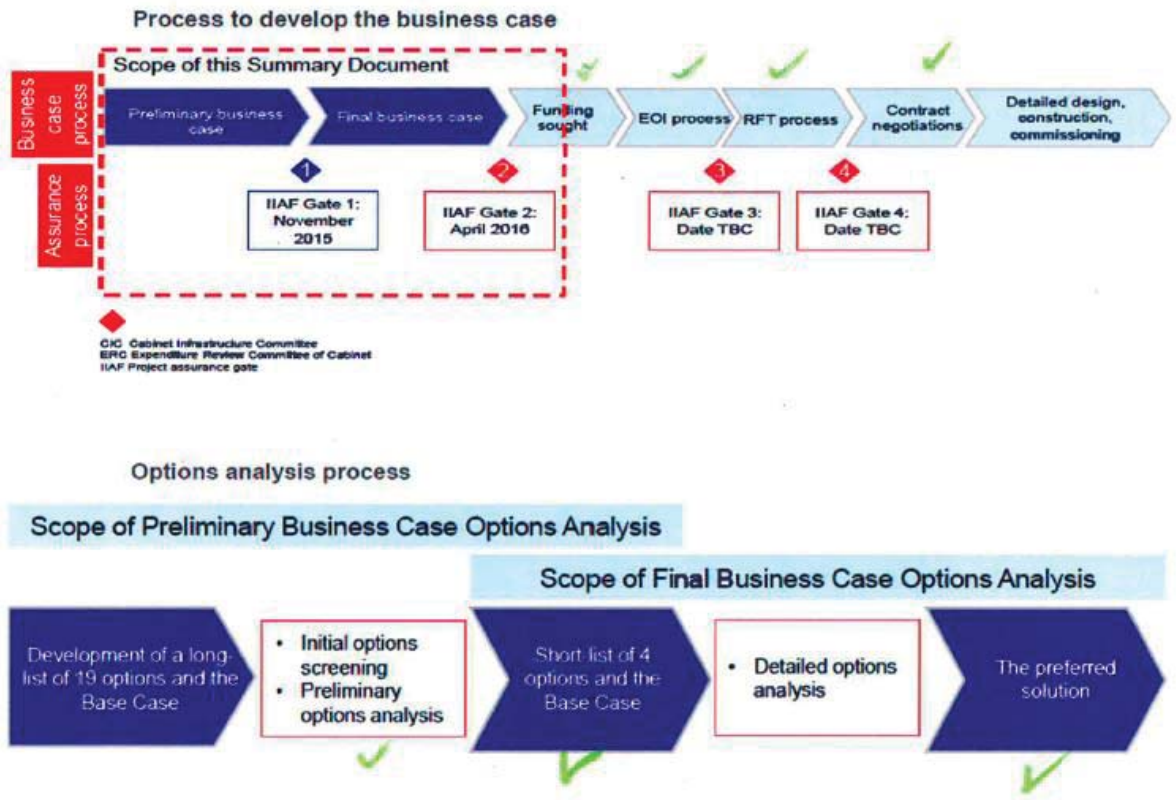

Figure 7. Annotated diagram of the planning and decision-making process. [SG] used green ticks to indicate the sections or the process she was aware that happened.

Partial agreement or lack of knowledge

Three of the nine interviewees partially disagreed with or were not aware of large sections of the process. These interviewees included the **local government [LG]**, **tourism [T]** and **pastoralist [P]** representatives. All of these interviewees mentioned that they felt the NSW Government did not adequately engage the stakeholder groups they represent, and should have done more to involve them. Their responses are presented below.

[LG] "So if you look on the face of it, it looks good all in those provided there [referring to the diagram] but the Broken Hill City Council didn't get to choose, didn't get to be consulted on what was the four options and what was the best option for the community. I don't know if the four options was ever presented to the community and what the options were.". Figure 8 shows this response.

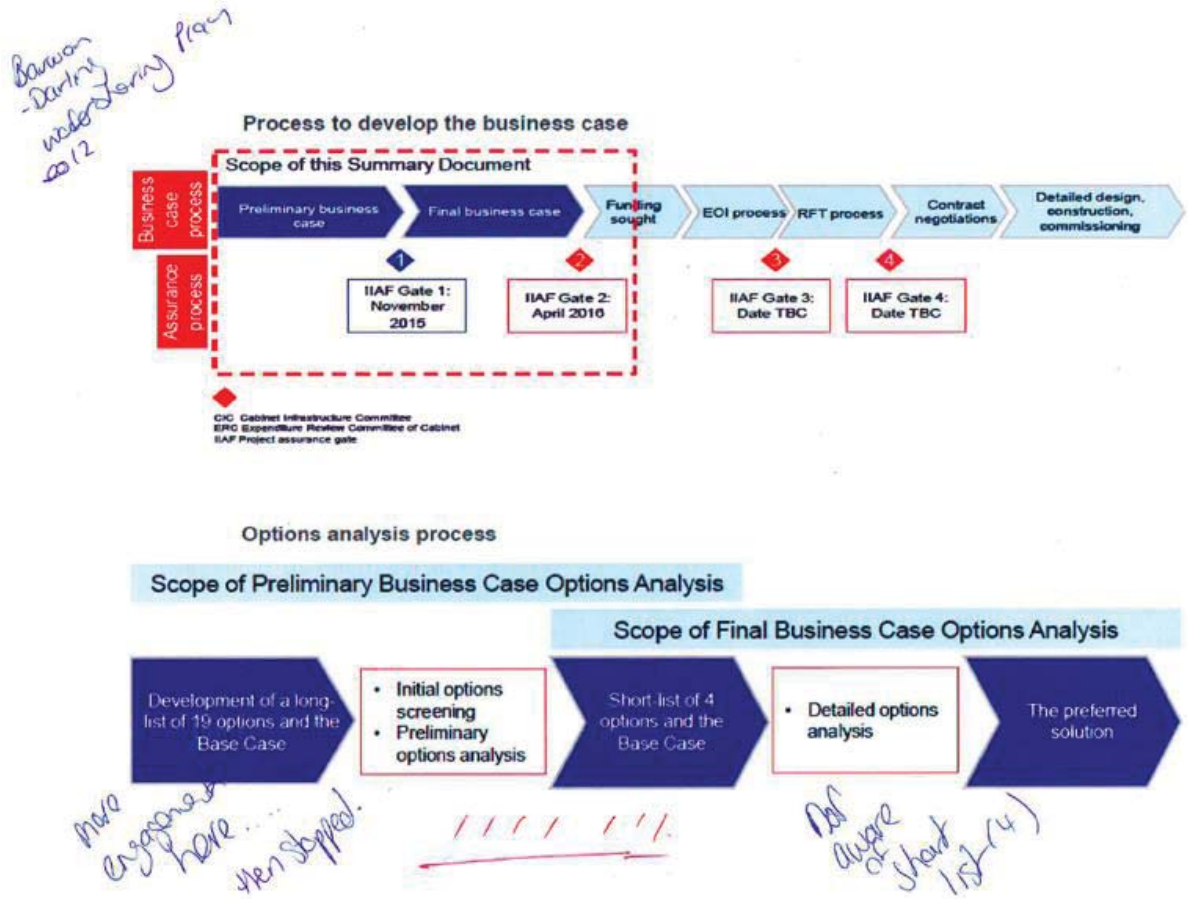

Figure 8. Annotated diagram of the planning and decision-making process. [LG] marked the section underlined with red dashed lines as a section she did not believe occurred in a way that involved the community. She also felt the negotiations of the Barwon Darling Water Sharing Plan in 2012 contributed to the decision to build the pipeline which was not included in the official publication.

[T] “When they have these meetings they weren’t really sort of advertised a lot … or its one of these things they advertise 2 or 3 days before they had the meeting which people have got lives to live and bits and pieces […].” When asked if this was a big problem she replied, **“**Well yeah I don’t really think they went into it as much as they should have or could have.”

[P] Responded similarly, and when asked if he agreed the process had taken place as published he said “Well I wouldn't be able to give you an accurate answer on that because we were not involved essentially. Landholders just weren't considered as a part of this process it was sort of tunnel vision about being an urban water supply for Broken Hill.”

Little or no agreement

Two of the nine interviewees expressed large disagreements about the published planning and decision-making process. This included the representative for **local businesses [B]** and the **local action groups [AG]**. Both of these interviewees were sceptical about the planning process leading up to the pipeline decision, believing it was either not openly publicised or did not occur at all as published.

[B] “Well I would say that most businesses in town would say that this did not happen [referring to the option analysis process (Figure 9)]. The announcement of the water pipeline was quite sudden and made a lot of us go what… oh ok. I don't remember too much discussion before at all.” Figure 9 was annotated by **[B]**.

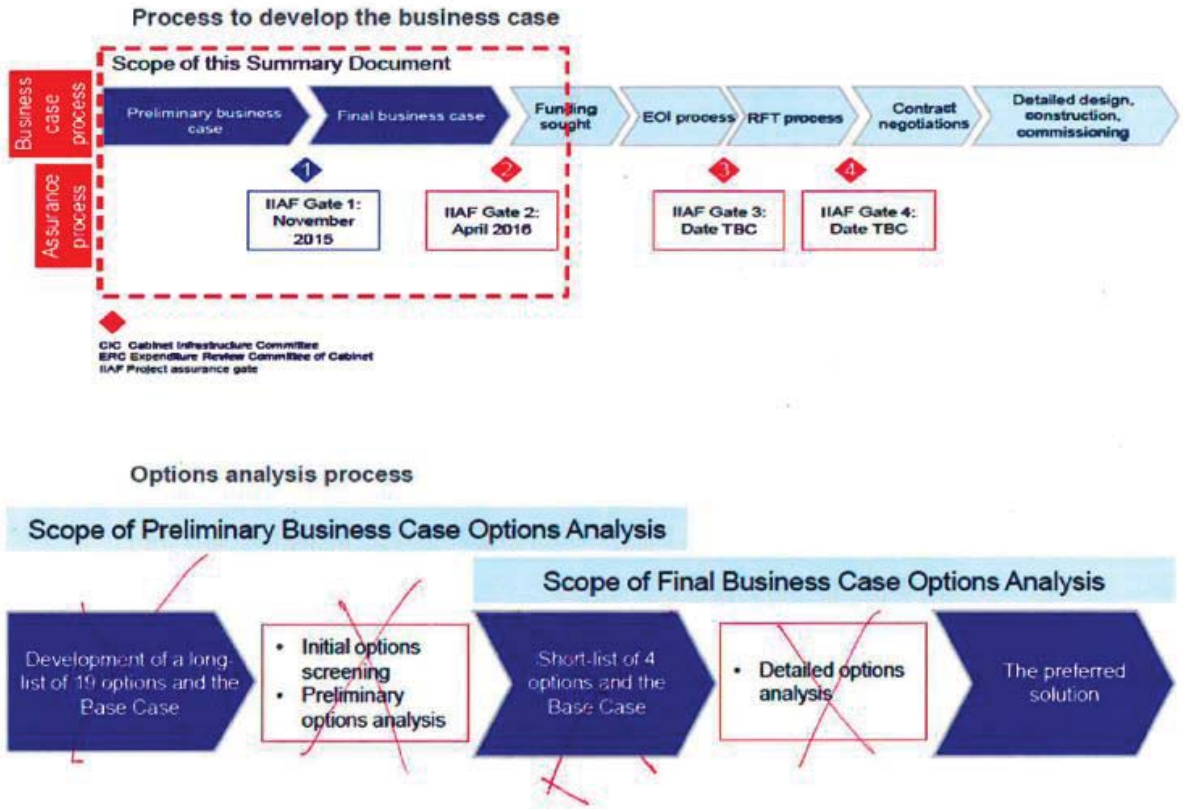

Figure 9. Annotated diagram of the planning and decision-making process. [B] expressed that most businesses in town felt the preliminary business case options and the decision-making process did not occur which is what the crosses on the diagram represent.

[AG] summed up his thoughts in a single concise sentence saying "Right so from here through to there [pointing from the beginning to the end of the option analysis process] starts with a capital B... is B*******"

6.2.2 Major complaints of stakeholders

Table 6. Lists the key complaints identified by stakeholder interviews.

Key complaints	
1)	The pipeline does not address the health of the Darling River and all those who rely on it.
2)	There was a lack of community involvement and transparency in the decision-making process.
3)	Concerns about the cost of the pipeline and who will have to pay for it.
4)	Cotton irrigators are the source of the problem and they should be addressed rather than building the pipeline.
5)	There was too much corruption and vested interests involved in the decision to build the pipeline.
6)	The decision to build the pipeline was politically motivated and not in the best interests of the people.

Complaint 1: The pipeline does not address the health of the Darling River and all those who rely on it.

One of the major arguments raised by many interviewees **[AG, B, I, LG, LR, P, T]** was the concern that the pipeline will not address the health of the Darling River (Broken Hill's current water source) and the many who rely on it. **[T]** "my opinion on the pipeline is that we don't need it. We should have the Darling River back, not just for environmental reasons for tourism reasons for the people that lived along the Darling River". This quote reflects how concerns are not just for Broken Hill but for all the surrounding smaller communities, the environment and landholders. By putting in the pipeline many felt it may help Broken Hill but would not assist others in the region, **[AG]** "the people of Broken Hill said, well if you want to drought proof Broken Hill […] what about the townships of Menindee and Pooncarrie?"

Within this argument comes the underlying assumption that the pipeline will reduce the pressure on the government to let water flow down the Darling River. This was highlighted by **[LR]** saying, "many people are worried [the pipeline] will be the death knell, if that's the word, death end of the Darling River, because it will mean less pressure for politicians and the government to have those flows down the Darling River". **[P]** also stated, "every indication is that there is going to be less water coming down the Darling River below Burke once the Pipeline is completed". **[AG, B, LG]** also explicitly stated this concern.

One group in particular that was at the centre of this concern were the indigenous people, who have a unique connection to water. **[LR]** "Badger Bates, he is a great guy he says […] the Rainbow Serpent can't live in a pipe it has to live in the Darling River". This quote shows this unique relationship and the concern around the pipeline. **[I]** reinforced this saying:

> "Aboriginal people have access too if they want cultural water, which gives them a flow that fills Billabongs and all that sort of stuff, and that's another thing that needs to be guaranteed is that those cultural flows continue […] There's a lot of past practices of weaving and hunting for yabbies and all that sort of stuff and they are traditional practices and we still maintain all these practices but if there's no water you sort of struggle so there are those concerns".

Complaint 2: There was a lack of community involvement and transparency in the decision-making process.

A lack of community involvement in the decision-making process was a key complaint of many. **[B, P, T]** were unaware of, or felt excluded from almost any consultation or engagement and **[AG, LG]** complained about the level of engagement, the sincerity and the openness of engagement. **[B]** "…the regular consultation process just did not happen". **[LG]** showed concerns for sincerity saying, "Engagement is supposed to be about adapting the communities' issues and concerns for a better delivery and you only engage if you really want to change, so engagement unfortunately they take it as the inform and consult". **[P]** expressed concerns saying, "certainly pastoralists were not involved in any consultation".

A lack of openness and transparency was closely tied to community involvement. Nearly all interviewees **[AG, B, I, LG, LR, P, S, T]** expressed concerns about how open and transparent certain aspects of the process was regarding information sharing. Poor transparency even caused **[AG, LG]** to say that the decision to build the pipeline may have already set before consultation began.

> **[AG]** "[we were] all invited to deliver our proposals which we did. Out of that every week or every month ping ping no we're not going that way, no we're not going that way, we knew what was happening, we knew that behind the scenes the Murray pipeline was one they threw in and push push push"

[LG] backed this up saying "so what we're doing [referring to the decision makers] we're listening to the community, we're consulting with the community, we're letting them have their say... but hey fellas this is what our plan is anyway."

Although transparency was an issue for many; **[LR[2], SG]** felt the process was largely open and transparent and the community had a chance to contribute. **[SG]** said "It was very well advertised and it was open […] people were involved, yeah, or they had the option to be involved." **[LR]** said "I mean we ask questions and mostly get the answers to them, the only sort of not transparent thing I suppose is not getting the full business case but everything else…"

Appendix B, show how each interviewee ranked public participation according to IAP2's public participation spectrum.

[2] **[LR]** is referenced for expressing concerns about transparency as well as claims that the process was quite open because she provided a general overview of both pro and anit pipeline supporters as the local news reporter.

Complaint 3: Concerns about the cost of the pipeline and who will have to pay for it.

Concerns about the long-term cost to the community were raised by **[B, LG, LR, S, T]**. Although the upfront costs had been covered by the government, the concern was that water bills might go up in the long run to cover the maintenance and ongoing operations. **[LG]** said "I keep thinking all the quality could be good I guess but I hope it doesn't cost me a fortune to turn it on."

Complaint 4: Cotton irrigators are the source of the problem and they should be addressed rather than building the pipeline.

Many interviewees **[AG, B, I, LG, LR, T]** expressed concerns that water extractions by cotton irrigators up stream were contributing to water shortages for Broken Hill more so than the drought as claimed by the NSW Government. This led to the argument that reducing the amount of water taken by irrigators is what needs to be addressed rather than finding a new supply through the pipeline.

> **[AG]** "What this plan did was allow them [cotton irrigators] to pump at small to medium flows as well as the large flows so with that less and less water came down the Darling River which caused the problem of the Darling River becoming unreliable for Broken Hill's water supply".

[T] supported this saying "I'd prefer them to blow up Cubby station [a major cotton farm upstream]. You know that holds ten times more [water] than Sydney harbour."

Complaint 5: There was too much corruption and vested interests involved in the decision to build the pipeline.

This complaint centred around the argument that there was too much corruption, and powerful voices influencing the decision-making process. **[AG]** "it was governed by policy, government policy which was forced through lobbying from large Cotton irrigation people". This view was supported by **[P]** saying "stakeholders [weren't] really properly involved or taken notice of in the consultation process and it was really the lobbying activities of New South Wales irrigators' that got this decision through." Put more simply, **[LG]** "Their collaboration [referring to the NSW Government] is with cotton farmers it is certainly not with the townies, the people that live in town". **[I, LR, T]** also expressed similar views.

Complaint 6: The decision to build the pipeline was politically motivated and not in the best interests of the people.

The view that the pipeline was a highly political decision was a complaint of many **[AG, B, I, LG, LR, P, S, T]**. Anti-pipeline advocates used this as an argument why the pipeline should not be built and even supporters of the pipeline were annoyed at how political water security in Broken Hill had become. **[B]** expressed concern that politicking had gotten in the way of sound planning and decision making saying "they had to have it done in 12 months which means that it is completed by the latest January next year with an election in March. […] we couldn't go through the whole decision-making process because the timeframes didn't work". Others shared similar views that water issues would not be addressed effectively when politics are involved **[I]** "and it's a political tool you know so if people couldn't use water as a political advantage or a political platform then you would see a change". Even the pro-pipeline supporter **[S]** said "You will not solve water issues while there is politics involved." Although closely related to the idea that there is too much corruption and vested interests involved, these complaints more so highlight the issue of a lack of trust in the current political system to effectively address water issues.

6.3 RQ3

Based on the complaints identified in RQ2, what aspects should have been addressed by the Murray Darling Basin Authorities' core governance principles and what aspects need further consideration?

Proper adoption of the eight core governance principles identified from the MDBA's strategic goals (Table 3) should have fully addressed three of the six major complaints identified in RQ2; however, three of the complaints were driven by aspects only partially, or not covered at all. Figure 10 visually shows this and Table 7 gives brief explanations. Detailed information is provided following.

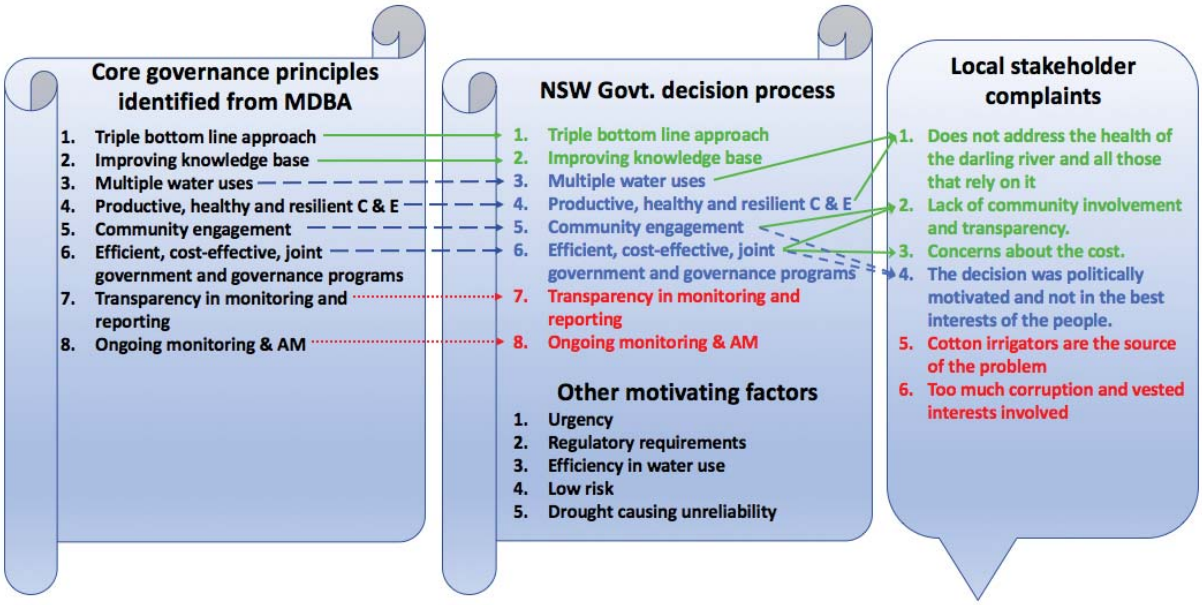

Figure 10. Left side: Shows the level of coverage of the eight core governance principles identified from the MDBA's strategic goals that was implemented in the pipeline project. Right side: shows which complaints identified by local stakeholders would have been addressed if full adoption of the eight core governance principles was adopted. Green colour indicates full coverage, blue colour indicates partial coverage and red colour indicates limited or no coverage. Source: (own illustration, 2018).

Table 7. Outlines the major complaints identified in RQ2 and if they should have been addressed if all governance principles interpreted from the MDBA's 2016-17 annual report were fully implemented. Justifications are given and if the complaint would not have been covered the underlying drivers of the complaint are listed.

Complaint	Should have been covered if core governance principles were followed	Core governance principles covering complaint (Yes) or *aspects driving the complaint not covered (No)*
1) The pipeline does not address the health of the Darling River and all those that rely on it.	Yes	- Multiple water uses – domestic, recreational, industrial and cultural. - Productive, Healthy and resilient communities and ecosystems long term.
2) There was a lack of community involvement and transparency in the decision-making process.	Yes	- Community engagement and use of local knowledge - Efficient, cost-effective, joint government and governance programs
3) Concerns about the cost of the pipeline and who will have to pay for it.	Yes	- Efficient, cost-effective, joint government and governance programs
4) The decision to build the pipeline was politically motivated and not in the best interests of the people.	*Partially*	- *Complaint about the legitimacy and ability of the current governance system to fairly represent the community's views.* - Community engagement and use of local knowledge - Efficient, cost-effective, joint government and governance programs.
5) Cotton irrigators are the source of the problem and they should be addressed rather than building the pipeline.	*No*	- *This highlights conflicting views or 'frames' around what water should be used for and problem formulation.*
6) There was too much corruption and vested interests involved in the decision to build the pipeline.	*No*	- *Highlights issues around uneven power relations.*

Complaint 1) should have been covered if all eight governance principles were adopted. A key focus of the MDBA is providing water for productive communities and healthy ecosystems considering a range of different water uses long term. This explicitly includes cultural water which many interviewees claimed was overlooked in this complaint (MDBA, 2017, p. 21). Although the MDBA does not specifically state who should be included in management decisions, as this would be case specific, they do advocate a "collaborative basin-wide approach" to water management (MDBA, 2017, p. 86), which should include surrounding communities as well as upstream and downstream users.

The second complaint contained three core components including: 1) insufficient community engagement; 2) feedback was not used in the decision-making process; and 3) the process was not open or transparent. The MDBA explicitly advocates for community engagement and the use of local

knowledge in decision making (MDBA, 2017, p. 29) which should have addressed components 1) and 2). Component 3) should also be addressed as the MDBA advocates for "efficient, cost effective and transparent governance" (MDBA, 2017, p. 46).

The third complaint about the cost of the pipeline and who will have to pay for it should have been covered. "Cost effective and transparent governance" is explicitly advocated for by the MDBA (MDBA, 2017, p. 46), which should cover any monetary concerns as well as any uncertainty around who will pay.

The fourth complaint is driven by the underlying driver of a lack of trust in the current governance system to fairly represent local stakeholder's views. This is shown by the negative sentiment that almost all interviewees attached to the political nature of the decision. This should have partially been addressed by community involvement and joint governance projects advocated for by the MDBA, however deeper aspects that drive the complaint such as concerns that the state has too much authority in the decision-making process are not addressed. A more detailed discussion of this is provided in section 7.3.

Complaint five highlights the issue of conflicting 'frames' from different stakeholders and a lack of joint problem formulation, and complaint six is largely driven by issues of uneven power relations. Both of these issues are currently not addressed at all by the MDBA, so even if the process had followed the eight core governance principles completely, these complaints would have still arisen. More detailed discussions of these, and why they are issues for sustainable water governance is provided in the following discussion (section 7.3).

7) Discussion

The case of the Broken Hill Pipeline has highlighted the many complexities that are often found in water governance, and shows how water management decisions affect everyone in society through both physical and social means. This case study has shown how different stakeholders can have very different perceptions about how water should be governed and that these multiple and often opposing views can lead to conflict if not properly addressed.

Of the results presented above, two key factors stand out as being major causes of concern for both current and future water governance. Firstly, the high level of disagreement from local stakeholders about the officially published planning and decision-making process, as well as the complaint about low community involvement, indicates public participation may have been limited to selected actors and not as open as it should have been. The second major concern is even if full adoption of the eight core governance principles had occurred, there were still core underlying issues that would not have been addressed. Both of these problems were key factors that led to the conflicts observed in Broken Hill, and need to be addressed by future water governance. In-depth discussion of these is provided below.

The following discussion is divided into four main sections. Section 7.1 looks into why the NSW Government did not follow all the governance principles supported by the MDBA and the implications of this; section 7.2 discusses the consequences of low public involvement and openness of the decision making process; section 7.3 discusses the underlying issues raised by local stakeholders that are not currently considered in water governance and why these are important for future sustainability; and section 7.4 moves on to suggest some possible future directions for sustainable water governance within the MDB.

7.1 Why weren't all the governance principles followed?

Looking at the motivating reasons of decisions is an important aspect of hydrosocial cycle analysis (Swyngedouw, 2009). In the Broken Hill Pipeline case the NSW Government used five key factors, outside of the eight core governance principles, to help motivate the decision. These factors neeed careful consideration as they were presented key drivers of the decision and hence may have taken away from, or over-ruled other important governance principles that should have been followed. These five motivating factors and their possible implications are discussed in the following section.

7.1.1 Urgency of the required solution

The NSW Government stated a secure long-term water supply needed to be operational by December 2018, as at the time of option development, current water supplies were predicted to be exhausted by April 2019 without significant rainfall (NSW DPI, 2017b, p. 2). This push for urgency however could have shifted attention away from the root causes of the problem favouring a quick fix solution (i.e. the pipeline). As Kenis and Lievens (2014) have highlighted, urgency can often take away form important, yet time consuming, struggles that impede on cooperation. Working out these struggles or conflicting interests is important however, so that a fair and democratic solution can be reached that will reduce the likelihood of future conflicts. Kallis (2008) has also pointed out that urgency is often employed by parties who benefit from quick fix solutions and can even be used to reinforce structures at the root cause of the problem. In the case of Broken Hill, many argued that the push for the pipeline (the quick fix solution), was due to the irrigation lobbyists upstream influencing the government, as the pipeline would allow them to access more water for their crops to generate profit (see section 6.2.2). The pipeline decision would also prevent further questions around cotton irrigation as the root cause of the problem and reinforce current structures of water governance.

7.1.2 Need to meet regulatory requirements

The ability to meet minimum supply, quality and reliability targets, was a key selection criteria for the project (NSW DPI, 2017b, p. 11). Water usage in Broken Hill is currently at similar levels to the 1960's when the population was almost double the current level (Essential Water, 2011). This should bring into consideration, questions of current water consumption rates, however the requirement to meet peak daily supply and reliability targets took away this argument. Secondly, this motivation also puts an emphasis on 'output oriented' management, that favours technical engineering solutions and a state-centric approach to water management (Linton, 2014), increasingly however water governance is shifting towards process oriented approaches that consider "people and processes, diversity of organisation and knowledge sharing" in decision-making (Tropp, 2007, p. 19).

7.1.3 Higher water efficiency than the current system

Higher water efficiency of the new solution also motivated the decision. A potential impact of this, is that it reinforces the idea of water as a 'resource' for human consumption and economic gain. This view of water takes focus away from other important aspects such as water for cultural purposes or environmental flows for example, overpowered by arguments for efficiency. This view reinforces the 'state hydraulic paradigm' or the idea of viewing water as a 'natural resource' that should be 'managed' by state run agencies guided by 'scientific experts' such as engineers and hydrologists (Linton, 2014). This view has dominated water management throughout the 20th century but is increasingly being questioned by the recognition that water cannot be thought of as a 'natural recourse' devoid of socio-cultural, political and historical factors (e.g. Budds, Linton, & McDonnell, 2014; Linton, 2014; Swyngedouw, 2009).

7.1.4 Low level of risk

Robbins (2011) has shown how traditional management systems are typically geared towards reducing risk. The use of low risk as a motivating factor by the NSW Government, acts to favour these traditional approaches, in effect locking in the current management paradigm. This argument could also take away from questioning more complicated issues, such as up-stream water use or problems with the current governance approach, as these would require far more radical changes and hence involve a higher level of risk.

7.1.5 Drought as a natural cause of the problems

The NSW Government used the idea of droughts as a 'natural phenomenon', worsened by climate change as a key driver of water shortages in Broken Hill and a major motivating factor to build the pipeline. As Kallis (2008) points out, droughts are in reality caused by "socioenvironmental phenomena, produced by admixtures of climatic, hydrological, environmental, socioeconomic, and cultural forces." (p. 85). Kallis further goes on to point out "The focus on weather, […] elides culpability and naturalizes causation directing attention away from questions of political agency, i.e., who is to blame or who stands to benefit from drought […]." (p.104). The push by the NSW Government to use the drought as a natural driver of the problems, takes questions away from more complex issues of any socio-political factors that could be contributing to water shortages in Broken Hill.

All of the above-mentioned motivations could be seen to draw attention away from deeper questions about socio-political and socio-economic factors contributing to water shortages in Broken Hill and favours quick fix technical solutions such as the pipeline. The decision could be seen to reinforce the 'state hydraulic paradigm' and current water governance structures, that are increasingly being called into question by approaches such as political ecology and the hydrosocial cycle. Deeper questioning of the root causes of issues and more democratic governance should be encouraged (Robbins, 2011; Swyngedouw, 2009); however as shown these motivating factors may have taken away from these questions.

7.2 Implications of poor community involvement in the planning and decision-making process

There are a couple of key reasons why community involvement in the planning and decision-making process is important in water governance. Firstly, there is the argument of democratic decision-making around water as a public resource. This argument states that all parties affected by a decision should have the opportunity to participate in the decision-making process. It is supported by principles of equity and social fairness, which claim voices of less powerful actors need fair consideration (Pahl-Wostl et al., 2007a). Secondly many competing interests and water requirements exist within water basins, and these differences need to be addressed for sustainable solutions to be found (Pahl-Wostl et al., 2007a). Moreover, there have also been a number of potential benefits identified from participatory processes used in water resource management, including increasing human capital for better informed decisions necessary in complex SES, providing deliberation to reduce conflicting views and improve decision making and increasing perceived legitimacy of outcomes leading to smoother implementation (Carr, 2015).

Many stakeholders in Broken Hill complained participation in the pipeline decision was limited, selective or superficial and this was one of the major reasons for conflict (see section 6.2.2). This suggests a more open and inclusive process for public engagement could not only help reduce this conflict in future governance decisions but also lead to improved outcomes and more accepted solutions.

7.3 Issues currently un-addressed by water governance within the MDB

Of most concern for future Governance of the MDB were the three complaints that highlighted aspects not currently addressed by the eight core governance principles identified. These complaints highlighted the issues of 1) different 'framings' of water 2) uneven power relations and 3) a lack of trust in the current governance system. These three factors were key sources of tension that led to conflict, and will likely impact future governance if left un-addressed. The following section outlines these three issues and why they are problematic for future governance of the MDB.

7.3.1 Different 'framings' of water

The 'state hydraulic paradigm' approach that was used in the pipeline decision is problematic because it misses many important aspects that influence how individuals view water, commonly referred to as 'frames'. Frames can be influenced by social roles, scientific training, cultural backgrounds and experiential relationships, all of which can provide contextual knowledge important in decision making (Linton & Budds, 2014, p. 174; Pahl-Wostl et al., 2007a). Different framings direct attention to or highlight different aspects of a situation which can impact how decision are made (Dewulf, Mancero, Cárdenas, & Sucozhanay, 2011).

The complaint that '*cotton irrigators are the source of the problem and should be addressed rather than building the pipeline*', shows how local stakeholders view Broken Hill's water problems, differently to the NSW Government. The government used natural drivers of climate change and low rainfall to explain Broken Hill's water scarcity, whereas many local stakeholders hold the view that human extraction of water upstream is the cause of the problem. This clashing of frames is an important issue, that if not properly addressed can often lead to miscommunications and conflicts (Dewulf et al., 2011; Pahl-Wostl et al., 2007a) which is exemplified in the Broken Hill Pipeline case. Therefore engaging multiple stakeholders at an early stage to identify and address these competing frames is an important step in sustainable river basin management (Carr, 2015). This idea is supported by popular water management approaches such as Integrated Water Resource Management and Adaptive Water Management, that both advocate for stakeholder engagement to recognise and incorporate different frames in both problem formulation and response development (Edalat & Abdi, 2017; Green & Fernández-Bilbao, 2006 as cited in; Hooper, 2006).

The MDBA does advocate for public participation and multiple uses of water, however they do not talk about eliciting different views or frames of different stakeholders. The fragmentation or misalignment of frames in Broken Hill, was a major cause of conflict that needs to be addressed in the future.

7.3.2 Uneven power relations

Uneven power relations are not covered at all by the eight core governance principles identified. This is an important issue as complaints around power relations were a key factor that led to the conflicts seen in Broken Hill. The complaint that '*There was too much corruption and vested interests involved in the decision to build the pipeline*' highlights that many local stakeholders felt certain actors had too much influence (and hence power) over the decision-making process. This is an important consideration in hydrosocial investigations as has been pointed out by Swyngedouw (2009) who says "Particular attention, therefore, needs to be paid to social power relations (whether material, economic, political, or cultural) through which hydro-social transformations take place.

To briefly examine the key power relations at play in the Broken Hill Pipeline case, Avelino and Rotmans (2011) power framework is used. This framework was chosen as it is simple to understand, was developed for use in sustainability research, and is suitable for interdisciplinary studies (Avelino & Rotmans, 2011). Two key power struggles were evident from the complaints of stakeholders in Broken Hill. Firstly, the NSW state government was identified as having too much 'power over' the decision-making process compared to other players involved[3] ('**one-sided dependency**'), and secondly cotton irrigators and irrigation lobbyists were claimed to have a '**cooperative**' power relationship with the NSW Government in which favours for the irrigation lobbyists in terms of water access resulted in political supports for the NSW Government[4] (see Table 8 for **typology** of power relations).

Both of these power relations could be classified as '**constitutive**' power (defined as: "the capacity of actors to constitute the distribution of resources, by establishing, enforcing and reproducing existing structures and institutions.") (Avelino & Rotmans, 2011, p. 799). By reinforcing existing governance structures, constitutive power act to suppress '**transformative power**' (defined as: "the capacity to transform the distribution of resources, not just in terms of redistributing or replacing old with new resources, but specially in terms of changing the way in which resources are distributed.") (Avelino & Rotmans, 2011, p. 799). These two power relations, act to lock in the existing governance structure

[3] E.g. **[S]** "without them [pointing to state governments] this [pointing to the MDBA agreement] doesn't happen."
[4] E.g. **[LG]** "Their collaboration [referring to the NSW Government] is with cotton farmers it is certainly not with the townies, the people that live in town"

with the state government primarily responsible for water resource management, holding the most power over decision making. These power relations are also important when considering different frames, mentioned previously, as powerful actors often impose their frames as the dominant view in decision making processes (Pahl-Wostl et al., 2007b). Hence, if future governance in the MDB is going to change, these restrictive power relations need to be addressed, to allow for more democratic decision-making.

Table 8. Typology of power relations and its manifestations. Source: (Avelino & Rotmans, 2011).

Power relation type	Manifestation of power relations		
Power 'over'	A depends on B but B also depends on A => A and B have power over each other	A depends on B but B does not depend on A => B has power over A	A and B do not depend on each other => A and B have no power over each other
	Mutual dependency	One-sided dependency	Independency
'More/less' power to	A exercises more power than B, but A and B have similar, collective goals =>	A exercises more power than B, while A and B have mutually exclusive goals =>	A exercises more power than B, A and B have independent co-existent goals =>
	Cooperation	Competition	Co-existence
'Different' power to	A's and B's different power exercises enable and support one another =>	A's and B's different power exercises restrict, resist or disrupt one another =>	A's and B's different power exercises do not (significantly) affect one another =>
	Synergy	Antagonism	Neutrality

7.3.3 A lack of trust in the current governance system

The complaint from local stakeholders that *'the decision to build the pipeline was politically motivated and not in the best interests of the people'* shows that many locals do not believe the current political system and the NSW government is fairly representing their views. Davenport, Leahy, Anderson, and Jakes (2007) have shown that a lack of trust in decision makers, (in this case the NSW Government) is a key factor that limits public participation. This is a major problem because the hydrosocial cycle advocates for politicising water as an avenue to increase public participation, which can lead to democratic change (Budds et al., 2014). If people do not have faith in the political system to deliver fair representation, they will not effectively engage in politics, which undermines this key premise of the hydrosocial cycle.

To overcome this issue the current water governance system needs to change. The hydrosocial cycle suggests a more democratic process that fairly represents stakeholder's views over a range of overlapping scales and sectors is needed (Swyngedouw, 2009). Collaborative approaches are increasingly being used in water governance, to address competing stakeholder positions, through allowing for inclusive deliberation between state, private, and civil society actors (Brisbois & de Loë, 2016b). Collaborative management is supposed to share power and decision-making authority between different actors involved, and hence increase the democratic process and increase legitimacy of decisions (Carr, 2015). Therefore, to increase legitimacy of decisions, governance needs to move

away from the state-centric approach and devolve official decision-making authority to multi-scale and multi-sector actors.

Although the MDBA does advocate for joint governance projects and community engagement, partially addressing this issue, they fall short of calling for decentralising official decision-making authority. This is what is needed to increase legitimacy and trust in the governance system, and facilitate fair and democratic decision-making.

This section has shown how a consideration of different frames, uneven power relations and a lack of trust in the current governance system are all currently not addressed by the MDBA core governance principles. These aspects were all identified as key factors that contributed to the conflict seen around the pipeline project, and will most likely contribute to further conflicts in the future if left unaddressed. Therefore, the following section gives some suggestions about possible approaches to deal with these aspects in the future.

7.4 Future directions for sustainable water governance within the MDB

In order to address the issues of different framings, uneven power relations and a lack of trust in the current governance system, I suggest future water governance in the MDB focuses on a more polycentric, co-management approach that facilitates social learning. Co-management emphasises the sharing of power between different levels and sectors of both government and civil society actors (Huitema et al., 2009), whilst polycentric governance is a system where "political authority is dispersed to separately constituted bodies with overlapping jurisdictions that do not stand in hierarchical relationship to each other" (Skelcher, 2005, p. 89). This approach to governance would help reduce uneven power relations and any lack of trust in governance authorities by involving more local level actors and providing them more authority in decision-making. The process of social learning that I advocate for here can be defined in the following steps:

1) Developing trust between stakeholders
2) Collaborative problem definition
3) Collaborative fact finding
4) Joint development and assessment of different alternatives
5) Joint decision making

6) Joint planning and implementation
   (Mostert et al., 2007)

By specifically incorporating this process of social learning, it would address the issue of conflicting frames (through collaborative problem definition) and mobilize human capital and place based knowledge to improve decision making (Wehn, Collins, Anema, Basco-Carrera, & Lerebours, 2018). Furthermore, studies have shown that polycentric governance regimes with dispersed power and effective coordination often result in better environmental outcomes (Newig & Fritsch, 2009; Pahl-Wostl, Lebel, Knieper, & Nikitina, 2012).

It should be noted however, although collaborative partnerships and polycentric approaches can facilitate power sharing, and consensus building, uneven power relations in collaborative approaches can also cause challenges to implementation, especially when parties have to sacrifice individual opportunities for joint gains (Kallis, Kiparsky, & Norgaard, 2009). Therefore, one area for possible future research is to look more in depth at the effects of power relations in co-management, polycentric governance systems. Morrison et al. (2017) give a good overview of current research in this field, however they highlight there are still some substantial research gaps, which is supported by Brisbois and de Loë (2016a) & Watson (2015) who claim power relations with respect to collaborative water governance is a field yet to be fully explored. The MDB could provide a useful context to examine these research gaps, with information being useful to guide future governance.

8) Conclusion

This thesis investigated the case study of the Broken Hill Pipeline and found that poor governance was a key factor contributing to many of the conflicts observed. In particular it was found that governance guidelines advocated for by the MDBA were only partially followed which contributed to the conflicts observed. More importantly however, complaints from local stakeholders revealed that current governance guidelines are missing important considerations including conflicting frames, uneven power relations and a lack of trust in the current governance system; all of which drove conflict. Furthermore, reasons given to motivate the pipeline decision could be seen to divert attention away from deeper questioning of the causes of water problems in Broken Hill, favouring quick fix technical solutions and reinforcing the current governance paradigm.

From these findings, I have suggested a new approach to governance that addresses uneven power relations, conflicting frames and includes more democratic decision making is needed. I suggest a polycentric governance approach that facilitates co-management and social learning could be one suitable method moving forwards.

This thesis contributes to the body of literature relating to the hydrosocioal cycle. I have shown how important it is to consider natural-social relations in governance and management decisions relating to water, and highlighted some potential pitfalls if this is not done properly. The key issues identified and discussed in this these should be considered in future management of the MDB and I hope this thesis could be used to help guide future governance.

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10) Appendices

10.1 Appendix A – Interview guide

Preparations for the interview:

- Introduce myself (Lund University, Masters in SS etc.).
- Introduce the aim of the thesis project (multiple stakeholder perspectives, opinions on the decision process, conflicts surrounding the pipeline -> hope to help with future planning).
    - Specify why you want to include them in particular.
- Explain the procedure (interactive session with drawing out decision process, semi-structured interview so feel free to interrupt, ask questions, clarification etc.)
- If you feel uncomfortable with any questions you can refrain from answering.
- Participants input is highly valuable, there are no wrong answers, I just want your insights.
- No liability from answers.
- **Do they want their identity to be kept confidential?**
- **Ask if I can record the interview?**
- **Write down the participants details (name, representation, time and place).**
- Remind them to speak clearly for the recording.
- **Turn on recording device!**

Background information:

1) How does water management in Broken Hill and the decision to build the pipeline effect you and the stakeholders you represent?

Problem understanding:

1) From your perspective, do you consider that there is a water availability problem in Broken Hill and the surrounding region?
    a) If so what is the problem?
    b) How does it affect you and the stakeholders you represent?
    c) Does it require action to solve?

The process of the pipeline:

Explain that the NSW Govt. has outlined the decision-making process in official documentation however I would like to find out if the perception of different local stakeholders reflects accurately what has been published. Therefore I would like to see whether you were aware of the different steps that were taken,

1) Does the decision process shown by the NSW Govt. reflect what occurred from your point of view?
    a) *Show the decision process diagram*

Figure 1-1: Process to develop the business case

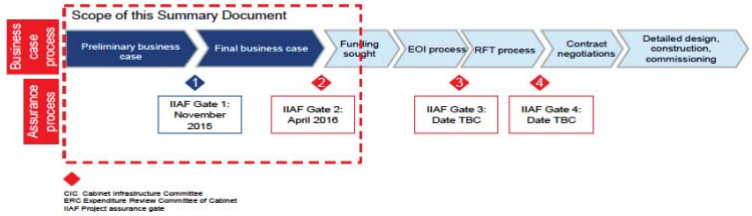
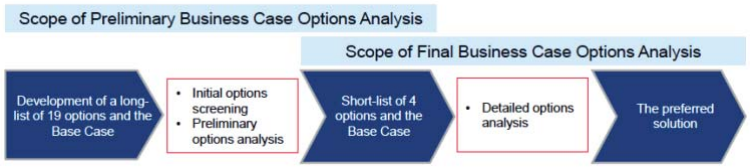
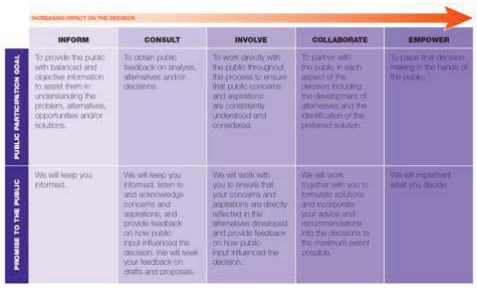


Figure 2-5: Options analysis process



    b) Do you agree that all of these steps have been undertaken?
        i) - If there are discrepancies mark them on the diagram.
    c) Were there any steps that you were unaware of?
        i) - If so do you feel these were not communicated well to the public?
    d) How many of these steps were you able to have an input or active participation in?
    Mark on the diagram – also show public participation diagram



2) Do you believe the process the NSW Govt. took adheres to the MDBA guiding principles/strategic goals?
    a) *Show the table of strategic goals.*

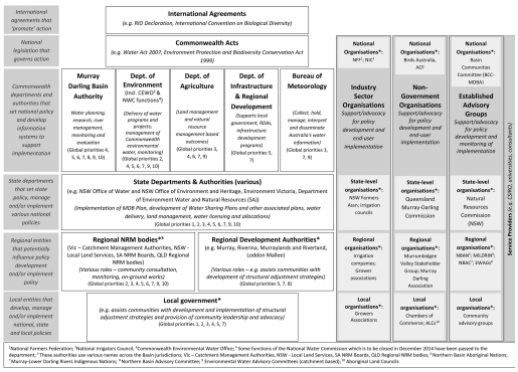
Conflict surrounding the pipeline decision:

1) Have any of the stakeholders you represent expressed any concerns or disagreements with the decision to build the pipeline or any stage of the decision-making process?
    a) Where in the decision process did these conflicts occur? -> *show the decision process again.*
    b) What were the conflicts about?
    c) What were the main concerns of your stakeholders?
    d) Have these concerns been addressed or are they still present?
    e) Were most of your stakeholders happy about the decision -> if so why?
    f) What are the biggest benefits of the pipeline?

Governance:

1) Who do you feel is primarily responsible for water resources in Broken Hill and the surrounding region?

    Show governance structure diagram



    a) Who currently controls water resources?
    b) Who should be able to control the water resources?
    c) What do you think of the current governance structure -> what should change?

Property rights:

1) Do you feel that property rights (both farmers and indigenous) have been considered in the pipeline project?

General:

1) Do you feel the pipeline will adequately address the issue of water scarcity in Broken Hill and the surrounding region?
    a) Are there any major trade-offs of the pipeline?
2) Who do you feel are the biggest winners and losers from the pipeline and why?
3) What would you say have been the major social, political, economic and power aspects that have driven the decision process?
4) Do you feel there has been anything missing from the decision-making process?
    a) What else should have been considered?
    b) Was anyone left out of the decision process?
    c) Where should the decision process have changed?
5) Do you think there is a better solution than the pipeline? If so what do you think this would be?
6) What do you think would need to change in order to improve water management in Broken Hill and the surrounding region and who should be responsible for these changes?
7) Anything else you want to add?

Ending the interview:

- Thank you so much for spending the time with me and giving me your valuable insights, I am sure it will help me a lot with my thesis and hopefully can contribute to future water management.
- Give the participant my contact details and explain that they can contact me at any time with follow up questions or aspects they feel are important but forgot to mention.
- Remind participants there is no liability from their answers and that they can remain anonymous if they wish.
- Turn off recording.

10.2 Appendix B - Public participation diagrams from stakeholders

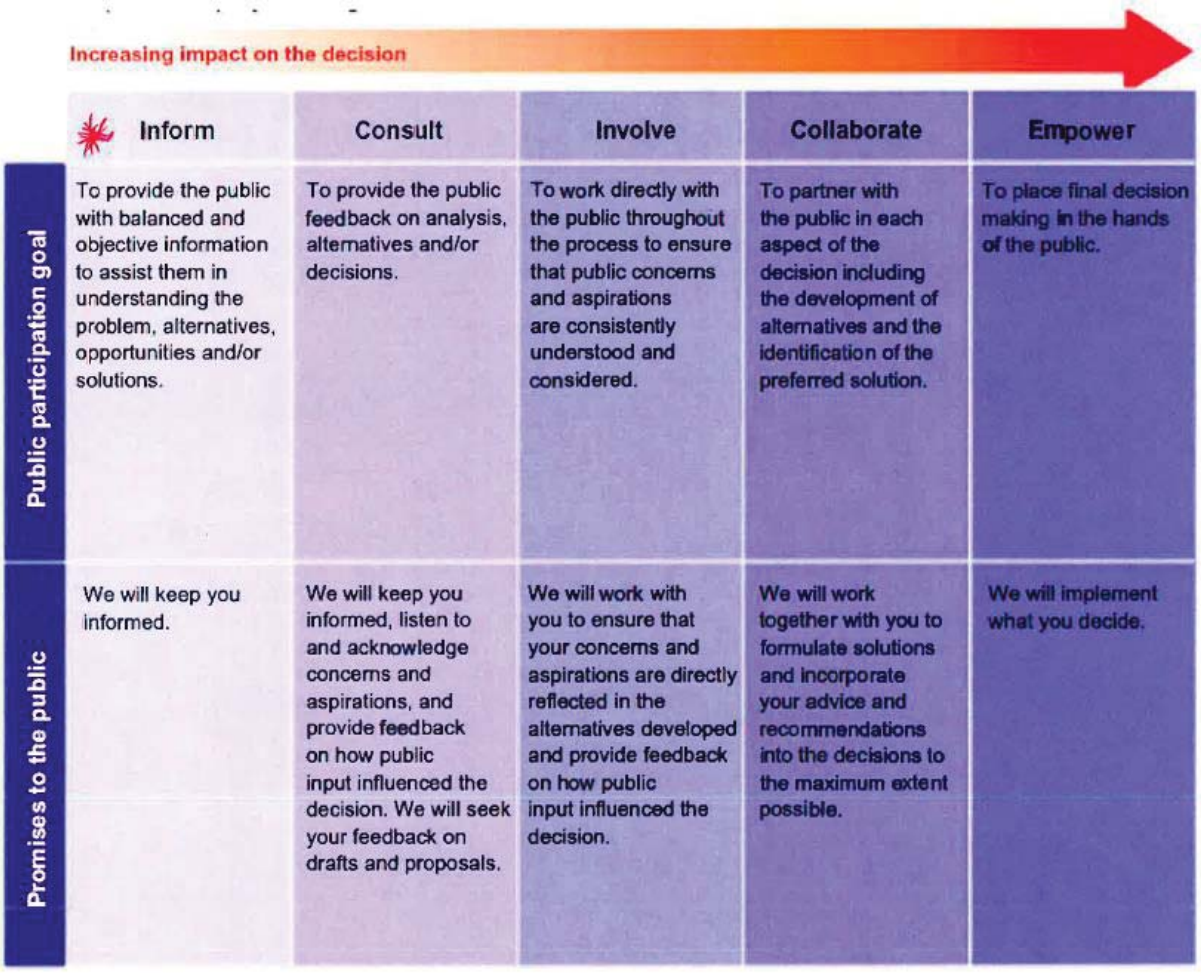


Figure B1: Public participation guide annotated by **[T]**.

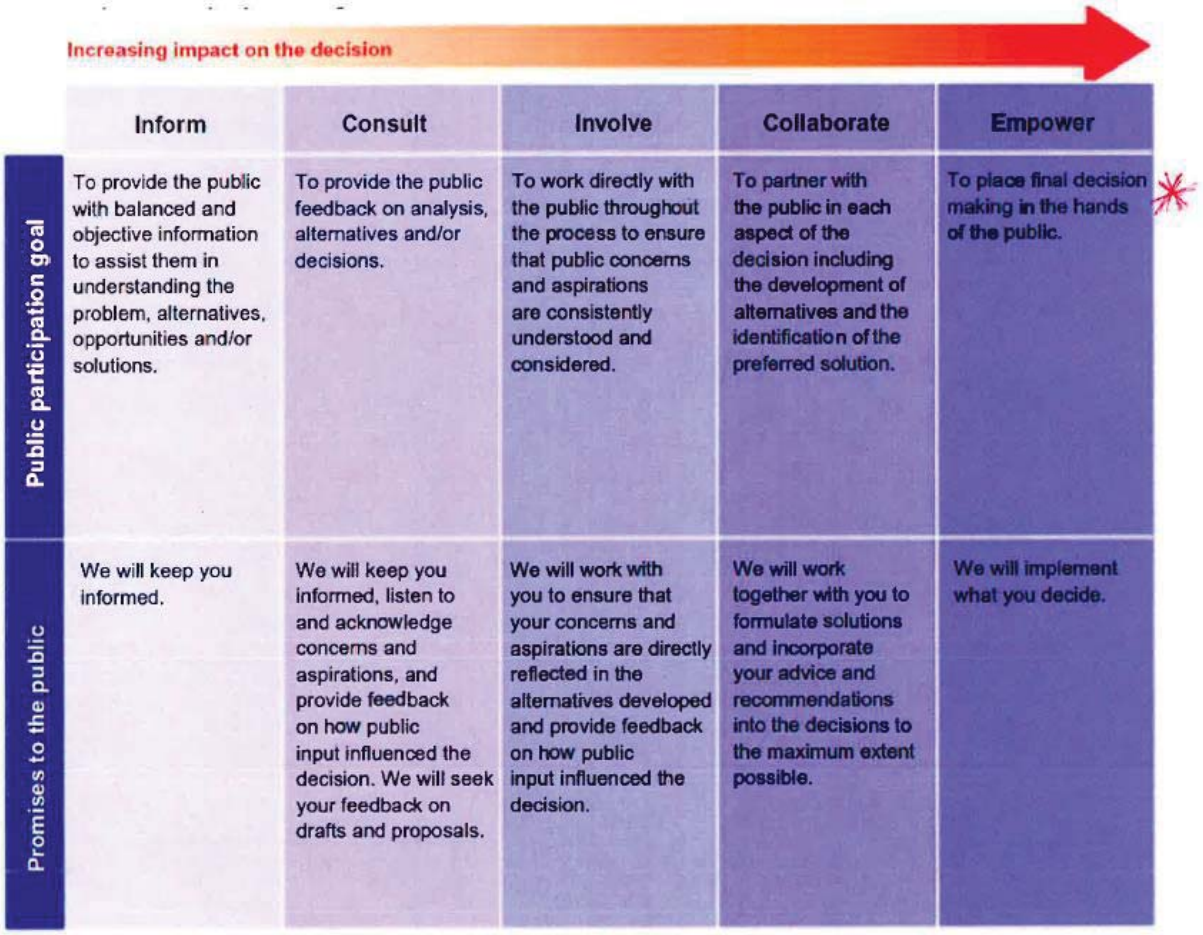


Figure B2: Public participation guide annotated by **[SG]**.

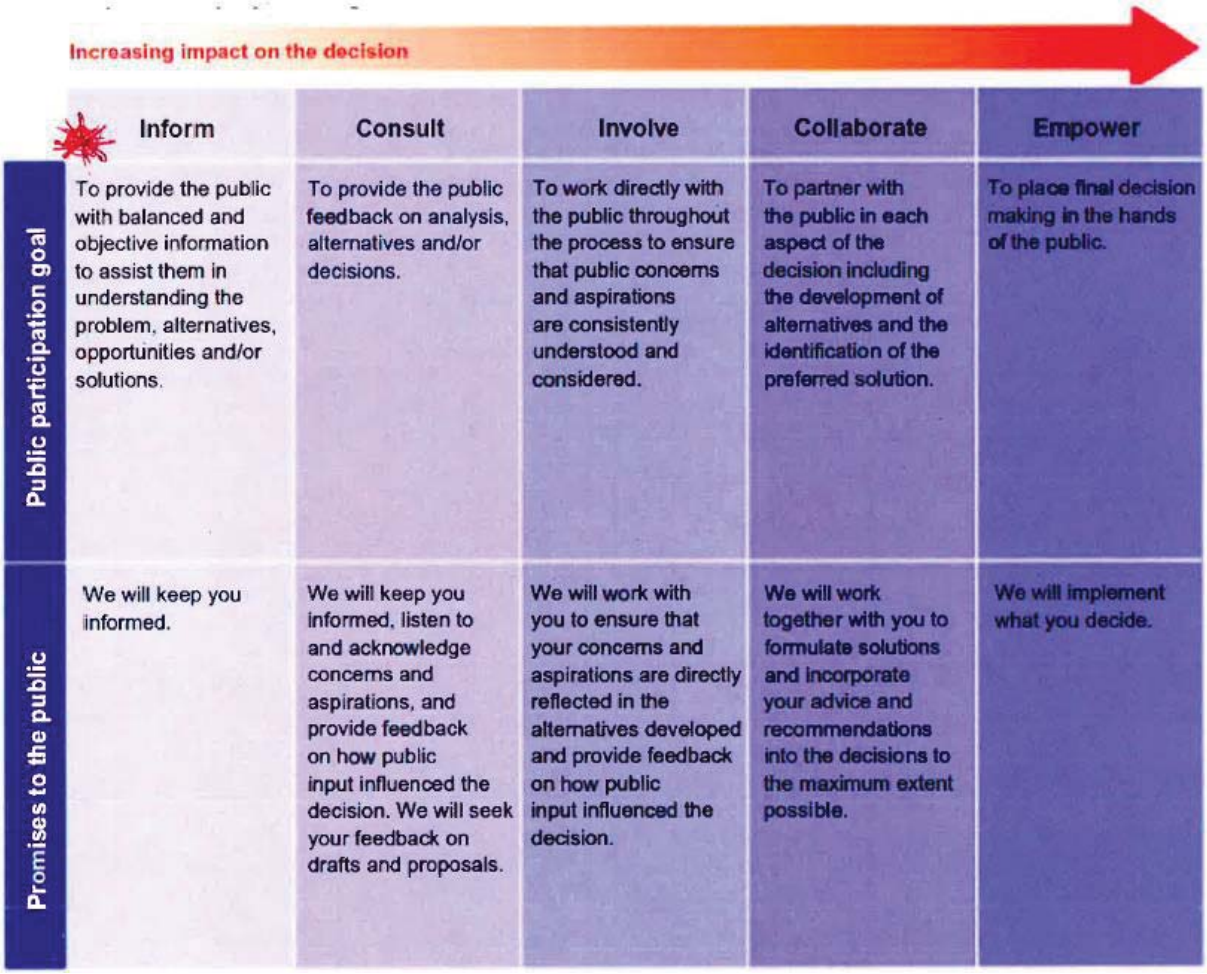


Figure B3: Public participation guide annotated by **[AG]**.

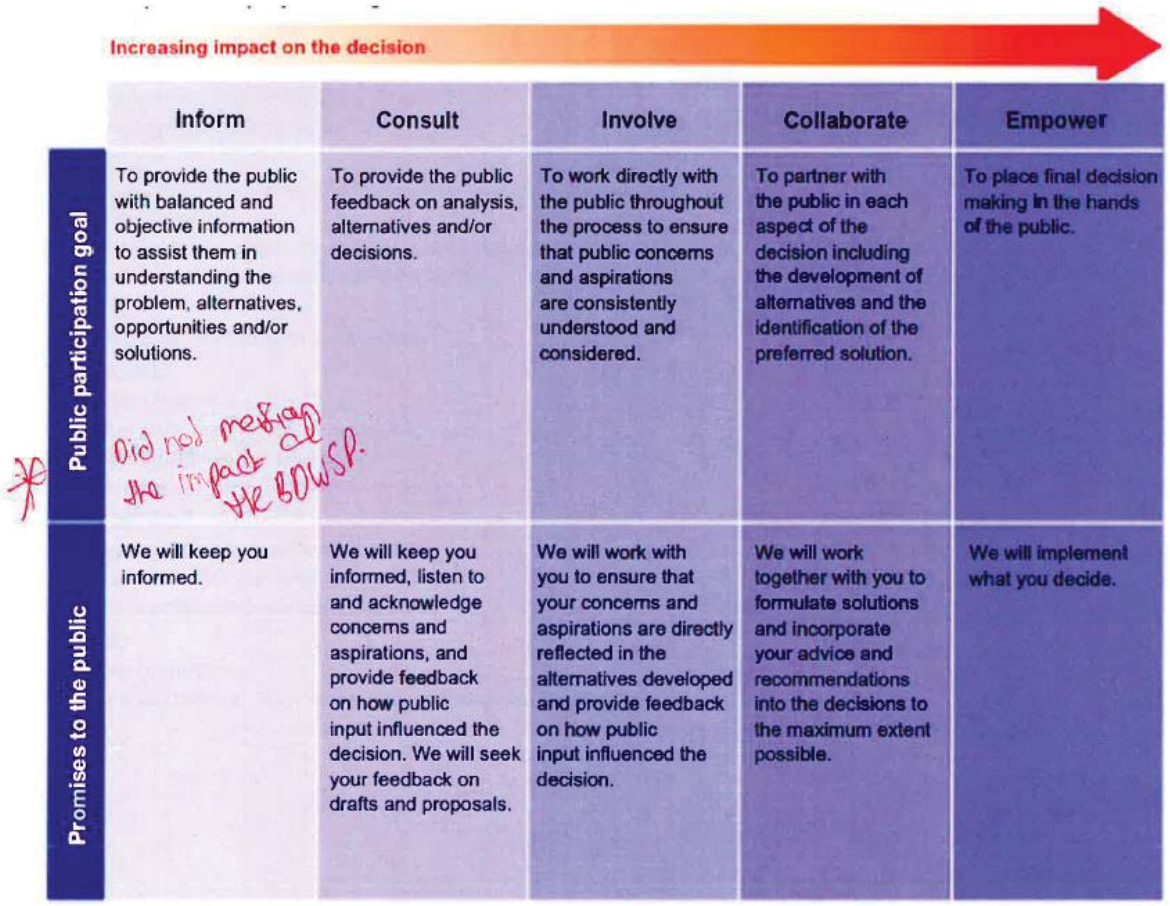
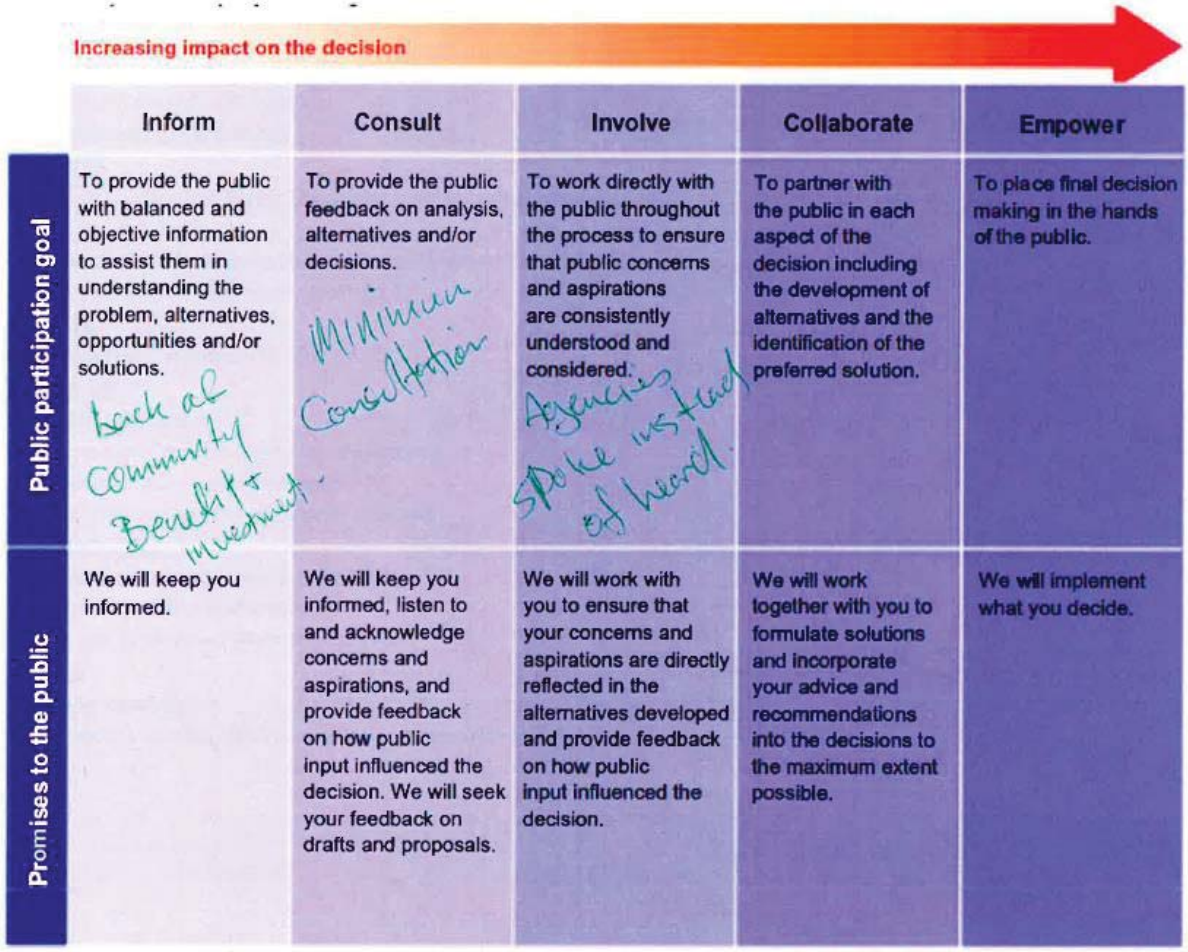


Figure B4: Public participation guide annotated by **[LG]**.



Increasing impact on the decision

	Inform	Consult	Involve	Collaborate	Empower
Public participation goal	To provide the public with balanced and objective information to assist them in understanding the problem, alternatives, opportunities and/or solutions. back of Community Benefit + Investment.	To provide the public feedback on analysis, alternatives and/or decisions. Minimum Consultation	To work directly with the public throughout the process to ensure that public concerns and aspirations are consistently understood and considered. Agencies spoke instead of heard.	To partner with the public in each aspect of the decision including the development of alternatives and the identification of the preferred solution.	To place final decision making in the hands of the public.
Promises to the public	We will keep you informed.	We will keep you informed, listen to and acknowledge concerns and aspirations, and provide feedback on how public input influenced the decision. We will seek your feedback on drafts and proposals.	We will work with you to ensure that your concerns and aspirations are directly reflected in the alternatives developed and provide feedback on how public input influenced the decision.	We will work together with you to formulate solutions and incorporate your advice and recommendations into the decisions to the maximum extent possible.	We will implement what you decide.

Figure B5: Public participation guide annotated by **[I]**.

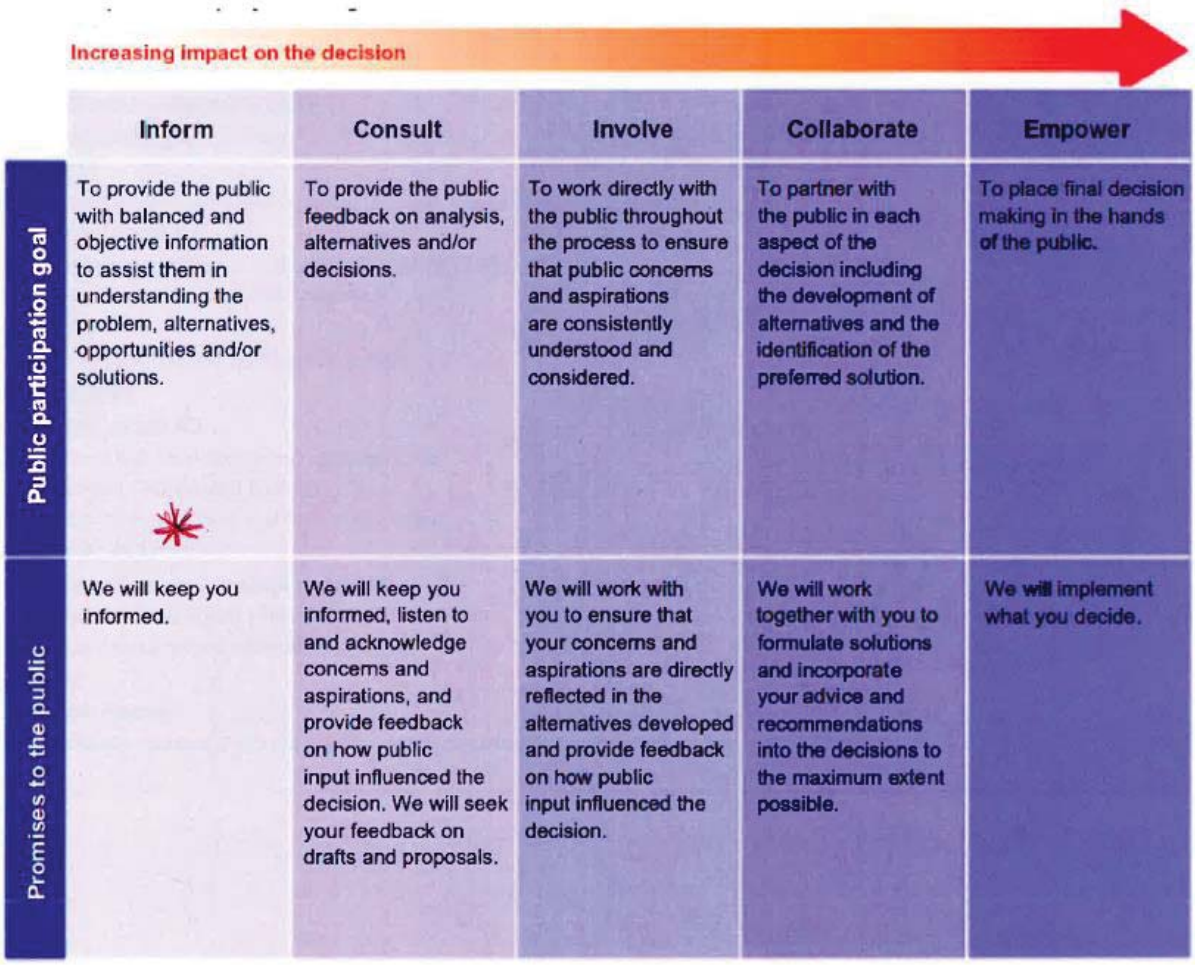


Figure B6: Public participation guide annotated by **[P]**.

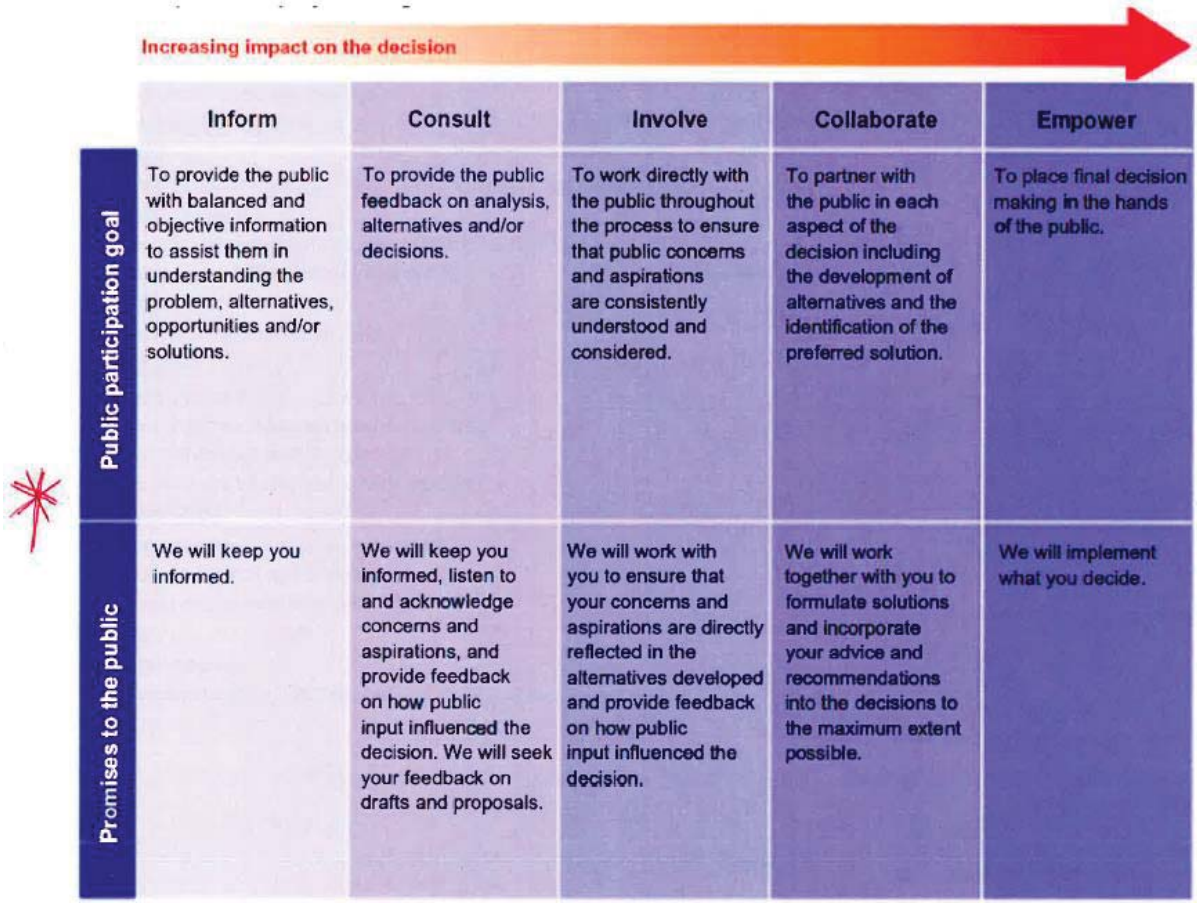


Figure B7: Public participation guide annotated by **[B]**.

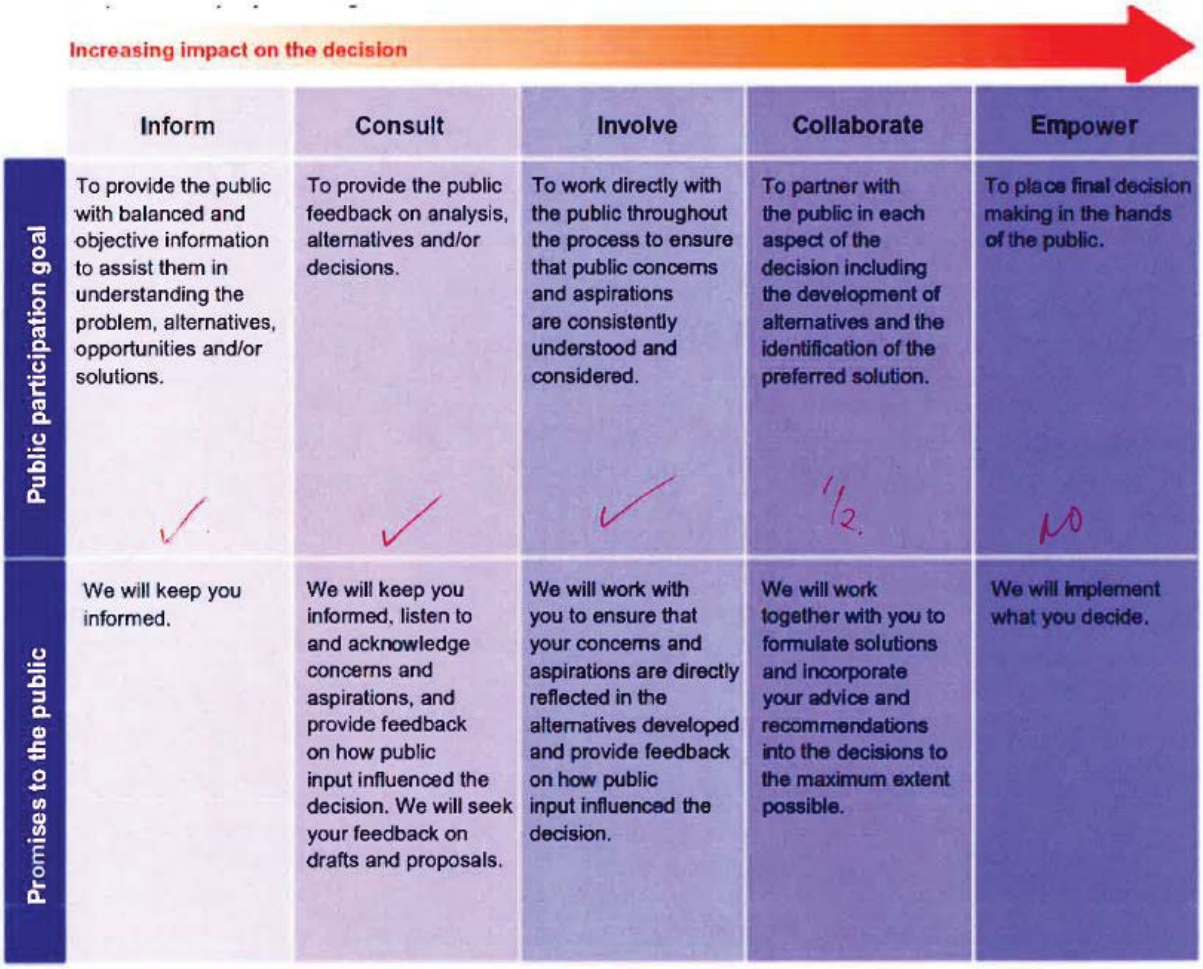


Figure B8: Public participation guide annotated by **[S]**.

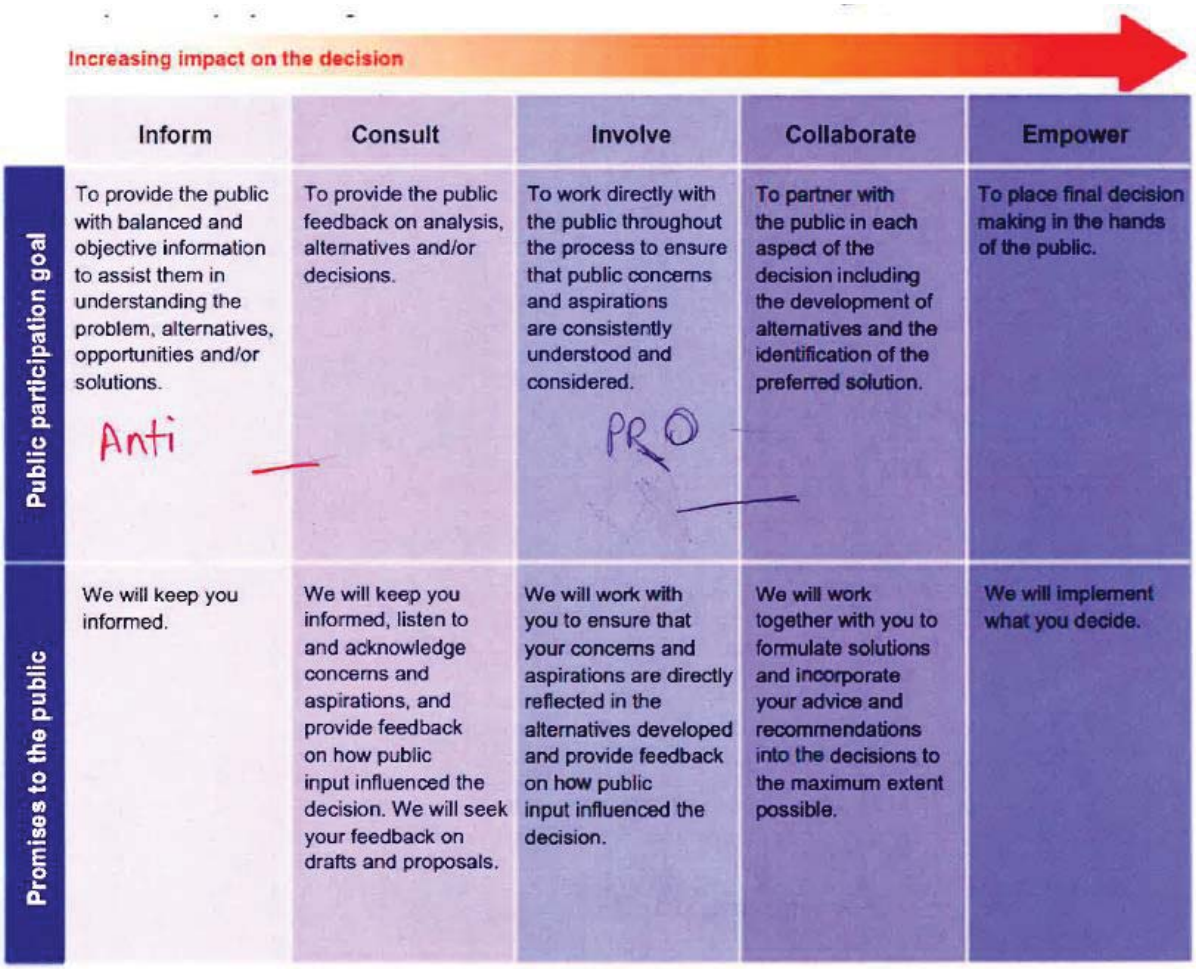


Figure B9: Public participation guide annotated by **[LR]**. As a news reporter and representative of the whole community, she marked on the diagram how she felt the majority of pro-pipeline supporters felt and the majority of anti-pipeline supporters felt that she had spoken to.