

Future scenarios for the Fitzroy River catchment: summary of key findings relevant to the Western Australia Government Discussion Paper

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Warning: Aboriginal and Torres Strait Islander people should be aware that this presentation may contain photographs of deceased persons.

Cover photograph: Fitzroy River at sunset. Photo: Dan Dixon.

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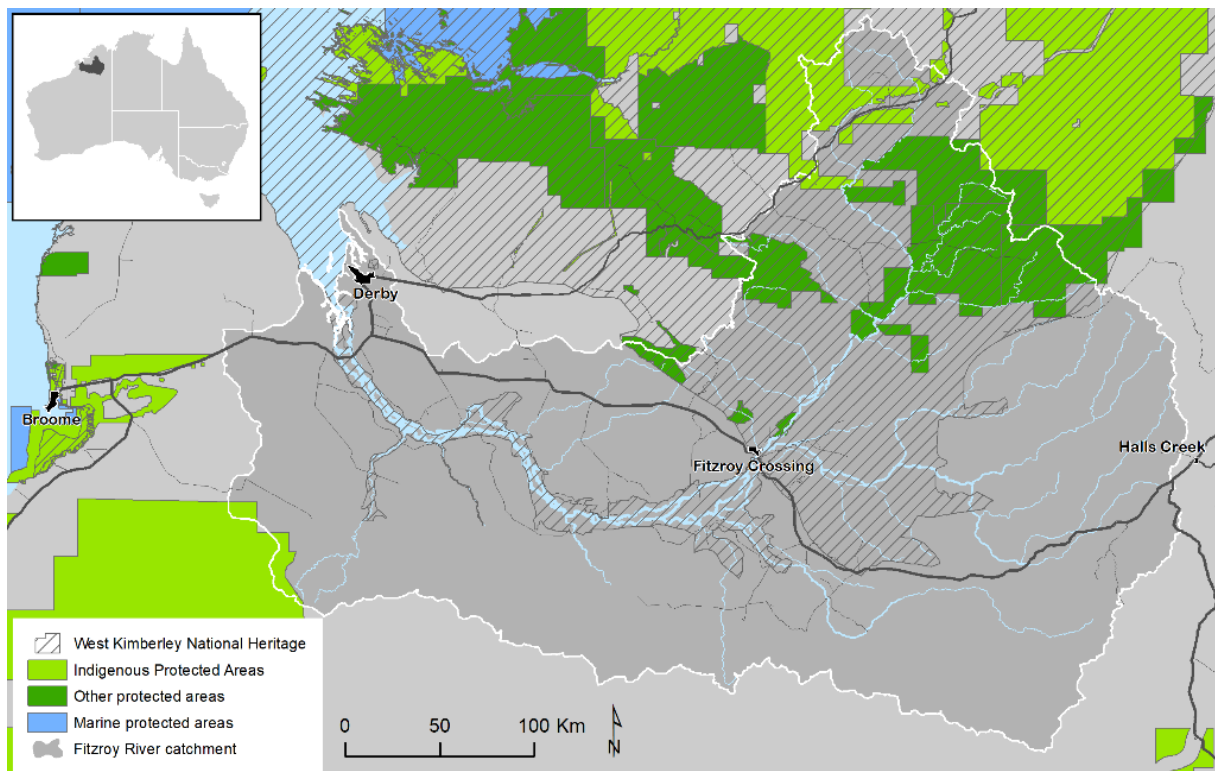
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1. Summary of NESP project 1.6 Multi-objective planning in northern Australia

Given ongoing plans to develop northern Australia and tensions among diverse interest groups, there is a need to develop new planning approaches that support multiple land and water uses while maintaining environmental and cultural values. This project aimed to demonstrate one way to operationalise multi-objective catchment planning by creating and exploring scenarios. The project used the Fitzroy River catchment in the Kimberley region of Western Australia as a case study (Figure 1).

Figure 1. Map of the Fitzroy River catchment.



We used participatory scenario planning (PSP) to systematically examine possible development trajectories and their environmental and socioeconomic outcomes. Scenarios are stories about things that could happen (policies, demand for products, collaboration), which can influence development in the region. Project participants used scenarios to consider how alternative futures may unfold, and to discuss their perceptions and visions of the future.

Scenarios are helpful to identify opportunities and risks associated with decisions – for example, environmental and socioeconomic changes associated with alternative development options. Through this multi-stakeholder PSP process, Traditional Owners and stakeholders (hereafter ‘scenarios team’) collaboratively built and assessed the outcomes of four alternative futures for the catchment in 2050.

1.1 Purpose of the research

- Help participants to collaboratively construct and assess the outcomes of alternative development scenarios of the Fitzroy River catchment.
- Understand the positive and negative effects of different development pathways on the wellbeing of people in the region.

1.2 Activities and outcomes of the research project

The **scenario team** created and assessed four development scenarios in a series of workshops (Figure 2).

The scenario team included people from diverse backgrounds: Traditional Owners (Bunuba, Gooniyandi, Nyikina Mangala, Wilinggin, Yi-Martuwarra Ngurrara, Yungngora), pastoralists, Commonwealth, state and local government, environmental groups, mining, and tourism.

Figure 2. Activities during the participatory scenario planning workshops.

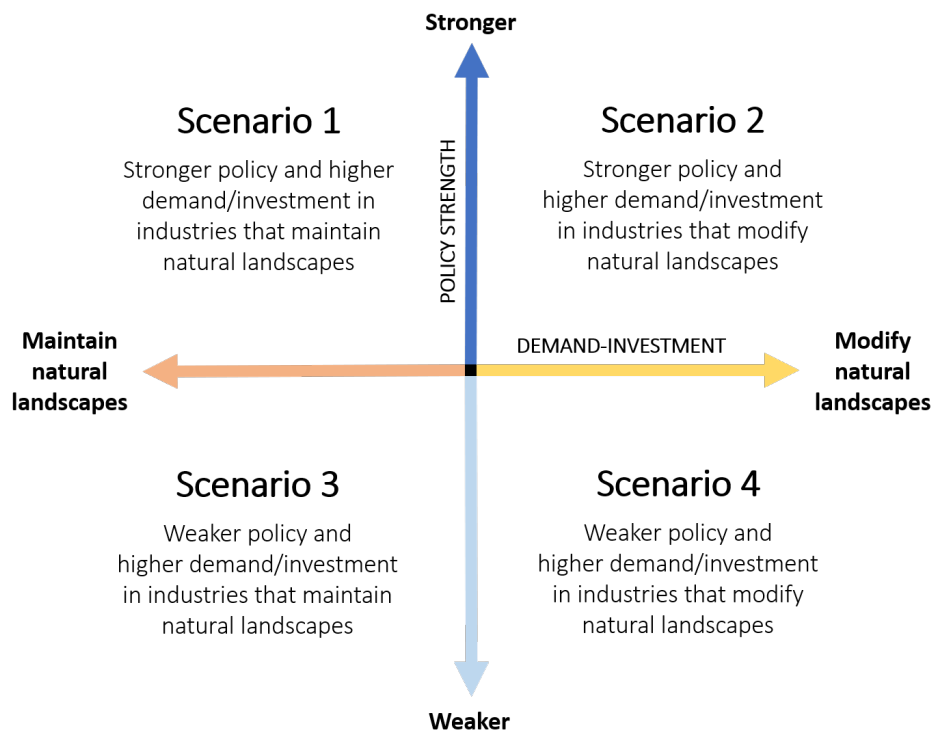


Scenarios were defined along two primary drivers of land-use change: the strength of policies and demand and investment in industries that maintain or modify natural landscapes (Figure 3).

Some development options were explored in more detail (Figure 4). The different types and amounts of water extraction associated with these initiatives in our scenarios are the most relevant to the WA discussion paper. Given available information, only irrigated agriculture and aquaculture developments (blue frames, Figure 4) were associated with hypothetical water extraction types and volumes.

Scenarios were described based on a combination of changes to governance, landscape and socioeconomic conditions expected to occur in 2050 under the four broad scenarios defined by the scenarios team (Figure 5).

Figure 3. Scenarios developed under the project.



5

Figure 4. Development options explored in the scenarios.



4

Project participants assessed the potential changes on people’s wellbeing under each scenario in two workshops: one exclusively with Traditional Owners, and another one with the scenario team (Figure 6). The results of the assessment can provide useful information about the proposed options (Point 7 of WA’s Draft Water Discussion Paper).

Figure 5. Main features of each scenario. The key development activities circled in red in the illustrations.

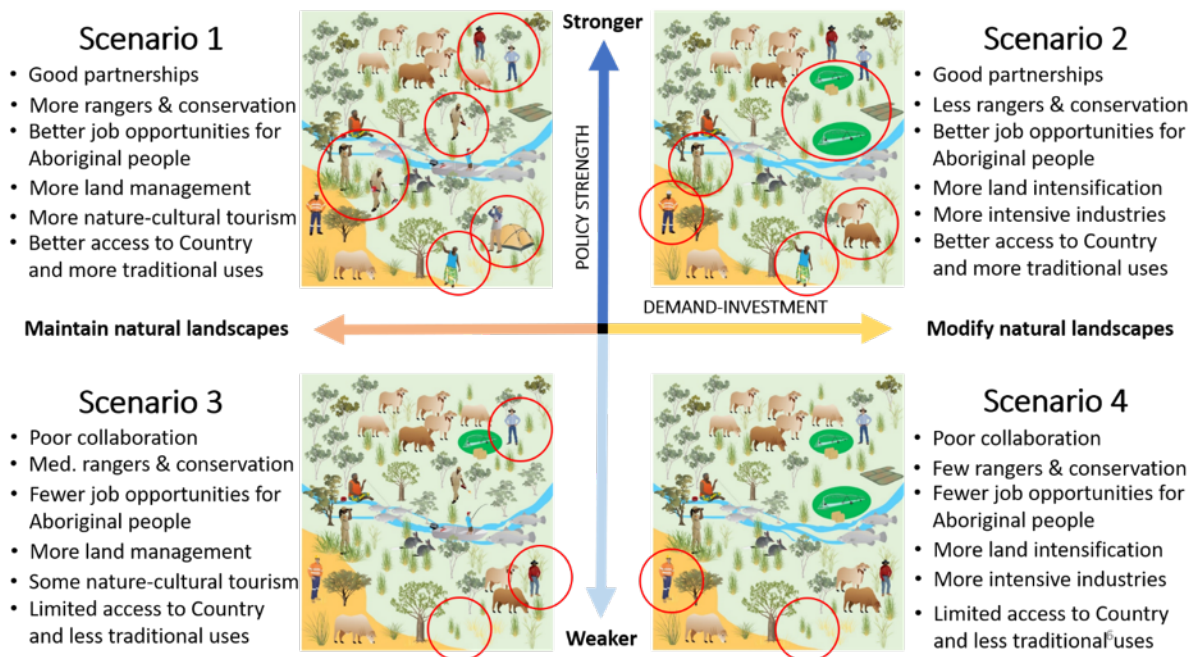
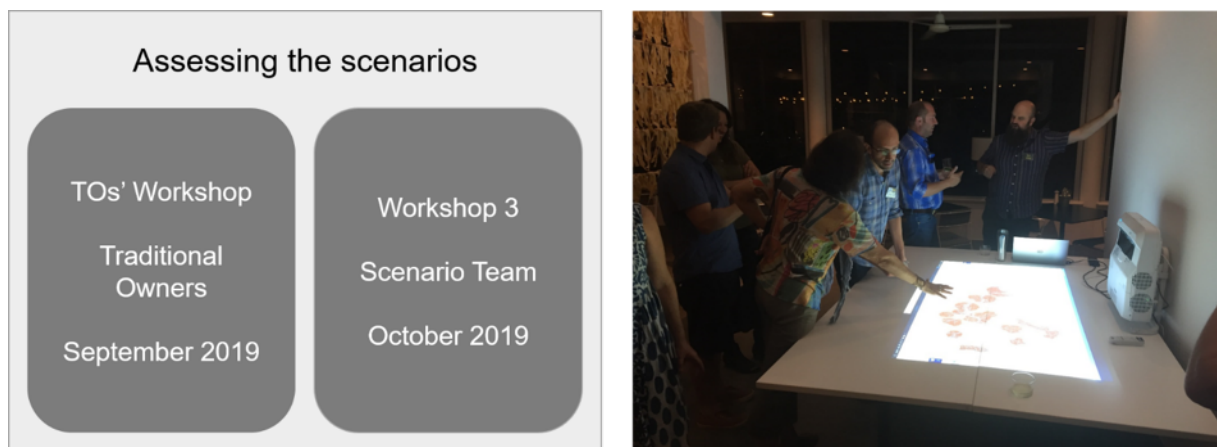


Figure 6. Scenario assessment workshops.



Our assessment of scenarios emphasized the importance of focusing on **wellbeing**. Our definition is based on Wallace et al. (2021), which was revised by project participants associated with Traditional Owners' perspectives. According to this revised definition, *wellbeing is a good life for you or your group, includes having what is most important in life and behaving well – this leads to a strong and healthy people and country*. It was also agreed that this concept of wellbeing is broadly equivalent with the Traditional Owners' concept of '**Liyan**' (Yap and Yu 2016).

During the assessment workshops we referred to the relationship between the concepts of wellbeing and Liyan, referred to in our assessment workshops: "*Mabu liyan is a Yawuru concept that means 'strong spirit', 'good feeling' and 'positive wellbeing'*". Personal to an

individual and also connected to the wider community and country, mabu liyan is the heart of the Yawuru social development agenda.”¹

Our assessment aimed to answer the following question: How could changes in different scenarios affect (positively or negatively) the wellbeing of people who live in or have significant interests in the catchment? To do this, the assessment explored nine wellbeing categories (Wallace et al. 2020, Figure 7) and rated the possible change in each (Figure 8), compared to the current situation in the catchment.

Figure 7. Nine wellbeing categories used in the scenario assessments, and notes on the discussion of one category (healthy country and river) during a workshop.

Wellbeing categories

- Enough food and water to drink
- Satisfying work
- Knowledge of culture and country
- Feeling safe
- Fun – recreation, leisure
- Strong family and community relationships
- Healthy country/ river
- Places and things that make you feel good
- Inner peace, spiritual fulfilment

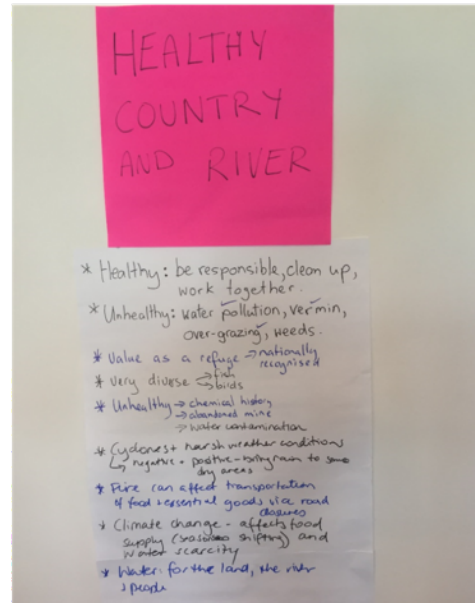


Figure 8. Scale used by participants to assess the change in each wellbeing category, under each scenario, as compared to their current wellbeing.



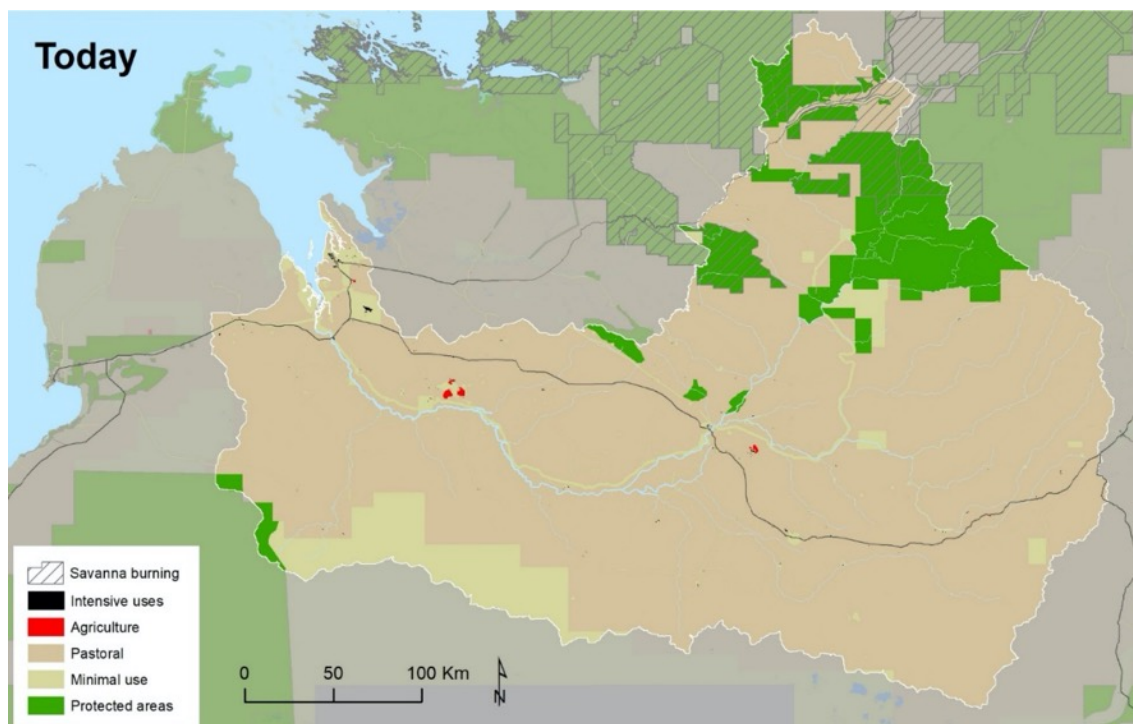
¹ The Yawuru people are the Native Title holders of the land in and around Broome. Downloaded 27 August 2019 from: jawun.org.au/2019/03/building-a-future-of-strong-spirit-mabu-liyan

1.3 Summary of scenarios, including associated types of water extraction and allocations and the ratings by the multi-stakeholder scenario team and by Traditional Owners

We created a land use maps for each of the four scenarios, including a description of the changes in the type of water extraction and use for industries that require water, specifically irrigated agriculture. The new maps and changes were discussed and compared with the current situation and land/water use in the catchment.

Today, there is some irrigated fodder within beef enterprises using surface water harvesting (6 GL, 0.12% of median discharge) and small areas using groundwater (Figure 9).

Figure 9. Current land uses in the Fitzroy River catchment.



1.3.1 Scenario 1

Scenario 1 had the following key features (Figures 10-12):

- Stronger policy and higher demand and investment in industries that maintain natural landscapes
- Six 1000-ha farms (6,000 ha) based on groundwater (100 GL, 2.9% of recharge)
- No surface water harvesting

Figure 10. Key drivers of change under scenario 1.

Scenario 1

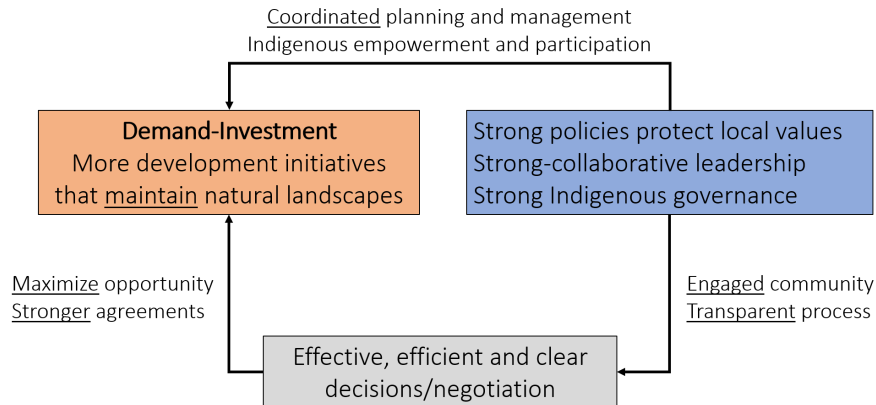
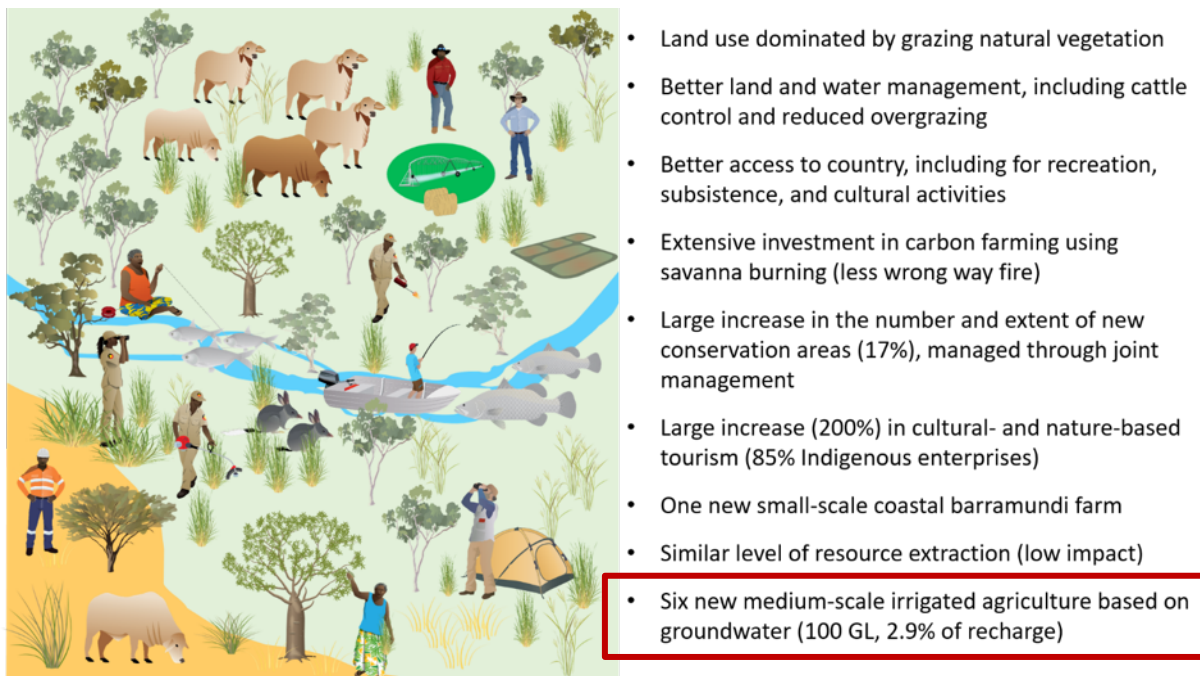


Figure 11. Key features of scenario 1.



Assessment results:

- The positive total score for scenario 1 in the Traditional Owners' workshop was substantially lower than that from the multi-stakeholder workshop (Figure 13).
- Concerns regarding 'healthy country and healthy river' were mostly associated with the withdrawal of water.
- Another concern was contamination related to land use intensification and promotion of pests and weeds.
- Regarding use of ground water only, a participant noted that even if only ground water was used, all living water is connected and thus it would impact the river.

Figure 12. A possible land use configuration representing scenario 1 in 2050.

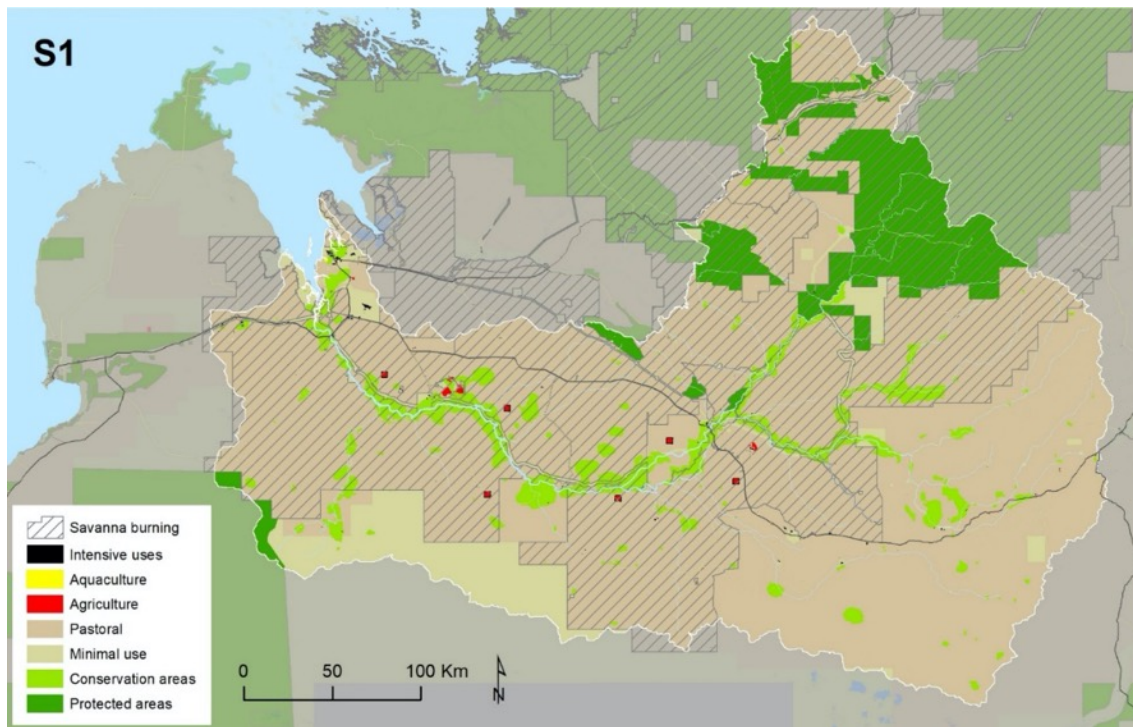
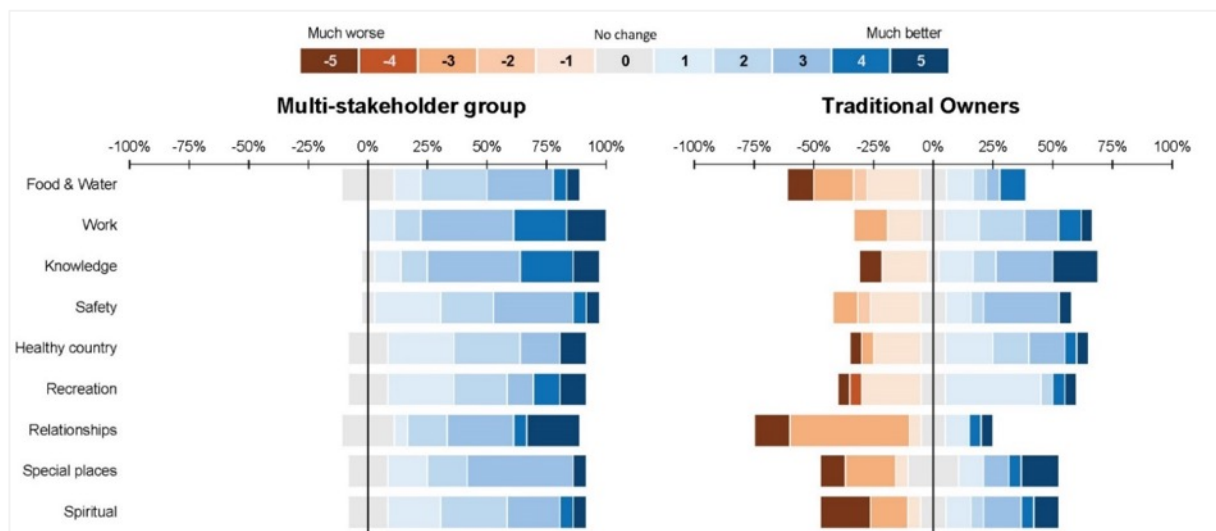


Figure 13. Participants' ratings of scenario 1, for the multi-stakeholder scenario team and Traditional Owners' workshops. Following group discussions on the wellbeing changes resulting from scenario 1, workshop participants were asked to rate changes from "much worse" to "much better" with the option of 'no change' in comparison with the current situation using a 10-point scale. The diverging bars show the percentage of participants that rated positively (blue tones, right), negatively (orange tones, left), or neutrally (grey, centre) the changes in each wellbeing category for scenario 1. Different tones of orange or blue correspond to the level of decline or improvement, respectively. The width of each segment corresponds with the percentage of participants that rated the change (e.g. very few participants of the multi-stakeholder group rated 'having enough food and drinking water' as 'much better' for scenario 1).

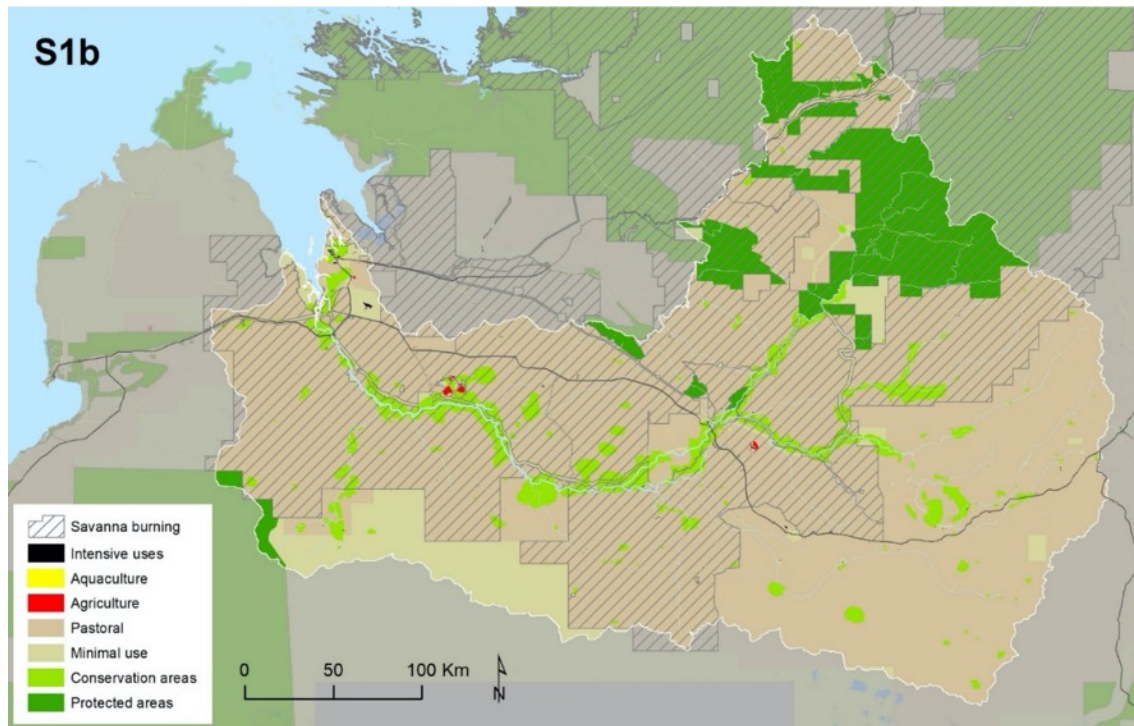


1.3.2 Scenario 1b

Scenario 1b had the following key features (Figure 14):

- Stronger policy and higher demand and investment in industries that maintain natural landscapes
- No new agriculture developments based on groundwater or surface water harvesting

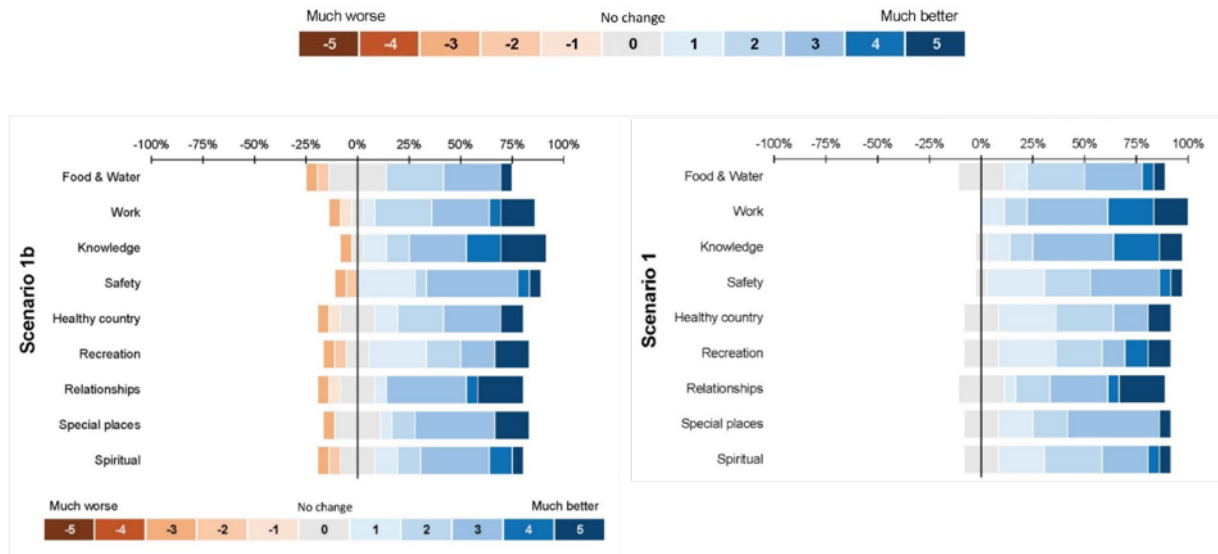
Figure 14. A possible land use configuration representing scenario 1b in 2050.



Assessment results:

This scenario was only rated in the multi-stakeholder workshop. It had mostly positive and 'no change' ratings (Figure 15); all the negative ratings came from participants linked to agricultural interests, who scored most wellbeing categories as worsening.

Figure 15. Participants' ratings of scenarios 1 and 1b for the multi-stakeholder scenario team workshop. Scenario 1b was not rated in the Traditional Owners' workshop.



1.3.3 Scenario 2

Scenario 2 had the following key features (Figures 16-18):

- Stronger policy and higher demand and investment in industries that modify natural landscapes
- Six 2000-ha farms (12,000 ha) based on groundwater (120 GL, 3.4% of recharge)
- Six 3000-ha farms (18,000 ha) based on off stream water harvesting (300 GL, 6.1% of median discharge)

Figure 16. Key drivers of change under scenario 2.

Scenario 2

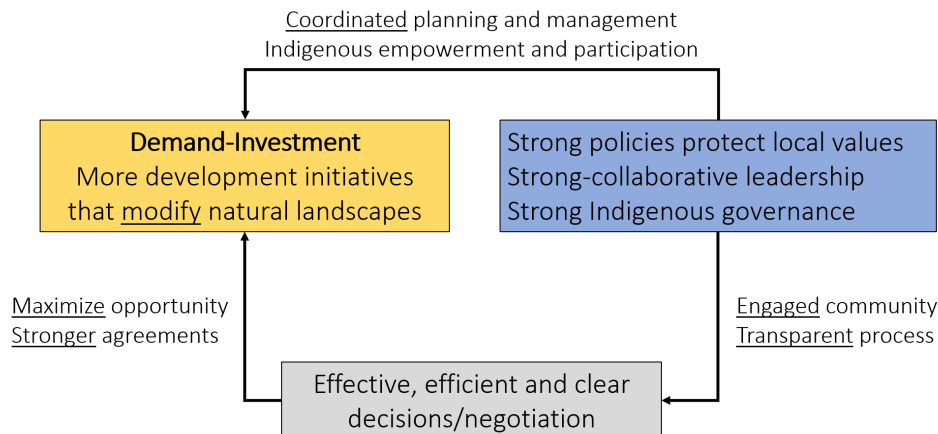


Figure 17. Key features of scenario 2.

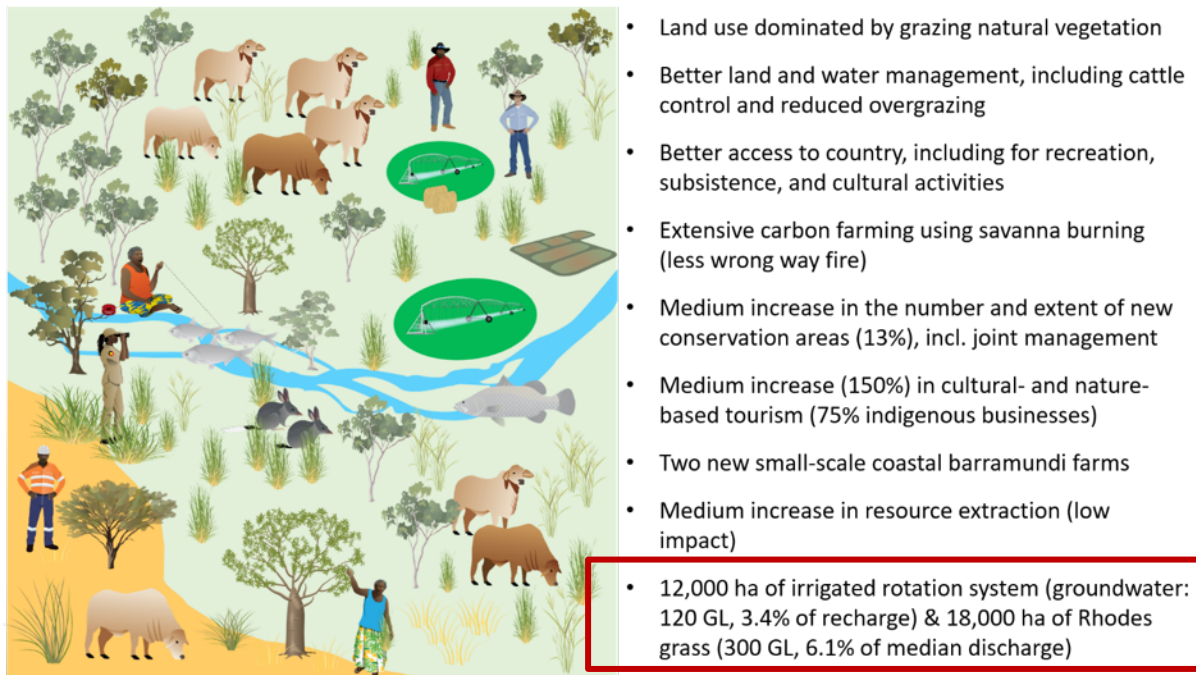
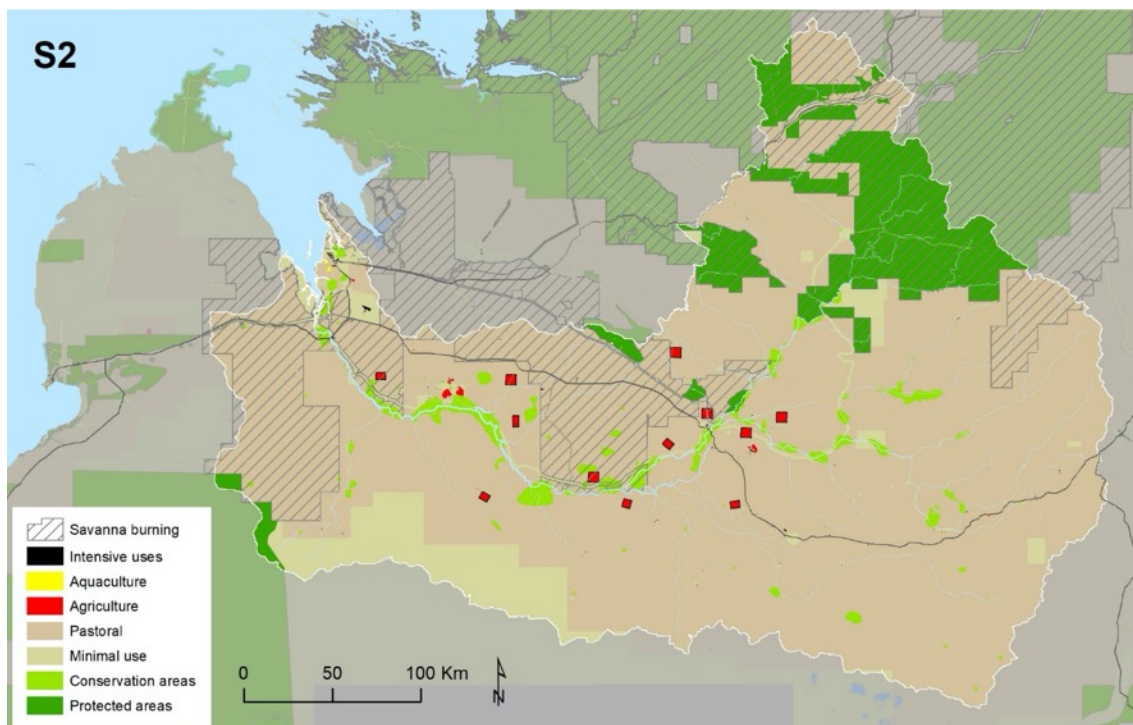


Figure 18. A possible land use configuration representing scenario 2 in 2050.

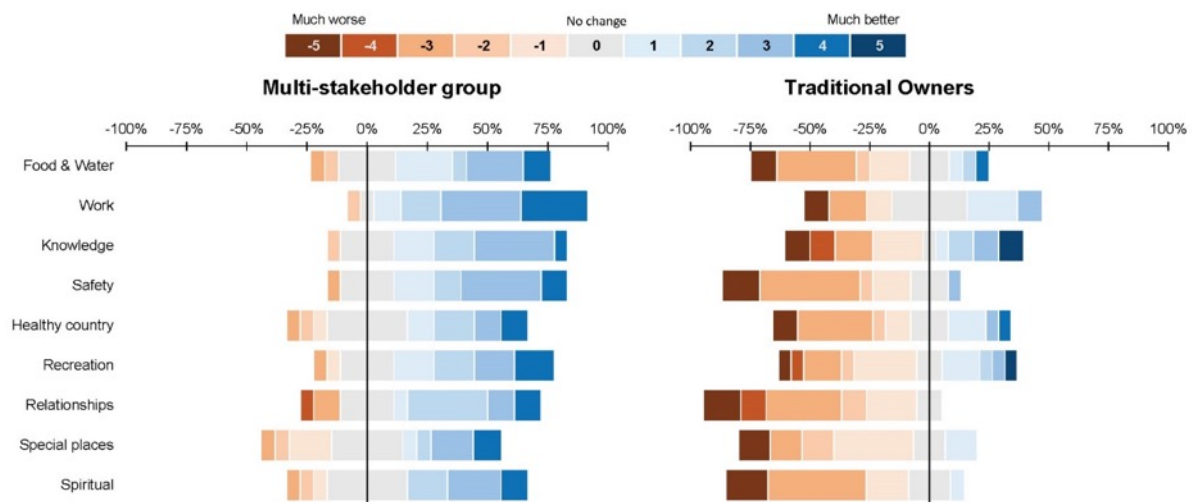


Assessment results:

- This scenario was also mostly positively scored in the multi-stakeholder workshop, while it was negatively scored by Traditional Owners (Figure 19).

- Some concerns about water withdrawn from the river or aquifers.
- A participant emphasized water is the source of life for everybody and everything, and the river is considered a living being, having its own right to life.
- Some participants described the current scarcity of water; for example, when going out on trips for collecting medicine plants they have to carry water because there is limited water available in the environment, negatively impacting on their ability to go on country and keep their connection to country strong. They feared that an intensification of irrigated agriculture would worsen this situation and significantly affect their wellbeing.

Figure 19. Figure: Participants' ratings of scenario 2, for the multi-stakeholder scenario team and Traditional Owners' workshops.



1.3.4 Scenario 3

Scenario 3 had the following key features (Figures 20-22):

- Weaker policy and higher demand and investment in industries that maintain natural landscapes
- No surface water harvesting

Figure 20. Key drivers of change under scenario 3.

Scenario 3

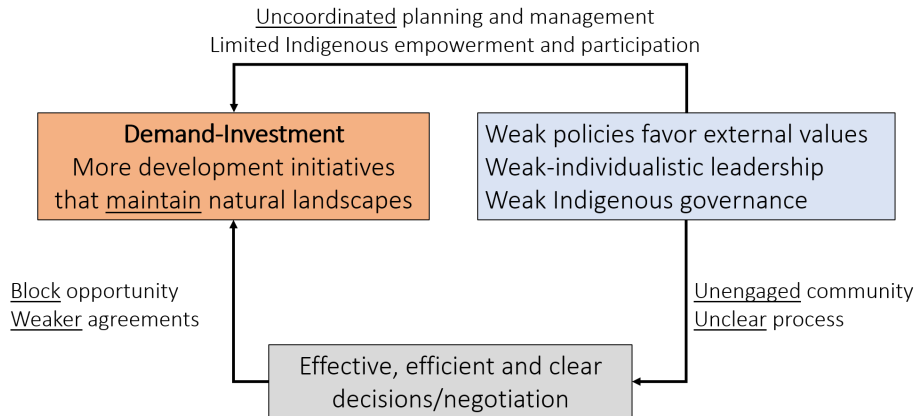
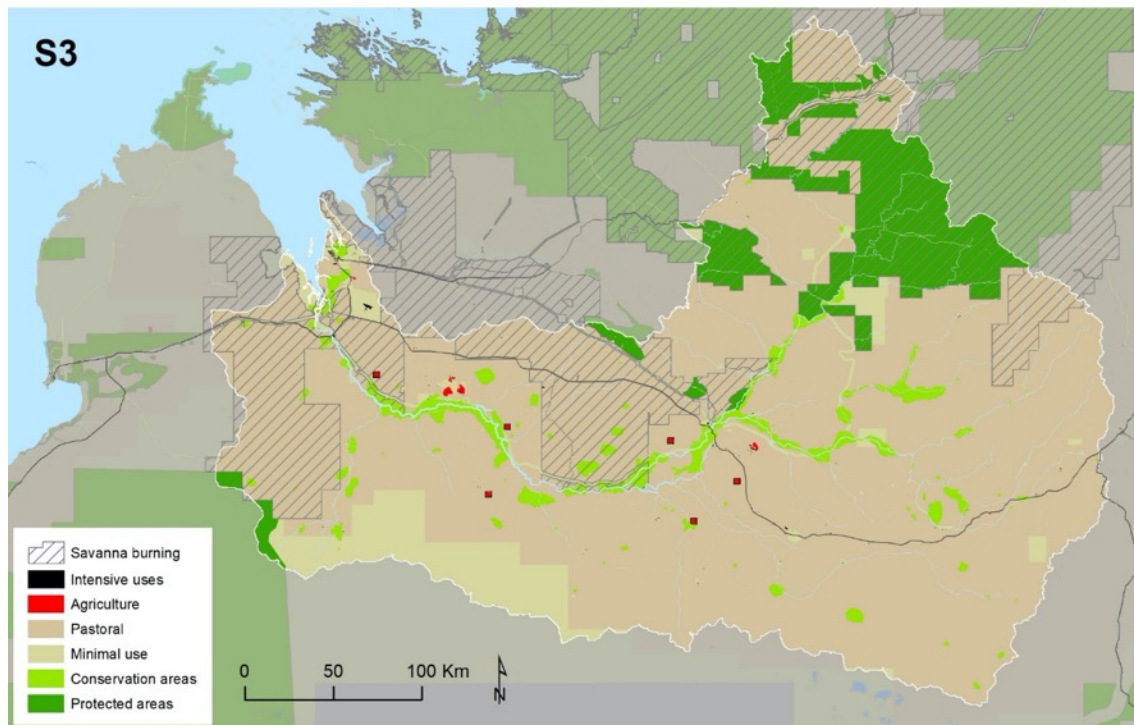


Figure 21. Key features of scenario 3.



- Land use dominated by grazing natural vegetation
- Land and water management, including cattle control and reduced overgrazing does not improve
- Access to country remains limited, including for recreation, subsistence, cultural activities
- Moderate carbon farming using savanna burning (some improvement vs wrong way fire)
- Moderate increase in the number and extent of conservation areas (14%), with limited joint management with TOs
- Little increase (110%) in cultural- and nature-based tourism (65% Indigenous)
- No coastal barramundi farms
- Similar level of resource extraction (some impacts)
- Six 1000-ha stand & graze farms (6000 ha) based on groundwater (110 GL, 3.1% of recharge)

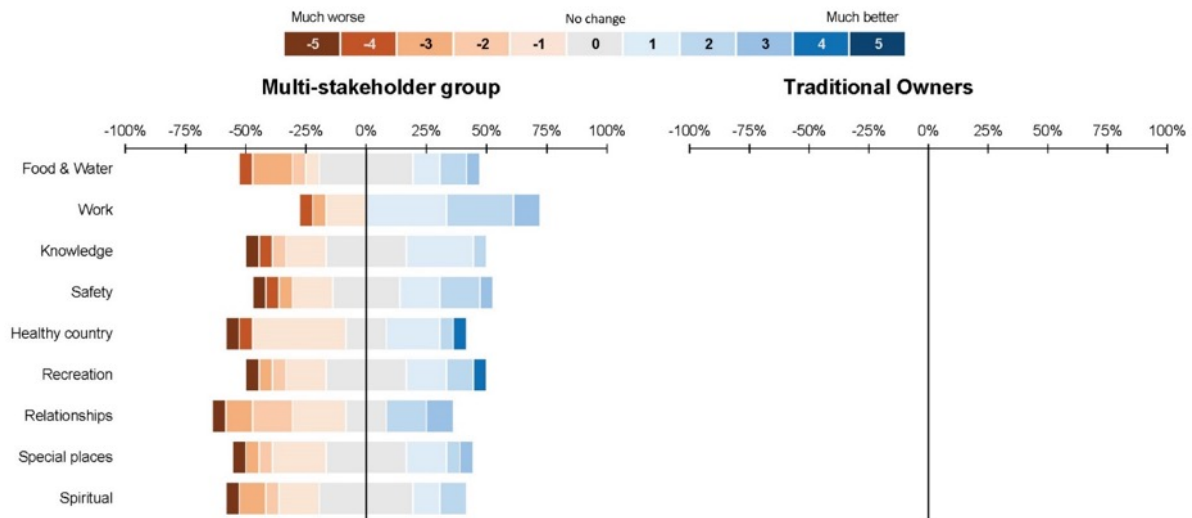
Figure 22. A possible land use configuration representing scenario 3 in 2050.



Assessment results:

- Scenario 3 was assessed only in the multi-stakeholder scenario team workshop, where it received the highest amount of ‘no change’ ratings among the scenarios assessed (Figure 23).
- Participants commented that this is the closest to a ‘business as usual’ scenario, and that it “seems like where we are heading if nothing changes”.
- Whilst responses were more divided, there was a small trend towards negative ratings across most wellbeing categories (except work), possibly associated with participants’ perceptions that weak policies could leave things open to contention, and that ultimately “everything comes down to governance”.

Figure 23. Participants' ratings of scenario 3 for the multi-stakeholder scenario team workshop. Scenario 3 was not rated in the Traditional Owners' workshop.



1.3.5 Scenario 4

Scenario 3 had the following key features (Figures 24-26):

- Weaker policy and higher demand and investment in industries that modify natural landscapes
- Six 1000-ha farms (6,000 ha) based on groundwater (110 GL, 3.1% of recharge)
- Six 3000-ha farms (18,000 ha) based on off stream water harvesting (360 GL, 7.3% of median discharge)

Figure 24. Key drivers of change under scenario 4.

Scenario 4

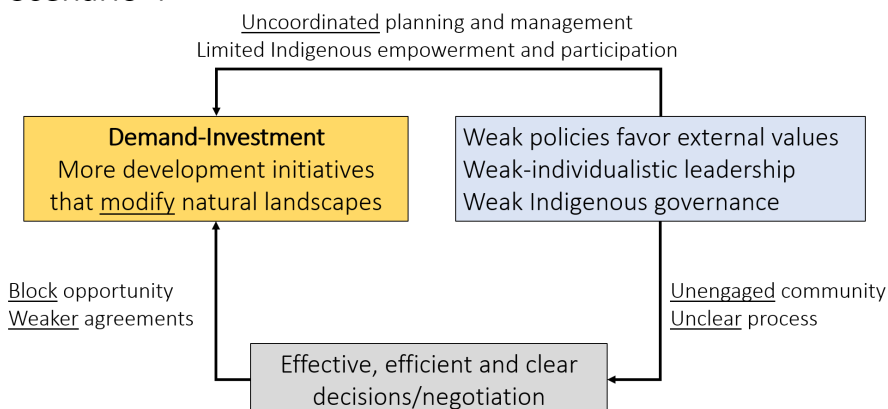
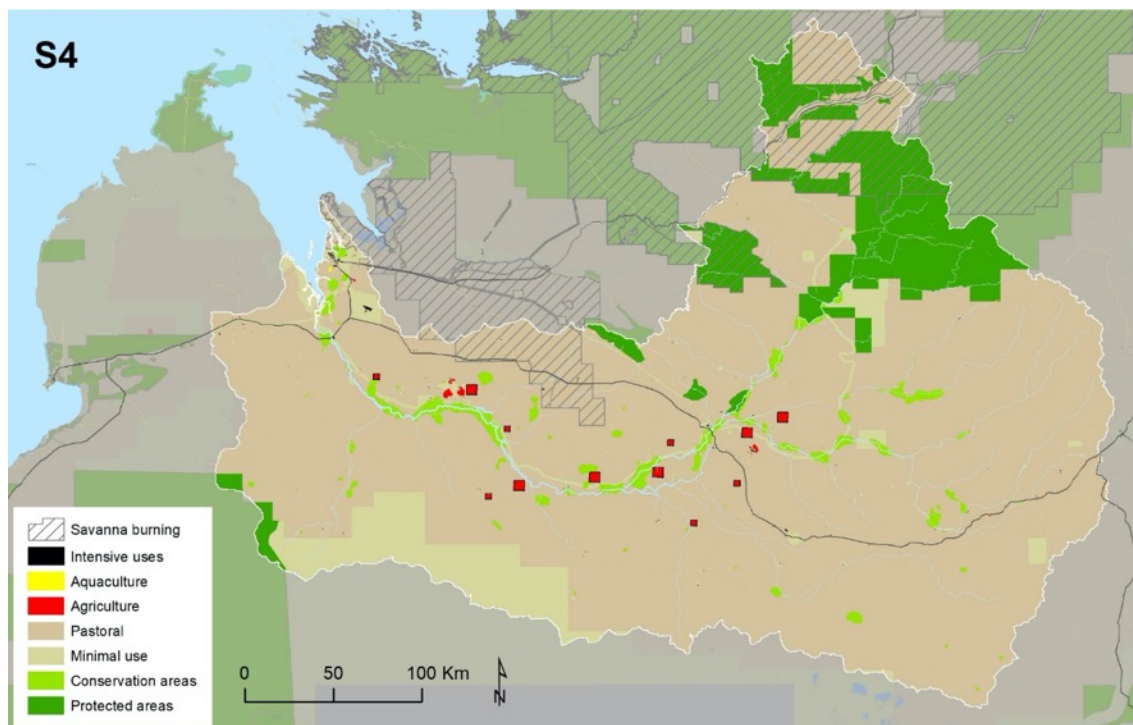


Figure 25. Key features of scenario 4.



- Land use dominated by grazing natural vegetation
- Land and water management, including cattle control and reduced overgrazing does not improve
- Access to country remains limited, including for recreation, subsistence, cultural activities
- Small-scale carbon farming using savanna burning (little improvement vs wrong way fire)
- Low increase in number and extent of conservation areas (12%), limited joint management with TOs
- Modest increase (125%) in cultural- and nature-based tourism (65% Indigenous)
- One new small-scale coastal barramundi farm
- High increase of resource extraction (higher impact)
- 6,000 ha of groundwater (110 GL, 3.1% of recharge) and 18,000 ha off-stream (360 GL, 7.3% of median discharge) irrigated Rhodes grass

Figure 26. A possible land use configuration representing scenario 4 in 2050.

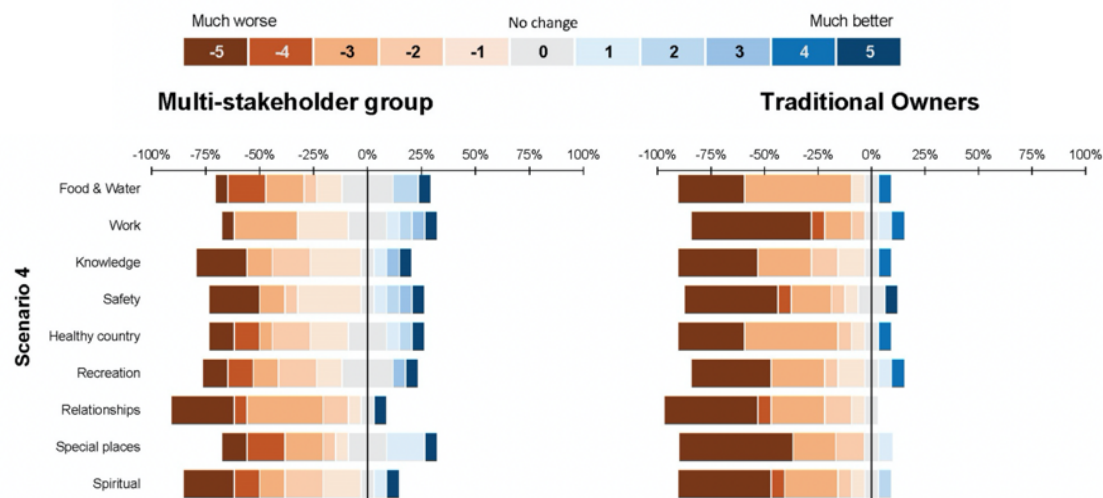


Assessment results:

- Lowest scores in both workshops and across all categories, especially by Traditional Owners (Figure 27).

- For Traditional Owners, negative scores relate mainly to the extensive agricultural development, intensified by perceptions that Traditional Owners would have less power in a weak policy and governance scenario.
- Given the poor governance associated with this scenario, local community would miss out on benefits but bear the consequences of poor environmental management and lack of compliance on water use.

Figure 27. Participants' ratings of scenario 4, for the multi-stakeholder scenario team and Traditional Owners' workshops.



1.4 General remarks from the assessment of scenarios

- The comments of participants of the two assessment workshops (TOs and multi-stakeholder group) reflect most points stated in the boxes “what people have said already” of the DWER Discussion Paper.
- It is important to consider the set of alternative uses of water associated with water allocation options presented in the scenarios to understand the positive and negative impacts associated with each option. Where, by who and for what will the water be used notably influenced responses.
- The diverse responses of participants to the scenarios shows there is no agreement or clear preference for any given scenario across all groups, but scenarios with higher water allocations (particularly water harvesting) were generally rated more negatively, especially by Traditional Owners.
- Water use was an important consideration when rating the scenarios, both in terms of potential changes in water flow, and of pollution associated with land use intensification. The effects of these changes affected several categories of wellbeing in different ways.
- It is important to have clarity on the proposed ways in which environmental and cultural changes (positive or negative) due to water extraction from different initiatives will be monitored and assessed

2. Key findings regarding specific sections of the Discussion Paper

2.1 Adaptive management

Discussion Paper proposal	Comments based on our research findings
<i>...water resources are managed and developed in a sustainable manner...</i>	From discussions of scenarios, it is evident there are diverse views on the type of development that should happen, including about their potential benefits (or lack of, or negative impacts) to different groups.
<i>...there will be requirements for careful and targeted monitoring...</i>	Appropriate monitoring systems (early-warning) that trigger mitigation measures when adverse changes (e.g. environmental impacts) are detected. This needs to be transparent to everyone; good compliance and enforcement are critical (Scenarios 1 and 2). Concern that even in scenarios with relatively low allocations there is potential for overuse of water if there is weak monitoring and little enforcement of rules (Scenarios 3 and 4).

2.2 No dams

Discussion Paper proposal	Comments based on our research findings
<i>Infrastructure that spans the width of the Fitzroy River and its tributaries will not be allowed...</i>	All the scenarios assume there will be no dams. We would expect that addition of dams into any scenario would result in notably more negative responses from most participants.
<i>Off-stream water storage infrastructure may be supported...</i>	Scenarios 2 and 4 consider this type of developments and responses on the potential changes in wellbeing associated with these options varied. Overall, scenarios including water harvesting were rated more negatively.

2.3 Taking groundwater

Discussion Paper proposal	Comments based on our research findings
<p><i>People are supportive of abstracting groundwater where the risks to the Fitzroy River are low</i></p>	<p>The scenarios team had more positive views on groundwater than participants of the Traditional Owners’ workshop. However, some participants of the scenarios team had concerns about potential impacts on the river and waterholes given hydrological connections, reflected in different ratings of changes in wellbeing.</p>
<p><i>Groundwater total allocation of 108.5 GL/year from the Grant Poole and Wallal aquifers and taking water from the Alluvial and Devonian Reef aquifers would be restricted.</i></p>	<p>Most scenarios included similar levels of groundwater extractions, between 100 GL (2.9% of recharge) and 120 GL (3.4% of recharge); a variation of scenario 1 excluded groundwater extraction, but the ratings did not vary notably. <u>More details in Point 7 and supplementary presentation</u></p>
<p><i>Alluvial aquifer: abstracting water from this aquifer is considered very high risk to these value</i></p>	<p>Scenarios were based on extraction of the Grant Poole aquifer, noting the uncertainty in the potential impacts due to limited knowledge. Given the large uncertainty and high risk of any extraction, it is important to define what ‘small scale’ means in this context.</p>
<p><i>Devonian Reef Aquifer: supports high number of significant cultural, environmental, geological and heritage values. The aquifer’s unique hydrogeology makes it difficult to assess the impacts of abstraction and so taking water from it is considered very high risk to these values.</i></p>	<p>As above, scenarios were based on extraction of the Grant Poole aquifer.</p> <p>A map showing the degree to which different areas can be used and how likely for each aquifer (e.g. <i>Not allowed, Unlikely, Likely, Very likely</i>) would be more useful than Figures 1 and 2 of the current Discussion Paper (see next page). This information will facilitate better informed discussions and feedback.</p>
<p><i>...ensuring the cultural, environmental, geological and heritage values that depend on groundwater are not negatively affected by water extraction.</i></p>	<p>It is important to use clear, agreed and consistent system to measure changes (positive, negative), on people’s wellbeing. Changes in “values” can affect people’s wellbeing in different ways.</p> <p>Maps are important to support discussions. Mapping ‘cultural values’ is complicated and the have many limitations (Figure 5, slide 20 of the attached presentation). Discussions on the impacts on local</p>

	values needs to be assessed case by case using appropriate protocols and tools (see Project 5.4).
<i>Up to a total of 108.5 GL/year could be released for allocation, a portion of which could be available through a Fitzroy Aboriginal Water Reserve.</i>	Indirectly, scenarios considered different access to resources by Aboriginal enterprises. For example, in scenarios 1 and 2 access to water resources for irrigated agriculture would include both Indigenous and non-indigenous land and led businesses.

Figure 1. Depth (in meters below ground level) to the top of the Grant Poole Aquifer

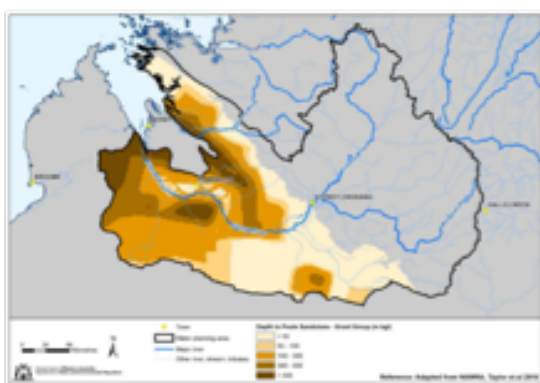
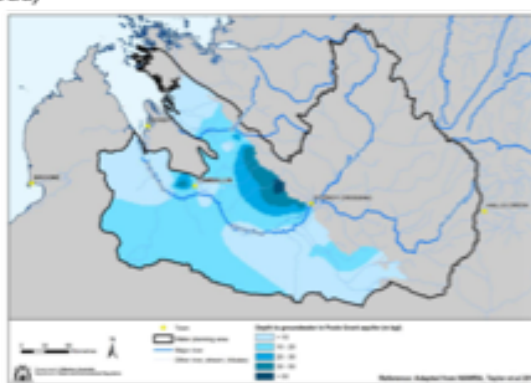


Figure 2. Depth (in meters below ground level) to water in the Grant Poole Aquifer (interpolated hydraulic head)



2.4 Taking surface water

Discussion Paper proposal	Comments based on our research findings
<i>There is interest in a range of economic activities that may bring positive economic and social outcomes for the local community. Many of these activities need reliable access to water.</i>	Scenarios included some of these activities and showed the interest in a diversified economy, not necessarily based on significant water extraction. It would be useful to have a summary table of the options considered and the water extraction associated with those options.
<i>Surface water could be licensed in stages up to an allocation limit. Up to 300 GL, with 100 GL initially released for general licensing and 90 GL released in a Fitzroy Aboriginal Water Reserve. For individual projects, up to 20 GL/year could be available from the general</i>	Scenarios reflect different levels of surface water (0 to 360 GL/year) assuming that maximum development and allocation will be reached by 2050. Staged developments are not explicit in scenarios, but they are implicit in scenarios that consider any water extraction.

<i>access pool for projects to stage development.</i>	
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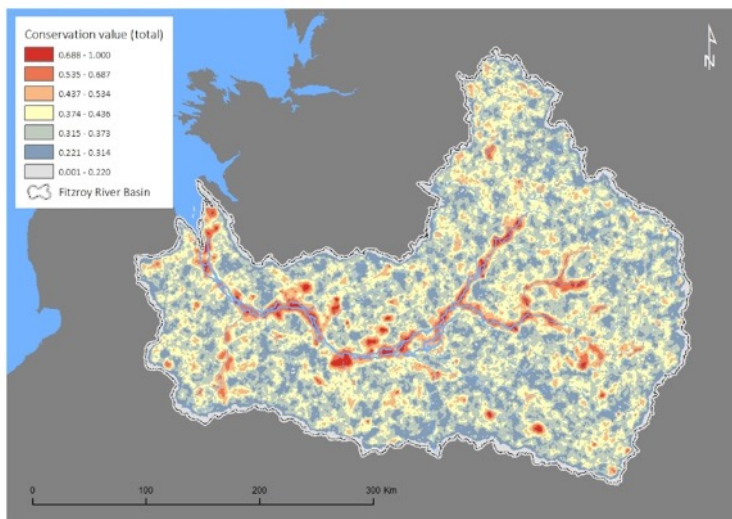
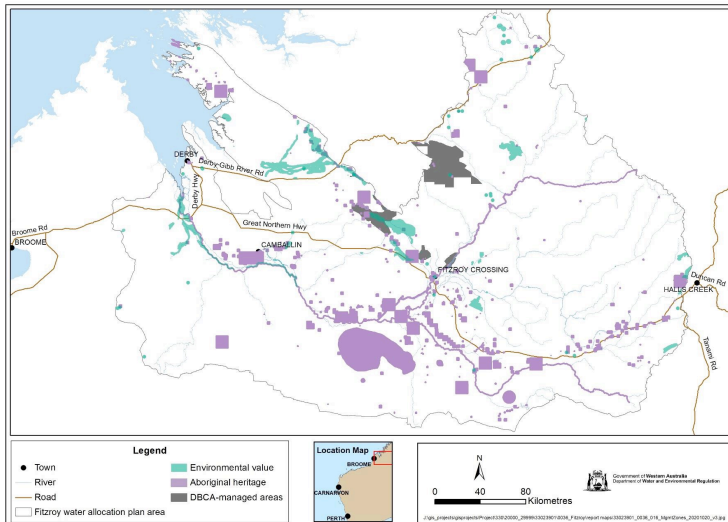
2.5 Opportunities for Aboriginal economic development

Discussion Paper proposal	Comments based on our research findings
<i>Establish a Fitzroy Aboriginal Water Reserve for native title holders...</i>	<p>Scenarios reflected differences in terms of access to opportunities derived from the use of land and water resources. These opportunities were considered by workshop participants when assessing their impacts and balance in the positive and negative changes in wellbeing.</p> <p>Scenarios 1 and 2 considered that the access to water resources for irrigated agriculture would include both Indigenous and non-Indigenous land and led businesses. These scenarios were associated with highest improvements in wellbeing, including access to satisfying work (category 'work' in the figures comparing workshop ratings above).</p>
<i>The points included for discussion and feedback implicitly focus on agricultural development as the main (or the only) economic opportunity for Aboriginal groups in the catchment.</i>	<p>Through our interviews of the scenario team members (including Aboriginal and non-Aboriginal people) and the comments of some participants of the workshops, it was clear that there is significant interest in alternative economic activities, especially by Traditional Owners.</p> <p>Some of these economic alternatives were included in scenarios (e.g. carbon farming, nature and cultural tourism) and others noted to be further investigated (e.g. bushfood).</p>

2.6 Regulatory requirements

Discussion Paper proposal	Comments based on our research findings
<i>The paper assumes the water allocation is (and will remain) to take place under a high level of legislative and regulatory</i>	Weaker policy and governance are possible in Western Australia, and these would have notable effects on the way people could access opportunities, how well local values are protected, and the ways

<p><i>requirements across the Fitzroy Catchment.</i></p>	<p>people perceive the potential risks and benefits of different forms of development.</p> <p>A conservative approach to water allocation that considers “imperfect” governance and management context is needed, including provisions that guarantee that Traditional Owner groups are not further disenfranchised – for example, including such groups in a co-management rather than advisory fashion.</p>
<p><i>The paper notes the proposed take and use of water will be ecologically sustainable and environmentally acceptable.</i></p>	<p>In scenarios 1 and 2 (stronger policies, good governance), developments avoid areas with potential environmental values (conservation of biodiversity). These scenarios were rated more positively in both workshops when compared to scenarios 3 and 4 (weak policies).</p>
<p><i>Development projects should avoid <u>where possible</u> and protect areas with significant heritage, cultural and environmental values.</i></p>	<p>It is important to use clear, agreed and consistent system to measure changes (positive, negative), on people’s wellbeing. Under such system, focusing on how changes in the “values” could affect wellbeing in different ways and magnitude is needed.</p> <p>Maps are important to support discussions. Mapping ‘cultural values’ is complicated and have many limitations (Figure 5 of the Discussion Paper below). Discussions on the impacts on local values needs to be assessed case by case using appropriate protocols and tools (see Project 5.4).</p>
<p><i>Existing areas where environmental and cultural values have been identified under current legislation and policy...</i></p>	<p>There are better ways to map and represent conservation, cultural and heritage value than the Figure 5. It is important to identify and assess different elements independently and with clear, explicit and science-based criteria. Our project provides several options (see project final report). The following map is an example of a map showing areas of importance for biodiversity conservation. Important areas for different elements can have different configurations and are limited by incomplete knowledge (e.g. modelled species without information about critical seasonal habitats).</p>



2.7 Options for consideration

Discussion Paper proposal	Comments based on our research findings
<p><i>Option 1: Only groundwater, total allocation of 108.5 GL/year from the Grant Poole and Wallal aquifers and taking water from the Alluvial and Devonian Reef aquifers would be restricted.</i></p>	<p>Our scenarios explored options that combined options 1 and 2, but also considered the different access to resources by Traditional Owners and levels of compliance and monitoring:</p> <p>Scenario 1. Stronger policy/governance and mostly industries that maintain natural landscapes</p> <p>100 GL groundwater + 0 GL surface water = 100 GL (Option 1)</p>
<p><i>Option 2: Groundwater (as per Option 1) + Up to 300 GL of surface water, with 100 GL initially released for general licensing and 90 GL released in</i></p>	<p>Overall positive, but some concerns due to water extraction. The positive total score in the Traditional Owners' workshop was substantially lower than that from the multi-stakeholder workshop. Concerns</p>

a Fitzroy Aboriginal Water Reserve. Strict water licensing rules about when, where and how water can be taken to protect the river, floodplains, wetlands and estuary would apply.

regarding 'healthy country and healthy river' were mostly associated with the withdrawal of water.

Another concern was the contamination related to land use intensification and promotion of pests and weeds.

Regarding use of ground water only, some noted that even if only ground water was used, all living water is connected and thus it would impact the river.

Scenario 1b. As above, but without new irrigated agriculture.

No groundwater or surface water (very similar to current water use)

This scenario was only rated in the multi-stakeholder workshop. It had mostly positive and 'no change' ratings; few negative ratings from participants with agricultural interests, who scored most wellbeing categories as worsening.

Scenario 2. Stronger policy/governance and more industries that modify natural landscapes

120 GL groundwater + **300 GL** surface water = **420 GL** (Option 2)

This scenario was also mostly positively scored in the multi-stakeholder workshop, while it was more negatively scored by Traditional Owners. Some concerns about water withdrawn from the river or aquifers.

Some Traditional Owners noted the current scarcity of water, already negatively affecting their ability to go on Country and keep their connection to country strong. They feared increasing irrigated agriculture could worsen this situation and significantly affect their wellbeing.

Scenario 3. Weaker policy/governance and more industries that maintain natural landscapes

110 GL groundwater + **0 GL** surface water = **110 GL** (Option 1)

Scenario 3 was assessed only in the multi-stakeholder workshop, where it received the highest amount of 'no change' ratings among the scenarios assessed. Participants commented that this is the closest to a 'business as usual' scenario, "*where we are heading if nothing changes*". Whilst responses were more

	<p>divided, there was a small trend towards negative ratings across most wellbeing categories (except work), possibly associated with participants' perceptions that weak policies could leave things open to contention, and poor management "<i>everything comes down to governance</i>".</p> <p>Scenario 4. Weaker policy/governance and more industries that modify natural landscapes</p> <p>110 GL groundwater + 360 GL surface water = 470 GL (Option 2)</p> <p>Lowest scores in both workshops and across all categories, especially by participants of the Traditional Owners' workshop. For Traditional Owners, negative scores relate mainly to the extensive agricultural development, intensified by perceptions that Traditional Owners would have less power in a weak policy and governance scenario.</p> <p>Given the poor governance associated with this scenario (which is a real possibility in the future), local community would miss out on benefits but bear the consequences of poor environmental management and compliance on water use.</p>
<p><i>Strict rules controlling when and how water harvesting could occur could include:</i></p> <ul style="list-style-type: none"> • <i>No water harvesting during the dry season</i> • <i>No water harvesting in poor wet seasons</i> • <i>Allow the first flush of the river and pools to reconnect after the dry season before water harvesting can start</i> • <i>Ensure the river remains connected during wet season harvesting periods</i> • <i>No water harvesting during late wet season</i> 	<p>Scenarios did not consider this level of detail, but some of this considerations were noted when discussing the risks of new developments associated with water extractions (e.g. no harvesting during wet season or in poor wet seasons, particularly for scenarios 1 and 2 with stronger policies).</p>

3. Final remarks from the scenario assessment

- The assessments were conducted with a small group (38 people in total), considered as experts on the knowledge and interests of Traditional Owners (23 participants, from 9 different groups), agriculture, pastoral, government, resource extraction, tourism, and environmental interests.
- Responses were influenced by the type, location, management and monitoring of the developments (e.g. Indigenous/non-Indigenous stations; close/away from areas of conservation importance, heritage; level of compliance, monitoring and enforcement).
- Assessment reflects the complex and diverse things that need to be considered when assessing the pros and cons of different development and water allocation options.
- Assessing the outcomes of different development options using wellbeing is more nuanced as a social impact assessment than focusing only on plants and animals, jobs, revenue or amount of water.

References

- Álvarez-Romero, J. G., M. Kiatkoski Kim, D. Pannell, M. Douglas, K. Wallace, R. Hill, V. Adams, A. Spencer-Cotton, M. Kennard, R. Pressey. 2021. Multi-objective planning in northern Australia: co-benefits and trade-offs between environmental, economic, and cultural outcomes. Final report to the Australian Department of Agriculture, Water and the Environment. James Cook University, Townsville, QLD, Australia. <https://doi.org/10.25903/p324-m141>
- Kiatkoski Kim, M., Álvarez-Romero, J.G., Wallace, K., Pannell, D., Douglas, M., Pressey, R.L., 2021a. Preliminary assessment of the potential changes in wellbeing of key interest groups in the Fitzroy river catchment under alternative development scenarios: Scenario Team's workshop 3 Broome, Western Australia, October 15-16. The University of Western Australia, Perth, Western Australia. <https://doi.org/10.26182/z9cd-2m61>
- Kiatkoski Kim, M., Álvarez-Romero, J.G., Wallace, K., Pannell, D., Hill, R., Pressey, R.L., 2021b. Preliminary assessment of the potential changes in wellbeing of key interest groups in the Fitzroy river catchment under alternative development scenarios: Traditional Owners' workshop, Fitzroy Crossing, Western Australia, September 10-12. The University of Western Australia, Perth, Western Australia. <https://doi.org/10.26182/yp8d-5j02>
- Wallace, K.J., Jago, M., Pannell, D.J., Kim, M.K., 2021. Wellbeing, values, and planning in environmental management. *Journal of Environmental Management* 277, 111447.
- Wallace, K.J., Kim, M.K., Rogers, A., Jago, M., 2020. Classifying human wellbeing values for planning the conservation and use of natural resources. *Journal of Environmental Management* 256, 109955.
- Yap, M., Yu, E., 2016. Community wellbeing from the ground up: a Yawuru example. Bankwest Curtin Economics Centre (BCEC), BCEC Research Report No. 3/16