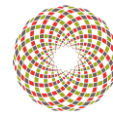




Braided rivers: The land the law forgot

Integrating legal, economic, social, and cultural factors into the well-established models of the topology of braided rivers, along with models of climatic uncertainty to better understand these unique landscape features.



Te Pūnaha Matatini

Complexity is at our heart

Eugenie Sage
Chair, Environment Select Committee
NZ Parliament
Wellington
en@parliament.govt.nz

4 February 2023

Subject: Natural and Built Environments Bill, clause 7 'Definitions'

Dear Eugenie and colleagues,

Thank you for the opportunity to submit on this bill.

The Land the Law Forgot is a group of scientists, lawyers, planners, policy experts, and engineers with shared interest in NZ's iconic braided rivers, with funding from Te Pūnaha Matatini, a national Centre of Research Excellence. Our scientific expertise spans river geomorphology, hydrology, natural hazards, environmental science, and ecology. We come from a range of organisations interested in braided rivers including:

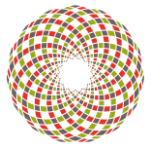
- University of Canterbury School of Earth and Environment
- Massey University
- University of Auckland
- NIWA
- Environment Canterbury
- Environmental NGOs

We came together to seek scientific consensus around braided rivers and their management. Many of our organisations will put in their own, broader, submissions on the NBEA. As such we do not speak for our respective organisations. This submission reflects our collective expertise on braided rivers.

In this submission, we describe a problem and identify the cause and solution as follows:

- 1) **Problem:** The continual and sustained constriction of braided rivers is making rivers less resilient, which causes problems – economically, agriculturally, culturally, and ecologically.
- 2) **Cause:** lack of a definition that works for braided rivers in the NBEA (and previous RMA). This is exacerbated by the Dewhirst decision in the Court of Appeal (2019).¹
- 3) **Solution:** change the definition in three ways:
 - a. Amend the Definitions of clause 7, to include a nuanced definition of 'braidplain';
 - b. Amend clause 38(1) by adding a new (g): 'Braidplains of braided rivers'.
 - c. Make aligned changes to SPA clauses 8 and 17 (to be reviewed in a separate but allied submission)

¹ *Canterbury Regional Council vs Dewhirst* [2019] NZ Court of Appeals 486



The problem of braided rivers' declining capacity to adjust -- Braided rivers are quintessentially New Zealand, yet visible from space. They are globally rare, yet locally abundant, with 163 in NZ.² They are as physically fragile as they are biologically diverse.

But they are losing their ability to adjust to environmental changes – weather, land use, and the like. In other words, braided rivers are losing their resilience.

Braided rivers are integral to Aotearoa New Zealand landscapes, especially, but not uniquely, in Waitaha Canterbury. They epitomise complexity and dynamism; yet they are fragile and sensitive to changes to flow, sediment supply, floodplain area, flood protection works, and encroaching vegetation. They are especially vulnerable to agricultural intensification and encroachment. The Canterbury Regional Council (ECan) reports that nearly 15,000 hectares undeveloped or forested land alongside lowland Canterbury braided rivers have been developed into intensive agriculture since 1990.³

Just as leopards are known for spots, braided rivers are known for dynamism. They move across, occupy, shape, and reshape large areas of New Zealand's landscape, especially on the South Island. They are characterised by multiple shifting channels known as braids, wide floodplains, and rapidly shifting bars and islands.⁴ Braids change course, shape, and extent with changes in sediment, hydrology, land use, vegetation, climate, and/or surrounding infrastructure.⁵ They move side to side, bifurcate then coalesce, and form islands or bars mid-stream.⁶

Active braids are often surrounded by abandoned dry braids, gravel bars, and islands (See Figure 1).⁷ These now abandoned braids are not always visible without remote sensing technology such as LiDAR, that can reveal that the past wet state is a reasonably predictable future state for a particular place (see Figure 2). The varying time since dry parts of the bed were last mobile results in a mosaic of differing habitats that support high biodiversity. The mosaic is maintained by the river continually adjusting.

² GH Wilson, *National distribution of braided rivers and the extent of vegetation colonization*, (2001) (Landcare Research, Report Number LC0001/068).

³ Environment Canterbury, *Land use change on the margins of lowland Canterbury braided rivers, 1990-2012* (2015) (Report Number R15/49).

Environment Canterbury, *Land use change on the margins of lowland Canterbury braided rivers, 2012-2019* (2021) (Report Number R21/05).

⁴ Peter Ashmore, "Morphology and Dynamics of Braided Rivers", (2013) 9(17) *Treat Geomorph* 289 at 289–312.

Hervé Piégay, Desmond Walling, Norbert Landon, Qiping He, Fred Liébault, Robert Petiot, "Contemporary changes in sediment yield in an alpine mountain basin due to afforestation", (2004) 55 *Catena* 183 at 183-212.

Jasper Candel, Maarten Kleinhans, Bart Makaske, and Jakob Wallinga, "Predicting river channel pattern based on stream power, bed material and bank strength", (2020) 45 *Prog Phys Geog: Earth & Enviro* 253 at 253-278.

⁵ GM Kondolf, Hervé Piégay, Norbert Landon "Channel response to increased and decreased bedload supply from land use change: Contrasts between two catchments" (2002) 45 *Geomorph* 35 at 35–51.

⁶ Peter Ashmore, "Morphology and Dynamics of Braided Rivers", (2013) 9(17) *Treat Geomorph* 289 at 289–312.

⁷ Peter Ashmore, "Morphology and Dynamics of Braided Rivers", (2013) 9(17) *Treat Geomorph* 289 at 289–312.

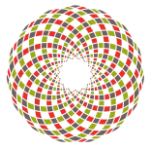


Figure 1 – Changing braidplain of the Waimakariri River, 1942 to 2020 (Source: The Conversation).

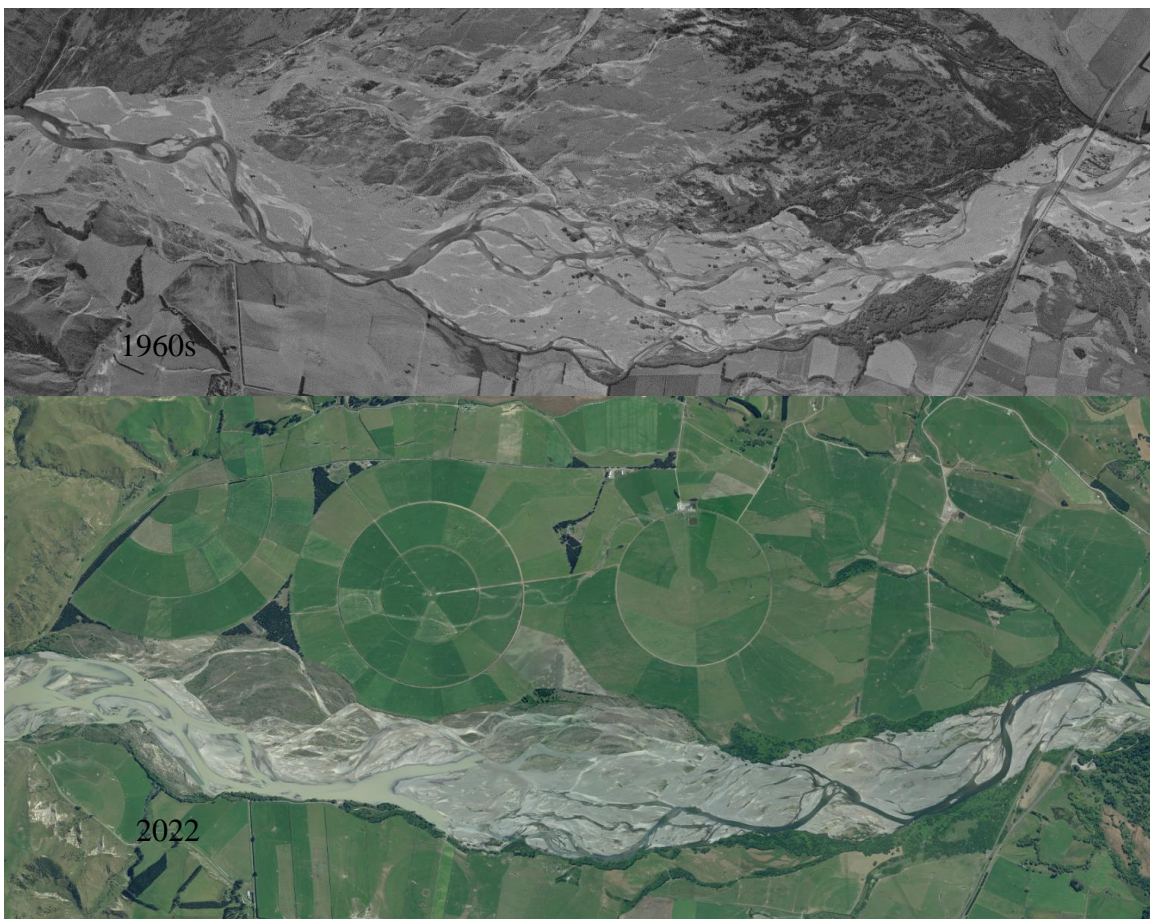
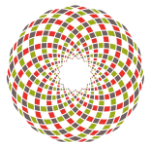


Figure 2 – Changing land use within the braidplain of the Waiou River, mid-1960s (top) and 2022 (bottom).



In order to form, abandon, and reform braids across wide ‘braidplains’, braided rivers require both large amounts of sediment coursing through their channels⁸ and room to move.⁹ The space and sediment requirements make braided rivers globally rare.¹⁰

Yet land use change is encroaching into the spaces of braided rivers, constricting their ability to adjust to ever-changing flows of water and sediment.¹¹ This is causing creeping, yet noticeable, declines in their capacity to adjust to all sorts of environmental change – weather, land use, and the like. This creeping encroachment is shown in Figures 1 and 2.

The declining capacity to adjust in braided rivers will have broad-reaching consequences if allowed to continue – in economic, ecological, cultural dimensions. It means our land systems are becoming less adaptive to climate change, meaning climate change will be more painful, and more expensive, to adapt to than if we start to address the problem of declining capacity to adjust now, through the NBEA.

More broadly, loss of capacity for braided rivers to adjust results in:

- Biodiversity loss, and habitat loss for threatened and endemic species¹²
- Reduced resilience and life-force of the river¹³
- Loss of the iconic natural character of braided rivers, for which NZ is globally famous
 - Noting that clause 5(a)(iii) states a desired ‘System Outcome’ of NBEA is to protect or restore the ‘natural character of ... rivers and their margins’)
 - Losing the physical form of such a prominent landscape feature induces ‘solastalgia, “the pain or distress caused by the loss of, or inability to derive, solace connected to the negatively perceived state of one’s home environment”¹⁴
- Reduced capacity for groundwater recharge¹⁵

⁸ Murray Hicks, Edwin Baynes, Richard Measures, Guglielmo Stecca, Jon Tunnicliffe, Heide Friedrich, (2020) “Morphodynamic research challenges for braided river environments: Lessons from the iconic case of New Zealand”, 46 *Earth Surf Proc & Land* 188 at 188–204.

⁹ Peter Ashmore, “Morphology and Dynamics of Braided Rivers”, (2013) 9(17) *Treat Geomorph* 289 at 289–312.

¹⁰ Charlie Mitchell, Alden Williams, “The Rewilding Project: The movement to revive our zombie rivers”, *The Press* (online edition, Christchurch, 25 June 2021 <interactives.stuff.co.nz/2021/06/rewilding-project-nz-braided-rivers/>).

¹¹ Peter Ashmore, “Morphology and Dynamics of Braided Rivers”, (2013) 9(17) *Treat Geomorph* 289 at 289–312.

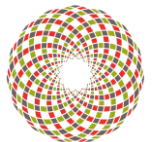
¹² <https://interactives.stuff.co.nz/the-long-read-podcast/2021/06/zombie-rivers-canterbury-floods-braided-rivers-farming-irrigation-stopbanks/>

¹³ Gray, D., Grove, P., Surman, M., & Keeling, C. (2017). Braided rivers: Natural characteristics, threats and approaches to more effective management (Environment Canterbury Technical Report R17/13; Issue R17/13, p. 18). Canterbury Regional Council.

¹⁴ Brierley, G. J., Hikuroa, D., Fuller, I. C., Tunnicliffe, J., Allen, K., Brasington, J., Friedrich, H., Hoyle, J., & Measures, R. (2022). Reanimating the strangled rivers of Aotearoa New Zealand. *WIREs Water*, e1624. <https://doi.org/10.1002/wat2.1624>

¹⁵ Albrecht G, Sartore G-M, Connor L, Higginbotham N, Freeman S, Kelly B, Stain H, Tonna A, Pollard G (2007) Solastalgia: The distress caused by environmental change. *Australasian Psychiatry* 15(Supplement):S95-98

¹⁶ Thomas Wohling, Moritz Gosses, Scott R. Wilson, and Peter Davidson. (2018) “Quantifying River-Groundwater Interactions of New Zealand’s Gravel-Bed Rivers: The Wairau Plain.” Vol. 56, No. 4—Groundwater—July-August 2018. pages 647–666



- Reduced adaptive capacity for coping with increasingly frequent extreme weather events and atmospheric rivers¹⁶
- Reduced capacity for flood control¹⁷
- Increased erosion risk¹⁸
- Economic cost of protecting communities from unsustainable system¹⁹

Reduced resilience of rivers in any of the above ecosystem services makes the nation's climate adaptation much more expensive at best, and impossible at worst. It is our proposal that the first step towards empowering climate adaptation and implementing the national Adaptation Plan²⁰ is to insert our proposed definition of braidplain into the Definitions clause of the NBEA. Without this, councils lack the authority to adapt to climatic changes, which will inevitably affect our braided river systems.

In terms that are slightly more stark, failing to define braidplain in the NBEA will:

- 1) Allow river constriction to continue, and
- 2) Create future disasters like we have seen in recent years (e.g. Rangitata, Ashburton Rivers).²¹

The cause -- Braided rivers are the land the law forgot. We ask the Environment Committee to rectify this, by including braidplain in the definitions of the NBEA in order to lay the groundwork for conversations (during the NPF formation) about how to manage braided rivers. We see this as the only way to start the process of managing braided rivers in a way that promotes climate resilience, instead of the current trajectory driven by the legislative definition of river 'bed' that is making our land and river systems ever more brittle.

We note with concern that the definition of river 'bed' in the NBEA echoes the RMA's definition, and does not work for braided rivers. Courts have struggled to construe braided rivers within the existing definition. This is because the legislative definition, and consequently the Courts, draw a fine line between 'flood' and 'fullest flow' whereby the former is larger than the latter.²²

But physically, neither flood nor fullest flow applies well to braided rivers. The terms, and the fine line between them, apply better to stable, single-channel

¹⁶ Gluckman, P., Bardsley, A., Cooper, B., Howard-Williams, C., Larned, S., Quinn, J., Hughey, K., & Wratt, D. (2017). New Zealand's fresh waters: Values, state, trends and human impacts (p. 120). Office of the Prime Minister's Chief Science Advisor.

¹⁷ Gluckman, P., Bardsley, A., Cooper, B., Howard-Williams, C., Larned, S., Quinn, J., Hughey, K., & Wratt, D. (2017). New Zealand's fresh waters: Values, state, trends and human impacts (p. 120). Office of the Prime Minister's Chief Science Advisor.

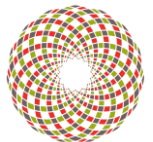
¹⁸ Piegay, H., Grant, G., Nakamura, F., & Trustrum, N. (2009). Braided River Management: from Assessment of River Behaviour to Improved Sustainable Development. In *Braided Rivers* (pp. 257–275). Blackwell Publishing Ltd. <https://doi.org/10.1002/9781444304374.ch12>

¹⁹ Brierley, G. J., Hikuroa, D., Fuller, I. C., Tunnicliffe, J., Allen, K., Brasington, J., Friedrich, H., Hoyle, J., & Measures, R. (2022). Reanimating the strangled rivers of Aotearoa New Zealand. *WIREs Water*, e1624. <https://doi.org/10.1002/wat2.1624>

²⁰ Ministry for the Environment. (2022). Aotearoa New Zealand's first national adaptation plan. Ministry for the Environment, Wellington Retrieved from <https://environment.govt.nz/assets/publications/climate-change/MFE-AoG-20664-GF-National-Adaptation-Plan-2022- WEB.pdf>

²¹ Davies, T. R., & McSaveney, M. J. (2006). Geomorphic constraints on the management of bedload-dominated rivers. *Journal of Hydrology New Zealand*, 45(2), 111–130.

²² *Canterbury Regional Council vs Dewhirst* [2019] NZ Court of Appeals 486



ivers, because flood and fullest flow rely on the presence of clear banks and exclude the presence of multiple channels, braidplains, and margins.²³

Continuing to rely on a single-channel river definition for river ‘bed’, even for NZ’s 163 braided rivers, quietly redefines braided river beds based on ‘fullest flow’ in a fixed location.²⁴ The two are vastly different, both geomorphologically²⁵ and legally²⁶.

Continuing to rely on the current definition of ‘bed’ dooms us to failure in achieving the goal of Te Mana o Te Wai NPS, of sustaining the ‘life-supporting capacity of freshwater’.²⁷

The solution = defining the ‘braidplain’ – The definition of river ‘bed’ does not, and cannot, work for braided rivers. To restore resilience to our braided rivers, we need to start by identifying and defining the ‘braidplain’.

For defining beds of other types of rivers, we support the submission from the Rivers Group. For braided rivers, our solution is three-fold:

1) Amend clause 7 Definitions, to include ‘Braidplain’

Braided rivers comprise both land and water, wet bits and dry bits, vegetation and bare patches, suspended sediment and vast stretches of gravel. Scientifically, they are complex flows of sediment and water. Like Schroedinger’s cat, they are neither land nor water, but both at once.

Braided rivers require a legislative definition at the national level that embraces their dynamism, complexity, and room to move: essentially their capacity to adjust, and therefore recognising their range of variability. Above all, to fulfil regional and national goals of protecting natural character of unique landscapes, the legislative definition must (1) recognise that braided rivers comprise both land and water and (2) be scientifically-informed.

The Land the Law Forgot group has found strong scientific consensus around a legislative solution that will stop the decline in braided river resilience, and start the journey towards halting the decline of, or even possibly restoring some of the resilience of, the rivers that define our landscapes.

The definition of river needs to change. Our proposed definition is a necessary pre-condition to fulfil one of the Purposes of the NBEA in clause 3, of upholding te Oranga o te Taiao, ‘the health of the natural environment, the essential

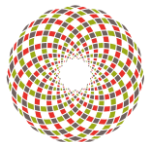
²³ Renate Vosloo, Franca Buelow, John Page, and Ann Brower. (in press) “Braided rivers: between land and water, between law and science.” *NZ Journal of Environmental Law*.

²⁴ Renate Vosloo, Franca Buelow, John Page, and Ann Brower. (in press) “Braided rivers: between land and water, between law and science.” *NZ Journal of Environmental Law*.

²⁵ Brierley, G. J., Hikuroa, D., Fuller, I. C., Tunnicliffe, J., Allen, K., Brasington, J., Friedrich, H., Hoyle, J., & Measures, R. (2022). Reanimating the strangled rivers of Aotearoa New Zealand. *WIREs Water*, e1624. <https://doi.org/10.1002/wat2.1624>

²⁶ Renate Vosloo, Franca Buelow, John Page, and Ann Brower. (in press) “Braided rivers: between land and water, between law and science.” *NZ Journal of Environmental Law*.

²⁷ <https://environment.govt.nz/acts-and-regulations/freshwater-implementation-guidance/te-mana-o-te-wai-implementation/#:~:text=Te%20Mana%20o%20te%20Wai%20means%20the%20first%20priority%20must,life%20supporting%20capacity%20of%20freshwater.>



relationship between the health of the natural environment and its capacity to sustain life, the interconnectedness of all parts of the environment’.

Because braided rivers are land, water, sediment, and gravel all at once, the NBEA needs a definition of ‘Braidplain’. We propose this have 3 forms. We do not propose management implications of these 3 forms. Instead we acknowledge that conversations around policy and management implications, if any, of the braidplain take place in the establishment of the proposed National Planning Framework (NPF).

Regardless of policy, planning, and management implications, we need to define braidplain as follows to acknowledge the unique, vibrant, and dynamic landscapes of NZ.

Amend clause 7, Definitions:

Braidplain, takes 3 forms in which (a) is the largest and (c) is the smallest, in both space and time:

- a) Topographic braidplain means the area of land covered potentially, currently and historically by the active river surfaces within the current hydrological and geomorphic context in the absence of flood defences or invasive weeds²⁸*
- b) Historically active braidplain means the corridor within topographic braidplain that has been mobilised by active river processes and occupied by water or bare gravel as evidenced by written history (e.g. aerial photographs and historic maps). The historically active braidplain is made up of all previous known active braidplains.*
- c) Currently active braidplain means the corridor within the historic braidplain that is currently being occupied by water, bare gravel, or sparse vegetation²⁹ at any point in time, and being actively impacted by river processes of erosion and deposition.*

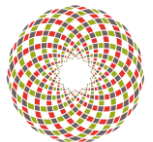
2) Amend clause 38(1) of NBEA by adding a new (g): ‘Braidplains of braided rivers’.

Amending clause 38 would mean that eventually limits and targets under clause 49(1) would need to be set, perhaps in conjunction with the rollout of the National Planning Framework. These targets should reinforce the significance of the issue.

By contrast, if we fail to define braidplain now in the NBEA, we will instead rely on the NPF to define braidplain *and* set limits and targets; this uses circular logic. Adding the definition acknowledges that braided rivers are different, and allows

²⁸ D. Gray. (2018) ‘Natural character assessment guidelines for braided rivers’. (Environment Canterbury Technical Report) <https://www.ecan.govt.nz/document/download?uri=343494>

²⁹ Peter F. Williams and Brian R. Rust. (1969) “The sedimentology of a braided river.” *Journal of Sedimentary Research*. 39 (2): 649–679.



us to start the conversation on identifying values (economic, ecological, cultural, and physical) in braided rivers and how we want to manage the values. So the proper solution to the problem is to define braidplain now, and have the conversation around management limits and targets with the NPF.

The Land the Law Forgot group would be happy to contribute to setting those limits and targets when the time comes.

3) Aligned changes to Spatial Planning Bill clauses 8, 17. See aligned submission.

In conclusion, it is often said we cannot manage what we cannot measure.³⁰ To that we add, we cannot manage what we have not defined in law.

Therefore, we see inserting a definition of braidplain into Clause 7 as a necessary first step towards solving the problem of the loss of adaptive capacity in our braided rivers. Flooding is likely to be a large part of Aotearoa's experience of climate change. Braided rivers are likely to be a large part of that increased flood risk, with predicted larger floods inundating larger areas of the historically active braidplain as currently active braidplains expand to accommodate more frequent and larger floods. Adding our proposed scientifically-informed braidplain definition to the NBEA will give us the necessary tools to start addressing climate resilience around our dynamic and iconic rivers.

Thank you for the opportunity to contribute to the discussion. We wish to speak to our submission. Please direct correspondence to ann.brower@canterbury.ac.nz.

Sincerely,

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Ian Fuller, professor of physical geography, Massey University

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Rasmus Gabrielsson, Chief Executive, North Canterbury Fish & Game Council
Jay Graybill, Chief Executive, Central South Island Fish & Game Council

Dr Philip Grove, terrestrial ecologist
Dr Duncan Gray, freshwater ecologist

³⁰ Myles, F., Duncan, R., & Brower, A. (2016). Measuring to manage: Reconfiguring people–water relations through water measurement standards and technologies in New Zealand. *Environment and Planning C: Government and Policy*, 34(3), 546–558.