Big Time: An Empirical Analysis of Regulating the Cumulative Environmental Effects of Coal Seam Gas Extraction under Australian Federal Environmental Law

Rebecca Nelson*

The cumulative environmental effects of coal seam gas (CSG) extraction are a notable challenge in regulating the transition to a more sustainable energy future. Federal legislation was introduced in 2013 to address concerns about the effects on water resources of CSG extraction, but the effectiveness of this five-year-old federal regime remains unclear. This study empirically analyses the ways in which CSG projects assessed under this federal "water trigger" legislation have considered cumulative environmental effects, with an emphasis on elements related to time. By highlighting key gaps in how cumulative effects are considered in practice under the water trigger, it aims to sharpen the attention of regulators on issues requiring additional legislative and policy guidance, and the attention of stakeholders in general on potential areas for greater attention in meeting the regulatory intentions underlying the legislation.

I. Introduction

Coal seam gas (CSG) now plays a substantial and growing role in Australian energy production and export. In 2016–2017, CSG accounted for one-third of Australian gas production and around two thirds of gas production on the east coast.[1] The end product of CSG extraction is familiar: natural gas (methane) flowing to houses or being compressed into liquefied natural gas for export. The production process is less familiar, involving the installation of hundreds to thousands of wells that extract both CSG and groundwater in areas that may have sensitive water-dependent ecosystems, non-renewable groundwater resources, and a constellation of other overlapping historical and existing water uses. The cumulative environmental effects of rapidly growing CSG extraction – its environmental effects when considered with other developments that have similar effects – are a notable challenge in regulating the transition to a more sustainable energy future.

In Australia, concerns about cumulative environmental effects have arguably received most attention in relation to CSG developments. CSG is subject to Australia's first federal legislative directive to consider cumulative environmental effects in the context of assessments and approvals under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (*EPBC Act*) (noting that some States also have cumulative effect assessment requirements). The *EPBC Act* prohibits a person from taking an action that has, will have, or is likely to have a significant impact on one of several listed "matters of national environmental significance" unless the action has been assessed and approved by the relevant federal minister (currently the Minister for the Environment) after a public comment period.[2] The "water

* This article benefited from research assistance from Jason Schroeder and Sophie Lloyd and thoughtful feedback from Amanda Cravens, Nicola Ulibarri, Anne Siders, Wendy Timms, Moya Tomlinson and the attendees of the workshop "Energy Transitions: Governing Unconventional Gas, Renewables and the Energy-Environment Nexus" held at the University of New South Wales from 5 to 6 February 2019. All errors remain those of the author. This work is based on research funded by the Australian Research Council (#DE180101154).

[1] Australian Government, Department of the Environment and Energy, *Australian Energy Update 2018* (August 2018) 2 <https://www.energy.gov.au/sites/default/files/australian_energy_update_2018.pdf>.

[2] *Environment Protection and Biodiversity Conservation Act 1999* (Cth) Pt 3.

trigger" provisions added a new matter of national environmental significance, being a CSG or large coal mining development that is likely to have a significant impact on water resources.[3] "CSG development" is defined as "an activity involving coal seam gas extraction" that is likely to have a significant impact on water resources "in its own right" or "when considered with other developments, whether past, present or reasonably foreseeable developments" (ie cumulatively).[4] No other "matter of national environmental significance" requiring assessment and approval under the *EPBC Act*, for example, World Heritage areas and endangered species, includes similar language directed at cumulative effects. Another unique feature of the arrangements related to the water trigger is that the Minister seeks the advice of independent expert scientists (the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Developments (IESC)) in relation to a proposed action,[5] in addition to the regular public comment period.

Perceptions of gaps in State-level regulation of the CSG industry were a substantial cause of the federal reforms that introduced the water trigger.[6] However, no empirical work has yet evaluated how adequately the water trigger leads proponents and the Minister to consider the cumulative effects of CSG in practice.[7] Such an evaluation is not only important in its immediate context, but also in light of further significant future expansions to unconventional gas extraction.[8] It may also inform advocacy and planning for an overhaul of federal environmental legislation,[9] which may include more widely applicable provisions dealing with cumulative effects.

This article evaluates a particularly important element of a cumulative effect assessment: time. As Part II explains, time is central to many concerns about CSG. In addition, the environmental impact assessment literature suggests that time, and temporal boundaries, are especially critical to assessing cumulative effects and especially challenging in practice, and it offers some guidance on these points, which is summarised in this part. Part III evaluates how CSG assessments under the water trigger deal with the temporal aspects of cumulative effects. Much of the discussion in Parts II to III may appear quite technical, informed largely by scientific literature, litigation and debates relating to environmental impact assessment. In making recommendations that respond to the findings of Part III, Part IV argues that, at their heart, these temporal issues in cumulative effects assessment are fundamentally normative and would benefit from the considered application of principles of ecologically sustainable development that straddle law and ethics. This argument is responsive to, and hopes to contribute to, a broader emerging focus on time in environmental law in both theoretical and conceptual work[10] as well as policy reform projects.[11]

II. CUMULATIVE ENVIRONMENTAL EFFECTS, COAL SEAM GAS, AND TIME

In the EPBC context, "cumulative environmental effects" are "the impacts of a number of different actions or other broader influences on a matter of national environmental significance which, when

---

[3] *Environment Protection and Biodiversity Conservation Act 1999* (Cth) ss 24D, 24E.

[4] *Environment Protection and Biodiversity Conservation Act 1999* (Cth) s 528.

[5] *Environment Protection and Biodiversity Conservation Act 1999* (Cth) Pt IID(3) s 131AB.

[6] Stephen Hunter, *Independent Review of the Water Trigger Legislation* (April 2017) 6.

[7] Note that Hunter, n 6, only considered the water trigger's effectiveness through aggregated data on affected projects and did not focus on the issue of cumulative effects.

[8] Geosciences Australia, *Gas* (2018) Australian Energy Resources Assessment <https://aera.ga.gov.au/#!/gas>.

[9] Australian Panel of Experts in Environmental Law, *Blueprint for the Next Generation of Australian Environmental Law* (2017) 9; Troy Bramston, "Labor Urged to Lead Way on Environment", *The Australian* (Sydney), 27 March 2018, 5.

[10] See, eg, Benjamin J Richardson, *Time and Environmental Law: Telling Nature's Time* (CUP, 2017).

[11] See, eg, recent reform discusses surrounding the future management of mine sites after the surrender or abandonment of the mine: Queensland Government, Department of Premier and Cabinet, *Managing Residual Risks in Queensland* (Discussion Paper, August 2018) <https://environment.des.qld.gov.au/management/pdf/managing-residual-risks-discussion-paper.pdf>; Penny Armytage, Jane Brockington and Janice van Reyk, *Independent Inquiry into the Environment Protection Authority* (2016) 67, 110, 292–302 <http://epa-inquiry.vic.gov.au/__data/assets/file/0008/336698/Inquiry-report-EPA_June.pdf>.

considered together, have a greater impact on that matter than each action or broader influence considered individually".[12] Assessing cumulative effects means assessing a proposed project in its real-world context: few projects actually occur in isolation from other human influences; most environmental values already face, or will foreseeably face, some kind of human pressure, whether of the same type or of a different type to that proposed. Assessing the cumulative environmental effects of a project is a formal way to evaluate this. Ignoring cumulative environmental effects – or assessing them incompletely – may conceal the real-world environmental significance of a project.

A. The Importance of Time to Cumulative Environmental Assessments

Issues of time arise most prominently in the scoping phase of an assessment of cumulative effects. Scoping includes selecting spatial, as well as temporal scopes for predicting effects; identifying the valued environments or resources (more technically termed "valued ecological components") that are assessed for cumulative effects; and the set of "past, present and reasonably foreseeable future activities" and natural environmental trends and perturbations, the effects of which aggregate with those of the proposed activity to cause cumulative effects. Effects can accumulate in an additive, synergistic or antagonistic way.[13] As a result, a cumulative view of effects may reveal a greater or lesser aggregate effect than considering a project in isolation (the latter being "upside" from a proponent's perspective).

By definition, a cumulative effect assessment has broader temporal boundaries than "regular" environmental effect assessment because it must include other relevant activities that have occurred in the past and that will occur in the future. Scoping is "critically important" because it sets the frame – from a past temporal boundary to a future temporal boundary – that determines everything that will later be included, and excluded, from the assessment.[14] It is "a pervasive factor affecting the overall quality of the assessment".[15]

Time also influences determinations of environmental significance. From the perspective of the future, effects that last longer tend to be more significant.[16] On the other hand, setting a past temporal boundary may also influence whether a proposed action will be deemed to have a significant cumulative environmental effect. If actions that caused significant environmental harm are within the temporal scope of a cumulative effect assessment, this increases the chance that a proposed development, even a minor one, might be determined to be significant. This is because any amount of additional degradation added to the past actions that have caused significant degradation, would be cumulatively significant.[17]

[12] Australian Government, Department of the Environment, *Significant Impact Guidelines 1.3 – Coal Seam Gas and Large Coal Mining Developments*: *Impacts on Water Resources*, Report (December 2013) 20 (Department of Environment).

[13] Melissa M Foley et al, "The Challenges and Opportunities in Cumulative Effects Assessment" (2017) 62 *Environmental Impact Assessment Review* 122, 123. An example of an antagonistic accumulation (ie lesser effect in the aggregate) in the context of CSG and groundwater withdrawals is that reduced groundwater withdrawal may be required for later CSG projects because of depressurisation of coal seams already occasioned by earlier CSG projects: JR Underschultz, S Vink and A Garnett, "Coal Seam Gas Associated Water Production in Queensland: Actual vs Predicted" (2018) 52 *Journal of Natural Gas Science and Engineering* 410, 421.

[14] Jill Gunn and Bram Noble, *Critical Review of the Cumulative Effects Assessment Undertaken by Manitoba Hydro for the Bipole III Project* (Report, Public Interest Law Centre, 2012) 9; Larry W Canter and Bill Ross, "State of Practice of Cumulative Effects Assessment and Management: The Good, the Bad and the Ugly" (2010) 28(4) *Impact Assessment and Project Appraisal* 261, 263.

[15] Wanda Baxter, *To What Standard? An Evaluation of Cumulative Effects Assessment in Canada* (Thesis, University of Calgary, 2001) 28.

[16] Larry W Canter and Geoffrey A Canty, "Impact Significance Determination: Basic Considerations and a Sequenced Approach" (1993) 13(5) *Environmental Impact Assessment Review* 275, 290.

[17] Charles H Eccleston, "Applying the Significant Departure Principle in Resolving the Cumulative Impact Paradox: Assessing Significance in Areas That Have Sustained Cumulatively Significant Impacts" (2006) 8(4) *Environmental Practice* 241, 241. This might, theoretically, require the assessment and approval of even trivial actions in a jurisdiction that has a wide "trigger" for assessment, such as the United States, where the relevant "trigger" is federal action: Eccleston, 243. However, this problem does not arise in relation to the water trigger, which applies only to CSG and large coal mining developments.

Indeed, formal federal policy accepts that a given action will be more likely to be significant in a more degraded environment.[18]

It should be noted that a past temporal boundary is not necessarily synonymous with the concept of a "baseline". The former indicates the frame for including activities that have affected, and could in the future affect, a valued environment in the context of a cumulative assessment; the latter is the benchmark set of conditions against which the impacts of an activity are compared to assess whether they are significant. Empirically, it appears that baselines are often set at the conditions that exist at the time a project is proposed, but other, arguably more appropriate, alternative comparators include past ecological conditions when human impacts and cumulative degradation were lower, or a set of conditions given by management goals for sustainability.[19]

As well as being critically important, temporal scoping is a "primary" cause of the infamous difficulty of cumulative assessments.[20] Practitioners find it difficult to define temporal boundaries because the meaning of a "reasonably foreseeable action" is unclear, past projects may lack sufficient data, and predicting future events involves significant uncertainty, particularly in relation to environmental interactions and recovery times. In the case of groundwater withdrawals, full recovery to pre-project conditions may never occur and a new equilibrium may take millenia to establish.[21] In addition, the public, politicians and affected government agencies may have different views on appropriate time frames.[22]

B. General Frameworks for Scoping Cumulative Environmental Assessments in Time

Relatively few scholars and government agencies offer detailed advice on scoping an activity-level cumulative effects assessment in time. This advice is typically cast as "options"[23] or "considerations".[24] This difficult area does not benefit from any "precise guidelines on how far to extend the past or future".[25] However, certain considerations, outlined below, are common to multiple frameworks of advice.

1. Setting Past Temporal Boundaries

Common considerations in setting past temporal boundaries include the availability of historical data, including about conditions and historical rates of change in relation to valued environments;[26] and the historical time at which valued environments were "undisturbed", or how long ago similar effects

---

[18] Department of Environment, n 12, 20. Note that since this outcome would appear to be possible only if one makes a comparison to less degraded past conditions, it implicitly accepts the relevance of a past temporal baseline in determinations of significance.

[19] Peter S Alagona, John Sandlos and Yolanda F Wiersma, "Past Imperfect: Using Historical Ecology and Baseline Data for Conservation and Restoration Projects in North America" (2012) 9(1) *Environmental Philosophy* 49; Foley et al, n 13, 126, 129. For a more thorough discussion of baselines in the context of Australian environmental and water laws, see Rebecca Nelson, "Breaking Backs and Boiling Frogs: Warnings from a Dialogue between Federal Water Law and Environmental Law" (2019) 42(4) *UNSW Law Journal* (forthcoming).

[20] Council on Environmental Quality, "Considering Cumulative Effects under the National Environmental Policy Act" (Executive Office of the President to the United States, 1997) Pt V.

[21] TA Cooper and Larry W Canter, "Substantive Issues in Cumulative Impact Assessment: A State-of-Practice Survey" (1997) 15(1) *Impact Assessment* 15, 22–23 (based on a survey of 25 US environmental professionals); J Bredehoeft and T Durbin, "Ground Water Development: The Time to Full Capture Problem" (2009) 47 *Ground Water* 506, 513.

[22] Cooper and Canter, n 21, 23.

[23] Hegmann et al, *Cumulative Effects Assessment Practitioners' Guide* (Canadian Environmental Assessment Agency, 1999) 16.

[24] See, eg, Larry W Canter, *Cumulative Effects Assessment and Management: Principles, Processes and Practices* (EIA Press, 2015) 144–5.

[25] Canter, n 24, 142.

[26] Canter, n 24, 146–147; Hegmann et al, n 23, 16; LJ Walker and J Johnston, *Guidelines on the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions* (Office for Official Publications of the European Communities, 1999) 66–7.

commenced.[27] Less commonly proposed matters include past practice,[28] and the cost (including delay-related costs) of procuring historical data.[29]

Much consideration of past temporal boundaries tends to focus on what setting this boundary means for the "baseline" against which the effects of the proposed activity are considered to determine if they are significant. One view accepts the practice of aggregating past activities into a baseline of current conditions, holding that it is generally possible to "conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions".[30] This effectively avoids setting a past temporal boundary and simply uses current conditions, before the development of the proposed activity, as the starting point. The opposing view strongly advocates explicitly setting a past temporal boundary and considering the effects of past notable actions individually where necessary. This controversy has been the subject of formal guidance and litigation in the United States,[31] the first view being criticised on the basis that "the lessons of [past] actions are effectively removed from the decision making process" and that it produces "a false sense of security, in which prior degradation is taken for granted because it is considered part of the environmental baseline".[32] It amounts to considering only the cumulative effects of the proposed and reasonably foreseeable future actions.[33]

Setting a past temporal boundary can lead to defining a baseline in different ways. A simple way is to set a date (and implicitly, a past temporal boundary), at the time when the valued resource was most abundant.[34] Another way is to make the baseline a historically informed question of sustainability, asking how the resource or environment has changed over time and "whether that change is significant in terms of the sustainability of the [resource or environment]".[35] An alternative is to construct the baseline as "the conditions that would exist if the actions were not implemented", which incorporates the effect of past, present and reasonably foreseeable future actions.[36] This formulation, termed by its advocates the "cumulative impact baseline", is calculated from a past temporal boundary, rather than being synonymous with it.[37]

2. Setting Future Temporal Boundaries

Common considerations in setting future temporal boundaries include the operational life of the proposed activity;[38] the point in the future at which environmental values will have recovered (taking

---

[27] Canter, n 24, 146–147; Tom Kaveney, Ailsa Kerswell and Andrew Buick, *Cumulative Environmental Impact Assessment Industry Guide* (Guide, Minerals Council of Australia, July 2015), 32, 34; Hegmann et al, n 23, 16; Walker and Johnston, n 26, 66–67.

[28] Canter, n 24, 146–147.

[29] James L Connaughton, Chairman to Heads of Federal Agencies, Council on Environmental Quality, *Guidance on the Consideration of Past Actions in Cumulative Effects Analysis* (Memorandum, 24 June 2005) 4 <https://ceq.doe.gov/docs/ceq-regulations-and-guidance/regs/Guidance_on_CE.pdf>.

[30] Connaughton, n 29, 2.

[31] See, eg, *Lands Council v Powell* 395 F 3d 1019 (9th Cir, 2005); Connaughton, n 29.

[32] John C Grothaus, "Questionable Authority: A Recent CEQ Guidance Memorandum" (2007) 37(3) *Environmental Law* 885, 885, 888. The same argument is also made by others: see Courtney A Schultz, "The US Forest Service's Analysis of Cumulative Effects to Wildlife: A Study of Legal Standards, Current Practice, and Ongoing Challenges on a National Forest" (2012) 32(1) *Environmental Impact Assessment Review* 74, 75; Lance N McCold and James W Saulsbury, "Including Past and Present Impacts in Cumulative Impact Assessments" (1996) 20(5) *Environmental Management* 767, 768.

[33] McCold and Saulsbury, n 32, 767.

[34] McCold and Saulsbury, n 32, 768.

[35] Gunn and Noble, n 14, 9.

[36] Eccleston, n 17, 245.

[37] This is the broad approach adopted by the underground water impact report used in the assessment evaluated in Part III(C).

[38] Canter, n 24, 146–147; Kaveney, Kerswell and Buick, n 27 32, 34; Hegmann et al, n 23, 16; Walker and Johnston, n 26, 66–67.

into account natural variability of conditions with time);[39] and the point in time to which impacts can be predicted with reasonable certainty.[40] Less commonly cited considerations include whether sustainable development policies are in place, and time periods required for economic valuation.[41]

Selecting a future temporal boundary has also been controversial[42] and subject to evolving advice. In 1999, a study commissioned by the European Commission suggested that a temporal boundary for project environmental impact assessment (EIA) "would probably be no more than five years into the future"[43] due to "uncertainty concerning impact prediction", "the projects seldom take place in a given sequence, unanticipated significant events can take place, and new information will become available".[44] Such short time frames have more recently been considered inadequate, with recommendations to adopt and clearly state "an expansive future temporal limit" more common.[45]

Changing technology may well have played a role in these changing views, with assessment methods once viewed "resource and capital-intensive"[46] now considered much more tractable with the benefit of more commonly available high-power computers, free and open source software and publicly available data clearinghouses.[47] The widespread recognition of climate change – and associated use of long-range models – may also have influenced tendencies to look further into the future.

C. Existing State of Practice in Considering Time in Cumulative Environmental Assessments

Temporal scoping of cumulative effects is considered both critically important and inadequate in practice. Inadequate temporal scoping "may diminish the quality of the entire analysis".[48] Dangers include not properly including historical conditions or historical environmental trends; and describing future boundaries too vaguely.

Lack of clarity has been a central problem: an early survey (1997) of environmental practitioners in the United States and internationally revealed that temporal boundaries were delineated about 65% of the time.[49] Similarly, evaluations of how temporal scoping is undertaken in individual cumulative effect assessments find that very few clearly define temporal boundaries[50] or consider past and reasonably

---

[39] Kaveney, Kerswell and Buick, n 27, 32, 34; Hegmann et al, n 23, 16.

[40] Kaveney, Kerswell and Buick, n 27, 32, 34; Walker and Johnston, n 26, 66–67.

[41] Canter, n 24, 147.

[42] Wanda Baxter, William A Ross and Harry Spaling, "Improving the Practice of Cumulative Effects Assessment in Canada" (2001) 19(4) *Impact Assessment and Project Appraisal* 253, 256. Note that concerns about selecting a far-future temporal boundary for assessing cumulative effects should be differentiated from concerns about "crystal ball inquiries" in environmental impact assessment when proponents or objectors seek to make arguments about the viability of a project having regard to future technological developments that are hypothetical and not realistic: Murray Raff, "Ten Principles of Quality in Environmental Impact Assessment" (1997) 14(3) EPLJ 207, 214.

[43] S Parr, *Study on the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions – Volume 1: Background to the Study* (Hyder Consulting, 1999) 134.

[44] Parr, n 43, 21.

[45] See, eg, Jill Gunn and Bram Noble, *Review of KHLP's Approach to the Keeyask Generation Project Cumulative Effects Assessment* (Report, Public Interest Law Centre, 2013) 22.

[46] Hyder Consulting, *Final Report on the Study on the Assessment of Indirect and Cumulative Impacts, as well as Impact Interactions within the Environmental Impact Assessment (EIA) Process – Volume 2: Research Study and Findings* (1999) vi (referring to GIS).

[47] Erin E Prahler et al, 'It All Adds Up: Enhancing Ocean Health by Improving Cumulative Impacts Analysis in Environmental Review Documents' (2014) 33(3) *Stanford Environmental Law Journal* 351, 375–6.

[48] Baxter et al, n 42, 256.

[49] R K Burris and Larry W Canter, 'Facilitating Cumulative Impact Assessment in the EIA Process' (1997) 53(1–2) *International Journal of Environmental Studies* 11, 25.

[50] Burris and Canter, n 49, 17, 21–2; Lourdes M Cooper and William R Sheate, 'Cumulative Effects Assessment: A Review of UK Environmental Impact Statements' (2002) 22(4) *Environmental Impact Assessment Review* 415, 424; Tarja Söderman,

foreseeable future projects.[51] Others may select temporal boundaries that are inappropriate because they do not capture cumulative effects of other projects identified as relevant,[52] or that are inappropriate for unspecified reasons.[53]

While it appears that there has been no evaluation of how Australian environmental practitioners have dealt with time in cumulative effects assessments, a recent survey by the author highlighted areas of time-related difficulty perceived by practitioners. They commonly highlighted the difficulty of obtaining information about historic ecological data, difficulty incorporating predictions of future climate change into models, and increasing uncertainty about modelling predictions with longer time horizons.[54] This uncertainty, combined with the irreversible nature of the effects of CSG extraction in many Australian contexts (discussed below), raises the potential application of the precautionary principle, discussed further in Part IV.

D. Time in the Context of Coal Seam Gas: Special Considerations

The matters for consideration in Part II(B) offer a useful starting point for temporal scoping in CSG. However, the time-related idiosyncrasies of groundwater and CSG, and Australian biophysical and political environments, reveal even farther-reaching elements related to time that deserve consideration.

1. Australian Biophysical Considerations

Groundwater systems fundamentally operate at longer time frames than those with which humans are accustomed to dealing. Some groundwater is thousands or millions of years old – for example that in the Great Artesian Basin (GAB), a CSG target – some of which is now not connected to any source of modern recharge.[55] This "fossil groundwater" is essentially non-renewable.[56] Groundwater often moves very slowly. Groundwater in some regions hosting CSG exploration and production flows at mere centimetres per year.[57] As a result, there can be time lags between withdrawing groundwater or depositing a contaminant and the effects of this propagating to a geographically distant, but ecologically or economically valuable location and effects reaching equilibrium.[58] This has several implications for impact assessment. Robust up-front analysis before an activity commences is indispensable because unsustainable extraction may not have obvious effects for years, decades or longer; by that time, a return to sustainable levels of extraction may not result in positive effects at land surface for decades.[59] As a result, adaptive management cannot substitute for effectively assessing cumulative effects, since "the cumulative degradation could be substantial", and time lags between adjusting management and seeing

'Treatment of Biodiversity Issues in Finnish Environmental Impact Assessments' (2005) 23(2) *Impact Assessment and Project Appraisal* 87, 91; Gunn and Noble, n 45.

[51] Burris and Canter, n 49, 17 (Note that under US NEPA, environmental assessments support a finding of no significant impact, representing a process distinct from an environmental impact assessment).

[52] Gunn and Noble, n 14, 15 (in relation to a high voltage transmission line).

[53] David P Lawrence, "Quality and Effectiveness of Environmental Impact Assessments: Lessons and Insights from Ten Assessments in Canada" (1997) 12(4) *Project Appraisal* 219, 229; Baxter, n 15, 39.

[54] See generally Rebecca Nelson, "Water Data and the Legitimacy Deficit: A Regulatory Review and Nationwide Survey of Challenges Considering Cumulative Environmental Effects of Coal and Coal Seam Gas Developments' (2019) 23(1) *Australasian Journal of Water Resources* (forthcoming).

[55] Kim de Rijke, Paul Munro and Maria de Lourdes Melo Zurita, "The Great Artesian Basin: A Contested Resource Environment of Subterranean Water and Coal Seam Gas in Australia' (2016) 29(6) *Society and Natural Resources* 696, 699.

[56] National Water Commission, *Groundwater Essentials* (2012) 10.

[57] See, eg, M Smith et al, *Context Statement for the Cooper Subregion: Product 1.1 for the Cooper Subregion from the Lake Eyre Basin Bioregional Assessment* (Department of the Environment, Bureau of Meteorology, CSIRO and Geoscience Australia, 2015) 73.

[58] Anthony J Jakeman et al, "Integrated Groundwater Management: An Overview of Concepts and Challenges" in Anthony J Jakeman et al (eds), *Integrated Groundwater Management: Concepts, Approaches and Challenges* (2016) 3, 11; see generally Bredehoeft and Durbin, n 21.

[59] Jakeman et al, n 58, 3, 11.

a response mean that degradation may continue even after management adjusts.[60] This is equally true where groundwater conditions are highly variable over time, so that "a sustained and relatively large amount of degradation must occur before management adjusts".[61]

Time lags also make it particularly dangerous to assume that the effects of past actions are appropriately aggregated in current conditions, averting the need to set a past temporal boundary: long time lags between project commencement and maximum effects may mean effects that are already "locked in" from past or present activities have not yet manifested in current conditions.[62]

The history of groundwater exploitation in regions relevant to CSG projects, combined with the vulnerability of valued environments, suggest that these time lags can be a real issue. This has important consequences for setting past temporal boundaries to assess the cumulative effects of CSG projects. In the Great Artesian Basin, mound springs are a key valued environment. Some spring mounds with currently flowing springs have been dated at between 10,000 and 740,000 years old.[63] For context, *Homo sapiens* are thought to have evolved about 300,000 years ago.[64] These entirely groundwater-dependent springs are subject to planning objectives to ensure flows do not decrease lower than natural variability, and are listed as endangered under the *EPBC Act*.[65] Other ecosystems depend on groundwater to differing degrees,[66] some in a way that varies with time, so that precise timing of effects is important. Highly groundwater-dependent ecosystems may be very sensitive – to the extent of total loss – to even small changes in groundwater availability or quality.[67]

Uncapped, free-flowing artesian bores used by pastoralists in the Great Artesian Basin have long had a significant impact on mound springs, with some known to have been lost 150 years ago.[68] In some target CSG areas, although CSG is a relatively new industry, coal mining and conventional petroleum are well established, with decades of exploitation, as is water-using agricultural activity, producing a complex map of likely relevant, more recent "past developments".[69] Considerations like the time of pre-disturbance conditions (or the time at which impacts similar to those of the proposed activity first arose), which are relevant to determining a past temporal boundary for a CSG development that might affect the springs, potentially place this boundary in the distant past. The unique nature of the springs also

---

[60] Lee H MacDonald, "Evaluating and Managing Cumulative Effects: Process and Constraints" (2000) 26(3) *Environmental Management* 299, 311.

[61] MacDonald, n 60, 311.

[62] This characteristic may be shared by other water-related activities: see, eg, Gunn and Noble, n 45, 20 (in relation to the effects of hydroelectric turbines).

[63] JR Prescott and MA Habermehl, "Luminescence Dating of Spring Mound Deposits in the Southwestern Great Artesian Basin, Northern South Australia" (2008) 55(2) *Australian Journal of Earth Sciences* 167, 176–177.

[64] Daniel Richter et al, "The Age of the Hominin Fossils from Jebel Irhoud, Morocco, and the Origins of the Middle Stone Age" (2017) 546(7657) *Nature* 293, 296.

[65] Smith et al, n 57, 75–76.

[66] Derek Eamus et al, "Groundwater Dependent Ecosystems: Classification, Identification Techniques and Threats" in Anthony J Jakeman et al (eds), *Integrated Groundwater Management: Concepts, Approaches and Challenges* (2016) 313, 314–315.

[67] Eamus et al, n 66, 314–5.

[68] Rod Fensham, Winston Ponder and Russell Fairfax, *Recovery Plan for the Community of Native Species Dependent on Natural Discharge of Groundwater from the Great Artesian Basin* (Report, Australian Government, Queensland Government, South Australian Government Department for Environment and Heritage, New South Wales Government Department of Environment, Climate Change and Water, 2010) 12.

[69] See, eg, Queensland Government, Department of Natural Resources and Mines, *Queensland Coal-Mines and Advanced Projects* (Industry Update, 2017) <https://www.dnrm.qld.gov.au/__data/assets/pdf_file/0011/238079/coal-mines-advanced-projects.pdf>. Note that the precise scope of the phrase "other developments" in the definition of "coal seam gas development" under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (s 528) is not defined, so it is not certain the precise scope of the other past, present and future activities that must be included in an assessment of cumulative effects. However, policy guidelines and the rationale behind cumulative effect assessments point to a broad scope, including not only other CSG and coal mining developments, but also other water-using activities that impact the same water resources as a proposed project. For further discussion of this point, see Nelson, n 19.

means they could be highly valuable refugia in a changed future climate.[70] Temporal boundaries thus play an important role in assessing the significance of impacts to springs in both the past and future.

2. Social, Cultural and Political Considerations

Time-related social, cultural, and political factors – from the profound to the prosaic – can also complicate matters. The ecologically valuable springs that are highly sensitive to CSG groundwater use have important heritage value. They have carried great cultural and spiritual significance for Aboriginal people for thousands of years,[71] and played an important role in supporting early European settlers two centuries ago.[72] Ancient ecosystems and individual organisms can attract sentiments of heightened value, respect and even sacredness across many cultures – particularly in relation to forests and trees.[73] Yet conservation biologists have observed that the social and cultural value attributed due to long-established organisms or ecosystems is not often taken into account in conservation planning.[74] The immense age of some groundwater and the springs it supports – twice the age of our own species' history – and the long relationships that people have had with these springs, would also appear relevant to assessing the significance of impacts on them in a cumulative assessment context.

More prosaically, practitioners generally acknowledge that assessing cumulative effects is more complex, and takes longer, than assessing the effects on an individual project in isolation.[75] The *EPBC Act* itself speaks to the trade-off between the speed and robustness of assessment. The Act formally seeks to pursue its objects by adopting "an efficient and timely Commonwealth environmental assessment and approval process that will ensure activities that are likely to have significant impacts on the environment are properly assessed".[76] The time taken to assess and approve a project has strong political salience. A "key evaluation question" considered by a recent review into the water trigger was "the additional administrative, substantive compliance and delay costs associated with the regulation to business, community organisations and individuals".[77] This mirrors the focus on the delay costs to proponents of obtaining regulatory approvals evident in industry advocacy and in the deregulation and "red tape reduction" agendas adopted by governments around Australia.[78] Interestingly, although the evaluation calculated that water trigger approval processes involved a total annual delay cost of $45.7 million, the number of days' delay had actually *reduced* after the water trigger was introduced, compared to approval times before it was introduced (for projects that would have been subject to the trigger).[79] Speculatively, this may have been due to "improvements in administrative efficiency associated with information availability, introduction of the bilateral assessment arrangements with States, and/or improvement in processes or staff performance".[80] In any case, although the review interpreted delay-related costs of the

---

[70] See generally Jennifer Cartwright and Henry M Johnson, "Springs as Hydrologic Refugia in a Changing Climate? A Remote-Sensing Approach" (2018) 9(3) *Ecosphere* e02155.

[71] See generally Janis Constable and Karen Love, *Aboriginal Cultural Water Values – Galilee Subregion: A Report for the Bioregional Assessment Programme* (Report, 2015).

[72] de Rijke, Munro and Maria de Lourdes Melo Zurita, n 55, 700; Prescott and Habermehl, n 63, 168–9.

[73] See generally Malgorzata Blicharska and Grzegorz Mikusiński, 'Incorporating Social and Cultural Significance of Large Old Trees in Conservation Policy' (2014) 28(6) *Conservation Biology* 1558.

[74] Blicharska and Mikusiński, n 73, 1563.

[75] Cooper and Canter, n 21, 26.

[76] *Environment Protection and Biodiversity Conservation Act 1999* (Cth) s 3(2)(d).

[77] Hunter, n 6, 81.

[78] Senate Select Committee on Red Tape, Parliament of Australia, *Policy and Process to Limit and Reduce Red Tape*, Final Report (2018) [2.52], <https://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Red_Tape/Policyandprocess/~/media/Committees/redtape_ctte/Policyandprocess/report.pdf>; Australian Government, Department of the Prime Minister and Cabinet, *Guidance Note: Regulatory Burden Measurement Framework* (2016) 2, 3, 13–14 <https://www.pmc.gov.au/sites/default/files/publications/Regulatory_Burden_Measurement_Framework.pdf>.

[79] Hunter, n 6, 66.

[80] Hunter, n 6, 66.

water trigger to industry as "significant", it found that these were "small when compared with the overall value of the ecosystem services associated with water and the scale of the regulated industry".[81]

3. Policy Guidance

Australian policy guidance on temporal aspects of the water trigger by no means addresses all of the issues identified above but does outline some key points. The EPBC Significant Impact Guidelines for CSG make some references to time, though they provide no detailed scoping requirements. The Guidelines state that a key criterion for determining whether a development is likely to have a significant impact is the duration of the impacts.[82] Specifically, criteria include the extent to which the development will reduce the "future utility of the resource for third party users, including environmental and other public benefit outcomes";[83] whether it is likely to change the hydrological characteristics of a water resource, including "the timing of variations in water quantity";[84] and whether it "is likely to impact on the hydrology of the system beyond the life of the proposed action"[85] or cause "persistent" water quality contaminants to accumulate in the environment.[86]

The policy guidelines clarify that the value of the water resource is a factor to consider in determining the significance of an impact.[87] As argued above, the springs that commonly occur in CSG target areas may be valuable for reasons that inherently relate to time: springs may have high cultural salience due, in part, to their ancient nature (noting the contingent nature of this form of value), and may offer critical refugia in a climate-changed future.

More thorough technical advice appears in the recently updated technical Information Guidelines published by the IESC established under the *EPBC Act*.[88] They state that temporal boundaries need to be "large enough to include all potential significant impacts on water resources from the proposed project, when considered with other activities within the region", for example, expanding boundaries to cover the impacts of other activities that overlap with the proposed development.[89] They list specific information needs in relation to groundwater as including various time-related groundwater characteristics[90] and require modelling of water impacts and recovery "for the life of the project and beyond", including time to maximum drawdown and time to reach "post-development drawdown equilibrium"[91] (ie how long it takes until the water table is stable). The Information Guidelines also require an assessment of "how impacts are predicted to change over time and any residual long-term impacts" and a proposal of "mitigation or offset measures for long-term impacts post mining".[92] In relation to cumulative impacts specifically, they require a statement about "the likely … timeframe over which impacts will occur, and significance of cumulative impacts".[93]

---

[81] Hunter, n 6, 70. Note that there was explicitly no attempt to determine the monetary value of relevant ecosystem services, but rather to outline the national economic value of provisioning services associated with water resources.

[82] Department of Environment, n 12, [5.1.1].

[83] Department of Environment, n 12, [5.2].

[84] Department of Environment, n 12, [5.3].

[85] Department of Environment, n 12, [5.3].

[86] Department of Environment, n 12, [5.3].

[87] Department of Environment, n 12, [5.1.1].

[88] Independent Expert Scientific Committee on Coal Mining and Coal Seam Gas Development (IESC), *Information Guidelines for Proponents Preparing Coal Seam Gas and Large Coal Mining Development Proposals*, Report (May 2018).

[89] IESC, n 88, 12.

[90] For example, time lags in interactions between water resources, data relating to seasonal and climatic cycles in water levels and quality: IESC, n 88, 16.

[91] IESC, n 88, 17.

[92] IESC, n 88, 18.

[93] IESC, n 88, 24.

The Australian Groundwater Modelling Guidelines, referenced in the Information Guidelines,[94] note that "The timescale of interest may relate to planning or development time frames, system response time frames (including system recovery such as water-level rebound after mine closure) or impacts on water resources by decadal-scale changes in recharge."[95]

III. How do Water Trigger Cumulative Environmental Assessments Treat Time?

A. Methodology

Ten CSG projects have been deemed controlled actions for water trigger purposes since its introduction (with one project having been withdrawn).[96] For each of the nine active projects, we reviewed and analysed online environmental assessment documentation,[97] advice about the project that the IESC provided to the Minister, and the final approval decision.

The evaluation focused on three broad aspects of time. The first is time in relation to decision-making. This engages with industry concerns that approval timelines represent a significant regulatory burden, and conversely, the concerns of some environmental advocates and practitioners that regulatory timelines do not allow enough time to effectively assess cumulative environmental effects. "Duration to approval" was calculated as the number of days between the date of signature of the referral and the date of approval. It did not take account of any subsequent variation. This aspect was evaluated in relation to all projects.

The second aspect of time assessed was the life of the CSG development from commencement to decommissioning ("project life"), as set out in the assessment documents. This aspect was evaluated in relation to all projects.

The third and most substantive area of time related to temporal scoping to assess cumulative environmental effects. This included whether a temporal boundary was explicitly stated in the environmental assessment,[98] the "baseline" used in relation to groundwater quantity (levels/pressure), the length of time over which adverse impacts of the CSG development are expected to be felt (eg the time predicted to elapse before groundwater resources recover), the duration of similar effects attributed to "other developments, whether past, present or reasonably foreseeable developments", and the nature of the past, present and future "other developments" included in the assessment.

This third aspect was evaluated briefly for all projects by considering the length of time over which adverse impacts were expected to be felt ("effect duration"). This information was anticipated to be available for all projects, since it is an item included in the Significant Impact Guidelines and the IESC's Information Guideline checklist for water trigger projects and is discussed in the Australian Groundwater Modelling Guidelines (see Part II(D)(3) of this article).

In addition, this third element was fully evaluated in relation to the case of the Western Surat Gas Project, which appeared most likely to represent best current practice in cumulative effects assessment.[99] Its

[94] IESC, n 88, 17.

[95] B Barnett et al, *Australian Groundwater Modelling Guidelines*, Report No 82 (National Water Commission, June 2012) 16.

[96] The withdrawn project was the Camden Gas Project: Nth Expansion (AGL Energy Ltd, EPBC No 2012-6638). This project is not considered further. The data is reported as at January 2019.

[97] Environmental assessment documents are not made available by the Commonwealth Department of the Environment and Energy; rather the notices of public availability of the assessment documents link to proponent websites. In some cases, proponents had removed environmental assessment documents from their websites. However, the websites and documents originally available there had been archived through the Internet Archive <https://archive.org/>.

[98] This was based on a review of the cumulative impacts section of the main environmental assessment report and any attachment that related specifically to water.

[99] The case therefore meets the rationale for a single case study of an "extreme case": Robert K Yin, *Case Study Research: Design and Methods* (SAGE, 4th ed, 2009) 47.

assessment approach was the relatively rigorous public environment report (PER), rather than assessment by preliminary documentation. Cumulative effects are also likely to be especially pronounced in the project's area – the Surat Basin, within the Maranoa Balonne Condamine region – where there is extensive existing and planned development of coal, conventional petroleum, and CSG.[100] Six of the nine active projects are proposed to occur within the Maranoa Balonne Condamine region. Cumulative effects are also expected to be significant for this project in a relative sense, because the project itself involves a smaller-than-usual number of wells for a CSG development (the median number of wells among the referred controlled actions being 740, as opposed to 425 for the selected project). The project also has one of the most recently prepared environmental assessments (2018), which means it can build on material previously prepared by other proponents. The project also benefits from the Queensland government's regional groundwater model, which is intended to inform cumulative effects assessments, as described below.

All three aspects of time relate directly or indirectly to environmental impacts. There is a direct connection in relation to project life and effect duration. Although duration to approval does not relate directly to impacts, debates about the regulatory burden associated with approval times are indirectly connected to impacts. The duration of effects influences whether the impacts of the project are considered significant,[101] and it seems reasonable to expect that there be a relationship between the time and effort devoted to assessing the likely impacts of a project (ie duration to approval), on the one hand, and the project's likely significance on the other.

B. Time in Decision-Making, Operations, and Cumulative Effects across All Water Trigger CSG Projects

Columns 1–5 of Table 1, below, summarise the basic characteristics of CSG projects found to be controlled actions under the water trigger (referral identification number, number of wells involved, the relevant bioregional assessment region (if any), the status of the project, and the approach to environmental assessment taken). Environmental assessment information was available online for only six of the active projects as of January 2019. In the remaining cases, the material had been removed from proponent websites and had not been archived by the Internet Archive service.[102]

Determining time to approval (column 6) and project life (column 7) was straightforward. Time to approval for the five approved projects ranged from 1.1 to 3.9 years, with an average of 2.8 years. Project life ranged from 25 to 47 years.

Determining effect duration (column 8) was not straightforward, despite this matter being expected under formal and informal policy documents. The duration of a project's effects was reported for only two of the six projects for which environmental assessment documentation was available. In these cases, the effects of the projects on groundwater were predicted to last for about 1,000 years on a cumulative basis and 1,500 years on a single project basis, respectively. Some of the projects that did not report effect duration did include some other temporal description relevant to their effects, for example maximum drawdown on a single project or cumulative basis. However, there was too much variation in how they did this to enable comparisons (eg reporting with respect to different kinds of receptors). The relevant timespans ranged from decades to a half-century (in the cumulative case) until maximum impacts would be felt. The practical implications of these types of figures are discussed further below in relation to the Western Surat Gas Project.

Even with this sparse data, considering these quantitative temporal elements together emphasises the differences in magnitude: the very short timelines for approval (less than a handful of years), compared to relatively short (multi-decadal) durations of operation compared to the very long (multi-century)

[100] Queensland Government, Department of Natural Resources and Mines, *Queensland's Mining and Petroleum Industry Overview* (Industry Overview, July 2016) 2, 8 <http://apps.dnrm.qld.gov.au/mobileapp/English/Overview/overview_english_2016.pdf>.

[101] See n 17 and accompanying text.

[102] Internet Archive, n 97.

duration of environmental effects. It is also important to note that these measures do not capture the significance of the effects, noting that effects may "tail off" significantly as the effect period proceeds. Nor do they capture the residual effects that may be present even after multi-century recovery times (indeed, this information is typically not given in the environmental assessments reviewed). A long duration of effects does not necessarily mean that a project is not justified, but it does tend to indicate the importance of proper assessment. Nonetheless, the data provide food for thought in the context of popular debates. Debates about regulatory efficiency and "green tape" should be informed by an understanding of the relative durations of time to approval, project life and duration of effects, and ideally, explicit consideration of whether it might be reasonable to expect time-consuming environmental assessment to be undertaken to support a project that might have effects lasting over a thousand years. These data, particularly the long effects durations, also highlight the relevance of more deeply considering environmental law principles related to time (see further Part IIIC(2) of this article).

Table 1: CSG projects deemed controlled actions under the *EPBC Act* water trigger

EPBC ID	Approved # wells	Bioregion and formation	Status	Assessment approach[103]	Time to approval (yrs)	Project life (yrs)	Effect duration (yrs)
2010-5344	6,500	Northern Inland: Maranoa Balonne Condamine sub-region (MBC)	Approved	EIS	3.9	40	Unstated
2012-6377	4,000	None	Approved	EIS	2.5	40	~1,000 (cumulative)
2012-6615	6,100	MBC	Approved	EIS	3.4	30	Unstated
2013-7047	400	MBC	Approved	PD [N/A online]	1.1	30	[PD N/A online]
2014-7376	850	Northern Inland: Namoi	Under assessment	EIS	Not yet approved	25	1,500 (single project); cumulative unstated
2015-7469	425	MBC; Walloon Coal Measures (in GAB)	Approved	PER	3.3	47	Unstated
2017-7881	114	None	Under assessment	PD	Not yet approved	30	Unstated
2017-7902	68	MBC	Assessment approach decided	PD [N/A online]	Not yet approved	40	[PD N/A online]
2018-8276	740	MBC	Assessment approach decided	PD [N/A online]	Not yet approved	41	[PD N/A online]

[103] EIS means assessment by environmental impact statement; PD means assessment on preliminary documentation; PER means assessment by preliminary environment report: *Environment Protection and Biodiversity Conservation Act 1999* (Cth) s 87.

C. Evaluating Time Elements of the Western Surat Gas Project Cumulative Assessment

The Western Surat Gas Project (WSGP) proposes to use 425 wells to extract CSG from a 685 km^2 area near Roma, Queensland.[104] The target coal seam is the Walloon Coal Measures, in the Surat Basin, which is part of the GAB.[105] The original referral for the project contemplated 1,000 wells, but this was subsequently varied because additional subsurface data suggested that some of the original project was "commercially unviable at this time".[106]

A key potential environmental effect of the project is that it will "draw down" groundwater, with potential to affect 1,029 registered users of groundwater for public, stock and domestic and agricultural purposes in the area, three groundwater-dependent spring complexes, and watercourse springs along reaches of three creeks.[107] The PER notes three other CSG projects located adjacent to the WSGP, no active coal mines, but areas over which two applications for mining leases have been made (but not approved), one approved mining development lease, and one exploration permit for coal.[108] Petroleum activities and other land uses (such as cattle grazing and feedlotting) are also noted but not discussed in detail.[109]

The assessment's main approach to modelling of cumulative effects was to use regional modelling undertaken by the Queensland Office of Groundwater Impact Assessment (OGIA).[110] This regional model is described in an "underground water impact report" produced pursuant to statutory obligations under the *Water Act 2000* (Qld),[111] discussed further below.

The PER concludes that 55 bores will suffer drawdown greater than Queensland's 5 m trigger for significance "as a result of the WSGP over the project life", but they will benefit from alternative water supply ("make good") arrangements.[112] That number increased to 123 bores when taking into account cumulative effects.[113] No changes to baseflow volumes (ie groundwater discharge) to streams was predicted,[114] and more broadly, Queensland's drawdown threshold for significance of 0.2 m at springs was not exceeded in the single-project or cumulative modelling scenarios.[115]

The discussion below explains the substantive time-related aspects of the assessment,[116] and how deficiencies in these aspects may compromise the confidence of these findings about impact in a broader sense. Overall, the evaluation suggests that time-related aspects were selected overly narrowly, contrary to both common advice in relation to cumulative effects (see Part II(B)) and Australian guidance in relation to the cumulative effects of CSG projects (the IESC Information Guidelines), and consistent with global observations about the relatively undeveloped state of practice in this area (Part II(C)). The PER does not model or otherwise report the cumulative effects of the WSGP over an appropriate

---

[104] Senex Energy Ltd, *Western Surat Gas Project Public Environmental Report*, Report (2018) 13.

[105] Senex Energy Ltd, n 104, 15.

[106] Senex Energy Ltd, n 104, 22.

[107] Senex Energy Ltd, n 104, 15.

[108] Senex Energy Ltd, n 104, 25.

[109] Senex Energy Ltd, n 104, Att K, 28, Att L, 31.

[110] Senex Energy Ltd, n 104, Att L, 118.

[111] Senex Energy Ltd, n 104, 48.

[112] Senex Energy Ltd, n 104, 110.

[113] Senex Energy Ltd, n 104, 116.

[114] Senex Energy Ltd, n 104, 111.

[115] Senex Energy Ltd, n 104, 116.

[116] Note that cumulative water resources impacts are detailed in just two paragraphs and one map in the main body of the WSGP PER: Senex Energy Ltd, n 104, 116–117 [5.3.2]. This material does not explicitly state or justify any time-related elements of the predictions. To evaluate these aspects, it was necessary to refer to a detailed technical attachment (intended as a report to the IESC, and presented as Attachment L to the PER), and the underground water impact report produced by OGIA to describe its regional model for the Surat basin.

timeframe, which means that there is unconsidered potential for the project to have significant cumulative effects for EPBC purposes.

1. Past Temporal Boundary, Past and Current Activities, and Baseline Conditions

To understand how the cumulative assessment deals with the past, it is necessary to understand whether and how the assessment includes "past" activities that could impact on water resources of interest (including "natural" factors).

(a) Historical Trends from Past Developments and Changing Natural Conditions

The Queensland statutory "underground water impact report" that describes the OGIA model results discusses long-term declining trends in GAB bores even before CSG development started,[117] probably due to expanding groundwater use for stock and domestic and intensive livestock purposes and declining rainfall.[118] The regional groundwater model includes these extractions in the aggregate, rather than individually modelling them,[119] as might be expected in a regional model.

This background trend and non-CSG groundwater use are not discussed (other than noting the presence of other groundwater users) in the WSGP PER, but extraction by "third parties" was included in the OGIA regional model (appropriately, given their character as "past developments" for EPBC purposes).[120] The concept of "baseline" conditions relevant to groundwater or groundwater-dependent ecosystems is not explicitly explained in the PER, but appears to be based on approximate regional conditions in 1995 (when CSG development commenced).[121] The regional model on which the assessment relies ignores the background trend of declining groundwater conditions given that it is "relatively minor" for "a majority of" boreholes.[122]

(b) Aggregating Past Activities and Current Conditions to Make Regional Predictions versus Considering Past Activities to Predict Local-Scale Effects

To evaluate whether the effects of a project are likely to be significant, it is necessary to make local-scale predictions and assess these against a set of reference conditions. OGIA's regional model, on which the WSGP relies heavily, is a "relevant consideration when assessing impacts at a specific location", but is not designed to make local-scale predictions itself.[123] Things that are appropriate to ignore when considering the regional "big picture" (like historically declining local groundwater conditions) may be significant for predicting cumulative impacts for an activity-level EPBC assessment. For example, the ecological condition of a spring may have been declining for some time due to other groundwater use or natural effects, such that a relatively small increased impact could have a significant effect.

Commenting on the WSGP draft assessment, the IESC noted that the "paucity" of baseline water data, including incomplete current data in relation to pastoral and other bores that may be affected by the

---

[117] Office of Groundwater Impact Assessment, Queensland Government, Department of Natural Resources and Mines, *Underground Water Impact Report for the Surat Cumulative Management Area* (2016) 65 <https://www.dnrm.qld.gov.au/__data/assets/pdf_file/0007/345616/uwir-surat-basin-2016.pdf>.

[118] Office of Groundwater Impact Assessment, n 117, 66.

[119] Office of Groundwater Impact Assessment, n 117, 80 (representing these extractions as 'drain' boundary conditions).

[120] Senex Energy Ltd, n 104, 126 ("Groundwater abstraction from some third party users can also be observed both [sic] the pre- and post-development maps"). See also nn 137–139 and accompanying text.

[121] Office of Groundwater Impact Assessment, n 117, 81 ("The groundwater model was set up to make predictions starting from 1995. For predictive runs, starting water levels were obtained from the steady state run which accounted for the water extraction existing in 1995.").

[122] Office of Groundwater Impact Assessment, n 117, 81 (although the GAB is recognised as a dynamic system, the majority of boreholes show relatively minor trends over the period of 1960 to 1995 in the Surat area. Therefore, the assumption of steady state conditions in 1995 is considered a reasonable approximation for regional modelling purposes.)

[123] Office of Groundwater Impact Assessment, n 117, 74.

project, would make it difficult to know whether impacts were as predicted.[124] The IESC also found that the insufficiently detailed assessments of the current condition of water-dependent ecosystems would make it difficult to assess the sensitivity of ecosystems to impacts or to "evaluate any future ecological condition against current conditions".[125] There had been no field investigation of one potentially affected groundwater-dependent ecosystem, and there was no information about how the conditions of springs varied with time, or how local water table depths varied with time close to groundwater-dependent ecosystems.[126]

It appears that these concerns were not met with substantial additional data in the final assessment.[127] That document states that there is no need to provide any further evaluation of (current) ecological conditions because the project had low potential to affect groundwater-dependent ecosystems.[128] It is not clear how it is possible to determine a low potential for impact without having any data about the sensitivity of the ecosystem. The final assessment also states that baseline ecological spring condition assessments will be conducted in the future as the project progresses but does not commit to ensuring that these assessments will be sufficient to capture temporal variability in natural conditions before disturbance by the project begins.[129]

The final assessment does refer to new local-scale modelling; however, that effort was limited to modelling shallow groundwater systems (relevant for ecological purposes, though not necessarily for all private water bores), did not attempt to model cumulative impacts, and the model run commences at 2015, so that it does not address the observations above in relation to the influence of past effects.[130]

Overall, the WSGP relies on a well-regarded regional model, which uses a past temporal boundary determined by considering past effects, in a way that may be appropriate to a regional model. However, it is questionable whether those same assumptions justify "glossing over" past effects in the same way in relation to an individual project, where local-scale effects that could be lost in the lower resolution of regional-level data should be investigated for their cumulative significance on local-scale water assets for EPBC purposes.

2. Future Temporal Boundary, Reasonably Foreseeable Future Actions, and Climate Change

(a) Future Temporal Boundary

The WSGP PER does not explicitly state a future temporal boundary, nor does it provide detailed or comprehensive statements about future points in time noted in the Information Guidelines, including the time to maximum drawdown, and the time to reach "post-development drawdown equilibrium" (ie "recovery"), describing residual effects.[131] The WSGP PER states the cumulative effects of groundwater drawdown at the future date of 2042 based on regional modelling that OGIA undertook for the project.[132] The WSGP PER states that this "may not correspond with maximum impacts",[133] and does not explain why 2042 (during the project's anticipated period of operation) was chosen. The PER provides no

---

[124] IESC, *Advice to Decision Maker on Coal Seam Gas Project: IESC 2017-087: Western Surat Gas Project (EPBC 2015/7469): New Development* (2017) 5–6.

[125] IESC, n 124, 7, 10, 12.

[126] IESC, n 124, 7, 10, 12. Note that there had been a field survey of one of the spring complexes, though the extent of the survey is unclear and the only reported finding of the survey included in the PER was that the spring comprised three vents: Senex Energy Ltd, n 104, Att L, 107.

[127] For example, the final report still notes that (current) baseline assessments of bores had been completed for only 89 of 126 bores within the relevant area: Senex Energy Ltd, n 104, Att L, 155.

[128] Senex Energy Ltd, n 104, Att L, I-4.

[129] Senex Energy Ltd, n 104, Att L, I-8.

[130] Senex Energy Ltd, n 104, Att L, 135–136.

[131] IESC, n 88, 17.

[132] Senex Energy Ltd, n 104, Att L, 123 & Apps V & VI.

[133] Senex Energy Ltd, n 104, Att L, 116.

information about cumulative maximum drawdown. It only discusses maximum drawdown (on a single-project basis) at several monitoring points.[134] It explicitly leaves unstated the time of maximum drawdown at sensitive receptors (private bores),[135] and does not show drawdown beyond this time period or for broader locations.[136] A simple local-scale model constructed in response to the IESC's concerns simulates drawdown at the springs on a single-project basis. Without explanation, the relevant graphs cease at 2065 and the report concludes that the springs will not be impacted, despite the graphs showing dramatic decreasing drawdown to 2065, on even a single-project basis (not including cumulative effects). That is, the predictions are cut short at a point in the future when impacts appear to be getting worse.

(b) Reasonably Foreseeable Future Developments

The OGIA model includes current non-petroleum and gas-related groundwater extractions[137] and other planned CSG development.[138] However, neither the underground water impact report nor the WSGP PER records any attempt to identify reasonably foreseeable future non-CSG groundwater-using activities, although water planning documents foresee increased water allocation for other purposes.[139]

(c) Climate Change

Climate change is not mentioned in the water context in the WSGP PER, nor the IESC advice related to the project, nor the OGIA report on predicted cumulative effects on groundwater from CSG.[140] Climate change could place further stress on ecological receptors and stimulate increased demand for groundwater, for example, if surface water supplies were to decrease or become less reliable. This could change predictions of cumulative drawdown. The availability of appropriately scaled climate models, and associated uncertainty, should at least be discussed (and if available, used) in the assessment.

3. Summary

In summary, key time-related apparent deficiencies of the WSGP assessment from an EPBC perspective are:

- *Past*: The assessment does not justify an assumption that historical groundwater declines, likely caused by non-CSG groundwater use, can appropriately be ignored at the local scale, and that these past effects can appropriately be aggregated into groundwater conditions at the onset of the region's CSG development. The assessment thereby omits the future cumulative effects of these historical trends, which could result in under-estimating cumulative effects.
- *Future*: While the assessment includes planned future CSG developments, it does not attempt to describe other reasonably foreseeable forms of groundwater extraction, nor the possible effects of climate change. This could result in under-estimating cumulative environmental effects and approving greater-than-expected ecological harms. This also has implications for affected private bore owners. Under Queensland's *Water Act 2000* (Qld), tenure holders' obligations to "make good" impaired bores continue even after the tenure ends.[141] However, private bore owners who will be affected by the project might reasonably want to know if groundwater conditions are

[134] Senex Energy Ltd, n 104, Att L, 129.

[135] Senex Energy Ltd, n 104, Att L, 139.

[136] Senex Energy Ltd, n 104, Att L, 129–130.

[137] Office of Groundwater Impact Assessment, n 117, 80, 81.

[138] Office of Groundwater Impact Assessment, n 117, 71 ("The extent of the long-term affected area in the Walloon Coal Measures has decreased because of reductions to planned CSG development").

[139] Water Plan (Great Artesian Basin and Other Regional Aquifers) 2017 (Qld) Sch 4. The underground water impact report notes that conventional petroleum and gas extraction is in decline, and so are included in the "base run" of the model, rather than the run that is used to predict effects into the future with CSG developments: Office of Groundwater Impact Assessment, n 117, 81.

[140] Office of Groundwater Impact Assessment, n 117.

[141] *Water Act 2000* (Qld) s 362 (underground water obligation) 439.

expected to become substantially worse (ie the time of maximum drawdown) after the project closes, when they may bear greater risk in relation to the proponent "making good" adverse impacts. Having too short term a picture of likely impacts may also adversely impact water planning processes, which are influenced by water availability.

Ironically, it appears that State investment in regional modelling relevant to CSG developments may dissuade proponents from undertaking the kind of local modelling required to present the most accurate picture of the likely effects of the project in its cumulative context, including as to elements related to time.

D. Summary of Empirical Evidence

In theory, the EIA literature and jurisdiction-specific policy guidance tends to counsel carefully scoping a project in time, likely with a relatively long temporal scope in a case like CSG development, to ensure that its cumulative effects can be predicted and communicated in context. Implementation appears to fall short of this theory, as has been noted elsewhere around the world (see Pt II(C) of this article). This paper's empirical findings add weight to Ben Richardson's observation about time in environmental law. He notes that, reflecting human psychological biases, environmental law is obsessed with the present, and suffers from "temporal amnesia" in failing to "appreciate the extent of past losses";[142] equally, Richardson observes that it is pre-occupied with the future, but that this is ultimately a "mirage", essentially ignored in favour of short-term considerations.[143] The findings reported here mirror this amnesia and relative short-sightedness.

The EIS documents reviewed here tend to adopt a truncated historical and future view of the world and potential impacts, made all the more striking by the cumulative effect context that necessarily encourages a wider and more considered temporal view. By taking this truncated view of time, it is difficult to gain an accurate picture of the significance of the likely environmental effects of a project in its real-life context, which is the central purpose of the EIA. Some assessment documents omit direct mention of time-related elements of an effects assessment, for example, leaving out predictions about the expected time and conditions at which a water resource will experience maximum adverse effects. This does not align with express policy about the information that is required for assessment. Finally, even where such statements may have been included in project assessments, documents may not remain publicly available after the required statutory exhibition period. This makes it difficult to check whether the predictions about the future that justify the legally binding conditions imposed on a project approval remain justified into the future, as effects aggregate and unfold in practice. It also poses difficulty for attempts at adaptive management by obscuring the relationship between the original predictions about cumulative effects, underlying assumptions, and conditions of approval, which could form the basis for learning and adjustment of conditions.

Beyond the larger problem of human psychological biases, the apparently cursory attention to temporal issues may be due, at least in part, to financial aspects of the assessment process. Specifically, the case study reported above points to a mismatch between the purposes and scopes appropriate to government approaches to assessing CSG developments at the regional scale, and those appropriate to project-level assessments that are funded by individual proponents. Proponents naturally wish to rely on existing models as much as possible to reduce the time and resources they devote to project-specific models, but in doing so, they may not fully represent the expected impacts of their project at temporal and spatial scales appropriate to the project.

[142] Ben Richardson, *Time and Environmental Law* (CUP, 2017) 15–16.

[143] Richardson, n 142, 121, 123.

IV. RECOMMENDATIONS AND CONCLUDING REFLECTIONS

A. Recommendations

Applying technical and scientific policy frameworks for cumulative effect assessment, this study suggests that there is room to improve temporal aspects of the assessments of Australian CSG projects in relation to water resources. Part III(B) suggests that basic temporal characteristics of cumulative effects assessments – the time it takes the environment to recover, or reach equilibrium, given the cumulative effects of a CSG development – are often not clearly specified. Evaluating a single "critical case" cumulative effects assessment, Part III(C) shows how temporal boundaries that are arguably inappropriate, or at least unjustified, can be used for assessing the cumulative effects of a project even in an area that has received significant scientific investment at the regional scale.

At its heart, though, issues of time in cumulative effects assessment transcend science and traverse decidedly normative and ethical territory. Impact assessment is typically conceived as an objective, scientific process,[144] but even the scientific literature accepts that some parts of the cumulative effects assessment process might not actually be strictly "scientific",[145] but constitutive of social goals to which the law points.[146] Often, key elements in an assessment involve significant discretion, professional judgment or even intuition.[147] Considering how cumulative effects assessment can improve should explicitly confront underlying value judgments.

1. Increase Transparency of Cumulative Environmental Assessment Documents

This study encountered difficulty in accessing environmental assessment documents produced for EPBC purposes, which are not made available directly by the federal environment department. Although the regulations require the proponent to publish notices and information in hard copy and online, they do not clearly require ongoing availability of the document.[148]

Transparency, efficiency, and the unique nature of cumulative impact assessments strongly suggest that these assessments should continue to be available after a decision has been made about a project. The assessments directly relate not only to the proposed activity, but to other activities, including future activities. Practitioners have frequently complained of the difficulty of accessing information about past projects for the purpose of cumulative assessments. Media and environmental NGOs might equally benefit from being able to cross-reference reports of actual impacts with previously predicted impacts. The heightened relevance of one water-affecting project to another, and the long periods of continuing relevance (corresponding to the long period of continuing impact) justifies the continued availability of these documents at least for the life of the project. To assist with locating and preserving this information, it should be held and made public by the federal environment department, with statutory amendment if necessary, to deal with concerns related to intellectual property.

2. Increase Transparency about Temporal Aspects of Cumulative Environmental Assessment

One way to encourage better specification of temporal boundaries and associated time-related elements of cumulative effects assessments would be to amend the IESC Information Guidelines and the accompanying checklist for proponents. They could clearly require proponents to specify past and future temporal boundaries, and separately identify the past, present and reasonably foreseeable future actions

---

[144] Matthew Cashmore, "The Role of Science in Environmental Impact Assessment: Process and Procedure Versus Purpose in the Development of Theory" (2004) 24 *Environmental Impact Assessment Review* 403, 408–412.

[145] Peter N Duinker et al, "Scientific Dimensions of Cumulative Effects Assessment: Toward Improvements in Guidance for Practice" (2013) 21(1) *Environmental Reviews* 40, 43.

[146] McCold and Saulsbury, n 32, 768 ("the choice of baseline is not a question of science, but of social goals. It is NEPA and its implementing regulations, rather than scientific questions, that point to the view of cumulative impact assessment advocated in this paper").

[147] Canter and Canty, n 16, 291; Baxter, Ross and Spaling, n 42, 256.

[148] See, eg, *Environment Protection and Biodiversity Conservation Act 1999* (Cth) Pt 16.

that have been included within these boundaries. Most importantly, proponents should be required to explain why certain time periods and actions have been included or excluded from the analysis. Proponents should also be alert to the dangers of relying too heavily on government-produced regional assessments where local assessments of environmental effects are required. The WSGP shows that different temporal scopes can be appropriate in these different contexts.

3. Justify, with Reference to Environmental Legal Principles, as well as Technical Principles, How Temporal Aspects of Cumulative Assessment Are Determined

Better requirements for specifying time-related matters assist with transparency, but do not address the normative issues underlying how proponents scope their projects in time. That is the realm of the Significant Impact Guidelines. These Guidelines should be updated to better advise proponents on elements that should be considered in setting a temporal boundary. The considerations included in general advice frameworks internationally (see Part II(B)) tend to be technical in nature and not accompanied by any advice on how to trade them off where they are in tension. An effort to update the Significant Impact Guidelines should consider, but go beyond, these considerations. It should consider the role played by principles of environmental law that deal, explicitly, or implicitly, with aspects of time.

The principle of intergenerational equity is a "principle of ecologically sustainable development" that the *EPBC Act* has as an object to promote.[149] As expressed there, "the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations".[150] The Minister must take this into account when deciding whether or not to approve the taking of an action, and what conditions to attach to an approval.[151] Clearly specifying and justifying a future temporal boundary for assessing, for example, groundwater drawdown, would clearly state the extent to which the assessment considers future generations. In particular, specifying the time of maximum cumulative environmental effect answers the question: which future generation will bear the greatest burden (eg experience the greatest jeopardy to its access to groundwater) to achieve present economic benefit? Specifying the time of recovery identifies the number of generations required to bear a burden for the economic benefit of the present.

Environmental principles also provide a way to be transparent about trade-offs between matters that are relevant to determining time-related elements of a cumulative effect assessment. The principle that "decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations"[152] does this. A proponent may incur present-day, short-term economic losses because doing a robust cumulative environmental assessment takes longer, or because it can be time-consuming to collect historical data about significant past actions or develop good information about current conditions based on field surveys that account for natural temporal variability in ecological conditions. This paper suggests that "integrating" these considerations should take account of the *very* long-term nature of the losses that are potentially incurred by future generations as a result of CSG projects, and the desirability of spending a very short time (in a relative sense) up-front to best understand these effects.

The precautionary principle is another "principle of ecologically sustainable development" under the Act: "if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation".[153] Longer time horizons in cumulative effects assessments – into the past and the future – inherently increase uncertainty via the potential unreliability associated with historical data and the uncertainty associated with predicted future impacts, relative to the apparent uncertainty associated with predicting

---

149 *Environment Protection and Biodiversity Conservation Act 1999* (Cth) ss 3(1)(b), 3A.

150 *Environment Protection and Biodiversity Conservation Act 1999* (Cth) s 3A(c).

151 *Environment Protection and Biodiversity Conservation Act 1999* (Cth) s 136(1), (2).

152 *Environment Protection and Biodiversity Conservation Act 1999* (Cth) s 3A(a).

153 *Environment Protection and Biodiversity Conservation Act 1999* (Cth) s 3A(b).

the impacts of a single development in isolation. (Though arguably, since developments never happen in isolation from the "real world" of multiple impacts, single-development predictions are almost certainly more wrong in terms of assessing the significance of a project's real-world environmental consequences.) The biophysical contexts in which CSG development often play out, such as non-renewable groundwater resources or extremely long-term declines in groundwater levels, would normally easily constitute "threats of serious or irreversible environmental damage".

This is to say that the precautionary principle should perhaps play an even greater role in the context of longer time-scope cumulative effects assessments than would typically be the case. This insight is distinct from the scientific literature's typical view of cumulative effects assessments as a *way to exercise* a precautionary approach by helping to avoid and minimise incremental environmental harms.[154]

Within a precautionary framework, increasing uncertainty is, at minimum, an additional reason to ensure that decision-making processes are transparent (eg in the ways suggested above), especially where judgments mix "questions of factual content" and "those of normative concern".[155] Other approaches to transparency relevant here include clearly communicating uncertainty and data reliability in cumulative assessment documents. The precautionary principle also usefully reminds decision-makers of the gravity of very long-term, essentially irreversible impacts that may burden many generations. Requiring proponents to make short-term investments in obtaining good information on historical, current and reasonably foreseeable future actions and conditions to reduce avoidable uncertainty should be seen in the light of this intergenerational burden.

B. Conclusion

Assessing cumulative environmental effects is an ongoing challenge for environmental governance globally and in Australia. Unless temporal elements of cumulative assessments are robust, these assessments may not paint a full picture of how significant a project is in its real-world context. Projects that can cause very long-term effects on water resources, like CSG developments, should attract particular attention in this respect. This is especially so where cumulative impacts are likely to be pronounced, as in groundwater basins with a history of use and subject to many new developments with overlapping effects.

Globally, advice in relation to considering time in cumulative assessments has evolved. At the time that the current *EPBC Act* was passed in Australia, comparative jurisdictions were being advised that using long time frames to assess cumulative effects was of "little value".[156] The last two decades have seen this change significantly. Yet the empirical evidence presented here suggests that current practice in undertaking cumulative effects assessment has room for improvement in relation to temporal elements – both past and future. Despite their technical guise, issues of time in cumulative effects assessments are fundamentally normative. They engage with principles of intergenerational equity, integrating long- and short-term considerations, and the precautionary principle. To date, these principles have been largely overlooked in policy for considering time in assessing cumulative effects. Australians confronting the possibility of overhauled federal environmental legislation should consider evolving global frameworks dealing with these issues and evidence of the robustness of practice to date. In this context, they should also consider how our guiding principles of ecologically sustainable development should influence new legislation that takes advantage of modern approaches to robustly assessing environmental change, and fairly allocating responsibility for it.

---

[154] See, eg, Chris F Jones, "Cumulative Effects Assessment: Theoretical Underpinnings and Big Problems" (2016) 24(2) *Environmental Reviews* 187, 199.

[155] Jacqueline Peel, *The Precautionary Principle in Practice: Environmental Decision-Making and Scientific Uncertainty* (Federation Press, 2005) 224–225.

[156] Parr, n 43, 21.