Expert Report: Groundwater Issues Associated With Vickery Extension Project

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Introduction

This report examines the topic of groundwater (and related surface water) impacts of the Vickery Extension Project (**Project**), a proposed coal mine extension in northern NSW. I was asked to prepare this report by EDO NSW acting on behalf of Lock the Gate. The report is based on my reading of the Project's Environmental Impact Statement, particularly the Groundwater Assessment prepared by HydroSimulations, as well as the advice on the Project provided by the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (**IESC**) on 14th November 2018.

I have read the Code of Conduct in Schedule 7 of the Uniform Civil Procedure Rules, and agree to be bound by it in preparing this report.

Summary of opinion

As is noted in the advice provided by the IESC, there remain data gaps and limitations in the Groundwater Impact Assessment study completed for the Vickery Extension Project. These issues result in uncertainty with respect to groundwater-related impacts of the Project, including:

1. Water quantity impacts, e.g. drawdown of alluvial groundwater levels and potentially, changes to ground-surface water interaction;
2. Water quality impacts in both groundwater and surface water, including possible mobilisation of heavy metals and other trace elements;
3. Impacts on groundwater dependent ecosystems, which are known to occur within the alluvial aquifer.

Additionally, there is currently a lack of detail and certainty with respect to the program that will be used to monitor groundwater and surface water impacts, and mitigate adverse consequences, should these arise (e.g. greater than anticipated drawdown, impacts on GDEs and/or water quality). It is proposed that these details will be included in a water management plan. As such, the water management plan should be completed and made available for public scrutiny prior to a decision regarding approval of the mine expansion plan.

Specific issues

Uncertainty regarding groundwater and surface water impacts

- The relationship between potential groundwater-dependent ecosystems and groundwater levels (including water table depths) requires further analysis and illustration. Without a detailed representation of the patterns of water table depth

currently, and ranges of possible change in these depths in the vicinity of mapped GDEs/potential GDEs, a proper assessment of risks to such ecosystems cannot be said to have been conducted.

- The range of possible hydraulic parameters (particularly storage coefficients) of the aquifer units affected by mining needs to be further explored and substantiated. Wider ranges of these parameters should be tested in the groundwater modelling to enable a fuller exploration of possible drawdown impacts, until such time as the appropriate values can be verified through further lines of evidence. Additional field investigations should be conducted to substantiate the values of hydraulic parameters over which there is uncertainty and/or doubts raised in the IESC's advice (e.g. storage coefficient in the Namoi Alluvium[1]).
- In turn, a more detailed assessment is needed regarding how possible drawdown impacts might influence hydraulic gradients between the aquifer(s) and Namoi River along its length. This should be informed by detailed analysis of hydraulic gradients and their spatial and temporal patterns, updated on the basis of further analysis of different combinations of hydraulic properties (and supported by field data).
- The implications of the range of possible changes to groundwater-surface water interaction as a result of mining for water quality should be more thoroughly assessed. For example, leakage volumes from the proposed Blue Vale void will have implications for surface water quality, which may be significant. Similarly, changes in the direction and magnitude of groundwater flows to surface water and surface flows to groundwater along different parts of the Namoi River are likely to impact biogeochemical conditions in the riverbed sediments and near-bank environment. These changes may have significant ecological implications which should be carefully studied and understood (e.g. by means of more detailed site-specific field studies of the alluvial system).
- Mobilisation of metals under a wider range of geochemical conditions that could be applicable during water-sediment interaction needs to be assessed more carefully. The IESC noted that testing of the leaching of metals from mine overburden and other material was conducted using de-ionised water. This does not necessarily simulate water-rock interactions (e.g. from rainfall infiltration or groundwater seepage) accurately. The IESC noted that re-analysis of these materials, and how metals and other elements leach from these should be conducted at a range of realistic environmental conditions (e.g. solutions with different pH and ionic concentrations[2]).

Monitoring & mitigation strategies

- The IESC point out that only a limited number of water quality parameters are proposed to be monitored in groundwater. Monitoring of heavy metals/trace elements which are shown to be elevated in some of the coal and mine waste material in the region – e.g. arsenic, mercury, as well as other common heavy metals that are sensitive to changes in pH and redox and can be mobilised in areas of coal mining

[1] See IESC, 2018. Vickery Extension Project Advice, p.4.
[2] IESC, 2018. Vickery Project Extension Advice, 14th November 2018, p.9.

(copper, nickel, zinc, manganese, lead) should be included in a revised monitoring program, which also addresses the issue of low sampling frequency (currently groundwater quality will only be monitored once per year[3]).

- Surface water quality monitoring must include elements where the geochemical study showed elevated levels in overburden and interburden, namely arsenic, silver, boron, antimony and selenium, as well as other metals which may be mobilised – cobalt, nickel, lead and zinc. Effort should be made to gain a greater understanding of potential geochemical conditions leading to mobilisation of these elements, and this information should be incorporated into a pro-active ground and surface water quality monitoring strategy (made available for public scrutiny prior to an approval decision).
- Water quality trigger levels set with respect to appropriate site-specific guideline values for groundwater and surface water are yet to be proposed. The interactions between groundwater and surface water (e.g. groundwater discharging to surface water) needs to be taken into account in this process- i.e., changes in groundwater quality may result in ecological impacts due to discharge of groundwater to surface water.
- Controlled and uncontrolled discharge from sediment dams to surface water will occur periodically and has the potential to impact on surface water quality. At present, as the IESC points out, only total suspended solids levels in the sediment dam water is proposed to be monitored. However, other elements such as heavy metals and other trace elements may be elevated in this water and should thus be monitored (including arsenic, aluminium, iron, manganese, lead & mercury).

In combination, these issues mean that there remains significant uncertainty regarding the full impacts of the Vickery Extension Project on groundwater and surface water quality and quantity. Resolution of these uncertainties and full detail of proposed water monitoring and mitigation strategies should be a pre-requisite for any decision regarding approval of the Project.

Declaration:

I declare that this report has been prepared in line with the requirements of an expert witness for the Land and Environment Court of NSW and that it contains my impartial expert opinion on matters relevant to my professional expertise.

Signed:

[redacted]

Date: 12th February, 2018.

[3] IESC, 2018. Vickery Project Extension Advice, 14th November 2018, p.6.