Independent Expert Scientific Committee
on Coal Seam Gas and Large Coal Mining Development

Advice to decision maker on Lake Vermont Coal Mine Northern Extension

IESC 2016-080: Lake Vermont Coal Mine Northern Extension (EPBC 2016/7701) – Expansion

Requesting agency	The Australian Government Department of the Environment and Energy
Date of request	27 September 2016
Date request accepted	28 September 2016
Advice stage	Assessment

Context

The Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (the IESC) was requested by the Australian Government Department of the Environment and Energy to provide advice on the Lake Vermont Coal Mine Northern Extension in Queensland. The proposed project is located in the Bowen Basin.

This advice draws upon aspects of information in the Matters of National Environmental Significance Assessment Report, together with the expert deliberations of the IESC. The project documentation and information accessed by the IESC are listed in the source documentation at the end of this advice.

The proposed project is an open cut extension, to the north of the existing approved Lake Vermont Coal Mine, located approximately 165 km south-west of Mackay. The existing Lake Vermont mine has been in operation since 2008. The proposed project is located closer to surface water features than the current Lake Vermont mine and has a disturbance area of approximately 2500 ha within a 3700 ha mine lease. The proposed project includes three new open cut pits and is predicted to extract 64 million tonnes of coal with mining expected to cease in 32 years. The proposed project will utilise the existing coal handling preparation plant (CHHP) and existing train loading facilities associated with the currently operating Lake Vermont Mine.

The proposed project includes three final voids, a 2.45-km diversion of Phillips Creek and an associated 7.8-km long flood protection levee to protect the project area from the flood waters of Phillips Creek. The proposed project also includes a flood levee surrounding a satellite pit for protection from Phillips Creek and Isaac River flood water, and a haul road crossing of Phillips Creek to access the Satellite Pit.

The proposed Lake Vermont Northern Extension has received approval from Queensland Department of Environment and Heritage Protection (DEHP) under a variation to the Environmental Authority

(EA). The EA allows for controlled release of water into a number of watercourses at approved discharge locations, providing water quality criteria are met. Discharge from the proposed project is also planned to occur through these approved locations. Additionally, there is the potential for overflows from site sediment dams.

In this advice the IESC has considered the direct impact of the proposed project only, with the existing Lake Vermont mine considered as part of potential cumulative impacts.

Water features that have the potential to be impacted by the proposed project are: Phillips Creek, Isaac River and Lake Vermont Wetland, a wetland classified as a Great Barrier Reef catchment wetland of High Ecological Significance by DEHP.

Key potential impacts of the project include:

- Changes to surface water quality due to increased downstream sediment loads as a result of potential erosion and/or failure of the proposed diversion, and controlled and uncontrolled mine water discharges.
- Altered surface water/groundwater regime at Lake Vermont Wetland as a result of catchment reduction and groundwater drawdown.
- Changes to the quantity of water available to groundwater-dependent ecosystems (GDEs) and remnant riparian vegetation along Phillips Creek due to altered hydrological regimes within Phillips Creek and groundwater drawdown.
- Interaction of the three final voids with surface water and groundwater water resources.

Assessment against information guidelines

The IESC, in line with its Information Guidelines (IESC, 2015), has considered whether the proposed project assessment has used the following:

Relevant data and information: key conclusions

Data on local water levels and water quality provided in the assessment are inadequate to determine baseline conditions for both surface water and groundwater. This prevents the identification of potential impacts and is inconsistent with the IESC guidelines (IESC, 2015).

There is inadequate understanding of the local and regional groundwater and surface water flow regimes to enable assessment of potential impacts. In particular, a robust hydrogeological conceptualisation underpinned by geological and hydrogeological field data has not been provided. Determination of site-specific hydraulic parameters has not been undertaken. Potential mining-induced impacts on the Lake Vermont Wetland cannot be adequately assessed as the hydrological regime of the wetland has not been adequately conceptualised.

The geomorphological assessment of Phillips Creek and modelling of flows in the Phillips Creek diversion is considered to be appropriate.

Site-specific field studies to identify potential GDEs, including riparian vegetation and stygofauna, have not been undertaken. The assessment of surface water/groundwater interactions is inadequate and, as a consequence, the pathways and effects of potential impacts are not adequately quantified.

Sediment dams that will receive runoff from waste rock material have the potential to overflow into the receiving downstream environment. A geochemical assessment of the waste rock was not presented. This prevents a full evaluation of the potential water quality impacts of these discharges. Additionally,

there is no consideration of potential cumulative impacts as a result of potential sediment dam discharges from other mines in the area.

There is inadequate information, particularly geotechnical information regarding the structural integrity of proposed levees, provided to enable an assessment of the long-term durability of proposed levees and their capability to protect active mine areas and final voids.

Application of appropriate methods and interpretation of model outputs: key conclusions

The 2-dimensional groundwater model used (SEEP-W) is suitable for estimating changes to groundwater levels and pressures in the immediate vicinity of the pits. However, it is not suited to predicting changes to groundwater levels and flows at a broader scale. It is therefore an inappropriate model to use for determining potential environmental impacts beyond the area immediately adjacent the pits, in areas such as Phillips Creek, Lake Vermont Wetland and the Isaac River.

The hydrogeological conceptualisation underpinning the current groundwater model does not consider fault characteristics, or other features in the region such as nearby mines, Phillips Creek, Lake Vermont Wetland and the Isaac River confluence. Insufficient site-specific data are available to parameterise and calibrate the model. The model does not adequately represent all three final voids in the proposed project area or the cumulative effects of the two other final voids in the adjacent approved Lake Vermont mine.

Site-specific data collection and re-conceptualisation of the hydrogeological regime is required. A 3-dimensional model is needed to assess the surface water/groundwater interactions that may occur in areas such the Lake Vermont Wetland, and to fully explore the potential mining-induced impacts in the vicinity of the proposed project. Construction, parameterisation and calibration of such a model will require collection of additional relevant site-specific data.

There is no detailed site water quality management and mitigation plan that outlines water quality monitoring and trigger values for site water storages, including all sediment dams.

The lack of assessment of GDEs and their possible groundwater requirements has led to an inadequate interpretation of potential impacts of the proposed project on GDEs within and downgradient of the project area.

Advice

In response to the requesting agency's specific questions, the IESC's advice provided below is presented as a summary response followed by further detailed explanation (where required).

Question 1: Do the groundwater and surface water assessments provide reasonable estimations of the likely impacts to water resources from catchment reduction, Phillips Creek diversion, groundwater contamination, and sediment dam overflow, including with reference to Lake Vermont, Phillips Creek and Downs Creek?

Response

1. No. Additional collection and analysis of site-specific baseline data are required to support development of robust geological and hydrogeological conceptualisations and models, and to estimate the likely impacts. Consideration should be given to:

    a. Site-specific monitoring and analysis of baseline data (water levels and quality) for surface water and groundwater.

b. Obtaining data to assess the spatial and temporal variability of the surface water/groundwater interactions of Phillips Creek, Lake Vermont Wetland and Downs Creek within the project site over (ideally) a two-year period to conceptualise how these will be affected by the project.

c. Assessing the water regime of Lake Vermont Wetland and how this may be affected by the diversion/levee and the truncation of the catchment area throughout the life of the project and post closure.

d. Characterising the nature of the final voids and assessing their potential for interaction with the alluvium of Phillips Creek, alluvium of Isaac River, flooding, faults and regional groundwater.

e. Undertaking a geochemical assessment for contaminants in the waste rock material in the project area.

f. Further assessing GDEs, including stygofauna and the aquatic biota of Phillips Creek, the confluence with the Isaac River, Lake Vermont, Downs Creek and Boomerang Creek.

Explanation

Site characterisation and baseline data

2. Site-specific geological and hydrogeological data are required to inform the hydrogeological conceptualisation.

3. The surface water quality data in the assessment are inadequate to define current conditions at the site. A total of two water quality samples were taken from each of the Lake Vermont Wetland, Phillips Creek wetland and Isaac River and nine local samples were taken from Phillips Creek (which includes historical data from 2012). This small data set lacks the spatial and temporal scale to adequately describe current conditions of these hydrologic systems.

4. The groundwater quality and level/pressure data in the assessment are inadequate to define baseline conditions. Baseline conditions for groundwater quality on site were derived from a desk-top study of the Department of Natural Resources and Mines (DNRM) database and three samples from site bores. The groundwater level data presented are based on six geographical bore locations, with a maximum of four observations per bore over a period of approximately two years and an uneven distribution of observations that were taken during generally drier months. There is no identification of groundwater elevation, pressure contours or flow paths. Much of the groundwater assessment is based on inferences with little or no reference to data.

Lake Vermont

5. The conclusions about the surface water/groundwater interactions at the Lake Vermont Wetland are based on inadequate data from one bore location that is approximately 300 metres to the south-west of the wetland.

6. There is inadequate assessment and presentation of the existing surface water regime at Lake Vermont Wetland. There is little or no quantification of peak inflows, volume, duration, frequency or seasonality of inflows, water depths (seasonal averages) or the wetting and drying cycles at the wetland. There is no impact assessment on the loss of rainfall runoff from the wetland's catchment area, which is stated to be truncated by up to 49% during the operation of the proposed project and by 12% post-project closure (MNES p. 88-89).

Final Voids

7. There is no assessment of the potential for surface water to infiltrate the alluvial systems of Phillips Creek and Isaac River and interact with the final voids, and limited assessment of the interaction of Isaac River and Phillips Creek flood water with the final void locations. There is little detail provided on the construction of permanent structures/levees proposed to protect final voids from flood waters and no risk assessment on the integrity of the levees. This is particularly concerning given the proximity of the proposed Pit B final void to Phillips Creek.

8. East Pit and B Pit final voids potentially intersect faults and there is inadequate discussion in relation to the nature and hydrogeological characteristics of the relevant faults. It is unclear whether the potentially intersecting faults may enable movement of contaminated groundwater out of the final voids or promote loss of water from aquifers.

9. Satellite Pit is relatively close to the Isaac River and has moderate to high modelled salinity after 400 years (approximately 20 000 mg/L, MNES Appendix C p. 73). Modelling of final void water quality should be conducted to a dynamic equilibrium with multiple scenarios of rainfall variability. In addition, there was no site-specific data on baseline groundwater levels or quality used in the model.

10. Cumulative impacts of multiple final voids are not addressed in the groundwater model. The model does not adequately represent the interaction of all three project voids (either during mining or post-mining) as only two are included in the model construction. Additionally, differentiation is needed between the mine voids in the approved Lake Vermont mine area and the proposed voids in the project area to enable assessment of potential cumulative impacts.

Geochemical assessment

11. A number of sediment dams are proposed to be used to intercept runoff from spoil dumps (MNES Appendix C p. 3), and it is anticipated that there will be overflow from the sediment dams to the offsite receiving environment (MNES Appendix C p. 59). It is also stated that geochemical characterisation of the overburden material indicates that runoff from spoil dumps draining to sediment dams should have concentrations of dissolved salts and metals below guideline values (MNES Appendix C p. 4). However, there is no geochemical assessment provided for the project area and therefore the potential impact of these overflows on receiving waters and their biota is unknown.

GDEs

12. There is inadequate assessment of groundwater-dependent vegetation and other GDEs, and there has been no sampling or desktop study of stygofauna as required by DSITI (2015). Conclusions around impacts are based on inadequate assessment. The GDE Atlas (BoM 2010) indicates: high potential for groundwater interaction (reliant on surface expression of groundwater) along Phillips Creek, Isaac River, Boomerang Creek, and at Lake Vermont Wetland; and moderate potential for groundwater interaction for the small wetland adjacent to the Satellite Pit access road.

Aquatic ecology

13. The aquatic ecology assessment was based on a single sampling event in May 2013. Water samples were collected from five sites, with only one site (Isaac River, downstream of the proposed project site) sampled for macroinvertebrates and two sites sampled for aquatic vertebrates. This data lacks the spatial and temporal scale required to adequately describe the baseline aquatic ecology of an ephemeral hydrologic system.

Question 2: Do these assessments give adequate consideration to the project's contribution to cumulative impacts associated with the other mining activities (e.g. the existing Lake Vermont Coal Mine, Saraji Coal Mine and the closed Norwich Park Coal Mine) in the area?

Response

14. No. There is inadequate consideration of the project's contribution to cumulative impacts associated with other mining activities. The proponent's assessment of cumulative impacts could be improved through:

    a. Consideration of the Arrow Energy Bowen Gas Project, the closed Norwich Park Coal mine and the recently proposed Saraji Underground Mine located approximately 8 km north-west of the project.

    b. A quantification of the impact on groundwater levels and water quality of the three proposed project voids and the two voids associated with the approved Lake Vermont Mine.

    c. Consideration of potential cumulative impacts in relation to sediment dam overflows from the proposed project and potential sediment dam overflows from other mining operations in the area.

Question 3: Does the modelling appropriately estimate the project's environmental impacts on water resources, including quantum of post-mining impacts to Isaac River and quantum of impacts where groundwater drawdown extends to other mine footprints? If not, what changes should be made to these models?

Response

15. No. The groundwater and surface water modelling does not appropriately estimate the project's environmental impacts on water resources. All aspects of the groundwater modelling require review as the groundwater modelling is not fit for purpose. Suggested improvements to the modelling are outlined below.

Groundwater modelling

16. A full site-specific hydrogeological investigation is required, targeted at identifying and characterising both the local and regional groundwater systems in the vicinity of the proposed project, and potential connectivity between these systems and the surface water. This should include:

    a. Collection of site-specific groundwater level and quality data, and testing to determine site-specific aquifer hydraulic parameters. Additional monitoring bores screened within the shallow sediments to identify potential shallow groundwater around the edge of the Lake Vermont Wetland and along Phillips Creek. Additional bores screened within relevant hydrostratigraphic units are also required to enable water quality sampling and water level monitoring.

    b. Hydrogeological characterisation of faults including determining the type, severity and penetration of faults, and their influence on groundwater flow.

    c. The conceptualisation of the groundwater system, both at local and regional scales should be revisited, with the newly collected site-specific data incorporated.

    d. A 3-dimensional groundwater model should be developed following the procedure outlined in the Australian Groundwater Modelling Guidelines (Barnett et al., 2012). Development and

parameterisation of this model must be informed by the site-specific data collected during the hydrogeological investigation outlined above. This model can then be used to predict mining-induced changes, assess changes to surface water/groundwater interactions, and to undertake a quantitative assessment of cumulative impacts.

Surface water modelling

17. Suggested improvements to the surface water modelling include:

    a. Model the surface water regime at Lake Vermont Wetland. A model of the water regime should identify:

        i. Peak inflows
        ii. Volume, duration, frequency and seasonality of inflows
        iii. Water depths (seasonal averages)
        iv. Wetting and drying cycles over multiple years (to span the responses to different climatic conditions)

    b. Provide pre and post-development modelling of the surface water regime at Lake Vermont Wetland. This should include quantification of estimated impacts to the Lake Vermont Wetland water regime during the phase of the project that truncates the greatest portion of catchment area.

    c. Model the interaction between the pits/final voids and the flood extent of Isaac River and Phillips Creek up to the 1 in 1000 annual exceedance probability event to enable appropriate design of flood protection levees.

    d. Compare estimates of peak flow quantiles with area-adjusted regional flood frequency analysis, and regional methods for estimation of peak flows as outlined by Australian Rainfall and Runoff (Ball et al. 2016).

    e. Undertake a sensitivity analysis on the water balance model for a high inflow parameter scenario and present results of sensitivity analyses explicitly.

Question 4: Will the mitigation and management commitments by the proponent provide reasonable strategies to effectively avoid, mitigate or reduce the likelihood, extent and significance of impacts to water resources?

Response

18. No. Strategies for monitoring and managing impacts can only be developed once representative onsite information and data have been gathered to identify potential impacts of the proposed project. As such the proposed mitigation and management strategies do not address potential risks to; groundwater and surface water as a result of groundwater drawdown, diversion of Phillips Creek, placement of final voids and project discharges. Information and data requirements to establish current onsite conditions, identify potential impacts and to inform future monitoring and management measures are provided in Questions 5, 6 and 7 of this advice.

Question 5: Is the proposed monitoring program adequate to establish baseline values and identify and quantify potential impacts to water resources as a result of the project?

Response

19. No. The proposed monitoring program is not adequate to establish onsite baseline conditions and identify potential impacts to groundwater and surface water resources. Consideration should be given to the following:

    a. Development of a robust onsite groundwater monitoring program that is spatially and temporally representative of the local and regional groundwater systems. This should include:

        i. Installing piezometers in all hydrostratigraphic units that have the potential to be impacted by the project. Particular areas to target and monitor include the shallow alluvium along Phillips Creek, Lake Vermont Wetland and the Isaac River alluvium adjacent to Satellite Pit. Control or reference bores should be installed and monitored in areas that will not be affected by mine activities.

        ii. Field testing for hydrogeological characteristics such as hydraulic conductivity and storativity, in relevant hydrostratigraphic units. This is needed for 3-dimensional numerical model parameterisation.

        iii. Frequent monitoring (e.g. monthly) of groundwater of levels and quality for a range of analytes including physical parameters, metal and ionic composition.

    b. Monitoring of GDEs in areas of high potential for groundwater dependency as indicated in the GDE Atlas (BoM 2010) or determined from field studies, particularly along Phillips Creek, Isaac River, Boomerang Creek and Lake Vermont Wetland.

    c. Surface water monitoring data (water quality and quantity) upstream and downstream of discharge sites, collected frequency (e.g. monthly) and daily during off-site releases.

Question 6: Would the Committee recommend any additional information which would assist in the identification and assessment of impacts to water resources?

Response

20. Yes. In addition to the groundwater and surface water modelling updates described in the response to Question 3, information that would assist in the identification and assessment of impacts includes:

    a. Further assessment of the groundwater environment, particularly around Phillips Creek and the Lake Vermont Wetland. This could include the installation of additional monitoring wells targeted at identifying the nature and magnitude of the potential impacts of drawdown, and bores screened in the shallow alluvium. Data loggers could be installed to provide improved temporal resolution of changes in groundwater level.

    b. Assessment and additional information regarding the protection of the Pit B and Satellite Pit final voids from the 1 in 1000 AEP event in Phillips Creek and Isaac River. Including geotechnical engineering studies to determine the long term integrity of the levees.

    c. Additional information on the influence of faults on groundwater flow as this is an area of considerable uncertainty given the location and potential risks associated with the final voids.

    d. Assessment of potential changes to the water regime of the Lake Vermont Wetland as a result of the reduction in reporting catchment area.

e. Assessment of potential impacts on water quality in receiving waters as a result of overflows from sediment dams.

f. Geochemical characterisation of waste rock to enable an adequate assessment of salinity, acid-forming materials and other contaminants that have the potential to contaminate sediment dam water, which is anticipated to be released offsite.

g. GDE vegetation mapping, especially along Phillips Creek and the fringes of Lake Vermont Wetland, and stygofauna sampling in the alluvium of Phillips Creek and Isaac River, as per DSITI Guidelines (2015).

h. Additional aquatic ecology sampling in Phillips Creek and Isaac River to establish a suitable baseline against which to assess any potential effects of the creek diversion, change in runoff (e.g. through catchment truncation) and/or impaired water quality.

Question 7: Would the Committee recommend any additional measures and commitments required to monitor, mitigate and manage impacts to water resources?

Response

21. Responses to the previous questions indicate that the impact analysis is such that substantial uncertainty remains regarding the nature and scale of potential impacts. This uncertainty would be partly addressed by gathering additional monitoring information as recommended in the response to Question 6. Additional measures and commitments that could assist to monitor, mitigate and manage impacts to water resources include:

    a. A detailed groundwater monitoring and management plan for the project that outlines monitoring procedures and specific sampling locations, identifies appropriate groundwater level and water quality triggers, and identifies response actions for trigger exceedances.

    b. A detailed surface water quality monitoring and management plan that includes monitoring of site water storages (including sediment dams) and the identification of site-specific trigger values that initiate mitigation actions.

    c. Monitoring of surface water and shallow groundwater levels in the vicinity of Lake Vermont Wetland, especially as it has been classified as a Great Barrier Reef catchment wetland of High Ecological Significance.

    d. Further consideration given to the location and potential risks of the proposed final voids, including a detailed assessment of an alternative location for the Pit B final void. The assessment should also consider: alternative design strategies which include limiting saline inflows and evaporative losses for the Satellite Pit final void; the possible impacts on and interactions with the groundwater systems; and the effects of faults.

    e. Specific mitigation strategies at the tight bends in the initial stages of the diversion. There is risk of a channel cut-off occurring in a flood at the tight bends and model results suggest that there will be significant shear stress at these bends, particularly the first bend. While this is acknowledged by the proponent, specific mitigation strategies for the tight bend locations are not clearly identified.

    f. A commitment to monitor surface water quality downstream of the controlled release locations, outside of release events, to establish baseline data. The monitoring suite should include all potential contaminants of concern (i.e. physico-chemical analytes as well as metals and hydrocarbons at an appropriate frequency (e.g. monthly)). Justification should also be provided on the use and relevance of proposed Environment Authority thresholds.

22. Commitments for surface and groundwater monitoring should be presented as part of a water monitoring and management plan and should be consistent with the National Water Quality Management Strategy.

Date of advice	11 November 2016
Source documentation available to the IESC in the formulation of this advice	Bowen Basin Coal Pty Ltd 2016. *Lake Vermont Northern Extension, Matters of National Environmental Significance Assessment Report*. Bowen Basin Coal Pty Ltd, Brisbane, QLD. ANZECC/ARMCANZ 2000. Australian Guidelines for Water Quality Monitoring and Reporting. National Water Quality Management Strategy (NWQMS). Canberra: Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand.
References cited within the IESC's advice	Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors), 2016, *Australian Rainfall and Runoff: A Guide to Flood Estimation*, Commonwealth of Australia [Online]. Available: http://book.arr.org.au.s3-website-ap-southeast-2.amazonaws.com/ [Accessed November 2016] Barnett, B., Townley, L. R., Post, V., Evans, R. E., Hunt, R. J., Peeters, L., Richardson, S., Werner, A. D., Knapton, A. & Boronkay, A., 2012. *Australian Groundwater Modelling Guidelines*, Waterlines report, National Water Commission, Canberra BoM 2010. *Groundwater Dependent Ecosystems Atlas* [Online]. Available: http://www.bom.gov.au/water/groundwater/gde/map.shtml [Accessed November 2016]. DSITI 2015. *Guideline for the Environmental Assessment of Subterranean Aquatic Fauna* [Online]. Available: https://publications.qld.gov.au/dataset/subterranean-aquatic-fauna/resource/ba880910-5117-433a-b90d-2c131874a8e6 [Accessed November 2016]. IESC 2015. *Information Guidelines for the Independent Expert Scientific Committee advice on coal seam gas and large coal mining development proposals* [Online]. Available: http://www.iesc.environment.gov.au/system/files/resources/012fa918-ee79-4131-9c8d-02c9b2de65cf/files/iesc-information-guidelines-oct-2015.pdf [Accessed November 2016].