Central Queensland Coal Project

Appendix 23 - IESC Guideline Checklist

Supplementary Environmental Impact Statement

Appendix A23 – IESC Guideline Checklist

Description of the Proposal – IESC Compliance Checklist

Table 1 Description of the Proposal

Question	Comments
Provide a regional overview of the proposed project area including a description of the geological basin; coal resource; surface water catchments; groundwater systems; water-dependent assets; and past, present and reasonably foreseeable coal mining and CSG developments.	Chapter 3 – Project Description provides a description of the Project including the geological setting and the coal resource. Chapter 9 – Surface Water and Chapter 10 – Groundwater describe the surface water catchments and groundwater systems respectively. There are no other coal mines or CSG developments proposed for the Styx Basin.
Describe the statutory context, including information on the proposal's status within the regulatory assessment process and any applicable water management policies or regulations.	Chapter 1 – Introduction provides an overview of the statutory context in respect of the Project. Each technical chapter includes further specific statutory context.
Describe the proposal's location, purpose, scale, duration, disturbance area, and the means by which it is likely to have a significant impact on water resources and water-dependent assets.	Chapter 3 – Project Description describes the Project's location, purpose, scale, duration and disturbance area. Impacts to water resources and water-dependent assets are discussed in Chapter 9 – Surface Water and Chapter 10 – Groundwater. Other relevant Chapters include Chapter 5 – Land, Chapter 8 – Waste Rock and Rejects, Chapter 11 – Rehabilitation and Decommissioning, Chapter 14 – Terrestrial Ecology, Chapter 15 – Aquatic Ecology and Chapter 16 – Matter of National Environmental Significance.
Describe how impacted water resources are currently being regulated under state or Commonwealth law, including whether there are any applicable standard conditions.	Chapter 1 – Introduction provides an overview of the statutory context in respect of the Project. Chapter 9 – Surface Water and Chapter 10 – Groundwater include further specific statutory context.

Table 2 Risk Assessment

Question	Comments
Identify and assess all potential environmental risks to water resources and water-related assets, and their possible impacts. In selecting a risk assessment approach consideration should be given to the complexity of the project, and the probability and potential consequences of risks.	Potential environmental risks and impacts to water resources and water-dependent assets are discussed in Chapter 9 – Surface Water and Chapter 10 – Groundwater. Other relevant chapters include Chapter 5 – Land, Chapter 8 – Waste Rock and Rejects, Chapter 11 – Rehabilitation and Decommissioning, Chapter 14 – Terrestrial Ecology, Chapter 15 – Aquatic Ecology and Chapter 16 – Matter of National Environmental Significance.

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Question	Comments
Incorporate causal mechanisms and pathways identified in the risk assessment in conceptual and numerical modelling. Use the results of these models to update the risk assessment.	Chapter 9 – Surface Water and Chapter 10 – Groundwater and Appendix A6 – Groundwater Technical Report discuss the modelling undertaken in respect of water resources and water-dependent assets and associated risk assessments.
Assess risks following the implementation of any proposed mitigation and management options to determine if these will reduce risks to an acceptable level based on the identified environmental objectives.	Chapter 9 – Surface Water and Chapter 10 – Groundwater and Appendix A6 – Groundwater Technical Report discuss the modelling undertaken in respect of water resources and water-dependent assets and associated risk assessments. Mitigation measures are also discussed in each chapter.
The risk assessment should include an assessment of: ▪ all potential cumulative impacts which could affect water resources and water-related assets; and, ▪ mitigation and management options which the proponent could implement to reduce these impacts.	As there are no other resource or CSG projects existing or foreseeably proposed for the Styx Basin cumulative impacts have been considered for the existing land uses. Mitigation measures are discussed in Chapter 9 – Surface Water and Chapter 10 – Groundwater.

Table 3 Groundwater

Question	Comments
Context and conceptualisation	
Describe and map geology at an appropriate level of horizontal and vertical resolution including: ▪ definition of the geological sequence(s) in the area, with names and descriptions of the formations and accompanying surface geology, cross-sections and any relevant field data. ▪ geological maps appropriately annotated with symbols that denote fault type, throw and the parts of sequences the faults intersect or displace.	Chapter 10 – Groundwater, Section 10.5.5 describes the geological sequence. Figure 10-16 shows the regional surface geology and Figure 10-17 shows a schematic geological cross section interpreted from the surface geology regional geological studies. Significant structure is not identified in geological units of interest, although there may be structural control to the Styx Basin.
Provide data to demonstrate the varying depths to the hydrogeological units and associated standing water levels or potentiometric heads, including direction of groundwater flow, contour maps, and hydrographs. All boreholes used to provide this data should have been surveyed.	Bore logs from the project area are provided in Appendix A6-Groundwater Technical Report which show interpretation of hydrogeological units and a record of standing water levels. Figure 10-20 shows the water table elevation across the study area and groundwater flow direction, inferred from field data. Figure 10-21 shows the measured depth to groundwater across the study area. Figure 10-22 to 10-26 present groundwater elevation hydrographs for all available timeseries data in the study area. Figure 10-27 presents groundwater elevations from nested monitoring sites for interpretation of vertical gradients. Groundwater elevations have been interpreted from Lidar and SRTM datasets and TOC height for all bores.

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Question	Comments
Define and describe or characterise significant geological structures (e.g. faults, folds, intrusives) and associated fracturing in the area and their influence on groundwater – particularly groundwater flow, discharge or recharge. ▪ Site-specific studies (e.g. geophysical, coring / wireline logging etc.) should give consideration to characterising and detailing the local stress regime and fault structure (e.g. damage zone size, open/closed along fault plane, presence of clay/shale smear, fault jogs or splays). ▪ Discussion on how this fits into the fault's potential influence on regional-scale groundwater conditions should also be included.	Geological structures are presented in Chapter 10 – Groundwater, Figure 10-16. Fracturing and faulting are unlikely to be significant in control of groundwater flow, and recharge/discharge given the (hydro)geological setting – generally low permeability units. Modelling undertaken for the Project assesses regional scale impacts, and therefore it is considered justified to give less priority to potential basin scale structural features that already control hydrostratigraphic response to mine water affecting activities.
Provide hydrochemical (e.g. acidity/alkalinity, electrical conductivity, metals, and major ions) and environmental tracer (e.g. stable isotopes of water, tritium, helium, strontium isotopes, etc.) characterisation to identify sources of water, recharge rates, transit times in aquifers, connectivity between geological units and groundwater discharge locations.	Chapter 10 – Groundwater, Section 10.5.4.2 presents water quality data for the surface water features in the study area including the two adjacent creeks (Tooloombah and Deep) and Styx River, in the form of EC timeseries, piper plots and seasonal stiff patterns. Chapter 10 – Groundwater, Section 10.5.6.5 presents water quality data for all identified hydro stratigraphic units in the form of EC timeseries, piper plots and seasonal stiff patterns. Chapter 10 – Groundwater, Section 10.5.6.6 presents a chloride mass balance approach for estimating recharge rates. Chapter 10 – Groundwater, Section 10.5.6.7 presents sodium vs. chloride ratio plots used to inform connectivity between groundwater and surface water Chapter 10 – Groundwater, Section 10.6.1.3 presents targeted stable isotope and radon studies used to inform connectivity between groundwater and surface water, and identify sources of water used by potential GDEs.
Provide site-specific values for hydraulic parameters (e.g. vertical and horizontal hydraulic conductivity and specific yield or specific storage characteristics including the data from which these parameters were derived) for each relevant hydrogeological unit. In situ observations of these parameters should be sufficient to characterise the heterogeneity of these properties for modelling.	Chapter 10 – Groundwater, Section 10.5.6.3 provides a summary of site specific hydraulic property estimates (including horizontal conductivity and storativity) obtained from aquifer tests performed in all identified hydrostratigraphic units as well as a literature review of hydraulic property information for the regional area and other relevant units. Appendix A6- Groundwater Technical Report provides the data and summary of the analyses for tests undertaken on Project bores. Low permeability sediments are not conducive to pumping tests that could provide data for analysis of K' and leakance. Low permeability sediments were generally only suitable for slug testing (deriving estimates of K, only).

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Question	Comments
Describe the likely recharge, discharge and flow pathways for all hydrogeological units likely to be impacted by the proposed development.	Chapter 10 – Groundwater, Figures 10-46 to 10-51 present conceptual cross-sections which show the likely recharge, discharge and flow pathways, also discussed in Section 10.5.6.6, 10.5.6.7 and 10.5.6.8. Chapter 10 – Groundwater, Figure 10-20 shows the water table elevation across the study area and groundwater flow direction, inferred from field data.
Provide time series level and water quality data representative of seasonal and climatic cycles.	Timeseries groundwater levels from February 2017 to November 2018 (21 months) are provided in Chapter 10 – Groundwater, Figures 10-22 to 10-26. The groundwater level data timeseries spans two wet seasons and two dry seasons with minor variations in water levels observed across the timeseries (max. up to 3 m). Timeseries groundwater water quality data from May 2017 to September 2018 are presented in Chapter 10 – Groundwater, Tables 10-16 to 10-67. The water quality data spans two dry seasons and one wet season. The quality of Alluvium groundwater shows some variation between the wet and dry seasons but the Styx Coal Measures does not show significant seasonal variability. Climate data (presented in Section 10.5.2) indicates that the site has experienced average long term rainfall during the baseline period. The available baseline data timeseries is considered representative of long term average seasonal cycles.
Assess the frequency (and time lags if any), location, volume and direction of interactions between water resources, including surface water/groundwater connectivity, inter-aquifer connectivity and connectivity with sea water.	Chapter 10 – Groundwater, Section 10.5.6.2 and 10.5.6.7 discuss hydraulic gradients (vertical and horizontal) and seasonal interactions between identified hydrostratigraphic units and surface waters, including estuarine and tidally influenced stream reaches (Styx River). Chapter 10 – Groundwater, Figures 10-46 to 10-51 present conceptual cross-sections which show the hypothesised interactions spatially. Chapter 10 – Groundwater, Table 10-69 presents field observations of watercourse pools which indicates the location, frequency and duration of potential connections Chapter 10 – Groundwater, Section 10.7.3.4 provides a summary of water balance modelling undertaken (details provided in Appendix A6- Groundwater Technical Report) to estimate the volume of groundwater discharge to connected surface waters.
Analytical and numerical modelling	
Provide a detailed description of all analytical and/or numerical models used, and any methods and evidence (e.g. expert opinion, analogue sites) employed in addition to modelling.	A detailed description of all modelling undertaken is provided in Appendix A6- Groundwater Technical Report, including numerical groundwater effects modelling and an analytical water balance model. Summary details of model are presented in Chapter 10 – Groundwater, Section 10.7.4.1

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Question	Comments
Provide an explanation of the model conceptualisation of the hydrogeological system or systems, including multiple conceptual models if appropriate. Key assumptions and model limitations and any consequences should also be described.	The conceptualisation underpinning the numerical modelling is described in Chapter 10 – Groundwater, Section 10.5.6.8. Alternative conceptualisations are presented in Section 10.7.4.8. The model limitations are described in Chapter 10 – Groundwater, Section 3.9 of Appendix A6- Groundwater Technical Report, and a description of the conservative aspects of model development is presented in Chapter 10 – Groundwater, Section 10.9.2.2. Model sensitivity and uncertainty testing supports the conceptualisation and model parameters adopted.
Undertaken groundwater modelling in accordance with the Australian Groundwater Modelling Guidelines (Barnett et al. 2012), including independent peer review.	Groundwater modelling has been undertaken in accordance with the Australian Modelling Guidelines, as demonstrated in Section 3.3 of Appendix A6- Groundwater Technical Report. Technical peer review by external experts is underway, with delivery planned for December 2018 / January 2019.
Consider a variety of boundary conditions across the model domain, including constant head or general head boundaries, river cells and drains, to enable a comparison of groundwater model outputs to seasonal field observations.	The model has been constructed with drain cells, constant head and no-flow cells, as described in Section 3.4.4 of Appendix A6- Groundwater Technical Report. Recharge has been used to represent diffuse rainfall recharge and watercourse flood recharge. Sensitivity of predictions to climate variability has been tested (see Section (10.7.4.7). The boundary conditions adopted are considered appropriate. The full groundwater catchment was modelled, therefore no flow boundaries at the catchment boundaries are appropriate. At the coast, constant head boundary was used rather than general head boundaries, which is more appropriate given the location of the coast (and mean sea level, the governing head control) is known. With regard to the creeks represented in the model, drain cells are considered more conservative than river cells for an ephemeral stream. For these cells, the heads have been defined by elevation and bed conductance is set high enough to enable drainage the be controlled solely by the hydraulic properties of the aquifers.

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Question	Comments
Calibrate models with adequate monitoring data, ideally with calibration targets related to model prediction (e.g. use baseflow calibration targets where predicting changes to baseflow).	Model calibration is discussed in Section 3.5 of Appendix A6- Groundwater Technical Report. Model calibration is considered satisfactory, with calibration statistics consistent with what would be expected for a well calibrated (steady state) model. However, most observation points only have a single observation, with a smaller number having time series data of almost 2-years – showing response of groundwater heads across more than two seasons. This could be regarded as a weakness in the calibration, but this is compensated by a comprehensive sensitivity and uncertainty analysis (see Appendix A6 - Groundwater Technical Report, Section 3.7). Given the lack of stream gauging data, baseflow has not been calibrated and therefore, uncertainty exists in the estimation of baseflow. Baseflow and evaporation are the main two outflows for the model (the third one being outflow at the constant head boundary representing the coast). The model may not accurately represent the ratio between baseflow and evaporation, but what may be an overestimation of one is an underestimation of the other (and vice versa) as they act as surrogates. Establishing the correct ratio would have also limited consequence in the propagation of drawdown which is mainly controlled by hydraulic conductivity and aquifer geometry (natural surface elevation and geometry of hydrostratigraphic units) which is well characterised.

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Question	Comments
Undertake sensitivity analysis and uncertainty analysis of boundary conditions and hydraulic and storage parameters, and justify the conditions applied in the final groundwater model (see Middlemis and Peeters [in press]).	Detailed sensitivity and uncertainty analyses have been undertaken, as presented in Appendix A6 - Groundwater Technical Report, Section 3.7. The sensitivity analysis included testing of a range of values for hydraulic conductivities and storage parameters, recharge rates, evaporation extinction depth and drain cell conductance. The adopted parameters for the model have shown to be more representative than any alternative conceptualisation tested. The model conditions not included in the sensitivity analysis are those which cannot be adjusted during calibration, including: ▪ The Drain boundary conditions – these are used to represent the creeks and are defined by the elevation of the creek and a conductance term. The creek bed elevation is not adjustable and not suitable for sensitivity analysis. As there are no in situ observations supporting a tighter river bed conductance vs. underlying units, the conductance was set with a sufficiently high value to enable the aquifer to control the baseflow. It was therefore designed to be insensitive, which has been confirmed during the sensitivity analysis. ▪ The Constant head boundary conditions – these are applied at the coast, set at mean sea level. Given it is a known/measured value, it is not a calibration parameter and is therefore inappropriate to include as part of sensitivity analysis. ▪ The no-flow boundary condition – these are used to represent the edge of the mapped groundwater catchment, and therefore were not a calibration parameter and do not require sensitivity analysis. ▪ Evaporation is controlled by potential-evaporation and the extension depth, which is representative of the depth to which evaporation can access the water table. Potential evaporation is a measured/ known value and is therefore not included in the calibration process or sensitivity analysis however a range of extension depths of 1-5 m was tested, showing limited sensitivity. ▪ - Storage parameters were not included in the uncertainty analysis, as conservative values were assumed
Describe each hydrogeological unit as incorporated in the groundwater model, including the thickness, storage and hydraulic characteristics, and linkages between units, if any.	A description of the model construction in terms of model layering and hydraulic properties to represent each hydrostratigraphic unit is presented in Section 3.4.3.3 of Appendix A6 – Groundwater Technical Report.

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Question	Comments
Provide an assessment of the quality of, and risks and uncertainty inherent in, the data used to establish baseline conditions and in modelling, particularly with respect to predicted potential impact scenarios.	In terms of modelling, the uncertainty analysis discussed in Section 3.7 of Appendix A6 - Groundwater Technical Report explores the consequence of a not representing hydraulic conductivity within modelled hydrostratigraphic units accurately by exploring a wide range of conservative values which also provides an insight of the conditions that would be required to trigger a significant expansion of the drawdown cone and related environmental risks (see section 3.7.3 of Appendix A6 - Groundwater Technical Report). Outcomes of the uncertainty analysis indicates that for most units (except the Styx Coal Measures- coal seams and interburden), even a non-accurate estimation of the hydraulic conductivity of those units has only very limited consequence in terms of drawdown propagation and risk to the environment.
Describe the existing recharge/discharge pathways of the units and the changes that are predicted to occur upon commencement, throughout, and after completion of the proposed project.	Predicted changes to discharge (baseflow) during and post mining are provided in Section 10.7.3.4 and Figures 10-81 and 10-82. Model predictive sensitivity to climate variability has been undertaken and is described in Appendix A6 – Groundwater, Section 3.7 and in Section .10.7.4.7
Undertake an uncertainty analysis of model construction, data, conceptualisation and predictions (see Middlemis and Peeters [in press]).	Detailed sensitivity and uncertainty analyses have been undertaken, as presented in Appendix A6 - Groundwater Technical Report, Section 3.7 and in Section .10.7.4.7.
Describe the various stages of the proposed project (construction, operation and rehabilitation) and their incorporation into the groundwater model. Provide predictions of water level and/or pressure declines and recovery in each hydrogeological unit for the life of the project and beyond, including surface contour maps for all hydrogeological units.	The representation of mining in the model is discussed in Appendix A6 - Groundwater Technical Report, Section 3.6.1, and in Chapter 10 – Groundwater, Section 10.7.4. Predictions of potentiometric surface drawdown is discussed and spatially presented in Appendix A6 - Groundwater Technical Report, Section 3.6.2 and Figures 3-26 to 3-37, respectively, and in Chapter 10 – Groundwater, Figure 10-71 to Figure 10-77.
Provide a program for review and update of models as more data and information become available, including reporting requirements.	Described in Chapter 10 – Groundwater, Section 10.8.9.
Identify the volumes of water predicted to be taken annually with an indication of the proportion supplied from each hydrogeological unit.	Chapter 10 – Groundwater, Figure 10-95 presents the predicted groundwater abstractions over time from each hydrogeological unit.
Provide information on the magnitude and time for maximum drawdown and post-development drawdown equilibrium to be reached.	The magnitude and time for maximum drawdown is shown in Chapter 10 – Groundwater, Figures 10-62 to 10-79 and discussed in Chapter 10 – Groundwater, Table 10-80.
Undertake model verification with past and/or existing site monitoring data.	Model verification is provided in Appendix A6 - Groundwater Technical Report, Section 3.5.4.

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Question	Comments
Impacts to water resources and water-dependent assets	
Provide an assessment of the potential impacts of the proposal, including how impacts are predicted to change over time and any residual long-term impacts. Consider and describe: ▪ any hydrogeological units that will be directly or indirectly dewatered or depressurised, including the extent of impact on hydrological interactions between water resources, surface water/groundwater connectivity, inter-aquifer connectivity and connectivity with sea water. ▪ the effects of dewatering and depressurisation (including lateral effects) on water resources, water-dependent assets, groundwater, flow direction and surface topography, including resultant impacts on the groundwater balance. ▪ the potential impacts on hydraulic and storage properties of hydrogeological units, including changes in storage, potential for physical transmission of water within and between units, and estimates of likelihood of leakage of contaminants through hydrogeological units.	The identified potential effects of mining are described in Section 10.7.2 and 10.7.3 The assessment of effects, including effects that result in changes to groundwater quantity, quality, interactions between surface water and groundwater and physical disruption to aquifers, and the associated threats to sensitive receptors is discussed in Section 10.7.4 and summarised in Tables 10-79 to 10-82. Connectivity with (and therefore, impacts to) seawater has been shown to be unlikely (see Section 10.5.6.2, 10.5.6.8 10.7.4.2 and 10.7.4.3)
Describe the water resources and water-dependent assets that will be directly impacted by mining or CSG operations, including hydrogeological units that will be exposed/partially removed by open cut mining and/or underground mining.	The sensitive receptors (third party users, Type 1, 2 and 3 GDEs) that are predicted to be affected by mining are discussed in Section 10.7.4 and summarised in Table 10-79. Section 10.7.4describes the mining schedule, which involves backfilling of pits as mining progresses.
For each potentially impacted water resource, provide a clear description of the impact to the resource, the resultant impact to any water-dependent assets dependent on the resource, and the consequence or significance of the impact.	The assessment of mining induced effects on the groundwater system (in terms of quantity, quality, interactions between surface water and groundwater and physical disruption to aquifers), and the associated threats to sensitive receptors is discussed in Section 10.7.4 and summarised in Tables 10-79 to 10-82. A threat assessment is provided in Section 10.7.4.8, and a risk assessment of identified threats is provided in Section 10.8.11.
Describe existing water quality guidelines, environmental flow objectives and other requirements (e.g. water planning rules) for the groundwater basin(s) within which the development proposal is based.	A description of the environmental objectives and applicable Environmental Values and Water Quality Objectives are outlined in Sections 10.3 and 10.4, respectively. Section 10.2 presents details concerning relevant legislation, plans and guidelines.

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Question	Comments
Provide an assessment of the cumulative impact of the proposal on groundwater when all developments (past, present and/or reasonably foreseeable) are considered in combination.	As there are no other known coal resources or CSG projects existing or foreseeably proposed for the Styx Basin, cumulative impacts have been considered in the context of the proposed Project and the existing land uses. Field data and modelling (Section 10.5.6.3 and 10.8.4.5, respectively) indicate the groundwater system provides very low sustainable yields under a pumping scenario (less than 1L/s) and water quality data (Section 10.5.6.5) indicate existing groundwater is generally only suitable for stock water/agricultural uses. Therefore, any future water supply development outside the ML is likely to be limited to stock/agriculture uses with low demands and are therefore unlikely to cause any additional (measurable) impact.
Describe proposed mitigation and management actions for each significant impact identified, including any proposed mitigation or offset measures for long-term impacts post mining.	Mitigation approaches are provided for each direct effect of mining linked to a potentially threatened sensitive receptor, as discussed in Section 10.8.4.
Provide a description and assessment of the adequacy of proposed measures to prevent/minimise impacts on water resources and water-dependent assets.	Mitigation measures are described and discussed in Section 10.8.4 including examples of where identified measures have been applied elsewhere.
Data and monitoring	
Provide sufficient data on physical aquifer parameters and hydrogeochemistry to establish pre-development conditions, including fluctuations in groundwater levels at time intervals relevant to aquifer processes.	Estimates of aquifer properties are presented in Section 10.5.6.3. It is considered that sufficient aquifer testing results (local and more regional) are available to assist with characterisation of the hydrogeology of the four HSUs present in the Project area. Timeseries groundwater levels from February 2017 to November 2018 are provided in Figures 10-22 to 10-26 The groundwater level data timeseries spans two wet seasons and two dry seasons with minor variations in water levels observed across the timeseries (max. up to 3 m in shallowest HSU (alluvium). Timeseries groundwater water quality data from May 2017 to September 2018 are presented in Tables 10-16 to 10-67. The water quality data spans two dry seasons and one wet season. The quality of Alluvium groundwater shows some variation between the wet and dry seasons but the Styx Coal Measures does not show significant seasonal variability. Climate data (presented in Section 10.5.2) indicates that the site has experienced around the average long term rainfall during the baseline period. The available baseline data timeseries is considered representative of long term average seasonal cycles.

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Question	Comments
Provide long-term groundwater monitoring data, including a comprehensive assessment of all relevant chemical parameters to inform changes in groundwater quality and detect potential contamination events.	Timeseries groundwater water quality data from May 2017 to September 2018 are presented in Tables 10-16 to 10-67. These data have been compared against relevant guidelines and criteria and exceedances have been highlighted. Box and whisker plots for each hydrostratigraphic unit are presented in Figures 10-34 to 10-36, which show the range of baseline monitoring data for selected analytes.
Develop and describe a robust groundwater monitoring program using dedicated groundwater monitoring wells – including nested arrays where there may be connectivity between hydrogeological units – and targeting specific aquifers, providing an understanding of the groundwater regime, recharge and discharge processes and identifying changes over time.	Table 10-84 presents a summary of the existing monitoring network that will be subject to ongoing monitoring. The network comprises dedicated monitoring bores including nested bores that target the various hydrostratigraphic units both within and outside the predicted zone of impact in order to monitor the changes to the groundwater regime due to mining and non-mining related (i.e. background) effects over time.
Ensure water quality monitoring complies with relevant National Water Quality Management Strategy (NWQMS) guidelines (ANZECC/ARMCANZ 2000) and relevant legislated state protocols (e.g. QLD Government 2013).	The baseline monitoring program is consistent with National and Queensland guidelines and protocols ((ANZECC/ARMCANZ 2000 and QLD Government 2013). The ongoing monitoring program will be fully consistent with afore mentioned guidelines, namely: ▪ Sampling frequency- monthly sampling, sufficient for identifying background trends ▪ Spatial coverage- sampling locations within anticipated potential impact area situated for early detection of impacts (and targeted locations near sensitive receptors) as well as comparable background (anticipated unimpacted) areas ▪ Quality control/assurance protocols- appropriate decontamination and calibration of sampling equipment, samples collected using appropriate sampling procedures, water quality analysis performed in accredited NATA laboratories, all laboratory holding times, sample storage, transport and preservation requirements adhered to, Chain of Custody records kept, duplicate samples collected, all data reviewed, and evaluated against relevant guidelines/criteria. Future monitoring will occur as per the Environmental Authority conditions.

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Question	Comments
Develop and describe proposed targeted field programs to address key areas of uncertainty, such as the hydraulic connectivity between geological formations, the sources of groundwater sustaining GDEs, the hydraulic properties of significant faults, fracture networks and aquitards in the impacted system, etc., where appropriate.	Section 10.8.2.2 outlines additional and ongoing monitoring and ecosystem investigations that will be undertaken to provide additional understanding of ecosystem dependence on groundwater and the pre-mine condition on dependent ecosystems. Studies include: ▪ Extended baseline monitoring ▪ Isotope analysis of surface water, groundwaters to assess connectivity over time ▪ Isotope analysis of soil water and plant xylem water, and leaf and soil water potentials to improve understanding of potentially dependent vegetation water use ▪ Development of a detailed water and solute balance for in-stream pools to improve estimates of groundwater discharge volumes over time. ▪ Analytic modelling of leaf water potentials to understand implications of declining water table over time. ▪ A soil water reservoir balance to assess quantity of soil water available to meet plant water requirements. ▪ Pre-mining condition monitoring of identified potential dependent ecosystems including macroinvertebrate surveys, vegetation transects, foliage index/leaf area index and canopy cover monitoring.

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Table 4 Surface Water

Question	Comments
Context and conceptualisation	
Describe the hydrological regime of all watercourses, standing waters and springs across the site including: ▪ geomorphology, including drainage patterns, sediment regime and floodplain features; ▪ spatial, temporal and seasonal trends in streamflow and/or standing water levels; ▪ spatial, temporal and seasonal trends in water quality data (such as turbidity, acidity, salinity, relevant organic chemicals, metals, metalloids and radionuclides); and, ▪ current stressors on watercourses, including impacts from any currently approved projects.	Section 9.4 discusses the hydrological regime of all watercourses, standing waters and springs across the site, including Deep Creek, Tooloombah Creek, and the Styx River. In the absence of historical stream gauging of the site watercourses, references, regional assessments and parameter sensitivity have been conducted in hydrological analysis and modelling discussed in Section 9.6. The hydrological modelling has been conducted with XP-RAFTS, AWBM/GoldSim to represent both peak floods and daily variability based on long-term historical rainfall records. Sections 9.4 and 9.5 discusses the water quality sampling and analysis conducted on Deep Creek, Tooloombah Creek, and the Styx River. Seasonal trends in turbidity, salinity, acidity, nitrogen, phosphorus, ammonia-N, dissolved aluminium, dissolved copper, dissolved zinc, and dissolved lead for Barrack, Deep, and Tooloombah Creeks and Styx River are shown in figures 9-29 to 9-47. The environmental values of surface waters within the Project area, downstream and upstream are discussed in Section 9.4. Section 9.10 discusses the potential impacts on environmental values.
Describe the existing flood regime, including flood volume, depth, duration, extent and velocity for a range of annual exceedance probabilities. Provide flood hydrographs and maps identifying peak flood extent, depth and velocity. This assessment should be informed by topographic data that has been acquired using lidar or other reliable survey methods with accuracy stated.	Section 9.6 discusses the hydrology and flood modelling that has been completed for the existing and developed land uses. The flood volume, depth, duration, extent, velocity and afflux for a range of annual exceedance probabilities has been conducted. Flood hydrographs and maps identifying peak flood extent, depth, velocity and afflux are incorporated in Chapter 9.
Provide an assessment of the frequency, volume, seasonal variability and direction of interactions between water resources, including surface water/ groundwater connectivity and connectivity with sea water.	Section 9.7 presents the GoldSim water balance inputs and results, and then a specific MCA water accounting framework summary of the average annual volumes, quality and certainty of water inputs and outputs.
Analytical and numerical modelling	
Provide conceptual models at an appropriate scale, including water quality, stores, flows and use of water by ecosystems.	Discussed in detail in Chapter 10 - Groundwater.

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Question	Comments
Describe and justify model assumptions and limitations, and calibrate with appropriate surface water monitoring data.	In the absence of historical stream gauging of the site watercourses, references, regional assessments and parameter sensitivity have been conducted in hydrological analysis and modelling discussed in Section 9.6. The hydrological modelling has been conducted with XP-RAFTS, AWBM/GoldSim to represent both peak floods and daily variability based on long-term historical rainfall records.
Use methods in accordance with the most recent publication of Australian Rainfall and Runoff (Ball et al. 2016).	Rainfall temporal pattern variability of storm events using "an ensemble" were tested for each storm duration, following the AR&R16 methodology Hydrographs produced by the XP-RAFTS model, with sensitivity analysis of input parameters Regional flood frequency assessment against 14 local gauged catchments, using AR&R16 tools Direct comparisons of GoldSim modelled Deep Creek rainfall flow events with nearby gauged Water Park Creek, with similar catchment size and coastal position, although different land use and aspect.
Provide an assessment of the risks and uncertainty inherent in the data used in the modelling, particularly with respect to predicted scenarios.	Rainfall temporal pattern variability of storm events using "an ensemble" were tested for each storm duration, following the AR&R16 methodology Hydrographs produced by the XP-RAFTS model, with sensitivity analysis of input parameters Regional flood frequency assessment against 14 local gauged catchments, using AR&R16 tools Direct comparisons of GoldSim modelled Deep Creek rainfall flow events with nearby gauged Water Park Creek, with similar catchment size and coastal position, although different land use and aspect.
Develop and describe a program for review and update of the models as more data and information becomes available.	The absence of historical stream gauging of the site watercourses is noted, and Section 9.7 discusses the program on commencement of mine construction, detailed water balance models should be constructed, continually updated with new data and validated to reflect the conditions encountered.
Provide a detailed description of any methods and evidence (e.g. expert opinion, analogue sites) employed in addition to modelling.	In the absence of historical stream gauging of the site watercourses, references, regional assessments and parameter sensitivity have been conducted in hydrological analysis and modelling discussed in Section 9.6. The hydrological modelling has been conducted with XP-RAFTS, AWBM/GoldSim to represent both peak floods and daily variability based on long-term historical rainfall records.

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Question	Comments
Impacts to water resources and water-dependent assets	
Describe all potential impacts of the proposed project on surface waters. Include a clear description of the impact to the resource, the resultant impact to any assets dependent on the resource (including water dependent ecosystems such as riparian zones and floodplains), and the consequence or significance of the impact. Consider: ▪ impacts on streamflow under the full range of flow conditions. ▪ impacts associated with surface water diversions. ▪ impacts to water quality, including consideration of mixing zones. ▪ the quality, quantity and ecotoxicological effects of operational discharges of water (including saline water), including potential emergency discharges, and the likely impacts on water resources and water-dependent assets. ▪ landscape modifications such as subsidence, voids, post rehabilitation landform collapses, on-site earthworks (including disturbance of acid-forming or sodic soils, roadway and pipeline networks) and how these could affect surface water flow, surface water quality, erosion, sedimentation and habitat fragmentation of water dependent species and communities.	As the watercourses adjacent to the Project site (Deep Creek and Tooloombah Creek) are ephemeral, the emphasis has been on the linkages between groundwater and water dependent ecosystems. Section 9.10 discusses the potential impacts on environmental values. Impacts to groundwater dependent assets are discussed in detail in Chapter 10 – Groundwater.
Discuss existing water quality guidelines, environmental flow objectives and requirements for the surface water catchment(s) within which the development proposal is based.	Section 9.5 discusses the potential impacts on environmental values. The Project has committed to implementing a program of supplementary flows should monitoring determine potential adverse impacts to ecological communities. The maintenance of environment flows are discussed in Chapter 15 – Aquatic Ecology as is the modelling of stream pool water balances for the permanent pools in Tooloombah Creek. Section 15.6 discusses the assessment. The environmental values of surface waters within the Project area, downstream and upstream are discussed in Section 9.4. Section 9.10 discusses the potential impacts on environmental values.
Identify processes to determine surface water quality guidelines and quantity thresholds which incorporate seasonal variation but provide early indication of potential impacts to assets	Water monitoring to be undertaken at the discharge locations of the environmental dams and mine-affected water dams, and at reference locations both upstream and downstream of the Project area. Section 9.9 identifies the processes to determine if the exceedance is site-specific, and thus likely to be a result of Project activities. The proposed upstream and downstream monitoring points are shown in Figure 9-103 and listed in Section 9.11.4.
Propose mitigation actions for each identified significant impact.	Section 9.11 discusses the mitigation actions proposed to address each identified significant impact on environmental values.

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Question	Comments
Describe the adequacy of proposed measures to prevent or minimise impacts on water resources and water-dependent assets.	Sections 9.11 and 9.12 discuss the adequacy of the proposed measures, and methods to evaluate if impacts are or may be occurring. Additional discussion is presented in Chapter 10 - Groundwater.
Describe the cumulative impact of the proposal on surface water resources and water-dependent assets when all developments (past, present and reasonably foreseeable) are considered in combination.	The cumulative surface water related impacts that may be associated with the proposed Project are discussed in Section 9.12.
Provide an assessment of the risks of flooding (including channel form and stability, water level, depth, extent, velocity, shear stress and stream power), and impacts to ecosystems, project infrastructure and the final project landform.	Section 9.6 presents the assessment of risks of flooding, based on the Project's modelled impact on localised flood characteristics such as flood depth, extent and velocity, as well as to quantify the immunity of critical infrastructure and the mine pits. Hydrodynamic modelling was used to create thematic maps showing flood extents, water depths and velocities, through input of the flood hydrographs developed by the hydrologic assessment.
Data and monitoring	
Identify monitoring sites representative of the diversity of potentially affected water dependent assets and the nature and scale of potential impacts, and match with suitable replicated control and reference sites (BACI design) to enable detection and monitoring of potential impacts.	Section 9.9 discusses water monitoring to be undertaken reference locations both upstream and downstream of the Project area. A commitment to the preparation of a Receiving Environment Management Plan (REMP) is provided in the Chapter. The REMP will be the overarching management plan that will describe the monitoring programs that will be implemented in respect of surface water quality and flows maintenance throughout the life of the Project and post mining. See Section 9.11.
Develop and describe a surface water monitoring program that will collect sufficient data to detect and identify the cause of any changes from established baseline conditions, and assess the effectiveness of mitigation and management measures. The program will: ▪ include baseline monitoring data for physico-chemical parameters, as well as contaminants (e.g. metals); ▪ comparison of physico-chemical data to national/regional guidelines or to site specific guidelines derived from reference condition monitoring if available; and, ▪ identify baseline contaminant concentrations and compare these to national guidelines, allowing for local background correction if required.	Section 9.9 discusses water monitoring to be undertaken reference locations both upstream and downstream of the Project area.
Ensure water quality monitoring complies with relevant National Water Quality Management Strategy (NWQMS) guidelines (ANZECC/ARMCANZ 2000) and relevant legislated state protocols (e.g. QLD Government 2013).	Section 9.9 discusses water monitoring to be undertaken reference locations both upstream and downstream of the Project area.

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Question	Comments
Describe the rationale for selected monitoring parameters, duration, frequency and methods, including the use of satellite or aerial imagery to identify and monitor largescale impacts.	Section 9.9 discusses water monitoring to be undertaken reference locations both upstream and downstream of the Project area.
Identify data sources, including streamflow data, proximity to rainfall stations, data record duration and describe data methods, including whether missing data have been patched.	The description of the environmental values, including climate and hydrology is provided in Section 9.4. Section 9.4 also discusses data availability and a comparison of SILO data and other data sources.
Develop and describe a plan for ongoing ecotoxicological monitoring, including direct toxicity assessment of discharges to surface waters where appropriate	A commitment to the preparation of a Receiving Environment Management Plan (REMP) is provided in the Chapter. The REMP will be the overarching management plan that will describe the monitoring programs that will be implemented in respect of surface water quality and flows maintenance throughout the life of the Project and post mining. See section 9.11.
Identify dedicated sites to monitor hydrology, water quality, and channel and floodplain geomorphology throughout the life of the proposed project and beyond.	Section 9.9 discusses water monitoring to be undertaken reference locations both upstream and downstream of the Project area.

Table 5 Water-dependent assets

Question	Comments
Context and conceptualisation	
Identify water-dependent assets, including: ▪ water-dependent fauna and flora and provide surveys of habitat, flora and fauna (including stygofauna) (see Doody et al. [in press]). ▪ public health, recreation, amenity, Indigenous, tourism or agricultural values for each water resource.	These aspects are discussed variously in Chapter 9 – Surface Water, Chapter 10 – Groundwater, Chapter 14, Terrestrial Ecology, Chapter 15 – Aquatic Ecology, Chapter 16 – MNES and Appendix A6 – Groundwater Technical Report
Estimate the ecological water requirements of identified GDEs and other water-dependent assets (see Doody et al. [in press]).	These aspects are discussed variously in Chapter 10 – Groundwater, Chapter 14, Terrestrial Ecology, Chapter 15 – Aquatic Ecology, Chapter 16 – MNES and Appendix A6 – Groundwater Technical Report
Identify the hydrogeological units on which any identified GDEs are dependent (see Doody et al. [in press]).	These aspects are discussed variously in Chapter 10 – Groundwater, Chapter 14, Terrestrial Ecology, Chapter 15 – Aquatic Ecology, Chapter 16 – MNES and Appendix A6 – Groundwater Technical Report
Identify GDEs in accordance with the method outlined by Eamus et al. (2006). Information from the GDE Toolbox (Richardson et al. 2011) and GDE Atlas (CoA 2017a) may assist in identification of GDEs (see Doody et al. [in press]).	These aspects are discussed variously in Chapter 10 – Groundwater, Chapter 14, Terrestrial Ecology, Chapter 15 – Aquatic Ecology, Chapter 16 – MNES and Appendix A6 – Groundwater Technical Report

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Question	Comments
Provide an outline of the water-dependent assets and associated environmental objectives and the modelling approach to assess impacts to the assets.	These aspects are discussed variously in Chapter 10 – Groundwater, Chapter 14, Terrestrial Ecology, Chapter 15 – Aquatic Ecology, Chapter 16 – MNES and Appendix A6 – Groundwater Technical Report
Describe the conceptualisation and rationale for likely water-dependence, impact pathways, tolerance and resilience of water-dependent assets. Examples of ecological conceptual models can be found in Commonwealth of Australia (2015).	These aspects are discussed variously in Chapter 10 – Groundwater, Chapter 14, Terrestrial Ecology, Chapter 15 – Aquatic Ecology, Chapter 16 – MNES and Appendix A6 – Groundwater Technical Report
Describe the process employed to determine water quality and quantity triggers and impact thresholds for water-dependent assets (e.g. threshold at which a significant impact on an asset may occur).	These aspects are discussed variously in Chapter 10 – Groundwater, Chapter 14, Terrestrial Ecology, Chapter 15 – Aquatic Ecology, Chapter 16 – MNES and Appendix A6 – Groundwater Technical Report
Impacts, risk assessment and management of risks	
Provide an assessment of direct and indirect impacts on water-dependent assets, including ecological assets such as flora and fauna dependent on surface water and groundwater, springs and other GDEs (see Doody et al. [in press]).	These aspects are discussed variously in Chapter 10 – Groundwater, Chapter 14, Terrestrial Ecology, Chapter 15 – Aquatic Ecology, Chapter 16 – MNES and Appendix A6 – Groundwater Technical Report
Provide estimates of the volume, beneficial uses and impact of operational discharges of water (particularly saline water), including potential emergency discharges due to unusual events, on water-dependent assets and ecological processes.	These aspects are discussed variously in Chapter 10 – Groundwater, Chapter 14, Terrestrial Ecology, Chapter 15 – Aquatic Ecology, Chapter 16 – MNES and Appendix A6 – Groundwater Technical Report
Describe the potential range of drawdown at each affected bore, and clearly articulate of the scale of impacts to other water users.	These aspects are discussed variously in Chapter 10 – Groundwater, Chapter 14, Terrestrial Ecology, Chapter 15 – Aquatic Ecology, Chapter 16 – MNES and Appendix A6 – Groundwater Technical Report
Assess the overall level of risk to water-dependent assets through combining probability of occurrence with severity of impact.	These aspects are discussed variously in Chapter 10 – Groundwater, Chapter 14, Terrestrial Ecology, Chapter 15 – Aquatic Ecology, Chapter 16 – MNES and Appendix A6 – Groundwater Technical Report
Indicate the vulnerability to contamination (e.g. from salt production and salinity) and the likely impacts of contamination on the identified water-dependent assets and ecological processes.	These aspects are discussed variously in Chapter 10 – Groundwater, Chapter 14, Terrestrial Ecology, Chapter 15 – Aquatic Ecology, Chapter 16 – MNES and Appendix A6 – Groundwater Technical Report
Identify the proposed acceptable level of impact for each water-dependent asset based on leading-practice science and site-specific data, and ideally developed in conjunction with stakeholders.	These aspects are discussed variously in Chapter 10 – Groundwater, Chapter 14, Terrestrial Ecology, Chapter 15 – Aquatic Ecology, Chapter 16 – MNES and Appendix A6 – Groundwater Technical Report

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Question	Comments
Identify and consider landscape modifications (e.g. voids, on-site earthworks, and roadway and pipeline networks) and their potential effects on surface water flow, erosion and habitat fragmentation of water-dependent species and communities.	These aspects are discussed variously in Chapter 10 – Groundwater, Chapter 14, Terrestrial Ecology, Chapter 15 – Aquatic Ecology, Chapter 16 – MNES and Appendix A6 – Groundwater Technical Report
Propose mitigation actions for each identified impact, including a description of the adequacy of the proposed measures and how these will be assessed.	These aspects are discussed variously in Chapter 10 – Groundwater, Chapter 14, Terrestrial Ecology, Chapter 15 – Aquatic Ecology, Chapter 16 – MNES and Appendix A6 – Groundwater Technical Report
Data and monitoring	
Identify an appropriate sampling frequency and spatial coverage of monitoring sites to establish pre-development (baseline) conditions, and test potential responses to impacts of the proposal (see Doody et al. [in press]).	These aspects are discussed in Chapter 9 – Surface Water, Chapter 10 – Groundwater, Chapter 15 – Aquatic Ecology, Chapter 16 – MNES and Appendix A6 – Groundwater Technical Report.
Consider concurrent baseline monitoring from unimpacted control and reference sites to distinguish impacts from background variation in the region (e.g. BACI design, see Doody et al. [in press]).	The monitoring program is discussed in Chapter 9 – Surface Water, Chapter 10 – Groundwater, Chapter 14, Terrestrial Ecology, Chapter 15 – Aquatic Ecology, Chapter 16 – MNES and Chapter 23 – draft Environmental Authority.
Develop and describe a monitoring program that identifies impacts, evaluates the effectiveness of impact prevention or mitigation strategies, measures trends in ecological responses and detects whether ecological responses are within identified thresholds of acceptable change (see Doody et al. [in press]).	The monitoring program is discussed in Chapter 9 – Surface Water, Chapter 10 – Groundwater, Chapter 14, Terrestrial Ecology, Chapter 15 – Aquatic Ecology, Chapter 16 – MNES and Chapter 23 – draft Environmental Authority.
Describe the proposed process for regular reporting, review and revisions to the monitoring program.	The reporting process is discussed in Chapter 9 – Surface Water, Chapter 10 – Groundwater, Chapter 14, Terrestrial Ecology, Chapter 15 – Aquatic Ecology, Chapter 16 – MNES and Chapter 23 – draft Environmental Authority.
Ensure ecological monitoring complies with relevant state or national monitoring guidelines (e.g. the DSITI guideline for sampling stygofauna (QLD Government 2015)).	The Stygofauna monitoring process is discussed in Chapter 15 – Aquatic Ecology, Chapter 16 – MNES and Appendix A9f – Stygofauna Results. Note: DES has confirmed that Central Queensland Coal has complied with Stygofauna sampling requirements. Further, Central Queensland Coal has committed to an ongoing Stygofauna sampling program.

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Table 6 Water and salt balance and water quality

Question	Comments
Provide a quantitative site water balance model describing the total water supply and demand under a range of rainfall conditions and allocation of water for mining activities (e.g. dust suppression, coal washing etc.), including all sources and uses?	A site water balance model for mining activities using GoldSim is presented. The key elements of the model include: ▪ stochastic daily rainfall based on daily historical rainfall applied to the Life of Mine (looping with a one year step for the period of record) ▪ surface catchment runoff applied with an in-built AWBM hydrology module (with catchments changing with mine plan development) ▪ mine open cut groundwater dewatering from the groundwater modelling ▪ the site water storages' stage-area-storage volumes from preliminary engineering drawings ▪ mine demands have been provided as annual volumes, evenly distributed to a daily demand.
Provide estimates of the quality and quantity of operational discharges under dry, median and wet conditions, potential emergency discharges due to unusual events and the likely impacts on water-dependent assets.	Water accounting framework tables for wet and dry seasons are presented in Tables 9-62 and 9-63 as per the Water Accounting Framework for the Minerals Industry User Guide (Minerals Council of Australia, 2014).
Describe the water requirements and on-site water management infrastructure, including modelling to demonstrate adequacy under a range of potential climatic conditions.	A site water balance model for mining activities using GoldSim is presented. The key elements of the model include: ▪ stochastic daily rainfall based on daily historical rainfall applied to the Life of Mine (looping with a one year step for the period of record) ▪ surface catchment runoff applied with an in-built AWBM hydrology module (with catchments changing with mine plan development) ▪ mine open cut groundwater dewatering from the groundwater modelling ▪ the site water storages' stage-area-storage volumes from preliminary engineering drawings ▪ mine demands have been provided as annual volumes, evenly distributed to a daily demand.
Provide salt balance modelling that includes stores and the movement of salt between stores, and takes into account seasonal and long-term variation	The release limits proposed for the Project are presented in Section 9.5.6 and based on Water Quality Objectives (WQOs) for the Styx Basin and an adopted instream dilution rate for electrical conductivity.

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Table 7 Cumulative Impacts

Question	Comments
Context and conceptualisation	
Provide cumulative impact analysis with sufficient geographic and temporal boundaries to include all potentially significant water-related impacts.	There are no other resource or CSG projects existing or foreseeably proposed for the Styx Basin cumulative impacts have been considered in the context of the proposed Project and the existing land uses.
Consider all past, present and reasonably foreseeable actions, including development proposals, programs and policies that are likely to impact on the water resources of concern in the cumulative impact analysis. Where a proposed project is located within the area of a bioregional assessment consider the results of the bioregional assessment.	There are no other resource or CSG projects existing or foreseeably proposed for the Styx Basin cumulative impacts have been considered in the context of the proposed Project and the existing land uses. The Project is not located in a bioregional assessment area.
Impacts	
Provide an assessment of the condition of affected water resources which includes: ▪ identification of all water resources likely to be cumulatively impacted by the proposed development; ▪ a description of the current condition and quality of water resources and information on condition trends; ▪ identification of ecological characteristics, processes, conditions, trends and values of water resources; ▪ adequate water and salt balances; and, ▪ identification of potential thresholds for each water resource and its likely response to change and capacity to withstand adverse impacts (e.g. altered water quality, drawdown).	Cumulative impacts associated with surface water and existing land uses are discussed in Chapter 9 – Surface Water, Section 9-12. For the cumulative assessment, we have chosen to restrict the assessment to the overall Styx River, as it is unlikely that the Project will impact area beyond this extent. The Styx River is dominated by cattle grazing with most of the catchment rural with minimal developments. There are three surface water entitlements in Tooloombah and Deep Creek. The existing water entitlements are small with extraction requirements of 18 ML and 8 ha. The combined existing water extraction is unlikely to impact the water flow within Tooloombah Creek as the Project is not planning to extract water from the creeks.

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Question	Comments
Assess the cumulative impacts to water resources considering: ▪ the full extent of potential impacts from the proposed project, (including whether there are alternative options for infrastructure and mine configurations which could reduce impacts), and encompassing all linkages, including both direct and indirect links, operating upstream, downstream, vertically and laterally; ▪ all stages of the development, including exploration, operations and post closure / decommissioning; ▪ appropriately robust, repeatable and transparent methods; ▪ the likely spatial magnitude and timeframe over which impacts will occur, and significance of cumulative impacts; and, ▪ opportunities to work with other water users to avoid, minimise or mitigate potential cumulative impacts.	Cumulative impacts associated with surface water and existing land uses are discussed in Chapter 9 – Surface Water, Section 9-12. For the cumulative assessment, we have chosen to restrict the assessment to the overall Styx River, as it is unlikely that the Project will impact area beyond this extent. The Styx River is dominated by cattle grazing with most of the catchment rural with minimal developments. There are three surface water entitlements in Tooloombah and Deep Creek. The existing water entitlements are small with extraction requirements of 18 ML and 8 ha. The combined existing water extraction is unlikely to impact the water flow within Tooloombah Creek as the Project is not planning to extract water from the creeks.
Mitigation, monitoring and management	
Identify modifications or alternatives to avoid, minimise or mitigate potential cumulative impacts. Evidence of the likely success of these measures (e.g. case studies) should be provided.	Mitigation measures for surface water are discussed in Chapter 9 – Surface Water, Section 9-11. Notwithstanding there are unlikely to be any cumulative impacts, the mitigation measures proposed would be relevant to countering adverse cumulative impacts.
Identify measures to detect and monitor cumulative impacts, pre and post development, and assess the success of mitigation strategies.	Mitigation measures for surface water, including ongoing monitoring, are discussed in Chapter 9 – Surface Water, Section 9-11. Notwithstanding there are unlikely to be any cumulative impacts, the mitigation measures proposed would be relevant to countering adverse cumulative impacts.
Identify cumulative impact environmental objectives.	Environmental objectives with respect to surface water are provided in Chapter 9 – Surface Water, Section 9.3. Notwithstanding there are unlikely to be any cumulative impacts, the environmental objectives proposed would be relevant to any cumulative impacts should they occur.
Describe appropriate reporting mechanisms.	Reporting mechanisms with respect to Surface Water are provided in Chapter 23 – draft Environmental Authority. Draft Trigger Action Response Plans, which include action and response mechanisms are included in Chapter 9 – Surface Water, Section 9.11.4. These will be updated to incorporate any additional requirements for monitoring and reporting.
Propose adaptive management measures and management responses.	Reporting mechanisms with respect to Surface Water are provided in Chapter 23 – draft Environmental Authority. Draft Trigger Action Response Plans, which include action and response mechanisms are included in Chapter 9 – Surface Water, Section 9.11.4. These will be updated to incorporate any additional requirements for monitoring and reporting.

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Table 8 Final landform and voids (coal mines) - IESC Compliance Checklist

Question	Comments
Identify and consider landscape modifications (e.g. voids, on-site earthworks, and roadway and pipeline networks) and their potential effects on surface water flow, erosion, sedimentation and habitat fragmentation of water-dependent species and communities.	These aspects are discussed variously in Chapter 5 – Land, Chapter 8 – Waste Rock and Rejects, Chapter 9 – Surface Water, Chapter 10 – Groundwater, Chapter 11 – Rehabilitation, Chapter 14, Terrestrial Ecology, Chapter 15 – Aquatic Ecology and Chapter 16 – MNES. Note: no retained voids are proposed as part of this Project.
Provide an assessment of the long-term impacts to water resources and water-dependent assets posed by various options for the final landform design, including complete or partial backfilling of mining voids. Assessment of the final landform for which approval is being sought should consider: ▪ groundwater behaviour – sink or lateral flow from void. ▪ water level recovery – rate, depth, and stabilisation point (e.g. timeframe and level in relation to existing groundwater level, surface elevation). ▪ seepage – geochemistry and potential impacts. ▪ long-term water quality, including salinity, pH, metals and toxicity. ▪ measures to prevent migration of void water off-site. For other final landform options considered sufficient detail of potential impacts should be provided to clearly justify the proposed option.	These aspects are discussed variously in Chapter 5 – Land, Chapter 8 – Waste Rock and Rejects, Chapter 9 – Surface Water, Chapter 10 – Groundwater, Chapter 11 – Rehabilitation, Chapter 14, Terrestrial Ecology, Chapter 15 – Aquatic Ecology and Chapter 16 – MNES. Note: no retained voids are proposed as part of this Project.
Assess the adequacy of modelling, including surface water and groundwater quantity and quality, lake behaviour, timeframes and calibration.	These aspects are discussed variously in Chapter 8 – Waste Rock and Rejects, Chapter 9 – Surface Water, Chapter 10 – Groundwater, Chapter 11 – Rehabilitation, Chapter 15 – Aquatic Ecology and Chapter 16 – MNES. Note: no retained voids are proposed as part of this Project.
Provide an evaluation of stability of void slopes where failure during extreme events or over the long term (for example due to aquifer recovery causing geological heave and landform failure) may have implications for water quality.	No voids will be retained as part of the final landform.
Evaluate mitigating inflows of saline groundwater by planning for partial backfilling of final voids.	No voids will be retained as part of the final landform.
Assess the probability of overtopping of final voids with variable climate extremes, and management mitigations.	No voids will be retained as part of the final landform.

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Table 9 Acid-forming materials and other contaminants of concern - IESC Compliance Checklist

Question	Comments
Identify the presence and potential exposure of acid-sulphate soils (including oxidation from groundwater drawdown).	These aspects are discussed variously in Chapter 5 – Land, Chapter 8 – Waste Rock and Rejects, Chapter 9 – Surface Water, Chapter 10 – Groundwater, Chapter 11 – Rehabilitation and Chapter 16 – MNES.
Describe handling and storage plans for acid-forming material (co-disposal, tailings dam, and encapsulation).	These aspects are discussed variously in Chapter 5 – Land, Chapter 8 – Waste Rock and Rejects and Chapter 11 – Rehabilitation and Chapter 16 – MNES.
Identify the presence and volume of potentially acid-forming waste rock, fine-grained amorphous sulphide minerals and coal reject/tailings material and exposure pathways.	These aspects are discussed variously in Chapter 5 – Land, Chapter 8 – Waste Rock and Rejects and Chapter 11 – Rehabilitation and Chapter 16 – MNES.
Assess the potential impact to water-dependent assets, taking into account dilution factors, and including solute transport modelling where relevant, representative and statistically valid sampling, and appropriate analytical techniques.	These aspects are discussed variously in Chapter 5 – Land, Chapter 8 – Waste Rock and Rejects, Chapter 9 – Surface Water, Chapter 10 – Groundwater, Chapter 11 – Rehabilitation and Chapter 16 – MNES.
Identify other sources of contaminants, such as high metal concentrations in groundwater, leachate generation potential and seepage paths.	These aspects are discussed variously in Chapter 5 – Land, Chapter 8 – Waste Rock and Rejects, Chapter 9 – Surface Water, Chapter 10 – Groundwater, Chapter 11 – Rehabilitation and Chapter 16 – MNES.
Describe proposed measures to prevent/minimise impacts on water resources, water users and water-dependent ecosystems and species.	These aspects are discussed variously in Chapter 5 – Land, Chapter 8 – Waste Rock and Rejects, Chapter 9 – Surface Water, Chapter 10 – Groundwater, Chapter 11 – Rehabilitation and Chapter 16 – MNES.