Aquatic ecology

EIS information guideline

Queensland Government

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Contents

Introduction

This guideline advises proponents about the information requirements in relation to aquatic ecology when preparing an environmental impact statement (EIS).

The Department of Environment and Science (the department) has published separate but related, EIS information guidelines (DES 2020) for terrestrial ecology, groundwater dependent ecosystems, matters of national environmental significance, coastal, and biosecurity (e.g. weeds and pests).

What are aquatic ecosystems and their values?

Aquatic ecosystems are defined by the Australia Government's Aquatic ecosystems toolkit as those ecosystems that depend on flows, or periodic or sustained inundation/waterlogging for their ecological integrity. Aquatic ecosystems include wetlands, rivers, karst and other groundwater dependent ecosystems, saltmarshes, estuaries and areas of marine water the depth of which at low tide does not exceed six metres.

Wetlands in Queensland have been classified into systems (lacustrine, palustrine, riverine, estuarine, marine and subterranean) and discrete wetland habitat types or classes based on their diversity, values and uses. This is supported by the Queensland wetland classification method, conceptual models, wetland management profiles and mapping outputs, which are all available on Wetland*Info*. The Queensland Wetland Mapping is based on the Queensland Wetlands Program wetland definition available on Wetland*Info* and in the *Queensland Wetland definition and delineation guideline* (DERM 2011).

The *Aquatic ecosystems toolkit* says: 'Ecological value is the perceived importance of an ecosystem, which is underpinned by the biotic and/or abiotic components and processes that characterise that ecosystem.' For the EIS, you should use the *Aquatic ecosystems toolkit* to identify those ecological values that are important through applying the criteria and identifying critical components and processes. From that you should describe the ecological character of the ecosystems. You may use another comparable process if you can demonstrate in the EIS that the process is as rigorous as the toolkit.

Legislation and policy

Provide an overview of the legislation that is most relevant when assessing aquatic ecology for an EIS, and explains why it is relevant. The EIS must describe what permits and licences would be required under all relevant legislation, and describe why and when they would be required for the construction, operation, or rehabilitation of the proposed project.

Wetland*Info* has information on a range of regulatory planning, assessment and approval mechanisms relating to the protection and management of Queensland's wetlands.

Environmental Protection Act 1994

Section 9 of the *Environmental Protection Act 1994* defines an environmental value as:

- a quality or physical characteristic of the environment that is conducive to ecological health or public amenity or safety; or
- another quality of the environment identified and declared to be an environmental value under an environmental protection policy or regulation.

The Environmental Protection (Water and Wetland Biodiversity) Policy 2019

Section 7 of the Environmental Protection (Water and Wetland Biodiversity) Policy 2019 describes the environmental values for wetlands to be enhanced or protected as qualities of a wetland that support and maintain the biodiversity of the wetland, including the following:

- the health of the wetland's ecosystems
- the wetland's natural state and biological integrity
- the presence of distinct or unique features, endemic plants or animals and their habitats, including threatened wildlife and near threatened wildlife under the *Nature Conservation Act 1992*
- the wetland's natural hydrological cycle
- the natural interaction of the wetland with other ecosystems, including other wetlands.

Under the Environmental Protection Act, the Environmental Protection (Water and Wetland Biodiversity) Policy provides the framework for developing environmental values, management goals and water quality objectives for Queensland waters. Schedule 1 of the Policy lists the environmental values and water quality objectives for Queensland waters.

Water plans

Statutory water plans are prepared under the *Water Act 2000* to advance the responsible and productive management of water. The water planning process addresses general ecological outcomes relating to wetlands.

For example, the Water Plan (Fitzroy Basin) 2011 includes general ecological outcomes that would:

- minimise changes to the natural variability of flows that support aquatic ecosystems
- provide for the continued capability of one part of the river system to be connected to another, including by maintaining flows that
  - allow for the movement of native aquatic fauna between riverine, floodplain, wetland, estuarine and marine environments
  - support water-related ecosystems
- minimise the impact of the taking of water on aquatic ecosystems
- protect and maintain refugia associated with waterholes, lakes, and wetlands
- support ecosystems dependent on groundwater including, for example, riparian vegetation and wetlands.

Matters of state environmental significance

Schedule 2 of the Environmental Offsets Regulation 2014 prescribes multiple matters of state environmental significance (MSES), several of which are relevant to assessing aquatic ecology, such as a wetland or watercourse in high ecological value waters. Proponents must use the Environmental Offsets Regulation to identify those MSES that are relevant to their EIS.

The State Planning Policy (SPP) defines the specific matters of state interest in land use planning and development, and those matters include biodiversity. Matters of environmental significance—national (MNES), state (MSES) and local (MLES), support the application of biodiversity policies by state government and local governments (in local and regional plans). The SPP state interest guideline Biodiversity includes a biodiversity overlay code, definitions, references, and technical resources, such as links to mapping data and methods.

Environment Protection and Biodiversity Conservation Act 1999

Matters of national environmental significance (MNES) are listed under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999*. The Australian Government's Protected Matters Search Tool can be used to identify MNES for a particular area of interest. A range of threatened ecological communities listed as MNES occur in aquatic environments in Queensland. For instance, Great Artesian Basin springs are discharge spring wetlands that support four threatened animal and seven threatened plant species. See the department's separate EIS information guideline—MNES (DES 2020) for further information on addressing MNES.

Other legislation

The following Queensland legislation may also be relevant to aquatic ecology assessments in Queensland:

- *Biosecurity Act 2014*
- *Fisheries Act 1994*
- *Nature Conservation Act 1992*
- *Planning Act 2016*
- *Vegetation Management Act 1999*

What should the EIS address?

The EIS must identify and quantify aquatic ecological values and the potential impacts on them. The assessment and detail required in an EIS should be proportionate to the size of the project area, the scale of the project, and the extent of its impacts both on and off the project site.

An EIS would typically address the following matters:

- the proposed project's location and context within the local and regional landscape
- the aquatic ecosystem components, processes, connectivity and condition
- all aquatic ecological values present or likely to be present within the area potentially affected, either directly or indirectly, by the proposed project including coastal waters, estuaries, rivers and streams, natural and artificial lakes and reservoirs, and permanent and ephemeral wetlands
- the level of certainty about the presence or absence of each ecological value
- the significance and sensitivity of the aquatic ecological values
- potential impacts including actual or potential threatening processes, such as vegetation clearing, stream diversions or other changes to hydrology, and/or discharges from the project
- the cumulative impact of the project in conjunction with other relevant existing and proposed activities
- measures to avoid and minimise impacts on aquatic ecological values
- significant residual impacts on aquatic ecological values
- an offset strategy for any significant residual impacts to MSES that demonstrates a conservation outcome can be achieved as required under state legislation.

The following sections of this guideline provide advice on how to achieve those requirements. Adapt the matters as necessary to suit the site and potential impacts of the proposed project. If a particular matter is not relevant, rather than being silent, the EIS should demonstrate why the matter is not relevant to the proposed project.

Where the impacts on aquatic ecology might occur as an indirect consequence of impacts on water resources, the EIS must cross-reference between the sections that assess aquatic ecology and water resources so that the EIS deals holistically with the impacts and mitigation measures.

The EIS may address aquatic ecology as part of the chapter that addresses ecology. Nevertheless, it should specifically identify and describe the aquatic ecological values, assess potential impacts on aquatic ecological values, and propose measures to avoid or mitigate the impacts.

When this guideline requires a matter to be described, illustrate the description using appropriate maps, diagrams, charts and/or photographs. Multiple graphics may be needed to adequately illustrate a matter.

Ecological surveys

Desktop assessment

Undertake a comprehensive desktop assessment in the early stages of the proposed project's planning. Review and evaluate existing information on aquatic ecology, including existing ecosystem data and local hydrogeological setting, to assess the likely presence and nature of aquatic ecology values in the project area and areas of influence.

The desktop assessment should address the following matters:

- Consider the scale and position of the aquatic ecosystems, where and how aquatic ecosystems are placed within the surrounding catchment landscape (e.g. upper catchment, middle reaches or lower floodplain), and the landscape's connection to other ecosystems. Interpret imagery to delineate, for subsequent field assessment, layers (strata) of vegetation produced by the occurrence at approximately the same level (height) of an aggregation of plants of the same habit. Base the strata on discernible vegetation, soils or topographic patterns. Use pre-existing mapping of wetlands, regional ecosystems, soils and other relevant attributes when interpreting images to classify the patterns.
- Identify potential aquatic ecological values such as: biota (vegetation, fauna); physiochemical (water, soil); form and structure (such as watercourse morphology); hydrology; and connectivity to other ecosystems. You may source assessment information from decision support tools such as Aquatic Conservation Assessments (ACA) and AquaBAMM that use existing information and expert input to assess conservation value in aquatic ecosystems. Use the most recent and comprehensive assessment information, such as ACAs, in preference to older information, such as the Directory of Important Wetlands in Australia. The AquaBAMM is applicable in freshwater riverine, freshwater non-riverine and estuarine wetlands. It uses a database platform for data storage, manipulation and values assessment, and outputs directly to a GIS platform for presenting and interpreting results. The output is an ACA for the study area.
- Wetland*Info* has an assessment toolbox that may assist in determining the appropriate method to use.

- Gather information about existing aquatic ecological values by undertaking database searches, mapping analysis and literature review. The aim is to discover as much as possible about the aquatic ecosystem, its support area, and how it interacts with the landscape.

Base the spatial extent of a database search on the location of the project area, the hydrological links across the landscape, the intensity and scope of previous ecological surveys in the area, and the nature and extent of potential impacts of the proposed project. The desktop assessment should be sufficient to ascertain the presence of wetland(s), landscape connectivity, and potential environmental values. Additionally, the desktop assessment should determine the habitat requirements for each ecological value and the key threats to its existence or function.

The interactive resource Wetland*Maps* and other key wetland information can be found through the Wetland*Info* website. Wetlands have been mapped digitally by building on existing information including water body mapping derived from satellite information, regional ecosystem mapping, the spring and small waterholes database and drainage lines from topographic mapping.

Review available aerial imagery to identify representative stream reaches and wetlands for field assessment.

Use conceptual models to support the characterisation of wetland components, processes and drivers. Together with other geomorphic and ecosystem information, conceptual models provide the basis for understanding how and why the aquatic ecosystem formed. Models should present the factors that are influencing the system and the linkages of these factors. Models can be used to describe different flow states, such as base flow or flood events.

It is important to determine if there are any groundwater dependent ecosystems in the project area (refer to the separate EIS information guideline—groundwater dependent ecosystems). Stygofauna distribution data may be available on request from the Queensland Herbarium.

The desktop assessment should provide information about aquatic ecosystem regional ecosystems, associated aquatic or terrestrial habitats, aquatic ecosystem types and mapped condition.

Aquatic ecology surveys

Planning ecological surveys

Use the information gained by the desktop studies to plan and design aquatic ecological surveys, and ensure the most effective timing (seasonality), methodology and duration of the survey work. The surveys must be sufficient to identify relevant ecological values, verify the findings from the comprehensive desktop review and address any critical knowledge gaps.

Survey area and survey effort

Aquatic ecological values are reliant on the underlying components and processes of the aquatic ecosystem. The EIS must not only identify aquatic ecological values, but also describe the processes at the scale at which they function ecologically. That scale may be broader than the aquatic ecosystem itself and incorporate surrounding areas. Consequently, the survey area may need to be significantly larger than the area taken by the project site and its associated aquatic ecological values.

Ephemeral watercourses and wetlands will require historical data to determine flows and inundation extent/period. Therefore, if that data is not available, plan to install the necessary flow gauges at the earliest opportunity.

The planned surveys must be capable of ground-truthing the watercourse or wetland regional ecosystem(s) (RE) and wetland type. The surveys must also be capable of finding any inconsistencies with the State's regional ecosystem mapping. The *Queensland wetland definition and delineation guidelines: Part B* (DERM 2011) provide a methodology to determine accurately the wetland boundaries if impacts are very close to the wetland area.

Survey effort must accord with relevant guidelines for the taxa or ecosystem of interest. The sampling effort must occur across the project area and in nearby areas outside the project area that act as reference or control sites. Ensure the surveys will provide representative sampling within each vegetation stratum across each aquatic ecosystem. Also, ensure the surveys will adequately capture the nature and spatial extent of seasonal ecological/hydrological changes.

Stygofauna sampling guidance is available through the Queensland Government's Guideline for the environmental assessment of subterranean aquatic fauna (DSITI 2015).

Identify potential constraints

Identify any constraints that would result in less than optimal field surveys, and plan to avoid or minimise the constraints. For example, aquatic surveys are particularly susceptible to weather and climate variations, so survey plans must be flexible and adaptive in order to obtain the best possible data. Then, when subsequently assessing

the survey data, take a conservative approach. For example, if the desk-top studies indicate a threatened species or community is likely to be present, but the field surveys are constrained in some way from adequately confirming their presence or absence, then the EIS must assume the threatened species or community is present.

Further information can be obtained from the Queensland wetland definition and delineation guideline (DERM 2011).

Timing of surveys

Conduct surveys at times that will ensure the aquatic habitat(s) and/or wetland(s) are assessed at their full range of productivity (e.g. including the wettest and driest times of the year). Many Queensland wetlands can be dry for years at a time, so proponents must be ready to take advantage of rain events. Take account not only of the prevailing weather conditions, but also other factors, such as previous rainfall, flooding, drought, cyclone damage, bush fire damage, tide conditions, flowering and fruiting periods, growth cycles, breeding cycles, and migrations.

Identification of suitable survey locations, equipment and personnel

Develop suitable aquatic field surveys for the project area and the potentially impacted wider vicinity. The field investigations must be able to fill any information gaps identified from the preliminary investigations.

Plan survey locations to cover all potentially impacted ecological communities, species and species habitats. For plants, select locations where meanders, transects, and/or plots will be surveyed. For animals, select locations and equipment for such activities as trapping, spotlight searching, call detection, roost searching, and so on. The field surveys must be sufficient to provide accurate mapping of aquatic ecosystems and habitat, and to target plant and animal species of particular interest (e.g. because they are threatened). Ensure that survey locations are adequately positioned within the habitat; that is, not adjacent to roads or cleared areas.

Use appropriate equipment to target threatened species. This is especially important for a taxon where call analysis and/or trapping alone will not determine the species, only the genus. Any limitations of survey methods used for a species must be explained in the EIS.

The study of ecology is a highly specialised field. The department may allow an EIS to proceed to the public notification stage only if the chief executive considers it addresses the final terms of reference in an acceptable form. The department would not consider an EIS addresses the final terms of reference in an acceptable form unless (among other things) the ecology section was prepared by ecologists with sufficient expertise in the relevant issues for the project. For example, proponents should engage an experienced specialist to deal with matters related to an endangered species rather than using only a junior or relatively inexperienced ecologist. Consequently, proponents must provide the department with a list all the ecologists who undertook field studies and/or wrote the ecology sections of the EIS. Proponents must also provide details of each ecologist's contribution and the issues they worked on.

Ensure that the survey team will have permission to access the selected sites at the appropriate seasons, and that they have all necessary permits and approvals (e.g. for trapping and handling of fauna).

Site verification

Undertake a reconnaissance visit to check that the desktop studies provided an adequate basis for designing the field survey program, particularly with regard to threatened species and communities.

The reconnaissance visit(s) should confirm that the proposed survey sites are accessible, and that the survey effort and equipment are adequate for the size of survey area and the ecological values targeted.

Consultation pre-survey

Consult the department prior to field surveys in order to discuss:

- the aquatic ecological values identified from preliminary work
- whether field surveys and other assessment methodologies are appropriate to detect and quantify aquatic ecological values
- any major limitations to the implementation of survey work that could compromise departmental requirements in terms of survey methods and effort
- any project specific issues that the proponent would like to raise.

A pre-survey meeting also provides the department with the opportunity to raise any aspects considered important about the project or potentially impacted ecological values that would need to be addressed or considered by the proponent.

Note that pre-survey consultation, while useful in obtaining advice, cannot guarantee that the proposed survey strategy will be adequate for the particular site and proposed project. It is the proponent's responsibility to

demonstrate in the EIS that the survey strategy used was appropriate.

Conducting surveys

Conduct the aquatic ecological surveys in accordance with relevant guidelines, including, but not limited to, those referenced in this guideline. The survey needs to adequately quantify the area of habitat for aquatic threatened species within the proposed project area and the quality/condition of the habitat. When a threatened species or a priority species for conservation is found, determine the population extent and density of the species within the impact area.

Record GPS locations in decimal degrees of latitude and longitude based on the Geocentric Datum of Australia 2020 (GDA2020). Take relevant photographs/videos of survey sites, and record their details and locations to aid assessment and analysis. Provide sufficient photographs in the EIS for the department and the community to gain an understanding the existing environment of the project site.

Aquatic water quality and ecology

Aquatic surveys must at least assess the following matters: habitat, water quality, aquatic plants, macroinvertebrates, amphibians, fish and turtles. Also, assess terrestrial vertebrate fauna that have some aquatic lifecycle dependency (e.g. amphibians, reptiles, birds and mammals) and cross-reference their assessment with the terrestrial ecology chapter of the EIS.

Describe aquatic habitats in accordance with AusRivAS protocols for Queensland streams (DNRM 2001) and the Australian River Assessment System: AusRivAS Physical Assessment Protocol (Parsons et al. 2001). Describe the aquatic habitat types of the site. Assess the current integrity or condition state of the ecosystems in relation to existing natural or anthropogenic impacts, such as: pest species; agriculture; industry; constructed barriers/flow regime alteration; native riparian or wetland vegetation modification (clearing or weed species presence); bank erosion or deposition; and instream habitat modification.

Summarise the current water quality associated with each aquatic habitat or ecosystem, and comment on how it affects the aquatic ecology. Cross-reference the assessment with the Water chapter of the EIS.

Survey aquatic plants at each site and identify them to species level using available literature and taxonomic keys where needed. Estimate abundance and diversity measures.

Conduct macroinvertebrates Bioassessment in accordance with AusRivAS protocols for Queensland streams (DNRM, 2001) and datasheets available at the AusRivAS website.

Ensure survey methods for amphibians, fish and freshwater turtles are consistent with methods presented in the Survey Guidelines for Australia's Threatened Frogs (SEWPAC 2010), Survey Guidelines for Australia's Threatened Fish (SEWPAC 2011) and the Survey Guidelines for Australia's Threatened Reptiles (SEWPAC 2011). Similarly, ensure amphibian and freshwater turtle surveys follow protocols in the Terrestrial vertebrate fauna survey guidelines for Queensland (DES 2018) and any relevant targeted survey approaches for significant species published on the Terrestrial vertebrate fauna survey guidelines website (DES 2018).

Wetlands

Ground-truth and classify the existing wetlands of the study area. Use field surveys to delineate wetland boundaries and identify key attributes, hydrological modifications, salinity and system type. Identify potential habitat for threatened species.

If field surveys indicate the latest available Queensland wetland mapping does not accurately reflect the actual environment, the proponent must propose changes to the wetland mapping and adjust the field surveys to ensure that wetlands and aquatic ecosystems at the project area are accurately mapped. The proposed changes must be supported by site-level information as detailed in the *Queensland wetland definition and delineation guideline* (DERM 2011a). This data must be made available to the department and must include spatial datasets of site locations and proposed new wetland polygons, site data sheets and site photographs. The EIS does not need to include all such information, but the department and the Queensland Herbarium will review the information to confirm the validity of the mapping presented in the EIS.

Quantify the functions and values of each wetland and associated wetland community. Provide a condition assessment that describes the baseline state and the maintenance of the aquatic values it supports, including any potential threatened species habitat.

Stygofauna

Conduct any necessary surveys for subterranean aquatic fauna (stygofauna) in accordance with the *Guideline for the environmental assessment of subterranean aquatic fauna* (DSITI 2015). Ensure the sampling results are compatible with, and provided to, the Queensland Subterranean Aquatic Fauna Database, which is curated by the

Queensland Herbarium. Necessary information includes: the sampling location, date, and method; the taxonomy and abundance of observed subterranean aquatic fauna; and the groundwater chemistry, lithology and stratigraphy of the proposed project area.

Terrestrial ecology surveys

Surveys of aquatic ecology will necessarily have some overlap and connection with surveys of terrestrial ecology. Ensure the EIS holistically addresses the interaction between aquatic and terrestrial ecology, and includes sufficient cross-referencing between the various sections. The department's EIS information guideline—Terrestrial ecology (DES 2020) provides additional advice.

Data management

Ensure that the survey results are compatible with the Queensland CORVEG Database, particularly if there is a possibility that the certified regional ecosystem mapping will need to be adjusted.

The differences in scale between the certified Queensland Herbarium REDD mapping and field-survey mapping can cause differences in ecosystem boundaries. If the field survey finds the REDD mapping is not accurate on the ground, the proponent must propose changes to the regional ecosystem mapping and adjust the field surveys to ensure that regional ecosystems at the project area are accurately mapped. This is particularly important if the project may require offsets for residual impacts. The department can only accept the REDD's certified mapping as the basis for setting offset requirements. So, while the department will accept the results of the field surveys for impact assessment, the proponent must get the Queensland Herbarium to accept the amended mapping before it can be considered for offsets.

Supporting information must include:

- appropriate site-level information as detailed in the survey and mapping methodology (Neldner et al. 2019)
- spatial datasets of site locations and proposed new regional ecosystem polygons
- site data sheets (DES 2019c)
- site photographs.

Furthermore, changes to REDD mapping must be approved by the Queensland Herbarium prior to submission of the EIS.

Describe existing aquatic ecological values

Identify, describe and map all aquatic ecological values present or likely to be present within the area potentially affected either directly or indirectly by the proposed project. Base the description on the desktop assessment, water quality surveys, and field surveys of relevant aquatic plant and animal species (including macroinvertebrates, fish and turtles). Address all significant aquatic species and ecological communities, including MSES and MNES, listed plant and animal species, and wetlands. Assess the condition of dependent terrestrial vegetation communities and habitats.

Based on this information, and using a conservative approach, quantify the level of certainty about the presence or absence of each ecological value. Determine whether aquatic ecological values that were identified as potentially occurring in the survey area but were not located by surveys are likely to be present permanently, seasonally or intermittently. Explain the rationale as to whether each ecological value is present or not present.

In the EIS, clearly describe the objectives, design, constraints, and findings of the aquatic ecological field surveys. For larger projects, summarise the main findings of the field surveys and outcomes in the main text of the EIS, and attach the full details of the field surveys and their results as an appendix. Show the field survey sites, transects and area on maps and figures, and support them with a detailed justification of the survey method and effort. Where proposed project timeframes were constrained (such that surveys could not be undertaken at the optimal time, intensity or frequency), state the reasons and evaluate the adequacy of the survey effort. This should include statements about how the constraints affected the ability of the survey to detect the occurrence of species that may be present.

Describe the aquatic ecosystems, wetlands, habitats, springs, plant and animal species (common and significant species) that have been identified in the desktop and field studies. Include any groundwater dependent ecosystems and potential habitat for subterranean aquatic fauna (stygofauna). Show the location of significant species found during field surveys on suitable maps and figures and describe their habitat.

Assess the connectivity and interdependence of aquatic habitats and ecosystems with other environmental values of the area, such as wildlife corridors or environmentally sensitive areas.

Use baseline data identified during field surveys to propose benchmarks to address rehabilitation indicators and

completion criteria. Also, identify reference/control sites that would be used in the project's monitoring program for comparison with impacted areas to assess the severity of impacts and the success of mitigation measures. Explain why the reference/control sites would be suitable.

Describe the presence and significance of any weed or pest species at or near to the proposed project area. See the department's separate EIS information guideline—Biosecurity (DES 2020) for more information.

Potential impacts

Assess, describe, quantify and illustrate potential direct and indirect impacts on aquatic ecological values from the proposed project activities. This must cover all areas potentially affected both on-site and off-site. Include all stages of the proposed project from initial development through to rehabilitation/de-commissioning.

Address in the assessment:

- all significant aquatic species and ecological communities (MNES, MSES, MLES, listed threatened flora and fauna species and regional ecosystems)
- the conservation status of each identified aquatic ecological value
- the integrity of ecological processes, including habitats of aquatic listed threatened, near threatened or special least-concern species
- interactions between terrestrial and aquatic ecosystems, including groundwater dependent ecosystems and subterranean fauna (stygofauna)
- connectivity of habitats and ecosystems
- the integrity of landscapes and places, including protected areas and places
- biological diversity
- chronic, low-level exposure to contaminants, or the bio-accumulation of contaminants
- direct and indirect impacts on aquatic species and ecosystems whether due to: hydrological or water quality changes; discharges of contaminants to water, air or land, diversions, vegetation clearing; noise; and other relevant matters
- the likelihood and potential significance (magnitude, extent and duration) of the impacts.

Provide detailed mapping that illustrates the potential extent of the impacts on aquatic ecological values. Describe and quantify (in hectares) the direct and indirect impacts on habitats (e.g. wetlands, fauna habitats). Include all proposed project activities and consequences (e.g. clearing, subsidence, groundwater drawdown, change of surface water flows) in the assessment.

Assess the potential edge effects from changes to habitat patterns (e.g. due to clearing, fragmentation, or because an area of land would be rehabilitated to a different ecosystem than present). Also, address the potential impacts of acute, or chronic, low-level exposure to contaminants or the bioaccumulation of contaminants.

Address any obligations imposed by Queensland or Commonwealth legislation or policy, or international treaty obligations, such as the China–Australia Migratory Bird Agreement; Japan–Australia Migratory Bird Agreement; and Republic of Korea–Australia Migratory Bird Agreement.

Assess the potential impacts of the proposed project on the spread of pest animals, weed species, and diseases.

Integrate and cross-reference those parts of the EIS that address aquatic ecology with other parts that address impacts (including cumulative impacts) from interrelated matters, such as terrestrial ecology, water resources, water quality, groundwater, noise, and air quality. Ensure that the ecology assessment work is coordinated with the work of specialists from other relevant disciplines. For example, ecologists liaising with hydrologists and mining engineers will help to determine what aquatic ecological impacts might result from groundwater drawdown, changes to stream flow, or subsidence.

Cumulative impact assessment

Assess the cumulative impacts on aquatic ecological values that could potentially occur because of the impacts of the proposed project added to the past, current and reasonably foreseeable impacts of other activities in the region. Assess cumulative impacts at a local, subregional and bioregional scale and over time (including the proposed project's various stages).

Propose how cumulative impacts will be managed and monitored, including what actions would be taken if monitoring indicates an impact has occurred.

Consider the cumulative impacts of the proposed project in conjunction with other proposed projects when

assessing whether an offset for the significant residual impacts of the proposed project could achieve a conservation outcome (as defined by the *Environmental Offsets Act 2014*).

Avoidance and mitigation measures

The EIS must detail measures that will be applied to manage the project's impacts by giving priority to the following hierarchy:

- avoid impacts wherever possible
- minimise unavoidable impacts
- where necessary, offset residual impacts (see the Offsets section below).

Describe the practicality, effectiveness and risks for each avoidance and mitigation measure. Explain how applying all proposed avoidance and management measures will result in acceptable outcomes for aquatic ecology. Include the time frames in which the results will be delivered; for example, immediately in the case of avoidance, but possibly much longer term for re-establishing habitat. Describe how achieving the measures successfully will be monitored, measured and audited.

Ensure that proposed mitigation measures and success criteria have stated measurable outcomes, and provide sufficient evidence and detail to demonstrate how and when the predicted outcomes can be achieved. Describe how and when the achievement of the proposed mitigation measures and success criteria would be monitored, measured and audited. Propose corrective actions to be taken if success criteria are not met.

Assess the need for buffer zones to aquatic ecological values and the retention, rehabilitation or planting of movement corridors. Assess the role of adequately sized buffer zones in maintaining and enhancing riparian vegetation to increase water quality and habitat connectivity.

Describe the proposed rehabilitation of aquatic ecosystems. Propose rehabilitation completion criteria, in relation to identified aquatic ecological values, that would be used to measure the progressive rehabilitation of disturbed areas. Ensure the rehabilitation goals and measures for aquatic ecosystems integrate with the project's progressive rehabilitation and closure (PRC) plan—see the department's *EIS information guideline—Terrestrial ecology* for further details about the PRC plan.

Include provisions to regularly evaluate all the mitigation measures so that improvements may be made as new technologies and best practices evolve.

Propose strategies to avoid, minimise and mitigate impacts from existing and new weed or pest species threats. See the department's EIS information guideline—Biosecurity (DES 2020) for more information.

Offsets

Describe, quantify, and assess the significance of any potential residual impacts on prescribed environmental matters. Use the Significant residual impact guideline (EHP 2014) to decide whether the proposed project might have a significant residual impact on MSES.

Where there are significant impacts on prescribed environmental matters assess the offsets requirements in accordance with the Environmental Offsets Act and the latest version of the Queensland environmental offsets policy (DES 2020). Describe in detail how the offsets were determined, or explain why no offsets are proposed.

Integrate the offset strategy for aquatic ecology with the offset strategy for terrestrial ecology.

Commitments and conditions

Provide a consolidated description of commitments in regard to nature conservation (including monitoring programs and management plans).

Propose conditions for nature conservation that may be placed on the environmental authority and any other required approvals or licenses. Use the department's guidelines Model mining conditions (DES 2017) or Streamlined model conditions for petroleum activities (DES 2016) as the basis for writing this section of the EIS. Explain where and how you modify any of the department's existing model conditions and eligibility criteria, or develop new ones, to suit site-specific and project specific issues. Conditions for aquatic ecology will necessarily overlap with those for terrestrial ecology. Integrate the proposed conditions for all areas of nature conservation.

Matters of national environmental significance (MNES)

Provide a separate section in the EIS that addresses the requirements for the environmental assessment of MNES under the Environment Protection and Biodiversity Conservation Act. Refer to relevant guidelines on field survey requirements and impact assessment available on the Australian Government website. See the separate EIS information guideline—Matters of national environmental significance (DES 2020) for more information.

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- Assessment monitoring and inventory: https://wetlandinfo.des.qld.gov.au/wetlands/assessment/