

Residual Risk Assessment

Guideline

Prepared by: Department of the Environment, Tourism, Science and Innovation.

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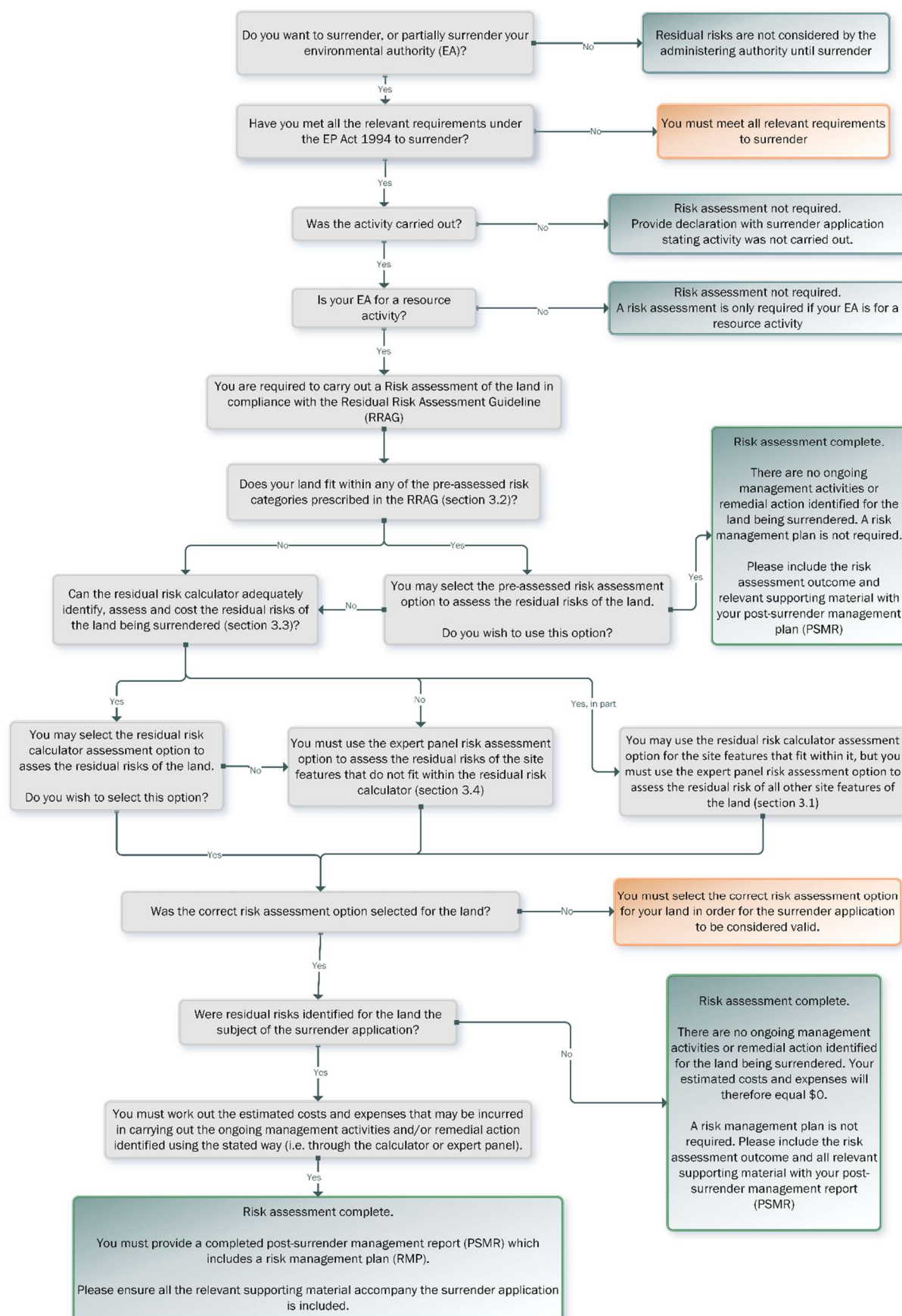
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Figure 1. Undertaking a residual risk assessment

Executive Summary

- This residual risk assessment guideline (guideline) provides the risk assessment method that must be used to satisfy the requirement under sections 262 and 264A of the *Environmental Protection Act 1994* (EP Act).
- This guideline only applies to resource activities that were **carried out** on the land under an environmental authority (EA).
- The EA holder can make a surrender application at any time, provided they demonstrate that all the EP Act requirements have been met and all rehabilitation requirements have been completed.
- Residual risks (RR), of land, means either or both of the following to the extent it relates to resource activities carried out on the land—
 - the risk that, although the land has been rehabilitated and appropriately managed, remedial action will need to be carried out in relation to the land in the foreseeable future;
 - the risk that ongoing management activities will need to be carried out in relation to the land, including—
 - monitoring the condition of the land or site features of the land; and
 - taking action to prevent or minimise environmental harm caused by the land or site features of the land.
- Multiple risk assessment options have been provided for in this guideline to accommodate the diversity of resource sites in Queensland.
- All risk assessment options use the same quantitative risk assessment method prescribed in this guideline. The EA holder is responsible for choosing the most appropriate risk assessment option for their site.
- The residual risk calculator (calculator) is one of the risk assessment options available to EA holders. The calculator was developed as a one-size-fits-most tool to assist EA holders with identifying potential residual risks of land and estimating the costs associated with those risks.
- The administering authority determines the residual risk payment amount, if any, based on the residual risk assessment completed and provided by the EA holder.
- Where a site has been rehabilitated to a stable condition in accordance with the environmental authority and/or progressive rehabilitation and closure plan, it is expected that residual risks will be minimised. Where no site features remain on the land being surrendered, there will be no residual risk payment required.
- On surrender, the State generally assumes responsibility for future costs and expenses associated with ongoing site management activities or remediation actions of former resource activities.
- The financial provisioning scheme only applies when the EA is in effect, thus any surety held by the State is released and returned to the EA holder after surrender¹.
- If the surrender application is approved, the surrender decision does not take effect until after the residual risk requirement (payment) is complied with.

¹ Contributions made to the Financial Provisioning Fund are not releasable or returnable.

1 Introduction

1.1 Scope

This guideline has been created under the *Environmental Protection Act 1994* (EP Act). It provides the residual risk assessment method to satisfy the requirement under section 264A of the EP Act. This includes methods to identify, assess and estimate the costs and expenses of risks that will remain on the land of a resource site after resource activities have ceased and the site has been appropriately rehabilitated.

This guideline applies to all surrender and partial surrender applications relating to an environmental authority (EA) for a resource activity. This guideline does not apply to resource activities that do not require an EA.

It is the responsibility of the EA holder to complete a residual risk assessment in compliance with this guideline. The administering authority must have regard to this guideline when deciding the residual risks requirement for a surrender application.

1.2 Legislative framework

Residual risks must be considered as part of the surrender application for an EA for a resource activity that was carried out (see [Figure 1](#) and [Figure 3](#)). EA holders can apply to surrender their EA following the completion of the resource activity, provided all conditions of their EA, including satisfactory rehabilitation, have been met. Where a Progressive Rehabilitation and Closure Plan (PRCP) applies to an activity, the rehabilitation milestones and management milestones under the PRCP schedule must be met.

See [section 2.4](#) of this guideline for information regarding sites with overlapping areas (i.e., tenures).

The EP Act requires the surrender application to be accompanied by a post-surrender management report (PSMR) that includes information about the site's residual risks. Under the EP Act, residual risks refers to either or both of the following:

- the risk that, although the land has been rehabilitated and appropriately managed, remedial action will need to be carried out in relation to the land in the foreseeable future (related to its past use as a resource site)
- the risk that ongoing management activities will need to be carried out in relation to the land, including—
 - monitoring the condition of the land or site features of the land; and
 - taking action to prevent or minimise environmental harm caused by the land or site features of the land (based on monitoring outcomes).

As part of making a decision on a surrender application, the administering authority may decide that the EA holder is required to provide a payment for residual risks that remain on the land as a result of the resource activity. Under section 273 of the EP Act, the administering authority is responsible for deciding the amount and form of payment required for any identified residual risks.

Residual risk payments are separate to surety paid and held under the Financial Provisioning Scheme for ensuring rehabilitation liabilities are satisfied for mining activities. Upon surrender of an EA, surety that is no longer required to be held will be released.

1.2.1 Residual risks and interaction with final rehabilitation requirements

For certain mining activities, PRCPs outline how resource companies plan for progressive rehabilitation of disturbed land during the life of a mining project to achieve safe, stable and non-polluting post-mining landforms. PRCPs do not apply to resource activities other than mining (e.g., they do not apply to petroleum and gas activities).

The PRCP specifies the final land use for a site, which must align with regulatory requirements and community expectations. Companies must rehabilitate land progressively according to the PRCP schedule, rather than waiting until completion of a project to commence rehabilitation activities. The PRCP schedule includes milestones and timeframes for progression and completion of rehabilitation.

Figure 2 illustrates the types of costs that may be incurred by EA holders to meet rehabilitation requirements. Following completion of major rehabilitation activities, these costs should generally decrease to zero. Costs associated with monitoring, maintenance, environmental management and managing rehabilitation failures may continue for an extended period but are expected to reduce over time as rehabilitated areas are successfully maintained at the required standard.

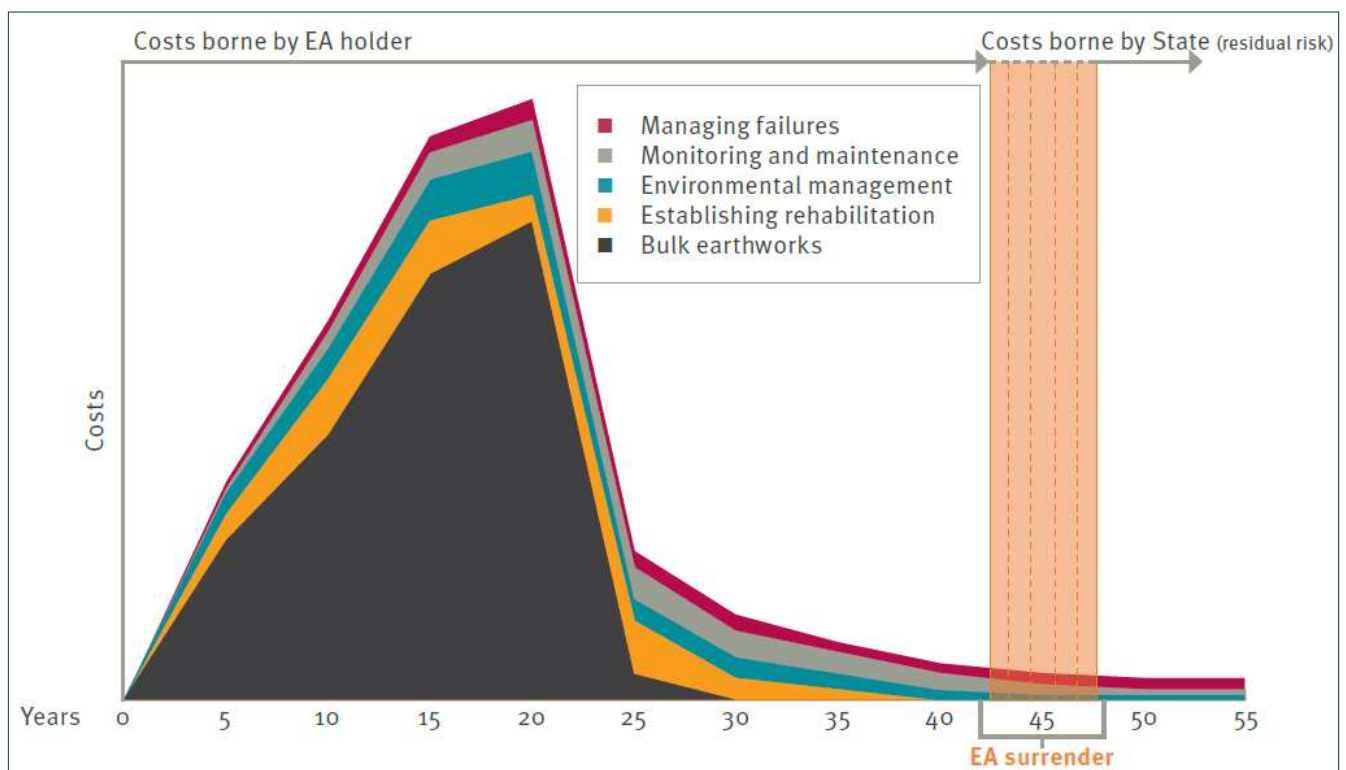


Figure 2: Costs when surrender occurs (no specific time): from Managing residual risks in Queensland discussion paper, 2018.

Once final milestones of a PRCP schedule (where applicable) are met, the EA holder may submit an application for EA surrender. Until surrender occurs, all costs associated with complying with an EA and PRCP schedule, including environmental management, rehabilitation, monitoring, maintenance and remediation of rehabilitation failures of a site remain the responsibility of the EA holder. Once an EA is surrendered, responsibility for managing the site generally transfers to the State.

Residual Risks vs PRCPs

Because some rehabilitated site features (e.g., tailing storage facilities) can deteriorate over time, the EP Act requires resource companies to assess the residual risks of the land at the time of surrender of a site. Even where rehabilitation has achieved an approved standard, ongoing management may be required to maintain some of the rehabilitated site features in a safe, stable and self-sustaining condition. Assessing residual risks of a site ensures future management and/or remedial costs are known and not borne by the community without appropriate funding.

Where residual risks are identified, the EA holder may be required to make a payment to the State to cover the future costs of managing those risks. The framework applies to the post-surrender phase of a site and covers activities required to maintain surrendered site features in the same state they were surrendered in.

Interactions between the residual risk and PRCP frameworks

- The PRCP sets out standards and outcomes for rehabilitation during the life of the project and for surrender of the environmental authority. These standards influence the extent and nature of residual risks that remain after rehabilitation is completed.
- High-quality rehabilitation under the PRCP framework can reduce the likelihood and magnitude of residual risks occurring, which will in turn minimise any residual risk payment that may be required for surrender of an EA.
- It is recommended that PRCPs are established with the residual risk framework in mind in the same way that rehabilitation outcomes are planned to allow for a successful surrender.
- As part of a surrender application for a resource EA, a residual risk assessment must be conducted to identify ongoing management activities (such as ensuring safety fencing around an open void remains intact to prevent harm to humans) or potential remedial action (e.g., a credible risk event causes the failure of a structure resulting in remedial actions being required - examples detailed in [Appendix 2](#)).
- If costs are calculated for ongoing management activities or remedial actions (credible risk events with risk quotients that exceed the state-wide risk threshold), the EA holder may be required to make a residual risk payment to the State to cover the costs of managing those risks in perpetuity.

1.3 Support from the administering authority

It is strongly recommended that before selecting the risk assessment option for a site, the EA holder attends one or more pre-lodgement meeting(s) with the administering authority.

During this meeting, the administering authority can provide advice on:

- the residual risk requirements, including the risk assessment options
- the residual risk assessment process
- the residual risk calculator (calculator) and its use
- site features that must be considered as part of the risk assessment
- the expert panel option and process
- how to select members to participate in the expert panel
- the suitability criteria and professional behaviours that the risk assessor of an expert panel must meet
- information the administering authority has that may assist an expert panel; and
- the types of information that may assist an expert panel with their deliberations.

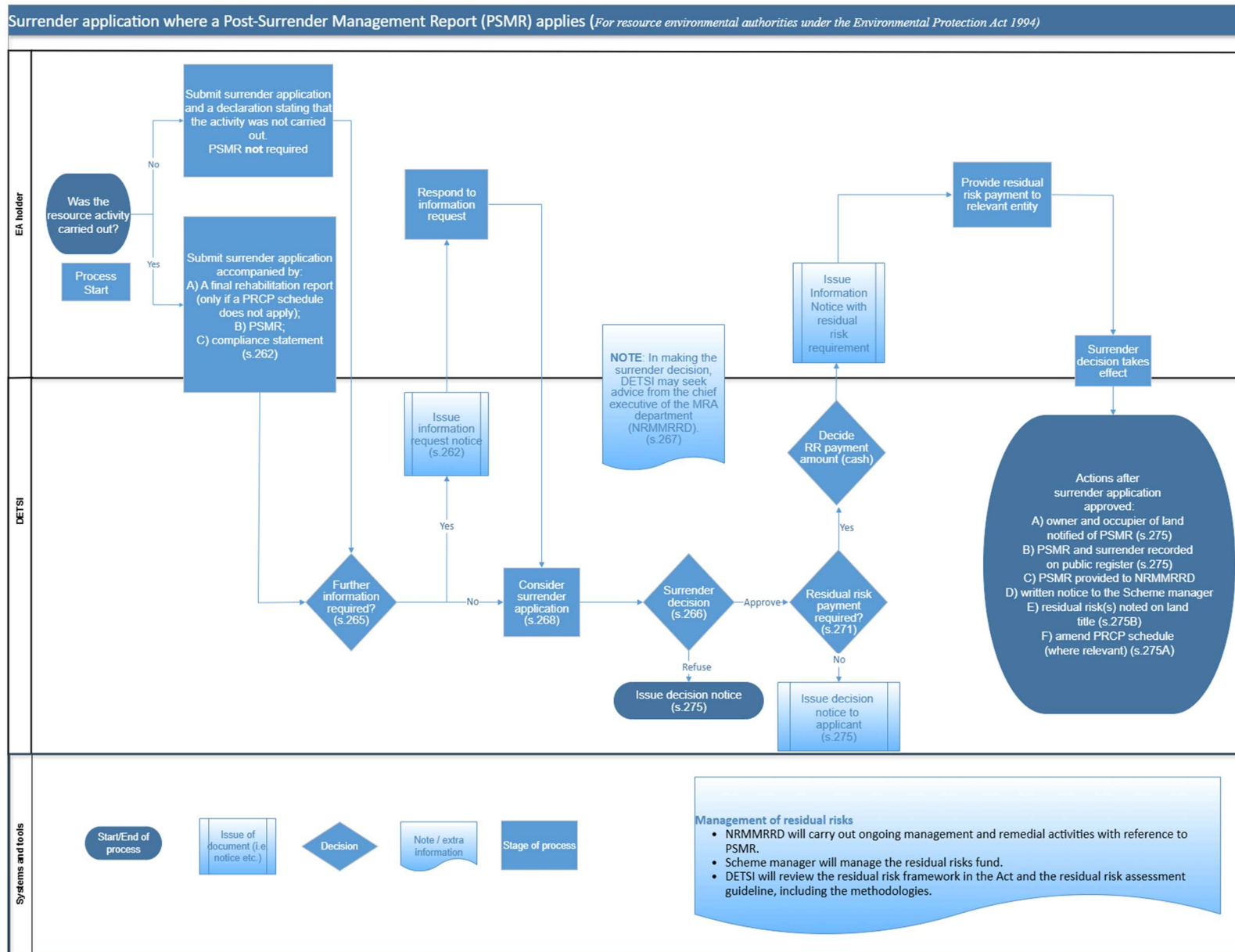
As part of the pre-lodgement meeting process, the administering authority may issue written advice to the EA holder relating to matters discussed in the meeting. The EA holder may also request written advice from

the administering authority as part of the pre-lodgement process to ensure that they have an accurate understanding of what was discussed during the meeting, including any relevant meeting actions.

It is important to note that pre-lodgement meetings do not influence the administering authority's final decision on an application to surrender an EA, including decisions related to residual risks. Pre-lodgement meetings provide general advice and do not include a formal assessment or analysis of the proposed surrender application material against the legislative requirements. Pre-lodgement meetings are free and do not oblige an EA holder to subsequently lodge a surrender application. EA holders can request a pre-lodgement meeting with the administering authority using the 'Application for pre-lodgement service (ESR/2015/1664)²' form. General advice on the process may be sought at any time from the relevant Business Centre.

² This is the publication number. The publication number can be used as a search term to find the latest version of a publication at www.qld.gov.au.

Figure 3: Overview of the surrender process



2 Surrender framework

The requirements associated with surrendering environmental authorities are set out in Chapter 5, Part 10 of the EP Act. This section provides an overview of the residual risk requirements as part of the surrender process for an EA for resource activities. The remainder of the guideline provides detail on how the risk assessment must be undertaken to comply with the EP Act.

The process for surrendering an EA for a resource activity involves submitting an EA surrender application³ to the administering authority for assessment and decision. If the EA holder never carried out the relevant activity, the surrender application be supported by enough information to allow the administering authority to decide the application and a declaration stating that the activity was not carried out.

If the activity was carried out, the surrender application can be progressed:

- once all EA conditions have been complied with⁴; and
- where a progressive rehabilitation and closure plan (PRCP) schedule does not apply, the land has been satisfactorily rehabilitated, or a transitional environmental program has been approved to ensure the land will be satisfactorily rehabilitated; and
- where a PRCP schedule applies, all rehabilitation milestones and management milestones under the schedule have been met⁵; and
- the administering authority is satisfied of any other circumstance prescribed under a regulation for section 269 of the EP Act.

The surrender application must also be supported by a compliance statement, the fee prescribed by regulation and enough information to allow the administering authority to decide the application. This will include information about rehabilitation, monitoring, consultation, as well as the residual risk assessment and outcomes.

The information required to be considered at surrender can be broadly separated into two main components:

- information on the rehabilitation that has been carried out; and
- information on any future management or potential remedial requirements due to residual risks of the land.

The exact documents required to be submitted at surrender depend on whether a PRCP schedule exists for the EA or not, as PRCP schedules already contain detailed information on the final rehabilitation outcomes sufficient to enable the consideration of rehabilitation. Where a PRCP schedule applies, the EA holder only needs to provide a post-surrender management report (ESR/2020/5434) with their surrender application.

If a PRCP schedule does not exist and the EA contains conditions about rehabilitation, the EA holder must provide a 'final rehabilitation report' (ESR/2015/1616) and a post-surrender management report (ESR/2020/5434) with their surrender application.

³ Application for surrender or partial surrender of an environmental authority for a resource activity (ESR/2015/1751)

⁴ Unless Section 269(2) applies to part or all of the disturbance under the environmental authority

⁵ Unless Section 269(2) applies to part of all of the rehabilitation requirements under the PRCP schedule

The post-surrender management report requires that a risk assessment of the land be carried out in compliance with this guideline. If the risk assessment of the land identifies ongoing management activities or potential remedial actions, and this guideline requires the estimated costs and expenses to be worked out in a stated way (see [section 3.1](#)), the risk management plan component of the post-surrender management report must also be completed.

The decision to approve a surrender application for an EA is the final step in the process for managing environmental risks under an EA for a resource activity. It represents the point in time where the administering authority has determined that the EA holder can demonstrate that they have complied with all relevant requirements, including the land being satisfactorily rehabilitated where the activity has been carried out. The administering authority must consider the management of any residual risk associated with the land that may be required after surrender as part of the approval of the EA surrender application.

Where the administering authority considers that residual risks will remain on the land post-surrender, it may require the EA holder to provide a payment for those residual risks. Under section 272 of the EP Act, the decision to require a residual risk payment can only be made if it is justified to do so, having regard to:

- a) *the degree of risk of environmental harm likely to happen if the land the subject of the surrender application is managed as required under the EP Act and instruments made under it; and*
- b) *the likelihood of action being needed to:*
 - i. *reinstate rehabilitation that fails to establish a safe, stable and self-sustaining ecosystem; or*
 - ii. *maintain environmental management processes needed to protect the environment; or (e.g., plugging a GHG well that is found to be leaking GHG into an overlying aquifer); or*
 - iii. *restore the environment because of environmental harm resulting from the relevant resource activity for the EA (e.g., pumping contaminated water to the surface for treatment).*
- c) *the cost of likely action in comparison with the cost of best practice environmental management of the similar use of land that has not previously been affected by the activities.*

If a payment is justified after considering the above criteria, the administering authority will then decide the amount and form of residual risk payment that is required. Under section 273 of the EP Act, the amount cannot be more than what the administering authority considers to be the likely management costs of the land (i.e., all likely costs and expenses that may be incurred in carrying out the ongoing management activities, and remedial actions should the identified credible risk events occur).

Note: If the administering authority decides to approve the surrender application and a residual risk payment is required, the surrender decision does not take effect until the EA holder has complied with the residual risk requirement by providing full and timely payment.

2.1 Final rehabilitation report

The final rehabilitation report is required if the EA contains conditions about rehabilitation and a PRCP schedule does not apply for the relevant resource activity. The final rehabilitation report

provides the administering authority with the information needed to determine if the rehabilitation is safe, stable and will not cause environmental harm.

The final rehabilitation report (ESR/2015/1616) must include enough information to allow the administering authority to decide whether the EA holder has satisfactorily rehabilitated the land on which each relevant activity was carried out in compliance with the conditions of their EA.

The final rehabilitation report must also state details of:

- the monitoring program and results of monitoring rehabilitation indicators required under any condition of the EA; and
- any consultation with affected stakeholders about any completion criteria for rehabilitation stated in the EA.

The guideline: ***Final rehabilitation report for resource activities (ESR/2016/1874)*** contains further information about the requirements for the final rehabilitation report.

2.2 Post-surrender management report

If a resource activity was carried out on the land, the post-surrender management report (ESR/2020/5434) must accompany the surrender application and include all the information prescribed under section 264A of the EP Act. Section 264A of the EP Act requires that a post-surrender management report be made in the approved form and:

- include a map of the land showing where the resource activities were carried out and all remaining site features of the land; and
- state whether the land is included in an environmental management register or the contaminated land register; and
- state whether a site management plan exists for the land; and
- state any assumptions made in relation to the rehabilitation or future use of the land; and
- include a risk assessment of the land that complies with this guideline; and
- in certain circumstances, include a risk management plan for the land.

The post-surrender management report will be placed on the administering authority's public register at the time the surrender is recorded.

If the relevant activity was carried out on the land, an assessment of residual risks must be completed by the EA holder in order for the surrender application to be a valid application. This risk assessment must be undertaken in compliance with this guideline. Note that the requirement to provide a post-surrender management report does not necessarily mean that the resource site will be required to make a residual risk payment or complete a risk management plan.

2.2.1 Risk management plan

The risk management plan component of the post-surrender management report must be completed if the risk assessment of the land identifies that ongoing management activities or remedial action may be required for the land. This guideline requires the estimated costs and expenses to be worked out in a stated way.

The purpose of the risk management plan is to provide the administering authority, other relevant government agencies, and future landholders with sufficient information on the residual risks remaining on the land. The risk management plan must also include the

estimated payment amount, worked out in accordance with this guideline, to be provided to the Queensland Government to manage residual risks post-surrender.

Although the EA holder must provide an estimated payment amount in the risk management plan, the administering authority is ultimately responsible for deciding the amount and form of residual risk payment required (see sections 271-273 of the EP Act).

Section 264A(2) of the EP Act requires that the risk management plan be provided in the approved form and include the following:

- a) *spatial information about the site features of the land, including the location, size and type of the features; and*
- b) *details of the consultation with affected owners and occupiers about—*
 - i. *any assumptions made in relation to the rehabilitation or future use of the land; and*
 - ii. *the remedial action and ongoing management activities that may need to be carried out in relation to the land; and*
- c) *a statement of any assumptions made in relation to the remedial action or ongoing management activities that may need to be carried out in relation to the land; and*
- d) *an activity schedule outlining details of any remedial action or ongoing management activities that may need to be carried out in relation to the land; and*
- e) *if a site management plan under chapter 7, part 8 for any part of the land provides for carrying out activities that are the same, or substantially the same, as remedial action or ongoing management activities mentioned in the activity schedule—details of how those activities are to be carried out and managed in perpetuity; and*
- f) *the estimated amount of costs and expenses that may be incurred in carrying out remedial action or ongoing management activities mentioned in the activity schedule, worked out as stated in the residual risk assessment guideline.*

2.2.2 Noting on title

Section 275B of the EP Act provides the process for recording and removing residual risk noting's on the land title. Where an EA is successfully surrendered and the application included a risk management plan, an administrative advice notice will be made on the relevant land title(s). The noting will remain on the land title for as long as the residual risks exist on the land.

This noting on title ensures current and prospective landholders are made aware, through a title search, that ongoing management and remedial actions may be required to be carried on the land. It will also advise current and prospective landholders of where further information regarding residual risks associated with the land can be obtained (i.e., by accessing the post-surrender management report from the public register maintained by the administering authority). This information is also likely to be helpful to third parties, such as tenants, mortgagees, and local governments.

2.3 Contaminated land framework and the residual risk framework

The contaminated land provisions must be considered independently of the residual risk requirements in the EP Act. The residual risk framework has some similarities to the contaminated land framework. For example, both frameworks have a requirement for information to be available on the relevant register and can require that an administrative advice note be made on the relevant land title in certain circumstances.

There are some differences between the two frameworks. Under the contaminated land framework if a site management plan exists for the land, the landholder must comply with that plan. In the case of residual risks, if a risk management plan existing for the land, the activities for the most part will be managed by the State. The residual risk framework has been designed so that owners or occupiers of the land are made aware of the residual risk activities likely to be associated with the land in future.

This occurs through a range of requirements in the legislation. If a risk management plan is being developed in response to the residual risk assessment, the owner or occupier must be consulted, and the final post surrender management report must be provided to owners and occupiers. The report includes details on the rehabilitation as well as assumptions about that rehabilitation, such as the exclusion of people or animals from certain areas. These requirements will ensure that the current owner or occupier are aware of any residual risks.

In terms of any future owners or occupiers, there is also a note on title made when a risk management plan exists, which is searchable in Queensland's (lands) Titles registry. In this way, when undertaking their due diligence, any possible future owners or occupiers can determine the rehabilitation that has been undertaken, any infrastructure remaining, what and where the site features are, and what the relevant management activities are. The post-surrender management report is a public document and will be available on the administering authority's public register.

To ensure there is an understanding of the total effect of both frameworks at surrender, the post-surrender management report asks whether details of the land are included on the environmental management register or contaminated land register and whether a site management plan exists for the land. If a site management plan does exist, the EA holder must state any potential overlaps in management activities, roles and responsibilities between the site management plan and post-surrender management report and describe how these overlaps will be managed.

In the event that the two plans require management of the same structure or area, both plans need to be clear and specific about what activities are required and who is responsible for what. If the residual risk assessment has determined activities and costs for managing the residual risks of the land in future (e.g., maintenance of safety fencing), those activities should be listed in the risk management plan for management by the Queensland Government. If the site feature is captured under the contaminated land framework and the residual risk assessment did not include consideration of that feature (e.g., because the ownership of the site features is to be transferred from the resource company to the landholder) or there is a general obligation associated with the contaminated site feature (e.g., do not dig, maintain top soil), these activities should be listed in the site management plan and are the responsibility of the landholder.

2.4 Overlapping areas and the residual risk framework

Section 269(1) of the EP Act prescribes restrictions placed on the administering authority when deciding whether to approve a surrender application for an EA. The restrictions primarily relate to compliance with rehabilitation requirements and meeting the conditions of the EA. Section 269(2) of the EP Act, however, prescribes exceptions to these restrictions whereby the administering authority may approve a surrender application for an EA that relates to land in an overlapping area⁶ if—

⁶ Section 104 of the *Mineral and Energy Resources (Common Provisions) Act 2014* defines the term overlapping area.

- a) *the administering authority is satisfied compliance with a rehabilitation condition of the environmental authority, or a PRCP schedule, is impossible or impractical due to the carrying out of an overlapping prescribed resource activity in the area; and*
- b) *an environmental authority or PRCP schedule for the overlapping prescribed resource activity has been amended to include a condition equivalent to the rehabilitation condition of the environmental authority to be surrendered.*

Although section 269(2) of the EP Act prescribes exclusions to the restrictions placed on the administering authority when giving approval, the EA holder must still meet all other legislative requirements relevant to their activity. They will need to provide information in the final rehabilitation report which provides the basis for this exception and provide a compliance statement that describes the extent to which the conditions have been complied with.

With regards to residual risk, the overlapping area(s) must still be referenced in the post-surrender management report under section 264A(1)(d) to explain why the area(s) has not been rehabilitated (e.g., the “assumption” is that the area will be rehabilitated as part of the rehabilitation and closure process for the overlapping prescribed resource activity). However, because the overlapping area has not been rehabilitated in line with the relevant requirements, it will not be subject to a residual risk assessment under this guideline.

3 Quantitative risk assessment method

Under the surrender framework, EA holders who have carried out a resource activity on the land are required to provide the administering authority with a risk assessment of the land. The purpose of the risk assessment is to determine whether any residual risks are likely to require ongoing management activities or remediation following surrender on the EA. This guideline outlines the quantitative risk assessment method that **must** be used by EA holders to meet the risk assessment requirement in section 264A (1)(e) of the EP Act.

A quantitative risk assessment method uses factual and measurable data to assign a numerical value to individual risks. This allows the results to be compared across risks that are highly variable, and which may be completely unrelated. Where the numerical information includes costs, this method also allows the outcome to be used to determine the residual risks payment.

A quantitative risk assessment must be used to assess whether there are any remaining risks on the land that need to be considered and, if there are, determine the actions and activities that may need to be undertaken to manage those risks, and a corresponding payment amount.

This method will ensure that residual risks are consistently assessed and documented across the Queensland resource sector. The quantitative risk assessment method prescribed by this guideline involves the following five steps (outlined in [Figure 4](#) below):

1. Determine the source of the risk (i.e., site features remaining)
2. Identify all credible risk events for the site
3. Identify and apply relevant risk treatments (i.e., ongoing management activities)
4. Identify potential remedial actions based on material credible risk events
5. Estimate the residual risk costs and expenses for the land being surrendered (if any).



Figure 4: Flowchart showing the five main steps involved in the quantitative risk assessment method

3.1 Residual risk assessment options

The resource industry in Queensland is large and diverse in terms of individual activities and the areas they cover. Activities range from large, highly complex resource activities through to relatively small exploration activities.

To reflect the diversity of the resource industry in Queensland, four risk assessment options have been developed to support EA holders to assess their residual risks ([Table 1](#)). All risk assessment options use the quantitative risk assessment method and are underpinned by the calculator. The options have been designed to maximise consistency and minimise administrative burdens where possible for both the resource industry and the Queensland Government.

EA holders must choose a risk assessment option that is applicable to their site. For example, if an EA holder meets the requirements for the pre-assessed risk option, they can select that option or any of the other risk assessment options available. However, if an EA holder does not meet the requirements for the pre-assessed risk option, they are only able to select the calculator or expert panel options.

In certain circumstances, the pre-assessed risk option and the calculator may be unable to consider all the relevant residual risks on a site or to adequately consider the site-specific aspects of some risks. The calculator is limited in its ability to consider large or complex sites, particularly where there are interactions or interrelationships between individual site features which will impact the assessment of likelihood or consequence of credible risk events associated with the features. Where certain parts of the land cannot be reflected in the calculator, the expert panel process must be used to ensure that residual risks are accurately assessed for the land the subject of the surrender application.

EA holders may use a combination of the calculator and the expert panel if they choose, provided such an option allows for all residual risks of the land to be adequately identified, assessed and costed. For example, the EA holder may choose to have one or more site features assessed by the expert panel and the remainder assessed by the calculator. This guideline recommends the type of resource site that the option is best suited to each risk assessment option in Table 1 below.

Table 1: Overview of the residual risk assessment options

Risk assessment options	Sites that can use this option	Effort to prepare risk assessment
Pre-assessed risk Described in section 3.2 of this guideline. This option includes a range of low-risk activities that have been pre-assessed using the residual risk calculator. This option <u>does not</u> require EA holders to work out the estimated costs and expenses in a stated way as this has already been completed.	Site features that align with one of the specified pre-assessed risk categories in section 3.2.	Low (e.g., match site features against a specified risk category. Provide evidence to support this selected option).
Residual risk calculator Described in section 3.3 of this guideline. This option relies solely on the use of the calculator. If residual risks are identified through this risk assessment option, the EA holder must work out the estimated costs and expenses in a stated way (i.e., in compliance with this guideline).	Sites with remaining site features that can be adequately assessed by the calculator. Also, for sites that are unable to satisfy the requirements of the pre-assessed risk option. (Not suitable for geothermal energy & GHG storage activities – see section 3.1.1 below).	Medium (e.g., include detailed, specific data on each site feature remaining on the land at surrender. Provide sufficient evidence to support the output and reports provided).
Expert panel Described in section 3.4 of this guideline. This option uses a panel of experts to assess the residual risks of the land being surrendered. It uses the residual risk calculator as a reference point during the assessment, but the assessment is not restricted by the calculator. If residual risks are identified through this risk assessment option, the EA holder must work out the estimated costs and expenses in a stated way (i.e., in compliance with this guideline).	Any resource site being surrendered.	High (e.g., in addition to the requirements for the residual risk calculator, EA holders will need to provide detailed evidence from the expert panel, as necessary to support the outputs and reports provided).
Combination of expert panel and residual risk calculator This option uses the expert panel to assess certain site features of the land and the calculator to assess all other risks of the land. The calculator is described in section 3.3 of this guideline and the expert panel is described in section 3.4 of this guideline. If residual risks are identified through this risk assessment option, the EA holder must work out the estimated costs and expenses in a stated way (i.e., in compliance with this guideline).	Sites with certain site features that can be adequately assessed by the calculator, but that have others site features that require assessment via the expert panel process.	Medium to High (e.g., in addition to the requirements for the calculator, EA holders will need to provide detailed evidence where appropriate, using peer reviewed documentation).

3.1.1 Geothermal and greenhouse gas storage activities

The calculator has been developed to assess the residual risk associated with the mining and petroleum and gas industry. **Geothermal energy and GHG storage activities must use the expert panel process to satisfy the residual risk assessment requirement in the EP Act.** Using the expert panel option will ensure all residual risks are adequately assessed and costed prior to surrender of the EA. Information about the expert panel option can be found in [section 3.4](#) of this guideline.

3.2 Pre-assessed risk

Pre-assessed risk is one of the residual risk assessment options available to certain EA holders. The primary purpose of this option is to streamline the risk assessment process for resource activities where it is possible to pre-assess the residual risk. This will reduce unnecessary administrative burden for both the resource industry and the Queensland Government.

The pre-assessed risk categories represent scenarios where the calculator produces a \$0 payment amount. To determine the categories, the administering authority used the calculator to assess the potential residual risks of a site that met the criteria in [Table 2](#) below and determined that these did not trigger ongoing management activities or potential remedial action (i.e., no residual risk requirements). **These are not the only scenarios that are likely to trigger a \$0 payment amount.**

Under this option, as no remedial action or ongoing management activities have been identified through the risk assessment, a risk management plan is not required to accompany the surrender applications.

The site must meet the stated criteria to be considered eligible for a pre-assessed risk category. In this case, there is no need to use any other method to determine residual risk, however EA holders are welcome to use other options if desired.

Table 2: Pre-assessed risk categories and criteria

Pre-assessed risk category	Criteria	Rationale	Risk category output
1	No site features remain on the land the subject of the surrender application.	Under the residual risk assessment process, site features are considered the source of residual risk. The risk assessment outcome for this land resulted in no residual risks likely to require management or remediation by the Queensland Government.	No residual risks have been identified for the land. EA holders are not required to complete a risk management plan for the land.
2*	20 or less mining exploration bores and wells plugged and abandoned. No buried pipeline. No other site features remain on the land.	The residual risk calculator was used to undertake a risk assessment of this surrender outcome. The risk assessment outcome for this land resulted in no residual risks likely to require management or remediation by the Queensland Government.	No residual risks have been identified for the land. EA holders are not required to complete a risk management plan for the land
3*	80 or less conventional and other non-conventional P&G plugged and abandoned bores and wells. No buried pipeline. No other site features remain on the land.	The residual risk calculator was used to undertake a risk assessment of this surrender outcome. The risk assessment outcome for this land resulted in no residual risks likely to require management or remediation by the Queensland Government.	No residual risks have been identified for the land. EA holders are not required to complete a risk management plan for the land
4*	100 or less CSG plugged and abandoned bores and wells. No buried pipeline. No other site features remain on the land.	The residual risk calculator was used to undertake a risk assessment of this surrender outcome. The risk assessment outcome for this land resulted in no residual risks likely to require management or remediation by the Queensland Government.	No residual risks have been identified for the land. EA holders are not required to complete a risk management plan for the land

**Note these categories cannot be selected by an EA holder if any site features, other than those listed as acceptable (in the criteria for the pre-assessed risk category), remain on the land. See [Section 4.1.1](#) of this Guideline for more information about how to determine what site features remain on the land.*

3.3 Residual risk calculator

The **Residual Risk Calculator (ESR/2022/6069)** is recommended for all resource sites that can effectively use the calculator to assess the residual risk of the land (e.g., EA holders that do not have site features with complex interactions). The calculator is freely available for use, in a user-friendly format and provides a consistent, replicable and robust process that is suitable for most resource sites in Queensland. **The EA holder will be required to demonstrate that they have input all the relevant site features into the calculator and to provide supporting evidence to substantiate the selection of risk factors.**

The calculator provides the following:

- a site registration sheet that, amongst other things, identifies the site, authority numbers and automatically identifies the remoteness of a site, and its climatic zone based on local government area
- data input sheets where users identify the relevant site features and their risk factors for the land the subject of the surrender application
- an activity schedule that provides an overview of all the ongoing management activities and potential remedial actions required for the site, sorted by site features
- a credible risk event (CRE) register that shows all credible risk events identified for the land, the credible risk events occurrence cost and likelihood, the risk quotients and which credible risk events are above or below the threshold value⁷ (which determines whether they are included in the residual risk payment)
- an ongoing management cost summary that automatically identifies and costs likely post- surrender ongoing management activities for the site
- data outputs in the form of a summary sheet that show information such as the overall residual risk cost, the cost breakdown and a summary of the residual risk activities.
- a graphical representation of the site risk profile, which shows the credible risk events and their risk quotients with the threshold value applied.

The calculator relies on pre-determined levels of likelihood and consequence for risk factors that are typically associated with CRE's. These likelihoods and consequences have been informed by:

- knowledge of historical occurrences of the credible risk events
- the design specification of site features during operation and at the completion of rehabilitation and
- experience on the ground in undertaking activities to rehabilitate or remediate ex-resource sites.

The pre-determined likelihoods and consequences, as well as the threshold method, were validated by experienced operators from the resource industry to ensure the outputs were both reasonable and consistent.

The ***Residual Risk Calculator User Manual (ESR/2022/6072)*** provides guidance on how to use the calculator and should be used when carrying out a risk assessment of the land under this option.

3.4 Expert panel

The expert panel option is provided as an alternative and separate option to the calculator and is available to all resource EA holders. The expert panel allows for a site-specific assessment of the land (e.g., cost rates may be varied from those in the calculator if applicable and supporting evidence is provided). It is advised that the expert panel use the rates and risk values in the calculator as a baseline for their assessment. The expert panel process is not constrained by these rates or values as this process is typically bespoke and tailored to the particular site being assessed, however, adequate justification should be provided if deviations or adjustments are made to support the assessment.

⁷ A detailed overview of the threshold method can be found in Appendix 1.

Assessing the residual risks of sites through the expert panel process has many benefits including for example, providing the ability to consider risks where site features overlap and interact. If EA holders are able to select other risk assessment options, the benefits of an expert panel should be considered alongside the potential drawbacks, such as the time and costs associated with running it.

The expert panel must use the quantitative risk assessment method prescribed in this guideline to carry out the risk assessment of the land.

It is recommended that the expert panel use the calculator rates and risk values as a baseline (e.g., pre-determined likelihoods and consequences for credible risk events) and provide justification where adjustments or deviations are made to support the assessment.

The expert panel will then consider the site-specific aspects of the land to precisely calculate the residual risks for the site.

The expert panel risk assessment option follows the process outlined in [Figure 5](#). Following that process in line with this guideline will enable the expert panel to consistently assess risks across different sites. The detail discussed within individual expert panel processes will, of course, be tailored to the resource site being assessed.

EA holders may use a combination of the calculator and the expert panel if they choose, provided such an option allows for the residual risks of the land to be adequately identified, assessed and costed.

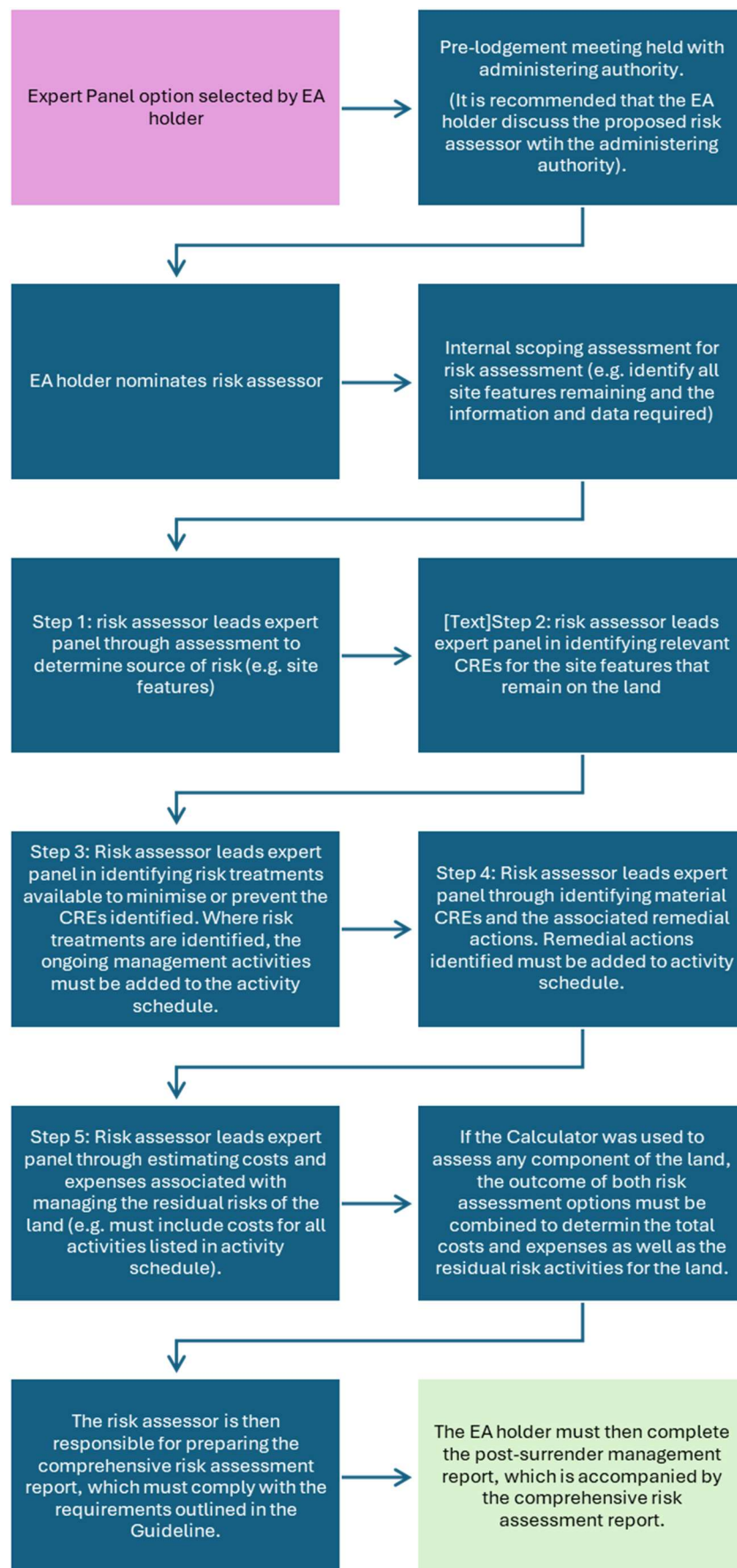


Figure 5: Expert panel risk assessment process

3.4.1 Following the quantitative risk assessment method

The expert panel process uses the same risk assessment method as the calculator (see [Figure 6](#)). In both cases, the EA holder is responsible for providing key sources of information about site features remaining on the land, which may include identifying site personnel with knowledge of the site feature. In the case of the expert panel, a risk assessment specialist (risk assessor) will use the information provided by the EA holder about the site to carry out the risk assessment of the land. When considering the residual risks of specific site features, the risk assessor will follow the quantitative risk assessment method prescribed in this guideline as well as being able to use the calculator as a reference point throughout the assessment.

Following the quantitative risk assessment method, the expert panel process will also result in an estimate of the costs and expenses that may be incurred in carrying out the ongoing management activities and potential remedial actions for the land. The outputs of the risk assessment process will include a comprehensive residual risk report certified by the risk assessor (see [Section 3.5.1](#)) with all required supporting information. This will be provided to the EA holder to submit as part of the post-surrender management report.

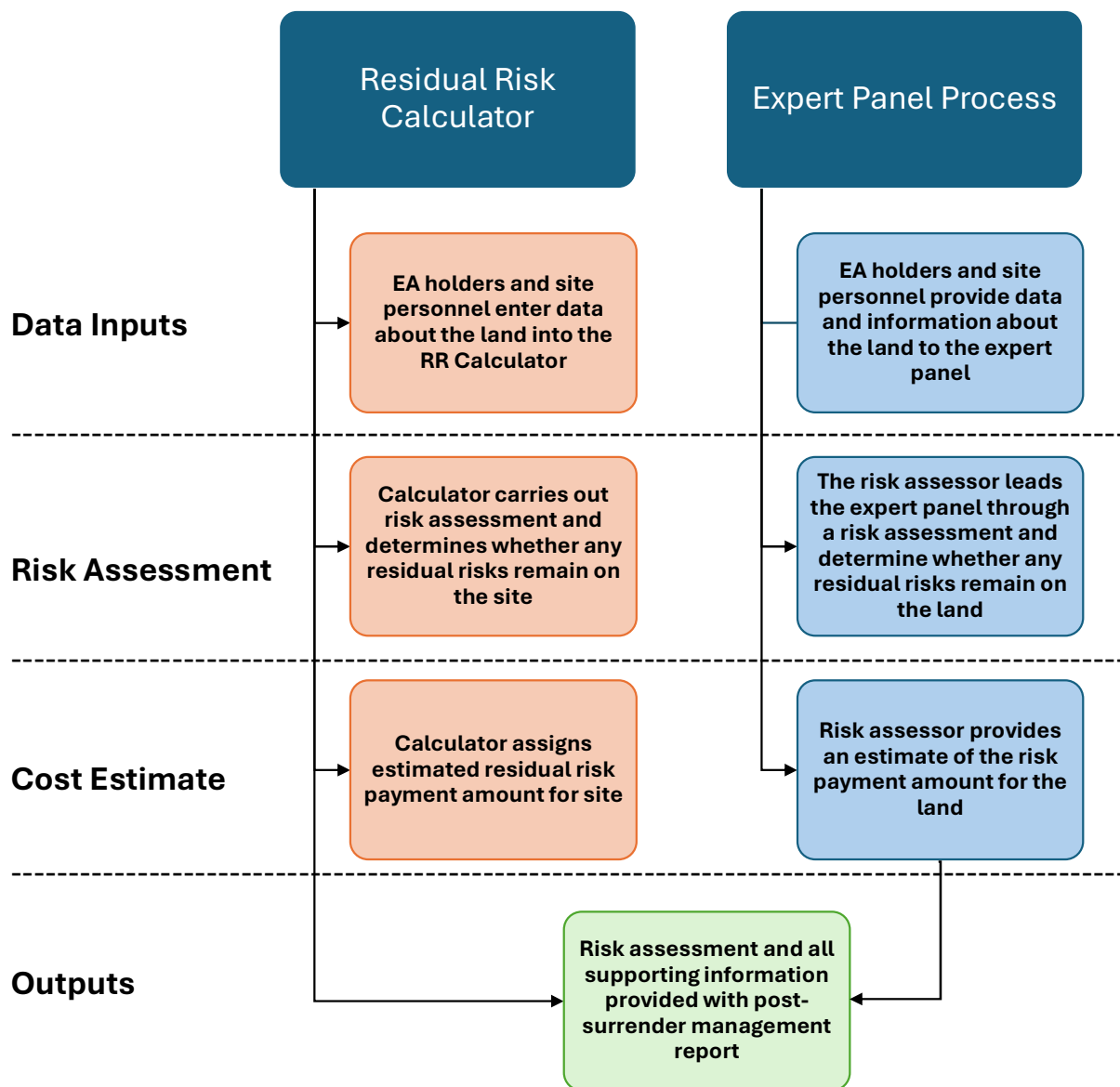


Figure 6: Flowchart showing the analogous steps between the calculator process and the expert panel process.

3.4.2 When to use an expert panel

EA holders may use the expert panel process at any time. For example, where there is an interrelationship between the individual risks of different site features that reduces risks and the calculator cannot fully reflect that circumstance (e.g., where an open void captures a waste rock emplacement's run-off, which affects certain risk factors).

EA holders must use an expert panel process if the calculator cannot adequately assess the residual risks of the land. This includes sites such as those that have greenhouse gas storage activities or for a geothermal activity because consideration of risks specific to these two resource activities were not considered during the development of the calculator.

In exceptional circumstances, the administering authority may advise that an expert panel is necessary for part or all of the land due to the complexity, scale or nature of the site or because it considers it to be necessary to ensure public confidence in the outcomes of the assessment.

EA holders may choose to select the expert panel option for their site if they do not wish to use the calculator to carry out the residual risk assessment of the land. An EA holder may also choose to use an expert panel to examine only particular site features and use the calculator to assess the rest of their site. Where this happens all parts of the assessment must be collated and provided in the comprehensive residual risk report prepared by the risk assessor.

3.4.3 Assurance of panel-to-panel consistency

To ensure consistency across separate expert panel processes, this guideline sets out a process and a number of mandatory elements which must be met.

The expert panel must use the calculator as a reference point from which any variations can be compared during the risk assessment. This means that the expert panel should aim to consider the same parameters (e.g., remoteness, sensitive receptor or infrastructure, environmental sensitivity) and use the same information (e.g., likelihoods and consequences for credible risk events and site feature risk factors) as the calculator, unless justification can be provided as to why such components were changed.

The panel members selected must meet the criteria prescribed in this guideline for their roles (see [section 3.4.5](#)). The risk assessor must ensure the panel has a balance of expertise and experience and ensure that no one panel member unduly influences the assessment outcome. The risk assessor is responsible for preparing the comprehensive residual risk report.

3.4.4 The EA holder's responsibilities

The EA holder is responsible for ensuring that all relevant legislative provisions relating to the surrender application are complied with. This includes all relevant documents associated with the surrender application (e.g., ensuring that the comprehensive residual risk report includes an assessment of all the relevant site features the subject of the surrender).

The EA holder is responsible for all the following:

- Understanding the process and obligations of the expert panel process, which may necessitate discussing the process with a departmental representative.
- Appointing an independent risk assessor who meets the suitability criteria and can comply with the professional behaviours prescribed in this guideline.
- Providing the risk assessor with the reports, documents, data, evidence, and access to personnel as required by the risk assessor.
- Submitting the unaltered outcomes of the expert panel assessment (i.e., the comprehensive residual risk report) as part of the post-surrender management report.
- Making the final decision on the content, and completing, the post-surrender management report.
- All costs associated with the expert panel process.

In submitting the surrender application, the EA holder will be required to state the extent to which the post-surrender management report is accurate. The post-surrender management report requires the EA holder to make a declaration stating that the information being provided is true and correct to the best of their knowledge.

3.4.5 Composition and roles of the expert panel

The expert panel process must be led by an independent risk assessor, who is appointed by the EA holder. The risk assessor is responsible for making sure that the composition of the panel provides the assessor with all necessary information and expertise so that the comprehensive residual risk report is complete in terms of the information considered and presented, meets current professional standards and is not false or misleading in any respect. It is critical that expert panel members perform their duties in an open and honest manner, without prejudice.

The expert panel may also include anyone the risk assessor considers necessary to ensure the comprehensiveness and adequacy of the assessment, including but not limited to:

- personnel with knowledge of the site features of the land being assessed; and
- independent technical advisors.

The risk assessor may request evidence from sources that are not part of the expert panel in order to inform deliberations of the expert panel (e.g., the administering authority, landholders, local government, other experts).

The expert panel members' roles are explained in more detail below.

3.4.5.1 *Independent risk assessor*

The risk assessor plays a critical role in an expert panel process. The risk assessor can be one or more people, however, the risk assessor(s) must remain the same throughout the expert panel process. The risk assessor must have specific risk assessment experience.

3.4.5.2 *Risk assessor's role*

The risk assessor's primary role is to lead the expert panel process and prepare the comprehensive residual risk report. The risk assessor must comply with the quantitative risk assessment method prescribed in this guideline when carrying out the residual risk assessment of the land. In setting up the expert panel, the risk assessor(s) will be required to:

- ensure a Chair is available to facilitate the expert panel process (note the risk assessor is also generally the Chair); and
- scope the risk assessment exercise (e.g., determine what site features are to be assessed and the panel members required to carry out the risk assessment successfully); and
- select independent technical advisors with suitable qualifications, experience and competency where the risk assessor requires additional information, expertise or advice.

As the expert panel discussions may over time reveal further risk events that require additional expertise, new panel members may need to be located and added to the panel throughout the process. The risk assessor must ensure the technical disciplines and experience of panel members cover the full range of expertise that is necessary to comprehensively undertake the risk assessment.

The risk assessor will work with the expert panel to:

- use the calculator as a reference point to inform the risk assessment
- identify potential sources of residual risk
- describe and quantify the residual risks of the land, including obtaining relevant information from a wide variety of sources to ensure the risk assessment is well informed
- identify any likely ongoing management activities or potential remedial action that may need to be carried out in future to manage the residual risks of the land, and
- provide an estimated amount of the costs and expenses that may be incurred in carrying out the remedial action or ongoing management activities mentioned in the activity schedule.

The risk assessor is required to prepare a comprehensive residual risk report reflecting the outcomes of the panel (see [section 3.5.1](#)). To maintain the integrity and independence of the expert panel, the risk assessor must meet the suitability criteria and exhibit the required professional behaviours prescribed in this Guideline.

It is recommended that the administering authority be consulted on the proposed risk assessor prior to commencing the expert panel process to ensure the criteria prescribed in this guideline can be met.

3.4.5.3 *Suitability criteria*

The risk assessor must meet all the following **suitability criteria**:

- Experience with facilitating complex risk assessment processes.
- Relevant qualifications for performing resource sector risk assessments.
- Familiarity, or the ability to acquire familiarity, with the quantitative risk assessment method set out in this guideline.
- Technical and/or assessment experience with the site features (or similar site features) being assessed.
- Membership of a relevant professional regulatory or industry body.
- Has not committed an offence under the EP Act 1994.
- Has not committed an offence under any other Act involving misleading or fraudulent conduct.
- Does not have, or could not reasonably be perceived to have, a **conflict of interest**.

A **conflict of interest** could arise through a financial interest in, or business association with, the land or an entity owning, developing or investigating the land. The risk assessor cannot be an employee of the same company, nor can one be a subcontractor to the other or their employer/company. However, a contract between the risk assessor and the EA holder to perform the risk assessment is not a business association that in itself creates a conflict of interest.

While experience and expertise in the relevant resource industry is highly desirable for the risk assessor, it is not mandatory. The risk assessor must provide evidence of their qualification(s), experience and membership(s) with the comprehensive residual risk report.

3.4.5.4 *Professional behaviours*

The risk assessor must exhibit all of the following professional behaviours when undertaking the risk assessor's functions:

- Act independently with integrity, diligence, and impartiality.
- Perform using current best practice and in accordance with the current State and Commonwealth legislation, policies and guidelines and Australian Standards.
- Be objective and honest.
- Avoid misrepresentation and prejudice.
- Not conceal or omit information so as to mislead opinion about the land being assessed.
- Provide advice only on matters based on qualifications or experience and obtain advice from independent technical experts for all other matters.
- Ensure where experts' opinions are relied on, that they have the qualifications, experience and competencies in the field of specialisation they are providing advice on.
- Ensure that all independent technical advisors also act independently and have no conflicts of interest.
- Take reasonable and practicable measures to verify another's opinion on which the risk assessor relies, and the data and information the other's opinion is based on.
- Avoid speculation in any written report and clearly distinguish any conjecture from matters that are firmly based on evidence.
- Not accept gifts or benefits that a reasonable person may see as an inducement to affect the outcome.
- Act in accordance with all relevant common law duties and responsibilities e.g., exercising due care.

3.4.5.5 *Personnel with knowledge of the site features being assessed*

A residual risk assessment requires a good understanding of the site features that will remain on the land following surrender. People employed by the EA holder that have designed, established or maintained the rehabilitation and structures on site are likely to be best placed to provide information on the site features of the land being assessed (hereafter site experts). They will primarily play an information-sharing and advisory role.

Site experts should be selected based on their expertise on the specific site features being assessed by the expert panel. They do not necessarily need to be experts in, or even familiar with, the quantitative risk assessment method.

Site experts must be objective and honest and avoid misrepresentation and prejudice when participating in the expert panel. Site experts must not conceal or omit information so as to mislead opinion about the residual risks of the land. Site experts should only provide advice on matters for which they are suitably qualified, experienced and competent.

3.4.5.6 *Independent technical advisors*

An independent technical advisor is any person the risk assessor deems necessary to support the risk assessment process. In scoping the risk assessment, the risk assessor should determine

whether independent technical advisors may be necessary, and if so, which specialisations are required. The role of independent technical advisors will generally include contributing their technical opinion to the assessment of likelihoods and consequences of the credible risk events and risk treatments relevant for the site features being assessed by the expert panel. For example, a geotechnical engineer may be asked to provide advice on the likelihood of a particular process waste emplacement failing and/or the cost of remediating the failure if it were to occur.

Independent technical advisor(s) should be selected by the risk assessor to ensure an appropriate level of technical advice to support a robust consideration of all residual risks as well as freedom from conflict of interest.

3.4.5.7 *Professional behaviours*

Independent technical advisors must abide by all the following professional behaviours when participating in the expert panel process:

- Act independently with integrity, diligence, and impartiality.
- Perform using current best practice and in accordance with the current State and Commonwealth legislation, policies and guidelines and Australian Standards.
- Be objective and honest.
- Avoid misrepresentation and prejudice.
- Not conceal or omit information so as to mislead opinion about the residual risks of the land.
- Provide advice only on matters in which qualifications, experience and competencies are possessed.
- Not accept gifts or benefits that a reasonable person may see as an inducement to affect the outcome (this constitutes a clear conflict of interest).
- Act in accordance with all relevant common law duties and responsibilities e.g., exercising due care.

Independent technical advisors may not be required to participate in every expert panel process. Their involvement should occur where the EA holder, risk assessor or the administering authority consider it desirable or necessary.

3.5 Outputs of the expert panel process

Full documentation of the expert panels' findings is required. To ensure consistency between the risk assessment options outlined in this guideline, the required outputs of the expert panel process will be similar to the outputs of the calculator. The administering authority will make available to the expert panel, templates and forms that must be used to present the required outputs.

The risk assessor is required to provide:

- the relevant **outputs of the calculator** for all site features assessed through the calculator
- a comprehensive **residual risk report** (certified by the risk assessor) that provides the evidence to support the inclusion of, or changes to, any site features, risk factors, credible risk events, remedial action or ongoing management requirements from that in the calculator.

3.5.1 Residual risk report

The comprehensive residual risk report **must** include the details of all the deliberations of the expert panel, including but not limited to:

- the specific site features considered
- a statement of any assumptions made in relation to the remedial action or ongoing management activities that may need to be carried out in relation to the land
- the site-specific risk factors and parameters considered for each site feature
- risk quotients, likelihoods and consequential costs for all credible risk events identified
- the basis for any deviation from what the calculator would produce for the same assessment
- explain and justify how decisions relating to, and including, the residual risk assessment were arrived at
- any evidence and other material on which the findings were based
- details of the expert panel members, including their qualifications, experience, competencies and scope of works on the expert panel
- identification of which expert opinions were considered in each aspect of the risk assessment, particularly where outcomes were based on another expert's opinion rather than the risk assessor.
- any other matters considered by the expert panel

The comprehensive residual risk report should also include a proposed:

- **activity schedule** outlining details of any ongoing management activities or potential remedial action that may need to be carried out in relation to the land (this should be categorised by site feature)
- **credible risk event register**, which shows all the credible risk events identified for the site and highlights the credible risk events that are above the state-wide risk threshold
- **estimated amount of the costs** and expenses associated with carrying out the ongoing management activities and potential remedial action (as per the activity schedule) and the total estimated residual risks payment amount.

3.5.2 Statutory Declaration

After preparing the comprehensive residual risk report, the risk assessor(s) must provide a **statutory declaration** that accompanies the report stating all of the following:

- the person's qualifications and experience relevant to the function
- the person has not included information that is false, misleading or incomplete or that the person ought reasonably to have known was false or misleading in the document
- the person has not failed to include or reveal any relevant information or document
- the person does not have, or could reasonably be perceived to have, a conflict of interest
- the document addresses the relevant matters for the function and is factually correct
- the risk assessor's opinions expressed in the document are honestly and reasonably held.

The EA holder cannot modify the comprehensive residual risk report prepared by the risk assessor(s). If the EA holder disagrees or is dissatisfied with any substantial part of the report, they must refer the matter back to the risk assessor who produced the document. If, after the matter is referred back to the risk assessor, the EA holder is still not satisfied, the EA holder may choose to include a statement outlining any concerns with their surrender application (e.g., in the compliance statement under section 262(2)(b)(iii) of the Act outlining the extent to which the report is accurate.

Where part of the assessment is undertaken by the expert panel, and the rest is via the calculator, all parts of the assessment must be collated and presented within the comprehensive residual risk report. All outputs and supporting information from the expert panel process must be included in the post-surrender management report, which accompanies the surrender application for an EA.

3.5.3 Funding the expert panel

The EA holder is responsible for all costs and expenses associated with the expert panel. This includes all costs and expenses associated with hosting the expert panel and the travel and logistics of all expert panel members. The risk assessor works independently, notwithstanding that they are engaged by the EA holder of the land being assessed.

3.5.4 Privacy

As outlined above, the outcomes of the expert panel process including the comprehensive residual risk report and all necessary documentation and evidence will form part of the post-surrender management report. This report, as part of the surrender application, is on the public register and will be a publicly accessible document. The risk assessor may choose to deidentify advice and information from individual panel members or other sources if it is considered necessary.

3.5.5 False, misleading or incomplete documents

It is an offence under section 480 of the EP Act to give the administering authority, or an authorised person, false or misleading documents or documents the person ought reasonably to have known were false or misleading.

It is also an offence under section 480A of the EP Act for a person to give the administering authority or an authorised person a document that they know, or ought reasonably to know, contains incomplete information about a matter of significance.

The offences associated with providing false or misleading documentation and/or information carry significant penalties under the EP Act for both individuals and organisations. Such penalties can include imprisonment. For EA holders this could also include the suspension or cancellation of their registration as a suitable operator under the EP Act.

4 Carrying out the risk assessment

Regardless of which risk assessment option is selected, the risk assessment should start by carrying out an initial scoping assessment of the land. If the calculator is the chosen risk assessment option, this exercise will likely be carried out by the EA holder. If the expert panel is the chosen risk assessment option, this exercise is likely to be carried out by the risk assessor. The initial scoping exercise is likely to involve the following steps:

- identifying all site features that remain on the land and the components of the site that are most likely to fail
- considering the nature of the risks that may be present (e.g., geochemical and geotechnical)
- considering the factors that may affect the likelihood and consequence of the risks (e.g., presence of sulfidic material, climatic factors, proximity to sensitive receptor or infrastructure and environmental sensitivity).

After completing the initial scoping assessment, the EA holder or risk assessor should use the outcomes to help plan the risk assessment, including for example:

- the objective of the risk assessment
- information and data requirements needed to carry out the assessment
- the experts that need to be involved and their expected contributions and outputs
- the resources required to undertake the assessment
- the timing and location of the assessments
- proposed record keeping.

Note: If the calculator is used for the risk assessment, the relevant credible risk events, applicable risk factors, likelihoods, costs and risk quotients will all be automatically generated based on the site information inputted by the user.

4.1 Step 1: Determine the sources of risk

4.1.1 Site features

The assessment needs to determine what, if any, components of the rehabilitation are likely to fail. Sources of residual risk typically stem from features or facilities that remain on, or affect the behaviour of, the land post-surrender. These are called 'site features'.

Site features are defined in the EP Act as:

- surface and subsurface infrastructure on the land related to resource activities
- other structures on the land related to resource activities
- modifications of the land related to resource activities carried out on the land.

While the definition of site features in the EP Act is broad, the residual risk assessment process is not intended to capture all possible disturbance or activities that occurred on a resource site, only those that pose residual risks to the land after the EA has been surrendered. Where infrastructure exists during operations but did not cause a permanent change to the landform, has been completely removed and rehabilitated (e.g., processing facilities, temporary camps), it is generally accepted that there will be no source of residual risk needing to be managed post-surrender.

Site features that must be considered by the risk assessment include:

- process waste emplacements (e.g., tailings storage facilities, tailings storage facilities within waste rock dumps, gypsum stacks)
- waste rock emplacements (e.g., waste rock dumps, overburden dumps, heap leach pads, co-disposal tailings and waste rock)

- open voids/ pits (e.g., open cut pits, wholly or partially filled voids, box cuts and major burrow pits that required long-term geotechnical or geochemical considerations)
- underground voids/pits (e.g., all underground excavations and workings, voids that have been wholly or partially backfilled)
- water management structures (e.g., major drainage channels, bunds, levees, river diversions)
- water holding facilities (e.g., dams, ponds, evaporation ponds)
- waste facilities (e.g., landfills containing contaminated soils, solid salt storage)
- bores, wells and pipelines (e.g., plugged and abandoned petroleum and gas wells, mining exploration boreholes and buried pipeline).

These site features represent the range of features that are most likely to be associated with resource activities in Queensland. If any of the following, in whole or in part, remain on the land they must be considered during the risk assessment process: rehabilitated voids, waste rock emplacements, process waste emplacements, waste facilities, permanent water holding structures and plugged and abandoned bores and wells. These must be considered as these site features remain a permanent change to landform following rehabilitation and may require some form of management or remediation in future.

The above list of site features is not exhaustive. The list represents the minimum range and type of site features that must be considered (as far as they are relevant for the site being assessed). These are the list of features that are included in the calculator and the calculator cannot be modified to include others.

A note on site features to be used by owners or occupiers of land

Some site features can be valuable assets for owners or occupiers of land (e.g., water holding facilities). Conditions on an EA, or rehabilitation outcomes in a PRCP schedule, can allow for the retention of certain site features as part of the rehabilitated landscape. This can be achieved when setting the initial rehabilitation conditions or through amendment of the EA or PRCP schedule during the life of the resource activity.

Provided that:

- the owner has agreed in writing to the retention of the site feature and has accepted responsibility for the ongoing management activities and remedial actions associated with it (if required);
- the EA conditions or PRCP schedule expressly allows for the retention of the site feature for an ongoing use by the owner or occupier of land; and
- at surrender the site feature can be demonstrated as meeting the EA conditions.

Where it has been demonstrated that the owner of the land has accepted responsibility for the site feature (if required), it is not intended that the site feature would need to be included in the company's residual risk assessment. Evidence of meeting the above criteria should be included in the final rehabilitation report.

Please note separate approvals under the *Mineral Resources Act 1989* and/or local or State planning legislation may be required where certain site features are to be retained onsite after the surrender of the mining lease.

4.1.2 Considering risk sources and receptors

To consider the residual risks of these site features, the EA holder will need to identify and collate a range of data that will be used to consider the risk of each site feature. The type of information will depend on the site feature being assessed.

The risks of the site features generally reflect the nature of project design, operation and closure. In particular, the environmental controls incorporated into the design, operation and closure of the facilities and features remaining at the site post-surrender. In addition, external risk sources such as climatic conditions and seismic activity may also significantly influence risk. This is the type of information that needs to be used in making the assessment.

The risk assessment also needs information on the risk receptors (i.e., what may be impacted by a failure of rehabilitation). The assessment will therefore need information on the proximity to sensitive receptors such as houses, schools and hospitals; infrastructure such as roads; and environmentally sensitive areas as defined under legislation.

All of the above information is needed as the risk assessment must consider the risk factors associated with each site feature in order to determine whether a credible risk event will occur. Risk factors alone, or in combination, may give rise to a credible risk event.

For example, to consider the risks of a waste rock emplacement, process waste emplacement or void, the information will need to include biophysical information on the site and surrounding sensitive receptors or infrastructures and environmental sensitivity; the size and dimensions of each site feature and how each was constructed, when, what they contain; what is the history with regards to spontaneous combustion and water quality of any seepage etc.

For wells and bores the EA holder will need to know how many, of which type, when they were plugged and abandoned, and how far they are from a sensitive receptor or infrastructure, such as a landholder's groundwater wells, and environmental sensitivity.

EA holders should refer to the **Residual Risk Calculator (ESR/2022/6069)** for the list of relevant factors for each site feature and ensure they have information relevant for each factor.

4.2 Step 2: Identify credible risk events

Where an EA holder identifies that there are site features that will remain on the land post-surrender, the risk assessment must then consider whether there are any credible risk events that could be associated with any of the site features.

Credible risk events are those residual risks that are unplanned or unwanted with a plausible likelihood of occurrence and a reasonable magnitude of consequences that may be expected to occur post-surrender. Twenty-one (21) credible risk events have been identified that are typically relevant and appropriate for the range of resource activities currently authorised in Queensland and these credible risk events have been incorporated into the calculator ([Appendix 2](#)).

The calculator considers the following credible risk events:

- credible risk events related to **geochemical risks** associated with discharges from process waste emplacements; waste rock emplacements; open and underground voids; water holding structures; and the failure of bores and wells

- credible risk events related to **geotechnical risks** related to the failure of process waste emplacements; waste rock emplacements; open and underground voids; water holding structures; and waste facilities
- credible risk events related to **spontaneous combustion** risks in underground and open voids (coal mines), and in waste rock emplacements (including backfill) (coal and metals mines)
- a credible risk event related to the risk that the treatment of discharge waters will **fail to meet water quality** requirements
- a credible risk event related to **waste facility contamination** risks.

Supporting documents specific to geochemical, geotechnical and spontaneous combustion risk considerations are available to support residual risk assessment and inform of the key factors considered by the residual risk calculator.

As with the site features, while the calculator only considers certain credible risk events, an expert panel process may identify other credible risk events relevant to a particular site. The expert panel must consider all credible risk events listed in [Appendix 2](#), where relevant, as well as any others that are deemed necessary to the assessment of the land the subject of the surrender application. For example, the calculator has not been built to be able to assess the residual risks of greenhouse gas storage (GHG). An expert panel should consider whether any additional credible risk events are relevant to a GHG site at surrender and assess these credible risk events as well. There are no restrictions on the amount of credible risk events an expert panel can consider.

Where different or additional credible risk events are identified for the land, they must be described and then included in the risk assessment. The comprehensive residual risk report will need to include a description of the credible risk events identified, its source and the potential receptor(s) of the impact.

4.2.1 Calculating the likelihood of credible risk events

The likelihood of the identified credible risk events should be determined based on:

- knowledge of the design and performance of post-surrender facilities (e.g., as in design reports, engineering audits and certification documents)
- information from other comparable projects, where comparable credible risk events may have occurred
- the consensus of the people involved in undertaking the assessment, informed by those with expertise in particular subject matter
- historical experience and data, including from other sectors where available and applicable.

Order of magnitude likelihoods should be determined with reference to [Table 3](#). Qualitative descriptions of likelihood categories are included in the table to assist with the residual risk assessments. [Appendix 3](#) includes a table that show the likelihood applied to credible risk events in the calculator.

The calculator automatically assigns likelihood values to each credible risk event identified.

The expert panel process **must** use the above considerations and [Appendix 3](#) as a reference point during their deliberations.

Table 3: Likelihood categories

Qualitative description of likelihood			Probability		
			Frequency (per year)	Percentage (per year)	Return period (years)
VIII	Certain	Certain, or as near to as makes no significant difference	1 (or 0.999)	100	1
VII	Almost certain	One or more incidents of a similar nature have occurred here	0.2-0.9	20-90	1-5
VI	Highly probably	A previous incident of a similar nature has occurred here	0.1	10	10
V	Possible	Could have occurred already without intervention	0.01	1	100
IV	Unlikely	Recorded recently elsewhere	0.001	0.1	1000
III	Very Unlikely	It has happened elsewhere	0.0001	0.01	10,000
II	Highly improbable	Published information exists but in a slightly different context	0.00001	0.001	100,000
I	Almost impossible	No published information on a similar case	0.000001	0.0001	1,000,000

4.2.2 Calculating the consequential cost of credible risk events

The quantitative risk assessment method in this guideline requires the consequence to be determined by quantifying the cost of the activities that remediate the impacts and/or the cost of avoiding the potential impacts (i.e., management activities).

The activities that must be considered for credible risk events fall into two categories, these are:

1. one-off costs to undertake the investigation and remediation of the credible risk event (e.g., investigations, earthworks and revegetation); and
2. any new/additional ongoing management costs that are due to the occurrence of the credible risk event (e.g., monitoring of the new remediation work). Net Present Value (NPV) is used to calculate the ongoing cost component of remedial action into perpetuity.

The calculator automatically assigns a consequential cost to each credible risk event identified.

During an expert panel process, the consequential cost of each credible risk event should be determined by considering the activities required to remediate the credible risk event and estimating the total cost of these activities.

To estimate the cost of remediating impacts, the expert panel should consider the following steps:

1. The likely remediation actions should be identified and defined as clearly as can be achieved (given the hypothetical nature of the exercise), based on consideration of the nature of the credible risk event and the effects it may have on a sensitive receptor or infrastructure and environmental sensitivity.
2. The actions should be set out in a spreadsheet.
3. Quantities of materials (e.g., competent rock, topsoil, seedlings), equipment (e.g., backhoes, dozers), personnel and management costs should be identified for each action.
4. Requirements for inspection and monitoring should be identified (to assess the initial nature and extent of the event, during the remediation process, and after remediation is complete to ensure that the issue has been resolved).
5. Requirements for communication with regulators, community and other stakeholders should be identified.
6. Appropriate cost rates should be identified and applied to each action.
7. Any required increases to ongoing maintenance and monitoring activities following remediation of the event should be identified and costed.

Depending on the nature of the credible risk event, remediation may involve activities such as earthworks, revegetation, clean-up of contaminants, water treatment, repair of damaged infrastructure, provision of alternative water supplies etc. If a credible risk event is similar to or the same as a credible risk event listed in the calculator, the associated remedial actions costs should be considered by the expert panel in determining the costs. Where the expert panel identifies new credible risk events for the land, the cost rates for remedial action must be developed using the following sources (where applicable):

- the calculator
- the estimated rehabilitation cost (ERC) calculators
- third party quotes.

4.2.3 Calculating the risk quotient of a credible risk event

Using the information gathered, an initial risk quotient for each credible risk event identified must be calculated. The risk quotient is calculated by multiplying the likelihood of the identified credible risk event (expressed as a numerical probability) and the consequential cost and expenses of the credible risk event (expressed in dollars). The risk quotient is a number, not a dollar figure.

The calculator automatically determines the risk quotient for each credible risk event identified. If the expert panel is calculating the risk quotient, the likelihood and consequential cost will need to be manually calculated.

Below is a simplistic example of a failure of a water holding structure to show a risk quotient calculation:

Likelihood is assessed using Table 3 above. In this example, this failure may be determined to be 'unlikely', which from Table 3 has a frequency per year of 0.001 (i.e., a one in a thousand chance of occurring in any one year).

Consequence is then determined by calculating the estimated cost of remediating the impact of the water and sediment release and repairing the structure after it has failed. In this example, a consequential cost could be \$300,000

The risk quotient would therefore be: $0.001 \times \$300,000 = 300$.

Another example of a risk quotient calculation for contaminated discharge from a small aboveground process waste emplacement can be seen here:

Likelihood is assessed using Table 3 as 'very unlikely', which in Table 3 has a frequency per year of 0.0001 (i.e., a one ten thousand chance of occurring in any one year).

Consequence is then determined by calculating the estimated cost of repairing cover damage, installing drainage at the toe and diverting discharge to an evaporation basin. In this case, the consequential cost of the failure for this feature is say \$4,000,000.

The risk quotient would therefore be $0.0001 \times \$4,000,000 = 400$.

As these examples show, credible risk events may have likelihoods an order of magnitude difference, and a large disparity in consequential cost amounts, but end up with similar risk quotients.

The use of risk quotient provides a ranking of risk events that is at a much higher resolution than is achievable with qualitative or semi-quantitative risk assessment methods. Importantly, the risk quotient provides a directly comparable measure of risk. Any risk quotient calculated by the expert panel is required to be assessed against the state-wide risk threshold. All credible risk event risk quotient(s) should be reflected in the sites overall risk profile (see section 4.4, [figure 7](#)).

Once initial risk quotients have been determined for each credible risk event, the expert panel must identify the ongoing management activities (i.e., risk treatments) relevant for the credible risk events (see Step 3) and determine the risk quotients after these risk treatments are applied.

4.3 Step 3: Identifying ongoing management activities and apply risk treatments

Once a credible risk event has been identified and assessed as relevant to the site, the next stage is to identify any risk treatments to minimise this risk. Risk treatment can include any technique that can be applied to reduce either the likelihood or the consequence of a credible risk event, or both (e.g., monitoring and maintenance activities). An example of a risk treatment might be to direct runoff from a waste rock dump into a final void as precaution in case drainage quality unexpectedly deteriorates over time. The containment of drainage would reduce the consequence of the risk.

Ongoing management activities should be considered as a risk treatment where they will minimise or remove the chance of a credible risk event occurring in future (e.g., routine inspection for emerging erosion on a tailings storage facility embankment and, where required, remediation, could prevent gullyng and eventual slumping).

Ongoing management activities that may be required include:

- routine geotechnical inspections and monitoring (e.g., tailing storage embankment)
- water treatment costs (e.g., wetland maintenance, or WTP operation and maintenance)

- safety and security (e.g., fencing to prevent access to non-use management area, or inspections to ensure land use restrictions are maintained)
- government inspection (e.g., routine site inspections by regulatory authorities)
- routine water quality monitoring (e.g., groundwater monitoring around waste rock dumps)
- land management (e.g., erosion control on tailing storage facility embankment)
- vegetation maintenance and monitoring (e.g., to maintain cover system free of trees).

Once the ongoing management activities have been determined, the risk assessment should consider to what extent these management activities reduce the risk quotient of the credible risk events, by reducing the likelihood and/or consequence of the credible risk events occurring.

The outputs of the risk assessment must include a schedule of all ongoing management activities that are identified as being relevant to manage residual risks on the land post-surrender (i.e., reducing the initial calculated risk quotient for a relevant credible risk event). The risk assessment must assume that all ongoing management activities occur in perpetuity and must state the intervals at which the activities are required (e.g., every 5 years).

If the calculator is used for the risk assessment, ongoing management activities will automatically be generated based on the site information input by the user. If the expert panel is used for the risk assessment, the risk assessor must provide a schedule of all ongoing management activities that were identified as being relevant to manage the residual risks of the land.

4.3.1 Exclusions to management activities considered

The cost of ongoing management activities that are considered beyond 'normal' activities are to be included in determining the residual risk payment amount.

Most land uses require some level of ongoing management to maintain a sustainable utilisation. For example, the use of fire to reduce fuel build up and/or encourage seed germination, weed eradication or feral animal control programs, or managing the impact of grazing through appropriate stocking numbers and rotation.

Land that has been rehabilitated following resource activities may require ongoing land management similar to land that has not been rehabilitated. For example, both rehabilitated grazing land and untouched grazing land may require the maintenance of fences or water holding structures. These 'normal' management activities are excluded from the residual risk framework and do not need to be considered in the residual risk assessment (i.e., the assessment excludes management costs that would be incurred regardless of whether or not the resource activity disturbance had taken place).

In addition to 'normal' management activities, rehabilitated land may require other types of ongoing management activities such as periodic monitoring to ensure that waste encapsulation systems have not degraded. Waste encapsulation monitoring is not considered a 'normal' management activity of grazing land and should be included in determining the residual risk payment amount.

4.4 Step 4: Identify potential remedial actions for material credible risk events

The risk quotients should be collated into a risk profile to allow for the comparative ranking of credible risk events for that site. The threshold must then be applied to the profile ([figure 6](#)). The calculator automatically generates a risk profile.

Where the ongoing management activities are sufficient to reduce the risk quotient below the threshold, no consideration of remedial actions is necessary for that credible risk event. The expert panel must provide supporting evidence to explain how the ongoing management activities have reduced the risk quotient below the threshold.

Where the ongoing management activities are not sufficient to reduce the risk quotient below the threshold, the assessment needs to include consideration of the actions that would be required to remediate the site should the credible risk event occur. This consideration will need to occur for any credible risk event where the final risk quotient is above the set state-wide risk threshold.

The use of a threshold ensures that remedial actions are only considered where the risks of a credible risk event occurring somewhere on site are still of a material nature. More detail on the threshold method is provided in [Appendix 1](#). If the calculator is used for the risk assessment, the calculation of the risk quotient and the selection of credible risk events with quotients above the threshold will be automatically generated.

If the expert panel option is used and the credible risk event is similar to, or the same as, a credible risk event listed in the calculator, the associated remedial action should be considered by the expert panel. If the expert panel decides that any remedial action is not to be included in the activity schedule, sufficient evidence and explanation must be provided as to why.

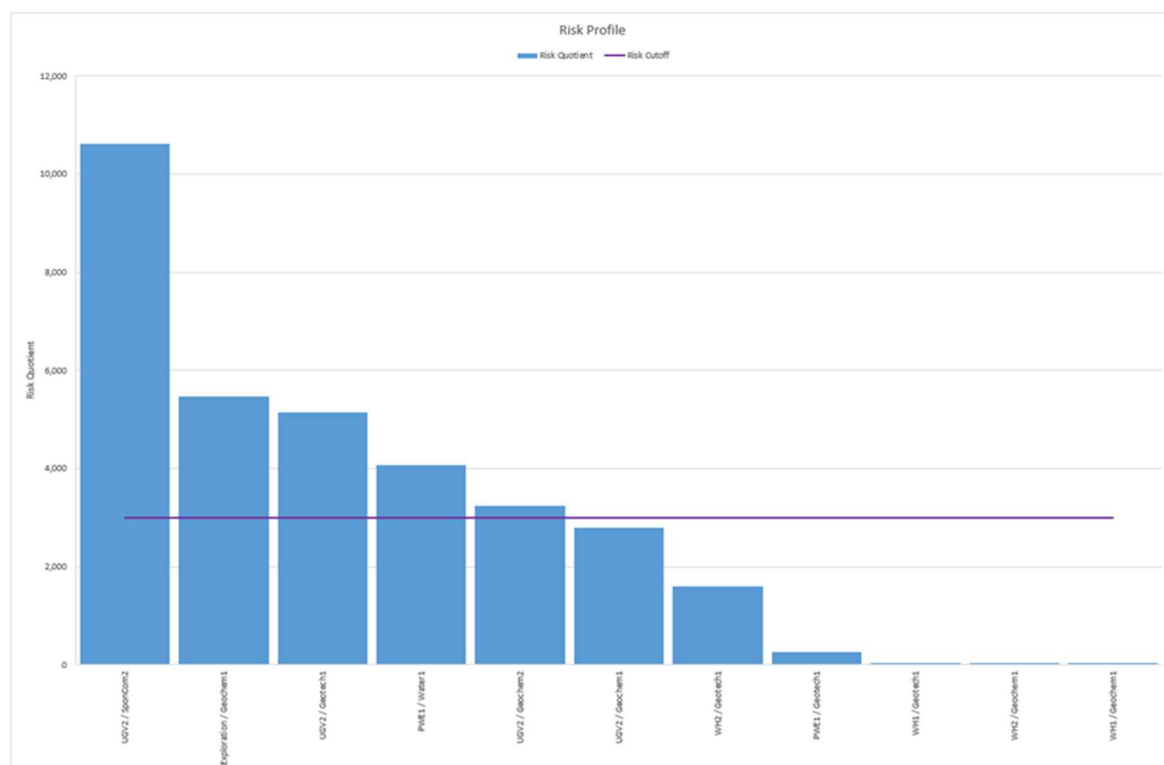


Figure 7. Example of a risk profile produced by the calculator using the threshold method

4.5 Step 5: Estimate costs and expenses (if necessary)

If the risk assessment process does not determine that ongoing management activities or remedial actions are relevant to manage residual risks of the land, then the EA holder does not need to estimate the costs and expenses.

The quantitative risk assessment involves the assessment of two components ([Figure 8](#)):

- ongoing management activities and associated costs and expenses (e.g., maintenance and monitoring)
- the risk of requiring remedial actions, and their likely associated costs and expenses.

Where the risk assessment process has determined that ongoing management activities or remedial actions are relevant to manage residual risks of the land, the EA holder must provide an estimate of the costs and expenses.

For the costs associated with remedial action, the threshold method is used as part of the quantitative risk assessment method in this guideline. Information on the threshold method is provided in [Appendix 1](#).

Please note that while this guideline provides the process for carrying out the risk assessment and estimating costs and expenses as stepwise sequenced process, the residual risk calculator allows the EA holder to do both processes simultaneously.



Figure 8. Components of the estimated payment amount for residual risks

4.5.1 Stated ways

Under section 264A (1) in the EP Act this guideline can require the estimated costs and expenses that may be incurred in carrying out the remedial action or ongoing management activities to be worked out in a **stated way**.

The EA holder must calculate the estimated costs and expenses through a **stated way** where ongoing management activities or remedial action have been identified for the land the subject of the surrender application.

The use of the **residual risk calculator** and/or **the expert panel** are the stated ways for the EA holder to estimate the costs and expenses that may be incurred in carrying out the remedial action or ongoing management activities.

4.5.2 Estimating costs and expenses

The residual risk payment amount to be provided to the Queensland Government is a means to fund the likely costs and expenses of carrying out the residual risk activities in perpetuity.

The estimated costs and expenses will be based on the assumptions made about future land use and how the land should be managed to prevent or minimise credible risk events from occurring. It is important that these assumptions are assessed, documented and justified to ensure the estimated amount is appropriate for the site's needs, and covers all the ongoing management activities and remedial actions identified during the risk assessment.

As stated above, the costs and expenses come from the two components assessed:

- ongoing management activities (e.g., maintenance and monitoring)
- potential remedial actions (e.g., credible risk events 'risk cost').

Not all sites will have both the ongoing management activity and remedial action components present at surrender. Where residual risks can be adequately addressed through ongoing management activities that occur post-surrender there may not be a need to consider remedial action.

4.5.3 Effects of remoteness

When estimating the costs and expenses associated with residual risk activities, it is important to consider the effects of remoteness. The distance of a resource site from a major population centre can affect the availability of equipment and resources, which in turn can affect the cost of responding to risk events. Remoteness may also affect the likelihood or consequence of a credible risk event as there is generally a reduced presence of human-related sensitive receptors or infrastructure at remote sites.

Remoteness should be factored into the cost estimate for remedial action by assuming higher mobilisation and demobilisation costs for sites located in remote areas (identified using the Remote Area Board classification of remote regions in Queensland). Remoteness is less of a factor for ongoing management activities, as routine ongoing management activities can be planned and equipped in advance. However, if a particular ongoing management activity is known to be impacted by remoteness, this cost impact should be factored into the cost estimate as well.

4.5.4 Design life of site features

When determining whether a site feature is likely to have ongoing management activities, amongst other things, the EA holder must consider the design life of the site feature, or part thereof (e.g., the replacement of a cover system after 80 years to prevent the chance of a credible risk event occurring). If a site feature, or part thereof, is identified as having a known design life, the cost of the replacement or refurbishment activities throughout and at the end of design life must be factored into the assessment as 'ongoing management activities' as it is a known cost.

4.5.5 Estimating costs of ongoing management activities

The risk assessment method uses the data input by users to identify the likely ongoing management activities associated with the site post-surrender. If the calculator is used for the risk assessment, the costs of ongoing management activities will be automatically generated based on the site information input by the user.

The risk assessment process requires that the unit cost (in today's costs) to carry out the activity be worked out first. Where ongoing management activities have been identified by the expert panel and are the same or practically the same as those in the calculator, the risk assessor must use the same cost rates as the calculator, unless the panel is able to provide evidence that supports a different cost rate that would be applicable following surrender (e.g., third party quotes or contracted rates).

It then requires the frequency at which the activity must be carried out to be calculated, for example at regular intervals (e.g., every 5 years) or at intervals that decrease over time (e.g., 5, 15, 30, 60 years). The risk assessment method must assume that all ongoing management activities occur in 'perpetuity' to calculate the activities net present value. Perpetuity is as defined and will be determined by the residual risk discount rate.

If there is more than one cost for ongoing management activities for the land, it will sum the total ongoing management costs for the land. Where relevant, costs may be adjusted to remove any duplication as per this guideline. This must be supported by evidence clearly explaining the duplication and how it was accounted for in the calculation.

The holder of an EA for a resource activity will not be required to provide funds to:

- cover typical management costs that would be incurred if the resource activity disturbance had not taken place, or
- be used to address 'inappropriate' site management practices by another entity post-surrender, for example another entity is utilising the land post-surrender, and they do, or fail to do, something that causes the rehabilitation to fail.

The ongoing management activities costs and expenses must be included in the final estimated payment amount. The requirement to make a payment for ongoing management activities applies regardless of whether an associated risk quotient for a credible risk event was above or below the threshold.

4.5.6 Estimating costs of potential remedial actions

As discussed, the risk assessment must consider whether any credible risk events have risk quotients that sit above the threshold, taking into consideration the ongoing management

activities (i.e., risk treatments). The risks that sit above the threshold after the application of relevant risk treatments are termed 'material' credible risk events.

Only those sites with material credible risk events (i.e., ones that cannot be reduced below the threshold through ongoing management activities) will be required to provide a payment that includes the costs and expenses for potential remedial action. The costs and expenses of remedial action is worked out by taking the full consequential costs of each credible risk event above the threshold and summing them (see [figure 9](#)).

While the costs charged reflect the costs of rectifying the credible risk events with quotients above the threshold, these particular credible risk events may not necessarily occur as the quotient reflects both the cost of the event and its likelihood. Therefore, the payment is intended to cover any remedial action that may be required on the land in future.

The remedial action costs fall into two categories:

- one-off costs to undertake the remediation of the risk event (e.g., investigations and earthworks)
- new/additional ongoing management activities costs that are due to the occurrence of the risk event (e.g., geotechnical assessments and monitoring of the remediation). These are activities required on top of the ongoing management activities already calculated.

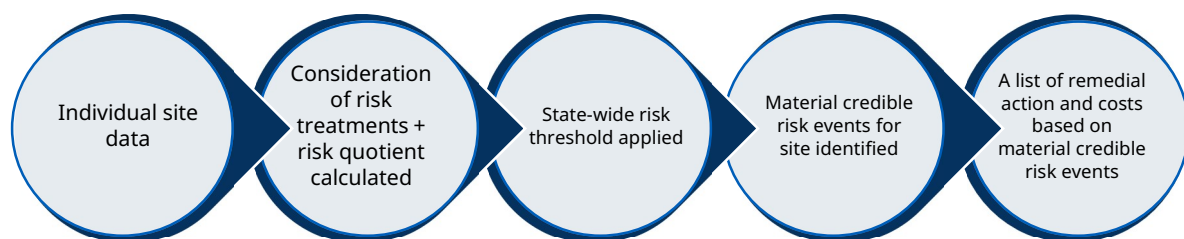


Figure 9. The process for identifying remedial actions and associated costs

Net present value should be used to calculate the ongoing management activities cost component of remedial action. To avoid cost duplication with the ongoing management activity costs, only the additional, incremental ongoing costs triggered by the credible risk event are included. Duplication is also avoided by considering the site as a whole and associate economies of scale, rather than simply multiplying the ongoing costs for a specific facility (e.g., a waste rock emplacement) by the number of facilities at the same site.

If the calculator is used for the risk assessment, the cost of remedial actions will automatically be generated based on the site information input by the user.

Where remedial actions have been identified by the expert panel and are the same or practically the same as those in the calculator, the risk assessor must use the same cost rates as the calculator, unless the panel is able to provide evidence that supports a different cost rate (e.g., third-party quotes or contracted rates).

If components of the site were assessed through the calculator and the expert panel, all ongoing management activities and potential remedial action identified by the calculator and the expert panel must be collated into an activity schedule.

4.5.7 Administrative costs

There will be administration costs associated with managing residual risks of the land. These include the costs incurred by the Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (DNRMMRRD) and Queensland Treasury in overseeing management of the activities, and the money respectively. Costs could include additional staff, contract management, technical advice, financial advice, and project management.

It is important that the residual risk payments include this administrative cost as the rest of the funds are necessary to manage the residual risks. Both the calculator and expert panel process involve the calculation of funds for administrative purposes, which is currently set to 10% of the total residual risk cost estimate.

The final total estimated residual risks payment amount must include a 10% administration amount.

5 Submitting the risk assessment

All outputs of any risk assessment are required to be provided with the post-surrender management report. The outputs for the pre-assessed risk option have been simplified and are provided in this guideline to help streamline the risk assessment process for low-risk activities. The outputs from the calculator will be automatically produced by the calculator upon completion of the required inputs. The outputs of the expert panel must include:

- likelihoods and consequential costs for all credible risk events identified
- risk quotients for all the credible risk events identified
- a risk register
- an activity schedule outlining details of any remedial action or ongoing management activities that may need to be carried out in relation to the land
- a statement of any assumptions made in relation to the remedial action or ongoing management activities that may need to be carried out in relation to the land
- the estimated amount of the costs and expenses that may be incurred in carrying out remedial action or ongoing management activities mentioned in the activity schedule.

An essential component of an effective residual risk assessment is having suitable information and data available to inform the assessment. The more detailed and robust the information and data, particularly with regards to key risk factors, the more accurate the risk assessment will be.

Examples for information and data that may be suitable for supporting the risk assessment process include:

- existing risk assessments of the land
- technical reports relating to remaining site features,
- certified consequence assessment reports, design plans and annual inspection reports
- rehabilitation and closure planning assessments that outline the engineering and environmental controls and rehabilitation techniques used

- outcomes of rehabilitation trials, particularly where they have identified potential rehabilitation risks or provided information on risk mitigation
- environmental incident reports that may reveal issues requiring post-surrender management
- monitoring and inspection results, particularly where trends can be identified that might provide an indication of the post-surrender geochemical or geotechnical stability of the site
- technical reports providing information on environmentally sensitive areas that may be vulnerable to post-surrender credible risk events
- plans showing the location of nearest sensitive receptors or infrastructure, and environmental sensitivities in proximity to the site
- plans of the site and major features and facilities remaining post-surrender
- planning and approval instruments (e.g., EAs and PRCPs).

5.1 Assessing the residual risk requirement

The scope for the residual risk assessment is the same regardless of the risk assessment option selected. In making a decision on the surrender application, the administering authority will consider the risk assessment to determine whether:

- the selected risk assessment option enabled an appropriate risk assessment of the site
- all the relevant site features were considered as part of the risk assessment
- the selection of risk factors is supported by appropriate evidence
- any decisions made in an expert panel process are supported by appropriate evidence
- the estimated costs and expenses are equal to or higher than the minimum payment level (currently \$0).

Note: The purpose of the minimum payment is to ensure that, if in future, it becomes apparent that government is expending more in administration costs than is collected for smaller payment amounts, this can be rectified.

For example, if in future, it costs government \$1,000 to collect and manage each payment, the minimum payment level could be set at \$1,000. This would mean any amount under the \$1,000 threshold would not be collected. The minimum payment level is currently set at \$0. This means that if a payment amount is generated via the risk assessment process, it must be collected.

5.1.1 Risk assessment options

When considering the risk assessment, the administering authority will first determine whether the selected risk assessment option was appropriate.

The calculator should be used to undertake the risk assessment unless the EA holders site identifies as large or complex (e.g., there is a strong causal interrelationship between the individual risks of different site features). The calculator is less suited to large or complex sites and in such cases, an expert panel must be used.

If the risk assessment was produced through the expert panel process, the administering authority will also consider if the expert panel process was completed appropriately (i.e., in line

with this guideline). A risk assessment produced by the expert panel must demonstrate to the administering authority that:

- the quantitative risk assessment method has been followed correctly
- the state-wide risk threshold has been correctly applied as part of the calculation
- the current discount rate has been incorporated; and
- all other expert panel protocols have been followed.

The comprehensive residual risk report must demonstrate that all the abovementioned requirements have been met.

5.1.2 Site features

All residual risk assessments will be required to demonstrate that all relevant, remaining site features have been considered. A site feature is considered relevant if it meets the definition in the EP Act and it is not subject to the exclusions mentioned in this guideline;

site features, of land, means each of the following—

- a) surface and subsurface infrastructure on the land related to resource activities;*
- b) other structures on the land related to resource activities;*
- c) modifications of the land related to resource activities carried out on the land.*

Examples of modifications of land—

tailings storage facilities, voids, waste rock dumps.

5.1.3 Residual risk requirement

During the assessment of the surrender application for an EA, the administering authority will decide whether there is justification to issue a written notice to the EA holder to pay a stated amount for the residual risks of the land. This is called the residual risks requirement under section 271(2) of the EP Act. The notice will only be issued to the EA holder when the surrender application has been assessed as appropriate for approval.

The residual risk requirement decision notice will state:

- the amount of payment that is required for the residual risks of land the subject of the surrender application
- a reasonable period during which the payment must be made
- that the residual risk payment is required to be made in the form of cash payment.

If a residual risk requirement notice is issued, the EA holder must pay the stated amount for the approval of the surrender application to take effect. If the EA holder disagrees with the residual risks requirement, they have the right to appeal the decision.

Note: Under section 276 of the EP Act, if the EA holder does not comply with the residual risk requirement (i.e., fails to make full and timely payment), then the surrender decision does not take effect.

6 Definitions

Term	Definition
Administering authority	For the purpose of this Guideline, the administering authority is the entity responsible for administering the <i>Environmental Protection Act 1994</i> .
Calculator	For the purpose of this document, see definition for residual risk calculator.
Credible risk event (CRE)	An unplanned and unwanted event (risk event) with a plausible likelihood of occurrence and reasonable magnitude of consequences that might be expected to occur at a resource site post-surrender.
Consequence/consequential cost	The cost associated with remediating a credible risk event.
Delegate from the administering authority	An officer who holds the relevant delegation to make decisions on behalf of the administering authority.
Discount rate	A percentage set by the Queensland Government that must be used when calculating the net present value of the residual risks payment amount. Discount rate: 2.5%
Environmental authority (EA) or authority	An environmental authority issued under the <i>Environmental Protection Act 1994</i> for an environmentally relevant activity.
Environmental sensitivity	A location or area with environmental or cultural values requiring protection under a legislative instrument. It includes environmentally sensitive areas (ESAs) such as national parks, wilderness areas, conservation areas, marine parks and Aboriginal Cultural Heritage Areas, and matters of state environmental significance (MSES), as defined in Schedule 2 of the <i>Environmental Offsets Regulation 2014</i> . The definition of 'environmental sensitivity' adopted for the residual risk assessment is separate from that of 'sensitive receptor or infrastructure', which focusses on components of the built environment that sustain human activity (defined below).
EP Act	The <i>Environmental Protection Act 1994</i> (QLD).
Estimated rehabilitation cost (ERC) calculator	The tool approved by the administering authority to calculate the estimated rehabilitation costs for a resource activity with an environmental authority.
Likelihood	The chance of something happening (ISO 31000:2018).
Material credible risk event	A credible risk event that sits above the state-wide risk threshold, for which a payment for remedial actions may be required.

Ongoing management activities	Ongoing monitoring and maintenance activities assumed to be required in perpetuity at a post-surrender resource site to reduce the potential for a credible risk event. This may include monitoring the condition of the land or site features of the land and taking action to prevent or minimise environmental harm caused by the land or site features of the land. Examples of ongoing management activities include— a) maintaining fences to ensure the safety of steep slopes or to prevent access to contaminated areas b) providing a pump-back system to manage the discharge of contaminants c) continuing a monitoring and verification plan under the <i>GHG Storage Act 2009</i> to ensure GHG stream storage under that Act is taking place as predicted.
Perpetuity	A point in time beyond which there is a trivial increase in the net present value of the ongoing site-related costs using the current nominated discount rate.
Progressive rehabilitation and closure plan (PRCP)	For land the subject of a mining lease, means a progressive rehabilitation and closure plan for the land that consists of— a) the rehabilitation planning part of the plan; and b) the PRCP schedule, including any conditions imposed on the schedule.
PRCP schedule	The schedule component of the PRCP that complies with section 126D and approved under Ch5, Pt5, Division 2 of the EP Act.
Remedial action	The actions that may be required in the foreseeable future in response to a credible risk event at a post-surrender resource site. Examples include installation of interception bores, drainage diversion, landform repair, groundwater monitoring, wetland management and geotechnical assessments.
Residual risk activities	The remedial action or ongoing management activities carried out in relation to the land because of residual risks of the land.
Residual risk assessment	An assessment of residual risks undertaken under section 264A of the <i>Environmental Protection Act 1994</i> and in accordance with this Guideline.
Residual risk calculator	The tool approved by the administering authority to identify, assess and cost the residual risks of land on a resource site at surrender. The calculator can be accessed via the Business Queensland Website by searching ESR/2022/6069.
Residual risks	Residual risks, of land, means either or both of the following to the extent it relates to resource activities carried out on the land—

	a) the risk that, although the land has been rehabilitated and appropriately managed, remedial action will need to be carried out in relation to the land in the foreseeable future; b) the risk that ongoing management activities will need to be carried out in relation to the land, including — i. monitoring the condition of the land or site features of the land; and ii. taking action to prevent or minimise environmental harm caused by the land or site features of the land.
Residual risks requirement	A requirement under section 271(2) of the <i>Environmental Protection Act 1994</i> which states that the administering authority may require the applicant to pay a stated amount within a stated reasonable period for the residual risks of land the subject of the surrender application.
Resource activity	A resource activity is an activity that involves – a) A geothermal activity, or b) A greenhouse gas storage activity, or c) A mining activity, or d) A petroleum activity.
Resource authority (RA)	An authority issued under the relevant resource legislation that allows the holder to explore or produce resources in Queensland.
Resource legislation	Means any of the following Acts; a) <i>Geothermal Energy Act 2010</i>; b) <i>Greenhouse Gas Storage Act 2009</i>; c) <i>Mineral Resources Act 1989</i>; d) <i>Petroleum Act 1923</i>; e) <i>Petroleum and Gas (Production and Safety) Act 2004</i>; f) <i>Petroleum (Submerged Lands) Act 1982</i>.
Resource site (or site)	An area of land to which a resource tenure and corresponding environmental authority apply or have previously applied.
Risk factors	Characteristics of a site feature, such as total footprint, perimeter, depth, contents, minimum distance to closest sensitive receptor and/or infrastructure, time since cover installed, construction material and nature of waste.
Risk quotient	A measure of risk that is the product of the likelihood of occurrence of a credible risk event and its consequential/occurrence cost.
Risk register	A list of all credible risk events considered in a residual risk assessment as well as each CRE's likelihood of occurrence, consequential cost and risk quotient.

Risk treatment	The process of selecting and implementing measures (e.g., ongoing management activities) to avoid, prevent, reduce, minimise or modify risk.
Sensitive receptor or infrastructure	A sensitive receptor or infrastructure is an area or place where an impact may be experienced. These tend to be components of the built environment that sustain human activity. Sensitive receptor or infrastructure can include dwellings, protected areas, public parks, hospitals, roads, rail lines, powerlines, gas/water/sewage pipelines and other forms of public or private infrastructure. The definition of 'sensitive receptor or infrastructure' adopted by the residual risk assessment is separate from that of environmental sensitivity. It is also separate from the definition of sensitive receptor under the EP Act and associated regulations.
Site features	Means each of the following- a) surface and subsurface infrastructure on the land related to the resource activities; b) other structures on the land related to resource activities; c) modifications of the land related to resource activities carried out on the land (e.g., tailings storage facilities, voids, waste rock dumps).
Site risk profile	The total of all the relevant risk quotients associated with credible risk events for a site. Generally displayed in a bar graph.
State	The State of Queensland.
State-wide risk threshold	A state-wide risk quotient value that determines which credible risk events are material credible risk events and must be included in calculation of the estimated residual risk payment amount. Threshold value: 3,000
Threshold method	A quantitative risk assessment method for assessing risks with low resolution of likelihoods. Appendix 1 provides a more in-depth explanation of the method.

7 Appendices

Appendix 1: Threshold method

The quantitative risk assessment uses the threshold method to estimate the overall remedial action costs associated with a site at surrender. The threshold method is considered the appropriate method to calculate the remedial action costs of the land as it overcomes the limitations of other methods that are compromised by the difficulty in accurately quantifying likelihood for low-probability events. The threshold method is used to determine which credible risk events are material and thus are to be included in the remedial action costs for a site.

Based on the site input data, the calculator automatically assigns orders of magnitude likelihoods to each applicable credible risk events. If the expert panel is the chosen risk assessment option, the panel may assign orders of magnitude likelihoods to each applicable credible risk event, or determine an appropriate likelihood of risk occurrence (e.g., a failure event that results from a 1 in 200 year rainfall or 1 in 5,000 year return period earthquake. The likelihood of each credible risk event is multiplied by the consequential cost to calculate the risk quotient. If credible risk events have risk quotients higher than the prescribed threshold value, the occurrence costs of these credible risk events must be summed to determine the remedial action cost component of the residual risk payment. The consequential costs of credible risk events that fall below the threshold value do not contribute to the remedial action costs.

The use of a risk quotient provides a ranking of credible risk events that is critical to sound risk management. Importantly, the risk quotient provides a directly comparable measure of risk. For example, a credible risk event that has a risk quotient of 100 poses half the risk of an event with 200 and an order of magnitude less than an event of 1,000. This comparative framework is impossible to achieve with qualitative or semi-quantitative methods. A risk quotient also provides a much higher resolution than is achievable with qualitative or semi-quantitative risk assessment methods.

The threshold method provides a conservative estimate of the remedial action costs. No discounting is applied to the consequential cost of the contributing credible risk events (except for remediation components that are ongoing), as it is assumed that the events occur immediately following surrender.

The threshold method does not predict that all (or any) of the credible risk events contributing to risk cost will actually occur. Rather, based on the level of identified risk, the method uses these credible risk events to calculate a risk cost that is expected to be sufficient to cover the cost of remediating any unwanted or unexpected risk events that occur in the future irrespective of how, when or where they occur.

A credible risk event may occur at a site that has been calculated as having a zero-risk cost. However, because of the conservatism in the threshold method, it is expected that there will be sufficient money available to remediate this risk event.

Appendix 2. The credible risk events (CREs) assessed by the Residual Risk Calculator

ID	Credible risk event (CRE)	Description	Inclusions	Exclusions
	Geotechnical risks			
PWE Geotech1	Failure of aboveground process waste emplacement	Failure (e.g., through slumping) of an aboveground (ex-pit) process waste emplacement, which results in the potential erosion and release of embankment, cover or tailings materials, and which potentially impacts on a sensitive receptor or environmental sensitivity, and requires remediation. The event could lead to physical impacts (e.g., sediment release) or geochemical impacts (e.g., due to the exposure of PAF materials).	Failure of tailings storage facilities, tailings emplacements within waste rock dumps, coal washery reject emplacements, gypsum stacks	In-pit tailings disposal, co-disposal with waste rock, heap leach pads, underground tailings deposition (all addressed by other CREs)
WRE Geotech1	Failure of aboveground waste rock emplacement	Failure (e.g., through erosion or slumping) of an aboveground (ex-pit) waste rock emplacement, which results in the potential erosion and release of dump or cover materials, and which potentially impacts on a sensitive receptor or environmental sensitivity and requires remediation. The event could lead to physical impacts (e.g., sediment release) or geochemical impacts (e.g., due to the exposure of PAF materials).	Failure of waste rock dumps, overburden dumps, unprocessed low grade ore stockpiles, decommissioned heap leach pads, emplacements of co-disposed tailings and waste rock	-
OV Geotech1	Open void wall failure	Failure of an open void wall (e.g., due to geotechnical instability) which results in a direct impact on nearby infrastructure or other sensitive receiver, or leads to an indirect impact (such as secondary geochemical impacts) on a sensitive receptor or environmental sensitivity, and which requires remediation	Wall failure in open cut pits, major borrow pits, and box cuts	Wall failure in underground voids (addressed by a separate CRE)

UGV Geotech1	Surface subsidence as a result of underground void failure	Failure of an underground void (e.g., due to geotechnical instability) resulting in surface subsidence which leads to a direct impact on infrastructure or other sensitive receptor or environmental sensitivity, and which requires remediation	Void collapse, chimney caving	-
WH Geotech1	Failure of water holding structure	Failure of a water holding structure which results in the release of sediments or contaminants, or redirection of flow away from natural or constructed watercourses, or redirection of flow to an area where erosion or contamination results, and which results in a potential impact on a sensitive receptor or environmental sensitivity and requires remediation	Failure of water holding ponds, brine ponds, and evaporation ponds	-
WM Geotech1	Failure of drainage control structure	Failure of a drainage control structure, which results in the release of sediments or contaminants, or redirection of flow away from natural or constructed watercourses, or redirection of flow to an area where erosion or contamination results, and which results in a potential impact on a sensitive receptor or environmental sensitivity and requires remediation	Failure of drainage control structures such as water diversion channels, bunds and decommissioned levees (this CRE is not considered relevant to surrendered P&G sites)	-
WF Geotech1	Failure of aboveground waste facility	Failure (e.g., through erosion or slumping) of an aboveground waste facility, which results in the potential erosion and release of waste materials, and which potentially impacts on a sensitive receptor or environmental sensitivity and requires remediation. The event could lead to physical impacts (e.g., sediment release) or impacts due to contamination (e.g., due to the exposure of contaminated materials)	Failure of facilities designed for the permanent containment of potential contaminants. Includes waste facilities regulated under the Environmental Protection Regulation 2019, such as landfills containing contaminated soils, or encapsulated residual brine/solid salt storages	Failure of process waste emplacements or waste rock emplacements (addressed under separate CRE)

Geochemical risks				
PWE Geochem1	Contaminated discharge from aboveground process waste emplacement	Discharge of untreated water from an aboveground process waste emplacement to surface waters or groundwater, where discharge contains contaminants as a result of geochemical processes, and results in a potential impact on a sensitive receptor, and requires remediation	Discharge from tailings storage facilities, tailings emplacements within waste rock dumps, coal washery reject storages, gypsum stacks	Discharge from co-disposal with waste rock, and from underground tailings deposition (all addressed by other CREs)
WRE Geochem1	Contaminated discharge from aboveground waste rock emplacement	Discharge of untreated water from an above-ground waste rock emplacement, where discharge contains contaminants as a result of geochemical processes, and results in a potential impact on a sensitive receptor or environmental sensitivity, and requires remediation	Discharge from waste rock dumps, overburden dumps, remaining low grade ore stockpiles, decommissioned heap leach pads, co-disposed tailings and waste rock	Discharge from waste rock emplacements underground voids (addressed by other CREs)
OV Geochem1	Contaminated discharge from an open void	Discharge of untreated water from open void to surface waters or groundwater, where discharge contains contaminants as a result of geochemical processes, and results in a potential impact on a sensitive receptor or environmental sensitivity, and requires remediation	Discharge from open cut pits, major borrow pits, box cuts, where left wholly or partially open. Includes voids partially filled with waste rock or tailings	Discharge from underground voids, portals/adits (all addressed by other CREs)
UGV Geochem1	Contaminated discharge to surface water from an underground void	Discharge of untreated water from underground workings to surface waters, where discharge contains contaminants as a result of geochemical processes, and results in a potential impact on a sensitive receptor or environmental sensitivity, and requires remediation	Discharge from underground voids to surface waters via portals, adits or other means. Includes discharge from voids containing waste rock or tailings	-
UGV Geochem2	Contaminated discharge to groundwater from an underground void	Discharge of untreated water from underground workings to groundwater, where discharge contains contaminants as a result of geochemical processes, and	Discharge from voids containing waste rock or tailings	-

		results in a potential impact on a sensitive receptor or environmental sensitivity, and requires remediation		
WH Geochem1	Discharge of contaminated water from water holding structure	Discharge of untreated water from a water holding structure, where discharge contains contaminants as a result of geochemical processes, and results in a potential impact on a sensitive receptor or environmental sensitivity, and requires remediation	Discharge from water holding dams	Discharge from final voids, tailings storage facility ponds, ponded water on waste rock dumps, and portals/ adits (all addressed by other CREs)
Spontaneous combustion risks				
WRE Sponcom1	Spontaneous combustion of aboveground or in-pit waste rock emplacements	Spontaneous combustion of aboveground or in-pit waste rock emplacements at coal mines or metals mines resulting in impacts on ambient air quality and potential impacts on land and infrastructure	Combustion in overburden dumps, spoil dumps, and waste dumps	
OV Sponcom1	Spontaneous combustion of coal mine open voids	Spontaneous combustion of coal mine open voids resulting in impacts on ambient air quality and potential impacts on land and infrastructure	Combustion in coal mine open voids (floor or wall rock)	Combustion in open voids at metals or other non-coal mines
UGV SponCom2	Spontaneous combustion in underground workings at coal mines	Spontaneous combustion of coal in the underground workings of a coal mine resulting in impacts on ambient air quality and potential impacts on land and infrastructure.	-	Combustion in underground workings at metals or other non-coal mines
Risk of water treatment failure				
PWE Water 1	Treatment of discharge from residual landform	Discharge of treated water from residual landform to surface water contains greater than predicted contaminant levels as a result of geochemical processes, and results in a potential impact on a	Planned discharge from any residual landform	-

	fails to meet water quality requirements	sensitive receptor or environmental sensitivity and requires remediation This may occur where drainage quality is poorer and/or of higher volume than predicted and exceeds capacity of any passive or active management or treatment systems		
WRE Water 1	Treatment of discharge from residual landform fails to meet water quality requirements	Discharge of treated water from residual landform to surface water contains greater than predicted contaminant levels as a result of geochemical processes, and results in a potential impact on a sensitive receptor or environmental sensitivity and requires remediation This may occur where drainage quality is poorer and/or of higher volume than predicted and exceeds capacity of any passive or active management or treatment systems	Planned discharge from any residual landform	-
OV Water 1	Treatment of discharge from residual landform fails to meet water quality requirements	Discharge of treated water from residual landform to surface water contains greater than predicted contaminant levels as a result of geochemical processes, and results in a potential impact on a sensitive receptor or environmental sensitivity and requires remediation This may occur where drainage quality is poorer and/or of higher volume than predicted and exceeds capacity of any passive or active management or treatment systems	Planned discharge from any residual landform	-
Waste facility risks (see also WF Geotech1)				
WF Contam1	Discharge of contaminants to	Failure of liner or seepage controls resulting in the discharge to groundwater of contaminants from	Failure of facilities designed for the permanent	Discharges from process waste emplacements or

	groundwater from waste facility	materials contained in a waste facility, resulting in a potential impact on a sensitive receptor or environmental sensitivity, and requiring remediation	containment of potential contaminants. Includes waste facilities regulated under the Environmental Protection Regulation 2019, such as landfills containing contaminated soils, or encapsulated residual brine/solid salt storages	waste rock emplacements (addressed under separate CREs)
Bore and well risks				
CSG Geochem1	Failure of plug and abandonment seals leads to groundwater deterioration	Failure of plug and abandonment seals leading to the escape of fluids (e.g., hydrocarbons or saline fluids) from one aquifer and transportation either to another aquifer or the surface, resulting in an impact that requires remediation	Coal seam gas (CSG) wells	Failure of water bores
NC&CPG Geochem1	Failure of plug and abandonment seals leads to groundwater deterioration	Failure of plug and abandonment seals leading to the escape of fluids (e.g., hydrocarbons or saline fluids) from one aquifer and transportation either to another aquifer or the surface, resulting in an impact that requires remediation	Conventional petroleum and gas wells and non-conventional wells other than CSG wells (e.g., shale, geothermal, carbon sequestration)	Failure of water bores
Exploration Geochem1	Failure of plug and abandonment seals leads to groundwater deterioration	Failure of plug and abandonment seals leading to the escape of fluids (e.g., hydrocarbons or saline fluids) from one aquifer and transportation either to another aquifer or the surface, resulting in an impact that requires remediation	Mining exploration wells.	Failure of water bores

Appendix 3: Likelihoods applied to credible risk events in the calculator

		Likelihood value range		
Risk Type	Feature	Low	Medium	High
Geotechnical	Processed waste emplacement	10 ⁻⁶ Almost impossible	5 x 10 ⁻⁵ Very unlikely to highly improbable	10 ⁻³ Unlikely
	Water holding structure			
	Waste facility			
	Waste rock emplacement	10 ⁻⁵ Highly improbable	10 ⁻⁴ Very unlikely	10 ⁻³ Unlikely
	Open void			
	Underground void			
Geochemical and contamination	Waste facility	10 ⁻⁶ Almost impossible	5 x 10 ⁻⁵ Very unlikely to highly improbable	10 ⁻³ Unlikely
	Processed waste emplacement			
	P&G wells (pre-Code)	10 ⁻⁶ Almost impossible	10 ⁻⁵ Highly improbable	10 ⁻⁴ Very Unlikely
	P&G wells (in accordance with Code)	10 ⁻⁷ <i>de minimis</i>	10 ⁻⁶ Almost impossible	10 ⁻⁵ Highly improbable
	Mining exploration bores	10 ⁻⁵	10 ⁻⁴	10 ⁻³
	Open void	Highly improbable	Very Unlikely	Unlikely
Spontaneous combustion	Waste rock emplacement	10 ⁻⁶	5 x 10 ⁻⁵	10 ⁻³
	Open void			
	Underground void			
Water treatment	Processed waste emplacement	Almost impossible	Very unlikely to highly improbable	Unlikely
	Waste rock emplacement			
	Open void			