Appendix O

Drawdown impacts in landholder bores – proposed ‘make good’ provisions

Drawdown in landholder bores

Proposed 'make good' provisions

Prepared for Hume Coal Pty Limited | 14 February 2017

Drawdown in landholder bores

Proposed 'make good' provisions

Prepared for Hume Coal Pty Limited | 14 February 2017

Ground Floor, Suite 01, 20 Chandos Street
St Leonards, NSW, 2065

T +61 2 9493 9500
F +61 2 9493 9599
E info@emmconsulting.com.au

www.emmconsulting.com.au

Drawdown in landholder bores

Final

Report J14136RP4 | Prepared for Hume Coal Pty Limited | 14 February 2017

Prepared by	**Liz Webb**	Approved by	**Nicola Fry**
Position	Director	Position	Associate Hydrogeologist
Signature		Signature	
Date	14 February 2017	Date	14 February 2017

Document Control

Version	Date	Prepared by	Reviewed by
DRAFT	21 July 2016	Liz Webb	Not reviewed
DRAFT	14 October 2016	Liz Webb	Nicola Fry
FINAL DRAFT	25 November 2016	Liz Webb	Nicola Fry
FINAL	14 February 2017	Liz Webb	Nicola Fry

T +61 (0)2 9493 9500 | F +61 (0)2 9493 9599

Ground Floor | Suite 01 | 20 Chandos Street | St Leonards | New South Wales | 2065 | Australia

www.emmconsulting.com.au

Table of contents

Appendices

Tables

Figures

1 Introduction

Hume Coal Pty Limited (Hume Coal) proposes to develop and operate an underground coal mine and associated mine infrastructure (the 'project') in the Southern Coalfield of NSW. The project has been developed following several years of technical investigations to define the mineable resource, and identify and address potential environmental, social and economic constraints.

As part of the project approval a water assessment is being prepared that documents the groundwater and surface water assessment methods and results, and the initiatives to avoid and mitigate water-associated impacts. A regional numerical groundwater flow model has been developed as part of the water assessment (Coffey 2016). This has identified and quantified the project's potential impacts on the water resources and users (including environmental and landholder users).

Landholder bores are common in the project area and surrounds, with 363 landholder bores registered in a 9 km radius of the mine (DPI Water 2015). The dominant licensed purpose is for domestic and stock. The radius of 9 km was selected following review of the results of the groundwater model as this provided an area well outside the maximum predicted extent of the area where the water level in bores was drawn down by at least 2 m.

The groundwater model assesses all registered bores, as recorded in the official DPI Water database (DPI Water 2015). It is possible bores may have been drilled without the correct water licence or approval, and/or without submitting the required *Form A – Particulars of completed works*. Unregistered and unlicensed bores are unknown to Hume Coal and therefore could not be considered in this assessment.

Drawdown in this report refers to the change in the water level (pressure head) in a bore over a period of time. Drawdown is occurring in the area due to a combination of climate, existing landholder pumping and ongoing take of water by Berrima Colliery. The model assesses the drawdown in each landholder bore over the time period of the model under various scenarios. The groundwater numerical model considers all 363 landholder bores and where drawdown occurs at a bore it provides data at six monthly time-steps.

The AIP minimal impact criteria requires the project to consider its own effects on bores where drawdown of greater than 2m are created. This occurred at 93 landholder bores on 71 properties as a direct result of the project i.e. impacts greater than 2m drawdown.

Where predicted impacts at a bore are greater than the minimal impact criteria (of 2m), the bore is subject to further investigations and potentially 'make good' provisions. Make good provisions for landholder bores are estimated and proposed in this document based on modelled and assumed information. As actual 'make good provisions' are not defined in the AIP or other NSW legislation, guidance has been sought from an AIP Fact Sheet (DPI Water 2014) and the Queensland Government's make good guidelines.

The effect of drawdown at each bore has been assessed, bore by bore, using a desktop investigation and considering aspects such as:

- total depth of bore;
- assumed depth of pump;
- available water column and drawdown on the water column;
- closeness to mine workings;

- magnitude and duration of predicted impact (ie how much time the impact is greater than 2 m); and
- the licensed use/purpose of the bore.

By applying the concept of make good for landholder bores, the drawdown effects are mitigated, and a landholder's access to water for farming and other purposes is not compromised.

Individual on-site bore assessments are the next step required to confirm or update the bore attributes against the attributes in the DPI Water database.

1.1 Project area geology and hydrogeology

Reference to the *Southern Coalfield 1:100,000 Geological Series Sheet* (Moffit 1999) indicates the project area is in the Permo-Triassic Sydney Basin, and Triassic sedimentary units mainly outcrop. The Triassic sedimentary units comprise the Hawkesbury Sandstone and the Wianamatta Group, Ashfield Shale. The Ashfield Shale outcrops over much of the eastern project area and the Hawkesbury Sandstone outcrops in the west (Moffit 1999). The Hawkesbury Sandstone has been incised by creek channels. In the west both the Hawkesbury Sandstone and the underlying Permian Coal Measures are deeply incised by watercourses, with Permian coal outcropping in some areas. The underlying Permian sequences consist of the Illawarra Coal Measures, (and contains the Wongawilli Seam, which will be mined by the project,) and the underlying Shoalhaven Group.

The hills to the immediate south of the project area comprise remnants of Tertiary Robertson Basalt flows that overly the Wianamatta Group (Moffit 1999).

The groundwater units within the project area are defined as:

1. localised low permeability groundwater systems associated with the Robertson Basalt and Wianamatta Group shales;
2. regional porous fractured rock groundwater system associated with the Hawkesbury Sandstone; and
3. localised water bearing zones associated with the Illawarra Coal Measures and the Shoalhaven Group.

2 Regulation, policies and strategies

2.1 *Water Management Act 2000*

The *Water Management Act 2000* (WMA 2000) is based on the principles of ecologically sustainable development, and the need to share and manage our water resources for future generations. The WMA 2000 recognises that water management decisions must consider: economic, environmental, social, cultural, and heritage aspects. The WMA 2000 also recognises that using water sustainably and efficiently brings economic and social benefits to NSW.

The WMA 2000 provides for water sharing between different water users, be they environmental, basic rights or existing water access licence holders. The core provisions of the WMA 2000, section 23, that are relevant here are:

> The water use provisions of a management plan for a water management area must deal with the following matters:
>
> > (a) the identification of existing and potential water use practices and related activities;
> >
> > (b) the identification of those uses and activities which have adverse impacts, including cumulative impact, on water sources or their dependent ecosystems or on other water users;
> >
> > (c) the identification of the occurrence of land degradation, including soil erosion, compaction, geomorphic instability, contamination, acidity, waterlogging, decline of native vegetation or, where appropriate, salinity within the area and any impacts on water sources

The WMA 2000 refers to the term 'make good' but only in relation to protection of the environment in section 353B, where it states:

> The court may order the offender to take such steps as are specified in the order, within such time as is so specified (or such further time as the court on application may allow):
>
> > (a) to prevent, control, abate or mitigate any harm to the environment caused by the commission of the offence; or
> >
> > (b) to make good any resulting environmental damage; or
> >
> > (c) to prevent the continuance or recurrence of the offence.

The WMA 2000 in section 364A considers penalties that can be applied in respect of impacting the rights of others. The WMA 2000 states:

> (1) In imposing a penalty on a person for an offence against this Act or the regulations, the court is to take into consideration the following (so far as they are relevant):
>
> > (a) the impact of the offence on other persons' rights under this Act;
> >
> > (b) the market value of any water that has been lost, misused or unlawfully taken as a consequence of the commission of the offence;

(c) the extent of the harm caused or likely to be caused to the environment (including, in particular, any water source or waterfront land) by the commission of the offence;

(d) the practical measures that may be taken to prevent, control, abate or mitigate that harm;

(e) the extent to which the person could reasonably have foreseen the harm caused or likely to be caused to the environment by the commission of the offence;

(f) the extent to which the person had control over the causes that gave rise to the offence;

(g) whether the offence was committed during a severe water shortage (that is, in contravention of an order in force under section 49A or 324);

(h) the person's intentions in committing the offence;

(i) whether, in committing the offence, the person was complying with orders from an employer or supervising employee;

(j) in the case of an offence of taking water in contravention of this Act, whether the water so taken had been released for environmental purposes and, if so, whether the person was aware of that fact; and

(k) any civil penalty that has been imposed on the person under section 60G in relation to the conduct from which the offence arises.

The WMA 2000 does not define the term make good in respect of existing extractive users or the environment.

2.2 Aquifer Interference Policy

The NSW Government released the Aquifer Interference Policy (AIP) in 2012. The AIP explains the Minister's role and requirements for aquifer interference activities when administering the WMA 2000. The AIP essentially:

- clarifies the requirements for licensing water intercepted during aquifer interference activities (such as mining, quarrying, dewatering for construction); and
- defines and establishes 'minimal impacts' for water-related assets (such as existing bores and groundwater dependent ecosystems).

The AIP defines water sources as being either 'highly productive' or 'less productive' based on yield and salinity. It defines highly productive water sources as those that have:

- levels of salinity of less than 1,500 mg/L; and
- bore yields of greater than 5 L/sec.

The groundwater source in the project area generally has salinity levels of less than 1,500 mg/L (except for the Wianamatta Group shale), and a median bore yield within 9 km of the project of 2 L/sec, according to the DPI Water database (DPI Water 2015).

These attributes would typically classify the area as being 'less productive'. However, DPI Water's (2012) map of groundwater productivity in NSW indicates the area surrounding the project is considered a 'highly productive' groundwater source, and so this criterion has been used to assess the project.

The AIP also defines groundwater sources by their geological providence as being either: alluvium, coastal sand, porous rock or fractured rock. The project is considered a 'highly productive' porous rock system.

The AIP then discusses an activity's impact as either being within 'level 1 minimal impact' or 'level 2 exceeding minimal impact'. The definition of minimal impact is outlined in a series of tables that show how the criteria are applied for different types of water sources and for different sensitive receptors (ie other users, and ecosystems). The defined minimal impact criteria are shown in Table 2.1.

If an activity is assessed as being minimal impact, then the project is considered to have impacts that are acceptable. Where an activity is assessed as being 'greater than minimal impact' but impacts are no more than the accuracy thresholds of the model, then this is also considered to be minimal impact.

Where impacts are predicted to be 'greater than minimal impact', then more studies are required to fully understand the predicted impact. If this assessment shows the predicted impacts, although greater than minimal, do not prevent the long-term viability of the relevant water-dependent asset, as defined in Table 2.1, then the impacts will be considered acceptable.

The initial desktop investigation considered bores potentially affected by greater than 2 m drawdown as having potential for greater than minimal impact. More studies are therefore being conducted for those bores that are predicted be affected by greater than 2m to fully understand the potential affects and consider optimal mitigation or make good strategies tailored for each bore/landholder.

Where they are predicted to be greater than minimal impact and the long-term viability of the water-dependent asset is compromised, then the impact is subject to make good provisions. The make good provisions referred to in the AIP are not defined in the AIP or in the WMA 2000.

Table 2.1 Minimal impact criteria for 'highly productive' porous rock

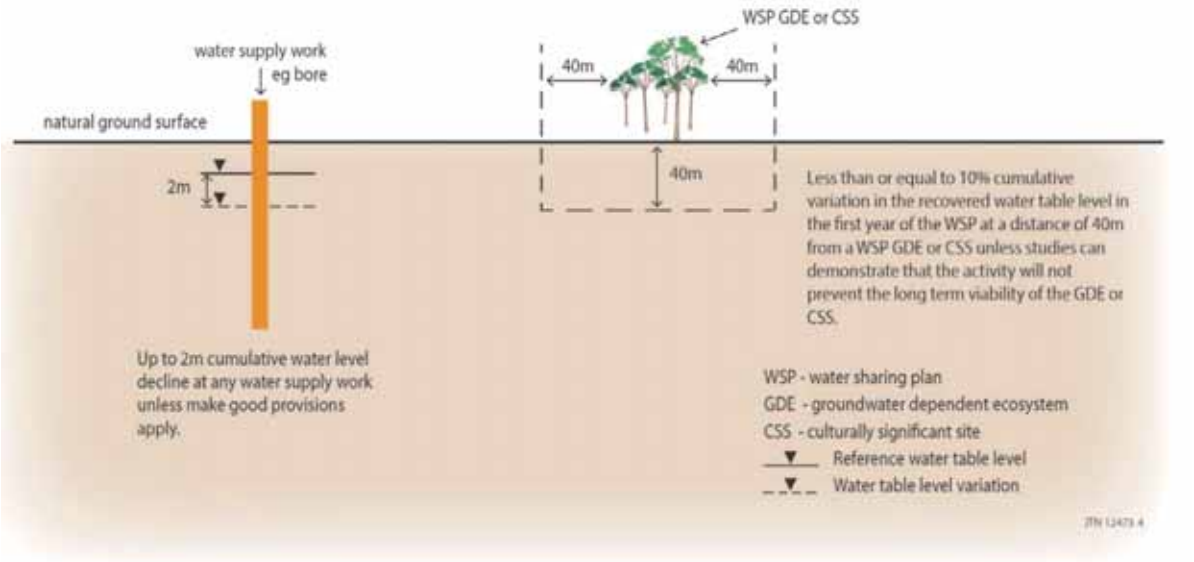
Water table	Water pressure	Water quality
1. Less than or equal to 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40 m from any: (a) high priority groundwater dependent ecosystem; or (b) high priority culturally significant site listed in the schedule of the relevant water sharing plan. A maximum of a 2 m decline cumulatively at any water supply work. 2. If more than 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40 m from any: (a) high priority groundwater dependent ecosystem; or (b) high priority culturally significant site; listed in the schedule of the relevant water sharing plan if appropriate studies demonstrate to the Minister's satisfaction that the variation will not prevent the long-term viability of the dependent ecosystem or significant site. If more than a 2 m decline cumulatively at any water supply work then make good provisions should apply.	1. A cumulative pressure head decline of not more than a 2 m decline, at any water supply work. 2. If the predicted pressure head decline is greater than requirement 1 above, then appropriate studies are required to demonstrate to the Minister's satisfaction that the decline will not prevent the long-term viability of the affected water supply works unless make good provisions apply.	1. Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity. 2. If condition 1 is not met then appropriate studies will need to demonstrate to the Minister's satisfaction that the change in groundwater quality will not prevent the long-term viability of the dependent ecosystem, significant site or affected water supply works.

2.3 Other relevant guidelines

2.3.1 The NSW Government AIP Fact Sheet 4

The NSW Government AIP Fact Sheet 4 (NOW 2013) describes the definition of minimal impact. Figure 2.1, sourced from the fact sheet, illustrates how the minimal impact criteria are applied to both a water supply work and a groundwater dependent ecosystem (GDE) defined in a water sharing plan. The fact sheet also defines the term make good.

> Make good provisions – the requirement to ensure third parties have access to an equivalent supply of water through enhanced infrastructure or other means for example deepening an existing bore, funding extra pumping costs or constructing a new pipeline or bore (NOW 2013).



Source: NOW 2013

Figure 2.1 Porous or fractured rock groundwater source – minimal impact consideration

2.3.2 NSW make good guidelines (yet to be published)

DPI Water is drafting make good guidelines to define what strategies and approaches are acceptable for making good on impacts greater than the minimal impact criteria. The guidelines are likely to include both options the NSW Government considers acceptable on make good, and also define what impacted parties can expect, and what is expected to be offered by impacting proponents. The policy will also help define what is an unrealistic expectation of make good.

2.3.3 Queensland Government guidelines

The Queensland Department of Environment and Heritage Protection released a guideline in 2016 on make good provisions for coal and petroleum activities (DEHP 2016). Given NSW does not have any guidelines, this has been used to inform the process for Hume Coal to make good on impacts to water-related assets as a result of the project.

The guideline requires proponents to follow four steps:

1. undertake individual bore assessments (in accordance with the bore assessment guideline and the baseline assessment guidelines (DEHP 2013));

2. enter into a legally binding make good agreement;

3. comply with the agreement; and

4. negotiate any requested variations to the make good agreement.

The baseline bore assessment is rigorous and requires landholders to allow access to their bores (Appendix A).

The Queensland make good requirements have adopted policy positions for make good of impacts to bores. These are likely to be similar, but not necessarily the same in NSW. The policy positions adopted in QLD are:

- Monetary compensation should consider the long-term viability of the land use, and the impact this might have on land value.

- Monetary compensation could also be used to improve other water infrastructure on the land.

- Mining proponents are not responsible for making good impairment that results from the poor maintenance of a bore (eg a bore with a collapsed or rusted casing).

- Multiple factors may limit a bore's ability to supply water (eg a bore with casing in poor condition may function suitably when water levels are high, but lowered water levels result in the bore collapsing due to rusted casing). In these cases it is proposed to share costs in proportion to the respective costs required. Either via:

    - the proponent paying for the costs of drilling a new bore, minus the cost for the bore owner to fix the existing problem; or

    - the proponent assesses a bore and provides appropriate make good measures when the bore owner fixes the problem with the existing bore.

Make good measures are not influenced by the degree to which a bore owner uses the supply. The main issue is the authorised capacity of the bore, and the level to which this capacity is impaired, or is likely to be impaired. For example, a functioning bore used at times of short water supply is still entitled to the same reasonable quality and quantity of water for its authorised use or purpose as if it was required for frequent use.

2.4 Strategies for make good

Strategies for potential make good measures to provide landholders to a reasonable quantity and quality of water that fits with the bore's authorised use include:

- making a financial contribution for increased pumping costs (increased power consumption) as a result of a lower water level;
- adding a rising main to lower the pump intake in the bore;
- supplying new headworks and piping to create a more efficient system;
- changing the pump so that it is better suited to or more efficient with a decreased water level in the bore;
- deepening the bore to allow it to tap a deeper part of the aquifer;
- reconditioning the bore to improve its hydraulic efficiency;
- drilling a new bore to a different depth or wider diameter;
- drilling a new bore in a different location on the property;
- providing an alternative water supply by:
    - constructing a farm dam (within existing licensing constraints);
    - installing tank/s and providing water (pipeline/carting/dams); and
    - installing infrastructure on/around existing buildings (eg sheds, houses) to better capture and store rainfall.
- planning to monitor the water bore, for example, by periodically assessing it to determine if/when impacts occur; and
- providing the water bore owner with compensation (monetary or otherwise) for the bore's impaired capacity.

2.5 Dispute resolution

The make good arrangements are a negotiated outcome between Hume Coal and the impacted bore owner. The initial areas of likely dispute include:

- landholder refusing access for initial or future assessment of bore condition;
- landholder refusing to discuss options or to enter into an agreement;
- misaligned expectations of compensation or make good suggestions; and
- disagreement on initial bore conditions.

The process for resolving disputes will include a make good 'contract'. However, if no contract exists, and the dispute is over the development of the initial contract, then the process is likely to be:

- facilitated negotiation;
- formal mediation;
- expert determination or arbitration; and
- the NSW Land and Environment Court.

Dispute resolution typically starts with negotiations and then facilitated mediation. If these are unsuccessful then expert determination or arbitration may be used. Expert determination is a merit-based determination by an independent party who knows the subject matter. Arbitration is an assessment of the legal facts (ie contract determination), and would be most likely used once an existing contract is in place.

3 Hume Coal Project landholder bore assessment

3.1 Groundwater modelling

3.1.1 Regional model

A complex, regional numerical groundwater flow model was developed for the project in accordance with the AIP requirement to inform predicted groundwater impacts. A substantial database of observations compiled from data provided by Hume Coal and obtained from published sources was analysed to build the numerical model, and then calibrate and refine the model. The model estimates mine inflows and drawdown associated with mine dewatering. This was used to simulate water level changes on the groundwater system and sensitive receptors (ie landholders and environmental users).

The model was developed using MODFLOW-SURFACT Version 3 (Hydrogeologic) in early 2015, and has undergone multiple refinements (Coffey 2016). It conforms to the majority of criteria for Class 3 models, as per the criteria in the *Australian groundwater modelling guidelines (*Barnett et al. 2012*)*, with the remaining aspects conforming to Class 2 criteria. The model domain covers an area of 752 km^2 and has 13 active grid layers.

Predictive assessment simulations were run for a 100-year period for the most probable future mining and environmental scenarios (ie first working mining method and average rainfall). The model and subsequent analysis calculated changes to groundwater hydraulic head under various scenarios, including:

- **existing extraction only drawdown**- this scenario assumes no Hume Coal project, and is the base case for assessing effects of the mine;
- **total cumulative drawdown** – effects from Hume Coal Project mine dewatering, and the existing stresses of drainage to the Berrima Colliery void and landholder pumping; and
- **Hume only drawdown** – effects from Hume Coal Project mine dewatering only.

The Hume only drawdown (ie project only drawdown) is relevant for assessing how much the project itself will lower levels in landholder bores and is what needs to be considered developing make good measures. For transparency and comparison, the total cumulative drawdown is also provided, and shows drawdown predictions from all extractive users including the project.

3.1.2 Basalt model

A tailored separate numerical basalt model was developed to calculate drawdown in the basalt associated with the project. The model was developed with MODFLOW-SURFACT Version 3, with a model domain of 15 km^2 and a boundary that followed the south-eastern basalt body. The model grid comprised two layers (Robertson Basalt and a notional underlying later) (Coffey 2016). Project drawdown was predicted in one landholder bore; although as this was less than 2 m it did not exceed the AIP minimal impact criteria.

3.2 Water level drawdown

The AIP 2 m drawdown minimal impact criterion is predicted to be exceeded in 93 landholder bores on 71 properties as a result of the project.

The number of the affected bores and their respective screened geology are included in Table 3.1. This includes the maximum project drawdown and time until maximum drawdown. Figure 3.1 shows the distribution of modelled maximum project drawdown at landholder bores.

The area of greatest drawdown migrates according to worked areas. The greatest drawdown of the water table occurs about 17 years after mining begins. At this time, the area where the water table is subject to 2 m drawdown or more extends 2 km past the south-east corner of the mine's footprint. The water table largely recovers to 2 m drawdown or less over most of the area within about 60 years after the start of mining.

Most of the impacted landholder bores target the Hawkesbury Sandstone, the most productive formation. Out of the total 93 bores, only four do not fully or partially screen the Hawkesbury Sandstone (Table 3.1).

There are four landholder bores that will be physically intercepted by the actual mine workings; they are included in those bore that need to be redrilled and potentially relocated.

Table 3.1 Number of bores affected per formation of groundwater extraction

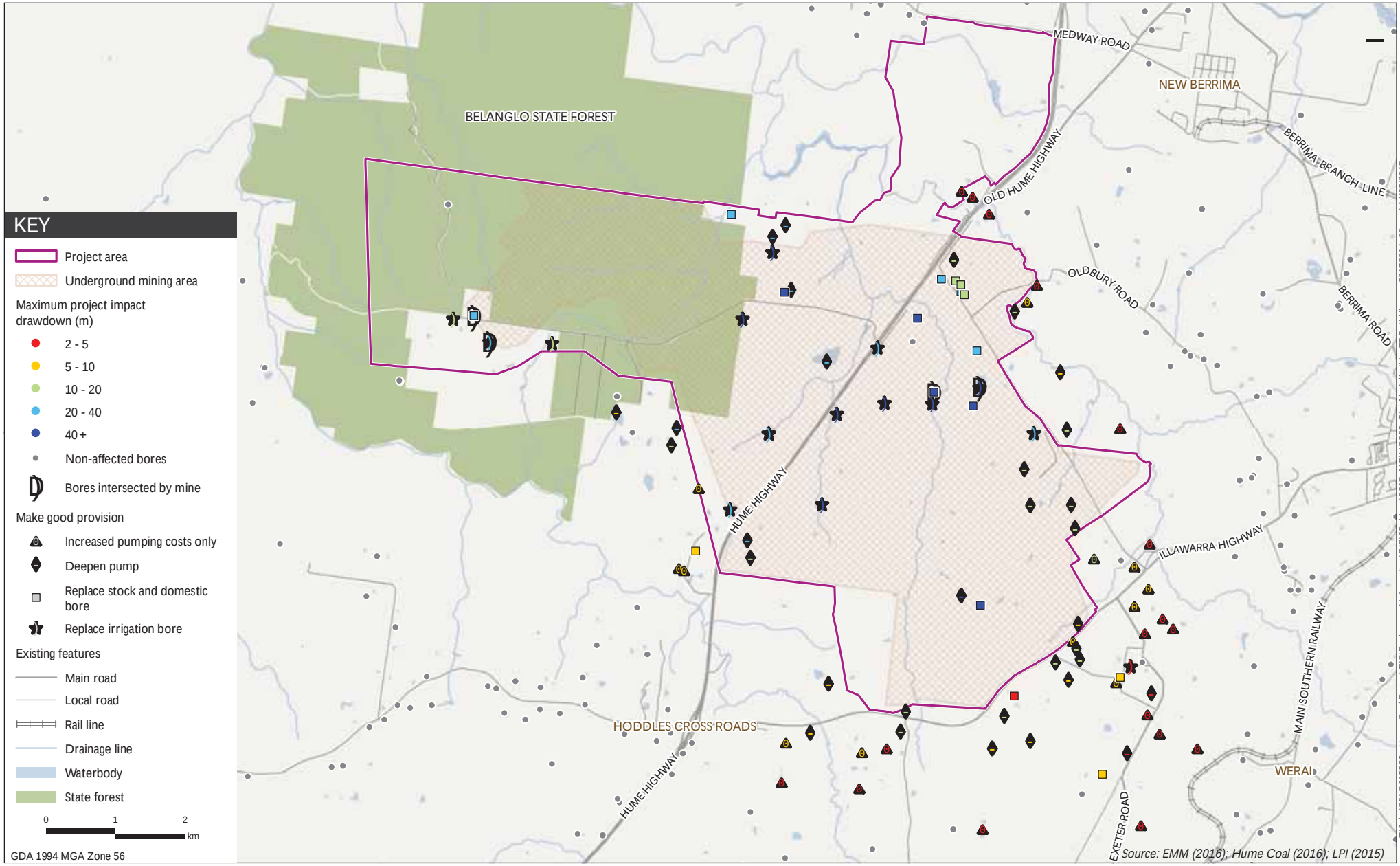
Formation of groundwater extraction	Number of bores
Wianamatta Group	3
Wianamatta Group and Hawkesbury Sandstone	7
Hawkesbury Sandstone	71
Hawkesbury Sandstone and Illawarra Coal Measures	11
Illawarra Coal measures	1

3.3 Water quality

The AIP defines minimal water quality impact as 'any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity'. The project is within an upland recharge environment, and, as such, the groundwater quality is fresh. It has a beneficial use of irrigation and raw potable supply.

The hydrogeochemical assessment concluded the project would not result in significant changes to the groundwater chemistry and would not change the beneficial use class (Geosyntec 2016). The hydrogeochemistry study considered both the effects of more saline water leaking through the Wianamatta Group shale, and the effects of emplacing co-disposed reject underground and pumping water into sealed voids.

The assessment concluded there are no predicted chemistry changes to landholder bores from the mine's operation.



Project drawdown and proposed make good provisions

Hume Coal Project

Proposed 'make good' provisions

Figure 3.1

3.4 High priority groundwater dependent ecosystems

There are no high priority groundwater dependent ecosystems within the predicted drawdown or depressurised areas of the project (EMM 2016c).

4 Preliminary make good provisions

4.1 Defining drawdown impact

The AIP defines an activity is assessed as having a 'greater than minimal impact' if a greater than 2 m drawdown occurs as a result of the project and any other "post water sharing plan" variations. In the case of the project, the effect of the project only drawdown is the only post-water sharing plan variation to consider.

The groundwater model (Coffey 2016) was used to estimate the drawdown on each registered bore within the model domain. Those with a maximum drawdown of 2 m or greater have been assessed and considered for make good arrangements.

4.2 Assessment criteria

Drawdown was calculated within the groundwater model (Coffey 2016) based on an extract of bores from the DPI Water database (DPI Water 2015). A dataset was collated and a series of steps and questions were developed to make a preliminary desktop assessment of each bore.

The desktop assessment:

1. Extracted data from the DPI Water groundwater database (DPI Water 2015) incorporating an area larger than total area of impact of the mine, as predicted in the groundwater model.

2. Analysed each bore's construction details:

    a) if a construction log is available, then the screened interval, or area of open hole is documented;

    b) where no construction detail is available, the drillers log and/or the total depth of the hole was used to determine the likely screened/ open hole interval; and

    c) if the bore has no construction details, no log, and no total depth then it is assumed the bore screens the entire section of Hawkesbury Sandstone at that location.

2. Cross-referenced the bore screened area/open area with the respective model layer/s.

3. Ran the groundwater model, and output drawdown predictions for each bore over time.

4. Assessed bores for relevance – remove monitoring bores, test bores, and bores on Hume Coal land from the dataset. The project effects result in 93 bores having maximum drawdown of greater than 2 m (not including bores owned by Hume Coal).

5. Assessed bores that will be intersected, or within 14 m of the mine workings, which are assumed to be adversely impacted. The value of 14m was derived as an appropriate distance to maintain bore integrity. It is recommended to relocate and redrill these bores as the preliminary make good strategy.

6. Assigned the depth of pump to each bore. The depth of bore pumps is not recorded on the DPI Water database, so the desktop assessment assumed the pump depth for each bore is 75% of the bore depth.

7. Reviewed the maximum drawdown predicted at each bore and assigned preliminary make good strategies:

    a) **Increased pumping costs only**: those bores where the maximum predicted drawdown results in less than 80% of the original hydraulic head and greater than 10 m of hydraulic head above the pump (where the pump is at 75% of the total bore depth). These bores are assumed to not need any capital works but require compensation for increased pumping costs (Figure 4.1).

    b) **Deepen pump (and increased pumping costs)**: those bores where the maximum predicted drawdown results in greater than 80% of the original hydraulic head and/or less than 10 m of hydraulic head above the pump (where the pump is at 75% of the total bore depth) *and* when the pump is lowered to 90% of the total bore depth there is less than 80% of the original hydraulic head and greater than 10 m of hydraulic head above the pump (at the greater depth). These bores are assumed to be fully functional provided the pump is lowered, and increased pumping costs provided (Figure 4.2).

    c) **New bore**: those bores where the maximum predicted drawdown results in greater than 80% of the original hydraulic head and/or less than 10 m of hydraulic head above the pump (where the pump is at 90% of the total bore depth). These bores are assumed to not be functional and need to be either relocated or redrilled to a different depth. New bores are also proposed for those bores that either intersect the mine workings or are within 14 m of the mine workings (Figures 4.3 and 4.4). Options for new bores are:

        i) potential new borehole location;

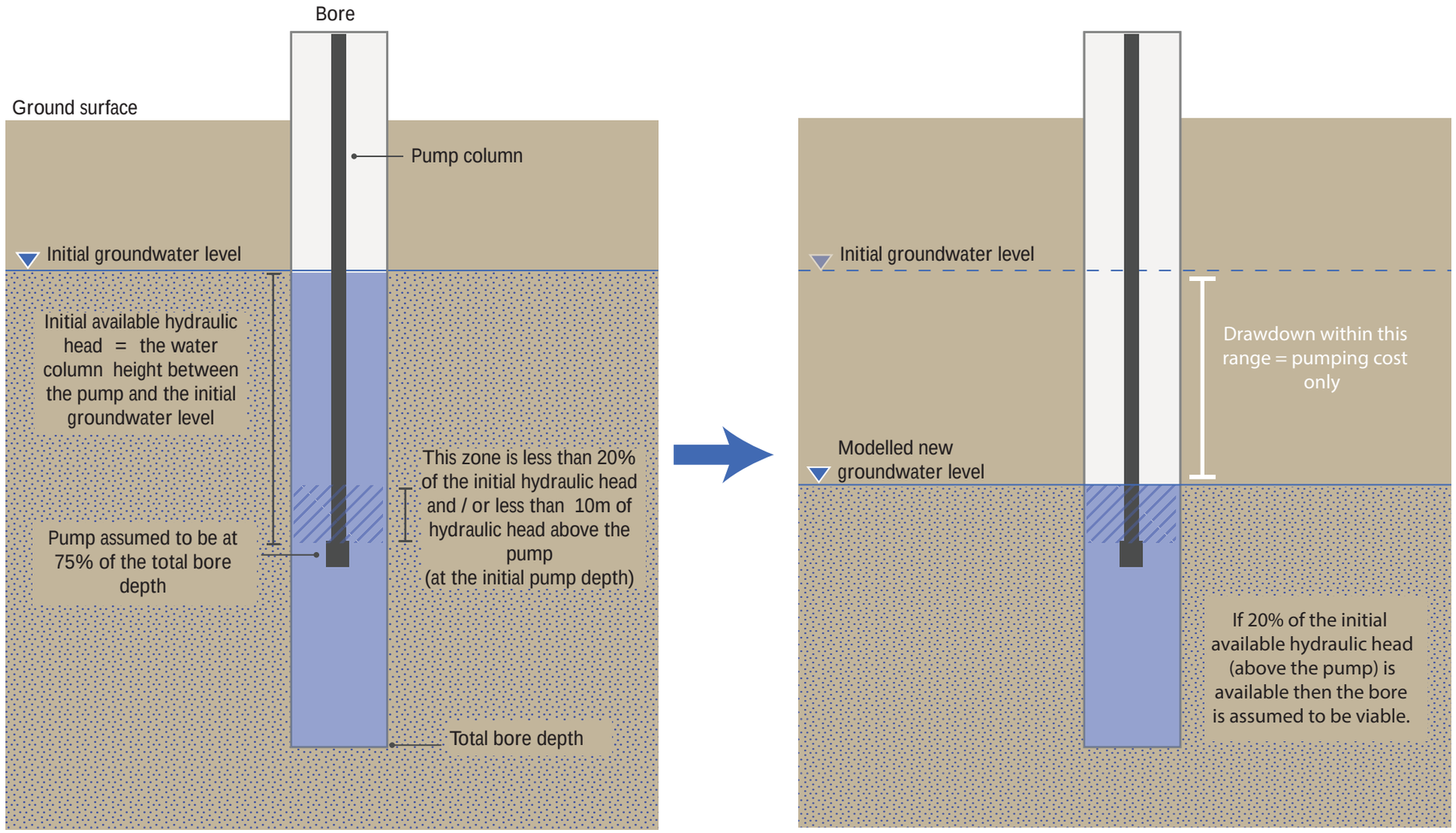
        ii) optimal borehole depth;

        iii) old and new bore related infrastructure required;

        iv) existing bore specifications (ie required diameter); and

        v) increased pumping costs.

The criteria used to determine the respective preliminary make good provisions for impacted bores are summarised in the flowchart presented in Figure 4.5 (which follows the assessment process from step 5, above).



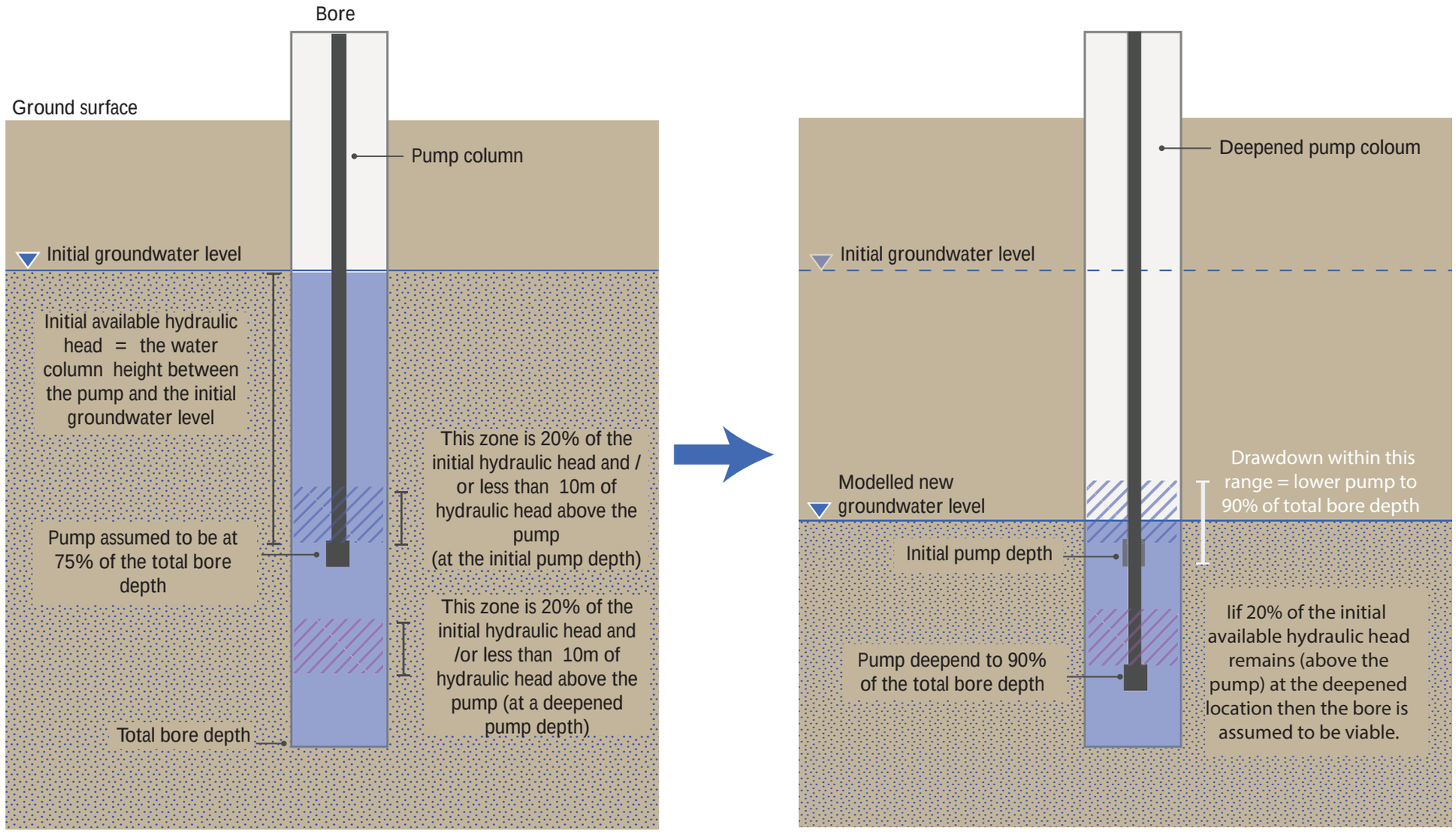
EMM HUMECOAL PROJECT

Make good strategy - increased pumping costs only

Hume Coal Project

Proposed 'make good' provisions

Figure 4.1



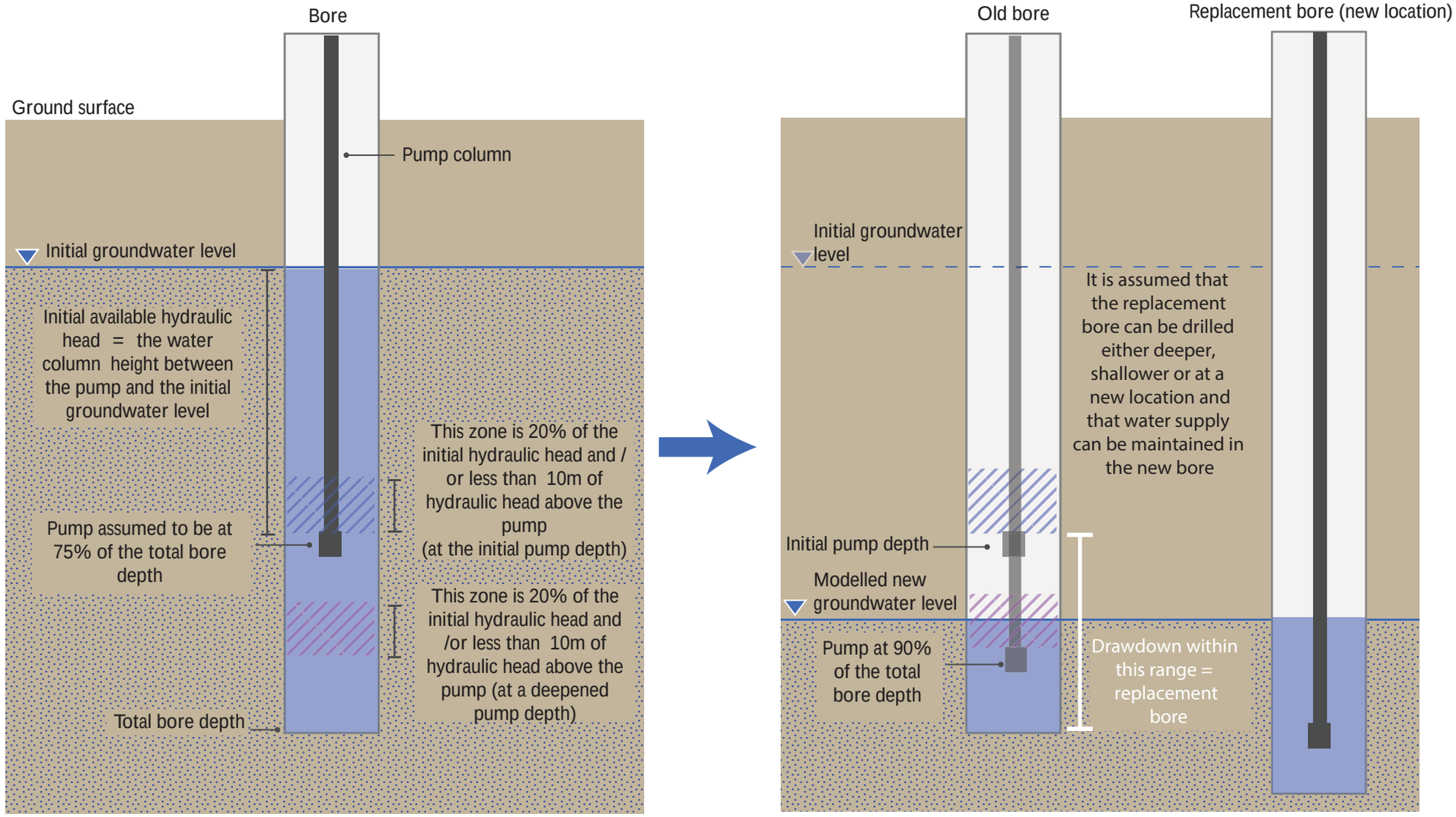
EMM HUMECOAL PROJECT

Make good strategy - deepen pump

Hume Coal Project

Proposed 'make good' provisions

Figure 4.2



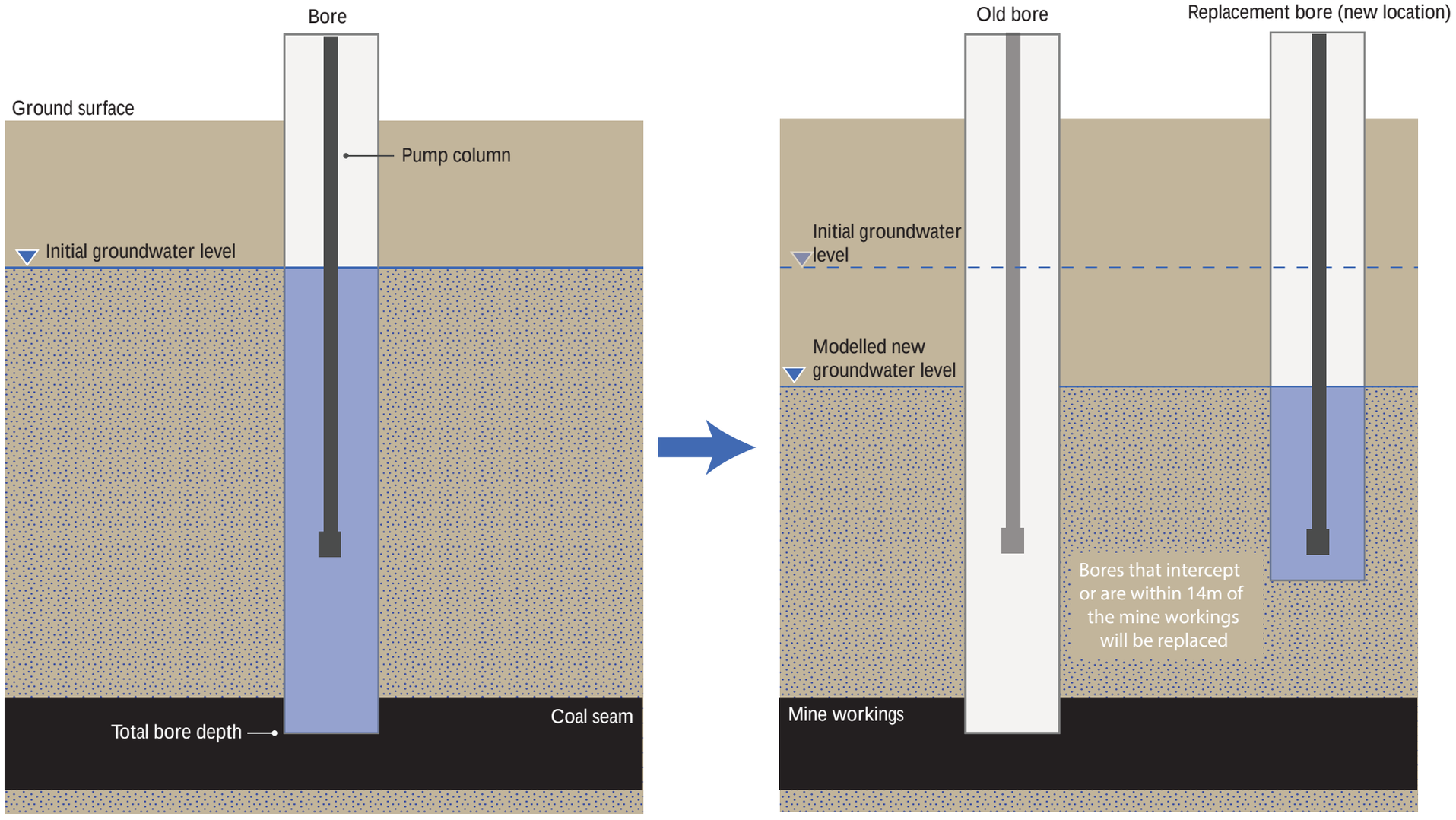
EMM HUMECOAL PROJECT

Make good strategy - replacement bore

Hume Coal Project

Proposed 'make good' provisions

Figure 4.3



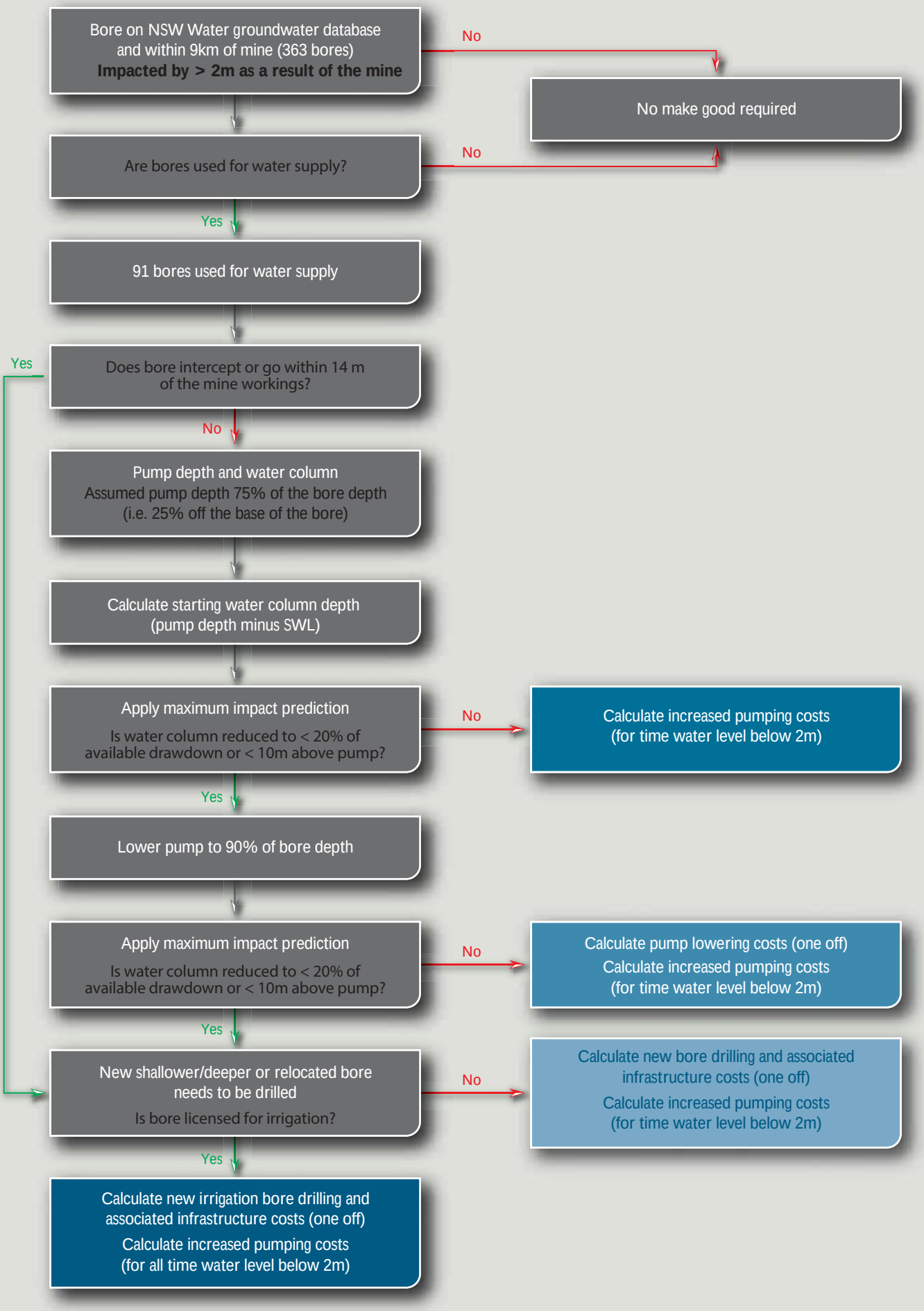
EMM HUMECOAL PROJECT

Make good strategy - replacement bore, intercepted mine workings

Hume Coal Project

Proposed 'make good' provisions

Figure 4.4



EMM HUMECOAL PROJECT

Flowchart of criteria and process for bore assessment

Hume Coal Project
Proposed 'make good' provisions
Figure 4.5

4.3 Results of preliminary make good impact assessment

Drawdown is predicted and considered based on two scenarios.

1. The second scenario **'total cumulative'** is that the Hume Project runs simultaneously with all existing landholder pumping in the area, and ongoing take by Berrima Colliery (this provides 'total cumulative effects').

2. The third analysis scenario **'Hume only'** assumes that the Hume Project runs, but all background landholder pumping and Berrima Colliery is switched off. This scenario is provides information on the 'Hume only' effects on landholder bores).

Drawdown and associated impacts to groundwater users (environmental and landholder) are assessed under the *Aquifer Interference Policy* (AIP) 2012. The AIP minimal impact criteria equates to drawdown of not more than 2 m at any water supply work. The above three scenarios are analysed using the predicted drawdown in bores that are in excess of 2m, and the results are presented in Table 4.1.

Table 4.1 Summary of modelled scenarios

Scenario	Bores effected by > 2m	Comments
Total cumulative	109	Drawdown in a result of existing pumping and ongoing take from Berrima Colliery, as well as the Hume Coal project. Total cumulative impact is assessed to ensure that all additional effects on bores can be considered holistically together with the project effects. This full impact is not necessarily subject to 'make good' provisions as bores are also affected by other causes.
Hume only	**93**	**This scenario provides the effect of the Hume project is on landholder bores. This is the scenario that the AIP requires proponents to assess (ie cumulative post water sharing plan) and is the reference point for initial consultation with landholders for make good provisions.**

The drawdown effects in the 93 bores as a result of the Hume project have been assigned one of three different make good provision strategies to each bore. These results are summarised in Table 4.2, and in detail in Appendix B, which shows the Hume only drawdown as well as the corresponding total cumulative drawdown, which is provided for comparison.

Individual bore hydrographs are provided in Appendix C. It should be noted the results of this make good assessment are based on a desktop assessment of registered bores only. After actual bore locations and details are confirmed the assessment will be revised (Section 5).

Table 4.2 Summary of proposed make-good provisions

Make good provision	Number of bores	Percentage of bores	Maximum drawdown (m)	Average years where drawdown is >2 m
1. Increased pumping costs	25	27%	8	22
2. Deepen pump and increased pumping costs	36	39%	60	40
3. Replace stock and domestic bore and increased pumping costs	17	18%	80	35
4. Replace irrigation bore and increased pumping costs	15	16%	59	39
Total/maximum/average	**93 (total)**		**18 (average)**	**34 (average)**

5 Make good framework

Following the results of the preliminary make good assessment described in Chapter 4, Hume Coal will consult affected landholders, verify the bores, and enter into make good agreements, where possible, before the Hume Coal Project starts operation. These steps are outlined below and presented in Figure 5.1.

5.1 Consultation

Consultation by Hume Coal to assess landholder bores is taking place. It began in late 2016 following the initial results of this desktop assessment of landholder bores. Landholders with affected bores (assessed to have a drawdown greater than 2 m as a result of the project) are being contacted via individual letters.

The make good assessment considers the predicted drawdown at registered bores within the DPI Water database. All bores drilled have to be registered and licensed as a legal requirement under the *Water Act 1912*. Under the *Water Management Act 2000*, to drill water supply bores requires a work and use approval and, depending on the intended use, may also require a Water Access Licence. Once a water supply bore is drilled (under both the *Water Act 1912* and the *Water Management Act 2000*) it is a requirement to submit the drilling details (via the drillers Form A) to DPI Water so they can be registered.

The make good assessment considers all registered bores, as per the official DPI Water database. It is possible bores may have been drilled without the correct water licence or approval, and/or without submitting the required Form A; any such unregistered and unlicensed bores could not be considered in this assessment.

Potentially affected landholders will continue to be consulted throughout the field verification (described below). Once verification is complete (and the bores reassessed for potential drawdown via updating landholder bore details in the model if necessary), the revised likely effect will then be confirmed and a formal make good agreement negotiated.

5.2 Verification

A thorough verification is required to allow detailed assessments of individual bores.

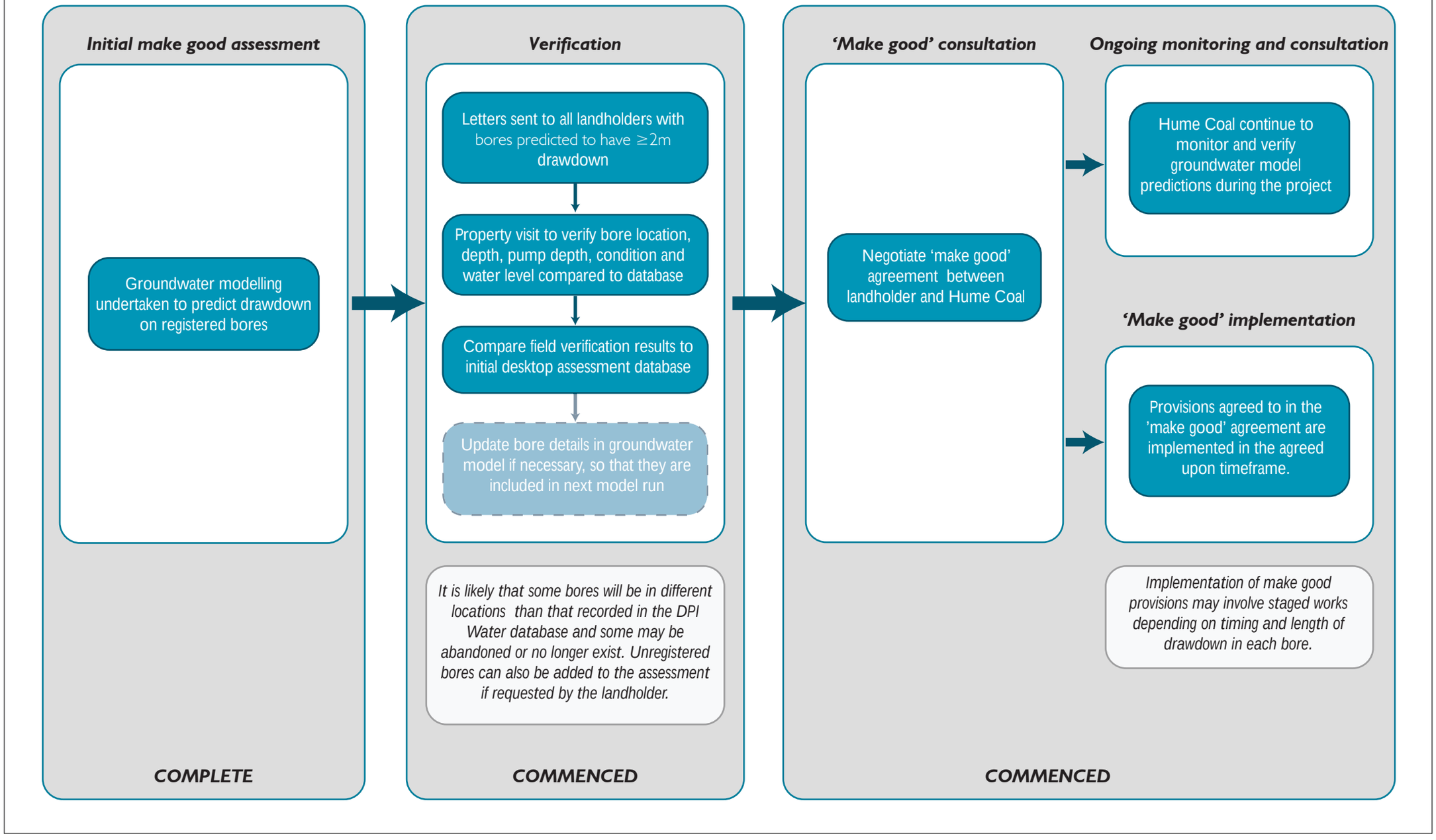
Individual bore verification assessments, including baseline assessments, will be used to define the current, pre-project conditions of each bore. In place of a NSW guideline or policy for bore assessments, Hume Coal has referenced the Queensland Department of Environment and Heritage Protection, Baseline Assessment Guideline (DEHP 2013).

The objective of the verification bore assessment is to collect information about the current (baseline) level and quality of groundwater in bores, and bore construction and pump details. This information is used as a measure of security for both bore owners and Hume Coal through understanding the current bore condition and providing a reference point for comparison with subsequent bore assessments. Bore assessments will be the basis of negotiations of make good arrangements and will be vital information if a compensation or impact dispute arises. A bore assessment template is included in Appendix A.

5.3 Make good agreement

Legally binding make good agreements will be negotiated between Hume Coal and the affected landholders, where possible. These will include specific make good measures and outline a timeframe of commitments. Negotiations will be made case-by-case.

Hume Coal will continue to monitor groundwater levels in dedicated monitoring bores and verify the model as mining progresses. This will allow the accuracy of drawdown predictions at landholder bores to be monitored and assessed over time.



EMM HUMECOAL PROJECT

Make good consultation process
Hume Coal Project
Proposed 'make good' provisions
Figure 5.1

6 Conclusions

This desktop assessment into the make good requirements of the project has been undertaken in accordance with the AIP, and results have been generated within the numerical groundwater model (Coffey 2016). There are 93 bores (on 71 properties) identified as being affected by more than 2 m of drawdown as a result of the Hume Coal mine. Strategies for make good are proposed for each individual bore based on depth and other factors. Strategies include; compensation for increased pumping costs, deepening bore pumps, and relocating or replacing bores.

The consultation and verification process has commenced for the project and the 71 potentially affected landholders have been in writing. Field investigations of each bore, and then negotiated make good agreements will be made.

References

Barnett B, Townley LR, Post V, Evans RE, Hunt RJ, Peeters L, Richardson S, Werner AD, Knapton A, and Boronkay A, 2012, *Australian groundwater modelling guidelines*, Waterlines Report Series, Number 82, National Water Commission, Canberra.

Coffey Geotechnics Pty Ltd 2016, *Hume Coal Project, Groundwater Assessment Volume 2: Numerical Modelling and Impact Assessment* GEOTLCOV 9 June 2016.

EMM Consulting Pty Ltd (EMM) 2016, *Hume Coal Project Biodiversity Assessment Report*. Appendix H of the *Hume Coal Project Environmental Impact Statement*. Prepared by EMM for Hume Coal Pty Ltd.

Geosyntec Consultants Pty Ltd (Geosyntec) 2016. *Hume Coal Project Hydrogeochemical Assessment*. Prepared by Geosyntec for Hume Coal Pty Ltd.

NSW Department of Primary Industries Water (DPI Water) 2015, PINNEENA Version 11.1 Groundwater Works database, NSW Government.

Moffit R S for the Mineral Resource Geological Survey of NSW 1999, *Southern Coalfields 1:100,000 geological sheet.*

NSW Department of Primary Industries (DPI) Water, 2012, Groundwater productivity in NSW, viewed 15 November 2016, www.water.nsw.gov.au/__data/assets/pdf_file/0008/547343/law_use_groundwater_productivity_nov_2012.pdf

NSW Department of Primary Industries Office of Water (NOW) 2012, *NSW Aquifer Interference Policy, NSW Government Policy for the licensing and assessment of aquifer interference activities*.

NSW Department of Primary Industries Office of Water (NOW) 2013, *Aquifer Interference Policy Fact Sheet 4, assessing the impacts*, NSW Government.

Department of Environment and Heritage Protection QLD (DEHP) 2013, *Baseline Assessment Guideline* Version 2, QLD Government.

2016, Quick guide: make good obligations, viewed 15 November 2016, www.ehp.qld.gov.au/management/pdf/good-obligations-guide.pdf.

Appendix A

Bore assessment criteria

Baseline bore assessment information

Note: If records are indicated as being 'available', they must be supplied as part of the baseline assessment.

PART A: DOCUMENT IDENTIFICATION AND BORE SITE INFORMATION		
Tenure holder	**Given name:**	**Surname:**
	Company name / Property name:	
	ABN (if applicable):	
Tenure	**Lot**	**DP**
Bore	**Bore name:**	**GW number:**
Date of site assessment:		
Location	**Easting:**	**Northing:**
	Location method: ☐ **GPS** ☐ **Surveyed** **Zone:**	
Status of works:	**Existing** ☐ **Abandoned but still usable** ☐ **Other:**	
Addition comments:		

PART B: BORE CONSTRUCTION DETAILS	
Are construction details available? ☐ **Yes** ☐ **No**	
If yes, then verify details (where possible) and supply in the format provided in the Date File Details document. If available, a copy of original log should also be provided. *If no, then complete this section based on the site inspection and reported information from the bore owner representative (if the information is not available then please leave blank)*	
Driller name:	**Drilling company:**
Date the bore was drilled:	**Depth of water bore** *(m)***:**
Water entry *(eg perforations, open hole, screens)***:**	**Water entry length:**
Casing material:	**Inside diameter** *(mm):*
Geological formation from which water is accessed:	
Additional comments:	

PART C: BORE EQUIPMENT AND CONDITION DETAILS					
Is the bore equipped with a pump? ☐ **Yes** ☐ **No** *If Yes then attach photo of surface mounted pumping equipment and well head and complete this section* *If No go to Part D*					
Pump type:			**Pump make and model:**		
Maximum pump capacity *(L/s)***:**					
Power source: ☐ **Electric motor** ☐ **Generator** ☐ **Direct engine** ☐ **Mains supply** ☐ **Windmill** ☐ **Solar**					
Pump intake depth *(depth from ground in metres)***:**					
Pumping rate at the time of visit *(L/s) (If possible, run the pump and measure the pumping rate)***:**					
Is the bore equipped with a meter?	☐ **Yes**	☐ **No**			
	Description				
Headworks description *(provide details on the size and type of riser pipe eg material, diameter, joint type, details of any connection to a reticulation system eg pipe sizes, distances, schematic, diagram, headworks; valves; flow meter)***:**					
Repairs/maintenance history *(provide any commentary on repairs/maintenance undertaken on the bore eg nature and date of work, who has undertaken the maintenance)***:**					
PART D: BORE WATER SUPPLY INFORMATION					
Purpose of bore *(select one or more)*	☐ **Stock** ☐ **Domestic** ☐ **Intensive livestock** ☐ **Irrigation** ☐ **Monitoring**				
	☐ **Other** *(please provide description)* **Description:**				
Usage	**Average volume used yearly (meter)** *(ML/y)*				
	Estimated volume used yearly *(ML/y)*				
	Estimated volume method description:				
Bore utilisation	**How often is the bore utilised** *(estimated hours pumped/day):*				
	Description *(provide information on operational capacity, seasonal variations, peak usage):*				

PART E: WATER LEVEL MEASUREMENT *(Attach landholder agreement)*		
Water level	**Water level** *(meters below top of casing):*	**Artesion pressure** *(KPa):*
	Water level (*meters below ground level)*:	**Method of measuring pressure:**
	Reference point and height of point above ground level *(metres):*	
	Reason not measured:	
Antecedent and/or current conditions relevant to the water level or pressure measurement:		
Are water level and/or pressure records available for this bore? ☐ **Yes** ☐ **No** **If so, type of records:**		
PART F: WATER QUALITY *(Please note that any measurement of water quality should only be undertaken after measuring the standing water level. Water quality parameters required to be sampled are detailed in the baseline assessment guideline.)*		
LABORATORY WATER QUALITY		
Were water quality samples taken for submission to a laboratory? ☐ **Yes** ☐ **No** *(provide reason)*		
Are the laboratory results for the samples indicated above supplied with this baseline assessment? ☐ **Yes** ☐ **No** *(provide reason)*		
Are historical water quality laboratory records available for this bore? ☐ **Yes** ☐ **No**		
FIELD WATER QUALITY		
Were water quality field measurements taken? ☐ **Yes** ☐ **No** *(provide reason)*		
Water quality meter used:		

Field measurements	**Units**	**Result**
pH:		
Temperature:		
Electrical conductivity:		
Dissolved oxygen:		
Dissolved oxygen:		
Redox:		
TDS:		
Other:		
Observations *(colour, smell):*		

Are historical water quality field records available for this bore?	☐ **Yes**	☐ **No**

WATER QUALITY SAMPLING METHODOLOGY

How was the water sample collected

☐ **Installed pump** ☐ **Bailer** ☐ **Grundfos** ☐ **Micropurge Other:**

Was bore purged according to guidelines *(three well volumes)***?**

☐ **Yes** ☐ **No**

Purge method description:

Has a copy of the water level and water quality information collected for the baseline assessment been retained by the bore owner representative?

☐ **Yes** ☐ **No**

ATTACHMENTS

Documentation Type	**Description**
Photos	
☐ **Pump**	
☐ **Water level measure point**	
☐ **Water quality sample setup**	
☐ **Other**	
Documents	
☐ **Drillers log**	
☐ **Water use log**	
☐ **Landholders agreement**	
☐ **Water quality sample lab results from this baseline assessment**	
☐ **Historical water quality results**	
☐ **Other**	

Appendix B

Make good assessment table – Hume Coal Project drawdown

Table B.1 Drawdown on landholder bores

	Bore	Over mine or within 14 m?	Initial standing water level	Screens from (m)	Screens to (m)	Total depth (m)	Licenced purpose	Project only drawdown					Total cumulative drawdown					
								Project drawdown - max (m)	Project time to max drawdown (years)	Project time to 2m drawdown (years)	Project time to 2m recovery (years)	Number of years drawdown > 2m (years)	Cumulative drawdown - max (m)	Cumulative time to max drawdown (years)	Cumulative time to 2m drawdown (years)	Cumulative time to 2m recovery (years)	Number of years drawdown > 2m (years)	Percentage of maximum total cumulative drawdown due to Hume project
1. increased pumping costs only	GW102757		96.5	19.0	210.0	210.0	irrigation	2.4	28.5	23.0	37.5	14.5	4.0	31.0	20.5	55	34.5	61%
	GW054137		12.9	6.4	46.0	46.0	domestic, stock	2.4	9.5	8.6	11.3	2.7	3.1	9.5	8.5	13	4.5	77%
	GW105102		72.1	85.0	151.0	151.0	irrigation	2.5	25.5	22.4	35.0	12.6	8.6	26.0	20.5	101	80.5	29%
	GW107677		24.8	44.0	66.0	103.0	stock	2.6	27.0	22.0	38.9	16.9	4.9	28.5	16	66	50	52%
	GW047117		9.8	4.9	33.5	33.5	lapsed	2.6	9.0	8.4	11.7	3.3	3.3	9.0	8	14	6	79%
	GW105950		106.8	79.5	168.0	168.0	irrigation, stock	2.9	28.5	23.1	42.9	19.8	10.0	32.5	20.5	101	80.5	29%
	GW057683		5.5	6.1	61.0	61.0	domestic, stock	2.9	9.0	8.1	11.8	3.7	3.5	9.0	8	13	5	83%
	GW025808		62.5	17.3	128.0	128.0	cancelled	3.1	19.5	15.6	43.8	28.2	6.1	22.5	11	72	61	50%
	GW028832		17.7	40.0	132.0	132.0	stock, irrigation	3.2	13.0	11.8	37.3	25.5	6.5	26.0	10.5	66	55.5	49%
	GW047076		7.9	5.8	89.9	89.9	stock, irrigation, domestic	3.5	25.0	16.6	37.2	20.6	10.2	25.0	12	101	89	34%
	GW107006		112.0	90.0	175.0	175.0	irrigation	3.7	25.5	20.5	42.1	21.6	6.7	26.0	20.5	60	39.5	54%
	GW106855		24.1	59.0	146.0	146.0	domestic, stock	3.8	23.0	15.1	38.7	23.6	10.4	25.5	11.5	101	89.5	37%
	GW111795		64.0	102.0	156.0	156.0	domestic, stock	3.8	25.5	17.5	41.3	23.8	9.3	25.5	14.5	98	83.5	41%
	GW069072		51.6	99.0	120.0	120.0	domestic	4.2	25.5	17.0	43.2	26.2	9.4	25.5	14.5	92	77.5	44%
	GW106517		42.3	88.0	144.0	144.0	irrigation	4.4	22.5	16.1	41.4	25.3	10.8	25.5	13.5	101	87.5	41%
	GW104728		13.7	67.0	79.0	79.0	domestic, stock	4.7	16.5	13.0	40.6	27.7	9.2	17.0	10.5	101	90.5	52%
	GW053801		40.9	30.2	99.1	99.1	domestic, stock	5.0	21.5	20.1	44.7	24.6	8.1	22.5	17	56	39	62%
	GW047443		13.4	24.4	67.1	67.1	stock, irrigation, domestic	5.1	25.5	18.2	47.1	28.9	8.2	26.0	14	70	56	63%
	GW104213		21.4	84.0	144.0	144.0	domestic, stock	5.2	16.5	13.8	42.2	28.4	10.2	17.0	11	101	90	51%
	GW102777		41.2	59.0	103.0	103.0	domestic, stock	5.5	22.5	15.0	46.4	31.4	11.8	25.5	12.5	101	88.5	46%

Table B.1 Drawdown on landholder bores

	Bore	Over mine or within 14 m?	Initial standing water level	Screens from (m)	Screens to (m)	Total depth (m)	Licenced purpose	Project only drawdown					Total cumulative drawdown					
								Project drawdown - max (m)	Project time to max drawdown (years)	Project time to 2m drawdown (years)	Project time to 2m recovery (years)	Number of years drawdown > 2m (years)	Cumulative drawdown - max (m)	Cumulative time to max drawdown (years)	Cumulative time to 2m drawdown (years)	Cumulative time to 2m recovery (years)	Number of years drawdown > 2m (years)	Percentage of maximum total cumulative drawdown due to Hume project
	GW067303		23.9	90.0	100.0	100.0	test bore	5.7	21.5	16.3	46.4	30.1	8.7	22.0	13.5	57	43.5	65%
	GW109039		29.5	44.0	120.0	120.0	stock, domestic	5.8	17.0	13.8	43.5	29.6	11.0	17.0	11	101	90	53%
	GW102775		18.9	59.0	116.0	116.0	domestic, stock	5.9	16.0	13.1	42.8	29.7	10.6	16.5	10.5	101	90.5	56%
	GW104684		60.4	66.0	156.0	156.0	domestic, stock	6.7	23.0	15.9	48.7	32.8	9.7	23.5	12.5	70	57.5	69%
	GW060125		12.9	7.0	107.0	107.0	stock, irrigation, domestic	8.0	10.0	7.7	36.8	29.1	9.5	10.0	7.5	40	32.5	85%
2. deepen pump	GW105082		61.1	38.0	102.0	102.0	domestic, stock	3.8	25.0	18.2	42.0	23.8	6.1	25.5	15	63	48	62%
	GW060067		36.9	6.0	76.0	76.0	domestic, stock	4.6	25.5	17.4	46.4	29.1	11.4	26.0	12.5	101	88.5	40%
	GW105744		40.3	55.0	67.0	67.0	domestic, stock	5.1	22.5	15.1	45.1	30.0	11.5	25.5	12.5	101	88.5	45%
	GW104526		18.0	40.0	61.0	61.0	domestic, stock	5.9	24.5	16.9	48.1	31.2	8.9	25.0	13	69	56	66%
	GW060199		11.4	12.0	37.0	37.0	domestic, stock	6.6	12.5	9.4	40.2	30.8	9.2	13.0	8.5	47	38.5	71%
	GW026805		22.9	2.7	82.9	82.9	stock, irrigation, domestic	8.6	24.0	8.3	66.4	58.1	14.8	26.5	8.5	101	92.5	58%
	GW111395		53.8	90.0	121.0	121.0	domestic	8.8	22.5	15.1	56.5	41.5	14.7	24.0	10.5	101	90.5	60%
	GW066800		28.4	14.0	81.0	81.0	stock, domestic	9.1	17.0	13.6	53.0	39.4	14.5	17.0	11	101	90	63%
	GW103597		27.1	6.0	90.0	90.0	domestic, stock	9.4	17.0	13.4	52.0	38.7	14.7	17.0	11	101	90	64%
	GW106711		75.0	60.0	145.0	145.0	domestic, stock, irrigation	9.7	20.0	12.3	45.9	33.6	13.8	20.0	12	54	42	71%
	GW103108		37.0	60.0	114.0	114.0	irrigation	9.8	23.0	15.6	56.2	40.6	13.1	23.5	12.5	67.5	55	75%
	GW104727		84.8	101.0	175.0	175.0	domestic, stock	9.8	22.5	15.1	57.2	42.2	15.1	23.5	10.5	101	90.5	65%
	GW066775		37.7	50.0	86.0	86.0	domestic	9.9	17.5	14.1	55.5	41.4	15.2	17.5	11.5	101	89.5	65%
	GW062326		43.3	13.7	94.5	94.5	irrigation, domestic	10.5	22.0	14.7	54.8	40.1	13.9	22.0	11	74	63	76%

Table B.1 Drawdown on landholder bores

Bore	Over mine or within 14 m?	Initial standing water level	Screens from (m)	Screens to (m)	Total depth (m)	Licenced purpose	Project only drawdown					Total cumulative drawdown					
							Project drawdown - max (m)	Project time to max drawdown (years)	Project time to 2m drawdown (years)	Project time to 2m recovery (years)	Number of years drawdown > 2m (years)	Cumulative drawdown - max (m)	Cumulative time to max drawdown (years)	Cumulative time to 2m drawdown (years)	Cumulative time to 2m recovery (years)	Number of years drawdown > 2m (years)	Percentage of maximum total cumulative drawdown due to Hume project
GW105079		39.6	54.0	114.0	114.0	domestic, stock	10.6	16.0	12.2	48.4	36.2	15.1	16.0	10.5	74	63.5	70%
GW028687		12.1	7.6	51.8	51.8	stock, irrigation, domestic	10.7	11.0	7.9	38.0	30.1	12.1	11.0	7.5	39	31.5	88%
GW102689		36.8	36.0	84.0	84.0	stock, irrigation, domestic	11.9	15.0	12.2	43.7	31.5	17.8	15.0	11.5	48	36.5	67%
GW104523		31.3	66.0	91.0	91.0	domestic, stock	11.9	17.0	13.5	55.8	42.4	17.1	17.0	11.5	101	89.5	70%
GW100153		33.7	20.0	85.0	85.0	domestic, stock	12.0	15.0	10.7	46.9	36.2	16.0	15.0	10.5	53	42.5	75%
GW100147		37.2	20.0	80.0	80.0	stock, domestic	12.3	15.0	11.4	48.1	36.8	16.4	15.0	10.5	58	47.5	75%
GW111551		22.6	60.0	78.0	78.0	domestic, stock	12.7	12.0	9.4	45.1	35.8	15.6	12.0	9.5	47	37.5	82%
GW108833		30.1	66.0	85.0	85.0	stock, domestic	14.3	17.0	13.3	56.4	43.1	19.4	17.0	11.5	101	89.5	74%
GW109323		65.8	72.0	132.0	132.0	irrigation	14.8	20.5	14.5	59.0	44.4	20.1	20.5	14	101	87	74%
GW021817		35.2	6.1	92.9	92.9	stock, irrigation, domestic	15.2	19.0	6.3	71.6	65.3	23.1	20.5	4	101	97	66%
GW106718		47.5	35.3	93.0	93.0	domestic, stock, irrigation	15.4	21.0	11.7	59.5	47.8	20.6	21.0	9	64	55	75%
GW105396		40.1	79.0	96.0	96.0	domestic, stock	15.4	21.0	14.1	56.8	42.7	19.1	21.0	11	75	64	81%
GW105068		33.0	67.0	91.0	91.0	domestic, stock	16.8	17.0	13.3	57.8	44.5	21.9	17.0	11.5	101	89.5	77%
GW104468		43.7	73.0	103.0	103.0	domestic, stock	18.5	13.0	9.9	49.0	39.0	22.2	13.0	9.5	52	42.5	84%
GW071741		25.1	12.0	85.0	85.0	stock, domestic	18.9	18.5	12.7	55.7	43.0	22.3	18.5	8	58	50	85%
GW053793		21.9	20.0	91.5	91.5	stock, irrigation, domestic	20.1	16.0	8.0	58.2	50.2	24.2	16.5	6.5	61	54.5	83%
GW115061		21.0	114.2	128.7	128.7	domestic, stock	21.1	11.0	1.1	37.1	36.1	22.1	11.0	1.5	38	36.5	96%
GW108825		8.1	52.0	79.0	79.0	stock, domestic	27.0	11.5	2.0	52.7	50.6	29.6	12.0	2.5	101	98.5	91%

Table B.1 Drawdown on landholder bores

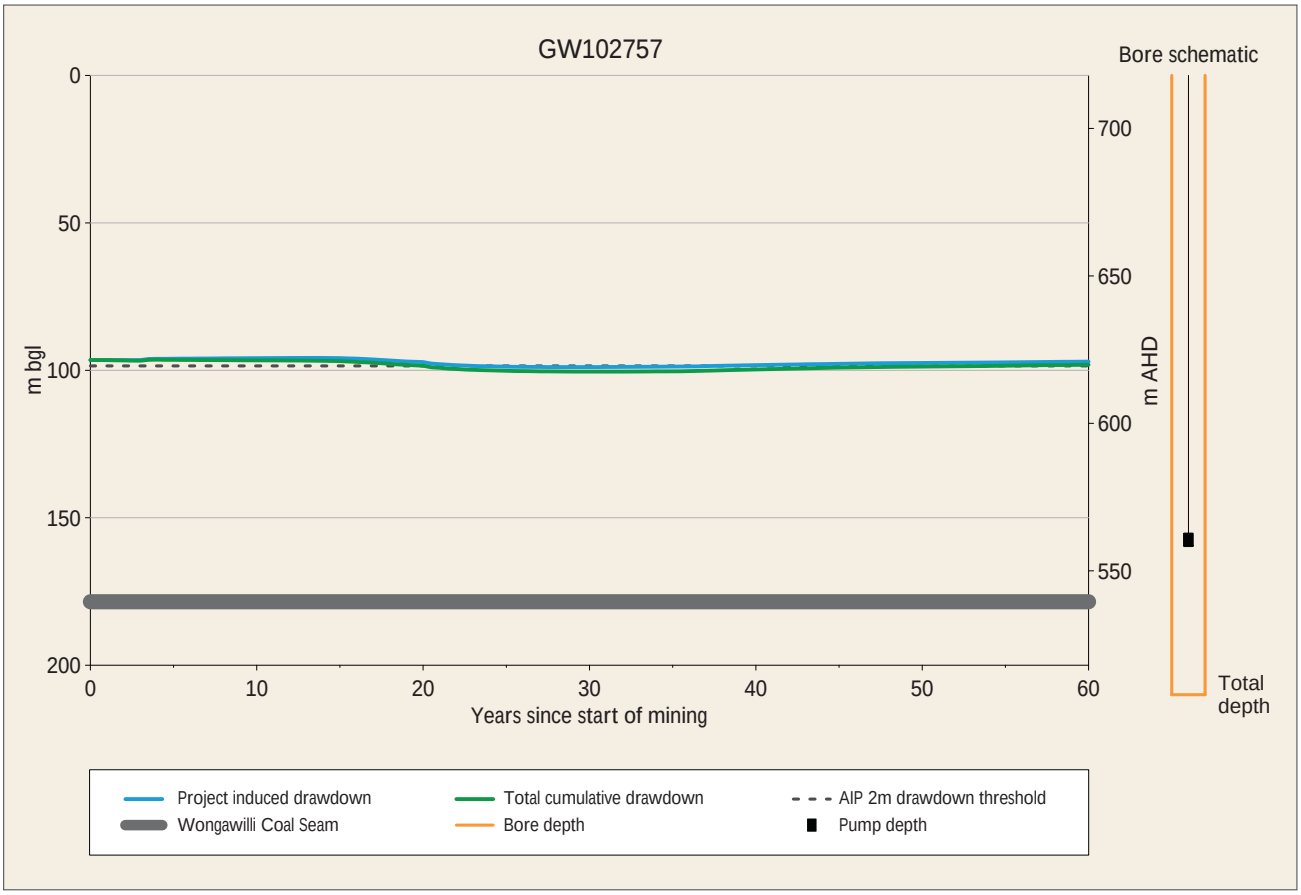
	Bore	Over mine or within 14 m?	Initial standing water level	Screens from (m)	Screens to (m)	Total depth (m)	Licenced purpose	Project only drawdown					Total cumulative drawdown					
								Project drawdown - max (m)	Project time to max drawdown (years)	Project time to 2m drawdown (years)	Project time to 2m recovery (years)	Number of years drawdown > 2m (years)	Cumulative drawdown - max (m)	Cumulative time to max drawdown (years)	Cumulative time to 2m drawdown (years)	Cumulative time to 2m recovery (years)	Number of years drawdown > 2m (years)	Percentage of maximum total cumulative drawdown due to Hume project
	GW109918		26.1	27.0	102.0	102.0	stock, domestic	27.3	11.0	1.1	39.3	38.2	28.5	11.0	1.5	40	38.5	96%
	GW112440		28.6	66.0	91.0	91.0	domestic, stock	29.6	18.0	11.8	56.9	45.1	33.0	18.0	7.5	58	50.5	90%
	GW024688		13.8	12.3	75.2	75.2	stock, irrigation	31.4	16.0	1.2	45.3	44.1	33.0	16.0	1.5	45	43.5	95%
	GW107807		30.6	113.0	121.0	121.0	stock, domestic	59.7	17.0	12.1	60.3	48.2	64.0	17.0	11.5	61	49.5	93%
3. replace stock and domestic bore	GW057943		44.2	19.8	25.9	25.9	domestic, stock	4.2	15.5	14.2	48.3	34.0	9.2	17.0	2	101	99	46%
	GW067521		46.6	21.0	33.0	33.0	stock	5.0	18.0	13.4	31.5	18.1	9.3	18.5	4.5	101	96.5	54%
	GW035590		25.8	1.8	33.5	33.5	domestic, stock	8.0	20.5	13.7	48.1	34.4	11.9	20.5	9.5	56	46.5	67%
	GW107240		15.6	14.0	42.0	42.0	domestic, stock	14.8	10.0	6.1	31.5	25.4	15.4	10.0	5.5	32	26.5	96%
	GW068965		14.4	8.0	37.0	37.0	stock, domestic	19.2	10.0	6.1	34.9	28.9	19.9	10.0	5	35	30	96%
	GW104421		14.5	30.0	42.0	42.0	domestic, stock	19.9	10.0	6.1	36.7	30.5	20.6	10.0	5	37	32	96%
	GW067319		17.7	10.0	31.0	31.0	test bore	19.9	10.0	5.1	34.9	29.8	20.6	10.0	4	35	31	97%
	GW052538	yes	37.9	6.6	88.0	88.0	stock, domestic	21.3	18.0	6.0	67.3	61.3	27.5	18.0	4.5	101	96.5	77%
	GW066798		17.9	10.0	32.0	32.0	domestic	22.0	10.0	6.0	36.9	30.8	34.7	10.0	4.5	37	32.5	63%
	GW104486		21.1	26.0	43.0	43.0	domestic, stock	25.0	12.5	8.1	46.3	38.2	44.1	12.5	8	46	38	57%
	GW032319		20.5	18.9	38.1	38.1	basic rights	26.0	10.0	3.5	35.1	31.7	33.4	10.0	3.5	35	31.5	78%
	GW064613		19.8	6.5	43.0	43.0	domestic	29.0	5.0	1.1	41.0	39.9	52.1	5.0	1.5	41	39.5	56%
	GW048345		17.3	25.3	38.1	38.1	domestic, stock	29.0	11.0	7.1	41.8	34.7	37.8	11.0	6.5	42	35.5	77%
	GW049172		17.4	15.8	70.1	70.1	domestic, stock	39.6	5.5	1.1	38.9	37.8	40.2	5.5	1.5	39	37.5	98%
	GW104745	yes	25.8	80.0	130.0	130.0	domestic, stock	42.6	13.0	7.1	43.9	36.8	44.7	13.0	7.5	44	36.5	95%
	GW102713		13.0	12.0	60.0	60.0	domestic, stock	45.0	11.5	2.2	38.8	36.7	45.8	11.5	2.5	39	36.5	98%
	GW108004		20.5	113.0	121.0	121.0	stock, domestic	80.0	16.0	12.2	61.5	49.3	84.2	16.0	11.5	64	52.5	95%

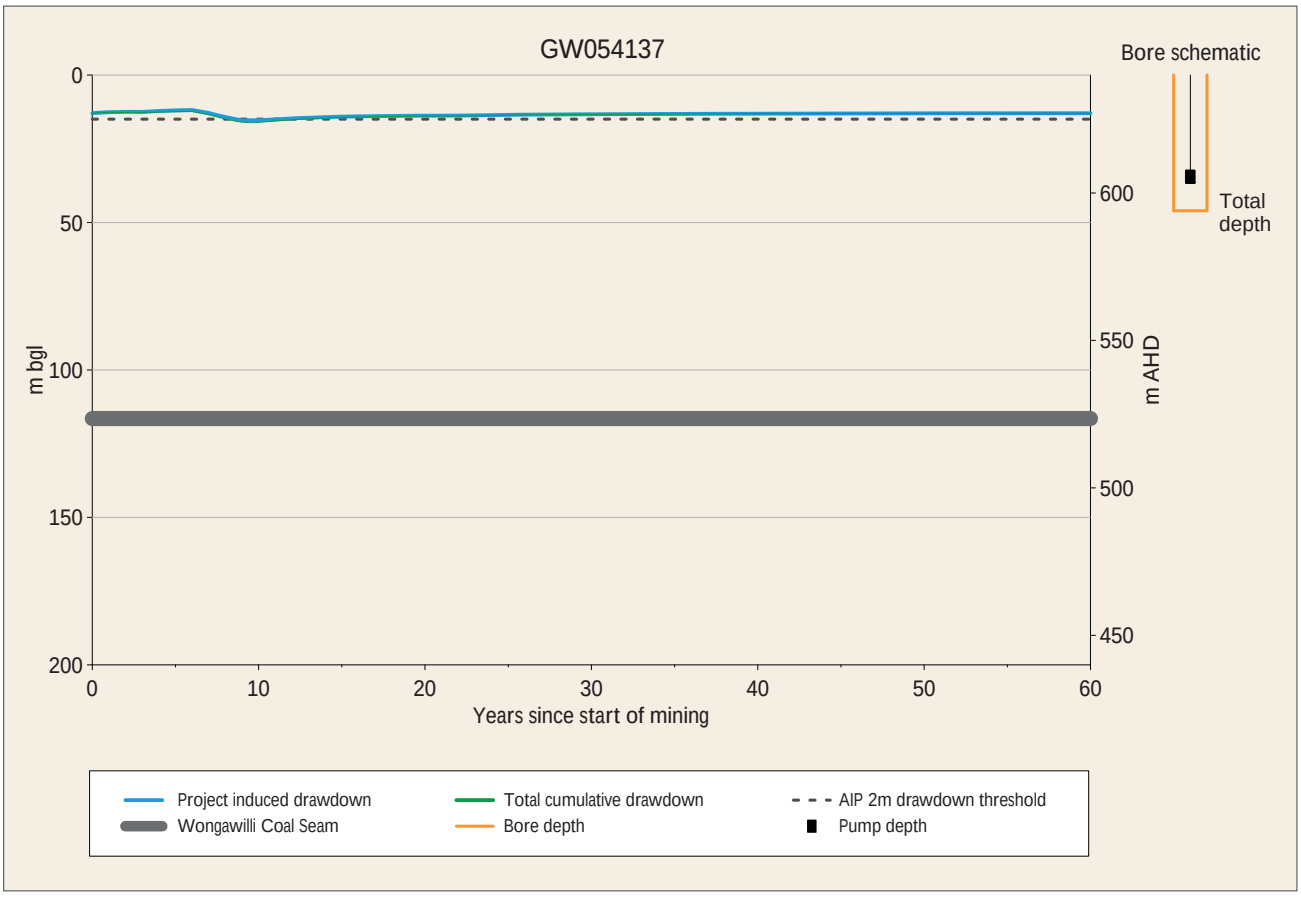
Table B.1 Drawdown on landholder bores

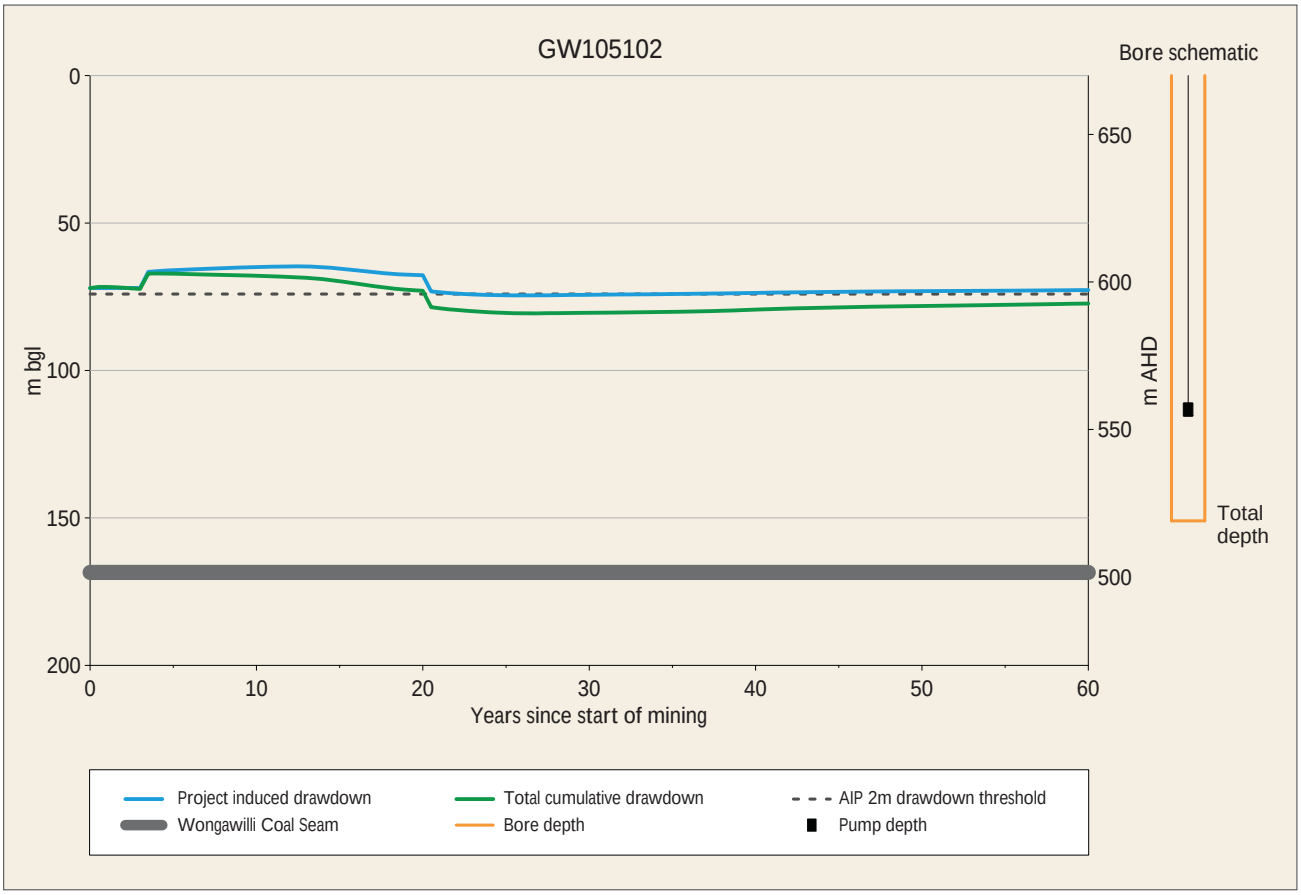
	Bore	Over mine or within 14 m?	Initial standing water level	Screens from (m)	Screens to (m)	Total depth (m)	Licenced purpose	Project only drawdown					Total cumulative drawdown					
								Project drawdown - max (m)	Project time to max drawdown (years)	Project time to 2m drawdown (years)	Project time to 2m recovery (years)	Number of years drawdown > 2m (years)	Cumulative drawdown - max (m)	Cumulative time to max drawdown (years)	Cumulative time to 2m drawdown (years)	Cumulative time to 2m recovery (years)	Number of years drawdown > 2m (years)	Percentage of maximum total cumulative drawdown due to Hume project
4. replace irrigation bore	GW011227		13.1	11.5	40.3	40.3	stock, irrigation, domestic	4.7	10.0	8.3	18.9	10.6	6.1	10.0	8	40	32	77%
	GW102309		37.6	45.0	67.0	67.0	irrigation	4.8	23.0	15.2	43.3	28.1	11.3	25.5	12.5	101	88.5	42%
	GW107964		63.2	63.0	96.0	96.0	irrigation	12.5	20.5	6.5	64.0	57.4	18.6	20.5	6.5	101	94.5	67%
	GW102588	yes	50.9	42.0	88.0	88.0	domestic, stock, irrigation	20.3	18.0	6.2	69.5	63.3	22.8	18.0	6	101	95	89%
	GW106710	yes	66.4	64.0	115.0	115.0	domestic, stock, irrigation	32.3	14.0	11.1	55.3	44.2	35.4	14.0	11.5	56	44.5	91%
	GW026136		20.0	20.0	52.7	52.7	stock, irrigation	33.0	22.0	2.7	47.8	45.1	47.8	22.0	3	47	44	69%
	GW102916		58.4	48.0	108.0	108.0	stock, irrigation, domestic	36.6	12.0	9.1	50.3	41.2	39.6	12.0	9.5	48	38.5	92%
	GW023322		19.7	6.7	44.8	44.8	stock, irrigation, domestic	37.0	14.5	3.4	4.5	1.0	40.1	14.5	3	57	54	92%
	GW057906		17.3	6.0	61.0	61.0	stock, irrigation, domestic	39.8	12.0	1.1	43.1	42.0	40.9	12.0	1.5	43	41.5	97%
	GW037851		31.3	2.4	78.6	78.6	stock, irrigation, domestic	46.2	11.0	1.0	41.1	40.1	47.5	11.0	1.5	41	39.5	97%
	GW072672	yes	21.5	12.0	122.0	122.0	stock, irrigation, domestic	46.3	12.0	7.8	45.2	37.4	48.6	12.0	7.5	45	37.5	95%
	GW106489		9.2	30.0	55.0	55.0	irrigation	50.0	21.0	2.1	53.6	51.5	56.6	21.0	2.5	53	50.5	88%
	GW047157		24.4	5.8	67.1	67.1	stock, irrigation, domestic	55.0	6.0	2.0	53.2	51.2	63.9	6.0	2.5	52	49.5	86%
	GW110236	yes	55.8	54.0	108.0	108.0	irrigation, stock	55.1	15.5	8.0	44.3	36.3	57.5	15.5	8	44	36	96%
	GW107535	yes	52.0	13.0	114.0	114.0	irrigation	58.6	20.0	13.5	52.9	39.4	62.0	20.0	12.5	52.5	40	95%

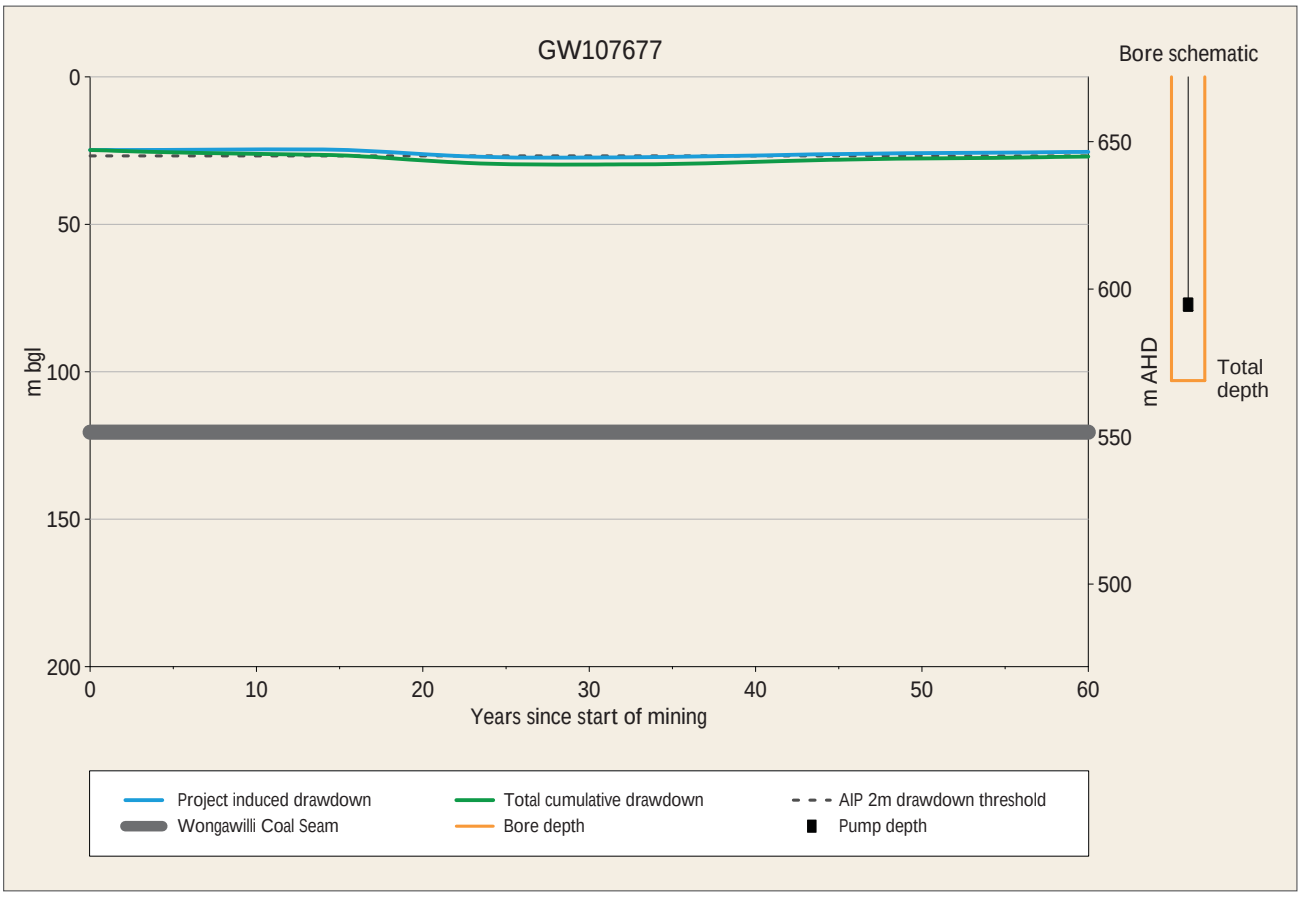
Appendix C

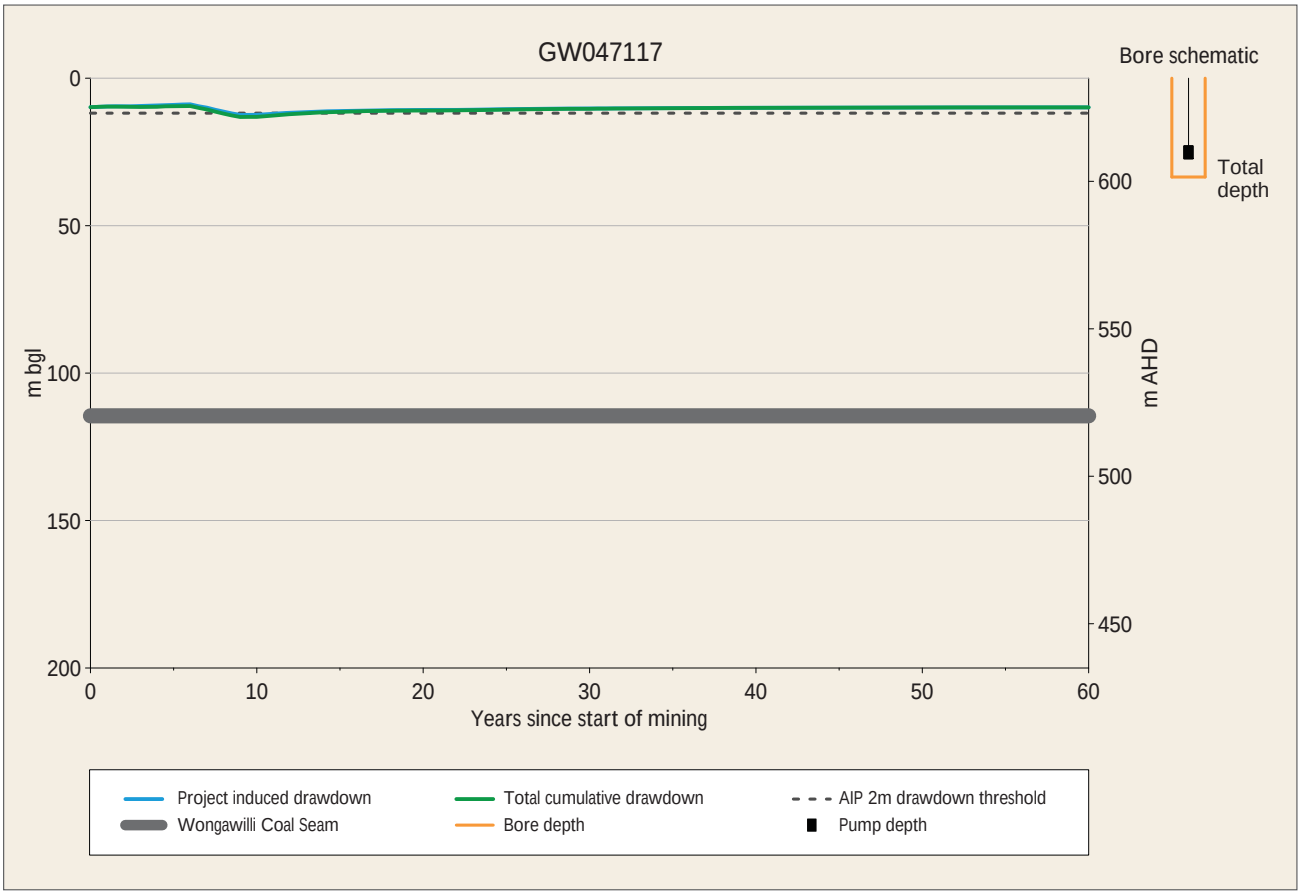
Predicted bore drawdown hydrographs

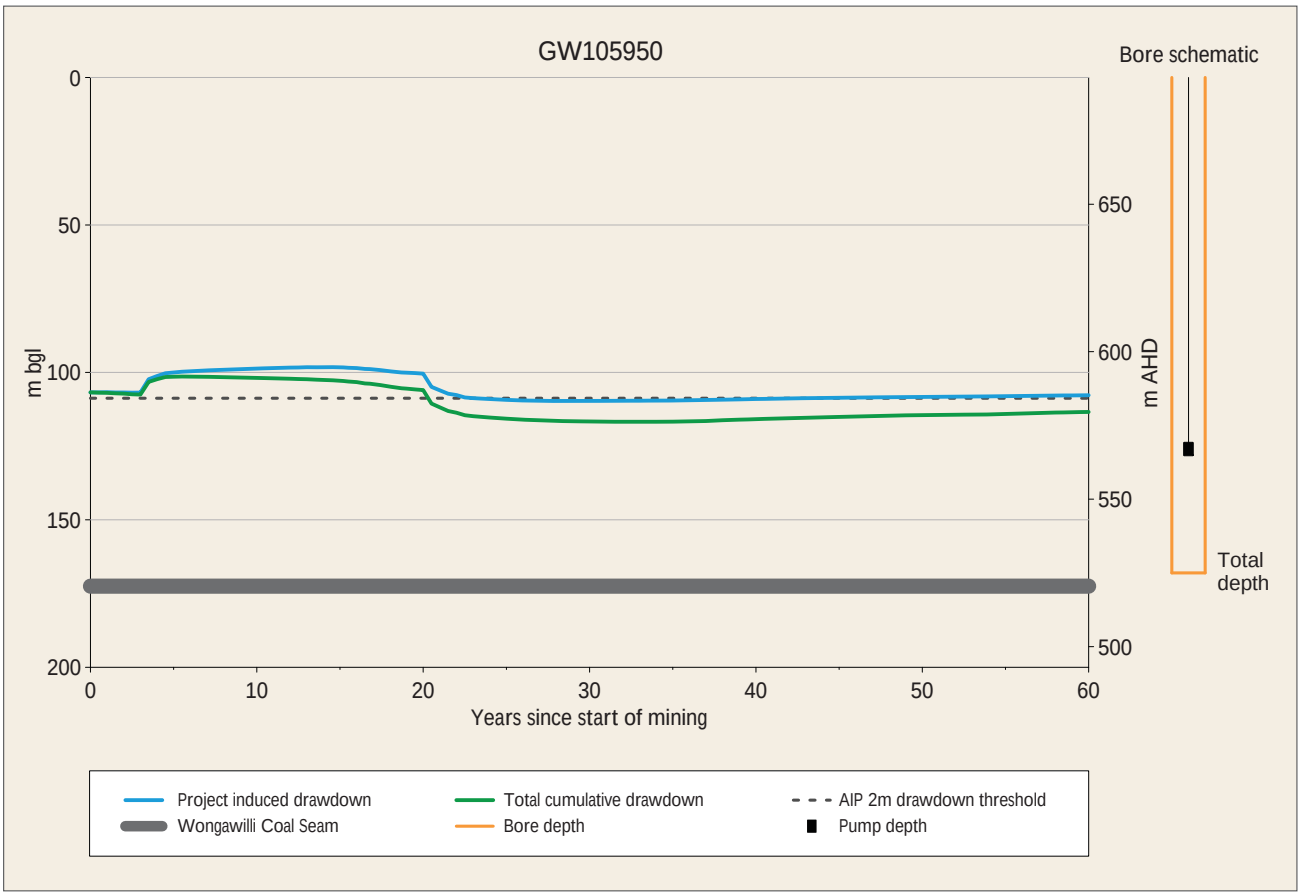

GW102757
Bore schematic
m bgl
m AHD
Years since start of mining
Total depth
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

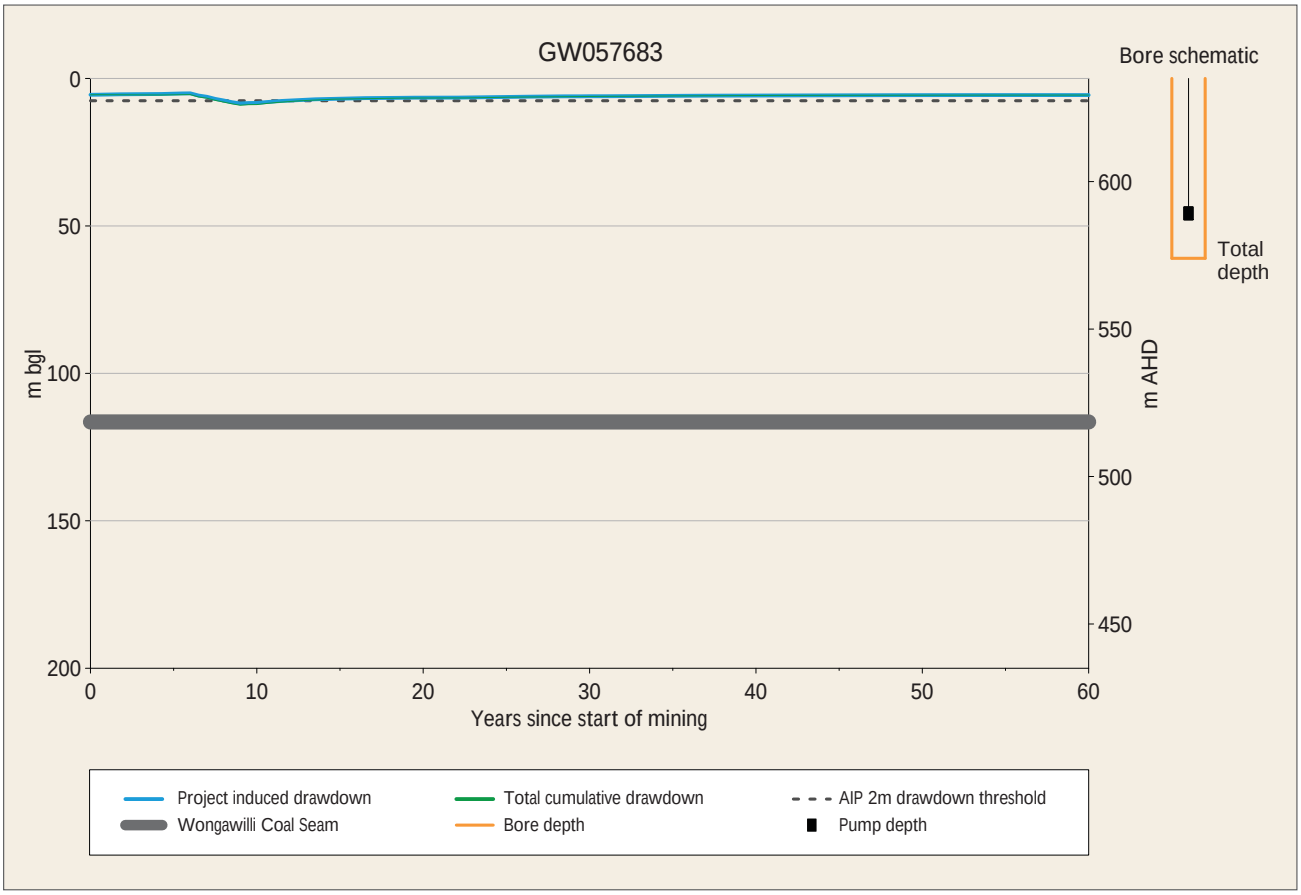

GW054137
Bore schematic
m bgl
m AHD
Years since start of mining
Total depth
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

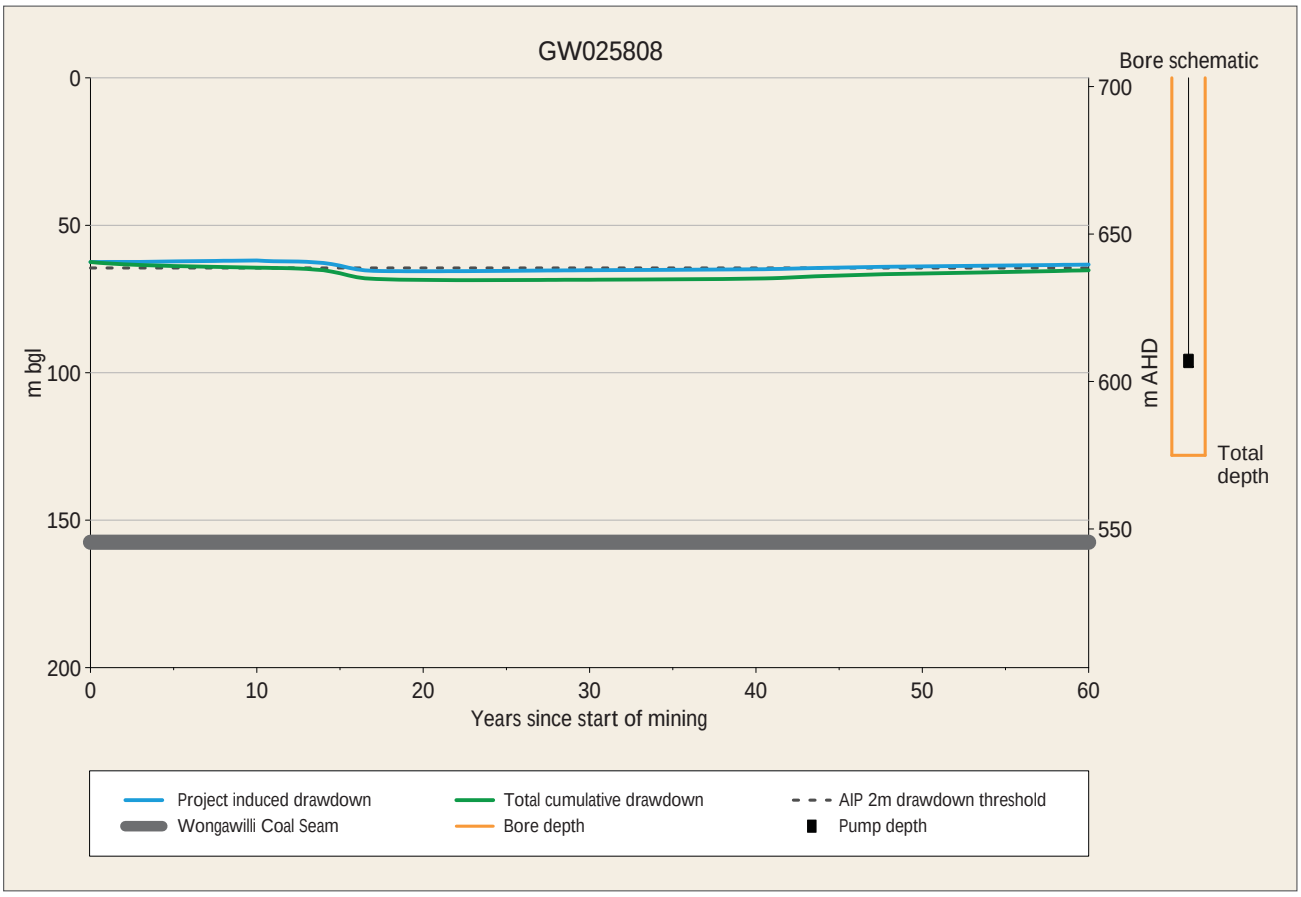

GW105102
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

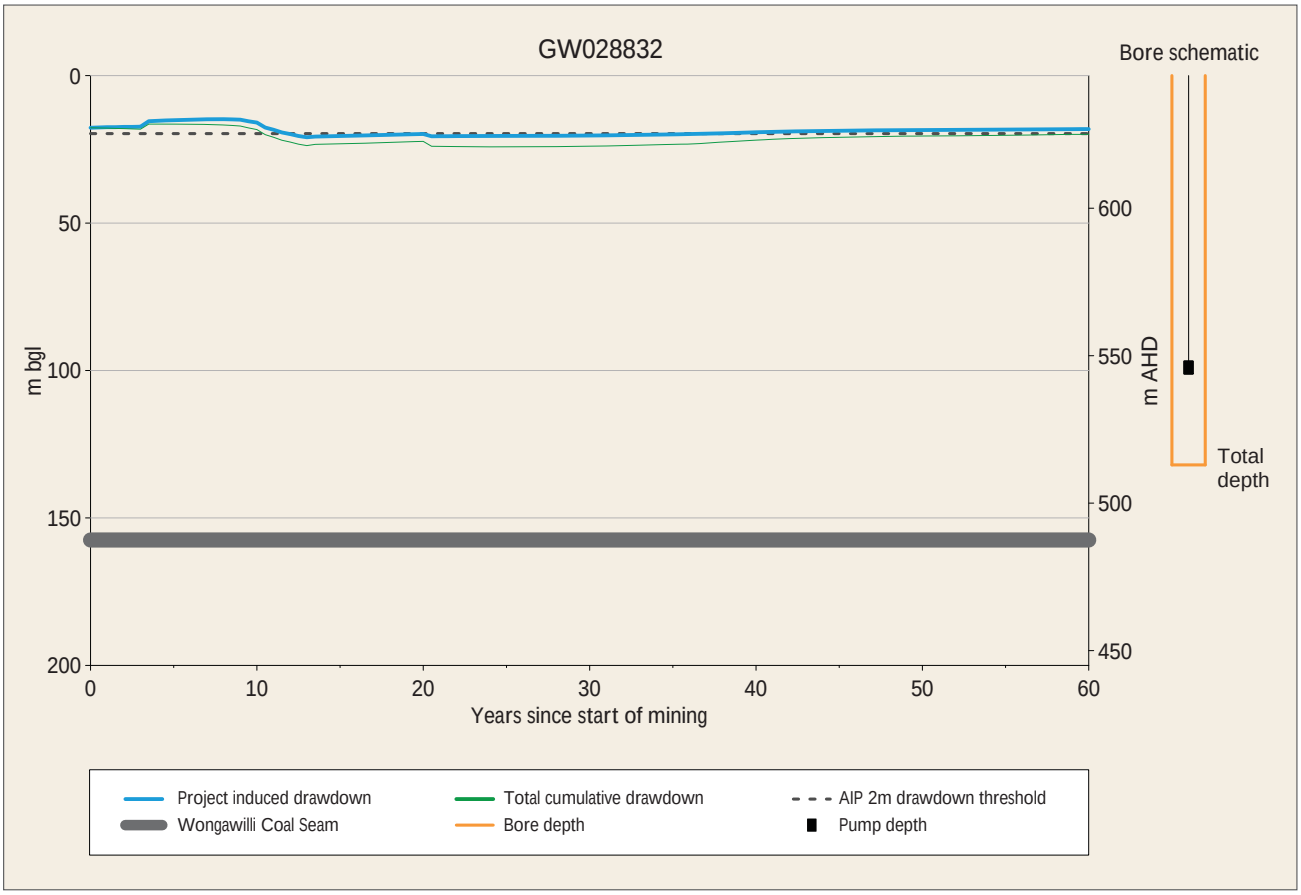

GW107677
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

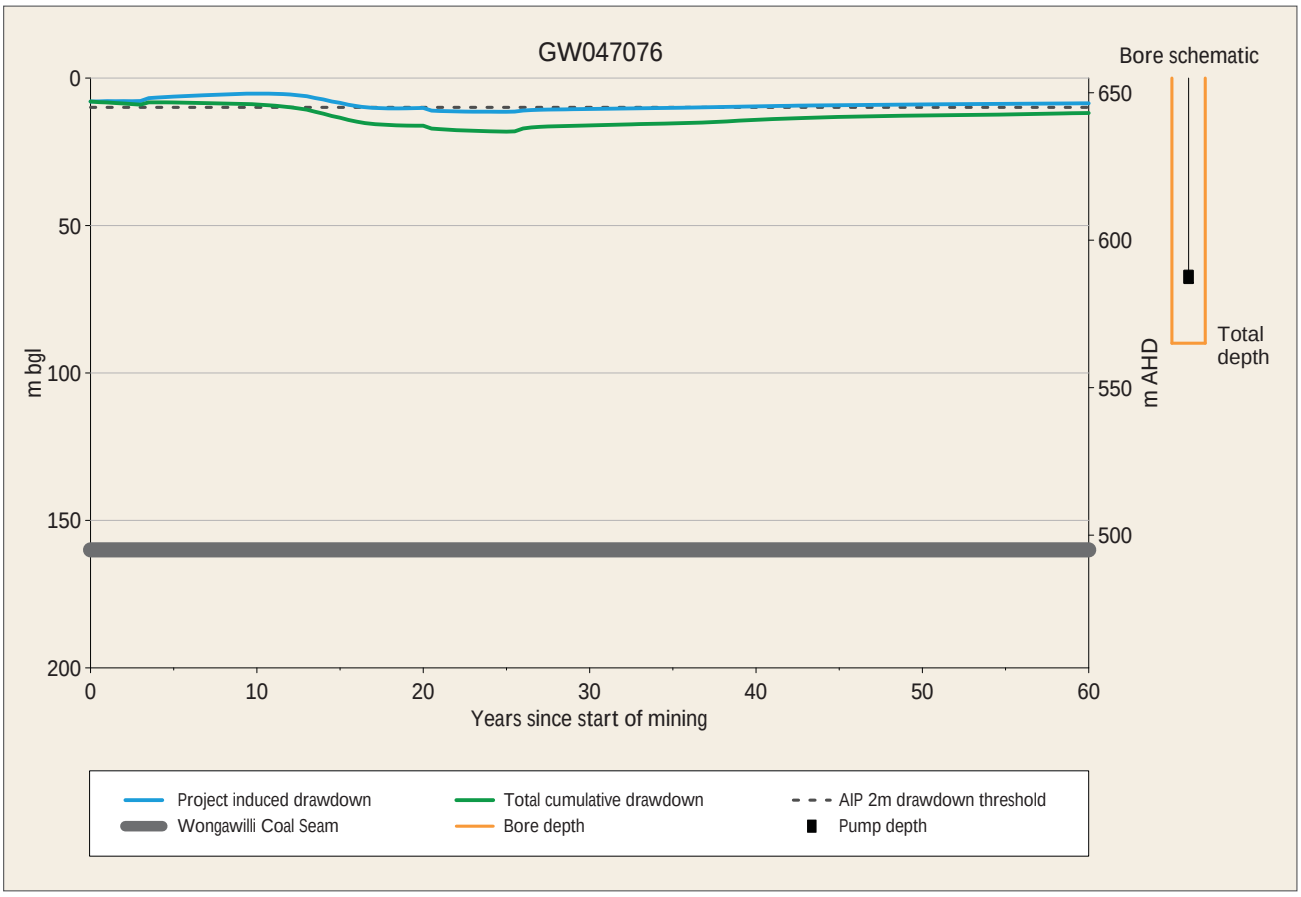

GW047117
Bore schematic
Total depth
m bgl
m AHD
0
50
100
150
200
600
550
500
450
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth


GW105950
Bore schematic
Total depth
m bgl
m AHD
0
50
100
150
200
650
600
550
500
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

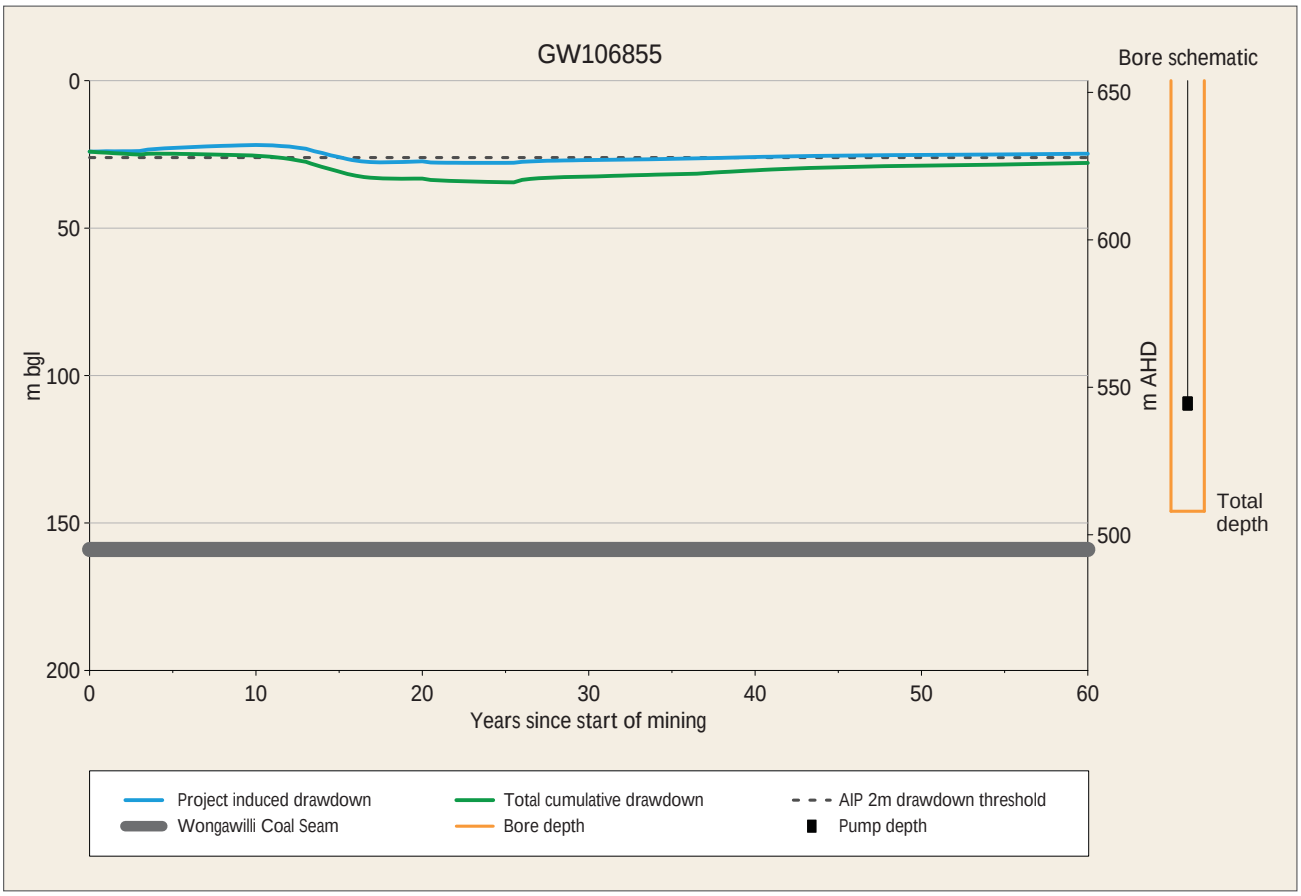

GW057683
Bore schematic
0
50
100
150
200
m bgl
600
550
500
450
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

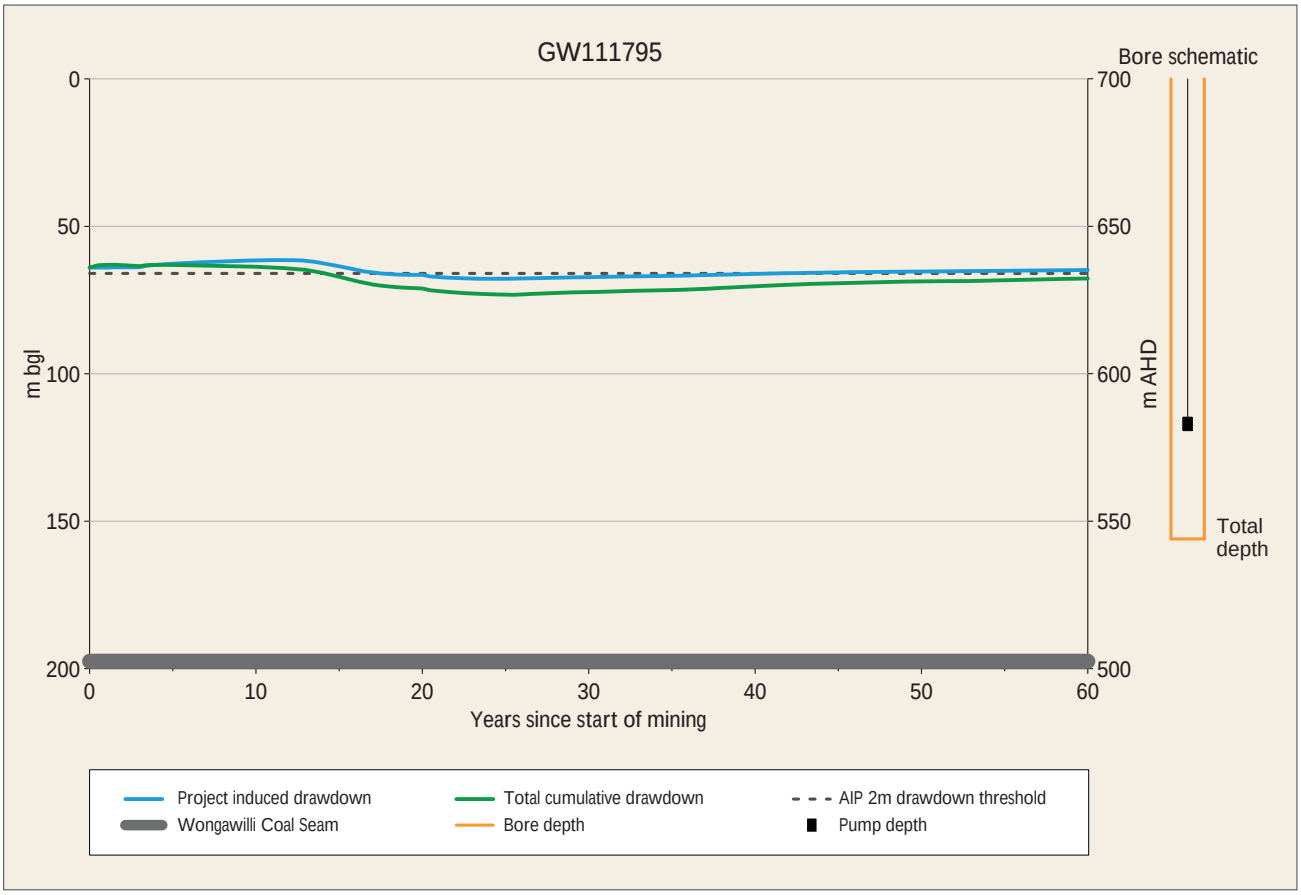

GW025808
Bore schematic
0
50
100
150
200
m bgl
700
650
600
550
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

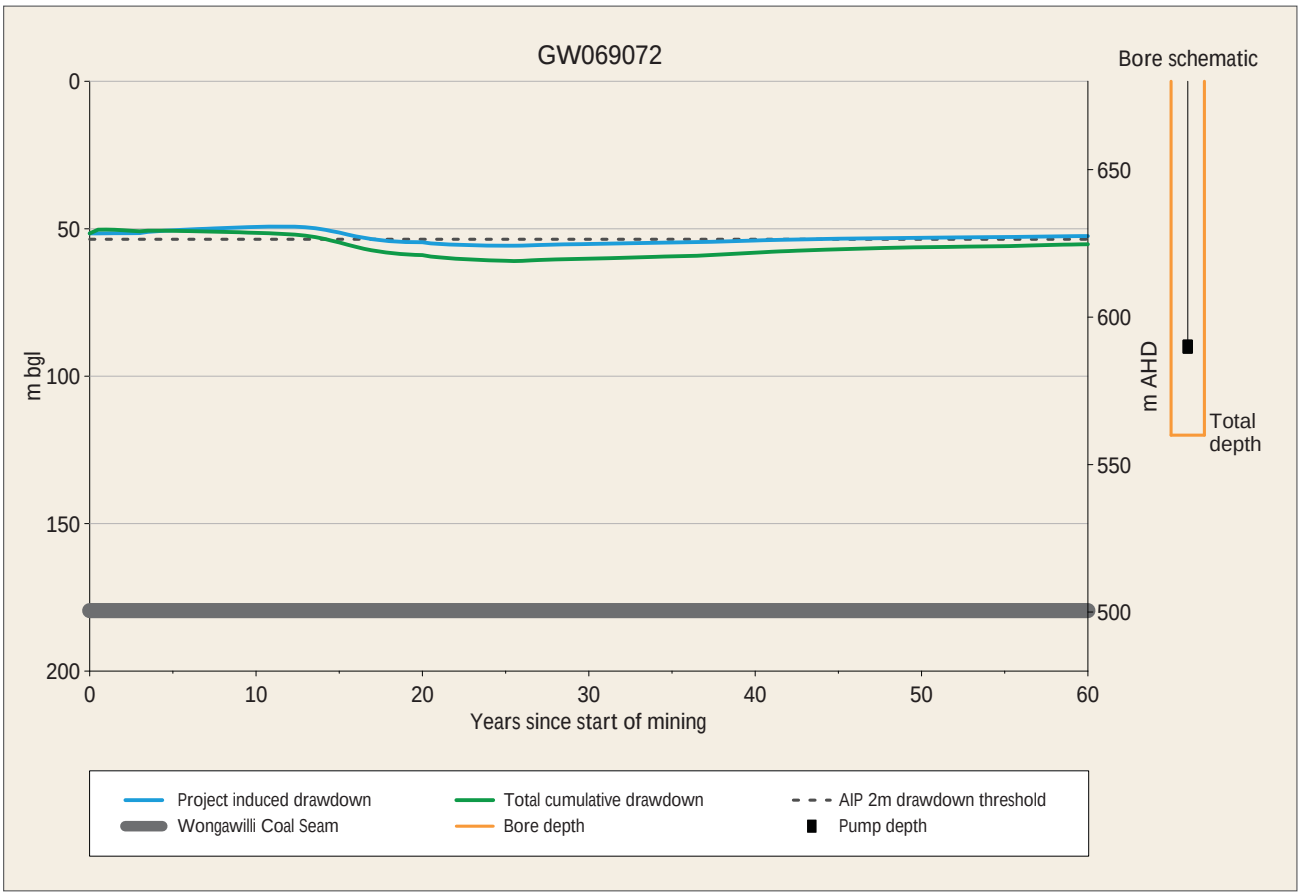

GW028832
Bore schematic
0
50
100
150
200
m bgl
600
550
500
450
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

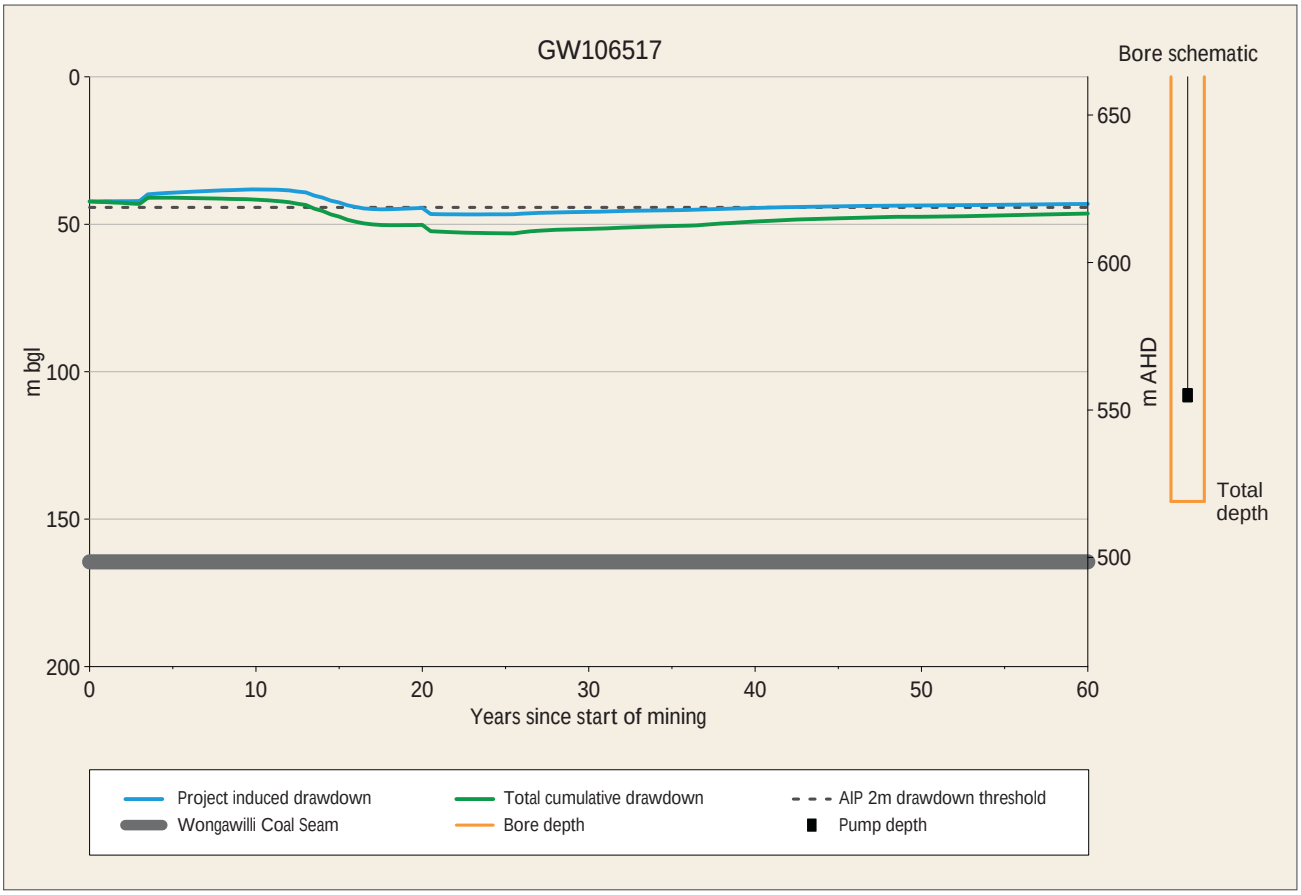

GW047076
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

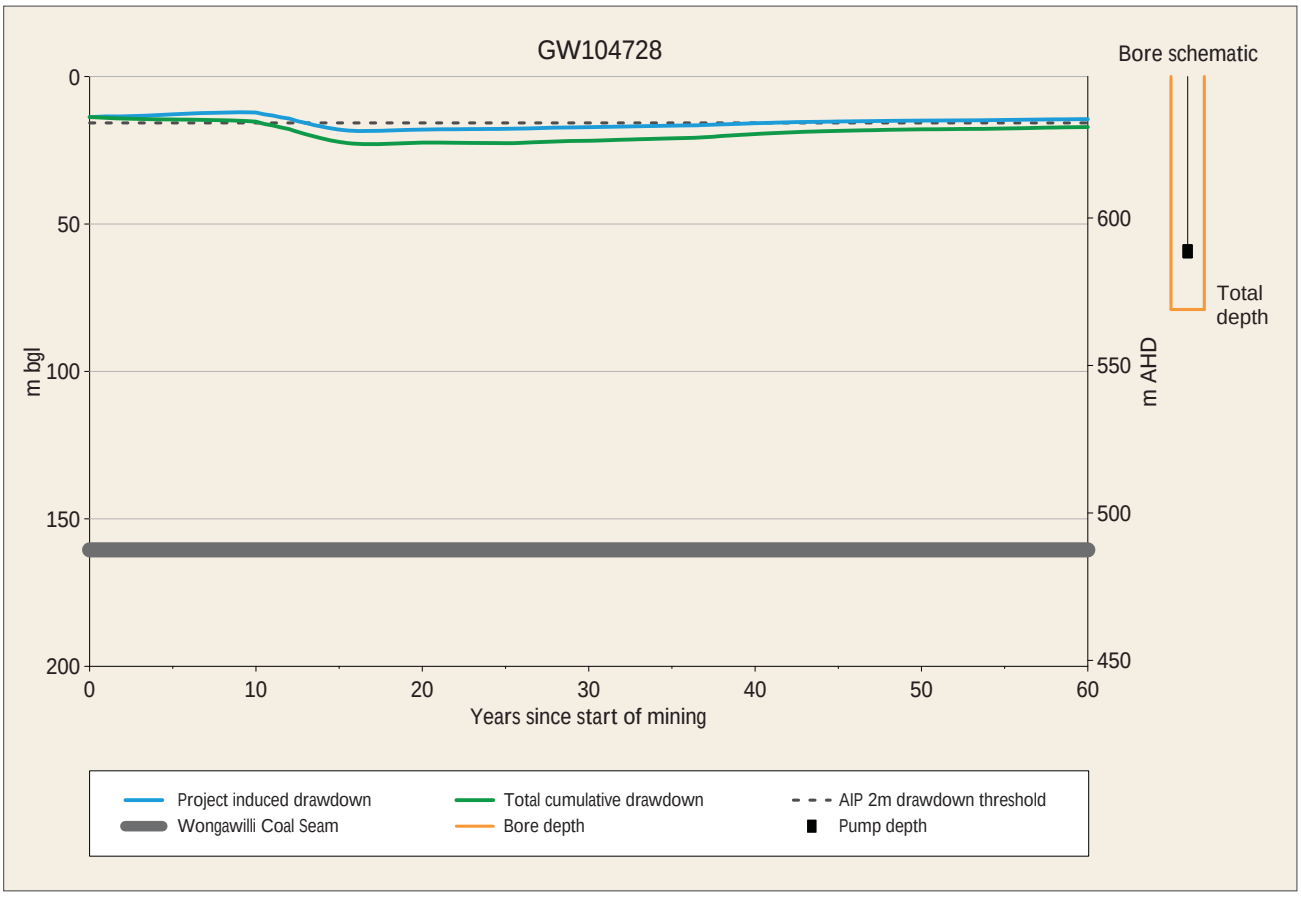

GW107006
Bore schematic
m bgl
m AHD
0
50
100
150
200
650
600
550
500
0
10
20
30
40
50
60
Years since start of mining
Total depth
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

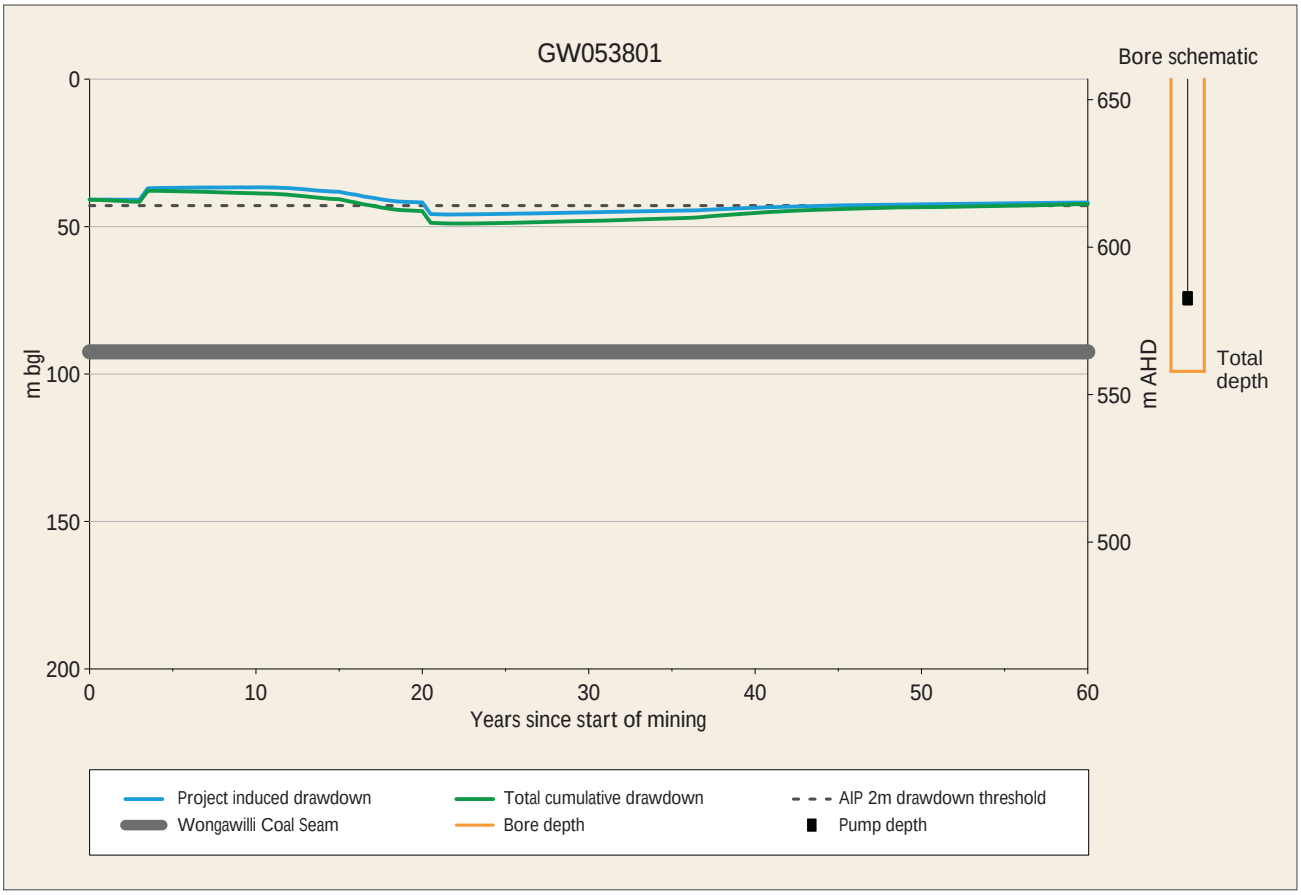

GW106855
Bore schematic
m bgl
m AHD
0
50
100
150
200
650
600
550
500
0
10
20
30
40
50
60
Years since start of mining
Total depth
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

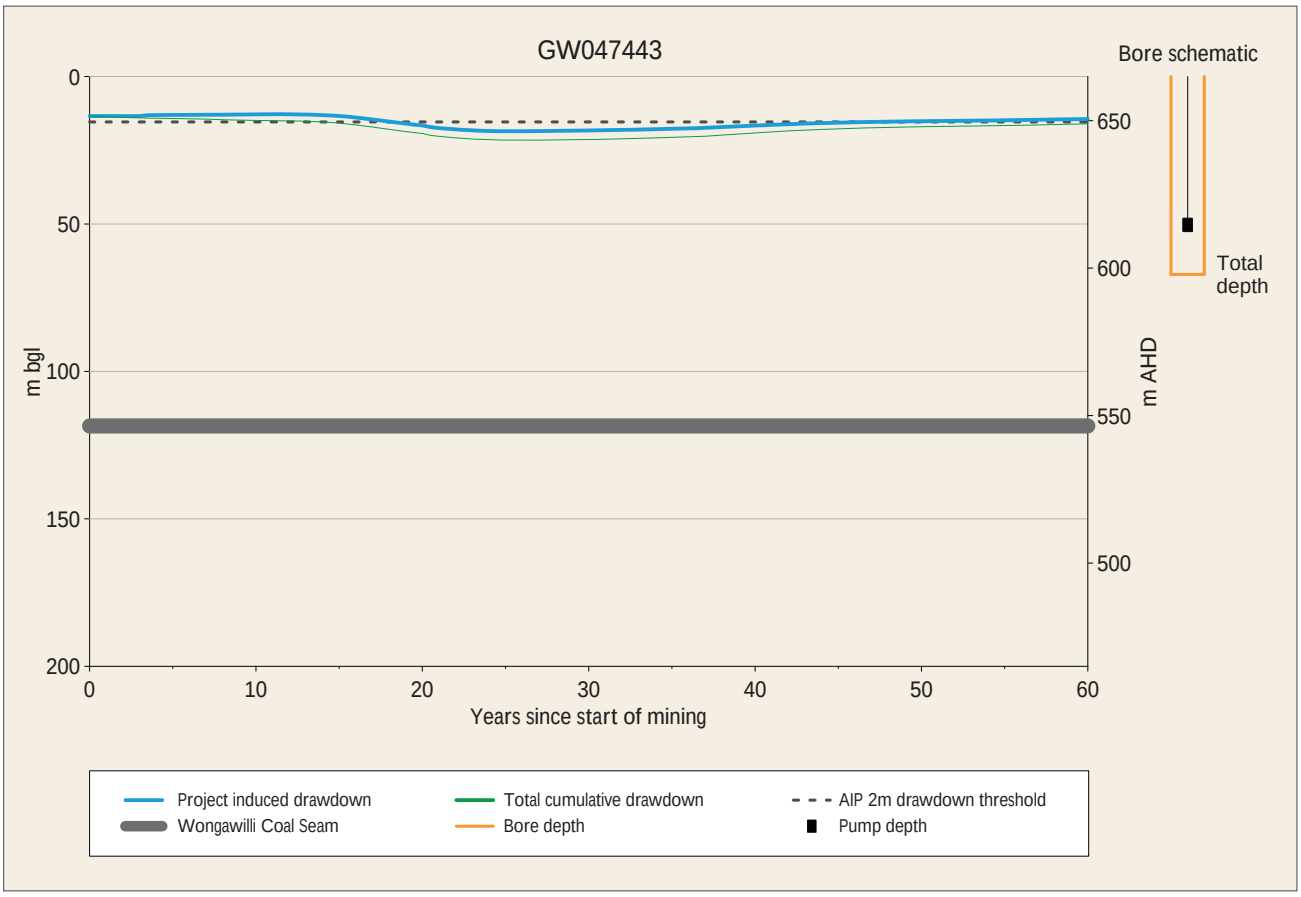

GW111795
Bore schematic
0
50
100
150
200
m bgl
700
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

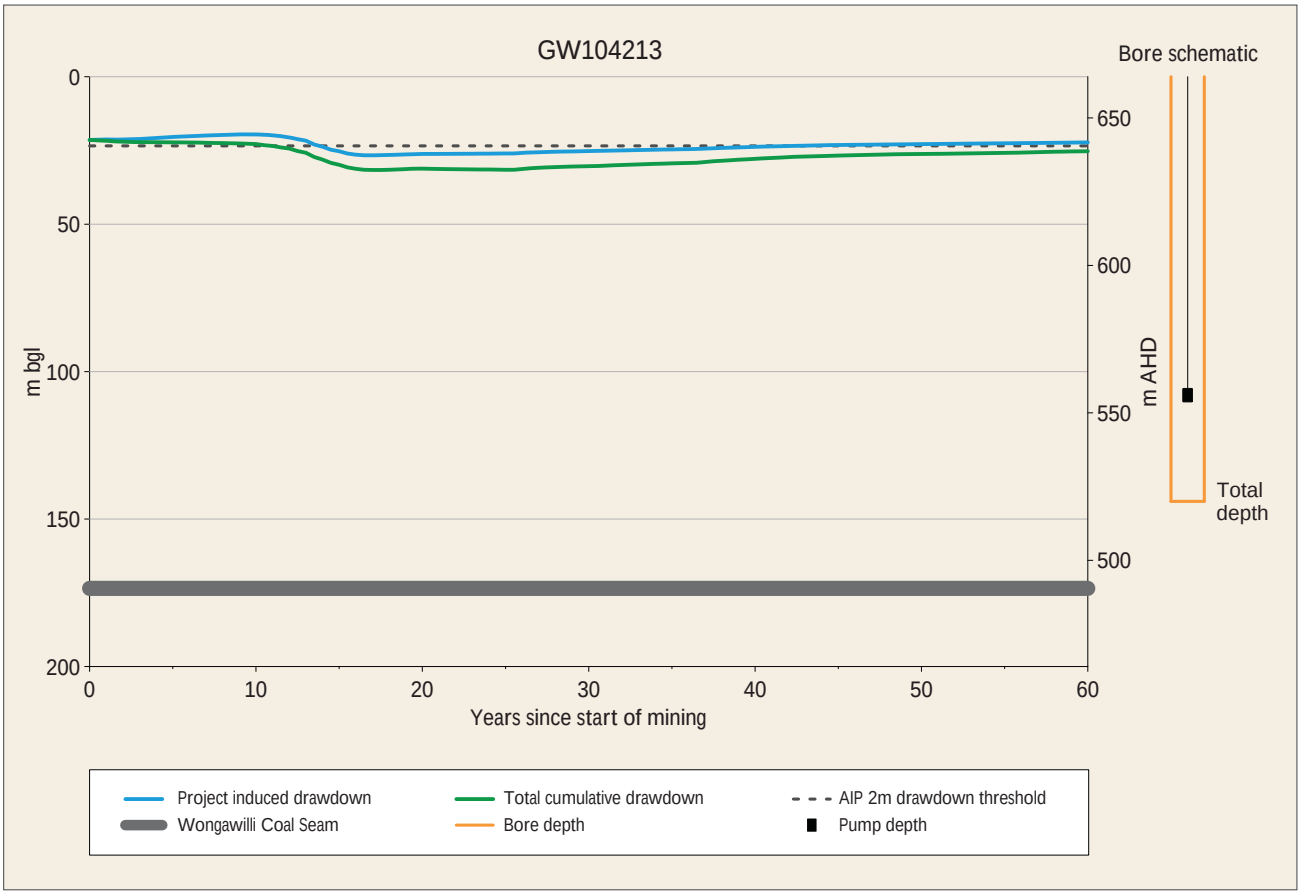

GW069072
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

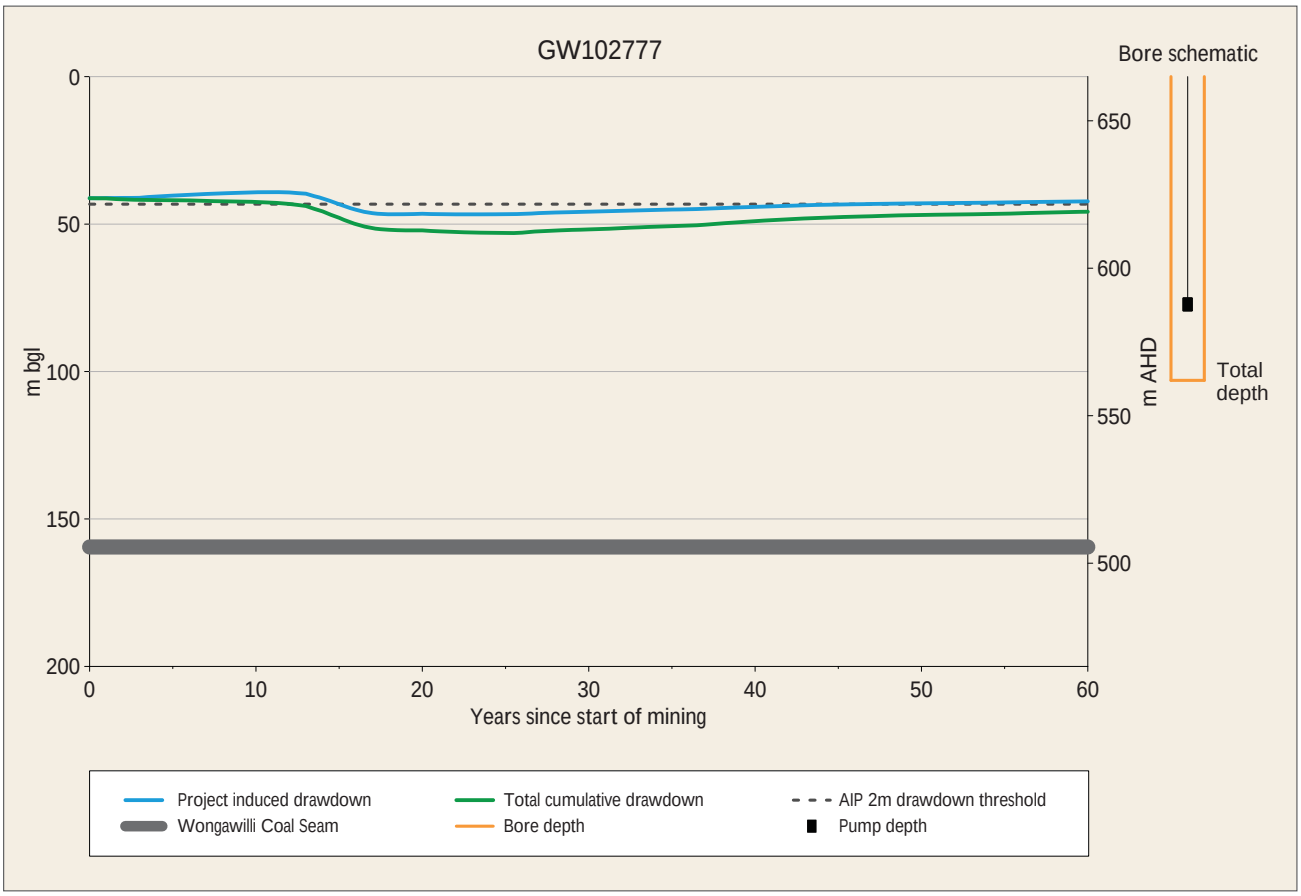

GW106517
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

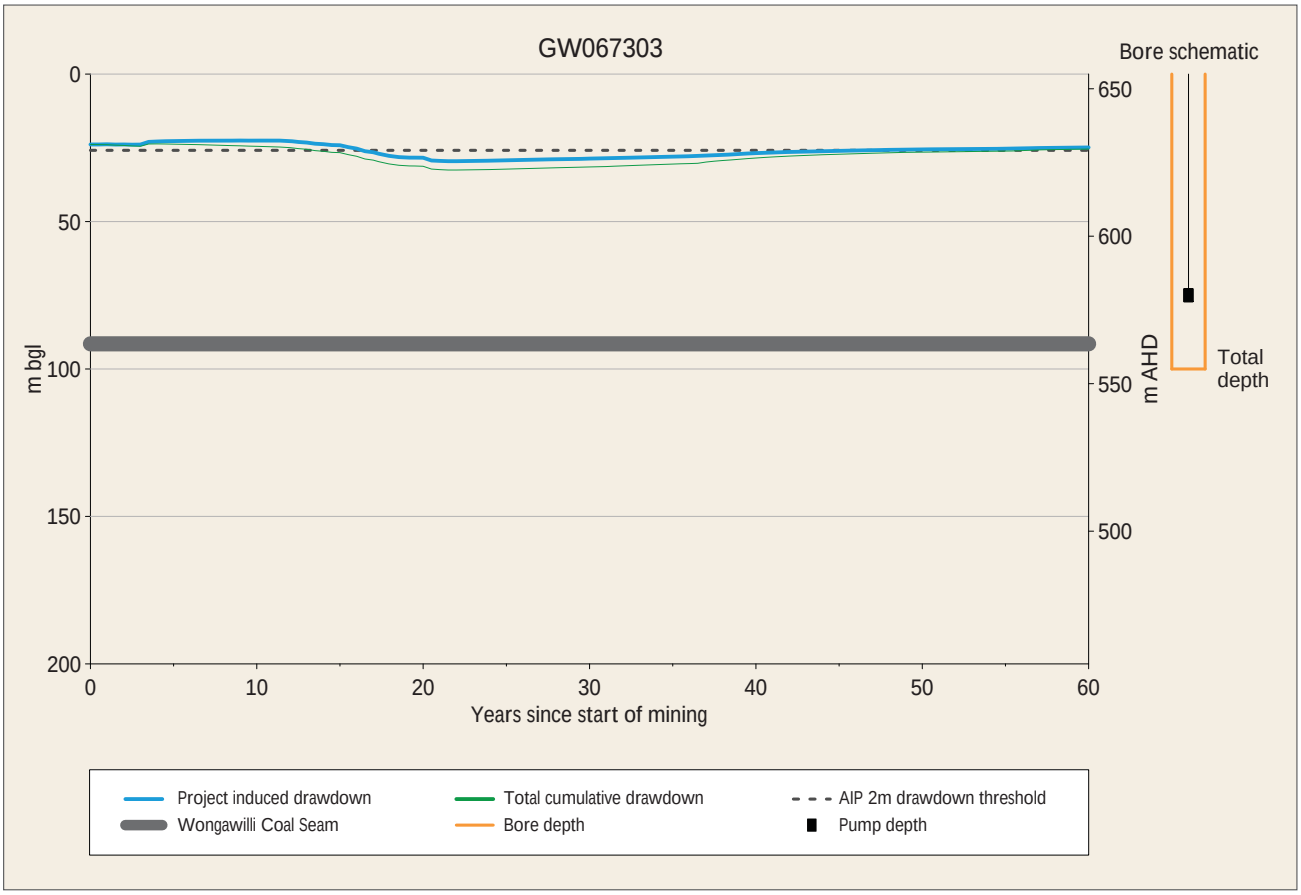

GW104728
Bore schematic
0
50
100
150
200
m bgl
600
550
500
450
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

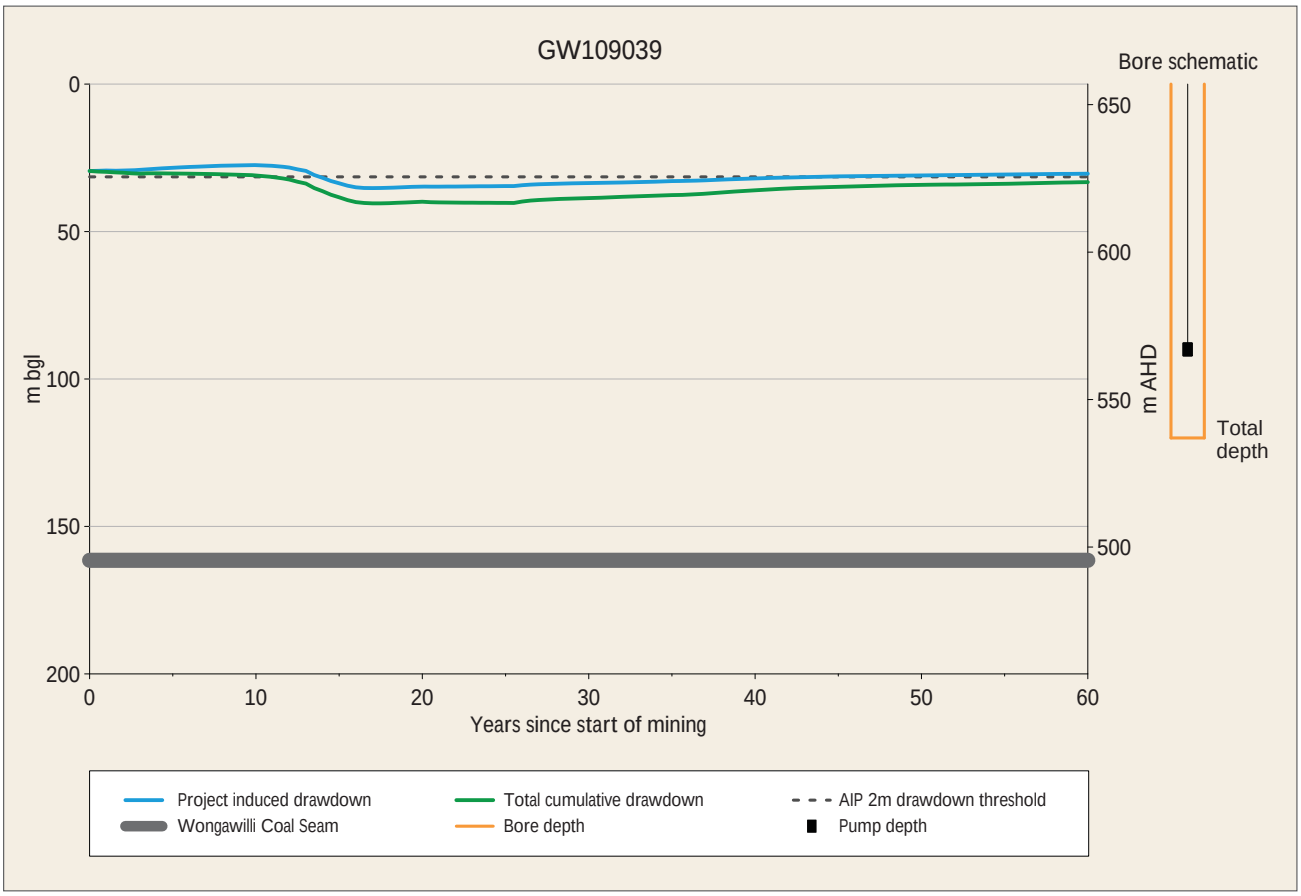

GW053801
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

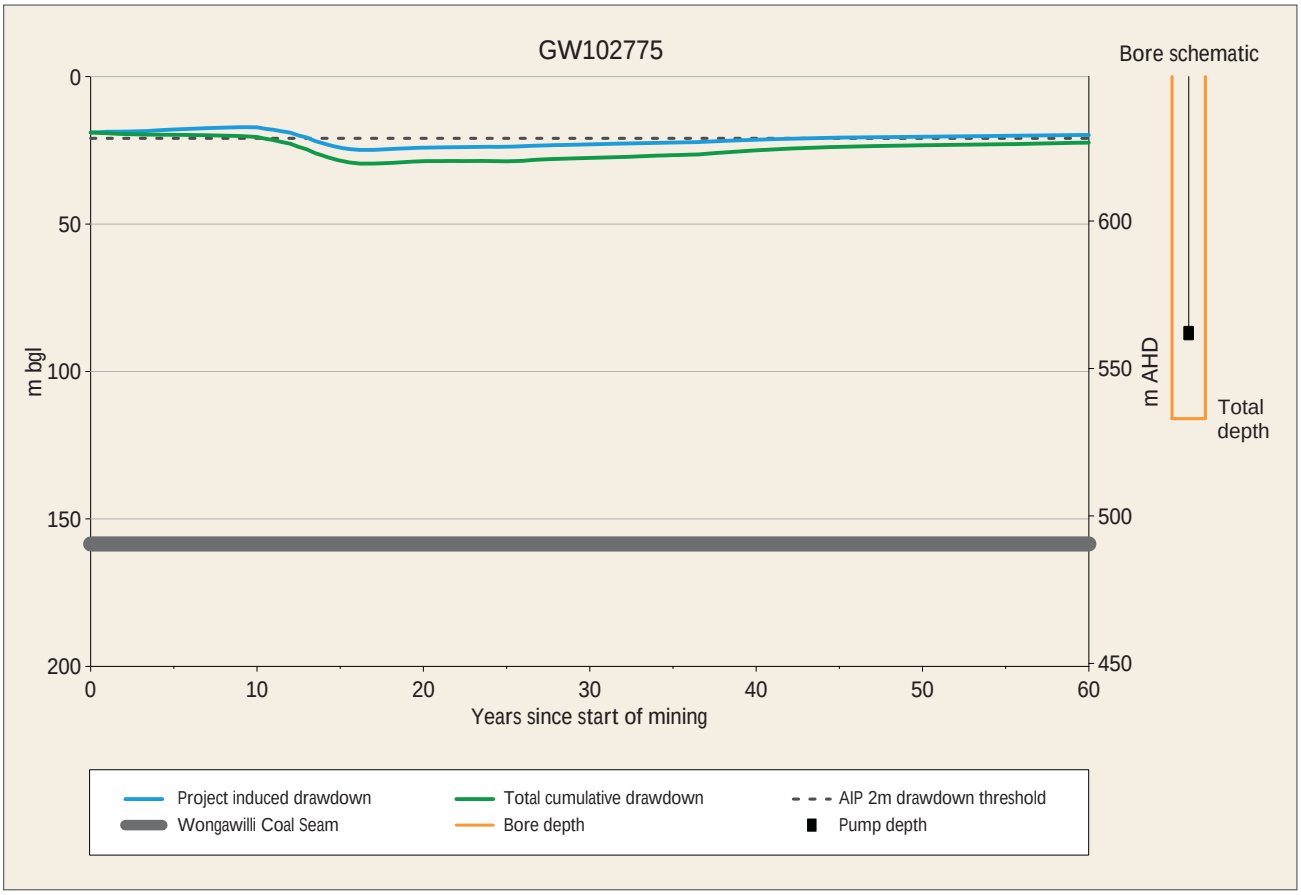

GW047443
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

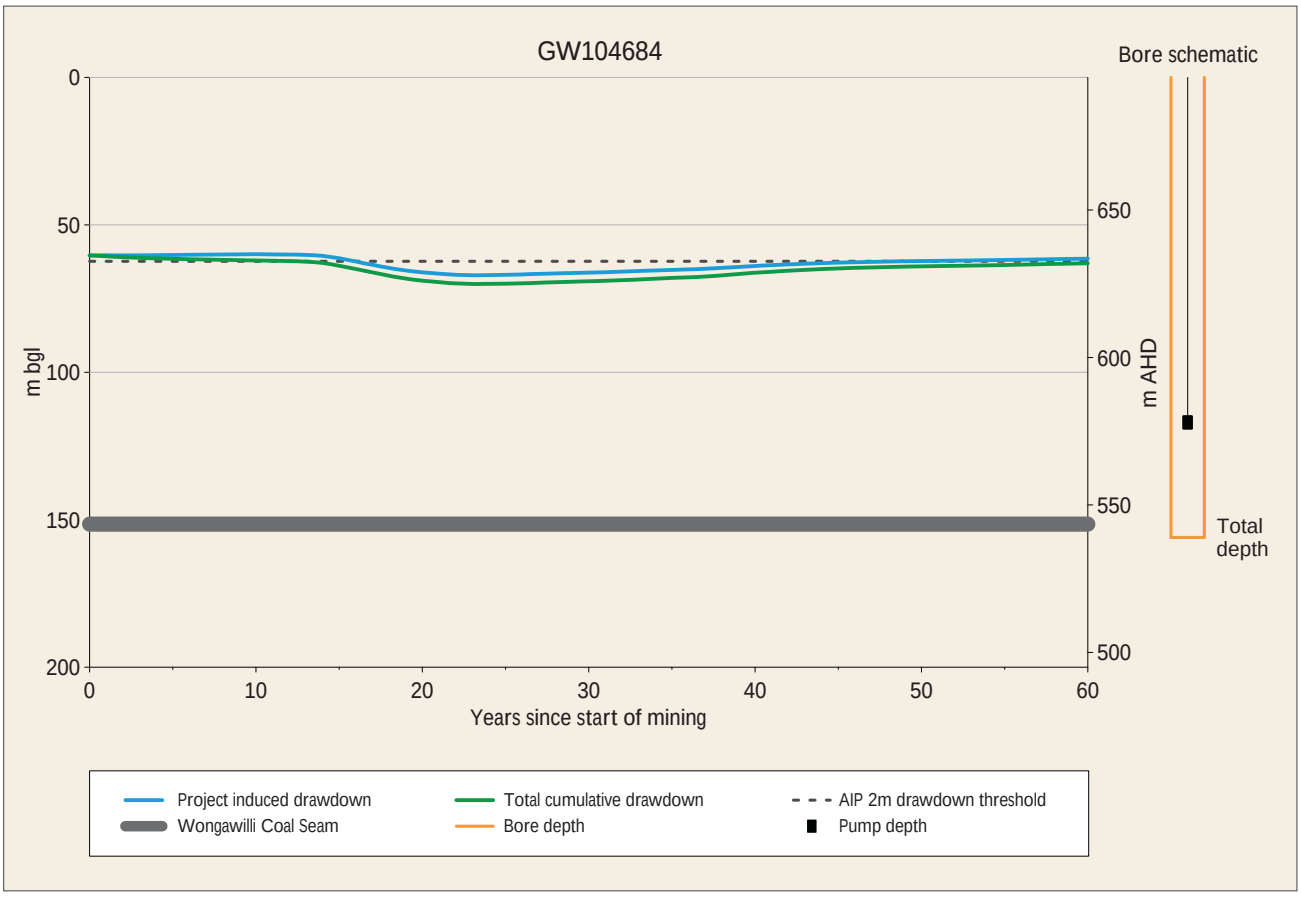

GW104213
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

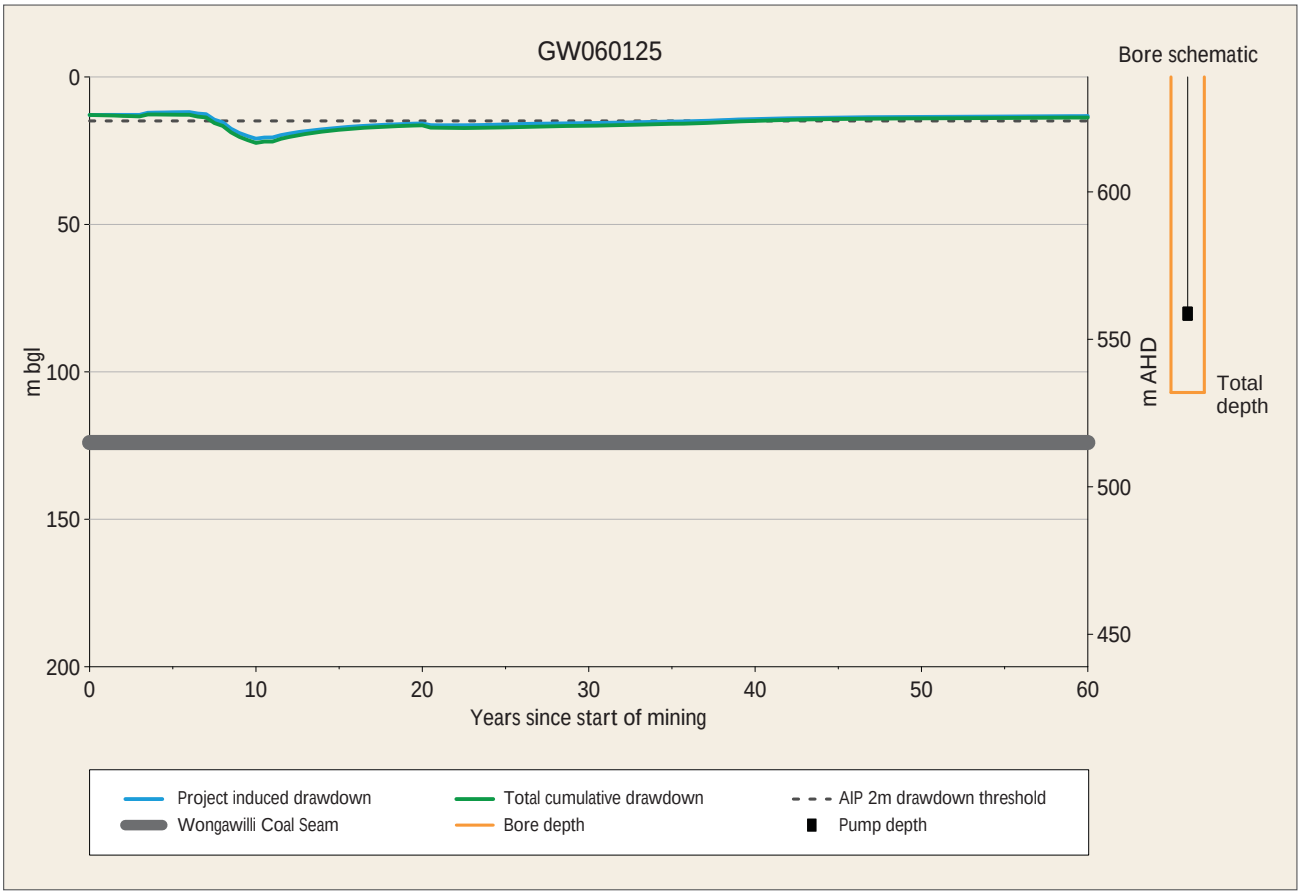

GW102777
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

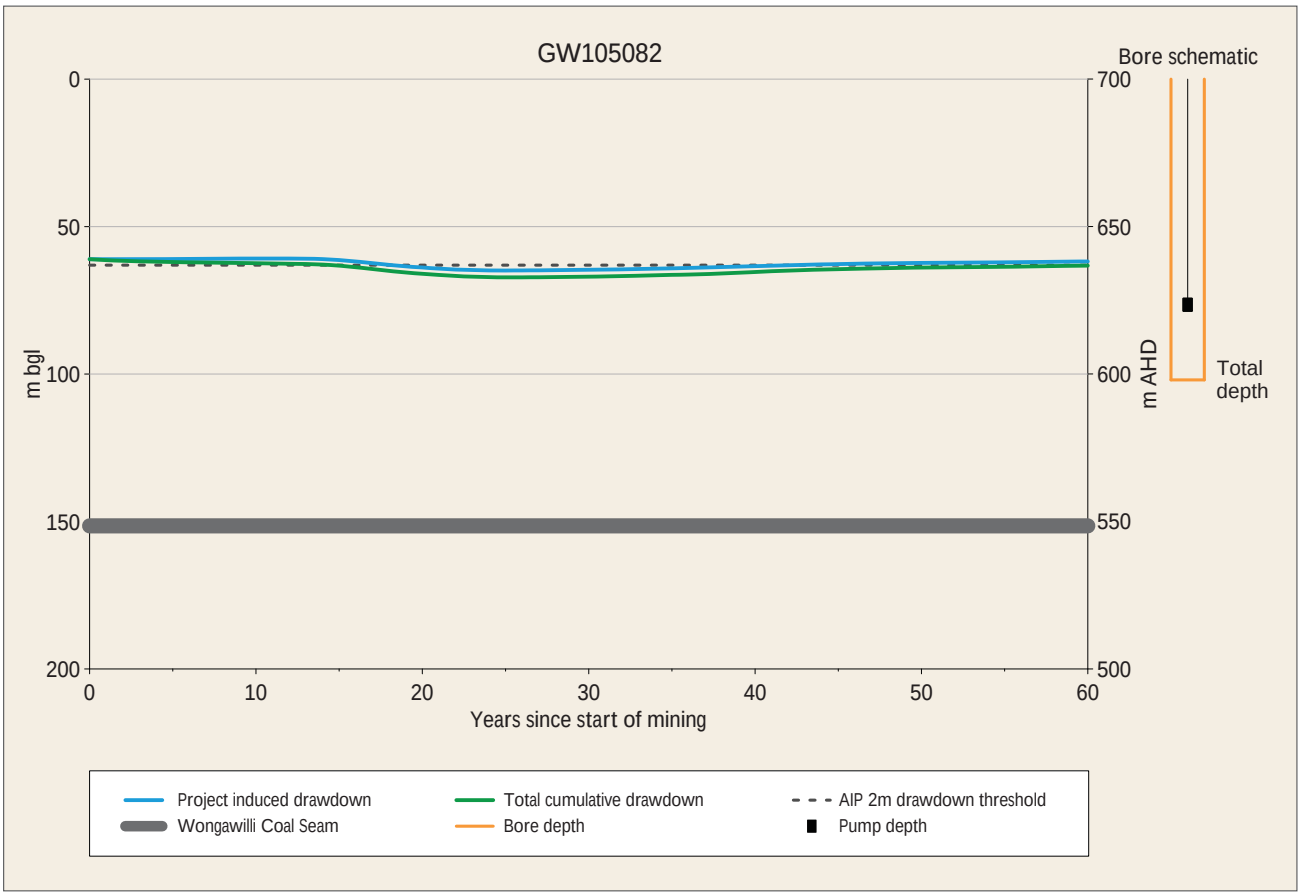

GW067303
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

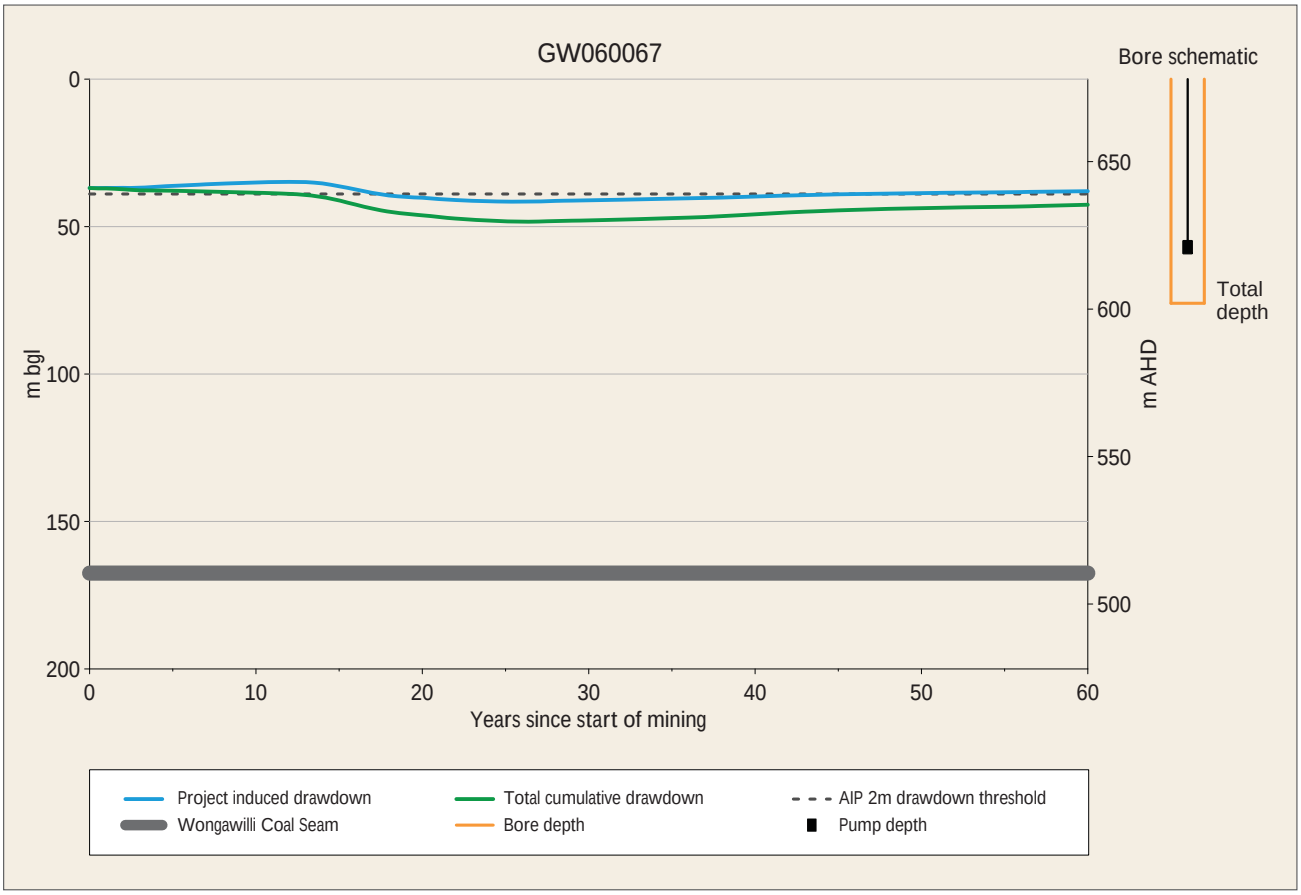

GW109039
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

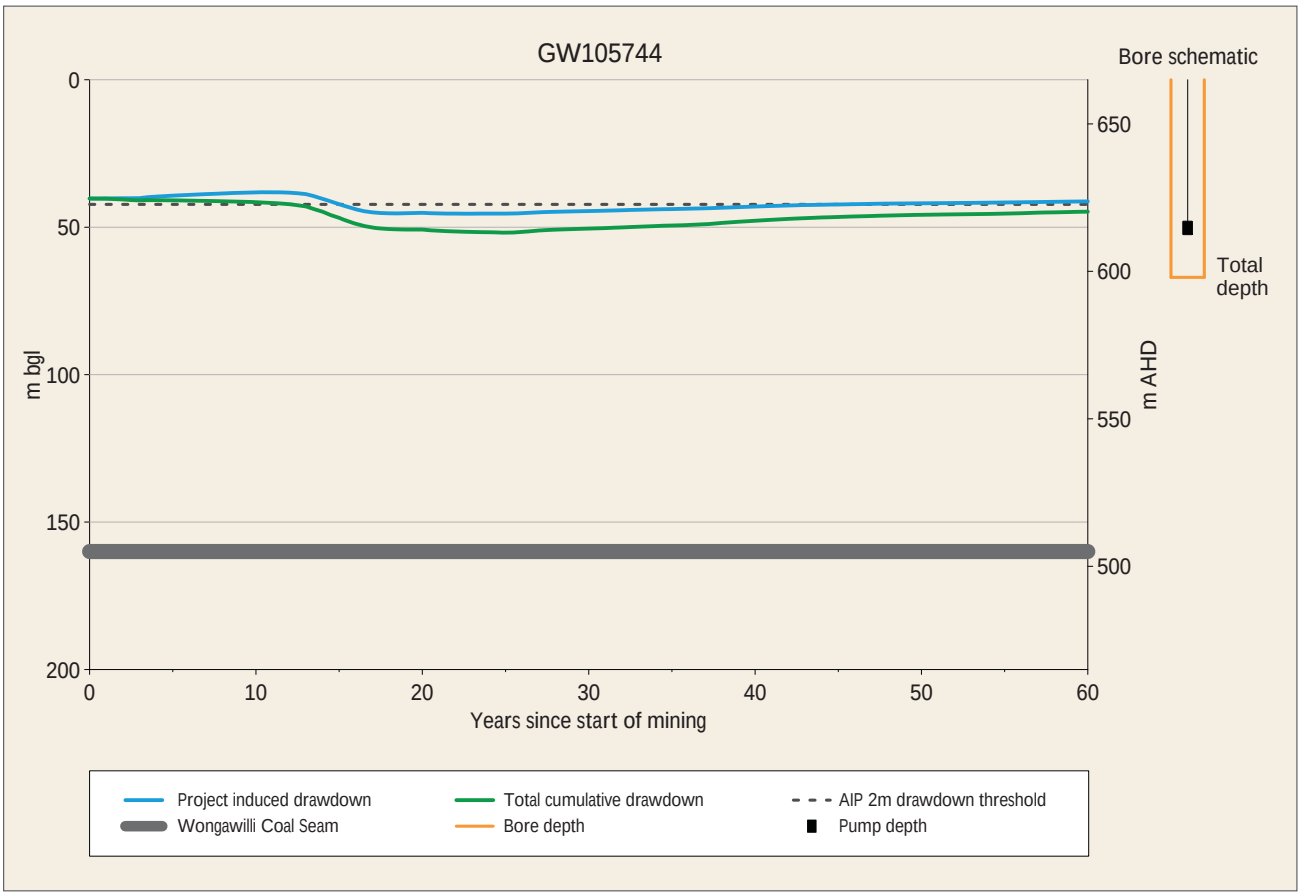

GW102775
Bore schematic
0
50
100
150
200
m bgl
600
550
500
450
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

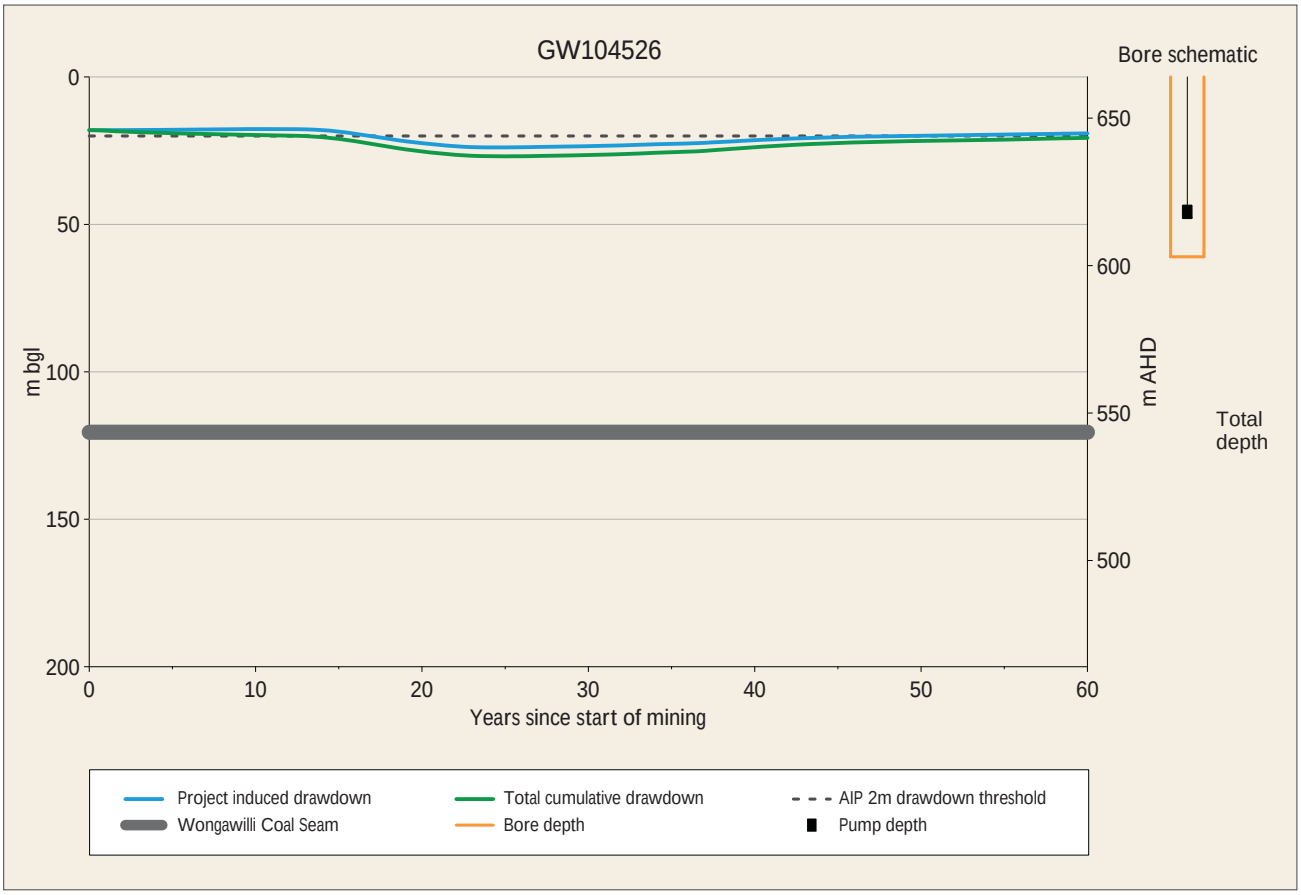

GW104684
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

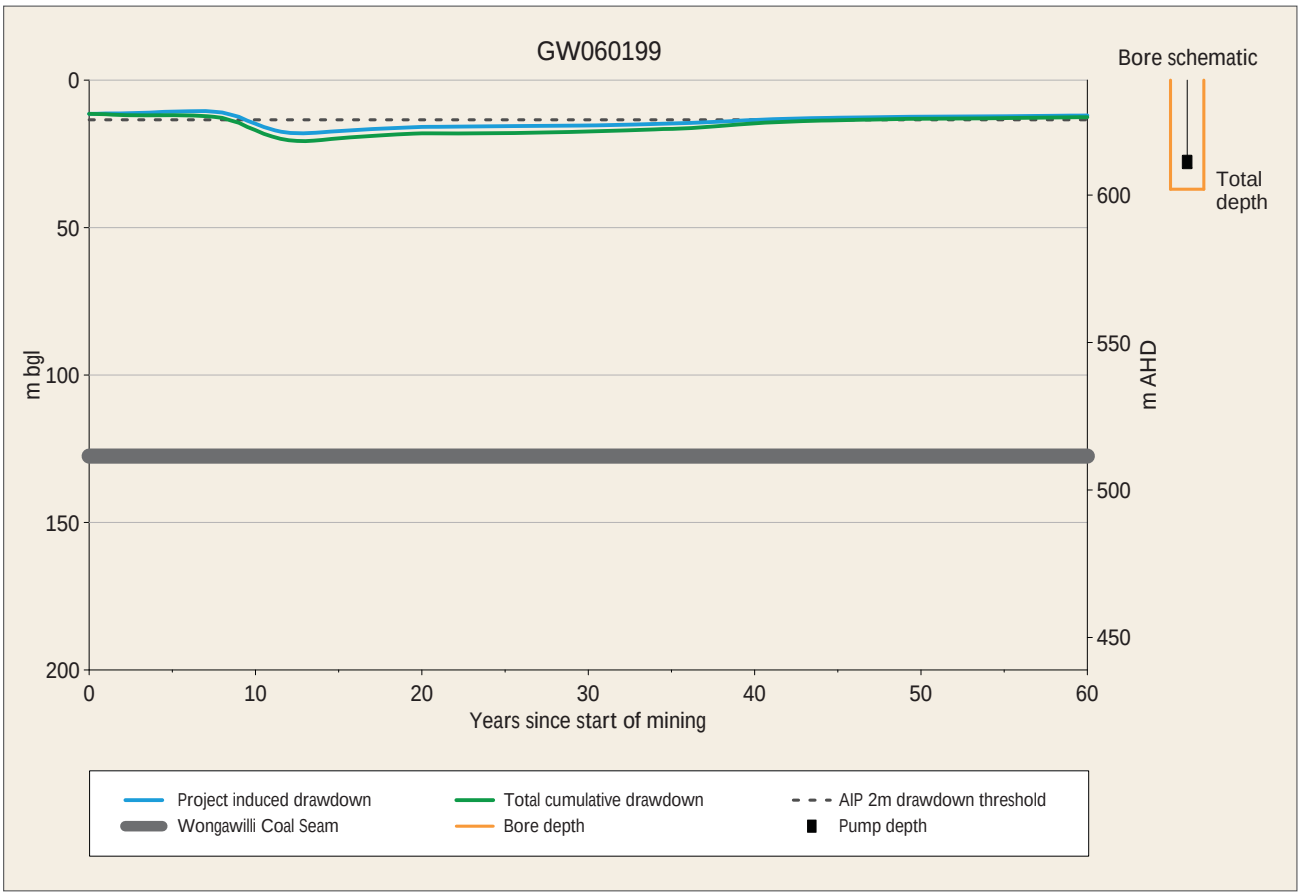

GW060125
Bore schematic
0
50
100
150
200
m bgl
600
550
500
450
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

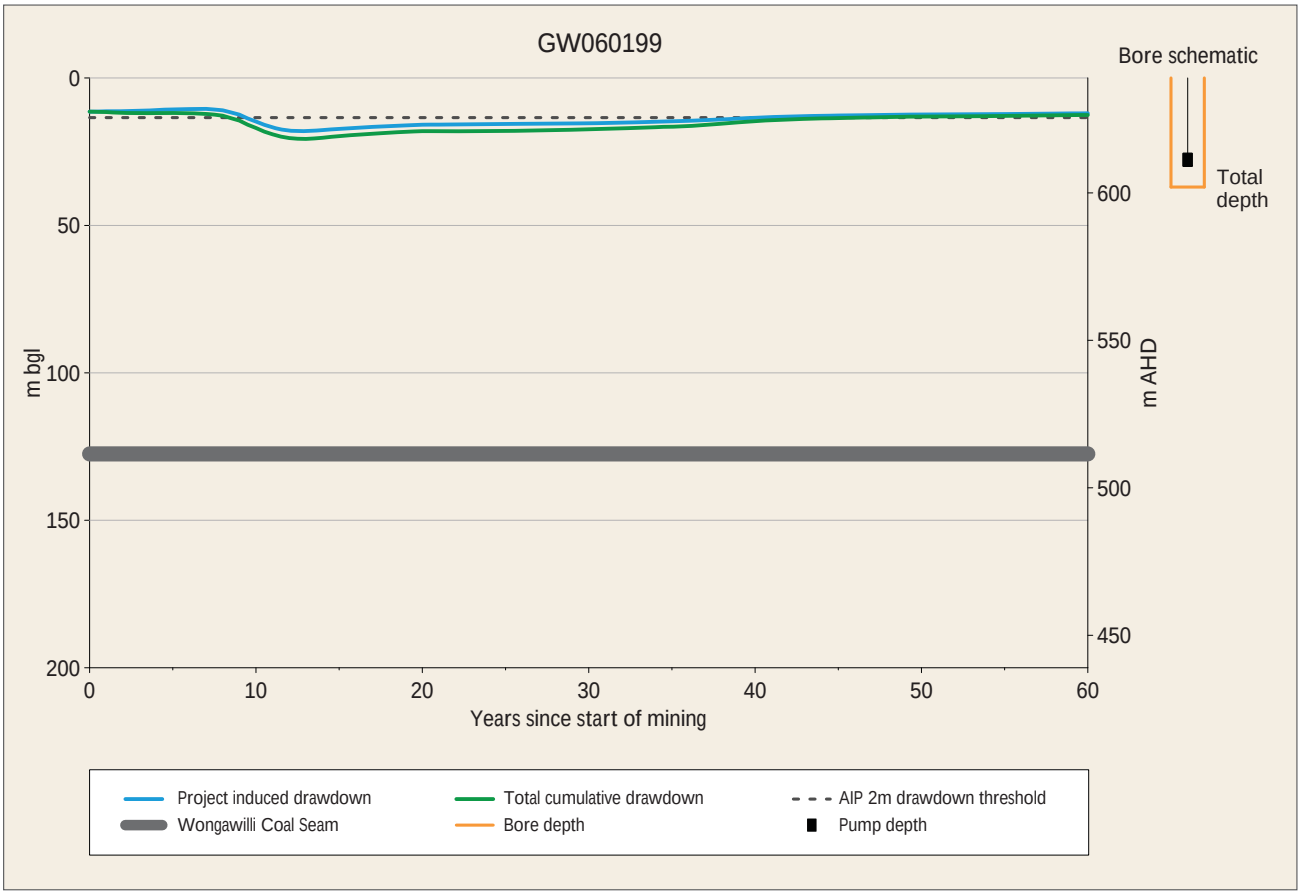

GW105082
Bore schematic
0
50
100
150
200
m bgl
700
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

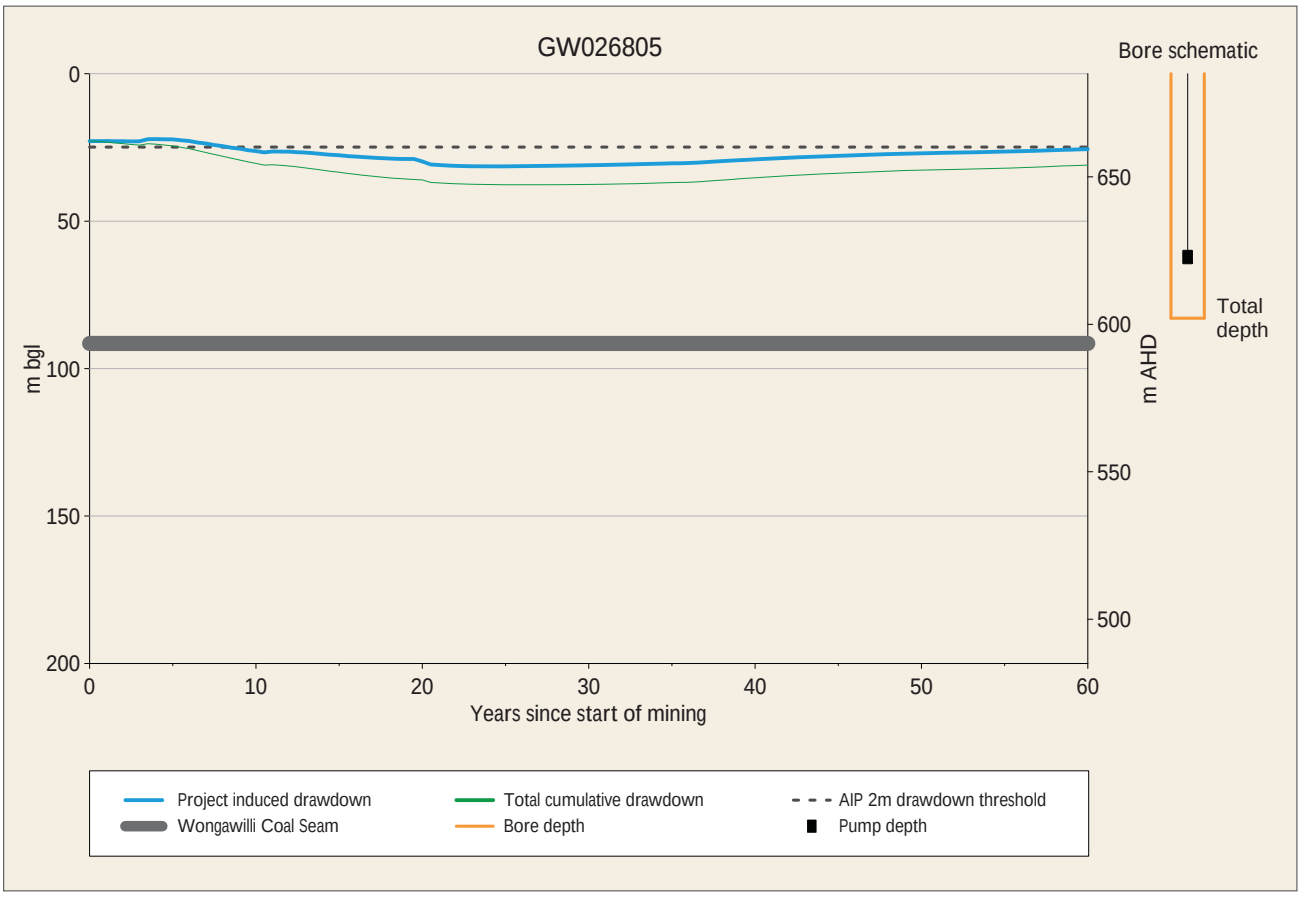

GW060067
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

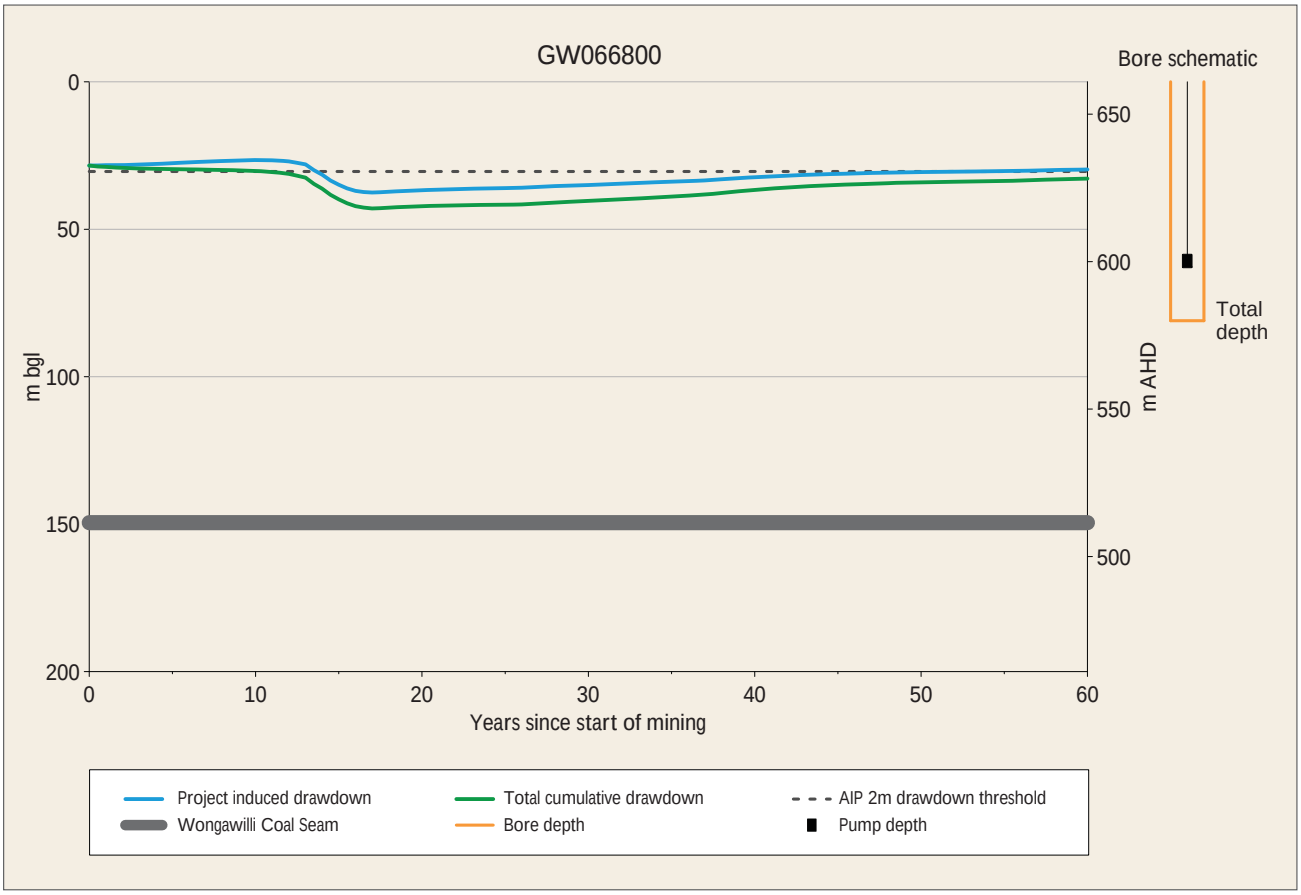

GW105744
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

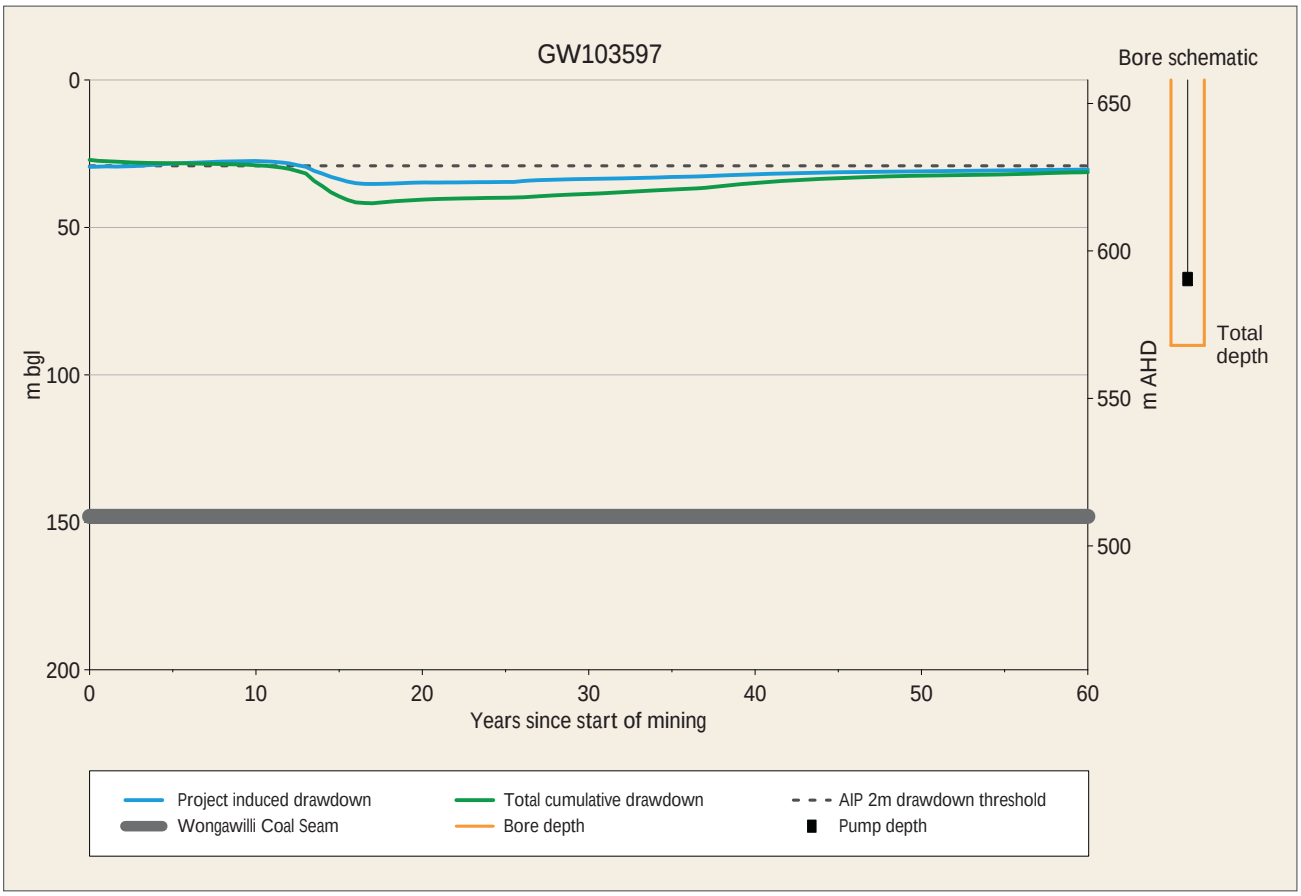

GW104526
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

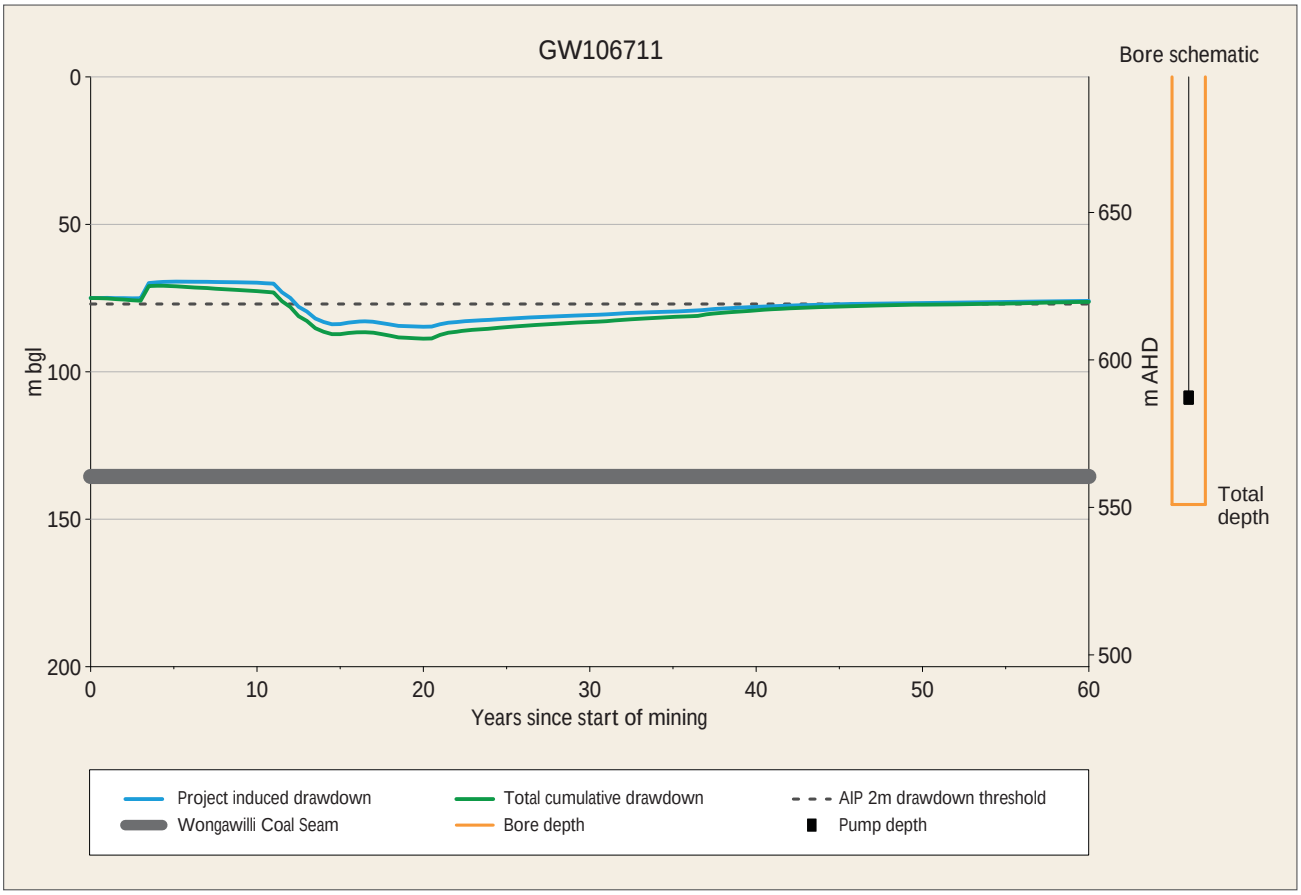

GW060199
Bore schematic
0
50
100
150
200
m bgl
600
550
500
450
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

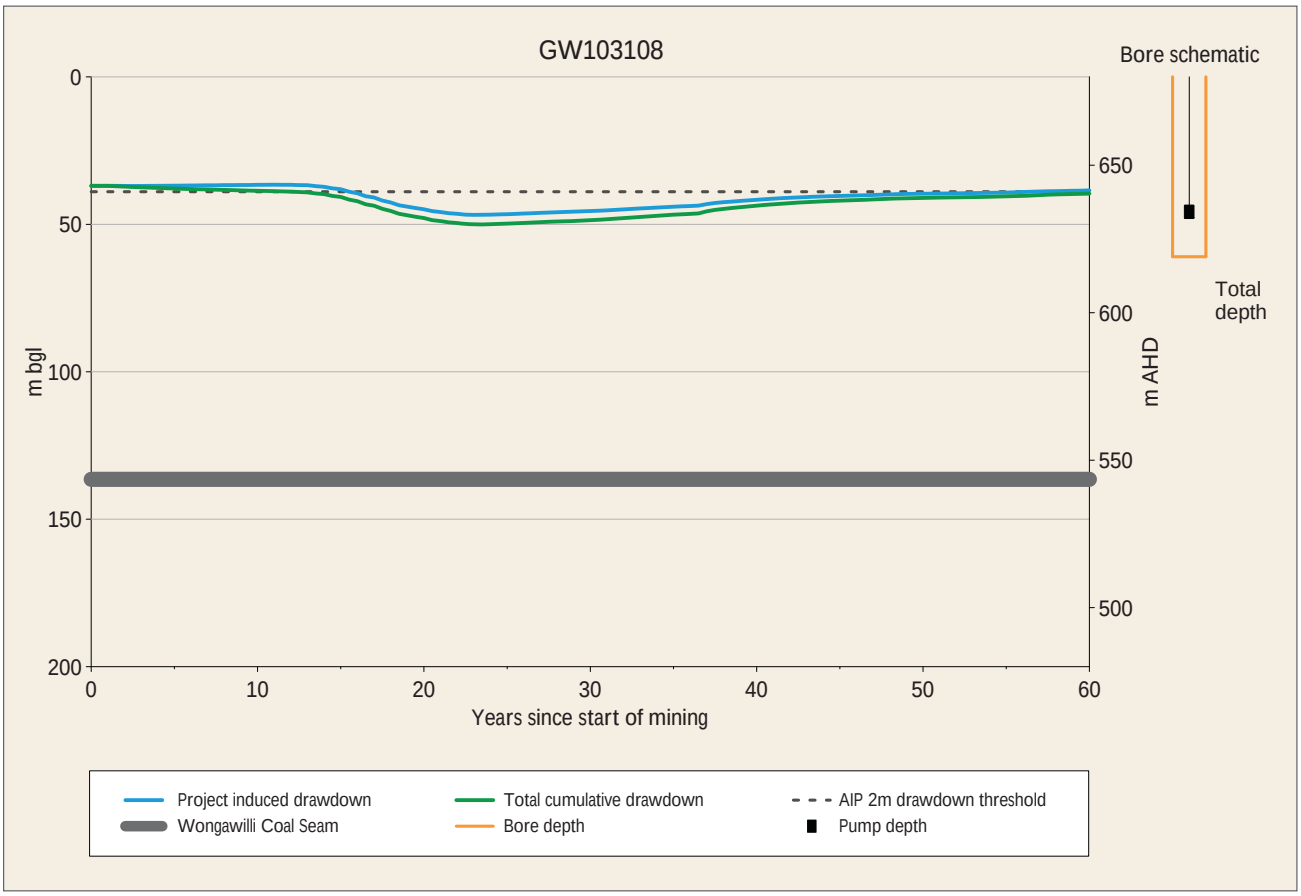

GW060199
Bore schematic
Total depth
m bgl
m AHD
0
50
100
150
200
600
550
500
450
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

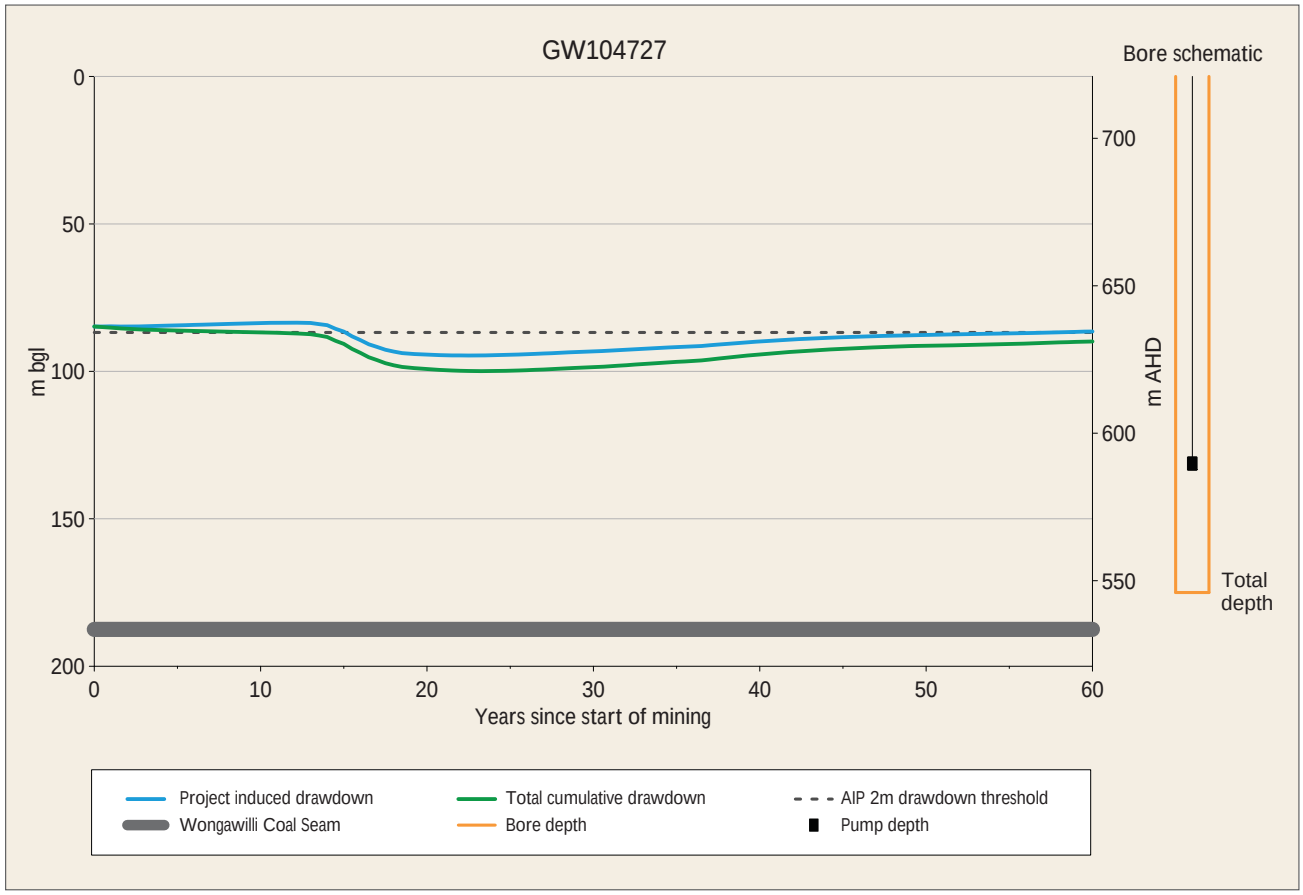

GW026805
Bore schematic
Total depth
m bgl
m AHD
0
50
100
150
200
650
600
550
500
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

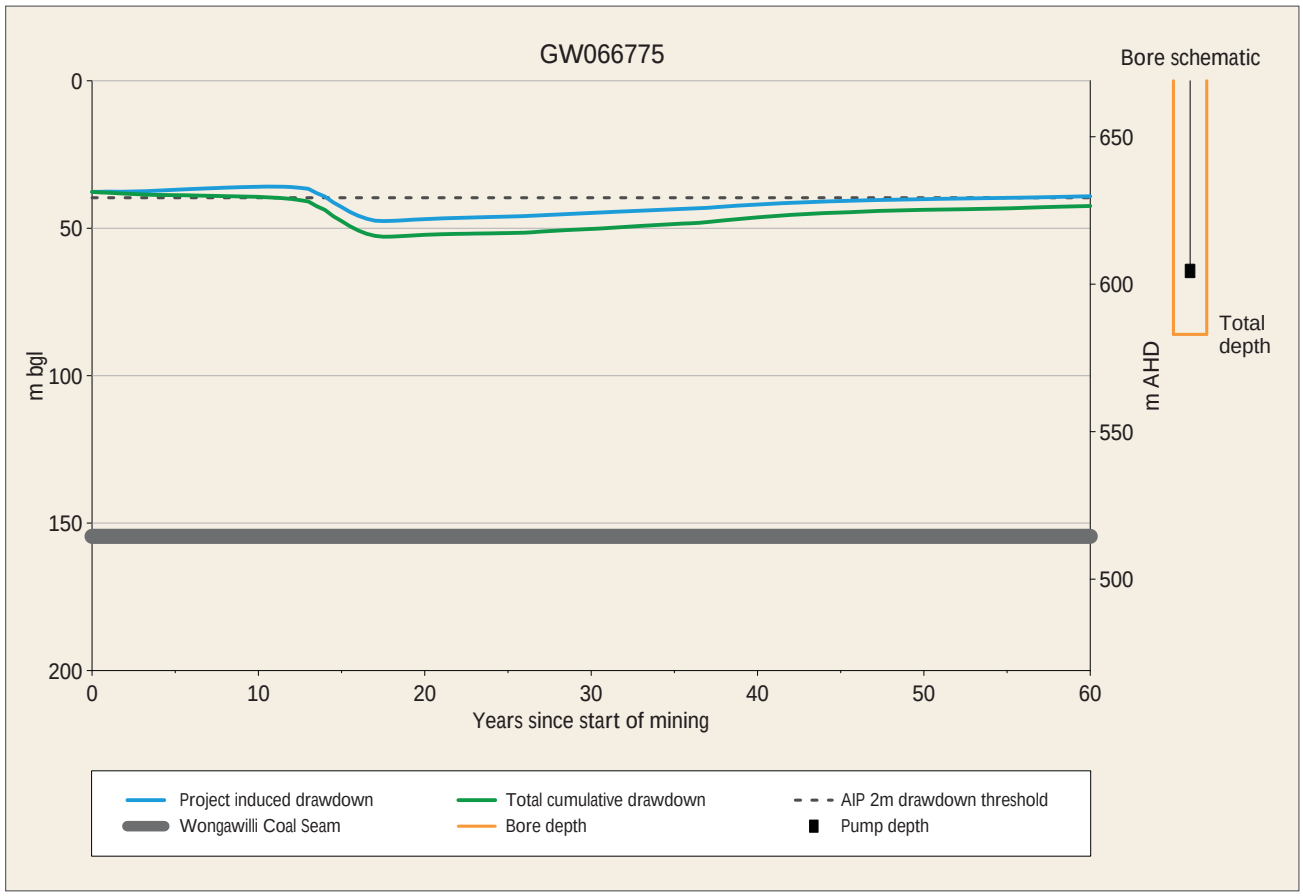

GW066800
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

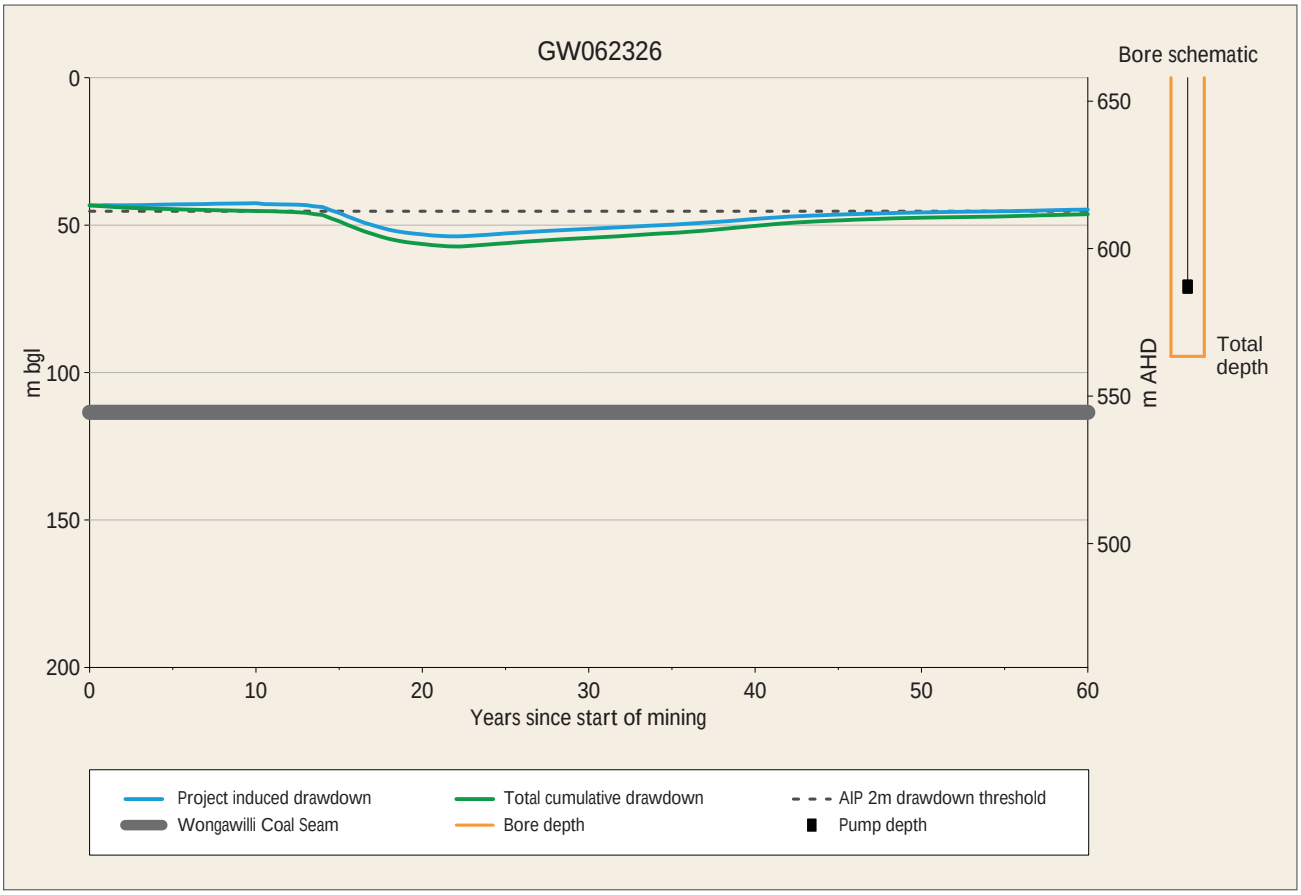

GW103597
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

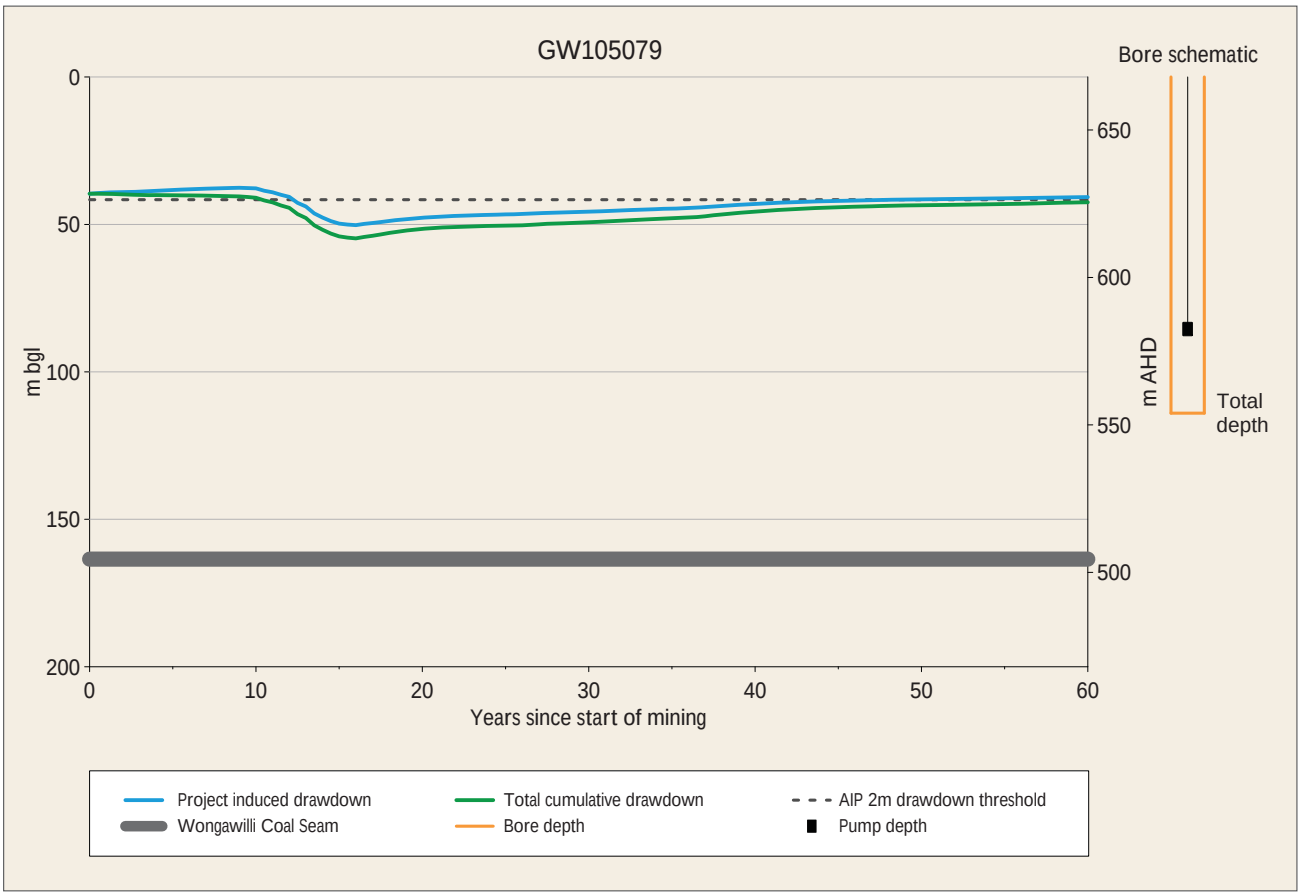

GW106711
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

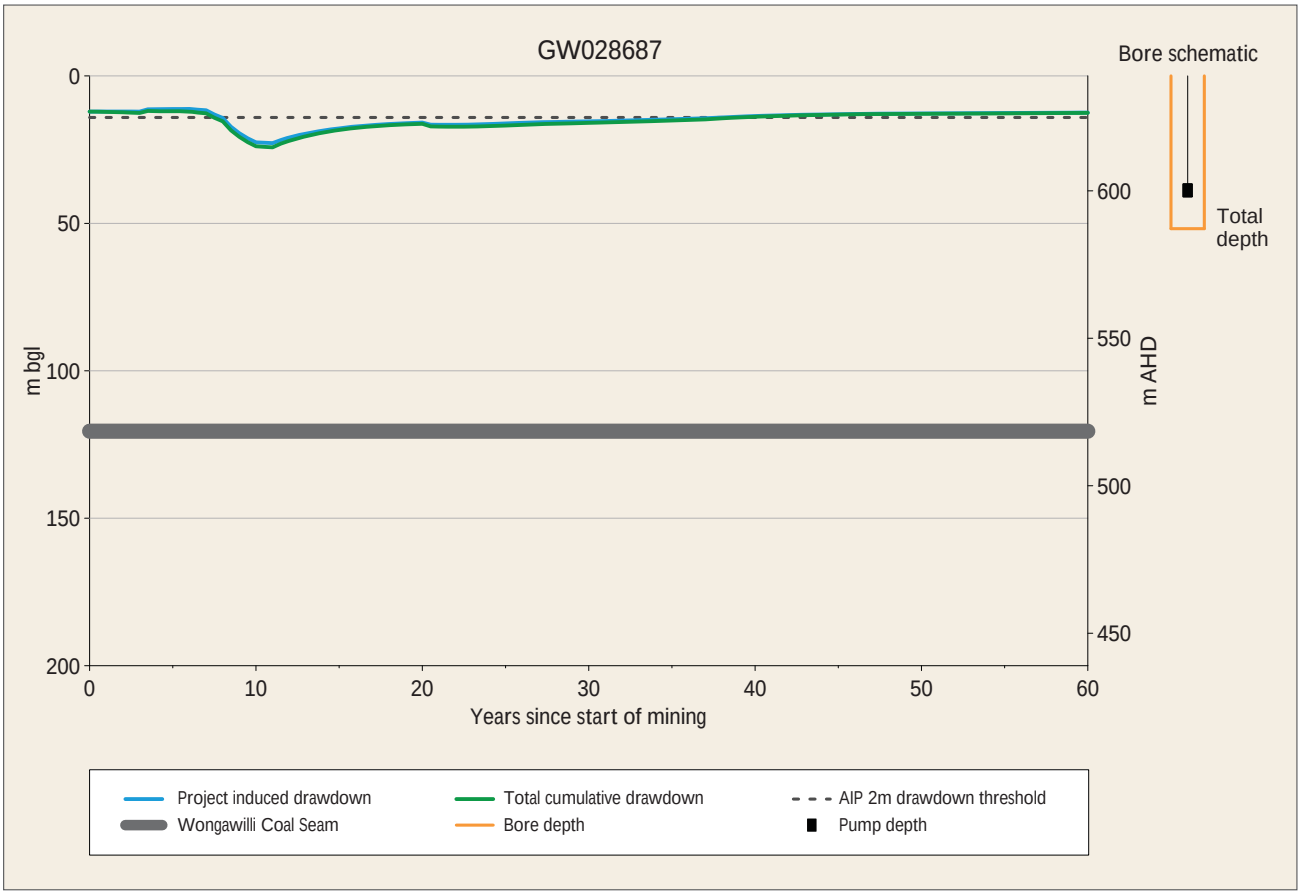

GW103108
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

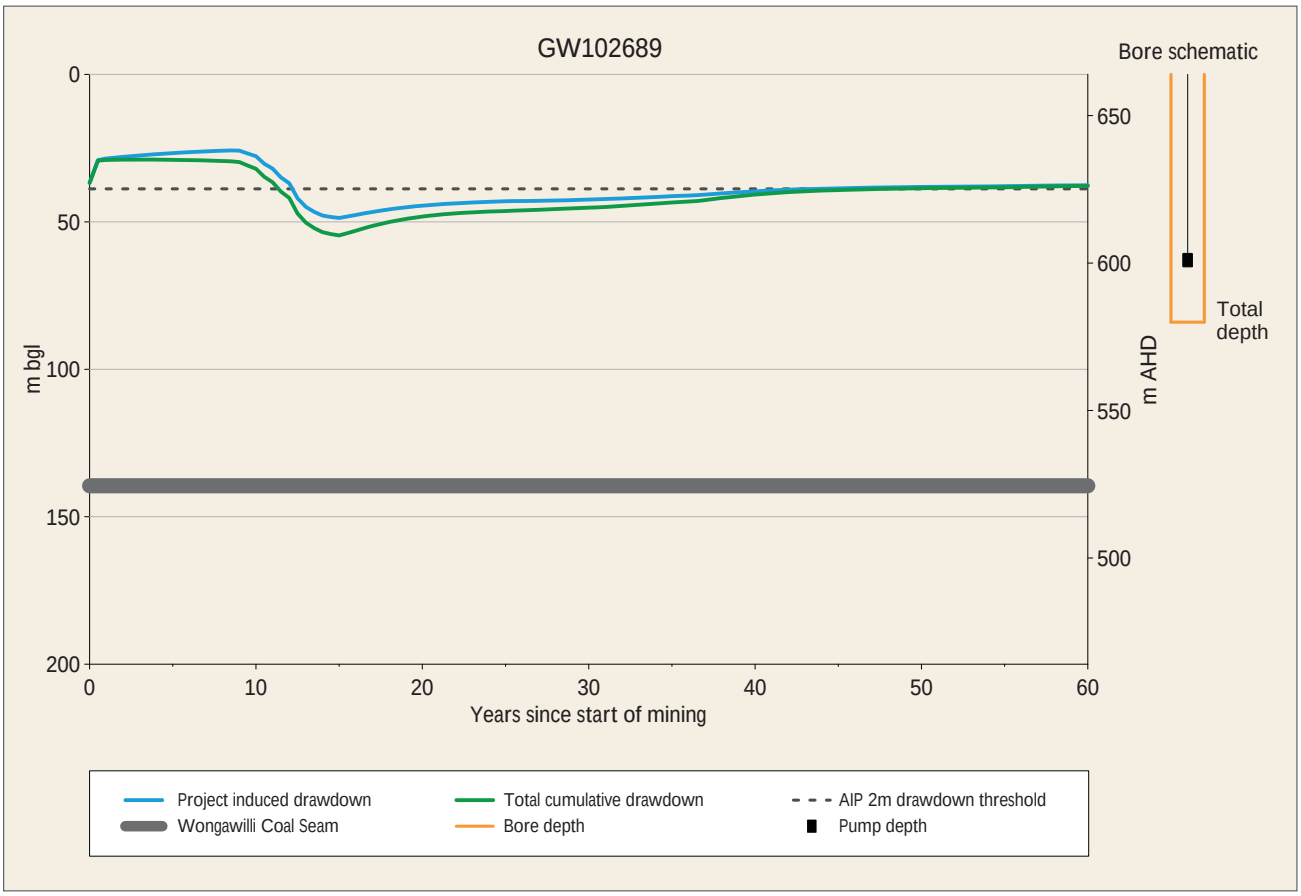

GW104727
Bore schematic
0
50
100
150
200
m bgl
700
650
600
550
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

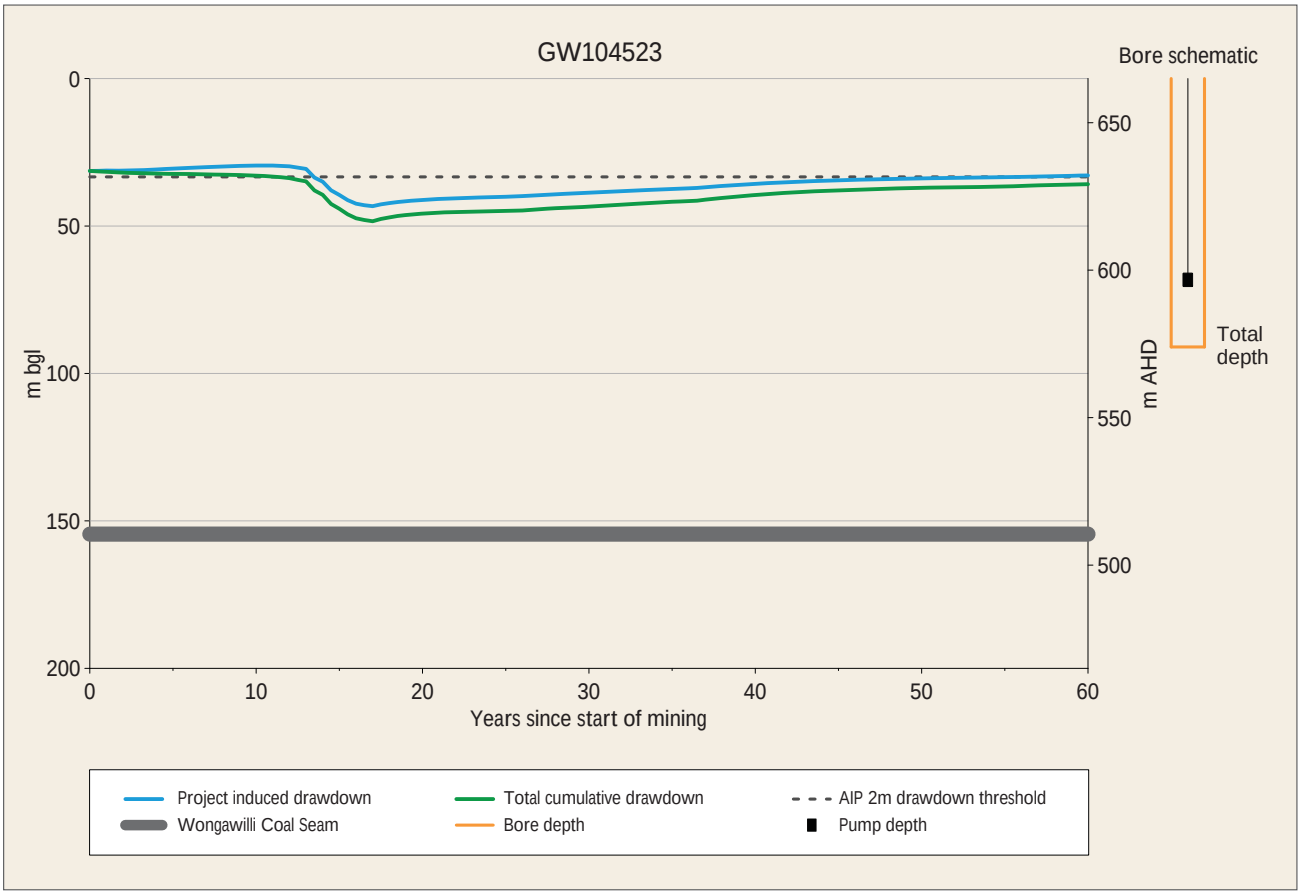

GW066775
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

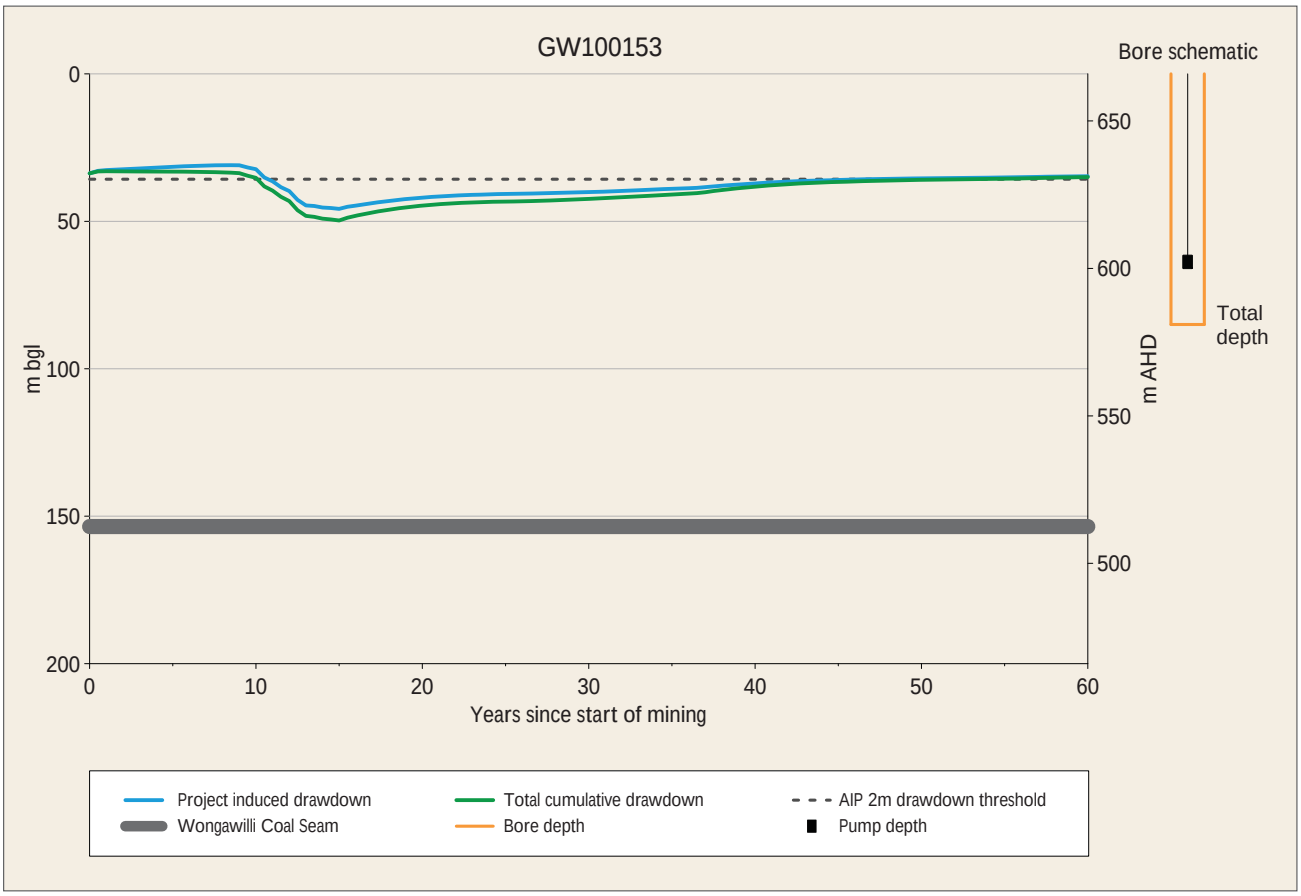

GW062326
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

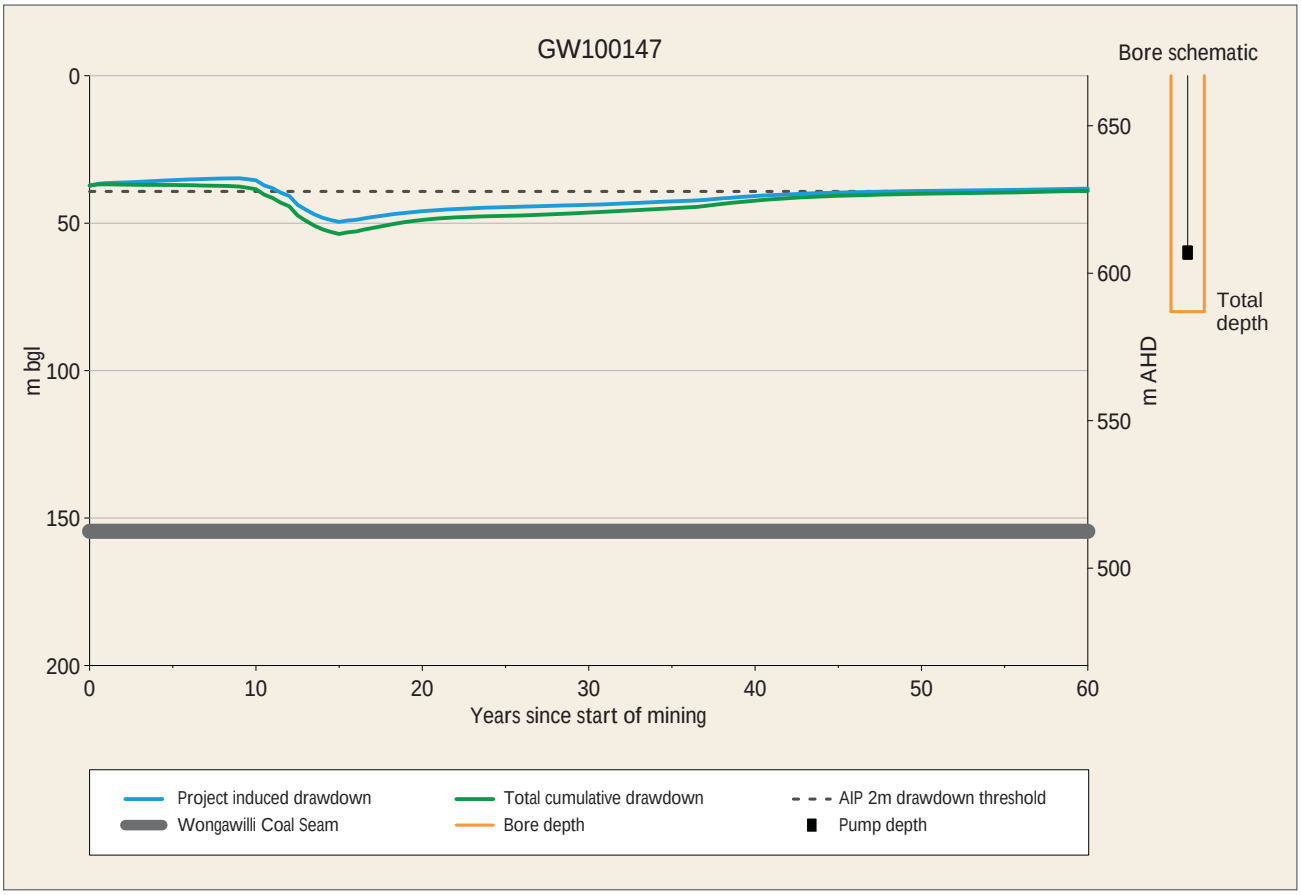

GW105079
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

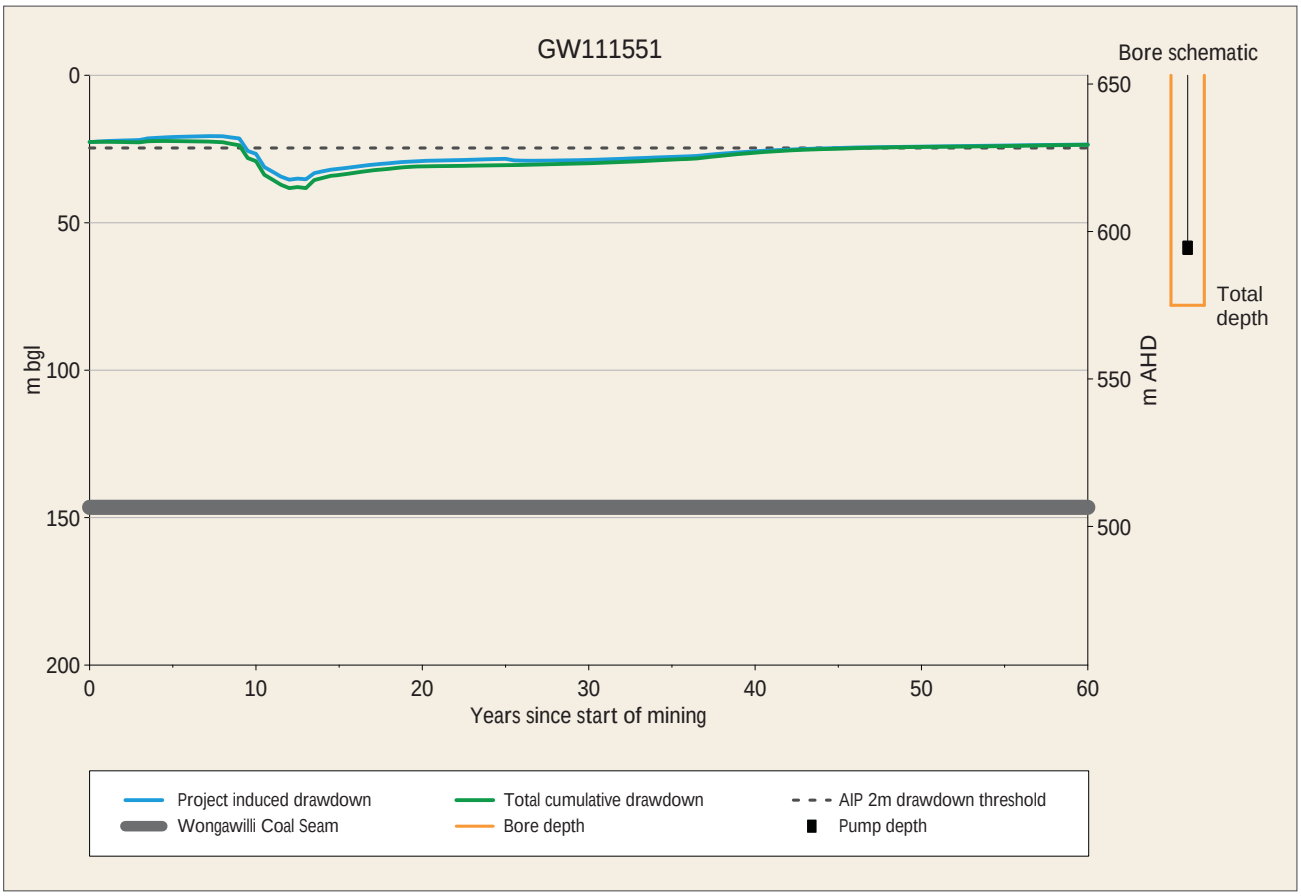

GW028687
Bore schematic
0
50
100
150
200
m bgl
600
550
500
450
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

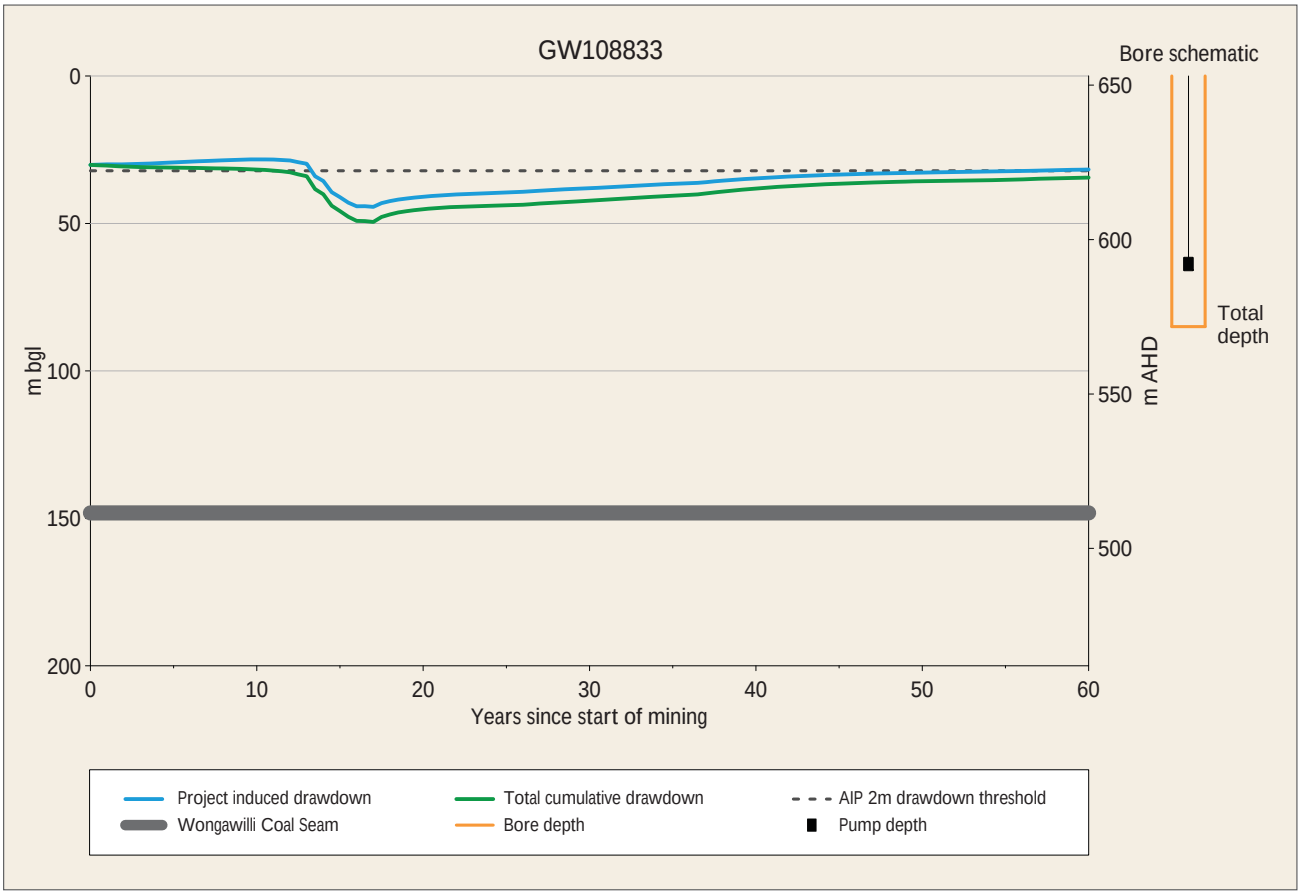

GW102689
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

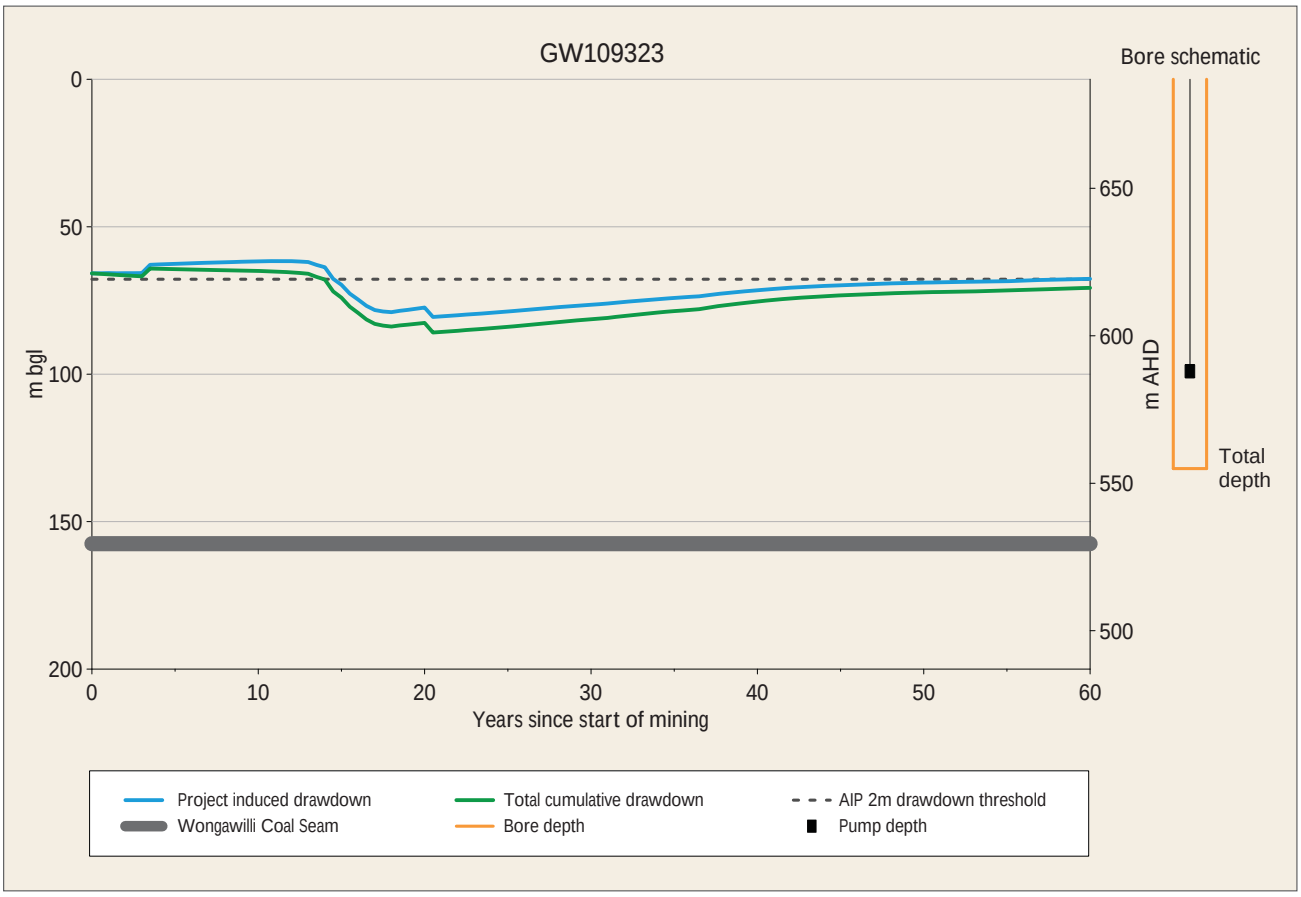

GW104523
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

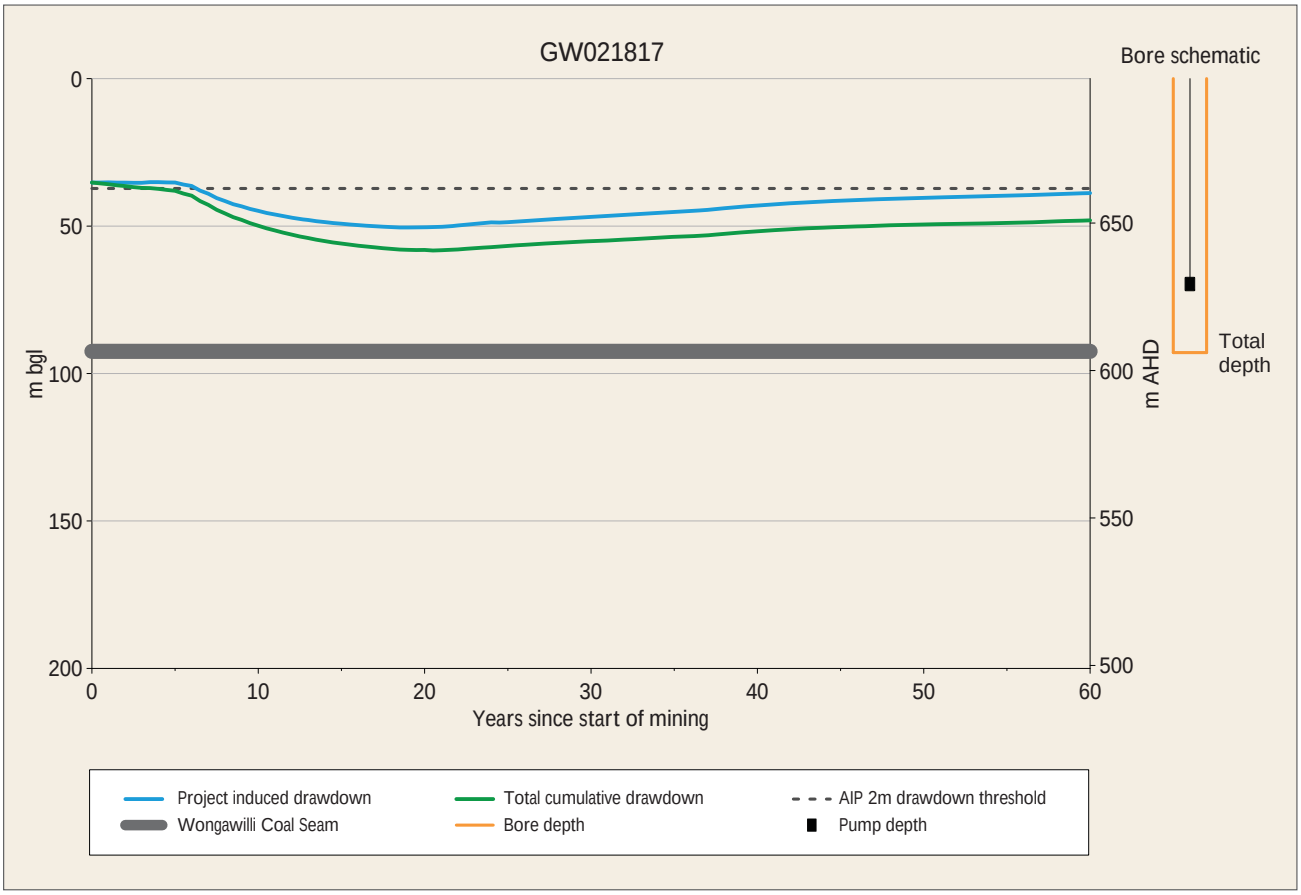

GW100153
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

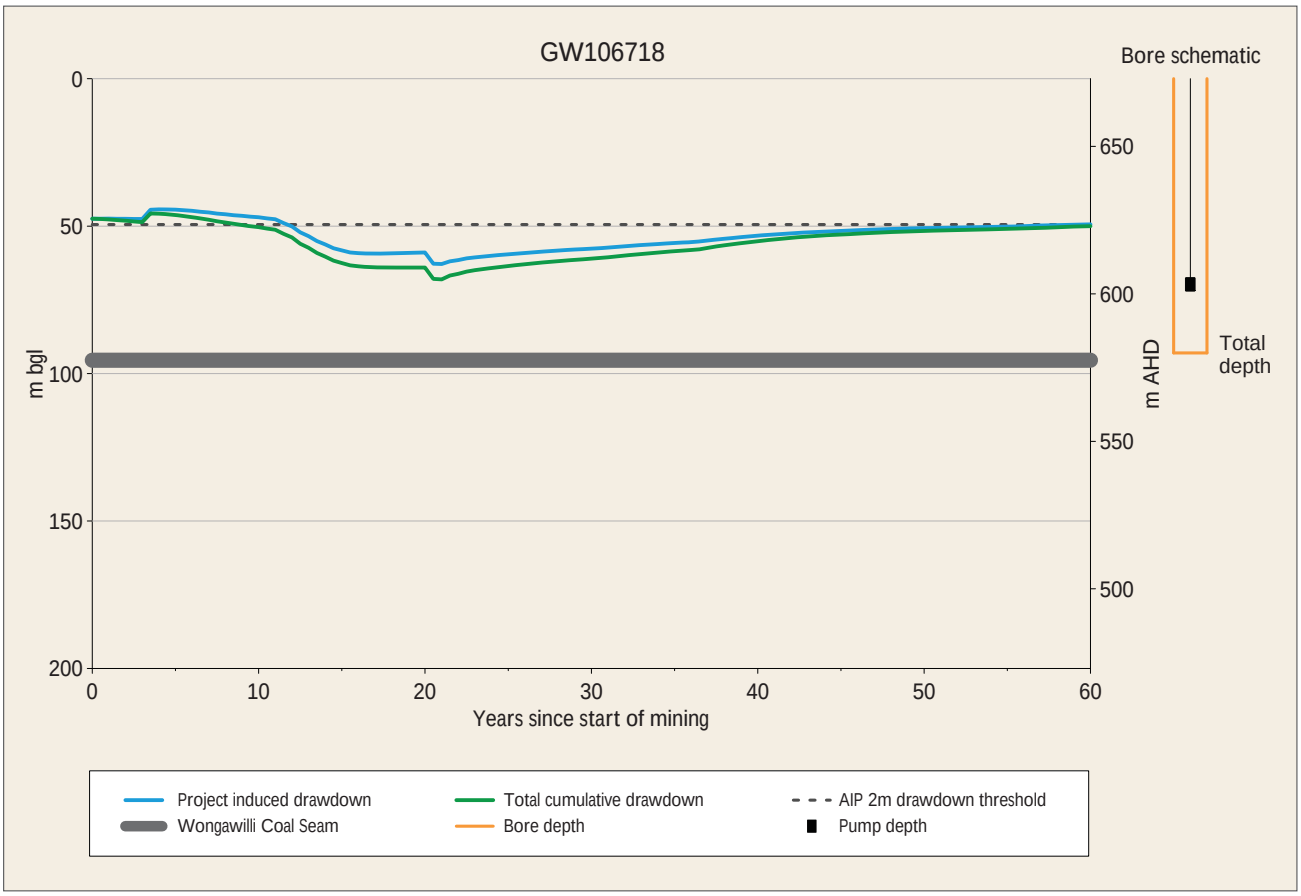

GW100147
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

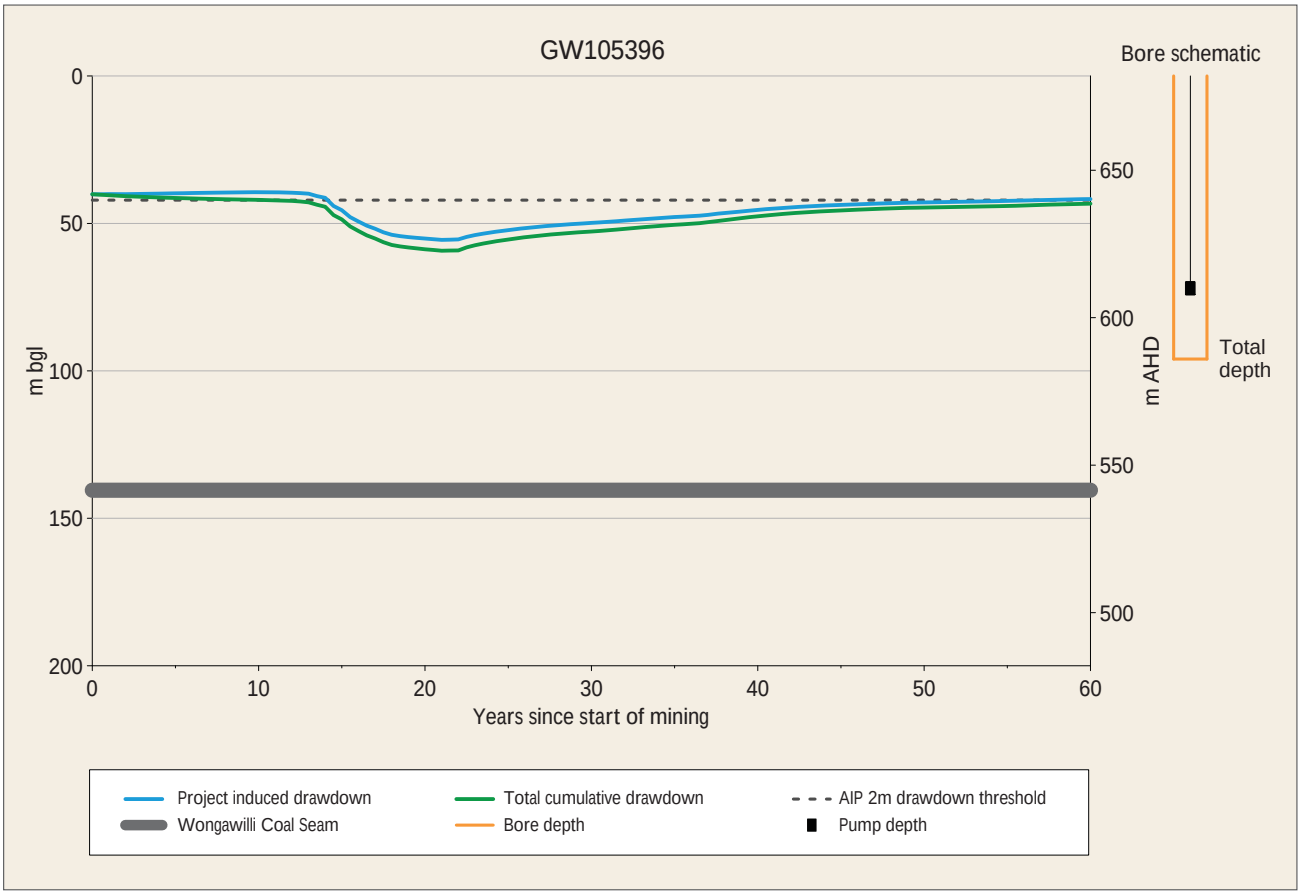

GW111551
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

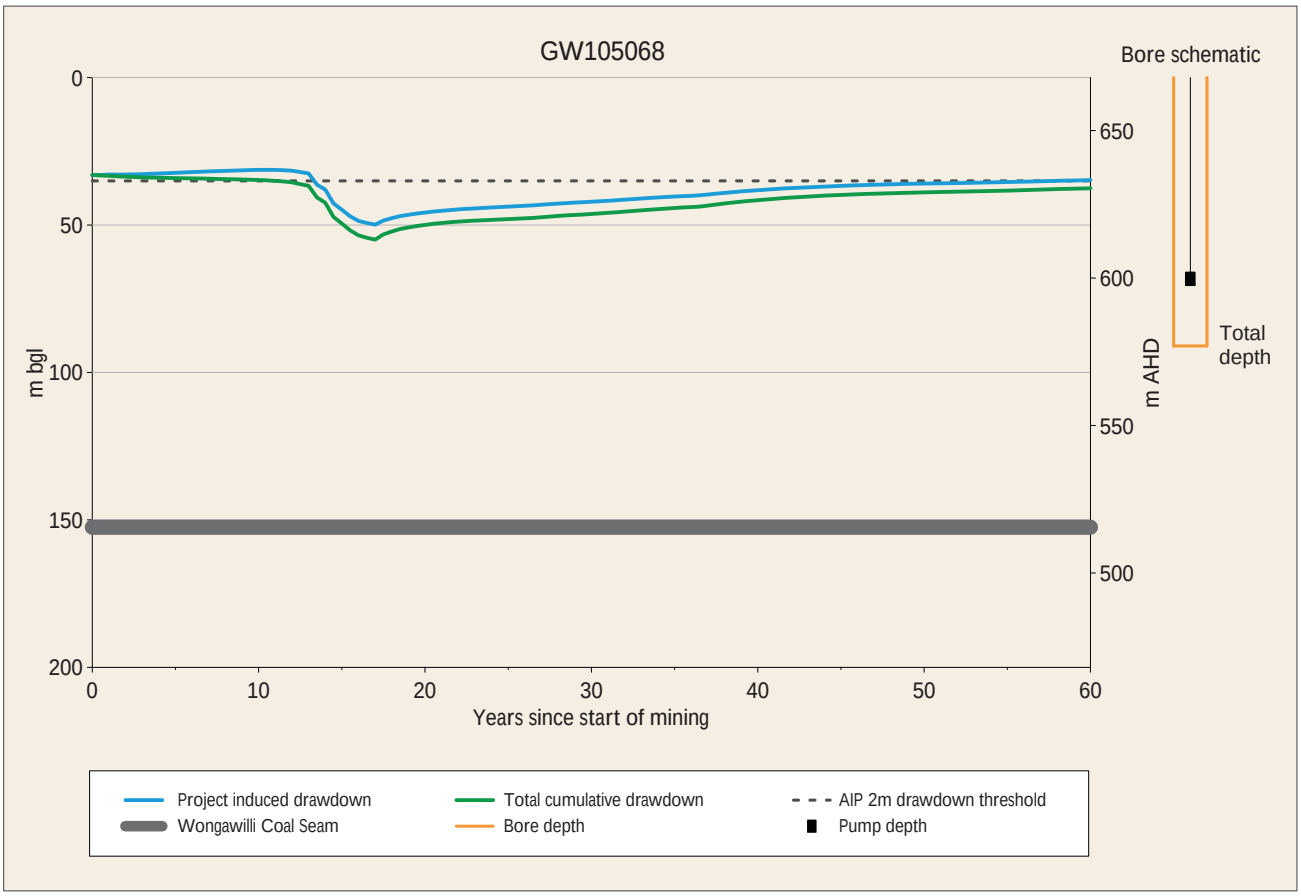

GW108833
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

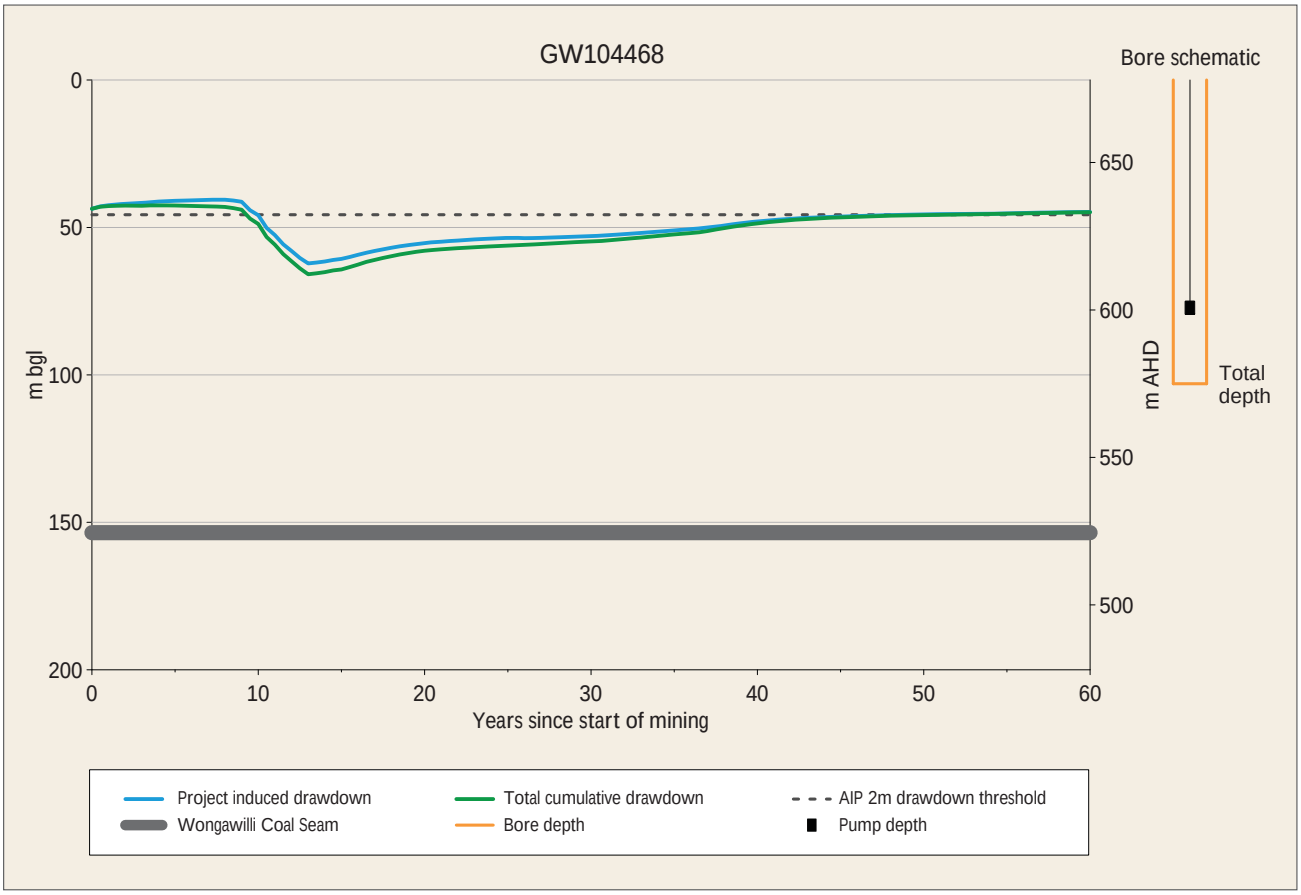

GW109323
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

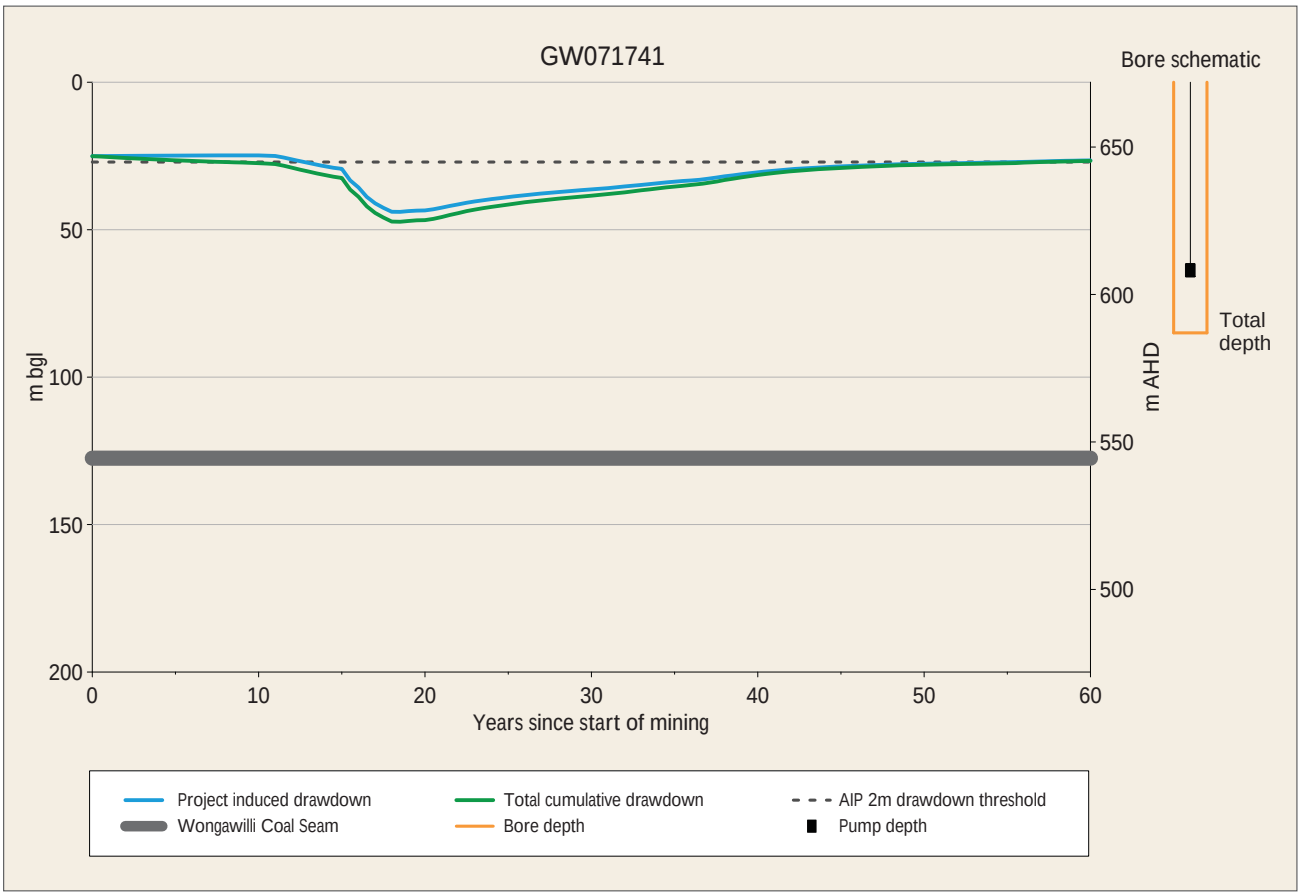

GW021817
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

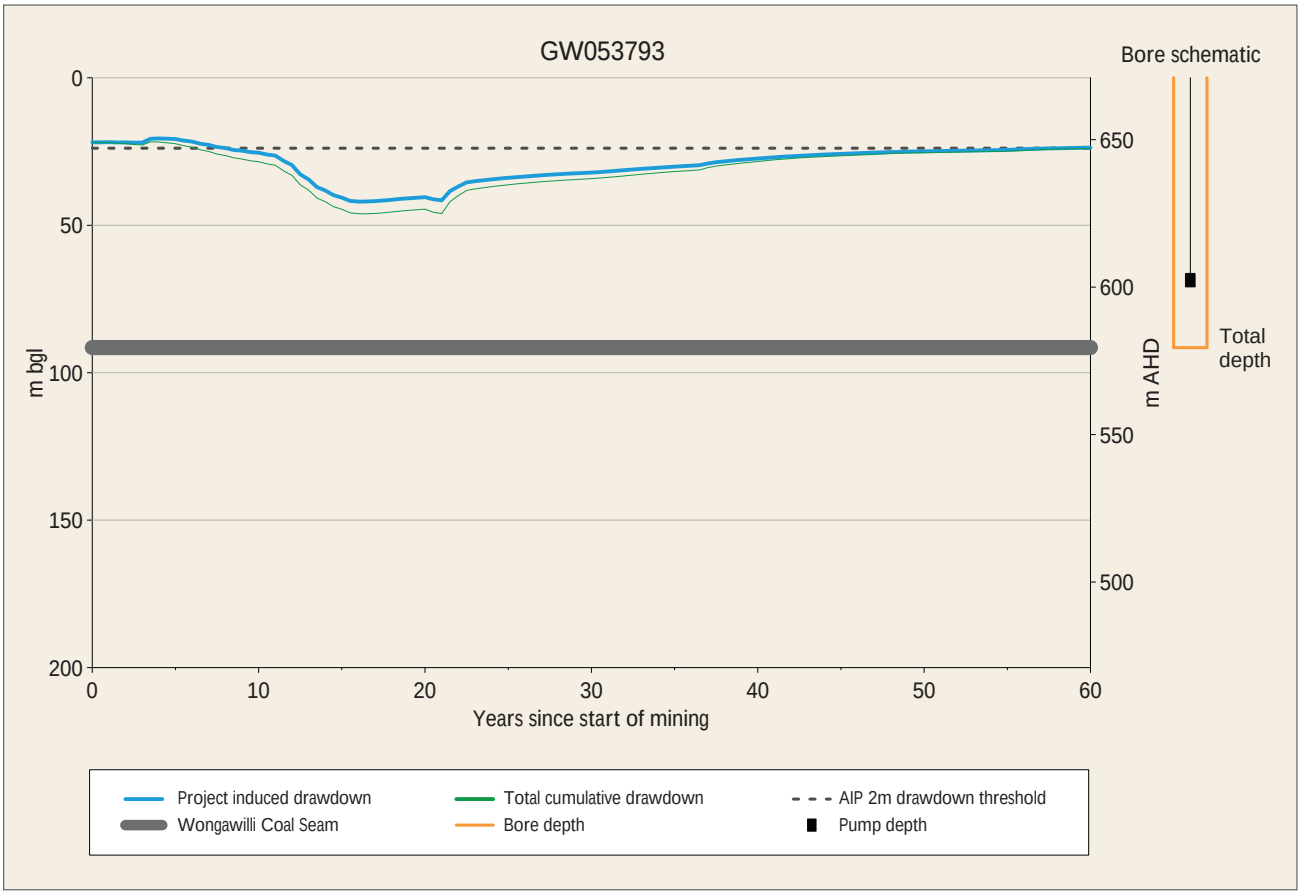

GW106718
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

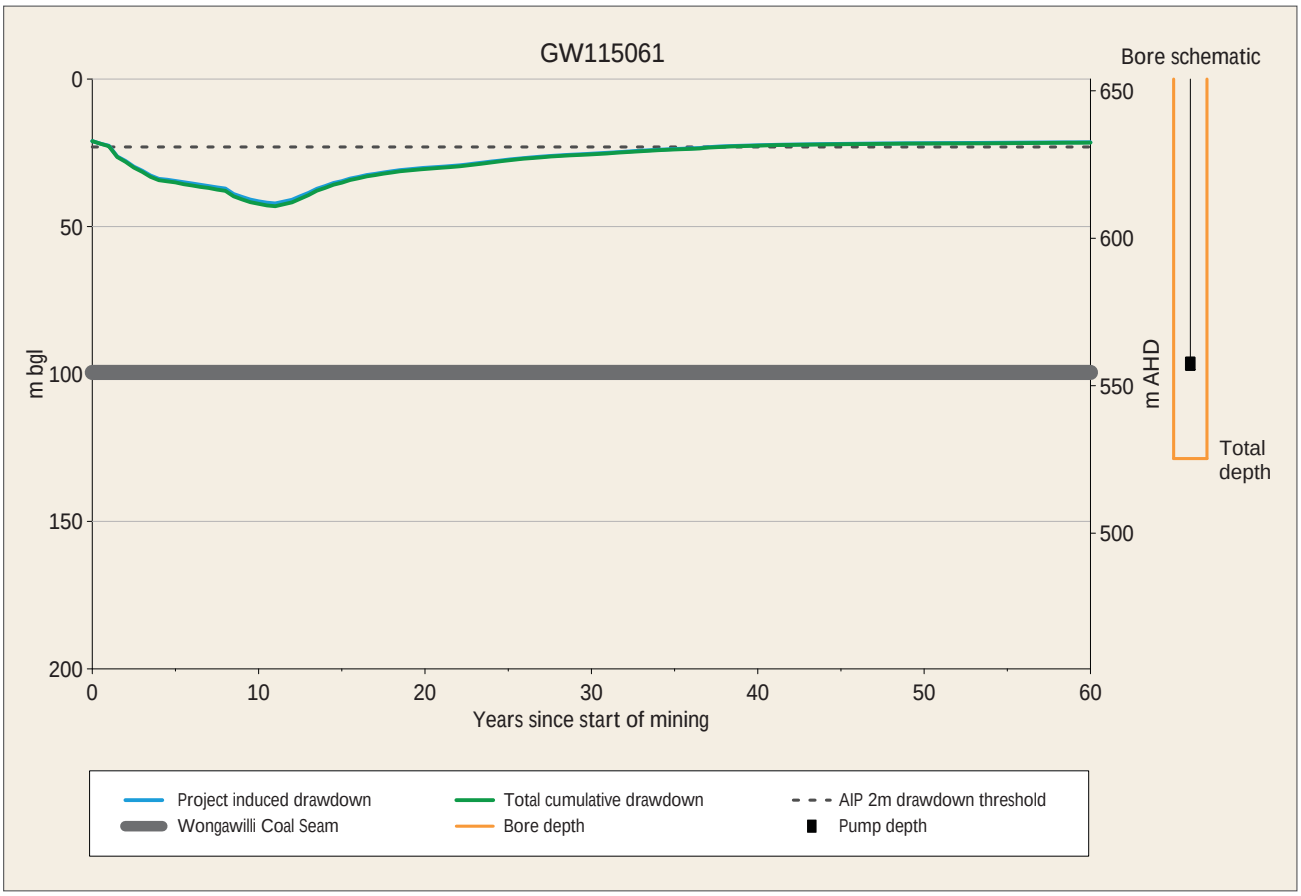

GW105396
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

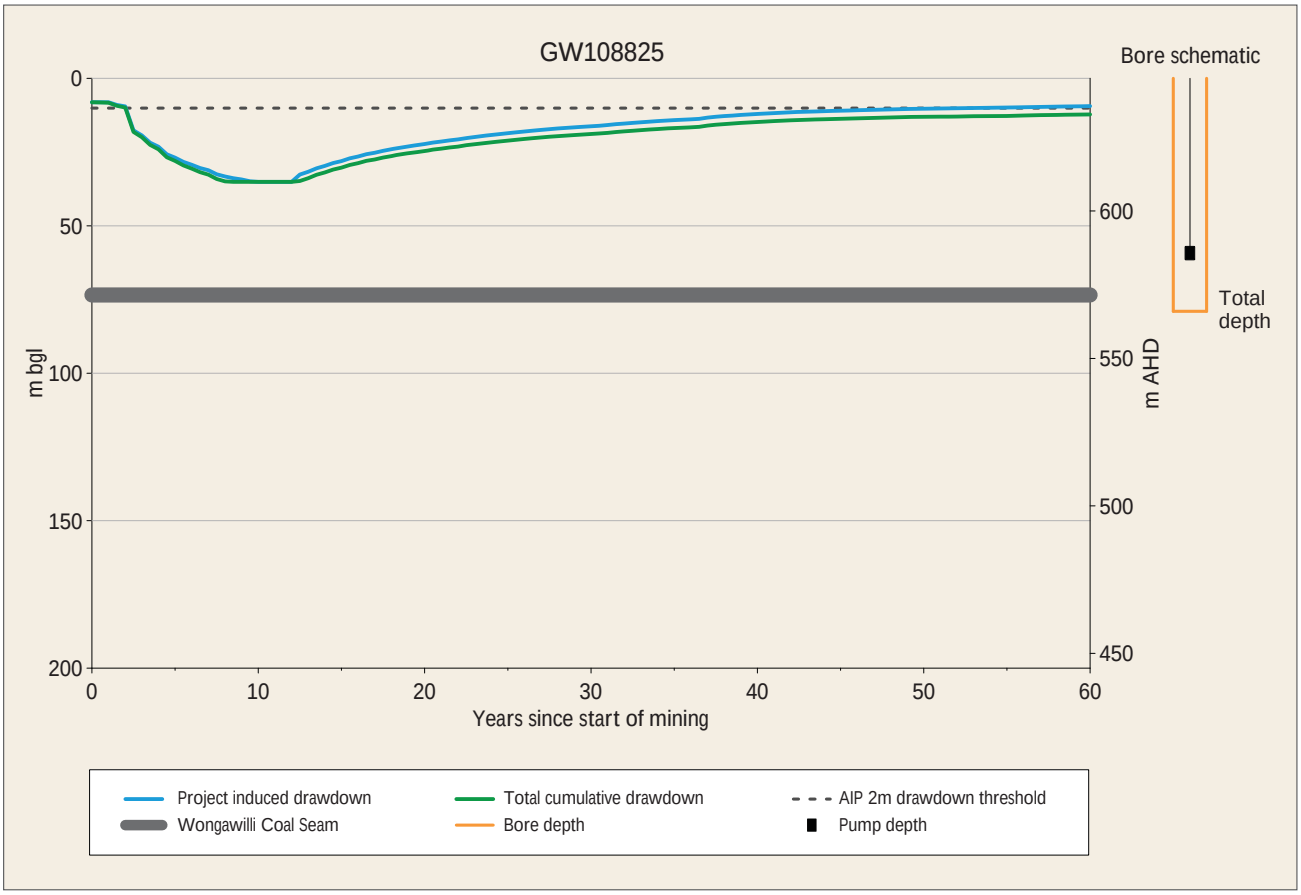

GW105068
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

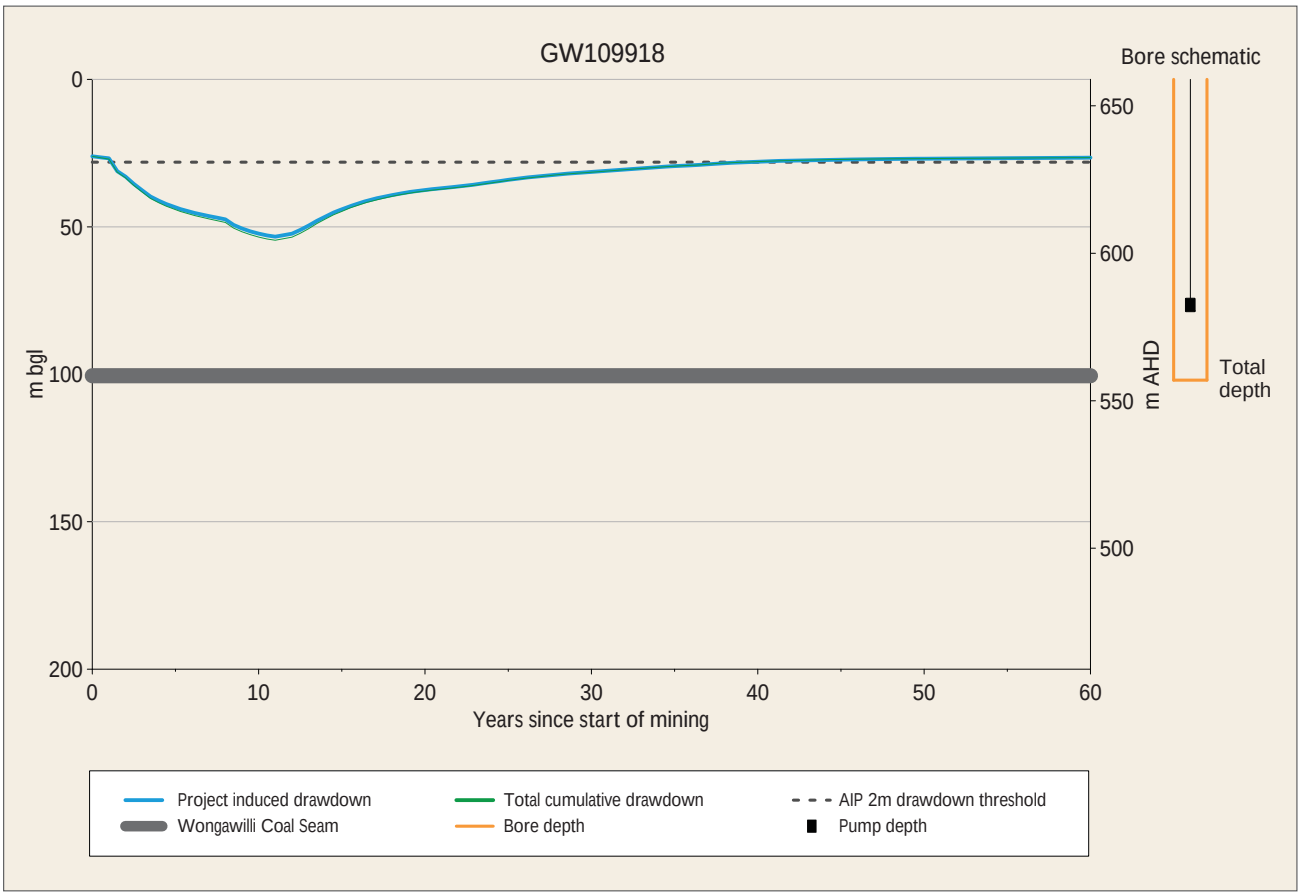

GW104468
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

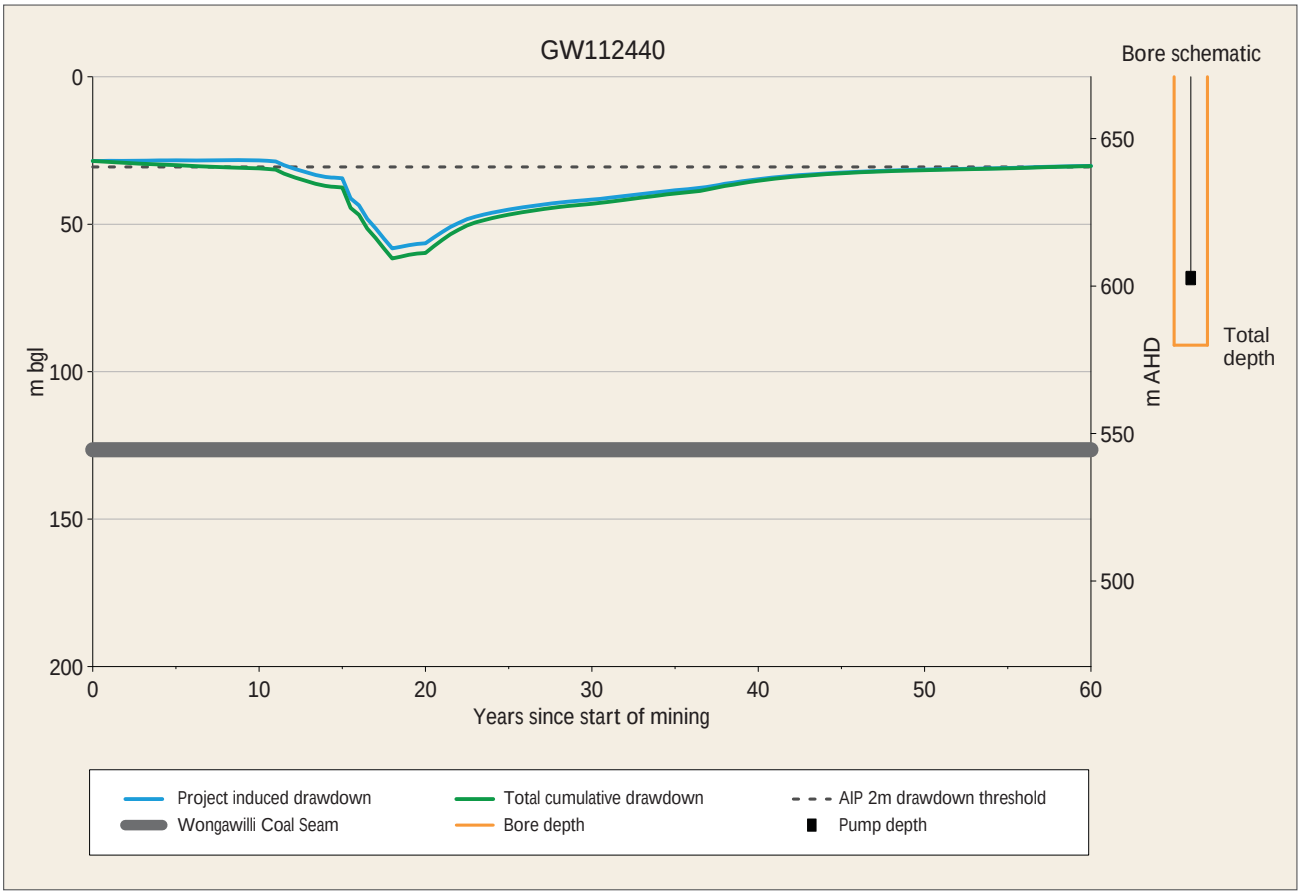

GW071741
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

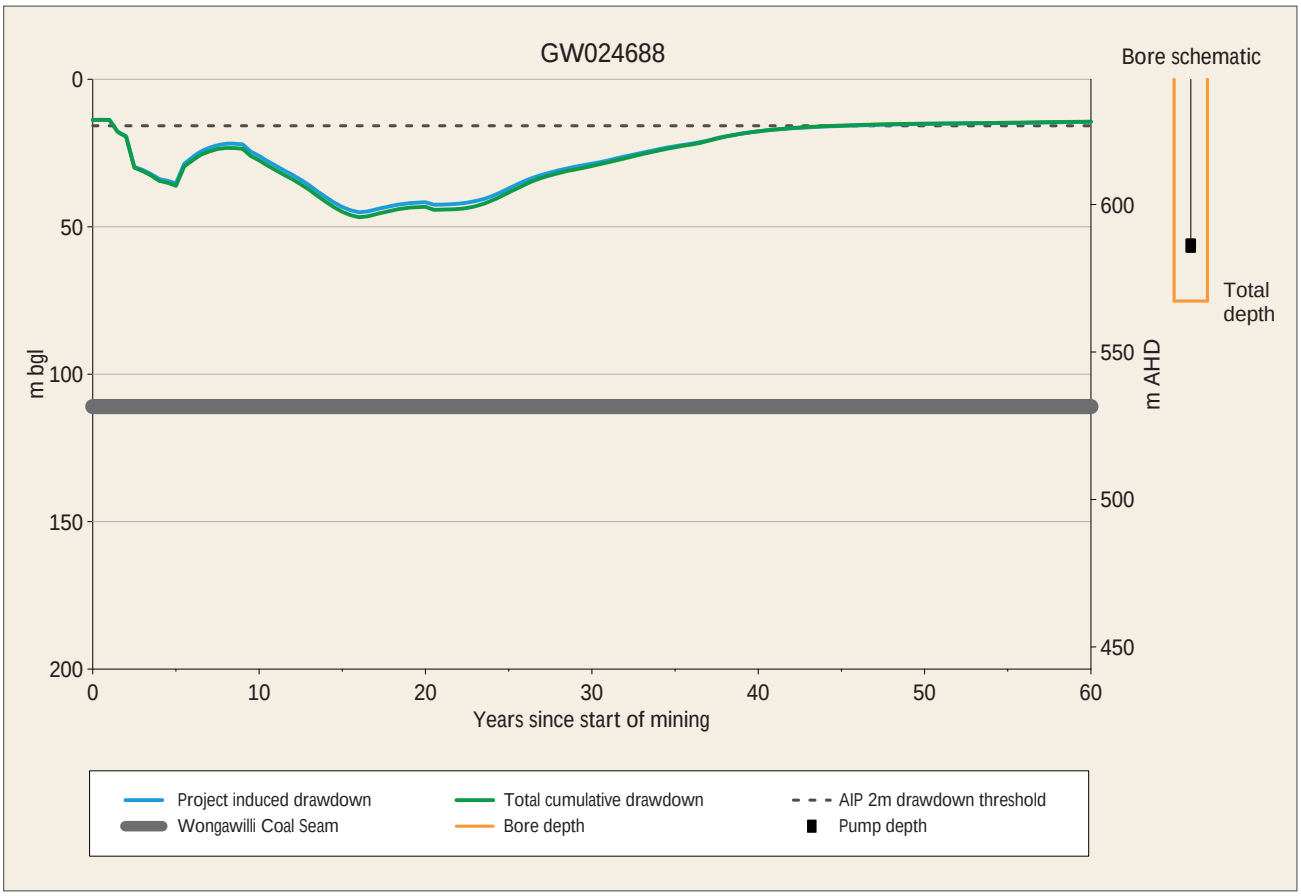

GW053793
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

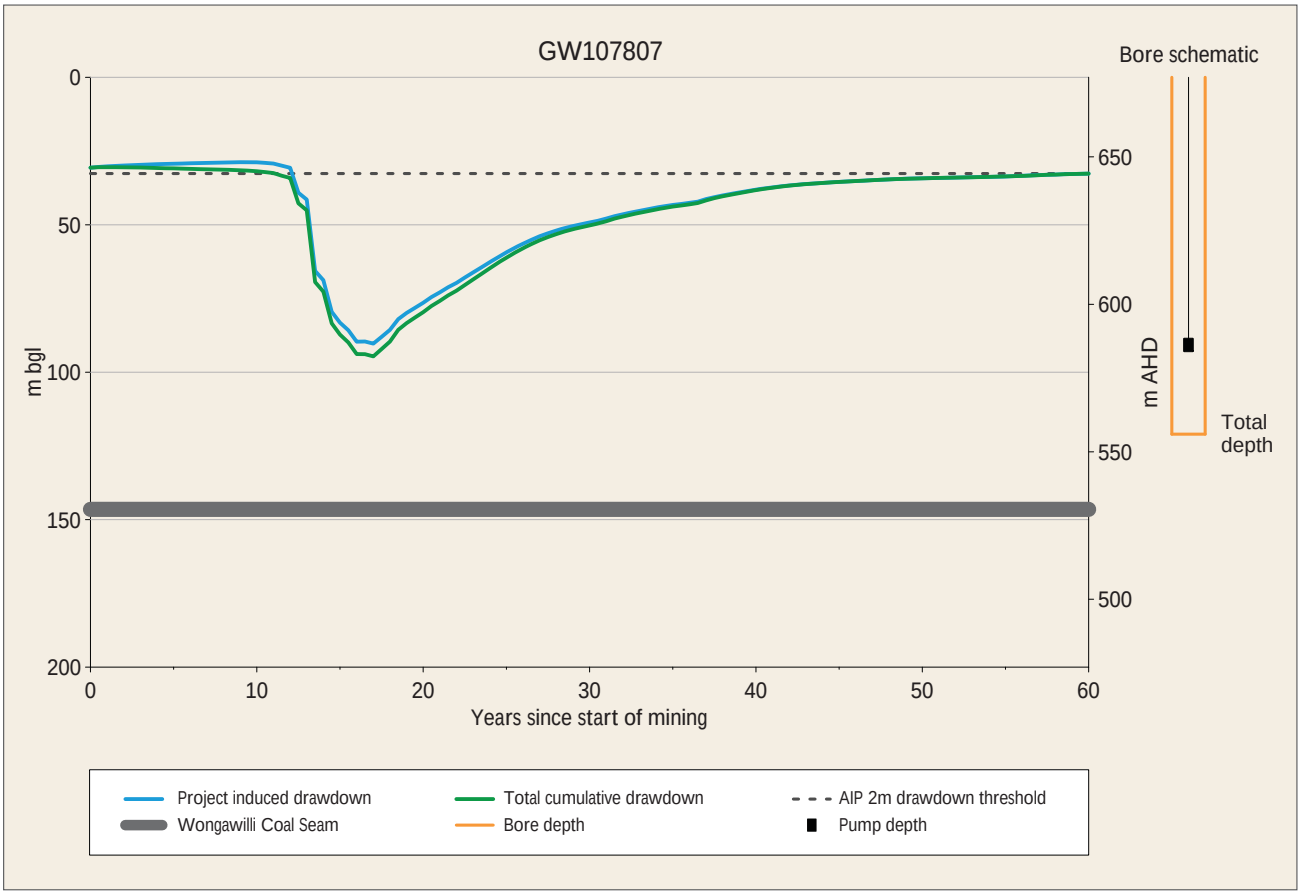

GW115061
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

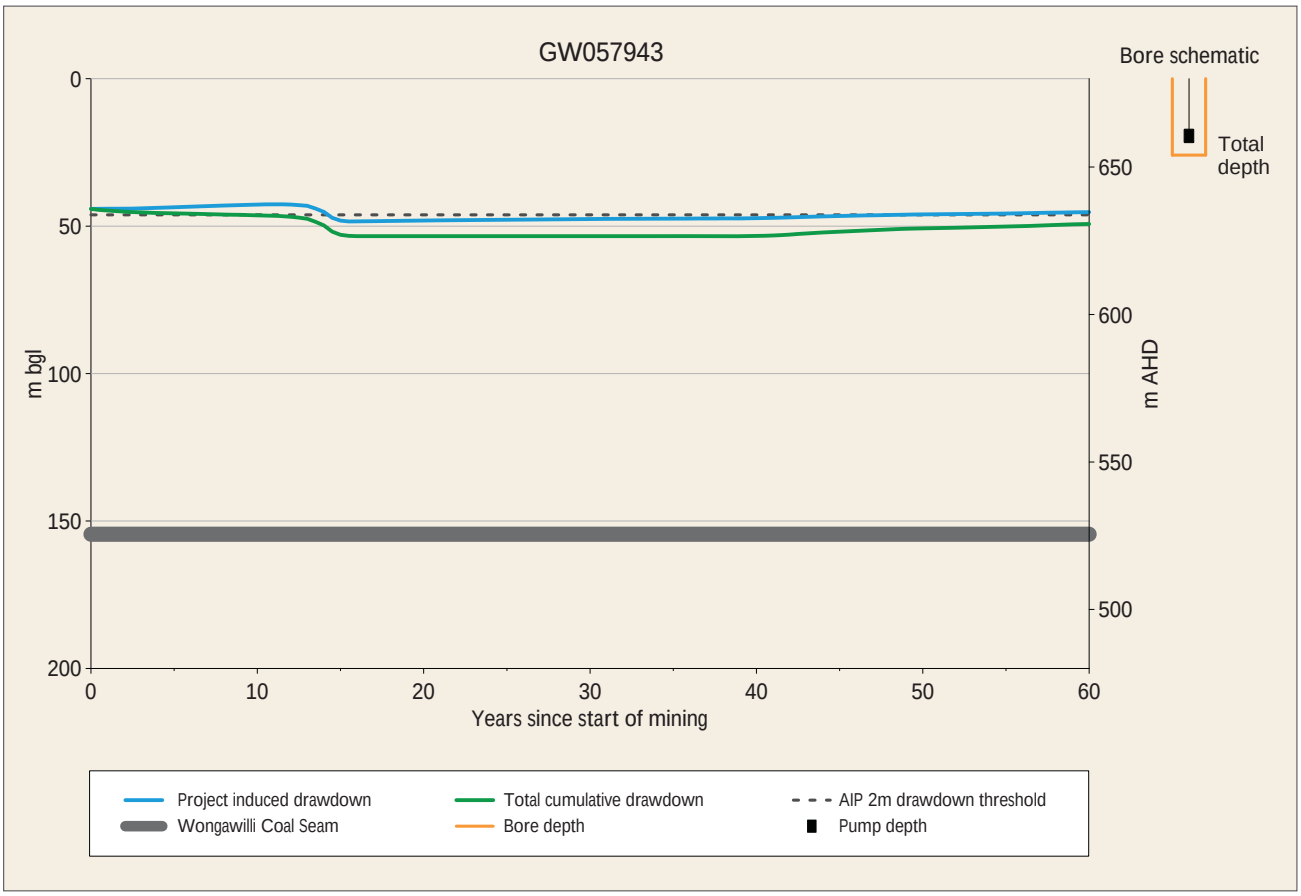

GW108825
Bore schematic
0
50
100
150
200
m bgl
600
550
500
450
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

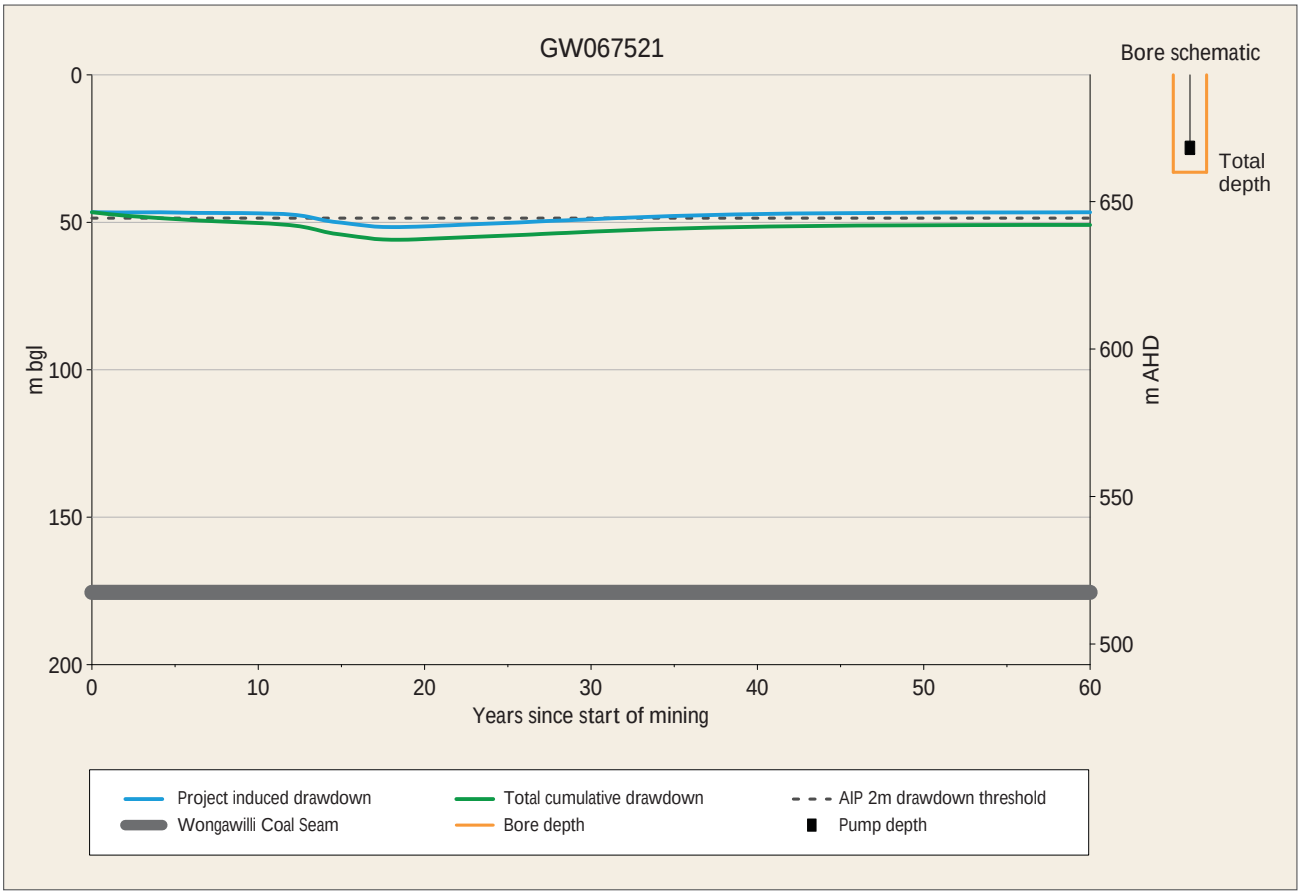

GW109918
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

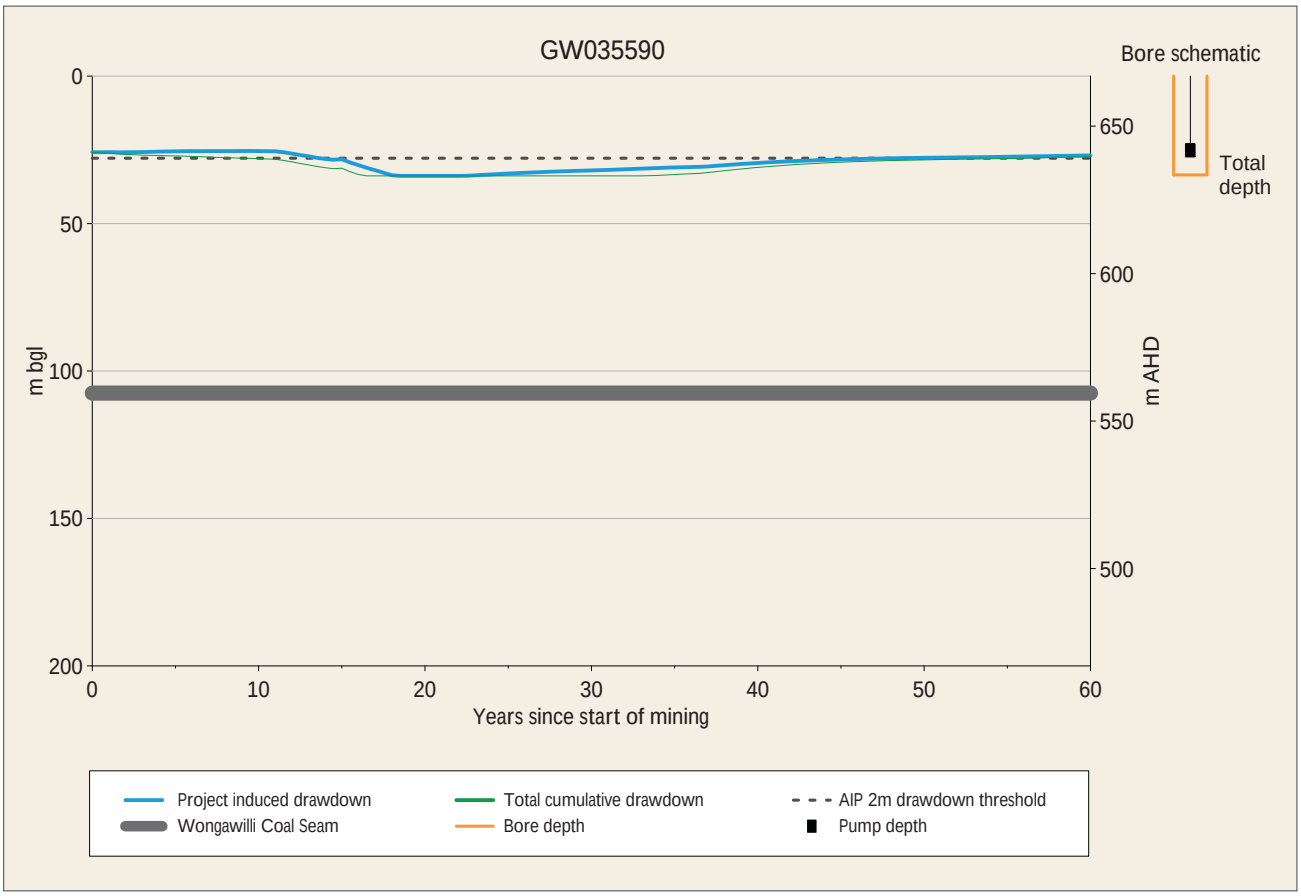

GW112440
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

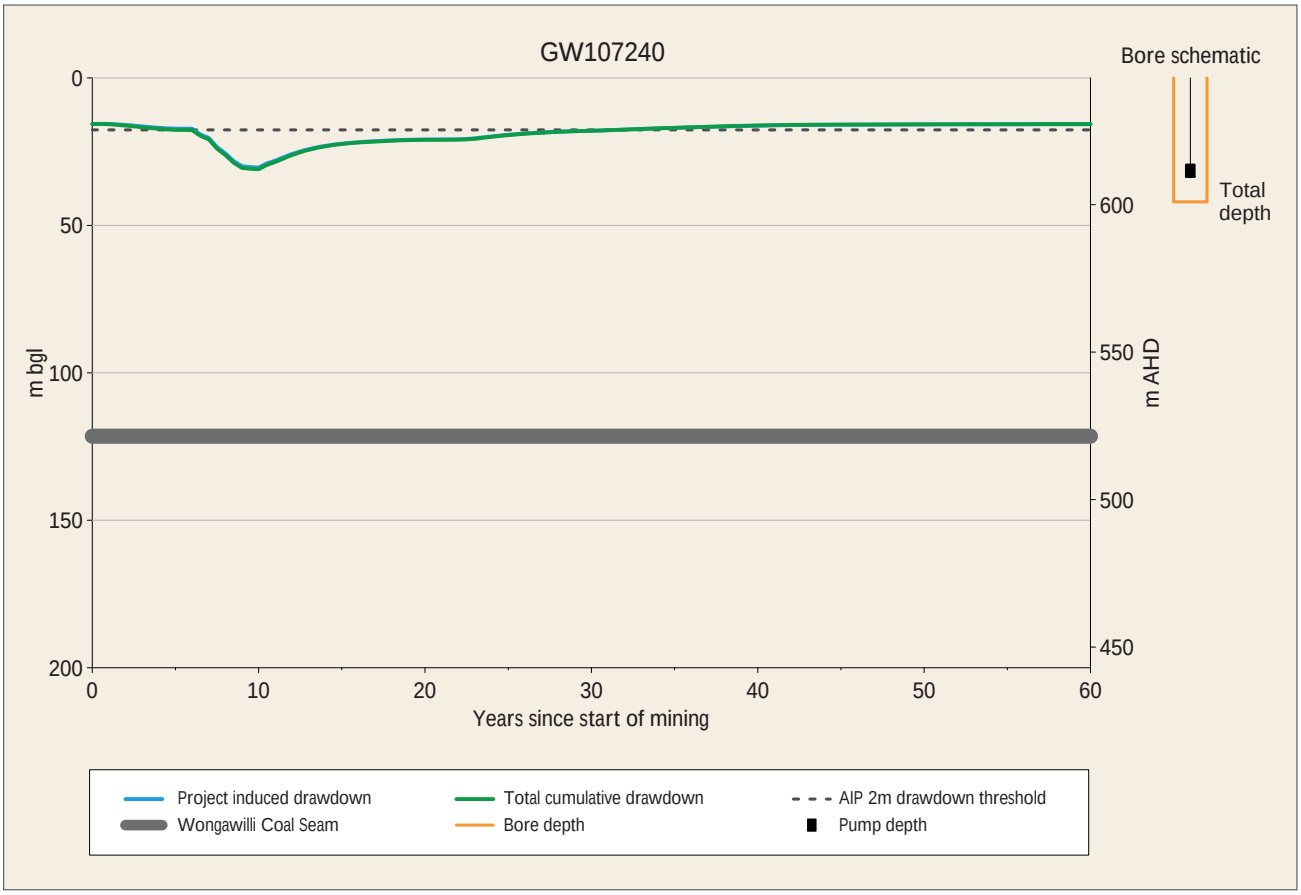

GW024688
Bore schematic
0
50
100
150
200
m bgl
600
550
500
450
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

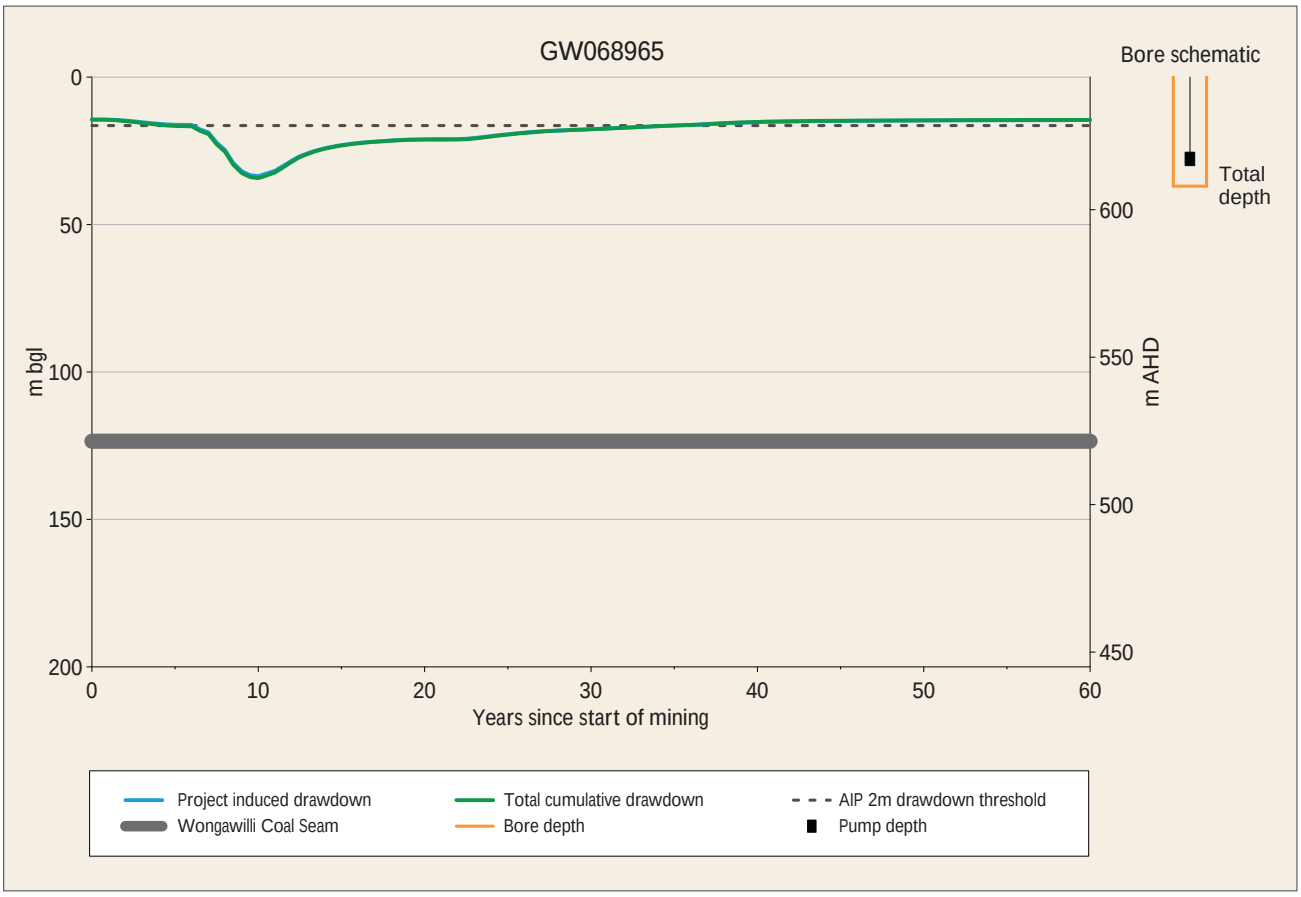

GW107807
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

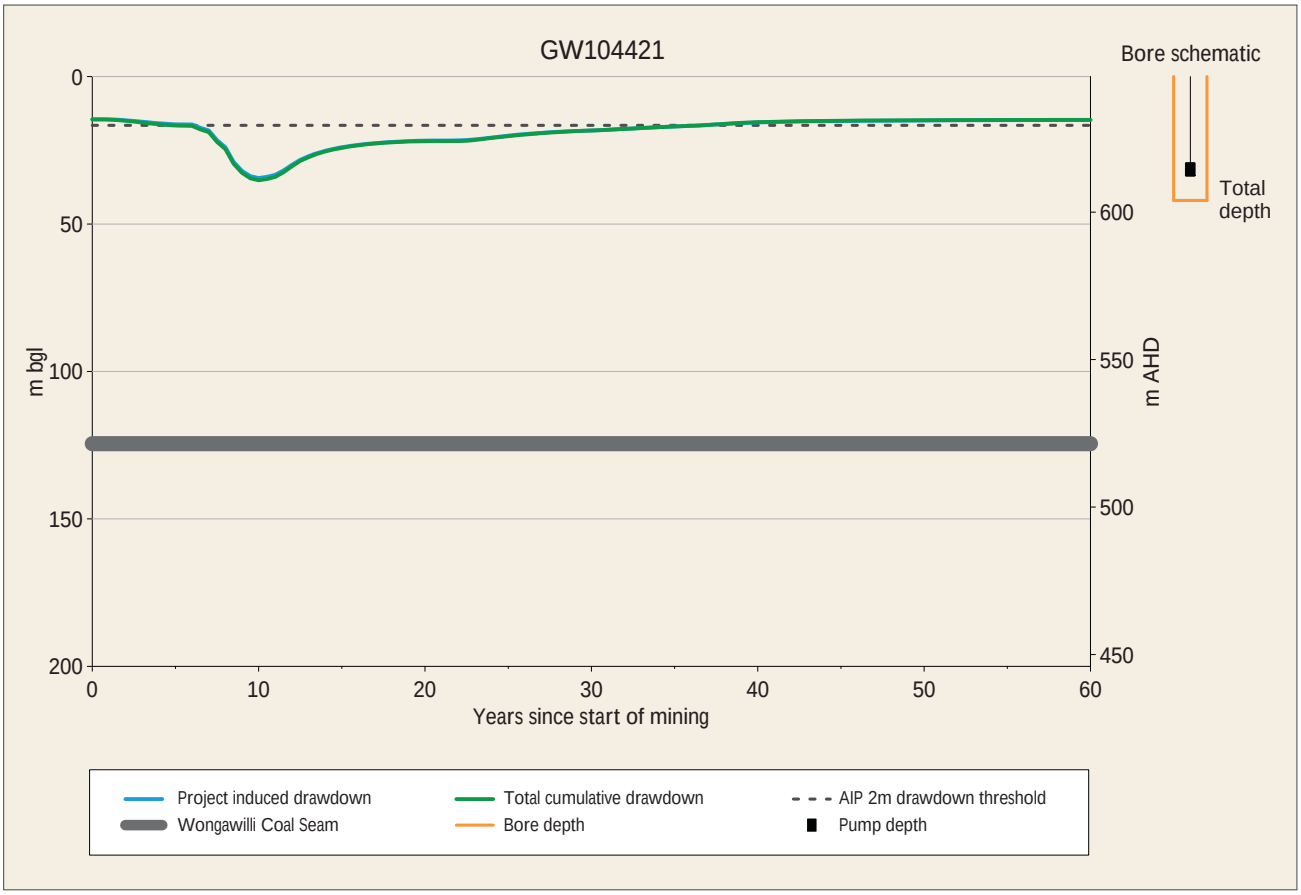

GW057943
Bore schematic
Total depth
0
50
100
150
200
m bgl
650
600
550
500
m AHD
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

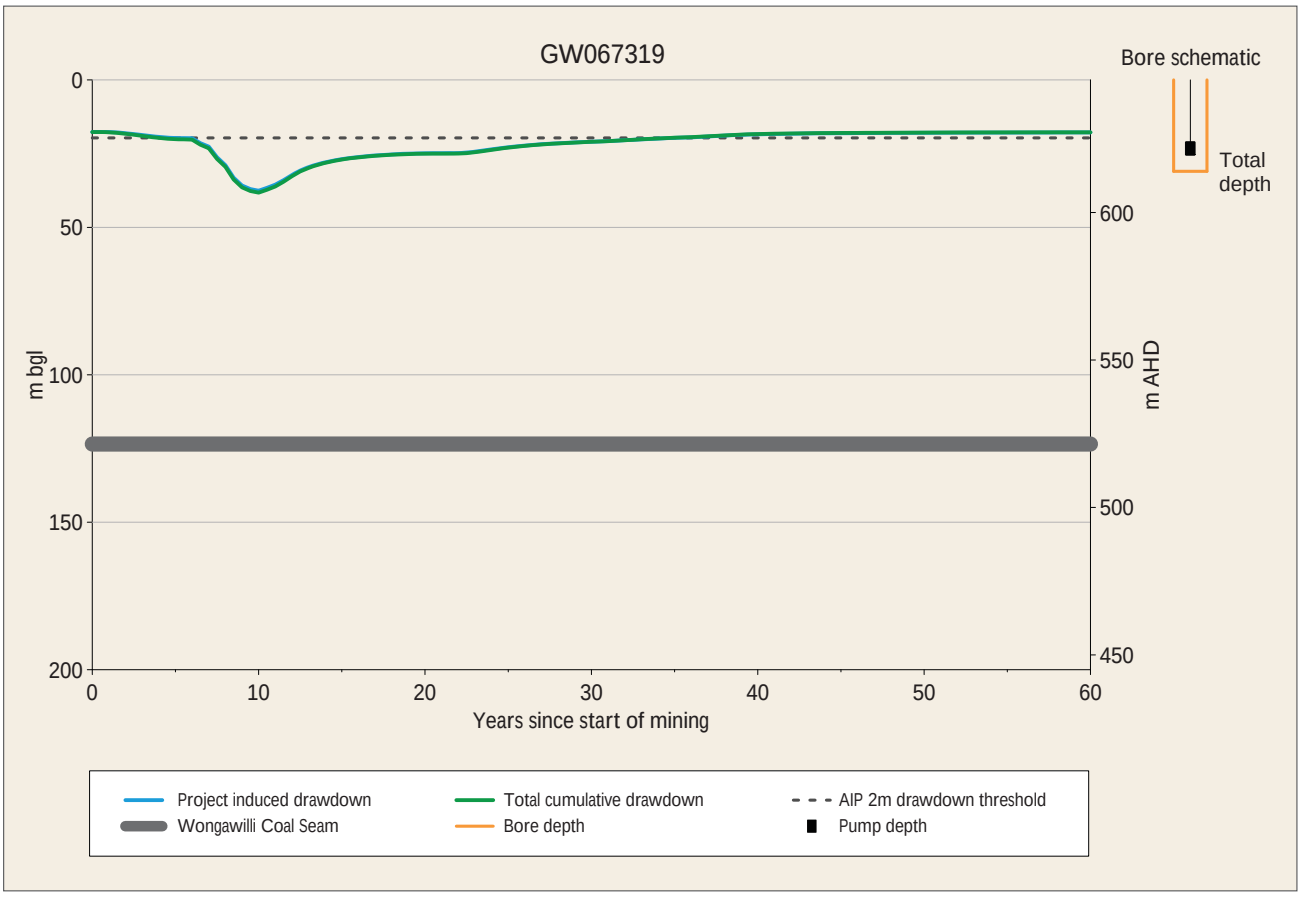

GW067521
Bore schematic
Total depth
0
50
100
150
200
m bgl
650
600
550
500
m AHD
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

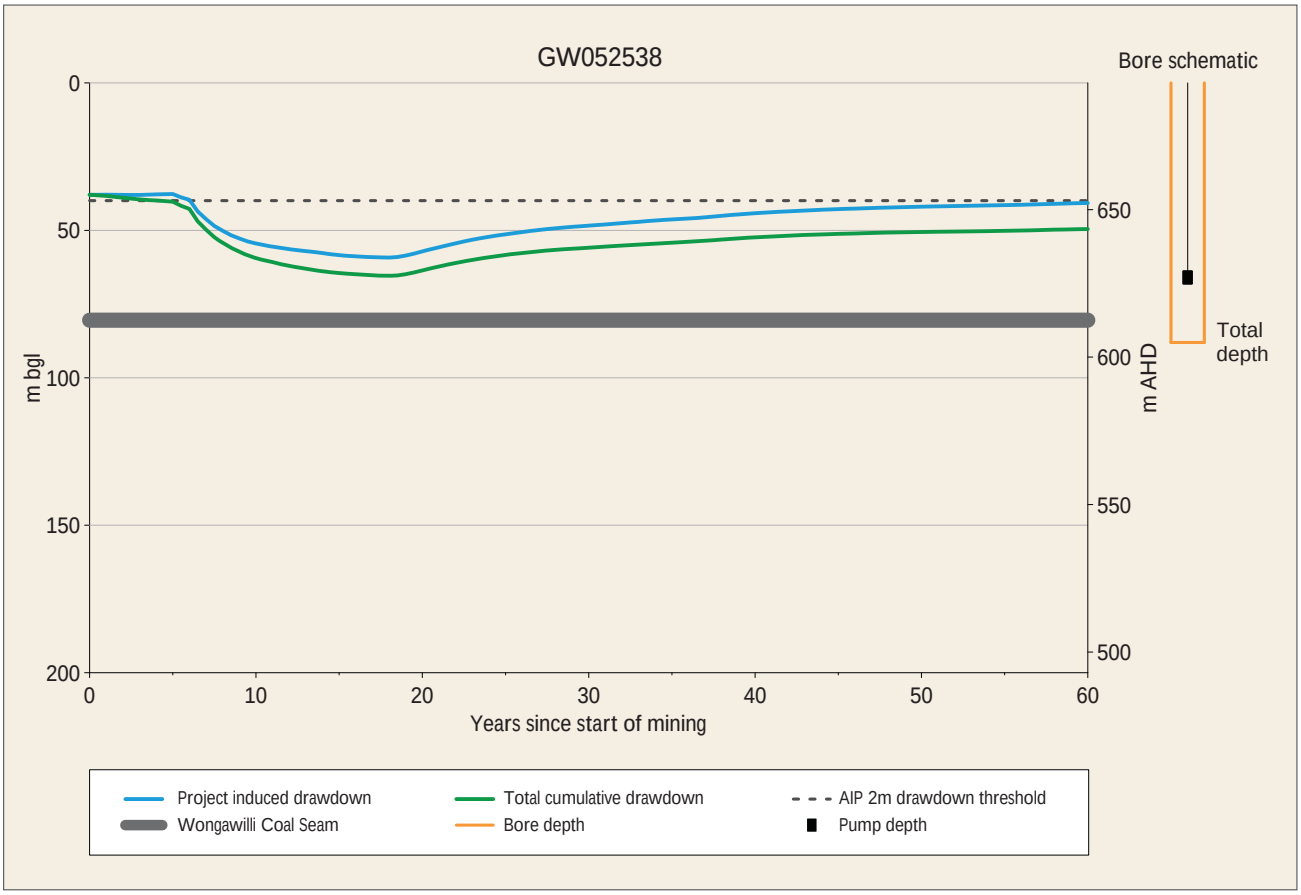

GW035590
Bore schematic
Total depth
0
50
100
150
200
m bgl
650
600
550
500
m AHD
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

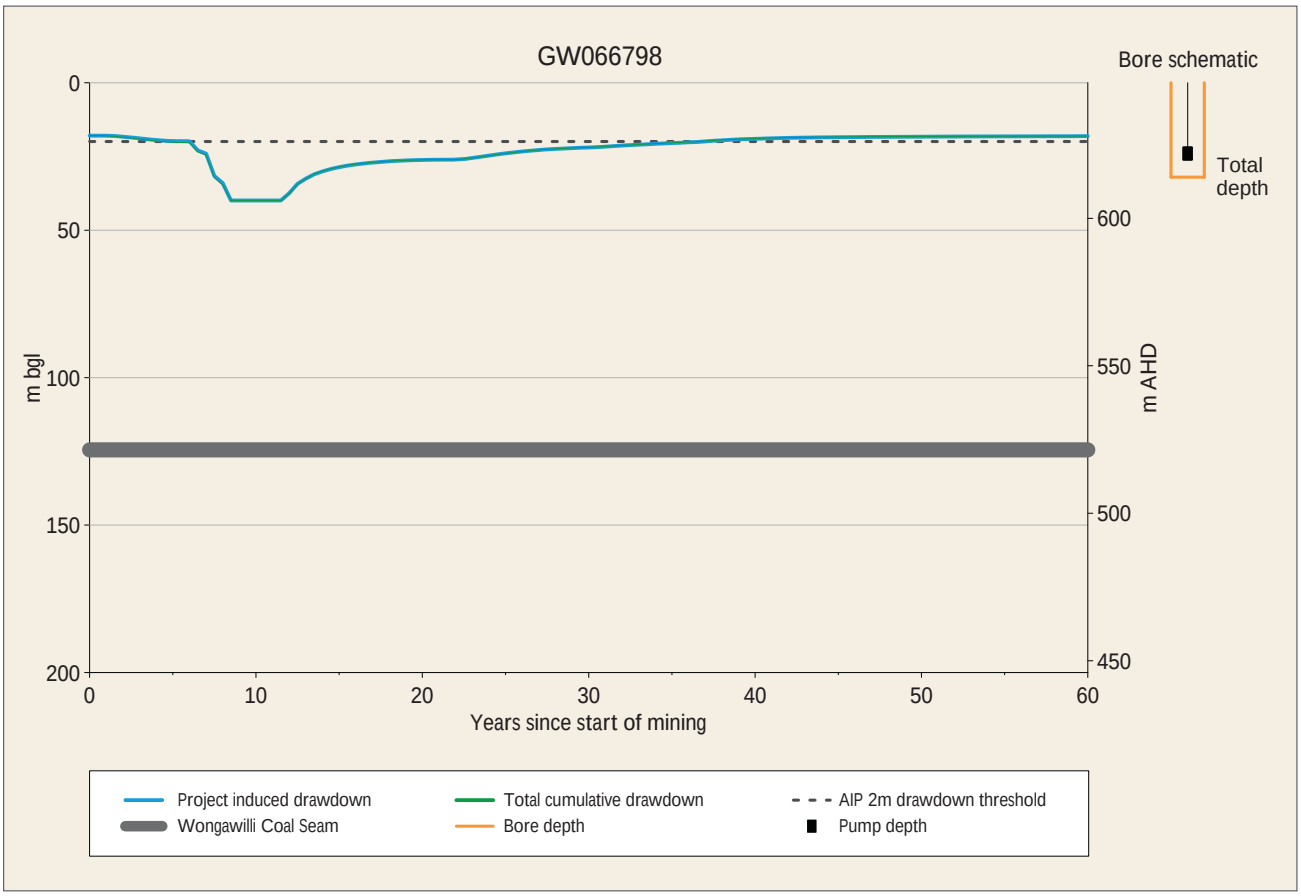

GW107240
Bore schematic
Total depth
m bgl
m AHD
0
50
100
150
200
600
550
500
450
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

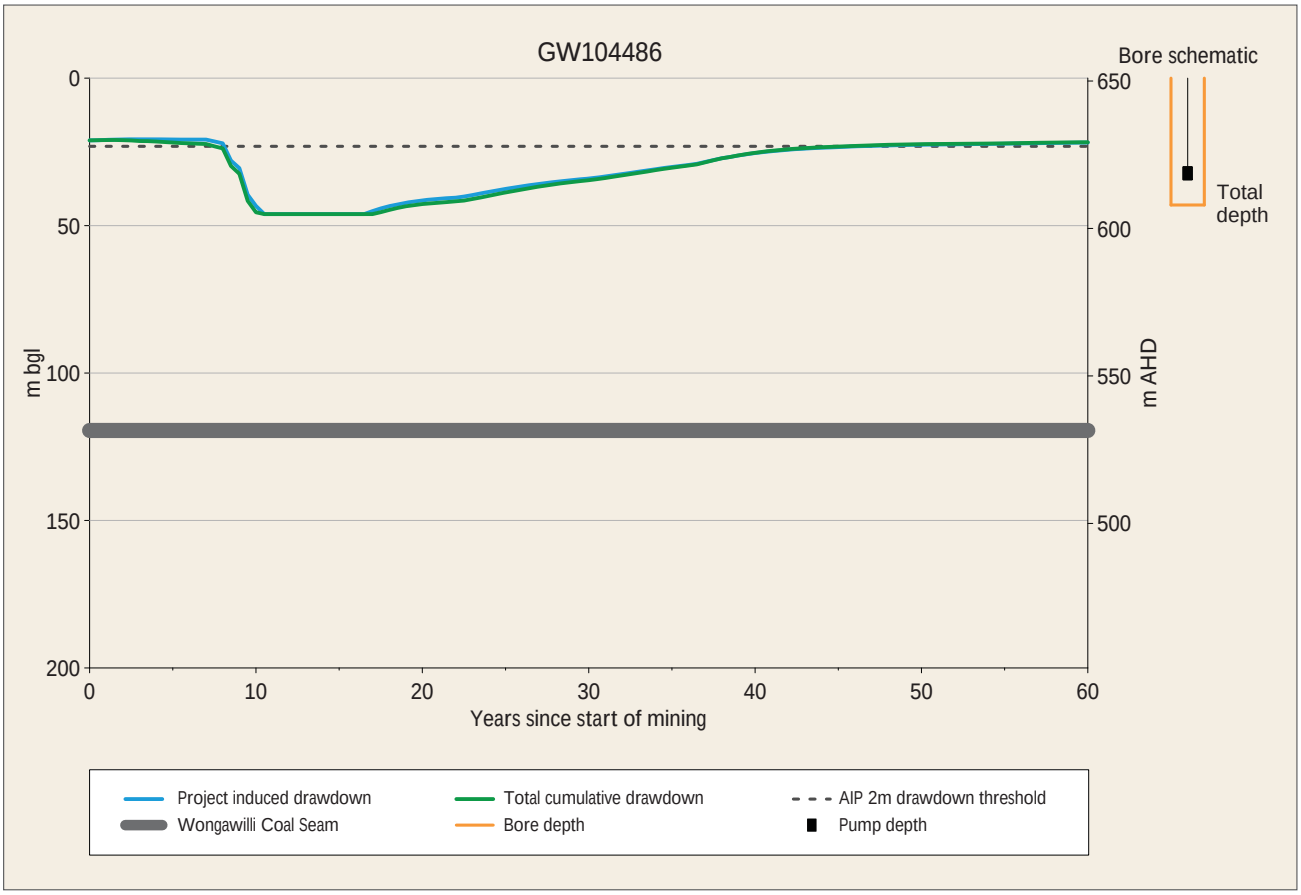

GW068965
Bore schematic
Total depth
m bgl
m AHD
0
50
100
150
200
600
550
500
450
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

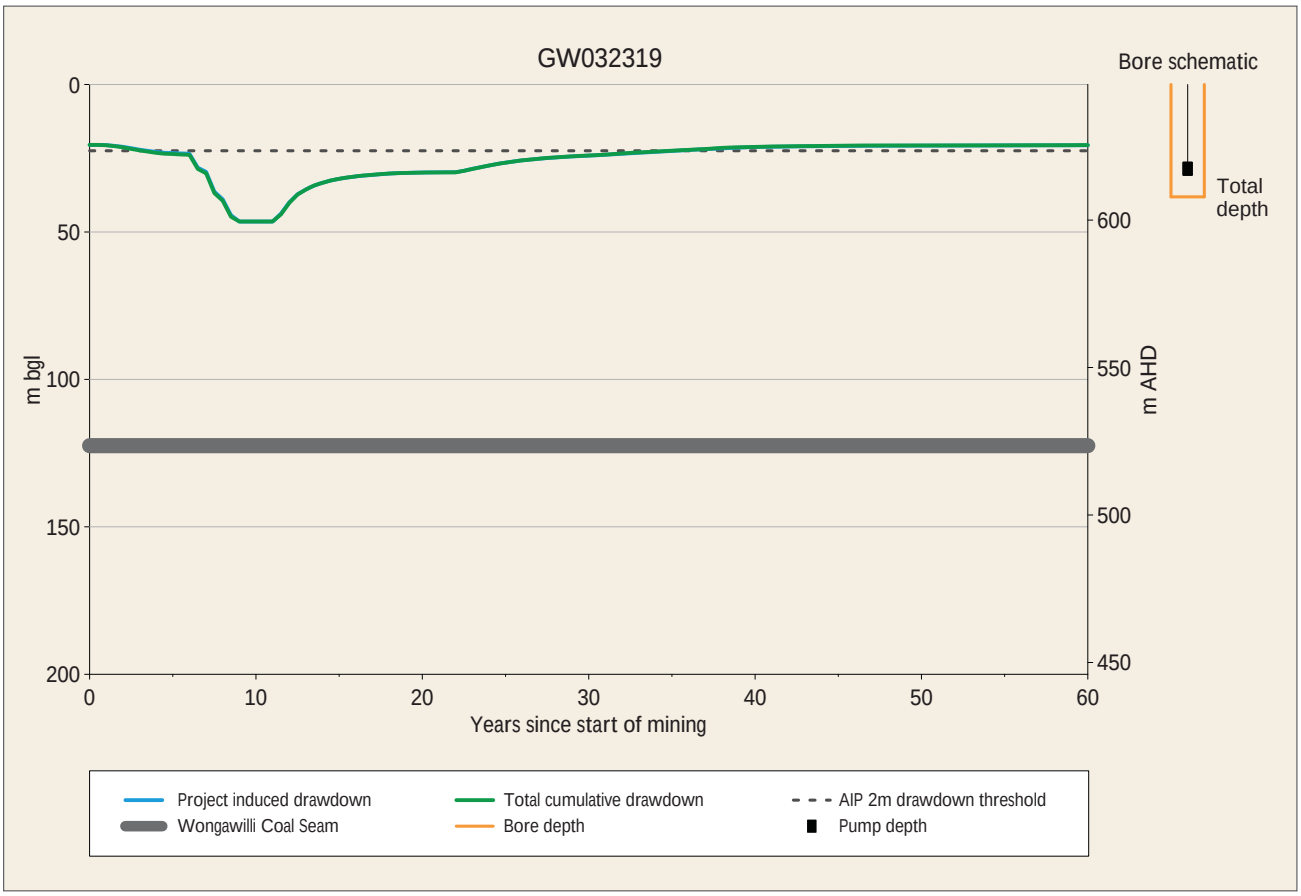

GW104421
Bore schematic
Total depth
m bgl
m AHD
0
50
100
150
200
600
550
500
450
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

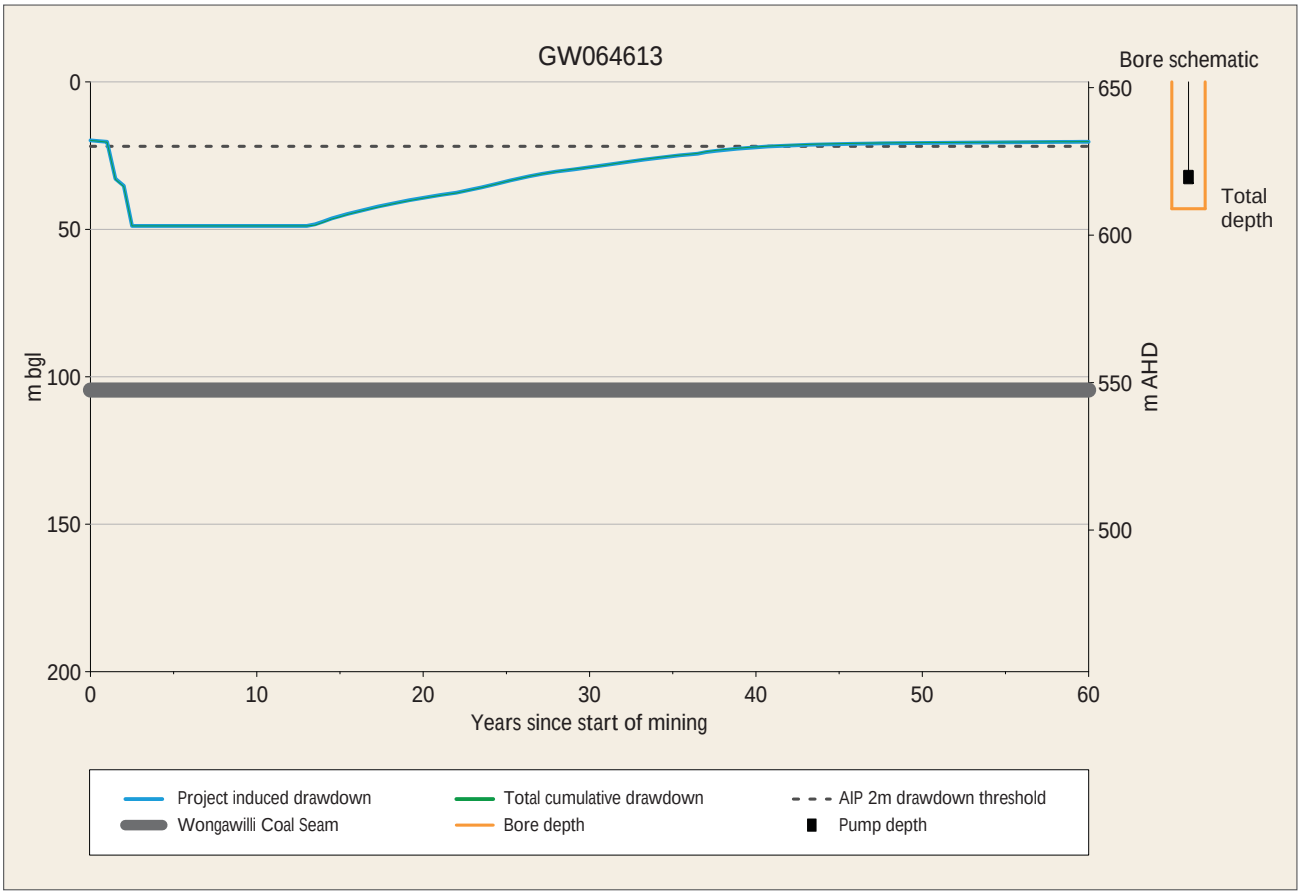

GW067319
Bore schematic
Total depth
m bgl
m AHD
0
50
100
150
200
600
550
500
450
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

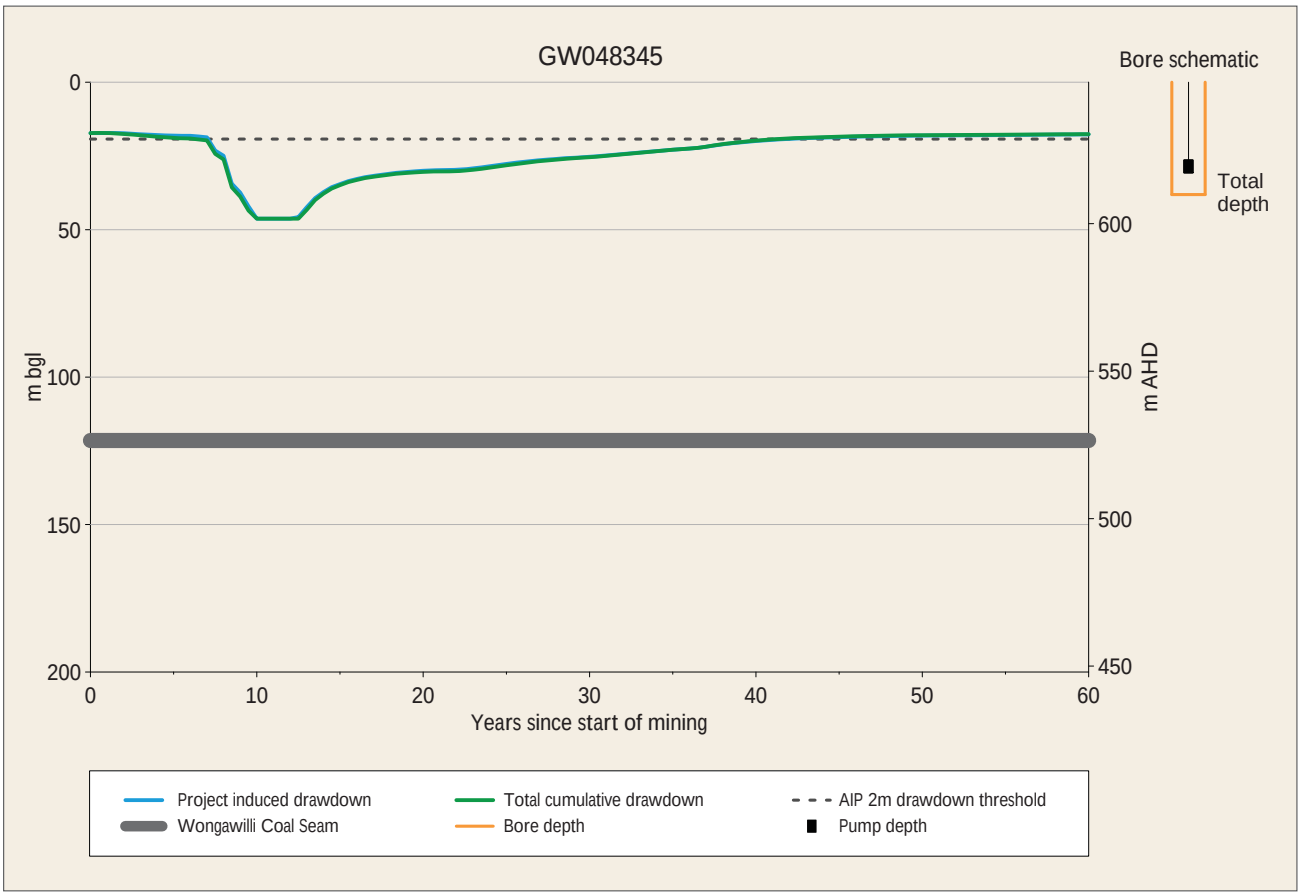

GW052538
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

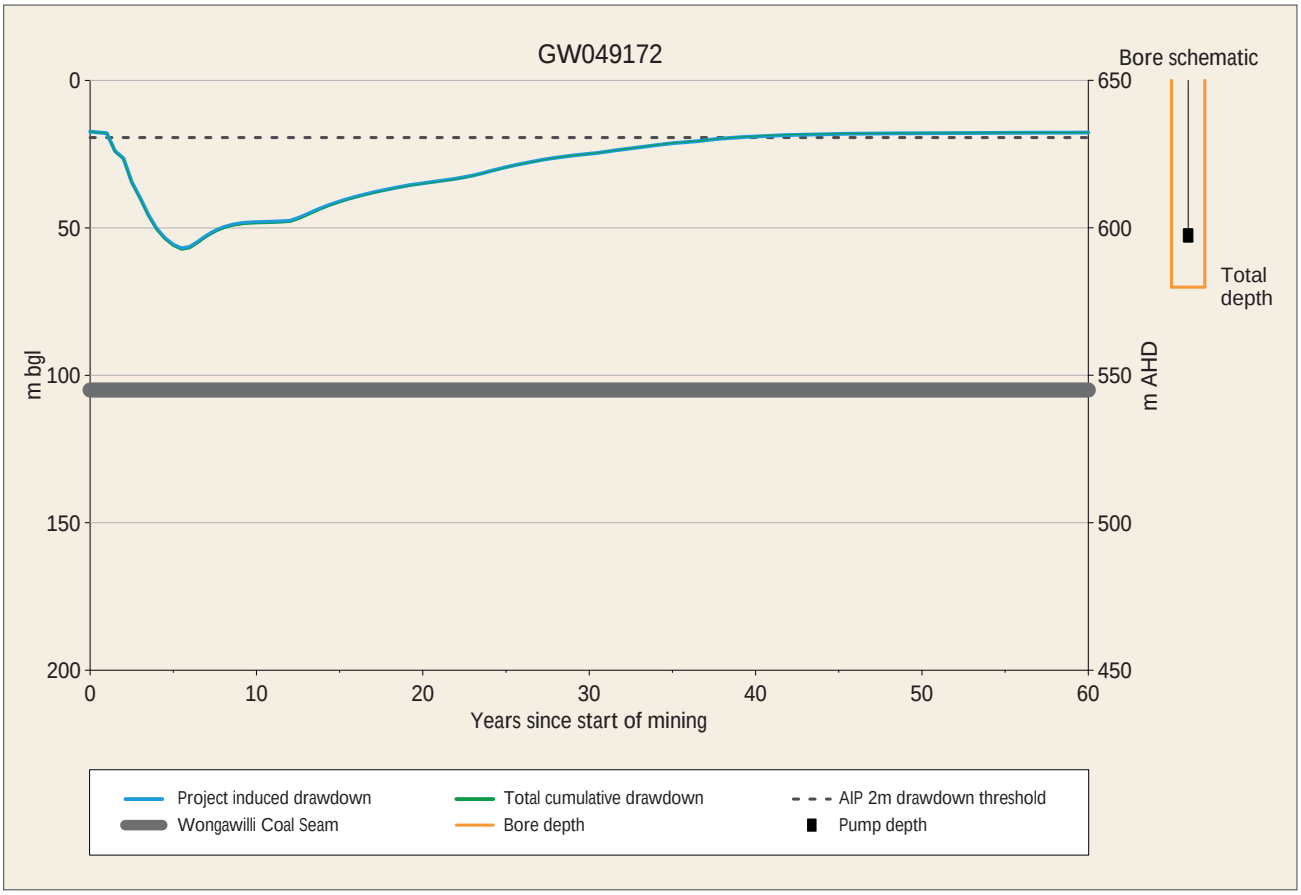

GW066798
Bore schematic
0
50
100
150
200
m bgl
600
550
500
450
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

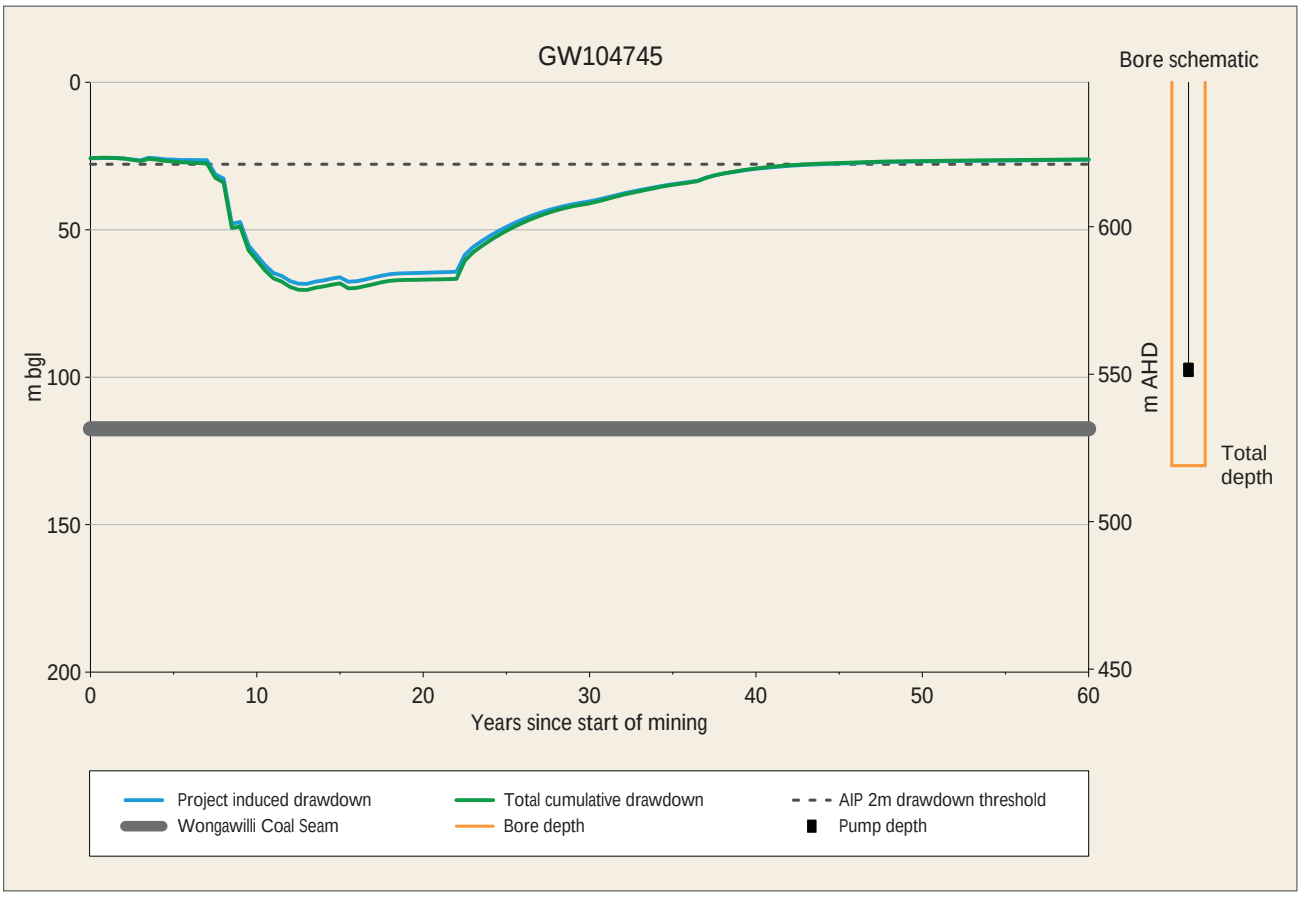

GW104486
Bore schematic
Total depth
m bgl
m AHD
0
50
100
150
200
650
600
550
500
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

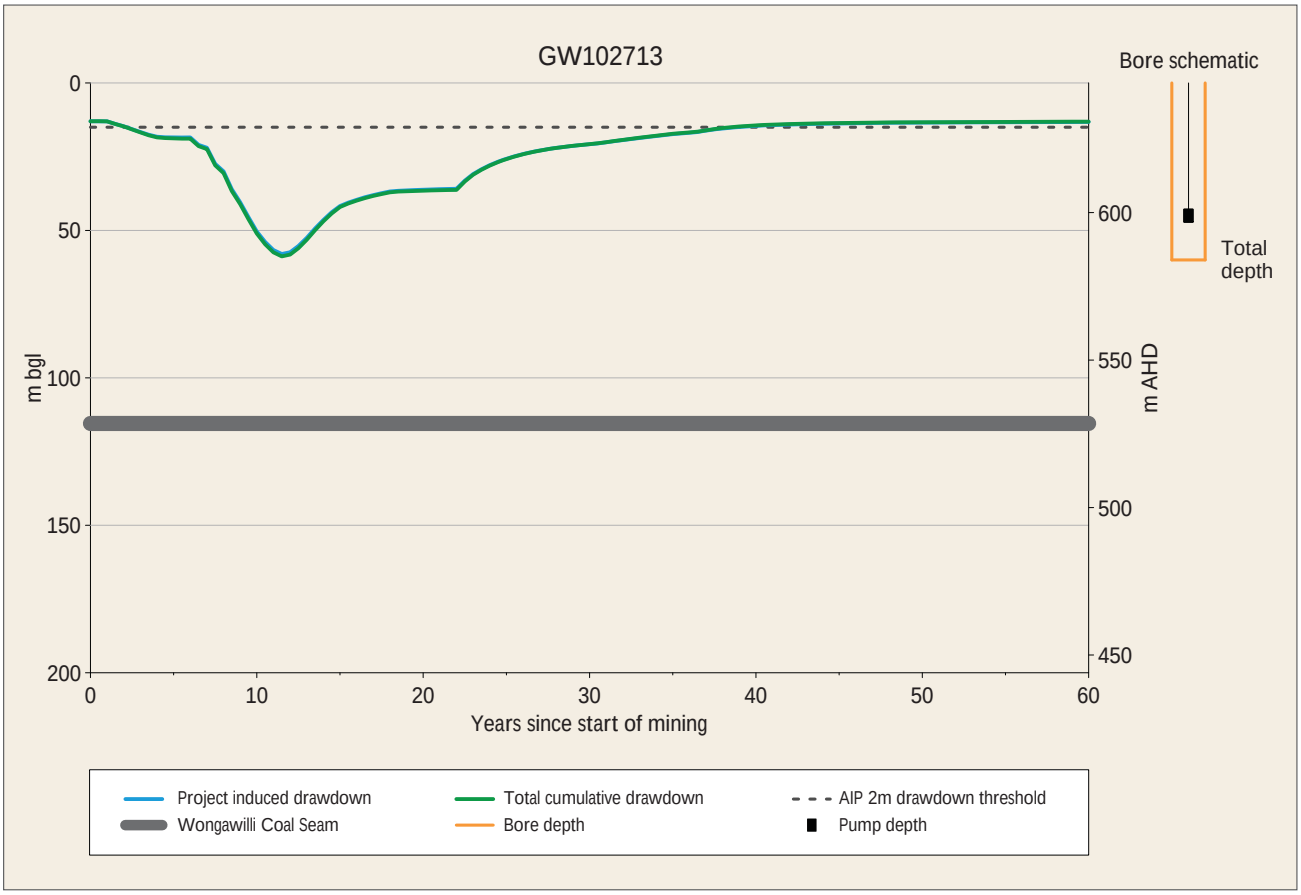

GW032319
Bore schematic
Total depth
m bgl
m AHD
0
50
100
150
200
600
550
500
450
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

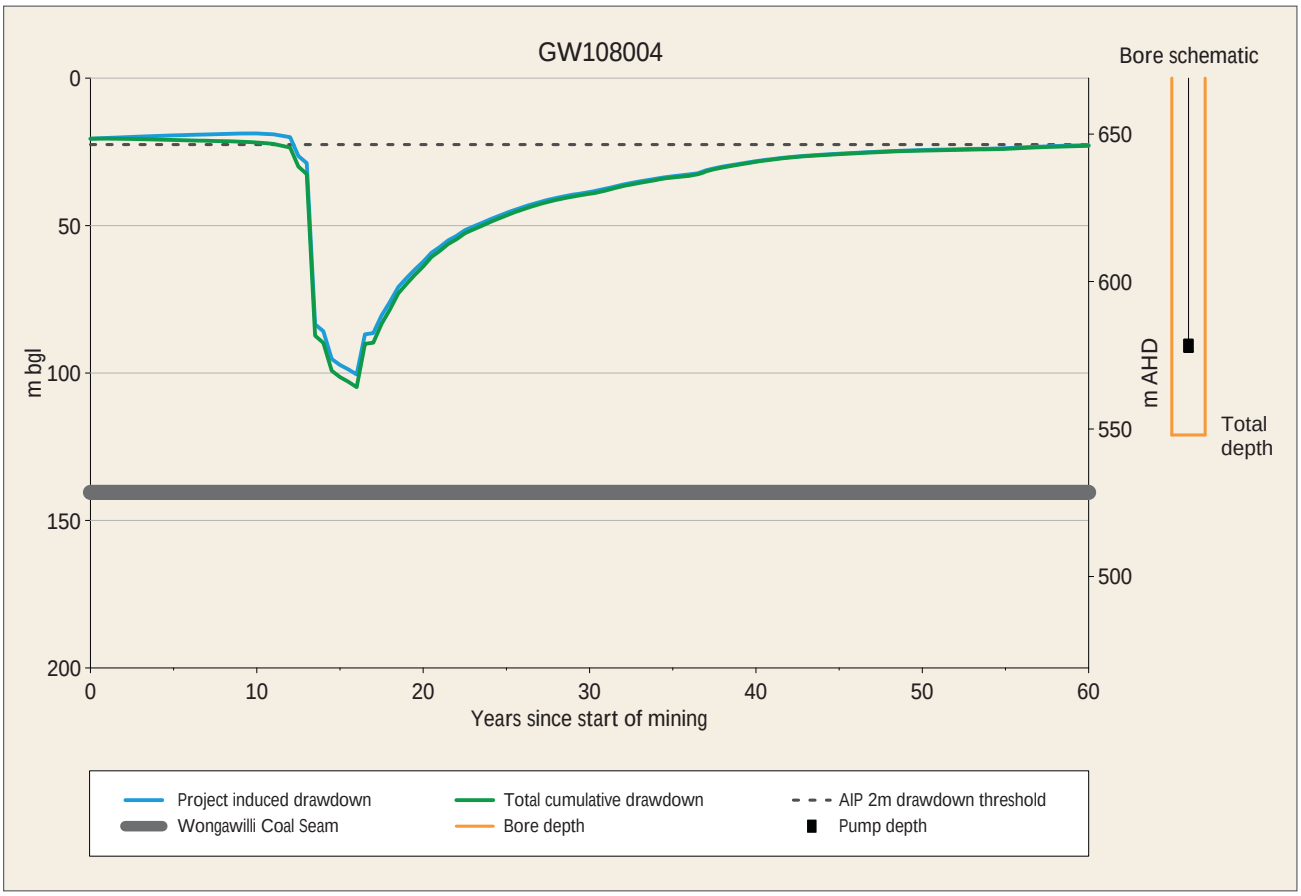

GW064613
Bore schematic
Total depth
m bgl
m AHD
0
50
100
150
200
650
600
550
500
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

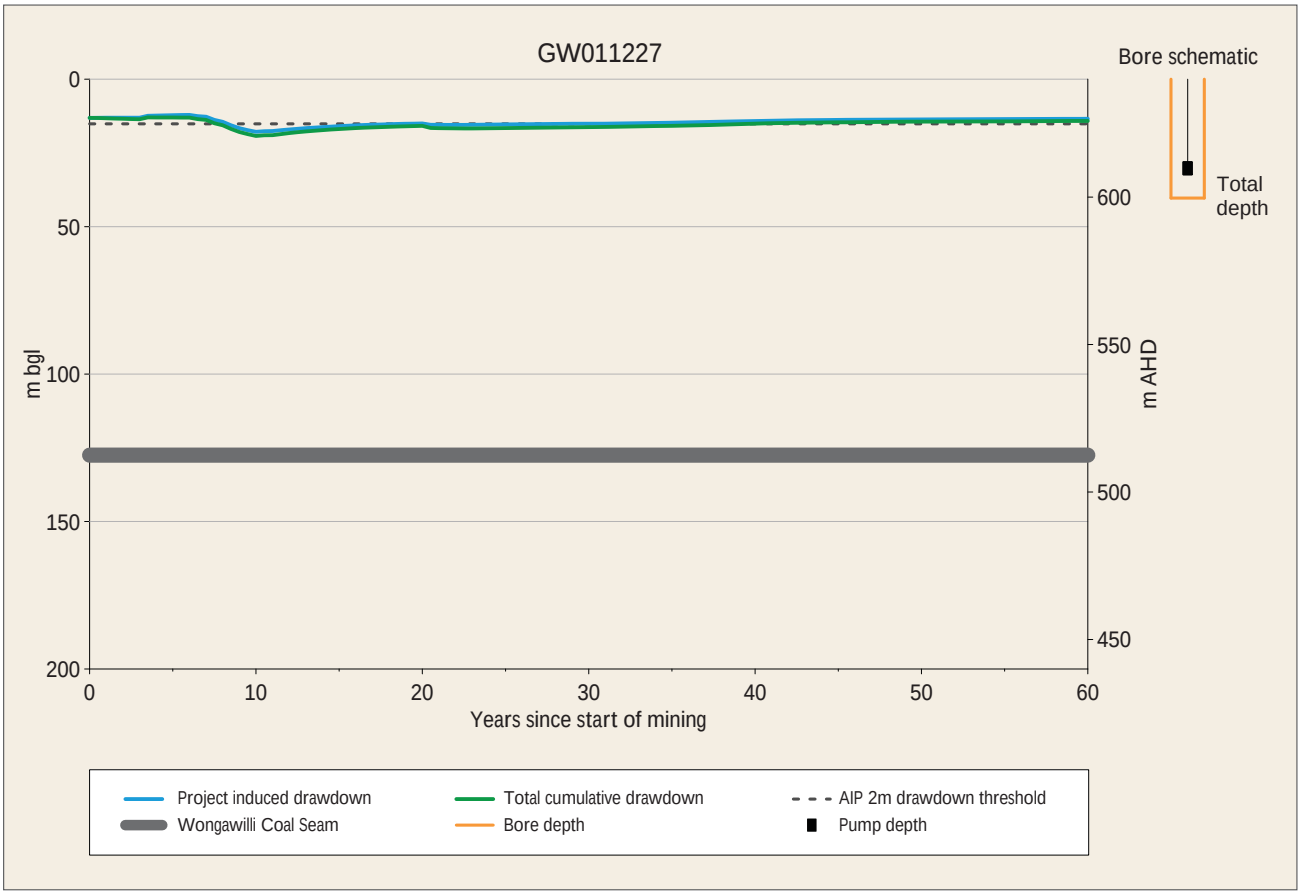

GW048345
Bore schematic
Total depth
m bgl
m AHD
0
50
100
150
200
600
550
500
450
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth


GW049172
Bore schematic
0
50
100
150
200
650
600
550
500
450
m bgl
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

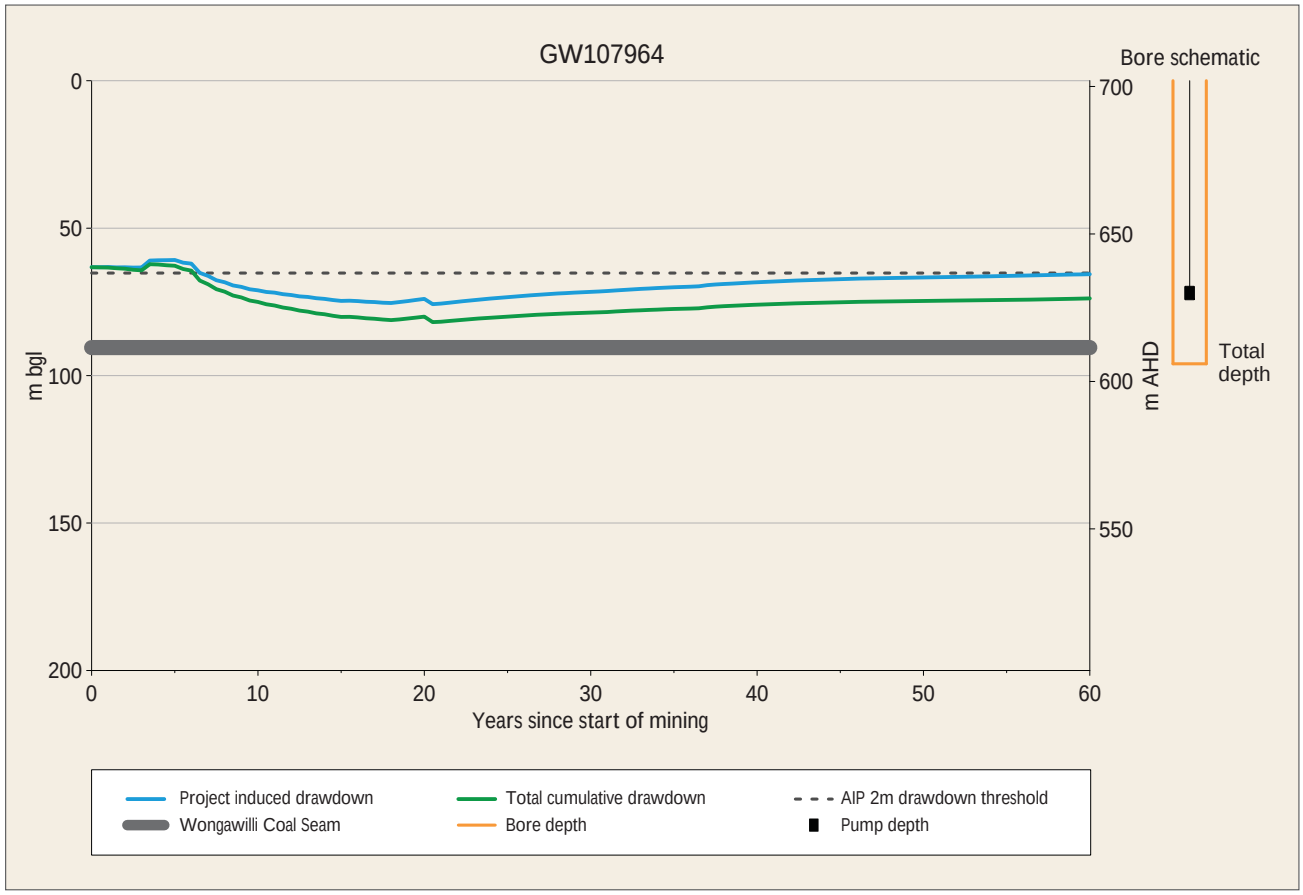

GW104745
Bore schematic
0
50
100
150
200
600
550
500
450
m bgl
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

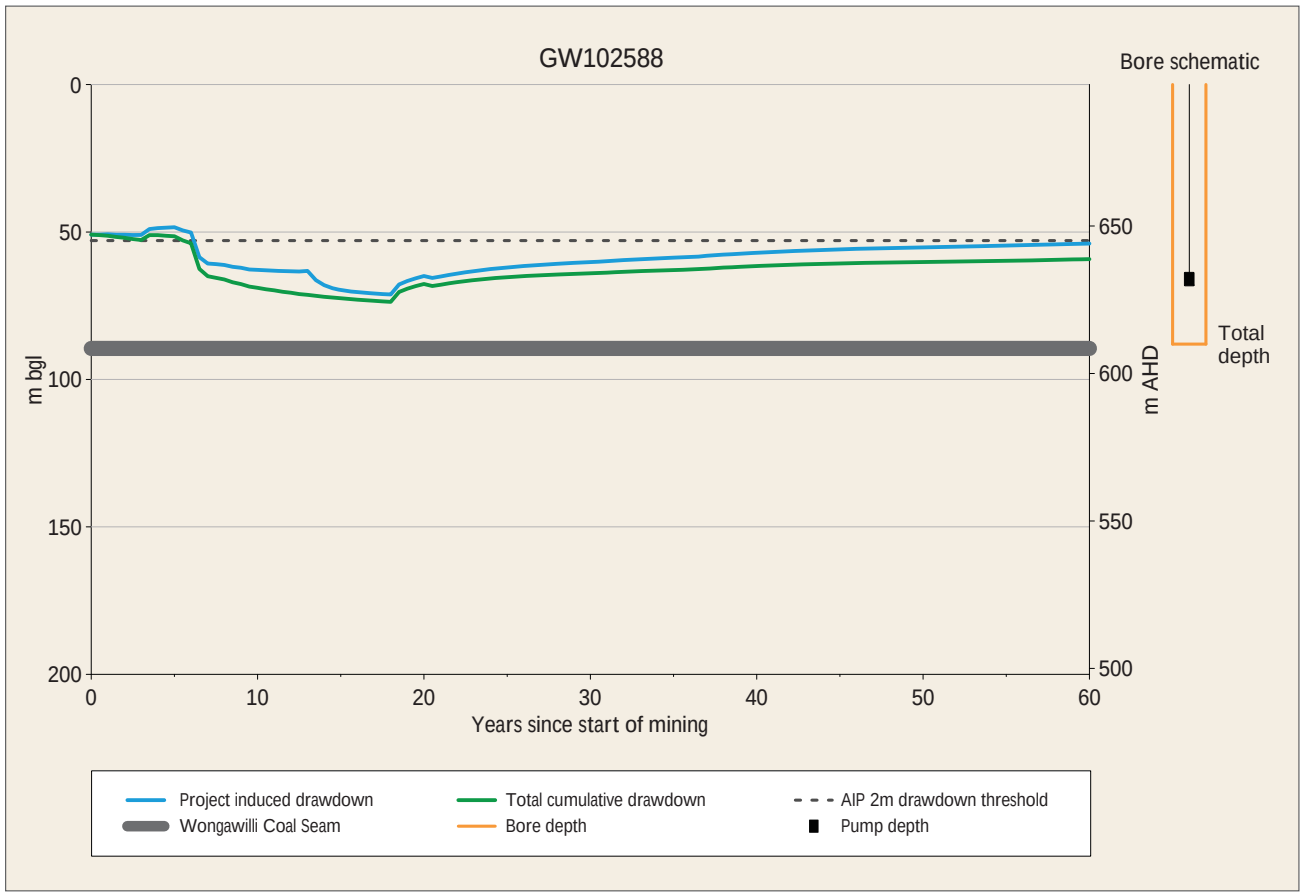

GW102713
Bore schematic
0
50
100
150
200
m bgl
600
550
500
450
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

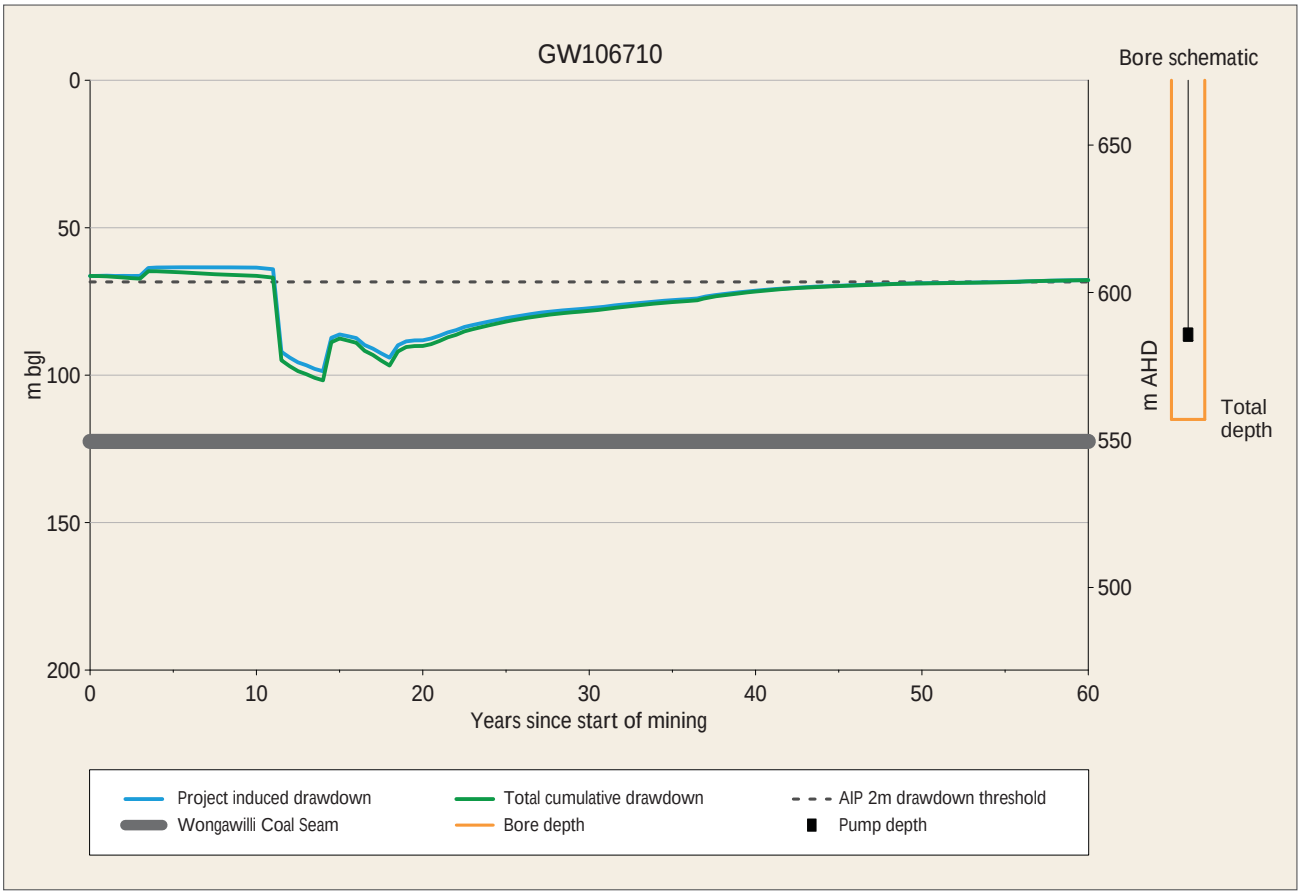

GW108004
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

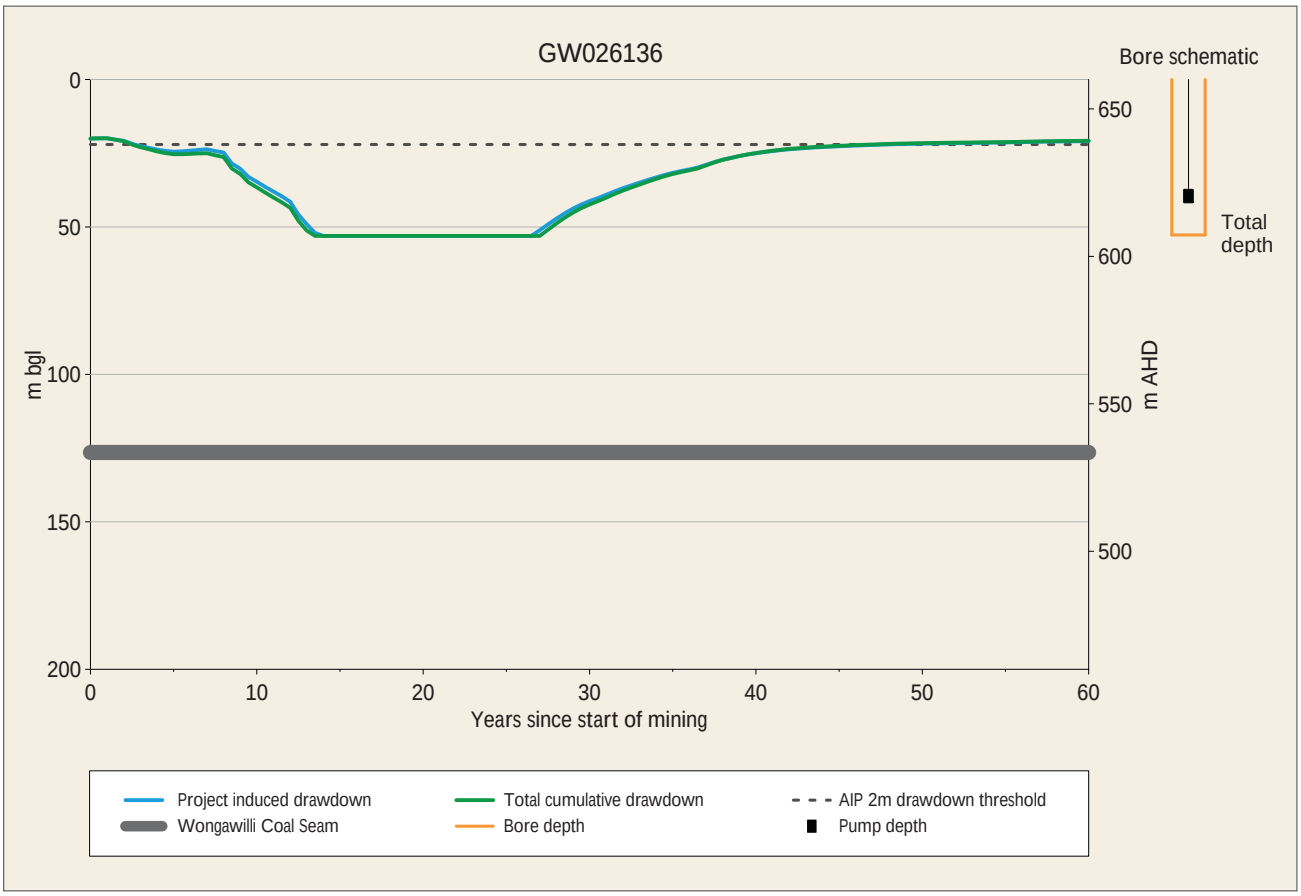

GW011227
Bore schematic
Total depth
m bgl
m AHD
0
50
100
150
200
600
550
500
450
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

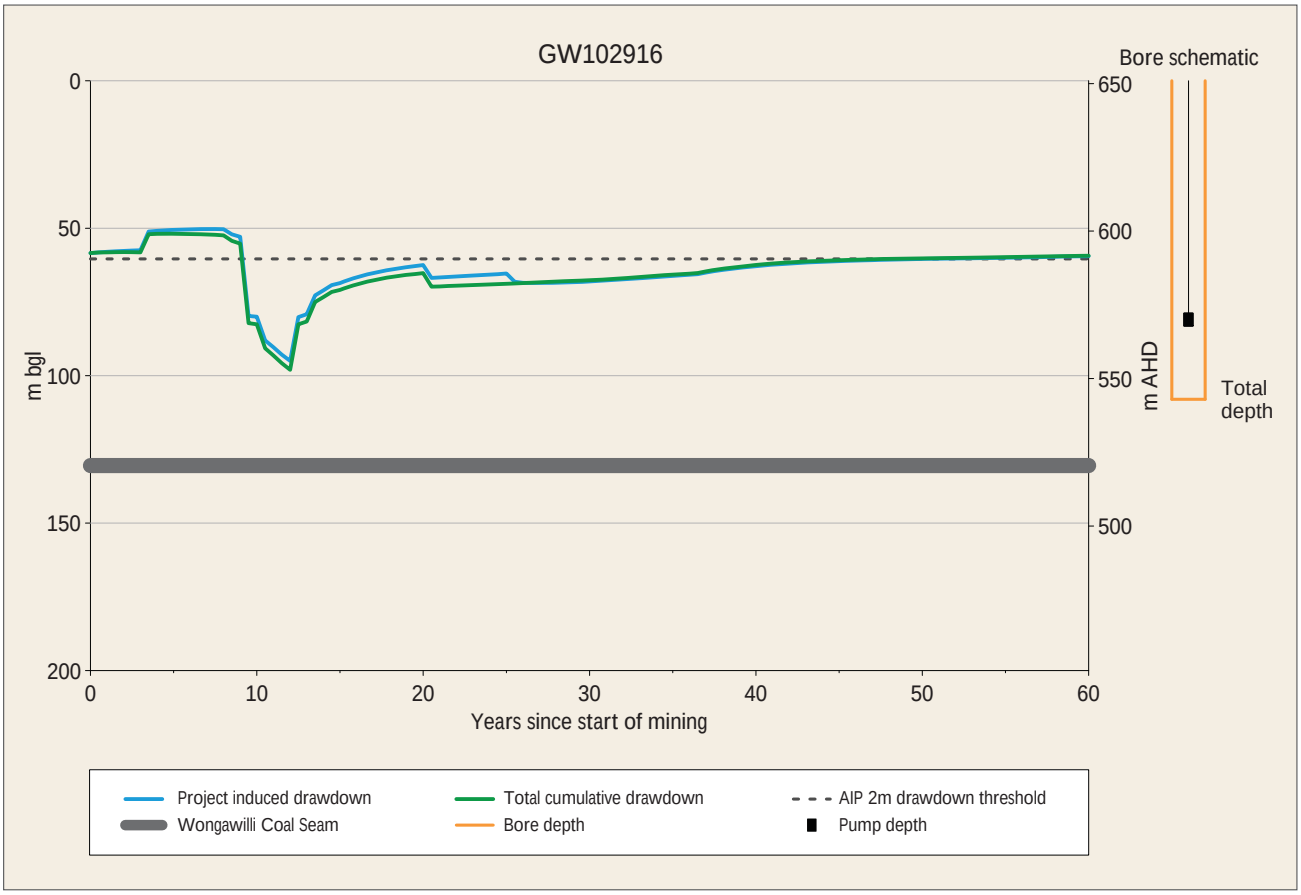

GW102309
Bore schematic
Total depth
m bgl
m AHD
0
50
100
150
200
650
600
550
500
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

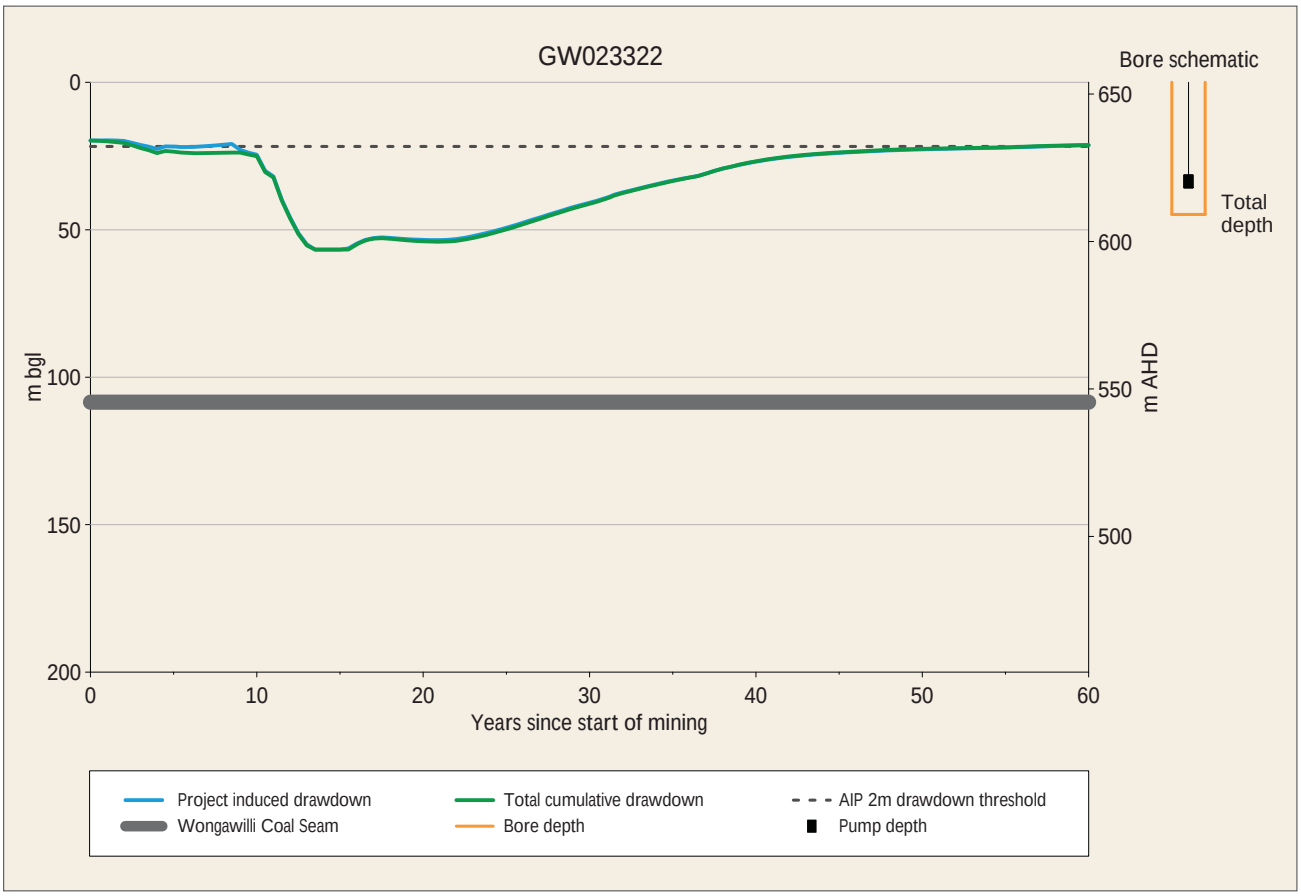

GW107964
Bore schematic
0
50
100
150
200
m bgl
700
650
600
550
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

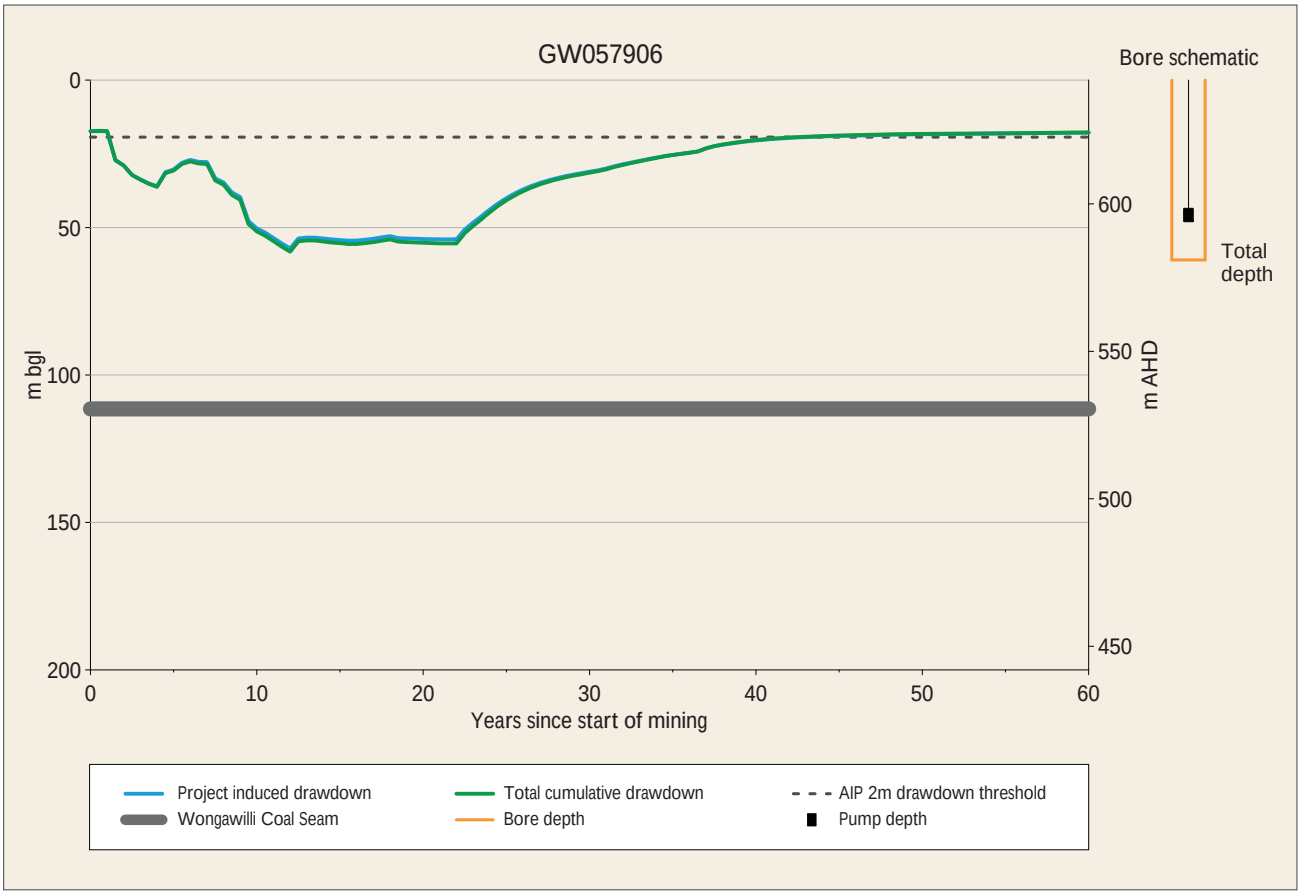

GW102588
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

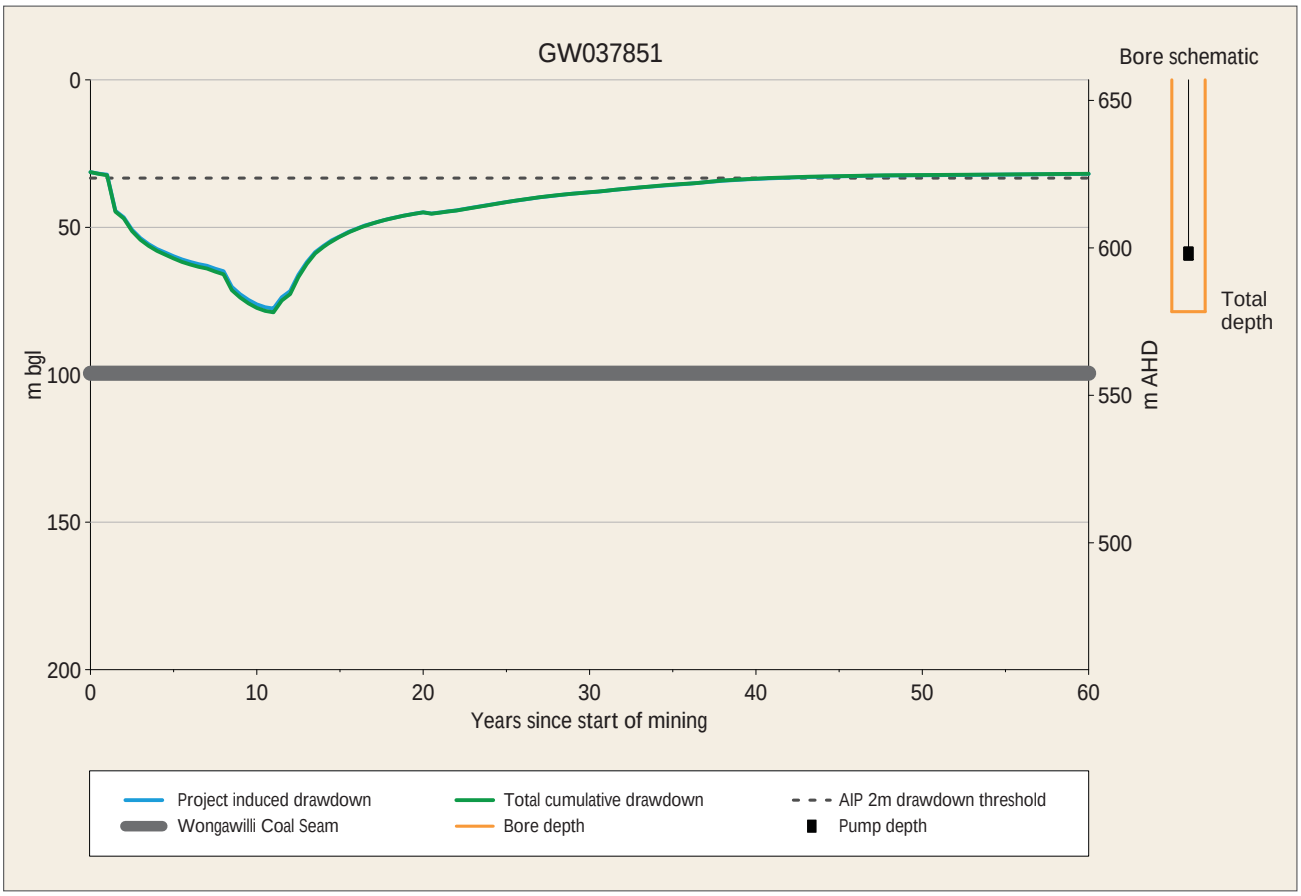

GW106710
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

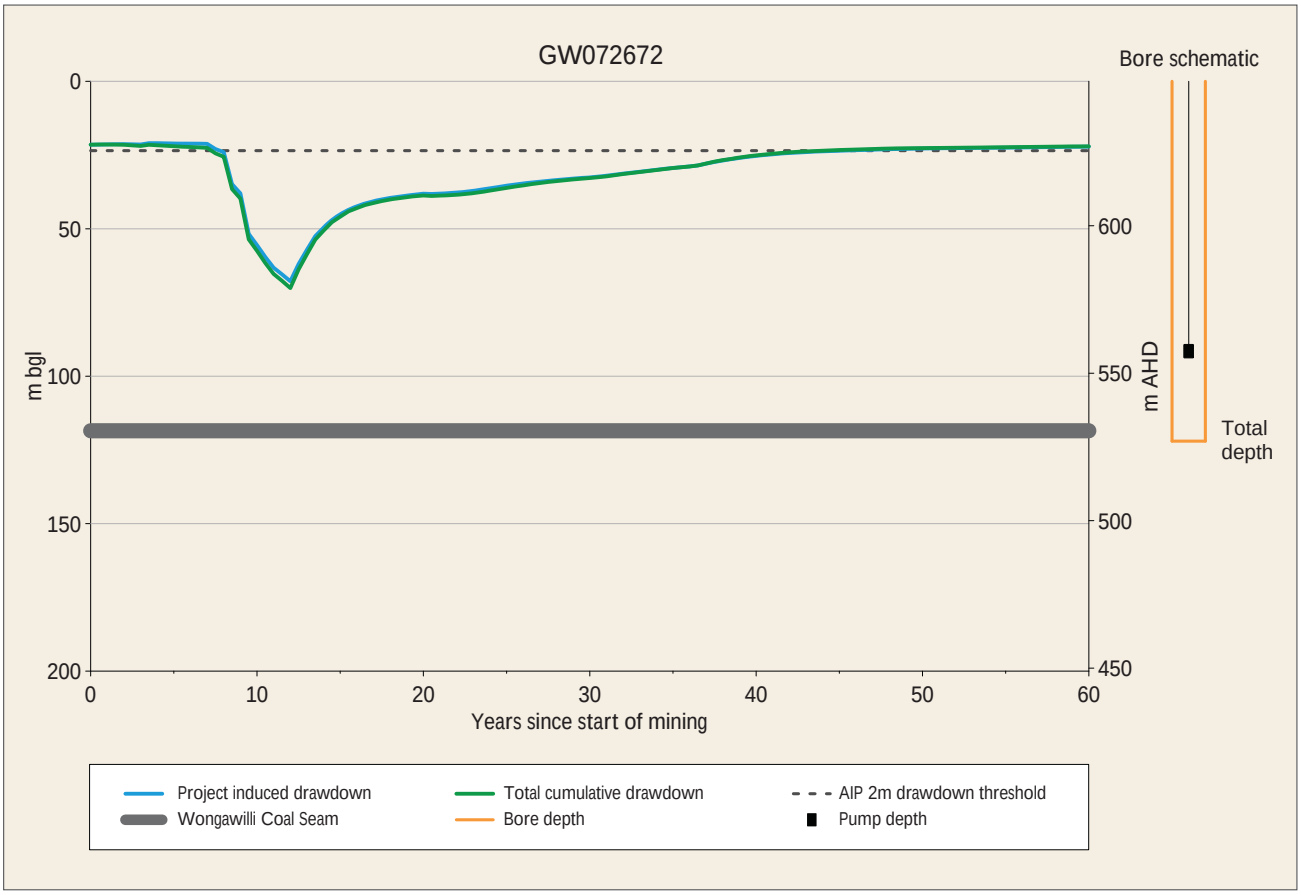

GW026136
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

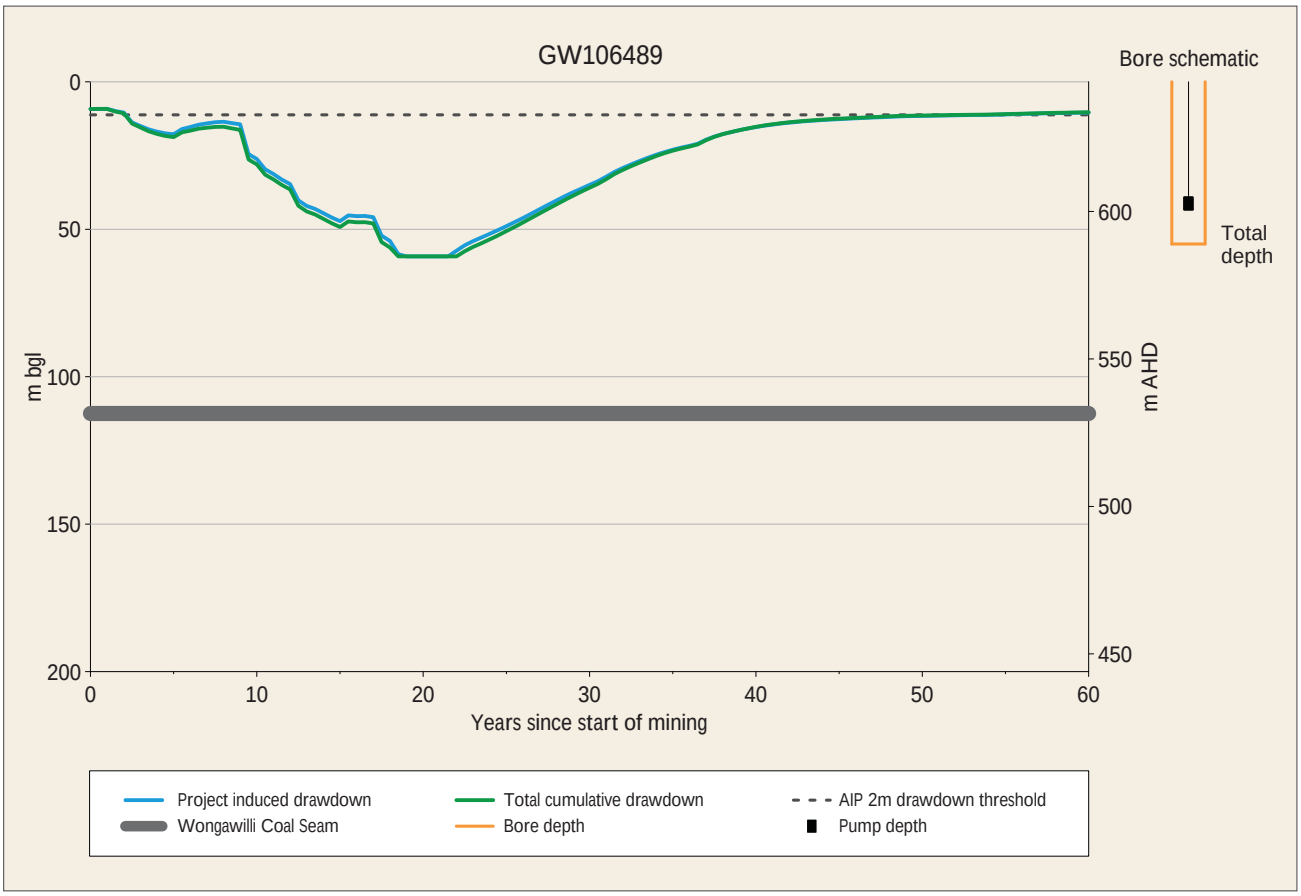

GW102916
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

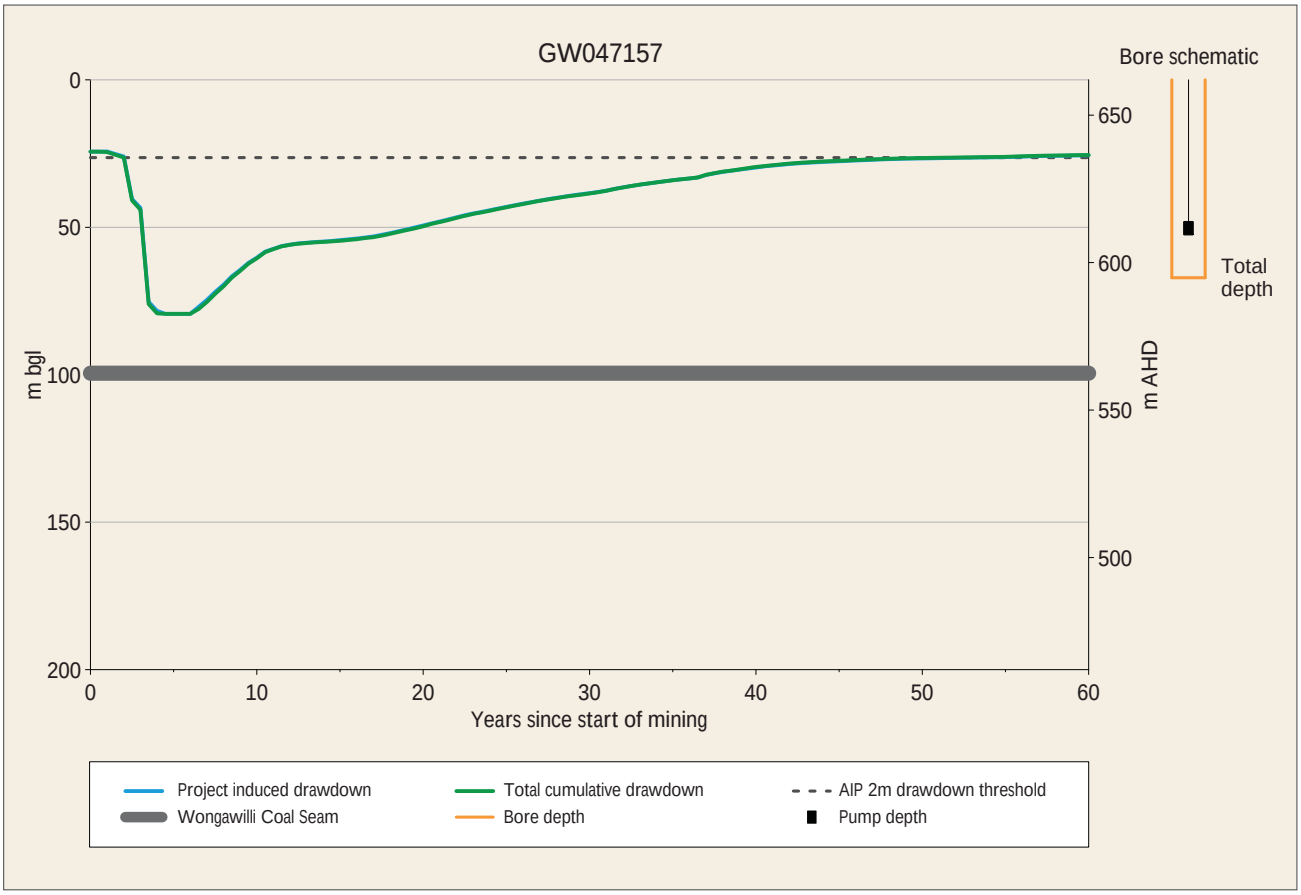

GW023322
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth


GW057906
Bore schematic
0
50
100
150
200
m bgl
600
550
500
450
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Wongawilli Coal Seam
Total cumulative drawdown
Bore depth
AIP 2m drawdown threshold
Pump depth

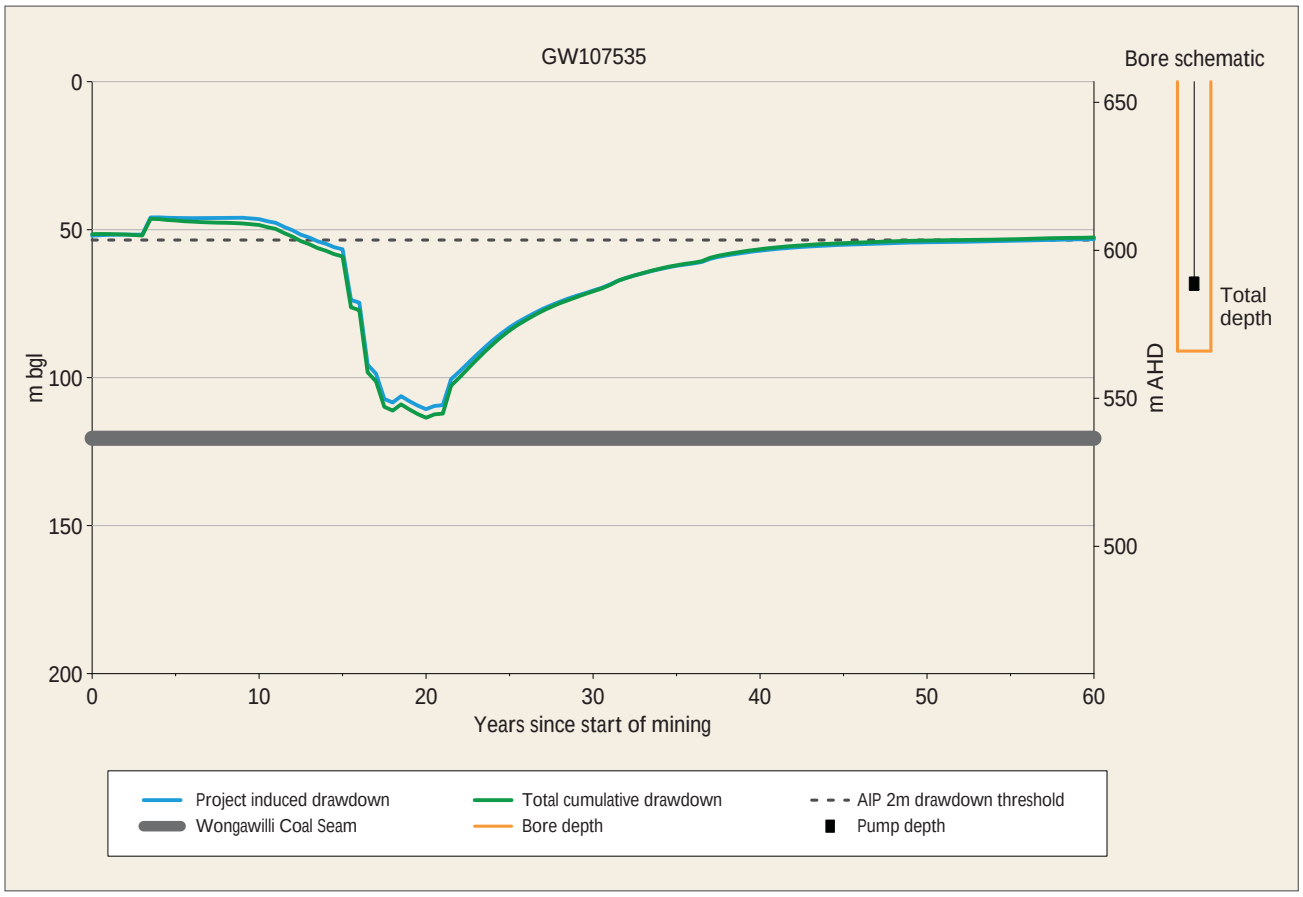

GW037851
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Wongawilli Coal Seam
Total cumulative drawdown
Bore depth
AIP 2m drawdown threshold
Pump depth


GW072672
Bore schematic
0
50
100
150
200
m bgl
600
550
500
450
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth


GW106489
Bore schematic
0
50
100
150
200
m bgl
600
550
500
450
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth


GW047157
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth


GW110236
Bore schematic
0
50
100
150
200
m bgl
600
550
500
450
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth


GW107535
Bore schematic
0
50
100
150
200
m bgl
650
600
550
500
m AHD
Total depth
0
10
20
30
40
50
60
Years since start of mining
Project induced drawdown
Total cumulative drawdown
AIP 2m drawdown threshold
Wongawilli Coal Seam
Bore depth
Pump depth

SYDNEY
Ground floor, Suite 01, 20 Chandos Street
St Leonards, New South Wales, 2065
T 02 9493 9500 F 02 9493 9599

NEWCASTLE
Level 1, Suite 6, 146 Hunter Street
Newcastle, New South Wales, 2300
T 02 4907 4800 F 02 4907 4899

BRISBANE
Level 4, Suite 01, 87 Wickham Terrace
Spring Hill, Queensland, 4000
T 07 3839 1800 F 07 3839 1866