MALABAR

MAXWELL UNDERGROUND MINE

Technical Report 3

Surface Water Review

Level 1
369 Ann Street
Brisbane

PO Box 10703
Brisbane Adelaide Street
Qld 4000

WRM
WATER +
ENVIRONMENT

07 3225 0200
wrm@wrmwater.com.au
wrmwater.com.au

ABN 96 107 404 544

MEMORANDUM

Date	13 January 2025
Attention	Donna McLaughlin
Company	Malabar Resources c/- Resource Strategies
WRM ref.	1383-14-B3
Subject	Woodlands Hill Panels 1 to 4 Extraction Plan - Surface Water Assessment - Technical Review Memo

Dear Donna,

This memorandum presents the results of our review of the predicted subsidence and potential surface water impacts for the secondary extraction of the first four longwalls in the Woodlands Hill Seam at the Maxwell Underground Mine.

1 BACKGROUND

1.1 OVERVIEW

The Maxwell Underground Mine (Maxwell Mine) is an underground coal mining operation located in the Upper Hunter Valley of New South Wales (NSW), east-southeast of Denman and south-southwest of Muswellbrook. The Maxwell Mine is owned and operated by Maxwell Ventures (Management) Pty Ltd (Maxwell), a wholly owned subsidiary of Malabar Resources Limited (Malabar). Maxwell has approval to extract bord and pillar panels (with partial pillar extraction) in the Whynot Seam, and extract longwalls in the Woodlands Hill, Arrowfield and Bowfield Seams.

Malabar submitted an Environmental Impact Statement (EIS) for the Maxwell Mine in July 2019 (SSD 9526). Development Consent State Significant Development (SSD) 9526 for the Maxwell Mine was granted by the NSW Independent Planning Commission (IPC) on 22 December 2020. The Maxwell Mine was subsequently approved under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) on 10 March 2021 (EPBC 2018/8287).

Malabar sought to modify Development Consent SSD 9526 under section 4.55(1A) of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for a minor extension to the mine entry area (MEA) (Modification 1). Modification 1 was subsequently approved on 19 November 2021, and EPBC 2018/8287 was varied on 14 December 2021.

The development consent was further modified (Modification 2) on 19 October 2022 to allow for:

- Re-orientation of the longwall panels in the Woodlands Hill, Arrowfield and Bowfield Seams resulting in a minor increase in the approved underground mining extent.
- Reduction in the width of some of the longwall panels in the Woodlands Hill Seam.
- Repositioning of the upcast ventilation shaft site and associated infrastructure.
- Other minor works and ancillary infrastructure components (e.g. access road and ancillary water management infrastructure for the repositioned ventilation shaft site).

1.2 SCOPE OF WORKS

Malabar is currently preparing an Extraction Plan for Woodlands Hill Seam Longwalls 1 to 4 (referred to as the EP). Malabar has engaged WRM Water & Environment (WRM) to:

- Review the subsidence reports associated with the EP;
- Identify the locations of predicted subsidence relevant to the EP, as well as any potentially impacted surface infrastructure and/or watercourses; and
- Prepare a memorandum presenting the results of the review and outlining a recommended surface water monitoring programme and Trigger Action Response Plan (TARP) measures.

This memorandum presents the methodology and results of the above tasks.

2 PREDICTED SUBSIDENCE

2.1 OVERVIEW

Predicted subsidence due to underground mining includes vertical displacement (subsidence), changes in slope (tilt), and rate of change of slope (curvature, both hogging and sagging).

Figure 2.1 shows the general layout of proposed Maxwell Mine underground workings for the Whynot, Woodlands Hill, Arrowfield and Bowfield seams, reproduced from the EIS Subsidence Assessment prepared by Mining Subsidence Engineering Consultants Pty Ltd (MSEC) (MSEC, 2019). This layout is referred to as the EIS layout.

Figure 2.2 shows the general layout of proposed revised Maxwell Mine underground workings for the Whynot, Woodlands Hill, Arrowfield and Bowfield seams, reproduced from the Modification 2 Subsidence Assessment prepared by MSEC (2022). This layout is referred to as the Modified layout. The Modified layout allowed for reorientation of the Woodlands Hill, Arrowfield and Bowfield seams longwall panels (resulting in a minor increase in the approved underground mining extent), and a reduction in the width of some of the Woodlands Hill Seam longwall panels.

Figure 2.3 shows the proposed layout of Woodlands Hill Seam Longwalls 1 to 4, for the EP, reproduced from the EP subsidence predictions and impact assessment prepared by MSEC (2025). This layout is referred to as the EP layout. The EP layout for Woodlands Hill Seam Longwalls 1 to 4 and the Modified layout are the same.

Malabar previously submitted an Extraction Plan for the first four bord and pillar panels in the Whynot Seam (Panels 2 to 5). The Woodlands Hill Seam EP Layout is located outside the extent of the Whynot Seam Panels 2 to 5 layout (Figure 2.3).

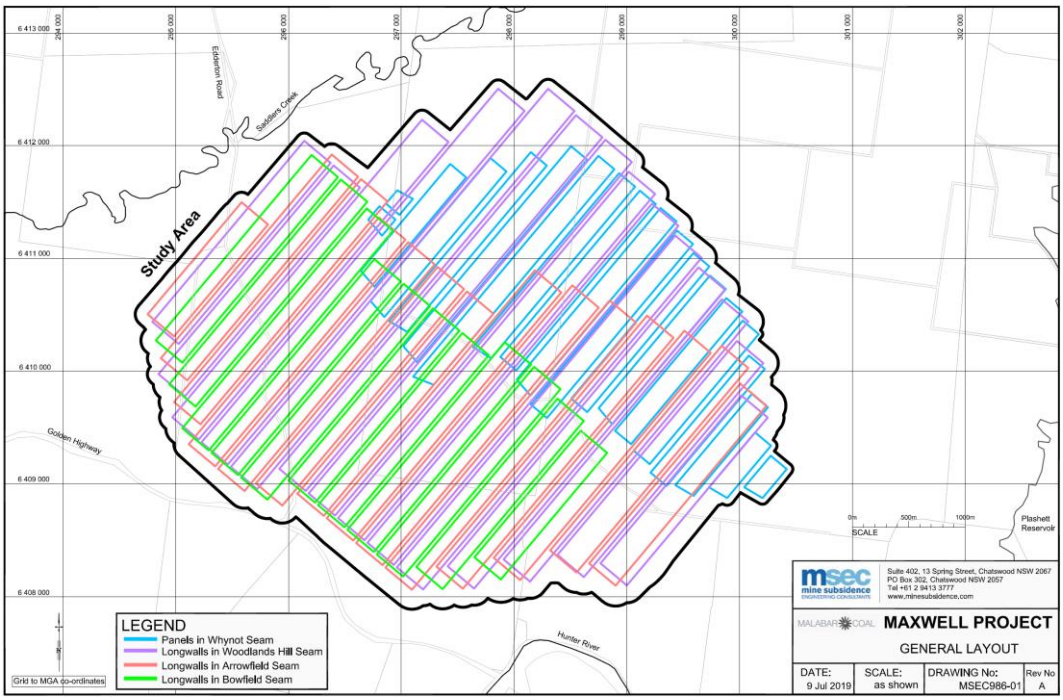

Figure 2.1 Proposed Maxwell Mine workings, EIS Layout (MESC, 2019)

Figure 2.2 Proposed Maxwell Mine workings, Modified Layout (MSEC, 2022)

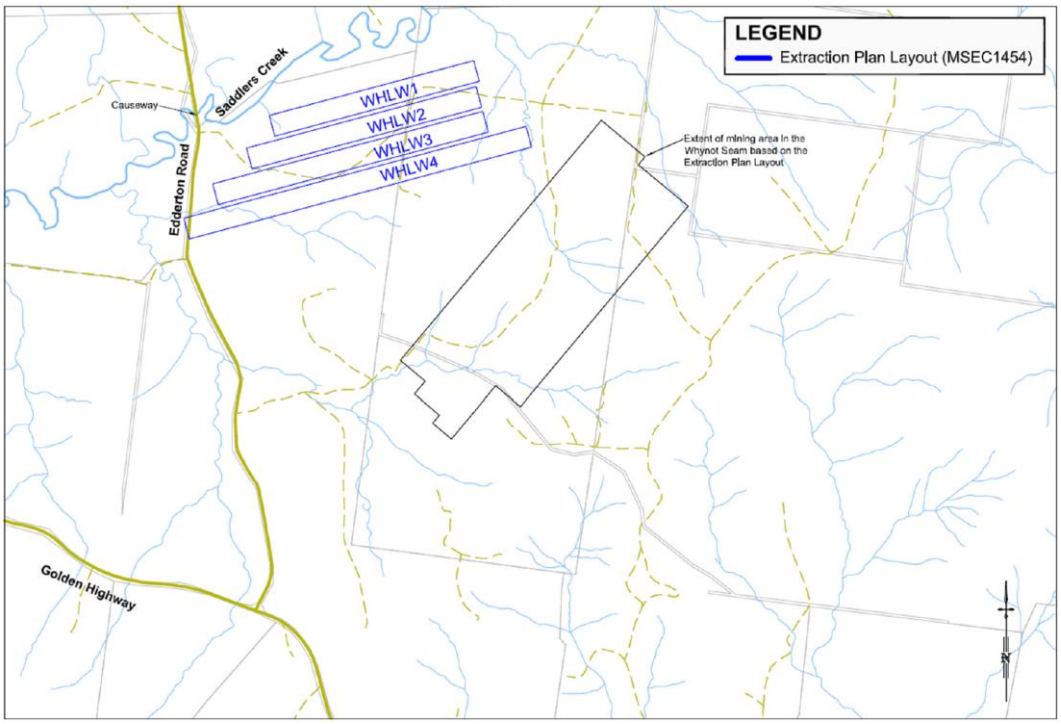

Figure 2.3 Extraction Plan layout for Maxwell Mine Woodlands Hill longwalls 1 to 4 workings, EP Layout. Reproduced from MSEC (2025).

2.2 PREDICTED EXTRACTION PLAN LAYOUT SUBSIDENCE

MSEC (2019, 2022) provides estimates of predicted subsidence for each seam, as well as cumulative total subsidence after extraction of each seam.

MSEC (2025) provides updated subsidence estimates for Woodlands Hill Seam Longwalls 1 to 4, based on the EP layout, and updated assumptions on extraction methods and maximum depth of cover.

Table 2.1 presents the maximum predicted subsidence due to extraction of longwalls in the Woodlands Hill Seam for the Modified layout and EP layout. It also includes the approved cumulative predicted subsidence due to the Maxwell Mine, for context.

The predicted subsidence data (MSEC, 2022 & 2025) shows that:

- The EP longwall layout for Woodlands Hill Seam extraction is generally the same as the Modified longwall layouts.
- Predicted EP layout subsidence from Woodlands Hill Seam extraction is unchanged from the predicted Modified layout subsidence from Woodlands Hill Seam extraction.
- Overall, the extent and magnitude of predicted subsidence for the EP layout extraction from Woodlands Hill Seam is unchanged from the approved predicted subsidence for the Modified layout.
- Predicted Woodlands Hill Seam subsidence for extraction of Longwalls 1 to 4 contributes a third of the predicted ultimate subsidence for the Woodlands Hill Seam, which itself contributes a little over half (approximately 51%) of the predicted ultimate subsidence for the Maxwell Mine underground workings.

- Subsidence impacts above Longwalls 1 to 4 could include:
  - Surface cracking with crack widths up to 100 mm in about 80% of cases, and greater than 100 mm in about 20% of cases; and
  - Compression heaving and stepping, with deformation heights typically less than 100 mm.

Table 2.1 Maximum predicted subsidence effects for extraction of longwalls in the Woodlands Hill Seam

Layout	Maximum predicted total vertical subsidence (mm)	Maximum predicted total tilt (mm/m)	Maximum predicted total hogging curvature (km^{-1})	Maximum predicted total sagging curvature (km^{-1})
EP Layout (longwalls 1 to 4)	1,100	25	0.7	1.2
Modified Layout (longwalls 1 to 4)	1,100	25	0.7	1.2
Modified Layout (all longwalls)	3,300	35	1.5	1.5
Modified Layout (Max. cumulative for all seams)	6,500	50	2.0	2.0

3 POTENTIAL IMPACTS

3.1 OVERVIEW

Figure 3.1 shows the maximum predicted subsidence contours due to extraction of Woodlands Hill Seam Longwalls 1 to 4 for the EP layout.

The EIS (WRM, 2019) and Modification 2 (WRM, 2022) surface water assessments identified the following key potential subsidence impacts for the Maxwell Mine:

- Direct subsidence impacts on the Hunter River and/or Saddlers Creek;
- Loss of catchment due to increased ponding caused by subsidence; and
- Surface cracking leading to loss of surface water flows.

The EIS and Modification 2 Surface Water Assessments (WRM, 2019 & 2022) concluded that:

- The Hunter River and Saddlers Creek are located outside the Maxwell Mine underground mining area and would not be subject to direct subsidence effects. There could, however, be potential subsidence impacts on the unnamed (Saddlers Creek tributary) drainage lines;
- The Geomorphology Assessment (EIS Appendix D) found that ultimate predicted subsidence would increase the surface area of depressions in drainage lines across the Maxwell Mine underground area. However, these depressions would also naturally fill with sediment over time, thus reducing the predicted surface area ponding. The potential reduction in Saddlers Creek flows due to ultimate predicted subsidence is negligible.

- Some fracturing of exposed bedrock and bedrock beneath the soil beds of drainage lines is predicted as a result of the project (MSEC, 2019). However, as the drainage lines within the Maxwell Mine underground area are ephemeral, surface water flows only occur during and for short periods after rainfall events. In times of heavy rainfall, the majority of the runoff would flow over the natural surface soil beds and would not be diverted into the dilated strata below (MSEC, 2019). In times of low flow, however, surface water flows could be diverted into the dilated strata below the beds where the bedrock is shallow or exposed (MSEC, 2019). Consequently, given the ephemeral nature of the drainage lines overlying the Maxwell Mine underground area, the potential diversion of flows into the underlying strata during low flow events would be negligible.

MSEC (2025) subsidence predictions also show that:

- The Hunter River is not expected to experience measurable subsidence effects;
- Saddlers Creek is predicted to experience less than 20 mm of vertical subsidence and the creek channel is not expected to experience cracking; and
- For the Saddlers Creek tributary drainage lines, there are no predicted reversals of stream grade due to the mining of Woodlands Hill Seam Longwalls 1 to 4, and crack widths are estimated to be typically between 25 mm to 50 mm, but could exceed 150 mm in some locations.

3.2 PREDICTED EXTRACTION PLAN SUBSIDENCE IMPACTS

Figure 3.2 shows the EP layout subsidence study area, overlaid on natural features in the Project area, including watercourses.

Potential subsidence impacts from Woodlands Hill Seam extraction for the EP layout remain similar to and no greater than, the potential impacts identified for Modification 2 including:

- Loss of catchment due to increased ponding caused by subsidence; and
- Surface cracking leading to loss of surface water flows.

However, as discussed in Section 2 above:

- The extent of predicted subsidence impacts remains consistent with the extent of predicted Modification 2 subsidence impacts for Woodlands Hill Seam extraction; and
- The magnitude of predicted subsidence impacts for the proposed extraction of Woodlands Hill Seam Longwalls 1 to 4 are unchanged from the predicted Modification 2 impacts for the Maxwell Mine.

Consequently, Woodlands Hill Seam extraction for the EP layout will have, consistent with Modification 2:

- No direct subsidence impacts on the Hunter River or Saddlers Creek (including flooding impacts);
- Negligible reduction in Saddlers Creek flows due to increased ponding from subsidence. Note, ponding depressions will naturally fill with sediment over time, thus reducing the predicted surface ponding area;
- Negligible diversion of flows into the underlying strata during low flow events in the Saddler Creek tributary drainage lines; and
- Negligible change in Saddler Creek tributary drainage lines flooding as a result of subsidence impacts for the EP layout.

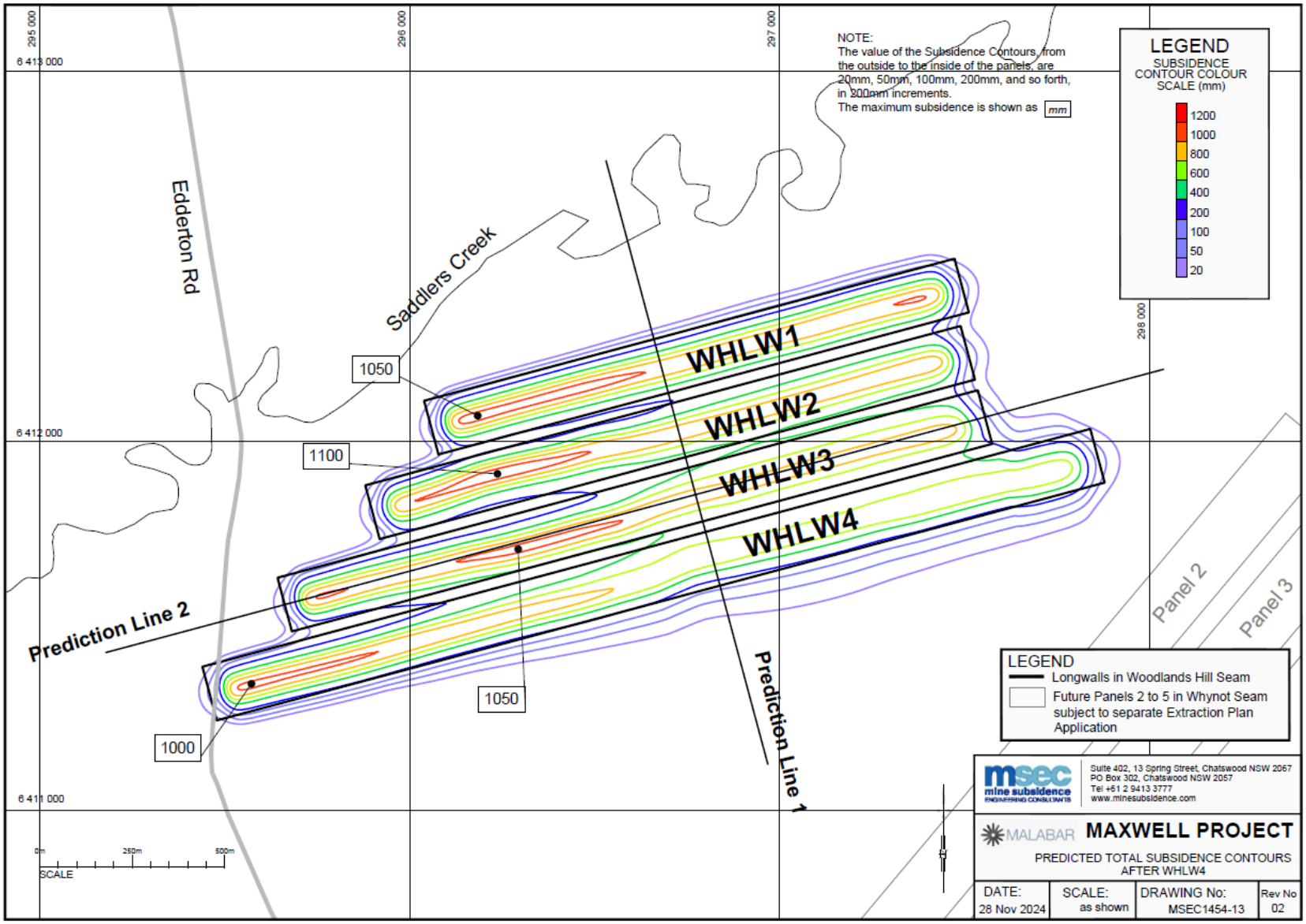

Figure 3.1 Maximum predicted subsidence contours for Extraction Plan layout extraction from Woodlands Hill Seam Longwalls 1 to 4. Reproduced from MSEC (2025).

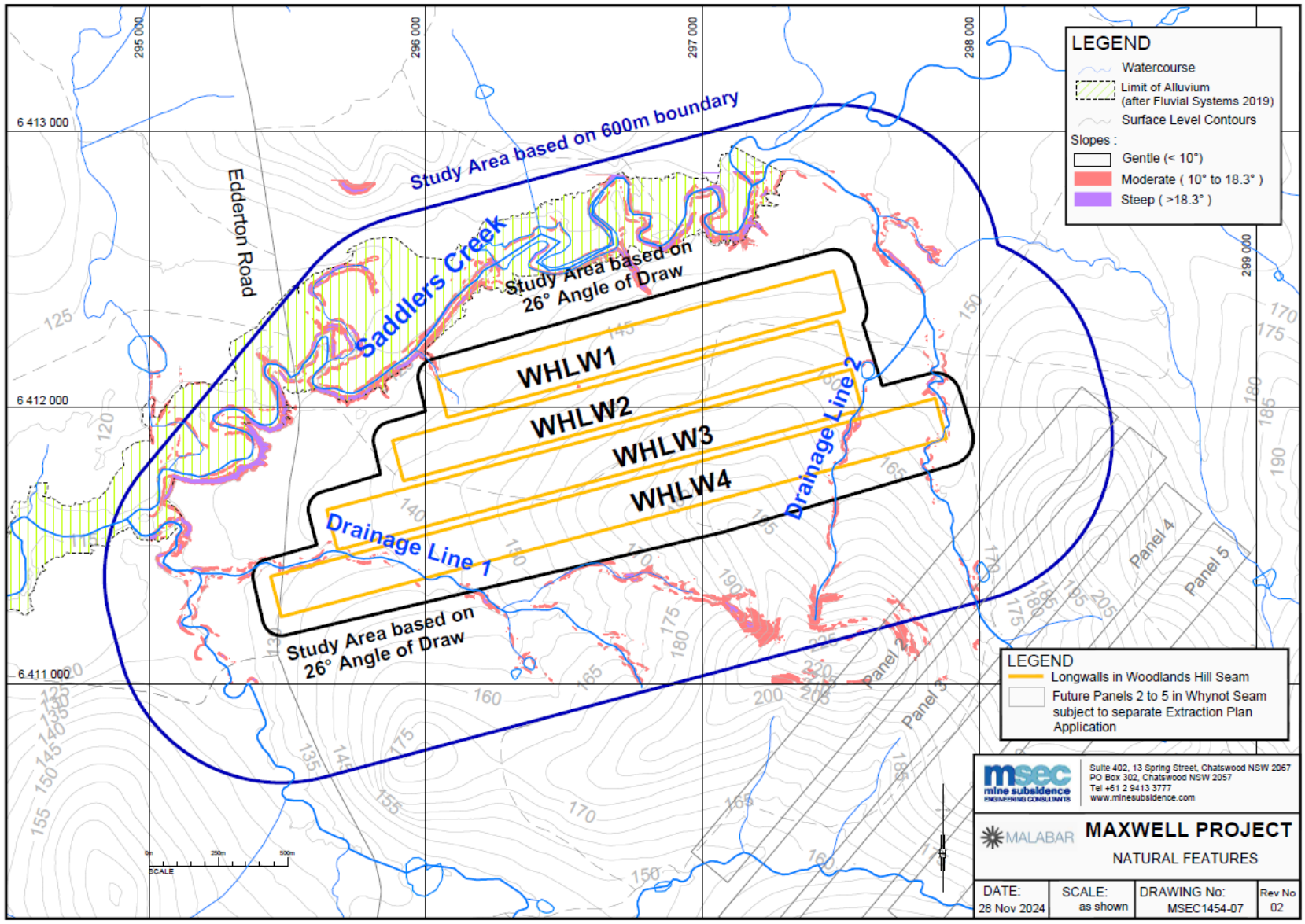

Figure 3.2 Predicted subsidence extent for Extraction Plan layout extraction from Woodlands Hill Seam Longwalls 1 to 4. Reproduced from MSEC (2025).

4 MONITORING AND MANGEMENT MEASURES

4.1 OBJECTIVES AND PERFORMANCE INDICATORS

Development Consent SSD 9526 sets out specific environmental conditions for underground mining, comprising a set of subsidence impact performance measures, as well as requiring a Subsidence Monitoring Program (SMP) as part of any extraction plan for second workings.

Table 4.1 shows key surface-water-related subsidence impact performance measures from Part C of Development Consent SSD 9526.

Table 4.1 Surface-water-related subsidence impact performance measures

Feature	Performance measures
All watercourses within the subsidence area	No greater subsidence impacts or environmental consequences to water quality, water flows (including baseflow) or stream health (including riparian vegetation), than predicted in the document/s listed in condition A2(c) (i.e., the EIS, EAs, Modification 1 report and Modification 2 report).
All land within the subsidence area	No greater subsidence impacts or environmental consequences than predicted in the document/s listed in condition A2(c)
All land outside the subsidence area	Negligible subsidence impacts or environmental consequences

4.2 MONITORING OF IMPACTS

As discussed in Section 2 and Section 3, surface water impacts for extraction of Woodlands Hill Seam Longwalls 1 to 4 are likely to be limited in magnitude and spatial extent. To verify the extent and magnitude of subsidence impacts, Development Consent SSD 9526 requires the development of an SMP and an updated Water Management Plan (WMP) as part of the EP.

As part of the Extraction Plan for Whynot Seam Panels 2 to 5, Malabar prepared a SMP and WMP. It is recommended the existing monitoring programs are continued and additional recommendations outlined below are implemented, where reasonable and practicable.

The SMP will describe the monitoring program, which will provide data to assist with subsidence risks and validate subsidence predictions.

The WMP will describe management measures for potential impacts of the underground workings on watercourses, including via baseline monitoring, a surface water monitoring program and the development of specific trigger levels for acting on potentially adverse impacts.

Table 4.2 shows the monitoring activities recommended to be included in the WMP. Surface water quality monitoring will continue to be done as part of the WMP, but it is unlikely to be sensitive to potential subsidence impacts. The primary monitoring activity recommended for surface water subsidence impacts will be visual inspection, including the collection of photographic records to confirm changes over time along key drainage paths.

Table 4.3 shows the recommended performance measure trigger events, as well as the response measures required to manage the potential impacts.

A key principle for the remediation of surface water impacts due to subsidence is to minimise land disturbance associated with intervention measures. Hence, once an issue is identified, it is recommended that specialist advice be obtained to ensure that any proposed intervention is effective. Wherever possible, proposed remediation works should be undertaken using soft engineering measures that minimise land disturbance and maximise vegetative cover.

Table 4.2 – Proposed monitoring for surface water impacts

Monitoring task	Methodology	Timing
Water quality & stream health monitoring	As per Surface Water Management Plan	As per Surface Water Management Plan
Walkover visual inspection and photographic record of drainage lines	Identify and mark the upstream and downstream limits of Woodlands Hill Seam Longwalls 1 to 4 on drainage lines	Prior to undermining of drainage lines
	Undertake a baseline inspection by walking along the drainage lines over Woodlands Hill Seam Longwalls 1 to 4 and noting the condition of vegetation in the channel and any areas of active erosion, sediment deposition, water ponding or streambed cracking	Prior to undermining of drainage lines
	Collect photographic record of channel condition along drainage lines over Woodlands Hill Seam Longwalls 1 to 4	Prior to undermining of drainage lines
	Undertake periodic walkover inspection along drainage lines over Woodlands Hill Seam Longwalls 1 to 4 and update photographic record	Within 3 months of undermining of drainage lines Ongoing inspections every 6 months for one year after undermining

Table 4.3 – Surface water response actions – subsidence drainage impacts

Issue	Performance indicator	Trigger event	Action
Drainage lines	Change in visible bed or bank erosion	Noticeable new areas of erosion or expansion of existing erosion	Obtain specialist advice on appropriate remediation works. Disturbance of existing vegetation increases the risk of erosion. Hence, machinery access for remediation works can potentially cause greater impacts than those caused by subsidence.
	Development of, or change in headcut erosion along drainage lines	Initiation of headcut or noticeable upstream advance of existing headcut	Obtain specialist advice on appropriate remediation works. Preferred management strategies would include slope stabilisation, revegetation and bed control using natural materials such as local rock and large woody debris.
	Extent and duration of water ponding	Development of new pools or drainage of existing pools	Obtain survey of ponded area to identify ponding depth and extent. Investigate potential drainage works to restore existing drainage characteristics.

Regards,

Daniel Sheehy

Principal Engineer

References

MSEC, 2019	'Environmental Impact Statement – Subsidence Assessment', report in support of Environmental Impact Statement, Mine Subsidence Engineering Consultants Pty Ltd, July 2019
MSEC, 2022	'Modification Application – Subsidence Assessment', report in support of modification application, Mine Subsidence Engineering Consultants Pty Ltd, June 2022
MSEC, 2025	'Extraction Plan Application – Subsidence Assessment', report in support of extraction plan application for WHLW1 to WHLW4 in the Woodlands Hill Seam, Mine Subsidence Engineering Consultants, January 2025
WRM, 2019	'Maxwell Project Surface Water Assessment', report in support of EIS, WRM Water & Environment Pty Ltd, 2019
WRM, 2022	'Maxwell Longwall Mining and Ventilation Shaft Modification – Surface Water Review', report in support of modification application, WRM Water & Environment Pty Ltd, June 2022