



04 December 2015

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Our ref: 22/18155/00
111687
Your ref:

Dear Shane

Proposed residential development - Thornton North Mine subsidence constraints

1 Introduction

This letter presents advice relating to mine subsidence constraints to proposed residential development at a CSR site near the corner of Haussman Drive and Raymond Terrace Road, Thornton North.

As the site is not within a Mine Subsidence District, the Mine Subsidence Board (MSB) is not an approval authority for development applications. However, Maitland City Council may consult the MSB and place similar conditions on development. For the purpose of this assessment, we have assumed Council will place conditions that are comparable to those expected from the MSB.

We understand the MSB advised the site is undermined by abandoned coal mine workings. The MSB have concerns that future subsidence may damage proposed dwellings as well as create a hazard to the public generally. In order for development to occur, the MSB advised CSR that the risk of subsidence would need to be eliminated by grouting and/or excavation.

This letter should be read in conjunction with the attached General Notes.

2 Methodology and key assumptions

GHD undertook a desktop study and interpreted the mine's location and cover depth (which is, the vertical distance from the ground surface to the top of the workings). We then developed an assumed scope of risk reduction work and estimated an indicative cost to complete these works based on the following key assumptions:

- Council will place conditions on development that are comparable to that expressed by the MSB and generally in line with the MSB Graduated Design Guidelines for Residential Construction (NSW)
- The location and orientation of the workings not only are approximate (as shown in the attached Figure 1: note that this interpreted location is different to that shown on the MSB plan provided) but also represent a poorly defined layout at a particular time. This mine layout may not represent the actual extent or shape of the workings at the time of abandonment
- The finished ground surface level will be not more than 1 m below the ground surface shown on the 2012 CSR borehole location plan provided
- Filling of mine voids with up to a cover depth of 20 m will be acceptable to Council as a means of eliminating the risk of future mine subsidence
- Not filling mine voids greater than 20 m cover depth will not preclude residential development, although Council may impose conditions on dwelling size and materials

- The two shafts and two tunnel entries will be located by excavation and backfilled with fill rather than capped with reinforced concrete slabs
- The scope of risk reduction work, quantities and cost rates are as presented in Section 5.

2.1 Desktop study

The desktop study comprised review of the following:

- historical information including mine record tracing RT 292, newspaper articles and NSW Department of Mines annual reports
- MSB plans provided
- historical and modern geological maps
- recent aerial photographs
- information provided by CSR including photos, a video, survey plans and logs of six 'U' series boreholes

A list of references is attached.

2.2 Site visit

The site visit on 20 November 2015 allowed observation of surface conditions, particularly where CSR reported a subsidence hole was filled in 2011 and 'U' series boreholes were drilled in August 2012.

No evidence of mine subsidence features such as shafts, tunnels, potholes or cracks was observed during the site visits. However, this does not confirm their absence as grass cover and general site disturbance may have obscured such features.

The location of the '2011 hole' and 'U' series boreholes are shown in Figure 1 attached.

3 Description of mining

3.1 Geology and mined seam

The reviewed geology maps show the site is located to the east of the Thornton syncline in sedimentary rocks belonging to the Tomago Coal Measures. The stratum dips generally toward the west to south-west at 10° to 22° to the horizontal. A localised seam dip of approximately 20° toward the west-south-west has been interpreted from review of the 1902 geology map, CSR borehole data, positioning of the mine workings relative to borehole locations and the 2011 subsidence hole location.

The 1902 geology map indicates the coal seam mined was known as the Morpeth Seam.

Neither the thickness of the seam or mining interval (thickness of coal mined) is shown on the record tracing or mentioned in the other references reviewed. Based on the U6 borehole log provided, the seam thickness appears to be approximately 1.8 m. The mining height is generally less than the geological seam thickness as beds within coal seams are frequently of a quality that was not worth extracting.

3.2 Groundwater

The U series borehole logs do not indicate a static groundwater level and it appears these boreholes were not sufficiently deep to intersect the groundwater table.

Aerial photographs of the quarry show ponded water at about RL 20 m AHD. As the mine workings (with the exception of the tunnel entries and shafts) are below this level, all of the workings are expected to be currently flooded.

3.3 Glenvale Colliery

General

A plan of the abandoned coal mine workings is shown on record tracing RT 292. The mine was known as “Glenvale” or “Glen Vale” Colliery and operated episodically between 1927 and 1952. Being a very small mine, there is little mention of Glenvale Colliery in departmental annual reports and newspapers. The following summarises what was ascertained.

- 1927 opening of “Glen Vale” colliery noted in the Greta Field. 4 people employed.
- 1928 notice of discontinuance of “Glenvale” colliery.
- 1929 17 people employed at “Glenvale” colliery. 14 of which were below ground.
- 1930 28 October. Henry Sharpe, manager of “Glen Vale Colliery, a small coal mine on the Raymond Terrace road near East Maitland” charged with having failed on 8 September to use clay or other non-combustible material for stemming.
- 1931 no mention in annual report
- 1932 no mention in annual report. Last date on record tracing RT 292 is 20/12/32.
- 1933 to 1950 no mention in annual reports
- 1951 notice of discontinuance and recommencement of “Glenvale” colliery.
- 1952 notice of abandonment of “Glenvale” colliery

The mining method was bord and pillar workings with access through two tunnel entries. Air was provided via a furnace shaft originally and later by a “new shaft” adjacent to the “furnace shaft”. The creation of the new shaft coincided with a new in-seam drive of 3 yard width through a single pillar. A note on the record tracing indicates this new drive was required as the tunnels were impassable beyond this due to “intense floor heave”.

This intense floor heave is expected to be due to swelling of expansive claystone forming the floor of the workings rather than a bearing capacity failure of the pillars. However, the latter is possible (although unlikely beneath loaded pillars) if the claystone floor became sufficient weak as it absorbed water, swelled and softened. In either case, the result is a reduction in remaining mine void volume. Record tracing RT 292 includes the reference “Vide papers M^s 52/1972” to additional information on the floor heave. Further investigation of these mine workings should include an attempt to source these papers.

The tunnel entries appear to be close to the sub-crop of the mined coal seam and are interpreted as being “in-seam”. That is, the miners followed the seam down dip from the surface to a depth where the coal was of a quality worth mining. At this point, the first bord was mined perpendicular to the main tunnel and hence approximately along the strike of the seam.

Pillars were not extracted although a hatched area on the record tracing indicates where a bord was widened on 20 December 1932, the last date on the record tracing.

Extent of mine workings

The mining activity between 1932 and 1952 is unknown and the record tracing (RT 292) is not marked as a 'plan of abandonment' and not signed by a mine surveyor. RT 292 includes dates of extraction in red and shows 'open ended' bords or headings. Image 1 below shows a portion of RT 292 illustrating these features.

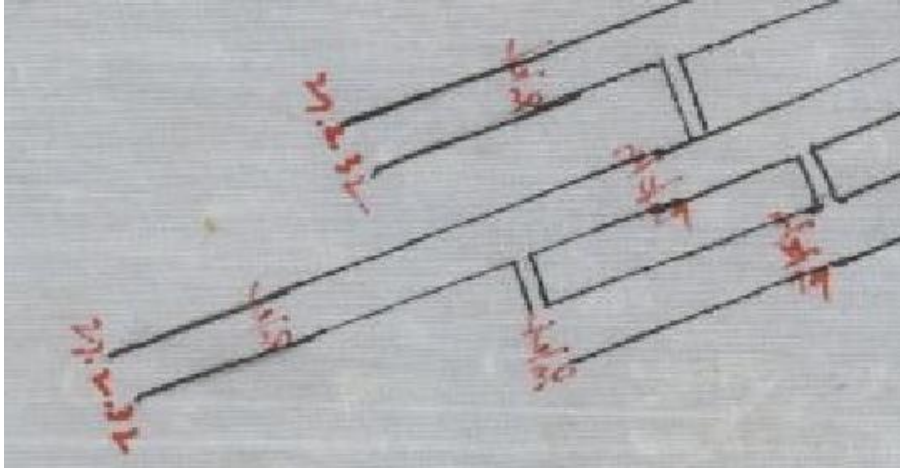


Image 1 Portion of record tracing RT 292 illustrating 'open ended' bords and dates

The 'open ended' bords and lack of certified plan of abandonment suggest that the actual mine workings may be more extensive than shown on RT 292. This possibility would need to be investigated by borehole drilling.

In the period between 1932 and abandonment in 1952, the only mention of Glenvale or Glen Vale Colliery found in the annual reports is in 1951. Here the annual report simply provides notice that Glenvale Colliery was discontinued and recommenced. Given the mine was abandoned in the following year, the volume of additional coal mined, if any, is likely to be very little and record tracing RT 292 is likely to present a reasonable representation of the extent of mining.

Position of mine

The position of the Glenvale Colliery workings has been interpreted from the location of the 2011 subsidence hole (as shown on the 2012 plan of surface contours and boreholes) as well as cadastre boundaries on the record tracing and positions of the U series boreholes. The interpreted location as shown on the attached Figure 1 is approximately 25 m east-north-east of where the MSB plan indicates.

The position of the mine workings is an important aspect of determining cover depth as the ground surface is lower to the west and south west. If the workings are further west, the cover depths will also be less than currently estimated.

Cover depth

Cover depth to the top of the mined seam have been estimated from the following:

- Inferred position of the workings as shown in Figure 1
- Ground surface contours from the 2012 CSR Housing Commission Proposed Drilling plan
- Inferred seam dip and dip direction of approximately 20° to the west-sou-west.

Resulting cover ranges are shown on Figure 1. Overall, cover is judged to vary from about 9 to 36 m, not including the tunnel entries which will be shallower.

4 Subsidence hazards and risk reduction

Broadly, subsidence hazards associated with mine workings relate to the following mechanisms:

- Pothole subsidence – where the roof of the mine, particularly at the intersections of mine headings, collapses and migrates toward the ground surface to form a depression or hole
- Collapse of shafts – where material settles or washes out such that the shaft re-appears as a hole
- Collapse of tunnels – where the roof of a tunnel entry collapses or the material used to fill the tunnel settles or washes out such that the tunnel re-appears as a hole or depression
- Trough subsidence – where an area of the mine roof converges over a region of several pillars due to lack of support from the mine pillars or complete removal of pillars during mining, or progressive deterioration of pillars since mining finished, resulting in surface cracking, compression ridges and typically broad depressions.

For the Glenvale Colliery workings as depicted on the record tracing, trough subsidence is not expected to be a mechanism of concern. This is due to the relatively large dimensions of the pillars shown to remain, their expected height of less than 1.8 m and the depth of cover being relatively shallow. Note that this assessment is based on the validity of the record tracing which may not be a reasonable representation of the mine workings.

Potholes, shafts and tunnel subsidence events occurring in residential areas can present one or a combination of the following consequences:

- Damage to houses, driveways, pools, sheds and the like - in some cases resulting in houses being unsafe and requiring demolition
- Damage to infrastructure such as roads, footpaths and utilities
- Injury or loss life.

Typically, the MSB require mine subsidence hazards to be eliminated where the cover depth to the workings is less than 20 m. This is usually achieved by injection of cementitious grout into the mine voids via boreholes or excavation of the workings and backfilling where the workings are very shallow (typically less than 10 m below the ground surface).

For workings at greater than 20 m cover depth, the MSB may also require grouting. However, in our experience the risk of subsidence associated with residential development is often acceptable without the need for grouting at greater than 20 m cover. Typically, in such circumstances, the MSB would place conditions on development in line with their Graduated Design Guidelines for Residential Construction. For example, where workings remain at 20 to 40 m cover depth, approval conditions may comprise single storey light weight construction, possibly with a requirement for pothole footings where in ground concrete beams extend beyond the footprint to span over a nominal diameter void.

Old mine entries such as shafts and tunnels generally need to be located by excavation, surveyed and backfilled. The nature of backfilling will depend on the final land use. In some cases, reinforced concrete slabs are required to cap shafts to mine closure guidelines.

5 Assumed risk reduction and preliminary cost estimate

To develop an preliminary cost estimate for works associated with mine subsidence assessment and risk reduction, an assumed scope of work has been developed. This is based on the preliminary assessment of mine workings presented herein and expected Council conditions placed on development.

The assumed scope is presented in Table 1 together with an indicative cost estimate and basis.

Table 1 Assumed scope and preliminary cost estimate

Item	Description	Basis / assumptions	Preliminary cost estimate	
			low	high
Geotechnical consulting services	Investigation of mine workings (including location, downhole identification and survey of shafts and tunnels), assessment of risk, risk mitigation strategy and grouting specification, remediation QA and reporting	Estimated from projects of similar nature and not determined through detailed scoping and cost estimating	\$ 100,000	\$ 150,000
Tunnels and shafts	Engineering filling of excavated shafts and tunnels over approximately 300 m ² area to average of 2 m depth	No concrete slab capping required	Cost assumed to be included in site regrade earthworks for subdivision	
Grout plant mobilisation and demobilisation	Set up plant and access, demobilisation following completion of grouting		\$ 15,000 ^A	\$ 25,000 ^A
Drilling and plug grouting	Low mobility gravel and grout to plug workings at about 20 m cover in 7 locations (headings)	14 boreholes to 20 m with gravel and grout plugs ~200 m ² area x 1 to 1.5 m depth at \$200/m ³ ^B	1 m avg. void height \$ 40,000	1.5 m avg. void height \$ 60,000
Drilling and infill grouting	Filling of mine voids shallower than 20 m with higher mobility cementitious grout	~2,400 m ² area x 1 to 1.5 m depth at \$150/m ³ ^A	1 m avg. void height \$ 360,000	1.5 m avg. void height \$ 540,000
Preliminary cost estimate (excluding GST)			\$ 415,100	\$ 645,130
A: Based on indicative rates for a similar project provided by a grouting contractor recently				
B: Additional \$50/m ³ included over base rate for grouting and drilling to allow for more complex and time consuming plug grouting				

The preliminary cost estimates presented in Table 1 do not include any additional contingency or allowance for rate rises. We recommend a contingency be applied to the above estimates, particularly for the cost of grouting which is difficult to predict due to the unknown volume of void to be filled.

As a guide, a contingency allowance of 30% for the drilling and grouting work is suggested at this stage.

6 Limitations

6.1 General

This report has been prepared by GHD for McCloy Group and may only be used and relied on by McCloy Group for the purpose agreed between GHD and the McCloy Group as set out in this report.

GHD otherwise disclaims responsibility to any person other than McCloy Group arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

6.2 Preliminary cost estimate

GHD has prepared the preliminary cost estimate set out in Section 5 of this Report ("Cost Estimate") using information reasonably available to the GHD employee(s) who prepared this Report; and based on assumptions and judgments made by GHD as set out in the Report.

The Cost Estimate has been prepared for the purpose of indicating likely costs associated with mitigating mine subsidence hazards prior to purchase of the land and must not be used for any other purpose.

The Cost Estimate is a preliminary estimate only. Actual prices, costs and other variables may be different to those used to prepare the Cost Estimate and may change. Unless as otherwise specified in this Report, no detailed quotation has been obtained for actions identified in this Report. GHD does not represent, warrant or guarantee that the works can or will be undertaken at a cost which is the same or less than the Cost Estimate.

Where estimates of potential costs are provided with an indicated level of confidence, notwithstanding the conservatism of the level of confidence selected as the planning level, there remains a chance that the cost will be greater than the planning estimate, and any funding would not be adequate. The confidence level considered to be most appropriate for planning purposes will vary depending on the conservatism of the user and the nature of the project. The user should therefore select appropriate confidence levels to suit their particular risk profile.

Regards
GHD Pty Ltd

A handwritten signature in black ink that reads "Sam Mackenzie". The signature is written in a cursive style with a large, stylized 'M'.

Sam Mackenzie
Principal Geotechnical Engineer
(02) 4979 9983, 0455 865 377

Attachments:

References

General Notes

Figure 1 – Preliminary plan of mine workings

References

Sorted by date: earliest to latest

Map: Geological Map of part of the Maitland Coal Field. T.W.E. David, Department of Mines and Agriculture, NSW. 1902.

Report: 1927 Annual Report. NSW Department of Mines. P89.

Report: 1928 Annual Report. NSW Department of Mines. P86.

Report: 1929 Annual Report. NSW Department of Mines. P70.

Article: "Clay Not Used – Mine Manager Fined". Newcastle Morning Herald and Miners' Advocate. Tuesday 28 October 1930, p4.

Report: 1951 Annual Report. NSW Department of Mines. P62.

Report: 1952 Annual Report. NSW Department of Mines. P65.

Record tracing: RT 292 "Glenvale Colliery". Scale 2 chains to 1 inch. Unsigned and undated. Department of Industry, Skills and Regional Development (DOI) ref. R10000287.

Map: Newcastle Coalfield Regional Geology. 1:100 000 scale, Sheet 9231 Ed. 1, 1995. NSW Department of Mineral Resources.

MSB files FN99-00826N0: showing plan of cadastre and mine workings within Lot 2 DP 867766. Newcastle District Office, 01/05/2008

CSR files: mine inspectors notice "Notice of Prohibition, Restriction, Evacuation or Closure of a Mine" NSW Mine Inspectorate, No. 10003, 25/10/2011. Provided by VGT Pty Ltd on 24 November 2015.

CSR files: 1 video and 21 photographs of clearing, excavation and filling associated with remediation of a subsidence feature in November 2011. Provided by VGT Pty Ltd on 24 November 2015.

CSR files: plan of surface contours and boreholes "Housing Commission Proposed Drilling" Figure 4, 8/10/2012. Provided by VGT Pty Ltd on 24 November 2015.

CSR files: cross section of U series boreholes "Housing Commission Cross Section" Figure 3, 8/10/2012. Provided by VGT Pty Ltd on 24 November 2015.

CSR files: borehole logs of U series boreholes. Drill Hole Number: U1, U2, U3, U4, U5, U6. Total Drilling Pty Ltd, August 2012. Provided by VGT Pty Ltd on 24 November 2015.

McCloy Group: Plan of proposed subdivision of Lot 2 DP 1145348. Project HD34, drawing HD05 Rev 3, 23/10/2015.

Emails: between MSB and McCloy regarding proposed development and MSB requirements, dated 4/11/2015, 10/11/2015, 11/11/2015.

Aerial photographs 2001 to 2015: Accessed from Google Earth and NSW Department of Lands during November 2015.

MSB Graduated Design Guidelines for Residential Construction (NSW). www.minesub.nsw.gov.au accessed 02/12/2015

GENERAL NOTES



GHD GEOTECHNICS

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The report contains the results of a geotechnical investigation conducted for a specific purpose and client. The results should not be used by other parties, or for other purposes, as they may contain neither adequate nor appropriate information. In particular, the investigation does not cover contamination issues unless specifically required to do so by the client.

TEST HOLE LOGGING

The information on the test hole logs (boreholes, test pits, exposures etc.) is based on a visual and tactile assessment, except at the discrete locations where test information is available (field and/or laboratory results). The test hole logs include both factual data and inferred information. Moreover, the location of test holes should be considered approximate, unless noted otherwise (refer report). Reference should also be made to the relevant standard sheets for the explanation of logging procedures (Soil and Rock Descriptions, Core Log Sheet Notes etc.).

GROUNDWATER

Unless otherwise indicated, the water levels presented on the test hole logs are the levels of free water or seepage in the test hole recorded at the given time of measuring. The actual groundwater level may differ from this recorded level depending on material permeabilities (i.e. depending on response time of the measuring instrument). Further, variations of this level could occur with time due to such effects as seasonal, environmental and tidal fluctuations or construction activities. Confirmation of groundwater levels, phreatic surfaces or piezometric pressures can only be made by appropriate instrumentation techniques and monitoring programmes.

INTERPRETATION OF RESULTS

The discussion or recommendations contained within this report normally are based on a site evaluation from discrete test hole data, often with only approximate locations (e.g. GPS). Generalised, idealised or inferred subsurface conditions (including any geotechnical cross-sections) have been assumed or prepared by interpolation and/or extrapolation of these data. As such these conditions are an interpretation and must be considered as a guide only.

CHANGE IN CONDITIONS

Local variations or anomalies in the generalised ground conditions do occur in the natural environment, particularly between discrete test hole locations. Additionally, certain design or construction procedures may have been assumed in assessing the soil-structure interaction behaviour of the site. Furthermore, conditions may change at the site from those encountered at the time of the geotechnical investigation through construction activities and constantly changing natural forces.

Any change in design, in construction methods, or in ground conditions as noted during construction, from those assumed or reported should be referred to this firm for appropriate assessment and comment.

GEOTECHNICAL VERIFICATION

Verification of the geotechnical assumptions and/or model is an integral part of the design process - investigation, construction verification, and performance monitoring. Variability is a feature of the natural environment and, in many instances, verification of soil or rock quality, or foundation levels, is required. There may be a requirement to extend foundation depths, to modify a foundation system and/or to conduct monitoring as a result of this natural variability. Allowance for verification by appropriate geotechnical personnel must be recognised and programmed for construction.

FOUNDATIONS

Where referred to in the report, the soil or rock quality, or the recommended depth of any foundation (piles, caissons, footings etc.) is an engineering estimate. The estimate is influenced, and perhaps limited, by the fieldwork method and testing carried out in connection with the site investigation, and other pertinent information as has been made available. The material quality and/or foundation depth remains, however, an estimate and therefore liable to variation. Foundation drawings, designs and specifications should provide for variations in the final depth, depending upon the ground conditions at each point of support, and allow for geotechnical verification.

CLIMATE CHANGE

GHD Geotechnics acknowledges the occurrence of ongoing climate change. Cognisance is given to climate change issues as may be applicable to specific geotechnical investigations and assessments.

REPRODUCTION OF REPORTS

Where it is desired to reproduce the information contained in our geotechnical report, or other technical information, for the inclusion in contract documents or engineering specification of the subject development, such reproductions must include at least all of the relevant test hole and test data, together with the appropriate Standard Description sheets and remarks made in the written report of a factual or descriptive nature.

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McCloy Group
Proposed Residential Development – Thornton North
Preliminary plan of mine workings

scale | As shown date | December 2015

job no | 22-18155
file ref | 22-18155_FIG1.ppt

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Figure 1