



2 September 2015

GRANTHAM QUARRY - GEOTECHNICAL INVESTIGATIONS & EXPERT OPINION ON FORMATION OF EARTHWORKS - SUPPLEMENTARY REPORT CONCERNING PRE-QUARRY TERRAIN AT SAND BATCHING PLANT

Grantham Floods Commission of Inquiry

Submitted to:
Grantham Floods Commission of Inquiry
Level 3, Annexe
100 George Street
BRISBANE QLD 4000



REPORT

Report Number. 1532696-003-Rev2

Distribution:

Ms Joanne Paterson
Director Flood Commission of Inquiry





Table of Contents

1.0 THE COMMISSION	1
1.1 Background	1
1.2 My Previous Instructions.....	1
1.3 My Current Instructions.....	1
2.0 QUALIFICATIONS & EXPERIENCE	2
3.0 DOCUMENTATION & DATA PROVIDED	2
4.0 THE QUARRY SITE & GEOLOGICAL SETTING	2
5.0 TOPOGRAPHY & MORPHOLOGY OF THE CONCRETE BATCHING PLANT AREA.....	2
6.0 RECONSTRUCTION OF PRE-QUARRY CONTOURS, BATCHING PLANT AREA.....	5
7.0 COMMENT ON PRE-QUARRY GROUND SURFACE	5
8.0 CONCLUSIONS ABOUT THE PRE-QUARRY GROUND SURFACE IN THE BATCHING PLANT AREA	6

TEXT PLATES

Plate 1: Portion of 1982 Air photo showing SE corner of site and initial stage of processing plant.

Plate 2: Survey Plan of Quarry Site dated August 1981.

Plate 3: Reconstructed topographic plan of Batching Plant Site superimposed on LiDAR survey.

FIGURES:

Figure12: Pre-flood contours South East.

Figure13: Re-constructed pre-quarry contours South East.

APPENDICES

APPENDIX A

Letter of Instruction



1.0 THE COMMISSION

1.1 Background

1. The Grantham Floods Commission of Inquiry (**The Commission**) has been established under the Commissions of Inquiry Act 1950 to make full and careful inquiry into the flooding of the Lockyer Creek between Helidon and Grantham on 10 January 2011, with specific reference to any natural or man-made features of the landscape which could have altered or contributed to the flooding.

1.2 My Previous Instructions

2. I have previously been engaged by The Commission to prepare an expert opinion on the method of formation of the embankments surrounding the quarry to assist it in determining whether those embankments acted as a levee during the 10 January 2011 flood event.
3. I provided that opinion in the form of a report entitled "*Grantham Quarry – Geotechnical Investigations & Expert Opinion on Formation of Earthworks*", Golder reference 1532696-001-R-Rev1, dated 28 July 2015. I refer to this report in the following as the Main Report.
4. I have also been engaged by The Commission to prepare a Supplementary Report entitled "*Grantham Quarry – Geotechnical Investigations & Expert Opinion on Formation of Earthworks - Supplementary Report Concerning Location of Failed Power Pole P182127*", Golder Reference 1532696-002-R-Rev0, dated 5 August 2015. I refer to this report as the First Supplementary Report.

1.3 My Current Instructions

5. I have now been instructed to prepare a further Supplementary Report on the pre-quarry terrain in the south east portion of the site (an area now occupied by the concrete batching plant).
6. A copy of my letter of instruction is attached in Appendix A.
7. The Commission has requested that I express an opinion on the following matters:
 - a. The pre-quarry AHD levels in the SE corner of the site, bounded by Lockyer Creek to the west and south, and by the agricultural sheds to the north of the batching plant (**The Batching Plant Area**).
 - b. If in forming my opinion regarding the pre-quarry terrain for the concrete batching plant area, I have made use of the 1981 survey plan that was provided during the course of giving evidence at the public hearings, I make comment as follows:
 - i. As to whether the 1981 survey plan affects the findings in my main report with respect to pre-quarry terrain for the quarry pit and embankments surrounding the quarry.
 - ii. If that survey plan does affect those findings, I advise on how my findings have been affected.
8. The Commission has also requested that I present my findings in the form of a contour plan.



2.0 QUALIFICATIONS & EXPERIENCE

9. My name is David Clark Starr and I am a Principal Geotechnical Engineer with Golder Associates Pty Ltd (Golder Associates) of 147 Coronation Drive, Milton, Brisbane, Queensland 4064.
10. I am a Geotechnical Engineer with 44 years' experience in consulting in geotechnical engineering and engineering geology.
11. My experience is detailed in a CV presented as Appendix D in the Main Report. I confirm that there has been no change in qualifications since preparation of the Main Report.

3.0 DOCUMENTATION & DATA PROVIDED

12. In forming my opinion, I have relied upon the following documents:
 - a. The 1982 air photography discussed and presented in Section 9.1 of my Main Report.
 - b. The 1981 spot height survey of the quarry site included in evidence presented as page 28 of Attachment IF2 to the statement of Ian Flint, CEO Lockyer Valley Regional Council made on 24 July 2015 (Exhibit 94).
 - c. Pre-flood contours derived from LiDAR data, taken over the quarry area in August 2010.
 - d. The findings and material contained in the Main Report.

4.0 THE QUARRY SITE & GEOLOGICAL SETTING

13. The quarry site is located approximately 4 km west of the town of Grantham, Queensland. It is enclosed within an oxbow bend in the Lockyer River, creating a "U" shaped parcel of land bounded on three sides by the creek.
14. I note that the site is formed of Quaternary Flood Plain material comprising alluvial sands, gravel and silt, and is underlain by Marburg Formation sandstone and siltstone of Lower to Middle Jurassic age. The geological setting is described in further detail in Section 5.0 of my Main Report.
15. The Concrete Batching Plant is located on the left bank of Lockyer Creek, downstream of the ford crossing point. I consider that this area is also formed of alluvial flood plain material.

5.0 TOPOGRAPHY & MORPHOLOGY OF THE CONCRETE BATCHING PLANT AREA

16. In order to re-construct the pre-quarry topography of the Batching Plant Area, I have made use of topographic data plotted from pre-flood LiDAR data (2010) for the area of the Batching Plant.
17. The first LiDAR survey was undertaken between 1st to 22nd August 2010 before the flood.
18. LIDAR is a remote sensing method that uses light in the form of a pulsed laser to measure ranges (variable distances) to the earth surface. These light pulses - combined with other data recorded by the airborne system - generate precise, three-dimensional information about the surface characteristics of the area being surveyed.



19. The LiDAR data has been plotted by Golder GIS expert Travis Brousseau under my direction and presented on Figure 12.
20. Stereographic air photo images have been obtained from Department of Natural Resources and Mines. I have been provided with a series of stereo images of air photos covering the Helidon/Grantham area for the years 1982, 1988, 1992, 1997, 2001, 2009, 2010 and 2011.
21. I have compared Figure 12 with an enlarged section of the 1982 air photo shown in Plate 1. I have made a stereo pair of this enlarged area by utilising adjacent photos QAP4014-12 and 13 (flown on 13 May 1982).



Plate 1: Portion of 1982 Air photo showing SE corner of site and initial stage of processing plant.

22. I can see from Plate 1 that there is an undisturbed area between the crest of the left bank of Lockyer Creek and the earthworks and pond associated with the processing plant in 1982. I deduce from comparing the contours shown on Figure 12 with the topography on Plate 1 that the crest of the bank is at about AHD 124 m.



GRANTHAM QUARRY - GEOTECHNICAL INVESTIGATIONS - EXPERT OPINION

- 23. I can also see from comparing Figure 12 with Plate 1 that:
 - a. There is an intermediate river terrace at about 120 m AHD.
 - b. There is a small area to the east of the Batching Plant which is at a slightly higher elevation than the flat area surrounding. This is marked on Plate 1, and based on the contours shown on Figure 12, I believe the elevation of this area is about 124.5 m AHD. In my opinion, this area which is shown in the 1982 photo probably had the same elevation before the quarry development.
- 24. I have compared Plate 1 with the 1981 Survey Plan that was provided to me during the course of my evidence at the hearings (presented as Exhibit 94).
- 25. I can recognise a corner of an agricultural field on the right bank of Lockyer Creek which has an RL at the base of a fence post of 122.0 m – refer to 1981 survey plan (see Plate 2).

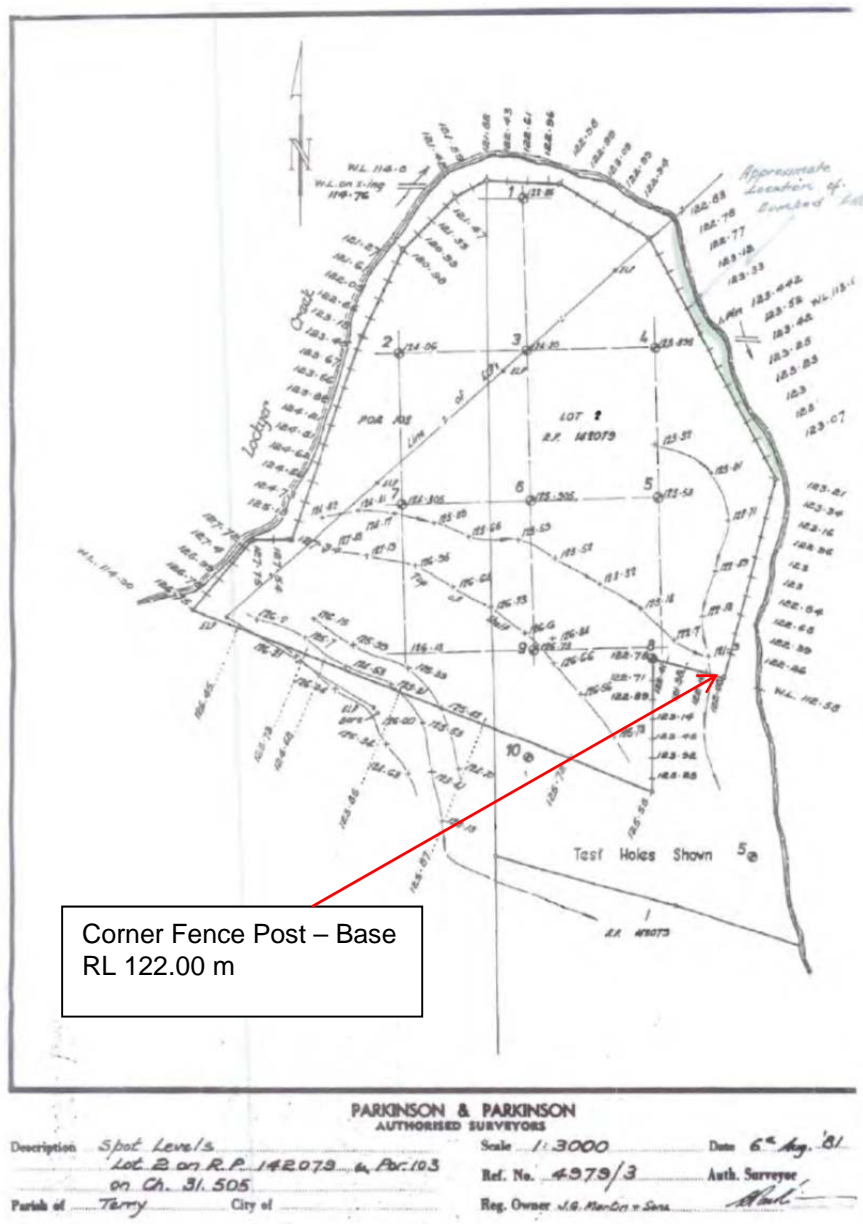


Plate 2: Survey Plan of Quarry Site dated August 1981



26. On examining the 1982 air photo under a stereo viewer, I can detect that the fence post location is slightly lower than the crest of the creek bank on the opposite (eastern) side of Lockyer Creek. I have marked the fence post location on Plate 1.

6.0 RECONSTRUCTION OF PRE-QUARRY CONTOURS, BATCHING PLANT AREA

27. I have created a pre-quarry contour plan based on the inferences outlined above. This is reproduced below as Plate 3. It should be noted that the reconstructed contours apply only to the batching plant area on the left bank of Lockyer Creek i.e. on the right side of plate. The contours on the right bank near the quarry lake have not been adjusted (but I have blanked out the area of the quarry lake and associated earthworks).



Plate 3: Reconstructed topographic plan of Batching Plant Site superimposed on LiDAR survey

28. The version of this plan produced for the purposes of making a digital terrain model is presented as Figure 13. Again, it should be noted that the reconstructed contours apply only to the batching plant area.

7.0 COMMENT ON PRE-QUARRY GROUND SURFACE

29. The survey plan presented as Plate 2 in this supplementary report was not available to me prior to preparing my Main Report.
30. From the above considerations, I can comment as follows on the Pre-Quarry Topography:



- a. After examining the spot heights depicted on Plate 2, I can confirm that the 1981 survey plan does not affect the findings in my Main Report as to the pre-quarry terrain for the quarry pit and embankments around the quarry;
- b. The spot height survey shows that the flow path from the site of the Main Breach pre-quarry crosses a land surface which dips gently from about RL 124 in the NW to about 122 m AHD in the SE of the Quarry site. This fall is consistent with the model shown in Plate 21 of my Main Report.

8.0 CONCLUSIONS ABOUT THE PRE-QUARRY GROUND SURFACE IN THE BATCHING PLANT AREA

31. Based on the findings from examination of available data, I draw the following conclusions about the Pre-Quarry topography in the Batching Plant Area:
 - a. The initial stages of the plant were built on flat agricultural land. The top of the river bank was about 124 AHD, and the ground was then essentially a flat flood plain (similar to the pre-flood quarry pit area to the east of the western levee).
 - b. I have marked up on a LiDAR survey plan the inferred location of the 124 m AHD contour – the land to the east of this (now occupied by the batching plant) is also interpreted to be at about RL 124 m, although I observed a small area with a slightly higher elevation of about 124.5 m AHD.
 - c. On the river bank there was one intermediate terrace as shown by the contours at about 120 m AHD.
 - d. The reconstructed contour plan for the Batching Plant Area is presented as Plate 13.

GOLDER ASSOCIATES PTY LTD

DC Starr

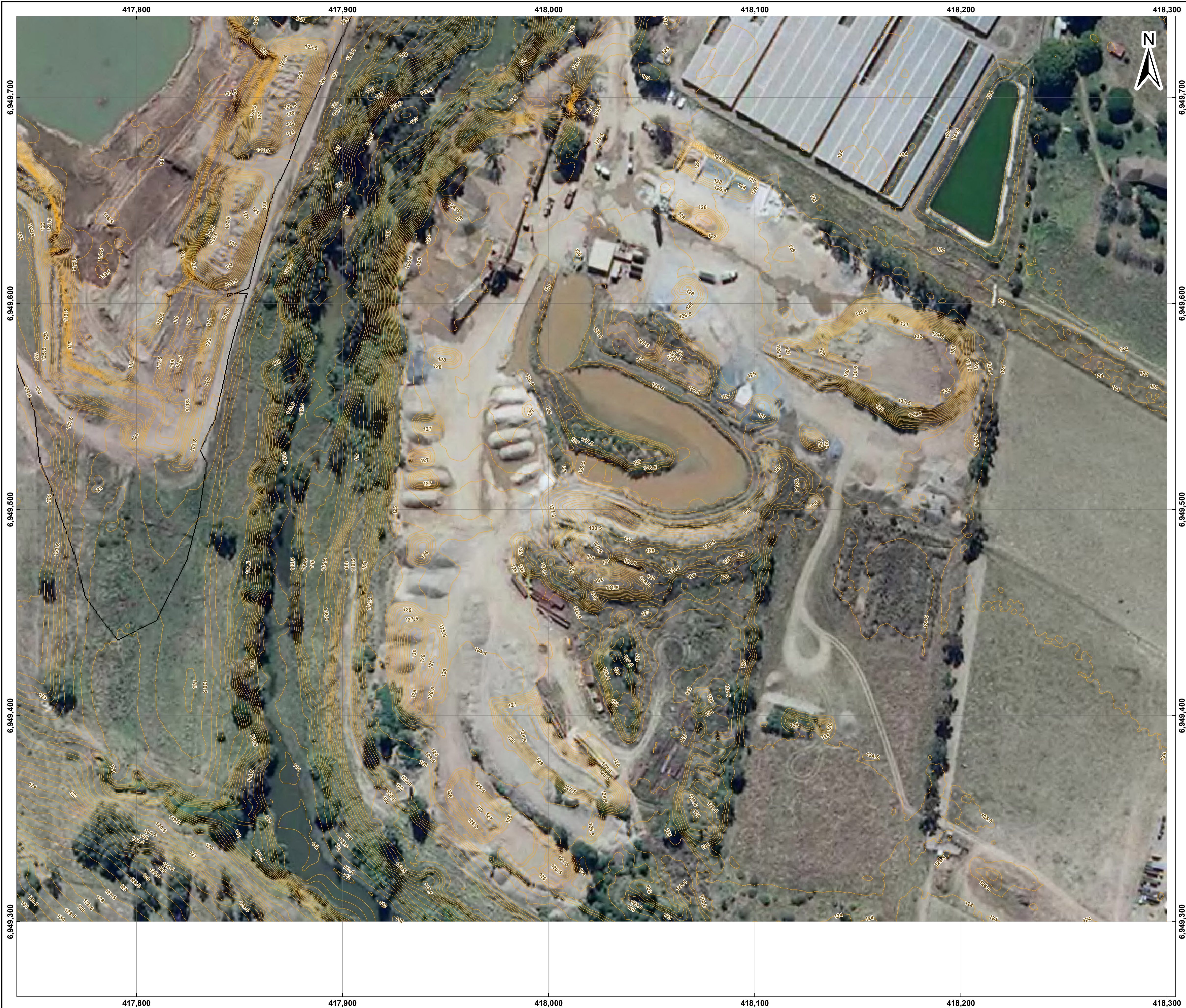
David Starr
Principal Geotechnical Engineer
BSc MSc FIEAust CPEng RPEQ 5836

DCS/dcs/mm

A.B.N. 64 006 107 857

Golder, Golder Associates and the GA globe design are trademarks of Golder Associates Corporation.

f:\1532696-002-r-revb_2 aug 2015.docx



GRANTHAM FLOOD COMMISSION OF INQUIRY

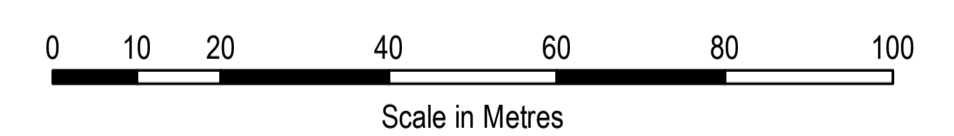
GRANTHAM QUARRY

**PRE FLOOD CONTOURS
SOUTHEAST**



LEGEND

— Contour (0.5m)



Scale in Metres
SCALE (at A1) 1:900
DATUM GDA94, PROJECTION MGA Zone 56

PROJECT: 1532696
DATE: 19 AUG 2015
DRAWN: TB
CHECKED: DS

FIGURE 12



Information contained on this drawing is the copyright of Golder Associates Pty. Ltd. Unauthorised use or reproduction of this plan either wholly or in part without written permission infringes copyright. © Golder Associates Pty. Ltd.

Information contained on this drawing is the copyright of Golder Associates Pty. Ltd. Unauthorised use or reproduction of this plan either wholly or in part without written permission infringes copyright. © Golder Associates Pty. Ltd.



GRANTHAM QUARRY

GRANTHAM FLOOD COMMISSION
OF INQUIRY

RECONSTRUCTED PRE-QUARRY CONTOURS SOUTHEAST

PROJECT:	1532696
DATE:	02 SEP 2015
DRAWN:	TB
CHECKED:	DS

FIGURE 13

Note: reconstructed contours
apply to Batching Plant Area only.





APPENDIX A

Letter of Instruction

Grantham Floods Commission of Inquiry

Reference number: DOC/15/146730

Mr David Starr
Golder Associates Pty Ltd
By email: dstarr@golder.com.au

Dear Mr Starr

GRANTHAM FLOODS COMMISSION OF INQUIRY – GEOTECHNICAL OPINION CONCERNING CONCRETE BATCHING PLANT

We refer to our letter of instructions dated 10 July 2015 in which we requested that you provide an expert opinion concerning the formation of embankments surrounding the Grantham quarry. We note that this opinion was provided in your report provided to the Commission on 28 July 2015 (**First Report**).

In addition to the First Report, we now request your opinion concerning the pre-quarry terrain in the South East corner of the Quarry site, bounded by Lockyer Creek to the west and south, and by the agricultural sheds to the north. More specifically, we request that you opine on the pre-quarry AHD levels for this area, an area that is presently occupied by a concrete batching plant.

If, in forming your opinion on the matters above, you consider it necessary to refer to a 1981 survey plan provided to you during the course of the hearings before the Commission, we request that you opine on whether that survey plan affects the findings in your First Report. If it does affect those findings, we request that you advise how those findings are so affected.

We request that you provide your opinion on the above matters in the form of a supplementary expert report. To the extent that you consider it necessary, please include in that report suitable drawings, maps, contour plans and photographs to explain your opinion.

We look forward to receiving your supplementary report in due course.

Yours sincerely

*PO Box 15185
CITY EAST QLD 4002*

*Telephone
(07) 300 39451*

*Email
mailbox@granthaminquiry.qld.gov.au*



Joanne Paterson
Director
Grantham Floods Commission of Inquiry

26 /8 /2015

At Golder Associates we strive to be the most respected global company providing consulting, design, and construction services in earth, environment, and related areas of energy. Employee owned since our formation in 1960, our focus, unique culture and operating environment offer opportunities and the freedom to excel, which attracts the leading specialists in our fields. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees who operate from offices located throughout Africa, Asia, Australasia, Europe, North America, and South America.

Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

solutions@golder.com
www.golder.com

Golder Associates Pty Ltd
147 Coronation Drive
Milton, Queensland 4064
Australia
T: +61 7 3721 5400

