COPPABELLA COAL MINE
SOUTH ARM DIVERSION SALINE SEEPAGE MONITORING REPORT

March 2017

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V1	March 2017	Murray Timms
General description of changes from previous version		

Contents

1 Purpose

Coppabella Mine identified areas of improvement with regards to; erosion and sediment control, seepage control, transitional dam conditioning and worked water management across site. During 2014 Coppabella Mine entered into a voluntary TEP. The TEP specified four key objectives, a number of actions to be implemented and a timeline for the completion of these actions.

Objective 3 of the TEP is; *Mitigate seepage impacts in Thirty Mile Creek from the Co-disposal and Return Water Dam system*. Five actions (17, 18, 19, 20 and 21) were developed to achieve this objective (refer to **Table 1** below). This report has been developed to meet action 21 of the TEP; *submit seepage mitigation monitoring report to Administering Authority*.

Table 1: Saline Seepage TEP Actions

TEP Action #	Description
17	Revise operating & maintenance plan for Co-disposal toe-drain
18	Topsoil & seed (targeting salt tolerant species) Co-disposal seepage section of Thirty Mile Creek South Arm Diversion
19	Commence a 2 year monitoring program to review effectiveness of revegetation in mitigating seepage impacts
20	Co-disposal toe-drain operating & maintenance plan implemented
21	Submit seepage mitigation monitoring report to Administering Authority

2 Scope

In accordance with the TEP Coppabella Mine has implemented a numbered of measures within and around the CDA and Thirty Mile Creek. These improvements have been implemented in order to manage and mitigate saline seepage impacts occurring within the Thirty Mile Creek South Arm Diversion.

This monitoring report covers the measures undertaken, the SAD Monitoring Program, TEP Compliance Requirements and the ongoing management practices implemented to mitigate these seepage impacts.

3 Acronyms & Definitions

Table 2: Acronyms and Definitions

Term	Definition
CDA	Co-Disposal Area
CHPP	Coal Handling Preparation Plant
EA	Environmental Authority
ESCP	Erosion & Sediment Control Plan
RP	Revegetation Plan
ROM	Run of Mine
SAD	South Arm Diversion
TEP	Transitional Environmental Program
WWD	Worked Water Dam

4 Summary

Thirty Mile Creek (south arm) naturally flowed through the Coppabella Mine via the WWD (then known as the Raw Water Dam). Due alterations in the water management system it was determined that the WWD was required for the worked water system and could no longer receive the flows from the Thirty Mile Creek (south arm). To implement this change in the water management system, a diversion of the Thirty Mile Creek (south arm) was required.

Investigations into potential diversion designs were commenced in 2010, preliminary works for the SAD commenced in late 2010, with primary works commencing in late 2011 and completing in 2012. The construction of the diversion channel, drain and levees required the following earthworks:

- Clearing and grubbing of site
- Topsoil stripping to stockpiles
- Excavation of the creek diversion channel, low flow channel and diversion drain
- Placing of homogenous earth fill and compaction to form embankments and levees
- Excavation of existing spillway and spillway channel gabion structures and recovery of rock
- Construction of scour protection at the end of the diversion using recovered rock and wire gabions and mattresses and geotextile fabric

During 2013 the visible presence of saline seepage was identified within the SAD (**refer to Appendix A**); as a consequence TEP actions regarding the management of the saline seepage were developed. In order to meet TEP actions #18 and #19, the RP for the SAD was developed and submitted to the Administering Authority. During 2014 the physical remediation works within the SAD commenced, additional works have occurred throughout 2015 and 2016. The key remediation works which have occurred with the SAD regarding saline seepage management are:

- Rock placement in the soak areas
- Erosion removal on diversion levee banks
- Topsoiling of diversion levee banks
- Vegetating of levee banks
- Rock checks within the diversion
- Improvements to CDA toe drains (primarily the eastern drain)
- Ongoing maintenance

Whilst the visibility of the saline seepage within the SAD was quite visible it should be noted that the potential environmental harm was quite low due to the localised nature of the seepage. Ephemeral creek systems like the one associated with the SAD often see elevated electrical conductivity (EC) present during the few hours of flow through the watercourse. The EC levels stabilise quickly to background water quality parameters.

Through the implementation of the RP and the associated physical works, there has been a noticeable change in the visibility of the saline seepage and a vast improvement in vegetation growth within the SAD. Please see below for further details. Please refer to **Appendices B to F** for photo monitoring images of the areas.

5 Revegetation Plan

In order to achieve a number of the TEP actions an RP was implemented in late 2014. This plan encompassed the implementation of erosion protection to identified seepage areas through rock placement, grading of existing diversion levee banks to remove erosion, topsoiling of diversion levee banks and the use of grass and salt tolerant tree species for erosion and seepage mitigation. Further details with regards to these actions are detailed below.

5.1 Rock placement in soak areas

The low clay content material of which is the current diversion levee banks are constructed of, has been identified as problematic as it is prone to erosion and with the added seepage impact, this has the potential to reduce the structural integrity of the diversion bank. In 2014 to mitigate this erosion impact and to ensure the stability of the diversion banks at the identified soak areas Coppabella Mine undertook; the removal of the unstable material and replacement of this material with component Permian material.

5.2 Erosion removal on diversion levee banks

Erosion scours formed along both diversion levee banks and required remediation to improve sediment control, bank stability and enable topsoil and seeding of the levee banks. In 2014 the erosion scours on north and south bank of the SAD were remediated in accordance with RMP. For further details and photos regarding this process please refer the RP.

2015 seen the re-ripping of the SAD banks in order to remediate minor erosion scours which were prevalent on banks. There has been a marked improvement with regards to erosion on the banks since this treatment.

During 2016 the outer facing batter of the south bank and the top of the levee was sheeted with reject material from the co-disposal. The run-off from this area is directed into the Worked Water Dam not the diversion. Visual inspections of this area have shown limited signs of erosion and weathering. As such an area on the northern bank was also selected for placement of reject material in order to minimise erosion.

Combined with the erosional benefits of course reject material; physical and chemical analysis showed similar to improved properties once compared with localised topsoil and overburden material.

5.3 Topsoiling of levee banks

In 2014 topsoiling of the SAD levee banks was conducted by scrapers and completed to enable vegetation establishment. Images showing topsoiling activities were provided in the RP.

5.4 Vegetating of levee banks

During 2014 the SAD banks were ripped and seeded. The soil was ripped to a depth of 500mm and seed was applied at a rate of 20kg/ha. Images showing both the undertaking of ripping and seeding activities and completed ripped and seeding levee banks were provided in the RP.

The grass seed mix used and applied was chosen for quick establishment and germination for erosion protection. Please refer to **Table 4** for further details.

Table 4: Grass Seed Species 2014

Common Name	Scientifc Name	Application Rate
Stylo Mix (Verano)	-	1kg/ha
Red Natal Grass	Meinis repens	5kg/ha
Callide Rhodes	Chloris gayana	1kg/ha
Sabi Grass	Urochloa mozambisenis	1kg/ha
Indian Blue Grass	Bothriochloa pertusa	2kg/ha

Due to limited rain in 2014/2015 and reduced vegetation establishment, the SAD banks were re-ripped and seeded in 2015. The seed applied during this treatment was the same species at a slightly different rate the previous application (refer to **Table 5**). The vegetation growth during late 2015 and early 2016 was a significant improvement after this treatment (there was increased rain during this period).

Table 5: Grass Seed Species 2015

Common Name	Scientifc Name	Application Rate
Stylo Mix (Verano)	-	1kg/ha
Red Natal Grass	Meinis repens	3kg/ha
Callide Rhodes	Chloris gayana	2kg/ha
Sabi Grass	Urochloa mozambisenis	2kg/ha
Indian Blue Grass	Bothriochloa pertusa	1kg/ha

During November 2015 200 salt tolerant seedlings were planted in the diversion (refer to **Table 6** for species information and **Appendix G** for map of planting location). However the survival rate of the seedlings was limited. The reason for the poor survival rate of the seedlings is unknown and could be contributed to a number of factors:

- climate and regular watering variance – seedlings were purchased from a nursery in SE QLD
- heat – seedlings planted in November
- rain – there was limited rain events after the seedlings were planted

Table 6: Seedling species 2015

Common Name	Scientifc Name	QTY
Daintree wattle	Acacia cinncinata	12
Sweet wattle	Acacia suaveolens	25
Swamp oak	Casuarina glauca	50
Tuckeroo	Cupaniopsis anacardioides	38
Silky oak	Grevillia robusta	25
Narrow-leaved ironbark	Eucalyptus crebra	33
Narrow-leaved paperbark	Melaleuca linarifolia	7
Weeping bottlebrush	Melaleuca viminalis	3

Seed of salt tolerant tree species were spread by hand across the north bank of the diversion (refer to **Table 7**). Unfortunately days after the sowing of this seed, Coppabella Mine received significant rainfall and a majority of the seed would have been washed out of the diversion.

Table 7: Salt tolerant tree species 2016

Common Name	Scientifc Name	Application Rate
Grey Box	Eucalyptus moluccana	1.5kg/ha
River Tea-Tree	Melaleuca bracteata	1.5kg/ha
Broad-leaved paperbark	Melaleuca quinquenervia	1.5kg/ha

5.5 Rock checks within the diversion

In order to improve the erosion and sediment control within the SAD, several rock checks were installed at regular intervals. To date the rock checks have made a visible improvement with regards to erosion and sediment control. However the most positive impacts rock checks have had within the SAD are; improved vegetation growth within the diversion bed and increased wildlife. This has occurred through increased water and sediment retention within the diversion.

Refer to **Appendix H** for images of the diversion pre and post rock checks.

5.6 Improvements to CDA eastern toe drain

The existing toe drain for the CDA was full of vegetation and sediment which was slowing the speed of the water traveling in the drain, subsequently allowing it to seep into the surround areas (i.e. the diversion).

During 2014 the CDA Operating Plan was updated to include a maintenance plan for the CDA drains. This was submitted to the Administering Authority as a requirement of TEP Action #17. The plan stipulates drain cleaning will be undertaken once sediment load has reached the lower ends of the drain, which will prevent the slowing of the water travelling within the drain. The plan also stipulates drains will be inspected weekly and 6 monthly.

During 2014 the eastern toe drain had vegetation and sediment removed and in 2015 a new drainage channel was established. Maintaining the drainage channel has enabled water to flow freely rather than ponding is has likely lead to the reduction of saline seepage. Refer to **Appendix I** for a map of the improvements made to the eastern toe drain. Refer to **Appendix J** for a map depicting the new eastern toe drain.

Seepage from cell CDA1A reports to the eastern toe drain, co-disposal material is no longer placed with this cell. As such there has been a reduction in the amount of seepage entering the eastern toe drain, which is likely to have had positive implications on the saline seepage occurring within the SAD.

5.7 Ongoing maintenance

As with many diversions in the early years of their establishment they will require minor to moderate maintenance. The key areas for the SAD are; management of erosion scours, establishment and encouragement of vegetation within the diversion bed and banks.

2017 will see a number of moderate scours remediated through; caving in and placement of competent material, additional seeding and controlled reject placement.

6 Monitoring Program

Photo reference points have been established in order to monitor the effectiveness of revegetation works with regards to mitigation of saline seepage impacts. Photos were taken progressively over a two year period at dedicated locations within the SAD. **Table 8** provides details on the photo reference points set out within SAD. Please refer to **Appendix K** for a map depicting photo reference point locations.

Table 8: Photo reference locations

Reference Point	Easting (AGD84)	Northing (AGD84)
PR-SSSUS2	646,503	7,581,941
PR-SSSUS1	646,473	7,581,878
PR-SSSDS2	646,673	7,581,950
PR-SSSDS1	646,585	7,581,974
PR-SSNUS2	646,470	7,581,992
PR-SSNUS1	646,386	7,581,839
PR-SSNDS2	646,603	7,582,037
PR-SSNDS1	646,542	7,582,028
PR-30MSDS3	647,136	7,581,951
PR-30MSDS2	647,070	7,581,868
PR-30MSDS1	646,866	7,581,885

Moving forward the monitoring of the SAD will occur on a biannual basis, with visual inspections and photos taken at the established photo reference points. Post wet weather and ad hoc inspections will continue to occur throughout the year.

7 References and Supporting Documents

- Coppabella Coal Mine South Arm Diversion Revegetation Plan (2014)
- Voluntary Transitional Environmental Program for Coppabella Mine – Water Management (2014)
- TEP Action Submissions
  - #17 Revise operating & maintenance plan for Co-disposal toe-drain (2014)
  - #18 Topsoil & seed (targeting salt tolerant species) Co-disposal seepage section of Thirty Mile Creek South Arm Diversion (2014)
  - #19 Commence a 2 year monitoring program to review effectiveness of revegetation in mitigating seepage impacts (2014)
  - #20 Co-disposal toe-drain operating & maintenance plan implemented (2015)
- Environmental Authority (EPML00579213) – Coppabella Mine (2014)

8 Appendices

8.1 Appendix A: Saline Soak Areas

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PER 00087 - South Arm Diversion Revegetation
Extent of Soak Areas 1 and 2

8.2 Appendix B: Photo Monitoring – Soak 1

Soak 1 – Photo Point 1 – July 14	Soak 1 – Photo Point 1 – Aug 14	Soak 1 – Photo Point 1 – Dec 14 (post remediation)
		
Soak 1 – Photo Point 1 – May 15	**Saline Seepage North Bank UpStream 2 (SSNUS2) – Feb 16**	**Saline Seepage North Bank UpStream 2 2 (SSNUS2) – Feb 17**
		

8.3 Appendix C: Photo Monitoring – Soak 1

Soak 1 – Photo Point 2 – Jul 14	Soak 1 – Photo Point 2 – Aug 14	Soak 1 – Photo Point 2 – Dec 2014 (post remediation)
		
Soak 1 – Photo Point 2 – May 15	**Saline Seepage South Up Stream 2 (SSSUS2) – Feb 16**	**Saline Seepage South Up Stream 2 (SSSUS2) – Feb 17**
		

8.4 Appendix D: Photo Monitoring – Soak 1

Soak 1 – Photo Point 3 – Jul 14	Soak 1 – Photo 3 Point – Aug 14	Soak 1 – Photo 3 Point – Dec 14 (post remediation)
		
Soak 1 – Photo 3 Point – May 15	**Saline Seepage South Bank Up Stream 2 (SSSUS2) – Feb 16**	**Saline Seepage South Bank Up Stream 2 (SSSUS2) – Feb 17**
		

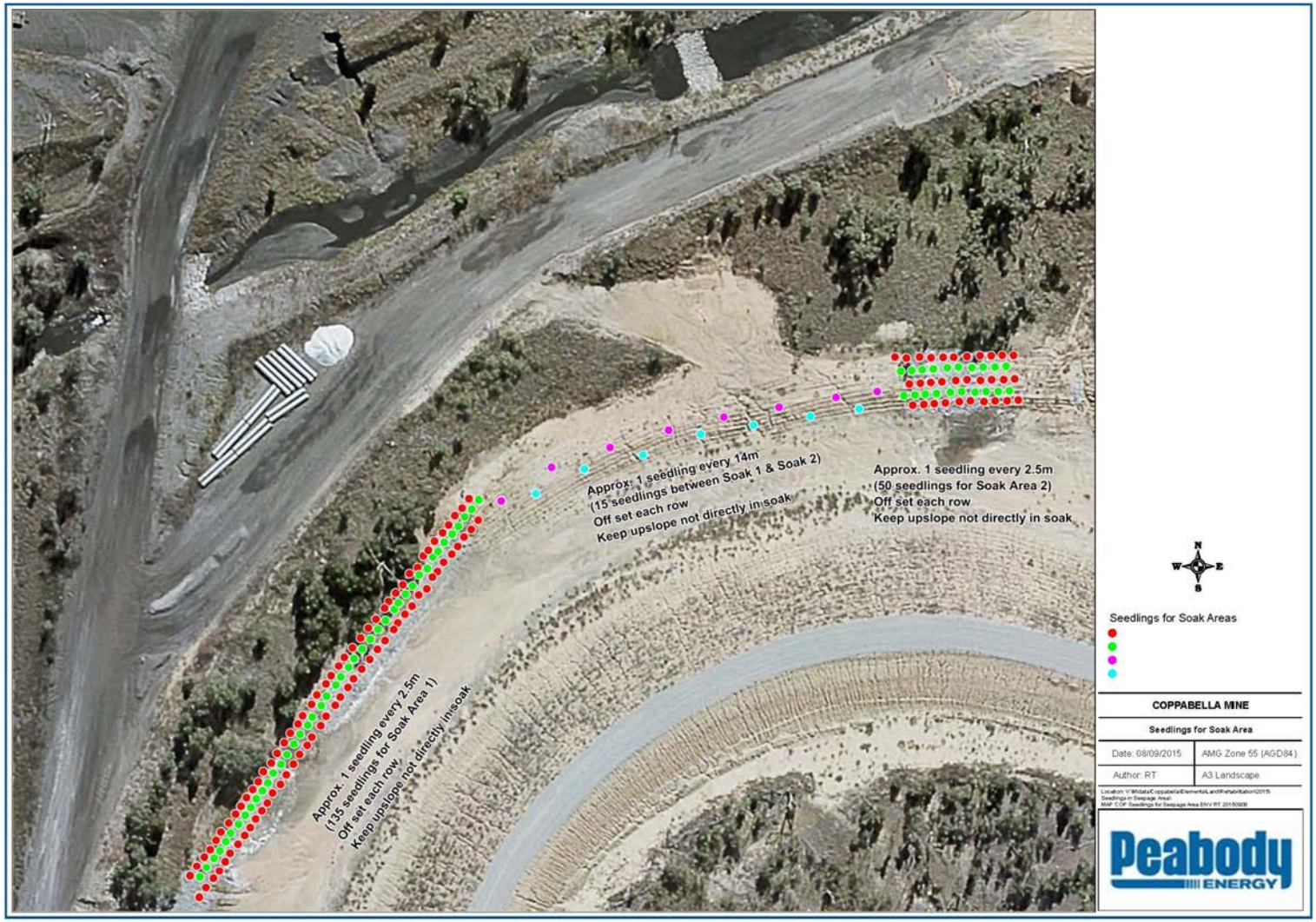
8.5 Appendix E: Photo Monitoring – Soak 2

Soak 2 – Photo Point 1 – July 14	Soak 2 – Photo Point 1 – Aug 14	Soak 2 – Photo Point 1 – Dec 14 (post remediation)
		
Soak 2 – Photo Point 1 – May 15	**Saline Seepage North Bank Down Stream 2 (SSNDS2) – Feb 16**	**Saline Seepage North Bank Down Stream 2 (SSNDS2) – Feb 17**
		

8.6 Appendix F: Photo Monitoring – Soak 2

Soak 2 – Photo Point 2 – June 14	Soak 2 – Photo Point 2 – Aug 14	Soak 2 – Photo Point 2 – Dec 14 (post remediation)
		
Soak 2 – Photo Point 2 – May 15	**Saline Seepage South Bank Down Stream 1 (SSSDS1) – Feb 16**	**Saline Seepage South Bank Down Stream 1 (SSSDS1) – Feb 17**
		

8.7 Appendix G: Seedling plantings 2015

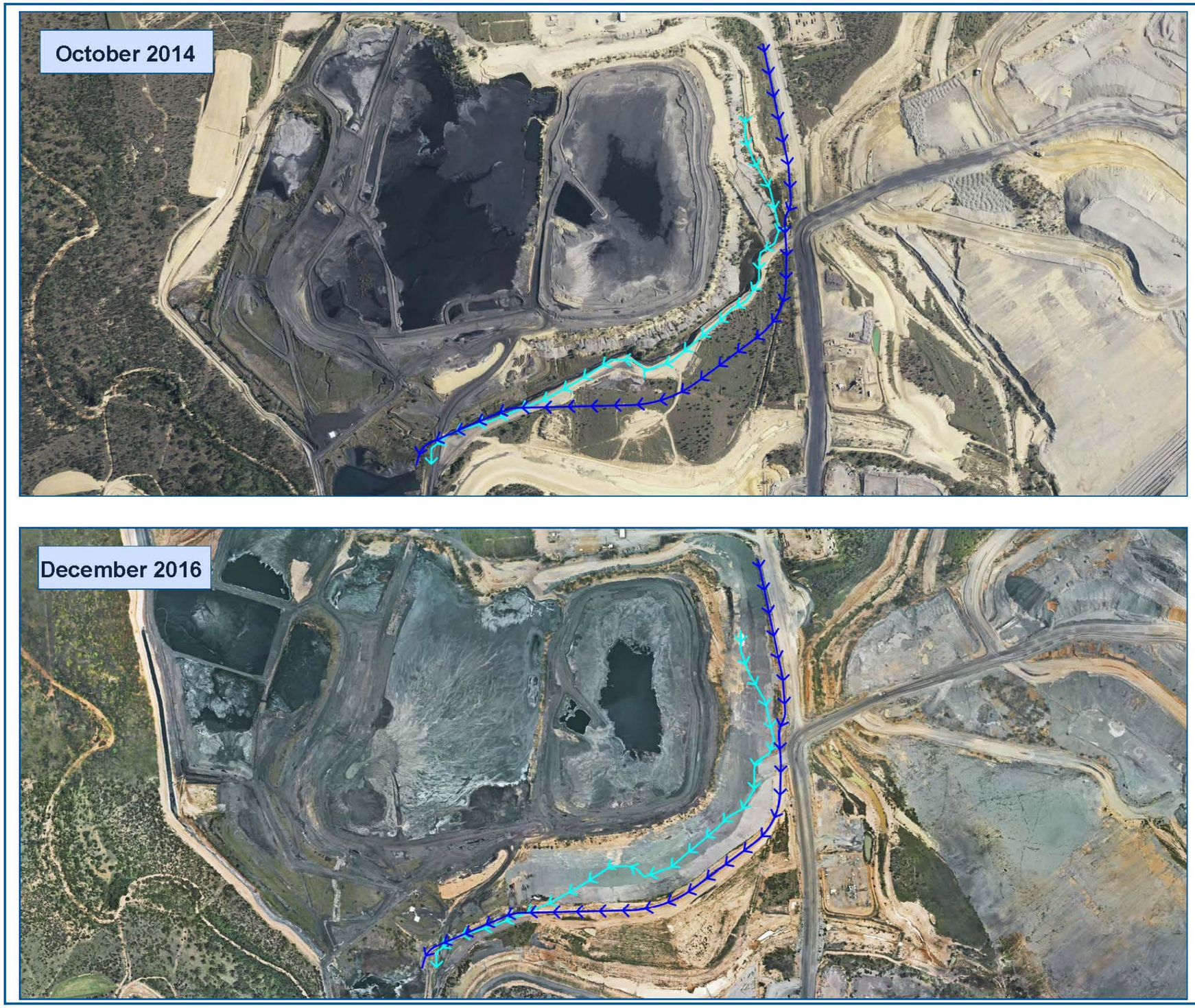


8.8 Appendix H: Rock checks

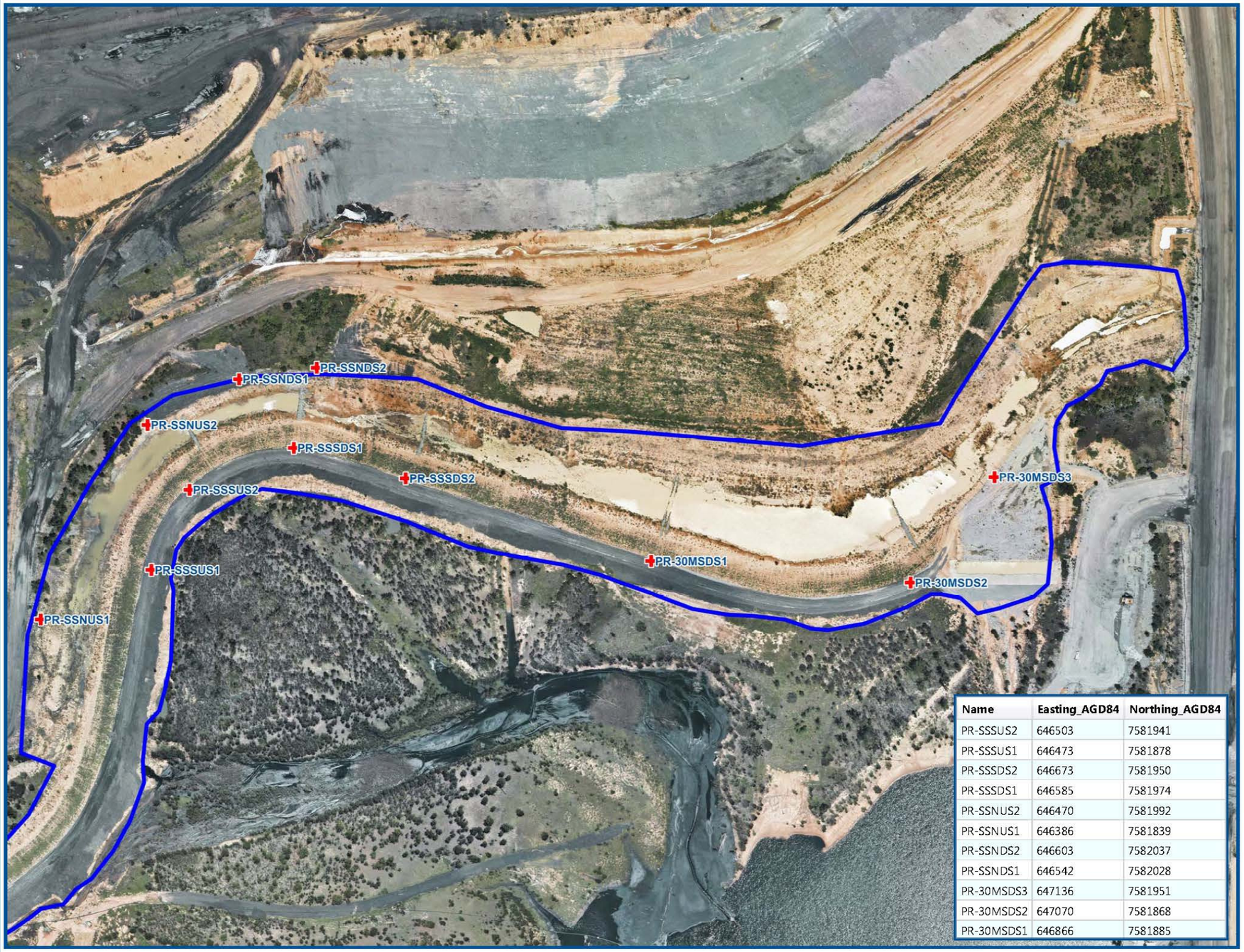
December 2015	
June 2016	
December 2016	

8.9 Appendix I: Improvements to the CDA eastern toe drain 2014

8.10 Appendix J: Establishment of new eastern toe drain 2015



8.11 Appendix K: Photo Reference Sites



Name	Easting_AGD84	Northing_AGD84
PR-SSSUS2	646503	7581941
PR-SSSUS1	646473	7581878
PR-SSSDS2	646673	7581950
PR-SSSDS1	646585	7581974
PR-SSNUS2	646470	7581992
PR-SSNUS1	646386	7581839
PR-SSNDS2	646603	7582037
PR-SSNDS1	646542	7582028
PR-30MSDS3	647136	7581951
PR-30MSDS2	647070	7581868
PR-30MSDS1	646866	7581885

Photo Reference Sites

30 Mile South Arm Diversion

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30 Mile South Arm Diversion
Photo Reference Sites

Date: 20/10/2015	AMG Zone 55 (AGD84)
Author: RT	A3 Landscape

Location: V:\Widata\Coppabella\Monitoring\30M SAD Saline Seepage
MAP COP 30M SAD Saline Seepage - Photo Reference Sites.ENV RT
20170328