

***ANNEXURE D: AMENDMENT TO SURFACE WATER MANAGEMENT PLAN FOR  
NEW PLANT LOCATION***



16 September 2010

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# **RASP MINE - Amendment to Surface Water Management Plan for New Plant Location**

**Submitted to:**  
Broken Hill Operations Pty Ltd  
RASP MINE  
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REPORT



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### 1.0 INTRODUCTION

Broken Hill Operations Pty Ltd (BHOP) commissioned Golder Associates Pty Ltd (Golder) in November 2009 to prepare a Surface Water Management Plan (SWMP) for the proposed mining operations at the Rasp Mine located on Consolidated Mine Lease 7 (CML7) in Broken Hill, NSW. The SWMP was prepared as part of the Part 3A application for approval from the NSW Department of Planning (DOP) and addressed the Director General's requirements as set out in the letter *Reference 07\_0018* dated 29 March 2009 from DOP.

In order to further reduce the environmental impact of the proposed mining operations, BHOP has undertaken a review of the mine processing plant layout and opted to have the plant located towards the eastern end of CML7.

This report presents amendments to the SWMP which were required to accommodate the new plant location and should be read in conjunction with the original SWMP. For details, including the procedures and assumptions underlying the assessment of SWMP measures, reference should be made to the original SWMP prepared for the Part 3A Application "Golder Associates, 2010. *RASP Mine – Surface Water Management Plan*. Reference No. 097626108-003-R-Rev0 dated 25 January 2010"

### 2.0 PROPOSED DEVELOPMENT MODIFICATIONS

The proposed mine processing plant has been moved to a new location towards the eastern end of the mine lease, along the southern edge of the Blackwood Pit (Figure 1). In addition, a rail load area has been proposed along Menindee Road for rail transport of the concentrate containers. A haul road is also proposed from the processing plant to the rail load area.

### 3.0 PROPOSED DRAINAGE LAYOUT

The new location of the processing plant has resulted in re-configuration of some of the catchments. Table 1 provides details of the catchments that have been modified. Figure 2 to Figure 5 show the location of the catchments.

**Table 1: Catchment Details**

Catchment No.	Storage/Description	Area (ha)	Runoff Volume (m <sup>3</sup> )	Comment
Kintore Pit		13.95	10230	No Change
Little Kintore Pit		2.42	1774	No Change
1A	S1A	3.48	2551	No Change
2	ROM (S2)	6.53	4786	No Change
4		1.33	974	No Change
3		0.48	349	No Change
1	Large Drain	4.32	3170	No Change
5	S5	1.57	1150	No Change
6	S6	1.55	1139	No Change
7		1.10	809	CHANGED
10		7.15	5247	No Change
8	S8	0.89	651	No Change
9A	S9A	0.61	450	No Change
9B	S9B	0.58	429	No Change
11A	S11A	1.78	1306	No Change
11B	S11B	1.90	1395	No Change
12	S12	0.55	404	No Change
13A	S13A	6.27	4596	No Change



## RASP MINE - SURFACE WATER MANAGEMENT PLAN

Catchment No.	Storage/Description	Area (ha)	Runoff Volume (m <sup>3</sup> )	Comment
13B	S13B	1.39	1016	No Change
18	S18	1.45	1066	No Change
14	Drain/sediment retention ponds	2.08	1523	No Change
15		0.63	464	No Change
16		0.83	608	No Change
17	S17	2.41	1765	No Change
37		2.64	1939	No Change
40	S40	0.48	355	No Change
42		5.14	3771	No Change
20A		6.94	5090	No Change
20B		1.75	1283	No Change
Horwood Dam		5.39	3950	No Change
19	Mt. Hebbard	5.18	3795	No Change
21A		1.14	836	No Change
21B		1.80	1318	No Change
22		4.14	3039	No Change
23	S23	1.43	1048	No Change
23A		1.70	1250	No Change
24		1.46	1068	No Change
25	S25	3.64	2666	No Change
26	S26	1.58	1158	No Change
27		1.08	794	No Change
28		2.40	1758	No Change
32		1.92	1407	No Change
34		2.64	1940	No Change
36		2.28	1674	No Change
BHP Pit		6.18	4536	No Change
29		2.52	1847	No Change
31B	Drain	1.55	1134	No Change
31A	S31A	2.60	1904	No Change
30		1.23	903	No Change
47		2.60	1905	No Change
46		1.01	741	No Change
33		1.92	1409	No Change
35	S35	6.13	4494	No Change
38	Proposed drain + overflow from 38A	1.14	836	CHANGED
38A	Proposed Sediment Pond	0.92	673	NEW
39	Sediment Pond	3.13	2294	CHANGED
39A	Proposed Sediment	1.43	1051	NEW



Catchment No.	Storage/Description	Area (ha)	Runoff Volume (m <sup>3</sup> )	Comment
	Pond			
39B	Proposed Sediment Pond	0.37	268	NEW
43	S43	1.09	802	No Change
44	S44	1.66	1215	CHANGED
44B	S44B	2.15	1575	NEW
41		1.84	1348	No Change
Blackwood Pit		14.18	10399	No Change
45	S45	1.00	735	No Change
TSF 1		11.61	8517	No Change
Decant Dam		0.59	433	No Change
<b>TOTAL</b>		<b>186.81</b>		

### 3.1 Catchment Analysis

The new plant location required adjustment of previously proposed storages and creation of a few new ones. Table 2 summarises the updated required storages for the various catchments. Sections 3.1.1 to 3.1.3 provides discussion of changes within each catchment that has been modified.

#### 3.1.1 Western Catchments

##### *Catchment 1A, 1, 3 and 4*

- No Change

##### *Catchment 8, 9A and 9B*

- No Change

##### *Catchment 2, 5, 6, 7 and 10*

The runoff in Catchment 2 will be diverted to a proposed pond (S2) on the western side of the catchment. This area will need to be re-graded to obtain a slope towards the proposed pond area. It is recommended that a spillway and drain be installed from S2 to Catchment 13A.

Runoff from Catchment 5 and 6 will flow into respective proposed ponds (S5) and (S6), where overflow from both ponds would flow down into the proposed drain that discharges to Catchment 14. These Catchments would require re-grading and the proposed ponds would be relatively shallow to promote evaporation. Catchments 7 and 10 would be directed to a proposed drain that discharges to Catchment 14. The runoff from these catchments would be channelled through the drainage network and water storage S17 and ultimately discharge to the Horwood Dam.

Required works include:

- Grade the area in Catchment 2 to create a new water storage area S2.
- Install a new drain and spillway from S2 to Catchment 13A.
- Install a new culvert between Catchment 10 to Catchment 14.
- Grade the areas to provide storage in respective Catchments, 5 and 6 for storage of the 100 year event.



## RASP MINE - SURFACE WATER MANAGEMENT PLAN

**Table 2: Storage Requirements**

Pond	Reporting Catchments	Runoff Volume for storage (m <sup>3</sup> )	Surface Area of storage (m <sup>2</sup> )	Depth of Inundation (m) <i>Note 1</i>	Height of required bunding (m)	Comment
S1A	1A	2,550	16,000	0.2	0.5	No Change
West Drainage Ditch	1,3,4	4,500	NA	NA	NA	No Change
S2	2	4,790	7,970	0.6	0.9	No Change
S5	5	1,151	2,443	0.5	0.8	NEW
S6	6	1,137	1,794	0.6	0.9	NEW
S8	8	650	1,100	0.6	0.9	No Change
S9A	9A	450	610	0.7	1.0	No Change
S9B	9B	430	1,090	0.4	0.7	No Change
S11A	11A	1,310	6,800	0.2	0.5	No Change
S11B	11B	1,400	3,680	0.4	0.7	No Change
S12	12	400	2,620	0.2	0.5	No Change
S13A	13A	4,600	10,140	0.5	0.8	No Change
S13B	13B	1,020	4,810	0.2	0.5	No Change
S17	5,6,7,10,14,15,16,17,18	<b>Note 2</b>				No Change
S18	18	1,060	1,610	0.7	1.0	No Change
S21A	21A	840	8,100	0.1	0.4	No Change
S22	21B,22	4,360	9,370	0.5	0.8	No Change
S23	23	1,050	620	1.7	2.0	No Change
S25	24, 25	3,720	6,000	0.6	0.9	No Change
S26	26	1,160	1,600	0.7	1.0	No Change
S29	29,30	2,750	5,110	-	-	No Change
S31A	31A, 31B, 47	5,210	6,160	0.8	1.1	No Change
S35	33,35	5,900	20,280	0.3	0.6	No Change
S38A (Proposed)	38	682	9,170	0.1	0.4	NEW – proposed



## RASP MINE - SURFACE WATER MANAGEMENT PLAN

Pond	Reporting Catchments	Runoff Volume for storage (m <sup>3</sup> )	Surface Area of storage (m <sup>2</sup> )	Depth of Inundation (m) <i>Note 1</i>	Height of required bunding (m)	Comment
sediment pond)						sediment pond-overflow reports to Blackwood Pit
S39 (Sediment Pond)	39	2,294	3,641	0.4	0.7	NEW – proposed sediment pond – overflow reports to Horwood Dam
S40	40	280	1,620	0.2	0.5	No Change
S43	43	800	2,310	0.3	0.6	No Change
(S39A) Proposed Sediment Pond)	39A	1,051	791	1.3	1.6	NEW – proposed sediment pond – overflow reports to S39
S44						REMOVED
S44B	44B	2,825	3,960	0.7	1.0	NEW – excavation will be required to create this storage
S45	45	740	2,710	0.3	0.6	No Change
S46	76	740	1,340	0.6	0.9	No Change
Mt Hebbard	19	3,800	18,290	0.2	0.5	No Change
BHP Pit	27,28,32,34, 36,BHP	12,110				No Change
Blackwood Pit	38,41, Blackwood	15,330				No Change
Horwood Dam	20A, 20B, 37, 39, 40 and 42	<b>Note 3</b>				No Change

Note: 1. The surface area for each storage has been estimated based on preliminary investigation. If during construction of these storages a larger surface area than nominated in this table is accommodated, the required depth will reduce which can be estimated from the above table; 2. Refer to Original SWMP for S17 storage estimations; 3. Refer to Original SWMP for Horwood Dam storage estimation.





### **Catchment 11A, 11B, 12, 13A, 13B and 14**

Catchment 13B discharges into Catchment 13A (Figure 2). To retain stormwater in this area it is proposed that a small pond be located within Catchment 13B (S13B) as shown on Figure 2. Some re-grading will be required in this catchment to divert flow to the storage.

The water from S13A will discharge to the drain along Little Kintore Pit. Catchments 11A, 11B and 12 (Figure 3) will have small ponds (S11A, S11B and S12) to capture local runoff. Once these ponds are full they will overflow to the existing drain which will deliver the water into the sediment retention ponds in Catchment 14.

Catchment 11B lies along the north-west boundary of the Kintore Pit. Storage will be provided in this catchment to prevent discharge into the Kintore Pit. Any overflow from this catchment would be diverted to Catchment 12. It is important that the integrity and stability of any bunding along the edge of Kintore Pit is checked and bunding reinforced if required to prevent failure of the bunding and sudden release of water into the Kintore Pit.

Catchment 14 consists of the area south of Little Kintore Pit. It is recommended that two sediment retention ponds be constructed within this area, which would receive runoff from a number of catchments and to provide additional sediment control. The sediment retention ponds will be a series of two ponds connected via an overflow drain and discharge into storage S17 in Catchment 17. The existing vegetation within the sediment retention ponds will remain to prevent erosion and facilitate sediment deposition.

There is an existing drain along the western edge of Kintore Pit which currently discharges to Little Kintore Pit. This drain will be upgraded to convey the 100 year storm runoff from upstream catchments including 13A, 13B and 14 and made to discharge the runoff into the sediment retention ponds within Catchment 14. An existing spillway into Little Kintore Pit will need to be removed to divert drainage away from the Little Kintore Pit and into the sediment retention ponds. Two existing pipes will also need to be removed or plugged to prevent drainage from sediment retention ponds flowing into Little Kintore pit.

Required works include:

- Regrade catchment 13B to retain stormwater.
- Construct sediment retention ponds in Catchment 14 to provide additional sediment control and maintain existing vegetation.
- Remove existing spillway into Little Kintore Pit and divert drainage to sediment retention ponds in Catchment 14.
- Install culvert across the service road in Catchment 14.
- Plug or remove the two existing pipes between the sediment retention ponds and Little Kintore Pit.
- Ensure integrity and stability of all bunding along the edge of Kintore Pit to prevent bunding failure.

### **Catchment 15, 16, 17, and 18**

Catchments 15, 16 and 17 (Figure 2) all contribute runoff directly into S17. Catchment 18 contains a low point which ponds prior to discharging to S17. The overflow from S17 will run down a proposed channel to be constructed along the base of Mt Hebbard and toe of the Old Tailings Dam (TSF1) to Horwood Dam. This channel will have the capacity to convey the 100 year storm runoff, see Section 3.2. The channel would be wide enough to be used as an access roadway during dry periods.

Required works include:

- Install culverts in Catchment 15 and Catchment 16 to direct runoff to S17.
- Assess current bunding of Catchment 17 to meet water storage requirements as listed and maintain the integrity of the tank located within the Catchment area.



- Install a channel and spillway at the south-east corner of Catchment 17 to convey water to Horwood Dam.
- Ensure the integrity and stability of the bunding for S17 to prevent bunding failure.

### 3.1.2 Central Catchments

#### **Catchment 19, 20A, 21A, 21B and 22**

Catchments 19, 21A, 21B and 22 will contribute runoff to S22 located in Catchment 22 (Figure 3). Catchment 19 comprises of Mt Hebbard and has a bunding around the top of the mound, which can contain the runoff from the 100 year 24 hour storm event. Overflow from the top of Mt Hebbard will discharge to S22.

Catchment 21A will store the 100 year 24 hour storm event and will overflow into Catchment 21B for larger events. Catchment 21B will report to a drain on the western side of the haul road and then via a pipe or causeway to storage S22.

Required works include:

- Construct new drains / pipes or causeway along Catchment 21B and Catchment 22 to direct water into S22.
- Ensure the integrity and stability of the bunding along the edge of Kintore Pit to prevent bunding failure.

#### **Catchment 23, 23A, 24 and 25**

Catchment 23 is a small catchment along the northern edge of the mine site, north of Kintore Pit. Runoff within this catchment will pond in S23 prior to discharge into the northern drain (Catchment 23A) onsite which is adjacent to the railway. The capacity of S23 and the onsite drain should be assessed and measures will be taken to obtain the required capacity for a 100 year ARI storm event.

Catchment 24, located at the north-east corner of Kintore Pit (Figure 3), currently discharges into this Pit. For safety reasons it is recommended that this area is re-graded away from the active Pit towards Catchment 25. This can be accomplished by lowering the ridge between Catchment 24 and 25 through excavation and using the spoil to fill the lower areas in Catchment 24 closer to the Kintore Pit.

The regrading of the entire Catchment 24 may not be possible and some storage may be required by constructing a bund along the Kintore Pit. In such case, a drain will be required to convey the flow from Catchment 24 into Catchment 25 through the ridge line.

The runoff from Catchment 25 will report to storage S25 (Figure 3). Overflow from S25 will enter the northern drain adjacent to the railway. Based on the assessment of the drain topography, water flows down towards S31A. To ensure runoff will not flow off site, a drainage channel along the boundary of Catchment 31B is proposed. Water will be channelled through this proposed drain into S31A (Figure 4).

Required works include:

- Install a bund between Catchment 24 and Catchment 21A.
- Fill and regrade Catchment 24 to direct runoff to Catchment 25.
- If required, install a culvert between Catchment 24 and Catchment 25 to convey runoff.
- Ensure the integrity and stability of the bunding along the edge of Kintore Pit to prevent bunding failure.

#### **Catchment 26, 27, 28, 34 and 36**

- No change



### **Catchment 32**

- No change

### **Catchment 29, 30, 31A, 31B, 46 and 47**

- No change

### **Catchment 33 and 35**

- No change

### **3.1.3 Eastern Catchments**

#### **Catchment 38A, 38, 41, 43 and 45**

Catchments 38A, 38, 41 and 43 currently discharge into Blackwood Pit (Figure 5). Catchment 38A will be graded towards a shallow pond (S38A) towards the northern end of the catchment near the haul road. The grading of this local area will be such that overflow from this pond will be channelled into the proposed drains along Catchment 38. This drain will also carry runoff from Catchment 38 to the Blackwood Pit.

Catchment 43 lies to the east of Blackwood Pit and is relatively flat but contains a small low lying area (S43). The overflow from S43 will report to Blackwood Pit. Runoff from Catchment 41 flows down the road and into the Blackwood Pit via the old haul road. As stated above, prior to the use of TSF2 the stormwater conveyance in these areas will be revisited to direct stormwater runoff away from Blackwood Pit.

Catchment 45 has a pond (S45) that stores water before discharging to Catchment 43 via an existing culvert. The capacity of this storage and conveyance of the existing culvert will be assessed to obtain the required runoff and flow capacity of a 100yr storm event.

Required works include:

- Assess capacity of S45 and existing culvert between Catchment 45 and Catchment 43.
- Increase capacity of S45 and pipe to ensure 100 yr runoff from Catchment 45 is diverted to Catchment 43 and ultimately into Blackwood Pit.

#### **Catchment 39, 39A and 39B**

The processing plant will be located in Catchment 39 (Figure 4 and 7). Stormwater runoff towards this area must be diverted away to minimise disruption to processing activities. The runoff from Catchment 39 can be expected to be contaminated as it will carry some sediment from the processing plant. Arrangements should be made within the processing plant footprint to capture any overflow or spill from the plant. A drain is proposed along the length of the processing plant to capture runoff and direct it to S39.

The existing pond S39 is proposed to be used as a sediment pond to capture the sediment from the processing plant. S39 will also provide the required runoff detention in addition to holding the sediment from Catchment 39. Regular cleaning of this pond would be required to maintain the runoff detention capacity.

The overflow from S39 will be diverted into the existing drainage system, which would ultimately carry the runoff to the Horwood Dam.

Runoff from Catchment 39A will be collected in a proposed sediment pond (S39A). This pond would collect runoff from the ROM pad. Overflow from S39 will enter catchment 39B and will flow into the proposed drain in Catchment 39, which discharges to S39. Overflow from S39 will be channelled into the drains down to Horwood Dam. Sediment in S39A would be regularly dug out and used in the processing plant.

#### **Horwood Dam and Catchment 20A, 20B, 37, 40 and 42**

- No change



### Catchment 44, 44B

Rail operations are proposed along the eastern boundary of Catchment 44. This location is the low point in the catchment and would receive the entire runoff from the Catchment. To prevent disruption to railway operations two storage ponds are proposed in this area. Storage S44 lies to the north of railway operations beside the railway line and would receive runoff from Catchment 44. Storage S44B lies further north and would receive runoff from catchment 44B. To facilitate flow into S44B a drain is proposed along the haul road as shown in Figure 5. This drain would cross under the haul road and discharge into the S44B.

Required works include:

- Construct drain along the haul road as shown in Figure 5.
- Ensure drainage of railway operations towards S44 at the detailed design stage.

### Catchment TSF1

- No change

## 3.2 Horwood Dam and Storage S17

### 3.2.1 Hydrologic Modelling

Hydrological modelling was updated to assess the impact of the catchment modifications. Details of the model are presented in the original SWMP (Golder, 2010). The results indicate that the new location of the processing plant would not invalidate the assessment presented in the original SWMP. The available capacity of the Horwood Dam is sufficient to hold the 100 year runoff.

## 4.0 EROSION AND SEDIMENT CONTROL

The new location of the processing plant was re-assessed for erosion and sediment control measures. A summary of the review is presented below.

### 4.1 Minerals Processing Plant

The process plant will be located to the South of Blackwood Pit. Any overflows or spills from the processing plant would be captured by the containment provided within the footprint of the plant. Only sediment generated from other activities would need to be managed. It is recommended that erosion and sediment control measures be put in place in this area to minimise the volume of sediment reaching the downstream storages, including the Horwood Dam.

The processing area slopes from west to east towards S39. It is recommended that a drain be constructed along the length of the processing plant to capture runoff. Sediment control ponds are generally not required in the processing area as S39 would provide sufficient sediment storage capacity. The proposed drain and sediment control measures are shown on Figure 7.

Relevant guidelines recommend various velocity reducing techniques and erosion control devices. One of the velocity reducing techniques that is recommended are gravel/rock check dams. Where required, gravel check dams will be placed within the proposed drain to both slow down the flow and capture some of the sediment. To increase the capture of sediment and stabilise the drain, vetiver grass can be planted within the drain. This grass survives in very dry climates.

The above comments are provided as a guide only as it is understood that the stormwater management around the processing plant will be addressed at the detailed design stage of the project. Any requirement for local sediment pond or detention basin may be considered at that stage.

## 5.0 RECOMMENDATIONS

The recommendations from the SWMP are summarised below:

- Provide various storages with capacities as defined in Table 2;



- Provide appropriate spillways for various catchments for discharge of runoff greater than 100 year event;
- Assess the bund integrity of various storages and provide adequate measures for safe storage of stormwater runoff. In particular, bunding along the edge of Kintore Pit should be checked/designed for withstanding water ponding without failure;
- Provide erosion and sediment control measures on site;
- Undertake regular inspection and maintenance of drainage infrastructure;
- Provide appropriate measures to reinforce the entry channels that convey discharge to BHP and Blackwood Pits from the surrounding catchments; and
- Provide appropriate freeboard for design of various infrastructures.

## 6.0 REFERENCES

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## Report Signature Page

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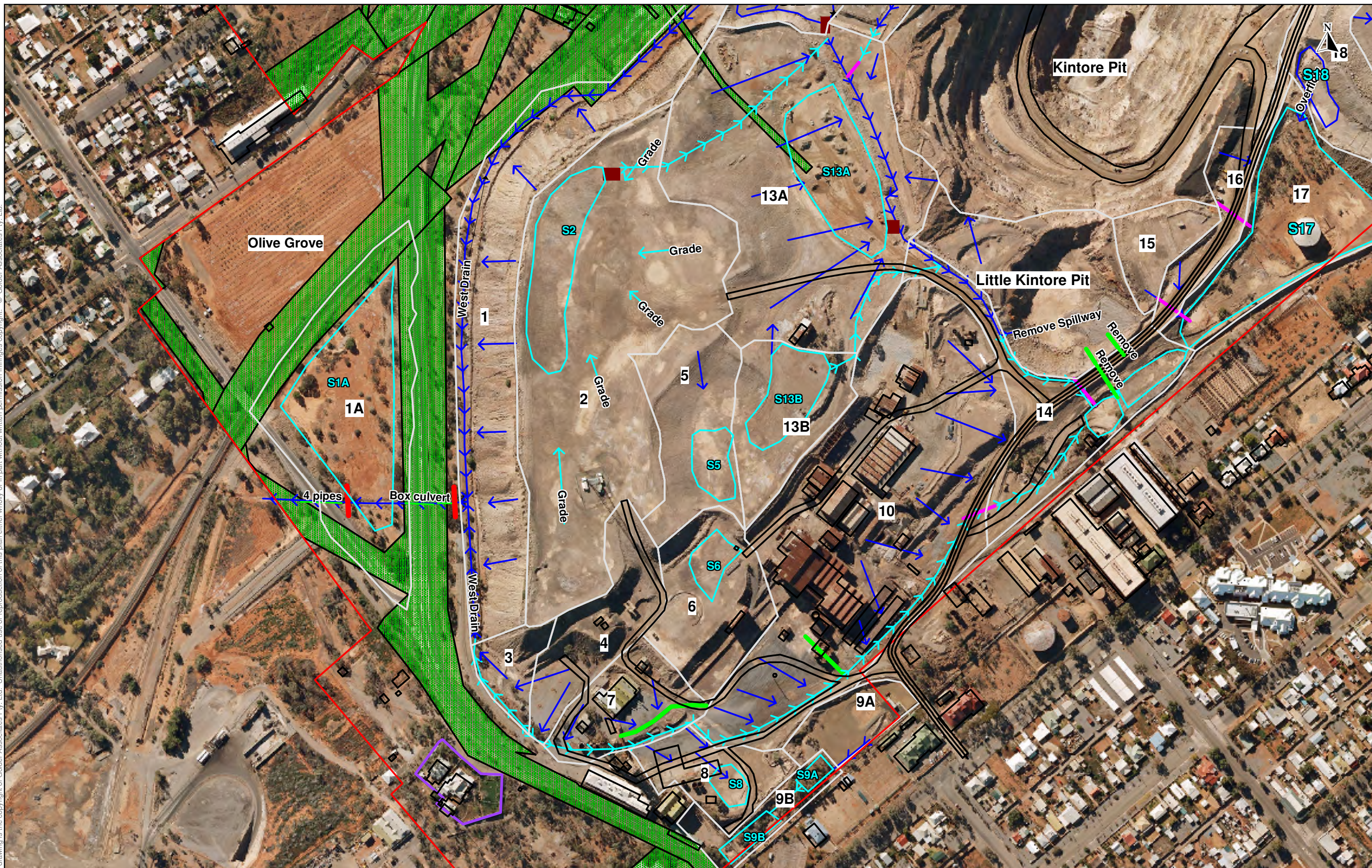
- |   |                            |   |                                   |   |                                   |
|---|----------------------------|---|-----------------------------------|---|-----------------------------------|
|  | Mine Lease Exclusion Areas |  | Key Features                      |  | ROM Pad and Proposed Process Area |
|  | CML 7 - Mine Lease Area    |  | Horwood Dam                       |  | Line of Lode Associations         |
|  | Rehabilitated Areas        |  | Browns Shaft and Block 10 Lookout |   |                                   |



CLIENT		Broken Hill Operations Pty Ltd		PROJECT		Surface Water Management Plan	
DRAWN	GM	DATE	16-09-2010	TITLE		MINE SITE AREA	
CHECKED	HR	DATE	16-09-2010				
SCALE		1:15,000		PROJECT No	097626108	FIGURE No	1
				REV No	0	A3	



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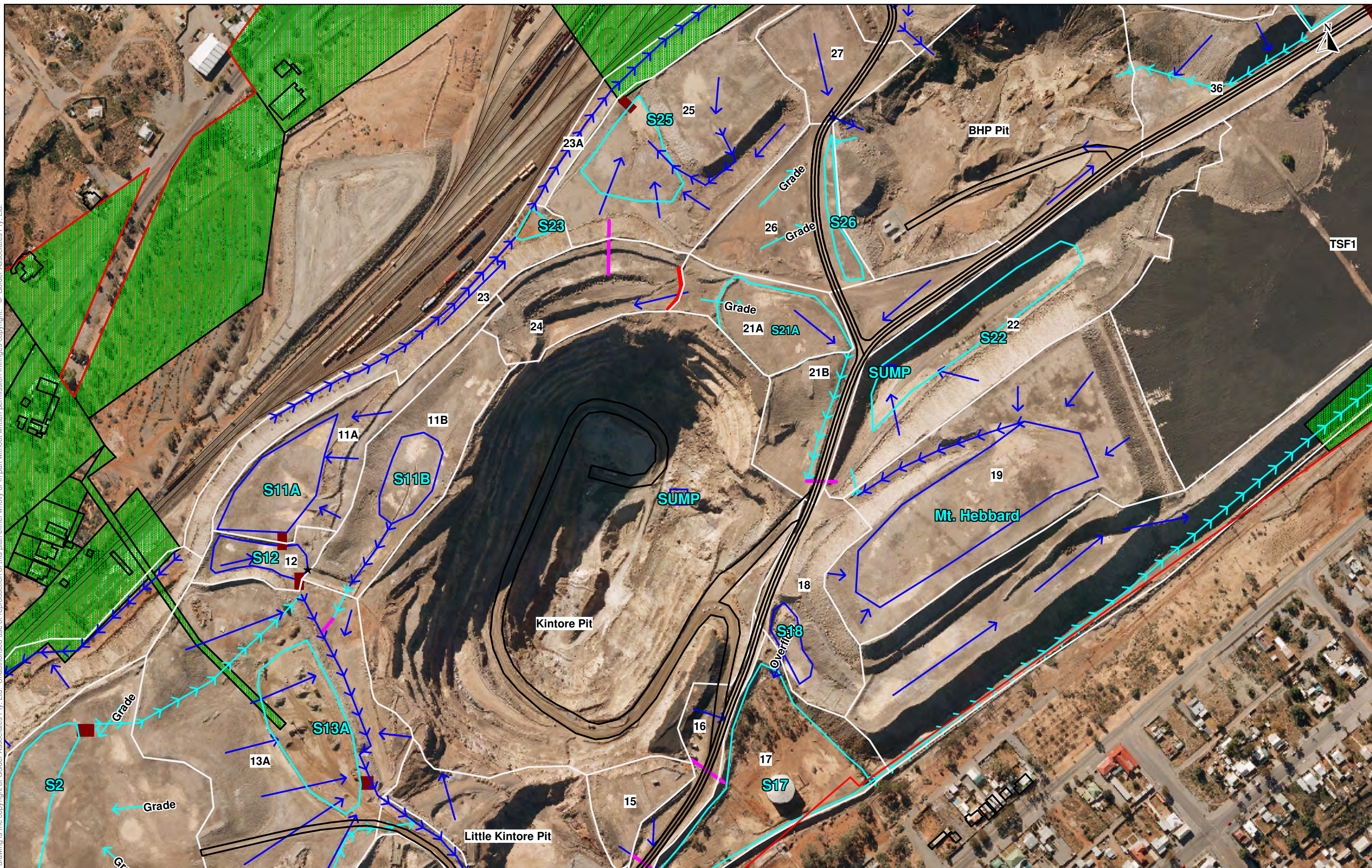
- |  |                   |  |                          |  |                    |  |                |
|--|-------------------|--|--------------------------|--|--------------------|--|----------------|
|  | Proposed Spillway |  | Existing Drainage        |  | Catchment Boundary |  | Proposed Pond  |
|  | Road              |  | Proposed Drainage        |  | Existing Pipe      |  | Existing Pond  |
|  | Flow Direction    |  | Grading Direction        |  | Proposed Pipe      |  | Exclusion Area |
|  | Proposed Bund     |  | Line of Lode Association |  | CML 7 Boundary     |  |                |



CLIENT		Broken Hill Operations Pty Ltd		PROJECT		Surface Water Management Plan		
DRAWN	GM	DATE	16-09-2010	TITLE PROPOSED WEST CATCHMENT AREAS				
CHECKED	HR	DATE	16-09-2010					
SCALE		1:4,000		PROJECT No 097626108		FIGURE No 2	REV No 0	A3



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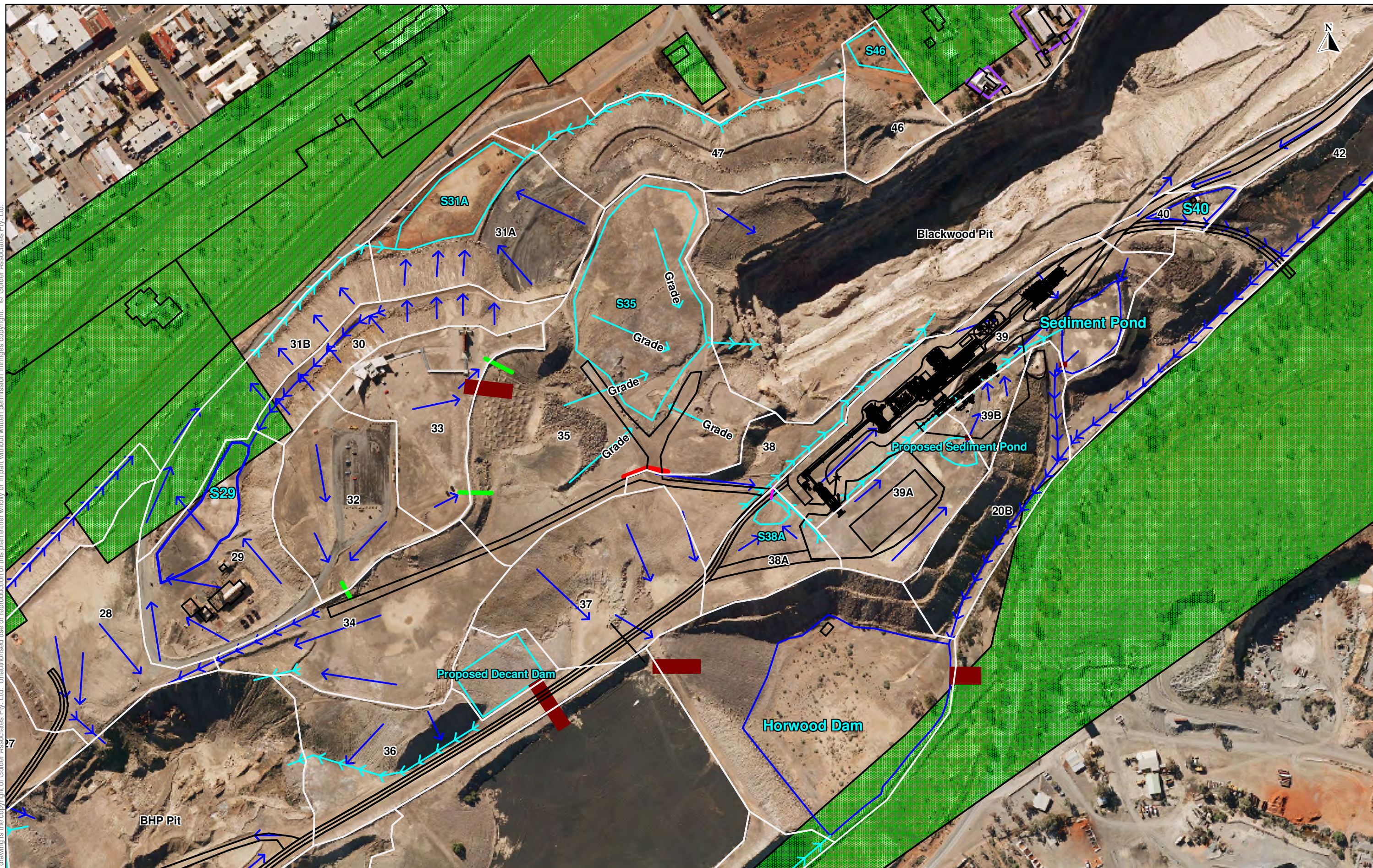
	Proposed Spillway		Existing Drainage		Catchment Boundary		Proposed Pond
	Road		Proposed Drainage		Existing Pipe		Existing Pond
	Flow Direction		Grading Direction		Proposed Pipe		Exclusion Area
	Proposed Bund				CML 7 Boundary		



CLIENT Broken Hill Operations Pty Ltd		PROJECT Surface Water Management Plan	
DRAWN GM	DATE 16-09-2010	TITLE PROPOSED WEST CENTRAL CATCHMENT AREAS	
CHECKED HR	DATE 16-09-2010		
SCALE 1:4,000		PROJECT No 097626108	FIGURE No 3
		REV No 0	A3



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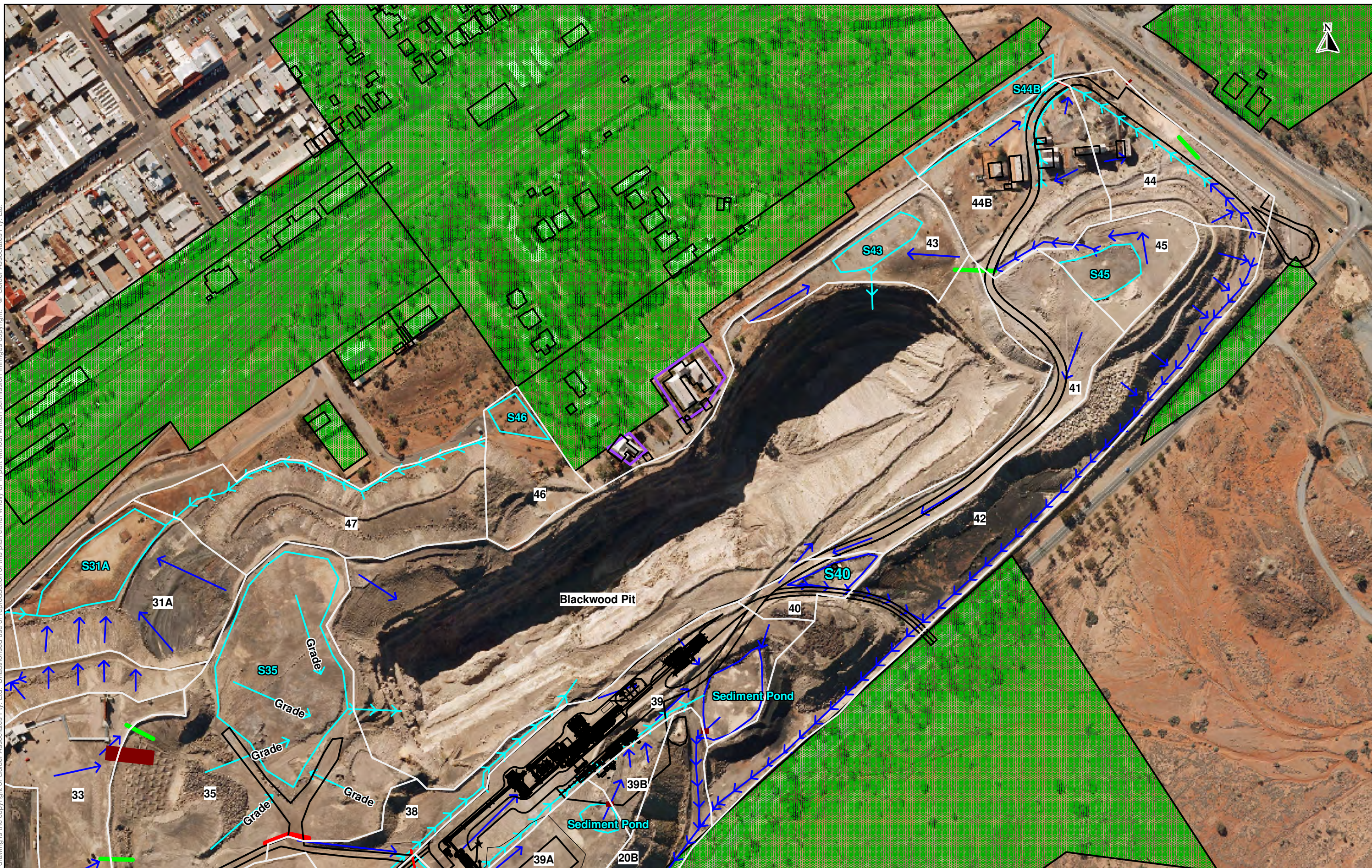
- |                   |                          |                    |                |
|-------------------|--------------------------|--------------------|----------------|
| Proposed Spillway | Existing Drainage        | Catchment Boundary | Proposed Pond  |
| Road              | Proposed Drainage        | Existing Pipe      | Existing Pond  |
| Flow Direction    | Grading Direction        | Proposed Pipe      | Exclusion Area |
| Proposed Bund     | Line of Lode Association | CML 7 Boundary     |                |



CLIENT Broken Hill Operations Pty Ltd		PROJECT Surface Water Management Plan		
DRAWN GM	DATE 16-09-2010	TITLE PROPOSED EAST CENTRAL CATCHMENT AREAS		
CHECKED HR	DATE 16-09-2010			
SCALE 1:4,000		PROJECT No 097626108	FIGURE No 4	REV No 0 A3



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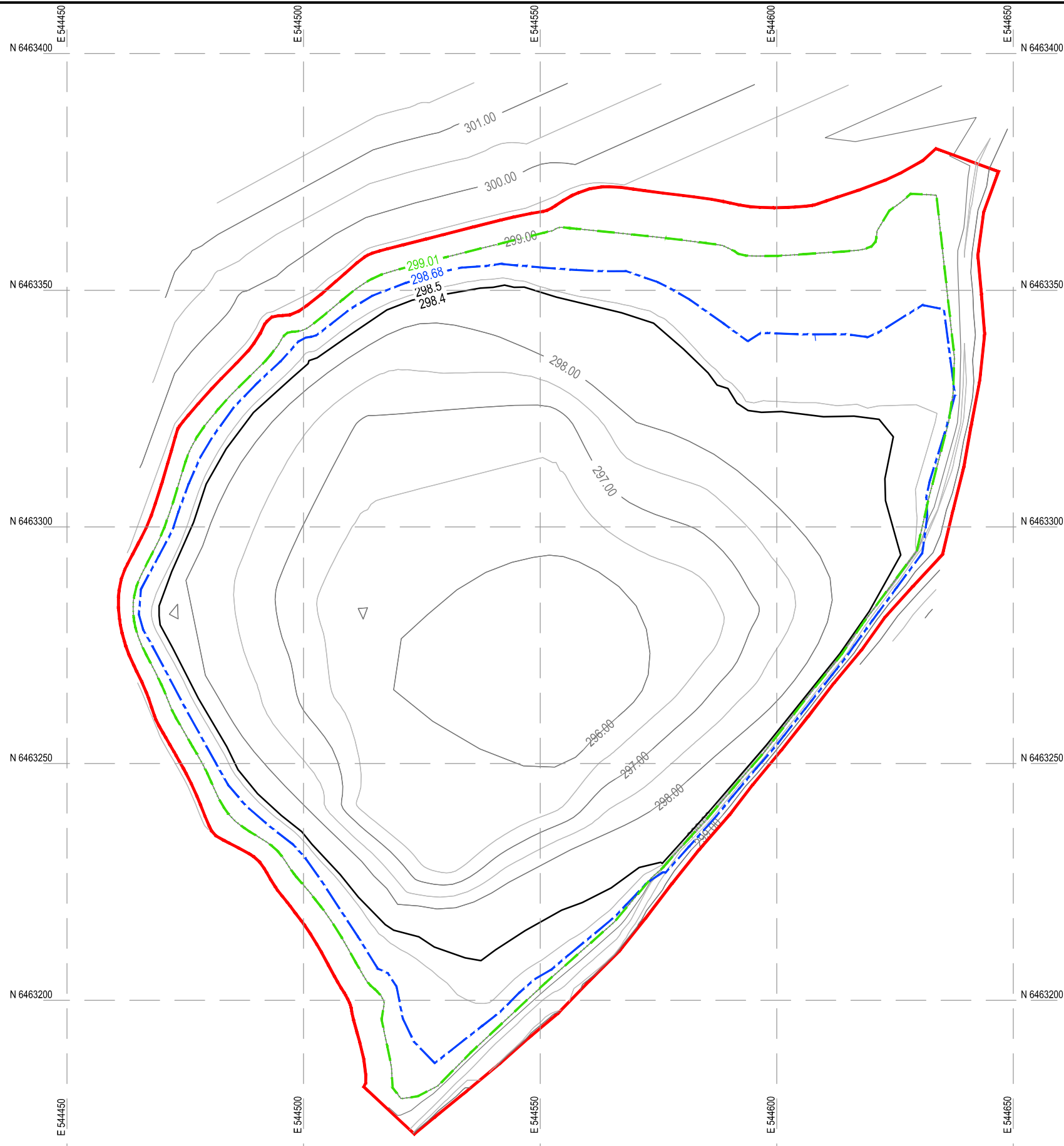
- |                   |                          |                    |                |
|-------------------|--------------------------|--------------------|----------------|
| Proposed Spillway | Existing Drainage        | Catchment Boundary | Proposed Pond  |
| Road              | Proposed Drainage        | Existing Pipe      | Existing Pond  |
| Flow Direction    | Grading Direction        | Proposed Pipe      | Exclusion Area |
| Proposed Bund     | Line of Lode Association | CML 7 Boundary     |                |



CLIENT				PROJECT			
Broken Hill Operations Pty Ltd				Surface Water Management Plan			
DRAWN		GM		DATE		16-09-2010	
CHECKED		HR		DATE		16-09-2010	
SCALE				PROJECT No		FIGURE No	
1:4,000				097626108		0	
						REV No	
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						A3	



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CALCULATED VOLUMES:

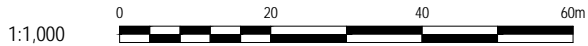
ALL SURFACE AND VOLUME CALCULATIONS ARE CREATED USING  
AUTOCAD LAND DEVELOPMENT DESKTOP 2008


BASE SURFACE:  
NS091125\_Pond 1

COMPARISON SURFACE:  
DS091125\_RL 299-40

LEGEND:

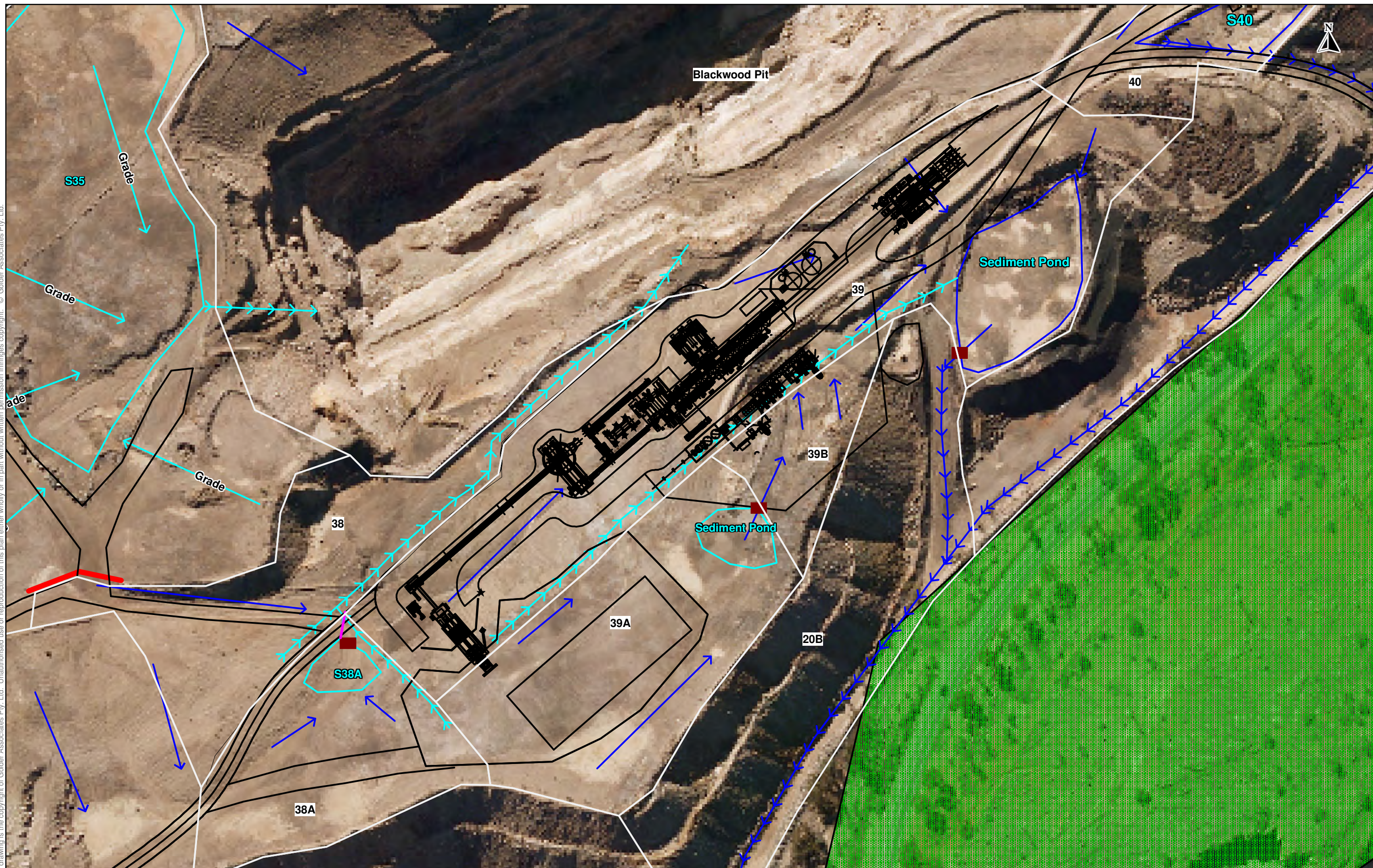
- BUNDED AREA AT ELEVATION 299.4m (AHD)
- - - 100 YEAR RUNOFF EVENT CONTAINMENT ELEVATION
- . . . 200 YEAR RUNOFF EVENT CONTAINMENT ELEVATION



 www.golder.com GOLDER ASSOCIATES PTY LTD		CLIENT BROKEN HILL OPERATIONS PTY LTD		PROJECT SURFACE WATER MANAGEMENT PLAN					
		DRAWN BY HC	DATE 14.09.1010	DRAWING TITLE  EXISTING VOLUME OF HORWOOD DAM					
		CHECKED BY GM	DATE 16.09.2010						
SCALE 1:1000		SHEET SIZE A3	PROJECT No 097626108	DOC No 004	DOC TYPE R	FIGURE No F0006	REVISION 0	FIGURE 6	



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- |                   |                          |                    |                |
|-------------------|--------------------------|--------------------|----------------|
| Proposed Spillway | Existing Drainage        | Catchment Boundary | Proposed Pond  |
| Road              | Proposed Drainage        | Existing Pipe      | Existing Pond  |
| Flow Direction    | Grading Direction        | Proposed Pipe      | Exclusion Area |
| Proposed Bund     | Line of Lode Association | CML 7 Boundary     |                |



CLIENT		Broken Hill Operations Pty Ltd		PROJECT		Surface Water Management Plan				
DRAWN	GM	DATE	16-09-2010	TITLE PROPOSED DRAINAGE AT PROCESSING PLANT						
CHECKED	HR	DATE	16-09-2010							
SCALE 1:4,000				PROJECT No	097626108	FIGURE No	7	REV No	0	A3



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