OB31 SURFACE WATER ENVIRONMENTAL IMPACT ASSESSMENT

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Prepared by:

RPS Aquaterra
38 Station Street, Subiaco WA 6008
PO Box 465, Subiaco WA 6904
T: 61 8 9211 1111
F: 61 8 9211 1122
E: water@rpsgroup.com.au
W: rpsaquaterra.com.au

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Prepared for:

BHP Billiton Iron Ore
Level 30
125 St Georges Terrace
Perth WA 6000

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	Name	Position	Signature	Date
Author	Rhod Wright Joanne Tierney	Principal Civil / Water Engineer Water Resources Engineer		4/08/2014
Reviewer	V Piper	Senior Principal Water Resources Engineer		4/08/2014

Disclaimer

EXECUTIVE SUMMARY

BHPBIO is seeking approval to construct and operate the proposed Orebody 31 (OB31) mine site within BHPBIO's ML244SA tenement in the Pilbara. The site is approximately 40km east of Newman and 10km northeast of Jimblebar Hub.

Currently, the mine development area is undisturbed by any mining operations. The planned operations include an open pit and Overburden Storage Areas (OSA).

This report has been prepared as an environmental summary to accompany a referral to the Environmental Protection Authority (EPA).

The OB31 Project is located in the OB18 Catchment, part of the Jimblebar Creek and upper Fortescue River catchment system, which drains to the Fortescue Marsh. Jimblebar Creek is a major ephemeral tributary of the Fortescue River, joining it about 40km to the north of OB31, and discharging into the Fortescue Marsh around 80km north.

Surface water quality around the Jimblebar area and adjacent creek systems is fresh.

OB31 is located adjacent to a dryland water course that joins Jimblebar Creek 5km downstream of Innawally Pool, a semi-permanent natural pool in Jimblebar Creek. When full the pool is about 1000m long, 40m wide and up to 1.5m deep. Drainage of the mining area to the south will be directed into the watercourse while the south side of the proposed pit will ultimately encroach into the floodplain of the water course, and bunded off from it, thereby reducing floodplain area and raising flood levels.

Drainage of the mining area to the north side of the mining development is generally northward into an area of flat undefined flow paths, also part of the Jimblebar Creek catchment.

Potential surface water impacts associated with mining operations at the OB31 mine site include:

- Interruption of existing surface water flow patterns through the construction of new open pits, OSA's, stockpiles and various service infrastructure;
- Increased risk of erosion and sedimentation from disturbed areas; and
- Contamination of surface water by chemicals or hydrocarbons.

Sediment basins will be used to control surface water sediment, and will be constructed down slope of all disturbed mine infrastructure.

With full development of the mine infrastructure, a number of internal catchments become trapped and runoff will pond against the pit bund or OSA's, and may need managing - allowing the ponds to dissipate by evaporation / seepage, run-off into the pit, or pump out.

It is predicted that no significant changes to surface water drainage or quality will occur.

The loss of catchment area contributed by the OB31 development is estimated as about 0.9% of the 900km^2 Jimblebar Creek catchment above its junction with the Fortescue River. When combined with the existing OB18 and planned and existing Jimblebar / Wheelarra Hill developments (together 1.9% loss), the total catchment loss is about 2.8%. This potential runoff volume reduction is not considered significant to the overall hydrological system, particularly in comparison to the natural seasonal variations in runoff.

From an environmental perspective, key surface water management objectives and principles have been incorporated into the planning of OB31 project through assessment of the potential impacts from the proposed development, and flood modelling studies to assess the flooding impacts of the development. Specific management plans will be developed and implemented.

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FIGURES (compiled at end of report)

1. INTRODUCTION

1.1 Project Description

BHP Billiton Iron Ore Pty Ltd (BHPBIO) is seeking approval to construct and operate the Ore Body 31 (OB31) mining infrastructure facilities in their ML244SA tenement in the Pilbara Region of Western Australia. The site is approximately 45km east of Newman and 10km northeast of Jimblebar Hub (refer Figure 1).

Currently, the mine development area is undisturbed by any mining operations (except for the exploration activities only). The planned operations comprise an open pit and Overburden Storage Areas (OSA).

1.2 Objectives

This report is an Environmental Impact Assessment (EIA) to describe the proposal, the potential environmental impacts and how these impacts will be managed in relation to surface water issues.

It identifies potential environmental impacts of the development, to ensure the development plan is environmentally responsive and presents management recommendations and strategies for key factors.

1.3 Purpose of this Report

This report has been prepared as an environmental summary to accompany a referral to the Environmental Protection Authority (EPA).

1.4 Environmental Approvals Process

EIA is a formalised process designed to provide information to the EPA, regulatory authorities and the community regarding proposed developments that have the potential to impact on natural (and social) environments. As a part of Western Australia's environmental approval process, the Environmental Protection Act 1986 provides the primary process for the EPA to carry out an EIA of development proposals that it considers are likely to have significant effects on the surrounding environment.

The objectives of the Act include the protection of the environment, and the prevention, control and abatement of pollution and environmental harm. It is an offence under the Act to cause pollution or environmental harm, these are regulated under the Act in a variety of ways, such as an EIA and authorisation of significant proposals under Part IV of the Act (refer EAG 1).

The EPA states that:

"The onus is on proponents to demonstrate through their environmental impact assessment documentation that the proposal or scheme, if implemented, can meet the EPA's objective for each relevant environmental factor" (refer EAG 8).

The proponent needs to demonstrate that best practicable measures have been taken in planning and designing the project to avoid, and where this is not possible, to minimise impacts on the environment. The unavoidable impacts should be found to be environmentally acceptable, taking into account cumulative impacts, which have already occurred in the region and encompass the principles of sustainability.

2. BASELINE HYDROLOGY

2.1 Climate

Western Australia has three broad climate divisions. The northern part which includes OB31/ the Pilbara has a dry tropical climate. The region is characterised by an arid-tropical climate resulting from the influence of tropical maritime and tropical continental air masses, receiving summer rainfall. Cyclones can occur during this period, bringing heavy rain.

The south-west corner has a Mediterranean climate, with long, hot summers and wet winters. The remainder is mostly arid land or desert climates.

2.2 Temperature

The Pilbara region has a large temperature range, rising to 50 degrees Celsius (°C) during the summer, and dropping to around 0°C in winter (Bureau of Meteorology [BOM]). The nearest BOM climatic station to the OB31 area is at Newman Aero (Site Number 007176). Mean monthly maximum temperatures at Newman range from 39°C in January to 23°C in July, while mean monthly minimum temperatures range from 25°C in January to 6°C in July. The average monthly temperatures at Newman are given in Table 2.1. High summer temperatures and humidity seldom occur together, giving the Pilbara its very dry climate. Light frosts occasionally occur during the winter season.

Table 2.1: Newman - Average Monthly Temperatures

Average Temperature	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Maximum [oC]	39	37	35	32	27	23	23	26	30	35	37	38
Minimum [oC]	25	24	22	17	12	7	6	8	12	18	21	24

2.3 Rainfall and Evaporation

The Pilbara region has a highly variable rainfall, which is dominated by the occurrence of tropical cyclones, mainly from January to March. The moist tropical storms from the north bring sporadic and drenching thunderstorms. With the exception of these large events, rainfall can be erratic, and localised, due to thunderstorm activity - rainfall from a single site may not be representative of the spatial variability of rainfall over a wider area.

During May and June, cold fronts move in an easterly direction across Western Australia, sometimes reaching the Pilbara region, producing light winter rains.

The annual average rainfall for Newman is 326mm (BOM, Newman Aero Site Number 007176). Annual variability is high with recorded rainfall varying between 153mm (1976) and 619mm (1999).

Average monthly rainfall for Newman is shown in Table 2.2. On average, the driest period is July to November, with September and October historically being the driest months. January and February are the wettest months.

Table 2.2: Newman - Average Monthly Rainfall and Evaporation

Average Rainfall/Evap	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Rainfall [mm]	67	75	39	19	17	15	15	7	4	6	12	39
Evaporation [mm]	461	369	343	290	174	173	199	193	264	377	424	466

The mean annual pan evaporation rate at Newman is above 3733mm (Department of Agriculture, 1987), which exceeds mean annual rainfall by around 3400mm. Average monthly pan evaporation rates for Newman are shown in Table 2.2. These evaporation rates vary between a minimum of 173mm in June and a maximum of 466mm in December. Evaporation rates in the OB31 area would be similar.

Design rainfall intensity data for the OB31 area for various rainfall durations and average exceedance probability (AEP) are given in Table 2.3 ("Australian Rainfall and Runoff", Institution of Engineers Australia, 1987).

These data can be used for waterway designs.

Table 2.3: OB31 - Average Rainfall Intensities [mm/hr]

Rainfall Duration	20% AEP*	10% AEP	5% AEP	2% AEP	1% AEP
1 hour	32.5	38.2	45.3	55	63
6 hours	9.56	11.9	14.7	18.8	22.2
9 hours	7.23	9.08	11.4	14.7	17.5
12 hours	5.93	7.52	9.51	12.4	14.8
24 hours	3.67	4.66	5.91	7.73	9.24
48 hours	2.21	2.81	3.58	4.69	5.62
72 hours	1.59	2.03	2.59	3.40	4.08

* Note that 1% AEP is equivalent to 100 year average recurrence interval (ARI) i.e. AEP $\equiv$ 100/ARI

2.4 Streamflow

Streamflow in the Pilbara region is typically correlated to rainfall, with the majority of streamflow occurring during the summer months. Streamflow in the smaller flow channels is typically short in duration, and ceases soon after the rainfall passes. In the larger river channels and catchments, runoff can persist for several weeks and possibly months following major rainfall events, such as those resulting from tropical cyclones.

Streamflow gauging stations are widely spaced in the Pilbara region, with none located in the immediate vicinity of the Jimblebar and OB31 area. The nearest Department of Water (DoW) gauging station is on the Fortescue River near Newman (Station 708011, catchment area 2,822km^2).

Available gauging data from 1980, indicates an average annual runoff volume of 5.4% of the Newman annual rainfall. However the variability of annual runoff is high, with annual runoff varying between 0 to 15% of the Newman average annual rainfall. Due to relative catchment sizes, streamflow data recorded at this station does not necessarily represent the runoff characteristics within the Jimblebar area. For comparison, Jimblebar Creek has an area of 340km^2 upstream from the Wheelarra Hill / Hashimoto ridgeline.

Peak streamflow discharges from ungauged catchments in the Pilbara region can be estimated using empirical techniques, such as those recommended in "Australian Rainfall and Runoff".

2.5 Climate Change

Climate change is generally defined as a change in average, long term, global weather patterns, commonly increases in temperature, greater or lesser precipitation at any given location, and occurrences of extreme weather events (Department of the Environment climate change website).

Climate change is contributing to increased rainfall in North West of WA, and rainfall trends in the area have shown a substantial increase since 1950. Increased rainfall implies an increased runoff in the river and creek systems.

Global climate models predict there may be a decrease in the total number of tropical cyclones, however, there is likely to be an increase in the proportion of cyclones in the more intense categories. By 2030 there may be a 60% increase in intensity of the most severe storms, and a 140% increase by 2070. Hence more extreme storm events and flash flooding are predicted, along with more frequent and severe droughts.

Since 1950, records have shown Australian average temperatures have increased 0.9°C and the frequency of hot days and nights has increased. Modelling predicts annual average warming by 2030 (above 1990 temperatures) of around 1°C across Australia, with warming of 0.70-0.90 °C in coastal areas and 1.00-1.20 °C inland. By 2070, warming is expected to be between 2.20-5.00 °C across Australia, depending on the emissions scenario adopted or endorsed. The North West is therefore becoming warmer with more hot days and less cold nights.

3. EXISTING ENVIRONMENT

3.1 Fortescue River System

The OB31 Project is located adjacent to Jimblebar Creek in the upper portion of the Fortescue River catchment, which ultimately drains to the Fortescue Marsh, as shown in Figure 1.

The Goodiadarrie Hills located within the Fortescue Valley and on the downstream (western) end of the Fortescue Marsh, effectively separates the Fortescue River into two river systems. The upper system comprises the upper Fortescue River and several large creeks including Jimblebar Creek. The upper Fortescue River system and Fortescue Marsh are considered to be a closed system. The lower Fortescue River, downstream from the Fortescue Marsh, drains in a general north-westerly direction to the sea at Cape Preston, south of Karratha.

The Fortescue Marsh is an extensive intermittent wetland, (about 100km long, 10km wide) and a total catchment area of ~29,700km^2. The marsh bed has an elevation of above RL 400m, with the Chichester Plateau to the north and Hamersley Range to the south. Following significant rainfall events, runoff from the various catchments drains to the marsh. Following a major flood event sufficient to flood the whole marsh area, anecdotal data indicates that water could pond up to 10m deep in the lowest areas. For smaller runoff events, isolated pools form on the marsh opposite the main drainage inlets, whereas for the larger events the whole marsh area has the potential to flood.

Surface water runoff to the marsh has low salinity and turbidity, though the turbidity typically increases significantly during flood peaks. Water stored on the marsh slowly dissipates through evaporation and seepage. Evaporation increases salinity in the ponded water and as the flooded areas recede, traces of surface salt can be seen. The ponded water is believed to seep into the valley floor alluvial deposits, and water becomes increasingly more saline over time due to evaporation. Groundwater below the marsh is believed to be saline to hypersaline.

3.2 Jimblebar Creek and Innawally Pool

Jimblebar Creek is a major ephemeral tributary of the Fortescue River, joining it about 40km to the north of OB31, and discharging into the Fortescue Marsh around 80km north. The OB31 Project is located within the Jimblebar Creek catchment, as shown in Figure 1.

Innawally Pool is located in Jimblebar Creek where the creek passes through a confining gorge in the Wheelarra / Hashimoto ridgeline. Higher velocities have formed a scour hole just downstream of the gorge, which has created the pool. When full, the pool is 1000m long and up to 40m wide. Runoff from the OB31 development enters Jimblebar Creek about 5km downstream from Innawally Pool, and the pool is therefore not impacted by the OB31 proposal.

3.3 Existing Surface Water Quality

A BHPBIO surface water monitoring programme shows the surface water quality around the Jimblebar area and adjacent creek systems as fresh with total dissolved solids (a measure of salinity) typically <500mg/L and pH 6-8 (neutral).

4. SURFACE WATER HYDROLOGY

4.1 General

The proposed OB31 pit and OSA developments lie in the OreBody 18 (OB18) Catchment, and are shown in Figure 2, along with the local surface water flowpaths. The catchment area is 77km² at Jimblebar Creek and 67km² at the eastern mine lease boundary with a 100 year ARI flow estimated as 102m³/s.

The elevation of ground surface at the OB31 pit varies from RL522m in the centre of the proposed pit, and up to RL577m higher in the hills to the west and east.

Most of the planned OB31 development areas naturally drain south into the adjacent valley, and then into Jimblebar Creek. A smaller portion of the planned OB31 area drains towards the north and eventually into Jimblebar Creek downstream. Mining operations at OB18 are also located within the same catchment.

4.2 Drainage from the OB31 Development to the South

OB31 is located adjacent to the dryland water course flowing into Jimblebar Creek. The creek is dry outside of seasonal rainfall events. The OB18 Catchment is confined by relatively steep rocky ridges on each side and slopes from RL565m in the west to about RL500m at the Jimblebar Creek confluence, with a typical bed slope of 0.3%.

The flow path in the upper part of the valley is largely undefined, with a wide shallow flood footprint. There is no mobile (sand/ gravel) bed, just some silt and sand in the flow path. The flow path is better vegetated in parts, and typical of the general valley vegetation in others. Water courses enter the valley from the ridges on the valley sides, but form deltas and reach the creek as sheet flow.

At about 5km from the Jimblebar confluence, the main flow path becomes a defined creek channel with a sand and gravel bed, and significant contributing water courses.

The south side of the OB31 pit will ultimately encroach into the floodplain. A flood management strategy has been derived for the floodplain using 2D flood modelling. The flood extents under existing natural conditions and with proposed infrastructure (pit and OSA's) are shown in Figure 3 and Figure 4 respectively. Figure 4 assumes a flood bund is in place along the southern pit boundary.

4.3 Drainage from the OB31 Development to the North

Drainage on the north side of the OB31 development area is generally northward, eventually discharging into flat terrain with undefined flow paths, part of the Jimblebar Creek catchment. With sufficient rainfall, run-off would eventually reach the Jimblebar Creek channel.

4.4 Internal Drainage

The north side of the pit and the waste landforms are located outside the floodway of major waterways.

With full development of the pit and the OSAs, some minor internal catchments will not be self draining and will result in water impacting the upstream side of the pit bunding and waste landforms. As the OSA's are progressed, the top surface of the OSA's will be sloped away from these potential ponding areas to minimise the impacting catchments. Water will be allowed to enter the pit and pond at the OSA's.

5. POTENTIAL MINE SITE IMPACTS

5.1 Potential Impacts from Mining Activities

Potential surface water impacts associated with mining operations at the OB31 mine site include:

Interruption of existing surface water flow patterns

- The interruption of surface water flow patterns through the construction of a new open pit, OSAs, stockpiles and service infrastructure has the potential to reduce (and in some cases increase) the surface water runoff volumes.

Increased risk of erosion and sedimentation from disturbed areas

- The planned mining operations would potentially mobilise additional sediment to the natural drainage systems, with the main potential sediment sources being the OSAs and stockpiles, as well as other disturbance areas;
- Rainfall and surface water runoff from mining areas has the potential to significantly increase erosion and sediment laden water transmitted to the environment / natural drainage systems, if appropriate management measures are not implemented;
- Diversion channels or flood bunds placed around infrastructure may concentrate sheet flow and potentially increase local flow velocities and therefore soil erosion.

Contamination of surface water by chemicals or hydrocarbons

- Spillage of chemicals or hydrocarbons from storage and / or transfer areas is possible if appropriate control measures and operating procedures are not used.

5.2 Management Objectives, Standards and Guidelines

Stormwater management, surface water discharges and activities that discharge to the environment are regulated under the Environmental Protection Act. The EPA applies the following objective (refer EAG 8) in its assessment of the hydrological processes that may affect surface water and water quality:

- To maintain the hydrological regimes of groundwater and surface water so that existing and potential uses, including ecosystem maintenance, are protected.

Applicable guidelines and standards include ANZECC / ARMCANZ Guidelines, WA Water Quality Protection Guidelines and the State Water Quality Management Strategy.

5.3 Sediment Basins

Sediment basins are a means to control surface water sediment, and will be constructed down slope of disturbed areas. Sediment basins will be used in conjunction with erosion minimisation strategies, such as vegetated batters, coarse sheeting and engineered drainage systems.

Sediment basins are located at low points in the drainage system and constructed by a combination of excavation and earth bunds. The basins collect internal dirty runoff and treat the water to remove sediments to acceptable levels prior to release to the natural environment. Bunds and drainage diversion works will be constructed to direct water from disturbed areas to the sedimentation basins.

For drainage south towards the valley, a sedimentation basin across the main OB18 catchment flow path is proposed, located downstream of OB31 (and OB18) disturbance areas (refer Figure 5).

On drainage to the north, run off from the development infrastructure, and OSA's in particular, will be captured and treated in a series of small sedimentation basins prior to leaving the site (refer Figure 5).

The final locations and layouts for these bunds and sediment basins will be determined in association with the detailed mine plans.

5.4 Runoff Loss to Downstream Environment

5.4.1 General

The planned mining development works will cause the loss of catchment area contributing runoff to the downstream drainage system, may have an impact on the downstream environment. Runoff volume is likely to decrease from areas containing pits, OSAs and catchments blocked or trapped by these works.

There are no planned significant surface water diversions. However, runoff volumes from upstream flowpaths diverted through or around the planned mine development works remain largely unchanged by the planned works.

Locally, within pit areas, internal stormwater runoff will collect at the pit base and typically be removed by sump pumping. On the OSA top surfaces, perimeter bunding will contain water and prevent runoff to the downstream environment. Overall, loss of runoff volume from pit and OSA developments is estimated at a maximum 50% of the pre-development runoff volume, and accounts for the losses to the downstream environment from non-recovered runoff from the pits and OSAs.

Runoff volumes from some infrastructure areas (e.g. roofs, hardstands, access roads) may increase, whereas from other infrastructure development areas (e.g. ponds, stockpiles) runoff volumes may be reduced. Overall runoff volumes from infrastructure and stockpile areas are considered to be effectively unchanged by the planned works.

5.4.2 Impact of OB31 Mining on the Jimblebar Creek Catchment

The existing and planned pit and OSA areas for the proposed OB31 mine are given in the table below. In addition, with full development of the mine infrastructure, a number of internal catchments become trapped and will pond against the pit bund or OSA's.

Adopting a maximum 50% runoff loss from the pit and OSA zones, the maximum loss of catchment area from the planned pit and OSA areas that currently contribute run-off to downstream drainage systems (i.e. Jimblebar Creek) is given in the table below. The loss from the trapped internal catchments is 100%.

Table 5.1: Catchment Areas Intercepted by OB31 Pits, OSA's & Trapped Internal Catchment

Location	Development Area (ha)	Adopted Runoff Loss	Catchment Area Loss Estimate (ha)
Planned Mining Areas			
OB31 - Pit	451	50%	226
OB31 - OSA	416	50%	208
OB31 - OSA	205	50%	103
Internal trapped catchments	263	100%	263
Total	1335		799

The maximum loss of catchment area contributing runoff to Jimblebar Creek is therefore estimated as 799ha (8.0km^2). This corresponds to about 0.9% of the total natural catchment of Jimblebar Creek at its junction to the north with the Fortescue River (about 900km^2).

5.4.3 Cumulative Impact of Mining on the Jimblebar Creek Catchment

Jimblebar Creek catchment also contains the current OB18 mining areas and the approved and planned Jimblebar and Wheelarra Hill development areas.

The area of the OB18 Pits and OSA's is about 168ha (after assumed 50% loss). The existing / approved or planned Jimblebar and Wheelarra Hill developments have a combined area of pits and OSA's of about 1588ha (after 50% loss, refer Aquaterra 2010) – total 1745ha.

Combining OB31 with these other mining dvelopements, the estimated catchment loss is 2544ha (254.4km^2). This is approximately 2.8% of the Jimblebar Creek catchment.

This potential runoff volume reduction is not considered significant to the overall hydrological systems downstream, particularly with consideration of the natural seasonal variations in catchment runoff.

5.5 Predicted Outcomes

No significant changes to surface water drainage or quality are anticipated due to the OB31 development. A management-based plan will ensure that potential impacts from the minesite are minimised. Reduction in surface water runoff volume will be minimal as most runoff will be redirected and distributed downstream, however some run-off loss will be incurred.

The potential for increases in surface water sediment loading will be minimal, due to appropriately designed diversion structures and sediment basin interceptors.

Therefore, consistent with the EPA objective for the hydrological processes, it is anticipated that the alterations to surface runoff and drainage should not have an adverse impact on surface water regime and the existing ecosystems.

However monitoring should be undertaken downstream of the OB31 planned development to establish surface water quality parameters.

6. SUMMARY OF IMPACTS AND MANAGEMENT MEASURES

The table below summarises the potential environmental impacts associated with the project, identifies the key management – based measures and objectives (EAG 11) that will be implemented to avoid or mitigate impacts, and describes the predicted outcomes once management measures have been implemented. On this basis, the proposal is not expected to have a significant impact on the environment.

Table 6.1: Summary of Impacts and Management Measures

Objectives and Scope of Work	Project Component / Potential Impacts	Proposed Mitigation and Management Measures	Predicted Outcomes
To maintain the hydrological regimes of groundwater and surface water so that existing and potential uses, including ecosystem maintenance, are protected.	Interruption to existing surface water flow patterns. Reduction of surface water runoff volume / quality in the environment downstream. Impact on downstream dependent vegetation communities. Discharge of chemicals, including hydrocarbons, etc. Pooling of water, growth of invasive vegetation in low-lying areas.	Limit clearing, provide adequate buffer zones between areas of disturbance and natural drainage lines. Divert upstream surface water flows around structures, into downstream water courses so natural (clean) runoff water originating outside the development site does not mix with internal (disturbed) site runoff. Construction on or near natural flow paths planned for the dry season where practicable. Chemical and hydro-carbon stores located away from, or bunded off from, external surface water surface water flows. Disturbance minimised to achieve the design function and as necessary for safe working conditions. Vehicle movements kept to the minimum necessary and existing tracks used where possible. Sediment laden surface water runoff from disturbed areas and stockpiles / dumps captured by bunding the perimeter of infrastructure areas, and treatment in sediment basins. Waste dumps dished to dissipate runoff by evaporation / seepage, and to reduce runoff and erosion down the face. Appropriate battering of the face and contour drains to minimise sheet water flows and benefit growth of vegetation. Construct access roads with a camber, table drains and regular turnouts to discharge the water into the natural surrounds. Place structures that must be located in floodplains, away from main flow channels; Locate sediment basins at drainage low points to control erosion and the deposition of sediment downstream. Use water preferentially for dust suppression, or other processes on site prior to discharge.	No significant changes to surface water flow patterns drainage or quality is expected. Minimal reduction in surface water runoff volume as most runoff redirected down-stream. Insignificant changes in surface flow volume (when compared with overall runoff). Minimal potential for increase in surface water sediment loading with appropriately designed diversion structures and sediment basin interceptors Maintenance of existing surface water hydrological regime so that existing and potential uses, including ecosystem maintenance, are protected.

7. REFERENCES

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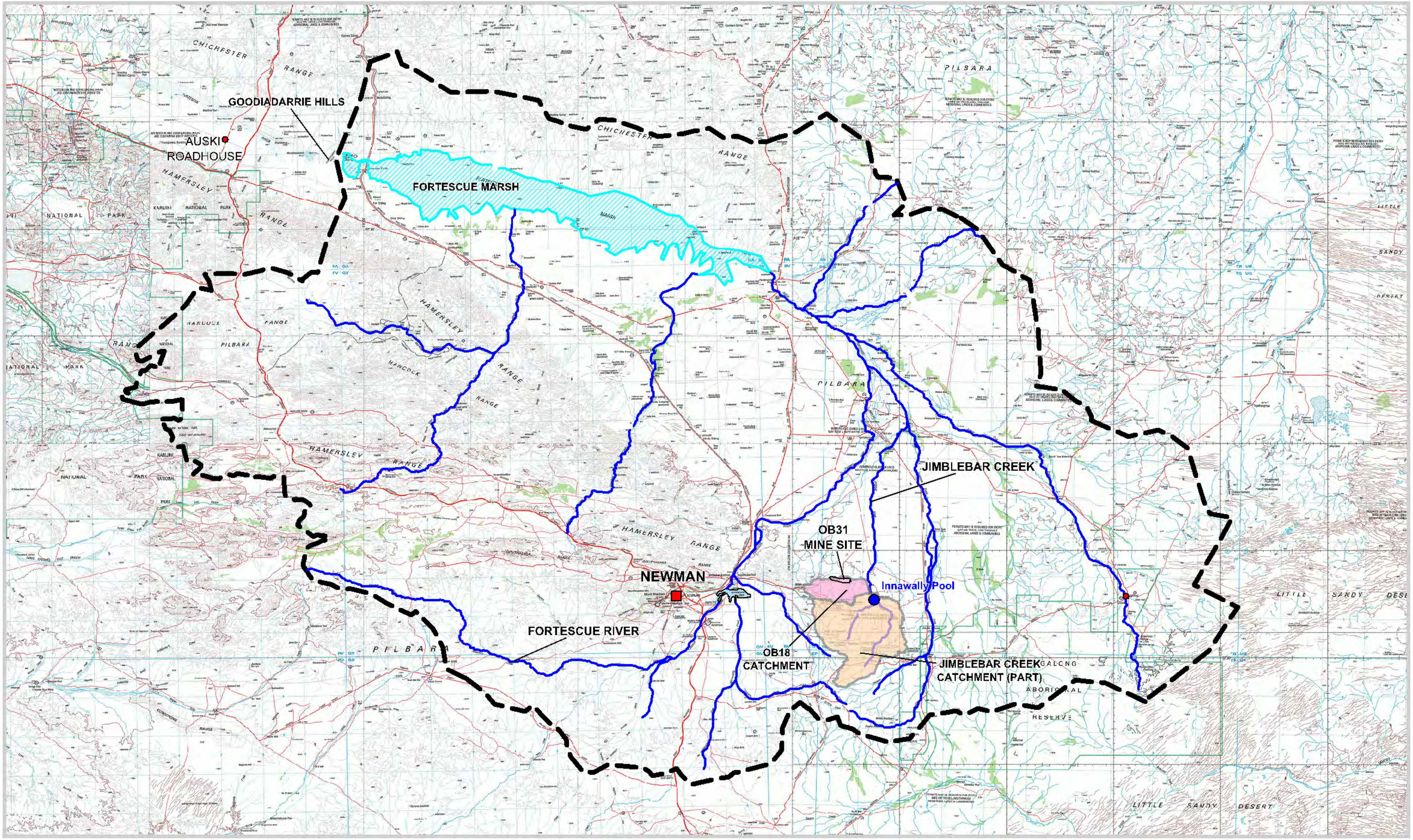
FIGURES



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GDA 1994 Zone 51

LEGEND

Fortescue Marsh Catchment Boundary
Creeks
Fortescue Marsh

AUTHOR: RW	REPORT NO: 003
DRAWN: NK	REVISION: B
DATE: 03/07/14	JOB NO: 1642D

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FIGURE 1
LOCATION PLAN AND FORTESCUE RIVER REGIONAL CATCHMENT PLAN

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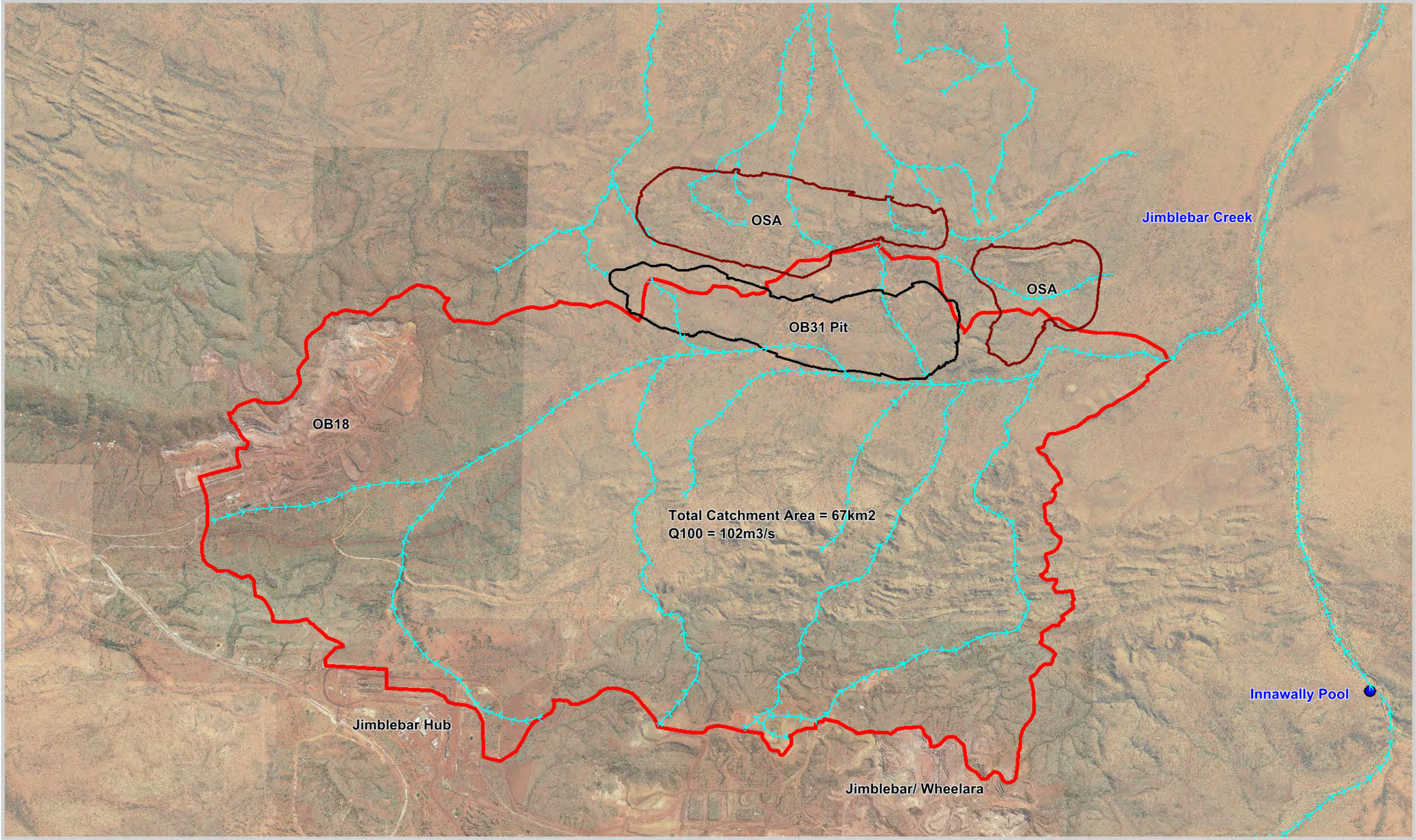

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DRAWN: NK	REVISION: B
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LEGEND

- OB18 Catchment Boundary
- Indicative Pit Outline
- Indicative OSA
- Mainstream Flow Path

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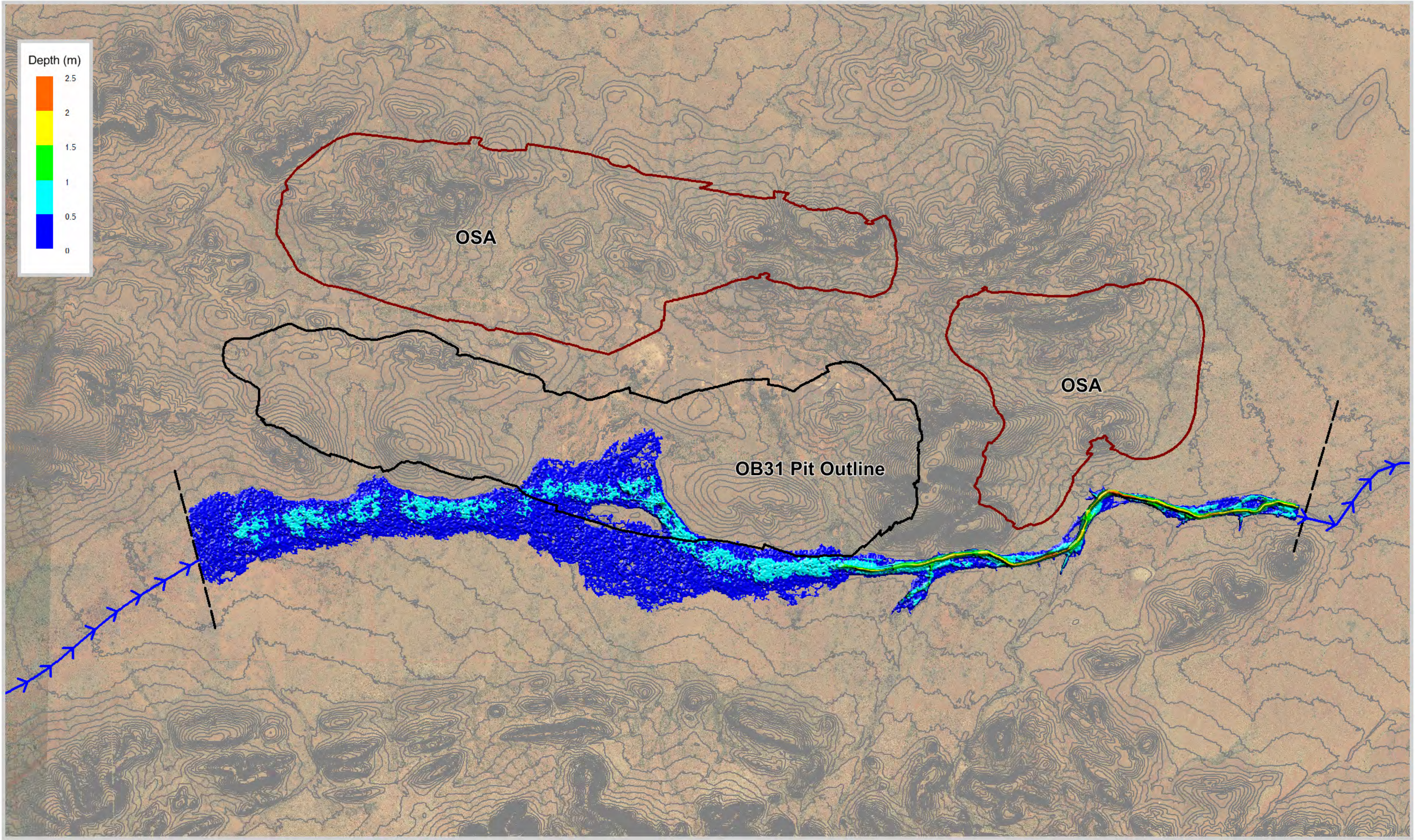
FIGURE 2

EXISITNG SURFACE WATER CATCHMENTS



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GDA 1994 Zone 51

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DRAWN: NK	REVISION: B
DATE: 01/08/14	JOB NO: 1642D

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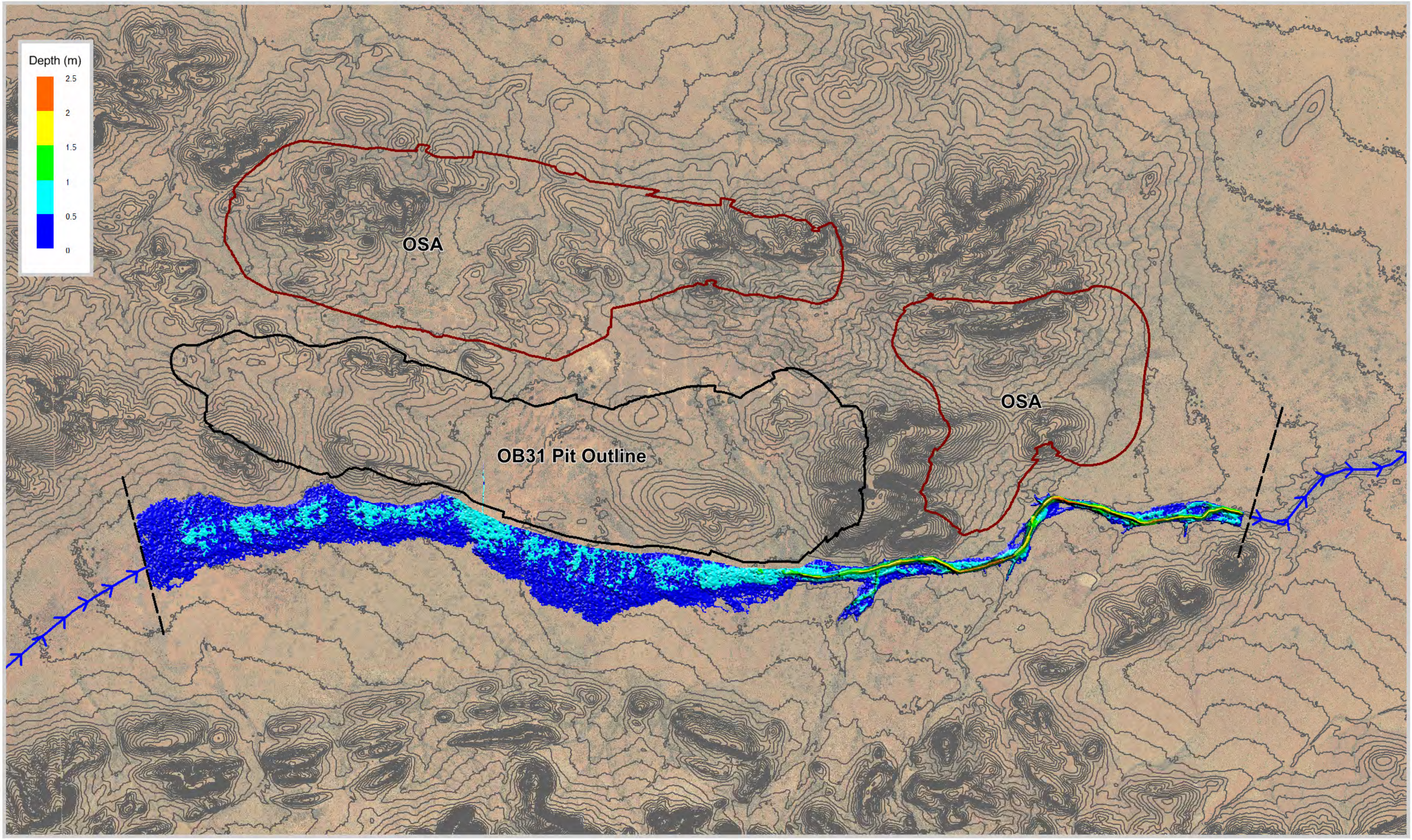
LEGEND

- Indicative OSA
- Indicative Pit Outline
- 2D Model Extent
- Contour (2m)
- Creek

RPS

FIGURE 3

100 YEAR PRE - DEVELOPMENT FLOOD EXTENTS



N
0 0.5 1
kilometres
Scale: 1:25,000 @A3
GDA 1994 Zone 51

AUTHOR: RW
DRAWN: NK
DATE: 01/08/14
REPORT NO: 003
REVISION: B
JOB NO: 1642D

LEGEND

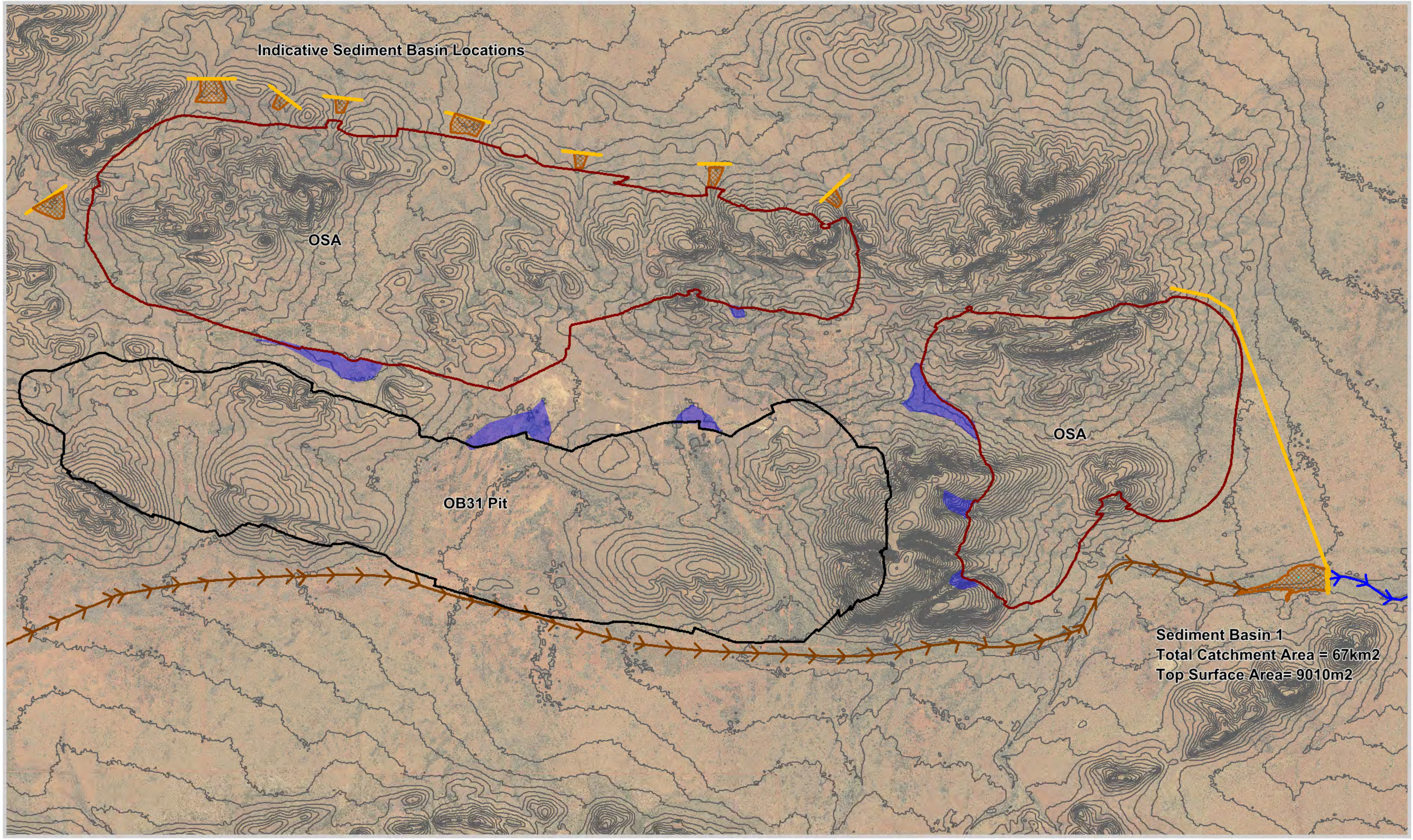
- Indicative OSA
- Indicative Pit Outline
- 2D Model Extent
- Contour (2m)
- Creek

RPS

FIGURE 4

100 YEAR POST - DEVELOPMENT FLOOD EXTENT

Location: F:\Jobs\1642\Spatial_Data\MapInfo\Workspaces\004a Figures



N

0 400 800

Metres

Scale: 1:20,000 @A3

GDA 1994 Zone 51

AUTHOR: RW	REPORT NO: 004
DRAWN: NK	REVISION: B
DATE: 01/08/14	JOB NO: 1642D

Location: F:\Jobs\1642\Spatial_Data\MapInfo\Workspaces\004a Figures

LEGEND

- Indicative OSA
- Indicative Pit Outline
- Sedimentation Basin
- Potential Ponding against Pit & OSA boundaries
- Earth Bunds
- Dirty Water
- Clean Water
- Contour (2m)

RPS

FIGURE 5

SEDIMENT CONTROL STRATEGY