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7 June 2013

Ms Parveen Bauer
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Dear Parveen

GINDALBIE METALS LTD – DESKTOP SURFACE WATER AND STORMWATER MANAGEMENT STUDY FOR THE HINGE PROJECT – SUMMARY OF CONCLUSIONS

Attached is a copy of the Desktop Surface Water and Stormwater Management Study produced by Gilbert and Sutherland in June 2013 for the Hinge Iron Ore Project (HIOP).

A summary of conclusions from this report is as follows:

This report outlines the water quantity and quality management measures required to satisfy the known objectives and requirements of the Project as well as the relevant Government guidelines and standards.

- Stormwater quantity was assessed by hydrological and hydraulic methods based on the underlying principle of separation and management of waters with different potential quality.
- Runoff from undisturbed areas (clean water) is best managed via diversion channels to redirect flows back into natural drainage lines downstream.
- Runoff from areas with the potential to exhibit elevated turbidity/sediment levels (site runoff) is managed via a system of mine run-off diversion channels and sediment basins.
- A total of fifteen (15) and six (6) clean water and site runoff diversion channels have been proposed within the project area respectively.
- Following the IECA guidelines it was determined that four (4) Type D sediment basins are required for collection of stormwater across the site. (Refer to Table 6.1.2.1 for basin volumes).
- To control potential spills on the site, it is recommended that particular catchment areas be bunded, including ROM and the Yard. These bunded areas should be capable of holding a 1-in-20 year flood event 72- hour storm event and 110% of tank contents as specified in the DME Water Quality Protection Guidelines No. 6 – Mining and Mineral Processing.
- In order to provide a level of immunity to inundation, cross-road drainage infrastructure has been conceptually sized for a 20 year ARI. A total of five (5) sets of culverts have been proposed throughout the project area. These culvert arrangements (infrastructure) range from 2x 300mm RCP to 3 x 450mm RCP.

- As per the DME water quality guideline, runoff from uncontaminated catchments, such as the waste area, may be used onsite for:
  - Process water make-up.
  - Cooling water.
  - Fresh water supply.
  - Rehabilitation.
  - Dust suppression.

We trust that this is sufficient for your current requirements.

Please let me know if you have any queries or require any additional information.

Yours sincerely

KNASAN PADAYACHEE
Project Leader - Civil

PROJECT

DESKTOP SURFACE WATER AND STORMWATER MANAGEMENT STUDY - HINGE IRON ORE PROJECT SHIRE OF PERENJORI WESTERN AUSTRALIA

PREPARED FOR

PRITCHARD FRANCIS PTY LTD

DATE

JUNE 2013

GILBERT SUTHERLAND

DOCUMENT CONTROL

DOCUMENT 11133 SWA RBS2F.docx

TITLE Desktop Surface Water and Stormwater Management Study - Hinge Iron Ore Project, Shire of Perenjori, Western Australia

PROJECT MANAGER Blake Stephens

AUTHOR(S) Blake Stephens

CLIENT Pritchard Francis Pty Ltd

CLIENT CONTACT Knasan Padayachee – Pritchard Francis Pty Ltd

SYNOPSIS This report describes desktop stormwater quantity and quality assessments undertaken in respect of the Hinge Iron Ore Project (HIOP) in the Shire of Perenjori, Western Australia to ensure the management of stormwater runoff from the development meets government requirements.

REVISION HISTORY

REVISION #	DATE	EDITION BY	APPROVED BY
1	09/04/13	B. Stephens	C. Anderson & L. Varcoe
2	11/04/13	B. Stephens	C. Anderson & L. Varcoe
3	11/04/13	B. Stephens	C. Anderson & L. Varcoe
4	07/06/13	B. Stephens	C. Anderson & L. Varcoe

DISTRIBUTION

	REVISION NUMBER									
Distribution	1	2	3	4	5	6	7	8	9	10
Gindalbie Metals Ltd	-	-	1	1						
Pritchard Francis Pty Ltd	2	2	2	2						
G&S file	2	2	2	2						

SUMMARY

Pritchard Francis Pty Ltd, on behalf of Gindalbie Metals Ltd, commissioned Gilbert & Sutherland Pty Ltd (G&S) to prepare a Desktop Surface Water and Stormwater Management Study for the proposed Hinge Iron Ore Project – HIOP (the project) mine site in the Shire of Perenjori, Western Australia.

This report outlines the conceptual water quantity and quality management measures for the proposed mine to meet approval objectives and requirements, as well as known operational requirements of the Project.

The desktop study described by this report has been undertaken in two stages:

- The calculation and provision of preliminary layout and sizing details for management of stormwater quantity; and
- Appropriate stormwater quality management advice in respect of the proposal, as amended for the purposes of incorporating initial stormwater quantity management measures.

Conceptual details for management of stormwater quantity were developed using the XP-Storm computer modelling software to define expected peak rates of stormwater flow at key locations around the Project site under specific design rainfall conditions. Assessment of peak flows associated with rainfall ranging between the 1-year Average Recurrence Interval (ARI) event and the 100-year ARI event was undertaken, with preliminary design of management measures based on appropriate guidelines for flood immunity and conveyance.

The stormwater quality management approach was developed based on the following well-founded principles:

(i) Separation of runoff of different quality (e.g. runoff from disturbed and undisturbed areas).
(ii) Interception and diversion of “clean” runoff around disturbed areas of the site and its return to natural drainage paths.

(iii) Interception and capture of runoff from disturbed areas and/or those areas with potential contaminants (e.g. hydrocarbons).
(iv) Treatment (e.g. settlement of sediment), release and/or re-use (where possible) of captured water from disturbed areas.

Conceptual details of stormwater quality management measures were determined in accordance with the WA Department of Minerals and Energy (DME) *Water Quality Protection Guidelines No. 6 – Mining and Mineral Processing* and the International Erosion Control Association (IECA) *Best Practice Erosion and Sediment Control* guidelines.

+GILBERT SUTHERLAND

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11133.06	Proposed road drainage infrastructure
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GLOSSARY

TERM	MEANING
Australian Height Datum (AHD)	National reference for relative height measurement in Australia.
Average Recurrence Interval (ARI)	The average or expected length of time between exceedance of a given variable, such as rainfall.
Catchment	The area above a given point which contributes to the runoff.
Clay	Very fine-grained sediment or soil (often defined as having a particle size less than 0.002 mm, or 2 microns, in diameter).
Ephemeral	A stream that flows briefly only in direct response to precipitation in the immediate locality and the channel of which is at all times above the watertable.
Erosion	The process by which material (such as rock or soil) is worn away or removed (as by wind or water).
Intermittent	A stream in which the flow is seasonal, usually in response to rainfall in the immediate area (see ephemeral).
Loam	Medium-textured soil composed of approximately 10% to 25% clay, 25% to 50% silt and less than 50% sand.
Sand	Sediment composed of particles within the size range 63 microns to 2 millimetres.
Scouring	The action of removing sediment from stream banks, particle by particle. This is a more destructive process than collapse when viewed over time due to incremental effects.
Sediment	Unconsolidated, fine-grained material (typically derived from the weathering of rocks), that is transported by water and settles on the floor of seas, rivers streams and other bodies of water.
Silt	Sediment having particles finer than sand and coarser than clay (i.e. 2 to 63 microns).
Sub-catchment	A smaller area within a catchment drained by one or more tributaries of the main water body.

1 Introduction

Pritchard Francis Pty Ltd, on behalf of Karara Mining Limited (KML), commissioned Gilbert & Sutherland Pty Ltd (G&S) to prepare a Desktop Surface Water and Stormwater Management Study for the proposed Hinge Iron Ore Project – HIOP ('the Project') in the Shire of Perenjori, Western Australia.

This report outlines conceptual stormwater water quantity and quality management measures required to satisfy the known objectives and requirements of the Project as well as the relevant Government guidelines and standards.

This report is divided into sections providing a description of the Project, the main physical characteristics of the site, an assessment of the likely stormwater runoff quantities and quality and recommendations for managing stormwater discharge from the site.

2 Site description and development proposal

2.1 Location

The site of the proposed mine is Lot 4415 on Plan 37543, in the Shire of Perenjori, as shown on Drawing No. 11133.01. The site is approximately 215km east of Geraldton and 320km north north-east of Perth in the mid-west region of Western Australia.

2.2 Site description vegetation and topography

The study area has a total area of approximately 672ha. The Hinge Project encompasses mining tenements, tenement application M59/748, that resides over the current tenements E59/817 and E59/1170.

The survey area is located within the Yalgoo-Singleton Archaean greenstone belt.

The general topography of the site consists of a north-easterly oriented ridge running through the central portion of the site, with gentle sloping sides that would convey site runoff both to the east and west. The ridge consists of shallow stony soils (<50 cm), with some outcropping flanked by alluvial and sand plains.

The largest external catchment that contributes runoff to the site is situated to the north-east. Flows from that catchment discharge in a south-south-westerly direction into the site. Site discharges are across the site's eastern, southern and western boundaries. The existing site contours are shown on Drawing No. 11133.03.

2.3 Climate data

Climate data relevant for the site held by the Bureau of Meteorology (BoM) comprises:

- Intensity-frequency-duration (IFD) data as detailed in Section 3 below.
- Daily rainfall data for the closest station to the Project site – some 80 years (1928 to 2008) of rainfall data for the Karara rainfall station (Stn No 10195).

Design temporal rainfall patterns for application to IFD information were sourced from AR&R (1998).

2.4 Receiving environment

The site lies within the Yarra Yarra Catchment Basin. The Yarra Yarra catchment is some 41,880km^2 in area and incorporates the shires of Mt Magnet, Yalgoo, Morowa, Perenjori, Dalwiallinu, Wongan-Ballidu and Koorda.

2.5 Proposed development

The total study area is approximately 672ha, with a proposed disturbance area of 90ha. The proposed Project layout extent is shown on Drawing No. 11133.02.

The Project consists of:

- one open-cut pit
- a waste dump
- ancillary infrastructure (e.g. ROM pads, plant area) with a total footprint of 36ha.

Approximate areas of the project components are shown in Table 2.5.

Table 2.5 Approximate area of project components

Feature	Area (ha)
Pits	34.06
Abandonment bund	3.90
Run of mine (ROM) pad	27.34
Contractor’s yard	9.87
Turkey’s nest	3.98
Waste dump	84.06
Road to contractor yard	11.21
Connection road to ROM pad	1.05
Haul road to ROM pad	4.29
Haul road to waste dump	2.47
Topsoil Stockpile	19.02
Connection road to Turkey’s Nest	0.92
Haul road contractor yard to ROM	6.29
Haul road to pit	7.21

3 Stormwater quantity assessment method

3.1 Hydrological assessment

Hydrological assessment was carried out to determine preliminary peak flows from the site under a range of design rainfall events. The assessment was undertaken using an XP Storm model. XP Storm is a software package for dynamic modelling of stormwater and river systems. It simulates natural rainfall-runoff processes and the performance of engineered systems that manage water resources. It also simulates flow in engineered and natural systems including ponds, rivers, lakes and floodplains.

The hydrologic simulations are provided in the Runoff component of the model. The Runoff component uses catchment information (including area, imperviousness and slope) to predict time varying runoff hydrographs. The Runoff simulation is driven by user-defined precipitation data.

The local catchment hydrographs for this study were generated for Average Recurrence Intervals (ARI's) of 1, 10, 20, 50 & 100 year for the 1, 2, 5, 12, 24, 36, 48 & 72 hour storm durations. The resulting runoff hydrographs were used to size diversion channels and cross-road drainage infrastructure to meet the relevant water management and Project approval requirements.

The XP Storm model is flexible in its data requirements and is able to produce satisfactory results with the following data input:

- local IFD coefficients
- design temporal patterns
- sub-catchment areas
- impervious areas
- catchment slope
- impervious/pervious losses
- surface roughness (Manning's n).

3.1.1 Local intensity frequency duration data

The rainfall intensities for the simulation of the design rainfall events were determined using the Bureau of Meteorology (BOM) Rainfall IFD Data System. Details of the resulting IFD coefficients for the location 29.05S 116.875E are summarised in Table 3.1.1.

3.1.2 Design temporal patterns

The design temporal patterns for the simulation of the design rainfall events were calculated in accordance with AR&R (1998) Book 2.

3.1.3 Catchment areas

The existing drainage characteristics of the

Table 3.1.1. Rainfall intensities (mm/hr) from the Bureau of Meteorology Rainfall IFD Data System (location 29.05S 116.0875E)

Duration	ARI (years)						
	1	2	5	10	20	50	100
5 mins	43.3	58.2	81.7	98.1	119.8	151.6	178.4
6 mins	40.2	54.0	75.9	91.1	111.3	140.8	165.7
10 mins	32.2	43.2	60.5	72.5	88.4	111.6	131.2
20 mins	22.8	30.5	42.3	50.5	61.4	77.1	90.4
30 mins	18.1	24.2	33.5	39.9	48.4	60.7	71.0
1 hour	11.9	15.8	22.0	26.1	31.7	39.6	46.2
2 hours	7.32	9.77	13.49	16.06	19.46	24.39	28.52
3 hours	5.50	7.35	10.16	12.10	14.67	18.41	21.53
6 hours	0.07	4.49	6.23	7.44	9.04	11.37	13.32
12 hours	0.02	2.75	3.84	4.59	5.61	7.08	8.31
24 hours	0.0	1.7	2.4	2.8	3.5	4.4	5.2
48 hours	0.0	1.0	1.4	1.7	2.1	2.7	3.2
72 hours	0.0	0.7	1.0	1.2	1.5	2.0	2.4

Project site and surrounds were defined and are shown in Drawing No. 11133.03. The impervious areas of the catchments have been estimated based on the site layout data submitted by Karara Mining Limited (KML) as at 18 March 2013 and Google earth imagery.[1]

The catchment areas and impervious percentage for each of the sub-catchments for the existing scenario and 'end-of-operation' development cases are presented in Appendix 2. The existing scenario delineates 18 sub-catchments while the end-of-operation scenario delineates 34 sub-catchments.

Drawing Nos 11133.03 and 11133.04 graphically present the existing and end-of-operation catchment boundaries for the XP-Storm model.

Impervious percentage for the existing scenario was determined as 0% for all catchments, as no hard surfaces were present on site. Similar to the existing catchment percentage impervious, the majority of the end of operation percentage impervious assumptions were attributed a value of 0. While the proposed haul roads will be gravel (and therefore assumed to be 0% impervious), some of the developed pads (i.e. ROM/yard/etc) have been assumed to be 80% impervious.

3.1.4 Initial and continuing losses

The method described in ARR (1998) for the calculation of initial and continuing losses for Western Australia was adopted for use within the hydrologic model and presented in this section.

From Table 3.3 of the ARR (1998) Book 2, the design loss rates for the wheatbelt region were adopted as follows:

$$IL_5 = 700P^{-0.47}.L^{-0.88}$$

Where:

IL_5 = Initial loss for the 5 year ARI

P = annual precipitation[2] (310.9mm/yr)

L = Mainstream Length (km)

Table 3.1.4.1 presents the calculated IL corresponding to their ARI event.

Table 3.1.4.1 Initial Losses for their corresponding ARI event

ARI (yrs)	Multiplier	Initial Loss (mm)
1	1	41
2	0.78	32
5	1	41
10	1.09	45
20	0.95	39
50	1	41
100	1	41

A point to note is that the tabulated initial loss values above have been calculated based on recommended methods within AR&R (1998) for the wheatbelt region. Whilst this represents the most appropriate methodology for initial planning purposes (consistent with a desktop study), actual loss behavior can vary markedly dependent on more localised, specific soil, topographical and vegetation conditions. Final design should be informed by actual site-specific conditions (in particular infiltration characteristics) in the selection of inputs assumptions.

3.2 Hydraulic assessment

3.2.1 Conceptual diversion channels

The approach to conceptual mine site water management detailed in this report is based on the underlying principle of separation and management of waters with different potential quality. Runoff from undisturbed areas ("clean water") is best managed via diversion around more disturbed areas of the Project site. Runoff from areas with the potential to exhibit elevated turbidity/sediment levels ("site runoff") is managed via a system of mine run-off diversion channels and sediment basins to reduce sediment loads via settlement and re-use.

[1] Source: Google Earth Imagery taken on the 21/03/2006, Alt 400m.

[2] Source: BOM data for Karara Station (st no. 10195).

To maintain separation of clean stormwater from site runoff, a series of diversion channels have been proposed. These would divert clean water around the disturbed areas (waste dump/ROM pad/etc) and then re-direct flows back into the natural drainage lines downstream of the disturbed areas. The following section describes the assumptions made in designing the diversion channels.

The manning's equation has been used to design a series of conceptual diversion channels around the site and is presented below.

$$Q= 1/n\ (A.R^{2/3}.S^{1/2})$$

Where:

Q = Peak flow (m^3/s)

n = manning's n

A = Area of channel/pipe

R = Hydraulic Radius

S = Slope

Appendix 4 summarises the parameters used in the conceptual design of diversion channels based on the contributing flows estimated from the hydrological model. Note that these diversion channels have been sized for a 100 year ARI to ensure conservatism at this preliminary stage. Note that clean water and mine run-off diversion channels have been separately sized to convey the external and developed stormwater respectively.

3.2.2 Conceptual cross-road drainage infrastructure

The proposed mine site includes proposed haul roads to provide access to the Pit, ROM pads, waste dump and other key mine site infrastructure. Some of these haul roads intersect existing flow paths and low areas.

To provide a level of immunity to inundation, cross-road drainage infrastructure has been conceptually designed, again using the manning's equation above. Appendix 4 summarises the parameters used to design the cross-road drainage infrastructure based on their contributing flows. Note that this infrastructure has been sized for a 20 year ARI.

4 Stormwater quantity assessment results

4.1 XP-storm hydrologic results

The results of the XP-Storm hydrological modelling are presented within this section.

4.1.1 XP-storm hydrologic results

The model results of the hydrologic simulation for the existing and end-of-operation scenarios are presented in Appendix 3.

Reported outcomes include maximum peak flow for each separate sub-catchment for both the existing and end-of-operation scenarios.

4.2 Hydraulic results

4.2.1 Conceptual diversion channels

The hydrologic results discussed above were used directly to design the diversion channels. Clean water diversion channels are proposed to deal with the clean water (i.e. runoff from undisturbed and undeveloped areas) and site runoff diversion channels proposed for the disturbed areas of the proposed development (i.e. waste dump/contractors yard/etc.).

A total of fifteen (15) and six (6) clean water and site runoff diversion channels have been proposed within the project area respectively and have been shown in Drawing No. 11133.05. Due to the substantial amount of tabulated information, diversion channel characteristics for the clean water and mine run-off channels are provided in Appendix 4. Information provided includes conceptual design parameters such as channel name, required capacity, Manning's n, grade, bed width, side slope, depth, top width, velocity and flow capacity.

Overall, the channel dimensions range from a 1m base, 0.2m depth, at 1 in 4 side slopes to a 1m base, 1.3m depth, at 1 in 4 side slope to convey its contributing Q100 flow rate.

4.2.2 Conceptual cross-road drainage infrastructure

The hydrologic results discussed above were used directly to design the cross-road drainage infrastructure. Appendix 4 summarises the required cross-road drainage infrastructure characteristics for each corresponding catchment.

A total of five (5) sets of culverts have been proposed throughout the project area. These culvert arrangements (infrastructure) range from 2 x 300mm RCP to 3 x 450mm RCP.

5 Stormwater quality assessment methods

Requirements for stormwater quality management were determined in accordance with the WA Department of Minerals and Energy (DME) *Water Quality Protection Guidelines No. 6 – Mining and Mineral Processing* and the International Erosion Control Association (IECA) *Best Practice Erosion and Sediment Control* guidelines.

5.1.1 Determination of basin requirements

Following the IECA guideline, catchment sizes, slopes and sediment types were assessed to determine the need for basins, the type of basins required and their approximate locations throughout the site.

5.1.2 Sizing of onsite basins

Once the requirement for basins in individual catchments had been determined, each basin was then sized. A number of factors were considered in the sizing of basins, including:

- catchment size
- catchment slope and length
- basin design life
- rainfall intensity values
- volumetric runoff coefficients
- IFD coefficients
- sediment storage volume and
- soil erodibility factors.

Rainfall intensity values, volumetric coefficients, sediment storage volume and soil erodibility factors were as provided in the IECA guideline. The IFD coefficients were obtained from the Bureau of Meteorology Rainfall IFD Data System (location 28.800S 116.925E).

Details of the IFD for the site are summarised in Section 3, Table 3.1.1.

Standard conceptual drawings, addressing installation, maintenance and advice in respect of stormwater quality improvement devices, are provided in Appendix 5.

6 Stormwater quality assessment results

6.1.1 Determination of basin requirements

Following the IECA guidelines it was determined that Type D sediment basins were required for collection of stormwater across the site. Wherever possible, clean water from undisturbed catchment areas should be diverted around disturbed areas. Run-off from disturbed areas should be captured in onsite basins.

6.1.2 Sizing of onsite basins

Basin sizes were calculated inline with the IECA Best Practice Erosion and Sediment Control guidelines. The required basin volumes are presented below in Table 6.1.2.1.

Table 6.1.2.1 Basin volumes for site catchments

Basin	Catchment name	Catchment area (ha)	Volume (m^3)
SB1	Turkey's Nest	3.07	875
SB2	Yard	9.97	2841
SB3	ROM	25.1	7154
SB4	Waste	32.85	9362

Basins must be constructed to no more than 2m in depth (a depth of 1.5m is preferred) with 1 in 3 length to width ratio sides. Basin dimensions were calculated on a depth of 1.5m. The approximate dimensions of the basins are presented in Table 6.1.2.2.

6.1.3 Other storage requirements

To control potential spills on the site, it is recommended that particular catchment areas be bunded, including ROM and the Yard. These bunded areas should be capable of holding a 1-in-20 year 72-hour storm event and 110% of tank contents as specified in the DME *Water Quality Protection Guidelines No. 6 – Mining and Mineral Processing*.

Due to the naturally low levels of sulfidic material in Western Australian soils, it is assumed that the acidification of stormwater will not be an issue on this site. If waste proves to be acid-forming, site water management would require appropriate modification.

Table 6.1.2.2 – Approximate basin dimensions

Basin	Particulars (approximate)
SB1 (Turk) Catchment area 3.07ha	Volume: 875m^3
	Surface area: 850m^2 Length: 51m Width: 17m
	Base area: 325m^2 Length: 42m Width: 8m
SB2 (Yard) Catchment area 9.97ha	Volume: 2841m^3
	Surface area: 2360m^2 Length: 84m Width: 28m
	Base area: 1431m^2 Length: 75m Width: 19m
SB3 (ROM) Catchment area 25.1ha	Volume: 7154m^3
	Surface area: 5500m^2 Length: 129m Width: 43m
	Base area: 4040m^2 Length: 120m Width: 34m
SB4 (Waste) Catchment area 32.85ha	Volume: 9362m^3
	Surface area: 7080m^2 Length: 146m Width: 49m
	Base area: 5412m^2 Length: 137m Width: 40m

6.1.4 Stormwater use onsite

As per the DME water quality guideline, runoff from uncontaminated catchments, such as the waste area, may be used onsite for:

- Process water make-up,
- Cooling water,
- Fresh water supply,
- Rehabilitation, and
- Dust suppression.

7 Discussion

The conceptual design details reported here are based on adoption of standard, accepted guidelines and performance criteria, including recommended assumptions regarding physical characteristics, such as initial loss associated with rainfall events. Finalisation of design beyond the level of desktop study should be undertaken in the context of and informed by site-specific conditions, determined by site reconnaissance and review of the final Project layout design.

8 Conclusions

A desktop stormwater quantity assessment and management plan has been prepared by Gilbert & Sutherland. Stormwater quantity management measures should be installed as described in this report. Providing these are properly installed and maintained, appropriate flood flow conveyance and flood immunity (defined herein) can be achieved.

The modelling results are considered acceptable given that they are generally within the limits of accuracy of the model and the assumptions made in creating it.

Stormwater quality management objectives will be achieved providing the proposed management strategies are pursued in accordance with the principles referenced and the advice provided herein and are confirmed by site-specific investigations at the detailed design stage. The recommended stormwater quality management advice does not conflict with, but rather augments, previous conceptual strategies applicable to the site.

9 Appendix 1 – Drawings

SCALE
1:1 000 000 @ A3
10 20 30 40 50 kilometres

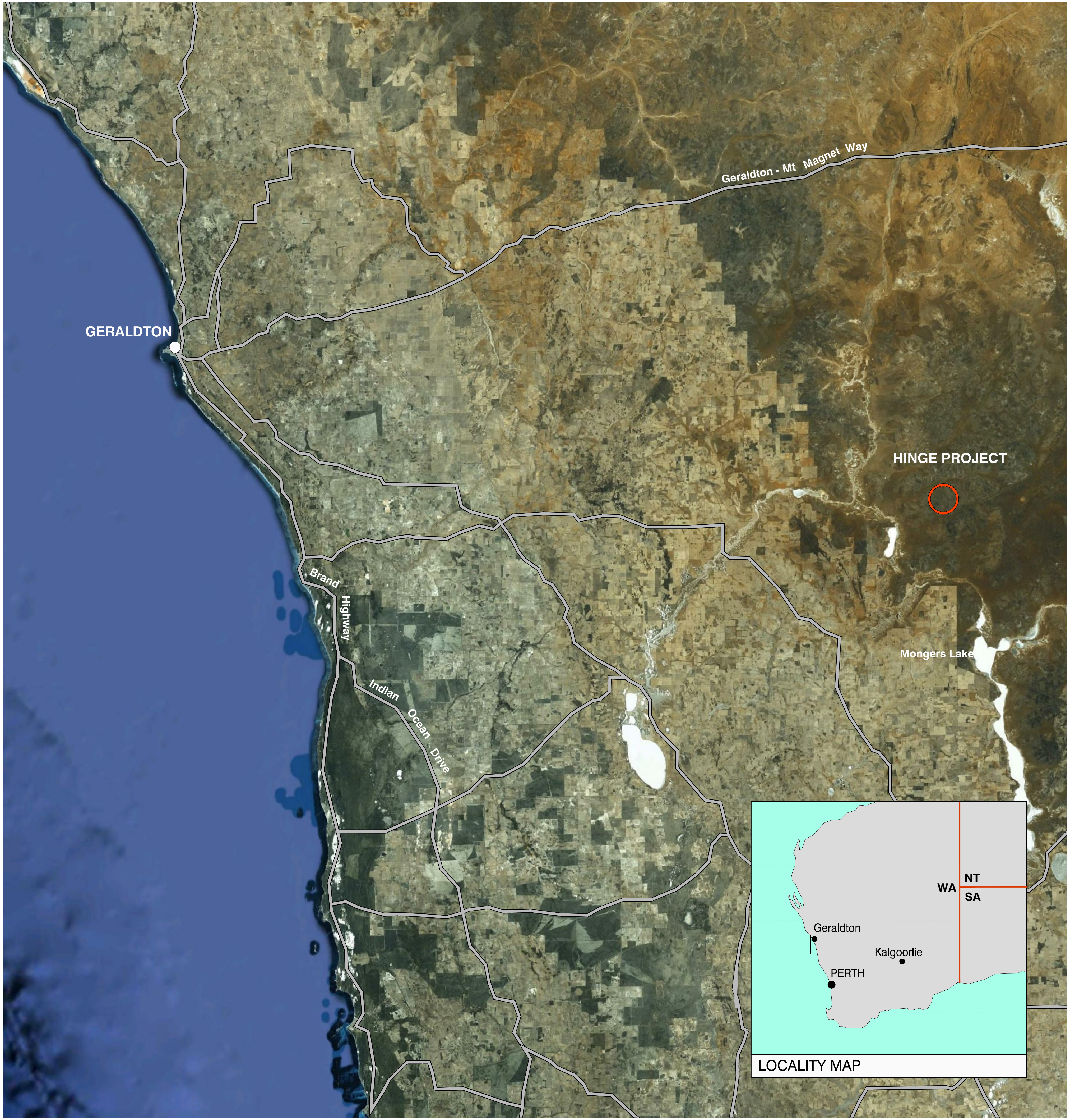
ORIENTATION
NORTH

LEGEND

Main roads

SOURCES

Image base: Google Earth Pro 2012,



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AGRICULTURE WATER ENVIRONMENT

GILBERT SUTHERLAND

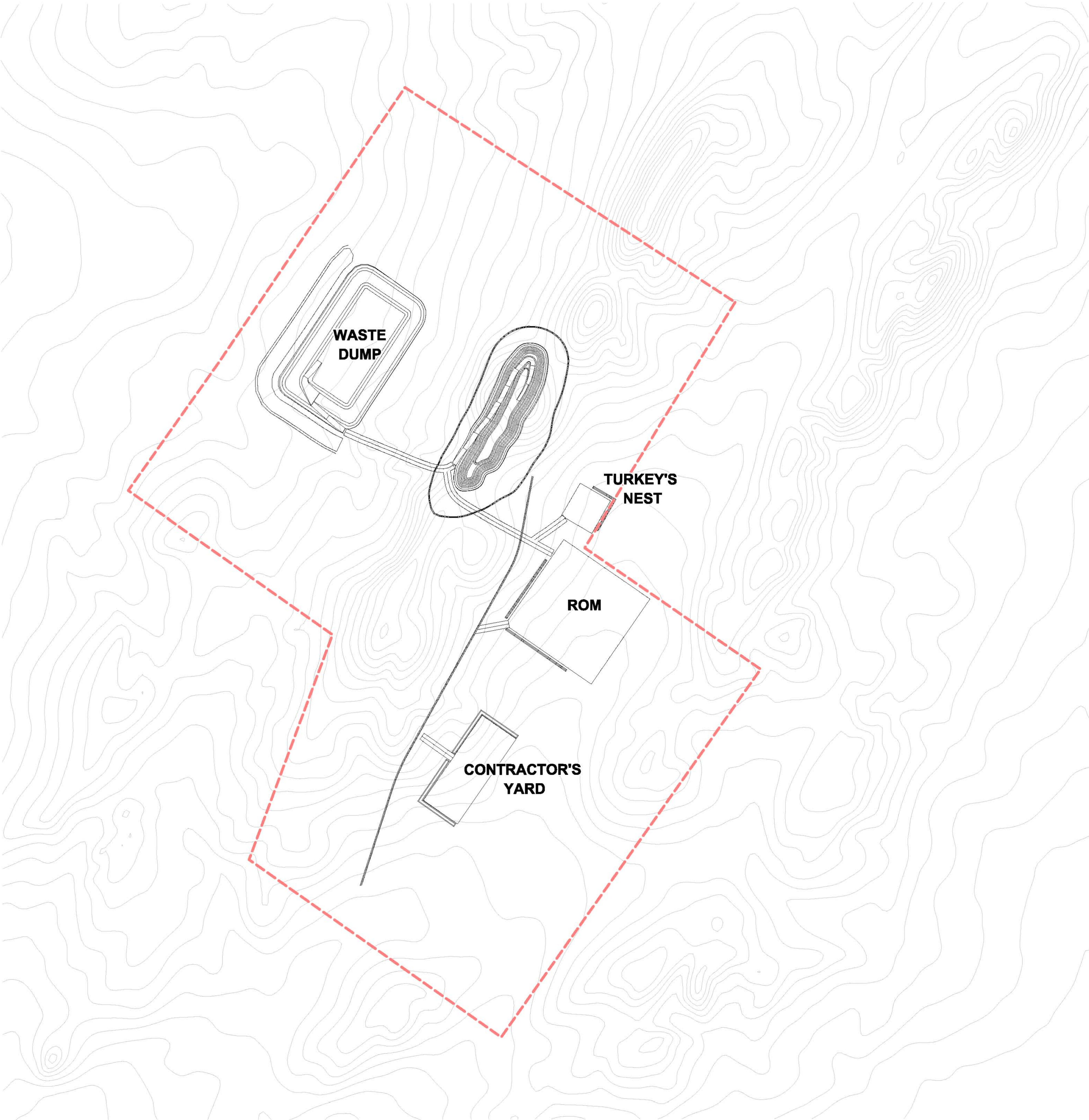
PROJECT
DESKTOP SURFACE WATER AND MANAGEMENT STUDY HINGE IRON ORE PROJECT SHIRE OF PERENJORI WA

CLIENT
PRITCHARD FRANCIS PTY LTD

DRAWING
SITE LOCATION

DATE 05/04/2013	DRAWN BWS
SCALE 1:1 000 000 @ A3	CHECKED CMA
PROJECT NO 11133	DRAWING NO 01

REVISION A



SCALE

1 : 20 000 @ A3

2000 4000 6000 8000 10000 metres

ORIENTATION

NORTH

SOURCES

Contour Source: Landgate -
1 : 250,000 series Topographical Mapping

LEGEND

Project area

Existing contours (2m)

Proposed Layout

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AGRICULTURE WATER ENVIRONMENT

PROJECT

DESKTOP SURFACE WATER AND STORMWATER MANAGEMENT STUDY
HINGE IRON ORE PROJECT
SHIRE OF PERENJORI
WESTERN AUSTRALIA

CLIENT

PRITCHARD FRANCIS PTY LTD

DRAWING

PROPOSED SITE LAYOUT AND PROJECT AREA

DATE		DRAWN
05/04/2013		BWS
SCALE		CHECKED
1:20 000 @ A3		CMA
PROJECT NO	DRAWING NO	REVISION
11133	02	A

SCALE
1 : 20 000 @ A3

ORIENTATION
NORTH

SOURCES
Contour Source: Landgate -
1 : 250,000 series Topographical Mapping

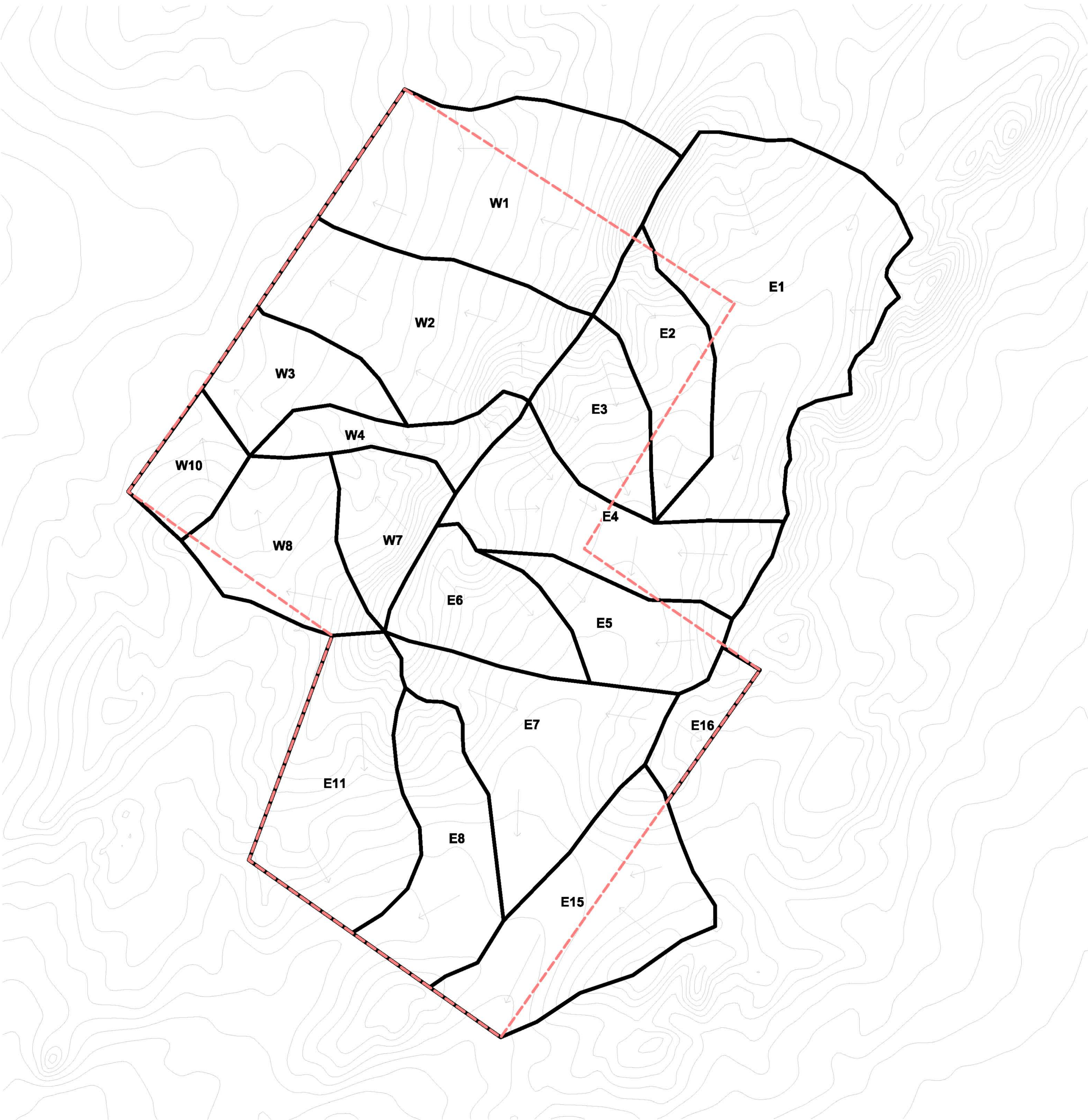
LEGEND

Project area

Existing catchment boundary

Existing contours (2m)

Existing overland flow direction



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AGRICULTURE WATER ENVIRONMENT

GILBERT SUTHERLAND

PROJECT
DESKTOP SURFACE WATER AND STORMWATER MANAGEMENT STUDY
HINGE IRON ORE PROJECT
SHIRE OF PERENJORI
WESTERN AUSTRALIA

CLIENT
PRITCHARD FRANCIS PTY LTD

DRAWING
EXISTING CATCHMENT PLAN

DATE		DRAWN
05/04/2013		BWS
SCALE		CHECKED
1:20 000 @ A3		CMA
PROJECT NO	DRAWING NO	REVISION
11133	03	A

SCALE
1 : 20 000 @ A3

2000 4000 6000 8000 10000 metres

ORIENTATION
NORTH

SOURCES
Contour Source: Landgate -
1 : 250,000 series Topographical Mapping

LEGEND

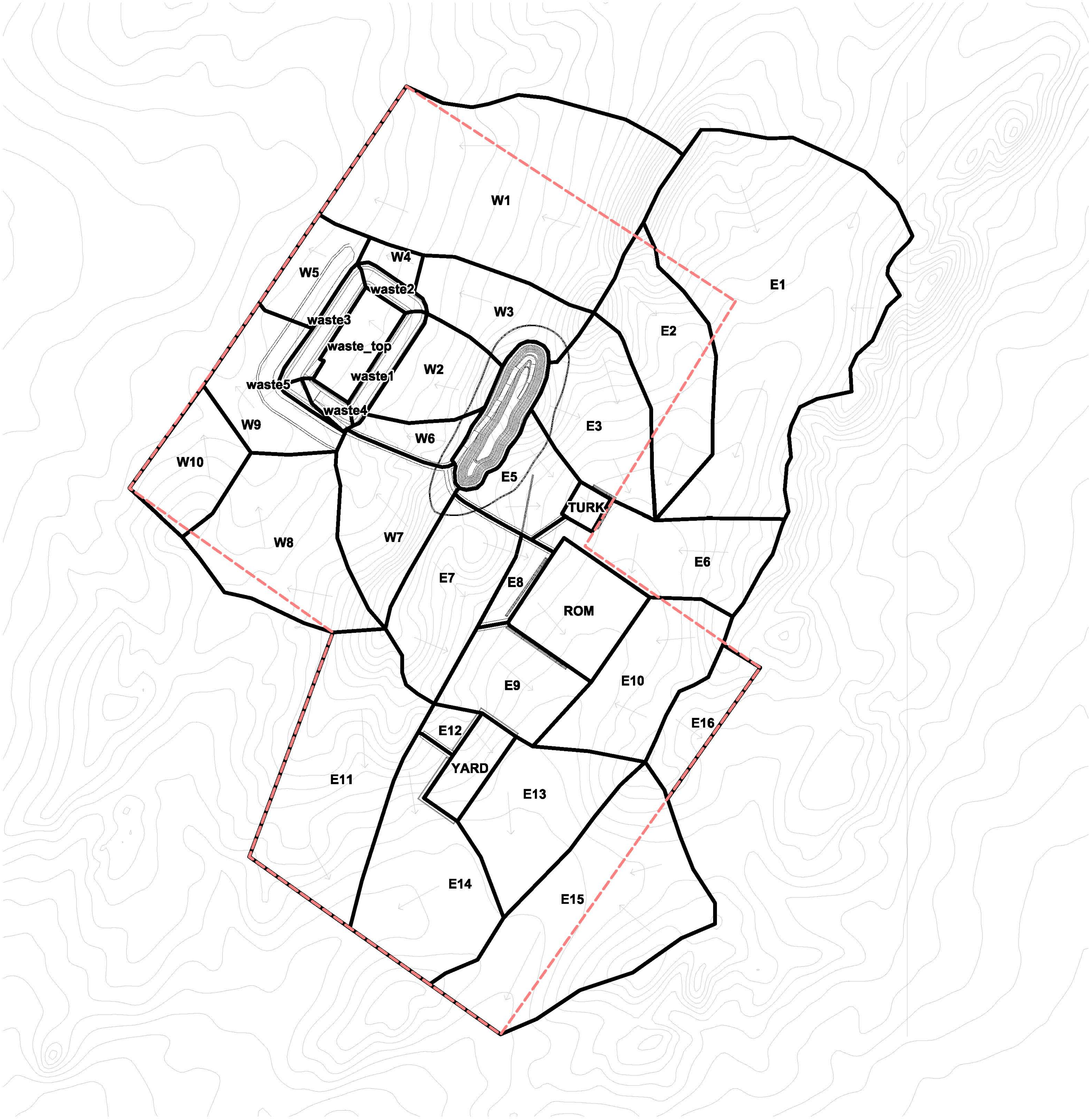
Project area

End of Operation catchment boundary

Design Contours

Existing contours (2m)

Developed overland flow direction



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CLIENT
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DRAWING
END OF OPERATION CATCHMENT PLAN

DATE		DRAWN
05/04/2013		BWS
SCALE		CHECKED
1:20 000 @ A3		CMA
PROJECT NO	DRAWING NO	REVISION
11133	04	A

2000 4000 6000 8000 10000
metres

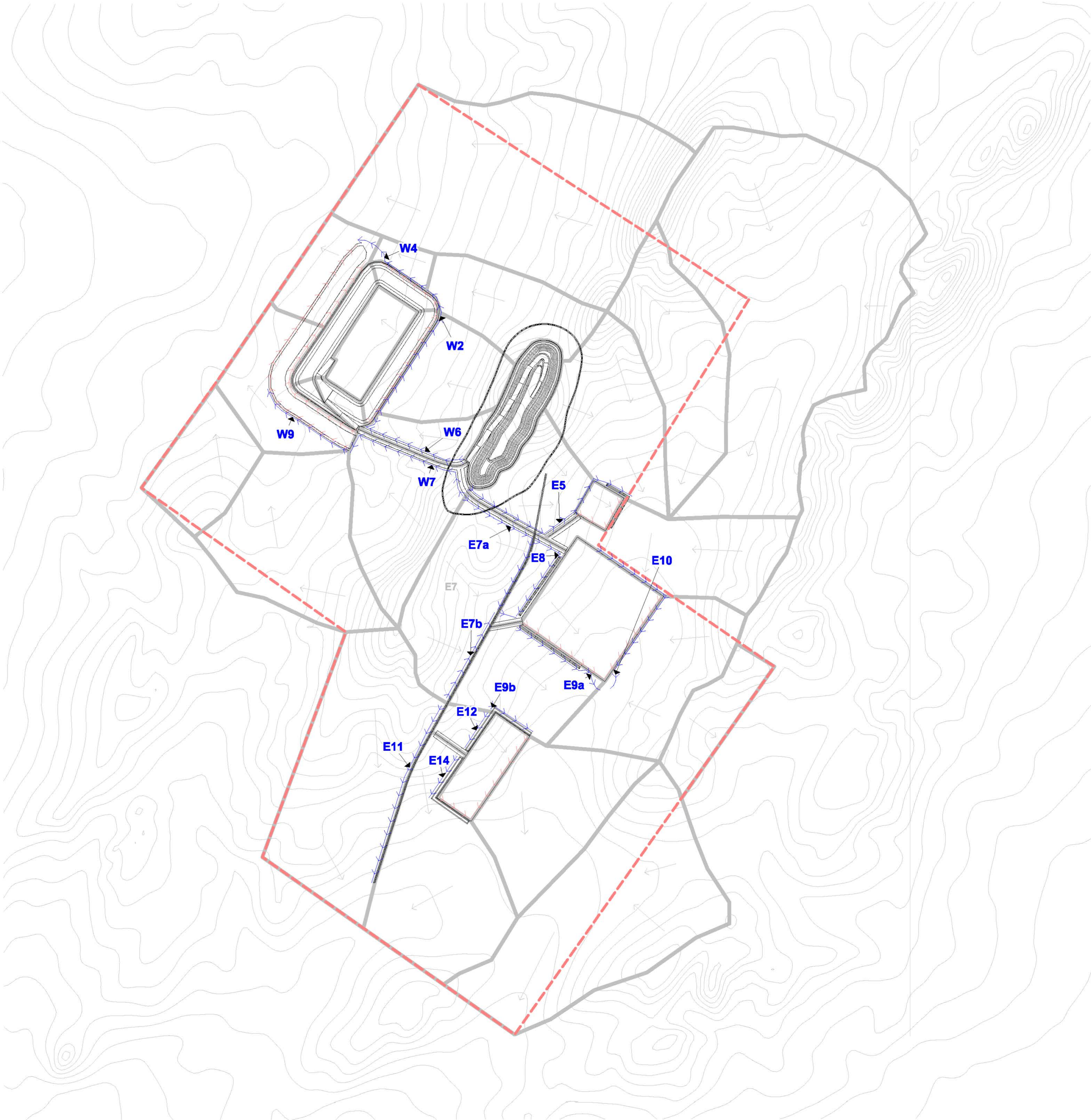
SCALE
1 : 20 000 @ A3

ORIENTATION
NORTH

SOURCES
Contour Source: Landgate -
1 : 250,000 series Topographical Mapping

LEGEND

- Project area
- End of Operation catchment boundary
- Design contours
- Existing contours (2m)
- Developed overland flow direction
- Conceptual clean water diversion channels
- Conceptual dirty water diversion channels



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HINGE IRON ORE PROJECT
SHIRE OF PERENJORI
WESTERN AUSTRALIA

CLIENT
PRITCHARD FRANCIS PTY LTD

DRAWING
PROPOSED DIVERSION CHANNELS

DATE	DRAWN
05/04/2013	BWS
SCALE	CHECKED
1:20 000 @ A3	CMA

PROJECT NO	DRAWING NO	REVISION
11133	05	A

2000 4000 6000 8000 10000
metres

SCALE
1 : 20 000 @ A3

ORIENTATION
NORTH

SOURCES
Contour Source: Landgate -
1 : 250,000 series Topographical Mapping

LEGEND

Project area

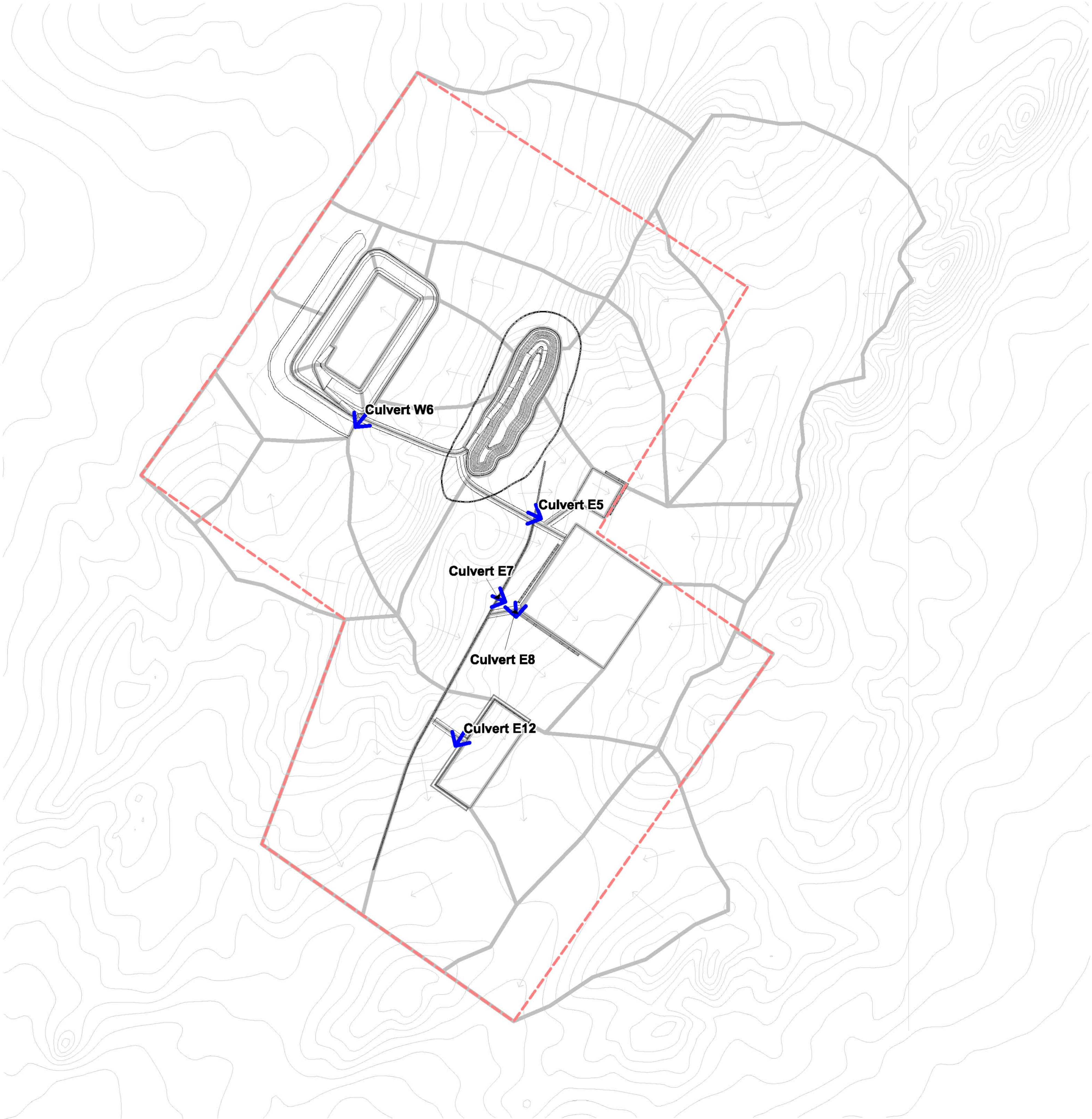
End of Operation catchment boundary

Design contours

Existing contours (2m)

Developed overland flow direction

Proposed cross-road drainage infrastructure



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PROJECT
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HINGE IRON ORE PROJECT
SHIRE OF PERENJORI
WESTERN AUSTRALIA

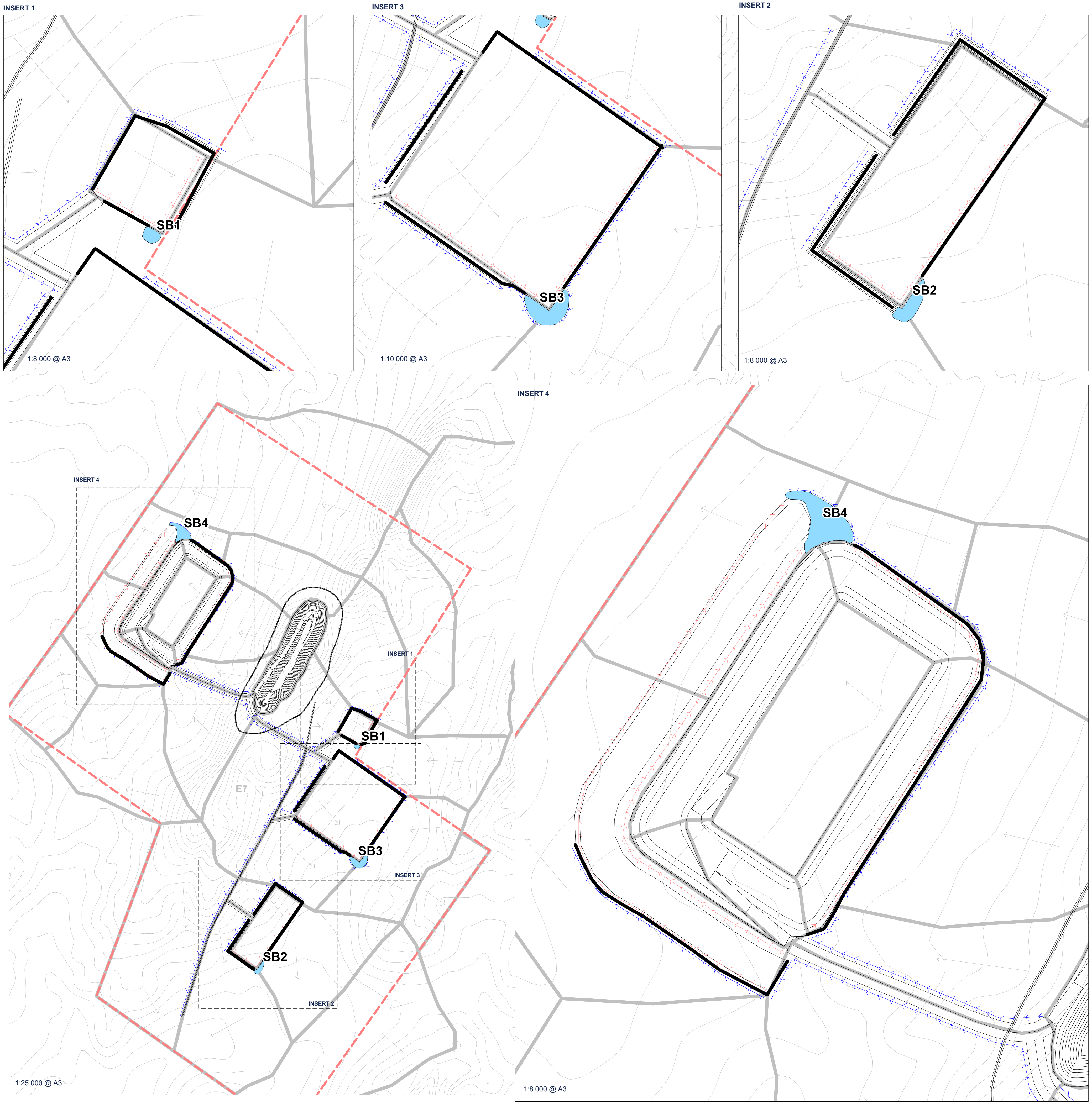
CLIENT
PRITCHARD FRANCIS PTY LTD

DRAWING
PROPOSED CROSS-ROAD DRAINAGE INFRASTRUCTURE

DATE	DRAWN
05/04/2013	BWS

SCALE	CHECKED
1:20 000 @ A3	CMA

PROJECT NO	DRAWING NO	REVISION
11133	06	A



100 200 300 400
metres

SCALE
1 : 8 000 @ A3

ORIENTATION
NORTH

SOURCES
Contour Source: Landgate -
1 : 250,000 series Topographical Mapping

LEGEND

- Project area
- End of Operation catchment boundary
- Design contours
- Existing contours (2m)
- Developed overland flow direction
- Conceptual clean water diversion channels
- Conceptual dirty water diversion channels
- Conceptual separation bund
- Conceptual sedimentation pond

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DESKTOP SURFACE WATER AND STORMWATER MANAGEMENT STUDY
HINGE IRON ORE PROJECT
SHIRE OF PERENJORI
WESTERN AUSTRALIA

CLIENT
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DRAWING
CONCEPTUAL WATER MANAGEMENT LAYOUT

DATE	DRAWN
05/04/2013	BWS
SCALE	**CHECKED**
1:8 000 @ A3	CMA

PROJECT NO	DRAWING NO	REVISION
11133	07	A

10 Appendix 2 – Catchment characteristics

Catchment Characteristics

Existing		
Catch	Area (ha)	Imp%
E1	145.2	0
E5	38.0	0
E11	75.7	0
E7	78.8	0
E8	55.6	0
E15	78.9	0
E16	15.6	0
E2	40.4	0
E3	35.8	0
E4	67.0	0
E6	41.3	0
W1	116.1	0
W10	21.8	0
W2	85.9	0
W4	24.8	0
W7	31.9	0
W8	49.7	0
W3	33.9	0

End of Operation		
Catch	Area (ha)	Imp%
E1	27.6	0
E10	17.8	0
E11	13.5	0
E12	4.0	0
E13	5.4	0
E14	8.1	0
E15	13.3	0
E16	1.7	0
E2	2.8	0
E3	20.6	0
E5	19.0	0
E6	19.6	0
E7	1.8	0
E8	3.3	0
E9	4.3	0
ROM	56.7	80
TURK	1.0	0
W1	4.7	0
W10	39.5	0
W2	9.6	0
W3	47.6	0
W4	21.2	0
W5	14.0	0
W6	16.3	0
W7	26.8	0
W8	28.8	0
W9	0.3	0
waste_top	22.5	0
waste1	22.9	0
waste2	11.7	0
waste3	4.5	0
waste4	14.7	0
waste5	12.6	0
YARD	1.7	80

11 Appendix 3 – Hydrologic results

Hydrologic Results

Existing

Catch	Q100	Q50	Q20	Q10	Q1
E1	3.70	2.07	1.07	0.13	0.00
E5	1.07	0.61	0.34	0.08	0.00
E11	1.96	1.15	0.66	0.14	0.00
E7	1.53	0.95	0.51	0.10	0.00
E8	1.40	0.84	0.48	0.10	0.00
E15	1.79	1.13	0.62	0.13	0.00
E16	0.70	0.35	0.17	0.05	0.00
E2	1.24	0.72	0.37	0.09	0.00
E3	1.29	0.70	0.35	0.09	0.00
E4	1.58	0.99	0.55	0.11	0.00
E6	1.41	0.78	0.40	0.10	0.00
W1	2.63	1.66	0.91	0.19	0.00
W10	0.74	0.41	0.21	0.05	0.00
W2	2.32	1.33	0.76	0.16	0.00
W4	0.93	0.50	0.25	0.07	0.00
W7	1.32	0.67	0.33	0.10	0.00
W8	1.30	0.76	0.43	0.09	0.00
W3	0.99	0.57	0.31	0.07	0.00

End of Operation

Catch	Q100	Q50	Q20	Q10	Q1
E1	3.70	2.07	1.07	0.13	0.00
E10	1.06	0.61	0.34	0.08	0.00
E11	1.80	1.04	0.60	0.13	0.00
E12	0.28	0.17	0.06	0.02	0.00
E13	0.87	0.55	0.30	0.06	0.00
E14	1.30	0.76	0.43	0.09	0.00
E15	1.79	1.13	0.62	0.13	0.00
E16	0.70	0.35	0.17	0.05	0.00
E2	1.24	0.72	0.37	0.09	0.00
E3	1.29	0.70	0.35	0.09	0.00
E5	0.76	0.38	0.19	0.06	0.00
E6	1.01	0.58	0.31	0.07	0.00
E7	1.27	0.68	0.34	0.09	0.00
E8	0.36	0.20	0.08	0.02	0.00
E9	0.79	0.45	0.23	0.06	0.00
ROM	1.63	1.39	1.18	0.96	0.41
TURK	0.19	0.11	0.04	0.01	0.00
W1	2.63	1.66	0.91	0.19	0.00
W10	0.74	0.41	0.21	0.05	0.00
W2	0.93	0.46	0.23	0.07	0.00
W3	0.94	0.50	0.25	0.07	0.00
W4	0.24	0.13	0.05	0.02	0.00
W5	0.37	0.21	0.11	0.01	0.00
W6	0.49	0.25	0.11	0.03	0.00
W7	1.33	0.68	0.34	0.10	0.00
W8	1.30	0.76	0.43	0.09	0.00
W9	0.81	0.47	0.24	0.06	0.00
waste_top	0.39	0.22	0.11	0.03	0.00
waste1	0.32	0.17	0.07	0.02	0.00
waste2	0.22	0.12	0.05	0.01	0.00
waste3	0.29	0.15	0.07	0.02	0.00
waste4	0.18	0.11	0.04	0.01	0.00
waste5	0.10	0.07	0.02	0.01	0.00
YARD	0.66	0.56	0.48	0.39	0.17

12 Appendix 4 – Hydraulic results

Clean Water Diversion Channel Design

	Units															
Catchment		**E5**	**E10**	**E7a**	**E7b**	**E8**	**E9a**	**E9b**	**E12**	**E14**	**E11**	**W7**	**W6**	**W2**	**W4**	**W9**
Required Q100 capacity	m³/s	0.758	9.256	0.6335	0.6335	0.364	2.0235	0.3925	0.282	1.58	1.803	0.6645	0.485	1.41	2.592	2.137
Manning n		0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Grade S	m/m	0.016	0.002	0.016	0.016	0.016	0.016	0.016	0.030	0.030	0.024	0.022	0.024	0.001	0.020	0.008
Bed Width	m	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
Side slope G	1 in G	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
Depth d	m	**0.3**	**1.3**	**0.3**	**0.3**	**0.2**	**0.6**	**0.3**	**0.2**	**0.4**	**0.4**	**0.3**	**0.3**	**0.7**	**0.5**	**0.6**
Top Width	m	1.2	5.2	1.2	1.2	0.8	2.4	1.2	0.8	1.6	1.6	1.2	1.2	2.8	2	2.4
Velocity v	m/s	1.39	1.16	1.37	1.37	1.1	2.06	1.39	1.52	2.23	1.98	1.61	1.7	0.66	2.05	1.46
Flow Q	m³/s	0.92	9.35	0.9	0.9	0.4	4.2	0.92	0.55	2.32	2.06	1.06	1.12	1.76	3.08	2.98

Mine Runoff Diversion Channel Design

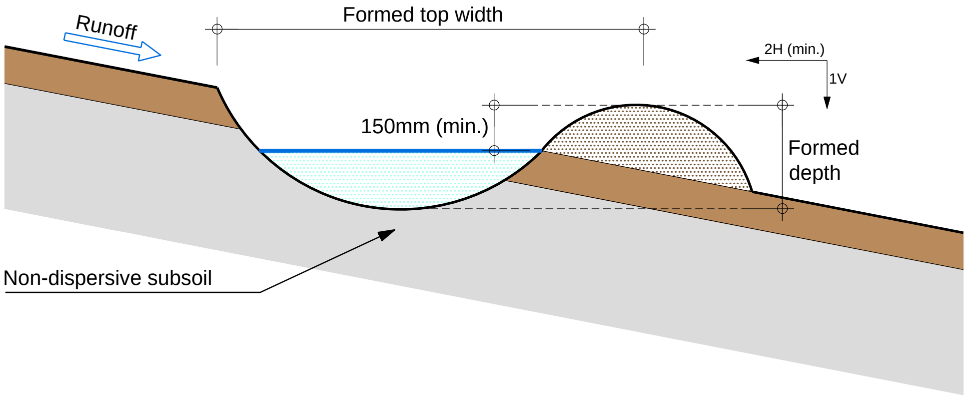
	Units						
Catchment		**Turkeys Nest**	**ROM**	**Yard**	**Waste1**	**Waste2**	**Top Soil**
Required Q100 capacity	m³/s	0.193	1.629	0.657	0.543	0.958	0.573
Manning n		0.03	0.03	0.03	0.03	0.03	0.03
Grade S	m/m	0.027	0.017	0.008	0.006	0.005	0.002
Bed Width	m	**1**	**1**	**1**	**1**	**1**	**1**
Side slope G	1 in G	**4**	**4**	**4**	**4**	**4**	**4**
Depth d	m	**0.2**	**0.4**	**0.3**	**0.3**	**0.4**	**0.4**
Top Width	m	0.8	1.6	1.2	1.2	1.6	1.6
Velocity v	m/s	1.43	1.7	1	0.84	0.95	0.62
Flow Q	m³/s	0.51	1.77	0.66	0.55	0.99	0.64

Road Drainage Infrastructure Design

	Units					
Catchment		**E5**	**E7**	**E8**	**E12**	**W6**
Required Q20 capacity	m³/s	0.19	0.341	0.422	0.064	0.11
Manning n		0.01	0.01	0.01	0.01	0.01
Grade S	m/m	0.01	0.01	0.01	0.01	0.01
Pipe size (dia)	m	**0.45**	**0.45**	**0.6**	**0.3**	**0.45**
number of pipes		**2**	**3**	**2**	**2**	**1**
Area	m²	0.16	0.16	0.28	0.07	0.16
Velocity v	m/s	2.31	2.31	2.81	1.76	2.31
Flow Q	m³/s	0.73	1.10	1.59	0.25	0.37

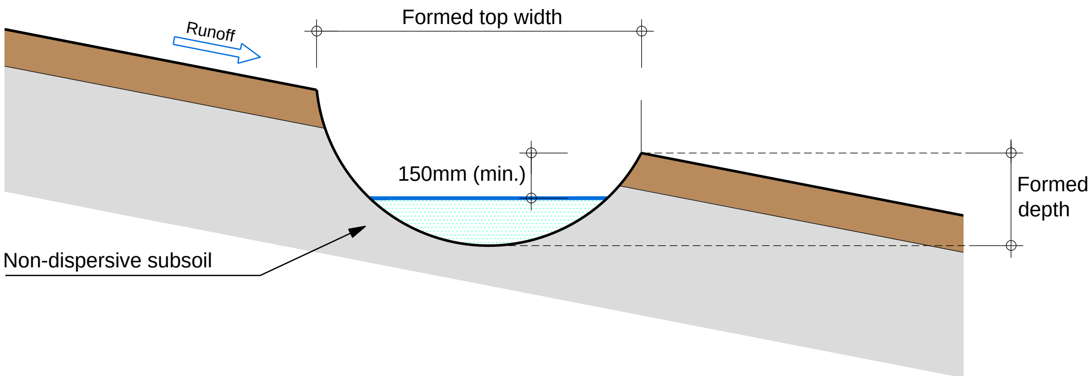
13 Appendix 5 – Standard drawings (G&S)

PARABOLIC CATCH DRAIN WITH DOWN-SLOPE BANK

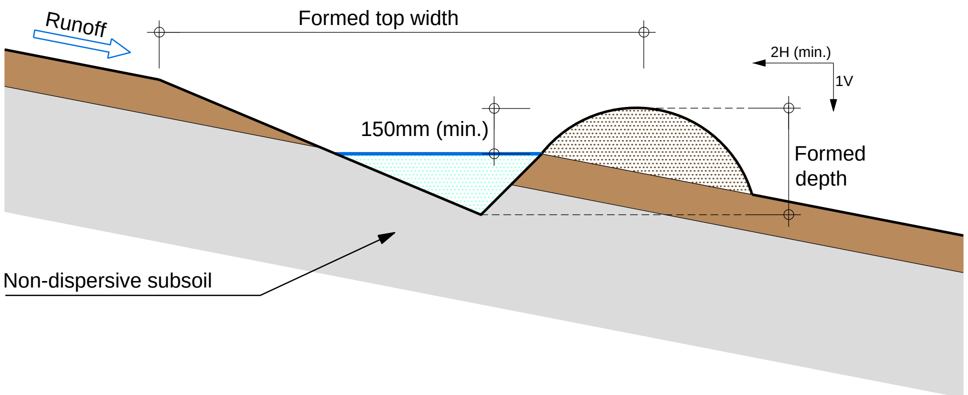


CONSTRUCTED DIMENSIONS OF PARABOLIC CATCH DRAINS		
Drain type	Formed top width with or without bank	Formed depth with or without bank
Type-A	1.60m	0.30m
Type-B	2.40m	0.45m
Type-C	3.60m	0.65m

PARABOLIC CATCH DRAIN WITHOUT BANK



TRIANGULAR V-DRAIN WITH DOWN-SLOPE BANK



CONSTRUCTED DIMENSIONS OF TRIANGULAR V- DRAINS		
Drain type	Formed top width with or without bank	Formed depth with or without bank
Type-AV	2.00m	0.30m
Type-BV	2.70m	0.45m
Type-CV	3.90m	0.65m

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Source:

Base text and schematics reproduced from IECA 2008, Best Practice Erosion and Sediment Control, International Erosion Control Association (Australasia), Piction NSW, Book 6

CATEGORY
DRAINAGE CONTROL TECHNIQUES

SUB-CATEGORY
CATCH DRAINS AND CHUTES

DRAWING
CATCH DRAIN TYPES

SCALE NTS

DRAWN SPD

DRAWING NO CDC.1

CHECKED CMA

INSTALLATION

1. Refer to approved plans for location, extent, and construction details. If there are questions or problems with the location, extent or method of installation, contact the engineer or responsible on site officer for assistance.

2. Ensure all necessary soil testing (e.g. soil pH, nutrient, levels) and analysis have been completed, and required soil adjustment performed prior to planting

3. Clear the location for the catch drain, clearing only what is needed to provide access for personnel and equipment for installation.

4. Remove roots, stumps and other debris and dispose of them properly. Do not use debris to build the bank.

5. Grade the drain to the specified slope and form the associated embankment with compacted fill. Note that the drain invert must fall 10cm every 10m for each 1% of required channel gradient.

6. Ensure the sides of the cut drain are not steeper than a 1.5:1 (H:V) slope and the embankment fill slope no steeper than 2:1.

7. Ensure the completed drain has sufficient depth (as specified for the type of drain) measured from the drain invert to the top of the embankment. Where necessary, cut the drain slightly deeper than that specified on the plans such that the correct channel dimensions are achieved following placement of the turf.

8. Ensure the drain has a constant fall in the desired direction free of obstructions.

9. Turf should be used within 12 hours of delivery, otherwise ensure the turf is stored in conditions appropriate for the weather conditions (e.g. a shaded area).

10. Moistening the turf after it is unrolled will help maintain its viability.

11.Turf should be laid on a minimum 75mm bed of adequately fertilised topsoil. Rake soil surface to break the crust just before laying the turf.

12. During the warmer months, lightly irrigate the soil immediately before laying the turf.

13. Ensure the turf is not laid on gravel, heavily compacted soil, or soils that have been recently treated with herbicide.

14. For wide drains and high velocity chutes , lay the first row of turf in a straight line diagonal to the direction of flow. Stagger subsequent rows in a brick-like (stretcher bond) pattern. The turf should not be stretched or overlapped. Use a knife or sharp spade to trim and fit irregularly shaped areas.

15. For narrow drains, lay the turf along the direction of the drain, ensuring, wherever practicable, that a longitudinal joint between two strips of turf is not positioned along the invert of the drain.

16. Ensure the turf extends up the sides of the drain at least 100mm above the elevation of the channel invert, or at least to a sufficient elevation to fully contain expected channel flow.

17. On channel gradients of 3:1 (H:V) or steeper, or in situations where high flow velocities (i.e. velocity > 1.5m/s) are likely within the first 2 weeks following placement, secure the individual turf strips with wooden or plastic pegs.

18. Ensure that intimate contact is achieved and maintained between the turf and the soil such that seepage flow beneath the turf is avoided.

19. Water until the soil is wet 100mm below the turf. Thereafter watering should be suficient to maintain and promote healthy growth.

20. Ensure the drain discharges to a stable outlet such that down-slope soil erosion will be prevented from occurring. Ensure the drain does not discharge to an unstable fill slope.

REMOVAL

1. When the soil disturbance above the catch drain is finished and the area is stabilised, the temporary drain and any associated banks should be removed, unless it is to remain as a permanent drainage feature.

2. Dispose of any sediment or earth in a manner that will not create an erosion or pollution hazard.

3. Grade the area and smooth it out in preparation for stabilisation.

4. Stabilise the area by grassing or as specified within the approved site rehabilitation plan.

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Source:

Base text and schematics reproduced from IECA 2008, Best Practice Erosion and Sediment Control, International Erosion Control Association (Australasia), Piction NSW, Book 6

CATEGORY
DRAINAGE CONTROL TECHNIQUES

SUB-CATEGORY
CATCH DRAINS AND CHUTES

DRAWING
CATCH DRAINS EARTH LINED

SCALE NTS

DRAWN SPD

DRAWING NO CDC.2

CHECKED CMA

MATERIALS

Earth fill:

Clean soil with Emerson class 2(1), 3, 4 or 5 and free of roots, woody vegetation, rocks and other unsuitable materials. Soil with Emerson class 4 and 5 may not be suitable depending on particle size distribution and degree of dispersion. Class 2(1) should only be used upon recommendation from a geotechnical specialist. This specification may be replaced by an equivalent standard based on the exchangeable sodium percentage.

Riser pipe:

Minimum 250mm diameter.

Spillway rock:

Hard, angular, durable weather resistant and evenly graded rock with 50% by weight larger than specified nominal (d50) rock size. Large rock should dominate, with sufficient small rock to fill the voids between the larger rock. The diameter of the largest rock size should be no longer than 1.5 times the nominal rock size. The specific gravity should be at least 2.5.

Geotextile fabric:

Needle-punched, non-woven filter cloth, minimum 'Bidim' A24 or equivalent.

CONSTRUCTION:

1. Notwithstanding any description contained within the approved plans or specifications, the contractor shall be responsible for satisfying themselves as to the nature and extent of the specified works and the physical and legal conditions under which the works will be carried out.

This shall include:

- Means of access
- Extent of clearing
- Nature of materials to be excavated
- Type and size of mechanical plants required
- Location and suitability of water supply for construction and testing purposes
- Any other like matter affecting the construction of the works.

2. Refer to approved plans for location, dimensions and construction details. If there are questions or problems with the location, dimensions or method of installation, contact the engineer or responsible on-site officer for assistance.

3. Before starting any clearing or construction, ensure all the necessary materials and components are on the site to avoid delays in completing the pond once works begin.

4. Install required short-term sediment control measures downstream of the proposed earthwork to control sediment runoff during construction of the basin.

5. The area to be covered by the embankment, borrow pits and incidental works, together with an area extending beyond the limits of each for a distance not exceeding 5 metres all around must be cleared of all trees, scrub, stumps, roots, dead timber and rubbish and disposed of in a suitable manner. Delay clearing the main pond area until the embankment is complete.

6. Ensure all holes made by grubbing within the embankment footprint are filled with sound material, adequately compacted and finished flush with the cut-off trench.

7. Before construction of cut-off trench or any ancillary works within the embankment footprint, all grass growth and topsoil must be removed from the area to be occupied by the embankment and must be deposited clear of this area and reserved for topdressing the completed embankment.

8. Excavate a cut-off trench along the central line of the earth fill embankment. Cut the trench to stable soil material, but in no cases make it less than 600mm deep. The cut-off trench must extend into both abutments to at least the elevation of the riser pipe crest. Make the minimum bottom width wide enough to permit operation of excavation and compaction equipment, but in no case less than 600mm. Make the slopes of the trench no steeper than 1:1 (H:V).

9. Ensure all water, loose soil and rock are removed from the trench before backfilling commences. The cut-off trench must be backfilled with selected earth-fill of the type specified for the embankment and this soil must have moisture content and degree of compaction the same as that specified for the selected core zone.

10. Material excavated from the cut-off trench may be used in construction of the embankment provided it is suitable and it is placed in the correct zone according to its classification.

EMBANKMENT:

11. Scarify areas on which fill is to be placed before placing the fill.

12. Ensure all fill material used to form the embankment meets the specifications certified by a soil scientist or geotechnical specialist.

13. The fill material must contain sufficient moisture so it can be formed by hand into a ball without crumbling. If water can be squeezed out of the ball, it is too wet for proper compaction. Place fill material in 150 to 250mm continuous layers over the entire length of the fill area and then compact before placement of further fill.

14. Place riser pipe outlet system, if specified, in appropriate sequence with the embankment filling. Refer to separate installation specifications.

15. Unless otherwise specified on the approved plans, compact the soil at about 1 to 2% wet of optimum and to 95% modified or 100% standard compaction.

16. Where both dispersive and non-dispersive classified earth fill materials are available, non-dispersive earth-fill must be used in the core zone. The remaining classified earth-fill materials must only be used as directed.

17. Where specified, construct the embankment to an elevation 10% higher then the design height to allow for settling; or otherwise finished dimensions of the embankment after spreading of topsoil must conform to the drawing with a tolerance of 75mm from the specified dimensions.

18. Ensure debris and other unsuitable building waste is not placed within the earth embankment.

19. After completion of the embankment all loose uncompacted earth-fill material on the upstream and downstream batter must be removed prior to spreading of topsoil.

20. Topsoil and revegetate/stabilise all exposed earth as directed within the approved plans.

SPILLWAY CONSTRUCTION

21. The spillway must be excavated as shown on the plans and the excavated material, if classified as suitable, must be used in the embankment, and if not suitable it must be disposed of into spoil heaps.

22. Ensure excavated dimensions allow adequate boxing-out such that the specified elevations, grades, chute width and entrance and exit slopes for the emergency spillway will be achieved after placement of the rock or other scour protection measures as specified in the plans.

23. Place specified scour protection measures on the emergency spillway. Ensure the finished grade blends with the surrounding area to allow a smooth flow transition from spillway to downstream channel.

(continued on drawing No. TC.2.2)

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Source:

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CATEGORY
SEDIMENT CONTROL TECHNIQUES

SUB-CATEGORY
TYPE 1 & 2 CONTROLS

DRAWING
SEDIMENT BASINS

SCALE NTS
DRAWN SPD
DRAWING NO TC.2.1
CHECKED CMA

24. If a synthetic filter fabric underlay is specified, place the filter fabric directly on the prepared foundation. If more than 1 sheet of filter fabric is required, overlap the edges by at least 300mm and place anchor pins at minimum 1m spacing along the overlap. Bury the upstream end of the fabric a minimum of 300mm below ground and, where necessary, bury the lower end of the fabric or overlap a minimum of 300mm over the next downstream section as required. Ensure the filter fabric extends at least 1m upstream of the spillway crest.

25. Take care not to damage the fabric during or after placement. If damage occurs, remove the rock and repair the sheet by adding another layer of fabric with a minimum overlap of 300mm around the damaged area. If extensive damage is suspected, remove and replace the entire sheet.

26. Where large rock is used, or machine placement is difficult, a minimum 100mm layer of fine gravel, aggregate or sand may be needed to protect the fabric.

27. Placement of rock should follow immediately after placement of the filter fabric. Place rock so that it forms a dense, well-graded mass of rock with a minimum of voids. The desired distribution of rock throughout the mass may be obtained by selective loading at the quarry and controlled dumping during final placement.

28. The finished slope should be free of pockets of small rock or clusters of large rocks. Hand placing may be necessary to achieve the proper distribution of rock size to produce a relatively smooth, uniform surface. The finished grade of the rock should blend with the surrounding area. No overfall or protrusion should be apparent.

29. Ensure that the final arrangement of the spillway crest will not promote excessive flow through the rock such that the water can be retained within the settling basin an elevation no less than 50mm above or below the nominated spillway crest elevation.

ESTABLISHMENT OF THE SETTLING POND:

30. The area to be covered by the stored water outside the limits of the borrow pits must be cleared of all scrub and rubbish. Trees must be cut down stump high and removed from the immediate vicinity of the work.

31. Establish all required inflow chutes and inlet baffles, if specified, to enable water to discharge into the basin in a manner that will not cause soil erosion or the re-suspension of settled sediment.

32. Install a sediment storage level marker post with a cross member set just below the top of the sediment storage zone (as specified on the approved plans). Use at least 75mm wide post firmly set into the basin floor.

33. If specified, install internal settling pond baffles. Ensure the crest of these baffles is set level with, or just below, the elevation of the emergency spillway crest

34. Install all appropriate measures to minimise safety risk to on-site personnel and the public caused by the presence of the settling pond. Avoid steep, smooth internal slopes. Appropriately fence the settling pond and post warning signs if unsupervised public access is likely or there is considered to be unacceptable risk to the public.

MAINTENANCE:

1. Inspect the sediment basin during the following periods:

- During construction to determine whether machinery, falling trees or construction activity has damaged any components of the sediment basin. If damage has occurred, repair it

- After each runoff event inspect the erosion damage at flow entry and exit points. If damage has occurred, make the necessary repairs.

- At least weekly during the nominated wet season (if any) otherwise at least fortnightly.

- Prior to, and immediately after, periods of 'stop work' or site shutdown.

2. Clean out accumulated sediment when it reaches the marker board/post, and restore the original storage volume. Place sediment in a disposal area or, if appropriate, mix with dry soil on the site.

3. Do not dispose of sediment in a manner that will create an erosion or pollution hazard.

4. Check all visible pipe connections for leaks and repair as necessary

5. Check all embankments for excessive settlement, slumping of the slopes or piping between the conduit and the embankment; make all necessary repairs.

6. Remove all trash and other debris from the basin and riser.

7. Submerged inflow pipes must be inspected and de-silted (as required) after each inflow event.

REMOVAL:

1. When grading and construction in the drainage area above a temporary sedimentation basin is completed and the disturbed areas are adequately stabilised, the basin must be removed or otherwise incorporated into the permanent stormwater drainage system. In either case sediment should be cleared and properly disposed of and the basin area stabilised.

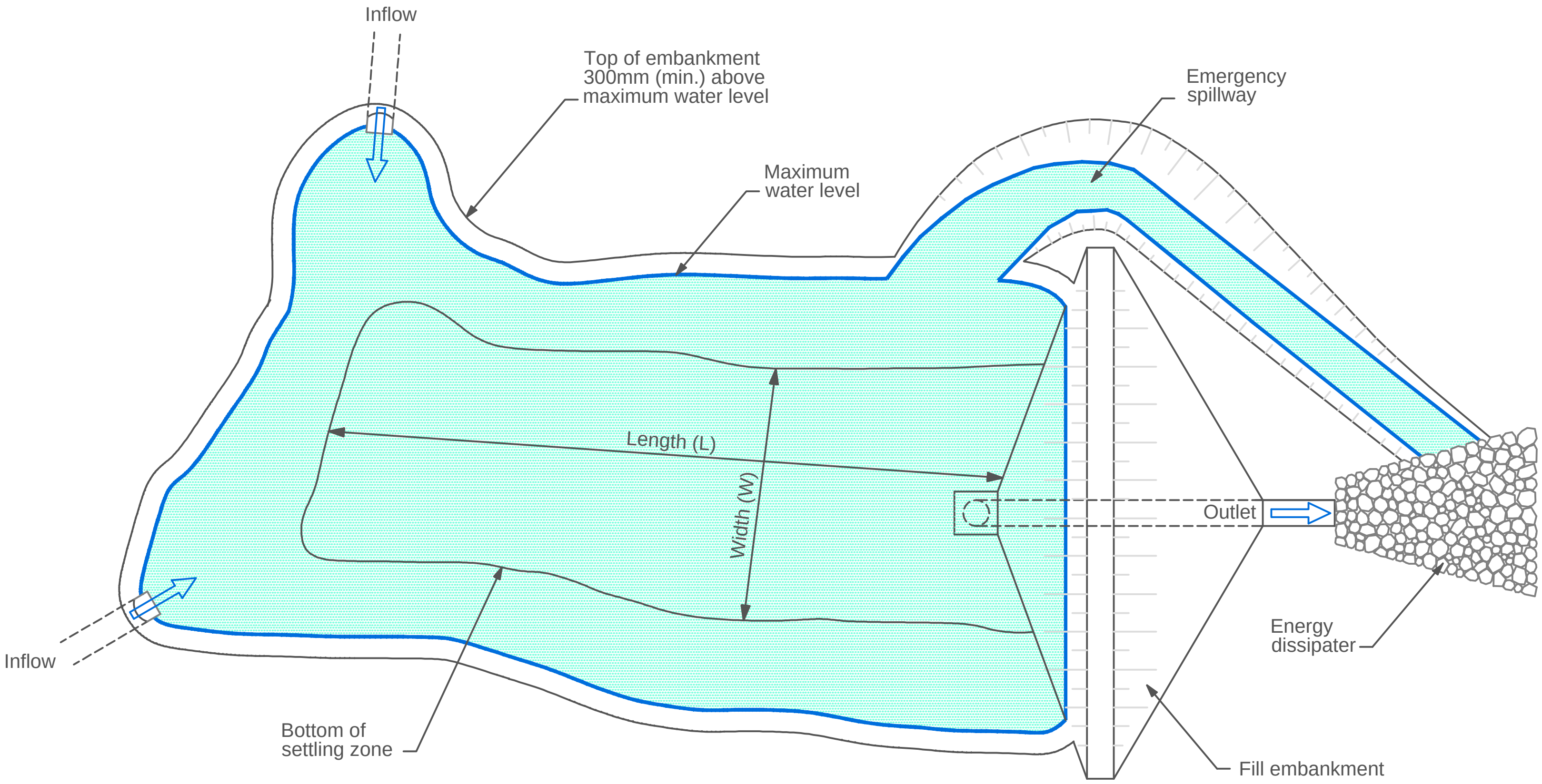
2. Before starting any maintenance work on the basin or spillway, install all necessary short-term sediment control measures downstream of the sediment basin.

3. All water and sediment must be removed from the basin prior to the dam's removal. Dispose of sediment and water in a manner that will not create an erosion or pollution hazard.

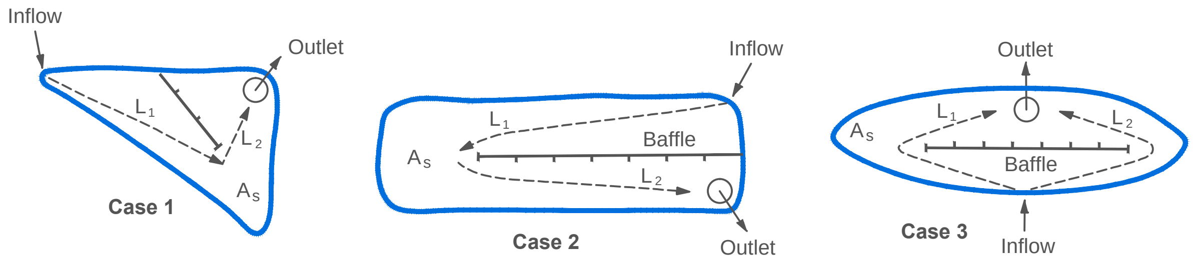
4. Bring the disturbed area to a proper grade, then smooth, compact and stabilise and/or revegetate as required to establish a stable land surface

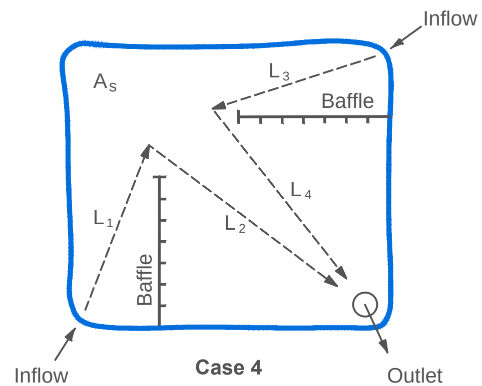
Source:

Base text and schematics reproduced from IECA 2008, Best Practice Erosion and Sediment Control, International Erosion Control Association (Australasia), Piction NSW, Book 6



TYPICAL PLAN OF A TYPE C (DRY) BASIN WITH RISER PIPE OUTLET SYSTEM





Case 1, 2 & 3: $W_e = A_s / (L_1 + L_2)$
Case 4: $W_e = A_s / (L_1 + L_2 + L_3 + L_4)$
Where: $W_e =$ effective width
$A_e =$ pond surface area

TYPICAL ARRANGEMENT OF INTERNAL FLOW CONTROL BAFFLES

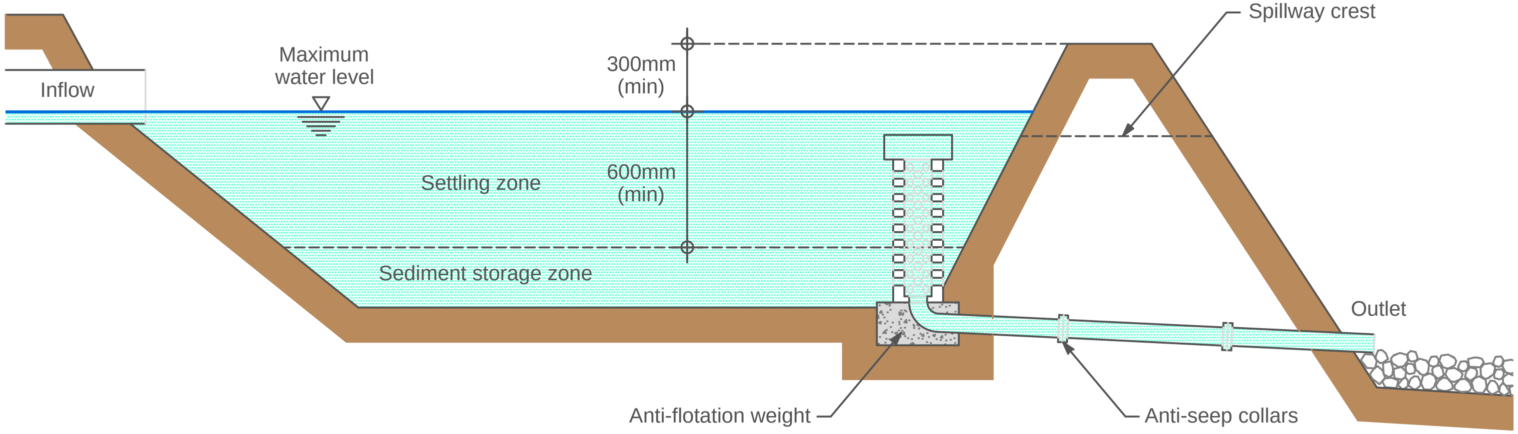
Source:
Base text and schematics reproduced from IECA 2008, Best Practice Erosion and Sediment Control, International Erosion Control Association (Australasia), Piction NSW, Book 6

CATEGORY
SEDIMENT CONTROL TECHNIQUES

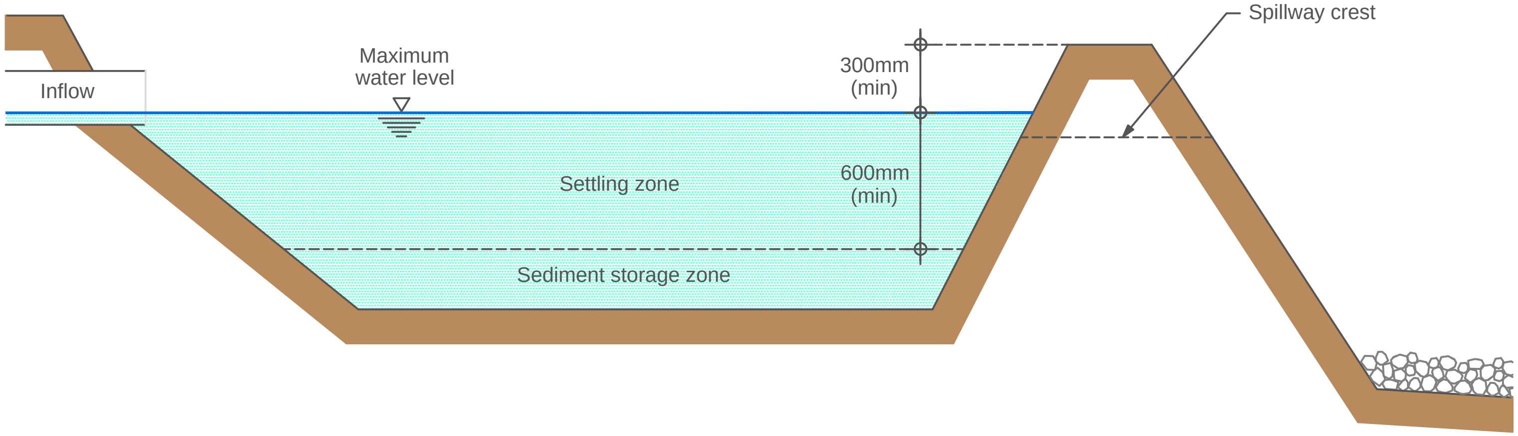
SUB-CATEGORY
TYPE 1 & 2 CONTROLS

DRAWING
SEDIMENT BASINS

SCALE NTS	**DRAWN** SPD
DRAWING NO TC.2.3	**CHECKED** CMA



TYPICAL SECTION THROUGH TYPE C (DRY) BASIN WITH RISER PIPE OUTLET SYSTEM



TYPICAL SECTION THROUGH TYPE F/D (WET) BASIN

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Source:

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CATEGORY
SEDIMENT CONTROL TECHNIQUES

SUB-CATEGORY
TYPE 1 & 2 CONTROLS

DRAWING
SEDIMENT BASINS

SCALE NTS	**DRAWN** SPD
DRAWING NO TC.2.4	**CHECKED** CMA

Engineering Opportunity and Constraints Report
for
Gindalbie Metals Limited
on
Hinge Haul Road Desktop Assessment of Road Options & Stormwater Management

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providng the right solution

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Engineering Opportunity and Constraints Report

for

Gindalbie Metals Limited

On

Hinge Haul Road
Desktop Assessment of Road Alignment Options
& Stormwater Management

October 2012

Revision	Description	Date
0	Client review	17 Oct 12

Table of Contents

Appendices

Appendix 11: SK11 Hinge Haul Road – Option 4 Plan & Profile

Appendix 12: SK12 Hinge Haul Road – Option 5 Plan & Profile

Appendix 13: SK13 Hinge Haul Road – Stormwater Catchment Areas & Culvert Locations

Appendix 14: GBG Overall Site Plan

Introduction and Background

Gindalbie Metals Limited (GBG) commissioned Pritchard Francis Pty Ltd to undertake a desktop study on potential haul route options for the Hinge Iron Ore Project and provide an Engineering Opportunity and Constraints Report listing any findings that may be pertinent in the overall decision towards the most appropriate haul route.

Project Description

On behalf of Karara Mining Limited, GBG is currently developing the mining and environmental approvals for the Hinge Iron Ore Project. The Hinge Project will be mining hematite iron ore from a single pit located on tenements E59/817 and E59/1170, which are located within the Shire of Perenjori.

The tenements are approximately 14km's to the north east of the existing Karara Iron Ore Project's Blue Hills North and 20km's North East of the Karara Minesite in the mid-west of WA.

This scope of works is to identify options for a suitable, fit-for-purpose new haul road, connecting the Hinge Project to the existing Karara and Mungada Iron Ore Projects (being the Greater Karara Iron Ore Project, GKIOP).

Refer to Appendix 14 for an overall site plan, as supplied by GBG, for the Hinge Project.

Study Objectives

The desktop civil engineering and surface water drainage assessment was undertaken with the following objectives:

- Provide an assessment of potential road alignment options and surface water drainage, within the designated tenements. (Refer to drawing SK.01 for 5 alignment route options.);
- Document all findings and proposed options in order to meet the Austroads 2009 Design Guide Series as the primary design guide reference for haul road geometry and operational safety and any other associated Austroads Standards or legislative requirements;
- Map and discuss the various proposed alignments and necessary surface water drainage control measures;
- Provide preliminary horizontal and vertical designs for each option.

Haul Road Design Criteria

A desktop study and detailed schematic designs were prepared for the most suitable haul routes within the study area, based on the criteria outlined in Table 1.

Haul Road Design Criteria	Value Applied
Design and Operational Speed	80kph
Design Vehicle	154 Tonne Kenworth T659 haulage truck
Total Number of Traffic Lanes	2
Transport Corridor Width	50m
Haul Road Width	10m
Batter Slopes	1V : 4H
Trapezoidal Table Drain Width	Variable
Minimum Horizontal Curve Radius	200m
Minimum Radius for Adverse Crossfall (80kph)	500m (3% adverse)
Superelevation	3%
Crossfall	3% Crowned
Maximum Longitudinal Grade	8%
Minimum Longitudinal Grade	0.5% Ideal (Flatter if necessary)
Minimum Crest K Value	30
Minimum Crest Vertical Curve Length	80m
Minimum Sag K Value	20
Minimum Sag Vertical Curve Length	80m

Table 1: Haul Road Design Criteria and Values Applied

Extracted From: Austroads (2009) Guide to Road Design Part 3: Geometric Design

Summary of Information Received

GIS Data

2m GIS contour intervals and land tenement boundaries were obtained from Gindalbie Metals Ltd (GBG). The extent of information provided was sufficient to perform the desktop study for all potential haul route options.

Hydrological Data

Hydrological metadata for rain and flow gauges within the region were obtained from the Bureau of Meteorology and Department of Water.

Hydrology Reports

Karara Iron Ore Project – Surface Water Baseline and Impact Assessment – MWH June 2008.

Karara Magnetite Surface Water Impact Assessment – Coffey Mining 2007

Analysis of Haul Routes

Based on the information provided and the above design criteria, we have identified and undertaken preliminary road designs for five potential haul routes. Refer to drawing SK01 which indicates these alignment route options.

The horizontal alignment for each of the preliminary road designs has been adjusted to suite the surrounding topography to minimise cut and fill heights whilst also ensuring that they remain outside of the tenement that has not been granted.

Alignment Options Overview

- **Option 1** – An 11km haul route heading north from the planned Syncline Haul Road which then ties into the proposed Hinge Pit. This alignment bisects mining tenements E59/817, P59/1831, E59/1522 and M59/649. Refer to drawing SK03 for a layout plan and drawing SK08 for a plan and profile.

- **Option 2** – A 10.9km haul route heading north from the planned Syncline Haul Road which then ties into the proposed Hinge Pit. This alignment is similar to Option 1 however the first 3km has been realigned to reduce the number of horizontal curves in order to provide a more direct haulage route.

  This alignment bisects mining tenements E59/817, P59/1831, E59/1522 and M59/649. Refer to drawing SK04 for a layout plan and drawing SK09 for a plan and profile.

- **Option 3** – An 11.3km haul route heading directly north from the existing track located south west of the planned Syncline Haul Road which then ties into the proposed Hinge Pit.

  This alignment bisects mining tenements E59/817 and M59/649. Refer to drawing SK05 for a layout plan and drawing SK10 for a plan and profile.

- **Option 4** – A 13.4km haul route heading north from the existing track located south west of the planned Syncline Haul Road which then ties into the proposed Hinge Pit. This alignment is similar to Option 1 for the first 6km and Option 3 from chainage 8.2km until it connects onto the existing track.

  This alignment bisects mining tenements E59/817, P59/1831 and M59/649. Refer to drawing SK06 for a layout plan and drawing SK11 for a plan and profile.

- **Option 5** – An 11.9km haul route heading north from the planned Syncline Haul Road which then ties into the proposed Hinge Pit. This alignment is similar to Option 3 for the first 5.7km and Options 1 and 2 from chainage 7.6km until it connects onto the planned Syncline Haul Road.

  This alignment bisects mining tenements E59/817, P59/1831, E59/1522 and M59/649. Refer to drawing SK07 for a layout plan and drawing SK12 for a plan and profile.

Shortcomings of Options 4 & 5

Early assessments clearly indicated that Options 4 and 5 are the least favourable alignments as they provide the least direct link between the Hinge Project and the southern tie-in point. Both these options also contain two ninety degree bends which are not ideal for use by haulage trucks and should be avoided if possible.

Both Options 4 and 5 are also the longest of the five alignments investigated and will require more clearing and disturbance to existing vegetation than the other options.

Due to the above cited key shortcomings of Options 4 and 5, they have been disregarded as potential haulage routes as part of the desktop assessment.

Preferred Selected Fit- for-Purpose Alignment – Option 3

The remaining three options, namely, Options 1, 2 & 3 are geometrically similar to each other in respect to the nature of the existing topography they traverse, design cut and fill heights, proposed finished haul road longitudinal grades, overall length, valley crossings, required clearing and disturbance to existing vegetation.

Refer to SK.02 for these three preferred alignment options.

After discussions with the client, GBG, it was mutually agreed upon that Option 3 be selected as the preferred fit-for-purpose alignment.

Some of the key reasons used in the selection of Option 3 as the preferred alignment were as follows:

- It is the most direct haulage route with fewer horizontal bends;
- A detailed design of this option will allow for more flexibility in the design process as it is not confined within narrow tenement boundaries;
- Options 1 & 2 have a significant portion of their lengths confined between narrow tenement boundaries. This reduces flexibility for geometric reconfiguration should this be required during the detailed design phase.
- Options 1 & 2 will be required to traverse adjacent to the existing Clay Pan as it connects onto the Planned Syncline Haul Road. This section of haul road for both options faces the risk of stormwater inundation during major storm events which will negatively impact on the iron ore haulage rate.

Refer below for Table 2 showing a haul road design consideration analysis with findings carried out on Option 3.

Table 2
Haul Road Design Considerations - Option 3 Analysis and Findings

DESIGN CONSIDERATION	FINDINGS
Horizontal Alignment	- Most direct and least invasive - Overall length of 11.3km - No reverse curves - 7 horizontal curves - Traverses 2 tenements
Vertical Alignment	- Vertical grades are flat – generally less than 3% with a maximum of 5% - Minimum vertical curve lengths are achievable - Minimum vertical crest & sag values are achievable
Cut/Fill Batters	- Maximum height cut and fill batters less than 2m - Road basically sits on ground and matches topography
Topography of Route	- Gently sloping with flat grades - Minimum disturbance to surrounding environment
Curve Widening	- Will not be required as horizontal curve radii will be larger than the minimum warranting curve widening

DESIGN CONSIDERATION	FINDINGS
Preliminary Runoff & Drainage	- 4 major stormwater crossings identified - Road not in floodplain - Table drains will be required - 4 Corrugated Steel Pipe culverts (CSP) or similar type culverts will be required - Other minor culvert crossings will be required and documented as part of the detailed design phase
Flora & Fauna	- Not considered as part of this desktop assessment
Heritage	- Not considered as part of this desktop assessment
Clear Zones & Errant Vehicles	- May be satisfied without additional pavement widening
Stopping Sight Distance	- Might not be an issue due to simplified horizontal geometry & relatively gentle vertical grades
Overtaking Sight Distance	- Good due to minimal curves and large radii

Stormwater Management

Hydrological Data

Hydrological metadata for rain and flow gauges within the region were obtained from the Bureau of Meteorology and Department of Water.

Hydrology Reports

Karara Magnetite Surface Water Impact Assessment – Coffey Mining 2007

Karara Iron Ore Project – Surface Water Baseline and Impact Assessment – MWH June 2008.

Hydrology

Estimates of peak flood flows and volumes have been derived for key culvert locations around the proposed Option 3 haul road. Refer to drawing SK.13 for stormwater catchment areas and proposed culvert locations. As there are no flow records available for any of the watercourses that drain across the haul road, a 'design event approach' has been adopted for these catchments.

This section describes the formulation of design rainfall events which are specified by rainfall duration, average rainfall intensity of a particular ARI and rainfall temporal pattern.

The design rainfall totals and intensities were determined using techniques recommended in Australian Rainfall and Runoff, (2003) (ARR). The resulting peak flows were calculated using the probabilistic Rational Method and the Index Flood Method. Despite its slightly higher standard errors of estimate, it should be noted that the Rational Method generally gives more accurate estimates.

Design Rainfall Totals

The design rainfall intensities (mm/hour) for a range of events and durations for the Hinge Haul Road Option 3 surrounding catchments are tabulated in Table 3.

DURATION	ARI (Years)						
	1	2	5	10	20	50	100
5 mins	43.3	58.2	81.6	98	120	152	179
6 mins	40.2	54	75.8	91	111	141	166
10 mins	32.2	43.2	60.4	72.3	88.2	112	131
20 mins	22.8	30.5	42.1	50.2	61.1	76.8	90.1
30 mins	18.1	24.2	33.3	39.6	48.1	60.3	70.6
1 hour	11.7	15.6	21.5	25.5	30.9	38.7	45.2
2 hours	7.31	9.75	13.4	15.9	19.3	24.2	28.2
3 hours	5.5	7.34	10.1	12	14.5	18.2	21.3
6 hours	3.37	4.5	6.2	7.38	8.96	11.2	13.2
12 hours	2.05	2.75	3.82	4.56	5.56	7	8.22
24 hours	1.24	1.67	2.35	2.83	3.46	4.39	5.19
48 hours	0.721	0.982	1.41	1.71	2.11	2.71	3.22
72 hours	0.51	0.7	1.01	1.23	1.53	1.98	2.36

Table 3: Hinge Haul Road Design Rainfall Intensities (mm/hr) from the Bureau of Meteorology Rainfall IFD Data System (location 29.150 S, 116.825 E)

Flood Flows for Culvert Sizing

The estimation of flood flows for the Hinge Haul Road Option 3 study catchments has been carried out using two methods:

- Rational Method
- Regional Flood Frequency Method

Methodology and results for each of the methods are detailed below:

Rational Method Peak Flow Estimates

Peak flows have been estimated using the Rational Method applicable to the Wheatbelt Region of Western Australia. The method described in ARR (ARR Vol 1, Book IV, Section 1.4.7).

The parameters used in the Rational methodology for each of the catchments are:

- Catchment area (km2)
- Mainstream channel length (catchment outlet to the most remote point of the catchment boundary, km)
- Time of concentration (calculated using catchment area in ARR equation 1.23 (ARR Vol 1, Book IV, Section 1.4.7)
- Rainfall Intensity for ARI events (with the duration equal to the time of concentration)
- Runoff coefficient (calculated from mainstream length using ARR equation 1.24 (ARR Vol 1, Book IV, Section 1.4.7)
- Frequency factor (Cy/C10):

ARI (years)	2	5	10	20	50	100
	0.41	0.65	1.00	1.54	2.20	2.47

Results of the Rational Method estimated peak flows for the Hinge Haul Road Option 3 proposed culvert locations are detailed in Table 4.

Culvert Number	ARI (Years)					
	2	5	10	20	50	100
1	0.8	1.7	3.1	6.0	10.2	13.9
2	0.8	1.7	3.1	6.0	10.2	13.9
3	4.0	8.6	15.8	29.8	54.1	69.4
4	4.0	8.6	15.8	29.8	54.1	69.4

Table 4: Hinge Haul Road - Rational Method Peak Flows (m^3/s)

Note: Refer to drawing SK.13 for proposed culvert locations.

Regional Method Peak Flow Estimates

Peak flows have also been estimated using the Index Flood (Regional) Method applicable to the Wheatbelt Region of Western Australia (ARR Vol 1, Book IV, Section 1.4.7).

The parameters used in the Regional methodology for each of the catchments are:

- Catchment area (km2)
- Average annual rainfall of 334mm (as recorded at Morawa, Station 008093)
- Frequency factor (Qy/Q5):

ARI (years)	2	5	10	20	50	100
	0.48	1.00	1.84	3.23	6.10	12.00

The resulting Regional Method estimated peak flows for the Hinge Haul Road Option 3 proposed culvert locations are detailed in Table 5.

Culvert Number	ARI (Years)					
	2	5	10	20	50	100
1	0.5	1.1	2.0	3.5	6.6	13.0
2	0.6	1.3	2.4	4.3	8.1	15.9
3	2.4	5.0	9.3	16.3	30.7	60.5
4	2.6	5.4	10.0	17.5	33.0	64.9

Table 5: Hinge Haul Road - Regional Index Method Peak Flows (m^3/s)

Note: Refer to drawing SK.13 for proposed culvert locations.

Adopted Design Flows for Culvert Sizing

As previously discussed, despite its slightly higher standard errors of estimate, it should be noted that the Rational Method generally gives more accurate estimates whereas the Regional method under-estimates the rainfall-runoff value.

It is recommended that the flood flow estimates derived by the Rational Method be adopted as the design flood flows in the sizing of suitable culverts.

Refer to Table 6 below for proposed corrugated steel pipe (CSP) diameters and number of barrels required for each culvert in order to pass the required Rational Method Q10 peak flood flows.

Design Information	Units	Values Applied			
Culvert Number		1	2	3	4
Required Q10 capacity	m^3/s	3.1	3.1	15.8	15.8
Manning's n (CSP)		0.024	0.024	0.024	0.024
Grade S	m/m	0.01	0.01	0.01	0.01
Pipe size (dia)	m	1.5	1.5	1.65	1.65
Number of pipes		1	1	4	4
Calculated Flow Q	m^3/s	3.84	3.84	19.6	19.6

Table 6: Haul Road Drainage Infrastructure Design for Alignment Option 3

Conclusion

From the information available and site constraints it is our opinion that Option 3 is the most suitable haul route for the following reasons:

- It is the most direct haulage route with fewer horizontal curves;
- Basically sits on the ground and matches the topography;
- Will have substantially lower cut and fill batter heights;
- Has no excessive cut and fill volumes
- Is likely to satisfy all sight distance criteria;
- A detailed design of this option will allow for more flexibility in the design process as it is not confined within narrow tenement boundaries;
- Options 1 & 2 have a significant portion of their lengths confined between narrow tenement boundaries. This reduces flexibility for geometric reconfiguration should this be required during the detailed design phase.
- Options 1 & 2 will be required to traverse adjacent to the existing Clay Pan as it connects onto the Planned Syncline Haul Road. This section of haul road for both options faces the risk of stormwater inundation during major storm events which will negatively impact on iron ore haulage.

Appendices

Appendix 1: **SK01 Hinge Haul Road – Alignment Route Options**

Appendix 2: **SK02 Hinge Haul Road – Alignment Route Preferred Options**

Appendix 3: **SK03 Hinge Haul Road – Option 1 Layout Plan**

Appendix 4: **SK04 Hinge Haul Road – Option 2 Layout Plan**

Appendix 5: **SK05 Hinge Haul Road – Option 3 Layout Plan**

Appendix 6: **SK06 Hinge Haul Road – Option 4 Layout Plan**

Appendix 7: **SK07 Hinge Haul Road – Option 5 Layout Plan**

Appendix 8: **SK08 Hinge Haul Road – Option 1 Plan & Profile**

Appendix 9: **SK09 Hinge Haul Road – Option 2 Plan & Profile**

Appendix 10: **SK10 Hinge Haul Road – Option 3 Plan & Profile**

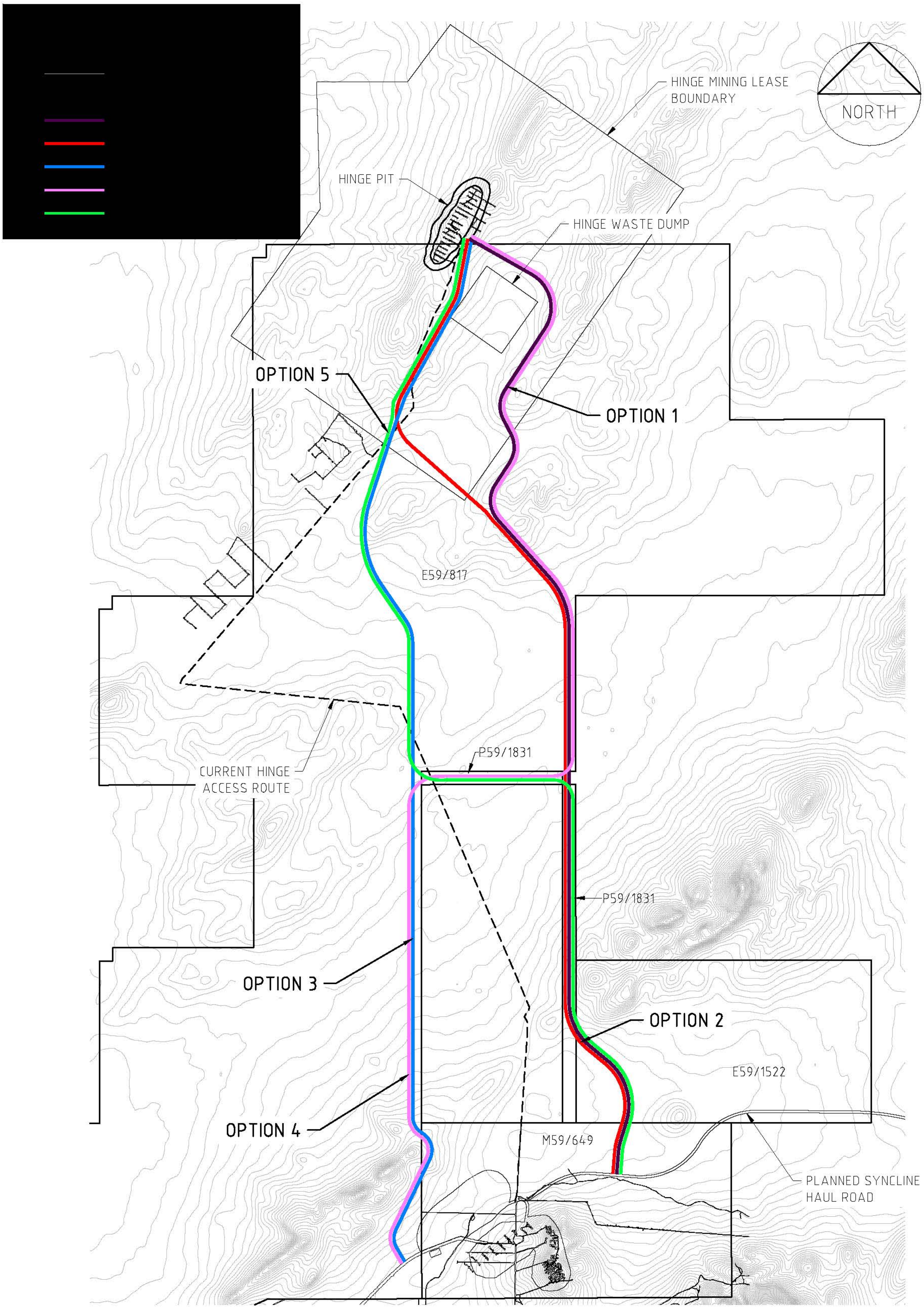
Appendix 11: **SK11 Hinge Haul Road – Option 4 Plan & Profile**

Appendix 12: **SK12 Hinge Haul Road – Option 5 Plan & Profile**

Appendix 13: **SK13 Hinge Haul Road – Stormwater Catchment Areas & Culvert Locations**

Appendix 14: **GBG Overall Site Plan**

Appendix 1: SK01 Hinge Haul Road – Alignment Route Options



NOT TO SCALE

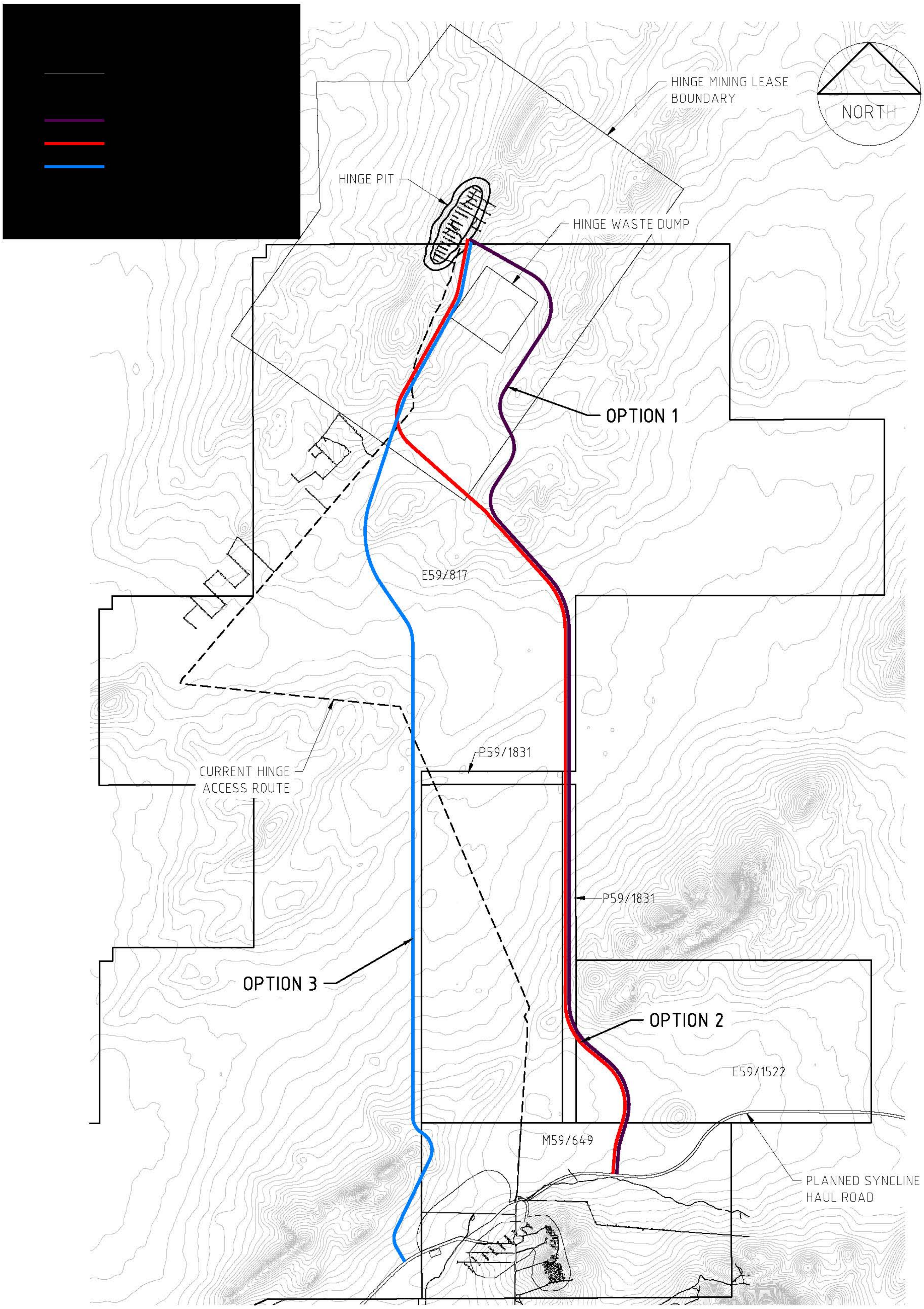
ORIGINAL SHEET SIZE A3

pritchard francis
civil and structural engineering consultants

GINDALBIE METALS LIMITED
HINGE HAUL ROAD
ALIGNMENT ROUTE OPTIONS

DATE	DESIGNED	DRAWN	CHECKED	JOB No.	DRG No.	REVISION
19.09.12	KP	JAS	KP	12-213	SK.01	A

Appendix 2: SK02 Hinge Haul Road – Alignment Route Preferred Options



NOT TO SCALE

ORIGINAL SHEET SIZE A3

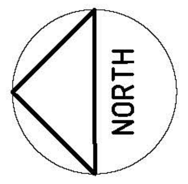
pritchard francis
civil and structural engineering consultants

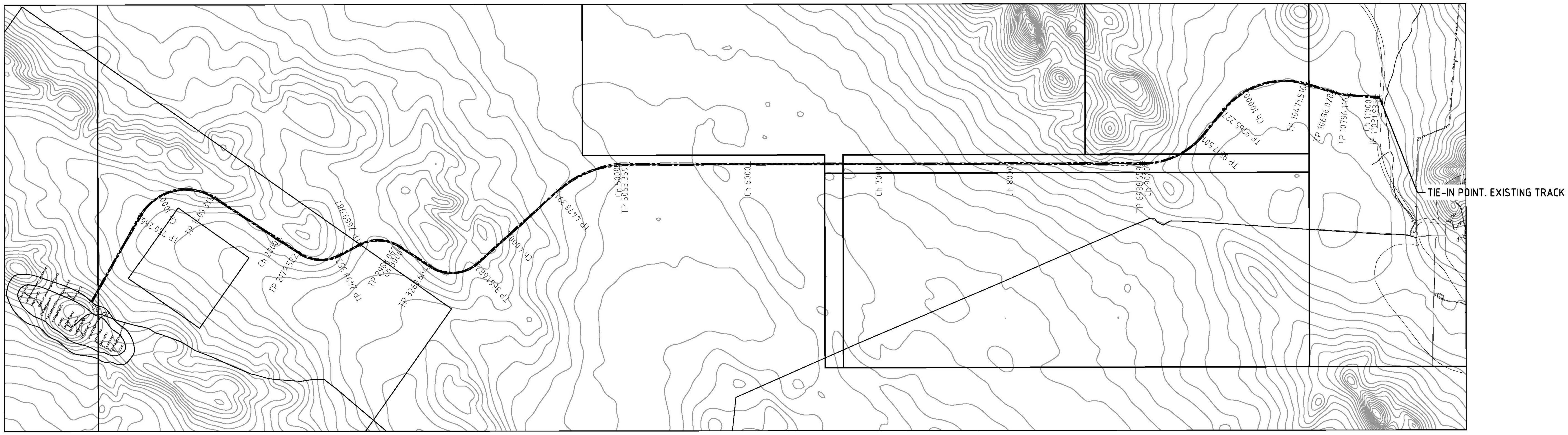
GINDALBIE METALS LIMITED
HINGE HAUL ROAD
ALIGNMENT ROUTE - PREFERRED OPTIONS

DATE	DESIGNED	DRAWN	CHECKED	JOB No.	DRG No.	REVISION
19.09.12	KP	JAS	KP	12-213	SK.02	A

Appendix 3: SK03 Hinge Haul Road – Option 1 Layout Plan

FOR INFORMATION ONLY





HINGE HAUL ROAD - LAYOUT PLAN
OPTION 1

Design Haul Rd Option 1 — CONTROL LINE DETAILS

PT	CHAINAGE	EASTING	NORTHING	BEARING	RAD/SPIRAL	TANGENT	DEF ANGLE	ARC LEN
IP1	0.000	487673.047	6788504.332	119d34'44"				
TC	750.286	488325.553	6788133.973	119d34'44"				
	1000	488491.647	6787952.946	155d20'52"				
IP2	1076.798	488695.602	6787923.936		400.000	425.502	93d32'20"	653.025
CT	1403.311	488463.123	6787567.557	213d07'04"				
	2000	488137.114	6787067.801	213d07'04"				
TC	2179.522	488039.029	6786917.443	213d07'04"				
IP3	2338.937	487942.688	6786769.756		300.000	176.333	60d53'31"	318.830
CT	2498.352	488024.857	6786613.738	152d13'33"				
TC	2669.987	488104.836	6786461.877	152d13'33"				
IP4	2829.027	488186.770	6786306.305		300.000	175.829	60d44'56"	318.080
CT	2988.067	488091.072	6786158.800	212d58'29"				
	3000	488084.577	6786148.789	212d58'29"				
TC	3269.664	487937.808	6785922.565	212d58'29"				
IP5	3465.673	487812.812	6785729.903		300.000	229.658	74d52'12"	392.018
CT	3661.682	487966.171	6785558.953	138d06'17"				
	4000	488192.090	6785307.121	138d06'17"				
TC	4478.391	488511.546	6784951.023	138d06'17"				
IP6	4770.875	488716.053	6784723.059		800.000	306.253	41d53'43"	584.969
	5000	488713.545	6784480.099	175d27'44"				
CT	5063.359	488716.053	6784416.806	180d00'00"				
	6000	488716.053	6783480.165	180d00'00"				
	7000	488716.053	6782480.165	180d00'00"				
	8000	488716.053	6781480.165	180d00'00"				
TC	8988.659	488716.053	6780491.506	180d00'00"				
	9000	488716.160	6780480.166	178d55'01"				
IP7	9253.080	488716.053	6780208.524		600.000	282.983	50d30'03"	528.842
CT	9517.501	488934.412	6780028.527	129d29'57"				
TC	9765.227	489125.565	6779870.956	129d29'57"				
	10000	489273.291	6779690.413	151d55'06"				
IP8	10118.371	489434.600	6779616.214		600.000	400.495	67d26'44"	706.288
CT	10471.516	489317.875	6779233.106	196d56'42"				
TC	10686.028	489255.355	6779027.906	196d56'42"				
IP9	10741.072	489239.248	6778975.038		500.000	55.268	12d36'55"	110.088
CT	10796.116	489235.075	6778919.928	184d19'47"				
	11000	489219.683	6778716.626	184d19'47"				
IP10	11031.935	489217.272	6778684.782	184d19'47"				

LEGEND

EXISTING TENEMENT BOUNDARY
2.0m GIS CONTOUR INTERVAL

REV	DATE	DESCRIPTION	REV	DATE	DESCRIPTION
A	19.09.12	ISSUED FOR INFORMATION			

pritchard francis
civil and structural engineering consultants
Level 1, 430 Roberts Road
PO Box 2150
Subiaco WA 6904
Telephone: (08) 9382 5111
Facsimile: (08) 9382 5199
admin@pfeng.com.au
ACN: 008 891 094

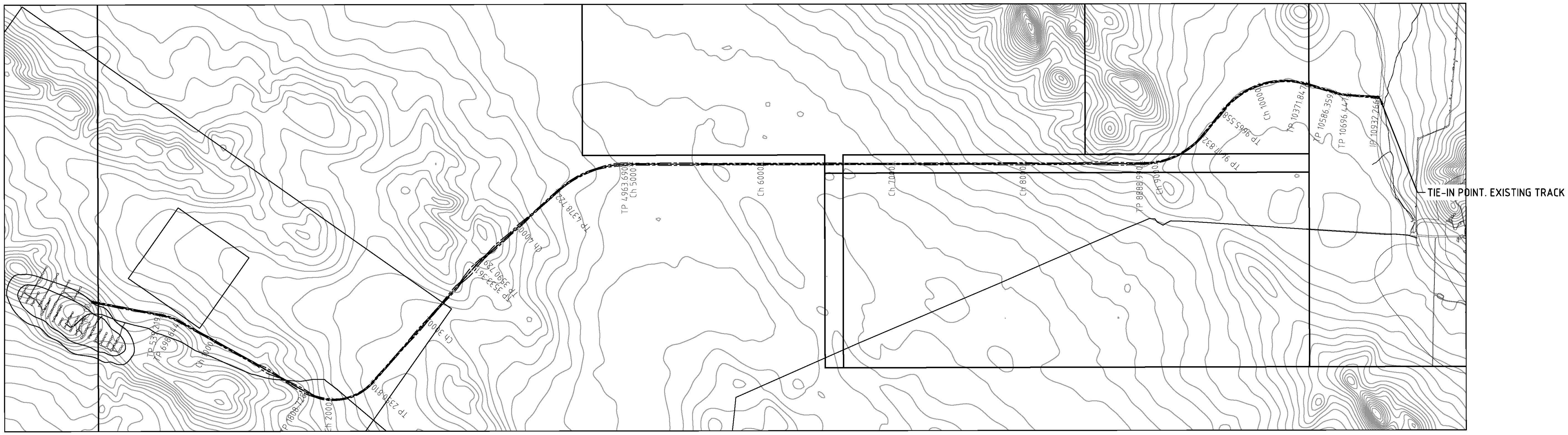
SCALE U.N.O.: N.T.S.
DATE: SEPT. 2012
DESIGNED: KP
DRAWN: JAS
CHECKED: KP

CLIENT & JOB: GINDALBIE METALS LIMITED
TITLE: HINGE HAUL ROAD
OPTION 1 LAYOUT PLAN

SHEET SIZE: A1
JOB No.: 12-213
DRG No.: SK.03
REVISION: A

Appendix 4: SK04 Hinge Haul Road – Option 2 Layout Plan

FOR INFORMATION ONLY



HINGE HAUL ROAD - LAYOUT PLAN
OPTION 2

Design Haul Rd Option 2 — CONTROL LINE DETAILS

PT	CHAINAGE	EASTING	NORTHING	BEARING	RAD/SPIRAL	TANGENT	DEF ANGLE	ARC LEN
IP1	0.000	487673.047	6788504.332	190d54'35"				
TC	539.219	487570.994	6787974.858	190d54'35"				
IP2	618.931	487555.779	6787895.917		500.000	80.394	18d16'07"	159.424
CT	698.644	487516.584	6787825.724	209d10'42"				
	1000	487369.664	6787562.607	209d10'42"				
TC	1808.728	486975.385	6786856.502	209d10'42"				
	2000	486924.821	6786673.919	181d46'50"				
IP3	2079.769	486818.458	6786575.465		400.000	321.882	77d38'51"	542.082
CT	2350.810	487059.418	6786362.050	131d31'51"				
	3000	487545.402	6785931.622	131d31'51"				
TC	3533.361	487944.675	6785577.992	131d31'51"				
IP4	3562.045	487966.171	6785558.953		500.000	28.716	6d34'26"	57.368
CT	3590.729	487985.347	6785537.578	138d06'17"				
	4000	488258.646	6785232.931	138d06'17"				
TC	4378.722	488511.546	6784951.023	138d06'17"				
IP5	4671.206	488716.053	6784723.059		800.000	306.253	41d53'43"	584.969
CT	4963.690	488716.053	6784416.806	180d00'00"				
	5000	488716.053	6784380.496	180d00'00"				
	6000	488716.053	6783380.496	180d00'00"				
	7000	488716.053	6782380.496	180d00'00"				
	8000	488716.053	6781380.496	180d00'00"				
TC	8888.990	488716.053	6780491.506	180d00'00"				
	9000	488726.293	6780381.128	169d23'57"				
IP6	9153.411	488716.053	6780208.524		600.000	282.983	50d30'03"	528.842
CT	9417.832	488934.412	6780028.527	129d29'57"				
TC	9665.558	489125.565	6779870.956	129d29'57"				
	10000	489312.706	6779598.993	161d26'10"				
IP7	10018.702	489434.600	6779616.214		600.000	400.495	67d26'44"	706.288
CT	10371.847	489317.875	6779233.106	196d56'42"				
TC	10586.359	489255.355	6779027.906	196d56'42"				
IP8	10641.403	489239.248	6778975.038		500.000	55.268	12d36'55"	110.088
CT	10696.447	489235.075	6778919.928	184d19'47"				
IP9	10932.266	489217.272	6778684.782	184d19'47"				

LEGEND

EXISTING TENEMENT BOUNDARY

2.0m GIS CONTOUR INTERVAL

REV	DATE	DESCRIPTION	REV	DATE	DESCRIPTION
A	19.09.12	ISSUED FOR INFORMATION			

pritchard francis
civil and structural engineering consultants
Level 1, 430 Roberts Road
PO Box 2150
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Telephone: (08) 9382 5111
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ACN: 008 891 094

SCALE U.N.O. N.T.S.

DATE SEPT. 2012 | DESIGNED KP

DRAWN JAS | CHECKED KP

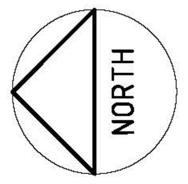
CLIENT & JOB: GINDALBIE METALS LIMITED

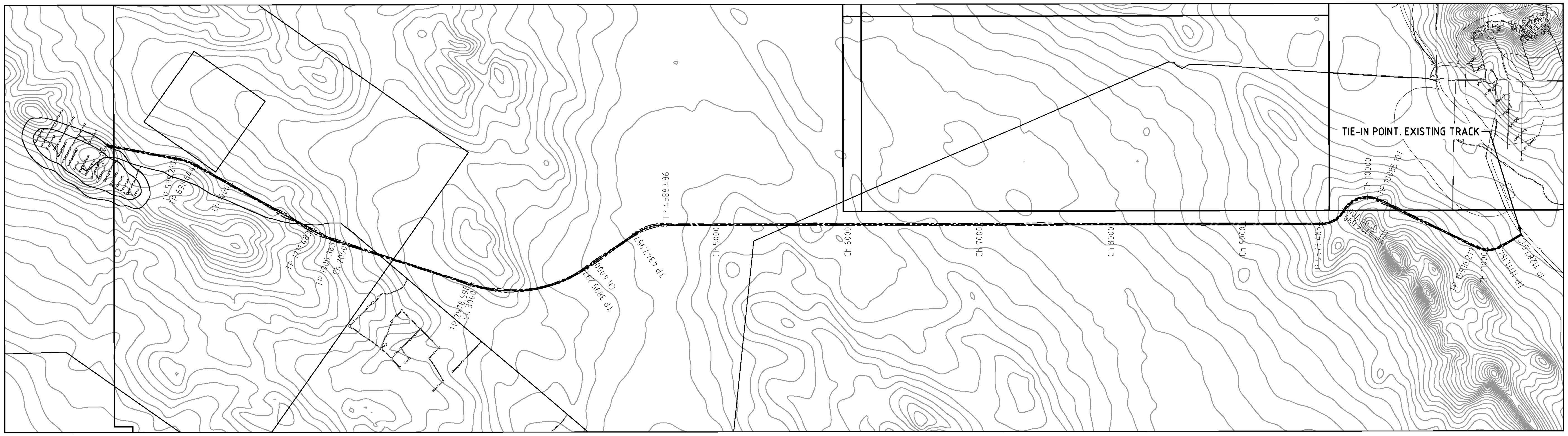
TITLE: HINGE HAUL ROAD OPTION 2 LAYOUT PLAN

SHEET SIZE A1 | JOB No. 12-213 | DRG No. SK.04 | REVISION A

Appendix 5: SK05 Hinge Haul Road – Option 3 Layout Plan

FOR INFORMATION ONLY





HINGE HAUL ROAD - LAYOUT PLAN
OPTION 3

Design Haul Rd Option 3 – CONTROL LINE DETAILS

PT	CHAINAGE	EASTING	NORTHING	BEARING	RAD/SPIRAL	TANGENT	DEF ANGLE	ARC LEN
IP1	0. 000	487673. 047	6788504. 332	190d54'35"				
TC	539. 219	487570. 994	6787974. 858	190d54'35"				
IP2	618. 931	487555. 779	6787895. 917		500. 000	80. 394	18d16'07"	159. 424
CT	698. 644	487516. 584	6787825. 724	209d10'42"				
	1000	487369. 664	6787562. 607	209d10'42"				
TC	1711. 483	487022. 795	6786941. 407	209d10'42"				
IP3	1808. 423	486975. 385	6786856. 502		1000. 000	97. 245	11d06'31"	193. 880
CT	1905. 363	486945. 222	6786764. 053	198d04'11"				
	2000	486915. 868	6786674. 084	198d04'11"				
TC	2978. 598	486612. 330	6785743. 751	198d04'11"				
	3000	486605. 910	6785723. 335	196d50'37"				
IP4	3436. 948	486459. 291	6785274. 691		1000. 000	493. 395	52d31'23"	916. 700
CT	3895. 297	486738. 420	6784867. 843	145d32'49"				
	4000	486797. 654	6784781. 506	145d32'49"				
TC	4347. 957	486994. 505	6784494. 585	145d32'49"				
IP5	4468. 221	487064. 669	6784392. 316		400. 000	124. 024	34d27'11"	240. 528
CT	4588. 486	487064. 669	6784268. 292	180d00'00"				
	5000	487064. 669	6783856. 777	180d00'00"				
	6000	487064. 669	6782856. 777	180d00'00"				
	7000	487064. 669	6781856. 777	180d00'00"				
	8000	487064. 669	6780856. 777	180d00'00"				
	9000	487064. 669	6779856. 777	180d00'00"				
TC	9573. 485	487064. 669	6779283. 292	180d00'00"				
IP6	9674. 787	487064. 669	6779172. 335		200. 000	110. 958	58d02'31"	202. 605
CT	9776. 090	487158. 809	6779113. 605	121d57'29"				
TC	9792. 706	487172. 907	6779104. 810	121d57'29"				
IP7	9938. 904	487325. 065	6779009. 886		200. 000	179. 340	83d45'54"	292. 395
	10000	487266. 993	6778930. 434	181d20'36"				
CT	10085. 101	487247. 228	6778848. 318	205d43'23"				
TC	10916. 219	486886. 504	6778099. 562	205d43'23"				
	11000	486866. 775	6778018. 767	181d43'18"				
IP8	11013. 702	486840. 492	6778004. 054		200. 000	106. 014	55d51'12"	194. 965
CT	11111. 184	486893. 707	6777912. 364	149d52'11"				
IP9	11287. 512	486982. 218	6777759. 861	149d52'11"				

LEGEND

EXISTING TENEMENT BOUNDARY
2.0m GIS CONTOUR INTERVAL

REV	DATE	DESCRIPTION	REV	DATE	DESCRIPTION
A	19.09.12	ISSUED FOR INFORMATION			

pritchard francis
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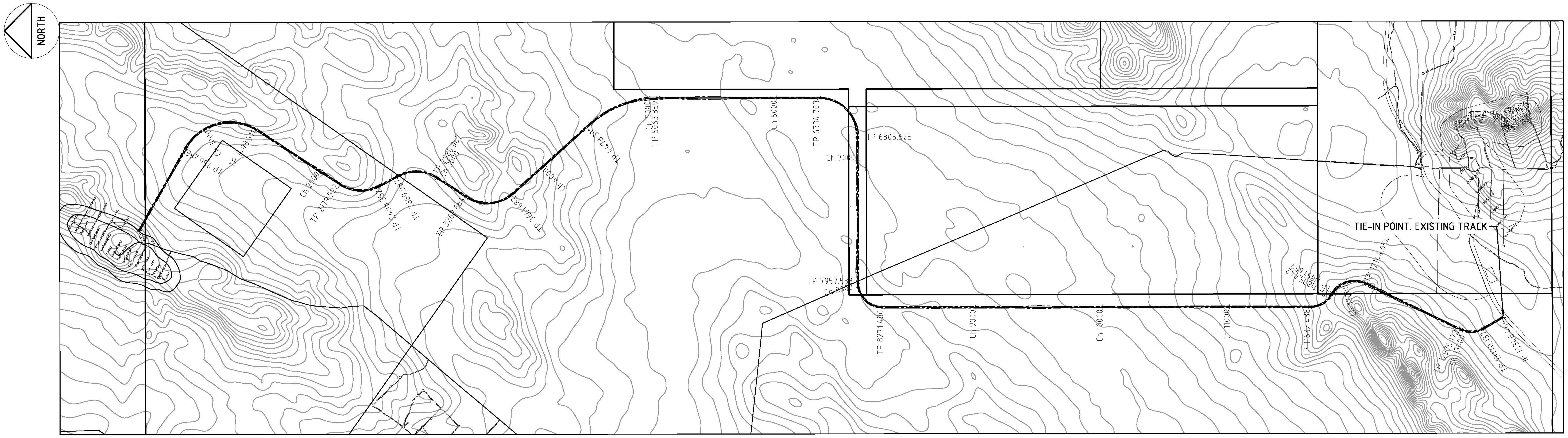
SCALE U.N.O. N.T.S.
DATE SEPT. 2012 | DESIGNED KP
DRAWN JAS | CHECKED KP

CLIENT & JOB: GINDALBIE METALS LIMITED
TITLE: HINGE HAUL ROAD OPTION 3 LAYOUT PLAN
SHEET SIZE A1 | JOB No. 12-213 | DRG No. SK.05 | REVISION A

Appendix 6: SK06 Hinge Haul Road – Option 4 Layout Plan



Design Haul Rd Option 4 — CONTROL LINE DETAILS

PT	CHAINAGE	EASTING	NORTHING	BEARING	RAD/SPIRAL	TANGENT	DEF ANGLE	ARC LEN
IP1	0.000	487673.047	6788504.332	119d34'44"				
TC	750.286	488325.553	6788133.973	119d34'44"				
	1000	488491.647	6787952.946	155d20'52"				
IP2	1076.798	488695.602	6787923.936		400.000	425.502	93d32'20"	653.025
CT	1403.311	488463.123	6787567.557	213d07'04"				
	2000	488137.114	6787067.801	213d07'04"				
TC	2179.522	488039.029	6786917.443	213d07'04"				
IP3	2338.937	487942.688	6786769.756		300.000	176.333	60d53'31"	318.830
CT	2498.352	488024.857	6786613.738	152d13'33"				
TC	2669.987	488104.836	6786461.877	152d13'33"				
IP4	2829.027	488186.770	6786306.305		300.000	175.829	60d44'56"	318.080
CT	2988.067	488091.072	6786158.800	212d58'29"				
	3000	488084.577	6786148.789	212d58'29"				
TC	3269.664	487937.808	6785922.565	212d58'29"				
IP5	3465.673	487812.812	6785729.903		300.000	229.658	74d52'12"	392.018
CT	3661.682	487966.171	6785558.953	138d06'17"				
	4000	488192.090	6785307.121	138d06'17"				
TC	4478.391	488511.546	6784951.023	138d06'17"				
IP6	4770.875	488716.053	6784723.059		800.000	306.253	41d53'43"	584.969
	5000	488713.545	6784480.099	175d27'44"				
CT	5063.359	488716.053	6784416.806	180d00'00"				
	6000	488716.053	6783480.165	180d00'00"				
TC	6334.703	488716.053	6783145.462	180d00'00"				
IP7	6570.164	488716.053	6782845.779		300.000	299.683	89d56'22"	470.922
CT	6805.625	488416.370	6782845.462	269d56'22"				
	7000	488221.995	6782845.257	269d56'22"				
TC	7957.538	487264.458	6782844.244	269d56'22"				
	8000	487222.319	6782839.709	257d46'30"				
IP8	8114.512	487064.669	6782844.033		200.000	199.789	89d56'22"	313.948
CT	8271.486	487064.669	6782644.244	180d00'00"				
	9000	487064.669	6781915.730	180d00'00"				
	10000	487064.669	6780915.730	180d00'00"				
	11000	487064.669	6779915.730	180d00'00"				
TC	11632.438	487064.669	6779283.292	180d00'00"				
IP9	11733.740	487064.669	6779172.335		200.000	110.958	58d02'31"	202.605
CT	11835.042	487158.809	6779113.605	121d57'29"				
TC	11851.659	487172.907	6779104.810	121d57'29"				
IP10	11997.856	487325.065	6779009.886		200.000	179.340	83d45'54"	292.395
	12000	487259.731	6778988.723	164d27'17"				
CT	12144.054	487247.228	6778848.318	205d43'23"				
TC	12975.172	486886.504	6778099.562	205d43'23"				
	13000	486877.143	6778076.584	198d36'37"				
IP11	13072.654	486840.492	6778004.054		200.000	106.014	55d51'12"	194.965
CT	13170.137	486893.707	6777912.364	149d52'11"				
IP12	13346.464	486982.218	6777759.861	149d52'11"				

HINGE HAUL ROAD - LAYOUT PLAN
OPTION 4

LEGEND

EXISTING TENEMENT BOUNDARY

2.0m GIS CONTOUR INTERVAL

FOR INFORMATION ONLY

REV	DATE	DESCRIPTION	REV	DATE	DESCRIPTION
A	19.09.12	ISSUED FOR INFORMATION			

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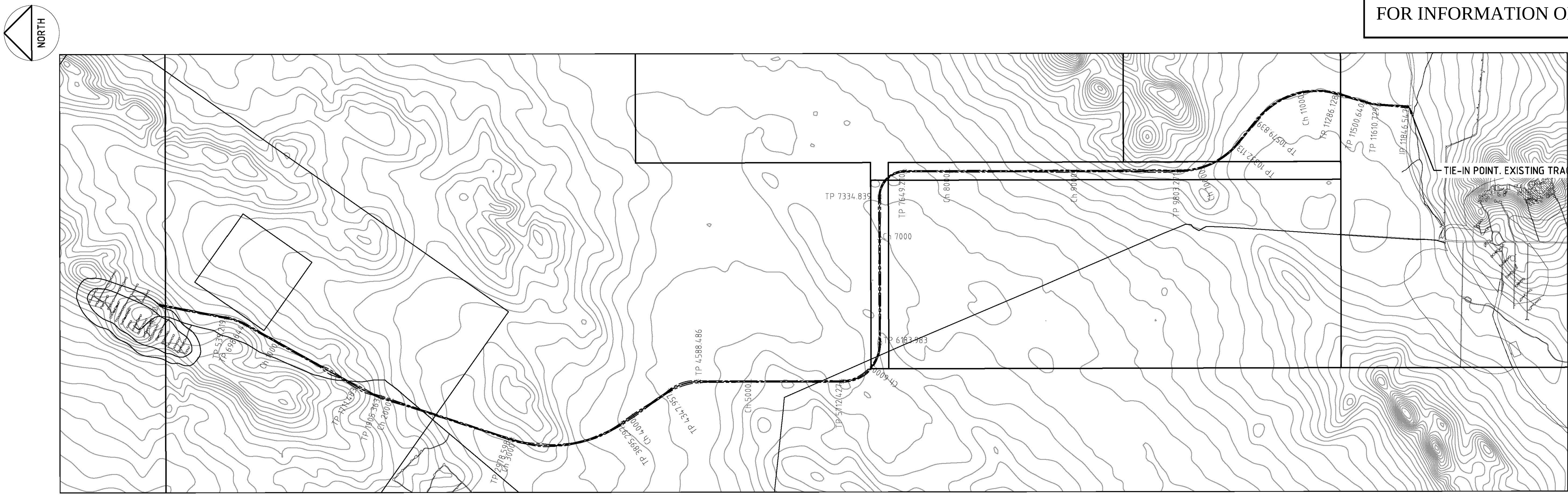
ACN: 008 891 094

SCALE U.N.O.	N.T.S.
DATE	SEPT. 2012
DESIGNED	KP
DRAWN	JAS
CHECKED	KP
CLIENT & JOB	GINDALBIE METALS LIMITED
TITLE	HINGE HAUL ROAD OPTION 4 LAYOUT PLAN
SHEET SIZE	A1
JOB No.	12-213
DRG No.	SK.06
REVISION	A

Appendix 7: SK07 Hinge Haul Road – Option 5 Layout Plan

FOR INFORMATION ONLY



HINGE HAUL ROAD - LAYOUT PLAN
OPTION 5

Design Haul Rd Option 5 — CONTROL LINE DETAILS

PT	CHAINAGE	EASTING	NORTHING	BEARING	RAD/SPIRAL	TANGENT	DEF ANGLE	ARC LEN
IP1	0.000	487673.047	6788504.332	190d54'35"				
TC	539.219	487570.994	6787974.858	190d54'35"				
IP2	618.931	487555.779	6787895.917		500.000	80.394	18d16'07"	159.424
CT	698.644	487516.584	6787825.724	209d10'42"				
IP3	698.644	487516.584	6787825.724	209d10'42"			0d00'00"	
	1000	487369.664	6787562.607	209d10'42"				
TC	1711.483	487022.795	6786941.407	209d10'42"				
IP4	1808.423	486975.385	6786856.502		1000.000	97.245	11d06'31"	193.880
CT	1905.363	486945.222	6786764.053	198d04'11"				
	2000	486915.868	6786674.084	198d04'11"				
TC	2978.598	486612.330	6785743.751	198d04'11"				
	3000	486605.910	6785723.335	196d50'37"				
IP5	3436.948	486459.291	6785274.691		1000.000	493.395	52d31'23"	916.700
CT	3895.297	486738.420	6784867.843	145d32'49"				
	4000	486797.654	6784781.506	145d32'49"				
TC	4347.957	486994.505	6784494.585	145d32'49"				
IP6	4468.221	487064.669	6784392.316		400.000	124.024	34d27'11"	240.528
CT	4588.486	487064.669	6784268.292	180d00'00"				
	5000	487064.669	6783856.777	180d00'00"				
TC	5712.427	487064.669	6783144.350	180d00'00"				
IP7	5948.205	487064.669	6782844.033		300.000	300.317	90d03'38"	471.556
	6000	487192.263	6782898.838	125d04'40"				
CT	6183.983	487364.986	6782844.350	89d56'22"				
	7000	488181.002	6782845.213	89d56'22"				
TC	7334.839	488515.841	6782845.567	89d56'22"				
IP8	7492.024	488716.053	6782845.779		200.000	200.212	90d03'38"	314.371
CT	7649.210	488716.053	6782645.567	180d00'00"				
	8000	488716.053	6782294.777	180d00'00"				
	9000	488716.053	6781294.777	180d00'00"				
TC	9803.271	488716.053	6780491.506	180d00'00"				
	10000	488748.017	6780298.283	161d12'50"				
IP9	10067.692	488716.053	6780208.524		600.000	282.983	50d30'03"	528.842
CT	10332.113	488934.412	6780028.527	129d29'57"				
TC	10579.839	489125.565	6779870.956	129d29'57"				
IP10	10932.984	489434.600	6779616.214		600.000	400.495	67d26'44"	706.288
	11000	489334.108	6779516.065	169d37'18"				
CT	11286.128	489317.875	6779233.106	196d56'42"				
TC	11500.640	489255.355	6779027.906	196d56'42"				
IP11	11555.684	489239.248	6778975.038		500.000	55.268	12d36'55"	110.088
CT	11610.729	489235.075	6778919.928	184d19'47"				
IP12	11846.547	489217.272	6778684.782	184d19'47"				

LEGEND

EXISTING TENEMENT BOUNDARY
2.0m GIS CONTOUR INTERVAL

REV	DATE	DESCRIPTION	REV	DATE	DESCRIPTION
A	19.09.12	ISSUED FOR INFORMATION			

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ACN: 008 891 094

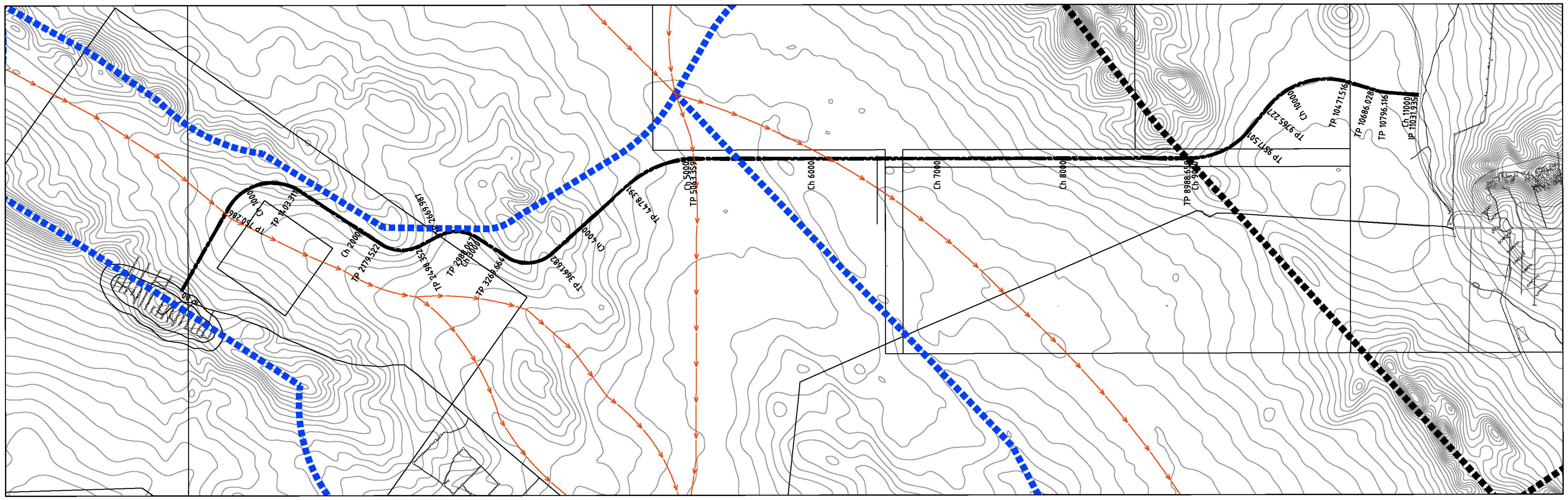
SCALE U.N.O. N.T.S.
DATE SEPT. 2012 | DESIGNED KP
DRAWN JAS | CHECKED KP

CLIENT & JOB: GINDALBIE METALS LIMITED
TITLE: HINGE HAUL ROAD OPTION 5 LAYOUT PLAN
SHEET SIZE A1 | JOB No. 12-213 | DRG No. SK.07 | REVISION A

Appendix 8: SK08 Hinge Haul Road – Option 1 Plan & Profile

FOR INFORMATION ONLY

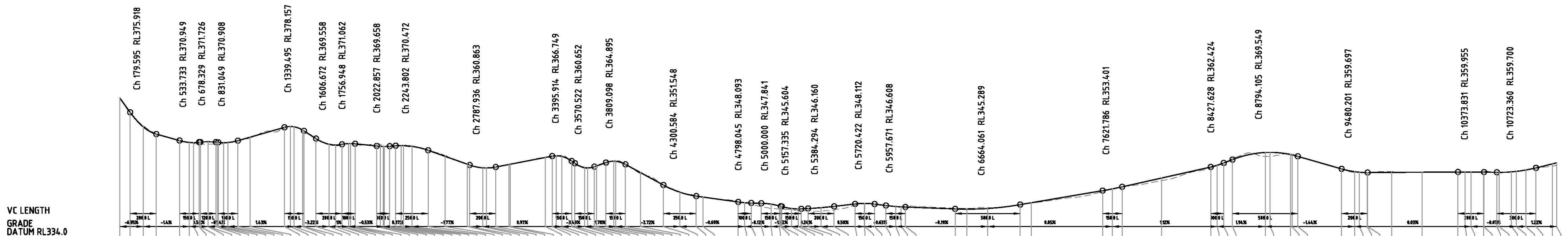
NORTH



HINGE HAUL ROAD - LAYOUT PLAN
OPTION 1
SCALE 1:20000

LEGEND

- EXISTING TENEMENT BOUNDARY
- 2.0m GIS CONTOUR INTERVAL
- CATCHMENT BOUNDARY
- SUB-CATCHMENT BOUNDARY
- DRAINAGE PATH



CHAINAGE	NATURAL SURFACE	DESIGN CENTRELINE
0.000	388.397	388.397
79.595	382.549	382.866
179.595	377.697	377.304
279.595	374.581	374.514
458.733	371.955	372.001
533.733	371.155	371.313
567.193	370.903	371.240
608.733	370.696	371.352
618.329	370.680	371.403
678.329	370.687	371.565
678.445	370.687	371.565
738.329	370.714	371.405
750.286	370.685	371.341
756.049	370.680	371.310
796.997	370.817	371.200
831.049	371.161	371.276
906.049	371.812	371.977
1000.000	373.071	373.317
1264.495	376.924	377.087
1310.543	377.522	377.416
1339.495	377.432	377.286
1403.311	376.211	376.084
1414.495	375.885	375.743
1506.672	372.699	372.777
1606.672	370.439	370.613
1659.226	370.002	370.322
1706.672	370.369	370.559
1706.948	370.372	370.562
1756.948	370.771	370.871
1772.400	370.814	370.890
1806.948	370.622	370.798
1972.857	370.754	369.922
2000.000	370.641	369.811
2022.857	370.057	369.770
2031.751	369.885	369.766
2072.857	369.590	369.842
2118.802	369.851	370.011
2161.986	370.104	370.091
2179.522	369.971	370.078
2243.802	369.626	369.805
2368.802	368.451	368.265
2498.352	366.334	365.977
2669.987	363.033	362.946
2687.936	362.768	362.629
2787.936	361.770	361.547
2817.117	361.788	361.489
2887.936	361.897	361.831
2988.067	362.753	362.801
3000.000	362.842	362.916
3269.664	365.566	365.527
3320.914	365.699	366.023
3353.474	366.069	366.181
3395.914	366.328	365.913
3470.914	364.141	364.130
3495.522	363.252	363.271
3570.522	361.374	361.640
3594.905	361.256	361.536
3645.522	362.159	361.986
3661.682	362.454	362.273
3734.098	363.410	363.561
3793.458	364.293	364.089
3809.098	364.385	364.052
3884.098	362.972	362.858
4000.000	359.362	359.711
4175.584	354.834	354.942
4300.584	352.023	352.179
4425.584	350.909	350.680
4478.391	350.280	350.313
4748.045	348.645	348.440
4798.045	348.161	348.164
4848.045	347.563	348.031
4925.000	346.690	347.935
5000.000	345.941	347.598
5063.359	345.724	346.934
5075.000	345.683	346.775
5082.335	345.657	346.671
5157.335	345.393	345.917
5210.287	345.206	345.761
5232.335	345.128	345.788
5284.294	344.958	345.915
5384.294	344.960	346.244
5484.294	345.338	346.741
5645.422	347.116	347.676
5717.136	347.925	347.885
5720.422	347.893	347.884
5795.422	347.724	347.637
5882.671	347.213	347.083
5957.671	346.685	346.692
6000.000	346.747	346.545
6032.671	346.802	346.468
6414.061	346.010	345.756
6504.366	346.000	345.672
6664.061	346.308	345.935
6914.061	347.409	347.407
7000.000	347.944	348.135
7546.786	352.435	352.766
7621.786	353.401	353.452
7696.786	354.146	354.241
8000.000	356.612	357.636
8377.628	361.565	361.864
8427.628	362.530	362.527
8477.628	363.442	363.396
8544.105	365.093	364.689
8794.105	365.894	367.436
8831.690	365.961	367.484
8988.659	366.900	366.651
9000.000	366.792	366.526
9044.105	366.059	365.959
9380.201	361.163	361.133
9480.201	359.842	360.063
9517.501	359.806	359.852
9576.252	359.772	359.725
9580.201	359.766	359.726
9765.227	360.104	359.779
10000.000	359.949	359.847
10273.831	359.977	359.927
10330.521	359.886	359.935
10373.831	359.960	359.930
10471.516	360.188	359.884
10473.831	360.189	359.882
10573.360	359.990	359.810
10590.344	359.949	359.803
10686.028	359.961	360.000
10723.360	360.092	360.184
10796.116	360.618	360.715
10873.360	361.317	361.528
11000.000	362.177	363.071
11031.935	362.570	363.460

HORIZONTAL 1:20000
VERTICAL 1:1000

HINGE HAUL ROAD - PROFILE
OPTION 1

REV	DATE	DESCRIPTION	REV	DATE	DESCRIPTION
A	19.09.12	ISSUED FOR INFORMATION			

pritchard francis
civil and structural engineering consultants
Level 1, 430 Roberts Road
PO Box 2150
Subiaco WA 6904
Telephone: (08) 9382 5111
Facsimile: (08) 9382 5199
admin@pfeng.com.au
ACN: 008 891 094

SCALE U.N.O. AS SHOWN
DATE SEPT. 2012 | DESIGNED KP
DRAWN JAS | CHECKED KP

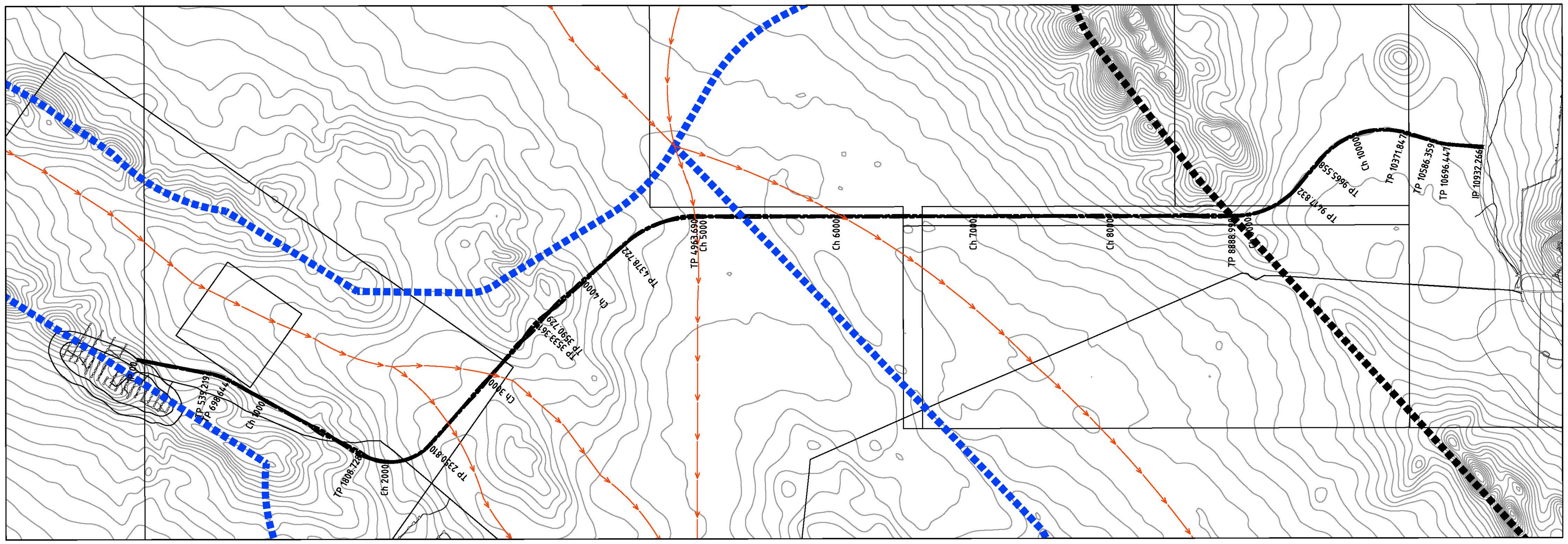
CLIENT & JOB: GINDALBIE METALS LIMITED
TITLE: HINGE HAUL ROAD
OPTION 1 - PLAN & PROFILE

SHEET SIZE A1 | JOB No. 12-213 | DRG No. SK.08 | REVISION A

Appendix 9: SK09 Hinge Haul Road – Option 2 Plan & Profile

FOR INFORMATION ONLY

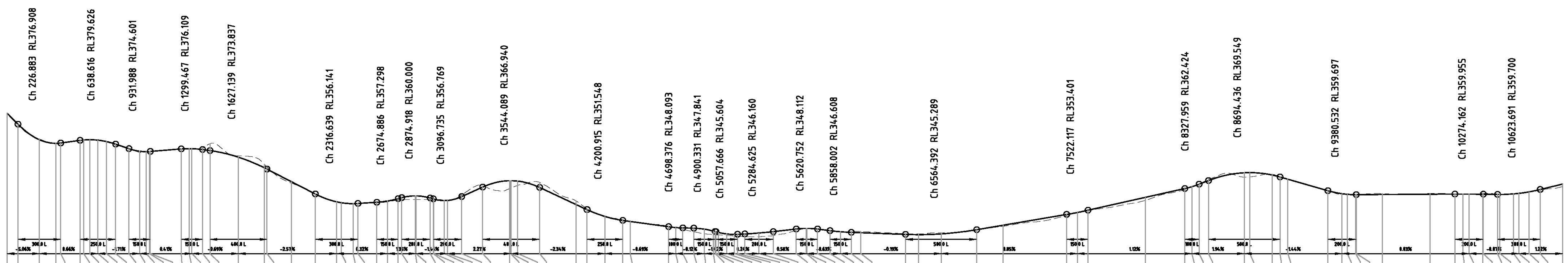
NORTH



HINGE HAUL ROAD - LAYOUT PLAN
OPTION 2
SCALE 1:20000

LEGEND

- EXISTING TENEMENT BOUNDARY
- 2.0m GIS CONTOUR INTERVAL
- CATCHMENT BOUNDARY
- SUB-CATCHMENT BOUNDARY
- DRAINAGE PATH



VC LENGTH
GRADE
DATUM RL334.0

CHAINAGE	NATURAL SURFACE	DESIGN CENTRELINE
0.000	388.397	388.397
76.883	384.307	384.504
226.883	379.331	379.055
342.288	377.753	377.784
376.883	377.896	377.898
513.616	378.772	378.801
539.219	378.822	378.939
583.155	378.857	379.030
638.616	378.795	378.884
698.644	378.239	378.397
763.616	377.244	377.485
856.988	375.872	375.885
931.988	374.600	374.999
977.987	374.764	374.849
1000.000	374.980	374.883
1006.988	375.045	374.909
1224.467	375.847	375.801
1280.238	375.957	375.916
1299.467	375.833	375.902
1374.467	376.012	375.589
1427.139	377.633	375.224
1627.139	373.423	372.900
1808.728	370.445	369.168
1827.139	369.509	368.704
2000.000	363.780	364.267
2166.639	360.079	359.991
2316.639	357.211	357.225
2350.810	356.892	356.898
2433.116	356.682	356.571
2466.639	356.533	356.626
2599.886	356.907	357.056
2674.886	357.242	357.491
2749.886	357.870	358.311
2774.918	358.000	358.649
2871.153	358.000	359.299
2874.918	358.000	359.298
2974.918	358.000	358.543
2996.735	358.000	358.226
3000.000	358.000	358.179
3074.831	357.722	357.657
3096.735	357.497	357.702
3196.735	359.629	359.043
3344.089	362.782	362.393
3533.361	361.890	364.629
3541.061	362.053	364.632
3544.089	362.110	364.632
3590.729	362.979	364.490
3744.089	364.061	362.253
4000.000	357.574	356.256
4075.915	354.834	354.477
4200.915	352.023	352.063
4325.915	350.909	350.680
4378.722	350.280	350.313
4648.376	348.645	348.440
4698.376	348.161	348.164
4748.376	347.563	348.031
4825.331	346.690	347.935
4900.331	345.941	347.598
4963.690	345.724	346.934
4975.331	345.683	346.775
4982.666	345.657	346.671
5000.000	345.596	346.441
5057.666	345.393	345.917
5110.618	345.206	345.761
5132.666	345.128	345.788
5184.625	344.958	345.915
5284.625	344.960	346.244
5384.625	345.338	346.741
5545.752	347.116	347.676
5617.467	347.925	347.885
5620.752	347.893	347.884
5695.752	347.724	347.637
5783.002	347.213	347.083
5858.002	346.685	346.692
5933.002	346.802	346.468
6000.000	346.793	346.343
6314.392	346.010	345.756
6404.697	346.000	345.672
6564.392	346.308	345.935
6814.392	347.409	347.407
7000.000	348.623	348.979
7447.117	352.435	352.766
7522.117	353.401	353.452
7597.117	354.146	354.241
8000.000	357.702	358.752
8277.959	361.565	361.864
8327.959	362.530	362.527
8377.959	363.442	363.396
8444.436	365.093	364.689
8694.436	365.894	367.436
8732.021	365.961	367.484
8888.990	366.900	366.651
8944.436	366.059	365.959
9000.000	365.227	365.161
9280.532	361.163	361.133
9380.532	359.842	360.063
9417.832	359.806	359.852
9476.583	359.772	359.725
9480.532	359.766	359.726
9665.558	360.104	359.779
10000.000	360.130	359.876
10174.162	359.977	359.927
10230.852	359.886	359.935
10274.162	359.960	359.930
10371.847	360.188	359.884
10374.162	360.189	359.882
10473.691	359.990	359.810
10490.675	359.949	359.803
10586.359	359.961	360.000
10623.691	360.092	360.184
10696.447	360.618	360.715
10773.691	361.317	361.528
10932.266	362.570	363.460

HORIZONTAL 1:20000
VERTICAL 1:1000

HINGE HAUL ROAD - PROFILE
OPTION 2

REV	DATE	DESCRIPTION	REV	DATE	DESCRIPTION
A	19.09.12	ISSUED FOR INFORMATION			

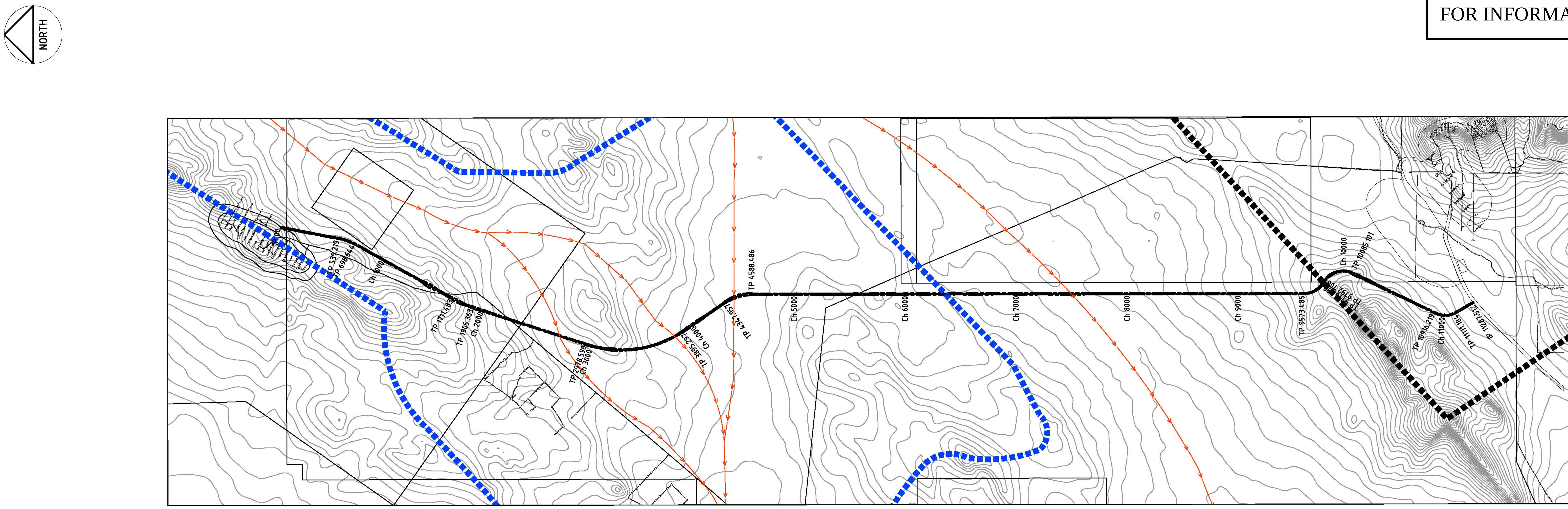
pritchard francis
civil and structural engineering consultants
Level 1, 430 Roberts Road
PO Box 2150
Subiaco WA 6904
Telephone: (08) 9382 5111
Facsimile: (08) 9382 5199
admin@pfeng.com.au
ACN: 008 891 094

SCALE U.N.O.
DATE: SEPT. 2012 | DESIGNED: KP
DRAWN: JAS | CHECKED: KP

CLIENT & JOB: GINDALBIE METALS LIMITED
TITLE: HINGE HAUL ROAD OPTION 2 - PLAN & PROFILE
SHEET SIZE: A1 | JOB No.: 12-213 | DRG No.: SK.09 | REVISION: A

Appendix 10: SK10 Hinge Haul Road – Option 3 Plan & Profile

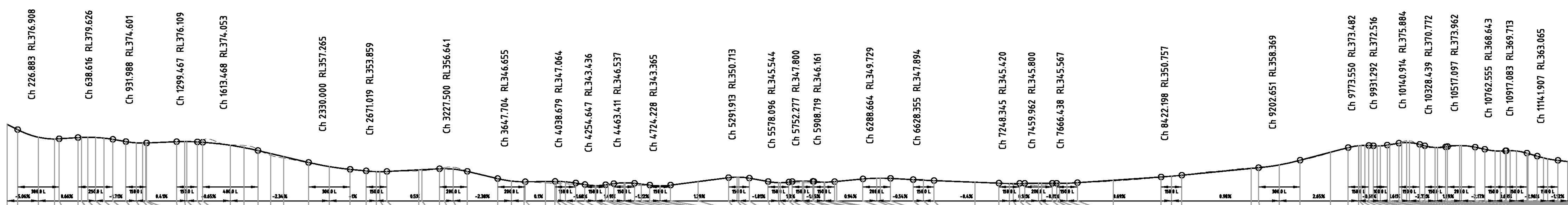
FOR INFORMATION ONLY



HINGE HAUL ROAD - LAYOUT PLAN
OPTION 3
SCALE 1:20000

LEGEND

- EXISTING TENEMENT BOUNDARY
- 2.0m GIS CONTOUR INTERVAL
- CATCHMENT BOUNDARY
- SUB-CATCHMENT BOUNDARY
- DRAINAGE PATH



CHAINAGE	NATURAL SURFACE	DESIGN CENTRELINE
0.000	388.397	388.397
76.883	384.307	384.504
226.883	379.331	379.055
342.288	377.753	377.784
376.883	377.896	377.898
513.616	378.772	378.801
539.219	378.822	378.939
583.155	378.857	379.030
638.616	378.795	378.884
698.644	378.239	378.397
763.616	377.244	377.485
856.988	375.872	375.885
931.988	374.600	374.999
977.987	374.764	374.849
1000.000	374.980	374.883
1006.988	375.045	374.909
1224.467	375.847	375.801
1282.262	375.944	375.920
1299.467	375.833	375.910
1374.467	376.012	375.618
1413.468	377.358	375.363
1613.468	373.382	373.209
1711.483	373.143	371.537
1813.468	370.080	369.367
1905.363	365.893	367.214
2000.000	363.874	364.996
2180.000	360.387	360.779
2330.000	357.965	357.769
2480.000	355.750	355.767
2596.019	354.763	354.608
2671.019	354.127	354.140
2695.973	354.018	354.109
2746.019	354.115	354.234
2978.598	354.641	355.397
3000.000	354.758	355.504
3127.500	356.539	356.141
3162.262	357.115	356.228
3227.500	357.359	355.922
3327.500	354.560	354.265
3547.704	348.647	349.031
3647.704	347.564	347.275
3739.259	346.974	346.755
3747.704	346.919	346.759
3895.297	345.867	346.914
3963.679	345.539	346.986
3972.486	345.504	346.990
4000.000	345.398	346.945
4038.679	345.264	346.730
4113.679	345.003	345.804
4179.647	344.668	344.696
4254.647	344.084	344.030
4259.261	344.046	344.027
4329.647	344.000	344.550
4347.957	344.000	344.822
4388.411	344.000	345.423
4463.411	344.000	346.030
4470.885	344.000	346.035
4538.411	344.000	345.625
4588.486	344.000	345.016
4649.228	344.000	344.277
4721.890	344.000	343.835
4724.228	344.000	343.836
4799.228	344.573	344.336
5000.000	346.601	346.934
5216.913	349.611	349.742
5279.532	350.000	350.147
5291.913	350.000	350.131
5366.913	349.008	349.358
5503.096	347.186	346.899
5578.096	346.341	346.125
5590.451	346.174	346.110
5653.096	346.000	346.515
5677.277	346.000	346.829
5752.277	346.000	347.361
5760.198	346.000	347.366
5827.277	346.000	347.014
5833.719	346.000	346.947
5908.719	346.221	346.533
5912.823	346.266	346.532
5983.719	347.033	346.865
6000.000	347.210	347.018
6188.664	348.846	348.790
6288.664	349.536	349.359
6315.644	349.614	349.386
6388.664	348.790	349.189
6553.355	348.579	348.299
6628.355	348.477	347.921
6703.355	347.788	347.595
7000.000	346.725	346.411
7173.345	345.840	345.719
7248.345	345.137	345.528
7276.776	344.837	345.513
7323.345	344.588	345.554
7359.962	344.511	345.620
7459.962	344.000	345.727
7482.756	344.184	345.731
7559.962	344.807	345.687
7591.438	345.062	345.651
7612.631	345.233	345.639
7666.438	345.979	345.717
7741.438	346.191	346.082
8000.000	347.298	347.857
8347.198	350.167	350.242
8422.198	350.757	350.811
8497.198	351.507	351.488
9000.000	356.922	356.392
9052.651	357.428	356.906
9202.651	359.302	358.996
9352.651	362.197	362.340
9573.485	367.820	368.186
9698.550	371.762	371.497
9773.550	373.056	372.871
9776.090	373.081	372.896
9792.706	373.277	373.026
9820.372	373.537	373.109
9848.550	373.616	373.023
9881.292	373.342	372.822
9908.887	373.095	372.738
9931.292	373.011	372.793
9981.292	373.317	373.319
10000.000	373.501	373.620
10065.914	374.788	374.679
10085.101	375.503	374.934
10121.535	376.535	375.126
10140.914	376.527	375.072
10215.914	372.949	373.839
10253.439	371.637	372.816
10328.439	371.680	371.600
10346.019	371.866	371.554
10403.439	372.634	372.040
10417.097	372.835	372.271
10504.763	373.325	373.012
10517.097	373.238	372.997
10617.097	371.511	371.795
10687.555	370.180	370.268
10762.555	369.213	369.179
10801.225	369.072	369.037
10837.555	369.278	369.163
10842.083	369.306	369.194
10870.544	369.413	369.293
10916.219	369.105	369.039
10917.083	369.094	369.029
10992.083	367.651	367.496
11000.000	367.453	367.261
11066.907	365.556	365.283
11111.184	364.157	364.094
11141.907	363.493	363.410
11216.907	362.018	362.225
11287.512	361.435	361.435

HORIZONTAL 1:20000
VERTICAL 1:1000

HINGE HAUL ROAD - PROFILE
OPTION 3

REV	DATE	DESCRIPTION
A	19.09.12	ISSUED FOR INFORMATION

pritchard francis
civil and structural engineering consultants
Level 1, 430 Roberts Road
PO Box 2150
Subiaco WA 6904
Telephone: (08) 9382 5111
Facsimile: (08) 9382 5199
admin@pfeng.com.au
ACN 008 891 094

SCALE U.N.O. AS SHOWN
DATE SEPT. 2012 | DESIGNED KP
DRAWN JAS | CHECKED KP

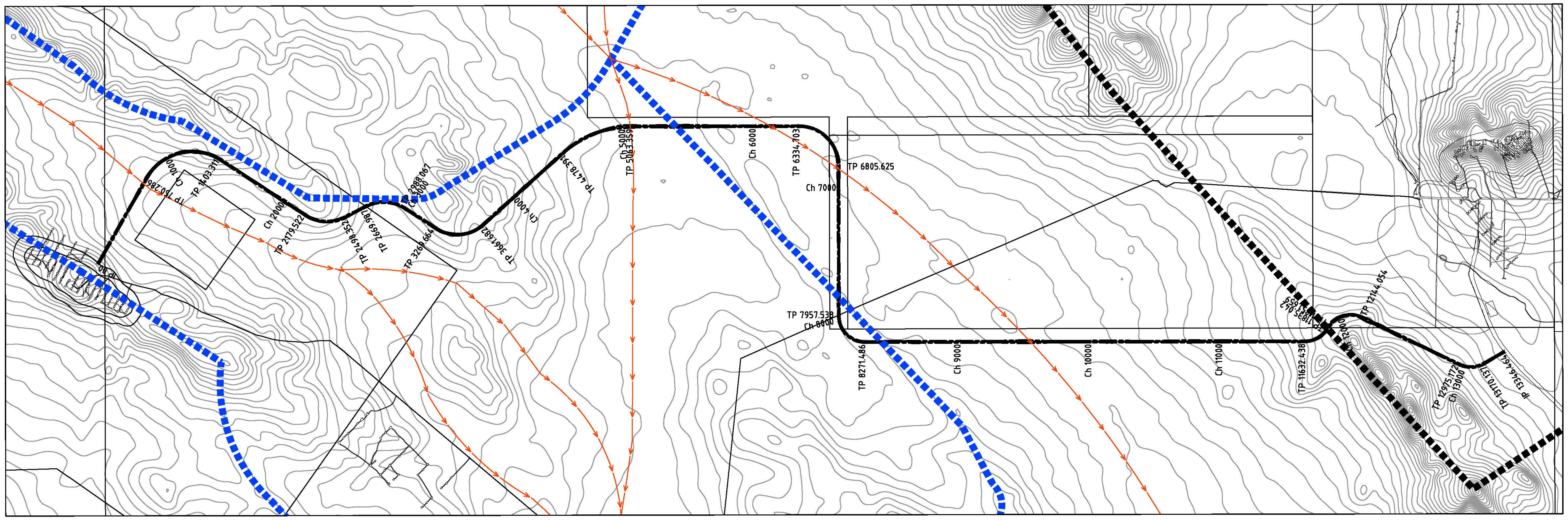
CLIENT & JOB: GINDALBIE METALS LIMITED
TITLE: HINGE HAUL ROAD
OPTION 3 - PLAN & PROFILE

SHEET SIZE A1 | JOB No. 12-213 | DRG No. SK.10 | REVISION A

Appendix 11: SK11 Hinge Haul Road – Option 4 Plan & Profile

FOR INFORMATION ONLY

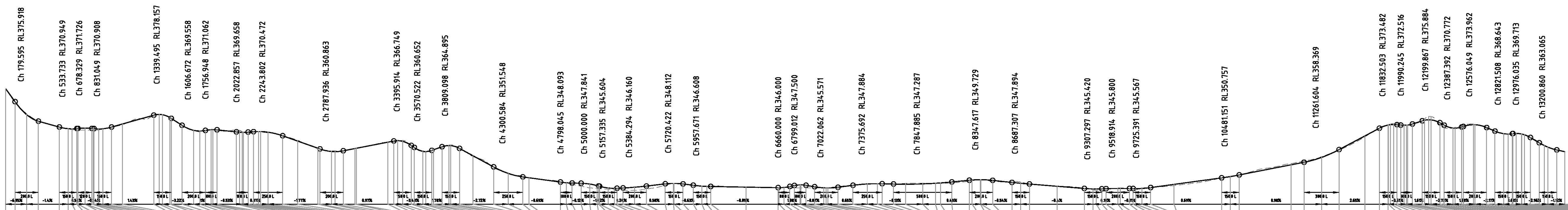
NORTH



HINGE HAUL ROAD – LAYOUT PLAN
OPTION 4
SCALE 1:20000

LEGEND

- EXISTING TENEMENT BOUNDARY
- 2.0m GIS CONTOUR INTERVAL
- CATCHMENT BOUNDARY
- SUB-CATCHMENT BOUNDARY
- DRAINAGE PATH



CHAINAGE	NATURAL SURFACE	DESIGN CENTRELINE
0.000	388.397	388.397
79.595	382.549	382.866
179.595	377.697	377.304
279.595	374.581	374.514
458.733	371.955	372.001
533.733	371.155	371.313
567.193	370.903	371.240
608.733	370.696	371.352
618.329	370.680	371.403
678.329	370.687	371.565
678.445	370.687	371.565
738.329	370.714	371.405
750.286	370.685	371.341
756.049	370.680	371.310
796.997	370.817	371.200
831.049	371.161	371.276
906.049	371.812	371.977
1000.000	373.071	373.317
1264.495	376.924	377.087
1310.543	377.522	377.416
1339.495	377.432	377.286
1403.311	376.211	376.084
1414.495	375.885	375.743
1506.672	372.699	372.777
1606.672	370.439	370.613
1659.226	370.002	370.322
1706.672	370.369	370.559
1706.948	370.372	370.562
1756.948	370.771	370.871
1772.400	370.814	370.890
1806.948	370.622	370.798
1972.857	370.754	369.922
2000.000	370.641	369.811
2022.857	370.057	369.770
2031.751	369.885	369.766
2072.857	369.590	369.842
2118.802	369.851	370.011
2161.986	370.104	370.091
2179.522	369.971	370.078
2243.802	369.626	369.805
2368.802	368.451	368.265
2498.352	366.334	365.977
2669.987	363.033	362.946
2687.936	362.768	362.629
2787.936	361.770	361.547
2811.117	361.788	361.489
2887.936	361.897	361.831
2988.067	362.753	362.801
3000.000	362.842	362.916
3269.664	365.566	365.527
3320.914	365.699	366.023
3353.474	366.069	366.181
3395.914	366.328	365.913
3470.914	364.141	364.130
3495.522	363.252	363.271
3570.522	361.374	361.640
3594.905	361.256	361.536
3645.522	362.159	361.986
3661.682	362.454	362.273
3734.098	363.410	363.561
3793.458	364.293	364.089
3809.098	364.385	364.052
3884.098	362.972	362.858
4000.000	359.362	359.711
4175.584	354.834	354.942
4300.584	352.023	352.179
4425.584	350.909	350.680
4478.391	350.280	350.313
4748.045	348.645	348.440
4798.045	348.161	348.164
4848.045	347.563	348.031
4925.000	346.690	347.935
5000.000	345.941	347.598
5063.359	345.724	346.934
5075.000	345.683	346.775
5082.335	345.657	346.671
5157.335	345.393	345.917
5210.287	345.206	345.761
5232.335	345.128	345.788
5284.294	344.958	345.915
5384.294	344.950	346.244
5484.294	345.338	346.741
5645.422	347.116	347.676
5717.136	347.925	347.885
5720.422	347.893	347.884
5795.422	347.724	347.637
5882.671	347.213	347.083
5957.671	346.685	346.711
6000.000	346.747	346.591
6032.671	346.802	346.543
6334.703	346.207	346.282
6610.000	346.000	346.043
6617.428	346.000	346.040
6660.000	346.000	346.146
6710.000	346.000	346.540
6749.012	346.000	346.960
6799.012	346.000	347.257
6804.516	346.000	347.260
6805.625	346.000	347.260
6849.012	346.000	347.067
6922.062	346.000	346.436
7000.000	346.000	345.992
7022.062	346.047	345.950
7035.932	346.094	345.943
7122.062	346.532	346.225
7250.692	347.207	347.066
7375.692	347.697	347.640
7460.180	347.595	347.752
7500.692	347.594	347.726
7597.885	347.594	347.603
7700.728	347.883	347.538
7847.885	348.000	347.671
7957.538	347.978	347.944
8000.000	347.896	348.089
8097.885	348.106	348.509
8247.617	348.855	349.240
8271.486	349.038	349.342
8342.622	349.522	349.472
8347.617	349.536	349.472
8447.617	348.790	349.189
8612.307	348.579	348.299
8687.307	348.477	347.921
8762.307	347.788	347.595
9000.000	346.761	346.646
9232.297	345.840	345.719
9307.297	345.137	345.528
9335.729	344.837	345.513
9382.297	344.588	345.554
9418.914	344.511	345.620
9518.914	344.000	345.727
9541.709	344.184	345.731
9618.914	344.807	345.687
9650.391	345.062	345.651
9671.584	345.233	345.639
9725.391	345.979	345.717
9800.391	346.191	346.082
10000.000	346.893	347.453
10406.151	350.167	350.242
10481.151	350.757	350.811
10556.151	351.507	351.488
11000.000	356.393	355.817
11111.604	357.428	356.906
11261.604	359.302	358.996
11411.604	362.197	362.340
11632.438	367.820	368.186
11757.503	371.762	371.497
11832.503	373.056	372.871
11835.042	373.081	372.896
11851.659	373.277	373.026
11879.374	373.537	373.109
11907.503	373.616	373.023
11940.245	373.342	372.822
11967.840	373.095	372.738
11990.245	373.011	372.793
12000.000	373.044	372.853
12040.245	373.317	373.319
12124.867	374.788	374.679
12144.054	375.503	374.934
12180.487	376.535	375.126
12199.867	376.527	375.072
12274.867	372.949	373.839
12312.392	371.637	372.816
12387.392	371.680	371.600
12404.972	371.866	371.554
12462.392	372.634	372.040
12476.049	372.835	372.271
12563.715	373.325	373.012
12576.049	373.238	372.997
12676.049	371.511	371.795
12746.508	370.180	370.268
12821.508	369.213	369.179
12860.178	369.072	369.037
12896.508	369.278	369.163
12901.035	369.306	369.194
12929.497	369.413	369.293
12975.172	369.105	369.039
12976.035	369.094	369.029
13000.000	368.719	368.688
13051.035	367.651	367.496
13125.860	365.556	365.283
13170.137	364.157	364.094
13200.860	363.493	363.410
13275.860	362.018	362.225
13346.464	361.435	361.435

HORIZONTAL 1:20000
VERTICAL 1:1000

HINGE HAUL ROAD – PROFILE
OPTION 4

REV	DATE	DESCRIPTION
A	19.09.12	ISSUED FOR INFORMATION

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ACN: 008 891 094

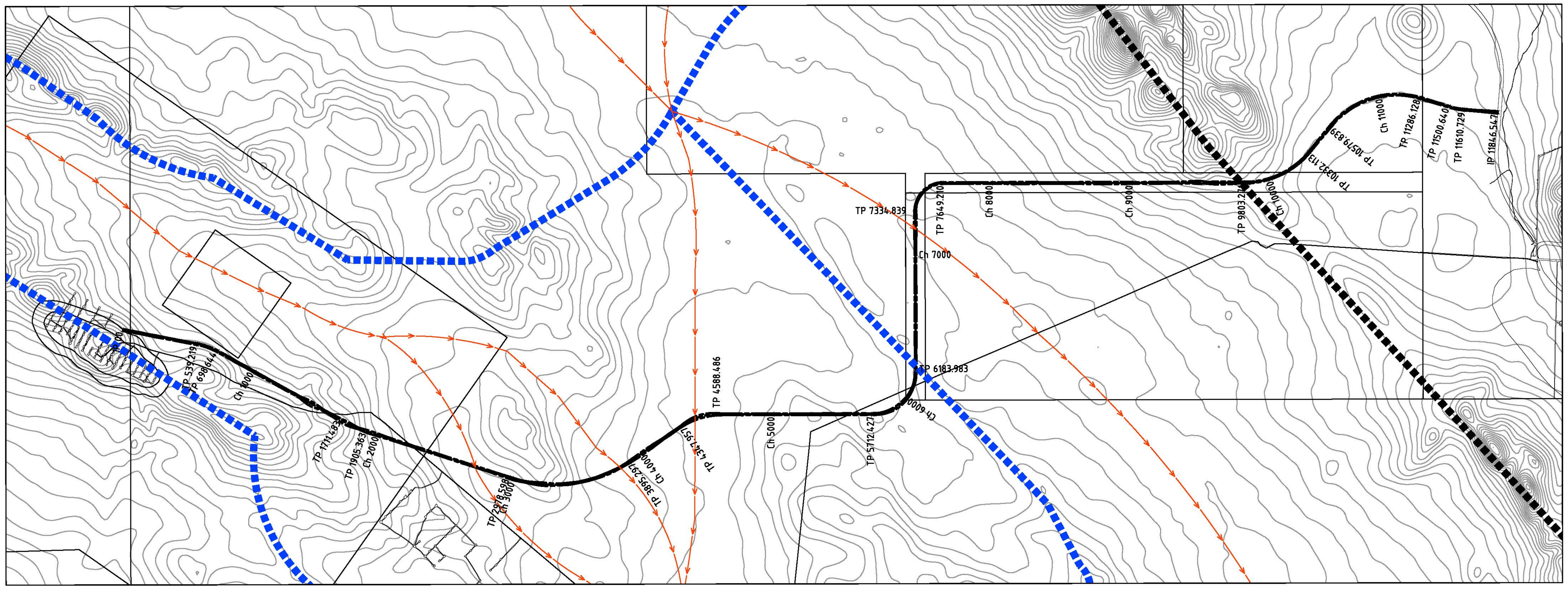
SCALE U.N.O. AS SHOWN
DATE SEPT. 2012 | DESIGNED KP
DRAWN JAS | CHECKED KP

CLIENT & JOB: GINDALBIE METALS LIMITED
TITLE: HINGE HAUL ROAD
OPTION 4 – PLAN & PROFILE
SHEET SIZE A1 | JOB No. 12-213 | DRG No. SK.11 | REVISION A

Appendix 12: SK12 Hinge Haul Road – Option 5 Plan & Profile

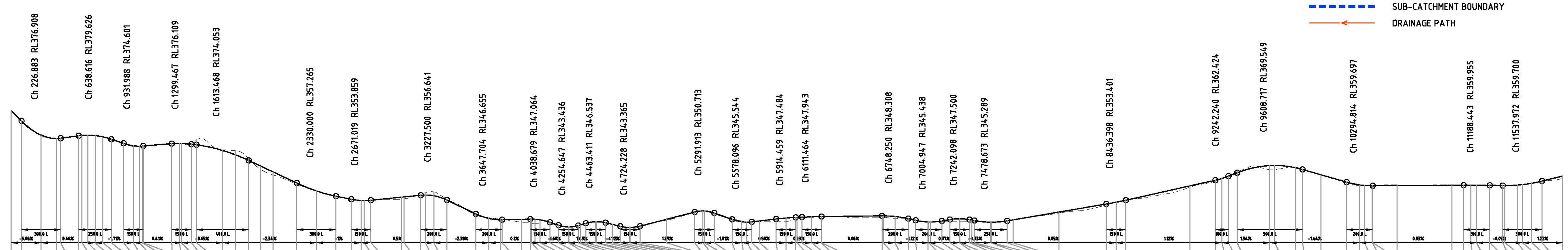
FOR INFORMATION ONLY

NORTH



HINGE HAUL ROAD - LAYOUT PLAN
OPTION 5
SCALE 1:20000

LEGEND
- EXISTING TENEMENT BOUNDARY
- 2.0m GIS CONTOUR INTERVAL
- CATCHMENT BOUNDARY
- SUB-CATCHMENT BOUNDARY
- DRAINAGE PATH



CHAINAGE	NATURAL SURFACE	DESIGN CENTRELINE
0.000	388.397	388.397
76.883	384.307	384.504
226.883	379.331	379.055
342.288	377.753	377.784
376.883	377.896	377.898
513.616	378.772	378.801
539.219	378.822	378.939
583.155	378.857	379.030
638.616	378.795	378.884
698.644	378.239	378.397
763.616	377.244	377.485
856.988	375.872	375.885
931.988	374.600	374.999
977.987	374.764	374.849
1000.000	374.980	374.883
1006.988	375.045	374.909
1224.467	375.847	375.801
1282.262	375.944	375.920
1299.467	375.833	375.910
1374.467	376.012	375.618
1413.468	377.358	375.363
1613.468	373.382	373.209
1711.483	373.143	371.537
1813.468	370.080	369.367
1905.363	365.893	367.214
2000.000	363.874	364.996
2180.000	360.387	360.779
2330.000	357.965	357.769
2480.000	355.750	355.767
2596.019	354.763	354.608
2671.019	354.127	354.140
2695.973	354.018	354.109
2746.019	354.115	354.234
2978.598	354.641	355.397
3000.000	354.758	355.504
3127.500	356.539	356.141
3162.262	357.115	356.228
3227.500	357.359	355.922
3327.500	354.560	354.265
3547.704	348.647	349.031
3647.704	347.564	347.275
3739.259	346.974	346.755
3747.704	346.919	346.759
3895.297	345.867	346.914
3963.679	345.539	346.986
3972.486	345.504	346.990
4000.000	345.398	346.945
4038.679	345.264	346.730
4113.679	345.003	345.804
4179.647	344.668	344.696
4254.647	344.084	344.030
4259.261	344.046	344.027
4329.647	344.000	344.550
4347.957	344.000	344.822
4388.411	344.000	345.423
4463.411	344.000	346.030
4470.885	344.000	346.035
4538.411	344.000	345.625
4588.486	344.000	345.016
4649.228	344.000	344.277
4721.890	344.000	343.835
4724.228	344.000	343.836
4799.228	344.573	344.336
5000.000	346.601	346.934
5216.913	349.611	349.742
5279.532	350.000	350.147
5291.913	350.000	350.131
5366.913	349.008	349.358
5503.096	347.186	346.899
5578.096	346.341	345.991
5616.795	346.000	345.872
5653.096	346.000	345.976
5712.427	346.000	346.319
5839.459	346.000	347.051
5914.459	346.048	347.419
5989.459	346.823	347.658
6000.000	346.934	347.683
6036.464	347.320	347.768
6111.464	347.943	347.910
6183.983	348.000	347.984
6186.464	348.000	347.986
6648.250	347.688	348.251
6658.018	347.706	348.254
6748.250	347.326	348.014
6848.250	346.923	347.190
6904.947	346.614	346.556
7000.000	346.109	345.942
7004.947	346.094	345.935
7017.458	346.052	345.927
7104.947	346.000	346.308
7167.098	346.000	346.848
7239.395	346.000	347.162
7242.098	346.000	347.162
7317.098	346.000	346.799
7334.839	346.000	346.633
7353.673	346.000	346.457
7478.673	346.000	345.846
7484.810	346.000	345.845
7603.673	346.545	346.348
7649.210	346.886	346.734
8000.000	349.321	349.705
8361.398	352.435	352.766
8436.398	353.401	353.452
8511.398	354.146	354.241
9000.000	359.221	359.712
9192.240	361.565	361.864
9242.240	362.530	362.527
9292.240	363.441	363.396
9358.717	365.093	364.689
9608.717	365.894	367.436
9646.302	365.961	367.484
9803.271	366.900	366.651
9858.717	366.059	365.959
10000.000	363.887	363.930
10194.814	361.163	361.133
10294.814	359.842	360.063
10332.113	359.806	359.852
10390.864	359.772	359.725
10394.814	359.766	359.726
10579.839	360.104	359.779
11000.000	360.161	359.901
11088.443	359.977	359.927
11145.133	359.886	359.935
11188.443	359.960	359.930
11286.128	360.188	359.884
11288.443	360.189	359.882
11387.972	359.990	359.810
11404.956	359.949	359.803
11500.640	359.961	360.000
11537.972	360.092	360.184
11610.729	360.618	360.715
11687.972	361.317	361.528
11846.547	362.570	363.460

HORIZONTAL 1:20000
VERTICAL 1:1000

HINGE HAUL ROAD - PROFILE
OPTION 5

REV	DATE	DESCRIPTION
A	19.09.12	ISSUED FOR INFORMATION

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ACN: 008 891 094

SCALE U.N.O.	AS SHOWN		
DATE	SEPT. 2012	DESIGNED	KP
DRAWN	JAS	CHECKED	KP

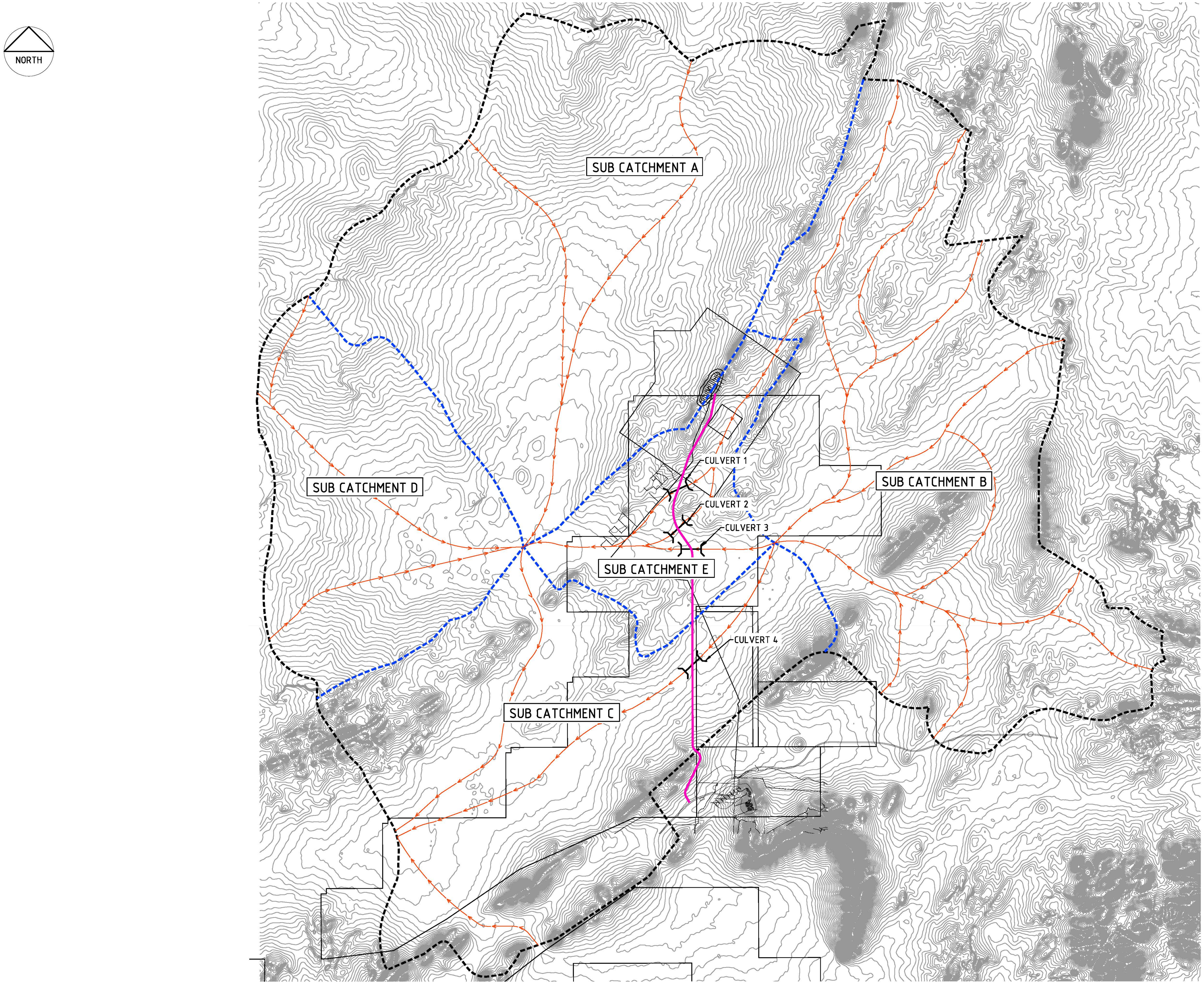
CLIENT & JOB: GINDALBIE METALS LIMITED

TITLE: HINGE HAUL ROAD
OPTION 5 - PLAN & PROFILE

SHEET SIZE	JOB No.	DRG No.	REVISION
A1	12-213	SK.12	A

Appendix 13: SK13 Hinge Haul Road – Stormwater Catchment Areas & Culvert Locations

FOR INFORMATION ONLY



LEGEND:

- CATCHMENT BOUNDARY
- SUB-CATCHMENT BOUNDARY
- DRAINAGE PATH
- HINGE HAUL ROAD OPTION 3

REV	DATE	DESCRIPTION	REV	DATE	DESCRIPTION
A	19.09.12	ISSUED FOR INFORMATION			

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SCALE U.N.O. 100m 0m 100m 200m
1:5000

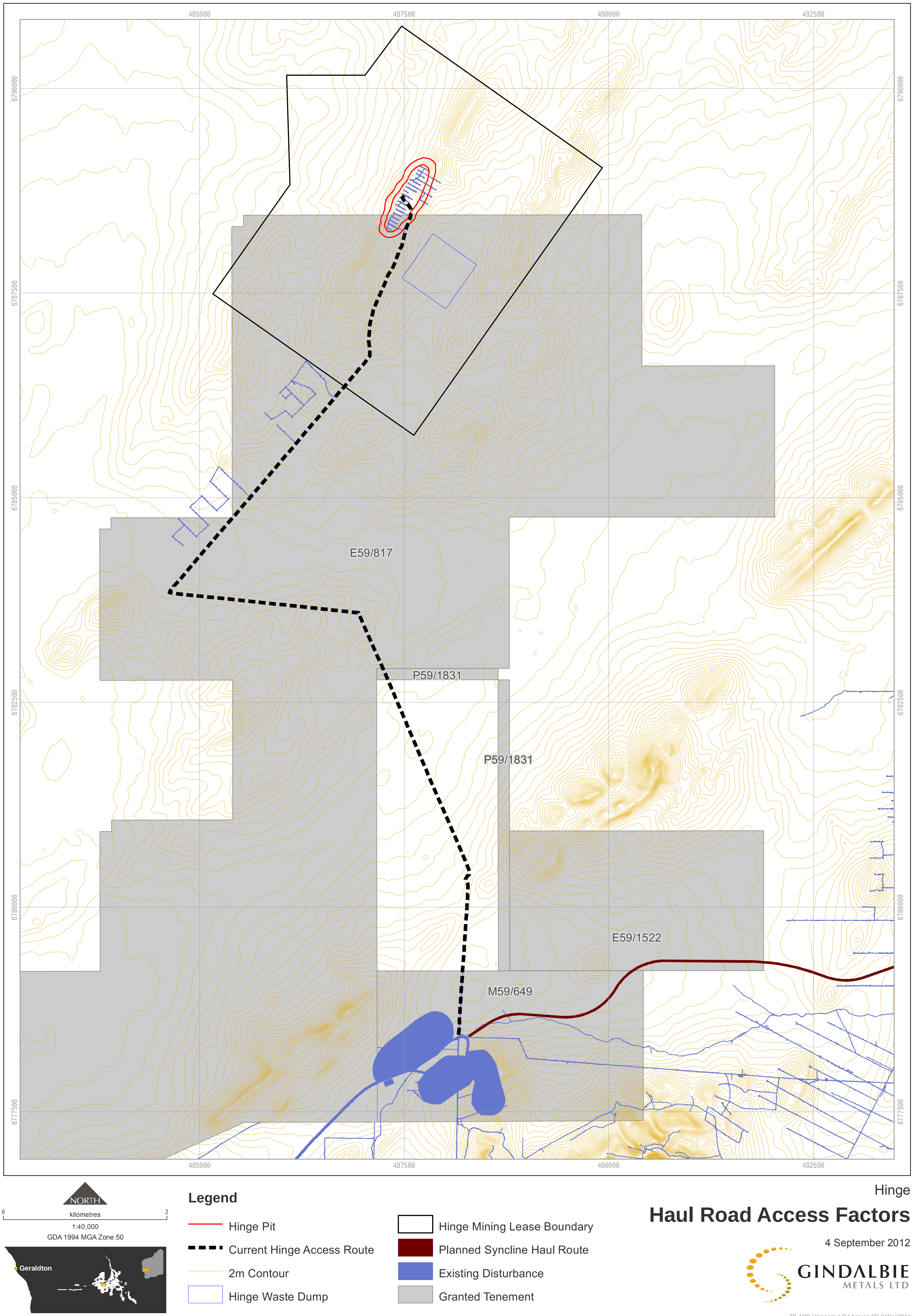
DATE	DESIGNED
SEPT. 2012	KP
DRAWN	CHECKED
JAS	KP

CLIENT & JOB: GINDALBIE METALS LIMITED

TITLE: HINGE HAUL ROAD
STORMWATER CATCHMENT AREAS & CULVERT LOCATIONS

SHEET SIZE	JOB No.	DRG No.	REVISION
A1	12-213	SK.13	A

Appendix 14: GBG Overall Site Plan



Legend

- Hinge Pit
- Current Hinge Access Route
- 2m Contour
- Hinge Waste Dump
- Hinge Mining Lease Boundary
- Planned Syncline Haul Route
- Existing Disturbance
- Granted Tenement

Hinge

Haul Road Access Factors

4 September 2012

GINDALBIE METALS LTD

G:\Exploration\GIS\Maps\Approvals\2012\09 04 - Hinge Access\TS-APP-Hinge Haul Rd Access-PB-04Sep2012.mxd

TS-APP-Hinge Haul Rd Access-PB-04Sep2012 civil

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