VOL. 1

MPUMALANGA
PROVINCIAL GOVERNMENT

VOL. 1

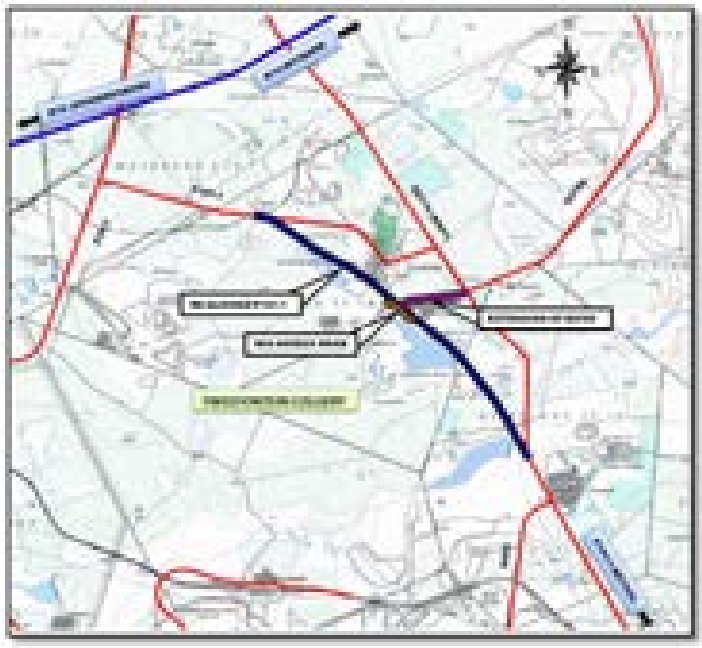
Department of Roads and Transport

DETAIL DESIGN REPORT FOR THE RE-ALIGNMENT OF PROVINCIAL ROADS P141-1 AND D2769 AND THE CLOSURE OF A PORTION OF D2770 AND P141-1

NKANGALA DISTRICT

EMALAHLENI MUNICIPALITY

March 2014



Issued To:
Head of Department
Department of Roads and Transport
Private Bag X11310
Nelspruit 1200

Initiated By:
Glencore Operations SA, Private Bag X19
Melrose Arch, 2076, Tel: (011) 772-0689

Prepared By:
Jeffares & Green (Pty) Ltd
PO Box 2973 Pretoria, 0001
Crestway Office Park, Block A,
Polmed Building, 20 Hotel Str.,
Persequor Park, Pretoria, 0020
Tel: (012) 349-7900

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Initiated By:

GLENCORE

Glencore Operations South Africa (Pty) Ltd
Private Bag X19
Melrose Arch, 2076

Tel: (011) 772-0689
Fax: (011) 772 0694
E-mail: scrane@xstratacoal.co.za

Project Manager: S Crane

Prepared By:

Jeffares & Green

Jeffares & Green (Pty) Ltd
PO Box 2973 Pretoria, 0001
Crestway Office Park, Block A,
Polmed Building, 20 Hotel Str.,
Persequor Park, Pretoria, 0020

Tel:(012) 349-7900
Fax: (012) 349-7979
E-mail: nelj@jgi.co.za

Compiler: LJ Nel

DETAIL DESIGN REPORT
FOR THE RE-ALIGNMENT OF PROVINCIAL ROADS P141-1 AND D2769 AND THE CLOSURE OF A PORTION OF D2770 AND P141-1

March 2014

REV 00

Jeffares & Green

QUALITY VERIFICATION

This report has been prepared under the control established by a Quality Management system that meets the requirements of ISO9001:2008 which has been independently certified by DEKRA Certification which holds certificate number 10000016.

DEKRA

Verification	Capacity	Name	Signature	Date
By Author	Project Leader	L.J. Nel		24/04/2014
Checked by	Associate	K. Thirsen		24/04/2014
Authorised by	Project Director	C.C. le Roux		24/04/2014

TABLE OF CONTENTS **Page**

MPUMALANGA PROVINCIAL GOVERNMENT

DEPARTMENT OF ROADS AND TRANSPORT

DETAIL DESIGN REPORT FOR THE RE-ALIGNMENT OF PROVINCIAL ROADS P141-1 AND D2769 AND THE CLOSURE OF A PORTION OF D2770 AND P141-1

EXECUTIVE SUMMARY

This report (Rev 00) is submitted to obtain approval from the Provincial Government of Mpumalanga, Department of Public Works, Roads and Transport (***Department***), for the Detail Design done for the realignment of portions of Provincial Roads for the proposed expansion of opencast mining activities at the Tweefontein Colliery by Glencore Operations SA, situated northeast of Ogies.

Portions of provincial road D2770 (R547), which is a through route from Clewer to Bethal, and a portion of the provincial road P141-1, which is the east-west link between provincial roads P29/1 and D2770 (R547), are affected. All roads are surfaced.

The east-west link (P141-1) between the P29-1 (R555) and the D2770 (R547) is to be realigned southwards past the proposed opencast mining areas, to link with road D2770 (R547) east of the Phoenix Dam. This will shorten the route from Witbank to Leandra or Bethal. (***Refer Annexure A01***)

Since the Preliminary Designs have been submitted and approved in December 2012, and approval granted in June 2013, minor changes have been made to the alignment of roads P141-1 and D2769. Which is discussed further in the report.

The geotechnical investigations have identified five possible borrow areas with material ranging from G5 to G8 material quality. With modification C3 and C4 material could be achieved.

The Environmental Investigation is currently underway, and a Record of Decision is expected in June 2014.

The construction is planned to commence towards the end of 2014 and will take approximately 12 months to complete, however mining is to start 6 months prior to the road construction. Due to the mine planning, construction is to be completed before the end of 2016.

MPUMALANGA PROVINCIAL GOVERNMENT

DEPARTMENT OF ROADS AND TRANSPORT

PRELIMINARY DESIGN REPORT FOR THE RE-ALIGNMENT OF PROVINCIAL ROADS D2770, P141-1 AND 0154 AND THE CLOSURE OF A PORTION OF D2770, P141-1 AND 0154

1. TERMS OF REFERENCE

Jeffares & Green (Pty) Ltd (**J&G**) were appointed by Glencore Operations SA (**GOSA**) as Consulting Engineers to re-investigate the possibility of permanently realigning portions of Provincial Roads D2770 (R547), P141-1 and D2769 (0154), northeast of Ogies and to obtain approval from the Provincial Government of Mpumalanga; Department of Roads and Transport (***Department***), on their behalf.

A Preliminary Design Report was prepared and submitted to the Department in December 2012. Approval has been granted by the Department to proceed with the Detail Design of the works, with reference to the letter dated 6 June 2013, from the Department (***Annexure A02***).

2. INTRODUCTION

2.1 General

This detail design report pertaining routes D2770 (R547), P141-1 and D2769 (0154), situated approximately 10km northeast of Ogies, comprises proposals for final approval of the planning.

2.2 Background

Glencore plans to optimize its current operations at the Tweefontein Colliery and to exploit coal reserves traversing provincial roads D2770 (R547) and P141-1, which is currently one of the available through routes between Witbank and Bethal and the link between road P29-1 and D2770 (R547) respectively. Based on economical and practical considerations, a portion of Roads D2770 (R547) and P141-1 will require permanent closure and re-alignment or re-routing. As the life of the mine is expected to be in excess of 20 years, these actions will be permanent. (***Refer Annexure A01***)

Construction of the proposed re-alignment is to commence in the third quarter of 2014.

2.3 Motivation for Realignment

A Preliminary Design Report had been submitted to the Provincial Government of Mpumalanga; Department of Roads and Transport in December 2012, and approval to proceed with Detail Design had been received, 6 June 2013. (***Annexure A02***)

The proposed works can be divided into the following:

- New road linking the existing road P141-1 to R547 (D2770) – **P141-1** - 7,435 km.
- Extension of road D2769 (0154) to the newly re-aligned P141-1 – D2769 – 1,374 km.
- Construction of a new private MIA Access road – 1,084km.
- Construction of two new bridges, one at km 3.140 (Bridge 01) along P141-1, and the other at km 0.160 (Bridge 02) along road D2769.
- Adding a pedestrian deck to an existing bridge at km 0,475 along the MIA Access Road (MIA Bridge).
- Construction of three major culverts along P141-1, one at the vlei crossing at km 0.940, one at the Tweefontein dam discharge at km 4.800 and one at km 7.165 adjacent the Tweefontein Bridge.

The design of the abovementioned works was done as a complete unit, however construction will be split into two phases, **Phase 1** and **Phase 2**. The construction was split into two phases, as the alignment on the northern section (Phase 2) traversed an existing graveyard, and approvals to move graveyards is very time consuming. This was also done as the EIA process currently underway only allows for the southern section (Phase 1).

Although the northern alignment has been moved to miss the graveyards, construction still remains in two phases.

2.4 Deviation from Preliminary Design

Minor changes were made to the alignments of road P141-1 and D2769 since the Preliminary Designs have been submitted and approved. (***Annexure A02***)

The alignment of road P141-1 was slightly moved between km 1.100 and km 2.800 with an s-curve to avoid an existing graveyard between km 1.800 and km 1.900, south of the alignment. This was done in order to expedite the EIA process.

The intersection of road D2769 was moved from km 3.642 to km 3.412, due to the MIA haul road's position which was fixed, as this was an operational requirement.

3. SURVEY AND REFERENCE INFORMATION

This detail design is based on a detail topographical survey, done by J&H Topographical Surveying Services, (September 2013).

Major catchment areas were verified on 1:50 000 topo-cadastral maps.

This detail design follows on the previous Preliminary Design report as prepared by J&G:

- *Preliminary Design Report for the re-alignment of Provincial Roads D2770, P141-1 and D2769 (0154), Rev 00, December 2012. (**Prelim Report**).*

4. TOPOGRAPHY AND CONSTRAINTS

The town of Clewer is to the north, Emalahleni is northeast, Bethal is south east and Ogies is northwest.

The alignment of road **P141-1** traverses the farm *Tweefontein 13 IS and Klipplaat 14 IS.*

The area can be described as a gently undulating plateau on the Mpumalanga Highveld or flat to rolling in road engineering terms. The general area is flat to gently sloping. The P141-1 alignment runs adjacent a drainage channel and the alignment generally slopes in the direction of this channel.

The alignment of road P141-1 was amended slightly between km 1.200 and km 2.700, north easterly, in order to avoid a graveyard south of km 1.800 to km 1.900.

Further constrains is the existing Phoenix dam and Tweefontein dam south west of the alignment.

The alignment of road D2769 traverses the farm *Tweefontein 13 IS,* and is to be an extension of road D2769 westwards, to join road P141-1 in the west. The alignment of the MIA Access road traverses the farm *Tweefontein 13 IS*.

Road D2769 and the MIA Access road alignments slope in a south westerly direction, draining towards the same channel as mentioned above.

With respect to the horizontal alignment, the following constraints were identified;

- existing graveyard,
- proposed opencast pits to the east,
- a vlei area to the north,
- the MIA Haul road towards the Klipplaat west planned open pit, crossing both alignments of P141-1 and D2769,
- Tweefontein dam to the west and,
- Phoenix dam to the south.

With respect to the vertical alignment, the following were identified:

- The MIA haul road traversing road P141-1 eastwards, requires a bridge, and traversing road D2769 southwards, requires a second bridge (provincial road over haul road).
- The intersection on road P141-1, at km 3.412, is located on a downgrade of 2.342%, due to the bridge at km 3.140. The approach from road D2769 has a steep downgrade of 7% and the Tweefontein dam on the other side of road P141-1.
- The MIA haul road was lowered to ±3.5m below ground level. The haul trucks used on the mine allows for a maximum clearance of 8,45m below the bridge deck's soffit.

5. ALIGNMENTS

5.1 Provincial Roads

5.1.1 P141-1: 7.435 km

The alignment of road **P141-1**, deviates south eastward from the existing road P141-1, just past the Grootpan haul road access. It continues south eastwards, past an old pit, on the right, which has been rehabilitated, since the Prelim Report, and then crossing the vlei area, at approximately the same location as an existing rail bridge (new major culvert to be installed, km 0.940). It continues along the vlei area to the right and the planned opencast pit to the left. An area with existing graves is avoided by a slight curve eastwards and southwards, before crossing the Waterpan No 1a dump, which is to be removed prior construction. At the crossing of the MIA haul road at km 3.140, a new bridge with a span of 87m is required, with an approached grade of 1.6%, to cross the haul road and a fill height of approximately 7.0m. At km 3.412, an intersection is required for the MIA Access to the right, and road D2769 to the left. The route continues south eastwards, past the Tweefontein dam to the right, with a major culvert structure at km 4.800 for the dam discharge. The route turns slightly south to avoid the Waterpan No 2 dump, continues south, past the Phoenix Dam, with another major culvert structure, almost in line with the existing Tweefontein Bridge, to cross the Olifants river (km 7.165), before it joins the existing road P141-1 (R547).

5.1.2 D2769: 1.538 km

The extension of road **D2769** starts at the intersection of road D2769 with road P141-1 (R547). The road continues west, past the Makause School, on the left, to be relocated. The route traverses westward, along the Ogies Dyke, and turns south, with a new bridge at km 0.160 and a span of 72.5m, to cross the haul road leading to Makupan Pit, before it joins the re-aligned road P141-1.

The approach grade to the bridge is very steep, with a fill of approximately 7.0m, due to the haul road, and was lowered to approximately 3.5m below ground level. The downgrade towards the intersection is at the Department's maximum grade of 7%. Additional signage have been incorporated for the steep grade and a lower speed restriction with no overtaking limits have been used.

5.2 Private Roads

5.2.1 MIA Access Road: 1.084 km

The MIA Access starts at the intersection with road P141-1 and road D2769, km 3.412. The access road turns northwest and continues parallel to the realigned road P141-1, before it turns south to join the existing mine access road.

An existing arch-cell culvert exist at km 0.475. A pedestrian deck will be added to the culvert structure on both sides.

6. TRAFFIC INFORMATION

Traffic information used was obtained from the Traffic Impact Study done by Avzcons, *Proposed closure / realignment of sections of roads D2770 (R547) & P141-1, Traffic Impact Study, September 2013*, (***Annexure A03***) as well as information from the Mpumalanga Department of Roads and Transport's website, www.mp-rams.co.za (dated 2012). The following is Average Daily Trips for the respective roads:

- P141-1 (between P29-1 and D2770 (R547)) – 1191 ADT – Section to be closed.
- D2770 (between N12 and P141-1) – 2626 ADT – Section to be closed.
- D2769 (between P141-1 and D2257) – 5895 ADT.
- P141-1 (between D2769 and P141-1 (R547) – 7991 ADT.

The daily traffic on road P141-1, between road P29-1 and road D2770, is of minimal importance to the regional road network, as the overwhelming majority of the existing daily trips on this road are related to the existing mining operations of the Tweefontein complex, according to Traffic Impact Study, September 2013, as mentioned earlier.

With the closure of a portion of P141-1, traffic is to be rerouted:

i. The re-aligned road P141-1 to the south east joins road P141-1 (R547) just opposite the Phoenix Dam. With the closure of a portion of road p141-1 (R547) traffic is to be rerouted either along road D2769 to the west to join the re-aligned road P141-1 at the intersection, from where they can go either north (Ogies or Witbank) or south (Bethal).

Construction traffic generated for the first two years have been allowed for in the pavement design although the impact is minor.

7. DESIGN STANDARDS

7.1 Condition on Road P141-1 (R547)

The seal and pavement on road P141-1 (R547) is in a poor condition, with potholes, extensive cracking and edge breaks, as seen on a recent site visit. The average daily traffic (ADT) on this road is 1191 (dated 2013).

7.2 Condition on Road D2769

The pavement on road D2769 is in a poor condition, with potholes, extensive cracking, rutting and edge breaks, as seen on a recent site visit. The average daily traffic (ADT) on this road is 5895 (dated 2013).

7.3 Design Parameters – Road P141-1 and D2769

The detail design of the alignment is based upon a classification of a single carriageway road class T(iii) with a high standard section, as the level of service will exceed service level B. The design speed used is 100km/h, standard requirement from the Department. Operating speed in the area is 80km/h.

The following main design parameters/standards were used:

- The proposed road reserve width is 40m, high standard section.
- A standard surfaced width of 8,6m (3,7m lanes, surfacing to extend 0,6m) with two 2,4m wide unpaved shoulders.
- Guardrail sections, shoulder of 3m with a kerb channel combination, on request from Department.
- Minimum horizontal curve radii of 350m.
- The maximum super-elevation on the curves is 6%.
- Maximum longitudinal slope of 7% and a minimum of 0,5%.
- Flood frequency for the design of culverts is 1:25 years.

Other parameters and standards, as per the Department's Typical Plans for Road Design.

The drawings referred to are the "Typical Plans for Road Design" of the Mpumalanga Department of Public Works, Roads and Transport.

A summary of both the minimum design standards applicable and the standards actually achieved are found in Table 7.3.1 & 7.3.2

Table 7.3.1: Summary of Standards – P141-1

Description	Minimum Standard	Standard Achieved
i) Design Speed	100km/h	100km/h
ii) Road Reserve width	40m	40m
ii) Minimum Curve Radius	350m	350m
iii) Maximum Superelevation	6%	6%
iv) Minimum Slope Vertical	0,5%	0,503%
v) Maximum Slope Vertical	7%	4,724%
vi) Vertical Curve Length (min)	180m	180m
vii) K-value minimum (sag)	37	37
viii) K-value minimum (crest)	62	62
ix) Sight distance at junctions	300m	300m and more
x) Design flood frequency	1:25year	1:25year culverts

Table 7.3.2: Summary of Standards – D2769

Description	Minimum Standard	Standard Achieved
i) Design Speed	100km/h	100km/h
ii) Road Reserve width	40m	40m
ii) Minimum Curve Radius	350m	*160m
iii) Maximum Superelevation	6%	6%
iv) Minimum Slope Vertical	0,5%	0,518%
v) Maximum Slope Vertical	7%	7%
vi) Vertical Curve Length (min)	180m	180m
vii) K-value minimum (sag)	37	37
viii) K-value minimum (crest)	62	**33.3
ix) Sight distance at junctions	300m	300m and more
x) Design flood frequency	1:25year	1:25year culverts

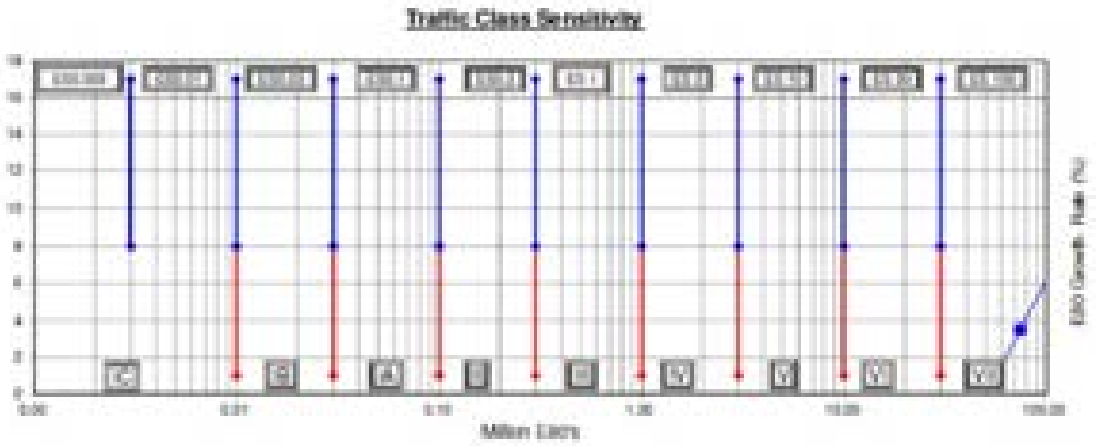
Note: * The minimum curve radius of 350m could not be achieved on curve 1, due to the horizontal constraints of the MIA Haul road's position which was fixed at the time of the design due to the operational requirement from the mine. We could fit a curve radius of 160m for a design speed of 70km/h; but the approach is on a 7% grade towards the intersection, and for safety measures we reduced the operating speed to 40km/h along this curve.

** The minimum k value for crest 1, over the bridge is 33.3, due to the fact that the MIA haul road's position is fixed at the time of the design due to the operational requirement from the mine. The minimum achieved k value is acceptable for an operating speed of 80km/h, k value achieved 33.3 vs. minimum k value 33, and for design speed of 80km/h.

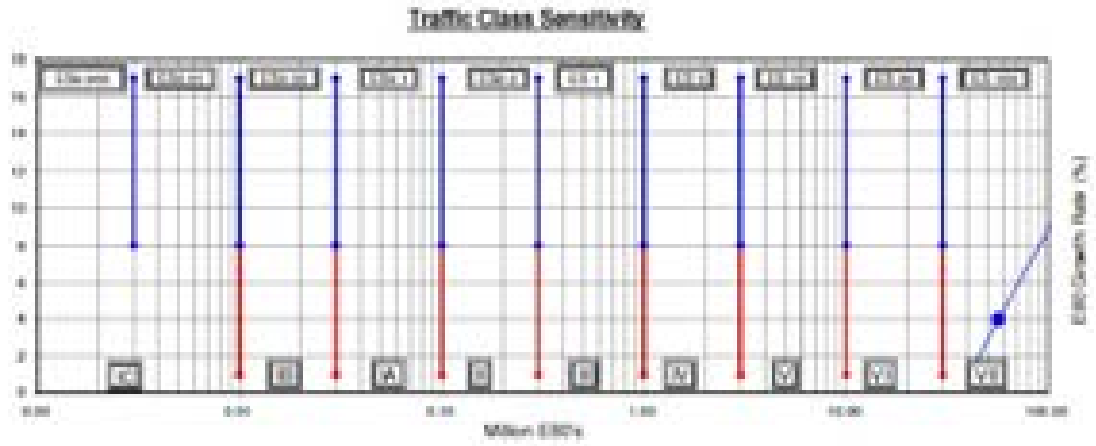
7.4 Basic Pavement Structure

A heavy pavement, Class VII, will be required for the expected 30.0-100.0 Million 80kN Axles/lane on the proposed **P141-1 and D2769**.

This is based on an estimated E80's/hv of between 2.85 and 3.30, and an E80 growth rate of less than 4%, over the 20year design period. Refer to Graph 7.4.1 and Graph 7.4.2 for roads P141-1 and D2769.



Graph 7.4.1: TRH4 Pavement Classes – P141-1



Graph 7.4.2: TRH4 Pavement Classes – D2769

The following road pavement structure for road **P141-1** & road **D2769**, Class VII, was used for detail design purposes:

- Surfacing: 40mm asphalt
- Base: 150mm Crushed Stone (G1)
- Upper Subbase: 150mm Stabilised Gravel (C3, UCS 1500 kPa)
- Lower Subbase: 150mm Stabilised Gravel (C4, UCS 1200 kPa)
- Upper Selected: 150mm Natural Gravel (G6, CBR 40)
- Lower Selected: 150mm Natural Gravel (G7, CBR 30)
- Upper Subgrade: 150mm Natural Gravel, in-situ (G9, CBR 20)
- Lower Subgrade: 150mm in situ roadbed preparation (G10, CBR 7)

7.5 Intersections and Accesses

The proposed realignments and closures will only affect access to one property other than that owned by Glencore. Only one farm access is planned along road P141-1, at km 6.490, to allow the farmer access, as indicated on drawing *TOP-J&G-5003-CV-01-1106*.

This will be a private access road as agreed between the farmer and GOSA.

From the intersection on road P141-1 (km 3.412), the previous intersection is approximately 3.612 km away, towards Ogies, (Grootpan haul road access) and 6.472 km from the T-junction with road P29-1 (R555). The next intersection, towards Bethal, is approximately 5.052 km away (road D455). The minimum distance required between intersections is 600m.

The intersection on road P141-1 (km 3.412) is to be similar to the detail on drawing no. MTP 3/6.

The drawings referred to are the *"Typical Plans for Road Design"* of the Department.

8. HYDROLOGY AND STORMWATER DRAINAGE

Flood estimates were carried out on the more significant catchment areas in order to size culverts. A mean annual rainfall of 750mm was used.

Minor catchment areas were calculated using the Rational Method. A runoff factor (C) of 0,3 to 0,4 was used for the predominantly flat (hydrological classification) area.

Three watercourse crossings exist along road P141-1, with one at the vlei crossing at km 0.940 (4 / 2.4 x 2.4) (phase 2), one downstream at the Tweefontein dam discharge at km 4.800 (14 / 1.5 x 1.5) (phase 1) and one at km 7.165 (4 / 2.4 x 2.1) adjacent the Tweefontein Bridge (phase 1).

Erosion is generally found where water velocities are high and the direction of flow changes rapidly. All the culverts envisaged have conventional inlets with wing-walls. Stone pitching is

provided over a distance of twice the vertical dimension upstream of the culvert inlet (or upstream of the concrete slab between the wing-walls), with stones 200mm in size.

Allowance is also made for effective energy dissipation and erosion protection downstream of the culvert, with stone pitching over a distance of twice the vertical dimension downstream of the culvert outlet (or downstream of the concrete slab between the wing-walls), with stones 200mm in size.

The slope (angle) of the culverts cannot be at the same level for the inlet and outlet of the culvert as the retardation in flow will cause the deposition of sediment, and acceleration may cause scour. Therefore deposition should be prevented, as it may lead to the reduction in the culvert capacity.

Water velocities should be altered as little as possible. Flow velocities through culverts should therefore not be lower than 1m/s, and the slope (angle) of a culvert should accordingly not be less than 1%. A slope (angle) of 1.5% was used for both water course crossings (km 4.800 and km 7.165), in order to minimise the risk of possible sedimentation and to lower the maintenance frequency thereof.

Discharge from the upstream and downstream side of the culverts, will be reduced by means of widening the inlet and outlet with gabions / stone pitching to reduce the velocity of the discharge.

9. STRUCTURES

For both roads P141-1 and D2769, bridge structures are envisaged to accommodate the haul road. On road P141-1, at km 3.140, with a span of 87m (Bridge 01 – phase 2) and on road D2769 at km 0.160 with a span of 72.5m (Bridge 02 – phase 1).

A meeting was held with MR. Ben Viljoen, Chief Road Superintendent, Nkangala District, from the Department, on 5 December 2013, with regards to the bridge clearances of 8.45m, respectively, and the vertical alignment over both bridges, one on road P141-1 at km 3,140 and on road D2769 at km 0,160, and Approval in Principle was received on 9 December 2013. (***Annexure A02***)

Construction of three major culverts is required on road P141-1, at the vlei crossing km 0.940 (4 / 2.4m x 2.4m), at the Tweefontein dam discharge km 4.800 (14 / 1.5m x 1.5m) and at km 7.165 adjacent the Tweefontein Bridge (4 / 2.4m x 2.1m).

10. SERVICES

Various service crossings do exist along the route. The shifting of the services, as indicated in the Services Schedule drawing (TOP-J&G-5003-CV-01-1414), is the responsibility of the entity indicated.

Various overhead powerlines are being crossed, which ranges from an 11kV, 22kV and a 400kV powerline, and an existing telephone line.

A bulk water pipeline within the road reserve of road P141-1 at km 3.241 will have to be relocated. Another bulk water pipeline within the road reserve of road D2769, was never commissioned, and can be removed, as confirmed by Glencore.

An old sewer valve chamber and sewer line within the road reserve of road D2769 will also need to be removed.

Various buildings are crossed along road P141-1, and needs to be demolished prior to construction.

Three storage containers for explosives are being crossed on road P141-1 at km 5.623 and will need to be relocated prior to construction.

The existing school infrastructure along road D2769, km 1.02, are in the process of being demolished by Glencore, and will be done prior to construction.

11. GEOTECHNICAL

A Geotechnical investigation was undertaken for the proposed road re-alignment which included a road prism investigation, a borrow pit investigation and the drilling of six boreholes at the two bridge locations.

11.1 Subgrade conditions

DCP testing indicates that the surficial soils along the proposed alignment generally have an approximate in-situ CBR in excess of 10. These CBR values are in excess of the minimum requirements for subgrade material with a minimum in-situ CBR of 3 required to 1m below final road level.

An area of exception is a section of the P141-1 (chainage 6365 – 7365) where subgrade conditions were found to have CBR's of 7.1 – 8.2. This area would be classified as SG2 (7<CBR<15) and special care to be taken to ensure the correct bearing capacity for the road subgrade is attained.

Alluvial clay soils found at the culvert positions, MIA Access Road alignment and the P141-1 alignment (chainage 6365-7365 m) were found to have medium to high potential expansiveness. If these soils are within 0.5m below the bottom of subgrade, then they should

be replaced with G9 or better quality materials and compacted to 90% modified AASHTO density.

Based on laboratory testing it was shown that generally subgrade conditions along the proposed alignment consisted of G5 to G7 material from surface to in excess of 2.0 m depth, and this may be used as construction material for the pavement layers where available (cuttings etc.). A section of the P141-1 (chainage 6365 m-7365 m) and alluvial deposits around rivers (culvert positions) and close to wetlands (e.g. parts of the MIA Access road alignment) may have poor subgrade conditions.

11.2 Cuts and Fills

Soft mechanical excavation or soft hand excavation can be expected for cuts of less than 1.2 m below ground level over all alignments, with the exception of the area around TP34 (approximate P141-1 chainage 6260-6460 m), where intermediate excavation conditions can be expected below 0.90m.

The embankment slopes is limited to a gradient of 1:2.5.

11.3 Drainage

The presence of ferricrete indicates that the water table may be shallower than 0.5 m depth during the rainy (summer) season, in parts of the site.

Provision should be made for drainage of any cuttings by means of subsurface drains. Positions to be confirmed on site by the engineer.

11.4 Founding conditions for new major culverts

The three major culverts are situated along road P141-1, one at the vlei crossing at km 0.905, one at the Tweefontein dam discharge at km 4.720 and one at km 7.100 adjacent the Tweefontein Bridge.

It is recommended that the culvert foundations be placed on an engineered raft foundation. The poor quality alluvial clay material found at the anticipated culvert founding levels should be removed to a depth of 1.0 m below the base of the drainage line where more competent “Firm” or “Medium dense” soils are encountered. The foundation excavations should then be filled with a layer of imported rock fill, a layer of geofabric should then be placed over the rock fill, as a separating layer and a layer of sand should be placed above the layer of geofabric up to the culvert founding level. Where culvert embankments are required the specified soil raft foundation must extend beneath the embankment.

11.5 Founding conditions for Bridges

It is recommended that the bridges are founded on end bearing piles, at depth, on competent rock stratum. A competent founding medium for the end bearing piles, consisting of widely jointed, medium hard to hard rock sandstone (with minor interbedded siltstone) was found to start at depths of 5.10-7.26 m and 13.30-16.80 m, respectively. Due to the variation of the depth to this layer, further inspections must be undertaken during construction to confirm the depth to this material and that the piled foundations are advanced into this layer. For the purposes of calculating pile capacity an intact rock strength of 10 MPa may be assumed at depths of 5.10 m, 6.48 m and 7.19 m in BH1, BH2 and BH3, for bridge 1, and 13.30 m, 13.72 m and 16.80 m in BH4, BH5 and BH6 respectively for bridge 2. This is a conservative estimate due to minor interbedded softer siltstone layers in the sandstone founding layer. The final choice of pile type and diameter will need to consider the required load capacity of the pile and the assumed safe bearing capacity of the rock.

11.6 Materials Investigation

The investigation involved the sourcing of materials for the proposed road pavements within acceptable haulage distance along the route. A number of different materials sources were identified. Additional borrow areas were investigated and existing discarded mine overburden material was sampled.

A total of 5 potential borrow pits were identified, named Borrow Pit Area (BPA) 1 – (BPA) 5.

All of the abovementioned borrow areas are located on the mine property. Borrow material will be taken from the proposed borrow areas which is included in the Tweefontein Optimisation Project Amendment (TOPA).

A sufficient volume of subbase, selected and subgrade materials are available from borrow areas in the vicinity of the proposed construction.

11.7 Constraints and mitigations

Geotechnical constraints identified during the investigation include:

- Poor quality subgrade material (alluvial deposit areas)
- Void intersected at bridge position 1
- Potentially expansive soils

Mitigation measures to minimize the risk associated with the abovementioned constraints are provided. These include:

- Heavy compaction during subgrade preparation
- It is not anticipated that the proposed founding depth, for bridge 1, will be

affected by the void.

- Removal of potentially expansive soils and replacement with suitable material.

Further information can be found in the "TOP Provincial Road Realignment and Associated Infrastructure Geotechnical Investigation" dated October 2013. (***Annexure A04***)

12. ENVIRONMENTAL ISSUES

The Environmental Impact Assessment is currently in progress. An application for Environmental Authorisation from Mpumalanga Department of Economic Development, Environment & Tourism is in progress, with the Public Participation meeting already done, which was a combined meeting for the road alignment and the EIA.

The proposed borrow areas, as mentioned earlier, forms part of the Tweefontein Optimisation Project Amendment (TOPA), which is currently in process.

Environmental Authorisation is expected to be granted in June 2014.

13. PUBLIC PARTICIPATION

A public Participation meeting was held on 15 October 2013. No issues were raised during the meeting. Minutes of meeting attached. (***Annexure B01***)

14. PROPERTY ISSUES

The alignment of road P141-1 and D2769 traverses Glencore Operations SA (GOSA) owned property. No additional land is required.

15. ESTIMATED COSTS

A bill of quantities based on the COLTO Standard Specifications for Roads and Bridge Works and a cost estimate has been prepared. A summary is included as ***Annexure C01***.

The rates are based on those of recently completed projects, and where applicable, escalated to a base date of February 2014.

Table 14: Summary of Construction Cost Estimate

Description	Amount
P141-1 (7,4km)	R 99 121 808.94
D2769 (1,3km)	
MIA Access road (1,1km)	
Bridge 01: P141-1 – km 3.140	R 18 013 750.00
Bridge 02: D2769 – km 0.160	R 17 848 380.00
MIA Bridge: MIA Access Road - km 0,475	R 265 110.00
Sub Total	**R 135 249 048.94**
Contingency (10%)	R 13 524 904.89
Total (Excl VAT)	**R 148 773 953.83**

Note: Base date is February 2014, Professional fees and disbursements are excluded.

16. PROJECT TIME FRAME

Construction is scheduled to commence in the third quarter of 2014 and the expected construction period is approximately 12 months. Construction is to be completed before the mining operations start in early 2016.

Construction will be executed in two phases.

Phase 1 will be the re-alignment of the southern section of P141-1 to R547, from the intersection with road D2769 (km 3.412) southwards to road R547. Included in phase 1 is the extension of road D2769, the associated bridge on road D2769, and the private MIA Access road.

- New road linking the existing road P141-1 to R547 (D2770) – P141-1 – km 3.412 to km 7,535.
- Extension of road D2769 (0154) to the newly re-aligned P141-1 – D2769 – km 0.000 to km 1,374.
- Construction of a new private MIA Access road – km 0.000 to km 1,084.
- Construction of a bridge at km 0.160 (Bridge 02) along road D2769.
- Adding a pedestrian deck to an existing bridge at km 0,475 along the MIA Access Road (MIA Bridge).
- Construction of two major culverts along P141-1, one at the Tweefontein dam discharge at km 4.800 and one at km 7.165 adjacent the Tweefontein Bridge.

Phase 2 (future phase) will be the re-alignment of the northern section of P141-1, from the intersection with road D2769 northwards to P141-1 including the associated bridge on road P141-1.

- New road linking the existing road P141-1 to R547 (D2770) – P141-1 – km 0,000 to km 3,412.
- Construction of a bridge at km 3,140 (Bridge 01) along road P141-1.
- Construction of a major culvert (watercourse crossing) along P141-1, at the vlei crossing at km 0.940.

Phase 1 is anticipated to start construction in the third quarter of 2014, for a period of 12 months.

Phase 2 is anticipated to start construction directly after phase 1, early in the third quarter of 2015, for a period of 10 months.

The Environmental Impact Assessment is currently underway and approval is envisaged for June 2014.

Traffic will only be affected over short periods of time when the tie-ins and junctions are constructed.

Given the tight envisaged programme, approval is required as a matter of urgency.

17. CONCLUSIONS AND RECOMMENDATION

The realignment of a portion of road D2769 and P141-1 and the consequent de-proclamation of the portion removed from service, are a pre-requisite for the implementation of the planned expansion activities of Glencore at the Tweefontein Colliery.

The detail design report has shown that the standards of the Department can be met or improved upon for the proposed re-alignment. It is therefore recommended that the detail design be scrutinized by the Department and that approval be granted for construction to commence.

--oOo--

ANNEXURE A01
Proposed Alignment

WATERPAN 8 I.S.

PREVIOUSLY PTN QF WATERPAN 8 I.S.

SG 541/1998
711.8468ha

BM 2 Seam North

Haul Rd 12m x 1.8 km
= 21 600 m²

Makou Pan

MAKOUPAN 590 I.S.

← OGIES

P141-1 KM 3.019 628 (PROV)
LIMIT OF CONSTRUCTION
KM 0.000 000

ROAD P141-1

Haul Rd 3.8km
= 30 400 m²

PTN 1
SG 7167/47
448.8372ha

New Haul Road 3.4 km x 9m
= 30 918 m²

100YR FLOOD LINE

Tweefontein
Admin Offices

RE FARM
SG 7
2611.5984ha

PTN 8
SG 3381/92

ROAD D2769

EMALAHLENI →

LIMIT OF CONSTRUCTION
KM 7.264 628
P141-1 KM 11 916 744
(PROV)

PTN 37
SG 1331/1992
347.0688ha

Klipplaats East

PTN 2
SG 4791/27
294.1988ha

KLEINKOPJE 15 I.S.

MIA ACCESS

LIMIT OF CONSTRUCTION
KM 11.916 744
P141-1 KM 7.264 628
(PROV)

Klipplaats West

PTN 7
SG 5470/05
310.5460ha

PTN 9
SG 8142/11
16.0728ha

Boschmans
Pan

TWEEFONTEIN 13 I.S.

Haul Rd 5.4km x 12m
= 64 800 m²

TWEEFONTEIN DAM

PTN 10
SG 6090/45
[illegible]ha

RE 6/2

BM South East

Haul Rd 4.1km x 20m
= 82 000 m²

PTN 3
SG 7167/47

PTN 4
SG 5455/53
21.4078ha

MINERAL RIGHTS DURCER (IMPINED)
SURFACE RIGHTS DURCER (IMPINED)

Farmers Pan

PHOENIX DAM

BOSCHMANSFONTEIN 12 I.S.

KLIPPLAAT 14 I.S.

BETHAL →

RE 4/2

5/2

BM South Central

+2880000 X

+2882500 X

+2877500 X

-12500 Y

-15000 Y

-17500 Y

-20000 Y

-22500 Y

LOCALITY PLAN (MAP 2628)
1 : 50 000

0 10 20 30 40 50
500
ON ORIGINAL PLAN

CONSTRUCTION PHASES
- CONSTRUCTION PHASE 1
- CONSTRUCTION PHASE 2

LEGEND
- FENCE WITH GATE
- POWER LINES
- TELEPHONE LINES
- DIRECTION OF TRAFFIC MOVEMENT
- BUILDINGS
- WATER PIPE LINES
- CULVERT NOTATION
- CADASTRAL INTERSECTION / BOUNDARY
- EXISTING ROAD
- EXISTING RAILWAY
- FUTURE RAILWAY

No	DATE	AMENDMENTS	for Head of Dept.	DATE
AA	28/02/2014	FOR APPROVAL		

SURVEYED BY:
J & E TOPOGRAPHICAL SURVEYING SERVICES
SEPTEMBER 2013

ONTWERP VIR / DESIGNED FOR
TWEEFONTEIN PROJECT
GLENCORE OPERATIONS SA
GLENCORE

ONTWERP DEUR / DESIGNED BY
JEFFARES & GREEN PTY (Ltd)
ENGINEERING AND ENVIRONMENTAL CONSULTING
Jeffares & Green
TEL. (012) 940-7900
FAX. (012) 940-7979
E-MAIL tpfpta@jaf.co.za
P.O. BOX 2973
PRETORIA
0001

DESIGNED BY	JN
CHECKED BY	JN
DRAWN BY	LN
CHECKED BY	CCLR

DESIGN APPROVED
for Consulting Engineers
CC Le Roux Pr. Eng
DATE:

APPROVED BY
for Head of Department
DATUM/DATE:

MPUMALANGA GOVERNMENT
PUBLIC WORKS, ROADS AND TRANSPORT
MPUMALANGA
REALIGNMENT OF PROVINCIAL ROADS
KEYPLAN

MPUMALANGA GOVERNMENT
PUBLIC WORKS, ROADS AND TRANSPORT

ORIGINAL SIZE	SCALE	FILE No	DISTRICT	PROVINCE PLAN No
A0	1000	–	NKANGALA	MRS 06/–/Sp

DESIGNED AND DETAILED UNDER THE CONTROLS RETAINED BY A QUALITY MANAGEMENT SYSTEM THAT MEETS THE REQUIREMENTS OF ISO9001: 2008 WHICH HAS BEEN INDEPENDENTLY CERTIFIED BY DEKRA CERTIFICATION UNDER CERTIFICATE NUMBER 5000/0002

TIPE ONTWERP / TYPE OF PLANNING	ROAD No	J&G PLAN No
DETAIL DESIGN	P141/1 & D2769	TOP-J&G-5003-CV-01-1000

PROVINCE PLAN No MRS 06/–/Sp
J&G PLAN No TOP-J&G-5003-CV-01-1000

\\Cdg001-pbhsvr\ewe\0035944 - Tweefontein Re-alignment P141-1 (DO to Rhino)\008 Drawings\Detail Design\0035944_TOP-J&G-5003-CV-01-1000_Key Plan and List of Drawings

ANNEXURE A02
Preliminary Design Approval

MPUMALANGA PROVINCIAL GOVERNMENT

No 7 Government Boulevard
Riverside Park
Ext. 2
Nelspruit, 1200
Republic of South Africa

Private Bag X11302
Nelspruit, 1200
☎ +27 (13) 766 8541
+27 (13) 766 0020
E-Mail: skgomo@ mpg.gov.za

Department of Public Works, Roads and Transport
ROADS INFRASTRUCTURE

Lisiko Letemisebenti Yemphakatsi, Temigwaco Netakuthutsa | Departement van Openbare Werke, Paale en Vervoer | UmNyango wezemiSebenzi yomPhakathi, zeNdlela nezoku Thutha

Enq PD Sonemann

Jeffares & Green
P.O.Box 2973
Pretoria
0001

Att: L.J Nel

APPROVAL IN PRINCIPLE: PRELIMINARY DESIGN FOR THE PERMANENT REALIGNMENT OF A PORTION OF PROVINCIAL ROADS P141-1 AND D2769 – NORTHEAST OF OGIES, MPUMALANGA (THE WORKS).

Your application regarding the above has reference.

Approval is hereby granted for the geometric designs of road P141-1 & D2769 respectively.

The Department will have to approve the wayleave prior to the commencement of the construction works.

Kind regards

NMD Malatji
General Manager: Roads Infrastructure
Date: 06/06/2013

MPUMALANGA PROVINCIAL GOVERNMENT

C/O LILIAN NGOYI & BEYERS NAUDE
STREETS, MIDDELBURG 1050
MPUMALANGA
Republic of South Africa

Private Bag X1800
Middelburg, 1050
+27 (013)283 7011
+27 (013)243 2111
E-Mail: [illegible]@mpg.gov.za

Department of Public Works, Roads and Transport
STEVE TSHWETE

Litiko Letemisebenti Yemphakatsi, Temigwaco Netekutfutsa

Departement van Openbare Werke, Paaie en Vervoer

Umnyango wezemiSebenzi yomPhakathi, zeNdlela nezokuThutha

REF: [illegible] D2769/P141-1
ENQ: JF VILJOEN

[illegible] December 2011

JEFFARES & GREEN
P.O. BOX 2873
PRETORIA
0001

RE: TWEEFONTEIN D2769,P141-1

I refer to our meeting on 2011-12-0[illegible] regarding the realignment of D2769, P141-1 approval in principal subject to final submission of design, reports and plans.

CHIEF ROAD SUPERINTENDENT
NKANGALA DISTRICT
DPWRT

ANNEXURE A03
Traffic Impact Study

ANNEXURE A04
Geotechnical Report

ANNEXURE B01
Minutes of Public Participation Meeting

ANNEXURE C01
Schedule of Quantities

ANNEXURE D01
Drawings

CULVERT DESIGN REPORT FOR THE RE-ALIGNMENT OF PROVINCIAL ROADS P141-1 & D2769

TWEEFONTEIN OPTIMIZATION PROJECT

APRIL 2014

REVISION 01

Compiled by:

Jeffares & Green (Pty) Ltd

PO Box 2127
Pinelands 0884
Tel (021) 531 1441
Fax (021) 531 1574

Project Manager: Jacques Nel
Email: nelj@jgi.co.za

Commissioned by:

GLENCORE

Glencore Operations SA (Pty) Ltd
Private Bag X10
Modderfontein 1645
Tel (011) 777 0600
Fax (011) 777 0601

Contact: Hartmann Viljoen

CULVERT DESIGN REPORT FOR THE RE-ALIGNMENT OF PROVINCIAL ROADS P141-1 & D2769

TWEEFONTEIN OPTIMIZATION PROJECT

Form 4.1
Rev 11

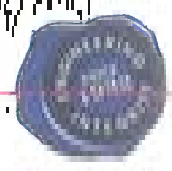
VERIFICATION PAGE

Job Book No:	0004/08	DATE:	18/04/2014	STATUS:	Final

QUALITY VERIFICATION

This report has been prepared under the controls established by a quality management system that complies with the requirements of ISO 9001 and has been independently verified by DEKRA Certification under certificate registration [illegible]

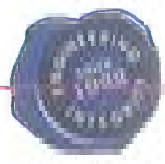
Verification	Capacity	Name	Signature	Date
Prepared by	Project Engineer	J Nel		
Checked by	Associate	R Dewhurst		
Authorised by	Project Director	CCC de Waal		



CULVERT DESIGN REPORT FOR THE RE-ALIGNMENT OF PROVINCIAL ROADS P141-1 & D2769 TWEEFONTEIN OPTIMIZATION PROJECT

TABLE OF CONTENTS

TABLES



FIGURES

1 General

[illegible]

2 Proposed culvert crossings

[illegible]

3 Hydrology

3.1 Catchments and Flood Estimation

[illegible]

Table 3-1: Affected Catchments (Middleton, B.J., Midgley, D.C. and Pitman, W.V., 1990)

Quaternary Catchment	Catchment Surface Area (ha)	Mean Annual Rainfall (mm)	Mean Annual Run-off (mm)	Potential Evaporation (mm)	Study area as a percentage of the Catchment
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

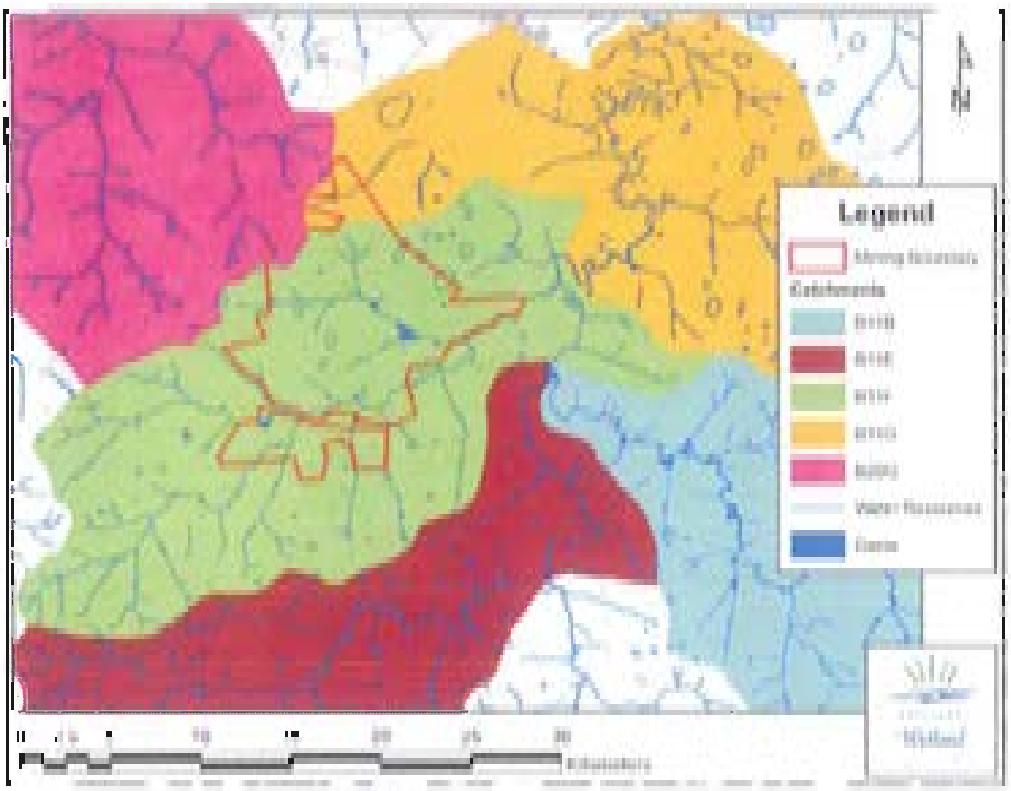


Figure 3.1 Map showing Catchments affected

3.2 Flood Peak Methods

Methods can be broadly classified as statistical, deterministic or empirical. As it is not normally used to directly assess peak discharges, statistical analysis is normally used to derive design rainfall depths for use in deterministic methods.

Flood peak methods are based on the traditional Rational method and Unit Hydrograph theory. These methods are described in the following paragraphs.

3.2.1 Rational Method

The Rational method is probably the most widely used method for the calculation of peak flows for small catchments. It was first presented in 1906 by the Irish Engineer Mulvaney (Mulvaney, 1906). It is recommended for use on catchments up to 15km². Its use is restricted by assumptions that the rainfall intensity is uniformly distributed over the catchment.

3.2.2 Standard Design Flood (SDF)

The Standard Design Flood method was developed by Abrassart (Abrassart, 2005) and is based on the Rational Method. It can be described as an empirically adjusted version of the Rational Method, and is more suitable for larger catchments.

3.2.3 Unit Hydrograph

The method is recommended for areas between 15 and 50km² and is described in detail in Chapter 17 of the Hydrology Handbook. Typically, a Unit Hydrograph is derived from observed rainfall and runoff data. It is not normally applied to short duration storms.

3.2.4 Deterministic Method

[illegible]

3.3 Flood Peak Method Used

[illegible]

3.3.1 Flood Volume Estimation

[illegible]

[illegible]

[illegible]

[illegible]

Table 3-2: Design Peak Discharge

Catchment		Design Peak Discharge (m³/s)				
Catchment	Catchment Area (km²)	1:2	1:5	1:10	1:25	1:50
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

3.4 Floodlines

[illegible]

Figure 3-2: 1:50 & 1:100 Year Floodlines

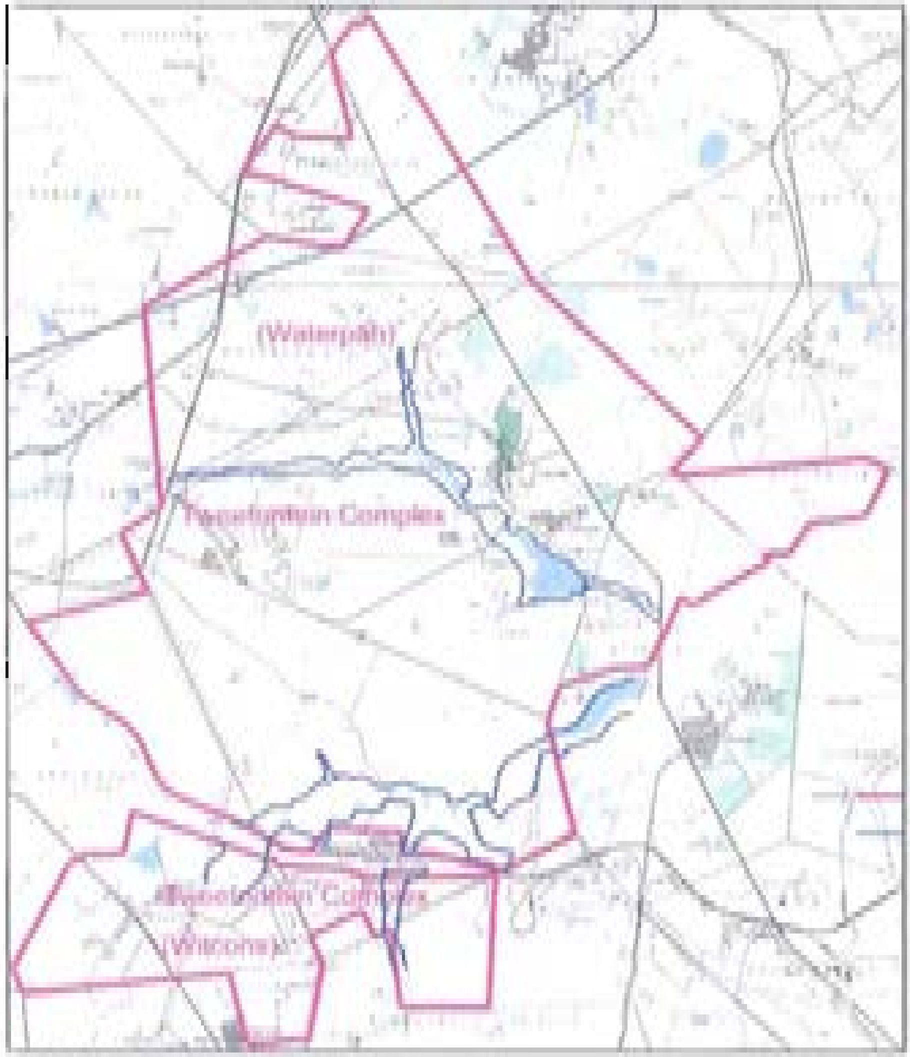


Figure 3-3 1:100 Year Floodlines

3.5 Culvert Description

[illegible]

[illegible]

[illegible]

3.6 Erosion Control

[illegible]

[illegible]

3.7 Overtopping

[illegible]

[illegible]

[illegible]

[illegible]

3.8 Slope (Angle) and Flow Velocities

[illegible]

[illegible]

[illegible]

3.9 Side slopes (Embankment Batters)

[illegible]

4 Conclusion

[illegible]

5 References

1 *Wetland Consulting Services, Manda Wood, Woolmer Instructions and Ingrow Assessment Report for the Demolition Implementation Report*

2 *Highways M Motorway Widening Scheme, Volume 2 Supplement Technical Highway Documentation, September 2003, Hydraulic Design of Highway Culverts.*

3 *CIRIA C, Control of Pollution Emergency Manual*