INTEGRATED WATER AND WASTE MANAGEMENT PLAN FOR THE PROPOSED GREENFIELDS RIETVLEI OPENCAST COAL MINING OPERATION

Rietvlei Mining Company (PTY) LTD

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2016/01/24

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1 Introduction

WSP Environment & Energy (WSP) was appointed by the Rietvlei Mining Company (Pty) Ltd (RMC) to compile an Integrated Water and Waste Management Plan (IWWMP) in support of an Integrated Water Use Licence Application (IWULA) required by the Department of Water and Sanitation (DWS) for the establishment and operation of the proposed Rietvlei opencast coal mine.

1.1 Activity Background

The RMC intends establishing and operating an opencast coal mine, referred to as the Rietvlei opencast coal mine (Proposed Project), on the following farm portions:

- Remaining Portion of Rietvlei 397 JS
- Portion 1 of Rietvlei 397 JS

The RMC is a joint venture between Butsanani Energy Investment Holdings (Pty) Ltd (Butsanani) and Emalangeni Mining Resources (Pty) Ltd (Emalangeni). Butsanani is jointly held between, Anglo Operations (Pty) Ltd (acting through its Anglo American Coal South Africa business unit), Anglo American Zimele (Pty) Ltd and Vunani Mining (Pty) Ltd (a 100% black owned company). The objective of Butsanani is to facilitate enterprise development by identifying junior coal mining operations and companies in South Africa with whom to collaborate, with the view to mine coal, and to the extent possible, facilitate access to the domestic, Eskom and export coal markets. RMC has been identified as such an operation. Emalangeni is a 100% Black Owned and controlled Investment Company Established in 2009, its objective being to take advantage of business and mining opportunities which continue to exist in South Africa. Emalangeni is committed to developing into a significant Black Economic Empowerment (BEE) multi-product coal producing, beneficiating and marketing Company. Shareholders include Entrepreneurs, Businessmen, Businesswomen and local groups located within the Mpumalanga Province and Nationally.

The mine will be situated to the south east of the R555 road, and located within the vicinity of Middelburg, within the Steve Tshwete Council (25°40’18.59”S 29°39’16.47”E) (**Figure 1-1**). The proposed mining footprint lies within a farming area within the larger Witbank Coalfield and is bordered by private properties on all sides. The mine area will extend over 2 225.30ha, with the pit covering approximately 800ha.

1.2 Project Proponent’s Contact Details

The project proponent and representative’s contact information for the project are listed in **Table 1-1**:

Table 1-1: Project Proponent Details

Project Proponent:	Rietvlei Mining Company (Pty) Ltd
Trading name:	Rietvlei Mining Company (Pty) Ltd
Company Registration:	2013/168342/07
Contact Person:	Chantelle Gerber
Postal Address:	Private Bag X1 Marshalltown 2107
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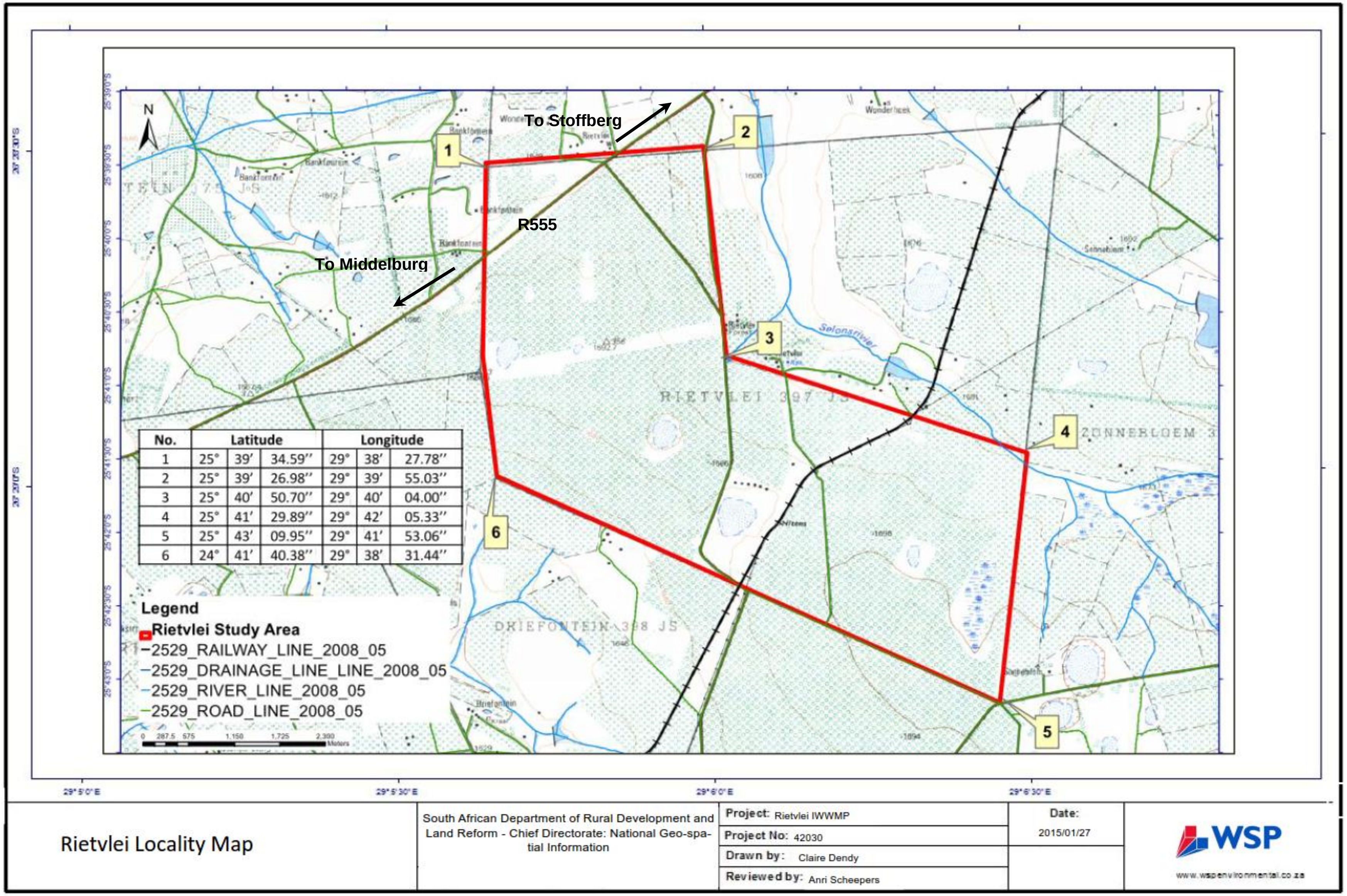
E-mail:	Chantelle.gerber@angloamerican.com

1.3 Regional Setting and Location of Activity

The mining footprint lies approximately 50km northeast of the town of Emalahleni and 22km northeast of Mhluzi (formerly Middelburg) in the Mpumalanga Province (**Figure 1-1**). It is linked to Mhluzi by the R555 provincial roadway. The prospecting area lies within a farming area and is bordered by private properties on all sides and is characterised by various “vlei” or wetland areas.



No.	Latitude			Longitude		
1	25°	39′	34.59″	29°	38′	27.78″
2	25°	39′	26.98″	29°	39′	55.03″
3	25°	40′	50.70″	29°	40′	04.00″
4	25°	41′	29.89″	29°	42′	05.33″
5	25°	43′	09.95″	29°	41′	53.06″
6	24°	41′	40.38″	29°	38′	31.44″

Figure 1-1: Rietvlei Locality Map

1.4 Property Description

The majority of the pre-mining land (approximately 75%) within the updated proposed opencast footprint is utilized for forestry (Eucalyptus trees), 12.27% for cultivation (soybeans), 5.96% for grazing (mainly cattle) and 7.05% are vacant spots where forestry or cultivation could not take place due to wetness (i.e. wetland areas). Small land uses such as graveyards, a quarry and housing footprint of the local community occupies 0.03% of the mining footprint.

Table 1-2: Rietvlei Property Description

Aspect	Description
Description of Site	Portion 1 and the remaining extent of the farm Rietvlei 397 JS
21 Digit Surveyor General Code for Each Farm Portion	TOJS00000000039700000 TOJS00000000039700001
Total Area	2 225.30ha
Elevation	Between 1670m and 1900m above sea level

1.5 Land Use

Some mining activity is evident along the railway line (to the east of the site), the R555 (to the west and north-east of the site) and the R104 (to the south-west of the site). The Vuna Colliery lies less than 2.5km east of the proposed site. This mining is predominantly opencast coal mining similar to that proposed for the site. Mines present in the area include Mafube Mine, Kopermyne Colliery, Klippan Colliery, Steelcoal Colliery, Arnot Colliery, Glisa Colliery, Optimum Colliery, Blackwattle Colliery, Middelburg Mine and Bank Colliery. Other industrial land uses within the study area include railway lines and power lines. **Figure 1-2** indicates the land uses and linear infrastructure on site respectively.

1.6 Purpose of IWWMP

The objective of the IWWMP is to comprehensively define the proposed water use and waste management practices at the proposed Rietvlei mine and appraise their potential impacts on regional water resources, as well as highlight the water use related practices requiring formal authorisation. Additional to this, the IWWMP aims to support the IWULA in the format required by DWS.

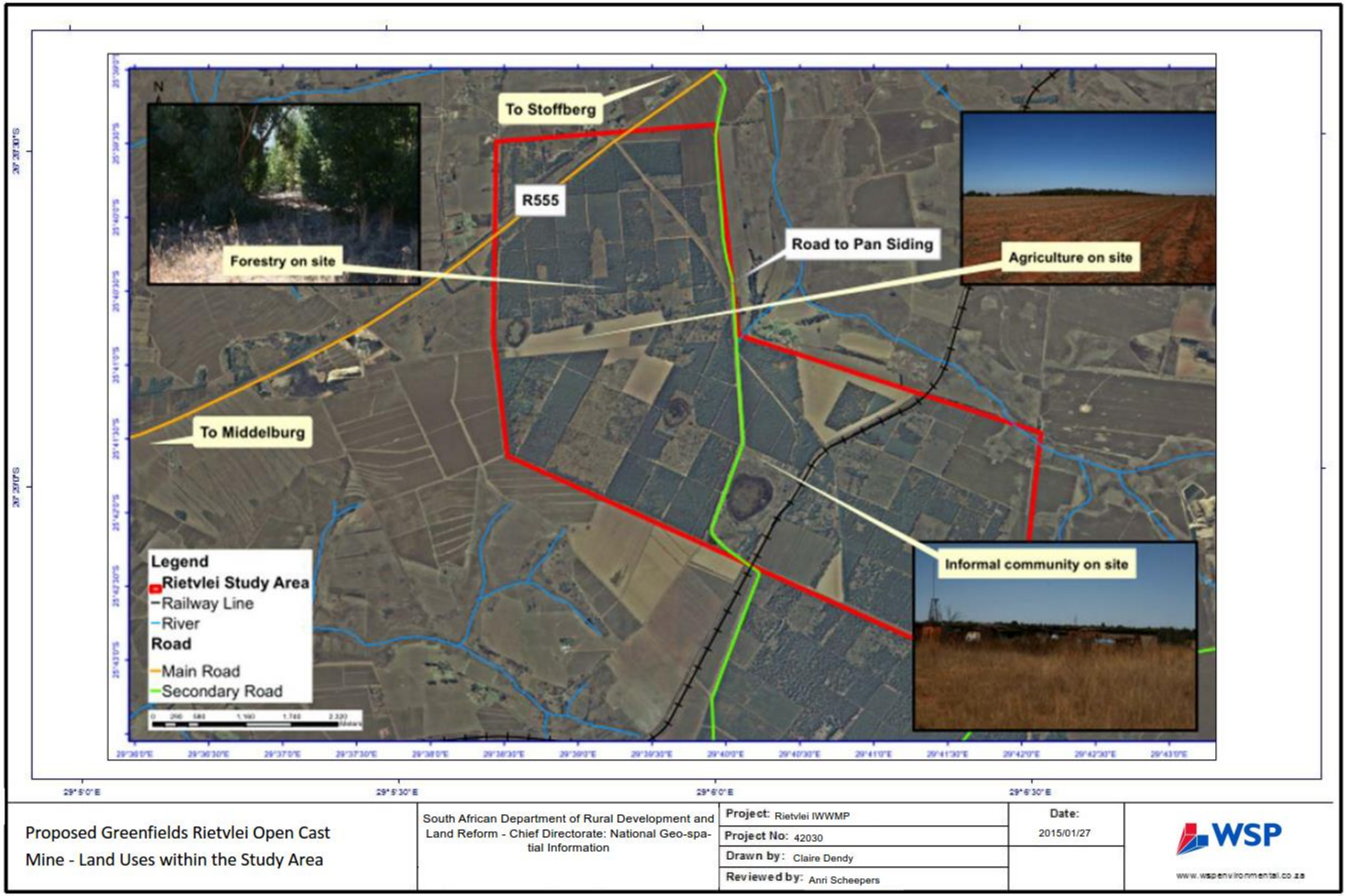


Figure 1-2: Locality map indicating the various land uses on site

2 Conceptualisation of the Activity

2.1 Project Description

The Proposed Project is located approximately 50km northeast of the town of eMalahleni and 22km northeast of the town of Middelburg in the Mpumalanga Province. It is linked to Middelburg by the R555. The proposed mining area lies within a farming area within the larger Witbank Coalfield and is bordered by private properties on all sides. The mine boundary covers an area of 2 225.30ha; of this approximately 800ha will be mined. **Figure 2-2** illustrates the proposed mine layout as at February 2015.

2.2 Location and Aerial Extent of the Main Mining Activities

Refer to **Figure 2-1** and **Figure 2-2** for the mine plan illustrating the annual progress of the mining operation relative to the overall plan as well as an indication of where structures and infrastructure may be located.

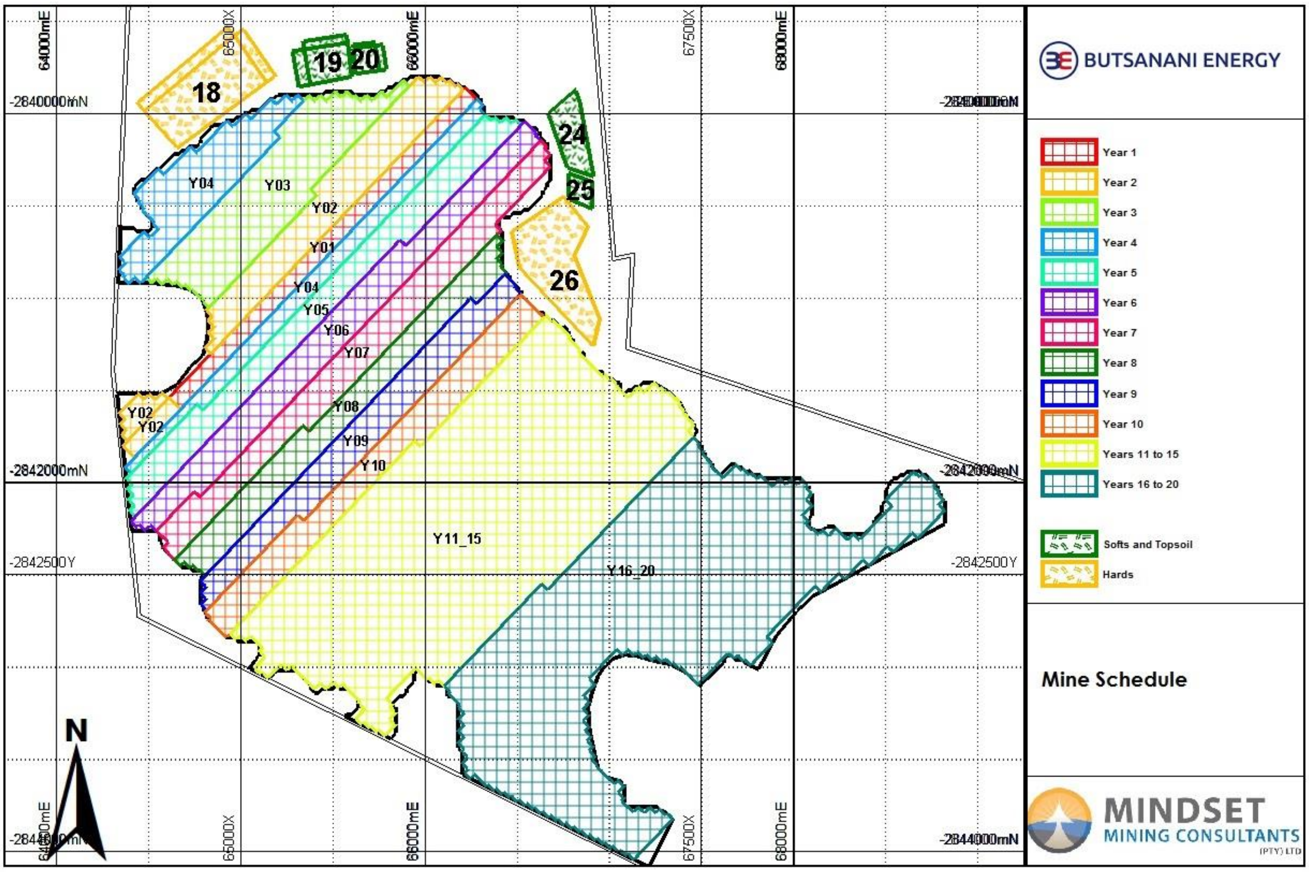


Figure 2-1: Mining Schedule Illustrating Annual Mining Progress (Source: Mindset, 2015)

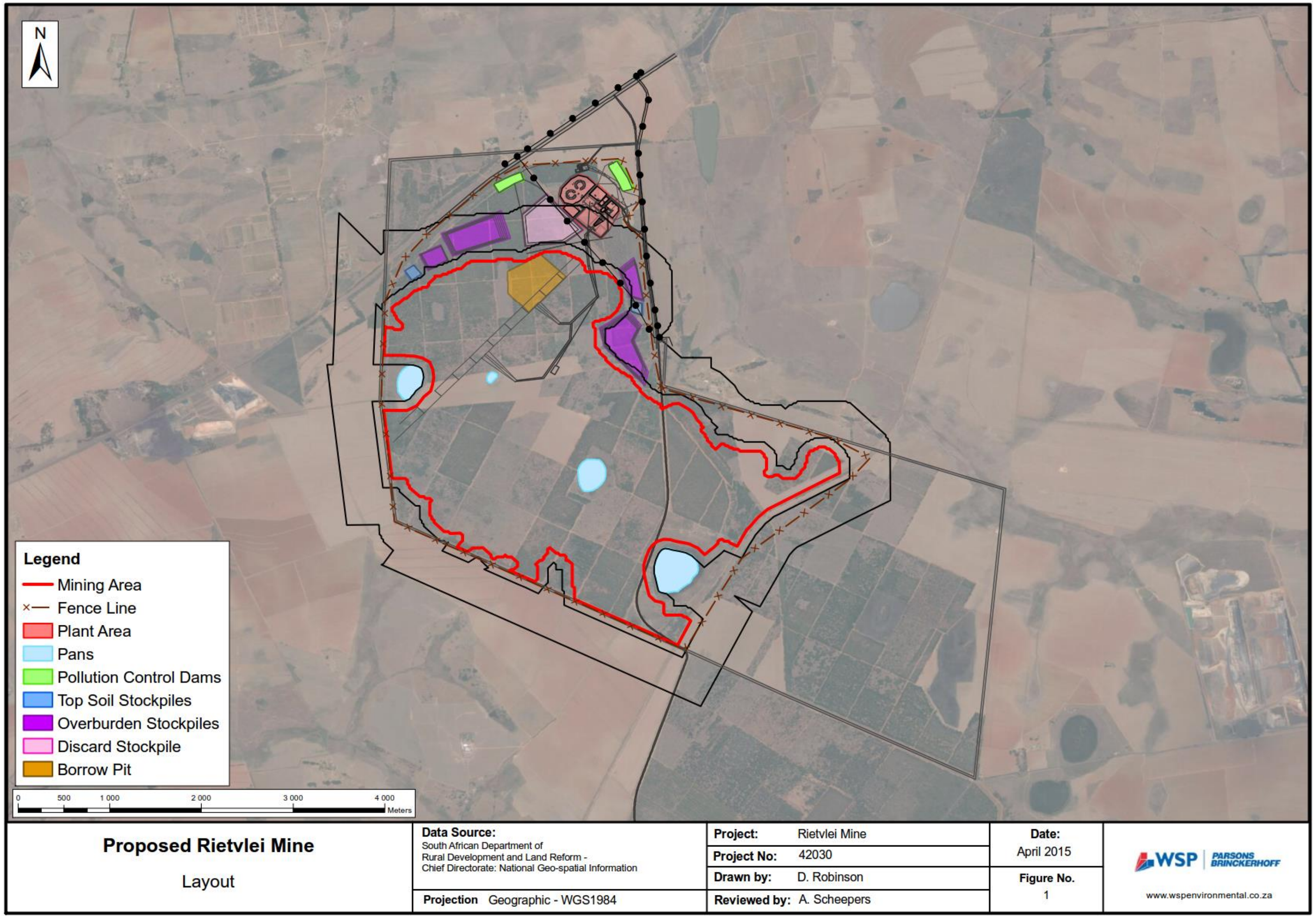


Figure 2-2: Schematic Illustration of the Infrastructure associated with the Reitvlei Mine (Mindset, 2013)

2.3 Mining Method

An opencast operation utilising conventional truck and shovel mining methods is the proposed mining method for the Rietvlei Mine. The Rietvlei opencast operation will consist of one pit. The pit will be divided into northern and southern sections by a single box cut (**Figure 2-3** to **Figure 2-5**) situated toward the centre of the opencast pit. The mining operation will initially progress in a northerly direction. The initial box cut has been designed to be 80m wide, which is double the width of a standard mining strip. This will ensure sufficient volume for the adjacent second and subsequent strip of hard material volumes to fit into the void created.

The construction phase should be completed within 18 months, whilst operational life of mine will be 20 years producing an average of 2.5 million tonnes per annum (Mtpa) of run of mine (RoM) coal. Opencast strip mining will occur with concurrent rehabilitation. The decommissioning and closure phase should take an additional two years to complete. Rehabilitation will form an integral part of the mining process and final rehabilitated land will not be further than four mining strips behind the mining face, thus approximately 160m.

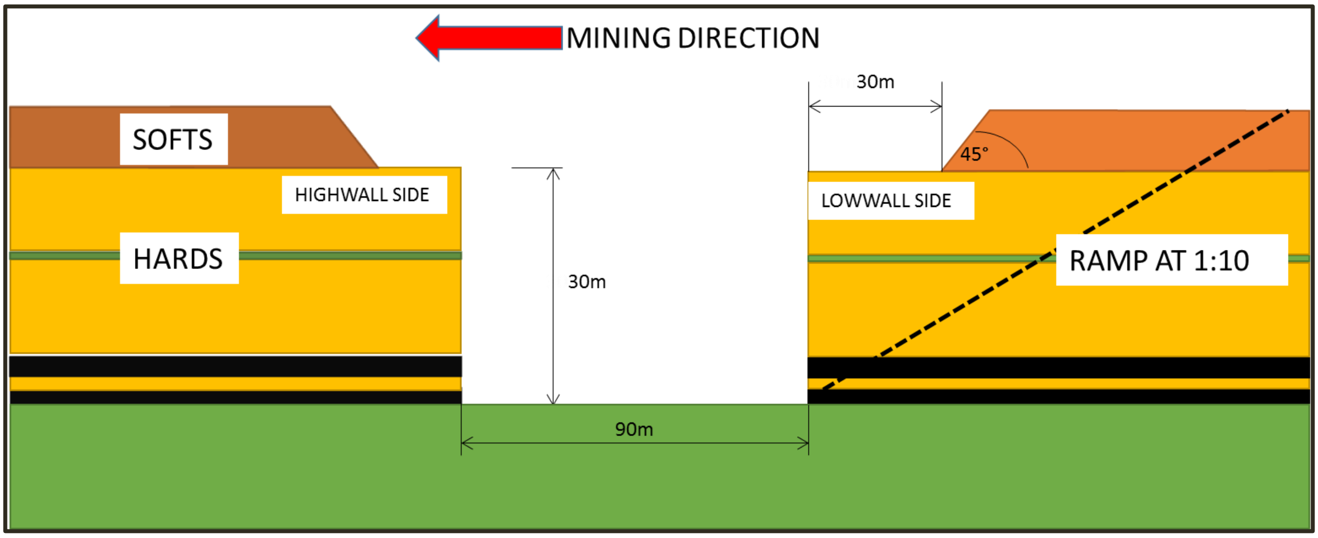


Figure 2-3: Schematic Section through Box cut looking North (Mindset, 2013)

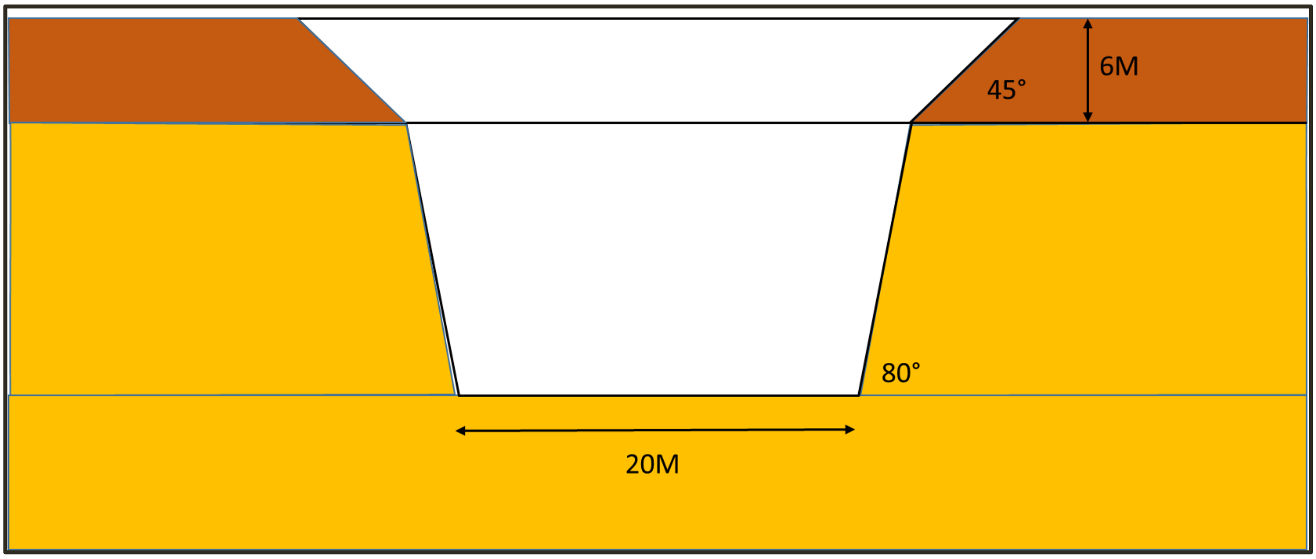


Figure 2-4: Schematic Section through Ramp Parallel to Box cut (Mindset, 2013)

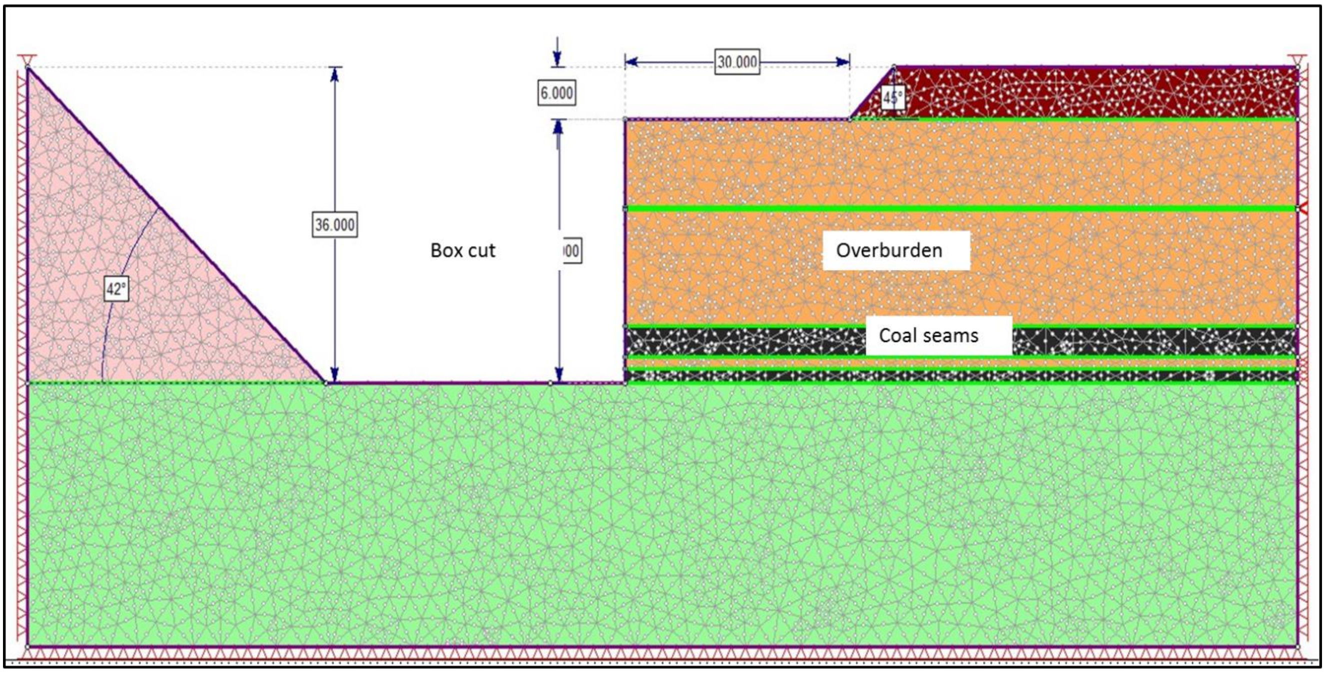


Figure 2-5: Diagrammatic Representation of the Box Cut (Mindset, 2013)

As a result of the shallow depth and thickness of the coal seams, the strip ratios for surface mining will vary. The coal that will be extracted can be divided into two grades namely, export grade thermal coal and domestic grade thermal coal which can be supplied to Eskom for use within specifically selected South African power stations.

The saleable products will be transported from the plant directly to the customer either by road or rail. The road from the plant, where it will link via a road diversion to the Afgri Pan Siding (the closest rail siding), will be upgraded to accommodate the transport of sales product.

The mining method will be a standard truck and shovel application where the topsoil is removed and stored. Thereafter; softs will be removed and stored at the designated material stockpiles. Drilling and blasting of the hard material will then take place. Following the blasting process of the hard material, this material will be dozed into the void after the coaling operation is concluded.

The remainder of the hard material will be loaded, trucked out of the pit and dumped over the high wall into the void created by the mining operation. Coaling will then commence and the process is repeated on a strip-by-strip basis. Material (apart from the topsoil) will then be rolled-over into the void created by the removal of the coal in the previous bench with hard and parting material forming the base, followed by softs, levelled and finally topsoil will be placed and seeded.

Figure 2-6 outlines the process flow for the proposed mining method at Rietvlei Mine.

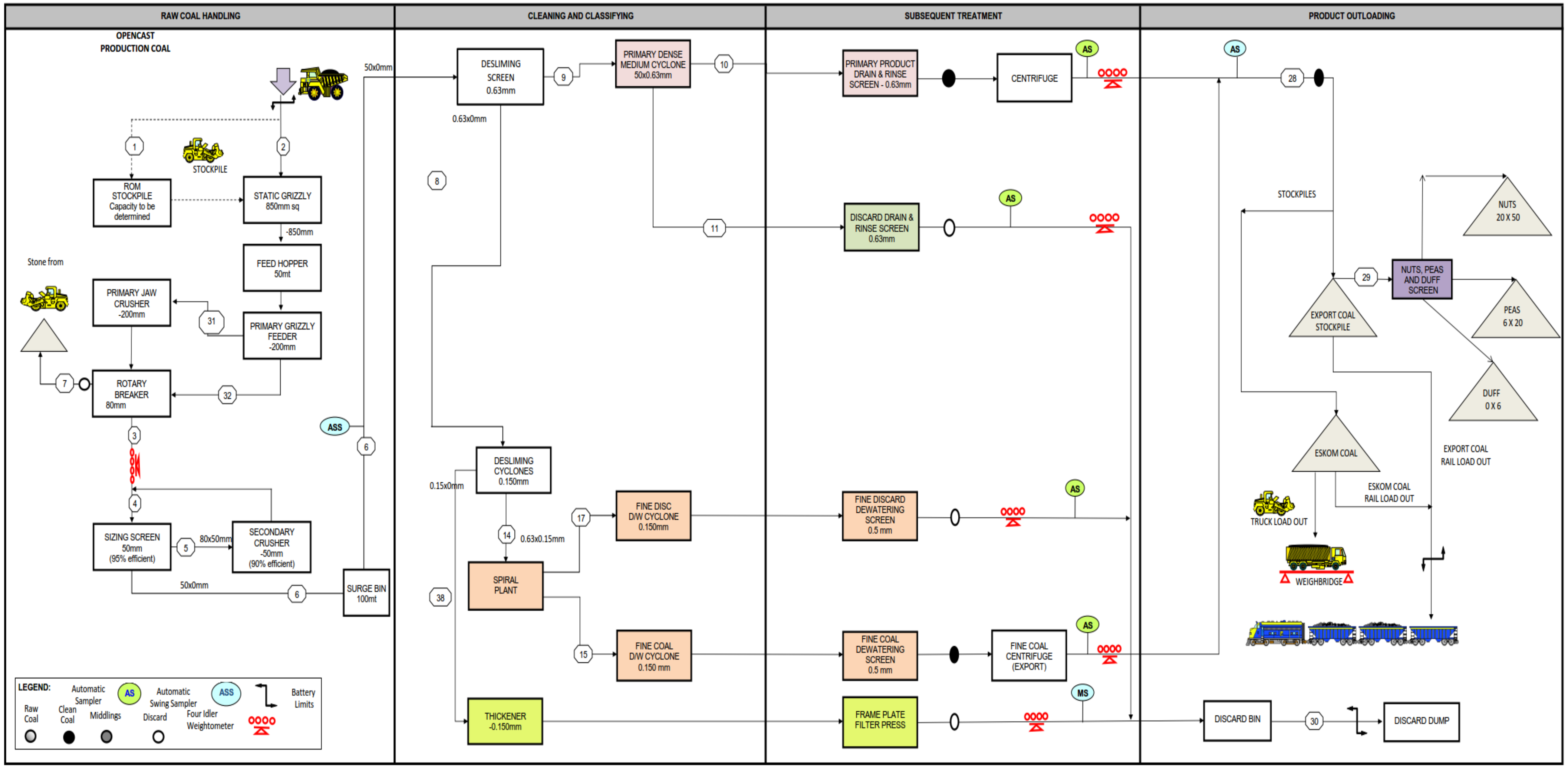


Figure 2-6: Proposed Mining Process Flow for Rietvlei Mine (Mindset, 2013)

2.4 Mine Infrastructure

2.4.1 Coal Processing Plant

The Coal Processing Plant (CPP) and its associated infrastructure will be located to the north of the box cut within the mining right area.

The CPP will be using Dense Medium Separation (DMS) cyclone technology. The design of the DMS Section will be based on modular concepts for simplicity and ease of operation. The Sections are designed to provide sufficient capacity for 2.5Mtpa of ROM coal.

The CPP will include retreatment, washing, screening, filtration, product handling and discard deposition. Three seams will be mined, 2 Lower (S2L), 1 (S1) and 1 Lower (S1L) seams. The initial view is that the S2L, S1L and S1 will be washed together to produce a domestic 23.5MJ/kg (air dried) product suitable for Eskom. However, should the export market reach more profitable levels, the S1 can be batch washed for a 5,500kcal/kg export product with the S2l and S1L continuing to be batch washed together for a 23.5MJ/kg (air dried) domestic (Eskom) product. The S2A and S2U will be mined as part of waste and will have the potential for a raw sale blend. **Figure 2-7** provides an indication of the layout of the CPP.

2.4.2 Power Supply

Eskom has been approached to provide power to the proposed mine site. It is expected that a 3MVa, connection will be provided from the Retreatment Plant to the “Die Nittens” substation.

2.4.3 Water Supply

2.4.3.1 Potable water

Potable water will be sourced from an abstraction borehole during the construction phase and the Selons River during the operational phase. A supply of 30m^3/day of potable water will be required per day and is based on the following:

- Consumption per person of 185l/day;
- Total number of persons 155; and

2.4.3.2 Fire water

Fire protection systems will be based on the minimum requirements of SANS 10400: The application of the National Building Regulations Part T: Fire protection. The water will be sourced from an abstraction borehole during the construction phase and the Selons River during the operational phase. The following will be provided on site:

- Fire water storage tanks;
- Fire water pumping system;
- Fire water main reticulation system;
- Strategically placed fire hydrants; and
- Take-off points on the main reticulation system for the plant and mining contractor.

2.4.3.3 Mine water requirement

It is anticipated that a total of 975m^3 per day (355 875m^3 per annum) will be required for the operation of the mine. The majority of this water will be obtained from the collection of storm water run-off and pit dewatering.

Due to the fact that on-site collection of water will not provide the full water requirement, the remaining water will be obtained from an external source such as the Selons River. The top-up water requirement is estimated to be approximately 120 000 m^3 per annum.

2.4.3.4 Clean and Dirty Water System

All water collected from the mining area (including storm water and pit water) will be stored in two high density polyethylene-lined pollution control dams (PCD) (i.e. the Discard PCD and the Plant PCD) and re-used in the beneficiation plant as well as for dust-control purposes on the haul roads. The locations of the PCDs are highlighted on **Figure 2-7**.

Storm water cut-off drains with dimensions of 2m deep by 1.5m wide will be provided around the entire periphery of the mining site. The cut-off drains and berms will be constructed to ensure that no clean run-off water enters the mining area but that it is rather diverted around the mining area and allowed to flow into surrounding water courses. These drains will be constructed so as to collect and deliver all dirty water from the mining site to the PCDs. All water will be routed through a silt trap before entering the PCDs. The PCDs have been designed with a volume of 66 000m^3 (excluding the freeboard) and will cater for a 1:50 year storm event. **Figure 2-8** shows the proposed surface water management infrastructure for the plant area.

Dirty water containment berms will need to be constructed around the mine to separate dirty water from clean water. Dirty water should be diverted back into the pit whilst clean water will be directed into the clean water catchment areas.

2.4.4 Road Infrastructure

2.4.4.1 D1433 upgrade

The existing Provincial Road D1433 (Pan Siding Road), which is currently in a state of disrepair, will not be able to carry the burden of heavily loaded coal trucks over the life of the mine. This road is therefore earmarked to be repaired and upgraded to enable it to meet the increased traffic volume between he R555 and to the Pan Siding. The proposed upgrading will be undertaken in two sections (**Figure 2-9**):

- Section 1: From the proposed mine, northbound to the intersection with the Provincial paved road P51/2 (also known as the R555). This section of road will be utilised as an access road to the proposed Rietvlei Mine; and
- Section 2: From the proposed mine, southbound to the paved section of road D1433, at the rail line crossing at Pan Station. This section of road will be utilised by the Rietvlei Mine for the haulage of their coal stock.

The proposed upgrading will include:

- The improvement of the road geometry (horizontal and vertical alignments) to accommodate the coal haulage trucks;
- Improvement of the road pavement structure to withstand laden haulage trucks;
- An improved gravel wearing course;
- Installation of storm water drainage cross culverts;
- Improving the storm water drainage along the road by means of side drain where necessary; and
- Relocation of intersections to improve sight distances; or, alternatively installation of traffic calming measures where the intersection cannot be relocated.

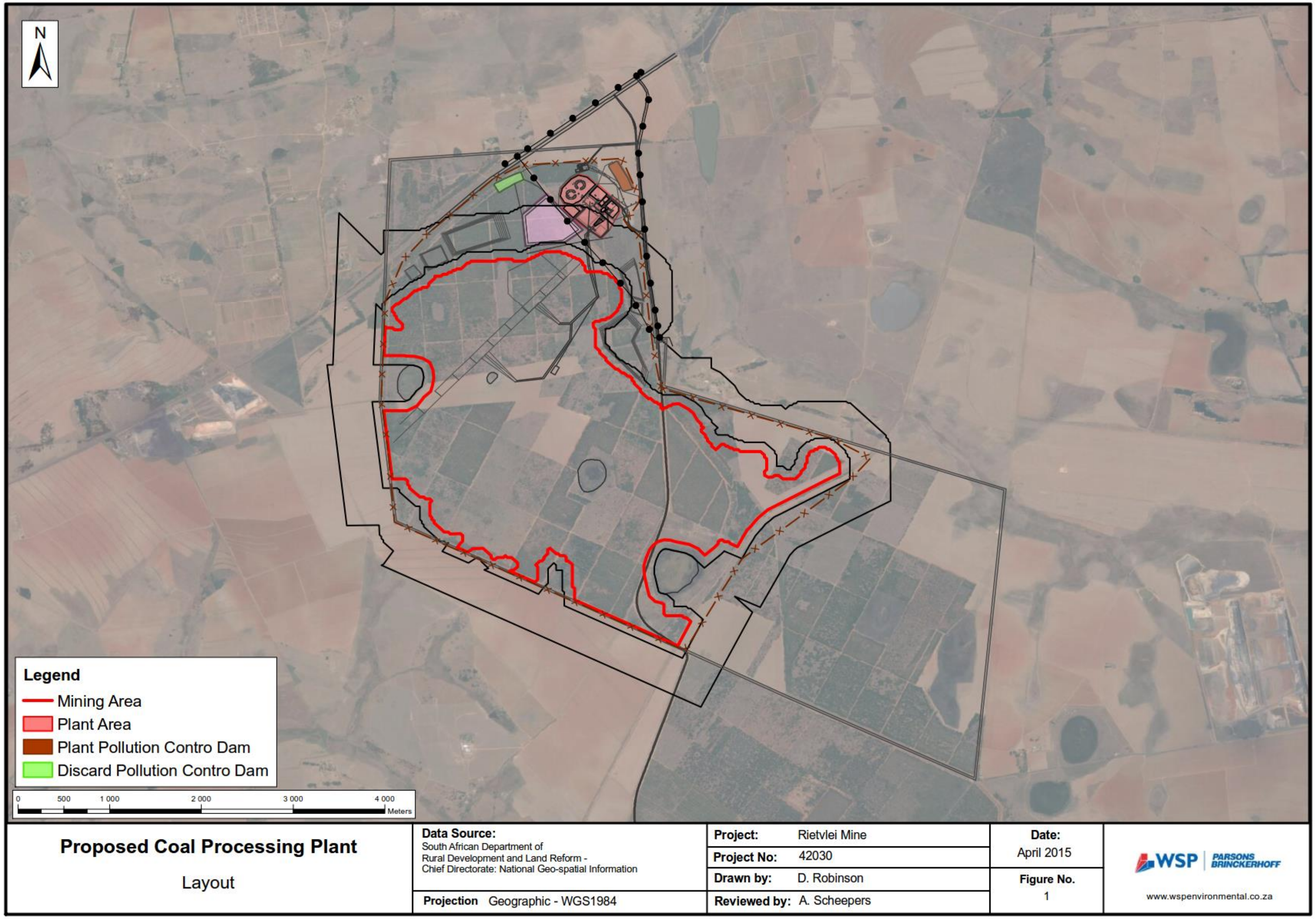


Figure 2-7: Proposed Coal Processing Plant Layout (Mindset, 2013)

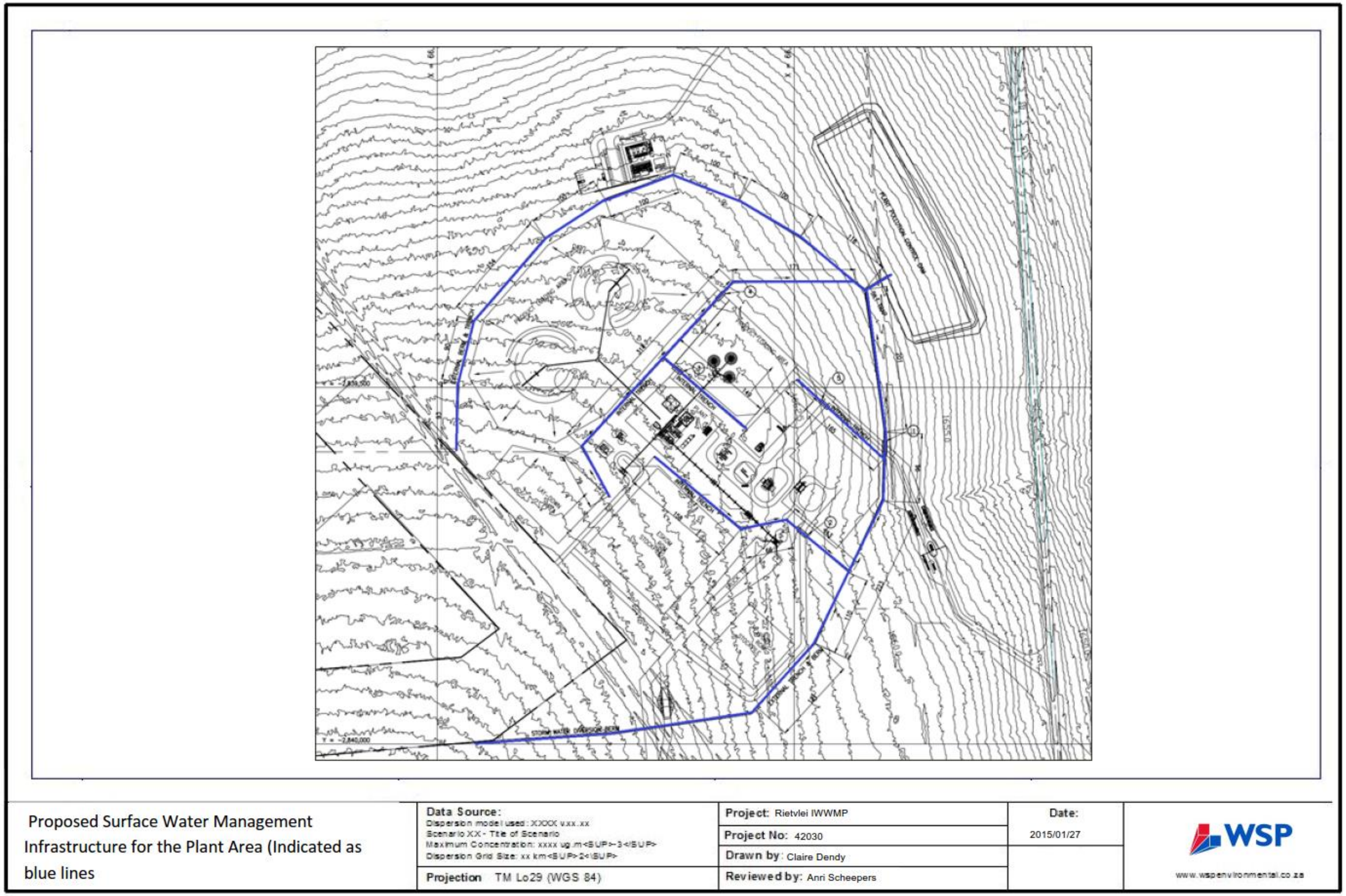


Figure 2-8: Proposed Surface Water Management Infrastructure for the Plant Area (Indicated as blue lines) (Mindset, 2013)

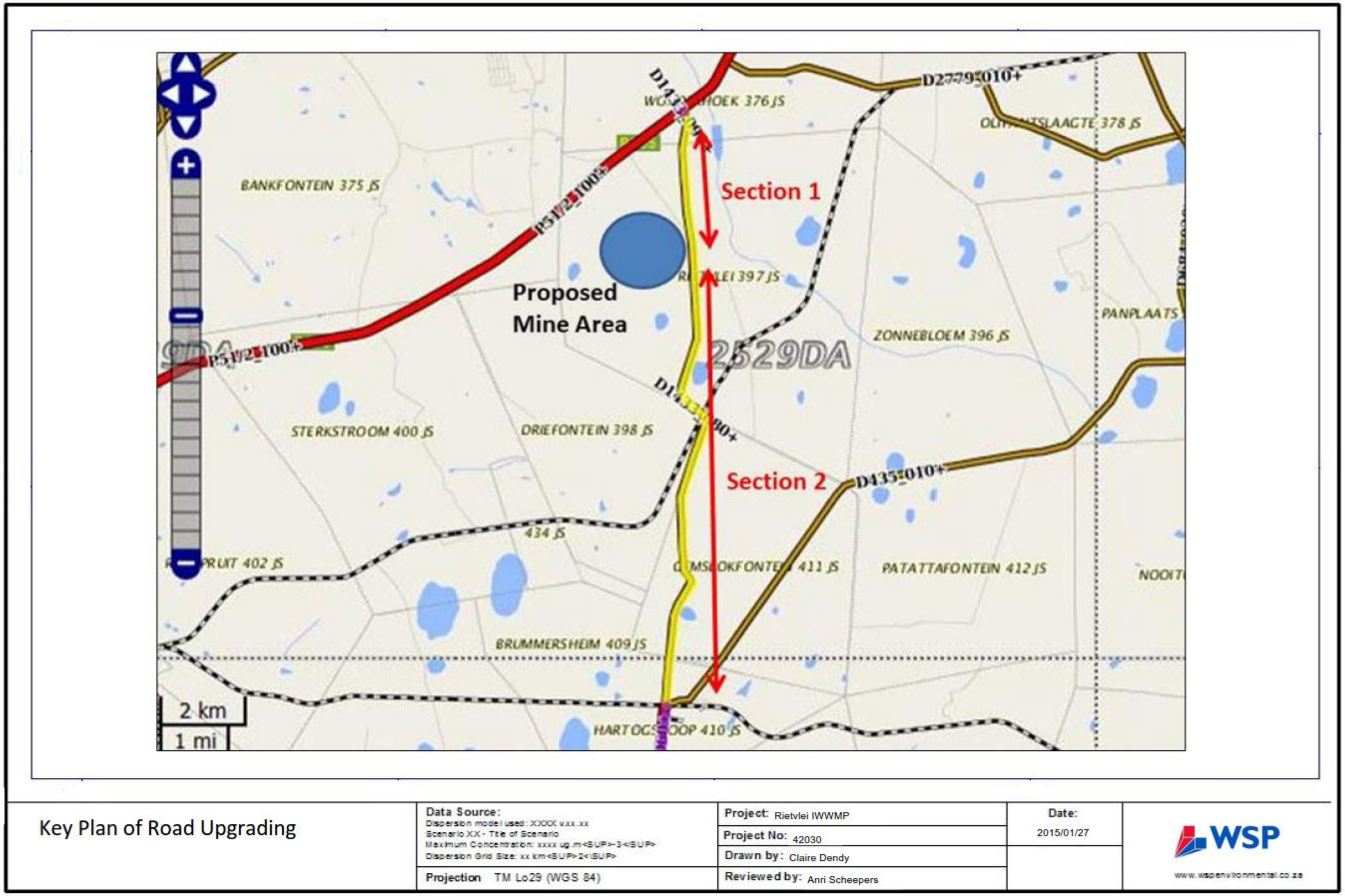


Figure 2-9: Key Plan of Road Upgrading

2.4.4.2 Pan Siding Road (D1433) Diversion

A portion of the district road (D1433) between the R555 and the Afgri Pan Siding will be impacted by the proposed mining activities towards the end of the life of mine and will therefore be required to be diverted at a later stage. The road is currently used by local farmers and inhabitants of the area. The local community will continue to have access to the road and the mine will need to ensure that all signage and road safety warnings are adequate to warn road users regarding the danger of heavy vehicles on the road. **Figure 2-10** indicates the proposed road diversion from Rietvlei to the siding.

2.4.4.3 Plant roads

Figure 2-11 outlines the layout of the roads associated with the plant area.

2.4.5 Buildings and Facilities

2.4.5.1 Buildings, Offices and Change Houses

The following buildings will be constructed on the site:

- An office complex to accommodate the full-time mine personnel, with a floor space of 365m^2;
- A plant office at the plant site; and
- A separate guard room at the mine entrance.

All other buildings will be container based, modular in design, and supplied as complete units based on the occupancy requirements. The total staff compliment for the day-, night, - third- and fourth shifts is estimated at a total of 155 people. A shared change house facility will be provided for the client and plant operator with shared water heating and sewer facilities.

2.4.5.2 Fuel storage and Dispensing area

Fuel will be stored in a steel tank supplied and maintained by the fuel suppliers. Oil will be stored in drums (provided by fuel suppliers.). A mobile pneumatic pump will be used for filling and will also be supplied by the fuels suppliers. All fuel and oil will be stored in a bunded area to be built and maintained in accordance with SANS 10131.

2.4.5.3 Parking

The following parking has been included for visitors and staff:

- Visitor's parking area will cater for 12 car ports;
- A total of 40 car ports are provided for with fencing around the parking area; and
- A total of 6 parking bays for busses have been provided, with fencing around the parking area.

2.4.6 Perimeter Fencing

A fence of 16 260m in length will be erected around the mine perimeter. The fence will be constructed of Galvanised Diamond Mesh 1.8m high, with 500mm Flat Wrap razor wire coils fitted to the top of the fence. Warning signs "DANGER KEEP OUT" will be fixed to fence at 500m intervals.

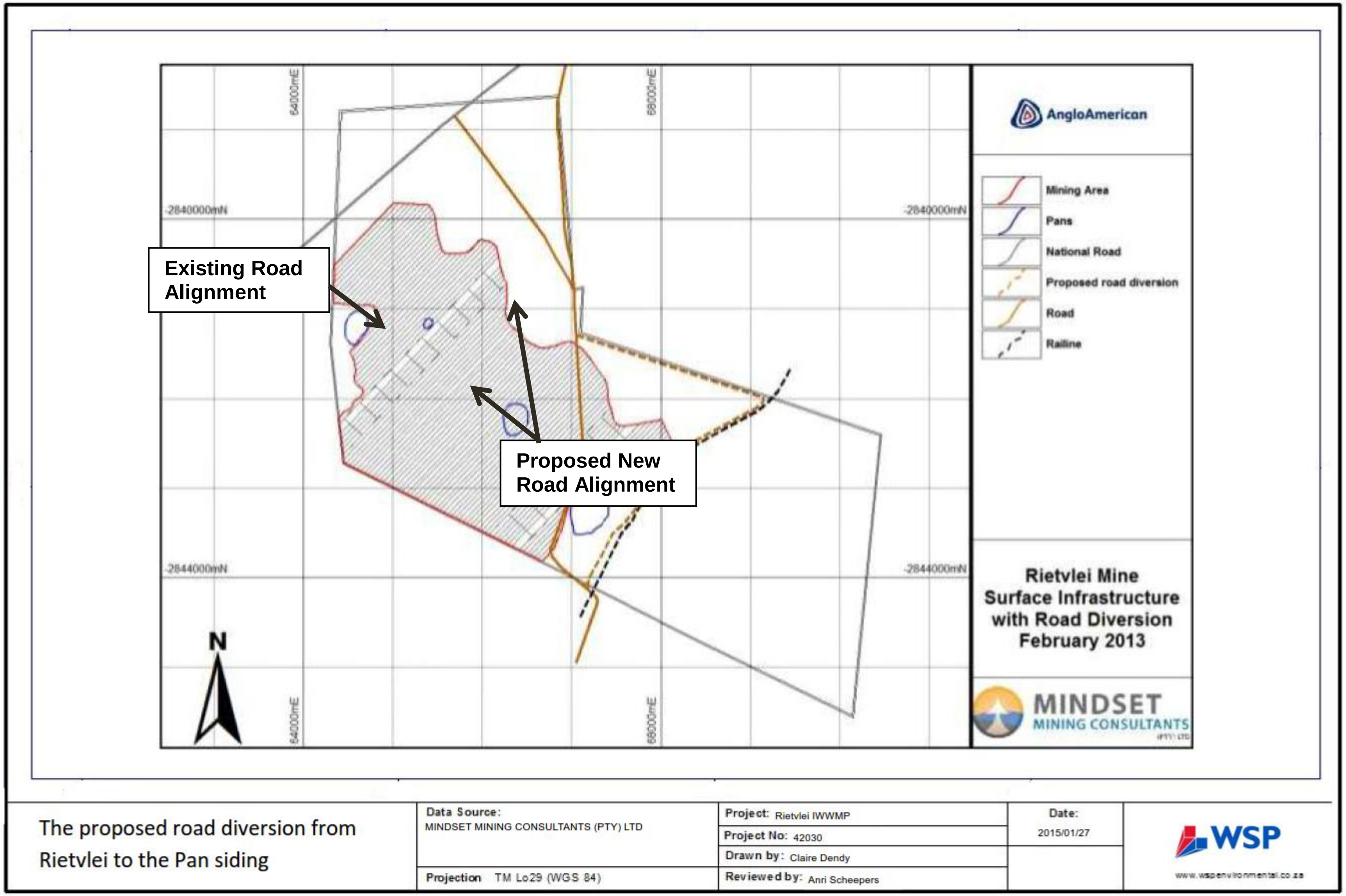


Figure 2-10: The proposed road diversion from Rietvlei to the Pan siding (Mindset, 2013)

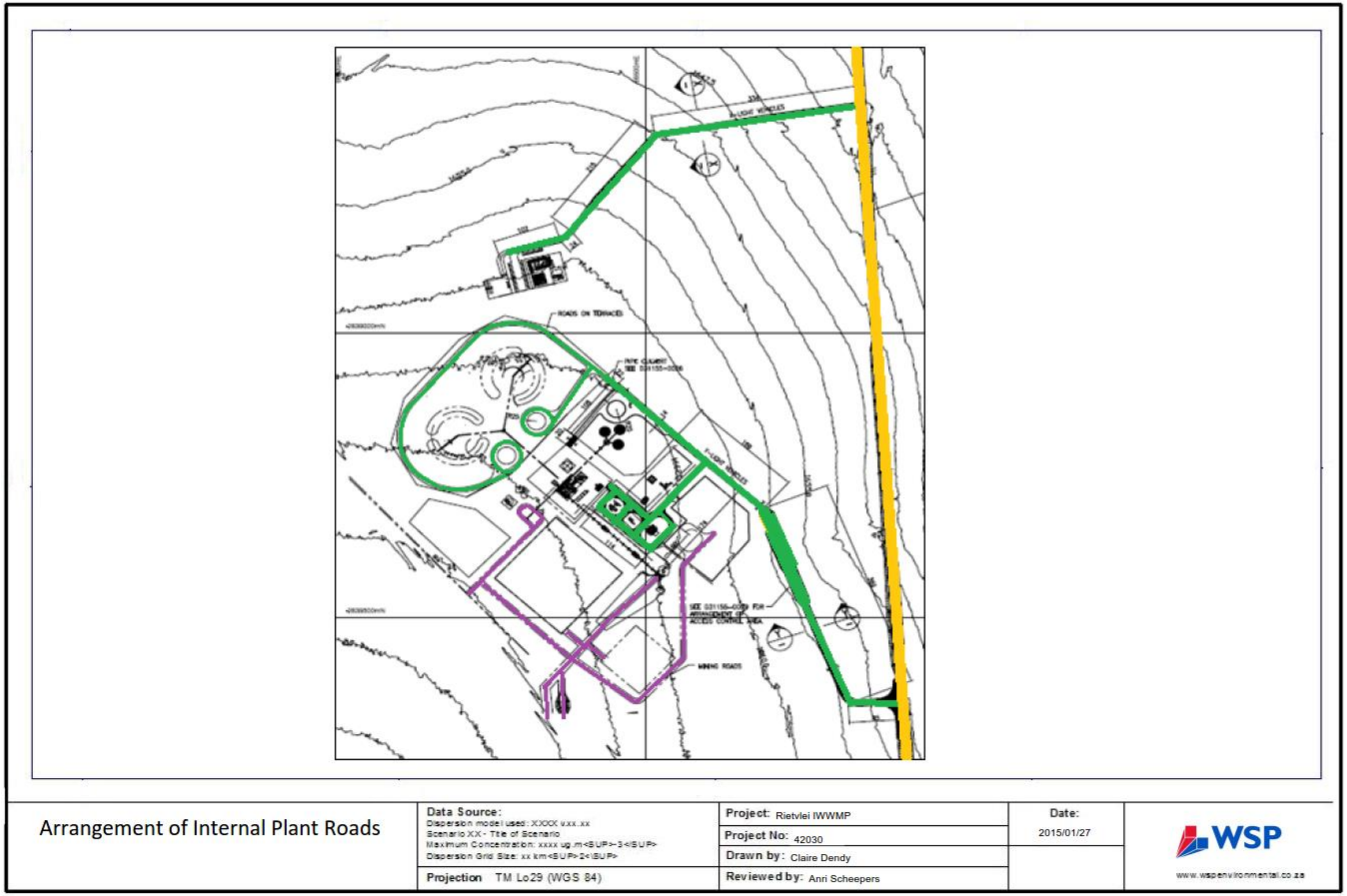


Figure 2-11: Arrangement of Internal Plant Roads (Mindset, 2013)

2.4.7 Overburden Stockpiles

Figure 2-13 shows the proposed areas for the storage of overburden material. Separate stockpiles have been proposed for hard material (indicated in brown), soft material (Indicated in orange) and topsoil (indicated in green).

2.4.8 Coal Discard Stockpile

Coal discard and fines from the filter plant will be discarded onto a coal discard facility to be located to the southwest of the plant area (**Figure 2-14**). The discard facility included on **Figure 2-14** is a phase 1 discard facility designed to accommodate 2.1 million m^3 of compacted discard for the first 5 years of the life of mine. The resultant height of the facility will be 30m at a 1:3 slope with a lined footprint of 15.8ha. Catchment paddocks and storm water channels surround the facility in order to convey run-off water directly to the Discard Pollution Control Dam.

This facility has been designed with the potential to be expanded over the life of mine as and when required in order to reduce the upfront costs. The design of Phase 1 of the Discard Disposal Facility incorporates the future extension of the facility for subsequent phases. The future extension of the facility will include the extension of the liner system, leakage detection systems (if required), catchment paddocks and run-off channels. The final Discard Disposal Facility will have a footprint of 42ha and a final design height of 30m.

As part of the Bankable Feasibility Study (BFS) test work was carried out on coal samples with regards to washability and quality. No discard was generated during this process and therefore no material was available for waste profiling. However, the proponent requested that the preliminary design of the lining for this facility would be based on a Class C liner as outlined in GNR 636. **Figure 2-12** shows the proposed preliminary liner design for the discard facility. The following describes the preparatory works proposed for the lining system:

- Clear and grub vegetation;
- Remove 200mm topsoil over the site;
- In-situ soil compaction to 95% Proctor Density at moisture content to +2% of O.M.C;
- Layer of Fibretex F-300M geotextile layer (or similar approved) over entire 15,8Ha site;
- Layer of 150mm, typically 19mm crushed stone aggregate (or similar) crushed on site and laid over entire site, including 110mm slotted leakage detection pipe work laid in trenches at 70m centres with a 2% minimum fall towards six concrete manholes along the perimeter;
- Layer of Fibretex F-300M geotextile layer (or similar approved) over the crushed stone;
- Two compacted soil layers of low permeability compacted to a minimum dry density of 95% Standard Proctor maximum dry density at a moisture content to +2% of OMC. The geotechnical investigation indicated that the selected site material may be suitable for use in the two 150mm compacted clay layers - but provision should also be allowed for additional field testing and a 4% bentonite mixture into the layer works if required;
- A single 1,5 mm thick HDPE geo-membrane then placed over the entire area of the Phase 1 discard storage facility (15.8 Ha); and
- Before commencing with the dumping of any discard – installation of a cushion layer of locally sourced silty-sand, placed in a 1000mm layer, end tipped and levelled out from one side of the site.

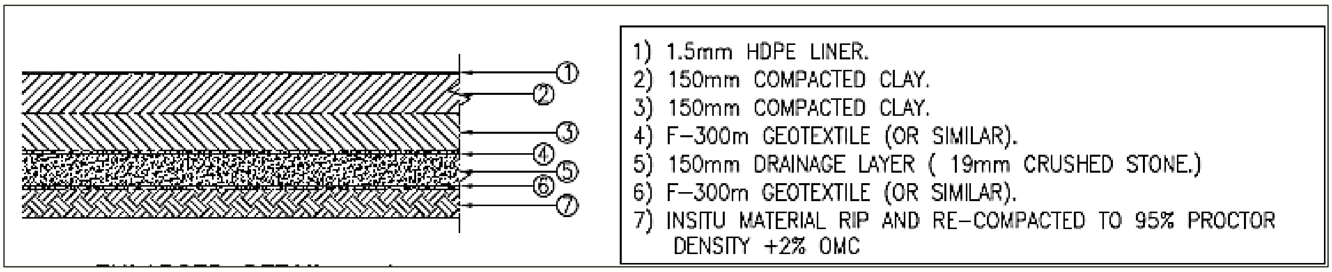


Figure 2-12: Proposed Preliminary Liner Design , as per Class C liner requirements as outlined in GNR 636, for the Rietvlei Coal Discard Facility

2.4.9 Sewage Plant

A sewage plant (in the form of a package plant) with the design capacity to process 96.8m^3 of fluid per day, with a total volume flow of 15Kl and a capacity of 80 persons, will be situated in the vicinity of the plant and main office complex. The plant requires a total surface area of 44m^2 (8.6m x 5.2m). Grey and black water will feed into a septic tank and then be pumped to the package plant. Water will be treated to general water quality limits and pumped into the Plant PCD for use in the beneficiation plant. Sludge will be removed by an external contractor.

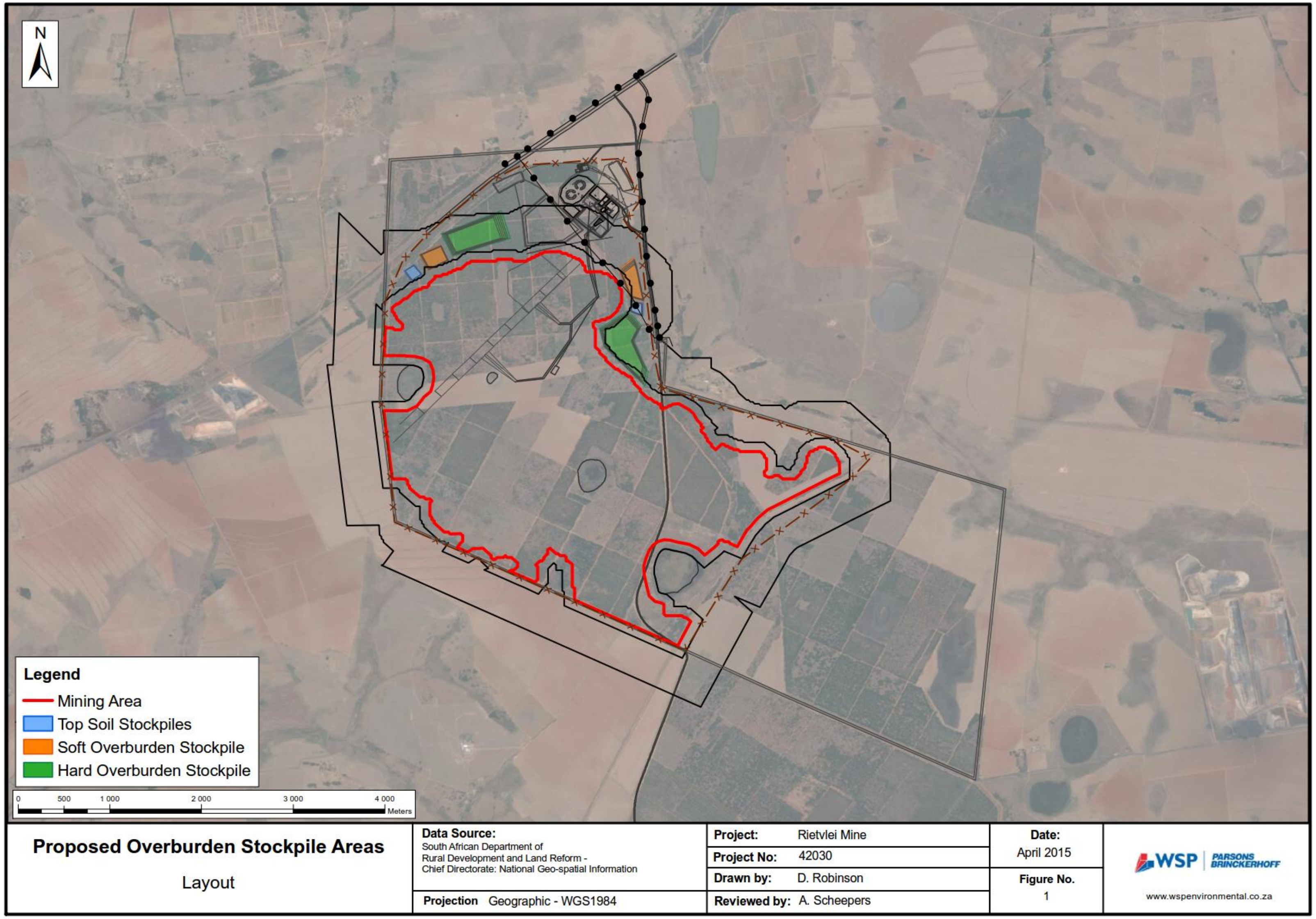


Figure 2-13: Proposed Overburden Stockpile Areas (Mindset, 2015)

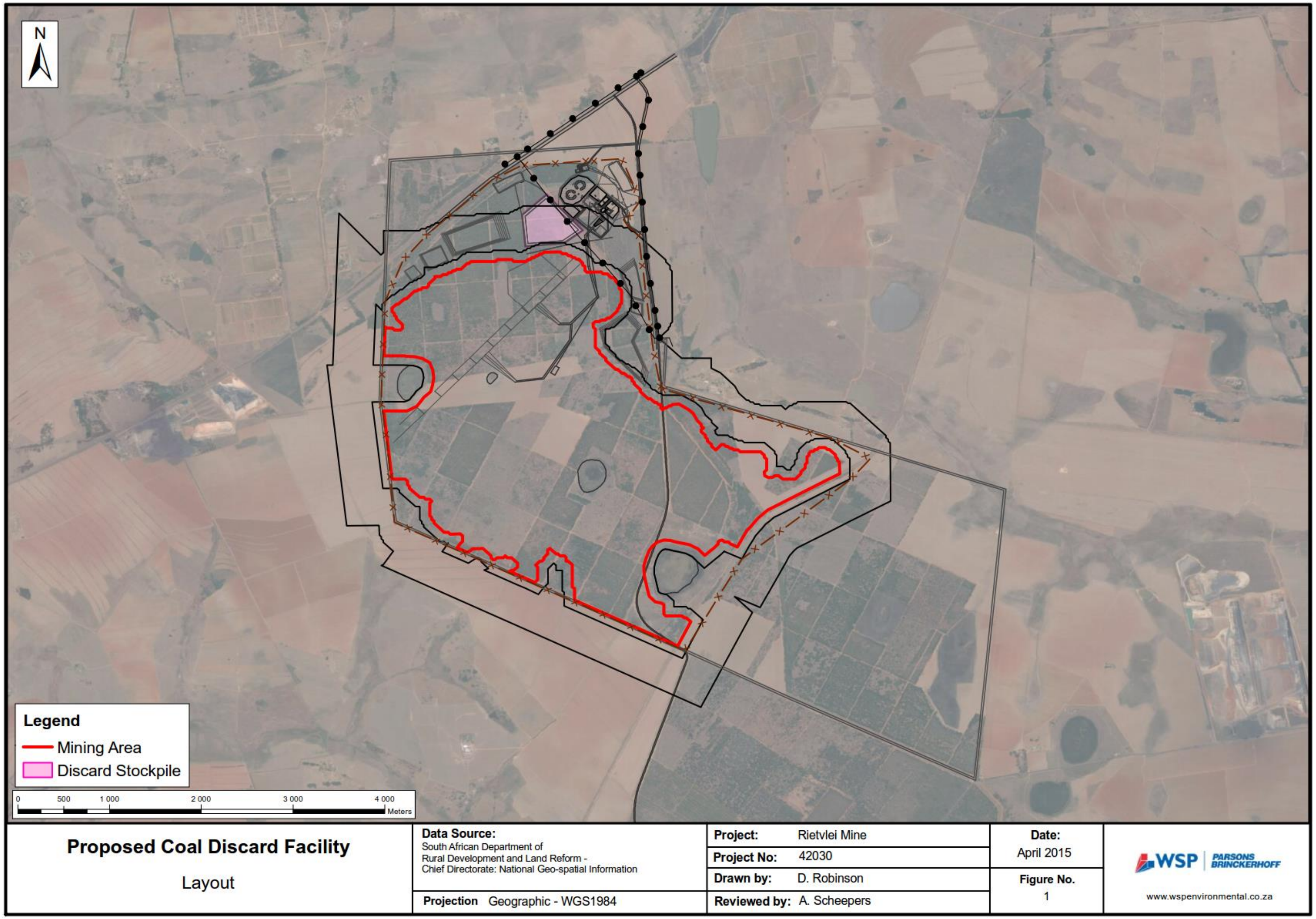


Figure 2-14: Proposed Coal Discard Facility (indicated in orange) (Mindset, 2015)

2.5 Project Implications on Water Resource Units

Mining activities will interact with various water resources with the proposed mining footprint and area. The implications of mining activities on the identified water resources are summarised below.

2.5.1 Surface Water

2.5.1.1 Construction Phase

The mine is situated in the headwater of the catchments and no major build-up of flows is expected to happen. The clearing of topsoil for footprint areas associated with construction activities (waste site, water control infrastructures, cut and fill) can increase siltation to the surface water resource during soil turning activities. Drainage lines flowing into the mining area will however have to be diverted to prevent clean water from entering the mining area and increase the risk of flooding. Slope associated with berms, and rerouting of the storm water runoff may enhance erosion and siltation, and flood risk at the receiving stream (river)

The construction activities are likely to be associated with accidental spills of hydrocarbons (oils, diesel etc.) from the construction vehicles, and other potentially hazardous chemicals during the construction phase. Such spills together with the construction waste constitute potential source of surface water contamination if not properly handled.

The design of the site infrastructure (rock dumps, discard dump, washing crushing plant) should take into account the specification stipulated in GN 36784. Thus construction may result in and the disturbance of Sub-catchment storm water runoff.

2.5.1.2 Operational phase

During the mining phase, surface water runoff may enter the operational areas (open pit, crushing/washing plant, stockpiles, etc.) and waste disposal area if not properly managed. This would result on the deterioration of clean surface water runoff. Water (groundwater, rainfall) will need to be pumped from the pit and groundwater, and store at the surface, for mine safety. Water from the operating areas, is considered dirty, and when not stored adequately constitutes a potential source of surface water pollution.

Mining activities that may impact on surface water are:

- Overburden dumping: the exposure of rock dumps, result in dirty water that may contaminate surface water, if not properly managed;
- Stockpiling and transport: the exposure of stockpiling and transporting of coal, to water and oxygen, together with hydrocarbon spills from storage (organic contaminants) may also result in contamination of surface water;
- Coal processing: coal will be exposed at the washing plant area to water (with chemical) and oxygen, resulting in dirty water, and spills/slurry from the site can contaminate surface water;
- Discard disposal: residual from coal processing will be disposed of onsite at a designated area or in pit. Such disposal when not handled correctly, constitute a potential source of water contamination; and
- Septic tank: spillage from septic may constitute source of bacteriological contamination to surface water. If not properly managed.

Dirty water from any of these activities should be drained, or pumped (where required) to pollution control dams. Pollution control dams, and contaminated water drains constitute potential sources of surface water contamination as result of leakage trough improper barrier system (absent, or leaking).

Handling and transport of waste material have some potential of contaminating surface water, including domestic waste, sewage water, hydrocarbons (storage).

2.5.1.3 Closure phase

The closing of mining activities and rehabilitation will be concurrently undertaken. Compaction equipment will include driving vehicle. All disused infrastructure will be demolished, and waste from demolition has to be removed from site and disposed at designated site. Surface water contaminants from the mine (including backfilled opencast pits and return water dams) can be enhanced.

Activities such as covering of the spillages with sand and collection and possibly treatment etc. are likely to be associated with accidental spills of hydrocarbons (oils, diesel etc.).

Dewatering would be stopped at that stage, and open pit flooding will occur, as recovering of groundwater levels, and subsequent decant to the surface is expected at the lowest mining area. The closure phase is usually too short to see the any evidence of decant. Decommissioning/closure is only complete once the proponent demonstrates no significant impacts.

2.5.2 Wetlands and Pans

Mining activities will interact with various wetland features within the proposed mining footprint. The implications of mining activities on the various wetland units are tabulated in **Table 2-1.**

Table 2-1: Implications pf mining activities on wetland units

Wetland Unit	Mining implications
Pan 1	Will not be subjected to mining activities.
Pan 2	Unavoidable and will completely be mined through
Pan 3	Will not be subjected to mining activities.
Pan 4	Unavoidable and will completely be mined through.
Pan 5	Not subjected to mining as located outside of mining footprint.
Pan 6	Will be protected and not subjected to mining activities.
Wetland 1 & 2	Not subjected to mining as located outside of mining footprint..
Wetland 3-7	Unavoidable and will completely be mined through.

The mining footprint and activities will have a significant effect on the permanent wetland features (pan 1-4, 6 and the Selons River) specifically referring to the highly sensitive features should mitigation measures not be implemented. Thus planning of the mining footprint should consider higher sensitivity areas as “no-go” areas. Pan 2 and wetland 1-7 will be completely mined through, which will result in the loss of wetland habitat, functioning and ecoservice provision.

Wetland units (wetland 1 & 2 and pan 5) will not be directly disturbed from mining; however they are directly dependant on the water they receive from their catchment supported by water percolating through different soil horizons, and a shallow perched aquifer. The complete mining of the wetland units within the mining footprint will result in eliminating seep water resulting in drying of the downstream and protected wetland units.

Due to extensive mining within the WMA and surrounding areas, along with extensive agriculture, the regional cumulative impacts as a result of loss of wetlands is considered to be highly significant. It is also critically important to consider the general impact from mining activities in the greater Olifants catchment, which includes coal mining as well as platinum group metals and the severe impact from the urban areas of Mpumalanga. In particular, specific mention is made of the impact of urban runoff and the release of treated and raw sewage effluent into the riverine systems in the area. Seepage from mining facilities such as waste dumps, TSF and general dirty water areas, agricultural activities, as well as spillages of hydrocarbons, has the potential to contaminate the groundwater environment which in turn can affect water quality in surface water sources in the area. Within the Olifants catchment there has been significant impact on wetlands due to erosion, incision, and sedimentation into the wetlands. These impacts have led to the loss of wetlands and the loss of the wetland’s ability to function naturally. All wetland areas will be rehabilitated upon decommissioning to ensure that wetland functions are re-instated.

2.5.3 Groundwater

The potential implications on groundwater are associated with activities during the construction phase, operation phase, and the closure and post-closure phases of the coal mining project.

2.5.3.1 Construction phase

The clearing of topsoil for footprint areas associated with the waste site construction can increase infiltration rates of water to the groundwater system and decrease buffering capacity of soils to absorb contaminants from possible spills on surface. Groundwater recharge from surface may increase, especially in the potential recharge area.

During the construction phase, it would be necessary to construct the berms to prevent storm water runoff to enter working area within the prospecting area. The cut and fill activities associated with the construction of infrastructures (waste site, water control infrastructures) may intercept shallow groundwater as static levels are found shallow as 1.7mbgl. In cases where the construction will intercept groundwater, lowering of the groundwater level by dewatering may be needed during construction. This will cause localise cones of groundwater depressions around the waste site area.

Contamination of groundwater can occur as a result of groundwater seeps standing in the footprint area. The construction activities are likely to be associated with accidental spills of hydrocarbons (oils, diesel etc) from the construction vehicles, and other potentially hazardous chemicals during the construction phase. Such spills together with the construction waste can infiltrate and cause contamination of the groundwater system if not properly handled.

The design of the waste disposal sites (rock dumps, tailings) will take into account the specification stipulated in GN 36784. Thus construction will result in:

- the reduction of the recharge potential at proposed site; and
- the disturbance of Sub-catchment storm water runoff.

2.5.3.2 Operational phase

Opencast mining of coal will result in groundwater inflows into the pits, which needs to be pumped out for mine safety. The dewatering of the groundwater system in the immediate vicinity of the pits will become more important and results in wider cone of depression as depth to pit floor will increase. According to the importance of cone of depression surrounding users' boreholes can be impacted.

Exposure of geological strata to rainfall in the opencast areas will result in deterioration in quality of groundwater flowing into the opencast areas. Groundwater will initially be of good quality but will with time deteriorate, due to oxidation of pyrite and/or other chemical processes that can occur as a result of mining activities. This can take place for years, until the neutralizing potential is depleted. Such dirty water in opencast pit, together with groundwater ingress, if not properly handle may infiltrate and contaminate deeper aquifer system. Others mine activities that may impact on groundwater quality are:

- Overburden dumping: the exposure of rock dumps, to water and oxygen, may result in dirty water that may contaminate groundwater systems, if not properly managed;
- Stockpiling and transport: the exposure of stockpiling and transporting of coal, to water and oxygen, together with hydrocarbon spills from storage (organic contaminants) may also result in contamination of the groundwater systems;
- Coal processing: coal will be exposed at the washing plant area to water and oxygen, resulting in dirty water, and spills/slurry from the site can contaminate groundwater; and
- Discard disposal: residual from coal processing will be disposed of onsite as tailings dam. Tailings constitute a potential source of groundwater contamination.

Dirty water from any of these activities should be drained, or pumped (where required) to pollution control dams. Pollution control dams, and contaminated water drains constitute potential sources of groundwater contamination as result of infiltration trough improper barrier system (absent, or leaking). Unlined dams will contribute highly to contamination of the groundwater system, while lined dams might still contaminate but to a lesser degree.

Handling and transport of waste material have some potential of contaminating groundwater, including domestic waste, sewage water, hydrocarbons (storage). Groundwater implications as a result of mining activities include but not limited to:

- Deterioration of groundwater quality due to rock dumps;
- Deterioration of groundwater quality due to open pit mining;
- Deterioration of groundwater quality due to coal processing;
- Deterioration of groundwater quality due to discard and fines disposal;
- Deterioration of groundwater quality due to leaks/spillages from dirty water quality dams and drain;
- Deterioration of groundwater quality due to handling and transport of waste material.

2.5.3.3 Closure phase

The closing of mining activities and rehabilitation will be concurrently undertaken. Compaction equipment will include driving vehicle. All disused infrastructure will be demolished, and waste from demolition has to be removed from site and disposed at designated site.

Contaminants from the mine (including backfilled opencast pits and return water dams) can seep through the unsaturated zone into the groundwater system. Lateral groundwater movement will allow the spread of the contamination within the groundwater system. If this groundwater feeds surface water bodies such as wetlands and streams, these can also be polluted. However dilution will take place therefore the impacts thereof are considered to be moderate.

Activities such as covering of the spillages with sand and collection and possibly treatment etc. are likely to be associated with accidental spills of hydrocarbons (oils, diesel etc.).

Dewatering would be stopped at that stage, and open pit flooding will occur, as recovering of groundwater levels. At this point in time it is calculated that it is likely for the mine to decant. It is expected that poorer quality groundwater will be present on the mine horizon when total flooding is completed.

Water management activities associated with closure activities will be conducted as appropriate. Generally decommissioning/closure phase is too short to see significant impacts on the groundwater, but in the present context where closure would be progressive, significant reduction of impacts could occur. The risk of such impacts will be reduced over time. With strong management options, the risk is expected to reduce even further. Decommissioning/closure is only complete once the proponent demonstrates no significant impacts.

2.6 Needs and Desirability

The Broad Based Socio Economic Empowerment Charter for the South African Mining Industry, hereafter referred to as “the Mining Charter”, is a government instrument designed to effect sustainable growth and meaningful transformation of the mining industry. The Mining Charter seeks to achieve the following objectives:

- To promote equitable access to the nations mineral resources to all the people of South Africa;
- To substantially and meaningfully expand opportunities for Historically Disadvantaged South Africans (HDSA) to enter the mining and metals industry and to benefit from the exploitation of the nation’s mineral resources;
- To utilise and expand the existing skills base for the empowerment of HDSA and to serve the community;
- To promote employment and advance the social and economic welfare of mine communities and major labour sending areas;
- To promote beneficiation of South Africa’s mineral commodities; and
- Promote sustainable development and growth of the mining industry.

To this end, the Proposed Project was earmarked by Anglo American Operations (Pty) Limited as a project to be developed, operated, and owned by a Black Economic Empowerment (BEE) company. RMC has been identified as the BEE company and forms part of Anglo American Operations (Pty) Limited’s strategy to assist emerging Black-owned companies to develop mining projects. RMC is a 60% BEE Company with 40% of RMC being held by Emalangenis and a further 20% held by Vunani Resouces through its one third share in Butsanani, a 60% shareholder in RMC.

Although some coal will likely be sold to the export market, once the market recovers, the majority of the coal from the Rietvlei Opencast Coal Mine will be sold domestically to Eskom, and thus contribute to the reliable provision of electricity which is critical to energy security, industrial development and poverty alleviation initiatives in the country.

The mining activity will also realise several advantages for the local community. The mining activity will provide an income generation for the area, as well as a cash injection into the country's economy. The employment of local labour will decrease the unemployment rate in the area, as well as allow for the uplifting of these workers (through the implementation of the Social and Labour Plan (SLP)).

The implementation of the SLP will contribute to the empowerment of both the workforce (through the SLP's Human Resources Development Programme) and local community (through the SLP's Local Economic Development Programme). It is estimated that for every one job created by direct employment, five are created by indirect employment.

3 Regulatory Water and Waste Management Framework

3.1 National Water Act (No. 36 of 1998)

3.1.1 Objectives

The NWA provides for fundamental reformation of legislation relating to water resources and use. The preamble to the Act recognises that the ultimate aim of water resource management is to achieve sustainable use of water for the benefit of all users and that the protection of the quality of water resources is necessary to ensure sustainability of the nation's water resources in the interests of all water users. The purpose of the NWA is stated, in Section 5 as, *inter alia*:

- Promoting the efficient, sustainable and beneficial use of water in the public interest;
- Facilitating social and economic development;
- Protecting aquatic and associated ecosystems and their biological diversity;
- Reducing and preventing pollution and degradation of water resources; and,
- Meeting international obligations.

3.1.2 Applicability

Section 22(1) of the NWA states that a person may only use water if the water use is authorised by a licence under NWA or if the responsible authority has dispensed with a licence requirement if it is satisfied that the purpose the NWA will be met by the granting of a licence, permit or other authorisation under any other law.

A person may only use water without a licence if the water use is permissible:

- Under Schedule I of NWA;
- As a continuation of an existing lawful use; and,
- In terms of a general authorisation issued under Section 39 of NWA.

A water use licence (WUL) is required in terms of Section 41 of the NWA for activities listed in Section 21 of the said Act. The water uses potentially applicable to the Proposed Project are included in **Table 3-1.**

3.1.3 Government Notice Regulation 704

GNR 704 (4 June 1999) under the NWA provides regulations on the use of water for mining and related activities aimed at the protection of water resources (requirements for clean and dirty water separation). GNR 704 requires *inter alia* the following:

- Separation of clean (unpolluted) water from dirty water;
- Collection and confinement of the water arising within any dirty area into a dirty water system;
- Design, construction, maintenance and operation of the clean water and dirty water management systems so that it is not likely for either system to spill into the other more than 1:50 years;
- Design, construction, maintenance and operation of any dam that forms part of a dirty water system to have a minimum freeboard of 0.8m above full supply level, unless otherwise specified in terms of Chapter 12 of the NWA; and,
- Design, construction, and maintenance of all water systems in such a manner as to guarantee the serviceability of such conveyances for flows up to and including those arising as a result of the maximum flood with an average period of recurrence of 1:50 years.

GNR 704 also stipulates that no person in control of a mine or activity may-

- Locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year flood line or within a horizontal distance of 100m from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on water-logged ground, or on ground likely to become water-logged, undermined, unstable or cracked;
- Place or dispose of any residue or substance which causes or is likely to cause pollution of a water resource, in the workings of any opencast or opencast mine excavation, prospecting diggings, pit or any other excavation; and,
- Use any area or locate any sanitary convenience, fuel depots, reservoir or depots for any substance which causes or is likely to cause pollution of a water resource within the 1:50 year flood line of any watercourse or estuary.

3.2 Summary of Water Uses

The promulgation of the NWA changed the manner in which consumptive and non-consumptive use of water is being authorised. "Water use" has been defined under Section 21 of the NWA, Chapter 4 "Use of Water". The following water uses (**Table 3-1**) are applied for as part of this WULA:

Table 3-1: Water use activities applicable in terms of Section 21 of the NWA

Section Number	Applicable Water Use	Applicability
Section 21(a):	Taking of water from a water resource	120 000 m^3 per annum of water from external source required. During the construction phase water will be sourced from a borehole and during the operational phase water will be sourced from the Selons River. Refer to **Section 2.5.**
Section 21(c):	Impeding or diverting the flow of water in a water course	Impact on wetlands, surface water resources and habitats identified onsite. Refer to **Section 2.5.**
Section 21(g):	Disposing of waste in a manner which may detrimentally impact on a water resource	Disposal and storage of dirty storm water in two pollution control dams. Discard and fines co-disposal facility. Refer to **Section 2.5.**
Section 21(i):	Altering the bed, bank, course or characteristics of a	Impact on wetlands, surface water resources and habitats identified onsite. Refer to **Section**

	watercourse	**2.5.**
Section 21(j):	Removing, discharging or disposing of water found opencast if it is necessary for the efficient continuation of an activity or for the safety of people	Seepage of groundwater into the opencast workings. Refer to **Section 2.5.**

3.3 Existing Lawful Water Uses

As the Rietvlei Mine is a new development, no existing water uses relevant exemptions and general authorisations have been granted to date.

3.4 National Environmental Management Waste Act (No. 59 of 2008)

3.4.1 Objectives

The NEM:WA serves to reform the law regulating waste management in order to protect human health and the environment. This is managed by providing reasonable measures for the prevention of pollution and ecological degradation. The NEM:WA aims to secure ecologically sustainable development while promoting justifiable economic and social development. The NEM:WA provides national norms and standards for regulating the management of waste by all spheres of government, for specific waste management measures and for matters incidental thereto. Furthermore, the Act protects the health, well-being and the environment by:

- Providing reasonable measures for minimisation of consumption of a natural resource;
- Minimising general waste;
- Reducing, re-using, recycling and recovering waste;
- Safely treating or disposing waste;
- Preventing pollution and ecological degradation;
- Securing ecological sustainable development;

The Act also promotes the:

- Economic and sustainable development;
- Effective delivery of waste services;
- Remediation of contaminated land; and,
- Integrated waste management.

3.4.2 Applicability

Section 20 of the NEM:WA states that no person may commence, undertake or conduct a waste management activity except in accordance with the requirements or standards determined in terms of the NEMWA for that activity or where a Waste Management License (WML) has been issued in respect of that activity. A list of waste management activities that require a waste management license was published in GNR.921 of 2013. GNR.921 details two categories of activities: Category A activities, which require a BA process in terms of GNR.543 to be undertaken, and Category B activities, which require a scoping and EIA process in terms of GNR.543 to be undertaken.

WSP undertook a detailed analysis of the listed activities contained in GNR 921 in order to ascertain which of the activities are relevant to the Proposed Project. The activities potentially applicable to the Proposed Project are listed below in **Table 3-2**. The result of the analysis indicated that an S&EIR process is required.

Table 3-2: Potentially Applicable Listed Activities Identified in terms of GNR 921

Regulation Number	Listed Activity Description	Applicability

GNR.921 of 2013 **Category B**	The disposal of any quantity of hazardous waste to land	The potential to dispose hazardous waste to land.

Category C activities do not require a waste management license, however, are subject to the requirements of the norms and standards. The purpose of the norms and standards is to provide a uniform national approach, to ensure best practice and to provide minimum standards for the design and operation of new and existing waste storage areas. Norms and standards that will be applicable to the Rietvlei Mine include Government Notice Regulation 926.

GNR 926 of 2013 under the NEM:WA provides a set of national norms and standards for the storage of waste, which apply, to any person who stores general or hazardous waste in a waste storage facility. The purpose of these norms and standards is to provide:

- A uniform national approach relating to the management of waste storage facilities;
- Best practice in the management of waste storage facilities; and,
- Minimum standards for the design and operation of new and existing waste storage facilities.

3.5 The National Environmental Management Waste Amendment Act (No. 26 of 2014)

3.5.1 Objectives

The National Environmental Management: Waste Amendment Act (No. 26 of 2014) (NEM:WAA) was promulgated on 2 June 2014 with an effective date of 2 September 2014. In terms of the proposed project the most notable amendments were the change in the definition of waste and the inclusion of Schedule 3. Waste is now defined as follows:

> *"any substance, material or object, that is unwanted, rejected, abandoned, discarded or disposed of, or that is intended or required to be discarded or disposed of, by the holder of that substance, material or object, whether or not such substance, material or object can be re-used, recycled or recovered and includes all wastes as defined in Schedule 3 to this Act"*

Schedule 3 provides a list of defined wastes categorised as either hazardous (Category A) wastes or general (Category B) wastes. An important inclusion in Category A is the inclusion of residue deposits and reside stockpiles as waste. Prior to the promulgation of NEM:WAA, residue deposits and stockpiles were dealt with under the MPRDA and not considered waste. Residue deposits and stockpiles include wastes resulting from exploration, mining, quarrying and physical and chemical treatment of minerals.

3.5.2 Applicability

As residue deposits and stockpiles are now considered wastes, compliance to the following is now required:

- Waste Classification and Management Regulations (GNR 634);
- National Norms and Standards for the Assessment of Waste for Landfill Disposal (GNR 635); and
- National Norms and Standards for Disposal of Waste to Landfill (GNR 636).

3.5.2.1 Government Notice Regulation 634

The Waste Classification and Management Regulations (GNR 634 of August 2013) were promulgated on 23 August 2013 and as from 2 September 2014 (or as agreed by the DEA and DMR 8 December 2014) the waste classification and management regulations apply to residue stockpiles and deposits.

Mining operations must determine whether waste streams generated by its operations are listed in Annexure 1 of the Regulations. If domestic waste, the regulations do not apply. If the waste is listed in Annexure 1, the regulations apply but no classification is required. All other wastes must be classified in terms of the Regulations within 180 days of generation. The waste needs to be reclassified every 5 years or within 30 days of modification of process or inputs or when the waste is treated.

Residue deposits and stockpiles are defined under Schedule 3 of the NEM:WAA. Based on our current understanding, the coal discard (mining residue) is recognised as hazardous under Schedule 3. Wastes either defined or listed do not require classification in terms of South African National Standard (SANS) 10234:2008 'Globally Harmonised System of Classification and Labelling of Chemicals (GHS)' (SANS 10234).

3.5.2.2 Government Notice Regulation 635 and 636

Coal discard is categorised as hazardous waste, due to the fact that this is a greenfield site, there was no coal discard available for profiling to determine the disposal/containment requirements (with specific reference to the landfill design) in terms of GNR 635 and GNR 636. Therefore, the Proponent made the decision to complete the lining design to fulfil the Class C lining requirements.

As part of the Proposed Project a coal discard stockpile is proposed. In terms of NEM:WAA the coal discard is now considered to be a waste. The following are important to note:

3.5.2.3 Proposed Government Notice Regulation 1005 of 2014 - Regulations Regarding the Planning and Management of Residue Stockpiles and Residue Deposits:

The Proposed Regulations Regarding the Planning and Management of Residue Stockpiles and Residue Deposits from a Prospecting, Mining, Exploration or Production Operation (Notice 1005 of 2014) aims to regulate the planning and management of residue stockpiles and residue deposits from a prospecting, mining, exploration or production operation.

The proposed regulation provides for the following:

- The assessment of impacts and analyses of risks relating to the management of residue stockpiles and residue deposits;
- Characterisation of residue stockpiles and residue deposits;
- Classification of residue stockpiles and residue deposits;
- Investigation and site selection for residue stockpiling and deposit;
- Design of the residue stockpile and residue deposit;
- Impact Prediction;
- Duties of the holder of right or permit;
- Monitoring and reporting system for residue stockpiles and residue deposits;
- Dust management and control; and
- Decommissioning, closure and post closure management of residue stockpiles and residue deposits.

Anything done in terms of regulation 73 relating to the management of residue stockpiles and residues deposits provision in the MPRDA Regulations, which can be done in terms of a provision of these Regulations must be regarded as having been done in terms of the provision of these Regulations.

Management measures of residue stockpiles and residue deposits approved in terms of the MPRDA Regulations, at the time of the coming into operation of these Regulations, must be regarded as having been approved in terms of these Regulations.

A holder of a right or permit in terms of the MPRDA must continue the management of the residue stockpiles and residue deposits in accordance with the approved management measures.

3.5.2.4 Proposed Government Notice Regulation 1006 of 2014 - to Exclude a Waste Stream or a Portion of a Waste Stream from the Definition of Waste:

The purpose of the Proposed Regulations to Exclude a Waste Stream or a Portion of a Waste Stream from the Definition of Waste (Notice 1006 of 2014) is to prescribe the manner in which:

- A person or category of persons may apply for the exclusion of a waste stream or a portion of a waste stream from the definition of waste; and
- The Minister may exclude a waste stream or portion of waste stream from the definition of waste through a publication of list in government gazette

Any portion of a waste generated from a source listed in Category A of Schedule 3 of the Act may be excluded from being defined as hazardous on demonstration that such portion of waste is non-hazardous in accordance with the Waste Management and Classification regulations.

Any waste or portion of a waste generated from a source listed in Schedule 3 of the Act may be excluded from the definition of waste where such waste will be used in a manner that will not have a significant adverse impact on the environment.

3.6 Existing Waste Related Authorisations

As the Rietvlei Mine is a new development, no existing waste related authorisations have been granted to date.

4 Present Environmental Situation

4.1 Regional Climate Description

The proposed mining footprint is located in Mpumalanga Highveld Region approximately 1 600m above sea level. No meteorological station is in place at the proposed Rietvlei Mine and to overcome this problem it was decided to make use of measured meteorological data obtained from the South African Weather service for their Rietvallei station. The weather station is approximately 23 km east of the proposed Rietvlei Mine.

Overall, the climate of this region is described as a summer rainfall area, where summers are mild to warm, whilst winters are cool to cold and dry. The area experiences an average of 8.3 hours of sunshine per day. The mean annual temperature is approximately 20.5°C (**Figure 4-1**). During the summer season (October to March); the average maximum temperature is 29.5ºC, while the average minimum temperature in winter (April to September) is approximately 9.7°C. The area falls into the summer rainfall region, with the most rain occurring between October and March (**Figure 4-2**). The average monthly rainfall is 72mm.

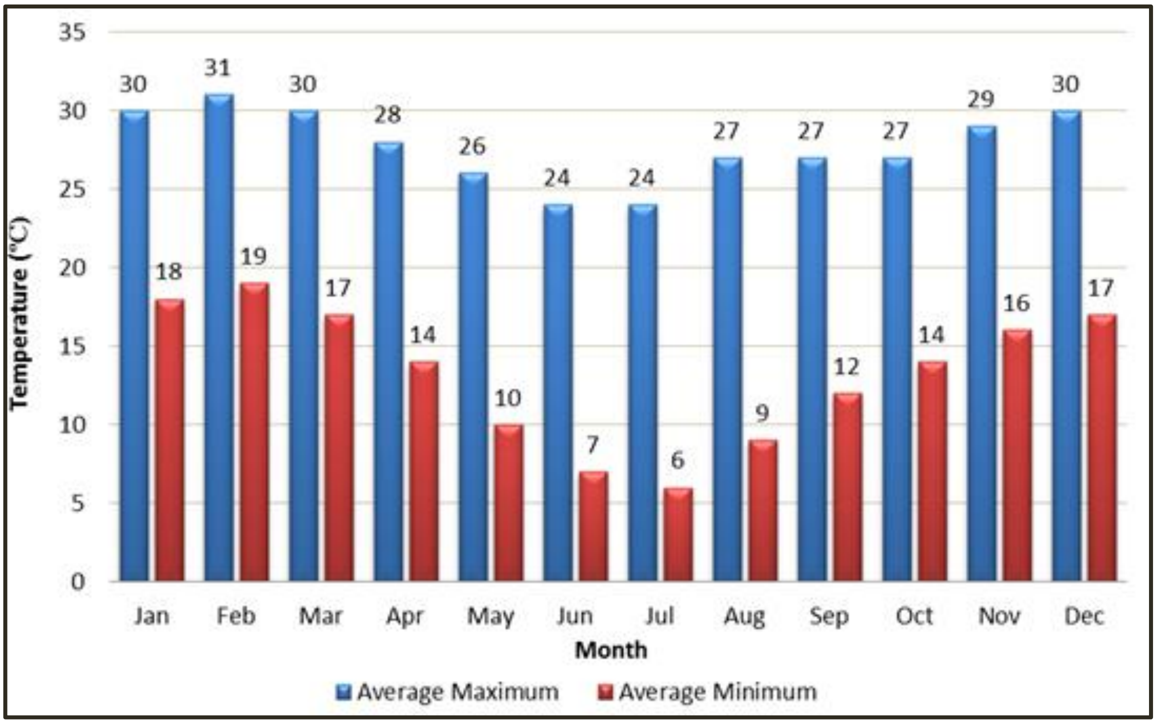


Figure 4-1: Average monthly temperatures[1]

[1] data source: http://www.myweather2.com/City-Town/South Africa/Mpumalanga/climate-profile.aspx

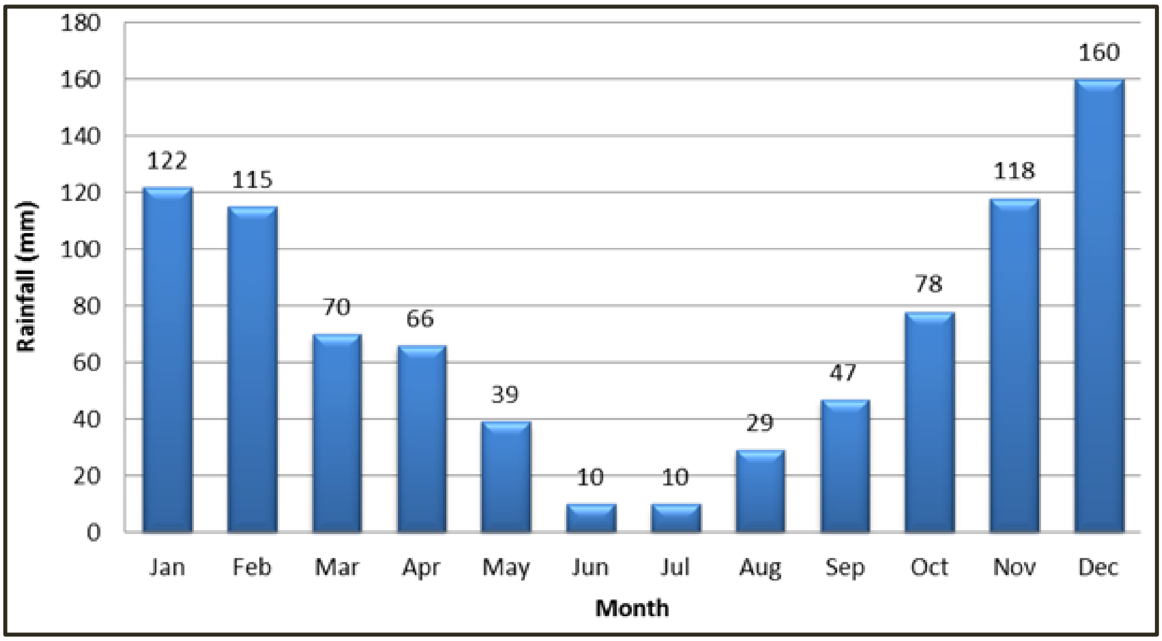


Figure 4-2: Average monthly rainfall[2]

4.1.1 Local Wind Field

Figure 4-3 shows that the predominant wind direction comes from the north-west and east with strong winds of up to 10m/s. Calm conditions are experienced 11.2% of the time with a wind direction of predominately north-westerly and easterly during day-time conditions. Wind tends to increase in north-westerly direction. Night-time conditions are characterised by winds from the north-easterly, easterly and south–easterly sectors.

As depicted (**Figure 4-4**) in the summer months are dominated by easterly, south easterly winds. Wind strength can be experienced of up to 15m/s. The autumn months experience strong winds of up to 8 m/s usually blowing in the north-westerly, south easterly and easterly sectors. The winter months reflect dominancy of winds from the north-westerly sectors and during spring the wind direction is in a north-westerly and north-easterly direction, with an increase in frequencies of occurrence being evident.

[2] data source: http://www.myweather2.com/City-Town/South-Africa/Mpumalanga/climate-profile.aspx

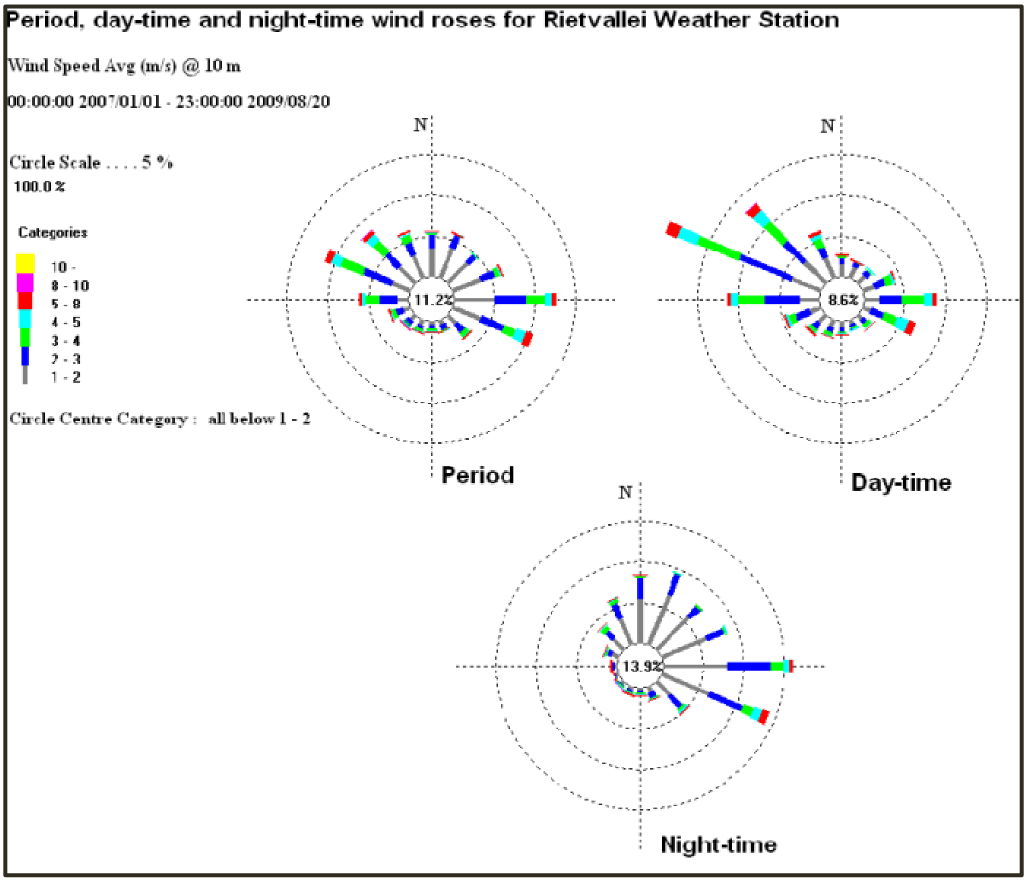


Figure 4-3: Wind Roses for Rietvallei for January 2007 to August 2009

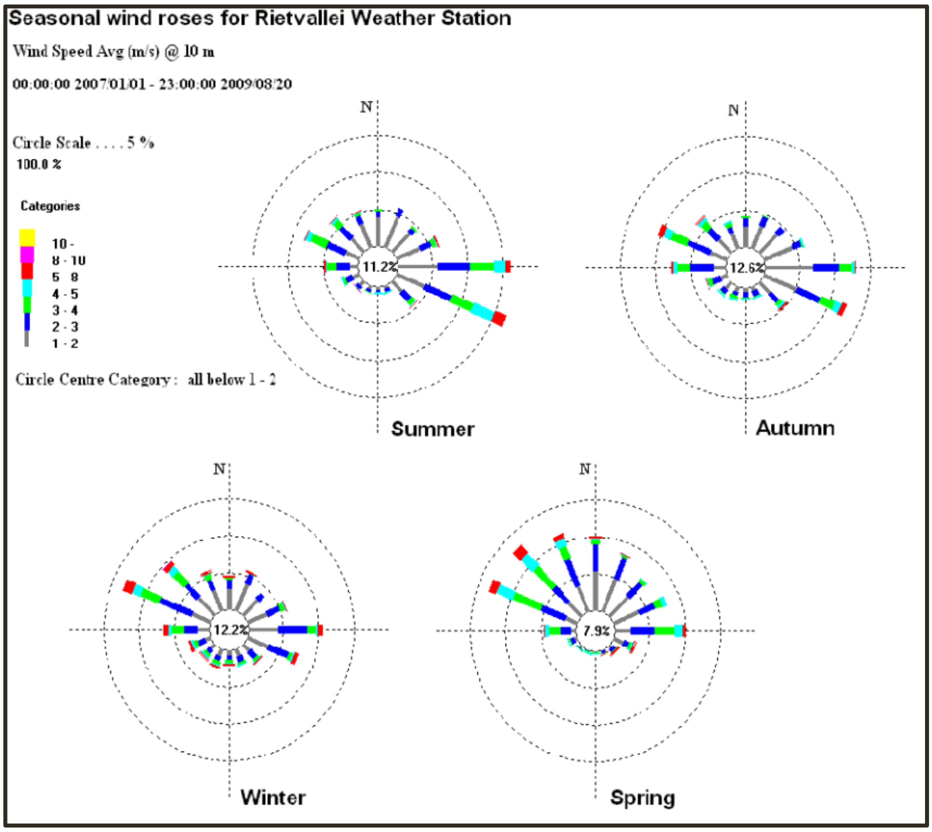


Figure 4-4: Seasonal wind roses for Rietvallei for January 2007 to August 2009

4.1.2 Air Temperature

Since no long term data are available for the proposed Rietvlei Mine area, reference was made to long term climate data for Middelburg. The long term temperature trends recorded for Middelburg from 1925-1950 are shown in **Table 4-1**. Minimum long-term temperatures range from -1.8°C to 13.7°C with maximum temperatures ranging between 18.4°C and 27.1°C.

Table 4-1: Long-term minimum, maximum and mean temperatures for Middelburg 1925-1950

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Maximum	27.2	26.8	26.0	23.9	21.3	18.5	18.4	21.4	24	26	26.2	27.1
Mean	20.5	20.1	18.7	15.7	11.7	8.3	8.3	11.1	14.7	18.0	19.0	20.1
Minimum	13.7	13.4	11.4	7.4	2.2	-1.8	-1.7	0.8	5.3	10.1	11.8	13.2

4.1.3 Precipitation

The average monthly precipitation data has been recorded in **Figure 4-5** depicting that the total annual rainfall is 735 mm. On average the rainfall tends to occur during the summer months from October to April, with the peak rainy season in January.

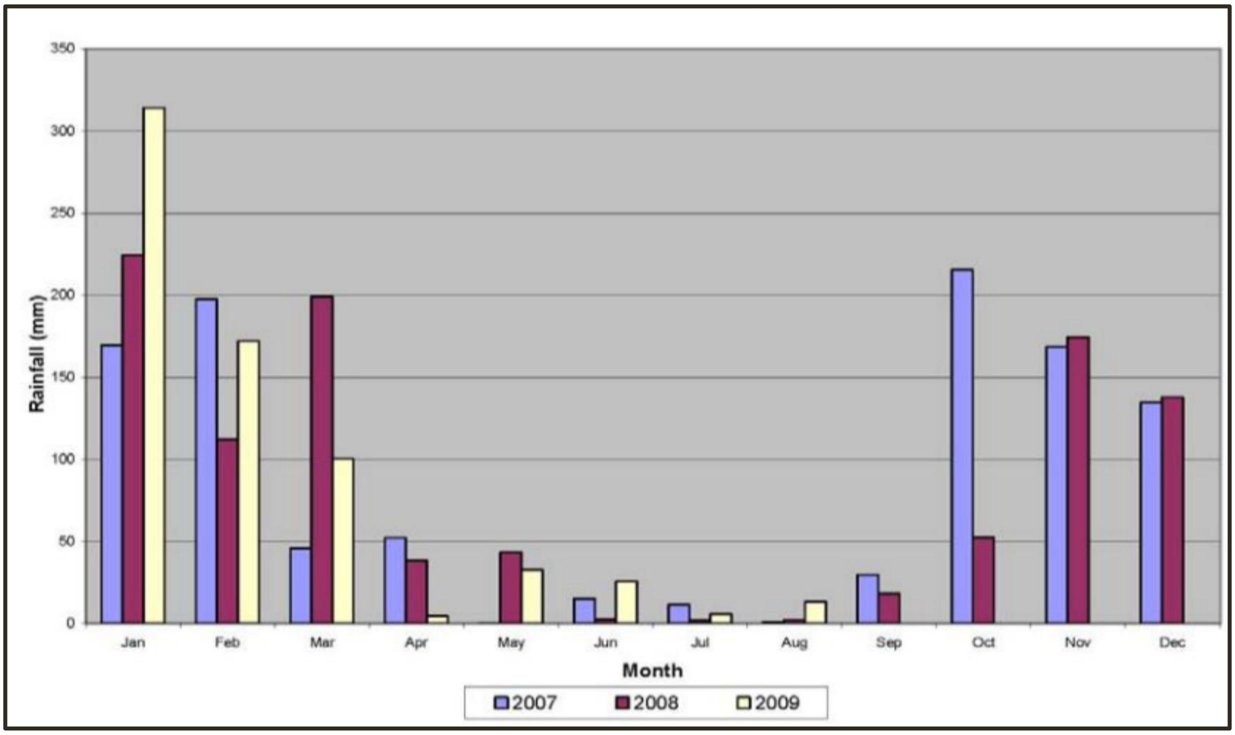


Figure 4-5: The average monthly rainfall for Rietvlei

4.1.4 Evaporation

Based on data provided by SA Explorer, the mean monthly evaporation for a Class "A" pan is shown in **Figure 4-6.**

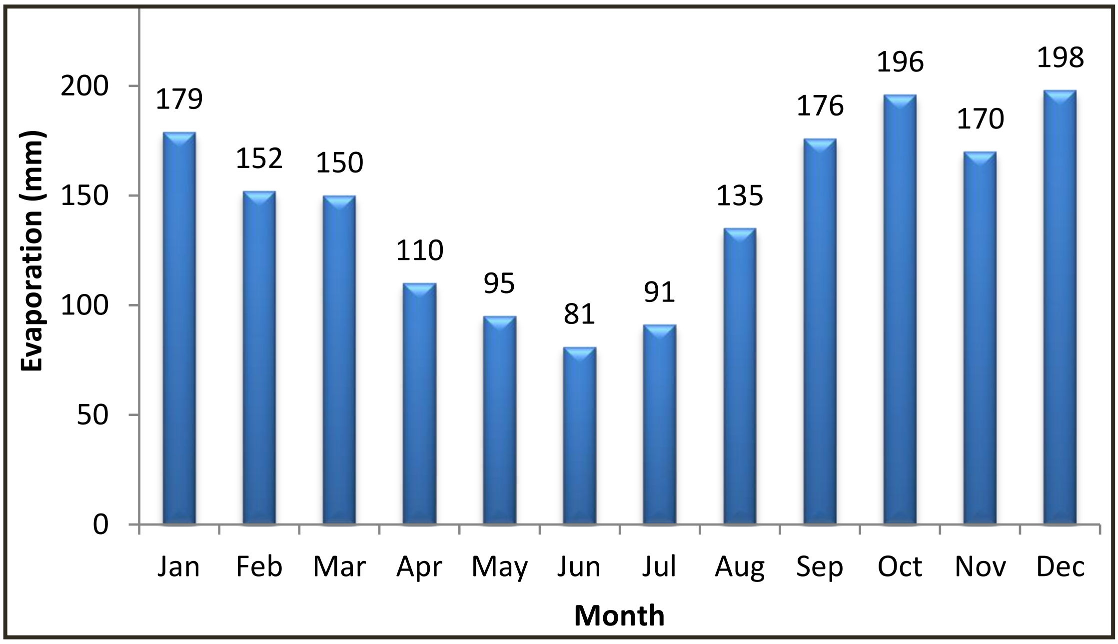


Figure 4-6: Average evaporation (SA Explorer)

4.2 Water Management Area Description

The mining footprint is located within the Olifants Water Management Area (WMA). The main river in the WMA is the Olifants River, of which the Doring River is the main tributary. Included in the WMA are number of small coastal rivers or water-courses to the north and south of the Olifants River estuary. The Olifants River originates in the Highveld of Mpumalanga and initially flows northwards before curving in an easterly direction through the Kruger National Park and into Mozambique.

The Olifants WMA falls within three provinces viz. Gauteng, Mpumalanga and the Limpopo provinces. For the purposes of discussing the potential issues and for developing WMA strategies, the DWS has divided the WMA into 4 sub-areas viz. the Upper Olifants, Middle Olifants, Steelpoort and Lower Olifants catchments (**Figure 4-7**).

The topography of the WMA is characterised in the southern part by gently rolling hills before the river cuts through the Drakensberg to enter the relatively featureless lowveld region. The rainfall is strongly seasonal occurring mainly in summer. The mean annual precipitation varies from 500 mm in the Lowveld region, reaching 1000 mm in the mountains and reducing to 700 mm in the south in the Mpumalanga Highveld. The potential evaporation is well in excess of the rainfall [refer to evaporation data inserted earlier in this section].

The Upper Olifants Sub-area is the most urbanised of the four sub-areas with the majority of the urban population located in Witbank and Middelburg. The population in these urban centres is projected to grow in the future. There is extensive coal mining activities in the sub-area both for export through Richards Bay and for use in the 6 active coal fired power stations in the sub-area. The presence of coal also led to the establishment of the steel manufacturing industries located in Middelburg and Witbank.

The scenarios for population growth show little if any increase in the rural areas beyond 2025. Economic growth and population increases are expected to be centred on the main industrial and mining towns of Witbank, Middelburg and Phalaborwa, as well as at new mining developments foreseen along the eastern limb of the Bushveld Igneous Complex in the Mogoto/Steelpoort area. Water requirements for power generation in the upper Olifants sub-area are also expected to increase. Water for mining developments in the Mokopane area (Limpopo water management area) may have to be supplied from the Olifants River.

Water quality is highly impacted upon by coal mining in the Upper Olifants sub-area. Special remedial measures have been implemented to control the discharge of mine leachate and wash-off to within the assimilative capacity of the natural streams. Priority attention will continue to be needed to contain pollution from mines, also after the discontinuation of operations. Further resource development through the construction of new infrastructure will be very expensive and is unlikely to be affordable by irrigation farming. Water for irrigation as a means of rural development and poverty relief will therefore have to be sourced largely through re-allocation from existing users.

With water resources in the Upper Olifants already fully developed and utilised, a growth in power generation requirements will have to be provided for by increased transfers of water. Water for new mining developments in the Middle Olifants and Steelpoort sub-areas can be provided by raising the Flag Boshielo Dam, the construction of a dam on the Steelpoort River, or from the proposed Rooipoort Dam.

4.3 Quaternary Catchment Description

The proposed mine is situated on the intersection of the B32B, B12E, B12D and B12C quaternary catchments (**Figure 4-8**) that form part of the upper and middle Olifants primary catchment area. **Table 4-2** provides general information concerning the affected quaternary catchments.

Table 4-2: General information - affected quaternary catchments

Catchment	B12D	B12E	B32B
Area (km²)	362.3	435.8	613.8
Mean annual runoff (mm/a)	38	53	51
Groundwater contribution to baseflow (mm/a)	7	18	16

Numerous farm dams and wetlands are situated along the drainage lines within these catchments. The quaternary catchments are characterised by a land use of mainly agriculture, with blue gum plantations as the main agricultural activity. The general topographic elevations of the catchments range between 1043 m and 1831m above sea level (**Figure 4-9**). In addition, variously sized pans and wetland features are irregularly spaced on the higher lying areas within these catchments. During the rainy season (October to March), the pans hold water, but are usually dry in winter (April to September).

4.3.1 B12C Quaternary Catchment

According to the ecological importance classification for the quaternary catchment, the system can be classified as a Moderately Sensitive system which, in its present state, can be considered a Class B (Largely natural) stream. The points below summarise the impacts on the aquatic resources in the quaternary catchment B12C. The aquatic resources within this quaternary catchment have been moderately affected by bed modification.

- Moderate flow modifications occur within the quaternary catchment.
- High impacts have occurred as a result of introduced aquatic biota such as *Labeo umbratus.*
- Impact due to inundation, is high.
- Riparian zones and stream bank conditions are considered to be moderately impacted due to erosion and some exotics.
- An impact on the aquatic community, due to altered water quality (high Total Dissolved Solids (TDS) and sulphates), is deemed to affect the catchment to a moderate degree.

In terms of ecological functions, importance and sensitivity, the following points summarise the conditions in this catchment:

- The riverine systems in this catchment have a moderately low diversity of habitat types, limiting the ecological sensitivity and importance of the resources in the area.
- The quaternary catchment has a no importance in terms of conservation.
- The quaternary catchment has a moderate sensitivity to flow and flow related water quality with special mention of the fish species *Amphilius uranoscopus*, *Chiloglanis pretoriae* and invertebrates.
- The quaternary catchment is regarded as having no importance for rare and endangered species conservation.

- The quaternary catchment is considered of a low importance in terms of provision of migration routes in the in-stream and riparian environments.
- The quaternary catchment has a marginal importance in terms of providing refuge for aquatic community members.
- The quaternary catchment can be considered to have a moderate sensitivity to changes in water quality and flow due to many riffles.
- The quaternary catchment is of moderate importance in terms of species richness.
- The quaternary catchment is of no importance in terms of endemic and isolated species.

4.3.2 B12D Quaternary Catchment

According to the ecological importance classification for the quaternary catchment, the system can be classified as a Moderately Sensitive system which, in its present state, can be considered a Class C (Moderately modified) stream. The points below summarise the impacts on the aquatic resources in the quaternary catchment B20D:

- The aquatic resources within this quaternary catchment have been affected by bed modification (town influence).
- Moderate flow modifications occur within the quaternary catchment due to the influence of the Middelburg and Pienaars dam.
- Significant impacts have occurred as a result of introduced aquatic biota such as *Labeo umbratus, Micropterus salmoides, Micropterus dolomieu*, and *Cyprinus carpio.*
- Impact due to inundation is moderate.
- Riparian zones and stream bank conditions are considered to be moderately low impacted due to populations of *Acacia mearnsii*.
- An impact on the aquatic community, due to altered water quality from farming, towns and other industries, is deemed to affect the catchment to a moderately low degree.

In terms of ecological functions, importance and sensitivity, the following points summarise the conditions in this catchment:

- The riverine systems in this catchment have a moderately low diversity of habitat types, limiting the ecological sensitivity and importance of the resources in the area.
- The quaternary catchment has a low importance in terms of conservation.
- The quaternary catchment has a moderate flow and flow related water quality and would be suitable for *Amphilius uranoscopus* and *Chiloglanis pretoriae* species below the town area.
- The quaternary catchment is regarded as having no importance for rare and endangered species conservation.
- The quaternary catchment is considered of very low importance in terms of provision of migration routes in the in-stream and riparian environments.
- The quaternary catchment has a low importance in terms of providing refuge for aquatic community members.
- The quaternary catchment can be considered to have a moderately low sensitivity to changes in water quality and flow.
- The quaternary catchment is of low importance in terms of species richness.
- The quaternary catchment is of no importance in terms of endemic and isolated species.

4.3.3 B12E Quaternary Catchment

According to the ecological importance classification for the quaternary catchment, the system can be classified as a Moderately Sensitive system which, in its present state, can be considered a Class B (Largely natural) stream. The points below summarise the impacts on the aquatic resources in the quaternary catchment B12E.

- The aquatic resources within this quaternary catchment have been highly affected by bed modification.
- Moderate flow modifications occur within the quaternary catchment.
- Medium to high impacts have occurred as a result of introduced aquatic biota such as *Labeo umbratus* and *Micropterus dolomieu.*
- Impact due to inundation, is high.
- Riparian zones and stream bank conditions are considered to be moderately impacted due to erosion and some *Acacia mearnsii.*

An impact on the aquatic community, due to altered water quality, is deemed to affect the catchment to a moderate degree. In terms of ecological functions, importance and sensitivity, the following points summarise the conditions in this catchment:

- The riverine systems in this catchment have a moderately high diversity of habitat types.
- The quaternary catchment has a low importance in terms of conservation.
- The quaternary catchment has a moderate flow and flow related water quality for *Amphilius uranoscopus, Chiloglanis pretoriae.*
- The quaternary catchment is regarded as having no importance for rare and endangered species conservation.
- The quaternary catchment is considered of a moderately high importance in terms of provision of migratory routes in the in-stream and riparian environments.
- The quaternary catchment has a marginal importance in terms of providing refuge for aquatic community members.
- The quaternary catchment can be considered to have a moderate sensitivity to changes in water quality and flow.
- The quaternary catchment is of moderate importance in terms of species richness.
- The quaternary catchment is of no importance in terms of endemic and isolated species.

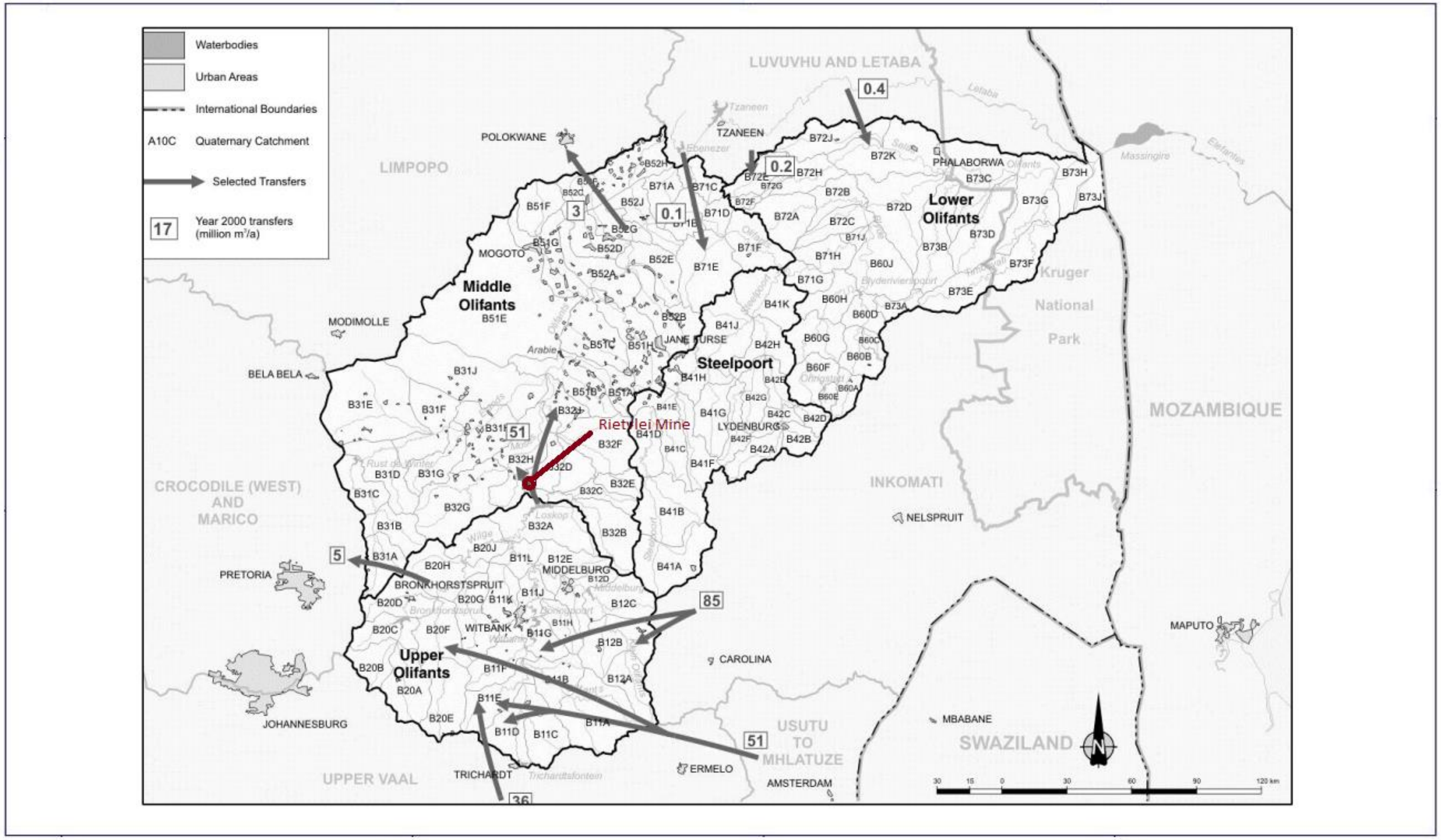
4.3.4 B32B Quaternary Catchment

According to the ecological importance classification for the quaternary catchment, the system can be classified as a Moderately Sensitive system which, in its present state, can be considered a Class B (Largely natural) stream. The points below summarise the impacts on the aquatic resources in the quaternary catchment B32B:

- The aquatic resources within this quaternary catchment have been moderately affected by bed modification due to sedimentation.
- Moderately low flow modifications occur within the quaternary catchment due to irrigation.
- High levels of impact have occurred as a result of introduced aquatic biota such as *Cyprinus carpio* and *Micropterus salmoides.*
- Impact due to inundation, is moderately high due to weirs.
- Riparian zones and stream bank conditions are considered to be moderately impacted due to cultivated lands and exotic encroachment such as *Acacia mearnsii*, and *Melia azedarach.*
- An impact on the aquatic community, due to altered water quality, is deemed to affect the catchment to a medium degree.

In terms of ecological functions, importance and sensitivity, the following points summarise the conditions in this catchment:

- The riverine systems in this catchment have a moderately low diversity of habitat types, limiting the ecological sensitivity and importance of the resources in the area.
- The quaternary catchment has a low importance in terms of conservation.
- The aquatic biota in the quaternary catchment has a high flow and flow related water quality with special mention of *Chiloglanis pretoriae.*
- The quaternary catchment is regarded as having no importance for rare and endangered species conservation.
- The quaternary catchment is considered of a moderate importance in terms of provision of migration routes in the in-stream and riparian environments.
- The quaternary catchment has a marginal importance in terms of providing refuge for aquatic community members.
- The quaternary catchment can be considered to have a high sensitivity to changes in water quality and flow.
- The quaternary catchment is of moderate importance in terms of species richness.
- The quaternary catchment is of no importance in terms of endemic and isolated species.



Olifants WMA	Data Source: Dispersion model used: XXXX v.xx.xx; Scenario XX - Title of Scenario; Maximum Concentration: xxxx ug.m⁻³; Dispersion Grid Size: xx km²	Project: Rietvlei IWWMP	Date: 2015/01/27	WSP www.wspenvironmental.co.za
		Project No: 42030		
		Drawn by: Claire Dendy		
	Projection TM Lo29 (WGS 84)	Reviewed by: Anri Scheepers		

Figure 4-7: Olifants WMA

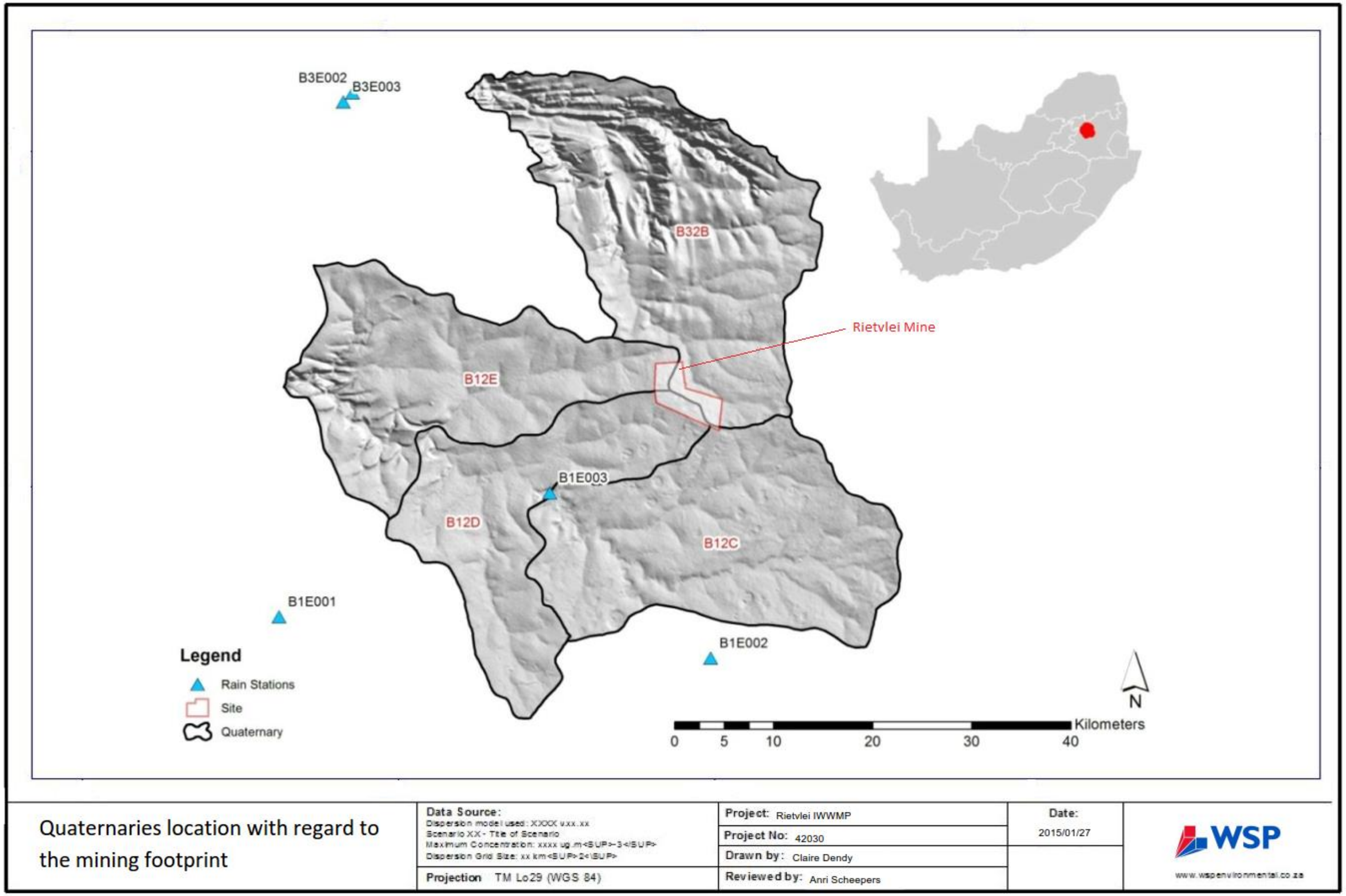


Figure 4-8: Quaternaries location with regard to the mining footprint

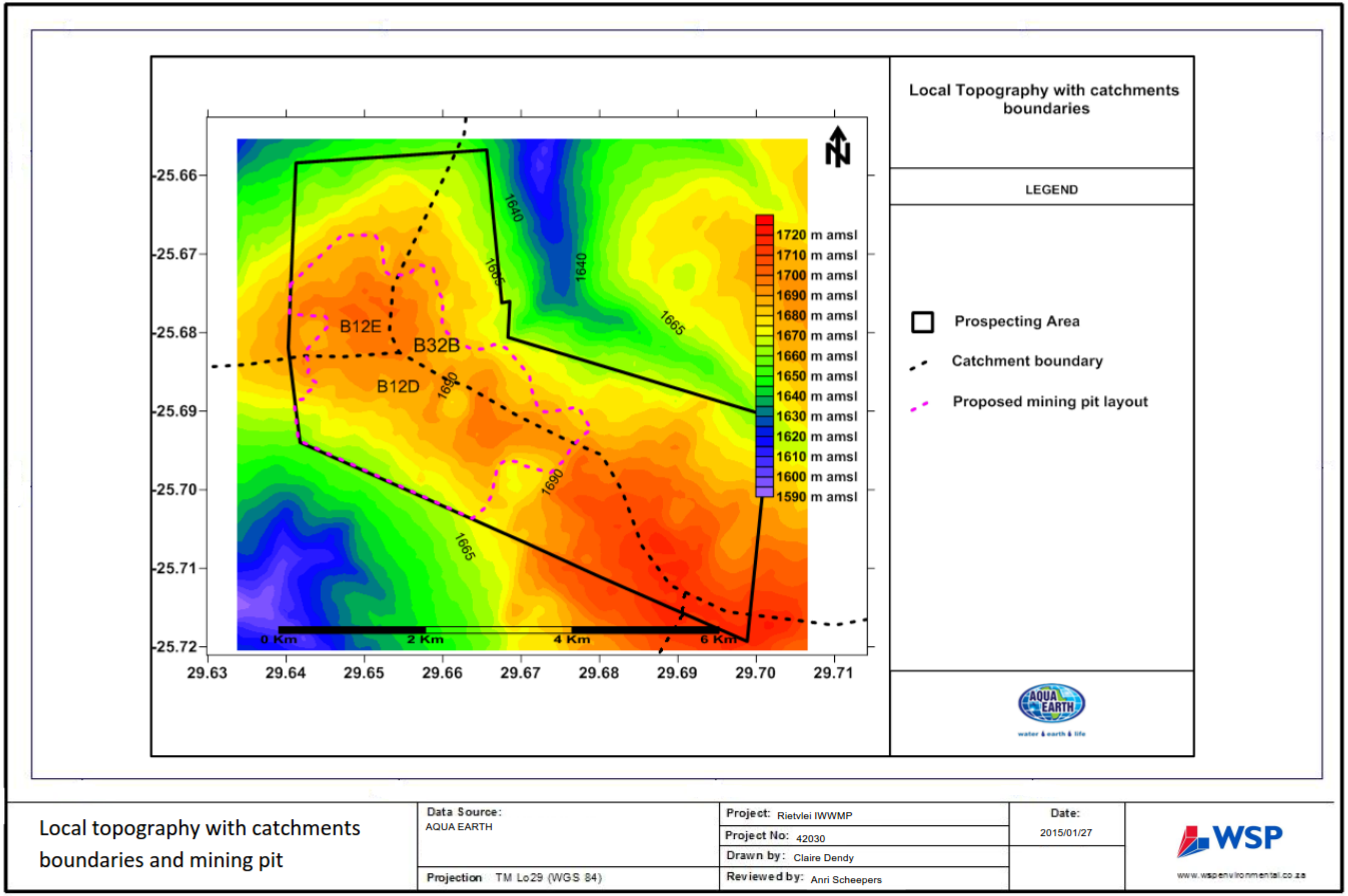


Figure 4-9: Local topography with catchments boundaries and mining pit (AquaEarth, 2014)

4.4 Aquatic Ecological

The aquatic ecological description was obtained from the Faunal, Floral, Wetland and Aquatic Assessment as Part of the Environmental Assessment and Authorisation Process for the Proposed Rietvlei Colliery, Middelburg, dated April 2014, undertaken by Scientific Aquatic Services, as attached in **Appendix 1**.

4.4.1 Visual Assessment

Table 4-3 summarises the observations for the various criteria made during the visual assessment undertaken at the aquatic assessment sites during October 2011 and January 2014. The description of the location of the assessment sites is provided in **Table 4-4**.

Table 4-3: Visual Assessment

 Upstream view of the Selons River site RV1 indicating the low flow at the time of assessment (2011).	 Downstream view of the Selons River site RV1 indicating bank side erosion (October 2011).
 Downstream view of the Selons River site RV2 near the R555 bridge (October 2011).	 Upstream view of the Selons River site RV2 (October 2011).

Upstream view of the Selons River site RV1 indicating the high flow at the time of assessment (2014).

Downstream view of the Selons River site RV1 indicating good vegetation cover on the right and bank side erosion on the left (January 2014).

Downstream view of the Selons River site RV2 near the R555 bridge indicating good vegetation (October 2014).

Upstream view of the Selons River site RV2 indicating high flow (January 2014).

Table 4-4: Description of the Location of the Assessment Sites in the Subject Property

Site	RV1 (US)	RV2 (DS
Upstream Features	Located upstream of the proposed Rietvlei Colliery on the Selons River with agricultural lands adjacent to the point.	Located downstream of the proposed Rietvlei Colliery on the Selons River.
Downstream Significance	The water downstream from this point along the Selons River feeds into a farmer's dam which most likely supplies water for irrigation and livestock consumption downstream of the site.	The Selons River downstream from this point joins the Olifants System. Downstream from this point the Selons River is most likely used for irrigation purposes.
Significance of the Point	The site serves as a reference point on the system prior to the proposed colliery development. Site serves as a spatial reference site for the RV2.	The site serves as a reference point on the system prior to the proposed colliery development
Riparian Zone Characteristics	Upstream of the assessment point the riparian zone runs through a relatively valley with a relatively gradual gradient. The stream bed alternates between pools and runs.	Upstream of the assessment point the riparian zone runs through a valley with a relatively gradual gradient.
Algal Presence	Low flow conditions indicated no algal presence (2011). Limited algal proliferation was evident at the high flow (2014) period indicating that limited addition of nutrients to the system is likely to be occurring at	Low flow conditions indicated no algal presence (2011). Under the high flow (2014)survey period, algal proliferation was evident indicating that upstream agricultural areas are possibly leading to the eutrophication of the system.

Site	RV1 (US)	RV2 (DS
	that period.	
Visual indication of an impact on aquatic fauna	None observed although upstream water abstraction and impoundment may affect the ecology of the system.	Upstream water abstraction and impoundment of the Selons River system for agricultural purposes was observed and may affect the ecology of the system.
Depth Characteristics	The system had limited depth diversity with most areas being on average 0.5m deep. Some deeper pools were observed with runs and glides formed within the system under the current flow conditions.	The system had limited depth diversity with most areas being on average 0.5m deep. Some deeper pools were observed.
Flow condition	Under the low flow conditions (2011), there is limited flow present and the flow can be regarded as slow to still throughout the system. The habitat conditions present provide limited habitats for aquatic macro-invertebrates and fish and some species requiring very fast flowing water are likely to be absent from the system. January 2014 site survey included high flow conditions. The habitat conditions during 2014 provided suitable habitat for aquatic macro-invertebrates and fish species.	Under the relatively low flow conditions (2011), there is limited flow present and the flow can be regarded as slow throughout the system. The habitat conditions present provide a fair range of habitats for aquatic macro-invertebrates and fish but some species requiring very fast flowing water are likely to be absent from the system. January 2014 site survey included high flow conditions. Habitat conditions during 2014high flow season provided suitable habitat for aquatic macro-invertebrates and fish species.
Water Clarity	Water is slightly silted.	Water is slightly silted.
Water Odour	No odours were evident.	No odours were evident.
Erosion potential	High potential for erosion is present, due to the poorly vegetated banks.	Some potential for erosion is present, especially under high flow conditions, however the banks are fairly well vegetated.

4.4.2 Physico-Chemical Water Quality

Table 4-5 reflects the biota specific water quality for the two assessment sites. In general the water quality can be considered fair although it is evident that dissolved salts are elevated in the region and there is some variability in salt concentrations between the two assessment sites. It is evident that the electrical conductivity (EC) between the two assessment sites on the Selons River during 2011 and 2014 indicate that salinization of the upper catchment is likely to be occurring, most likely as a result of agricultural activities in the area. The pH may be considered natural and no impact on the aquatic ecology of the system is deemed likely at the current time and for the 2011 site survey period. The dissolved oxygen (DO) concentration is acceptable and can be regarded as suitable for supporting a diverse and sensitive aquatic community. Temperatures can be regarded as normal for the time of year and time of day when assessment took place.

Table 4-5: Biota specific water quality data along the Selons River

Site	Year	Electrical Conductivity (EC) (mS/m)	pH	Dissolved Oxygen (DO) (mg/l)	Temperature (°C)
RV1	2011	23.0	8.10	N/A	15.8
RV2	2011	17.8	8.80	N/A	16.5
RV1	2014	11.7	8.07	7.38	21.9
RV2	2014	10.9	7.94	6.55	28.1

4.4.3 Riparian Vegetation Response Assessment

The Riparian Vegetation Response Assessment Index (VEGRAI) is designed for qualitative assessment of the response of riparian vegetation to impacts in such a way that qualitative ratings translate into quantitative and defensible results (Kleynhans et al, 2007).

The results of this assessment indicate that both the upstream RV1 and downstream RV2 sites fall within an Ecological Category Class C (Kleynhans et al, 2007) for year 2011 and 2014, indicating a loss and change of natural habitat having occurred, but the basic ecosystem functions are still predominately unchanged (Kleynhans et al, 2007). The primary modifier to this system is likely to be the water quality and flow modification, due to the proximity to historical and current agricultural activities, that include livestock farming, which may contribute to the moderately modified vegetation in the system.

4.4.4 Invertebrate Habitat Integrity Assessment (IHIA)

It is important to assess the habitat of each site, in order to aid in the interpretation of the results of the community integrity assessments by taking habitat conditions and impacts into consideration. The general habitat integrity of the site should be discussed based on the application of the Intermediate Habitat Integrity Assessment for (Kemper; 1999). By calculating the mean of the instream and riparian Habitat Integrity scores, an overall Habitat Integrity score can be obtained for each site. This method describes the Present Ecological State (PES) of both the in-stream and riparian habitats of the site. The method classifies Habitat Integrity into one of six classes, ranging from unmodified/natural (Class A), to critically modified (Class F).

- **2011 IHIA summary**

  The RV1 site achieved an IHIA score of 49% while the RV2 site achieved a score of 54%. Based on the classification system of Kemper 1999 both sites have habitat conditions that can be described as largely modified (Class D), where a loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.

- **2014 IHIA summary**

  During the 2014 site survey, the two Selons River sites achieved an IHIA rating of 70% (RV1) and 72% (RV2), where an increase from class D to a class C was observed since the 2011 early spring late winter survey. Currently in 2014 the habitat is deemed moderately modified indicating a loss and change of natural habitat and biota, but the basic ecosystem functions are still predominantly unchanged (Kemper, 1999).

4.4.5 Aquatic Macro-Invertebrates Assessment (SASS5)

Aquatic Macro-invertebrates were sampled using the qualitative kick sampling method called SASS5 (South African Scoring System version 5) (Dickens and Graham, 2001). The results of this assessment can be summarised as follows:

- **2011**
  - During the early spring 2011 assessment, the two assessment sites can be considered as Class D (largely impaired) sites according to the Dickens and Graham (2001). With mostly tolerant taxa present.
  - According to Dallas (2007) classification systems the upstream RV1 site and the downstream RV2 sire are classed a Class E/F (severely/critically impaired). This is due to the naturally limited habitat that is available and the lack of flow in the river at the time of assessment (early spring 2011).
  - Based on the available habitat conditions with special mention of the lack of flow and the lack of bankside vegetation cover, the poor aquatic macro-invertebrate community score in the system is most likely due to the limited availability of natural habitat at the RV1 and RV2 sites.

- **2014**
  - During the early 2014 assessment, the two assessment sites can be considered as Class D (largely impaired) sites according to the Dickens and Graham (2001).

- According to Dallas (2007) classification systems both upstream RV1 site and downstream RV2 sites are classed a Class E/F (severely/critically impaired). Even with an increase in flow these classifications have remained the same since the 2011 site survey at both sites.
- Based on the available habitat conditions the poor aquatic macro-invertebrate community score in the system is most likely due to the limited availability of natural habitat at the RV1 and RV2 sites.

4.4.6 Aquatic Macro-Invertebrates Assessment (MIRAI)

The Macro-invertebrate Response Assessment Index (MIRAI) provides an approach to deriving and interpreting aquatic invertebrate response to driver changes. The index has been applied to the aquatic sites following methodology described by Thirion (2007). Aquatic macro-invertebrates expected at each point were derived both from previous studies of rivers near the area as well as habitat, flow and water parameters (Thirion 2007).

The MIRAI results (in terms of Ecological Category classification) follow similar trends as those obtained using the SASS class classifications. The PES obtained from the application of MIRAI (Thirion, 2007) were as follows; for 2011 RV1 was a class D (41%) and RV2 class D (43%). During the 2014 site survey, RV1 was a class D (45%) and RV2 a class D (47%). The overall general deterioration in terms of macro-invertebrate community integrity is clearly evident throughout the two assessment sites along the Selons River at both low flow as well as the high flow periods. The MIRAI results confirm the SASS results for these sites.

4.4.7 Fish Community Integrity

During the 2011 early spring survey no fish were observed or captured at the RV1 or RV2 site on the Selons River during the survey period. Similarly no fish was observed or sampled within the non-perennial pans which occur within the site. Habitat Cover Rating (HCR) results for the two sites on the Selons River (RV1 and RV2) showed that the habitat conditions during this period were suited for slow flowing shallow and deep water species.

- The absence of fish in the system is indicative of long term impacts on the system, with special mention of loss of spawning habitat due to upstream and downstream migration barriers.
- Some limitations due to natural distribution patterns and constraints are also deemed highly possible.
- Instream modifications such as sedimentation and impacts from impoundments are considered to significantly impact on the fish community of the system and interfering with fish migrations along the rivers.
- Due to the limited integrity, diversity and sensitivity of the fish community, it is not deemed likely that any highly significant additional impacts on the fish community of the aquatic resources in the area due to the proposed mining operation will occur.

During the 2014 site survey period, the HCR results for the two sites on the Selons River (RV1 and RV2) are provided below:

- It is clear that shallow-fast conditions predominate in the Selons River system followed by deep-fast conditions. The fish expected in the area will therefore be limited to fish with high intolerance values for slow flowing water habitats and to a lesser degree species with a high intolerance value for shallow slow water habitats and water column cover.
- Electro-shocking for fish was conducted within the Selons River within a 100m radius upstream and downstream from the sites over a 20 to 30 minute period. Fish species that were caught were photographed and then released during the survey done within the Selons River sites.
- Along the upstream site RV1, *Clarias gariepinus* (Sharptooth Catfish) and *Barbus anoplus* (Chubbyhead barb) species were captured while at the downstream site RV2 *B. anoplus* and *Barbus neefi* (Sidespot barb) were identified in the catch.

4.5 Surface Water

The surface water description was obtained from the Rietvlei Colliery Surface Water Study, dated July 2014, undertaken by Aqua Earth Consulting, as attached in **Appendix 2**.

4.5.1 Surface Water Hydrology

The project area is located on the intersection of three quaternary catchments B12D, B12E and B32B, with a small part (0.255 km^2) of the prospect area falling under B12C. The landscape slopes gently towards the different streams and rivers. The surface run-off catchments with the associated local drainage are shown together with the mining layout in (**Figure 4-10**).

Rietvlei forms the headwaters of:

- The Olifants River in B12D: A number of small sized dams intercept the South-West furrows that feed into Olifants River;
- The Selons River in B32B which flows North-West into Olifants River; and
- The Keerom stream (B12E) which flows West-West-South into Olifants River; number of small sized dams intercept the South-West furrows (**Figure 18**) that feed into Keerom stream.

Based on the main drainage lines, specific flow accumulation criteria and rain gauge and flow gauge data, the B32B catchment is considered to be the main catchment of impact. As a result the B32B catchment was delineated into Hydrological Response Units (HRU) or model entities as shown in **Figure 4-11**. Based on the analysis of a surface run-off model it has been determined that the only hydrological response units (HRU) that will be affected by the mine will be HRU10, as indicated in **Figure 4-11**. The model also indicated that storm water runoff outside of HRU10 will not have an effect on any of the other catchment areas.

4.5.2 Surface Water Quality

A surface water quality investigation of the Selons River was undertaken as part of the baseline groundwater study (**Appendix 3**). The results indicated a relatively neutral pH (7.12 and 7.46) and low electrical conductivity values (11mS/m and 13mS/m). All the major and minor constituents analysed for fell within the recommended operational limits for drinking water (SANS 241; 2005) except for Aluminium, which exceeds the maximum allowable limit.

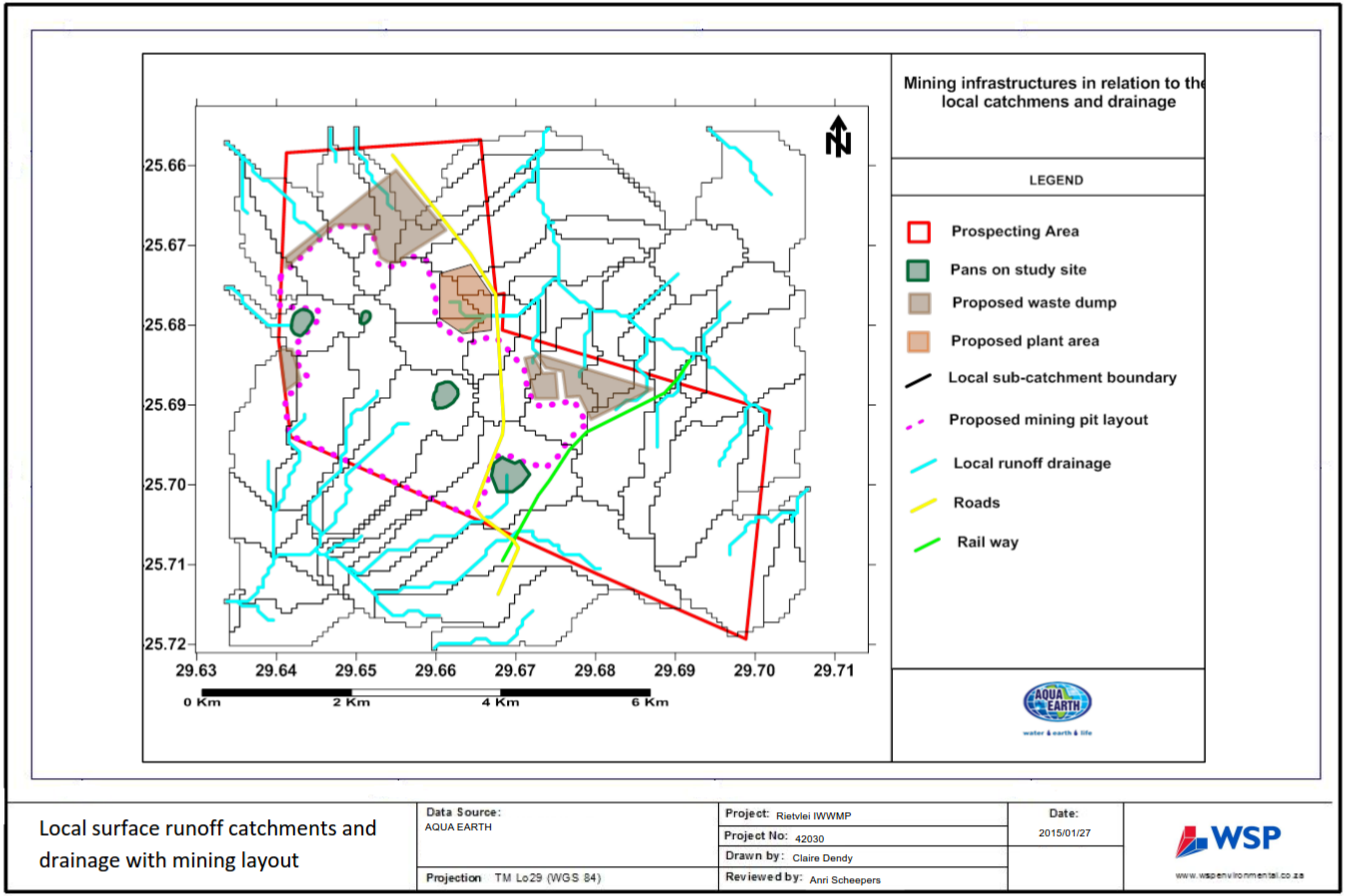
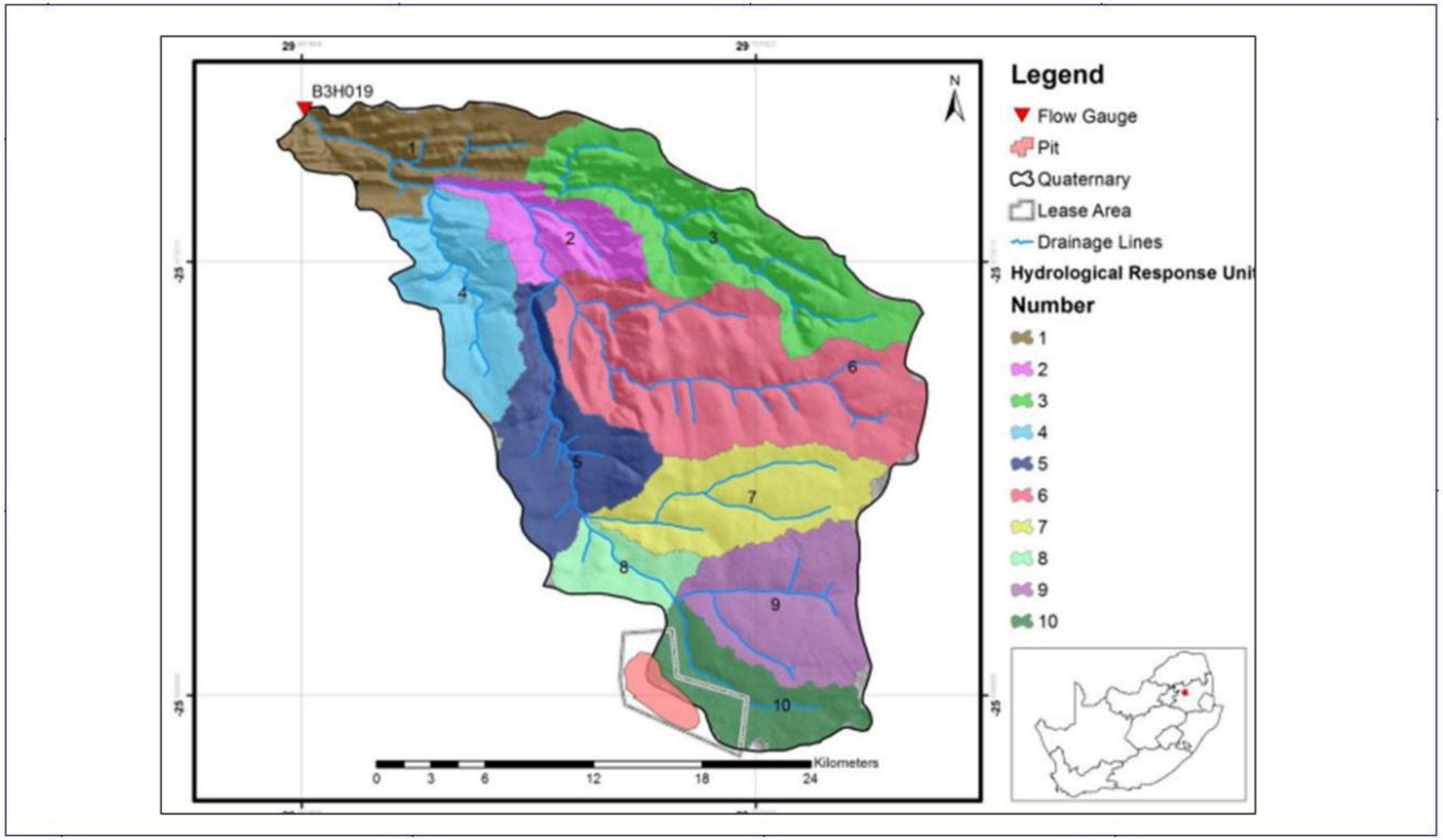


Figure 4-10: Local surface runoff catchments and drainage with mining layout (AquaEarth, 2014)



Delineation of hydrological response units	**Data Source:** Dispersion model used: XXXX v.xx.xx Scenario XX - Title of Scenario Maximum Concentration: xxxx ug.m⁻³ Dispersion Grid Size: xx km<SUP>2<\SUP>	**Project:** Rietvlei IWWMP **Project No:** 42030 **Drawn by:** Claire Dendy	**Date:** 2015/01/27
	Projection TM Lo29 (WGS 84)	**Reviewed by:** Anri Scheepers	

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Figure 4-11: Delineation of hydrological response units

4.5.3 Baseline Storm water Modelling

4.5.3.1 Regional surface water model results

The results of the regional surface water model compared to that of the Water Resources of South Africa 2005 (WRC Report No.: K5/1491) (WR2005) are shown in **Figure 4-13**, **Figure 4-14** and **Figure 4-15** for Outputs 1 to 3 as shown in **Figure 4-12**. Good comparison is obtained for both Output 2 and 3 over all ranges of flow. Output 1 has good calibration with peak flows which is important for storm water simulations, but shows a slightly weaker comparison for the low flow conditions.

The overall results compare very well to that of the WR2005 data in the absence of actual flow gauging data. If assumed that proper calibration was done in the WR2005 project then the regional surface water model can also be considered a well calibrated model. The catchment parameters are scaled down to site level to setup the local storm water model.

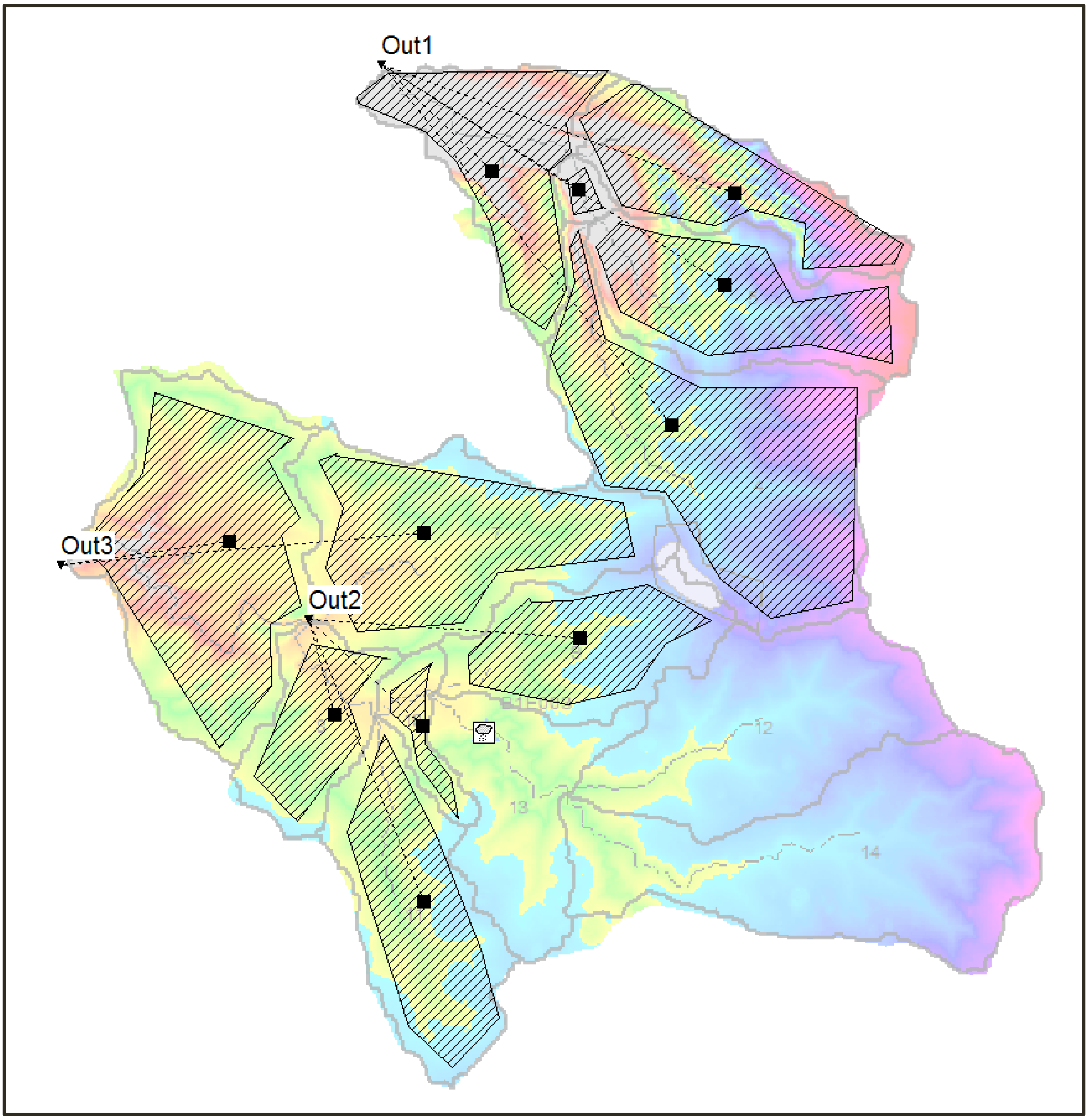

Figure 4-12: Regional Surface water Model Network (AquaEarth, 2014)

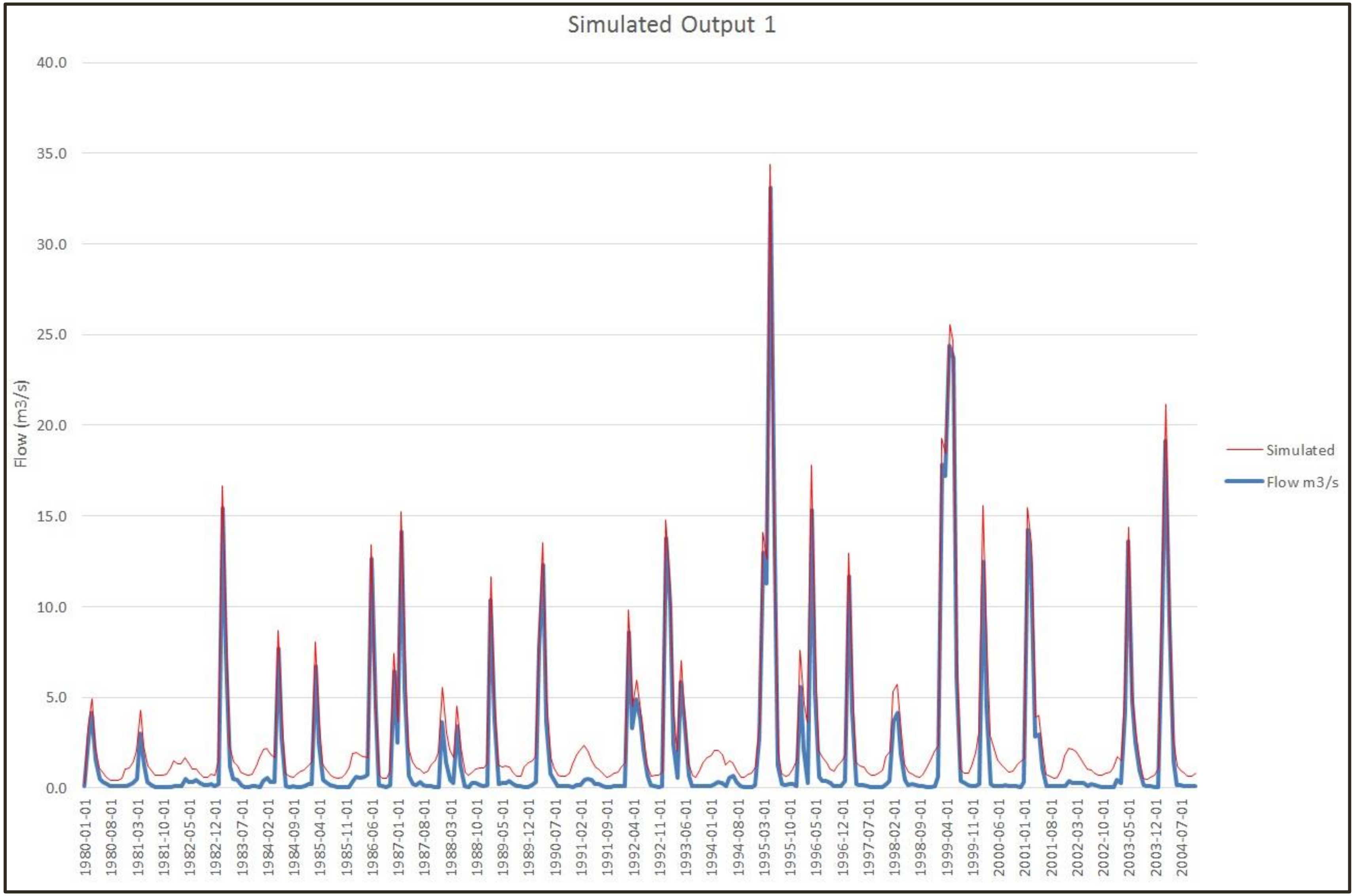

Figure 4-13: Simulated flow for Output 1 (AquaEarth, 2014)

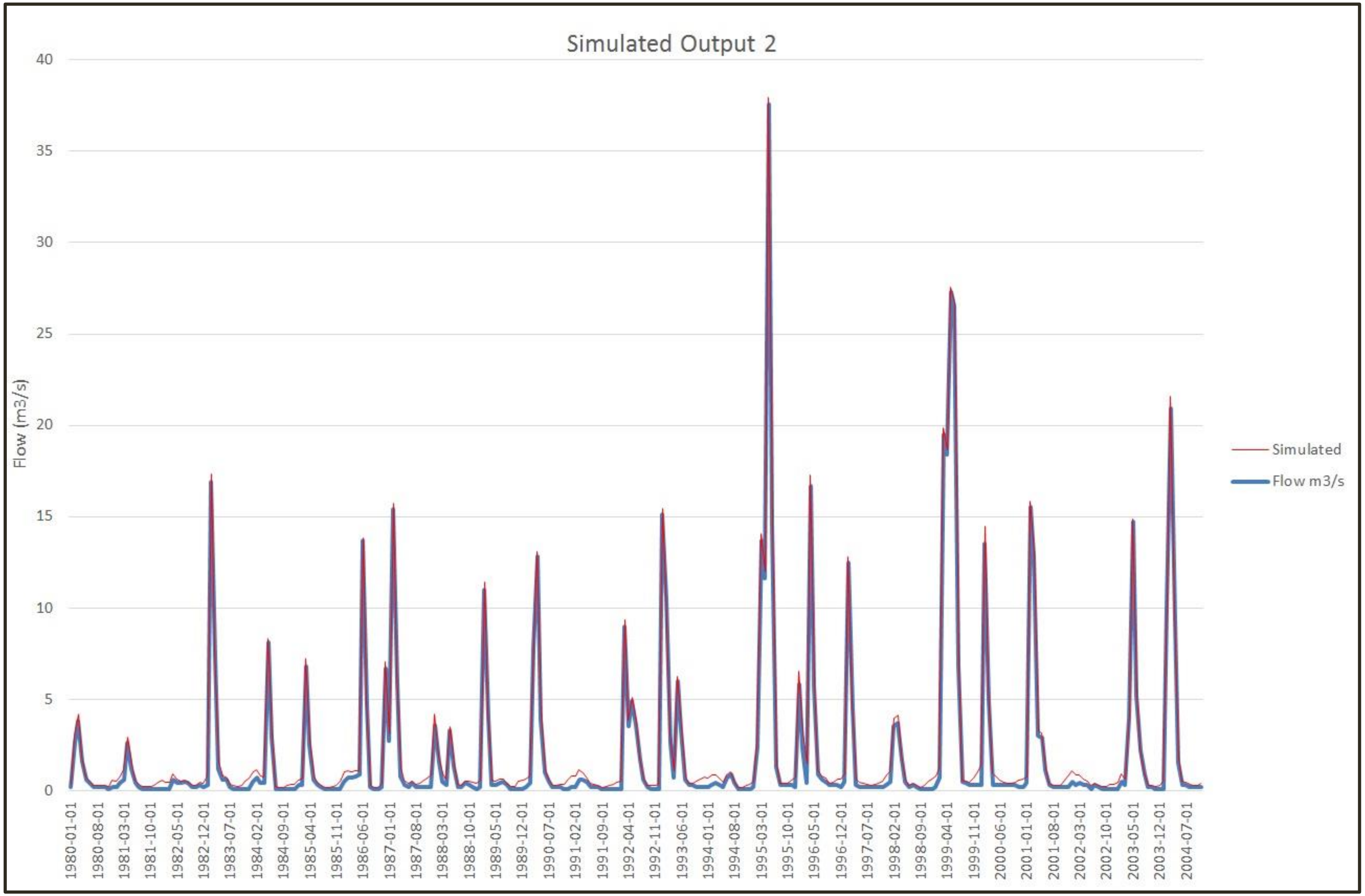

Figure 4-14: Simulated flow for Output 2 (AquaEarth, 2014)

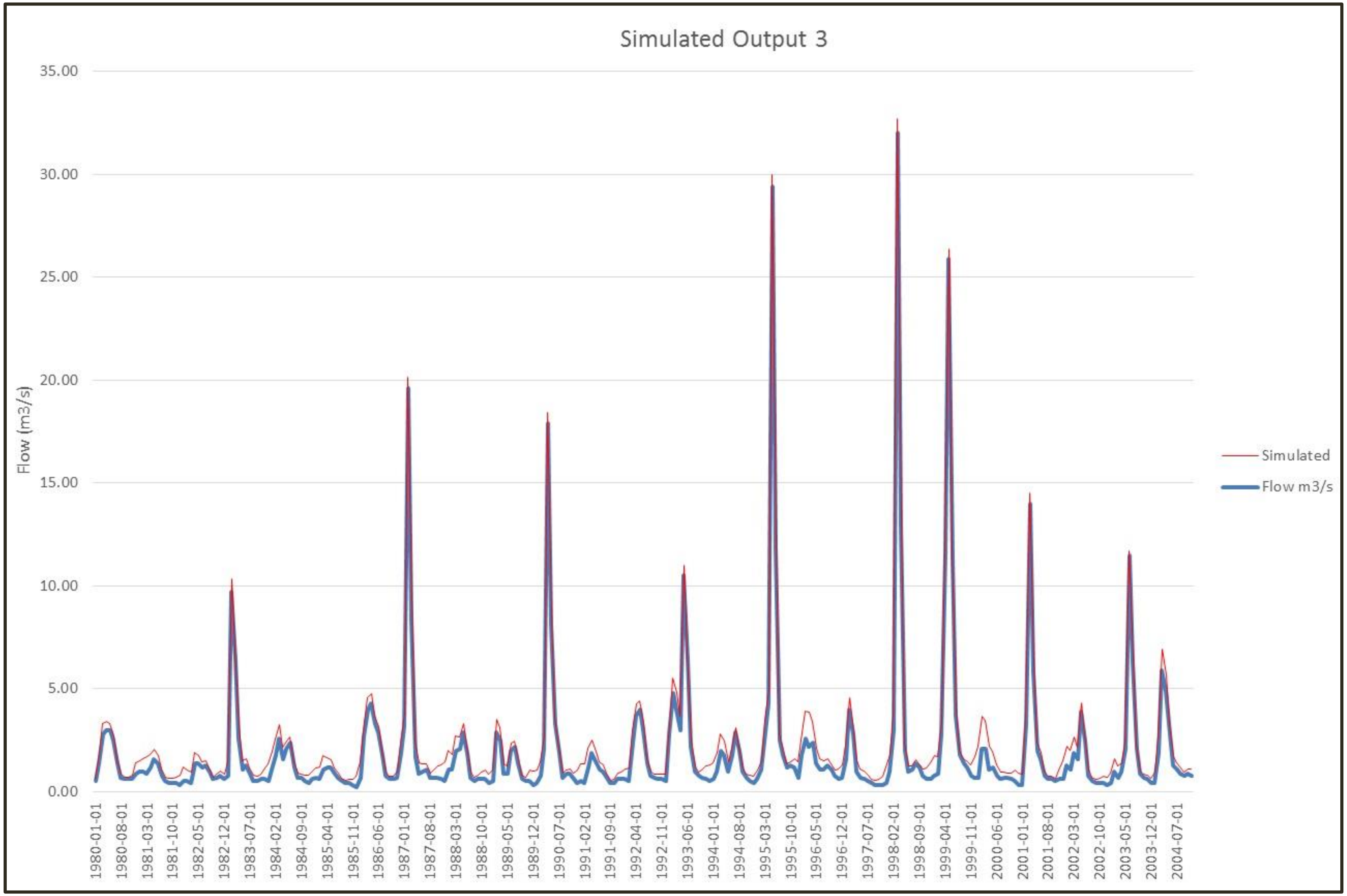

Figure 4-15: Simulated flow for Output 3 (AquaEarth, 2014)

4.5.3.2 Local Storm water Model Results

The simulated monthly averages for the clean and dirty water dams are presented in **Figure 4-16** and **Figure 4-17** respectively.

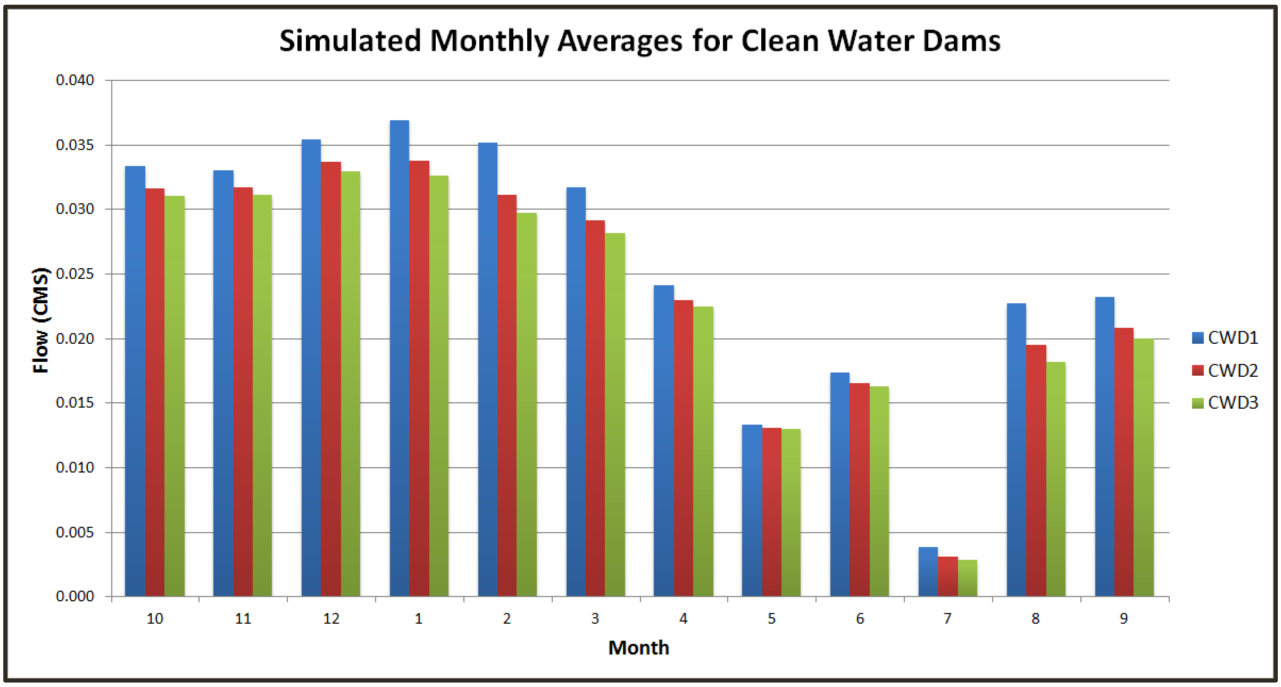

Figure 4-16: Simulated monthly averages for the clean water dams (AquaEarth, 2014)

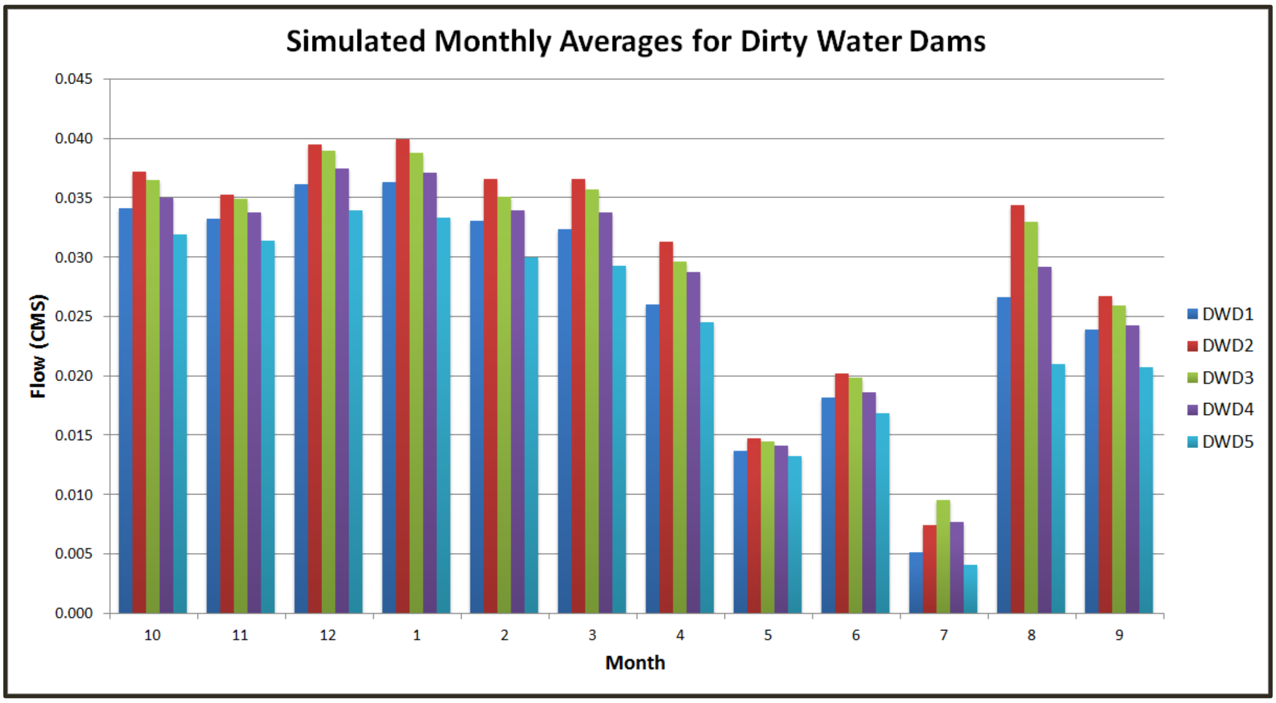

Figure 4-17: Simulated monthly averages for dirty water dams (AquaEarth, 2014)

A monthly comparison of the total clean water vs. the total dirty water is presented in **Figure 4-22** and the total clean water flow is an estimated 34% of all flow on the site as shown in **Figure 4-23**. Note that the total flow on the site presented here excludes the water to be pumped from the pit during operation.

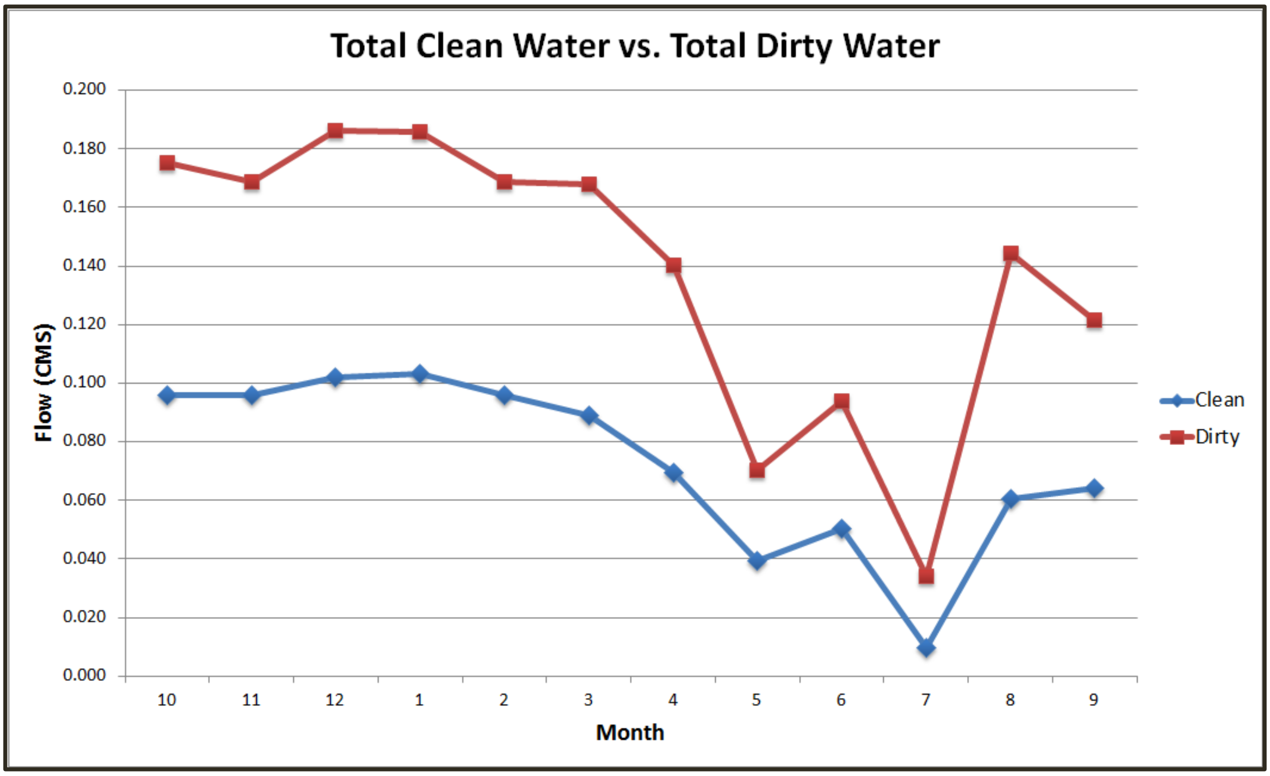

Figure 4-18: Total clean water vs. total dirty water on monthly basis (AquaEarth, 2014)

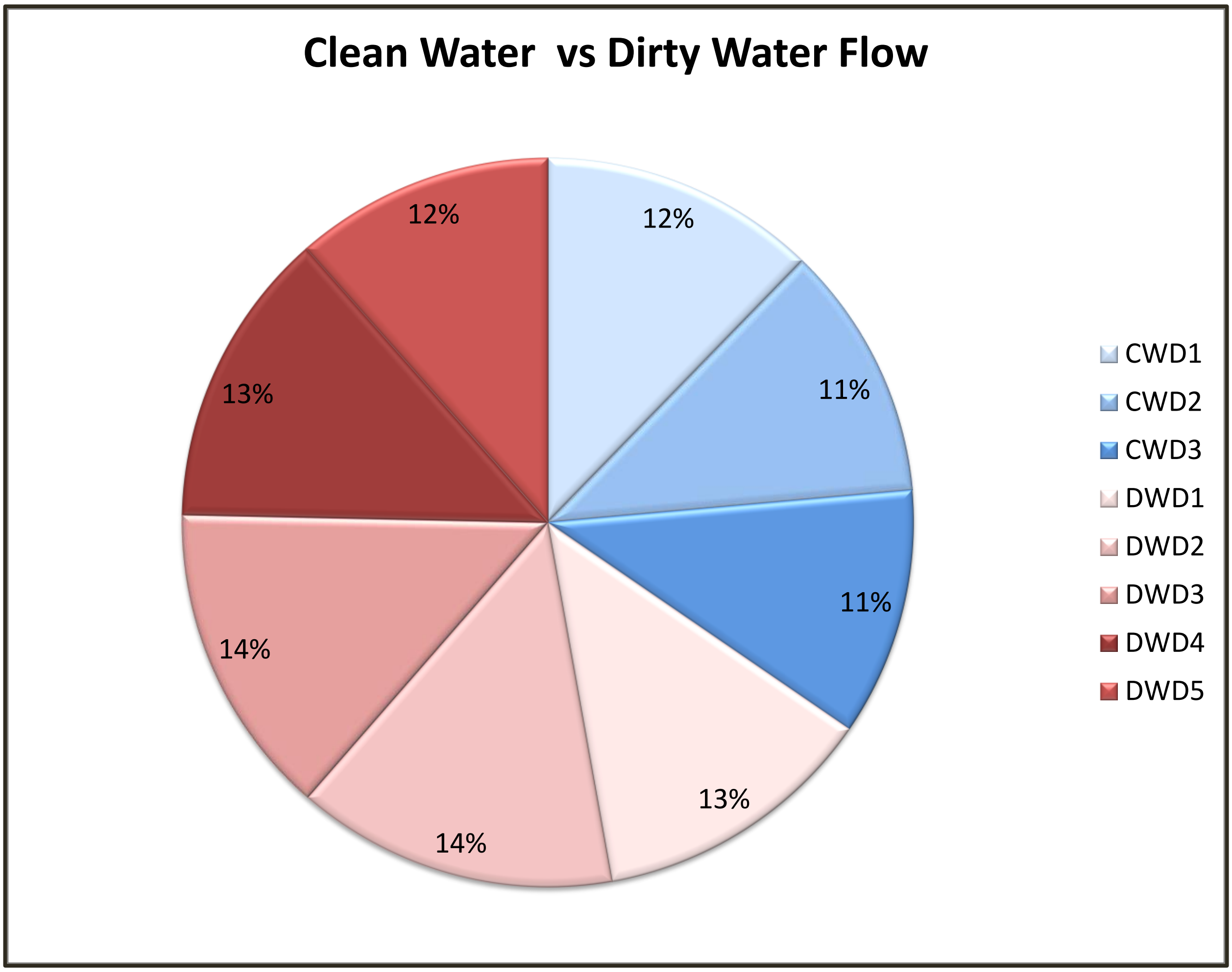

Figure 4-19: Contribution of flow to each dam (AquaEarth, 2014)

Assuming a general trapezoidal channel shape for all channels, the required sizes to contain peak flow are presented in **Table 4-6**. The individual dam sizes based on a dam with a maximum depth of 1 m that will contain the peak flow in the simulated rainfall records are presented in **Table 4-7**. The same evaporation sequences were applied to the storm water model as what was applied in the regional surface water model.

Table 4-6: Channel sizing based on generic trapezoidal shape (AquaEarth, 2014)

Canal to Dam	h(m) Based on peak flow
CWD 1	0.16
CWD 2	0.12
CWD 3	0.48
DWD 1	0.12
DWD 2	0.14
DWD 3	0.12
DWD 4	0.12
DWD 5	0.09

Table 4-7: Channel sizing based on generic trapezoidal shape (AquaEarth, 2014)

Dam	Volume (m^3)
CWD 1	140,000
CWD 2	55,000
CWD 3	35,000
DWD 1	50,000
DWD 2	82,000
DWD 3	60,000
DWD 4	44,000
DWD 5	18,000

4.5.3.3 Flood lines calculation results

A summary of the calculated flood peaks (using SCS-SA) per catchment is presented **Table 4-8**.

Table 4-8: Summary of flood peak calculations (m^3/s) (AquaEarth, 2014)

Catchment	Return Period (years)					
	1:2	1:5	1:10	1:20	1:50	1:100
1	4.43	7.52	9.96	12.60	16.39	19.52
2	7.61	12.89	17.07	21.55	28.00	33.32
3	3.35	5.78	7.73	9.84	12.89	15.43

The 1:100 year flood line is shown in **Figure 4-24**. The flood lines in relation to the infrastructure are shown in **Figure 4-21**. The flood line in catchment “3” (southern side of mine lease area) is running close to the pit. The flood line profile is broad in these areas because the natural channel is not well defined as it is situated on the watershed. Furthermore, the calculated flood peak is applied to the whole of the catchment resulting in an over estimation of the flood lines upstream. It is proposed to divert part of this water to clean water dam 3 (CWD3) through the use of a storm water channel.

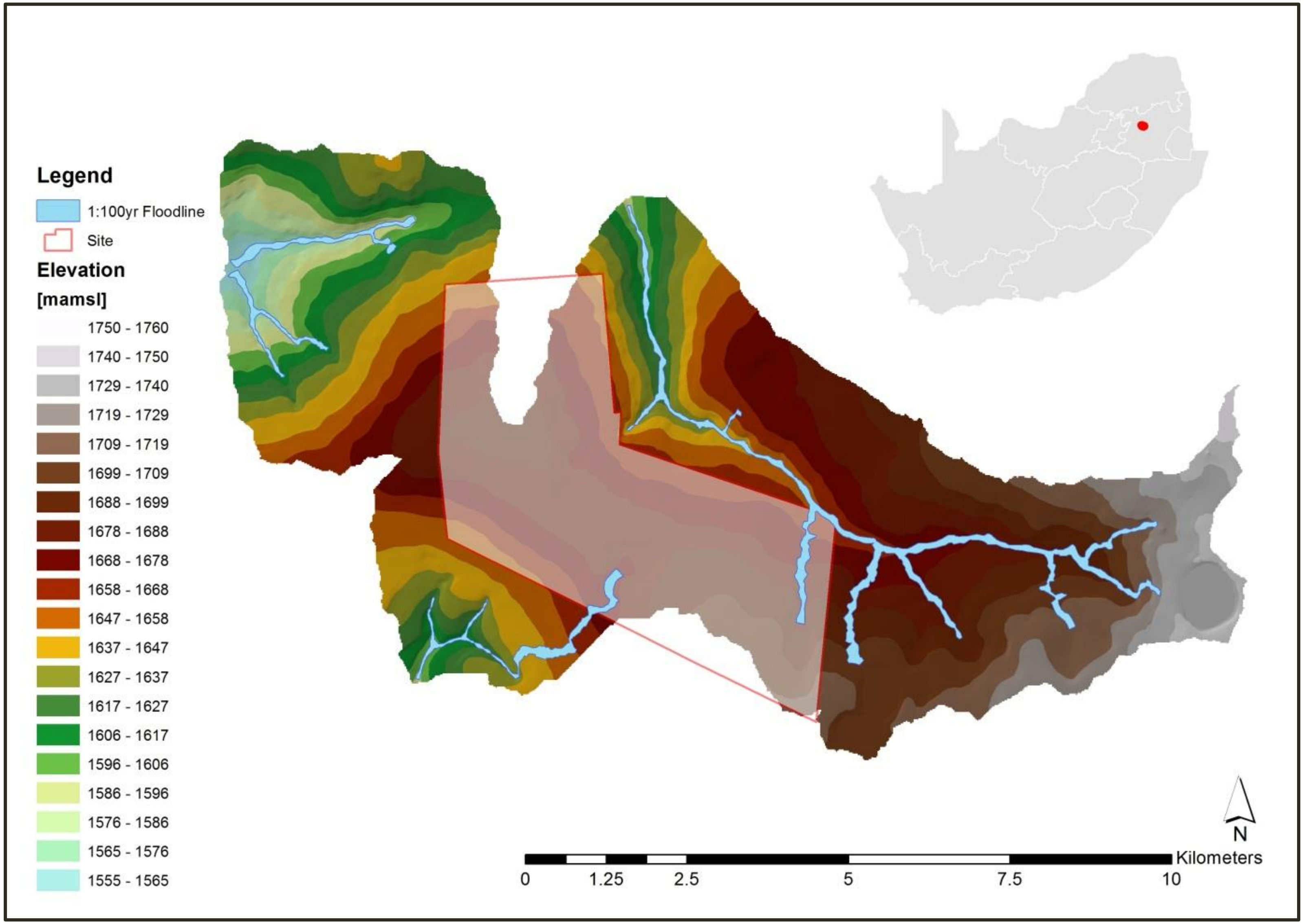

Figure 4-20: 1:100year flood line (AquaEarth, 2014)

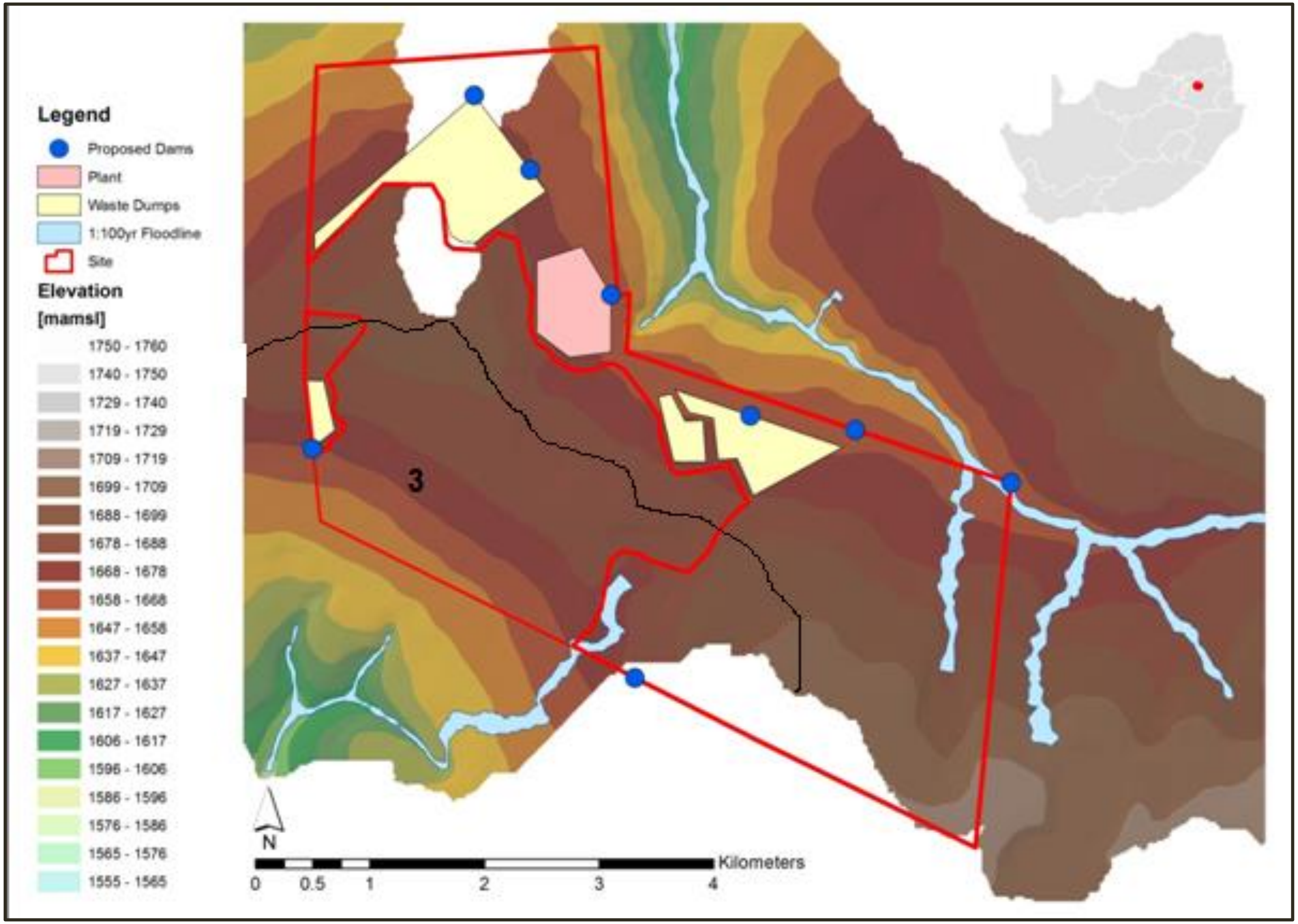

Figure 4-21: 1:100year flood line in relation to infrastructure (AquaEarth, 2014)

4.5.4 Wetland Resource Units

The proposed mining footprint interacts with several wetland systems (*viz.* 7 x wetlands and 6 x pans) (**Figure 4-22**). The variously sized pans and wetland features are irregularly spaced on the higher lying areas within the mine's footprint. The wetland systems have been delineated and the Present Ecological State (PES) determined as part of a wetland assessment (Refer to **Appendix 1**). A summary of the findings is presented below.

4.5.5 Wetland Classification Study

The wetland and pan features identified during the assessment were categorised according to the method provided by Ollis et al., (2013). The results of the classification, which show that the features were classified as an Inland system falling within the Highveld Ecoregion, are presented in **Table 4-9** and **Table 4-10** identifies the two broad wetland feature types, based on the levels of inundation observed in the systems.

Table 4-9 Classification system for the wetland features on the site

Wetland Feature Location	Level 1: System	Level 2: Regional Setting	Level 3: Landscape Unit	Level 4: Hydrogeomorphic (HGM) Unit / HGM Type
Rietvlei Mine	**Inland:** An ecosystem that has no existing connection to the ocean but which is inundated or saturated with water, either permanently or periodically	**Highveld Ecoregion:** The subject property falls within the Highveld Ecoregion **WetVeg Group:** Mesic Highveld Grassland Group 4	**Plain:** An extensive area of low relief. These areas are characterised by relatively level, gently undulating or uniformly sloping land with a very gently gradient that is not located in a valley	**Depression:** A landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates
			Valley floor: The base of a valley, situated between two distinct valley side-slopes	**Channelled valley-bottom wetland:** A valley-bottom wetland with a river channel running through it
			Bench (hilltop/saddle/shelf): An area of mostly level or nearly level high ground (relative to the broad surroundings)	**Wetland flat:** A level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench

Table 4-10: The two broad wetland feature types identified on the site

Wetland features with permanent zones of saturation (Permanent wetland)	Wetland features with no permanent zones of saturation (Seasonal Wetland)
Pan 1	Pan 4
Pan 2	Pan 5
Pan 3	Wetland 1
Pan 6	Wetland 2
Selons River	Wetland 3

Wetland features with permanent zones of saturation (Permanent wetland)	Wetland features with no permanent zones of saturation (Seasonal Wetland)
	Wetland 4
	Wetland 5
	Wetland 6
	Wetland 7

According to the National Freshwater Ecosystem Priority Areas (NFEPA) the pans were characterised as endorheic depression systems while the wetlands have been considered to be a flat seepage inland systems falling within the Highveld Ecoregion. The landscape setting of the wetland features are classified as a "plain; valley floor and bench". In addition, the wetlands hydro-geomorphic (HGM) units are classified as depressions, channelled valley bottoms and wetland flats. Further to this the wetlands and pans were further divided into two categories *viz*. wetland units with permanent zones of saturation and (permanent wetlands) and seasonal wetland units i.e. wetlands with no permanent zones of saturation (**Figure 4-22**).

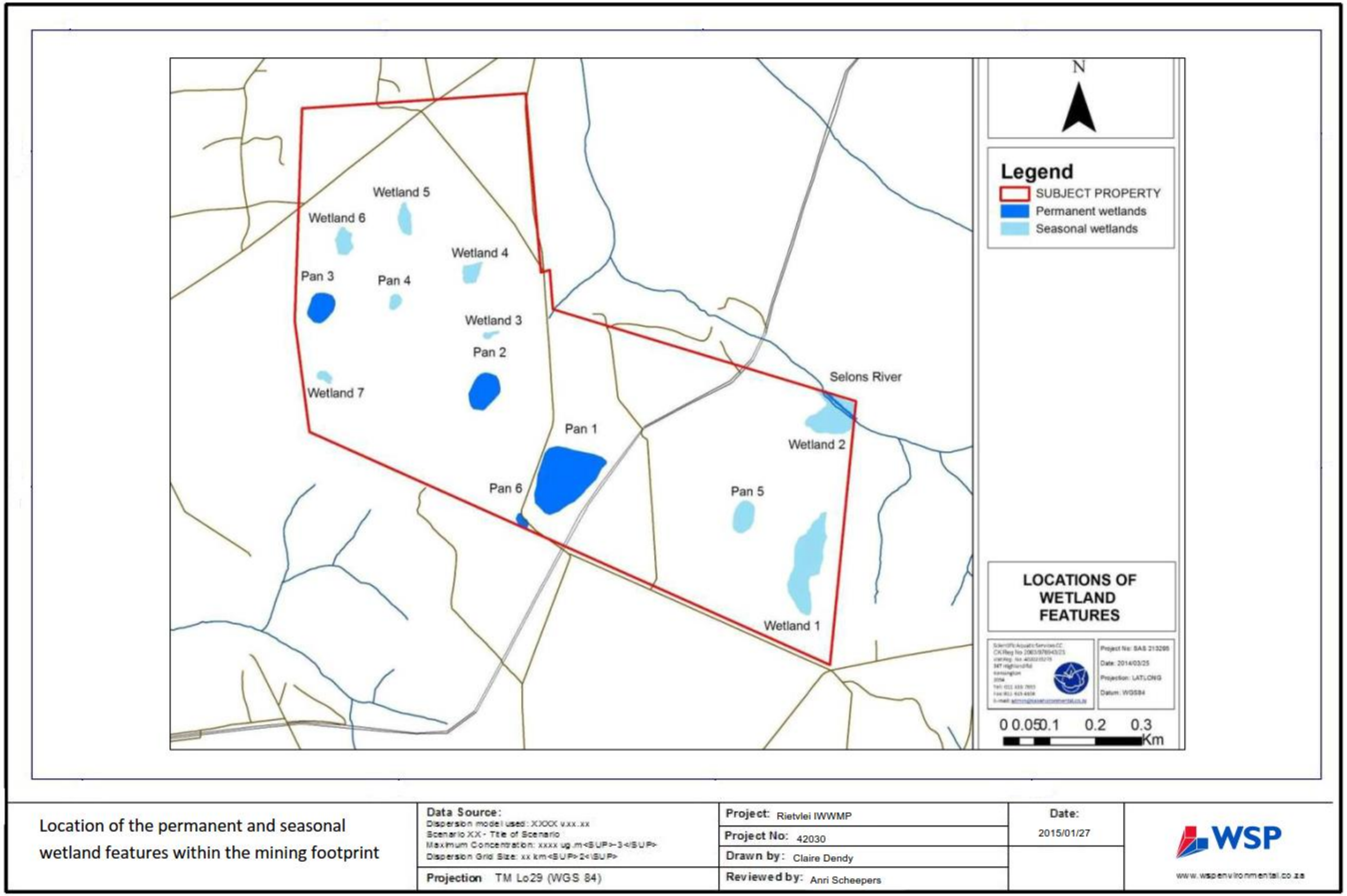

Figure 4-22: Location of the permanent and seasonal wetland features within the mining footprint (Scientific Aquatic Services, 2014)

4.5.5.1 Permanent Wetland Units

The Selons River was located on the north eastern corner of the subject property and pans 1, 2 & 3 are classified as National Fresh Ecosystem Priority Areas (NFEPA) wetlands, providing suitable habitat for avifaunal and aquatic species. Some transformation has occurred within these systems due to grazing of livestock and vegetation clearance resulting in erosion of the riverbanks.

4.5.5.2 Seasonal Wetland Units

The seasonal wetland features (Pan 4, 5 and Wetlands 1-7) within the mining footprint have a moderately low level of ecological function and service provision. Exotic and invader vegetation species occurred within the seasonal wetland features (Pan 4-5; Wetland 1-7). Although some alien encroachment occurred due to the adjacent plantation and agricultural activities, pockets of well-vegetated habitat still occur within these features and will allow flora and fauna species to occur.

These features are the most important in terms of nitrate assimilation. The results obtained were mainly due to, that all of the wetland features have no permanent zone of saturation and therefore display diffuse flow characteristics causing a seepage area to occur. Agricultural practises surround some parts of these wetlands, causing water and possibly fertilisers to wash off into the wetland sections. This increases the nutrient levels within the wetlands, thus lowering the water quality.

4.5.6 Wetland Functional Assessment

The wetland function and service provision assessment was undertaken which examined and rated the following services according to their degree of importance and the degree to which the service is provided within the wetland units:

- Flood attenuation;
- Stream flow regulation;
- Sediment trapping;
- Phosphate trapping ;
- Nitrate removal;
- Toxicant removal;
- Erosion control;
- Maintenance of biodiversity;
- Water supply for human use;
- Natural resources;
- Cultivated foods;
- Cultural significance;
- Tourism and recreation;
- Education and research; and,
- Carbon storage.

The characteristics were used to quantitatively determine the extension sensitivity of each wetland units. Each characteristic was scored to give the likelihood that the service is being provided in accordance to **Table 4-11.** The scores for each service were then averaged to give an overall score to the wetland unit.

Table 4-11: Classes for determining the likely extent to which a benefit is being supplied

Score	Rating of the likely extent to which the benefit is being supplied
<0.5	Low
0.6-1.2	Moderately low
1.3-2	Intermediate
2.1-3	Moderately high
>3	High

The average scores for the wetland feature are presented in **Table 4-12** below as well as the radar plot (**Figure 4-23** and **Figure 4-24**) in the figures that follow.

4.5.6.1 Permanent Wetland Units

The results of the functional assessment indicated that Pan 1 and the Selons River have an intermediate level of ecological function and service provision while Pan 2, 3 and 6 demonstrate a moderately low level of ecological function and service provision.

The pan features 1-3 and 6 have been identified as the most important in terms of carbon storage **Figure 4-23**. These results obtained were mainly due to these pan features having higher peat content and little soil disturbances, thus increasing the wetlands contribution to trapping carbon.

The overall scores obtained from the wetland ecoservices calculations, it was found that pan feature 1 and the Selons River was the most important in terms of services and function, therefore obtaining a higher service value than the Pans 2, 3 and 6.

Table 4-12: Wetland functions and service provision for permanent wetlands

EcoService	Wetland features with a permanent zone of saturation				
	Pan 1	**Pan 2**	**Pan 3**	**Pan 6**	**Selons River**
Flood Attenuation	0.8	0.9	0.8	0.7	1.2
Stream flow Regulation	0	0	0	0	2.4
Sediment Trapping	1	0.6	1.6	0.6	1
Phosphate Assimilation	1.9	1.6	1.6	1.6	1.6
Nitrate Assimilation	2.1	1.9	1.9	2	2.1
Toxicant Assimilation	2	1.9	1.8	1.8	1.9
Erosion Control	1.6	1.9	1.5	1.3	1.4
Carbon Storage	2.7	2.6	2.7	2.3	2
Biodiversity Maintenance	2.1	1.3	1.5	1.7	1.6
Water Supply	1.5	1.2	1.3	1.3	1.5
Harvestable Resources	1.2	0.6	0.6	0.8	0.6
Cultural Value	0	0	0	0	0
Cultivated Foods	1	0.6	0.6	0.8	0.6
Tourism and Recreation	0.75	0.5	0.5	0.4	0.5
Education and Research	1	0.8	0.5	0.8	0.8
Sum	**19.7**	**16.4**	**16.9**	**16.1**	**19.2**
Average Score	**1.3**	**1.1**	**1.1**	**1.1**	**1.3**

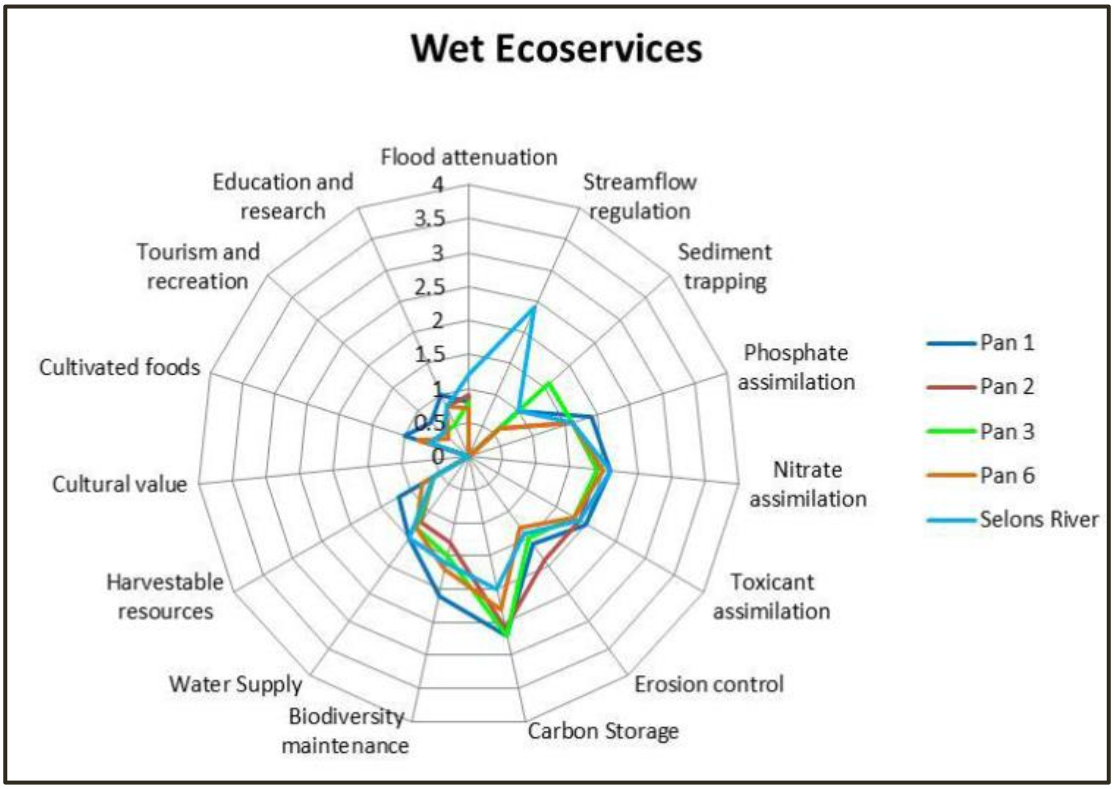

Figure 4-23: Radar plot of wetland services provided by the permanent wetlands

4.5.6.2 Seasonal Wetland Units

The results of the functional assessment indicated that all of the seasonal wetland features in the mining footprint have a moderately low level of ecological function and service provision (**Table 4-13**).

These wetland features and pans are the most important in terms of nitrate assimilation. The results obtained were mainly due to the fact that all of the seasonal wetland features display diffuse flow characteristics causing a seepage area to occur. Agricultural practises surround some parts of these wetland units, causing water and possibly some fertilisers to wash off into the wetland sections. This increases the nutrient levels within the wetlands, thus lowering the water quality.

Table 4-13: Wetland functions and service provision for the seasonal wetlands

Ecosystem Service	Wetland features with no permanent zone of saturation		
	Pan 4-5	Wetland 2	Wetland 1,3-7
Flood Attenuation	0.9	0.9	0.8
Stream flow Regulation	0	1.8	0
Sediment Trapping	0.75	0.5	0.5
Phosphate Assimilation	1.7	1.6	1.3
Nitrate Assimilation	2	2.2	1.4
Toxicant Assimilation	1.8	1.8	1.3
Erosion Control	1.6	1.4	1.1
Carbon Storage	1.7	1.7	1.3
Biodiversity Maintenance	0.9	1.3	0.9
Water Supply	1.2	1.2	0.3

Ecosystem Service	Wetland features with no permanent zone of saturation		
	Pan 4-5	Wetland 2	Wetland 1,3-7
Harvestable Resources	0.2	0.8	0
Cultural Value	0	0	0
Cultivated Foods	0.2	0.8	0
Tourism and Recreation	0.1	0.1	0.1
Education and Research	0.5	0	0.5
Sum	**13.6**	**16.1**	**9.5**
Average Score	**0.9**	**1.1**	**0.6**

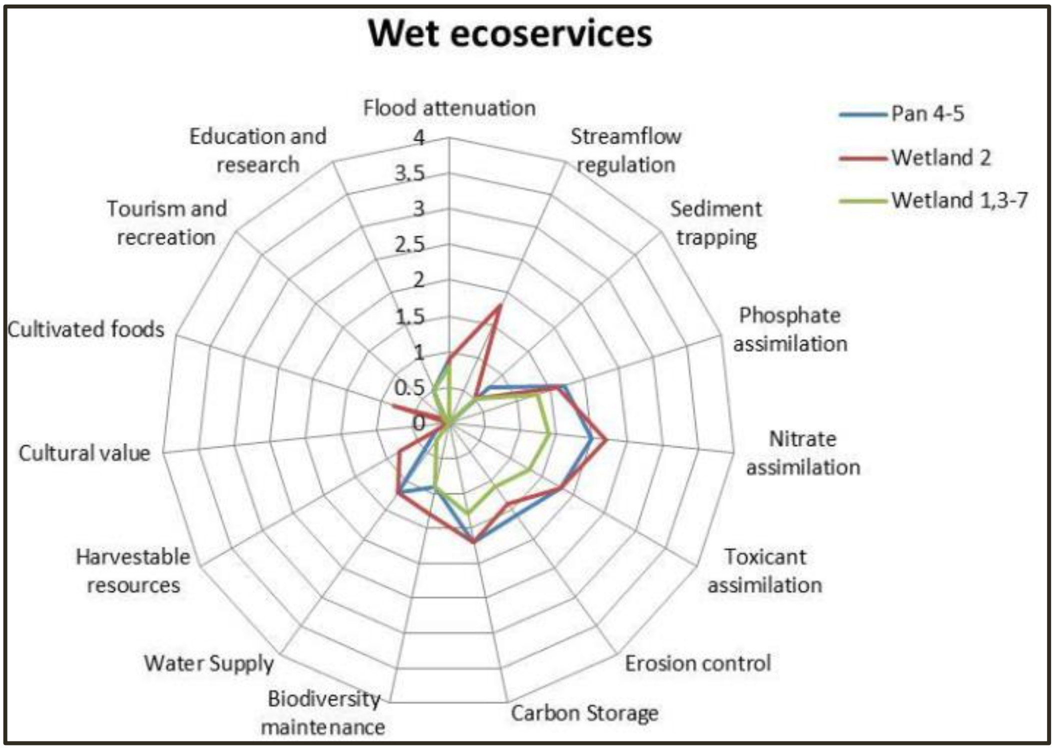

Figure 4-24: Radar plot of wetland services provided by the seasonal wetland features

4.5.7 Summary of the WET-Health Assessment

A Level 1 WET-Health assessment was applied to the wetland units within the mining footprint. The primary purpose of this assessment was to evaluate the Present Ecological State (PES) of the wetland features (i.e. eco-physical health of wetlands), in order to promote their conservation and management recommendations. The assessment comprised a set of three modules combined from the set of processes, interactions and interventions that take place in wetland systems and their catchments, *viz.:*

- Hydrology (water inputs, distribution and retention, and outputs);
- Geomorphology (sediment inputs, retention and outputs); and,
- Vegetation (transformation and presence of introduced alien species).

Table 4-14 summarises the scores received for the three modules assessed as part of the WET-Health assessment.

Table 4-14: Summarised results of the WET-Health assessment

Wetland Feature	Hydrology	Geomorphology	Vegetation	Overall Score
Pan 1	C	A	C	**C**
Pan 2	D	A	D	**C**
Pan 3	C	A	C	**B**
Pan 6	C	A	D	**C**
Selons River & Wetland 2	B	A	C	**B**
Pan 4	C	B	E	**C**
Pan 5	D	B	E	**D**
Wetland 1,3-7	D	B	E	**D**

The present hydrological state of the wetland units displayed a score falling between Category B (A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place) and Category D (A large change in ecosystem processes and loss of natural habitat and biota and has occurred).

The present geomorphological state of the features calculated a score falling between a Category A (A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place) and a Category B (A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place).

The current vegetation status within the wetland features was calculated with a score falling between Category C (A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact) and Category E (Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota).

The above results indicate that moderate to high levels of modifications of hydrology, geomorphology and vegetation have occurred within the wetland units. Modifying factors include historic and current agricultural activities such as vegetation clearing for crop cultivation, plantation and grazing activities contributing to increased erosion and sediment input. Considering the current rate of transformation of the landscape and proximity and expansion of plantation and agricultural activities in the vicinity, deviation from a Category B-D is expected in all of the systems, unless mitigation measures are implemented to prevent further deterioration.

4.5.8 Environmental Importance and Sensitivity

The method used for the Environmental Importance and Sensitivity (EIS) determination was adapted from the method as provided by DWS (1999) for floodplains. The method takes into consideration the PES scores obtained for WET-Health as well as function and service provision to determine the most representative EIS category for each wetland systems within the mining footprint.

4.5.8.1 Permanent Wetland Units

The scores of 2.0 to 2.89 calculated during the assessment (**Table 4-15**) indicate that the permanent wetland units fall into the “high” EIS category (Category ‘B’). It should be noted that the high EIS score was obtained primarily as a result of habitat diversity and ecological function and status of these wetland units.

4.5.8.2 Seasonal Wetland Units

The scores of 1.33 to 1.56 calculated during the assessment (**Table 4-16**) indicate that the seasonal wetland features falls into the “moderate” EIS category (Category ‘C’). It should be noted that the lower EIS score was obtained primarily as a result of historical agricultural practices such as crop cultivation and grazing may have contributed to the present condition of these pans through water attenuation, increased siltation and clearing of natural vegetation.

Table 4-15: Wetland EIS scores for the permanent wetland systems

Determinant	Permanent Wetland Features									
	Pan 1		Pan 2		Pan 3		Pan 6		Selons River	
	Score	Confidence	Score	Confidence	Score	Confidence	Score	Confidence	Score	Confidence
Primary Determinants										
Rare & Endangered Species	2	4	2	4	2	4	1	4	2	3
Populations of Union Species	1	4	1	4	1	4	1	4	2	3
Species/taxon Richness	2	4	1	4	1	4	1	3	2	4
Diversity of Habitat Types or Features	2	3	1	4	2	3	1	3	2	3
Migration route/breeding and feeding site for wetland faunal and avifaunal species	3	3	2	3	2	3	1	3	2	3
PES as determined by WET Health assessment	3	4	3	4	4	4	3	4	4	4
Improvement in terms of function and service provision	3	4	2	4	2	4	2	3	3	4
Modifying Determinants										
Protected Status according to NFEPA WetVeg	4	4	4	4	4	4	4	4	4	4
Ecological Integrity	3	3	2	3	2	3	4	3	3	3
Total	**26**	-	**18**	-	**20**	-	**18**	-	**24**	-
Mean	**2.89**	-	**2.0**	-	**2.22**	-	**2.0**	-	**2.67**	-
Overall EIS	**B**	-	**B**	-	**B**	-	**B**	-	**B**	-

Table 4-16: Wetland EIS scores for seasonal wetland systems

Determinant	Seasonal Wetland Features							
	Pan 4		Pan 5		Wetland 2		Wetland 1,3-7	
	Score	Confidence	Score	Confidence	Score	Confidence	Score	Confidence
Primary Determinants								
Rare & Endangered Species	0	3	0	3	0	3	0	4
Populations of Union Species	1	4	1	3	1	3	0	4
Species/taxon Richness	1	4	1	3	1	2	1	4
Diversity of Habitat Types or Features	1	4	1	3	1	3	1	3
Migration route/breeding and feeding site for wetland faunal and avifaunal species	1	3	0	4	1	3	1	3
PES as determined by WET Health assessment	3	4	3	4	4	4	3	4
Improvement in terms of function and service provision	1	3	1	3	1	3	1	4
Modifying Determinants								
Protected Status according to NFEPA WetVeg	4	4	4	4	4	4	4	4
Ecological Integrity	1	3	1	3	1	4	1	4
Total	**13**	**-**	**12**	**-**	**14**	**-**	**12**	**-**
Mean	**1.44**	**-**	**1.33**	**-**	**1.56**	**-**	**1.33**	**-**
Overall EIS	**C**	**-**	**C**	**-**	**C**	**-**	**C**	**-**

4.5.9 Recommended Ecological Category

The results of the wetland functionality, EIS and WET-Health assessment were used to form the Recommended Ecological Category (REC) for the wetland units. It is recommended that the REC for the wetland and pan features not to be mined is improved where possible and no further degradation occurs as a result of the mining activities. Strict mitigation measures need to be implemented to ensure that the wetland function is restored. This could ensure that the impact on the wetland units that may result in a decrease of the PES can be mitigated as far as possible.

4.5.10 Wetland Delineation

A wetland delineation was undertaken according to the method presented in "A practical field procedure for identification and delineation of wetlands and riparian areas" published by the DWS in February 2005, the following temporary zone indicators were used to delineate the wetland units:

- Terrain units were used to determine in which parts of the landscape the wetland unit is most likely to occur.
- The soil form indicator was used to determine the presence of soils that are associated with prolonged and frequent saturation, as well as variation in the depth of the saturated soil zone within 50cm of the soil surface. This indicator was used to identify gleyed soils where the soil is a greyish/greenish/bluish colour due to the leaching out of iron. Whilst mottling was not extensive, it was present in the temporary zone. These factors were utilised to aid in determining the location of the wetland zones and their boundaries.
- The vegetation indicator was used in the identification of the wetland unit boundary through the identification of the distribution of both facultative and obligate wetland vegetation associated with soils that are frequently saturated. Changes in vegetation density and levels of greening were also considered during the delineation process.
- Presence of surface water. Surface water was absent during the field assessment, but saturated soils were noted within some of the wetland areas.

The delineation revealed that pan feature 1, 3 and 6 and the Selons River are considered high and medium sensitivity areas including the associated 100m buffers, while low sensitivity was allocated to the seasonal wetland units (i.e. pans 2 & 4 and wetland units 1-7) (**Figure 4-25**).

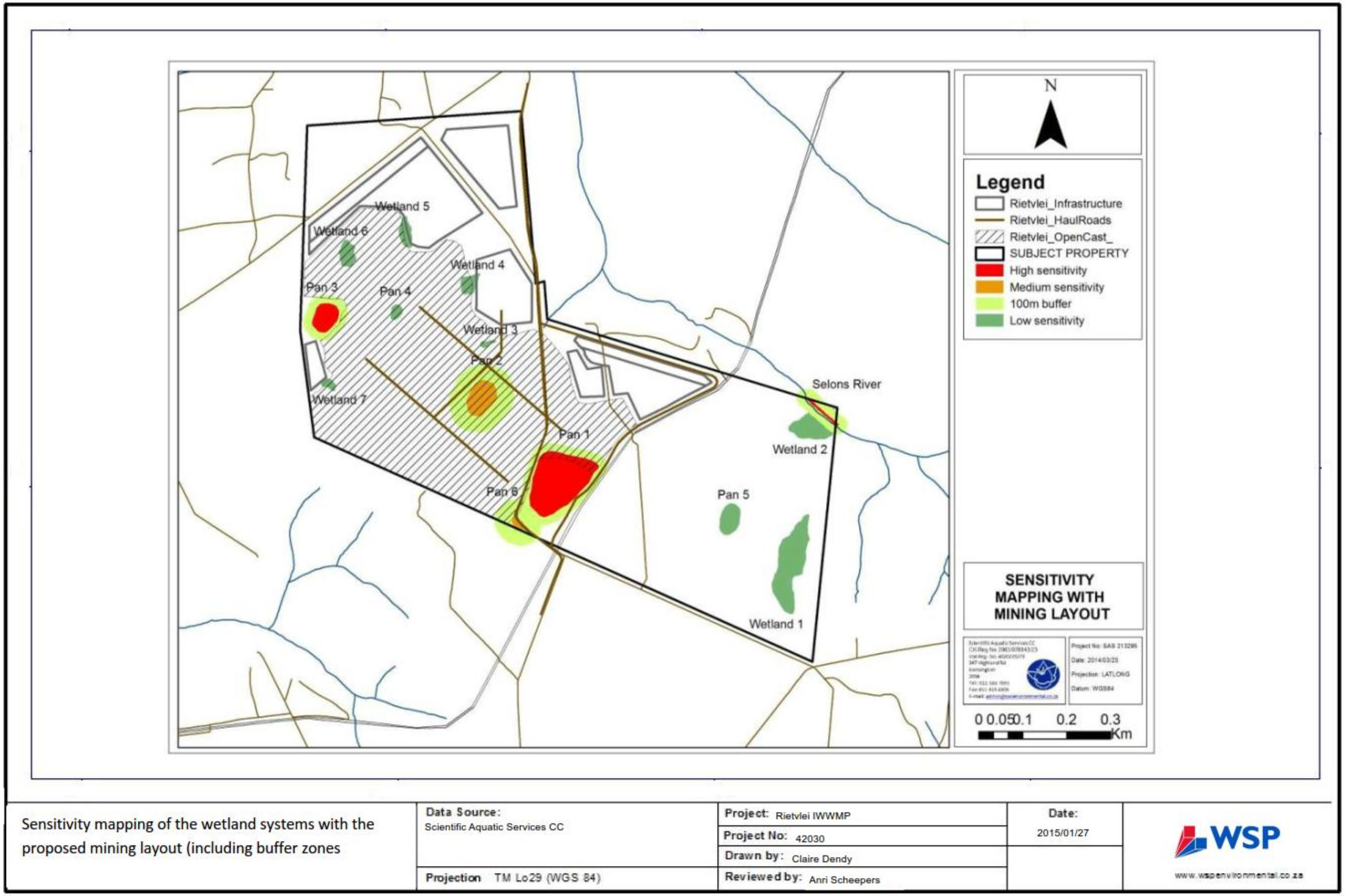

Figure 4-25: Sensitivity mapping of the wetland systems with the proposed mining layout (including buffer zones) (Scientific Aquatic Services, 2014)

4.5.11 Summary of Wetland Classification and Functionality

All the wetlands in the study area have been considered sensitive and should be treated as required by Mpumalanga Biodiversity Conservation Plan. The sensitivity ratings ascribed to the wetlands on site, range from Low to High Sensitivity, and are based on the varying degrees of degradation of the wetlands on site (**Table 4-17**).

Table 4-17: Summary of Wetland classification and functionality

Wetland Unit	Description
Pan 1	Permanently wet endorheic depression system with an intermediate level of ecological function and service provision.
Pan 2	
Pan 3	
Pan 4	Seasonal endorheic depression systems with a moderately low level of ecological function and service provision.
Pan 5	
Pan 6	Permanently wet endorheic depression system with moderately low level of ecological function and service provision.
Wetland 1 & 2	Permanently wet endorheic depression system with moderately low level of ecological function and service provision.
Wetland 3-7	Seasonal flat seepage inland systems with a moderately low level of ecological function and service provision.

4.6 Geology

The area is characterised by quartzite ridges of the Witwatersrand supergroup and the Pretoria group as well as the Selons river formation of the Rooiberg group, supporting soils of various quality of the Rand Highveld Grassland. The geology of the area is shown in **Figure 4-26**.

The mining footprint is located in the Karoo Sequence (Vryheid Formation). The Vryheid Formation consists of mudstone, shale, rhythmite, siltstone and fine- to coarse-grained sandstone (pebbly in places). The Formation contains up to five (mineable) coal seams (**Figure 4-27**). The different lithofacies are mainly arranged in upward coarsening deltaic cycles.

Since the shales are very dense, they are often overlooked as significant sources of groundwater. The permeabilities of the sandstones are also usually very low. The main reason for this is that the sandstones are usually poorly sorted, and their primary porosities have been lowered considerably by digenesis. These sedimentary formations have been extensively intruded by dolerite dykes.

The Karoo dolerite consists of an interconnected network of dykes and sills. Dolerite dykes are vertical to sub-vertical discontinuities that, in general, represent thin, linear zones of a lower permeability sandwiched between fracture zones. These fracture zones can have a relatively higher permeability and can therefore act as conduits for groundwater flow within the aquifer. On the other hand, dykes may also act as semi- to impermeable barriers to the movement of groundwater.

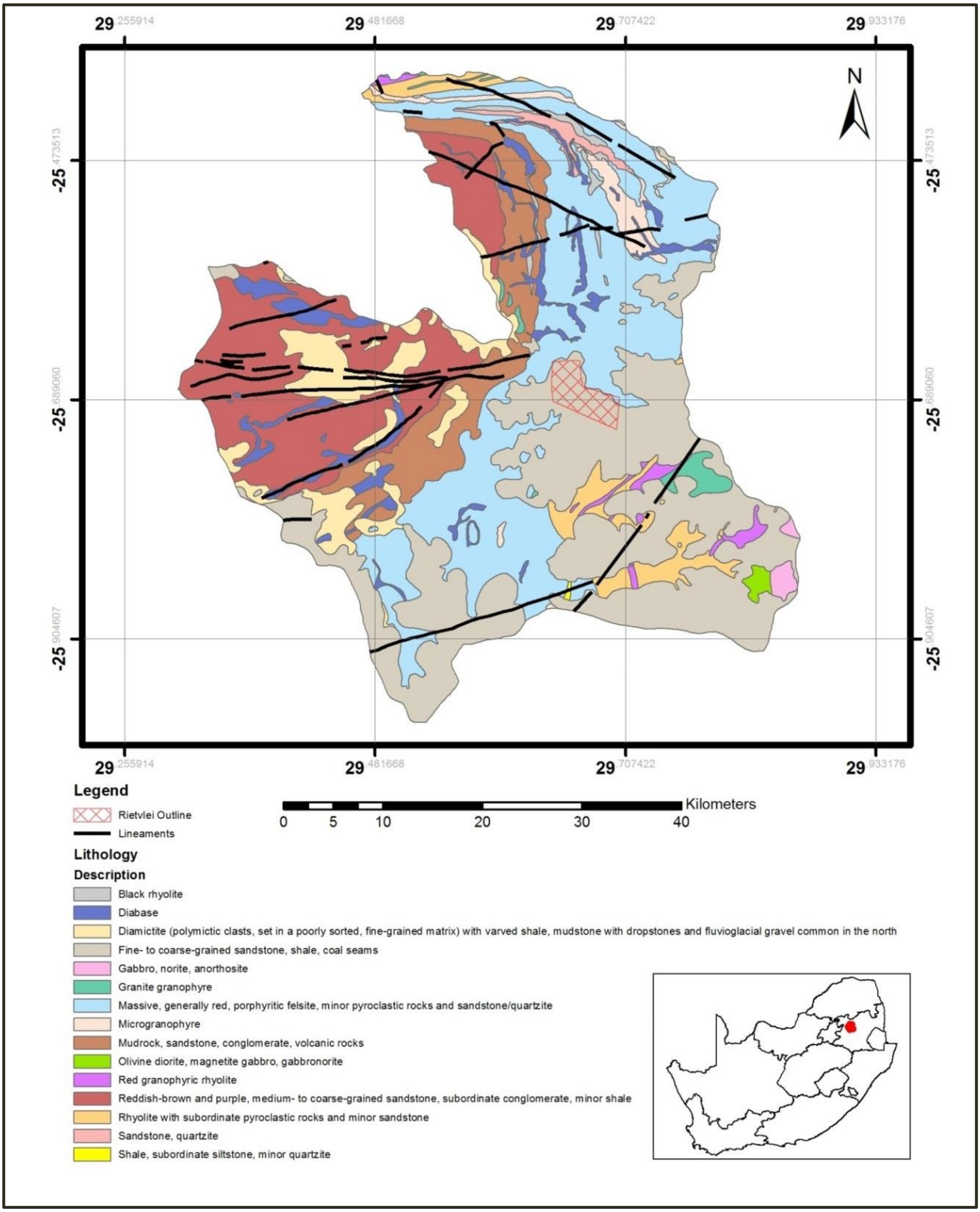

Figure 4-26: Regional geology (modified from the 1/250000 Geological Series: 2528 Pretoria). Rietvlei Mine is shown by the red cross-hatched area near the center of the map (Aqua Earth, 2014)

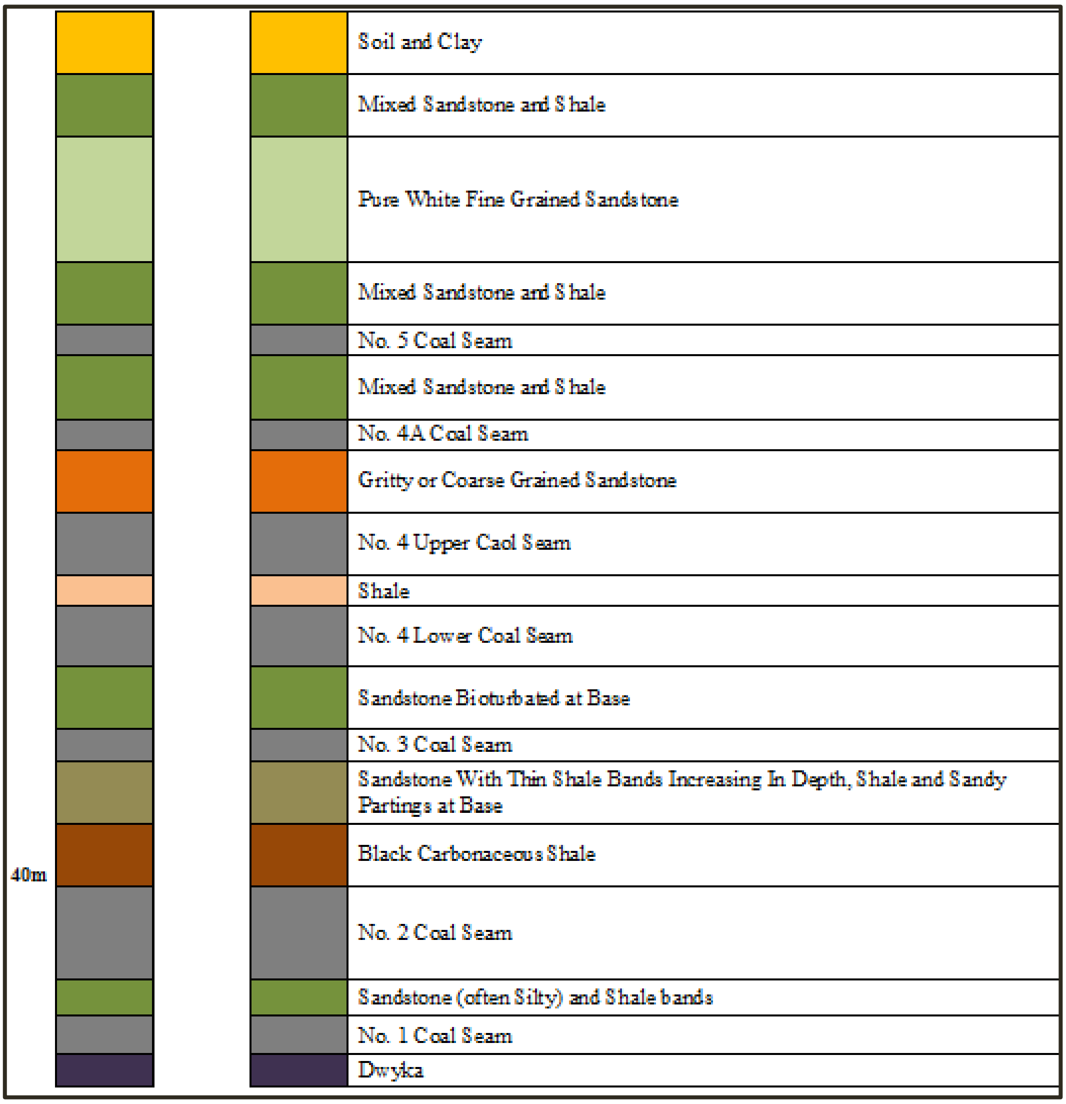

Figure 4-27: Generalised stratigraphy of the underlying geology – Rietvlei Mine (Solution H+, 2014)

4.7 Groundwater

This section presents the characterisation and the impacts assessment of the two aquifer systems within the mining footprint. Refer to **Appendix 3** for a copy of the complete groundwater assessment report undertaken for the proposed project.

4.7.1 Field Investigations

Field investigations were completed according to WSP gap analysis recommendations which included;

- Review of existing geological and hydrogeological information;
- A geophysical survey using a magnetometer identified potential flow paths for preferential groundwater/contaminant migration.
- Eight groundwater exploration/monitoring boreholes were sited and drilled to characterise the underlying hydrogeological environment. Six deep and two shallow boreholes were drilled, to depths of 50 and 24m bgl respectively. Most of the water strikes were encountered within the shallow aquifer, between 19 and 25m bgl.
- Sampling and testing of drill chips for Acid Potential Drainage, the results of which are included in the specialist geochemist report (**Appendix 4**);

- Sampling and analysis of water intercepted in all the additional boreholes. The expanded Durov diagram suggests unpolluted groundwater quality for all the samples collected at proposed Rietvlei Mine. Piper diagram shows calcium/magnesium bicarbonate water as result of freshly recharge to ground's water table. Such water quality results are in agreement with the surrounding general groundwater quality as established by the baseline groundwater investigation conducted previously;
- Aquifer testing to estimate hydraulic parameters of all aquifers present within and surrounding the study area; this comprised of slug tests, calibration tests, recovery tests, step tests and a 12 hour constant discharge test. Aquifer characteristics were determined from the test data and are summarised as follows;
- Permeability
  - Falling head tests carried out on auger holes in November 2011 have shown that the overlying unsaturated zone is characterized by high hydraulic conductivities at an average of 12m/d.
- Transmissivity
  - Estimated transmissivity values vary between 0.6 to 8 m^2/d with an average of 4.5 m^2/d. Initial model built by AEC used a transmissivity value of 4m^2/d. However, transmissivities may be much higher in fracturing associated with contact zones between sediments, and dolerite.
- Storativity
  - Estimated storage coefficients fall within the range between $2x10^{-2}$ and $3x10^{-5}$ with an average of $4x10^{-3}$.
- Update of the baseline numerical model with new characterisation information; and
- Update the project (open cast mining) impacts assessments.

4.7.2 Update of the conceptual model

The site characterisation was used to simplify (conceptualise) the description of the aquifer systems. The conceptualisation was done to guide the numerical modelling and assessment of groundwater management issues.

Although it has been found (based on distribution of water strikes) that the main preferential path for the groundwater may be located at depth between 15 and 31 mbgl, the distribution of estimated hydraulic parameters (mainly T), did not show any dependence of depth within the top 50 mbgl as investigated on site. Therefore, a single weathered and fractured Karoo sedimentary aquifer is conceptualised for the site.

The depth to the base of the aquifer system is estimated at 50mbgl, based on drilling information. The aquifer has little potential of yielding large volumes of water and has a mean annual groundwater recharge estimated at 35mm.

The thickness of the unsaturated zone is determined by the depth to the groundwater level that varies between 0.33 and 21mbgl in the vicinity of the area, but range from 1.7 to 19.2mbgl within the Rietvlei site.

Groundwater occurrence is within pores in disintegrated/decomposed, partly decomposed rock and fractures which are principally restricted to a zone directly below the water table. The average depth to the groundwater level is at 10 to 2mbgl.

Since the evidence of physical subsurface no-flow boundaries have been clearly identified at the present level of sites characterisation and a good correlation exists between the groundwater level elevations and the surface topography, it is assumed that the groundwater extends over the geometry of the surface water catchment system(s). Consequently, most of the groundwater recharges occurring within the study area are expected to discharges to the surface drainage systems via springs (wetland in depression) and discharge to the base of the main river drainage systems:

- Selons River in B32B;
- Olifants River in B12C, B12D, and B12E; and
- Keerom stream in B12E.

The field results have shown that the saturated zone is characterized by high hydraulic conductivities at an average of 12m/d, with an estimated transmissivity values vary between 0.6 to 8 m^2/d with an average of 4.5 m^2/d.

The groundwater flow direction is moving away from proposed Rietvlei Mine in the following direction:

- North-West, probably discharging into the furrows that feed into Olifants River;
- South West, probably discharging into Olifants River; and,
- North East, discharging into Selons River which also flows North-West into Olifants River;

4.7.3 Potential Impacts

The overall project impacts (construction, operation, closure) significance is expected to be from Low to Very High without any appropriate mitigation. The impacts associated with dewatering the proposed open pit during operation and closure of the mine has been assessed in the report contained in **Appendix 3**; and these impacts included in **Section 5.9**. It is expected, that contaminant plumes generated from mining activities such as waste rock dumps, processing plants, tailing management facilities would migrate towards the proposed open pit, due to the required dewatering of the proposed open pit.

- Thorough planning, design, suitable investment, management measures, workplace procedures and good housekeeping will generally mitigate the potential impacts rising from proposed Rietvlei Mine development will be reduced to Low, Except the for impacts at post closure phase;
- Specific measures have been proposed for certain infrastructure units to address particular potential impacts, these are detailed in the specialist report presented in **Appendix 3**;
- Monitoring will be necessary to ensure that any impacts on water quality and quantity that do arise are dealt with rapidly; and,
- An initial monitoring network has been proposed for the management of groundwater resources this is detailed in **Appendix 3**.

4.8 Socio Economic Environment

4.8.1 Population density, growth and location

According to the 2011 Census, the Steve Tshwete Local Municipality had a total population of 229 831 people, of which the majority (73.6%) are black African (**Table 4-18**) and 70.7% of the population fall into the working age of 15 to 65 (**Figure 4-28**). The gender ratio is fairly equal, with 52% of the population male and 48% of the population female.

Table 4-18: Ethnic delineation

Race	Population
Black African	169 156
Coloured	5 976
Indian/Asian	3 677
White	50 103
Other	919

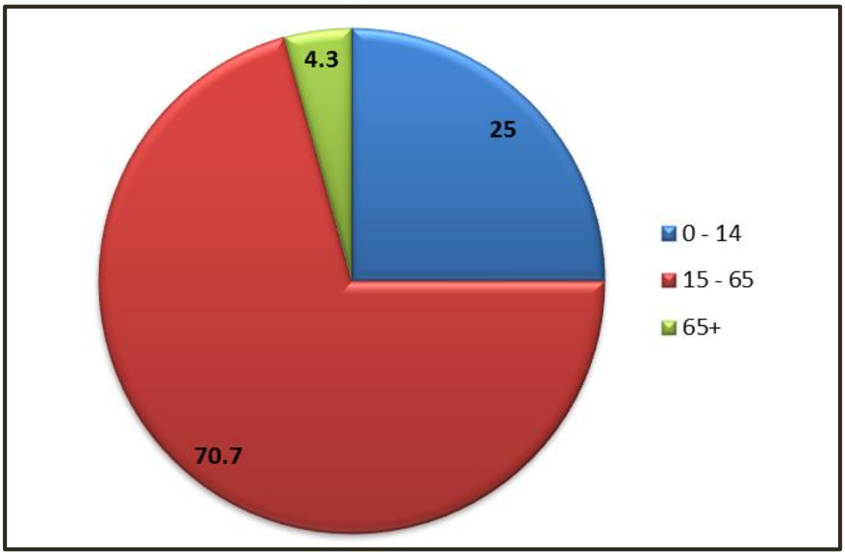

Figure 4-28: Age Groups (Stats SA Community Survey 2011)

4.8.2 Major economic activity and sources of employment

107 069 people are economically active (employed or unemployed but looking for work) and of these, 19.7% are unemployed (**Figure 4-29**). The majority of the 53 630 economically active youth (15 – 34 years) is employed, with only 27.1% being unemployed 12.8% of the population have no household income, while the biggest income bracket (17%) has a household income of R38 201 – R76 400 (**Figure 4-30**).

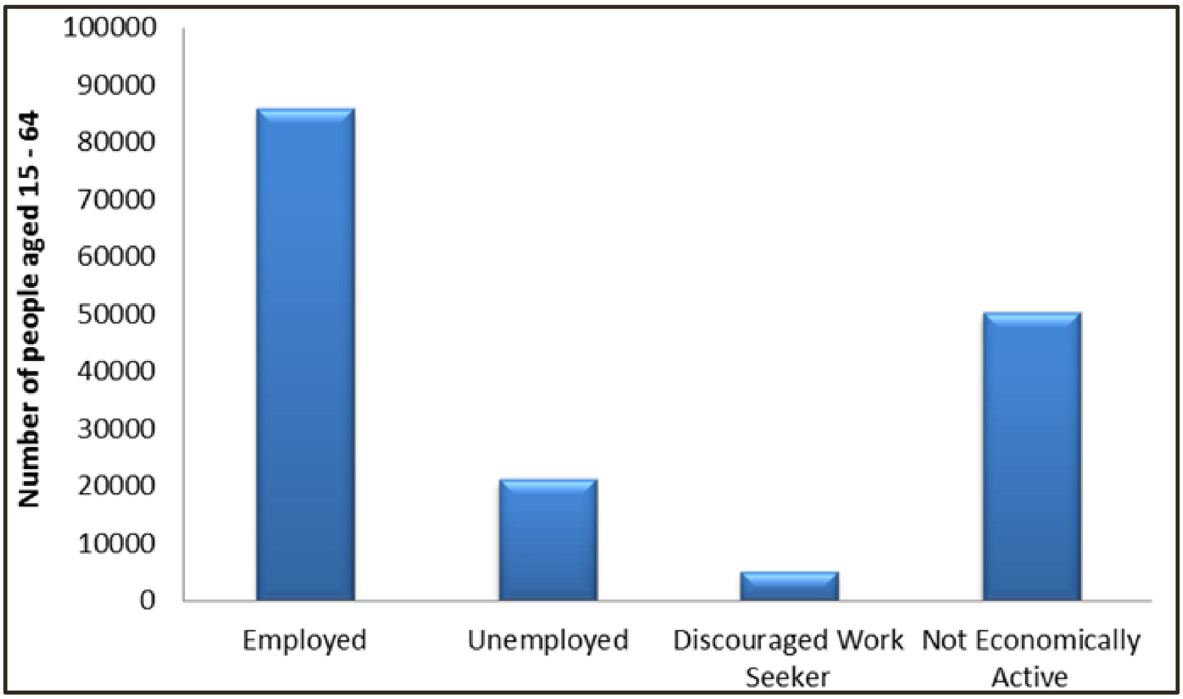

Figure 4-29: Employment for those aged 15 - 64 (Stats SA Community Survey 2011)

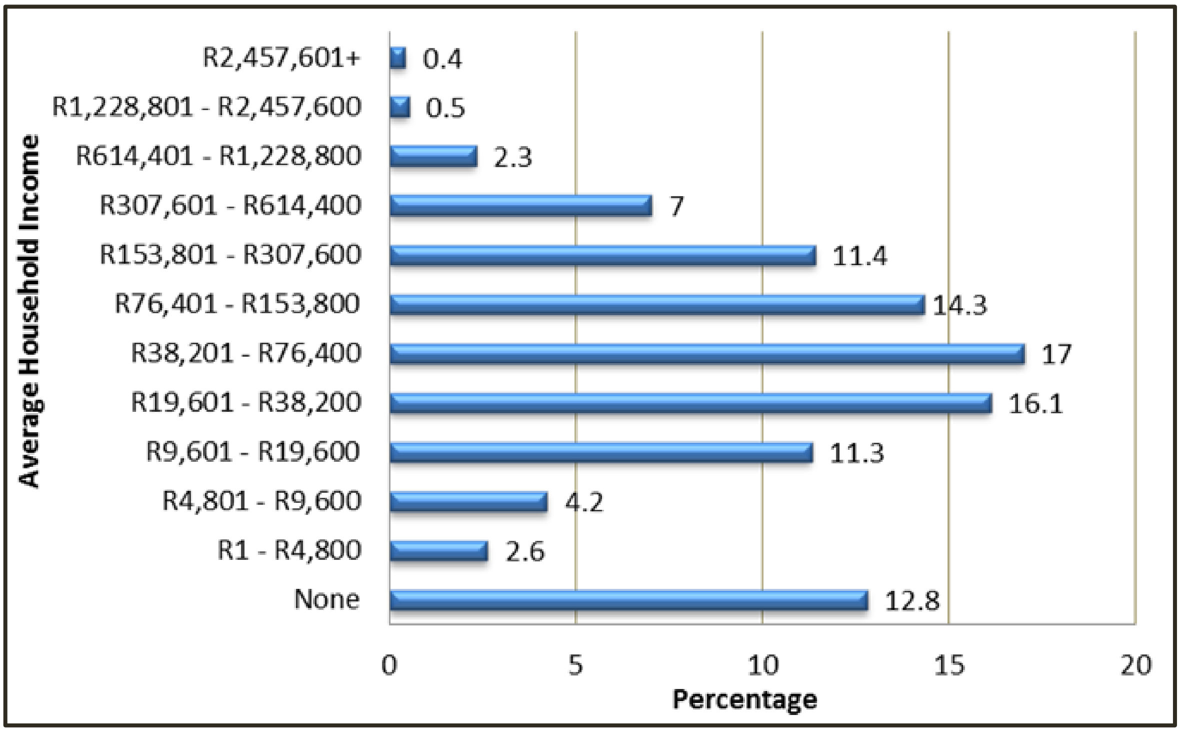

Figure 4-30: Average Household Income (Stats SA Community Survey 2011)

4.8.3 Basic services provision

4.8.3.1 Water and sanitation

The provision of water within the municipality is detailed in (**Table 4-19**). The majority of households (62.2%) have piped water available inside the dwelling, 23.5% of households have access to piped water in their yard and 1.8% has no access to piped water.

Table 4-19: Percentage provision of water distribution within the municipality

Source of Water	Percentage (%)
Regional/local water scheme (operated by municipality or other water services provider)	**90.7**
Borehole	**4.8**
Spring	**0.3**
Rain-water tank	**0.2**
Dam/Pool/Stagnant water	**0.6**
River/Stream	**0.2**
Water vendor	**0.3**
Water tanker	**1.6**
Other	**1.3**

As seen in (**Figure 4-31**) the sanitation type for 81.9% of the population is a flush toilet connected to sewerage, 8.8% make use of pit toilet sanitation facilities and 5.2% make use of other forms of sanitation such as bucket and chemical toilets. A minor 2.1% of the population has no access to any form of toilet sanitation facility.

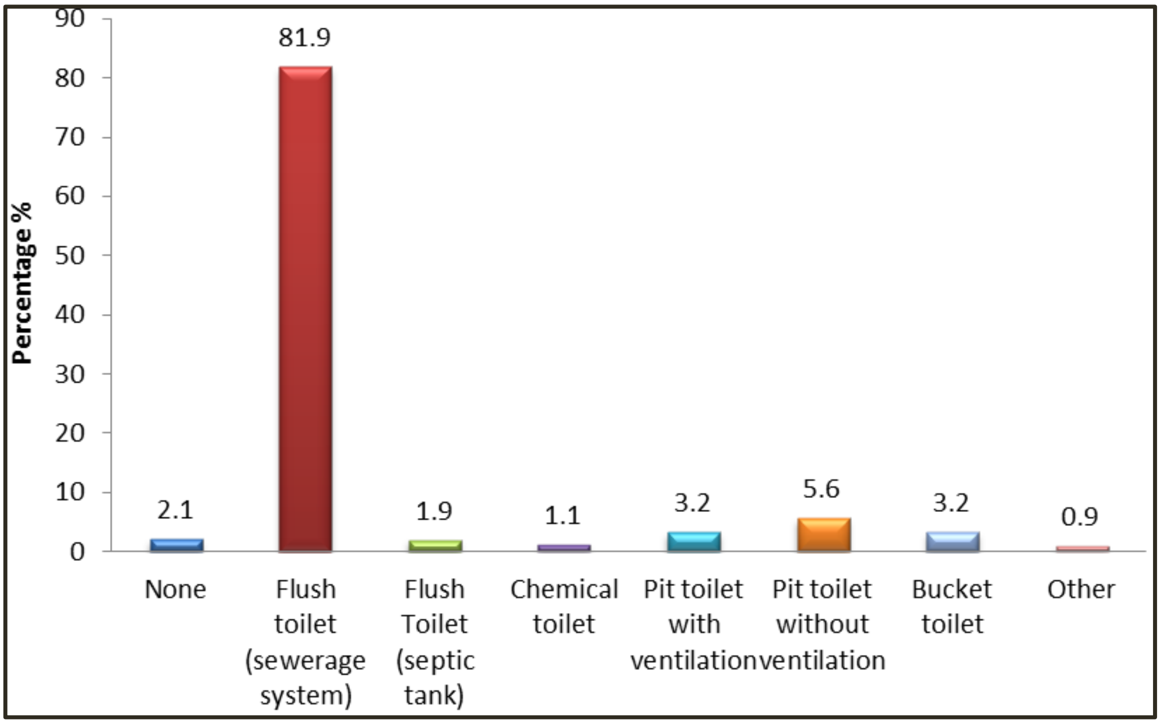

Figure 4-31: Sanitation Types (Stats SA Community Survey 2011)

4.8.3.2 Refuse removal

The majority (84.7%) of the population in the municipality have their refuse removed on a regular basis by the local authority, whist 11% utilise either a communal refuse dump or their own refuse dump as a means of refuse disposal. 2.4% of the population have no means of refuse disposal (**Figure 4-32**).

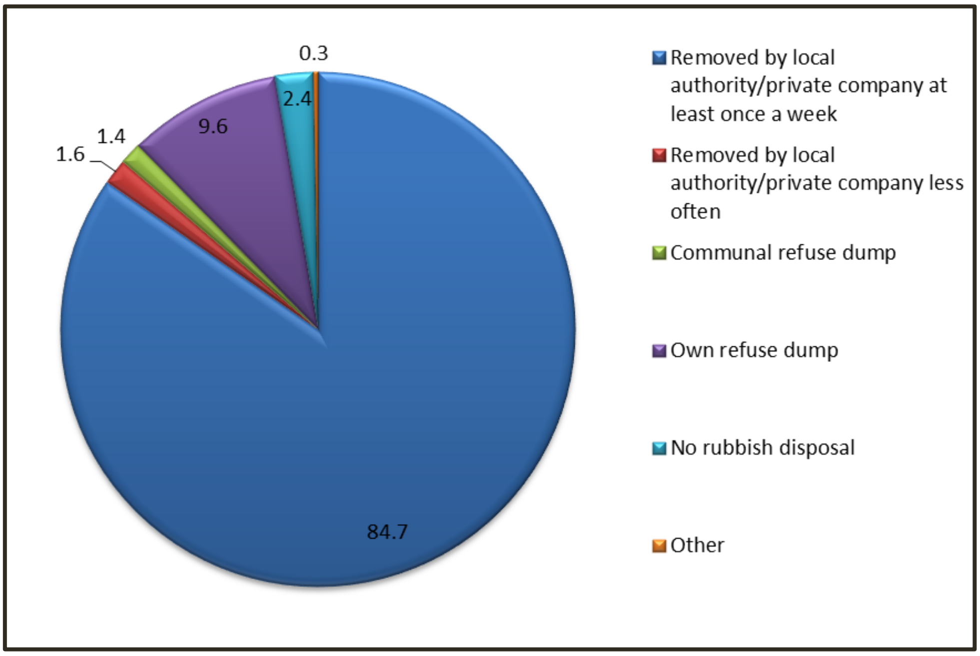

Figure 4-32: Refuse Removal (Stats SA Community Survey 2011)

4.8.3.3 Electricity provision

The provision of energy in the municipality is shown in **Figure 4-33** and details the energy sources used for cooking, heating and lighting. 90.8% of the population have access to electricity for lighting, while 81.7% use electricity for cooking.

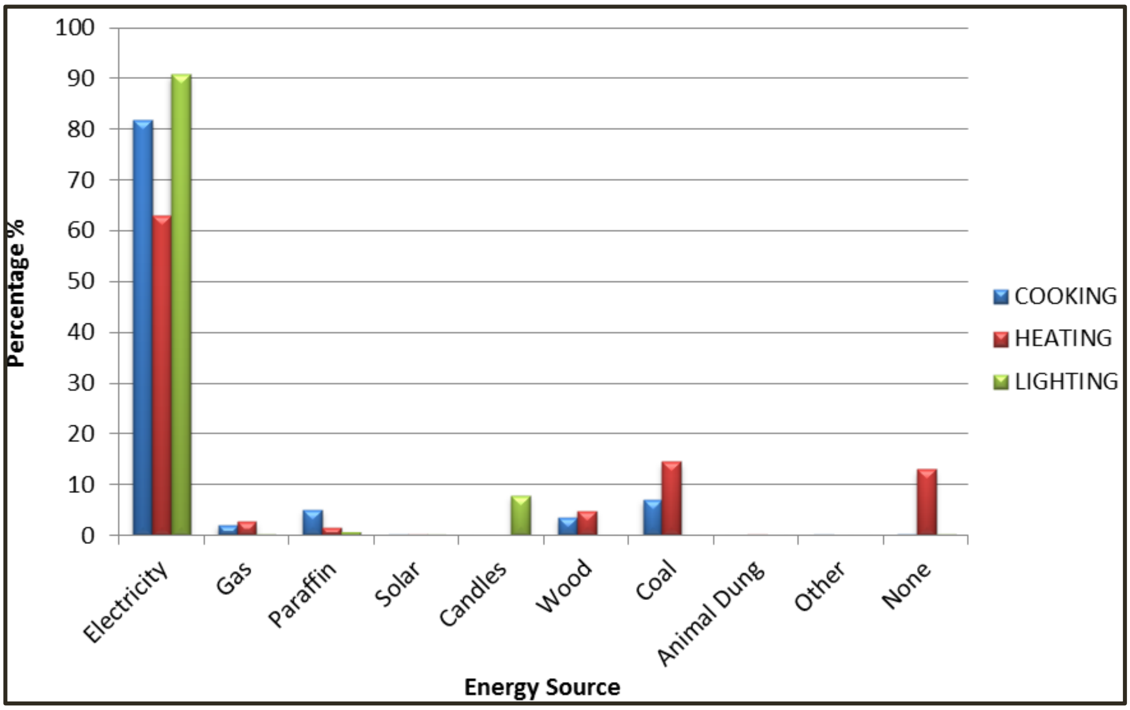

Figure 4-33: Provision of Electricity (Stats SA Community Survey 2011)

4.8.3.4 Social services provision – housing

There are 64 971 households in the municipality, with an average household size of 3.3 persons per household and 29.4% of households are headed by females. The majority (88.7%) of the population live in an urban area and 11.3% of the population live on a farm (**Figure 4-34**).

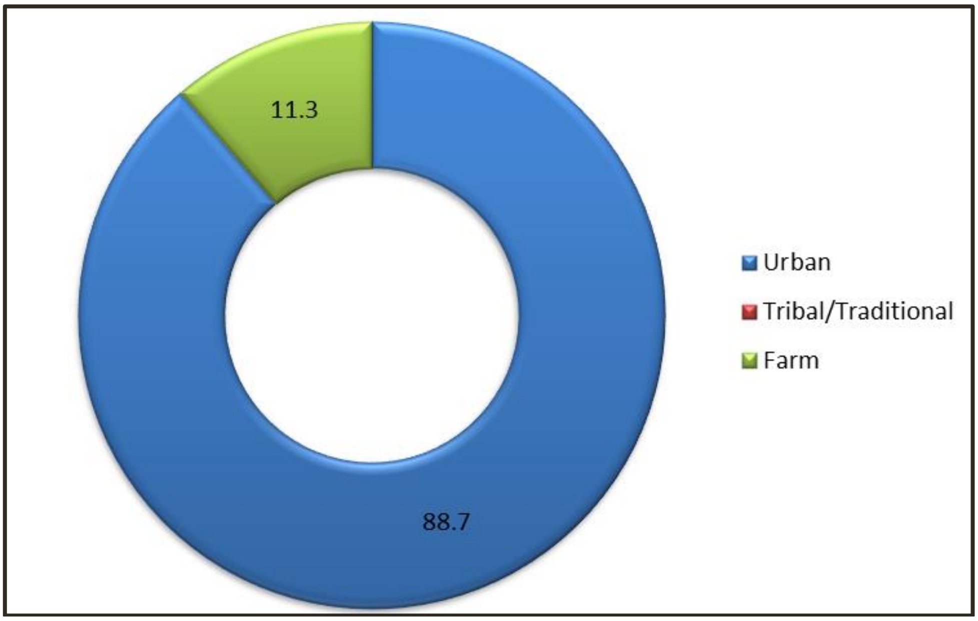

Figure 4-34: Settlement Types (Stats SA Community Survey 2011)

4.8.3.5 Social services provision – education

The educational profile of the population within the municipality is described in **Figure 4-35.** Due to the low income range that the majority of the population are situated in, the majority of the population have only partially completed Primary and/or Secondary Education. 3.1% have not undergone any form of education (and are most likely illiterate).

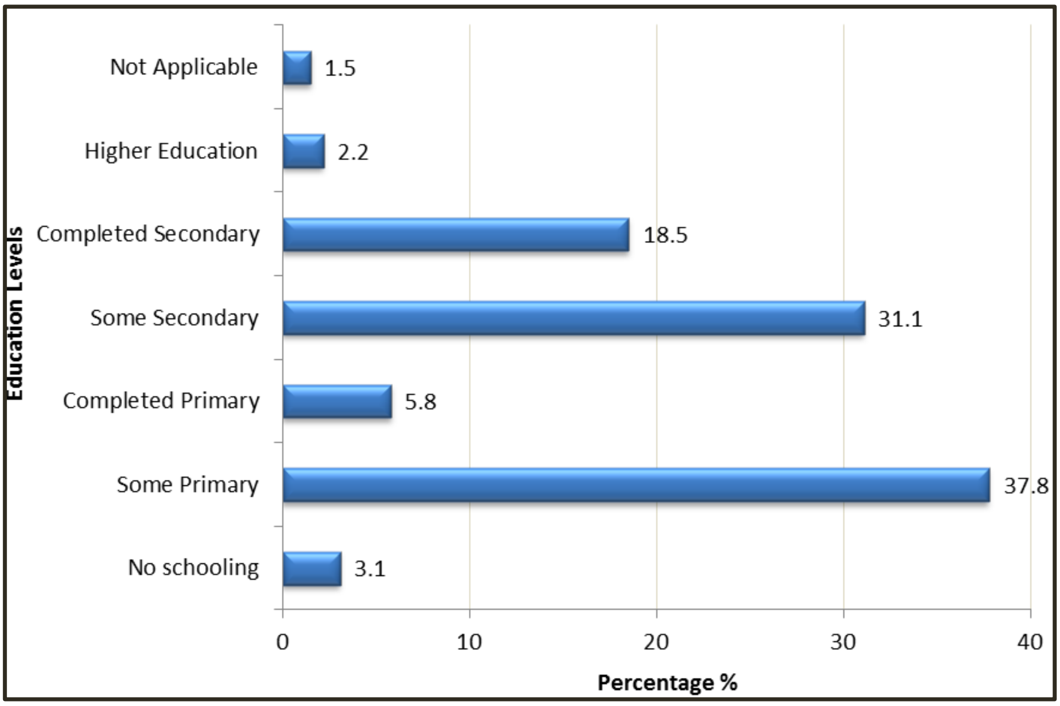

Figure 4-35: Education Levels (Stats SA Community Survey 2011)

5 Analyses and Characterisation of Activity

5.1 Site Delineation for Characterisation

The Proposed Project is located approximately 50km northeast of the town of eMalahleni and 22km northeast of Middelburg in the Mpumalanga Province. It is linked to Middelburg by the R555. The proposed mining area lies within a farming area within the larger Witbank Coalfield and is bordered by private properties on all sides. The mine boundary covers an area of 2 225.30ha; of this approximately 800ha will be mined. **Figure 2-2** illustrates the proposed mine layout as at October 2014.

The proposed mining footprint, activities, associated infrastructure, identified water uses, have been specifically delineated to enable appropriate characterisation of the mining activities and their associated environmental risks and are highlighted in **Section 5.6**.

5.2 Water and Waste Management

5.2.1 Process Water

The mine will require water for the construction, operation and decommissioning[3] phases. Top off water will be sourced from a borehole during the construction phase and the Selons River during the Operational Phase. The results for the borehole are attached in **Appendix 5**. A volume of 120 000 m^3/annum is required for top up during the operational phase. Additional water supply will be sourced from water harvesting, resulting from runoff of 'dirty' areas within the surface layout.

Plant and infrastructure locations were changed after specialist assessments were conducted. However, the general requirements of surface water management remain relevant to the new locations.

5.2.2 Water balance

A Water balance was developed with the available information (regional meteorological data, flow simulation from groundwater and surface water numerical model) for 20 years of operation (**Appendix 6**). The water balance developed during this investigation is considered a preliminary water balance and is an iterative process and will be updated as the mine's activities commence and will be updated regularly to reflect the dynamic process of change at the mine.

The purpose of the preliminary water balance was to develop an initial water management tool to determine areas (pits, plant, water dams) to be targeted for water management and assess possible water management measures and identifying points of metering and monitoring in order to develop a realistic and site specific water balance.

The approach to developing the balance was generally consistent with BPG G2[4]:

- Identify water management units (WMUs). These were identified from the draft water balance supplied by Turgis and subsequent revisions communicated by the engineers conducting the mine feasibility study (which was not complete at the time of developing this water and salt balance). The water balance documented selected average flows in kL/d.
- Clarify flows between WMUs from the water balance. These were summarised into a spreadsheet which represents inputs, storages and outputs from each WMU in vertical columns.
- The only flows quantified at this stage, include the dust suppression volume, the makeup water to the plant from an external source, the total plant water usage per day, and the groundwater inflow to the open cast pit. Therefore, most flows in the water balance have been estimated or calculated by difference to achieve balance. The calculated flows are highlighted in yellow on the attached spreadsheet (Tab: SBv1). They were calculated by using the following assumed values:

[3] For the purpose of this study, water required for the decommissioning phase has not been considered, as this will need to be calculated five years prior to the commencement of decommissioning activities.

[4] Best Practice Guidelines for Management of Water Resources in the South African Mining Industry. Department of Water Affairs and Forestry, August 2006.

- Areas of PCDs, plant and offices, and discard facility from preliminary feasibility study drawings
- Area of open cast pit 3.5% of total pit area (800 ha)
- Annual rainfall of 735 mm per annum
- Annual evaporation of 1 734 mm per annum (from AEC hydrology report)
- Moisture content of coal product and discard of 8% (from Mindset feasibility study)
- 50% of annual rainfall reports as runoff in pit and hardstand areas

■ Assign water qualities to flows:

- Groundwater quality flowing into the open cast pit (as per results provided by AEC)
- The quality of remaining flows were estimated based on Solution[H+] experience and published information on South African underground coal mining sites. All qualities used in the salt balance are listed in the spreadsheet.

■ Include sources and sinks of salt. These are tabulated and described in **Table 5-1**.

Table 5-1: Expected sources and sinks of salt

Sources	Sinks
Open cast pit – Unused explosives, explosive residue, cement used for construction, and leaching from the walls of the mine workings all increase the salt load in mine water	Discard facility – Much of the salt load from the process plant water may be retained on the discard facility. This is especially so for Rietvlei since the facility is lined.
Process plant – the coal washing process leaches salts from the processed crushed rock and coal. Oxidation of sulphide minerals in the coal contributes to the salt load in process water	

■ Balance using total dissolved solids (TDS) as a parameter and assuming conservation of salt mass across each WMU. Note that this is not necessarily valid for the TDS parameter, particularly if there are significant changes in pH in circuit. Calculated water qualities are highlighted in purple in the attached spreadsheet (Tab: SBv1). There were few constraints given the limited number of input water qualities for this preliminary salt balance. The salt balance spreadsheet includes the calculated percent difference in salt mass across each WMU. The following points are noted:

■ Both water and salt are perfectly balanced since there are few flows and qualities to constrain the system. This is an unrealistic situation and emphasises that this is preliminary water and salt balance that should be updated as soon as additional flow and quality information is available.

■ The salt balance represents a steady state situation considering average water flows between WMUs and no change in storage within WMUs. Excess salt is assumed to be retained in the discard facility.

■ The salt balance highlights points in the circuit where water quality monitoring should be conducted to assess salt sources and losses in the mine water system. Based on this preliminary balance, flow volumes and water quality should be monitored at the following key points:

- Make up water quality at all sources;
- Open cast pit water quality at in pit dam (before pumping to PCD 1);
- Process water to discards (at process plant);
- Discards seepage to PCD 2 (in drains);
- Water quality in PCD 1; and
- Water quality in PCD 2.

5.2.3 Waste

According to the MPRDA, mining residue stockpiles can be defined as any debris, tailings, slimes, screening, slurry, waste rock, foundry sand, beneficiation plant waste, ash or any other product derived from or incidental to a mining operation and which is stockpiled, stored or accumulated for potential reuse, or which is disposed of, by the holder of the mining right, mining permit or production right. According to the NEMWA, waste is defined as “any substance, whether or not that substance can be reduced, reused, recycled and recovered:

a. That is surplus, unwanted, rejected, discarded, abandoned or disposed of;
b. Which the generator has no further use for the purposes of production;
c. That must be treated or disposed of; or
d. That is identified as a waste by the Minister by notice in the Gazette, and includes waste generated by the mining, medical or other sector, but—
   i. A by-product is not considered waste; and
   ii. Any portion of waste, once re-used, recycled and recovered, ceases to be waste.

Waste storage areas for the temporary storage of general and hazardous waste that may be generated from the mining activities will need to be constructed. The waste storage and handling facilities will be constructed in accordance with the requirements of Section 21 – 25 of the NEMWA and will also take cognisance the recently promulgated national norms and standards for the storage of waste (Notice 436 of 2011). Furthermore, the waste generated as a result of the mining activities will also be classified in terms of the national norms and standards for waste classification and management regulations (Notice 614 of 2012). Domestic and hazardous waste will be stored temporarily on site in suitable containment facilities. It will be removed periodically by a licenced waste management contractor.

- General Waste Management

General waste, as defined by the NEMWA, means waste that does not pose an immediate hazard or threat to health or to the environment, and includes:

- domestic waste;
- building and demolition waste;
- business waste; and
- Inert waste.

General waste that is to be generated by the mining activities will be temporarily stored onsite according to the requirements of the NEMWA and draft regulations (GNR.436 of 2011), collected by an independent waste service provider and disposed of at a licensed general waste site. Where applicable, the hierarchy of waste management will be implemented in order to avoid, reuse, recycle and reduce the volume of general waste generated by the proposed mining activities.

- Hazardous Waste Management

The definition of hazardous waste in accordance with NEMWA refers to any waste that contains organic or inorganic elements or compounds that may, owing to the inherent physical, chemical or toxicological characteristics of that waste, have a detrimental impact on health and the environment.

Examples of hazardous waste include certain solvents, grease, used oil, fluorescent light bulbs, spilled chemicals and fuel, etc. All hazardous waste will need to be collected and temporarily stored in suitable receptacles located on an impermeable, bunded surface and covered. Hazardous waste will be collected by an independent waste service provider and disposed of at a permitted hazardous landfill site.

- Mine Residue Waste Management

Therefore, residues generated from the beneficiation of coal and waste rock produced from mining activities are excluded from the ambit of the NEMWA; however, best practise will be applied to the mine residues. Fines from beneficiation activities will be co-disposed with discard on an engineered facility, Furthermore, coal spillages from loading of product coal onto trucks may also be produced. The beneficiation/ wash plant and coal stockpiling/ loading areas will be constructed on hardstanding for ease of clean-up and collecting of coal that can be placed on the vehicles transporting product coal.

Waste rock generated from initial development activities and waste rock generated from the mining activities (including beneficiation activities) will be transported by conveyor to a discard dump. Similarly, discard material generated during beneficiation activities will be transported and stockpiled on the discard dump.

- Management of Effluent and Waste Water

All effluent and waste water from the ablution facilities (excluding toilets which will be routed to the septic tank and sewage treatment plant); wash plant and vehicle wash bay will be routed to the PCD for storage. The septic tank will be emptied on a weekly basis by an independent contractor. No sewage will be permitted to be disposed of onsite or discharged into the environment. It is anticipated that effluent generated from the wash bay will undergo primary treatment through an oil-skimmer/ oil separation system in order to reduce hydrocarbons within the effluent prior to pumping into the PCD.

Effluent and waste water originating from the opencast workings may contain sewage, hydrocarbons and nitrates from explosive residues. This water will be required to undergo treatment before being discharged into the PCD.

5.2.4 Reuse, Recycling and Minimisation

The RMC will strive to reuse, recycle and minimise wastage of water and waste during the construction and operational phases of the proposed Rietvlei Mine. It has been noted that all runoff from ‘dirty’ areas will be contained onsite and reused as process water. Clean water runoff will be diverted around areas considered ‘dirty’ and discharged into the environment. Dirty surface water runoff will be reused within the mines operations, thereby reducing the need for make-up water.

5.3 Storm water (clean and dirty water management)

Refer to **Appendix 7** for a copy of the Storm water Management Plan (SWMP).

Storm water will be managed as per GNR.704 of the NWA: Regulations on use of water for mining and related activities aimed at the protection of water resources (GG 20119 of 4 June 1999). A conceptual SWMP has been developed considering surface infrastructures as proposed in **Table 5-2**.

Clean and dirty water systems will be constructed in order to ensure clean and contaminated water is kept separated within the mine area. Storm water systems will also be constructed, ensuring that clean runoff water cannot become contaminated by any mining activities. Clean storm water will be directed away from the mining operations using berms and dirty water will be captured within the dirty area and directed towards the pollution control dams for settling and evaporation. The pollution control dam will be sized such that it will be able to contain the runoff from a 1:50 year storm event. The DWS best practise guidelines for storm water management will in addition be applied to the design of the storm water control infrastructure and implemented onsite.

Table 5-2: List of proposed storm water management infrastructure

Area	Proposed infrastructure
Operations area	■ Earth channels; ■ Containment berms; ■ Culverts;
Pollution control dam	■ Silt trap; ■ Water treatment plant;
Stockpiles	■ Erosion containment; ■ Dirty water berms; ■ Containment berms; ■ Vegetated “buffer” zone;
Mining area	■ Depression (coffers); ■ Containment berms (clean and dirty waters); ■ Dewatering dam;
Haul roads	■ Small coffer dams
Dewatering dam	■ Water treatment plant

- Operating areas

These areas will include stockpiles, roads, workshop, stores and refuelling areas. Pollution sources include runoff from the stockpiles and haul roads spills of hydrocarbons and other chemicals within the workshops, stores and refuelling areas. To limit the impact to surface water bodies, water flow from this area will be directed through dirty water drainage system (earth channels, beams and culverts) towards a silt trap just upslope of a Pollution Control Dam (PCD). The silt trap will remove suspended solids, while the lined PCD will contain any polluted runoff.

Capturing and returning of decant water into a dedicated PCD will be implemented as a minimum measure and consideration will be given to for the design of a water treatment system (plant) based on the expected decant volumes and associated water quality.

- Pollution control dams

The PCD's will be designed to contain recurrence events up to the 1:50 year flood event. In addition, the dam embankments will also allow containment of the 1:200 year recurrence event. The dam will be lined with a 1.5mm thick HDPE liner. The dam will be designed with a free-board of 800 mm above the maximum working level. A sub-surface drainage system will be installed to ensure that all seepage water within the dam area is also collected. The locations of the PCD's are illustrated in **Figure 5-1**.

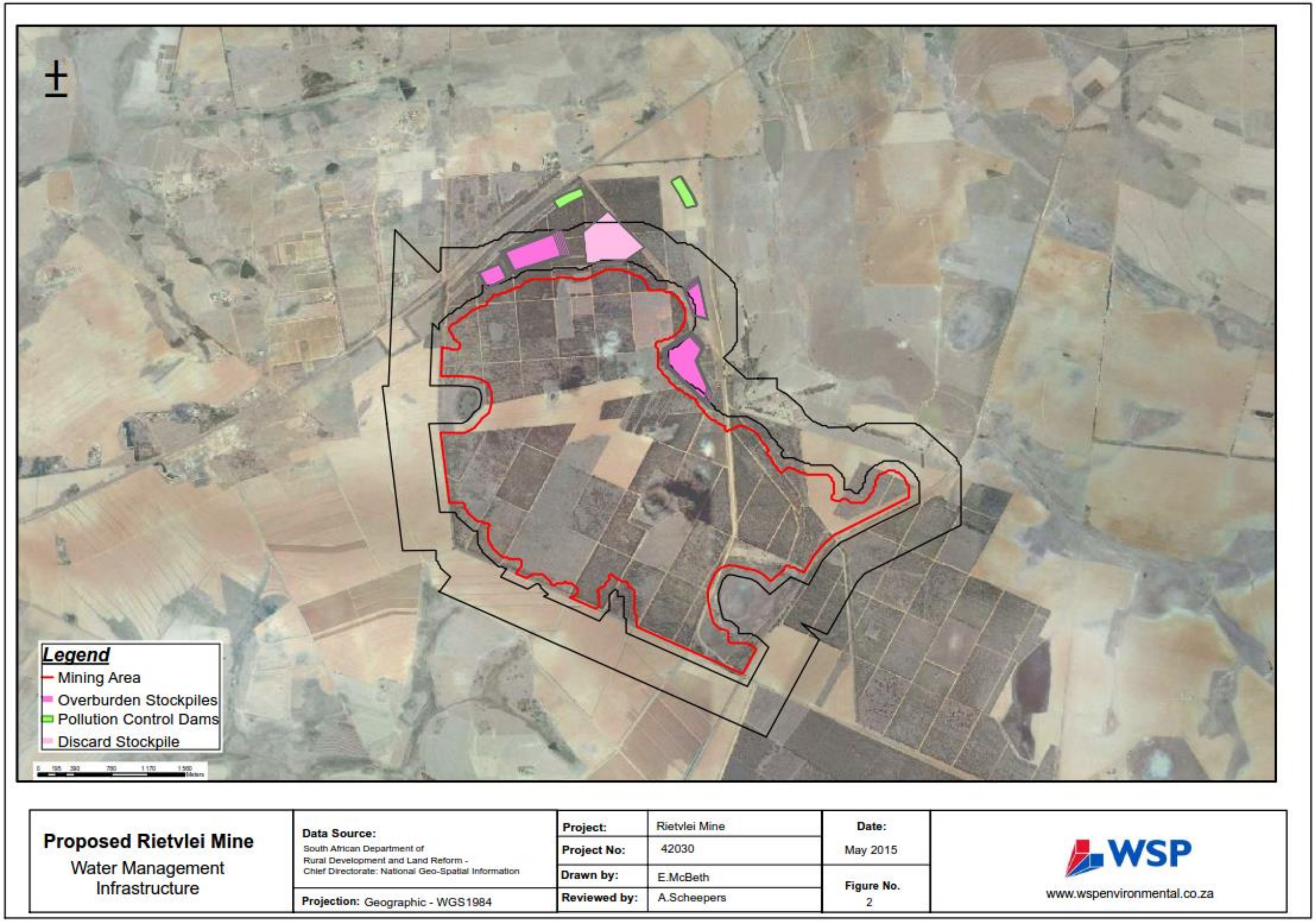

Figure 5-1: Layout of proposed water management infrastructure

- Clean water holding dam

Although the clean areas would allow for the discharge of clean storm water to the adjacent watercourses by gravitation, a system of clean water dams will be installed to control potential risks (erosion and flooding) that the discharged volume may pose. Water for irrigation during rehabilitation will also be sourced from the clean water holding dam.

The dam will be fed by water filtered through a silt trap to remove suspended solids. The clean water dam will not overflow for recurrence events up to the 1:50 year event. In addition, the dam embankments will also not overflow for the 1:200 year recurrence event. The clean water dam will then discharge into natural watercourses under controlled conditions.

- Stockpiles (Dumps)

An erosion containment and dirty water berm will be constructed around the outside of each stockpile. Containment berms will also be constructed perpendicular to the outside berm to ensure that dirty water “coffers” are created. The area between the berms and stockpile will be vegetated to promote rapid evaporation, to reduce ponding within these areas. A 15m wide thickly vegetated “buffer” zone must also be constructed around the outside of berms to contain sediment. Overburden stockpiles will be separated, with one portion containing carbonaceous waste and the other containing inert materials. The treatment of each of these stockpiles will differ:

  - Carbonaceous stockpiles: Surface water will be contained within the stockpile and berms. Groundwater contamination will be prevented by placing a 125mm clay liner at the bottom of the stockpile. Captured water will be lost through evaporation.
  - Inert stockpiles: Dirty water will be contained within the stockpile and berms. Surface water seepage through the containment berms can be accommodated, with the provision that siltation is prevented.

- On-site Haulage Roads

Pit access roads will either traverse rehabilitated or mining areas and may exhibit some pollution potential.

Wherever pit access roads traverse rehabilitated areas, small coffer dams, constructed adjacent to the road, are proposed. This will prevent pollution from entering newly defined clean water areas.

- Mining area

Dirty water containment berms will be constructed around the mine to separate dirty water from clean water. Dirty water will be diverted back into the pit whilst clean water will be directed into the clean water catchment areas.

The pit will be rehabilitated as work progresses. Rehabilitated areas will also be vegetated and contour berms will be constructed to slow surface water and to prevent erosion from taking place. In addition, during rehabilitation buffer zones, containing thick vegetation, will be established downstream of the rehabilitated areas. This will ensure that erosion and subsequent sedimentation is minimised. Rehabilitated areas will be classified as clean water areas and the surface water will be released into clean water areas. Coffer dams will also be constructed along the mining areas to prevent a significant amount of surface water from being concentrated at one specific point.

Run-off water collected from disturbed areas will be collected and stored in holding ponds located near the pits. The water will be routed to the holding area, utilising a series of diversion berms. Collected water will be used for the mining and treatment processes. All water generated by the mining activities will be stored in a high density polyethylene-lined pollution control dam and re-used in the beneficiation plant as well as for dust-control purposes on the haul roads.

5.4 Operational Management

5.4.1 Organisational Structure

The organisational structure of the RMC is illustrated in

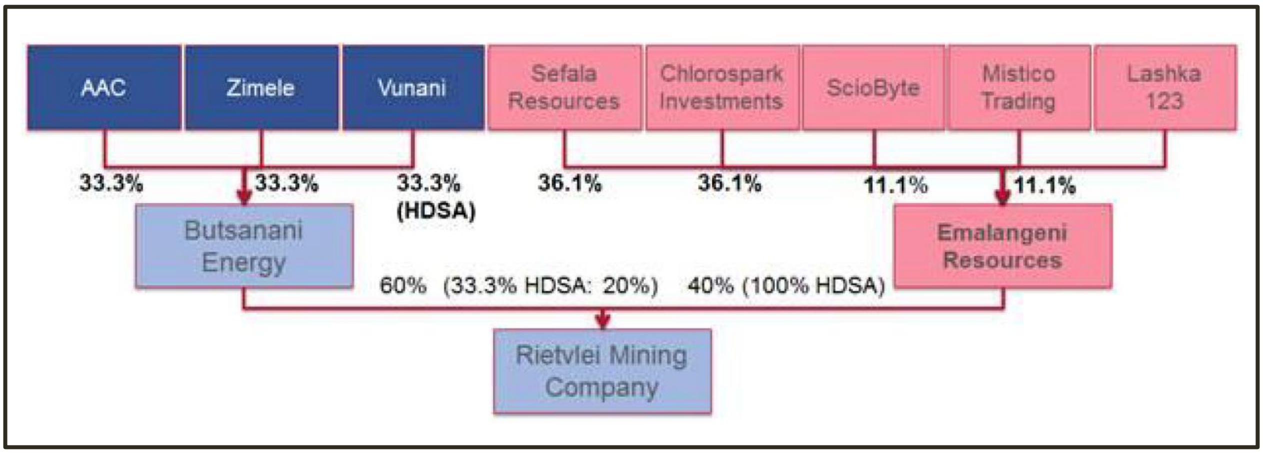

Figure 5-2: RMC Organisational Structure

5.4.2 Resources and Competence

Key operations are managed by individuals with recognised qualifications and where appropriate, the experience to meet the legal appointments as required by the Mine Health and Safety Act No. 29 of 1996 (MHSA) and the Minerals Act Regulations. The RMC's human resources department together with the relevant section manager, draw up additional criteria for selecting operating staff.

5.4.3 Education and Training

It is important to ensure that all personnel, contractors and their sub-contractors have the appropriate level of environmental awareness and competence to ensure continued environmental due diligence and ongoing minimisation of environmental harm. As a minimum environmental training must include the following:

- Employees must have a basic understanding of the key environmental features of the site and the surrounding environment;
- Employees will be thoroughly familiar with the requirements of the ESMP and the environmental specifications as they apply to the mine;
- Employees must undergo training for the operation and maintenance activities associated with the mine and have a basic knowledge of the potential environmental impacts that could occur and how they can be minimised and mitigated;
- Awareness of any other environmental matters, which are deemed to be necessary by the Environmental Coordinator; and
- Training must include the environment, health and safety as well as basic HIV/ AIDS education.

The following facets to training form part of the Environmental and Social Awareness Plan:

5.4.3.1 Induction

Environmental and social awareness training will be given at induction when personnel join the company and/ or return from leave. Induction training will also be given to visitors entering the site.

5.4.3.2 Job Specific Training

Job specific training programs will be developed as and when required. The programs will be based on the significant environmental and social aspects/ impacts that are identified during regular audits and site inspections.