Archaeological, Cultural and Heritage Assessment

Archaetnos Culture & Cultural
Resource Consultants
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A REPORT ON A PRE- FEASIBILITY HERITAGE STUDY FOR THE PROPOSED YZERMYN COAL MINE CLOSE TO DIRKIESDORP, MPUMALANGA PROVINCE

For:

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DISCLAIMER:

Although all possible care is taken to identify all sites of cultural importance during the survey of study areas, the nature of archaeological and historical sites are as such that it always is possible that hidden or subterranean sites could be overlooked during the study. Archaetnos and its personnel will not be held liable for such oversights or for costs incurred as a result thereof.

The South African Heritage Resources Agency (SAHRA) or one of its subsidiary bodies needs to comment on this report and clients are advised not to proceed with any action before receiving these. It is the responsibility of the client to submit this report to the relevant heritage authority.

SUMMARY

Archaetnos cc was appointed by WSP Environment & Energy to conduct a heritage study as part of a pre-feasibility study for the proposed Yzermyn Coal Mine. This is close to Dirkiesdorp in the Mpumalanga Province. Information about the infrastructure of the mine is not yet available. Therefore a large area was surveyed. Site layout plan only became available in August 2013.

The fieldwork undertaken revealed eighteen sites of cultural heritage significance. These are discussed in the report.

No final mitigation measures can be proposed as this is a pre-feasibility study. However the importance of the sites is given and possible mitigation measures suggested. The developer also needs to take note that all archaeological and historical sites may not have been identified due to the size of the area as well as the density of vegetation. It also is possible that subterranean archaeological sites may be found later on. These need to be dealt with by an archaeologist.

CONTENTS

1. INTRODUCTION

Archaetnos cc was appointed by WSP Environment & Energy to conduct a cultural heritage study for the proposed Yzermyn Coal Mine. This is situated to the north of Dirkiesdorp in the Mpumalanga Province.

The client indicated the area where the proposed development is to take place, and the survey was confined to this area.

2. TERMS OF REFERENCE

The Terms of Reference for the survey were to:

1. Identify objects, sites, occurrences and structures of an archaeological or historical nature (cultural heritage sites) located on the property (see Appendix A).

2. Assess the significance of the cultural resources in terms of their archaeological, historical, scientific, social, religious, aesthetic and tourism value (see Appendix B).

3. Describe the possible impact of the proposed development on these cultural remains, according to a standard set of conventions.

4. Recommend suitable mitigation measures to minimize possible negative impacts on the cultural resources by the proposed development.

5. Review applicable legislative requirements.

3. CONDITIONS & ASSUMPTIONS

The following conditions and assumptions have a direct bearing on the survey and the resulting report:

1. Cultural Resources are all non-physical and physical man-made occurrences, as well as natural occurrences associated with human activity (Appendix A). These include all sites, structure and artifacts of importance, either individually or in groups, in the history, architecture and archaeology of human (cultural) development. Graves and cemeteries are included in this.

2. The significance of the sites, structures and artifacts is determined by means of their historical, social, aesthetic, technological and scientific value in relation to their uniqueness, condition of preservation and research potential. The various aspects are not mutually exclusive, and the evaluation of any site is done with reference to any number of these aspects.

3. Cultural significance is site-specific and relates to the content and context of the site. Sites regarded as having low cultural significance have already been recorded in full

and require no further mitigation. Sites with medium cultural significance may or may not require mitigation depending on other factors such as the significance of impact on the site. Sites with a high cultural significance require further mitigation (see Appendix C).

4. The latitude and longitude of any archaeological or historical site or feature, is to be treated as sensitive information by the developer and should not be disclosed to members of the public.

5. All recommendations are made with full cognizance of the relevant legislation.

6. It has to be mentioned that it is almost impossible to locate all the cultural resources in a given area, as it will be very time consuming. Developers should however note that the report should make it clear how to handle any other finds that might occur. In this particular case the area was very large and mountainous making it possible that certain areas may not have been surveyed fully. The vegetation cover in certain areas also is very dense making archaeological visibility difficult.

7. Since this is a pre-feasibility study and information relating to the infrastructure of the mine is not available, it is not possible to give mitigation measures. However the importance of sites is indicated and possible mitigation measures are envisaged.

4. LEGISLATIVE REQUIREMENTS

Aspects concerning the conservation of cultural resources are dealt with mainly in two acts. These are the National Heritage Resources Act (Act 25 of 1999) and the National Environmental Management Act (Act 107 of 1998).

4.1 The National Heritage Resources Act

According to the above-mentioned act the following is protected as cultural heritage resources:

a. Archaeological artifacts, structures and sites older than 100 years
b. Ethnographic art objects (e.g. prehistoric rock art) and ethnography
c. Objects of decorative and visual arts
d. Military objects, structures and sites older than 75 years
e. Historical objects, structures and sites older than 60 years
f. Proclaimed heritage sites
g. Grave yards and graves older than 60 years
h. Meteorites and fossils
i. Objects, structures and sites or scientific or technological value.

The national estate (see Appendix D) includes the following:

a. Places, buildings, structures and equipment of cultural significance
b. Places to which oral traditions are attached or which are associated with living heritage

c. Historical settlements and townscapes
d. Landscapes and features of cultural significance
e. Geological sites of scientific or cultural importance
f. Archaeological and palaeontological importance
g. Graves and burial grounds
h. Sites of significance relating to the history of slavery
i. Movable objects (e.g. archaeological, palaeontological, meteorites, geological specimens, military, ethnographic, books etc.)

A Heritage Impact Assessment (HIA) is the process to be followed in order to determine whether any heritage resources are located within the area to be developed as well as the possible impact of the proposed development thereon. An Archaeological Impact Assessment only looks at archaeological resources. The different phases during the HIA process are described in Appendix E. An HIA must be done under the following circumstances:

a. The construction of a linear development (road, wall, power line canal etc.) exceeding 300m in length
b. The construction of a bridge or similar structure exceeding 50m in length
c. Any development or other activity that will change the character of a site and exceed 5 000m^2 or involve three or more existing erven or subdivisions thereof
d. Re-zoning of a site exceeding 10 000 m^2
e. Any other category provided for in the regulations of SAHRA or a provincial heritage authority

Structures

Section 34 (1) of the mentioned act states that no person may demolish any structure or part thereof which is older than 60 years without a permit issued by the relevant provincial heritage resources authority.

A structure means any building, works, device or other facility made by people and which is fixed to land, and includes any fixtures, fittings and equipment associated therewith.

Alter means any action affecting the structure, appearance or physical properties of a place or object, whether by way of structural or other works, by painting, plastering or the decoration or any other means.

Archaeology, palaeontology and meteorites

Section 35(4) of this act deals with archaeology, palaeontology and meteorites. The act states that no person may, without a permit issued by the responsible heritage resources authority (national or provincial):

a. destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;
b. destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;

c. trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or

d. bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment that assists in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.

e. alter or demolish any structure or part of a structure which is older than 60 years as protected.

The above mentioned may only be disturbed or moved by an archaeologist, after receiving a permit from the South African Heritage Resources Agency (SAHRA). In order to demolish such a site or structure, a destruction permit from SAHRA will also be needed.

Human remains

Graves and burial grounds are divided into the following:

a. ancestral graves
b. royal graves and graves of traditional leaders
c. graves of victims of conflict
d. graves designated by the Minister
e. historical graves and cemeteries
f. human remains

In terms of Section 36(3) of the National Heritage Resources Act, no person may, without a permit issued by the relevant heritage resources authority:

a. destroy, damage, alter, exhume or remove from its original position of otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves;

b. destroy, damage, alter, exhume or remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority; or

c. bring onto or use at a burial ground or grave referred to in paragraph (a) or (b) any excavation, or any equipment which assists in the detection or recovery of metals.

Unidentified/unknown graves are also handled as older than 60 until proven otherwise.

Human remains that are less than 60 years old are subject to provisions of the Human Tissue Act (Act 65 of 1983) and to local regulations. Exhumation of graves must conform to the standards set out in the **Ordinance on Excavations** (**Ordinance no. 12 of 1980**) (replacing the old Transvaal Ordinance no. 7 of 1925).

Permission must also be gained from the descendants (where known), the National Department of Health, Provincial Department of Health, Premier of the Province and local police. Furthermore, permission must also be gained from the various landowners (i.e. where the graves are located and where they are to be relocated) before exhumation can take place.

Human remains can only be handled by a registered undertaker or an institution declared under the **Human Tissues Act** (**Act 65 of 1983 as amended**).

4.2 The National Environmental Management Act

This act (Act 107 of 1998) states that a survey and evaluation of cultural resources must be done in areas where development projects, that will change the face of the environment, will be undertaken. The impact of the development on these resources should be determined and proposals for the mitigation thereof are made.

Environmental management should also take the cultural and social needs of people into account. Any disturbance of landscapes and sites that constitute the nation's cultural heritage should be avoided as far as possible and where this is not possible the disturbance should be minimized and remedied.

5. METHODOLOGY

5.1 Survey of literature

A survey of literature was undertaken in order to obtain background information regarding the area. Sources consulted in this regard are indicated in the bibliography.

5.2 Field survey

The survey was conducted according to generally accepted HIA practices and was aimed at locating all possible objects, sites and features of cultural significance in the area of proposed development. If required, the location/position of any site was determined by means of a Global Positioning System (GPS), while photographs were also taken where needed. The survey was undertaken by a physical survey via off-road vehicle and on foot.

5.3 Oral histories

People from local communities are interviewed in order to obtain information relating to the surveyed area. It needs to be stated that this is not applicable under all circumstances. When applicable, the information is included in the text and referred to in the bibliography.

5.4 Documentation

All sites, objects features and structures identified were documented according to the general minimum standards accepted by the archaeological profession. Co-ordinates of individual localities were determined by means of the Global Positioning System (GPS).The information was added to the description in order to facilitate the identification of each locality.

5.5 Evaluation of Heritage sites

The evaluation of heritage sites is done by giving a field rating of each (see Appendix C) using the following criteria:

- The unique nature of a site
- The integrity of the archaeological deposit
- The wider historic, archaeological and geographic context of the site
- The location of the site in relation to other similar sites or features
- The depth of the archaeological deposit (when it can be determined or is known)
- The preservation condition of the site
- Uniqueness of the site and
- Potential to answer present research questions.

6. DESCRIPTION OF THE AREA

The area that was surveyed is situated more or less 13 km to the west of Dirkiesdorp in the Mpumalanga Province. This is more or less half way between the towns of Wakkerstroom and Piet Retief (Figure 1-2).

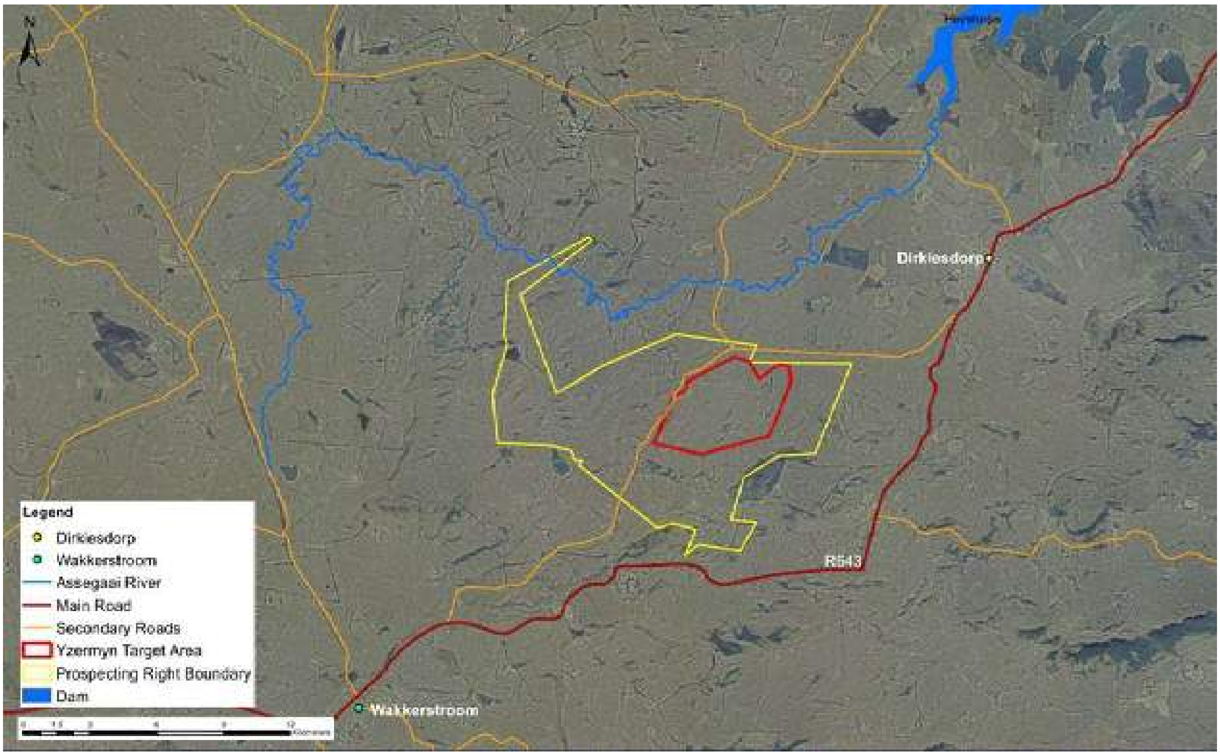

Figure 1 Location of the surveyed area.

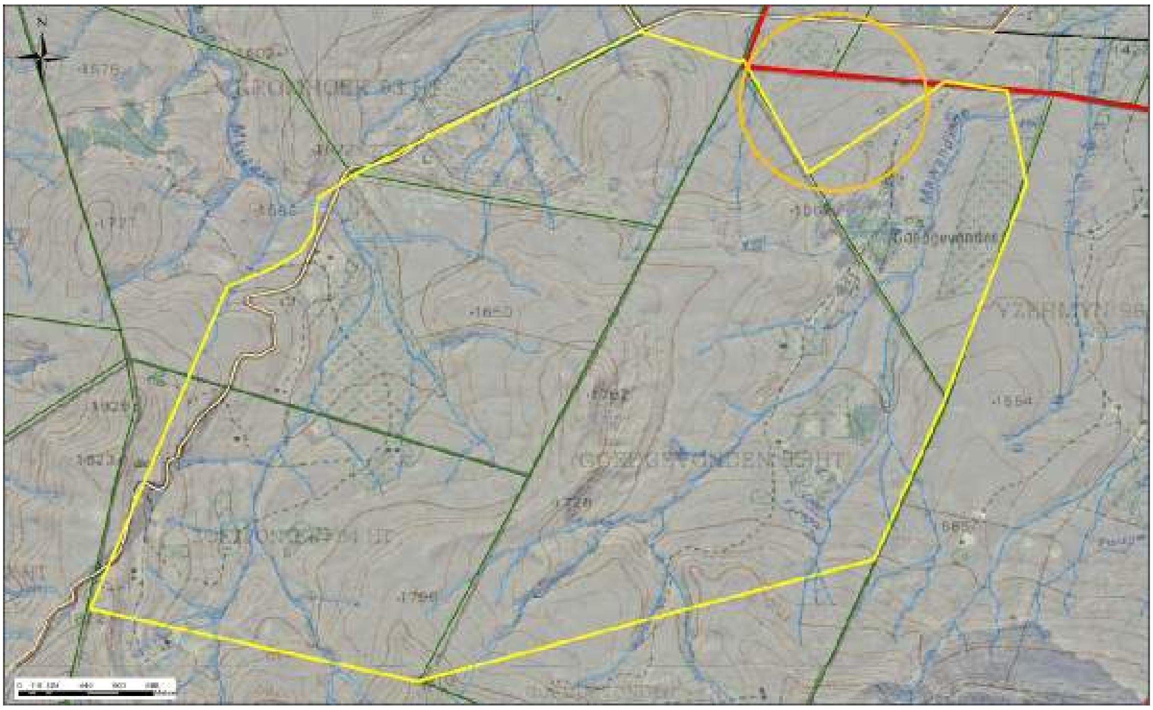

Figure 2 Location of the site indicating the proposed new developments.

The environment of the area is mostly undisturbed. However, some disturbance are seen in certain areas, mainly agriculture, grazing and previous mining activities. The vegetation cover is dominated by grassland with here and there some indigenous trees as well plantations with foreign trees in certain instances (Figure 3-5). During the survey the grass cover was reasonably long, making archaeological visibility difficult.

The area consists of high mountains with valleys in between. The topography therefore varies throughout the surveyed area. A number of rock outcrops are visible as well as a few cliffs. Different rivers and streams also cut through the landscape.

Here and there some homesteads of farm workers are found. No farm house or other farm infrastructure is visible since the farm is only used by the farmer during the winter months for grazing of livestock (Personal Communication: Johan Uys).

Figure 3 General view of the surveyed area showing mountains, grassland and a plantation.

Figure 4 Another view of the surveyed area.

Figure 5 View of a rock cliff in the surveyed area.

7. HISTORICAL CONTEXT

During the survey eighteen sites of cultural heritage significance was located in the area to be developed. However, there always is a possibility that more sites may become known later and that those need to be dealt with in accordance with the legislation discussed above. In order to enable the reader to better understand archaeological and cultural features, it is necessary to give a background regarding the different phases of human history.

Delius (2006: 86) indicates that little research has been done in the southeastern portion of Mpumalanga. Therefore other sources including data bases and text books become more important in providing information, and these have been relied on for this report.

7.1 Stone Age

The Stone Age is the period in human history when lithic material was mainly used to produce tools (Coertze & Coertze 1996: 293). In South Africa the Stone Age can be divided in three periods. It is however important to note that dates are relative and only provide a broad framework for interpretation. The division for the Stone Age according to Korsman & Meyer (1999: 93-94) is as follows:

Early Stone Age (ESA) 2 million – 150 000 years ago
Middle Stone Age (MSA) 150 000 – 30 000 years ago
Late Stone Age (LSA) 40 000 years ago – 1850 - A.D.

No Stone Age sites have been identified by scientists previously in the study area. From a map in Inskeep (1978: 67) it seems as if Early Stone Age material was identified in the south-east of Mpumalanga, but the scale of the map makes it impossible to determine exactly where these sites are situated. Also no Early Stone Age sites in the investigated area are indicated in a fairly recent publication (Mitchell 2002: 43). This is confirmed by Esterhuysen & Smith (2006: 8) who also constitutes that very little evidence of the Early Stone Age was found in Mpumalanga. They also do not mention any specific sites in the area under investigation. It can therefore be stated that no important site dating to the Early Stone Age has been recorded in the study area.

A map showing Late Stone Age sites (Inskeep 1978:85) also indicate that no such sites were found in the south-eastern part of Mpumalanga. The same goes for a map in Phillipson (1985:77) which indicate no Middle or Late Stone Age occurrences here. Similarly no Middle or Late Stone Age sites in the study area are shown on maps by Mitchell (2002: 61, 73, 110, 127, 138, 162). Again Esterhuysen & Smith (2006: 9-10) agrees and they state that very little evidence of the Middle and Late Stone Age was found in Mpumalanga. They do not mention any sites in the Piet Retief/ Wakkerstroom area. This however only indicates the lack of research in the area.

The above mentioned information is confirmed in a historical atlas which also does not show any such sites in the broader geographical area (see Bergh 1999). This includes rock art sites which usually are associated with the Late Stone Age. The lack of evidence probably rather proofs the lack of research in the area as one surely would find rock art sites in the high mountains close to Wakkerstroom and Dirkiesdorp. However, a source on the rock art of Africa (Willcocks, 1984) also does not indicate the recording of any rock art in the Wakkerstroom/ Piet Retief area. This is confirmed by Mitchell (2002: 193, 228) and Smith & Zubieta (2006: 36). Last mentioned publishes a list of known rock paintings and engravings in Mpumalanga, which does not include any in the investigated area. However, a popular publication about Wakkerstroom indicates that rock art have been identified on the farms Rietvlei, Driefontein and Doornhoek (Hofmeyr & Smith 2009: 40). Driefontein is adjacent to the area that has been surveyed for this study.

The database of the South African Heritage Resources Agency (SAHRA) and the Archaeological Data Recording Centre (ADRC) at the National Cultural History Museum (NCHM) also does not list any Stone Age sites in this area. Apart from the lack of research it should be mentioned that the lack of heritage surveys done in the area, may be contributing factors for this.

From the above mentioned it is difficult to state that Stone Age people did utilize and settled in the area. However, it is highly unlikely that they would not have been present here. This is corroborated by Hofmeyr & Smith (2009: ix) which do indicate that San people settled close to Wakkerstroom during the 1500's, but this is not a scientific publication and the information needs to be verified. There probably are many sites to be identified and developers should therefore be careful when any large projects are planned.

A number of natural shelters were seen during the survey and therefore it is possible that these people may have utilized these. One rock art site was found in such a shelter. The close vicinity of water sources and ample grazing would have made it a prime spot for hunting and obtaining water during the past. Therefore one may assume that Stone Age people probably would have used through the area.

7.1 Iron Age

The Iron Age is the name given to the period of human history when metal was mainly used to produce metal artifacts (Coertze & Coertze 1996: 346). In South Africa it can be divided in two separate phases according to Van der Ryst & Meyer (1999: 96-98), namely:

Early Iron Age (EIA) 200 – 1000 A.D.
Late Iron Age (LIA) 1000 – 1850 A.D.

Huffman (2007: xiii) however indicates that a Middle Iron Age should be included. His dates, which now seem to be widely accepted in archaeological circles, are:

Early Iron Age (EIA) 250 – 900 A.D.
Middle Iron Age (MIA) 900 – 1300 A.D.
Late Iron Age (LIA) 1300 – 1840 A.D.

No Early or Middle Iron Age sites have been identified in the area of study (Mitchell 2006: 260; Bergh, 1999: 6-7; Phillipson, 1984: 174; Inskeep, 1978: 120). It however needs to be said that very few Early Iron Age sites have been identified throughout South Africa. Again this points to a lack of research. Proper surveys and research may therefore provide evidence of this period in time in the wider geographical area, especially since Early Iron Age sites are known to both the north and south hereof, in Lydenburg and Kwazulu-Natal. No sites from the Early, Middle or Late Iron Age are included on the SAHRA or NCHM database.

However the historical atlas does show that a large number of Late Iron Ages sites are found in the south-east of Mpumalanga. Late Iron Age sites are the easiest of all archaeological sites to identify as it usually contains a variety of stone walls and are situated against the slopes or on top of hills and mountains. In a band stretching from Wakkerstroom in the east to far within the boundaries of the Free State Province, 823 sites have been identified. Unfortunately no specific sites are mentioned (Bergh 1999: 7).

At none of these sites signs of archaeo-metallurgy were found (Bergh 1999: 8-9). Inskeep (1978: 135) does however indicate that iron ore was mined by prehistoric people in the broader geographical area. Again his information is not location specific.

Other scholars (Inskeep 1978: 137; Huffman 2007: 32) also indicate stone walled settlements in this area, without giving any particulars of the locations or mentioning any names of sites. According to Esterhuysen & Smith (2006: 11) Late Iron Age people moved into the Highveld areas of Mpumalanga by the 12th century. Huffman (2007: 301) indicates that Iron Age people from the Maguga facies of the Kalundu tradition inhabited this area as early as 1100 A.D. He also does not mention specific sites.

During CA 1760 Swazi people settled at kwaMadlangampisi. This was the start of the Tshabalala dynasty (Hofmeyr & Smith 2009: ix). Even today the Swazi's are the most dominant group in the area.

The people that inhabited the southern parts of Mpumalanga before the 19th century were the Bakgatla, Barolong, Bantwane, Bakone, Bakopa and Southern Ndebele communities (Makhura 2006: 42). The Eastern-Sotho, in this case consisting of the BaPai, inhabited an area close to modern day Swaziland during the 17th century (Makhura 2006: 50). The sites mentioned probably are the remains of their settlements.

Again it should be emphasized that chances are good that more Iron Age material will be identified in this area, should more research and heritage surveys be done in future.

7.2 Historical Age

The historical age started with the first recorded oral histories in the area. It includes the moving into the area of people that were able to read and write. This era is sometimes called the Colonial era or the recent past.

Due to factors such as population growth and a decrease in mortality rates, more people inhabited the country during the recent historical past. Therefore and because less time has passed, much more cultural heritage resources from this era have been left on the landscape. It is important to note that all cultural resources older than 60 years are potentially regarded as part of the heritage and that detailed studies are needed in order to determine whether these indeed have cultural significance. Factors to be considered include aesthetic, scientific, cultural and religious value of such resources.

None of the early trade routes in the interior of South Africa went through the area of study (Bergh 1999: 9). However it is possible that due to the little research in the area, this still has to be discovered. It also is possible that secondary routes did pass through the south-east of Mpumalanga.

At the beginning of the 19th century a Sotho group, the Phuthing, inhabited the western section of southern Mpumalanga. To the south-east the Swazi were present (Delius 2006: 83-86; Bergh 1999: 10). It was therefore mainly the Swazi who inhabited the south-eastern parts of Mpumalanga during this time (Makhura 2006: 55; Mitchell 2006: 371). In 1800 Dingiswayo fled to Hlubi close to Wakkerstroom. He died in 1818 and his empire was taken over and strengthened by Shaka (Hofmeyr & Smith 2009: ix).

During the Difaquane (1820-1837) the Ndebele of Mzilikazi moved through this landscape and some even settled here. As a result the Phuthing fled to the south. The Swazi now moved to the north and west, therefore inhabiting the area (Bergh 1999: 11; Bergh & Bergh 1984: 22). One would therefore expect remains of settlements of all three these groups, although the Ndebele of Mzilikazi usually didn't develop their own settlements but reused those of the people they conquered.

Early white travelers did not travel to this area (Bergh 1999: 12-13**)**. White farmers only moved into the south-eastern Mpumalanga after 1853 when the government of the South African Republic (ZAR or Transvaal) traded the land from the Swazi. Wakkerstroom became a town and district in 1859 (Bergh 1999: 17-19). The town was originally known as Marthinus Wesselstroom. Dirk Cornelius Uys was the founder of the town. He and his wife are buried in the municipal cemetery in the town (Smit n.d.: 1). The town mainly served as market for local farmers (Hofmeyr & Smith 2009: 42).

Missionaries also came to this part of the country during the 19th century. The Dutch Reformed Church and the Hermannsburg Missionaries established mission stations at Volksrust and Wakkerstroom during this time (Bergh 1999: 57).

During the Anglo-Transvaal War (1880-1881) the south-eastern part of Mpumalanga was the focus point of battles between the British and the Boers. The British had a camp in Wakkerstroom and were beleaguered by the Boers. Three important battles were fought during this time. These were at Laingsnek on 25 January 1881, Schuinshoogte on 8 February 1881 and Amajuba on 27 February 1881. The Boers were victorious in all of these which led to peace being declared (Bergh 1999: 46). Although these sites are all situated close to the town of Volksrust, it does indicate that commandos may have moved through the entire area. In the Wakkerstroom cemetery there is a commemorative stone for 18 British soldiers who died during this War (Smit n.d.: 1).

The broader geographical area also experienced some action during the Anglo-Boer War (1899-1902). During the British offensive, Lt-genl R Buller moved through the area and occupied Volksrust on 12 June 1900. He then moved further to the north and reached Amersfoort on 7 August 1900. At this time Boer commandos were placed at Laingsnek and Amajuba, but Buller had them on the retreat. They moved through Volksrust and Amersfoort. The only battle in this area was on 22 July 1900 when a skirmish broke out to the north of Volksrust, between the Boer commando of General D Joubert and the British troops under command of Genl Coke (Bergh 1999: 51). There were however also a skirmishes, namely at Kastrolsnek, close to Wakkerstroom (Hofmeyr & Smith 2009: 96).

The British later established a concentration camp for the Boer woman and children in Volksrust (Bergh 1999: 54). A memorial for British soldiers who died during the War is found in the Wakkerstroom municipal cemetery (Smit n.d.: 1).

The British also occupied Wakkerstroom and established a large camp here. This included blockhouses at Kastrolsnek (Hofmeyr & Smith 2009: 99). They also erected some blockhouses (small fortifications) in the broader geographical area during this War. Between Volksrust and Wakkerstroom they build 19 of these and the line of blockhouses was completed on 6 February 1902. Unfortunately it is not known how many of these survived even partially.

Between Wakkerstroom and Piet Retief the remains of 11 blockhouses were identified. Some of these are no more than a few stones left on some farms (Van Vollenhoven & Van den Bos, 1997: 67-77). Again this indicates that both Boer and British commandos moved through the area and remains of their fortifications may be found along these routes.

A further indication of the lack of research and heritage work in the south-east of Mpumalanga comes from the SAHRA list of declared heritage sites. The only declared provincial sites in the area are buildings and streetscapes in some of the towns.

Although not formally declared, many historical buildings are found in south-eastern Mpumalanga. This would be mostly sandstone buildings typical of the years approximately 1870-1920 as well as Victorian architecture from the 1890's to early in the twentieth century. Many of the latter were probably built during the Anglo- Boer War and are usually made of corrugated iron. However these are mostly to be found in the towns with only a few located on farms.

The last kind of heritage site to refer to is graves. All graves older than 60 years are regarded as being heritage graves. Those with an unknown date are also regarded as heritage graves. Graves of this age will be found in all the formal municipal cemeteries in the area. However, many informal cemeteries on farms and close to traditional homesteads are also present. It is impossible to predict where these may be located as they are placed randomly within communities. Some of these were indeed found within the surveyed area.

The historical features and sites se are mostly dominant in and around the historically white towns, but some will be found on remote areas on farms and in the mountains. As is the case with the prehistory of the area, proper research and heritage surveys in the area are needed to compile a more complete list.

8. DISCUSSION OF SITES IDENTIFIED DURING THE SURVEY

8.1 Site 1

The site consists of two small circular structures made from stone (Figure 6). The stones are nothing more than a foundation and the size thereof is approximately 2,5 m in diameter. It may have been used for ritual initiation purposes during the Late Iron Age, but it also may have another, yet unknown function.

Figure 6 One of the stone circles at site no. 1.

GPS: 27°13.435'S
30°18.461'E

The site has a **medium** cultural significance based on its historic and social value. It has a general local significance and is therefore given a rating of Grade B (IVB). This report is seen as ample mitigation and it may therefore be demolished during site development.

8.2 Site 2

The site consists of a semi-circular stone wall of approximately 4 m long and 0,5 m high (Figure 7). It is on a high vantage point and a flat stone on top gives the impression that it may have a defensive purpose. It is therefore suggested that it may be a fortification wall erected during the Anglo Boer War.

GPS: 27°13.372'S
30°18.480'E

The site has a **medium** cultural significance based on its historic value. It has a general local significance and is therefore given a rating of Grade B (IVB). A phase II study is recommended. This should entail the drawing of the structure after which it may be demolished.

Figure 7 Site no. 2, a defensive wall.

8.3 Site 3

This is a Late Iron Age/ Historical structure. It is a circular stone enclosure (Figure 8) used for keeping cattle. The structure is approximately 30 m in diameter and the walls still 0,5 m high. Since no other structure is found nearby, this is a cattle outpost.

GPS: 27°13.490'S
30°18.448'E

The site has a **low** cultural significance since it is not very unique. It has a general local significance and is therefore given a rating of Grade C (IVC). This report is seen as ample mitigation and it may therefore be demolished during site development.

Figure 8 Part of the stone walling at site no. 3.

8.4 Site 4

This is another Late Iron Age/ Historical site consisting of one circular stone wall (Figure 9). The structure is approximately 30 m in diameter and 0,30 m high. Again this is probably a cattle outpost. It is situated in one of the saddles between the high ridges.

GPS: 27°13.863'S
30°17.756'E

Figure 9 Part of the stone walling site no. 4.

The site has a **low** cultural significance based on its historic and social value. It has a general local significance and is therefore given a rating of Grade B (IVB). This report is seen as ample mitigation and it may therefore be demolished during site development.

8.5 Site 5

Figure 10 Site no. 5.

This is another Late Iron Age/ Historical site consisting of one circular stone wall (Figure 10-11). The structure is approximately 20 m in diameter and 0,30 m high. Again this is probably a cattle outpost. It is situated in one of the saddles between the high ridges and reasonably close to sites 4 and 6.

GPS: 27°13.775'S
30°13.755'E

The site has a **low** cultural significance based on its historic and social value. It has a general local significance and is therefore given a rating of Grade B (IVB). This report is seen as ample mitigation and it may therefore be demolished during site development.

Figure 11 View of site no. 5 and 6. This gives an indication of the location of such sites. The saddles between the high mountains should therefore be regarded as areas where stone walled sites may be identified.

8.6 Site 6

This is a Historical site consisting of a rectangular enclosure (Figure 12). The structure has measurements of approximately 6 x 4 m and 0,80 m high. Again this is probably a cattle outpost. It is situated in one of the saddles between the high ridges and reasonably close to sites 4 and 5.

GPS: 27°13.722'S
30°17.723'E

The site has a **low** cultural significance based on its historic and social value. It has a general local significance and is therefore given a rating of Grade B (IVB). This report is seen as ample mitigation and it may therefore be demolished during site development.

Figure 12 Site no. 6.

8.7 Site 7

Figure 13 Remains of a stone hut marked as site no. 7.

This is another Late Iron Age/ Historical site. It consists of one circular stone wall with a diameter of about 3 m and 0,50 m high (Figure 13). This is a hut most likely used by the cattle herder at one of these outposts (it is reasonably close to these).

GPS: 27°13.677'S
30°17.663'E

The site has a **low** cultural significance based on its historic and social value. It has a general local significance and is therefore given a rating of Grade B (IVB). This report is seen as ample mitigation and it may therefore be demolished during site development.

8.8 Site 8

This is another Late Iron Age/ Historical site consisting of a circular stone walled enclosure (Figure 14). The structure has a diameter of approximately 25 m and 0,50 m high. Again this is probably a cattle outpost.

GPS: 27°13.621'S
30°17.617'E

The site has a **low** cultural significance based on its historic and social value. It has a general local significance and is therefore given a rating of Grade B (IVB). This report is seen as ample mitigation and it may therefore be demolished during site development.

Figure 14 Stone walled enclosure marked site no. 8.

8.9 Site 9

This is a small grave yard consisting of at least six graves (Figure 15). It is found at the site of an abandoned homestead. The graves are stone packed and have no headstones or information.

The graves therefore have an unknown date of death, but is seems as if the homestead was abandoned fairly recently. Therefore the graves are more than likely younger than 60 years. It should however be regarded as heritage graves until this can be confirmed.

GPS: 27°13.865'S
30°16.852'E

Figure 15 One of the graves at site no. 9.

Graves always are regarded as having a **high** cultural significance. These graves are of a local significance and are therefore given a rating of Grade IIIB. It may therefore be mitigated.

There are two options when dealing with graves. The first would be to fence it in and write a management plan for the preservation thereof. This option will come into play if there is no direct impact on the graves. It should be kept in mind that there always is a secondary impact on graves since families may not have access thereto once a mine comes into operation.

The second option is to have the graves exhumed and the bodies reburied. This option is preferred when graves cannot be avoided by the development. Before exhumation can be done a process of social consultation is needed in order to find the associated families and obtain permission from them. For graves younger than 60 years only an undertaker is involved in the process, but for those older than 60 years or with an unknown date of death, an undertaker and archaeologist should be involved.

8.10 Site 10

This is another Late Iron Age/ Historical site. It consists of two structures. The first one is similar to the hut remains (site 7) made of stone (Figure 16). The second one consists of a circular stone walled structure with an L-shaped wall attached thereto (Figure 17). This first structure is a hut most likely used by the cattle herder at the outposts. The second is the cattle kraal linked thereto.

GPS: 27°13.505'S
30°17.736'E

The site has a **medium** cultural significance based on its historic value. It has a general local significance and is therefore given a rating of Grade B (IVB). A phase II study will be needed if the site is to be demolished. This would entail drawing a plan of the site.

Figure 16 Remains of stone hut at site no. 10.

Figure 17 Part of the stone walling at the kraal of site no. 10.

8.11 Site 11

This is the ruins of a house and outbuildings from the Historical period. It is found within a wattle and eucalyptus plantation and may therefore possibly be linked to the forestry history of the area. There are two main structures, the first being a house and the second a rondavel. The structures are built from stone (Figure 18).

Figure 18 Site no. 11.

GPS: 27°13.459'S
30°18.839'E

The site has a **low** cultural significance based on its historic value as it is not very unique. It has a general local significance and is therefore given a rating of Grade C (IVC). This report is seen as ample mitigation in this regard.

8.12 Site 12

The site consists of stones packed in an L-shape (Figure 19). The function thereof is unknown, but it may have something to do with the outline of a farm road.

GPS: 27°13.782'S
30°18.549'E

The site has a **low** cultural significance based on its historic value as it is not very unique. It has a general local significance and is therefore given a rating of Grade C (IVC). This report is seen as ample mitigation in this regard.

Figure 19 Stone wall at site no. 12.

8.13 Site 13

This is a recent site inside of the riverbed of one of the streams in the surveyed area. It consists of stone walls which seem to have the function of damming up the river (Figure 20).

According to the farmer this was done by the previous farmer (J Uys: Personal communication).

GPS: 27°13.792'S
30°18.596'E

The site has a **low** cultural significance based on its historic value as it is not very unique. It has a general local significance and is therefore given a rating of Grade C (IVC). This report is seen as ample mitigation in this regard.

Figure 20 Possible dam wall at site no. 13.

8.14 Site 14

Site 14 consists of three structures. It is the remains of three buildings built from stone (Figure 21). All of these are connected to the early mining history of the area. Two of these probably are houses, but the third is quite large. It may be communal accommodation or it may have been used for offices.

GPS: 27°13.200'S
30°17.170'E

Figure 21 One of the buildings at site no. 14.

The site has a **medium** cultural significance based on its historic and aestetic value. It has a general local significance and is therefore given a rating of Grade B (IVB). The buildings should be documented if it is going to be demolished.

8.15 Site 15

Site 15 consists of a number of shafts and related features linked to the early mining history of the area (Figure 22). The shafts are cut into the rock face and seem to run in a horizontal direction.

GPS: 27°13.321'S
30°17.269'E

Figure 22 The adit entrance at site no. 15.

The site has a **medium** cultural significance based on its historic value. It has a general local significance and is therefore given a rating of Grade B (IVB). This report is seen as ample mitigation in this regard and it may therefore be demolished if needed.

8.16 Site 16

This is a small grave yard (amatuna) consisting of at least six graves (Figure 23). Two of these are fenced in by a stone wall. It is found at the site of a homestead. This most likely means that one will find some family graves at all the homesteads in the surveyed area. The graves are stone packed and have headstones made from stone, but without any information.

The graves therefore have an unknown date of death, but is seems as if the homestead was abandoned fairly recently. Therefore the graves are more than likely younger than 60 years. It should however be regarded as heritage graves until this can be confirmed.

GPS: 27°13.585'S
30°16.841'E

Graves always are regarded as having a **high** cultural significance. These graves are of a local significance and are therefore given a rating of Grade IIIB. It may therefore be mitigated.

Figure 23 The two fenced in graves at site no. 16.

There are two options when dealing with graves. The first would be to fence it in and write a management plan for the preservation thereof. This option will come into play if there is no direct impact on the graves. It should be kept in mind that there always is a secondary impact on graves since families may not have access thereto once a mine comes into operation.

The second option is to have the graves exhumed and the bodies reburied. This option is preferred when graves cannot be avoided by the development. Before exhumation can be done a process of social consultation is needed in order to find the associated families and obtain permission from them. For graves younger than 60 years only an undertaker is involved in the process, but for those older than 60 years or with an unknown date of death, an undertaker and archaeologist should be involved.

8.17 Site 17

Site 17 is a rock shelter with rock paintings against the back wall. No sign of Stone Age artifacts have been found, but these may be concealed under a layer of soil and rodent droppings on the floor of the shelter. The whole rock face have been weathered and there probably were much more paintings originally. It also is possible that the paintings may have been damaged by people who tried to remove it.

The panel consists of two sections (Figure 24-25). On the left hand side one figure is visible and on the right a number of at least eight figures. These are divided by red ochre lines in between. All the figures are monochrome – only red ochre has been used. The figure on the left hand side may be that of a woman.

Rock art are usually linked to the San people. It dates to the Late Stone Age.

GPS: 27°13.297'S
30°17.595'E

Figure 24 View of the rock painting at site no. 17.

Figure 25 Another view of the rock painting at site no. 17.

The site is regarded as having a **high** cultural significance due to its aestetic, historical, scientific and social value. Every rock art site is unique. The painting has a local significance and is therefore given a rating of Grade IIIB. It may therefore be mitigated. (Normally a site such as this one would be given a rating of Grade IIIA. However, this site is exposed to such an extent that the rock art will not last for very long.) It should therefore be mitigated by having it documented by drawing thereof. It should however never be demolished on purpose (the site should be avoided) and should be preserved as long as natural factors allows.

8.18 Site 18

This is another area containing a number of shafts and related features linked to the early mining history of the area (Figure 26). The shafts are cut into the rock face and seem to run in a horizontal direction.

GPS: 27°12.878'S
30°19.367'E

The site has a **high** cultural significance based on its historic and scientific value. The site is given a higher grading as site no 15 for two reasons. Firstly the site is aesteticly more pleasing and accessible which means it should be much easier to utilise for research purposes. Secondly some artifacts close to the entrance were found indicating that this particular shaft dates back to the late 19th/ early 20th century.

The site receives a field rating of provincial significance, meaning Grade II. The site may therefore not be demolished and should be managed as part of the provincial estate.

Figure 26 Entrance to the mine at site no. 18.

9. CONCLUSIONS AND RECOMMENDATIONS

It is concluded that the assessment of the area was conducted successfully. In the surveyed area 18 sites (Figure 27) of cultural significance have been found. The mining will be undertaken underground and if the recommendations contained herein are complied with, the impact to the cultural sites identified within this report may not be impacted.

Figure 27 Google map indicating the location of sites found during the survey.

The final recommendations are as follows:

- It needs to be states that this is a pre-feasibility study. As this assessment was undertaken in 2012, no site layout was available. Recommendations given are therefore very broad and should be taken into consideration during future planning.

- In all instances where it is indicated that sites may be demolished, this means if the development will have an impact thereon. Should it not be the case, the sites should be left to natural degradation.

- Sites number 3, 4, 5, 7 and 8 (Late Iron Age/ Historical sites) as well as site 6, 11, 12 and 13 (recent Historical sites) all have a low cultural significance. This report is seen as ample mitigation and it may therefore be demolished during development.

- Site number 1 (stone circles) and number 15 (old mine shafts) are regarded as having a medium cultural significance. The report is also seen as ample mitigation in this regard and these may therefore also be demolished during development.

- Site number 2 (fortification wall), number 10 (Late Iron Age/ Historical site) and number 14 (old mine buildings) are given a cultural significance of medium. These should however be further mitigated by drawing plans thereof after which it may be demolished.

- Sites number 9 and 16 (graves) have a high cultural significance. Should it be directly impacted on by the mine the graves may be exhumed and the human remains reburied. Before this may happen the necessary advertising, possible social consultation and permitting applications should be implemented. Should these not be impacted on directly, there will definitely be a secondary impact. The graves should then be fenced in a management plan for the preservation and maintenance thereof be written.

- Site number 17 (rock art) is also regarded as having high cultural significance. The rock art should therefore be documented. Due to natural factors it would unfortunately be impossible to preserve the site. It may however not be demolished, but should be left to deteriorate via natural processes. Even if there is no direct impact, the site should be documented as it is of high scientific value a record thereof needs to be retained for eternity.

- Site number 18 (old mine shaft) is also given a rating of high cultural significance. It should be preserved and managed, but no documentation more than what was done in this report is needed.

- The recommendations therefore mean that the areas where sites number 17 and 18 are found, are no-go areas.

- It should be remembered that due to the natural factors indicated in the report and the size of the surveyed area, it is possible that more cultural sites may be present. Also the subterranean presence of archaeological and/or historical sites, features or artifacts are always a distinct possibility. As indications of all three phases of past human activities were found this increase the possibility. Therefore a detailed survey is recommended once information is available on infrastructure, the mine plan and other site developments. Care should also be taken when development work commences that if any more artifacts are uncovered, a qualified archaeologist be called in to investigate.

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APPENDIX A

DEFINITION OF TERMS:

Site: A large place with extensive structures and related cultural objects. It can also be a large assemblage of cultural artifacts, found on a single location.

Structure: A permanent building found in isolation or which forms a site in conjunction with other structures.

Feature: A coincidental find of movable cultural objects.

Object: Artifact (cultural object).

(Also see Knudson 1978: 20).

APPENDIX B

DEFINITION/ STATEMENT OF HERITAGE SIGNIFICANCE:

Historic value:	Important in the community or pattern of history or has an association with the life or work of a person, group or organization of importance in history.
Aestetic value:	Important in exhibiting particular aesthetic characteristics valued by a community or cultural group.
Scientific value:	Potential to yield information that will contribute to an understanding of natural or cultural history or is important in demonstrating a high degree of creative or technical achievement of a particular period
Social value:	Have a strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.
Rarity:	Does it possess uncommon, rare or endangered aspects of natural or cultural heritage.
Representivity:	Important in demonstrating the principal characteristics of a particular class of natural or cultural places or object or a range of landscapes or environments characteristic of its class or of human activities (including way of life, philosophy, custom, process, land-use, function, design or technique) in the environment of the nation, province region or locality.

APPENDIX C

SIGNIFICANCE AND FIELD RATING:

Cultural significance:

- Low	A cultural object being found out of context, not being part of a site or without any related feature/structure in its surroundings.
- Medium	Any site, structure or feature being regarded less important due to a number of factors, such as date and frequency. Also any important object found out of context.
- High	Any site, structure or feature regarded as important because of its age or uniqueness. Graves are always categorized as of a high importance. Also any important object found within a specific context.

Heritage significance:

- Grade I	Heritage resources with exceptional qualities to the extent that they are of national significance
- Grade II	Heritage resources with qualities giving it provincial or regional importance although it may form part of the national estate
- Grade III	Other heritage resources of local importance and therefore worthy of conservation

Field ratings:

- National Grade I significance	should be managed as part of the national estate
- Provincial Grade II significance	should be managed as part of the provincial estate
- Local Grade IIIA	should be included in the heritage register and not be mitigated (high significance)
- Local Grade IIIB	should be included in the heritage register and may be mitigated (high/ medium significance)
- General protection A (IV A)	site should be mitigated before destruction (high/ medium significance)
- General protection B (IV B)	site should be recorded before destruction (medium significance)
- General protection C (IV C)	phase 1 is seen as sufficient recording and it may be demolished (low significance)

APPENDIX D

PROTECTION OF HERITAGE RESOURCES:

Formal protection:

National heritage sites and Provincial heritage sites – grade I and II
Protected areas - an area surrounding a heritage site
Provisional protection – for a maximum period of two years
Heritage registers – listing grades II and III
Heritage areas – areas with more than one heritage site included
Heritage objects – e.g. archaeological, palaeontological, meteorites, geological specimens, visual art, military, numismatic, books, etc.

General protection:

Objects protected by the laws of foreign states
Structures – older than 60 years
Archaeology, palaeontology and meteorites
Burial grounds and graves
Public monuments and memorials

APPENDIX E

HERITAGE IMPACT ASSESSMENT PHASES

1. Pre-assessment or scoping phase – establishment of the scope of the project and terms of reference.
2. Baseline assessment – establishment of a broad framework of the potential heritage of an area.
3. Phase I impact assessment – identifying sites, assess their significance, make comments on the impact of the development and makes recommendations for mitigation or conservation.
4. Letter of recommendation for exemption – if there is no likelihood that any sites will be impacted.
5. Phase II mitigation or rescue – planning for the protection of significant sites or sampling through excavation or collection (after receiving a permit) of sites that may be lost.
6. Phase III management plan – for rare cases where sites are so important that development cannot be allowed.

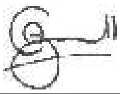
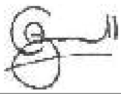
Surface Water Impact Assessment

PROPOSED YZERMYN UNDERGROUND COAL MINE - HYDROLOGICAL ASSESSMENT

Atha-Africa Ventures (Pty) Ltd

2013/08/16

Quality Management

Issue/revision	Issue 1	Revision 1	Revision 2	Revision 3
Remarks	Final Report	Final Report		
Date	August 2013	August 2013		
Prepared by	A. Gemmell	A. Gemmell		
Signature				
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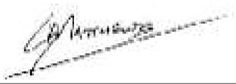
Signature				
Project number	24514-004			
File reference	G:\000 Projects\000 LRGE\LRGE Live Projects\24514 - Task 4 - Yzerrmyn EIA Hydrology\5 Reports\Final			

PROPOSED YZERMYN UNDERGROUND COAL MINE - HYDROLOGICAL ASSESSMENT

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2013/08/16

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Table of Contents

1 Introduction and Terms of Reference

WSP Environment & Energy (WSP) was appointed by Atha-Africa Ventures (Pty) Ltd (Atha) to undertake an Environmental and Socio-Economic Impact Assessment (ESIA), with all associated specialist studies in support of a Mining Right Application for a proposed underground coal mine located within a prospecting right in the Dirkiesdorp area in the Mpumalanga Province. The ESIA aims to fulfil the requirements of the Equator Principles and International Finance Corporation (IFC) standards and guidelines.

As part of the specialist studies, WSP carried out a hydrological assessment to determine the potential impacts of the proposed mine on both water quantity and quality of the receiving hydrological environment. This report outlines the results of this study.

2 Project Description

Atha has been granted the prospecting rights to an 8360 ha coal prospect area, comprising 10 farms some 58 km south-west of Piet Retief in the Mpumalanga Province (**Figure 1**). A two-phased approach has been suggested, with the first phase being aimed at bringing a target area of some 2,500 hectares into production, while the remainder of the area is to further explored and developed.

The proposed project mine area contained within the prospecting right (**Figure 2**) is named Yzermyn Underground Coal Mine after the farm of the same name incorporated into the project area (Farm Yzermyn 96, Portion 1 and remaining extent). Atha has appointed Mindset Mining Consultants (Pty) Ltd (Mindset) to undertake the project planning, engineering and development of the mine and to manage the mining right application process.

It is anticipated that the mine will produce approximately 1.8 million tonnes per annum from eight underground sections with a washing plant onsite. On the basis of the measured reserves, the initial life of mine is calculated to approximately 15 years, with the potential for extension based on resources in the remaining areas.

It is anticipated that the coal will be transported to a coal wash plant on the surface that will be crushed and washed prior to transportation offsite. The wash plant is designed to maximise the recovery of sellable coal and minimise the discard quantity. Discard from wash plant will be deposited on the discard dump and the washed coal will be stockpiled. Provision has been allowed for discard disposal whilst the product will be transported by road to the existing Piet Retief Coal Siding (operated by Jindal) near Piet Retief for dispatch to Richards Bay Coal Terminal. The haul route will take the unpaved road through the village of Dirkiesdorp, which is situated about 13km from the proposed mine site.

The proposed development plan is represented in **Appendix A** and can be summarised as follows:

- The mine adit is located to the south-east of the proposed development footprint, from which runs a stockpile conveyor leading to the Run of Mine (ROM) stockpile, processing plant and primary and secondary stockpiles. The stockpile areas are expected to be underlain by hardstanding.
- East of the stockpiles is located the administrative and operations area, including the office block, ablutions, workshop, oil store, gas/chemical store, wash bay and associated silt trap, parking areas and sewage plant. The majority of the proposed administration area is expected to be covered by hardstanding.
- West of the stockpiles is the proposed Water Treatment Plant (WTP) and Pollution Control Dam (PCD).
- An access road is proposed to lead from the existing road located adjacent to the northern boundary of the site. A weigh bridge and office is proposed on the portion of this access road north-east of the administration area.
- A co-disposal facility (referenced as a discard dump on the development plan) is proposed north of the mine and administration area. No design was given for this facility, but in line with other coal mine co-disposal facilities, it is expected that this facility will comprise an above-ground reservoir constructed from coarse coal discard, and used to contain slurry derived from the processing plant (including coal wash water).
- As indicated in the available mine plan, a cut-off trench is proposed to surround the proposed surface infrastructure area, forming the boundary. This acts to prevent clean water entering the mine area and dirty water from leaving the mine area.

3 Scope of Work

The objective of the hydrological assessment associated with the proposed underground mine is to determine the potential impacts of the mining activities on the local and regional surface water in terms of both quantity and quality related impacts. The scope of work covered as part of the hydrological assessment included:

- Desktop review of environmental conditions;
- Site reconnaissance;
- Baseline flow measurements;
- Develop a water balance for the proposed mine;
- Development of a desktop hydrological model to represent baseline and post-development watercourse flow conditions;
- Baseline water quality assessment; and
- Impact assessment and identification of mitigation measures.

4 Legal Context

The objective of the hydrological assessment is to limit any potential impacts of the proposed development to the surface water resources. The National Water Act (No. 36 of 1998) (NWA) was used as the guidance document to meet this objective.

The preamble to the NWA 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 Act is stated, in Section 2 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.

The NWA presents strategies to facilitate sound management of water resources, provides for the protection of water resources, and regulates use of water by means of Catchment Management Agencies, Water User Associations, Advisory Committees and International Water Management.

5 Approach

5.1 Desktop Review

A desktop review was conducted to determine the local and regional geoenvironmental characteristics associated with the proposed mine. This review included the following information sources:

- Available documentation to define the geological, hydrological and climatic conditions:
  - Jeffrey, L. 2005. Challenges associated with further development of the Waterberg Coalfield. *The Journal of The South African Institute of Mining and Metallurgy* **105**.
  - Water Research Commission (WRC), 1994. The Surface Water Resources of South Africa, 1990, Volume VI, Eastern Escarpment (WRC Report No 298/6.1/94 and 298/6.2/94).
  - Schulze, RE. 1995. Hydrology and Agrohydrology: A text to accompany the ACRU 3.00 Agrohydrological Modelling System. Water Research Commission, Pretoria, Report TT69/95.

- Schmidt, EJ and Schulze, RE. 1987. Flood Volume and Peak Discharge from Small Catchments in Southern Africa based on the SCS Technique, Water Research Commission, Pretoria, Report TT31/87.

- Groundwater specialist report:
  - Irene Lea Environmental and Hydrogeology. 2013. Yzermyn Underground Coal Mine: Numerical Groundwater Model. Draft Report. July 2013.
- Relevant mapping for the area to define the regional setting, topography, geology, vegetation, soils and land use, including:
  - Mucina, L. & Rutherford, M.C. (eds), Reprint 2011. The Vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria;
  - Department of Agriculture, Forestry and Fisheries (DAFF) (2012). Environmental data for South Africa in GIS format.
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5.2 Site Assessment

A site walkover was conducted by Andrew Gemmell and Ayanda Mthalane of WSP between the 1st and 5th of July 2013. The objective was to groundtruth the information gathered during the desktop review, focussing on the watercourses with the potential to be impacted by the proposed mining development. Key aspects considered during the site assessment included:

- General catchment characteristics (i.e. topography, general soil types, soil depth, vegetation, and landuse);
- Current state of the drainage channels, streams and rivers (i.e. channel dimensions, channel characteristics, vegetation); and
- Observation of anticipated low flow conditions.

5.3 Baseline Flow Measurement

The proposed mining activities have the potential to impact the baseflow contributions to the regional water courses as a result of the proposed dewatering of the mine during operations. Estimations of baseflow were therefore undertaken as part of the hydrological assessment.

As no flow gauges are located on the watercourses in the vicinity of the proposed mine, baseline flow measurements were taken during the site reconnaissance in order to determine the potential magnitude of the baseline baseflow conditions within the water courses (i.e. mid-winter). The flow rates were calculated through the following methodology:

- A cross sectional river profile was determined at key hydrological nodes. . This was used to calculated the cross sectional area (m^2) of the river at the point of concern.
- Flow velocities (m/s) were measured using a semi-buoyant float at the relevant hydrological node.
- Flow rates in m^3/s were determined. This was based on multiple measurements across the stream width, and corrected for the bed friction through a correction factor (0.8).

5.4 Water Balance

Accurate water and salt balances are considered one of the most important and fundamental water management tools available to mines. According to the Best Practice Guidelines G2: Water and Salt Balances (DAFF, 2006), the uses of a water and salt balance include:

- Providing the necessary information that will assist in defining and driving water management strategies.
- Auditing and assessment of the water reticulation system, with the main focus on water usage and pollution sources. This includes identifying and quantifying points of high water consumption or wastage, as well as pollution sources. Seepage and leakage points can also be identified and quantified when the balances are used as an auditing and assessment tool.
- Assisting with the design of storage requirements and minimising the risk of spillage.
- Assisting with the water management decision-making process by simulating and evaluating various water management strategies before implementation.

Since the mine is only in the planning stages, the balance takes a conceptual format that includes the entire mine as a single management unit. Once operational, the boundaries of the water and salt balance can be refined to include smaller management units.

Since the salt balance of a mine is dependent on source concentrations, flow paths and management measures which are unavailable at this time, this cannot be calculated during the pre-development phase and needs to be developed once the mine has been commissioned, hence only a water balance for anticipated wet and dry conditions was generated for the mine.

5.5 Water Quantity Assessment

To determine the potential impacts of the proposed mine on the regional hydrological environment, the hydrology of the local and regional watercourses expected to be impacted was modelled using the ACRU Agrohydrological modelling package.

ACRU is a physical conceptual model which integrates the various water budgeting and runoff producing components of the terrestrial hydrological system. The model uses daily time steps and thus daily rainfall input, thereby making optimal use of available data. The ACRU model revolves around daily multi-layer soil water budgeting. The model has been developed essentially into a versatile total evaporation model. It has therefore been structured to be highly sensitive to climate and to land cover/use changes on soil, water and runoff conditions. The model was used to determine the daily streamflow and peak flows.

Two hydrological modelling scenarios were included within the water quantity assessment; including:

- Pre-Development Scenario - The current hydrological status quo; and
- Post-Development Scenario - The hydrology taking into account the impacts of operation of the proposed mine on the receiving hydrological environment.

5.6 Water Quality Sampling

Due to the proposed mining operations, there is the potential for negative impacts to the regional water quality. To determine the baseline water quality within watercourses potentially affected by the proposed mine, water samples were obtained during the site reconnaissance.

Samples were collected by directly placing a laboratory-supplied sample bottle directly into the flow of the watercourse. Clean disposable gloves were used at all times during sampling and changed between sampling locations in order to minimise the potential for cross contamination.

Samples were appropriately stored prior to submission to the relevant laboratories, i.e. ALcontrol and ALS Inspection, located in the United Kingdom and South Africa respectively and were analysed for the following determinants:

- Faecal coliforms;
- *E. Coli;*
- pH;
- Suspended solids;
- Total organic carbon;
- Conductivity;
- Chemical oxygen demand;
- Total dissolved solids;
- Metals (arsenic, cadmium , chromium, copper, lead, nickel, selenium , zinc, mercury);
- Anions (sulphate, nitrite as NO_2, nitrate as NO_3, ortho-phosphate as PO_4); and
- Polycyclic Aromatic Hydrocarbons (PAH).

5.7 Impact Assessment

The methodology utilised to assess the environmental impacts (**Appendix B**) associated with the mine on the hydrological environment are summarised in **Table 1**. The consequence of the environmental impact is determined based on the expected severity, duration and extent. The impact likelihood is determined based on the frequency and probability of the impact. The environmental significance is then determined based on the consequence and likelihood. The environmental significance is used to guide the required management and mitigation measures to limit these impacts. This methodology was carried across all of the impact assessment conducted as part of the ESIA.

Table 1: Summary of Environmental Impact Assessment Methodology

■ SEVERITY of the impact ■ DURATION of the impact ■ Spatial scale (EXTENT) of the impact	**Consequence**	**Significance**
■ FREQUENCY of the activity ■ PROBABILITY of the impact	**Likelihood**	

6 Environmental Setting

The information obtained from the desktop review was collated and used to determine the regional environmental setting. In addition, the desktop review was also used to identify hydrological nodes to be used as control points for surface water appraisal and associated hydrological modelling.

6.1 Hydrology

The proposed mine is located within quaternary catchment W51A, located on the upper reaches of the Assegaai River catchment (**Figure 1**). The Assegaai River passes through the northern extremity of the prospecting right. This river contributes to the Heyshope Dam located 15km north-east of the mine area. The Assegaai River confluences with the Ndlozane River 50km east of the site, becoming the Mkhondvo River which confluences with the uSuthu River in Swaziland.

In the vicinity of the proposed surface infrastructure, various groundwater seep areas are evident which would be associated with baseflow contribution to the adjacent water courses. Based on the available mapping, a non-perennial watercourse located approximately 100m to the west and a perennial watercourse is located approximately 300m to the east of the proposed surface infrastructure boundary (**Figure 2**).

For the purposes of the hydrological modelling, the watercourses originating within the prospecting right were divided into 27 contributing catchments. The discretisation of these catchments factored in watercourse routing, topography, landuse and proposed development extent (**Figure 3**). These catchments comprise the entirety of the quaternary catchment W51A and were used within the hydrological modelling described in **Section 8**.

6.2 Climate

The typical climatic conditions, rainfall and runoff amounts for the W51A quaternary catchment are represented in **Table 2**. The Mean Annual Precipitation (MAP) for the area is 922mm with a Mean Annual Evaporation (MAE) of 1,400mm. This results in a Mean Annual Runoff (MAR) of 87.6 million m^3 (WRC, 1994).

Table 2: Quaternary catchment information (WRC, 1994)

Quaternary Catchment	Area (km^2)	MAP (mm)	MAE (mm)	MAR (mm)	MAR (m^3)
W51A	624	922	1,400	140	87,600,000

Rainfall data was retrieved from the database compiled by the Institute for Commercial Forestry Research (ICFR) and School of Bioresources Engineering and Environmental Hydrology (BEEH) associated with the University of KwaZulu-Natal. The most representative rainguages in the vicinity of the prospecting right, based on the reliability of the data, altitude, distance, and record length are outlined in **Table 3** and their location represented in **Figure 3**. The data associated with these rainguages was carried forward into the surface water modelling.

Table 3: Rainfall station summary (ICFR, 2004)

Station Name	Station Number	Record (years)	Reliable data (%)	MAP (mm)	Altitude (mamsl)
Spitskop	0407397 W	115	34.1	858	1,732
Dirkiesdorp (Pol)	0407730 W	96	27.3	586	1,350
Biki Baia	0407261AW	94	18.0	796	1,752
Zomershoek	0407039 W	115	18.9	610	1,820

Figure 4 shows the time series plot of the recorded monthly rainfall for each of the rainguages; the constant slope of the cumulative rainfall plots is an indication that there are no anomalies in the rainfall records associated with the gauge.

The wet season runs from October through March, and the evaporation demand is highest during September through February. Evaporation rates are typically highest towards the north of the prospecting right in the lower elevations, driven by the higher temperatures in these areas.

6.3 Topography

The catchments included in the hydrological investigation are characterised a rolling hill topography. The highest elevations occur within the southern and eastern extremities of the prospecting right, where the elevation approaches 2,200 and 2,250m above mean sea level (amsl) respectively.

Slopes approaching 20% are present in the vicinity of the watercourses located within the southern and western portions of the prospecting right. The slopes become more moderate (approximately 5% to10%) within the catchments east and west of the prospecting right.

Within and immediately surrounding the proposed mine area the topography is moderate to steep (5% to 10%, with the terrain being steeper towards the watercourses to the east and west. Rock outcrops are located adjacent the southern boundary of the surface infrastructure boundary.

6.4 Geology

The proposed Yzermyn Underground Coal Mine is located within the Vryheid Formation of the Karoo Supergroup, on the northern boundary of the Utrecht Coalfield. Primary economic coal seams formed in the Utrecht Coal field are the Alfred and Dundas seams. Numerous dolerite intrusions (dykes and sills) intrude the Vryheid Formation, influencing the stratigraphy of the area and quality of the coal (Competent Persons Report, 2009). According to Jeffrey (2005), the Utrecht Coalfield has seams rich in moderately good coking coal and require little beneficiation. The Lower Dundas seam rank varies from medium volatile bituminous to anthracitic, with the coal mined as a source of bituminous coal in the north eastern sector of the coalfield and as anthracite in the southern sector. However, the sulphur content can be high (in excess of one per cent).

The Gus seam is subdivided into three coal quality zones with the upper part comprising mainly dull coal, the central part predominantly bright coal and the bottom section mainly poor quality coal with shale partings. The seam has been noted to have elevated methane gas concentration. The Alfred seam is of better quality in the Utrecht Coalfield, particularly towards the bottom portion of the seam. The seam is generally high in ash and sulphur content but beneficiation can produce relatively high quality, low ash coal with low sulphur and phosphorus (Jeffrey, 2005).

According to the Competent Persons Report (2013), the Alfred and Dundas coal seams are of economic significance with each seam thickness averaging around 1.65m with suitable qualities within the target area.

6.5 Soils

Based on soil class maps for the area (**Figure 5**), generalisations regarding the dominant soils and associated properties within each of the catchments can be made:

- Within the upper reaches of the Assegaai River catchment, west of the prospecting right, the soils are expected to be dominated by structureless soils with the potential for plinthite to be present (hardened iron and manganese oxides). Land type mapping indicates Kroonstad and Clovelly soil forms dominate within the catchment, with medium to deep sandy loams and sandy clays expected. The crests of hills are dominated by rock outcrops and Mayo soil forms with shallow sandy loams and sandy clays expected. The lower slopes adjacent to the Assegaai are dominated by shallow sandy loams and sandy clays of the Mispah and Glenrosa soil form.
- Within the prospecting right, the soils comprise structureless soils and clays and undifferentiated shallow soils. Based on land-type mapping, the soils at the crests of hills to the south of the prospecting right are expected to be dominated by rock outcrops and shallow sandy loams and sandy clays of the Mayo soil forms. Within the lower slopes, shallow to medium depth sandy clay loams and sandy clays of the Glenrosa and Hutton soil forms are expected, with rock outcrops expected.
- Within the lower altitudes, north-east of the prospecting right, the soils of the catchments are expected to be undifferentiated structureless soils. Based on land-type mapping, these soils are expected to be dominated by shallow to medium depth sandy clay loams and sandy clays of the Glenrosa soil form.

The site reconnaissance identified that the majority of catchments under consideration were dominated by clayey sands and sands rather than the more sandy clays as is notable based on the desktop study. The reason for this is possibly because the land-type mapping is at a course scale and does not account for localised variability. The observed soil conditions were taken into account during the hydrological modelling process.

6.6 Vegetation and Landuse

Based on Mucina and Rutherford (2006) (**Figure 6**), the general natural vegetation within the catchments in the upper portion of the Assegaai River catchment is dominated by Wakkerstroom Montane Grassland. As the altitude decreases the vegetation becomes dominated by Paulpietersburg Moist Grassland and then with Eastern Highveld Grassland. Within the central and eastern catchments, within the steeper terrain associated with watercourses, indigenous Northern Afrotemperate Forest is present.

The land-use mapping determined in 2000 by the Department of Agriculture, Forestry and Fisheries (DAFF, 2012) (**Figure 7**) indicates that areas of irrigated and dryland cultivated agriculture are present within the catchments east and west of the prospecting right, where the topography is more moderate. The remainder of the grassland was observed to be formalised through fencing and is currently utilised as cattle grazing. Within the eastern catchments the land type mapping indicates that the natural vegetation has evidence of degradation.

The asphalt R543 regional road passes through the south-eastern and eastern portions of the study area.

The site reconnaissance verified the accuracy of the land use mapping, with no significant changes observed; hence this is considered representative of the current catchment conditions and was carried forward in the associated modelling.

7 Water Balance

The water balance was created for the wet season (October to March) and dry (April to September) seasons for the following broad management areas:

- Water treatment plant;
- Administration area;
- Coal wash plant;
- Plant and stockpiles;
- Co-Disposal Facility; and,
- PCDs associated with the plant and stockpiles and Co-Disposal Facility.

The water balance took into account the following components:

- Water inputs to the mine: Groundwater abstractions (either from borehole or mine dewatering), rainfall and the water content inherent in the mined coal;
- Water outputs from the mine: Sewage and potable water losses, evaporation, dust suppression;
- Excess storage within PCDs; and
- Transfers of water within the mine area (runoff, seepage and transfers between areas) were included.

7.1 Assumptions and Calculations

7.1.1 Working Month

Based on the Mining Works Programme (Mindset, 2013), there is expected to be a 22 day working month associated with the mine operations. This has been factored into the water requirements of the plant operations and administration area (i.e. potable water, car wash and dust suppression water requirements).

7.1.2 Decant and Dewatering

Based on the groundwater report, the rate of groundwater seepage into the underground workings may vary from between 330m^3/d to 1,280m^3/d over the life of the operation. It has been assumed that this water will be treated at the on-site water treatment works for use within the plant area (i.e. at the coal wash plant, car wash and as potable water). Any excess abstracted groundwater is assumed to be treated to a suitable water quality and released to the environment.

It should be noted that this seepage volume is related to the full extent of the mine workings. As a result, during the initial mine stages where the void space is limited, there is expected to be less groundwater abstracted. This will limit the availability of water to the operations during its initial stages.

Based on the conclusion of the groundwater report, the contaminated groundwater decant is expected to be limited because of the declined mine adit. Furthermore, the mine operations will be undertaken within the zone of the deep aquifer, which is not expected to contribute significant volumes to surface flows in the form of baseflow contribution. This interaction is represented in **Figure 8**.

7.1.3 Rainfall and Evaporation

The rainfall is based on the MAP for the Dirkiesdorp rainfall station (**Table 3**) and the A-Pan evaporation is based on the expected MAE for the quaternary catchment (**Table 2**), divided into the wet season (October to March) and dry season (April to September) accordingly (**Table 4**).

Since the evaporation rate from open water, wet coal and slimes material and moist coal and slimes material differs from the A-Pan evaporation, correction factors were utilised, as is summarised in **Table 4**. The evaporation rates for open water bodies were obtained from the ACRU Agrohydrological model manual (Schulze, 1997). The evaporation factors from coal and slimes were estimated; however needs to be refined over time based on the actual material properties (i.e. particle size and moisture content).

It was assumed that the coal stockpiles contain moist material. Since the proportion of the Co-Disposal Facility containing open water, wet slimes and dry slimes is unknown at this stage, typical values were assumed (10%, 70% and 20% respectively).

Table 4: Seasonal rainfall and evaporation distribution, and evaporation correction factors

	Wet Season (October -March)	Dry Season (April to September)
Rainfall (mm)	486	100
Evaporation (A-Pan) (mm)	845	555
Evaporation Factor (Open Water)	0.66	0.63
Evaporation Factor (Wet Material)	0.75	0.75
Evaporation Factor (Dry Material)	0.25	0.25

To determine the surface area of the PCDs and sediment traps to which rainfall and evaporative losses occur, the dimensions were estimated based on the Storm Water Management Plan developed by WSP as part of this study (*Proposed Yzermyn Underground Coal Mine - Hydrological Assessment*, Report 24514, dated August 2013), assuming a standard 2m depth (**Table 5**). It has been assumed that the PCDs are at least 2m deep. It was assumed that the sediment traps are designed with “duty and standby” channels, where one half allows sediment to dry prior to upliftment and disposal (thus divided into open water and wet material).

Table 5: Contributing catchment areas

Catchment	Area (m^2)
Plant and Stockpiles	80,482
PCD1 and associated Sediment Trap (Sedi1)	5,270
PCD2 and associated Sediment Trap (Sedi2)	1,870
PCD3 and associated Sediment Trap (Sedi3)	2,170
Co-Disposal Facility	364,982

7.1.4 Seepage

It has been assumed that the Co-Disposal Facility will be located on a liner to limit seepage to the groundwater environment; hence, seepage from this facility is expected to emerge as toe-seep and is diverted to the PCDs associated with the facility. To determine the amount of toe-seep, it was assumed that 10% of the seasonal rainfall to the facility, used in the water balance calculations, emerges as toe-seep. This value will need to be updated in the future based on site specific measurements.

The groundwater report has assumed that the liner allows a small portion of seepage (3.15mm per annum) to contribute to the groundwater store, which equates to 575m^3/season.

7.1.5 Runoff

The runoff from the plant and stockpile area and Co-Disposal Facility was calculated using the SCS equation, used to convert rainfall into runoff and infiltration.

The basic assumption of the SCS method is that, for a single storm, the ratio of actual soil retention after runoff begins to potential maximum retention is equal to the ratio of direct runoff to available rainfall. The equation can be written as follows:

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

Where

- Q: Runoff (mm)
- P: Rainfall (mm)
- S: Potential maximum soil moisture retention after runoff begins (mm).

The potential maximum soil moisture retention parameter (S) was calculated through the SCS Curve Number method:

$$S = \frac{1000}{CN} - 10$$

The runoff curve number is based on the area's hydrologic soil group, land use, treatment and hydrologic condition. The curve number used are summarised in **Table 6**, based on the values given in the SCS-SA hydrological model, specific to South African conditions (Schmidt and Schulze, 1987).

Table 6: SCS-SA Model Curve Numbers

Area	Soils and Landuse	Curve Number
Plant and Stockpiles	Hardstanding (concrete)	98
Co-Disposal Facility	Un-vegetated sand and gravel material	77

The Co-Disposal Facility is expected to act like a dam and it has been assumed that the side walls will be constructed to contain the 50-year storm event runoff. As a result, only the side slopes of the Co-Disposal Facility will contribute to direct surface runoff to the PCDs. Given the lack of design details available for the facility, the side slope areas have been estimated as per the Storm Water Management Plan developed for this project (**Table 7**) and need to be updated once the design details are finalised.

Table 7: Side slope areas of the Co-Disposal Facility

Catchment	Area (m^2)
Eastern Co-Disposal Portion	49,528
Western Co-Disposal Portion	57,916

7.1.6 Process Water Requirement

Based on communication from Mindset, the Coal Wash Plant requires an initial volume of 40,000m^3, with a monthly make-up water requirement of 1,100m^3 per month thereafter. It has been assumed that the monthly make-up water will be preferentially obtained from the mine dewatering, with additional water then sourced from the PCDs and dedicated abstraction boreholes.

Since the dewatering will only commence once mining is underway, the initial Coal Wash Plant water requirement is expected be sourced from alternative sources (i.e. boreholes or surface water flows).

7.1.7 Coal and Slimes Material Moisture Content

Based on the Mining Works Programme (Mindset, 2013), a total of 2.5Mt of ROM material is to be mined per year. This is expected to have an inherent moisture content of 4.25%; however, it has been assumed that only the first 1% will be available for evaporation.

A conventional two-stage wash is to be used, where the crushed ROM material is separated into coarse material and fine material at the de-sliming screen. The fine material is further refined at the de-sliming cyclone. Based on the supplied process flow (**Appendix C**), 11% of the ROM is coarse discard and 9.2% is fine discard (derived from the Spiral Plant and Thickener and Frame Filter). The discard is dewatered prior to disposal. The water content of this discard material was determined based on an assumption of 2% moisture for the coarse discard, and 5% for the fine discard.

7.1.8 Miscellaneous Use

Based on SABS 10252 (South African National Standard: Water Supply and Drainage for Buildings), the water demand per person is given as between 135 and 200 litres per person per day (l/p/day). To provide a conservative assessment, the maximum expected demand of 200 l/p/day was assumed (i.e. 0.2m^3/p/day). It has been assumed that 95% is required for sewage and ablutions, while 5% is required for drinking. There is proposed to be a maximum of 576 staff employed at the mine during the operational stages.

The vehicle wash bay will operate within the plant area. In the absence of expected water requirements, it has been assumed that the water requirement is 20m^3 per day.

Based on typical dust suppression values for small to medium mines, a requirement of 300m^3 per day has been assumed during both the dry and wet season.

7.2 Results and Discussion

The water balance for the wet season (October to March) and dry season (April to September), including the expected minimum and maximum mine dewatering volumes, is represented in **Figures 38 to 41**. Based on these water balances, the following can be noted:

- It has been assumed that water for dust suppression is to be obtained from any of the three PCDs, which will be dependent on a suitable water quality. In the dry season there is expected to be insufficient water held within the PCDs; hence the additional water for dust suppression (16,938m^3/season) will need to be obtained from the mine dewatering activities.
- Due to the dewatering volumes, there is an excess of water expected under all climatic conditions and seepage estimates. It has been assumed that this is treated at the Water Treatment Plant and released to the environment. Taking into account the dry season dust suppression requirements (i.e. 16,938m^3/season), the excess abstracted groundwater can be summarised as follows:
  - 209,314m^3/season during the wet season and 192,375m^3/season during the dry season under the high seepage estimate; and,
  - 35,820m^3/season during the wet season and 18,881m^3/season during the dry season under the low seepage estimate.
- It must be noted that the mine dewatering volumes have been determined based on the maximum mine void space. As a result, during the initial mine stages where the void space is limited, it is expected that the dewatering volumes will be insufficient to supply the required start-up volume (40,000m^3) and dust suppression volumes (300m^3/day). This water will need to be sourced from alternative sources (e.g. borehole and/or surface water resources) and stored within clean water reservoirs.

The water balance and associated water demand requirements will need to be re-rationalised based on the final mine plan and associated groundwater modelling.

8 Hydrological Quantity Assessment

In order to determine the impacts of the proposed mine on the hydrological environment, hydrological modelling was conducted using the ACRU model. This was based on a comparison of the hydrology expected both under the pre-development (i.e. current status quo) and post-development scenarios for each of the sub-catchments.

The catchment and climate characteristics utilised in the modelling exercise were obtained from information obtained in the desktop study as well as groundtruthed during the site reconnaissance. The rainfall record from the relevant rain gauges (**Table 3**) utilised in the modelling extended from 1949 to 1999 (50 years).

The model inputs include the following information for each catchment:

- **Catchment Characteristics:** Catchment area, slope and length.
- **Landuse:** Influences runoff volumes and peak flows.
- **Soil Properties:** Influences infiltration and runoff.
- **Impervious Areas:** The impervious areas are divided into adjunct impervious areas (reporting directly to the watercourse) as well as disjunct impervious areas (areas that do not lie adjacent to a watercourse, with runoff contributing to the adjacent soil water store).

- **Stormflow response:** This fraction (≤1) represents the fraction of the stormflow that leaves the catchment on the same day as the rainfall event. This is determined predominantly by the catchment size, soil depth, and topography.
- **Baseflow Response:** The fraction (≤1) of water from the intermediate or groundwater store is defined as the baseflow response. This is predominantly influenced by the plant available water, which is determined by the soil properties.
- **Peak Flows:** The peak flow originating from the catchments was determined within the ACRU model based on the SCS modelling methodology. The SCS hydrological soil group defines the runoff potential ranging from low to high, denoted by letter A through D respectively. The soil group is defined based on the soil form and family. Based on the landuse and associated management practice and the SCS hydrological soil group, the SCS curve number is determined. The curve number typically ranges from 25 (forests on sandy soils) to 98 (impervious paved areas).
- **Climatic Data:** Monthly averages of A-pan evaporation and monthly means of maximum and minimum temperature. In addition the daily rainfall record for the representative rainfall stations was utilised.

8.1 Limitations and Assumptions

- Hydrological modelling is a representation of reality, however due to site specific environmental variations outside the control of the modelling environment; the estimation of the catchment hydrology can only be used as a conceptualisation tool.
- The modelling and impact assessment was based on the proposed development infrastructure and layout. Should this change, the modelling results and associated discussion will need to be updated.
- Due to a lack of flow gauges in the vicinity of the proposed mine development, the model was calibrated based on flow measurements made during the dry season at a single point in time. To ensure the validity of the model, additional flow measurements for calibration purposes are required, including wet season flows.
- The impacts to water quantity will be highest during the operational phase due to the proposed stormwater infrastructure and increased impervious areas; hence, the hydrological model was only run for the this phase (thereby representing a worst case scenario), with impacts for the construction and decommissioning/rehabilitation phases derived from this assessment.
- Based on the geohydrological impact assessment, it is expected that the impact associated with mine dewatering to the shallow aquifer and subsequent baseflow to water courses (i.e. impact to seep zones) will be in the immediate vicinity of the mining operations. Although impacts to the local baseflow conditions are expected to be pronounced, it has been assumed in the hydrological modelling that the impact as a result to regional baseflow conditions will be nominal. This will need to be confirmed through surface flow monitoring during the various phases of the mines operations.

8.2 Baseflow Measurements

To allow comparison to the ACRU modelling results, baseline baseflow measurements were obtained at the hydrological nodes associated with the outlets of Catchment 16, 17, 19 and 21. In addition, the baseflow on the Assegaai upstream of the confluence with the water course associated with Catchment 17 was measured (**Table 8**, **Figure 9**). It has been assumed that the baseflow measurements are representative of the winter (i.e. dry season) flow conditions.

Table 8: Hydrological nodes associated with baseflow measurement

Hydrological Node	Global Coordinates
Catchment 16	27.186230°S / 30.312506°E
Catchment 17	27.186087°S / 30.312951°E
Catchment 19	27.207285°S / 30.344699°E
Catchment 21	27.146719°S / 30.369339°E
Assegaai River	27.184989°S / 30.312692°E

8.3 Modelling Scenarios

8.3.1 Pre-Development Scenario

The climatic conditions and catchment characteristics, including vegetation, landuse, and soils, as described in Section 6 were utilised in the hydrological modelling. These inputs are summarised for each of the sub-catchments in **Table 9**.

To confirm the modelling, the July simulated flows over the modelling period simulated, were compared to the July observed flows at the corresponding locations. The results are summarised in **Table 10**, with the simulated flows best representing the observed flows highlighted. Based on these results, the following can be noted:

- The simulated flows at Catchment 16 and Catchment 21 represent flow measurements taken during the site reconnaissance, with the measured flows equivalent to the flows expected in the 33rd to 67th percentile of the results.
- The following was noted for the hydrological nodes associated with Catchment 19 and the Assegaai River:
  - The simulated results for the hydrological nodes associated with Catchment 19 exceeded the observed flow.
  - The observed flow conditions at the hydrological node associated with the Assegaai River exceeded the simulated flows.
  - The associated anomalies may be related to the variability and inherent limitations with calculating the observed flows.

However considering the overall range of simulated flow versus observed flow conditions for the catchments of concern, the hydrological simulation was considered to be representative of flow conditions associated with the watercourses. It is however noted that additional flow measurements will be required to ratify the hydrological modelling.

8.3.2 Post-Development Scenario

Based on the proposed development plan (**Appendix A**), and taking into account the stormwater management plan developed for the mine (*Proposed Yzermyn Underground Coal Mine - Hydrological Assessment*, Report 24514, dated August 2013) the following changes in catchment characteristics is expected as a result of the proposed mining activities (**Table 11**):

8.3.2.1 Catchment 16

- This catchment includes the plant and stockpile area, as well as the western portion of the Co-Disposal Facility. Since these areas generate dirty water that is to be contained within the PCDs (PCD1 and PCD3), and will no longer report to the watercourse, the contributing catchment area was reduced by 0.34km^2 (~7%).
- Due to the stormwater infrastructure proposed for the conveyance of clean water, the stormflow response fraction was increased from 0.95 to 0.98 within this catchment.

Table 9: Pre-development scenario catchment conditions utilised in the modelling

Catchment	Rainfall Station	Catchment Area (km^2)	Slope (%)	Soil	Vegetation	Stormflow Response Fraction	Baseflow Response Fraction	Adjunct Impervious (%)	Disjunct Impervious (%)	Coefficient of Initial Abstraction	Hydraulic Length of Main Stream	SCS Curve Number
1	Zomershoek	45.48	4.2	Very deep clayey sand	Veld in good condition	0.7	0.01	0.005	0.05	0.2	9008	69
2	Zomershoek	56.86	3.3	Very deep clayey sand		0.7	0.01	0.005	0.05	0.2	9940	69
3	Zomershoek	56.94	8.99	Very deep clayey sand		0.7	0.01	0.005	0.05	0.1	16465	69
4	Zomershoek	43.08	12.18	Shallow clayey sand		0.7	0.01	0.005	0.05	0.1	6851	69
5	Spitskop	18.13	14.85	Shallow clayey sand		0.9	0.01	0.005	0.05	0.1	8209	61
6	Biki Baia	26.32	11.44	Shallow clayey sand		0.85	0.01	0.005	0.05	0.1	9648	69
7	Biki Baia	42.61	15.17	Shallow clayey sand		0.7	0.01	0.005	0.05	0.2	13401	61
8	Spitskop	9.87	10.25	Shallow clayey sand		0.9	0.01	0.005	0.05	0.1	5198	61
9	Spitskop	19.95	13.75	Shallow clayey sand		0.85	0.01	0.005	0.05	0.2	9404	61
10	Dirkiesdorp	13.9	14.31	Shallow clayey sand		0.85	0.01	0.005	0.05	0.2	7916	61
11	Dirkiesdorp	5.36	18.75	Shallow clayey sand		0.9	0.01	0.005	0.05	0.1	4029	61
12	Dirkiesdorp	2.17	14.71	Shallow clayey sand		0.95	0.01	0.005	0.05	0.2	2161	61
13	Dirkiesdorp	5.93	13.23	Shallow clayey sand		0.8	0.01	0.005	0.05	0.1	5769	61
14	Spitskop	19.32	8.33	Deep clayey sand		0.8	0.01	0.005	0.05	0.1	7960	61
15	Dirkiesdorp	3.86	12.08	Shallow clayey sand		0.9	0.01	0.005	0.05	0.2	4100	61
16	Dirkiesdorp	4.92	7.62	Moderately shallow clayey sand		0.95	0.01	0.005	0.05	0.2	5700	61
17	Dirkiesdorp	3.5	5.6	Deep clayey sand		0.85	0.01	0.005	0.05	0.2	3322	61
18	Spitskop	15.03	5.03	Deep clayey sand		0.85	0.01	0.005	0.05	0.2	9283	61
19	Dirkiesdorp	15.95	11.61	Deep clayey sand		0.85	0.01	0.005	0.05	0.2	9502	61
20	Dirkiesdorp	14.5	6.95	Deep clayey sand		0.85	0.01	0.005	0.05	0.2	7454	61
21	Dirkiesdorp	18.05	4.78	Deep clayey sand		0.75	0.01	0.005	0.05	0.2	9372	61
22	Dirkiesdorp	20.63	7.05	Deep clayey sand		0.85	0.01	0.005	0.05	0.2	10251	61
23	Biki Baia	24.64	11.42	Moderately shallow clayey sand		0.85	0.01	0.005	0.052	0.1	6904	69
24	Dirkiesdorp	28.03	8.09	Deep clayey sand		0.7	0.01	0.005	0.052	0.1	9392	61
25	Dirkiesdorp	45.94	9.9	Deep clayey sand		0.7	0.01	0.005	0.052	0.1	9305	61
26	Dirkiesdorp	16.14	7.93	Deep clayey sand		0.7	0.01	0.005	0.052	0.2	7133	61
27	Dirkiesdorp	37.11	8.75	Deep clayey sand		0.7	0.01	0.005	0.052	0.2	9666	61

Table 10: Baseline flow comparison -Simulated versus Observed

Percentile (%)	Catch 16(m3/s)		Catch 17 (m3/s)		Catch 19 (m3/s)		Catch 21 (m3/s)		Assegaai (m3/s)	
	Obs.	Sim.	Obs.	Sim.	Obs.	Sim.	Obs.	Sim.	Obs.	Sim.
5	0.016	0.002	0.029	0	0.089	0	0.089	0.001	0.438	0.432
10		0.003		0		0.001		0.002		0.472
20		0.005		0		0.003		0.008		0.544
33		0.014		0.002		0.009		0.026		0.622
50		0.022		0.004		0.026		0.071		0.743
67		0.03		0.008		0.037		0.111		0.864
80		0.038		0.012		0.056		0.167		0.995
90		0.047		0.016		0.074		0.222		1.222
95		0.053		0.018		0.087		0.26		1.461

Table 11: Changes in the catchment conditions used in the post-development scenario modelling

Catchment	Catchment Area (km^2)	Stormflow Response Fraction	Disjunct Impervious (%)
16	4.58	0.98	No change
17	3.36	No change	No change
19	15.91	0.87	0.0504

8.3.2.2 Catchment 17

- The eastern portion of the Co-Disposal Facility is located within this catchment. Since dirty water generated from this area is to be contained within the PCD2 and wont report to the watercourse, the contributing catchment area was reduced by 0.14km^2 (~4%).

8.3.2.3 Catchment 19

- The eastern portion of the Co-Disposal Facility and plant area is located within this catchment, once the stormwater management infrastructure has been implemented, stormwater generated within this area will be contained in PCD1 and PCD2. As a result, this catchment area was reduced by 0.04km^2 (~0.3%) in the post-development scenario.
- Due to the improved clean stormwater infrastructure proposed within this catchment, the stormflow response fraction was increased from 0.85 to 0.87.
- Because the parking areas, expected to be under asphalt, are to be located within this catchment, the disjunct impervious area was increased by 0.0004%.

8.1 Modelling Results and Interpretation

8.1.1 Rainfall

The expected monthly rainfall distribution of the rainfall data for each the rainfall stations (**Table 3**) inputted into the ACRU model are represented in **Figures 10** through **13**. The 10th, 50th and 90th percentiles represent the monthly rainfall during dry, median and wet climatic conditions respectively. As would be expected, rainfall occurs predominantly during the summer months (i.e. October to March). The peak monthly rainfall occurs in between December and January. The lowest rainfall occurs during the months of June and July. No rainfall is expected during the months of May to September under dry climatic conditions.

8.1.2 Runoff

The results generated from the ACRU model were utilised to conduct a statistical analysis on the monthly runoff values (m^3 per month) for the dry, median and wet climatic conditions (represented by 10^{th}, 50^{th} and 90^{th} percentiles).

In order to determine the impact of the mining activities on the regional hydrology, the runoff results for the pre-development scenario were compared to the post-development scenario. The analysis focussed on the catchments expected to be directly impacted by the development (i.e. Catchment 16, 17 and 19) as well as the impact to the Assegaai River at the outlet of the W51A quaternary catchment (i.e. Catchment 27). Based on this comparison of the monthly flows for the dry, median and wet conditions (**Figure 14** to **Figure 25)**, the following can be concluded:

- Under dry conditions, the proposed mine is expected to cause a decrease in surface runoff during summer (months October to April). The decrease is 6.9% at Catchment 16, 4.0% at Catchment 17 and 0.25% at Catchment 19. This is expected due to the reduction contributing catchment area through the containment of dirty runoff in the PCDs. In the winter months (May to September) the proposed mine is expected not to have a significant impact on the mean monthly runoff.
- Under the median climatic conditions, the proposed mine is expected to result in a decrease in runoff from September to May. The decrease is 6.9% at Catchment 16, 4.01% at Catchment 17, and between 0.25% and 1.53% at Catchment 19. The decrease is expected to be due to the reduction of the catchment contributing area. In the months of June, July and August there is no impact expected on the monthly runoff.
- Under wet conditions there is a general decrease in runoff, with a decrease of between 6.5% and 6.9% at Catchment 16, 4.01% at Catchment 17 and at Catchment 19 it is between 0.25% and 0.26%. This decrease is throughout the year, with the exception of an isolated increase of 0.37% in October at Catchment 19. The decrease is expected to be due to the reduction of a catchment's contributing area. The isolated increase is expected to be due to the increase in impervious areas within this catchment.

To determine the impacts of the development on the flow changes on the Assegaai River, the flow conditions of the outlet point of Catchment 27 was modelled (i.e. outlet of W51A quaternary catchment). This outlet point is located approximately 10km north-east of the mine. The statistical analysis of the results indicates the following:

- Under dry conditions a decrease in runoff ranging from 0.08% to 0.23% is expected for the summer months (October to April). For the rest of the winter months (May to September) there is no impact expected.
- Under median conditions a decrease in runoff ranging from 0.05% to 0.09% is expected for the majority of the year (September to May), with an exception of winter months (June to August) where no impact is expected.
- Under wet conditions there is expected to be a decrease in runoff ranging from 0.01% to0.09% in all months.

8.1.3 Peak Flow

A statistical analysis was conducted on the peak flow results generated from the ACRU model for the dry, median and wet climatic conditions (represented by the 10^{th}, 50^{th} and 90^{th} percentiles) to determine the maximum monthly peak flow. Based on this comparison of the peak flows for the pre-development and post-development scenario (**Figure 26** to **Figure 37**), the following can be concluded:

- Under both the dry and median conditions, the proposed mine is expected to have no significant impact on the maximum monthly peak flows.
- Under wet conditions, the development is expected to have no significant impact on the Catchment 17 peak flow. In Catchment 16, the development is expected to increase the maximum monthly peak flow by between 0.3% and 1.6%. This is expected due to the improved stormflow reticulation proposed that increases runoff volumes. In Catchment 19 there is an expected increase in runoff for the months between October and December (ranging from 0.3% to 0.4%), expected to be due to the increase in impervious areas and improved storm water reticulation which results in an increase in stormflow. A slight decrease of 0.3% in peak flow for the month of March is expected in Catchment 19.

- This increase in peak flows is expected to result in an increase in peak flow in November, December, January and March at the outlet of the W51A quaternary catchment, with a maximum increase of 0.09%.

8.2 Discussion

The hydrological modelling does do not factor in changes to baseflow contribution owing to the mine dewatering. Based on the expected zone of influence outlined in the geohydrological report, the regional impacts to flow (i.e. Assegaai River) as a result of dewatering are expected to be nominal; hence are not described further within this report.

The hydrological assessment indicated that there is expected to be impacts to both the total flows and peak flows. The total flows are generally expected to decrease (maximum decrease of 6.9% during the wet season in Catchment 19) due to the containment of dirty runoff in the PCDs. The peak flows are expected to increase during the wet season at Catchment 16 and 19, with a maximum increase of 1.6% and 0.4% respectively.

The modelling has not taken into account the contributions of the dewatering volumes outlined within the Water Balance (Section 7). There is expected to be any excess water abstracted from the mine operations that needs to be treated and discharged to watercourse. It has been assumed this water will be discharged to the closest perennial watercourse, located within Catchment 19, the following surface water impacts are therefore expected:

- Under the high seepage estimate, the contributions are expected to increase the flow at the catchment outlet in the dry, median and wet climatic conditions by a maximum of 1,779%, 99% and 34% respectively.
- Under the low seepage estimate, the contributions are expected to increase the flow at the catchment outlet in the dry, median and wet climatic conditions by a maximum of 175%, 11% and 3% respectively.

The alternative is to discharge the decant water to the Assegaai River. The impact associated with flow as a result of dewatering on the Assegaai River is expected to result in a maximum increase in flow of 5.7% during dry season flow conditions. It must be noted that this would require a pipe to convey a maximum of 13.25l/s across neighbouring properties to allow for the realisation of this option.

Due to the proximity of the development to the local watercourses, a qualitative floodline assessment was undertaken. The watercourse considered to pose the highest risk for flooding is the watercourse located 100m west (i.e. Catchment 16) of the Co-Disposal Facility. However, based on the distance to the watercourse, the associated contribution catchment area ($4.25km^2$) and the vertical elevation difference between the watercourse bed and Co-Disposal Facility (between 8m and 10m), this risk of flooding is considered to be insignificant. The increase in peak flow within this catchment due to the proposed development is 1.6%, which is expected to have an insignificant impact in increasing the flood risk. As a result, a floodline assessment is not considered necessary based on the proposed mine site layout.

With regards to the impacts of the dewatering volumes on the downstream infrastructure associated with Catchment 19, two road bridges are located across the watercourse adjacent to and at a distance of 5km north-east of the proposed mine. In addition a farm house is located in close proximity to this watercourse 5km north-east of the proposed mine. The increase in flow volumes as a result of dewatering to this watercourse, should this option be followed is expected to alter the flood risk to the associated infrastructure. This will need to be considered once the final discharge point has been finalised.

9 Water Quality Assessment

The water quality sampling locations were selected to represent the local and regional hydrological conditions. To enhance access for future sampling, the sampling locations were located at road crossings. The locations are represented in **Figure 9**, and described in **Table 12**.

Table 12: Water quality sampling locations

Sampling Location	Global Coordinates	Rationale
WQ1	27.183381°E / 30.295533°S	Assegaai River, upstream of potential mine impacts
WQ2	27.211324°E / 30.306341°S	Unnamed non-perennial watercourse, directly down-slope of proposed mine. Representative of potential impacts from mine area.
WQ3	27.212460°E / 30.323820°S	Unnamed perennial watercourse, directly down-slope of proposed mine. Representative of potential impacts from mine area.
WQ4	27.132870°E / 30.378050°S	Assegaai River, downstream of potential mine impacts

9.1 Limitations and Assumptions

The type and degree of water quality impacts of the proposed mine are dependent on the potential pollution sources and pollution control measures on site. Since the site is not yet operational, the contaminants of concern are based on typical contaminants expected to be generated as a result of coal mining operations.

9.2 Results and Interpretation

The water quality results, representing winter conditions, are summarised in **Table 13**, with analytical certificates given in **Appendix D**. The analytical results were compared to the South African water quality guidelines (DWAF, 1996) for freshwater aquatic ecosystems, domestic use, livestock watering and irrigation; representative of the potential current water users. Based on an assessment of the water quality results, the following observations can be made:

- The count of faecal coliforms (ranging from 17 colony forming units (cfu)/100ml to 380cfu/100ml) exceeds the domestic and irrigation guidelines (<1cfu/100ml) at each of the sampling locations .The livestock water quality guidelines (0-200 cfu/100ml) are exceeded at the WQ3 and WQ4 sampling points. This faecal contamination may be due to the cattle observed within the contributing catchments.
- The concentration of Total Dissolved Solids (TDS) (ranging from 82.7mg/l to 137mg/l) exceeds the irrigation guidelines (<40mg/l) at each of the sampling locations. TDS includes dissolved minerals, salts. Since the TDS is elevated at the WQ2 and WQ3 sampling points, with limited human development in the contributing catchments, the potential exists that the relatively high TDS is related to the natural sources.
- Based on a comparison of the sampling location upstream of the contributions arising from the vicinity of the proposed mine surface infrastructure (WQ1) to the sample downstream of these contributions (WQ4), the following parameters show a marked increase within the downstream sample:
  - Faecal coliforms and *E. Coli*; potentially due to the cattle noted within the contributing catchments; and,
  - Nitrate, lead and zinc, potentially due to fertiliser applications to agricultural fields located between the sampling locations.

Table 13: Summary of water quality results

Parameter	Units	Aquatic Ecosys-tems	Domestic	Livestock	Irrigation	WQ1	WQ2	WQ3	WQ4
Faecal coliforms	cfu/100ml	NA	<1	0-200	<1	38	17	380	270
E.Coli	cfu/100ml	-	-	-	-	30	18	150	130
Total suspended solids	mg/l	NA	NA	NA	0-50 (Drip Irrigation)	<4	<4	<2	<4
Total organic carbon	mg/l	NA	0-5	NA	NA	<3	<3	<3	<3
Chemical oxygen demand	mg/l	NA	NA	NA	NA	<7	<7	<7	<7
Conductivity	mS/cm	-	-	-	-	0.176	0.106	0.108	0.139
Total dissolved solids	mg/l	-	0-450	0-2,000 (Cattle and Horses)	<40	137	82.7	84.3	107
Arsenic	µg/l	10	0-10	0-1,000	0-100	<0.12	0.139	<0.12	<0.12
Cadmium	µg/l	150	0-5,000	0-10,000	0-10,000	<0.1	<0.1	<0.1	<0.1
Chromium	µg/l	-	-	-	-	4.04	2.49	2.72	3.21
Copper	µg/l	0.3	0-1,000	0-1,000 (Cattle)	0-200	<0.85	<0.85	<0.85	<0.85
Lead	µg/l	0.2	0-10	0-100	0-200	0.02	0.031	0.069	0.038
Nickel	µg/l	NA	NA	0-1,000	0-200	0.587	0.51	0.424	0.477
Selenium	µg/l	2	0-20	0-50,000	0-20	<0.39	<0.39	<0.39	<0.39
Zinc	µg/l	2	0-3,000	0-20,000	0-1,000	0.463	0.672	0.586	0.809
Mercury	µg/l	40	0-1	0-1,000	NA	<0.01	<0.01	<0.01	<0.01
Sulphate	mg/l	NA	0-200	0-1,000	NA	3.8	<2	<2	2.1
Nitrite as NO2	mg/l	-	0-6	0-10	-	<0.05	<0.05	<0.05	<0.05
Ortho-phosphate as PO4	mg/l	-	-	-	-	<0.05	<0.05	<0.05	<0.05
Nitrate as NO3	mg/l	-	0-6	0-100	-	<0.3	<0.3	0.64	0.588
pH	pH Units	-	6-9	NA	6.5-8.4	8.12	7.85	7.77	7.79
Total Polycyclic Aromatic Hydrocarbons (USEPA 16)	µg/l	-	-	-	-	<0.247	<0.247	<0.247	<0.247

9.3 Discussion

Despite an impervious liner being proposed beneath the Co-Disposal Facility, there is the potential seepage to the groundwater (Section 7.1.4), leading to contaminated baseflow contributing to the watercourses associated with Catchment 17 and Catchment 19, both of which have a baseline sulphate concentration of <2mg/l. Based on the groundwater report, the following is notable in relation to baseflow water quality impacts associated with the facility:

- As per the groundwater report, a volume of $27m^3/d$ with a sulphate concentration of 30mg/l is expected to report to the tributary associated with Catchment 19 at mine closure (i.e. after 15 years). After 100 years, this concentration is expected to increase to 150mg/l. Taking into account dilution within the watercourse, the concentration within the watercourse is expected to be 9.4mg/l after 15 years increasing to 47mg/l after 100 years.
- At Catchment 17, a volume of $17m^3/d$ with a sulphate concentration of 200mg/l is expected to discharge to the watercourse after 100 years. Taking into account dilution, the concentration within the watercourse is expected to be183.4mg/l after 100 years. At mine closure, the concentration is expected to be insignificant.
- Based on dilution within the Assegaai River, the maximum additional sulphate concentration within this watercourse will be 0.2mg/l after 100 years. Given that the baseline sulphate concentration of 3.8mg/l, this contribution is considered insignificant and the associated impact nominal.

9.4 Water Monitoring Plan

The water quality results can form part of a longer water quality record that may be used as an indication of the baseline water quality in order to quantify the impacts of the proposed project. A formal monitoring programme will need to be developed for the mine and be implemented for the duration of the mining operations to quantify the potential impacts of the mining operations on surface water quality. As a result, the following is recommended:

- The sampling locations and parameters should be maintained at a minimum, to determine any impacts arising from the mining activities. These should be expanded to additional watercourses and parameters should additional impacts be expected.
- It is recommended that monitoring is conducted on at least a quarterly basis for at least a year prior to the commencement of mining activities to determine baseline water quality. Thereafter, during mining activities monitoring should be conducted on at least a monthly basis in order to determine impacts to the water quality through the mining activities. Post closure of the mine, monitoring should continue in order to detect residual contamination sources.
- To ensure the water quality of the treated mine seepage water is suitable for disposal to the watercourse (as discussed in Section 8.2), additional testing of this water quality should be undertaken to ensure impacts to the receiving watercourse are limited. This should be undertaken daily and include the full suite of analytes.

10 Impact Assessment

Due to the proposed mine, there is expected to be an alteration of the flow characteristics of the local watercourses, including both the runoff and peak flow volumes. In addition, there is the potential for water quality impacts.

The impacts to water quantity will be highest during the operational phase due to the proposed stormwater infrastructure (including channels, pipes and pollution control dams) and increased impervious areas (i.e. parking areas). As a result, the model was only run for the operational phase, with impacts for the construction and decommissioning/rehabilitation phases derived from this assessment.

Based on the impacts identified, mitigation measures are outlined to reduce the environmental significance of the impact. The environmental significance of the impacts (both with and without the mitigation measures) is outlined in **Figure 16** using the methodology outlined in **Appendix B**.

10.1 Construction Phase

During the construction of the mine and associated infrastructure, there is expected to be the reworking of the soils (i.e. cut and fill, blasting, land levelling and foundation excavations) with associated vegetation removal. This has the potential to lead to the following impacts:

- Damage or removal of vegetation cover through construction activities and vehicle and foot traffic;
- Compaction of soils due to foot and vehicle traffic, leading to increased runoff;
- Erosion of unvegetated soils and stockpiled soils during rainfall events due to the sandy soil properties and the moderate to steep topography encountered at the site;
- Spills of hydrocarbons from heavy machinery; and,
- Additions of carbonaceous material (as well as explosive residues) to the soil, derived from fly rock during the blasting of the mine adit.

10.1.1 Water Quantity Impacts

During the construction phase there is expected to be an increase in runoff (both as peak flow and total flow) due to the loss of vegetative cover and increased impervious areas and soil compaction. The increase in total flow has the potential to influence the biota within the local watercourses. The increase in peak flow has the potential to lead to surface erosion and erosion within the receiving watercourses.

Based on the risk assessment calculation (**Table 14**), the following can be noted:

- The potential impact to the watercourse ecology has a **Low Medium** environmental significance. This is reduced to **Low** should mitigation measures (Section 10.1.3) be implemented.
- The increased potential for erosion due to the increased peak flow has a **Low Medium** environmental significance; reduced to **Low** should suitable mitigation measures (Section 10.1.3) be implemented

10.1.2 Water Quality Impacts

There is expected to be water quality impacts to the adjacent watercourses due to contributions of runoff arising from the construction site, including an increase in turbidity due to erosion from the construction site, contributions of hydrocarbons from any onsite spills, and contaminants associated with the blast rock (i.e. explosives residue and carbonaceous material).

The decrease in the water quality is expected to have a **Medium** environmental significance (**Table 15**). With mitigation measures (Section 10.1.3), the environmental significance is expected to be reduced to **Low Medium**.

10.1.3 Mitigation Measures and Recommendations

To limit the impacts to water quantity and quality during the construction phase, the following is recommended (with the required actions and responsible parties detailed in **Table 16**):

- Undertake biomonitoring (at least bianually) during the construction phase to ensure aquatic biota health is not adversely effected by proposed mine development.
- Machinery should be checked to ensure no hydrocarbons leaks are occurring, and drip trays used where necessary. In addition, during the filling of vehicles this should be undertaken in a designated area where any spills are contained. Fuels and oils should be stored within bunded areas.
- During blasting, measures should be employed where practical to limit the spread of fly-rock.
- Large areas of soil excavation should be phased to limit the erosion potential during rainfall events (more common between October to March). Construction activities outside of the designated development areas should be limited.
- Where excavation occurs, it is recommended that erosion control measures are implemented to ensure any entrained sediments in runoff have time to settle before reaching watercourses.

- Erosion observed (both on site and within the local watercourses) should be rehabilitated, with mitigation measures adopted in high risk areas (i.e. gabions, gabion mattresses).
- Excavated soils should be appropriately stored in stockpiles which are protected from erosion (i.e. through use of vegetation cover in the case of long-term stockpiles).
- Due to the potential for soil compaction due to vehicles, traffic should be limited to existing or proposed roadways as far as possible. The construction of roads should be limited in width and length as far as is practical to limit impacts.
- Vegetation removal should be kept to a minimum and limited to the area of development. Where an impact to the vegetation outside of the development footprint occurs, rehabilitation measures need to be undertaken to maintain the baseline vegetation population and health.
- To allow for more accurate modelling, flow measurements on the local and regional watercourses expected to be impacted by the development should be initiated and continued during the lifespan of the project.
- Formalisation of a water monitoring plan as per Section 9.4 for the duration of mine life cycle.

10.2 Operational Phase

10.2.1 Water Quantity Impacts

It is proposed that excess seepage water removed from the mine workings will be treated at the Water Treatment Plant prior to release to Catchment 19. This is expected to increase the flow within the watercourse by as much as 1,779% (under dry climatic conditions, factoring in the high seepage rate estimate).

The hydrological assessment indicated that the total flows are generally expected to decrease by a maximum of 6.9% at Catchment 16 and 4.0% at Catchment 17 due to the containment of flows within the PCDs. The peak flows are also expected to increase during the wet season at Catchment 16 and 19 due to the influence of the storm water infrastructure (i.e. perimeter channel) proposed at the site.

The change in runoff to the Assegaai River (taking into account both the decrease of flow due to the contributions from Catchment 16 and 17, and increased contributions from Catchment 19) is expected to have a limited influence at the outlet of the W51A quaternary catchment, with a maximum increase of 3.12% under dry climatic and high seep conditions, and a maximum decrease of 0.14% under wet climatic and low seep conditions.

Based on the water quantity assessment, the following impacts are expected:

- The decrease in runoff at Catchment 16 and 17, and increase at Catchment 19 has the potential to alter the riverine ecosystems. This is considered highly likely within Catchment 19 due to the increase in flows. This is expected to be limited to the catchments adjacent to the proposed mine, with insignificant impacts to ecosystems as a result in change in flow expected on the Assegaai River.
- The increase in peak flows within the watercourses has the potential to lead to erosion impacts within the watercourses adjacent to the proposed mine. The elevated flows at Catchment 19 are expected to lead to significant geomorphological impacts within the associated watercourse. Insignificant impacts are expected on the Assegaai River.
- The increase in flow at Catchment 19 was the potential to lead to increased flood risk on infrastructure located adjacent to or traversing the water course.

Based on the risk assessment calculation (**Table 14**), the following can be noted:

- The potential impact to the geomorphology and associated watercourse ecology due to changes in flow (in particular the increase due to the discharge of dewatering to Catchment 19) has a **High** environmental significance. This is reduced to **Low Medium** should mitigation measures (Section 10.2.3) be implemented.
- The increased potential for catchment erosion (i.e. outside of the watercourse) due to the increased peak flow has a **Low Medium** environmental significance; reduced to **Low** should suitable mitigation measures (Section 10.2.3) be implemented.

10.2.2 Water Quality Impacts

- There is a potential for surface water impacts from the stored coal and Co-Disposal Facility and associated pollution control dams should these not be located on properly designed and monitored impermeable layers which has the potential to impact surface water through potential contaminated baseflow contribution. Based on the expected seepage from the Co-Disposal liner, this is expected to lead to water quality impacts at Catchment 17 and Catchment 19, with a concentration of 183mg/l and 47mg/l respectively.
- There is also the potential for pollution of the receiving watercourses due to spills from machinery. In addition, through the storage of mining machinery, as well as the operations of fuel store, workshops and car washes, there is the potential for an increase in petroleum hydrocarbons within the runoff.
- Since the dirty areas are proposed to be under hardstanding, with runoff reporting to PCDs, the potential for dirty water discharge to the environment is considered low. However the watercourses have the potential to be contaminated through dust generation and settlement associated with the mine operations.

Based on the risk assessment calculation (**Table 15**), the following can be noted:

The decrease in the water quality is expected to have a **High** environmental significance. With mitigation measures (Section 10.2.3), the environmental significance is expected to be reduced to **Medium High**. The environmental significance remains Medium High, even with the use of a liner to limit groundwater seepage contributions assuming limited seepage (i.e. 3.15mm/annum).

10.2.3 Mitigation Measures and Recommendations

To limit surface water impacts during operation, the following is recommended (with the required actions and responsible parties detailed in **Table 16**):

- Discharge of excess groundwater associated with dewatering of the mine to the watercourses needs to be appropriately managed to ensure continuous steady release. The option of piping the water across to the Assegaai River should be considered as a preferable option owing to the lower expected impacts to flow.
- Undertake biomonitoring (at least bianually) to ensure aquatic biota health is not adversely effected by proposed mine development.
- To appropriately manage storm water, the Storm Water Management Plan developed as part of the specialist studies for this project needs to be implemented. This includes the required infrastructure sizings for pipes, channels and reservoirs, as well as recommendations for erosion control at the releases of clean water to the environment. This should also factor in the management requirements for the Co-Disposal Facility, including the use of a liner to limit groundwater seepage.
- Erosion observed (both on site and within the local watercourses) should be rehabilitated, with mitigation measures adopted in high risk areas (i.e. gabions, gabion mattresses).
- Impacts that are expected to lead to long term degradation of soil quality (i.e. soil contamination) needs to be limited through appropriate onsite management measures. This includes the proper handling and storage of hazardous materials, the use of hardstanding in areas where spillages are possible, the use of bunding around storage of hazardous materials (i.e. fuel storage tanks), and proper upkeep of machinery and vehicles.
- Formalisation of a water monitoring plan as per Section 9.4 for the duration of mine life cycle.

10.3 Decommissioning and Rehabilitation Phases

During rehabilitation, it is proposed that the impervious areas are uplifted and the site is rehabilitated so that the soils and vegetation resemble baseline conditions. Due to the content of the co-disposal facility and PCDs, it is expected that these will be appropriately managed to limit environmental impacts; however since these measures are unknown at this stage, it has been assumed that the areas will continue to be managed as dirty areas.

10.3.1 Water Quantity Impacts

During the decommissioning and rehabilitation of the mine and associated infrastructure, there is expected to be a removal of impervious areas, and an increase in vegetation cover. As a result, the runoff from these areas is expected to return to the pre-mining conditions over time.

Due to the dirty nature of the Co-Disposal Facility and PCDs, it has been assumed that these will continue to be managed as dirty areas, with runoff not contributing to the watercourses. This will result in a continued reduction in the contributing catchment area reporting to the local watercourses, leading to a potential impact to the local aquatic health.

Based on the risk assessment calculation (**Table 14**), the potential impact to the watercourse ecology has a **Low Medium** environmental significance. With mitigation measures (Section 10.3.3), the environmental significance remains **Low Medium**.

10.3.2 Water Quality Impacts

The decommissioning phase and rehabilitation phases have the potential to lead to similar water quality impacts as during the construction phase (i.e. increased turbidity through soil exposure and spills of hydrocarbons from heavy machinery used in the decommissioning).

The decrease in the water quality is expected to have a **Medium** environmental significance (**Table 15**), reduced to **Low Medium** should the mitigation measures outlined in Section 10.3.3 be implemented.

10.3.3 Mitigation Measures and Recommendations

To limit the impacts to water quantity and quality during the decommissioning and rehabilitation phases, the following is recommended (with the required actions and responsible parties detailed in **Table 16**):

- Undertake biomonitoring (at least bianually) to ensure aquatic biota health is not adversely effected by proposed mine development. This is only required should moinitoring during the operational phase indicate significant impacts.
- Machinery should be checked to ensure no hydrocarbons leaks are occurring, and drip trays used where necessary. The filling of vehicles should be undertaken in a designated area where any spills are contained.
- Large areas of soil excavation should be phased to limit the erosion potential during rainfall events. Construction activities outside of the designated development areas should be limited.
- To limit the generation of dirty water during the decommissioning of the plant and administration area, it is recommended that the stormwater management infrastructure associated with these areas (channels and PCD) remain to capture dirty runoff.
- Where excavation occurs, it is recommended that erosion control measures are implemented to ensure any entrained sediments in runoff have time to settle before reaching watercourses.
- Due to the potential for soil compaction due to vehicles, traffic should be limited to existing or proposed roadways as far as possible.
- Once the site has been fully decommissioned, there are expected to be limited water quality impacts, provided that the site is properly rehabilitated. To limit erosion, it should be ensured that the soils maintain their pre-development characteristics as far as is practicable to ensure infiltration and vegetation rooting. The vegetation health should be returned to the baseline health where practically feasible.
- Formalisation of a water monitoring plan as per Section 9.4 for the duration of mine life cycle.

Table 14: Impact Assessment Calculation – Water Quantity

Ref.	Phase	Impact Description	Mitigation Measure	A Severity	B Duration	C Extent	D Consequence (A+B+C)/3	E Frequency	F Probability	G Likelihood (E+F)/2	(DxG) Environmental Significance (Without Mitigation)	(DxG) Environmental Significance (With Mitigation)
Water Quantity												
1.1	Construction	Impacts to watercourse ecology due to increase of total flow	Limit soil compaction. Biomonitoring on local watercourses	2	3	3	2.7	3	3	3.0	**8.0**	
				1	2	3	2.0	1	1	1.0		**2.0**
1.2		Erosion due to increase in peak flow	Monitor and rehabilitate erosion. Environmental management to limit pollution and sediment generation. Water quality monitoring.	2	3	3	2.7	3	3	3.0	**8.0**	
				1	1	1	1.0	1	2	1.5		**1.5**
1.3	Operation	Impacts to watercourse ecology due to change (increase/decrease) of total flow	Biomonitoring on local watercourses. Transfer the excess seepage water to the Assegaai River rather than its tributary.	5	5	4	4.7	5	5	5.0	**23.3**	
				2	3	3	2.7	3	2	2.5		**6.7**
1.4		Erosion due to increase in peak flow	Monitor and rehabilitate erosion.	2	3	3	2.7	3	3	3.0	**8.0**	
				1	2	1	1.3	1	2	1.5		**2.0**
1.5	Decomm./ Rehab.	Decreased watercourse flow due to containment of runoff in PCDs	Limit soil compaction. Biomonitoring on local watercourses if aquatic ecology health impacts shown to be significant during the operational phases.	2	4	3	3.0	4	2	3.0	**9.0**	
				1	3	3	2.3	3	2	2.5		**5.8**

Table 15: Impact Assessment Calculation – Water Quality

				A	B	C	D	E	F	G	(DxG)	(DxG)
Ref.	**Phase**	**Impact Description**	**Mitigation Measure**	**Severity**	**Duration**	**Extent**	**Consequence (A+B+C)/3**	**Frequency**	**Probability**	**Likelihood (E+F)/2**	**Environmental Significance (Without Mitigation)**	**Environmental Significance (With Mitigation)**
Water Quality												
1.6	Construction	Decreased water quality due to construction activities	Environmental management to limit pollution and sediment generation. Water quality monitoring.	4	2	3	3.0	4	3	3.5	10.5	
				2	1	3	2.0	3	2	2.5		5.0
1.7	Operation	Decrease in water quality due to the operational activities (including seepage from the Co-Disposal Facility)	Environmental management to limit pollution and dust generation. Water quality monitoring. Storm Water Management Plan to be followed.	4	5	4	4.3	5	5	5.0	21.7	
				4	5	3	4.0	5	4	4.5		18.0
1.8	Decomm./ Rehab.	Decreased water quality due to the decommissioning and rehabilitation activities	Environmental management to limit pollution and sediment generation. Water quality monitoring.	4	2	3	3.0	4	3	3.5	10.5	
				2	1	3	2.0	3	2	2.5		5.0

Table 16: Mitigation measures

Management Measure Ref.	Management Recommendations	Action Ref.	Required Action	Responsible Party	Phase
1.1	Route mine seepage excess water to Assegaai River	1.1	This should be investigated by mine planners	Mine Planner	Pre-Construction
1.2	Undertake biomonitoring	1.2	This should be incorporated into an EMPR and initiated by mine environmental manager	WSP, Environmental Manager	Construction/ Operation/ Decommissioning/ Rehabilitation
1.3	Contamination needs to be limited through appropriate on-site environmental management practices	1.3	This should be incorporated into an EMPR and implemented by on-site contractors.	WSP, mine planner, on-site contractor, Environmental Compliance Officer (ECO), Environmental Manager	Construction/ Operation/ Decommissioning/ Rehabilitation
1.4	Measures to be employed during blasting to limit the spread of fly-rock	1.3	This should be incorporated into an EMPR and implemented by on-site contractors.	WSP, mine planner, on-site contractor, Environmental Compliance Officer (ECO), Environmental Manager	Construction
1.5	Limit excavation and vegetation removal extent and duration; use erosion controls.	1.3	This should be incorporated into an EMPR and implemented by on-site contractors.	WSP, mine planner, on-site contractor, Environmental Compliance Officer (ECO), Environmental Manager	Construction/ Decommissioning/ Rehabilitation
1.6	Vegetate stockpiled soils	1.3	This should be incorporated into an EMPR and implemented by on-site contractors.	WSP, mine planner, on-site contractor, Environmental Compliance Officer (ECO), Environmental Manager	Construction
1.7	Limit soil compaction by keeping to designated paths/roads	1.3	This should be incorporated into an EMPR and implemented by on-site contractors.	WSP, mine planner, on-site contractor, Environmental Compliance Officer (ECO), Environmental Manager	Construction/ Decommissioning/ Rehabilitation

Management Measure Ref.	Management Recommendations	Action Ref.	Required Action	Responsible Party	Phase
1.8	Initiate water monitoring plan	1.2	This should be incorporated into an EMPR and initiated by mine environmental manager	WSP, Environmental Manager	Construction/ Operation/ Decommissioning/ Rehabilitation
1.9	Measure watercourse flows	1.2	This should be incorporated into an EMPR and initiated by mine environmental manager	WSP, Environmental Manager	Construction/ Operation
1.10	Implement Storm Water Management Plan. This includes installation of liner to limit seepage to groundwater from Co-Disposal Facility.	1.2	This should be incorporated into an EMPR and initiated by mine environmental manager	WSP, Environmental Manager	Operation
1.11	Rehabilitate eroded areas	1.2	This should be incorporated into an EMPR and initiated by mine environmental manager	WSP, Environmental Manager	Construction/ Operation
1.12	Maintain Storm Water Management Infrastructure during decommissioning	1.2	This should be incorporated into an EMPR and initiated by mine environmental manager	WSP, Environmental Manager	Decommissioning/ Rehabilitation
1.13	Soil and vegetation to be rehabilitated to pre-development condition as far as is practicable	1.2	This should be incorporated into an EMPR and initiated by mine environmental manager	WSP, Environmental Manager	Decommissioning/ Rehabilitation

10.4 Cumulative Impacts

Cumulative impacts are the combined, incremental effects of human activity that pose an environmental risk. They result when the effects of an action are added to, or interact with, other effects in a particular place and within a particular time. With regards to the hydrological impacts, the following can be noted:

- The level of development within the contributing catchment is relatively low, within only the township of Dirkiesdorp being located in the lower portions of the catchment. As a result, the anthropogenic impacts of human development in altering the flow conditions of the local and regional watercourses (either through water abstractions, or through increased urban runoff) are expected to be limited. As a result, the cumulative impact of the mine on water flows is expected to be limited.
- The landuse within the contributing catchments is largely grassland, with limited agriculture. This agriculture has the potential to increase sediments and nutrients within the watercourses due to runoff. Although these are no other mines noted within the contributing catchment, this runoff, in combination with the runoff from the Dirkiesdorp townships, is expected to lead to a reduction in water quality. The influence of the proposed mine in potentially impacting water quality will thus have a cumulative impact when these landuses are taken into account. However, given the limited degree of agriculture and urban development, this cumulative impact is expected to be limited.

11 Conclusions

The objective of the hydrological assessment was to determine the potential impacts of the proposed mine on both water quantity and quality of the receiving hydrological environment.

The following limitations to the assessment need to be noted:

- Due to a lack of flow gauges in the vicinity of the proposed mine development, the model was calibrated based on flow measurements made during the dry season at a single point in time. To ensure the validity of the model, additional flow measurements for calibration purposes are required, including wet season flows.
- Based on the geohydrological impact assessment undertaken for this project (iLEH, 2013) , it is expected that the impact associated with mine dewatering to the shallow aquifer and subsequent baseflow to water courses (i.e. impact to seep zones) will be in the immediate vicinity of the mining operations. Although impacts to the local baseflow conditions are expected to be pronounced, it has been assumed in the hydrological modelling that the impact as a result to regional baseflow conditions will be nominal. This will need to be confirmed through surface flow monitoring during the various phases of the mines operations.
- The hydrological modelling did not factor in changes to baseflow contribution owing to the mine dewatering. However, based on the expected zone of influence outlined in the geohydrological report, the regional impacts to flow (i.e. Assegaai River) as a result of dewatering on baseflow contributions to the water course are expected to be nominal; hence were not considered significant.

Based on the assessment, the following can be concluded:

- The Water Balance concluded the following:
  - Due to the dewatering volumes, there is an excess of water expected. Assuming this is treated at the Water Treatment Plant and released to the environment, the excess is expected to be 209,314m^3/season (wet season) and 192,375m^3/season(dry season) under the high seepage estimate. Undder the low seepage estimate, the excess is expected to be 35,820m^3/season (wet season) and 18,881m^3/season (dry season).
  - There is expected to be an insufficient volume of water to supply the coal wash plant start-up volume and dust suppression due to limited dewatering volumes. This water needs to be sourced from alternative sources (i.e. boreholes or surface water).
- The proposed mine is not expected to have a significant risk of flooding. However, should the dewatering volumes be discharged to Catchment 19 as is proposed, this will increase the flood risk to downstream infrastructure.
- During the construction phase, the environmental impacts can be summarised as follows:
  - The potential impact to the watercourse ecology due to increase watercourse flow has a **Low Medium** environmental significance. This is reduced to **Low** should mitigation measures be implemented.
  - The increased potential for erosion due to the increased peak flow has a **Low Medium** environmental significance; reduced to **Low** should suitable mitigation measures be implemented.

- There is expected to be a reduction in water quality, expected to have a **Medium** environmental significance, reduced to **Low Medium** should mitigation measures be implemented.

During the operational phase, the environmental impacts can be summarised as follows:

- The potential impact to the watercourse ecology due to changes in flow (in particular the increase due to the discharge to Catchment 19) has a **High** environmental significance. This is reduced to **Low Medium** should mitigation measures be implemented.
- The increased potential for erosion due to the increased peak flow has a **Low Medium** environmental significance; reduced to **Low** should suitable mitigation measures be implemented
- The operations are expected to lead to a decrease in the water quality, expected to have a **High** environmental significance, reduced to **Medium High** should suitable mitigation measures be implemented.

- During the decommissioning and closure phases, the environmental impacts can be summarised as follows:
  - The continued reduction in flows expected post-closure of the mine is expected to have a **Low Medium** environmental significance, both with and without mitigation measures.
  - The decrease in the water quality is expected to have a **Medium** environmental significance, reduced to **Low Medium** should mitigation measures be implemented.
- The cumulative impacts with regards to water quality and quantity are expected to be limited.

12 References

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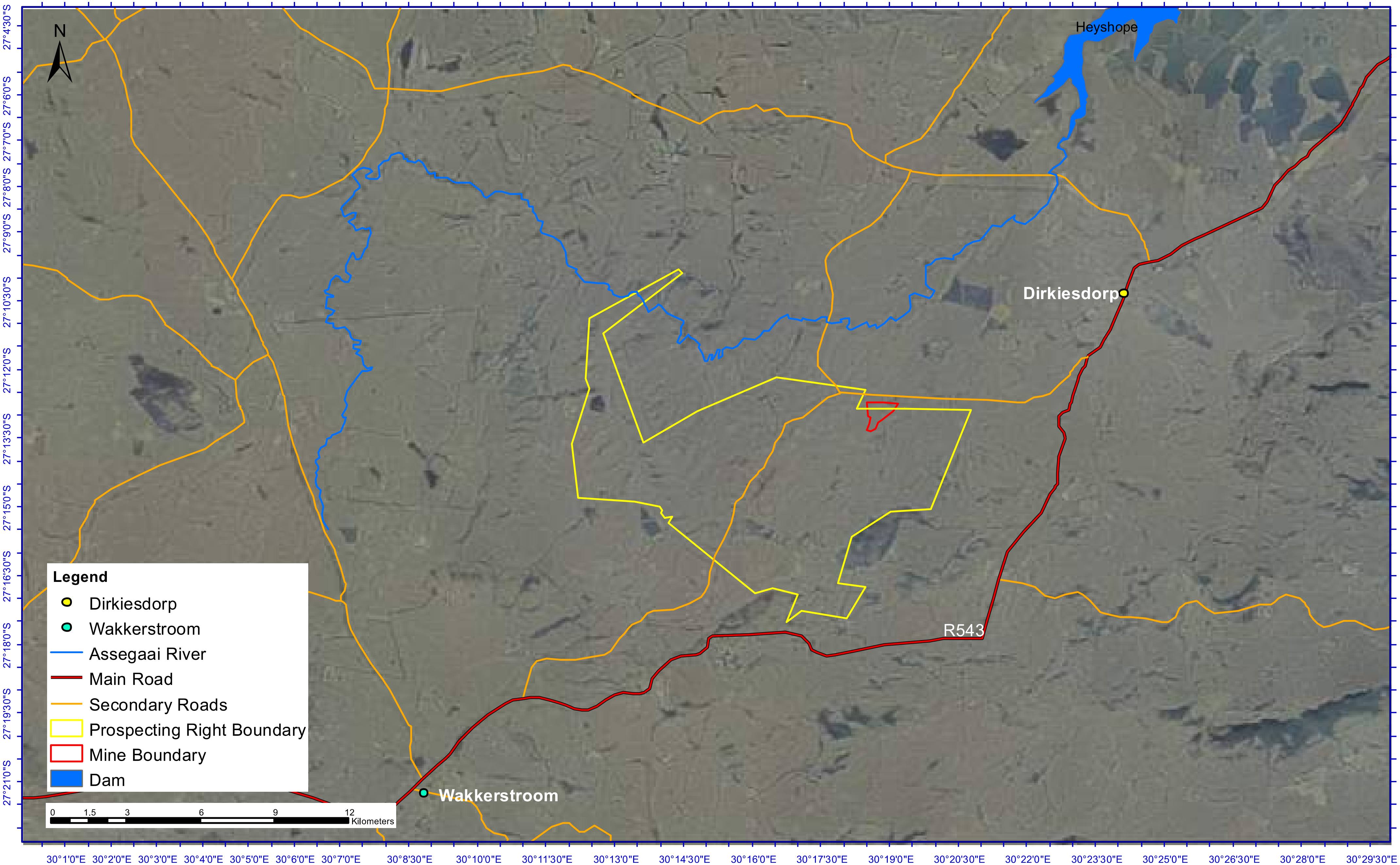
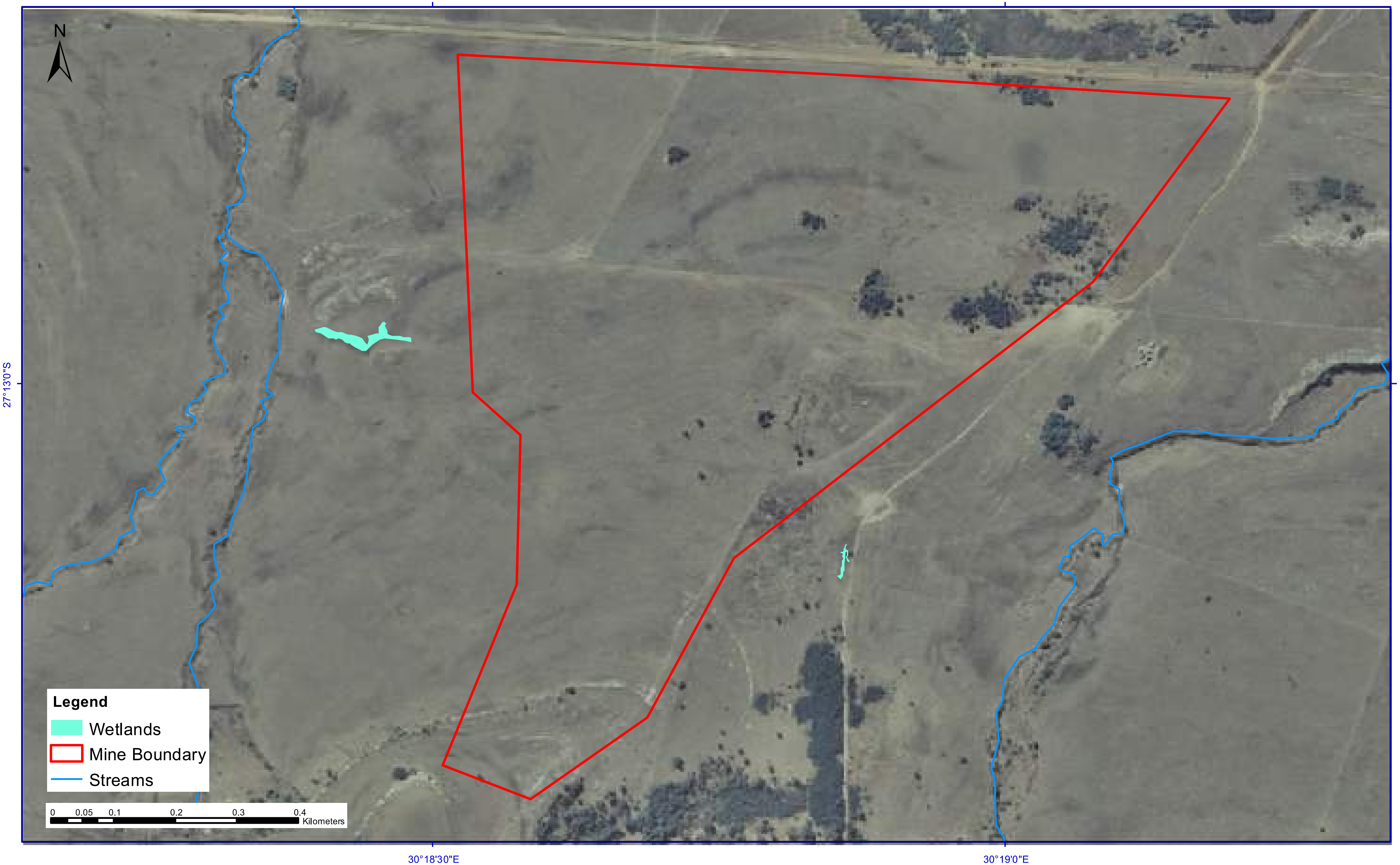
Figures



Atha-Africa Ventures (Pty) Ltd.	**Data Source:** South African Department of Rural Development and Land Reform - Chief Directorate: National Geo-spatial Information	**Project:** Yzermyn Hydrological Assessment	**Date:** 07 August 2013	WSP www.wspenvironmental.co.za
Locality Map		**Project No:** 24514-04		
		Drawn by: A. Mthalane	**Figure No.** 1	
	Projection Geographic - WGS1984	**Reviewed by:** A. Gemmell		



Atha-Africa Ventures (Pty) Ltd

Mine Area

Data Source:
South African Department of
Rural Development and Land Reform -
Chief Directorate: National Geo-spatial Information

Projection Geographic - WGS1984

Project: Yzermyn Hydrological Assessment

Project No: 24514-04

Drawn by: A. Mthalane

Reviewed by: A. Gemmell

Date: 07 August 2013

Figure No. 2

WSP

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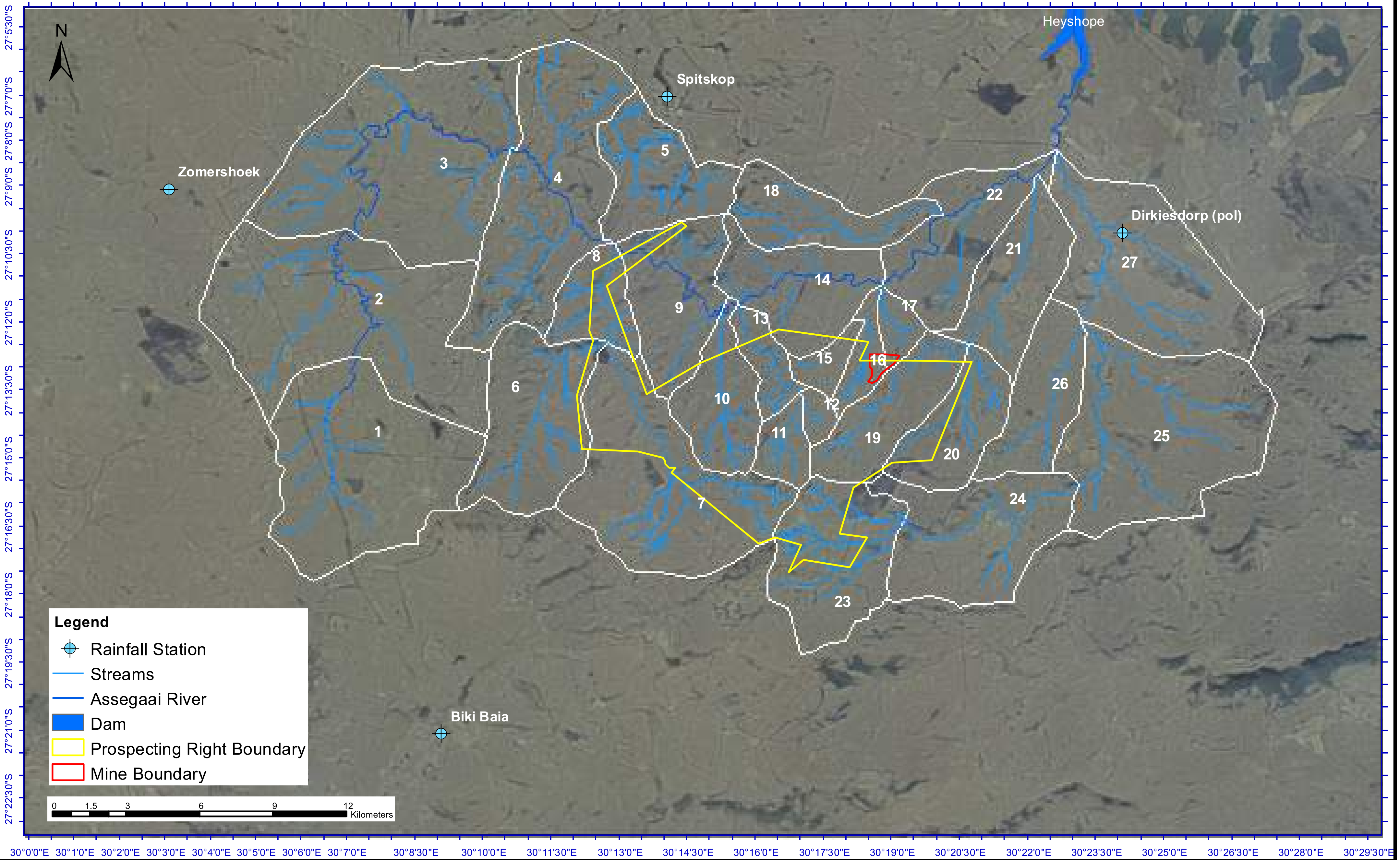

Atha-Africa Ventures (Pty) Ltd. Catchment Layout	**Data Source:** South African Department of Rural Development and Land Reform - Chief Directorate: National Geo-spatial Information	**Project:** Yzermyn Hydrological Assessment **Project No:** 24514-04 **Drawn by:** A. Mthalane	**Date:** 07 August 2013
	Projection Geographic - WGS1984	**Reviewed by:** A. Gemmell	**Figure No.** 3

WSP
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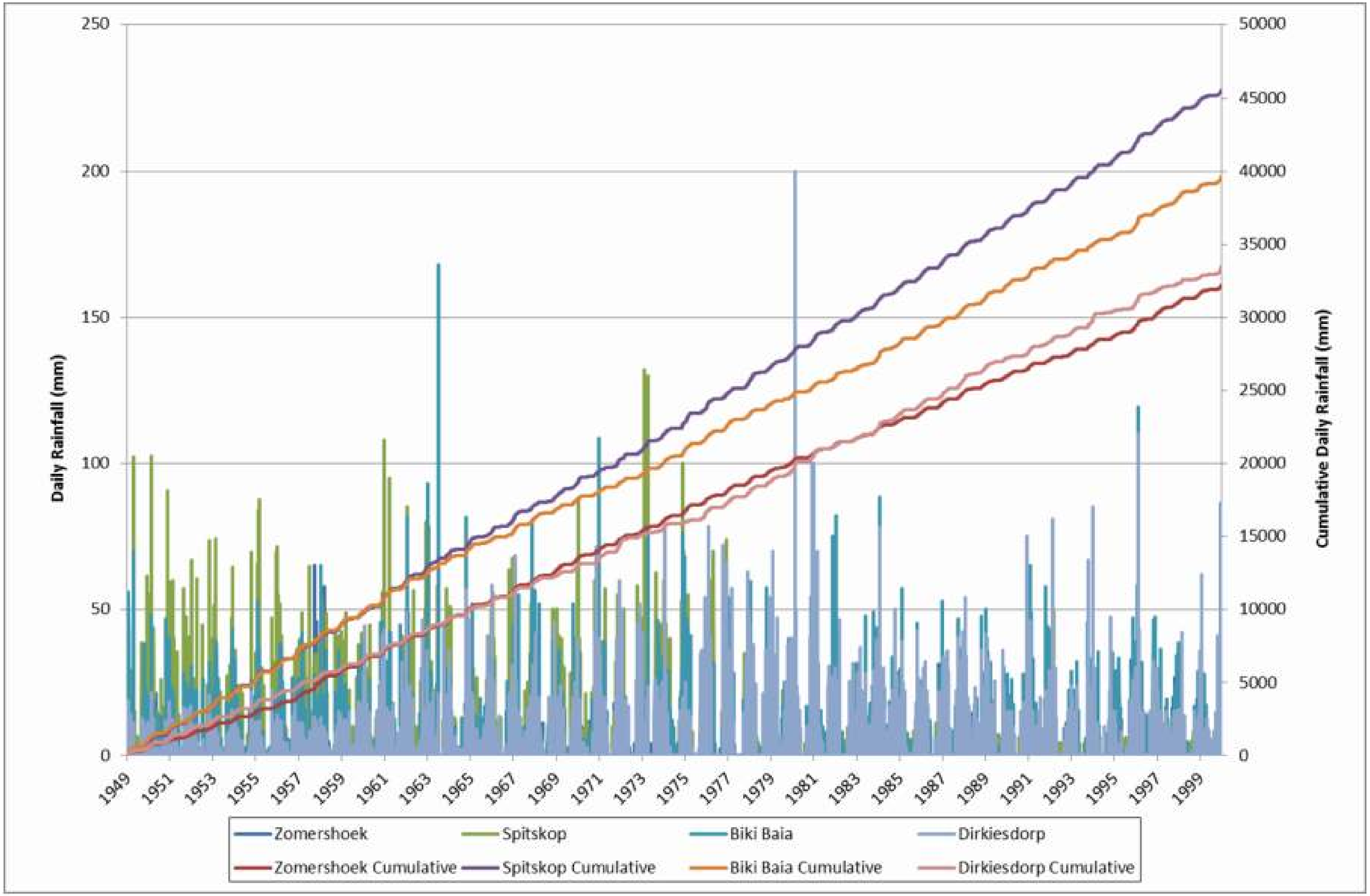
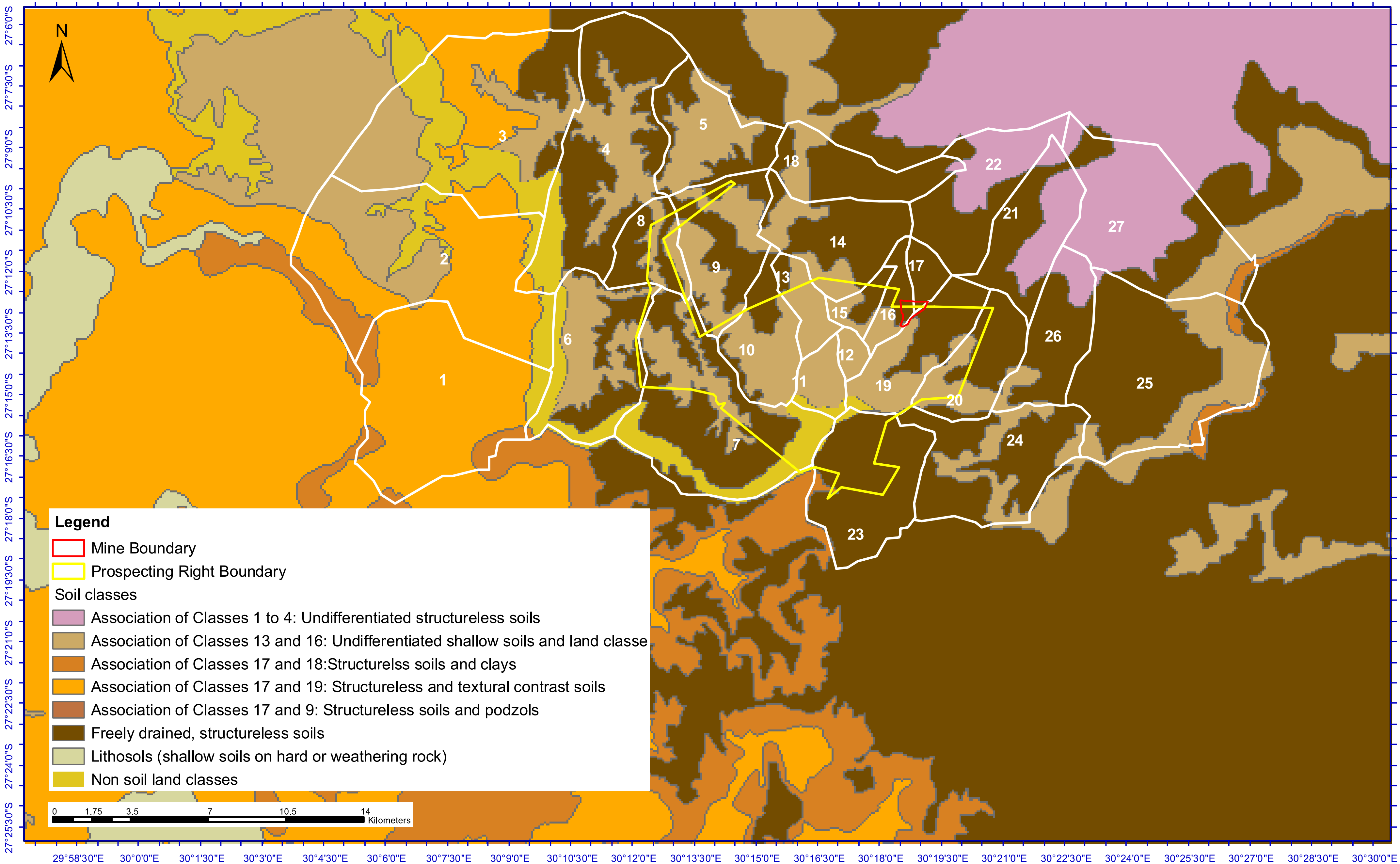


Figure 4: Daily and cumulative Time Series Plot



Atha-Africa Ventures (Pty) Ltd.

Soil Class Map

Data Source:
South African Department of Rural Development and Land Reform - Chief Directorate: National Geo-spatial Information

Projection Geographic - WGS1984

Project:	Yzermyn Hydrological Assessment
Project No:	24514-04
Drawn by:	A. Mthalane
Reviewed by:	A. Gemmell

Date:
07 August 2013

Figure No.
5

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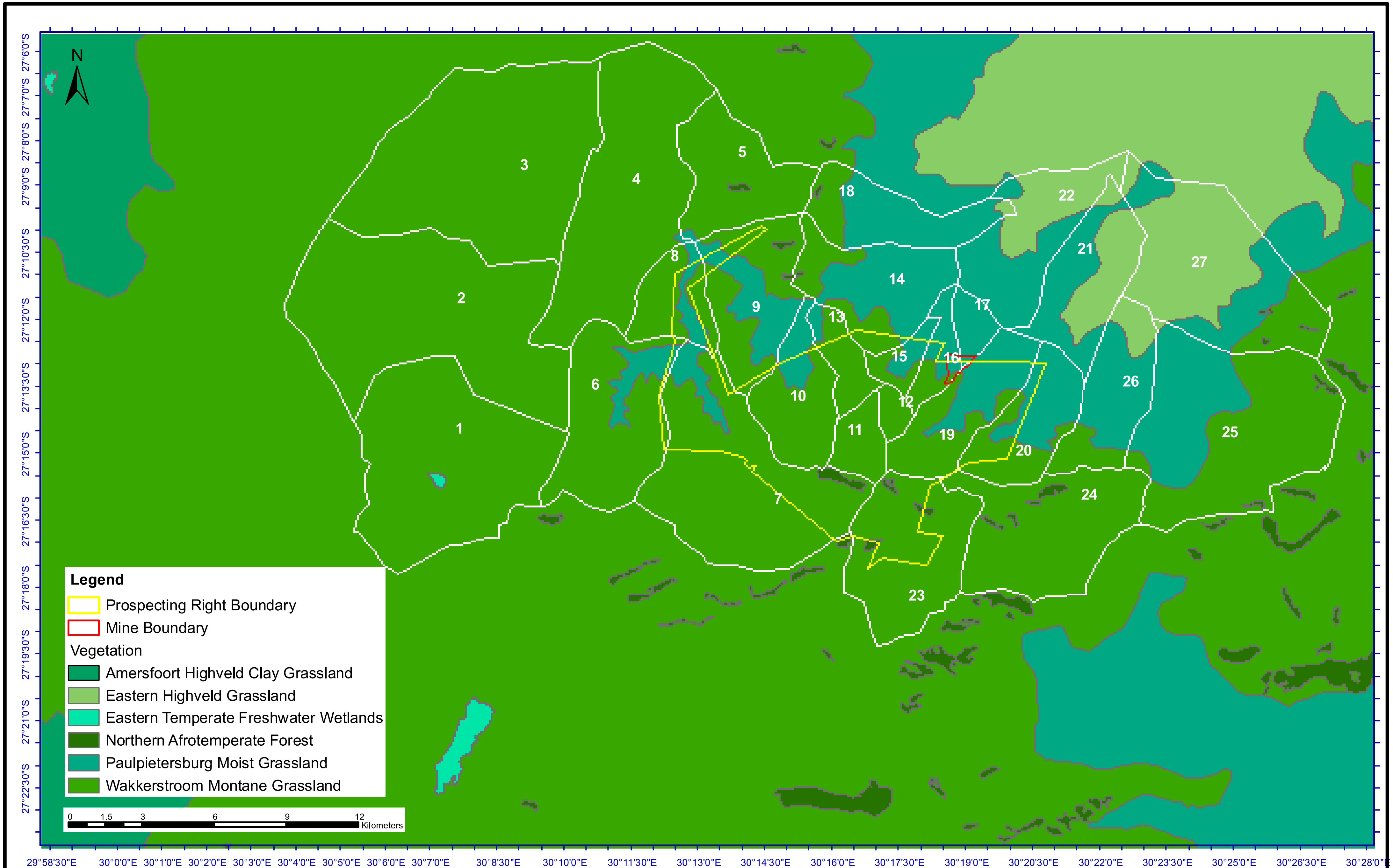

Atha-Africa Ventures (Pty) Ltd.

Vegetation Map

Data Source: Mucina and Rutherford, 2006

Projection Geographic - WGS1984

Project: Yzermyn Hydrological Assessment

Project No: 24514-04

Drawn by: A. Mthalane

Reviewed by: A. Gemmell

Date: 07 August 2013

Figure No. 6

WSP

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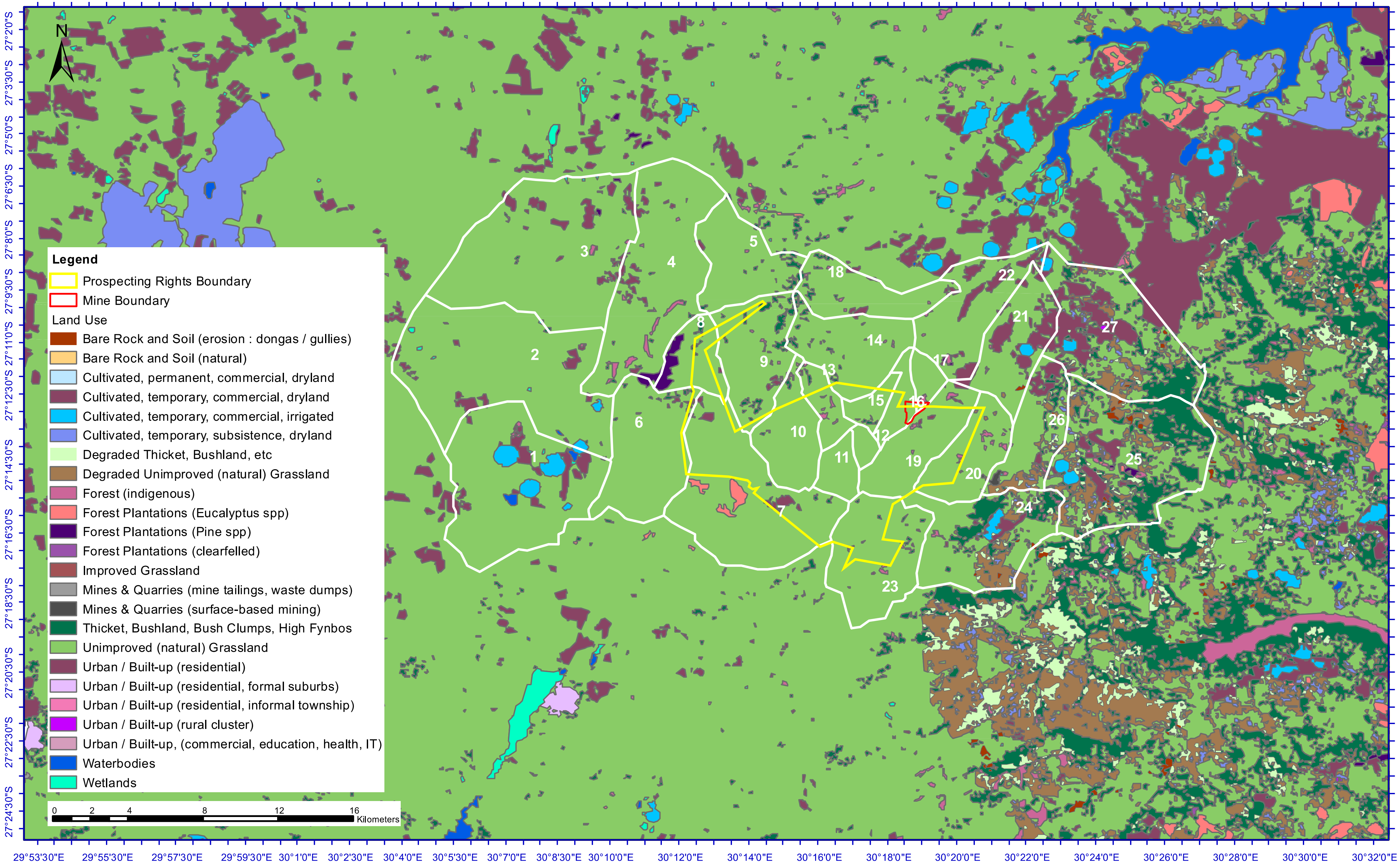

Atha-Africa Ventures (Pty) Ltd. Land Use Map	**Data Source:** South African Department of Rural Development and Land Reform - Chief Directorate: National Geo-spatial Information **Projection** Geographic - WGS1984	**Project:** Yzermyn Hydrological Assessment **Project No:** 24514-04 **Drawn by:** A. Mthalane **Reviewed by:** A. Gemmell	**Date:** 07 August 2013 **Figure No.** 7

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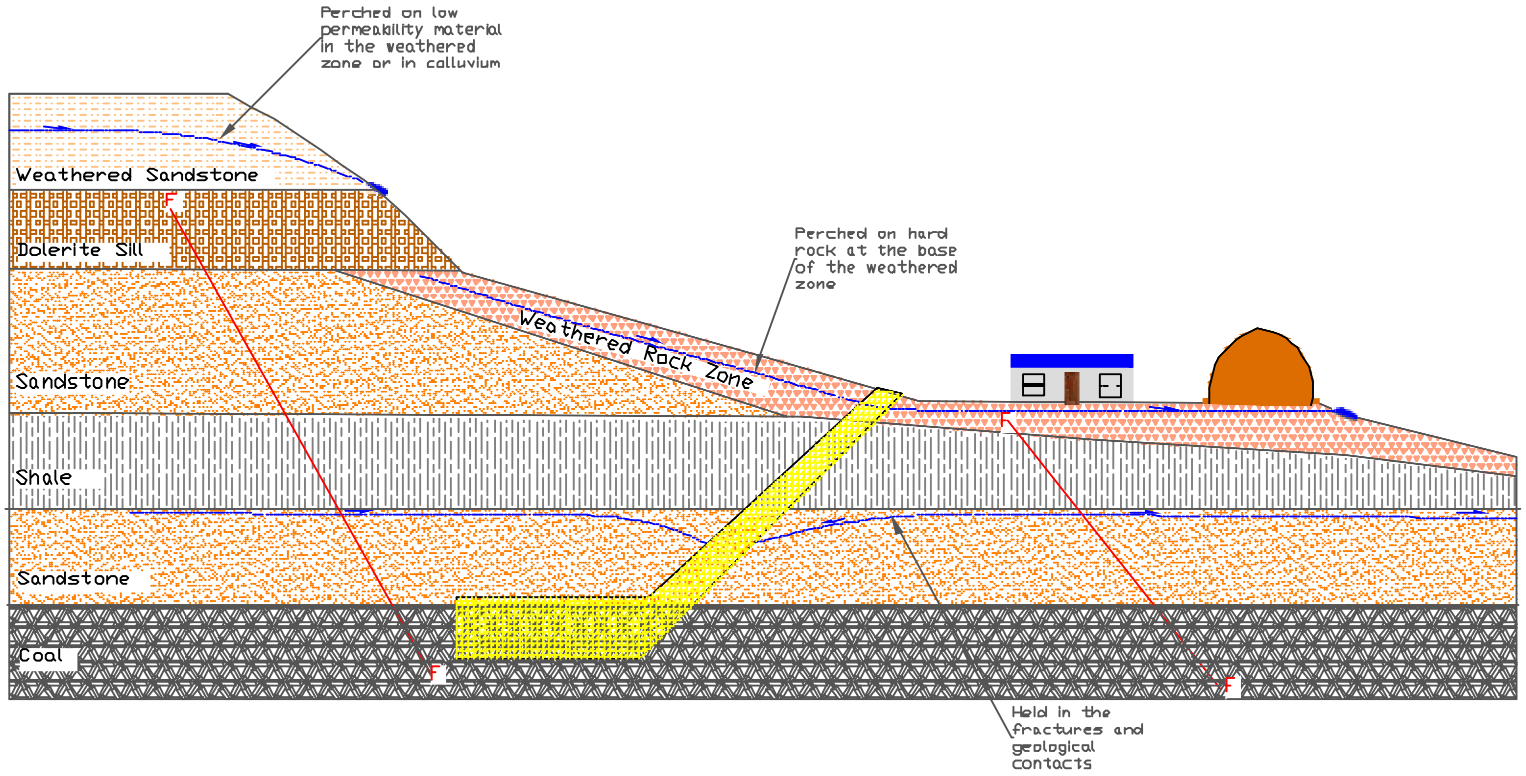

DO NOT SCALE

Legend

- Administration Building
- Co-Disposal Facility
- Adit
- Spring
- Fracture

Drawing status: FINAL

WSP

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Client: Atha Africa Ventures (Pty) Ltd

Consultant: Ayanda Mthalane

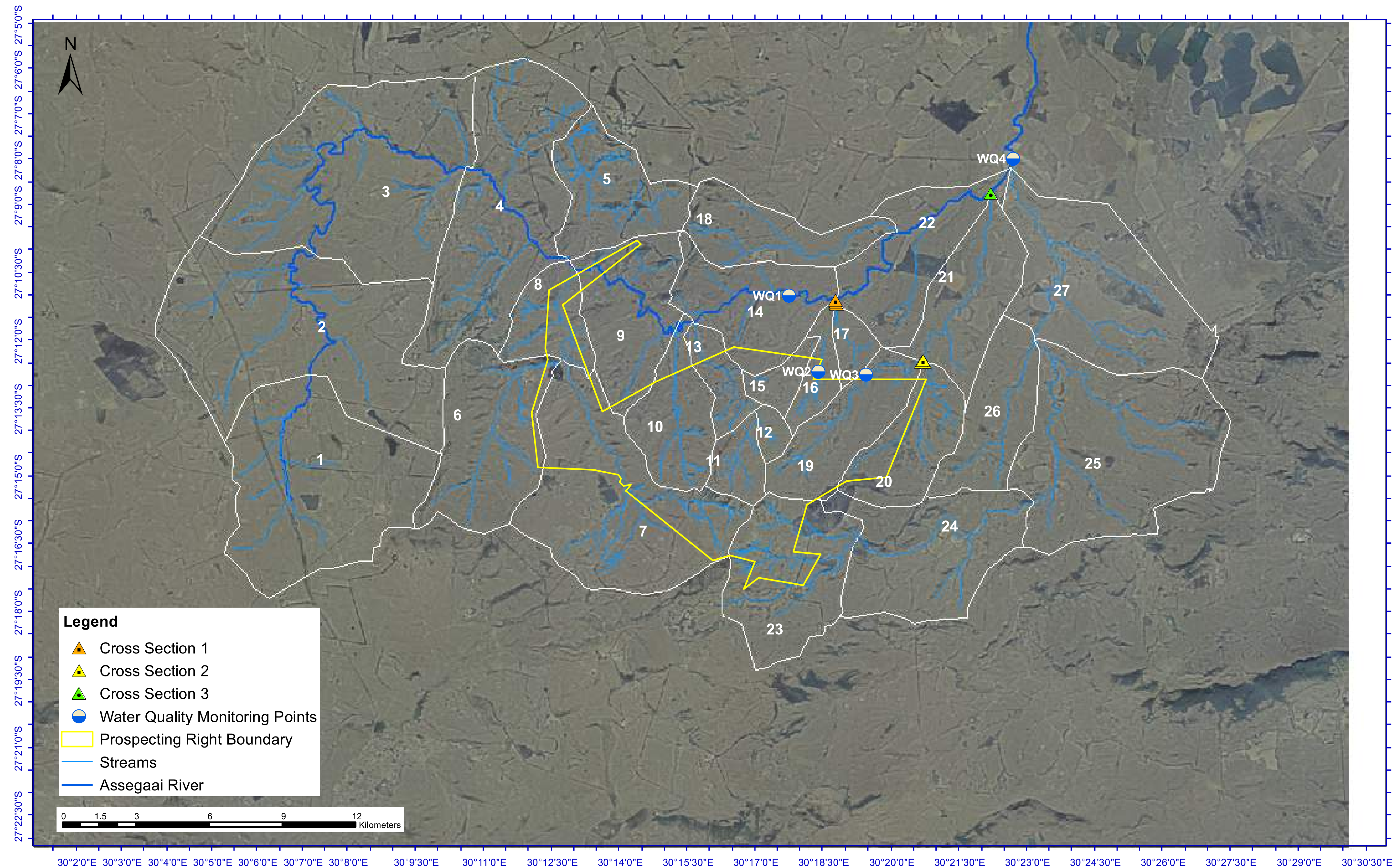
Project: Yzermyn Underground Coal Mine

Title: Conceptual Groundwater Model

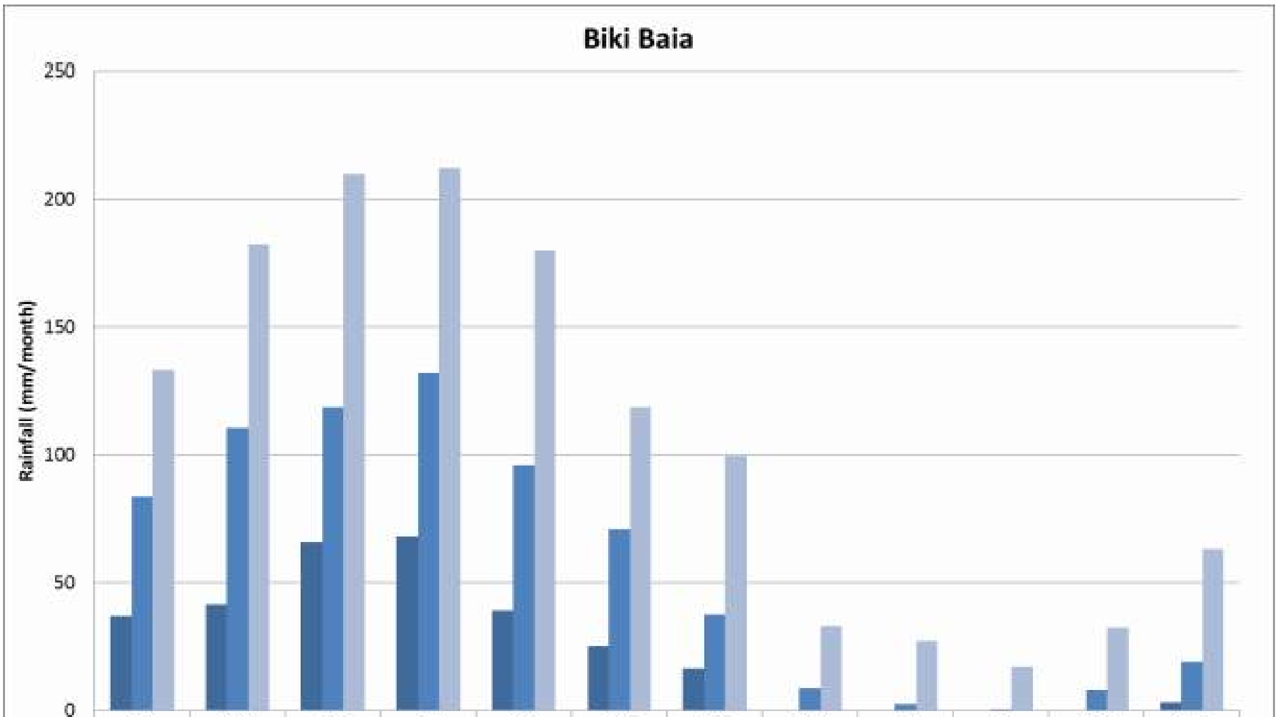
Scale @ A3	Checked	Approved
Not to Scale	Ayanda Mthalane	Adam Smith

CAD File	Design / Drawn	Date
		August 2013

Project No	Figure No	Rev
24514-04	5	

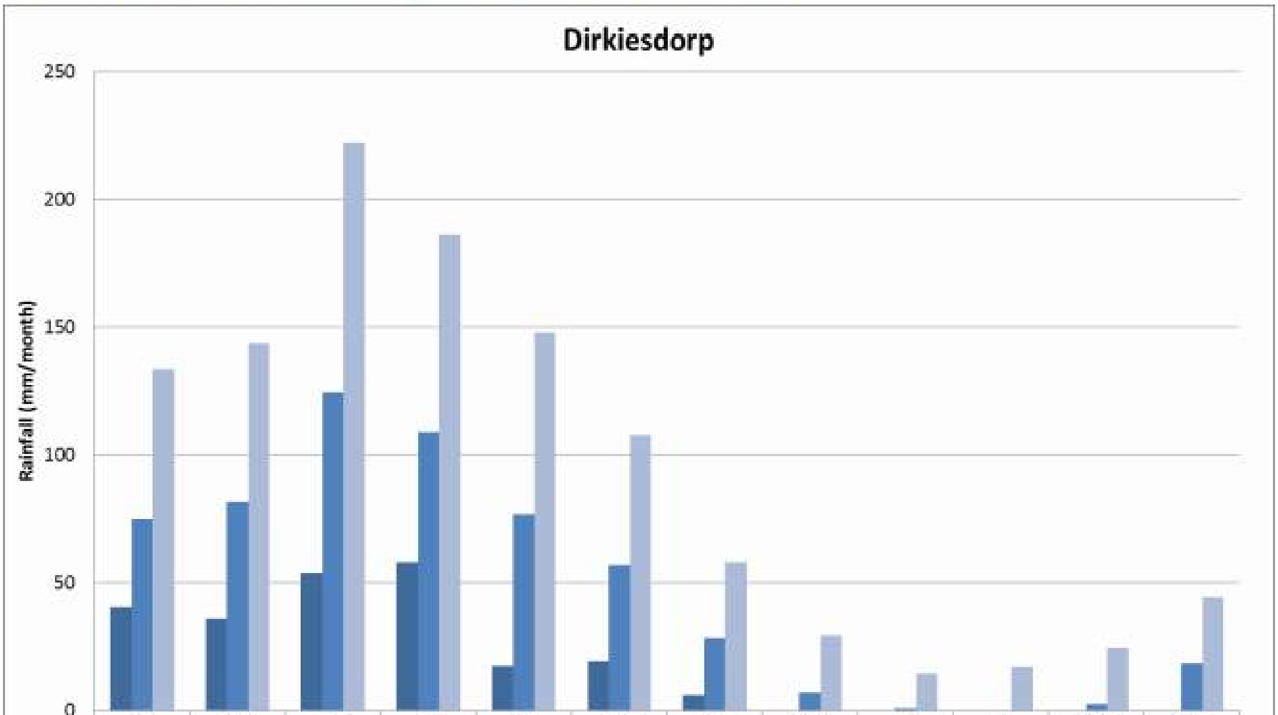


Atha-Africa Ventures (Pty) Ltd. Cross Section and Water Quality Monitoring Points	**Data Source:** South African Department of Rural Development and Land Reform - Chief Directorate: National Geo-spatial Information	**Project:** Yzermyn Hydrological Assessment	**Date:** 07 August 2013	WSP www.wspenvironmental.co.za
		Project No: 24514-04		
		Drawn by: A. Mthalane	**Figure No.** 9	
	Projection Geographic - WGS1984	**Reviewed by:** A. Gemmell		



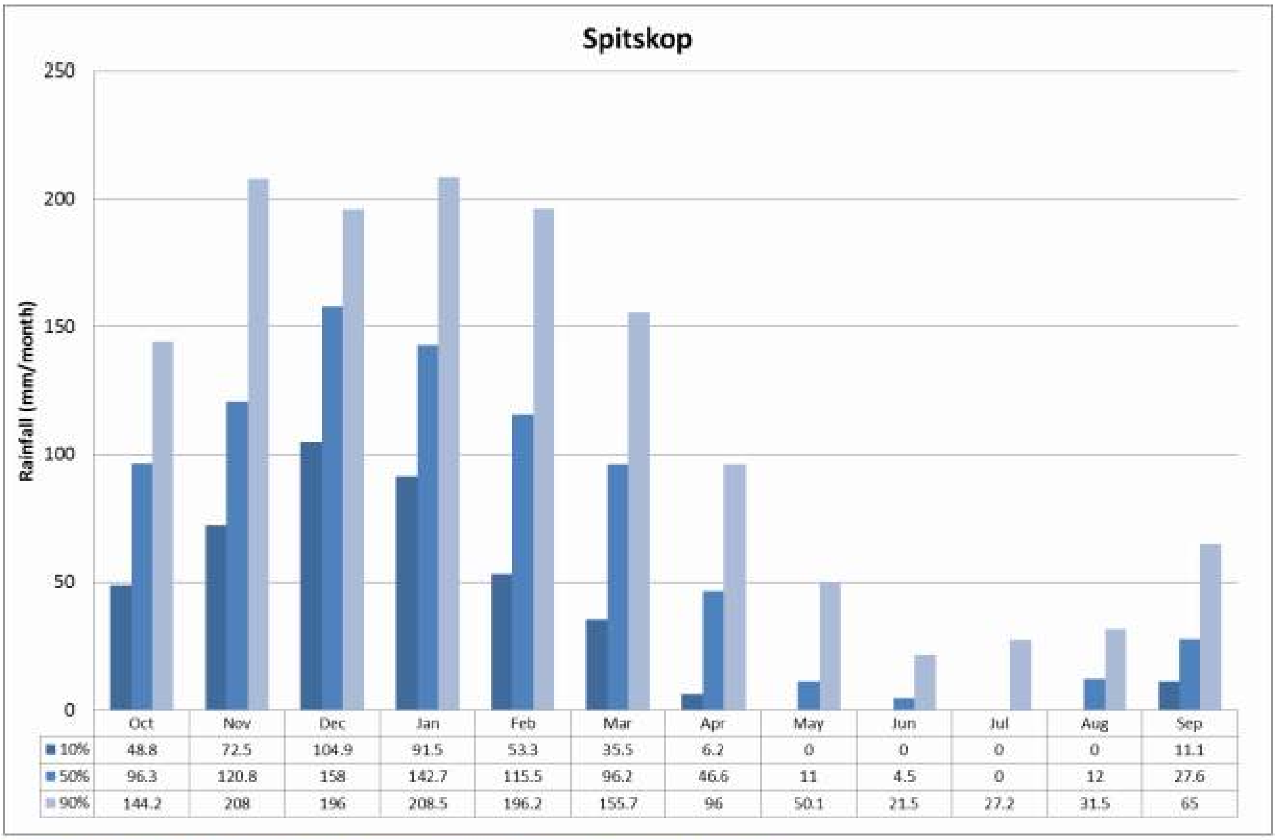
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
10%	37	41.5	65.8	67.9	39	25.2	16.4	0	0	0	0.2	3
50%	83.5	110.4	118.6	132	95.8	70.8	37.5	8.5	2.5	0.4	8	19.1
90%	133.1	182.3	209.9	212.1	180.1	118.5	99.4	33.1	27	17.1	32.4	63

Figure10: Rainfall distribution (mm/month), Biki Baia rainfall station



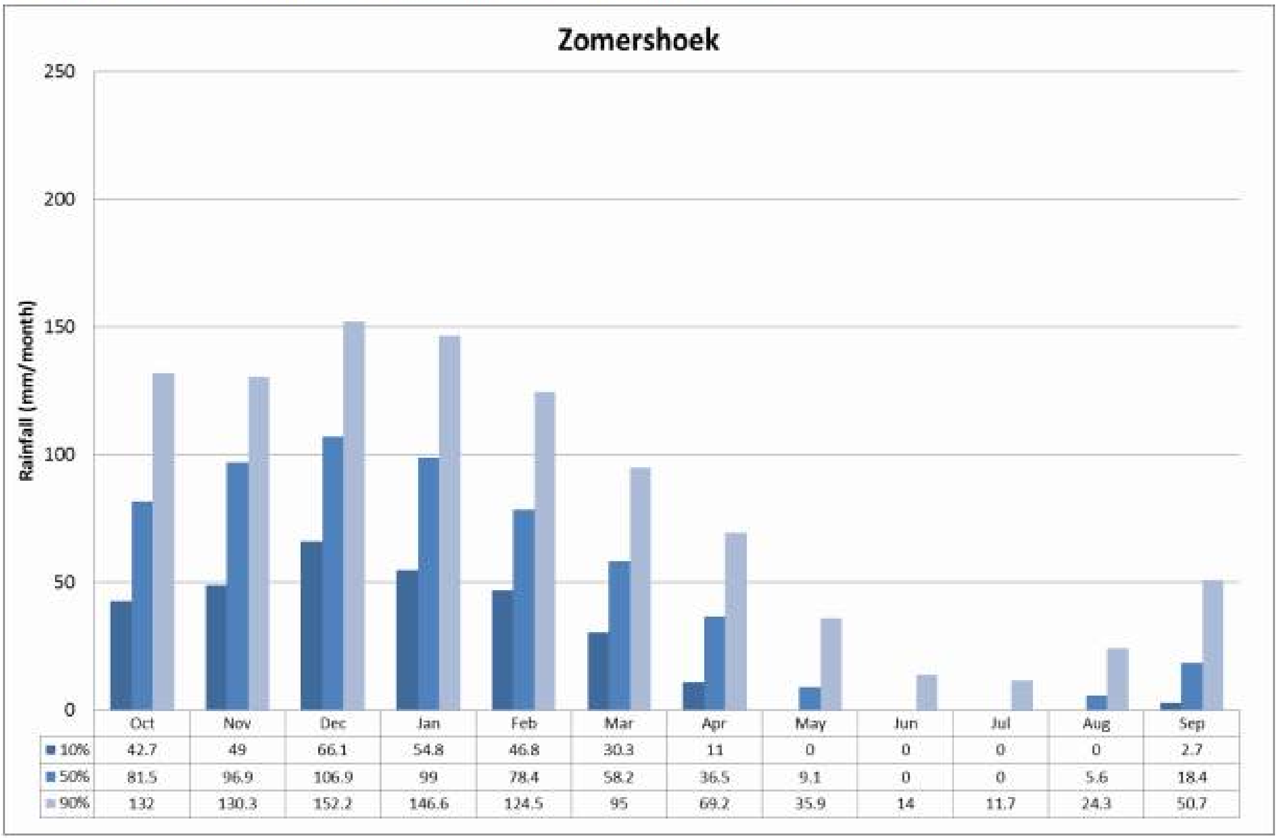
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
10%	40.3	36	53.6	57.9	17.5	19.5	5.9	0	0	0	0	0
50%	75	81.5	124.5	109	76.8	57	28.6	7	0.9	0	2.6	18.5
90%	133.5	143.5	222.1	186	147.8	107.7	58	29.5	14.6	17.2	24.4	44.5

Figure 11: Rainfall distribution (mm/month), Dirkiesdorp rainfall station



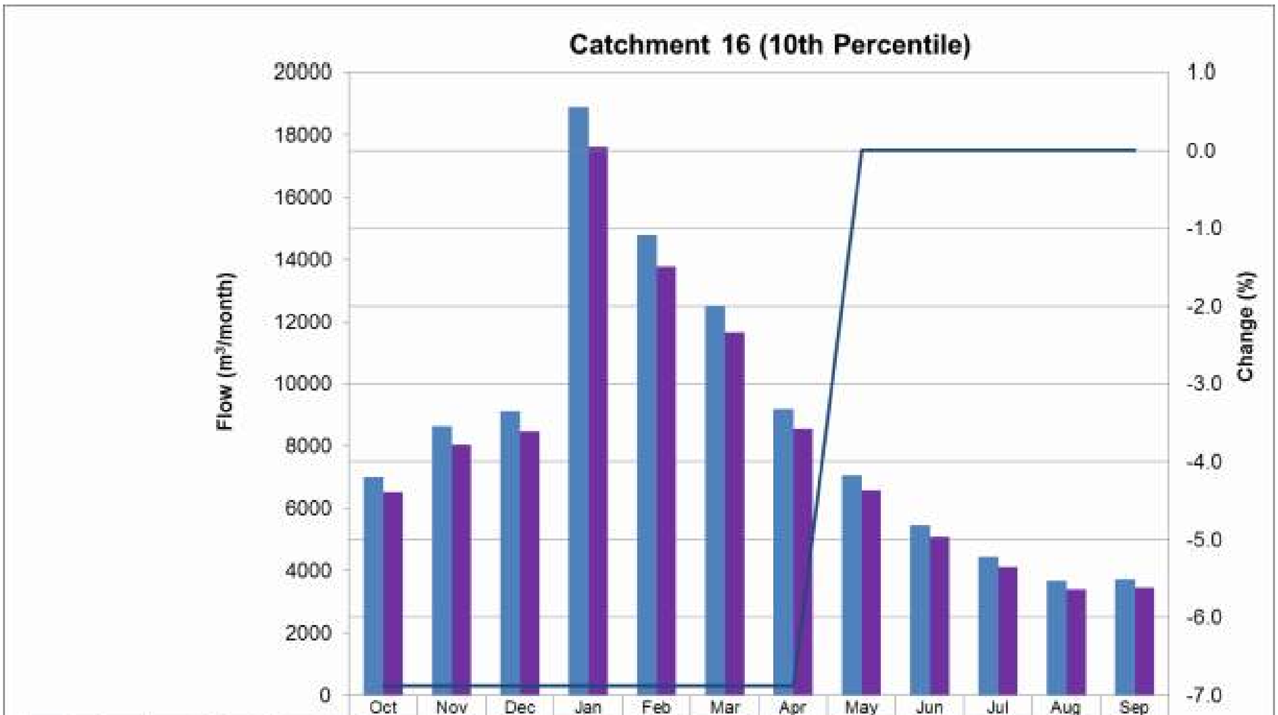
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
10%	48.8	72.5	104.9	91.5	53.3	35.5	6.2	0	0	0	0	11.1
50%	96.3	120.8	158	142.7	115.5	96.2	46.6	11	4.5	0	12	27.6
90%	144.2	208	196	208.5	196.2	155.7	96	50.1	21.5	27.2	31.5	65

Figure 12: Rainfall distribution (mm/month), Spitskop rainfall station



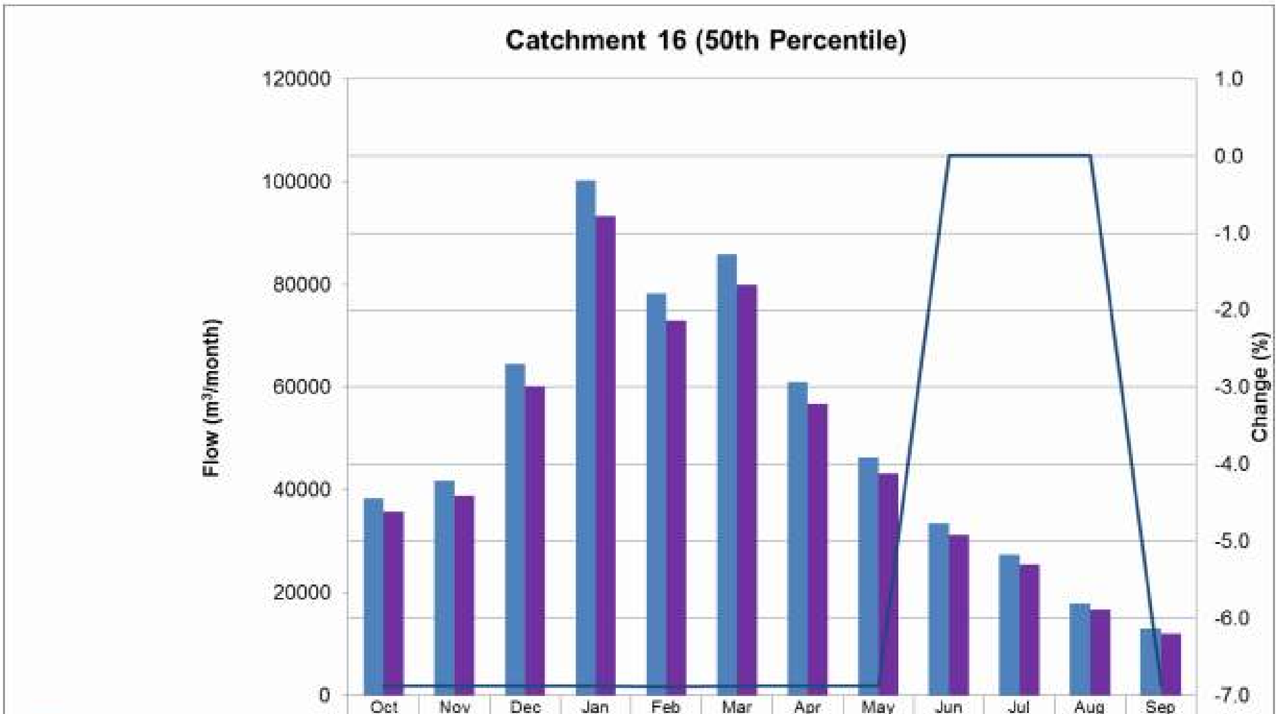
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
10%	42.7	49	66.1	54.8	46.8	30.3	11	0	0	0	0	2.7
50%	81.5	96.9	106.9	99	78.4	58.2	36.5	9.1	0	0	5.6	18.4
90%	132	130.3	152.2	146.6	124.5	95	69.2	35.9	14	11.7	24.3	50.7

Figure 13: Rainfall distribution (mm/month), Zomershoek rainfall station



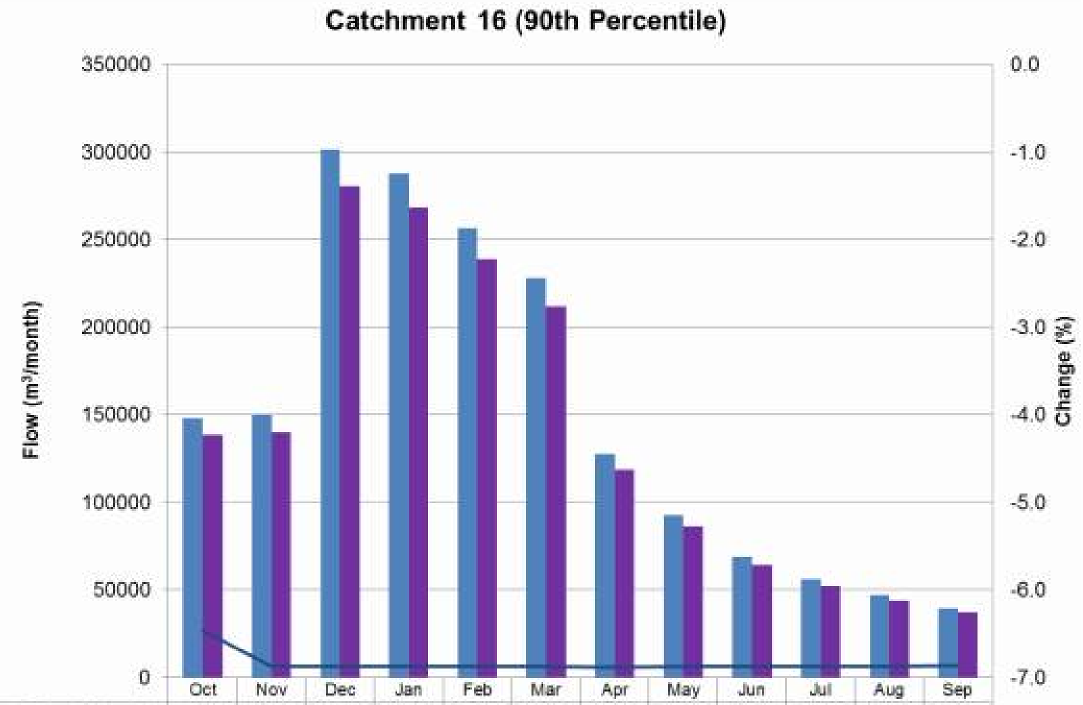
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Pre-Development Flow (m3/month)	7009	8638	9116	18911	14796	12527	9200	7063	5454	4435	3657	3716
Post-Development Flow (m3/month)	6527	8045	8489	17611	13779	11666	8567	6578	5079	4130	3406	3461
Change (%)	-6.9	-6.9	-6.9	-6.9	-6.9	-6.9	-6.9	0	0	0	0	0

Figure 14: Catchment 16 monthly flow (dry climatic conditions)



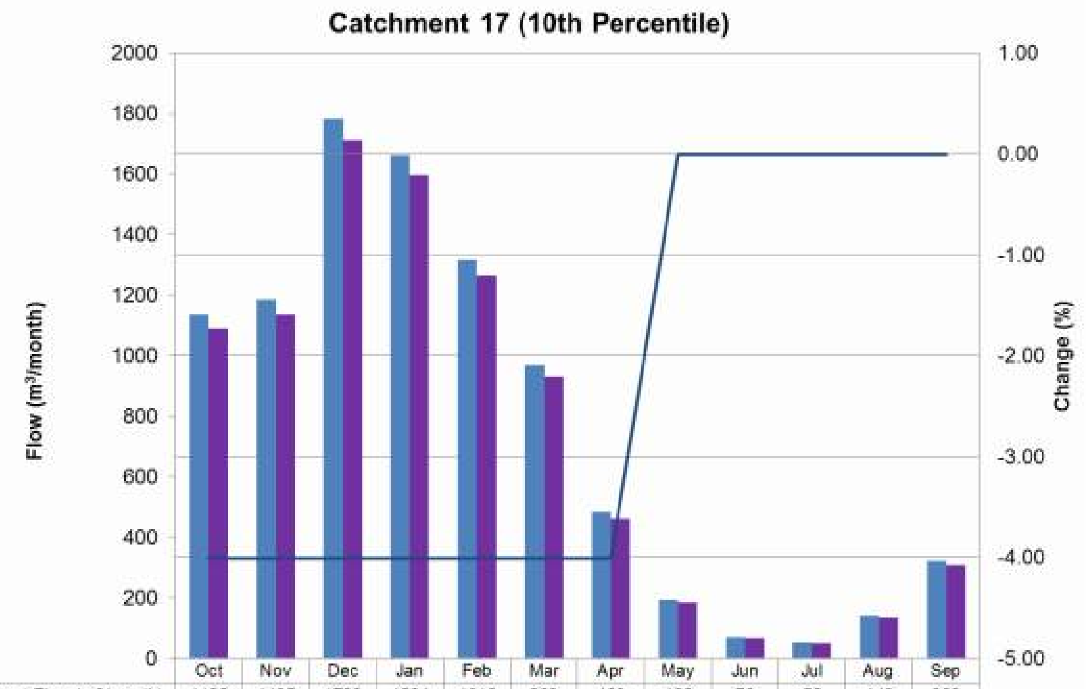
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Pre-Development Flow (m3/month)	38413	41765	64575	100177	78303	85843	60912	46308	33570	27328	17897	12985
Post-Development Flow (m3/month)	35772	38894	60135	93290	72911	79942	56725	43125	31262	25450	16667	12092
Change (%)	-6.9	-6.9	-6.9	-6.9	-6.9	-6.9	-6.9	-6.9	0	0	0	-6.9

Figure 15: Catchment 16 monthly flow (median climatic conditions)



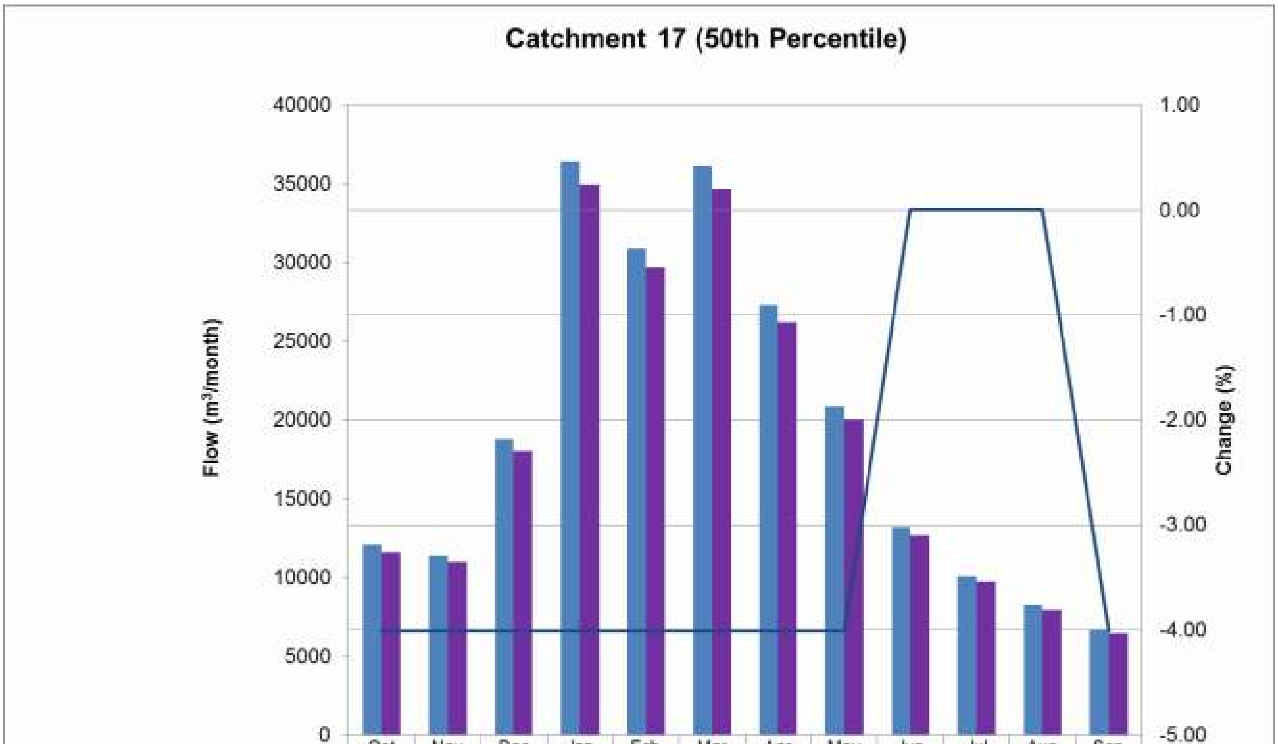
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Pre-Development Flow (m3/month)	147967	150487	301353	287984	256566	227869	127554	92602	69019	56325	46889	39747
Post-Development Flow (m3/month)	138395	140142	280637	268182	238928	212205	118781	86236	64275	52453	43666	37019
Change (%)	-6.5	-6.9	-6.9	-6.9	-6.9	-6.9	-6.9	-6.9	-6.9	-6.9	-6.9	-6.9

Figure 16: Catchment 16 monthly flow (wet climatic conditions)



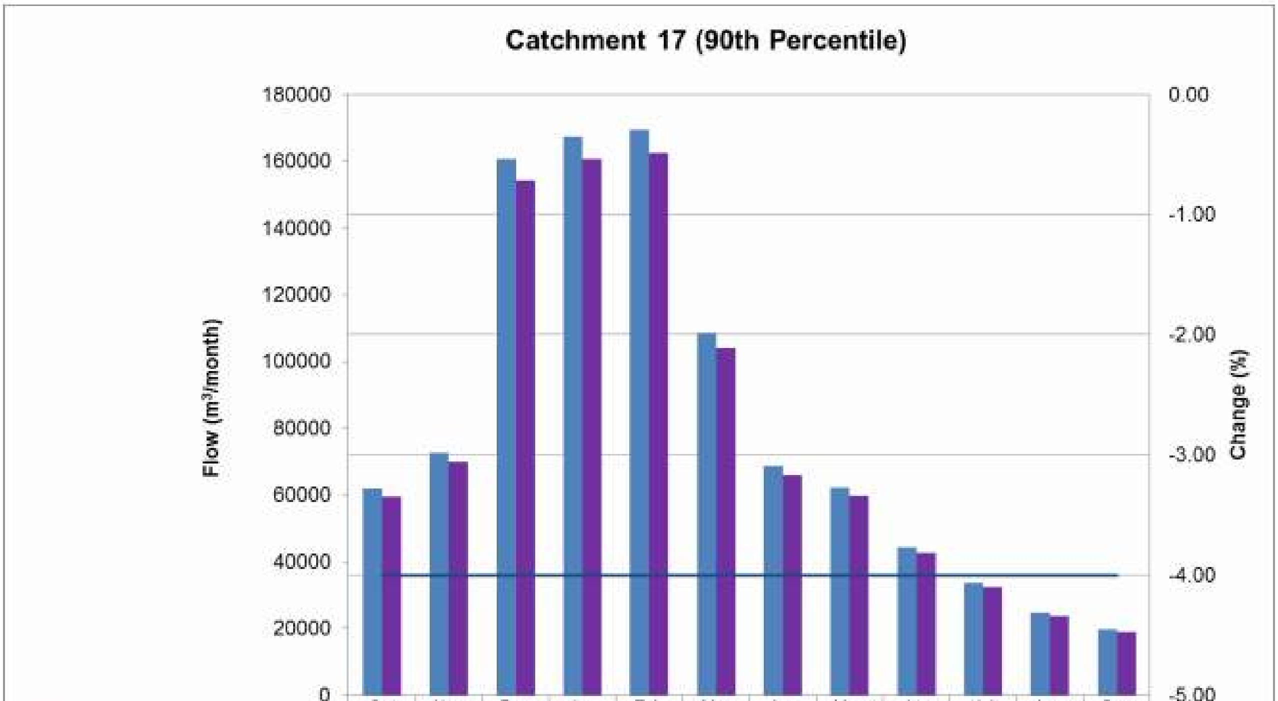
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Pre-Development Flow (m3/month)	1136	1185	1783	1664	1318	969	483	192	70	52	140	322
Post-Development Flow (m3/month)	1091	1138	1712	1598	1265	930	463	185	67	50	134	309
Change (%)	-4.01	-4.01	-4.01	-4.01	-4.01	-4.01	-4.01	0	0	0	0	0

Figure 17: Catchment 17 monthly flow (dry climatic conditions)



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Pre-Development Flow (m3/month)	12070	11413	18773	36382	30882	36120	27288	20878	13172	10091	8255	6696
Post-Development Flow (m3/month)	11587	10956	18021	34925	29645	34673	26194	20042	12644	9687	7925	6428
Change (%)	-4.01	-4.01	-4.01	-4.01	-4.01	-4.01	-4.01	-4.01	0	0	0	-4.01

Figure 18: Catchment 17 monthly flow (median climatic conditions)



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Pre-Development Flow (m3/month)	62037	72771	160711	167453	169264	108388	68747	62268	44459	33742	24711	19854
Post-Development Flow (m3/month)	59552	69856	154273	160744	162483	104046	65993	59773	42678	32391	23721	19058
Change (%)	-4.01	-4.01	-4.01	-4.01	-4.01	-4.01	-4.01	-4.01	-4.01	-4.01	-4.01	-4.01

Figure 19: Catchment 17 monthly flow (wet climatic conditions)

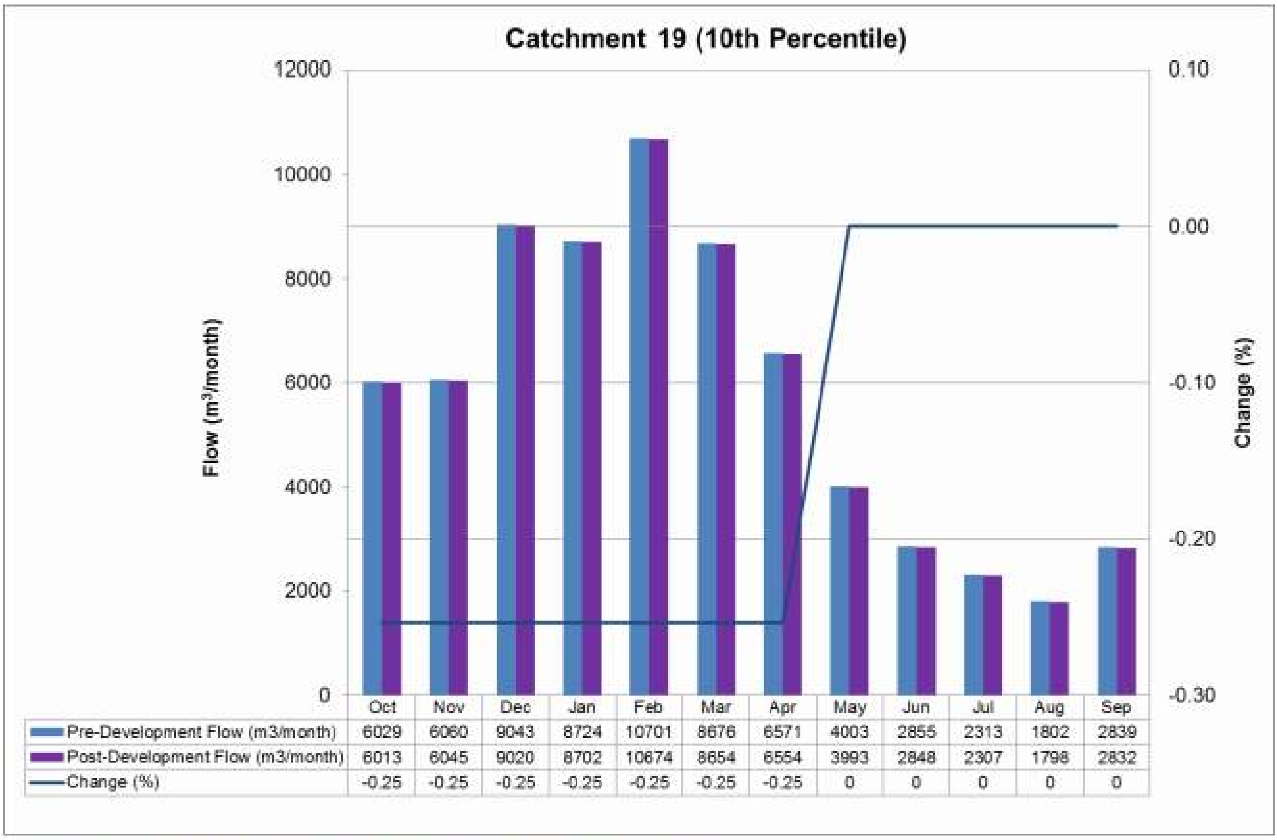


Figure 20: Catchment 19 monthly flow (dry climatic conditions)

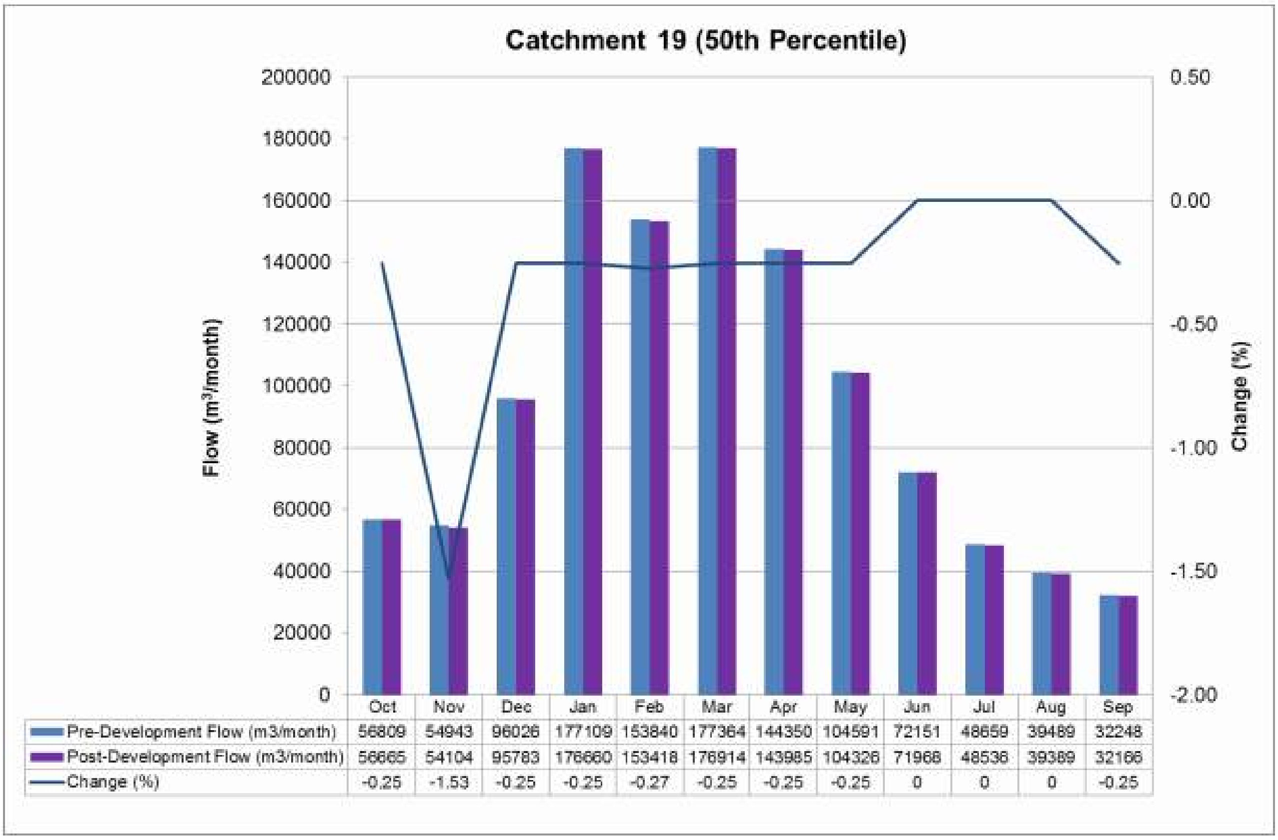
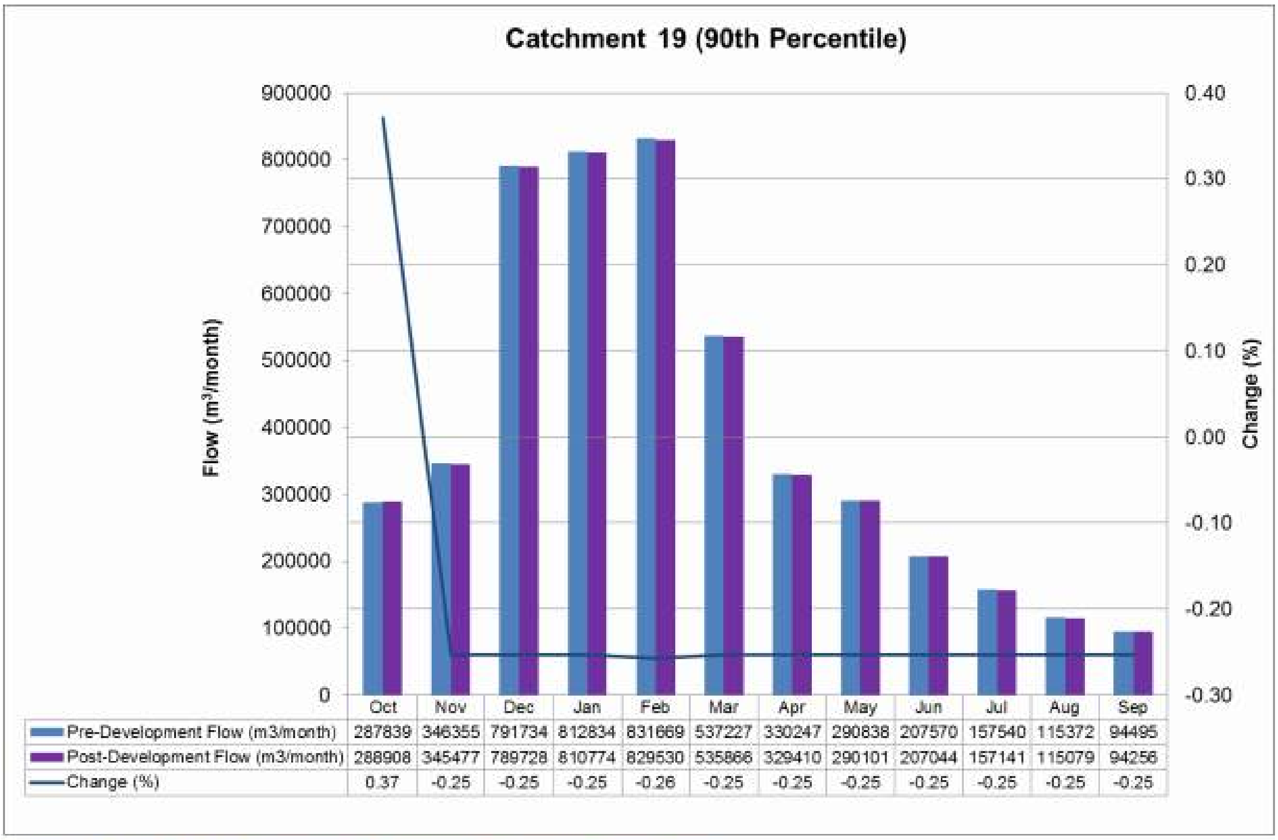
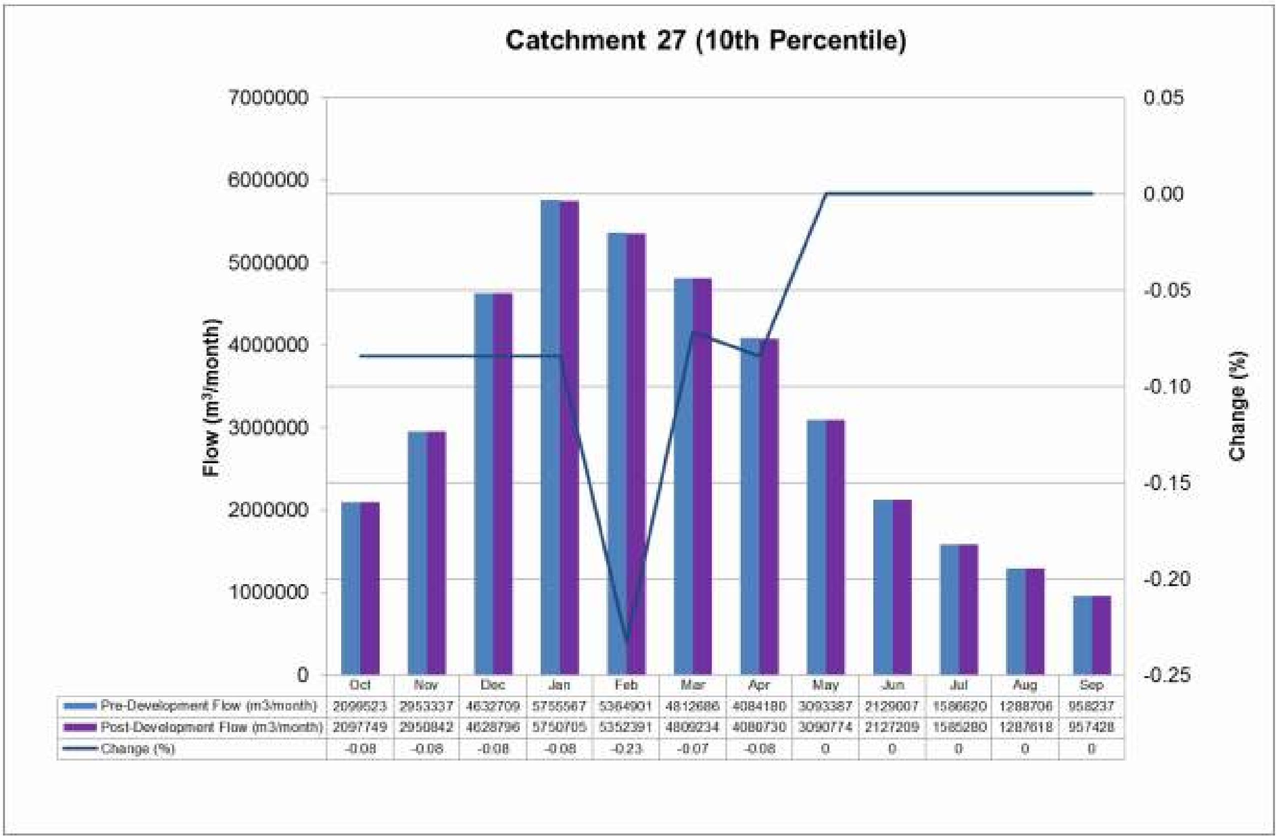


Figure 21: Catchment 19 monthly flow (median climatic conditions)



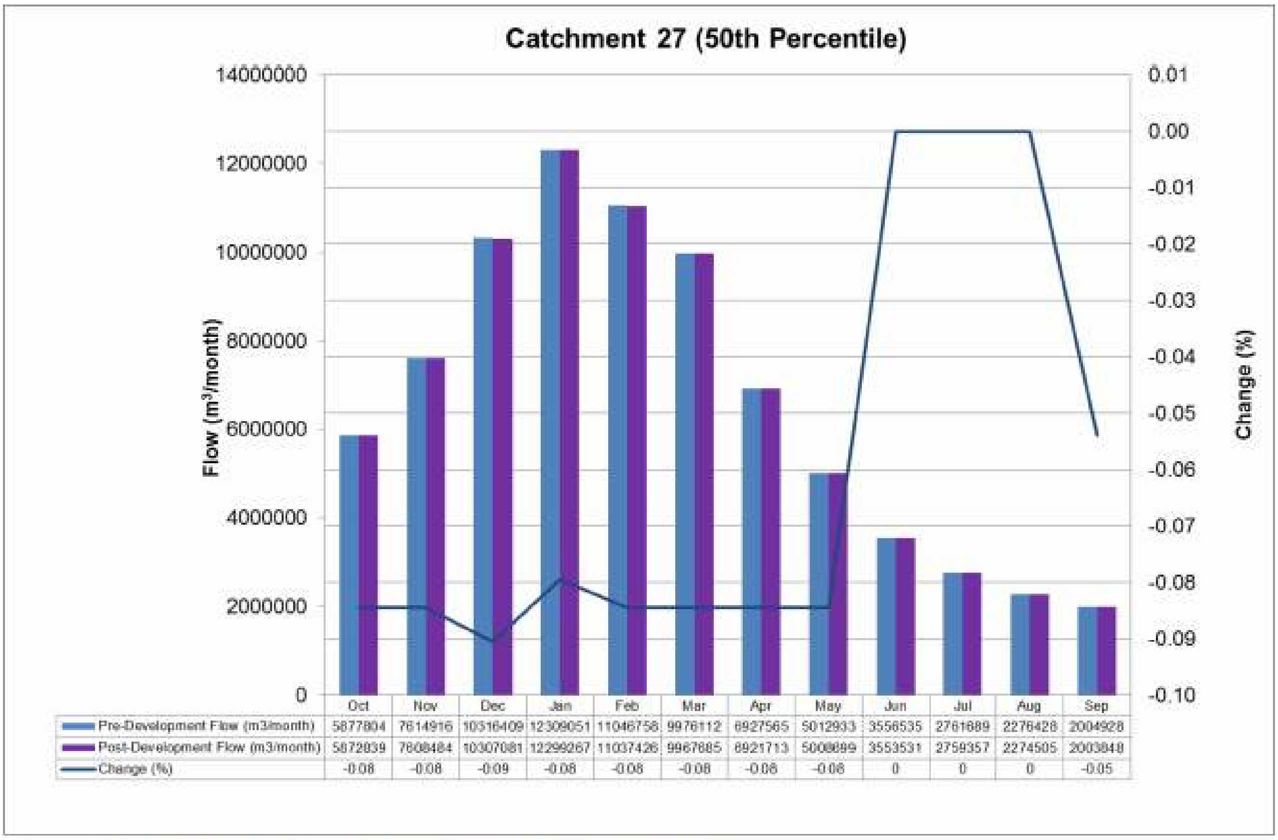
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Pre-Development Flow (m3/month)	287839	346355	791734	812834	831669	537227	330247	290838	207570	157540	115372	94495
Post-Development Flow (m3/month)	288908	345477	789728	810774	829530	535866	329410	290101	207044	157141	115079	94256
Change (%)	0.37	-0.25	-0.25	-0.25	-0.26	-0.25	-0.25	-0.25	-0.25	-0.25	-0.25	-0.25

Figure 22: Catchment 19 monthly flow (wet climatic conditions)



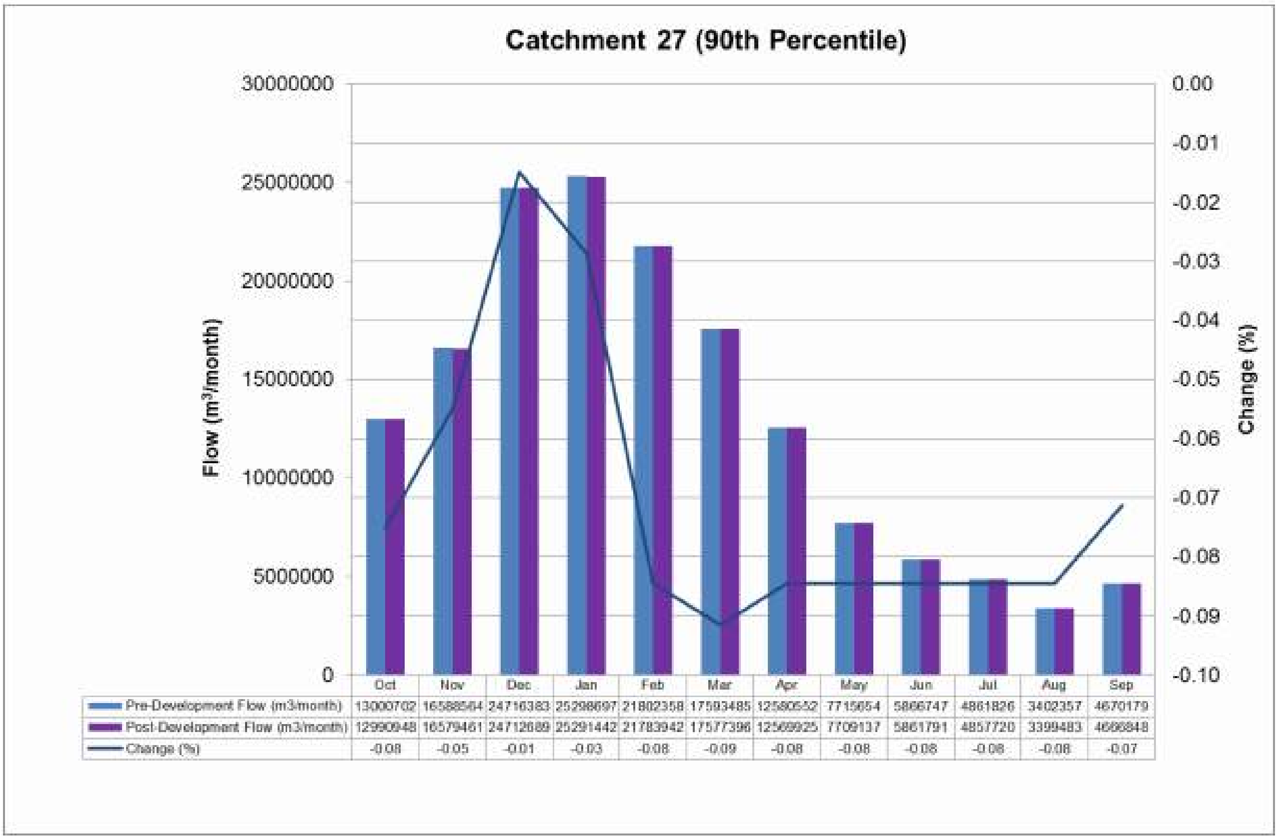
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Pre-Development Flow (m3/month)	2099523	2953337	4632709	5755567	5364901	4812686	4084180	3093387	2129007	1586620	1288706	958237
Post-Development Flow (m3/month)	2097749	2950842	4628796	5750705	5352391	4809234	4080730	3090774	2127209	1585280	1287618	957428
Change (%)	-0.08	-0.08	-0.08	-0.08	-0.23	-0.07	-0.08	0	0	0	0	0

Figure 23: Catchment 27 monthly flow (dry climatic conditions)



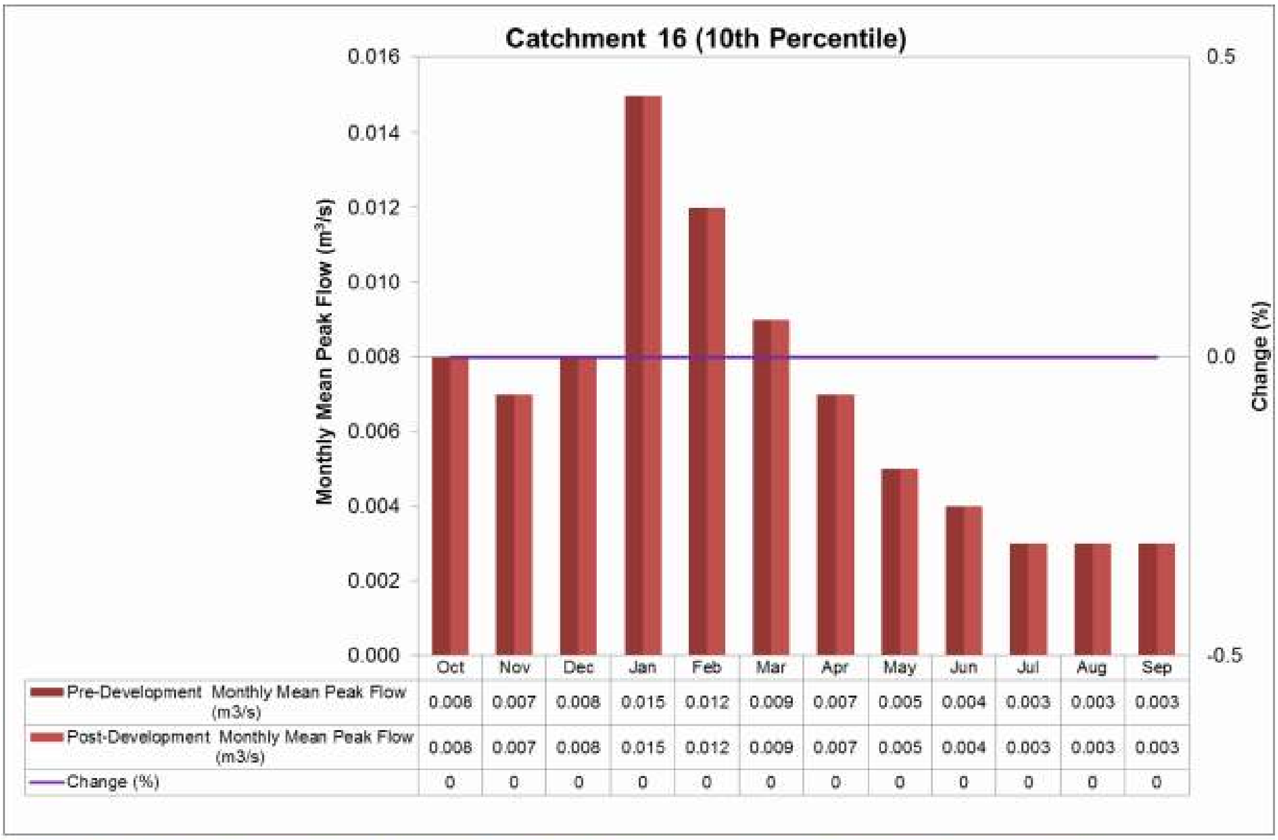
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Pre-Development Flow (m3/month)	5877804	7614916	10316409	12309051	11046758	9976112	6927565	5012933	3556535	2761689	2276428	2004928
Post-Development Flow (m3/month)	5872839	7608484	10307081	12299267	11037426	9967885	6921713	5008699	3553531	2759357	2274505	2003848
Change (%)	-0.08	-0.08	-0.09	-0.08	-0.08	-0.08	-0.08	-0.08	0	0	0	-0.05

Figure 24: Catchment 27 monthly flow (median climatic conditions)



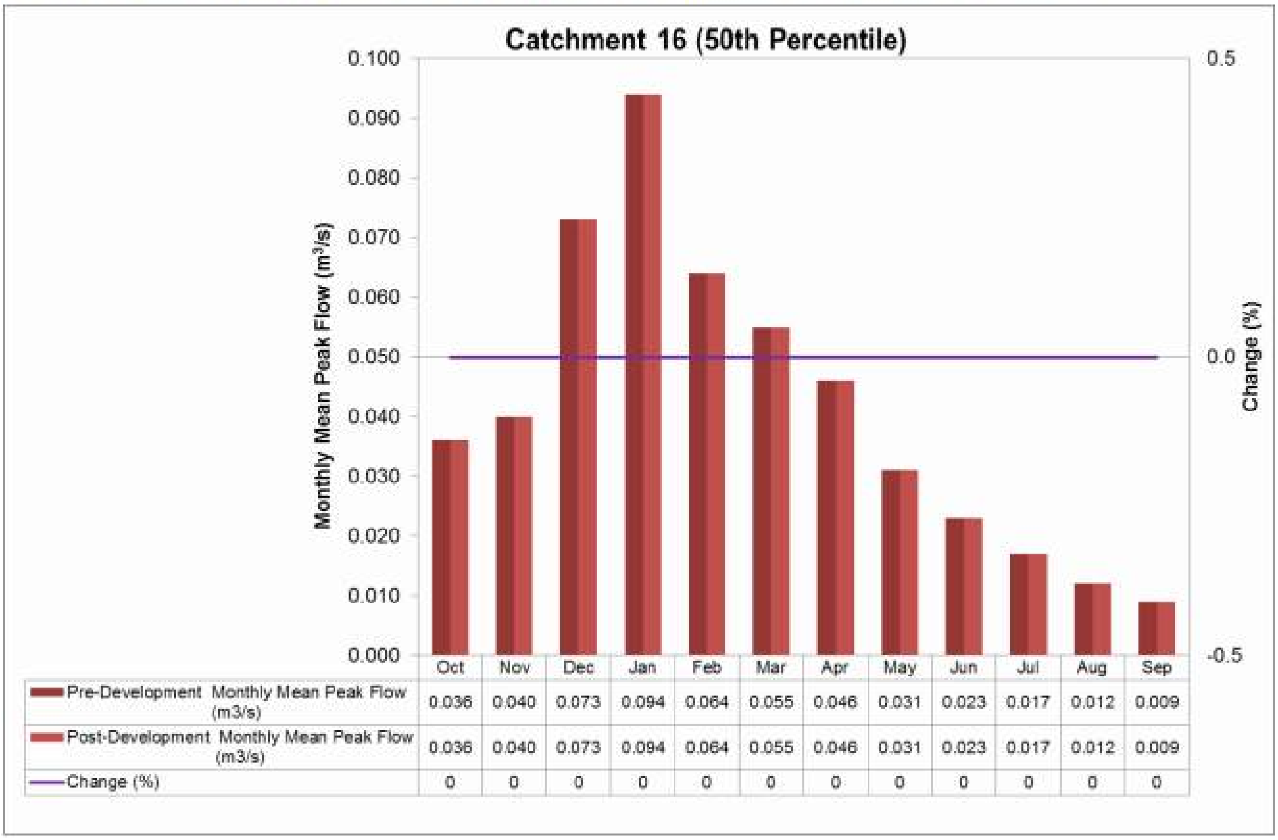
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Pre-Development Flow (m3/month)	13000702	16588564	24716383	25298697	21802358	17593485	12580552	7715654	5866747	4861826	3402357	4670179
Post-Development Flow (m3/month)	12990948	16579461	24712689	25291442	21783942	17577396	12569925	7709137	5861791	4857720	3399483	4666848
Change (%)	-0.08	-0.05	-0.01	-0.03	-0.08	-0.09	-0.08	-0.08	-0.08	-0.08	-0.08	-0.07

Figure 25: Catchment 27 monthly flow (wet climatic conditions)



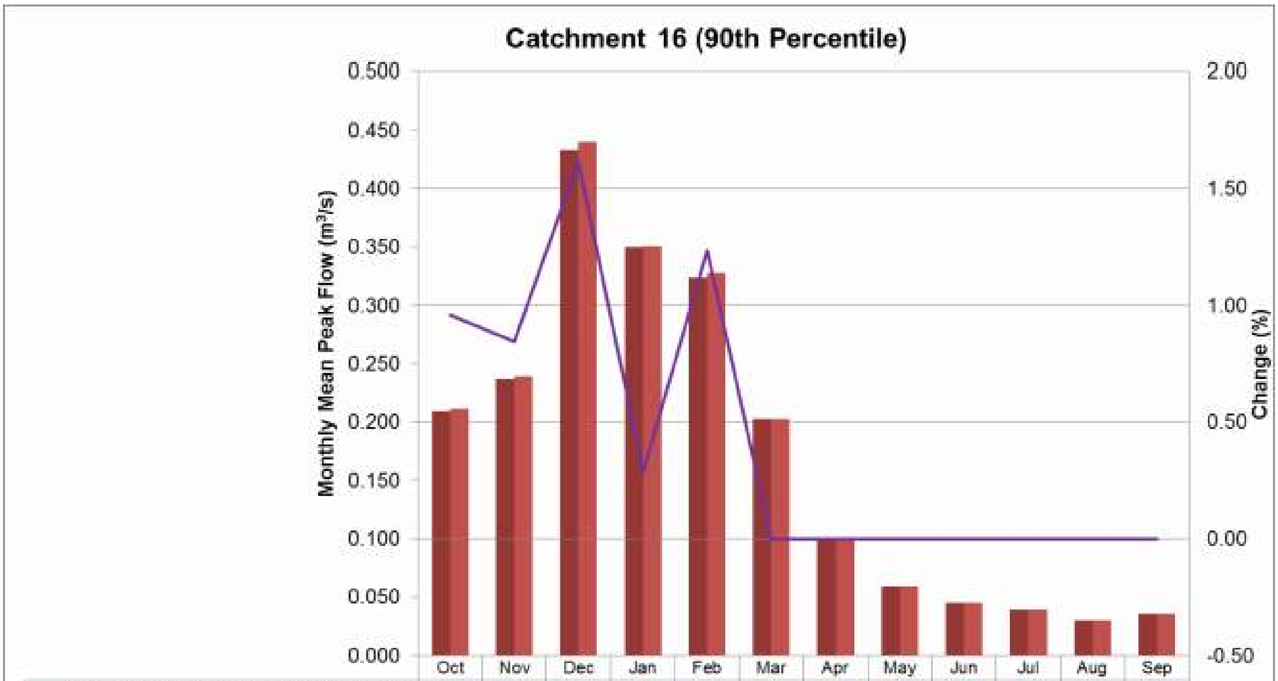
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Pre-Development Monthly Mean Peak Flow (m3/s)	0.008	0.007	0.008	0.015	0.012	0.009	0.007	0.005	0.004	0.003	0.003	0.003
Post-Development Monthly Mean Peak Flow (m3/s)	0.008	0.007	0.008	0.015	0.012	0.009	0.007	0.005	0.004	0.003	0.003	0.003
Change (%)	0	0	0	0	0	0	0	0	0	0	0	0

Figure 26: Monthly average peak flow (m^3/s) for the dry environmental conditions (Catchment 16)



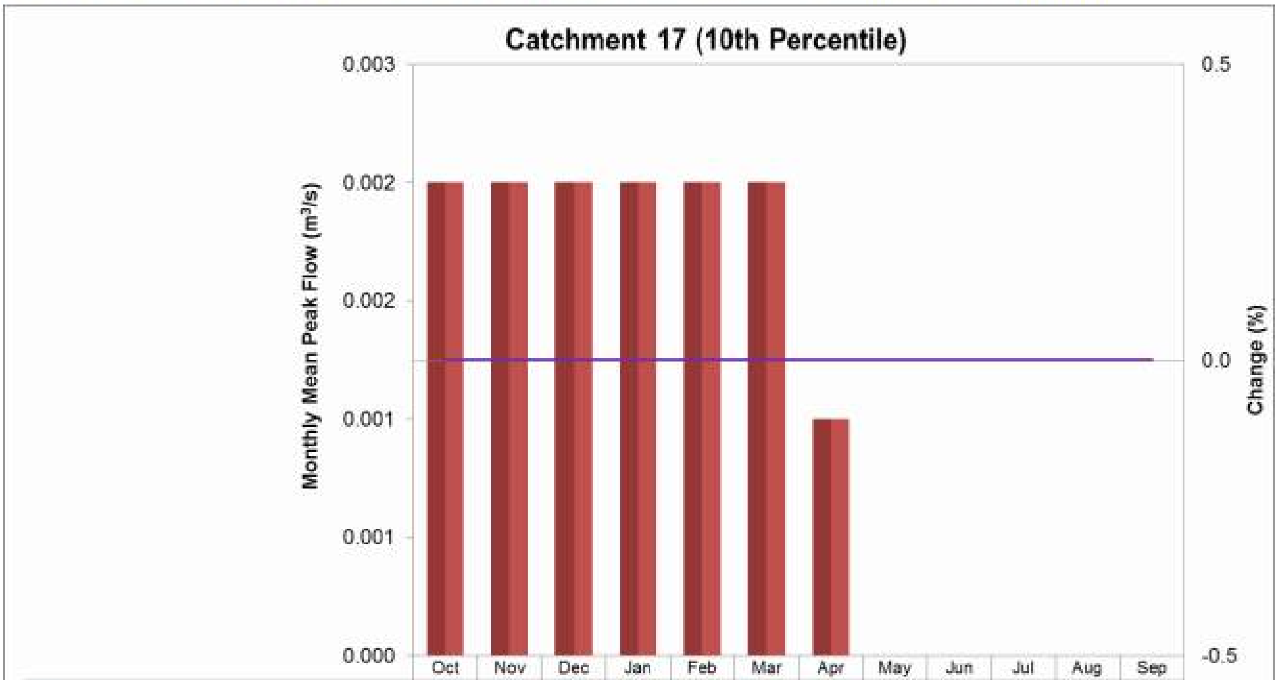
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Pre-Development Monthly Mean Peak Flow (m3/s)	0.036	0.040	0.073	0.094	0.064	0.055	0.046	0.031	0.023	0.017	0.012	0.009
Post-Development Monthly Mean Peak Flow (m3/s)	0.036	0.040	0.073	0.094	0.064	0.055	0.046	0.031	0.023	0.017	0.012	0.009
Change (%)	0	0	0	0	0	0	0	0	0	0	0	0

Figure 27: Monthly average peak flow (m^3/s) for the median environmental conditions (Catchment 16)



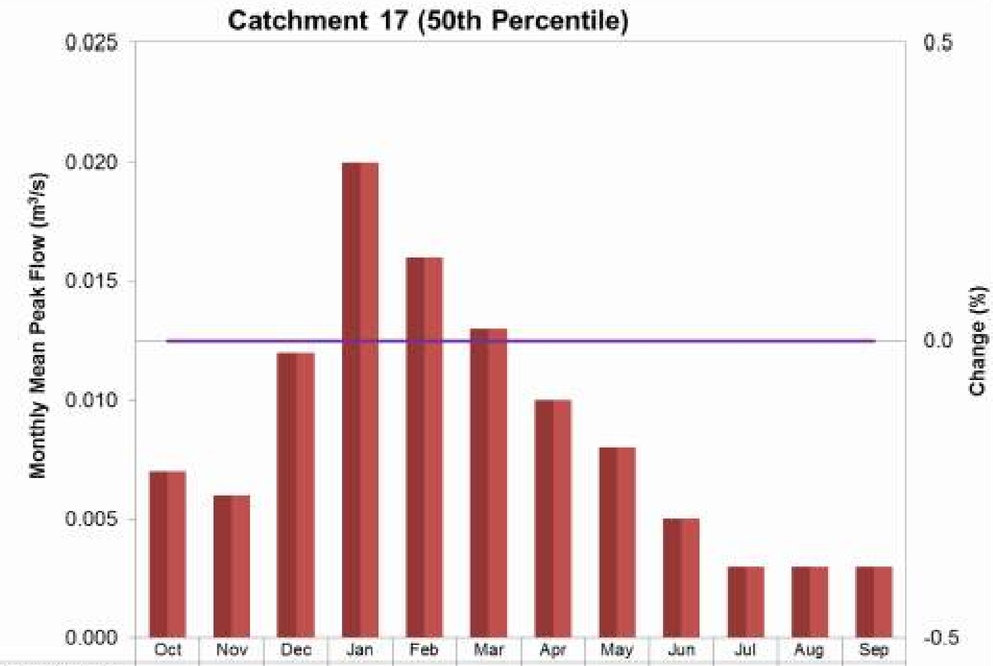
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Pre-Development Monthly Mean Peak Flow (m3/s)	0.209	0.237	0.433	0.350	0.324	0.203	0.100	0.059	0.045	0.039	0.030	0.036
Post-Development Monthly Mean Peak Flow (m3/s)	0.211	0.239	0.440	0.351	0.328	0.203	0.100	0.059	0.045	0.039	0.030	0.036
Change (%)	0.96	0.84	1.62	0.29	1.23	0	0	0	0	0	0	0

Figure 28: Monthly average peak flow (m^3/s) for the wet environmental conditions (Catchment 16)



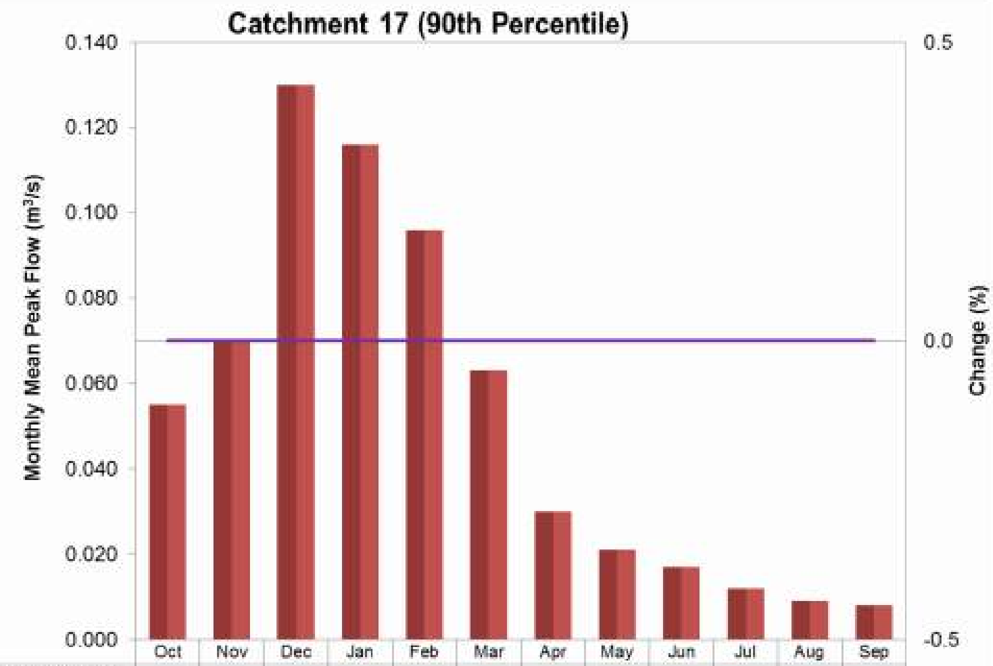
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Pre-Development Monthly Mean Peak Flow (m3/s)	0.002	0.002	0.002	0.002	0.002	0.002	0.001	0	0	0	0	0
Post-Development Monthly Mean Peak Flow (m3/s)	0.002	0.002	0.002	0.002	0.002	0.002	0.001	0	0	0	0	0
Change (%)	0	0	0	0	0	0	0	0	0	0	0	0

Figure 29: Monthly average peak flow (m^3/s) for the dry environmental conditions (Catchment 17)



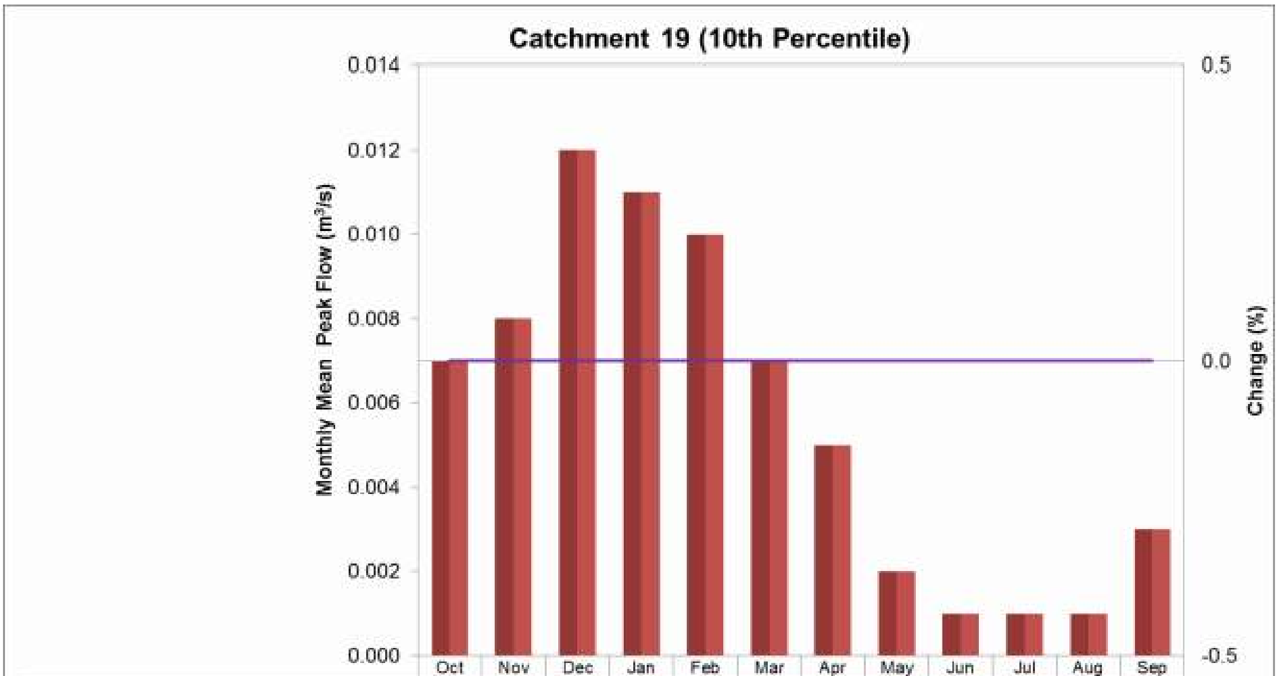
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Pre-Development Monthly Mean Peak Flow (m3/s)	0.007	0.006	0.012	0.020	0.016	0.013	0.010	0.008	0.005	0.003	0.003	0.003
Post-Development Monthly Mean Peak Flow (m3/s)	0.007	0.006	0.012	0.020	0.016	0.013	0.010	0.008	0.005	0.003	0.003	0.003
Change (%)	0	0	0	0	0	0	0	0	0	0	0	0

Figure 30: Monthly average peak flow (m^3/s) for the median environmental conditions (Catchment 17)



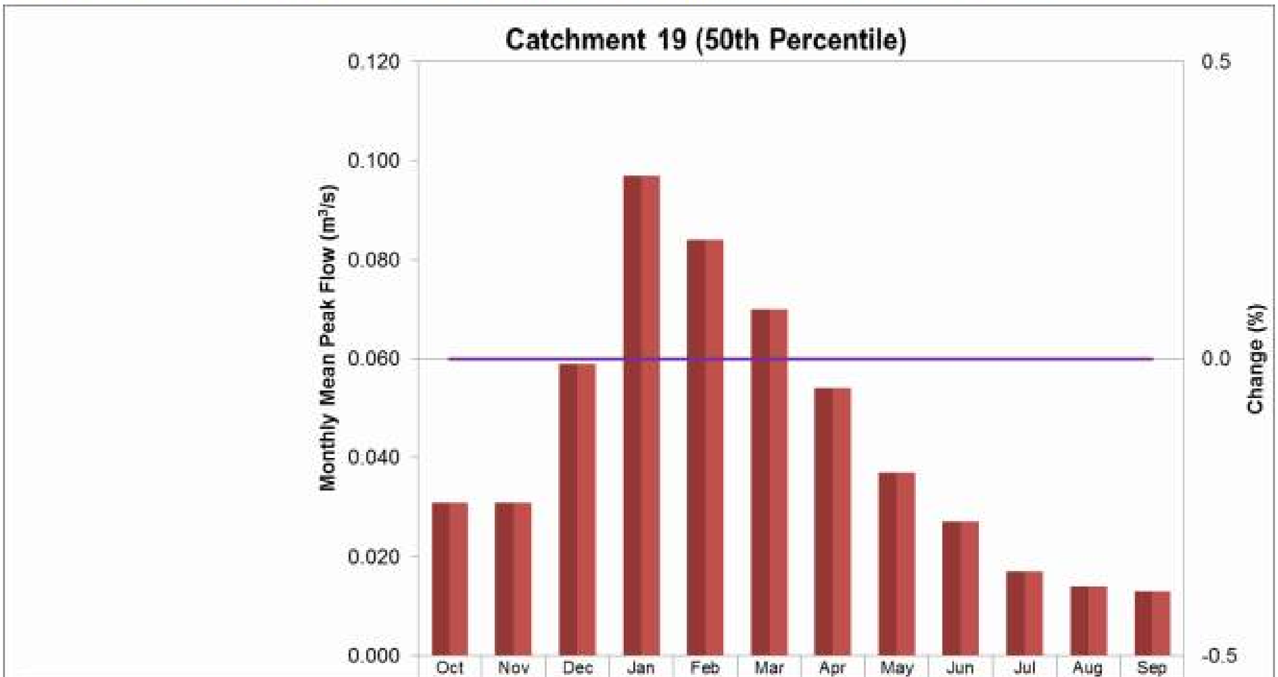
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Pre-Development Monthly Mean Peak Flow (m3/s)	0.055	0.070	0.130	0.116	0.096	0.063	0.030	0.021	0.017	0.012	0.009	0.008
Post-Development Monthly Mean Peak Flow (m3/s)	0.055	0.070	0.130	0.116	0.096	0.063	0.030	0.021	0.017	0.012	0.009	0.008
Change (%)	0	0	0	0	0	0	0	0	0	0	0	0

Figure 31: Monthly average peak flow (m^3/s) for the wet environmental conditions (Catchment 17)



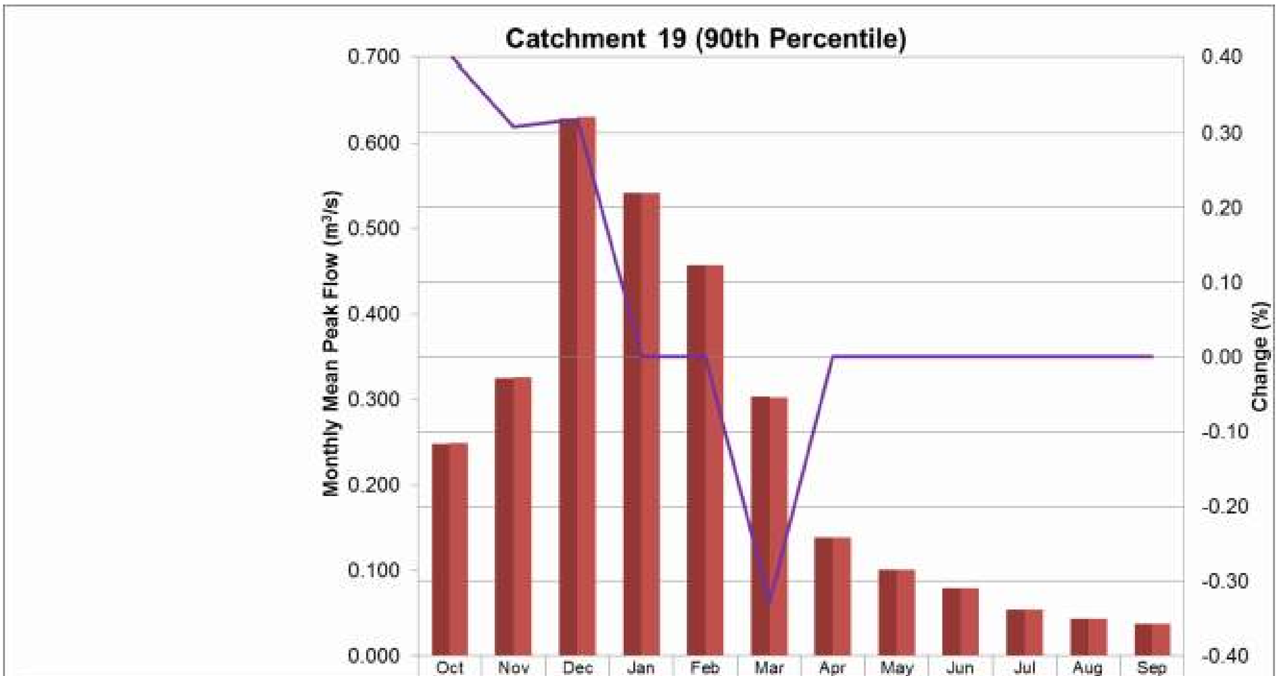
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Pre-Development Monthly Mean Peak Flow (m3/s)	0.007	0.008	0.012	0.011	0.010	0.007	0.005	0.002	0.001	0.001	0.001	0.003
Post-Development Monthly Mean Peak Flow (m3/s)	0.007	0.008	0.012	0.011	0.010	0.007	0.005	0.002	0.001	0.001	0.001	0.003
Change (%)	0	0	0	0	0	0	0	0	0	0	0	0

Figure 32: Monthly average peak flow (m^3/s) for the dry environmental conditions (Catchment 19)



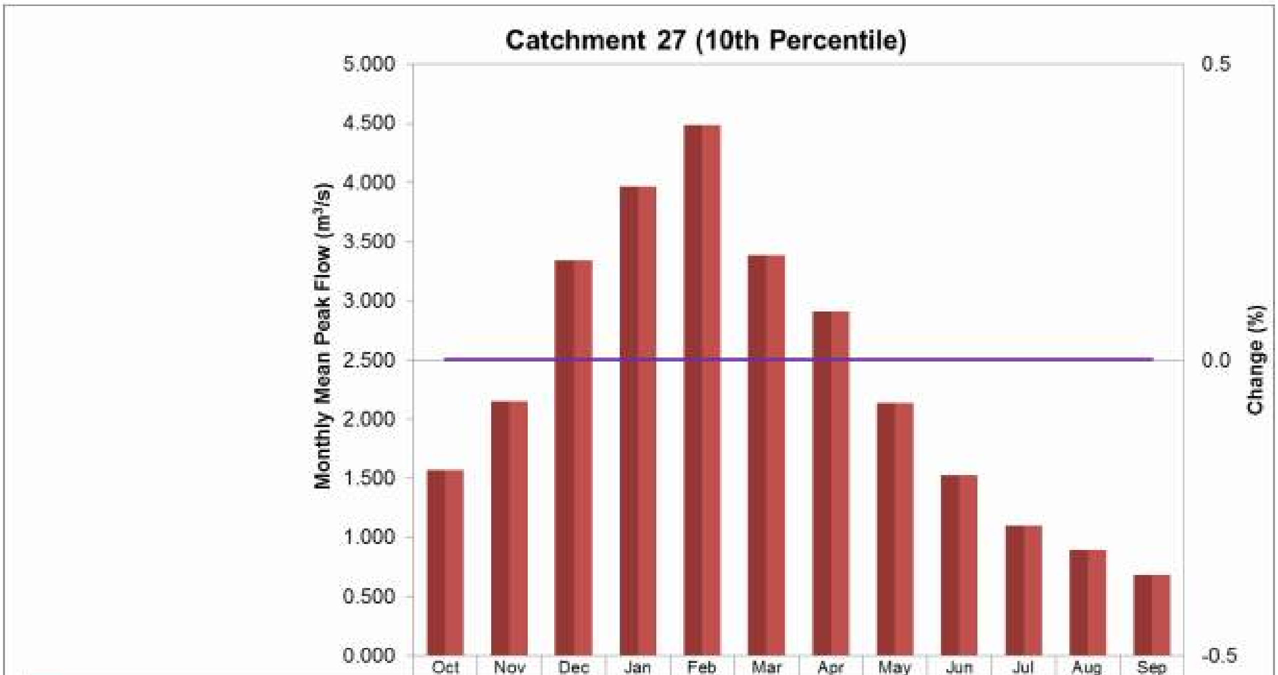
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Pre-Development Monthly Mean Peak Flow (m3/s)	0.031	0.031	0.059	0.097	0.084	0.070	0.054	0.037	0.027	0.017	0.014	0.013
Post-Development Monthly Mean Peak Flow (m3/s)	0.031	0.031	0.059	0.097	0.084	0.070	0.054	0.037	0.027	0.017	0.014	0.013
Change (%)	0	0	0	0	0	0	0	0	0	0	0	0

Figure 33: Monthly average peak flow (m^3/s) for the median environmental conditions (Catchment 19)



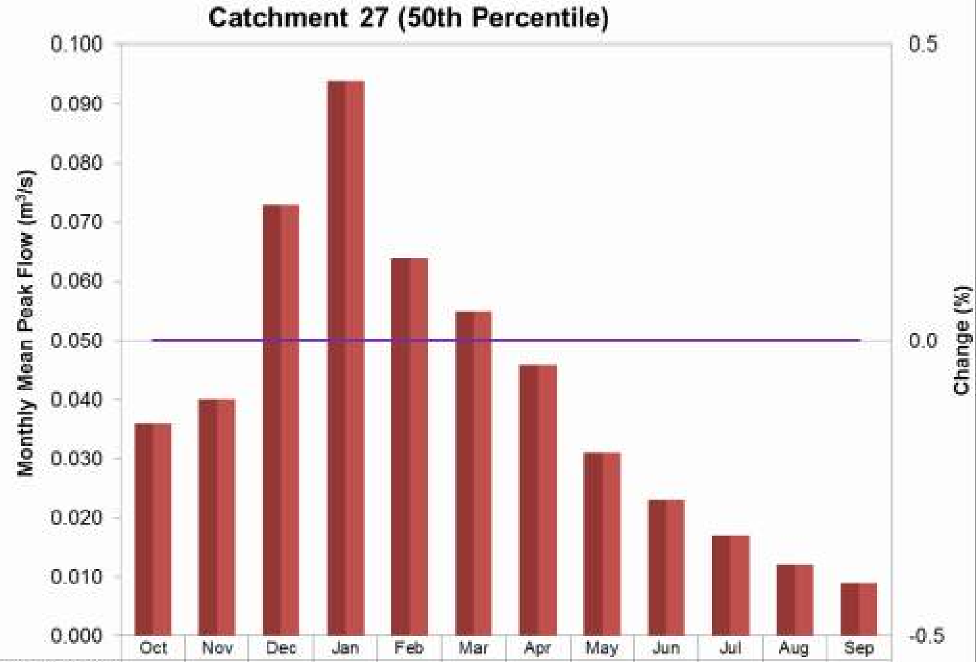
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Pre-Development Monthly Mean Peak Flow (m3/s)	0.248	0.325	0.629	0.542	0.457	0.304	0.138	0.100	0.079	0.054	0.043	0.037
Post-Development Monthly Mean Peak Flow (m3/s)	0.249	0.326	0.631	0.542	0.457	0.303	0.138	0.100	0.079	0.054	0.043	0.037
Change (%)	0.40	0.31	0.32	0	0	-0.33	0	0	0	0	0	0

Figure 34: Monthly average peak flow (m^3/s) for the wet environmental conditions (Catchment 19)



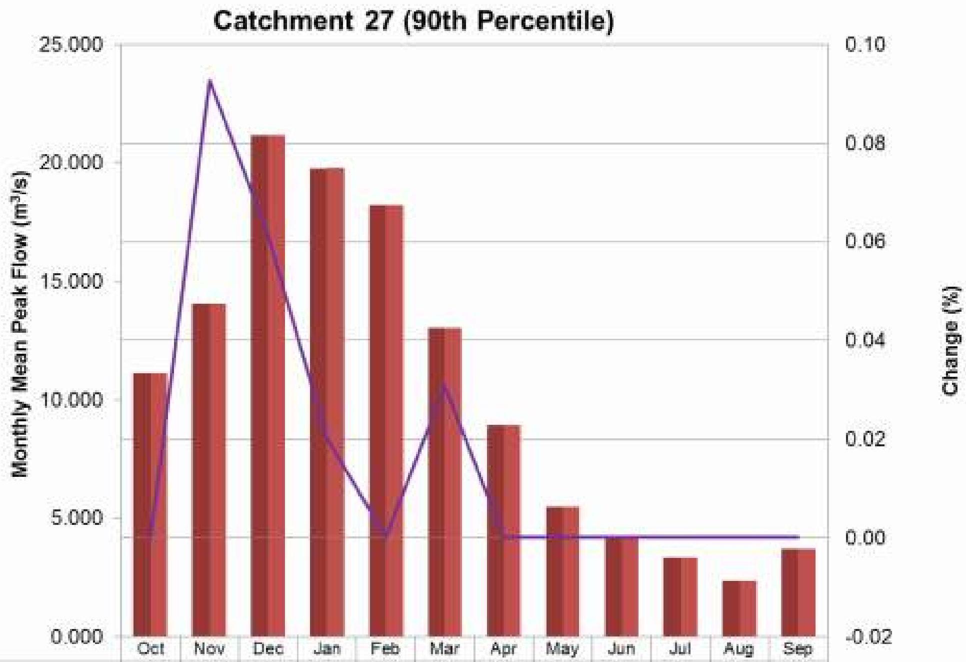
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Pre-Development Monthly Mean Peak Flow (m3/s)	1.571	2.151	3.342	3.969	4.484	3.384	2.906	2.133	1.528	1.095	0.892	0.684
Post-Development Monthly Mean Peak Flow (m3/s)	1.571	2.151	3.342	3.969	4.484	3.384	2.906	2.133	1.528	1.095	0.892	0.684
Change (%)	0	0	0	0	0	0	0	0	0	0	0	0

Figure 35: Monthly average peak flow (m^3/s) for the dry environmental conditions (Catchment 27)



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Pre-Development Monthly Mean Peak Flow (m3/s)	0.036	0.040	0.073	0.094	0.064	0.055	0.046	0.031	0.023	0.017	0.012	0.009
Post-Development Monthly Mean Peak Flow (m3/s)	0.036	0.040	0.073	0.094	0.064	0.055	0.046	0.031	0.023	0.017	0.012	0.009
Change (%)	0	0	0	0	0	0	0	0	0	0	0	0

Figure 36: Monthly average peak flow (m^3/s) for the median environmental conditions (Catchment 27)



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Pre-Development Monthly Mean Peak Flow (m3/s)	11.115	14.031	21.146	19.773	18.203	13.022	8.934	5.479	4.178	3.333	2.355	3.705
Post-Development Monthly Mean Peak Flow (m3/s)	11.115	14.044	21.159	19.777	18.203	13.026	8.934	5.479	4.178	3.333	2.355	3.705
Change (%)	0	0.09	0.06	0.02	0	0.03	0	0	0	0	0	0

Figure 37: Monthly average peak flow (m^3/s) for the wet environmental conditions (Catchment 27)

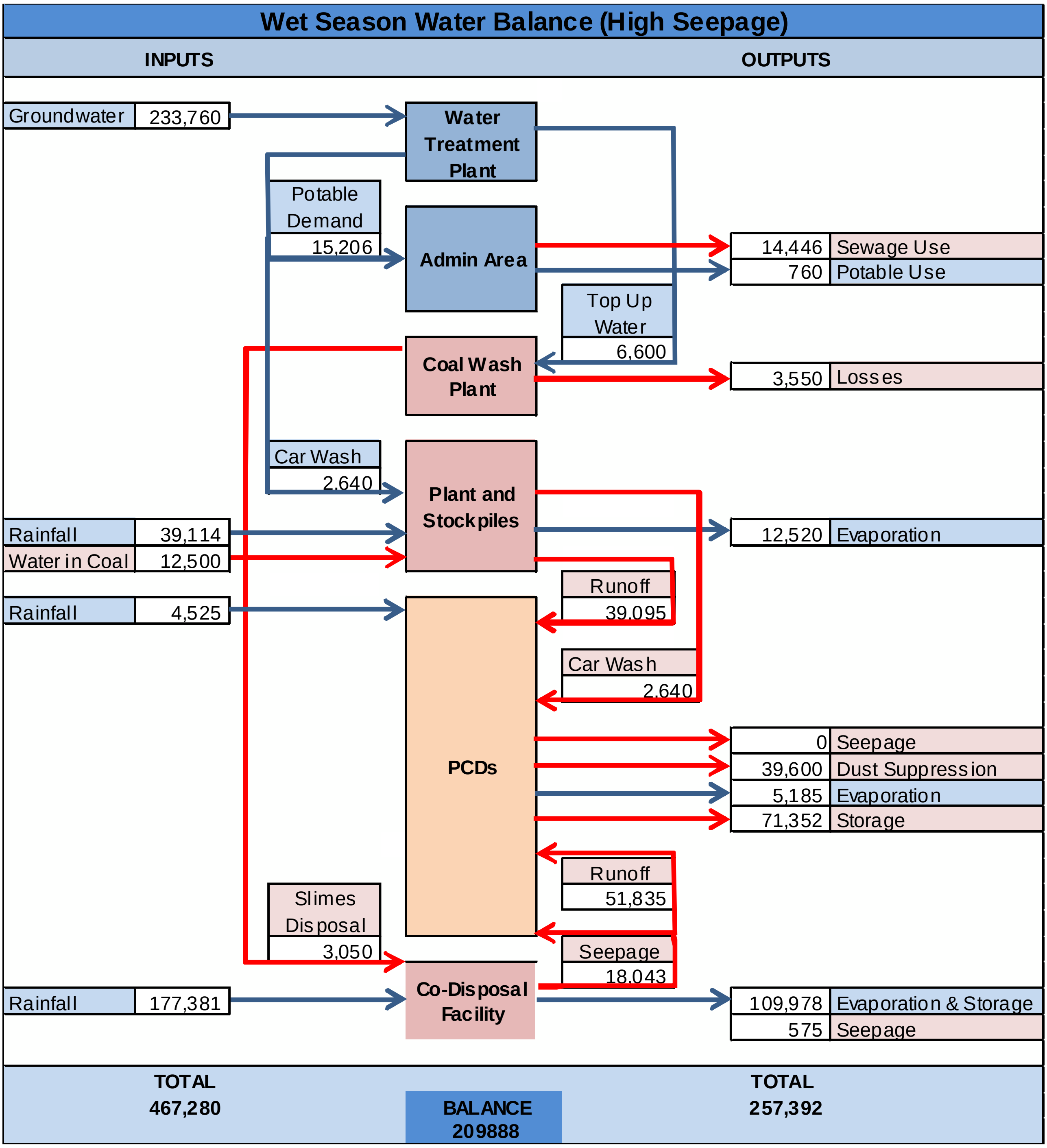


Figure 38: Wet season water balance: High Seepage (October to March)

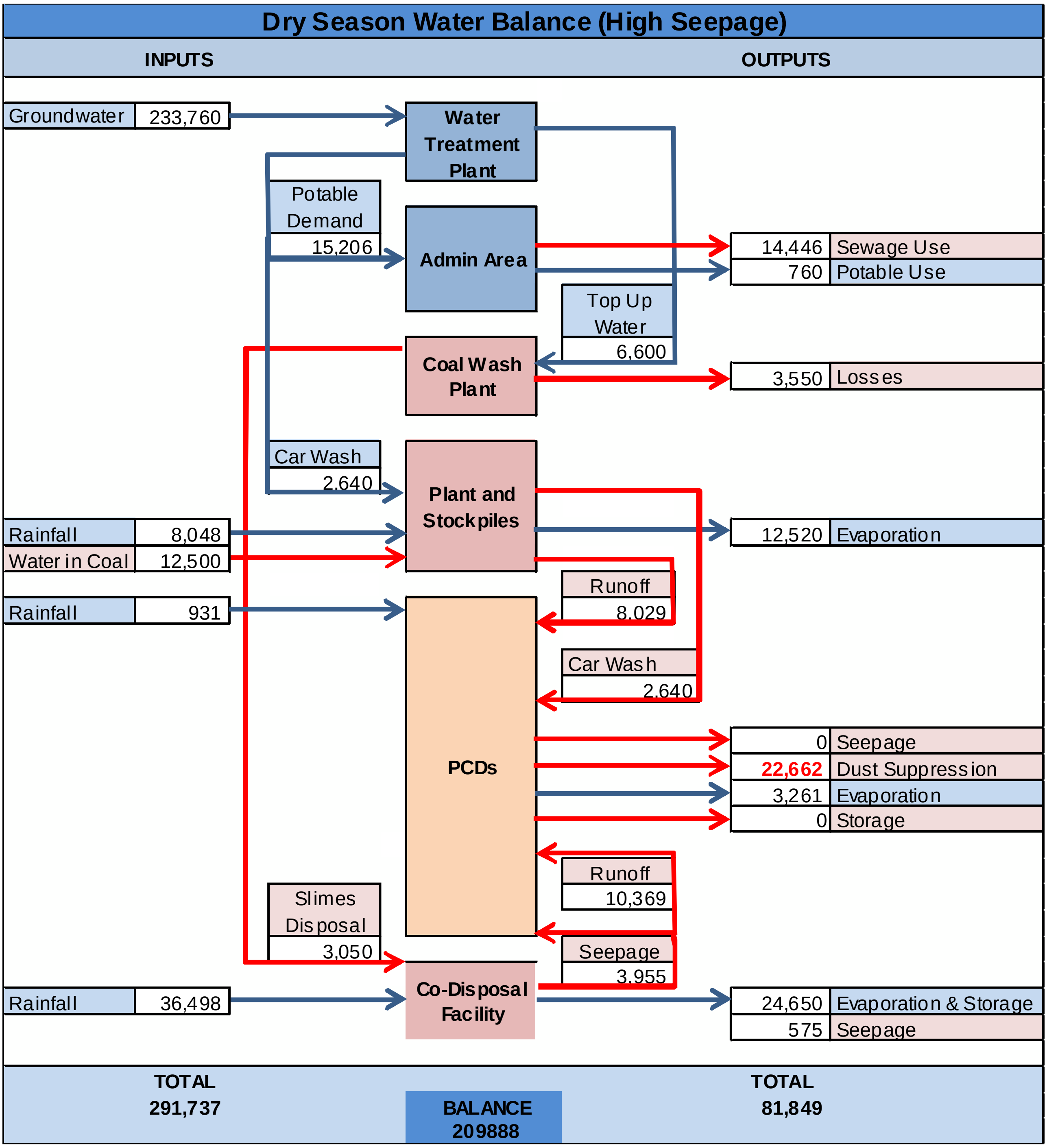


Figure 39: Dry season water balance: High Seepage (April to September)

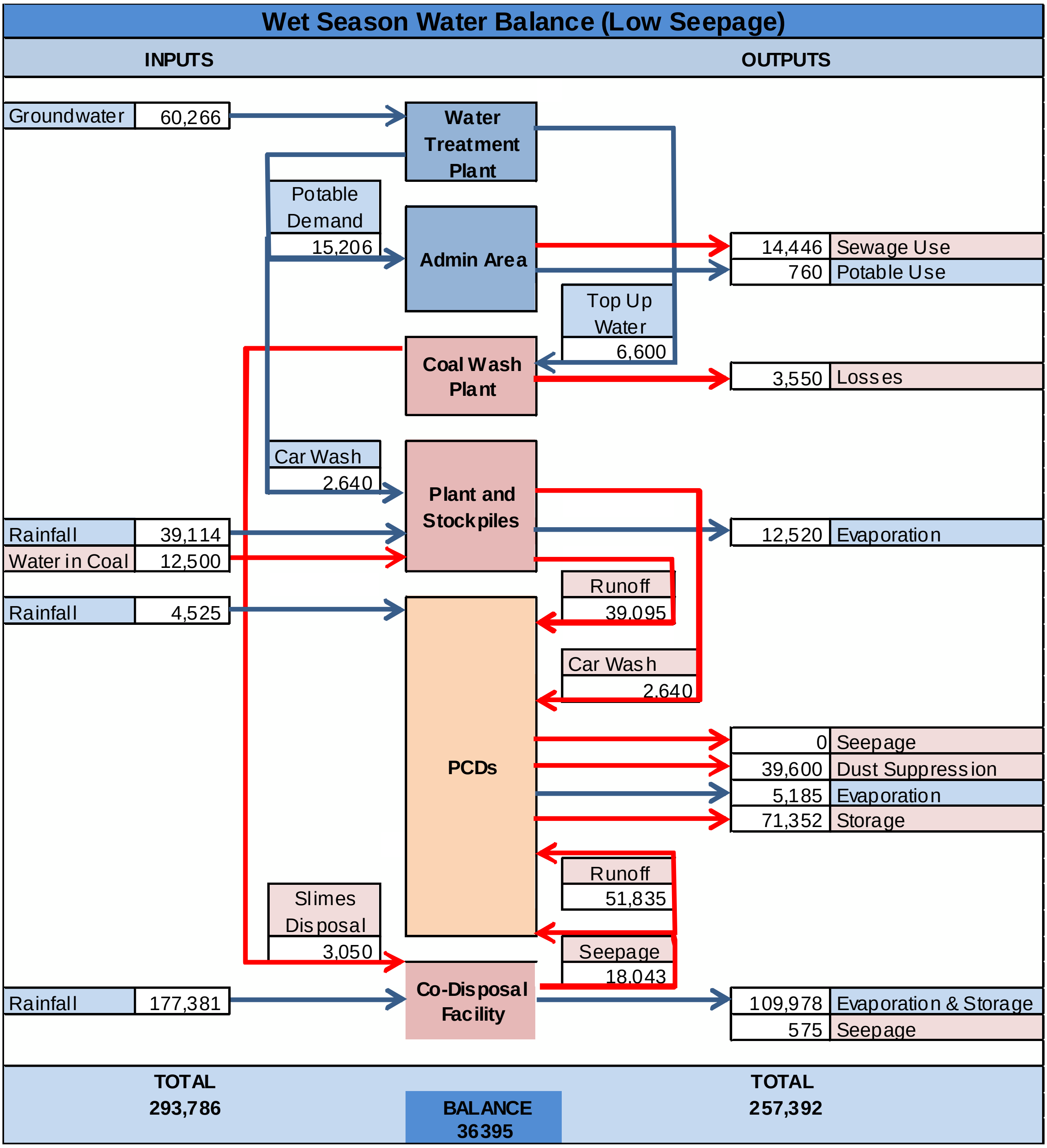


Figure 40: Wet season water balance: Low Seepage (October to March)

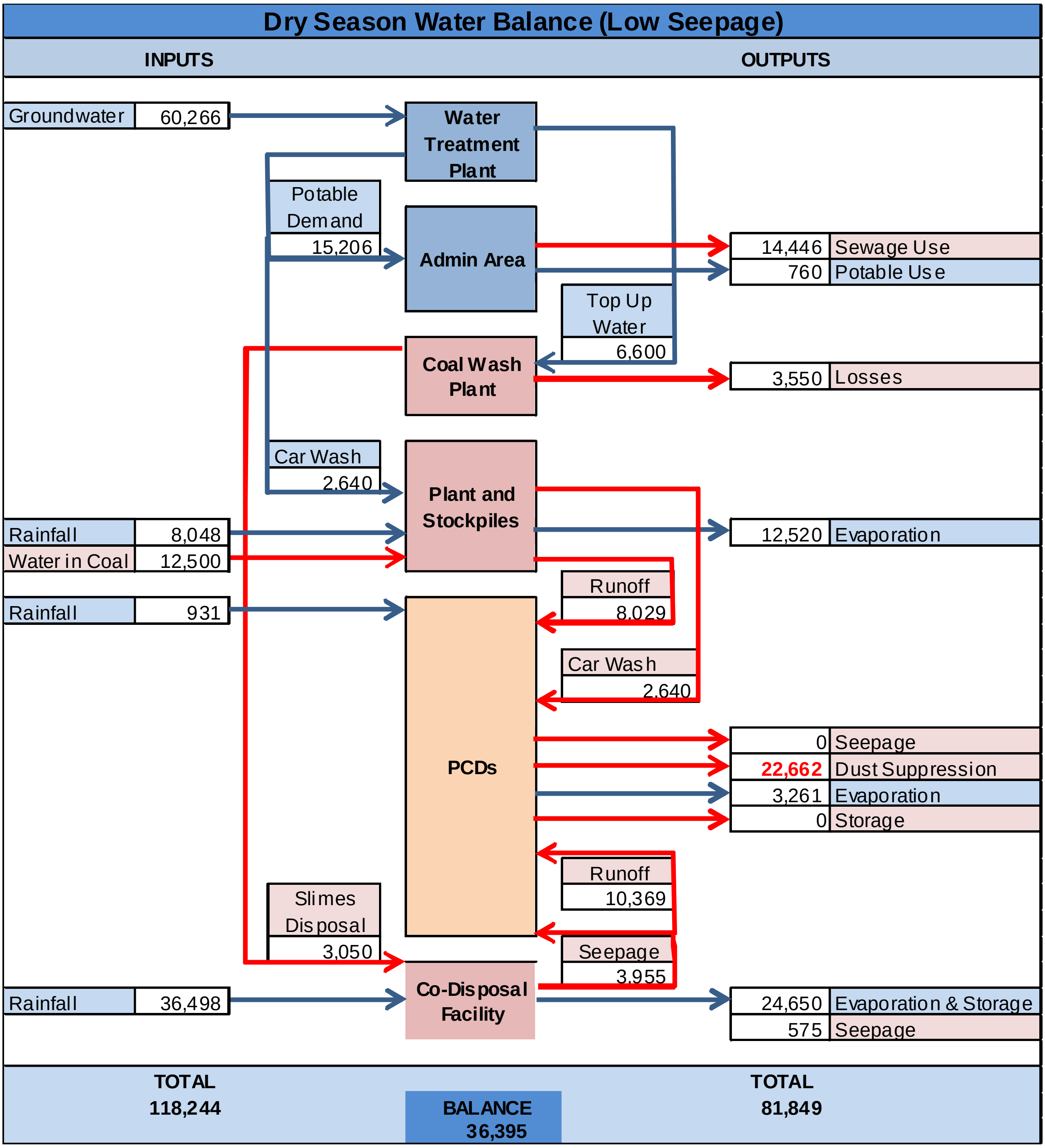
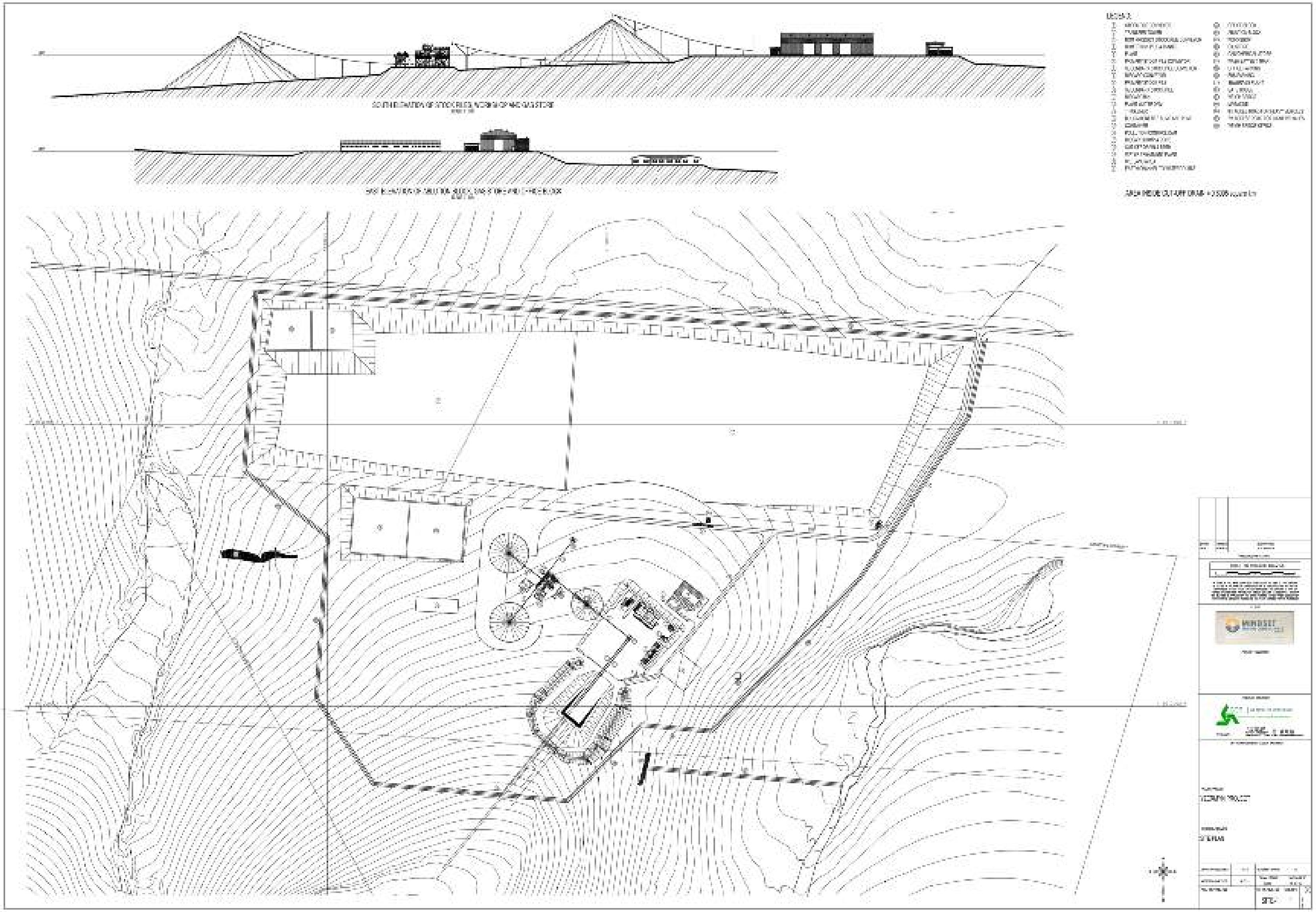


Figure 41: Dry season water balance: Low Seepage (April to September)

Appendix A: Mine Plan



Project number: 24514-004
Dated: 2013/08/16
Revised:

Appendix B: Impact Assessment Methodology

WSP Impacts Rating Methodology

The potential environmental impacts will be evaluated according to their severity, duration, extent and significance of the impact. Furthermore, cumulative impacts will also be taken into consideration. WSP's risk assessment methodology will be used for the ranking of the impacts.

This system derives environmental significance on the basis of the consequence of the impact on the environment and the likelihood of the impact occurring. Consequence is calculated as the average of the sum of the ratings of severity, duration and extent of the environmental impact. Likelihood considers the frequency of the activity together with the probability of an environmental impact occurring.

The following tables (**Table 1** to **Table 8**) describe the process in detail:

Table 1: Assessment and Rating Sensitivity

Rating	Description
1	Negligible/ non-harmful/ minimal deterioration (0 – 20%)
2	Minor/ potentially harmful/ measurable deterioration (20 – 40%)
3	Moderate/ harmful/ moderate deterioration (40 – 60%)
4	Significant/ very harmful/ substantial deterioration (60 – 80%)
5	Irreversible/ permanent/ death (80 – 100%)

Table 2: Assessment and Rating of Duration

Rating	Description
1	Less than 1 month/ quickly reversible
2	Less than 1 year/ quickly reversible
3	More than 1 year/ reversible over time
4	More than 10 years/ reversible over time/ life of project or facility
5	Beyond life of project of facility/ permanent

Table 3: Assessment and Rating of Extent

Rating	Description
1	Within immediate area of activity
2	Surrounding area within project boundary
3	Beyond project boundary
4	Regional/ provincial
5	National/ international

Consequence is calculated as the average of the sum of the ratings of severity, duration and extent of the environmental impact.

Table 4: Determination of Consequence

Determination of Consequence (C)	(Severity + Duration + Extent) / 3

- Likelihood

Table 5: Assessment and Rating of Frequency

Rating	Description
1	Less than once a year
2	Once in a year
3	Quarterly
4	Weekly
5	Daily

Table 6: Assessment and Rating of Probability

Rating	Description
1	Almost impossible
2	Unlikely
3	Probable
4	Highly likely
5	Definite

Likelihood considers the frequency of the activity together with the probability of the environmental impact associated with that activity occurring.

Table 7: Determination of Likelihood

Determination of Likelihood (L) =	(Frequency + Probability) / 2

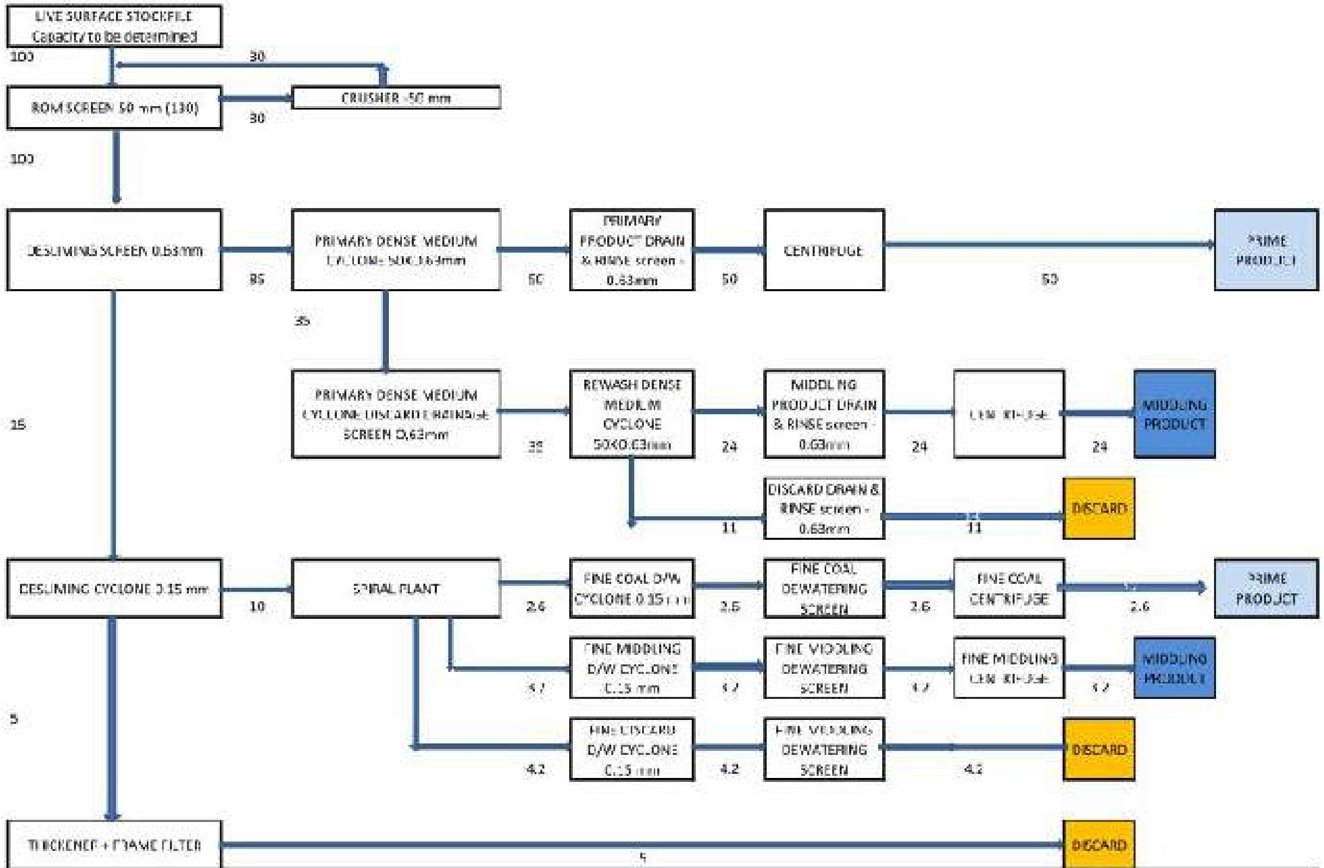
- Impact Significance

Impact significance is the product of the consequence and likelihood values.

Table 8: Determination of Environmental Significance

Environmental Significance (Impact) = C × L	Description
L (1 – 4.9)	Low environmental significance
LM (5 – 9.9)	Low to medium environmental significance
M (10 – 14.99)	Medium environmental significance
MH (15 – 19.9)	Medium to high environmental significance
H (20 – 25)	High environmental significance. Likely to be a fatal flaw.

Appendix C: Process Flow



NOTE1: Considering ROM Coal feed to wash plant as 100, the material balance in various section is expressed in % of ROM feed.

NOTE 2: Prime Prodect Recovery =53% of ROM

Appendix D: Laboratory Certificates

ALS ANALYSIS AND INSPECTION – DURBAN (PTY) LTD
Unit 5, 89 King Dinuzulu (Berea) Road,
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Post Net Suite #290 Private Bag X04
Dalbridge, 4014, South Africa
Tel: +27 31 301 1257
Fax: +27 31 301 1256
Email: info.dbn@alsglobal.com
www.alsglobal.com

Reference No: ALSD 452

Date: 12 July 2013

CERTIFICATE OF ANALYSIS

Report On:	4 (Four)	Samples I.D.:	Water
Date & Time Received:	04/07/13 – 15:30	Taken By:	Yourselves
Date & Time Analysis Started:	08/07/13 – 14:00	From:	Yusuf Simjee
Date & Time Analysis Finished:	11/07/13 – 14:00		

MARKED AS BELOW

Results marked "Not SANAS Accredited" in this report are not included in the SANAS Schedule of Accreditation for this Laboratory.
* Refers to tests that are not SANAS accredited.

Analysis on an as received basis:

	Faecal Coliforms, cfu/100ml [Membrane Filtration]	***E.coli*** **cfu/100ml [Membrane Filtration]**
1. WQ1	58	30
2. WQ2	17	18
3. WQ3	3.80×10^2	1.50×10^2
4. WQ4	$2.70\ 10^2$	1.20×10^2

Technical Signatory: Chemistry ______________________ Mr S. Ramdeen Supervisor

Microbiology ______________________ Ms N. Kassim Supervisor

Branch Manager: ______________________ Dr A. A. Khan

WSP Environmental & Energy
P.O Box 1442
Westville
3630

1 of 1

[illegible]
This report relates only to the samples supplied and ALS Analysis and Inspection Durban (Pty) Ltd. does not accept responsibility for any matters arising from further use of these results. This document may only be reproduced in full and with the written approval of the Branch Manager.
"Opinions and interpretations expressed herein are outside the scope of SANAS Accreditation"

REGISTERED NO. 2011/005247/07 Part of the ALS Laboratory Group An ALS Limited Company

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ALcontrol Laboratories

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email: mkt@alcontrol.com
Website: www.alcontrol.com

WSP Environment & Energy Africa
WSP House
Bryanston Place
199 Bryanston Drive
Bryanston
2191

Attention: Yusuf Simjee

CERTIFICATE OF ANALYSIS

Date:	19 July 2013
Customer:	H_WSP_BRY
Sample Delivery Group (SDG):	130708 26
Your Reference:	24514
Location:	Yzermyn Coal Mine
Report No:	234042

We received 4 samples on Monday July 08, 2013 and 4 of these samples were scheduled for analysis which was completed on Friday July 19, 2013. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

All chemical testing (unless subcontracted) is performed at ALcontrol Hawarden Laboratories.

Approved By:

Sonia McWhan

Operations Manager

ALcontrol Laboratories

Validated

CERTIFICATE OF ANALYSIS

SDG:	130706-25	**Location:**	Yzermyn Coal Mine	**Order Number:**	DU6824
Job:	H_WSP_BRY-31	**Customer:**	WSP Environment & Energy Africa	**Report Number:**	234042
Client Reference:	24514	**Attention:**	Yusuf Simjee	**Superseded Report:**	

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
7723035	WQ1	EW		03/07/2013
7723036	WQ2	EW		03/07/2013
7723037	WQ3	EW		03/07/2013
7723038	WQ4	EW		03/07/2013

Only received samples which have had analysis scheduled will be shown on the following pages.

15:58:30 19/07/2013

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CERTIFICATE OF ANALYSIS

Validated

SDG:	130706-25	**Location:**	Yzermyn Coal Mine	**Order Number:**	DU6624
Job:	H_WSP_BRY-31	**Customer:**	WSP Environment & Energy Africa	**Report Number:**	234042
Client Reference:	24514	**Attention:**	Yusuf Simjee	**Superseded Report:**	

LIQUID

Results Legend

X Test

N No Determination Possible

Lab Sample No(s)			723035		723036		723037		723038	
Customer Sample Reference			WQ1		WQ2		WQ3		WQ4	
AGS Reference			EA		EA		EA		EA	
Depth (m)										
Container			1l Glass bottle (ALC	1l plastic (ALE221)	1l Glass bottle (ALC	1l plastic (ALE221)	1l Glass bottle (ALC	1l plastic (ALE221)	1l Glass bottle (ALC	1l plastic (ALE221)
Anions by Kone (w)	All	NDPs: 0 Tests: 4		X		X		X		X
COD Unfiltered	All	NDPs: 0 Tests: 4		X		X		X		X
Conductivity (at 20 deg.C)	All	NDPs: 0 Tests: 4		X		X		X		X
Dissolved Metals by ICP-MS	All	NDPs: 0 Tests: 4		X		X		X		X
Mercury Dissolved	All	NDPs: 0 Tests: 4	X		X		X		X	
Nitrite by Kone (w)	All	NDPs: 0 Tests: 4		X		X		X		X
PAH Spec MS - Aqueous (W)	All	NDPs: 0 Tests: 4	X		X		X		X	
pH Value	All	NDPs: 0 Tests: 4		X		X		X		X
Suspended Solids	All	NDPs: 0 Tests: 4		X		X		X		X
Total Dissolved Solids	All	NDPs: 0 Tests: 4		X		X		X		X
Total Organic and Inorganic Carbon	All	NDPs: 0 Tests: 4	X		X		X		X	

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CERTIFICATE OF ANALYSIS

SDG:	130706-25	**Location:**	Yzermyn Coal Mine	**Order Number:**	DU6624
Job:	H_WSP_SRY-31	**Customer:**	WSP Environment & Energy Africa	**Report Number:**	234042
Client Reference:	24514	**Attention:**	Yusuf Simjee	**Superseded Report:**	

Results Legend

- # ISO17025 accredited.
- M mCERTS accredited.
- aq Aqueous / settled sample.
- diss.filt Dissolved / filtered sample.
- tot.unfilt Total / unfiltered sample.
- * Subcontracted test.
- ** % recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery.
- (F) Trigger breach confirmed
- 1-4+§@ Sample deviation (see appendix)

Customer Sample R			WQ1	WQ2	WQ3	WQ4		
Depth (m)			-	-	-	-		
Sample Type			Water(GW/SW)	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)		
Date Sampled			03/07/2013	03/07/2013	03/07/2013	03/07/2013		
Sample Time			-	-	-	-		
Date Received			06/07/2013	06/07/2013	06/07/2013	06/07/2013		
SDG Ref			130706-25	130706-25	130706-25	130706-25		
Lab Sample No.(s)			7733856	7733086	7733857	7733093		
AGS Reference			EW	EW	EW	EW		
Component	**LOD/Units**	**Method**						
Suspended solids, Total	<2 mg/l	TM022	<4 #	<4 #	<2 #	<4 #		
Organic Carbon, Total	<3 mg/l	TM090	<3 #	<3 #	<3 #	<3 #		
COD, unfiltered	<7 mg/l	TM107	<7 #	<7 #	<7 #	<7 #		
Conductivity @ 20 deg C	<0.005 mS/cm	TM120	0.176 #	0.106 #	0.108 #	0.139 #		
Dissolved solids, Total (meter)	<5 mg/l	TM123	137 #	82.7 #	84.3 #	107 #		
Arsenic (diss.filt)	<0.12 µg/l	TM152	<0.12 #	0.139 #	<0.12 #	<0.12 #		
Cadmium (diss.filt)	<0.1 µg/l	TM152	<0.1 #	<0.1 #	<0.1 #	<0.1 #		
Chromium (diss.filt)	<0.22 µg/l	TM152	4.04 #	2.49 #	2.72 #	3.21 #		
Copper (diss.filt)	<0.85 µg/l	TM152	<0.85 #	<0.85 #	<0.85 #	<0.85 #		
Lead (diss.filt)	<0.02 µg/l	TM152	0.02 #	0.031 #	0.069 #	0.038 #		
Nickel (diss.filt)	<0.15 µg/l	TM152	0.587 #	0.51 #	0.424 #	0.477 #		
Selenium (diss.filt)	<0.39 µg/l	TM152	<0.39 #	<0.39 #	<0.39 #	<0.39 #		
Zinc (diss.filt)	<0.41 µg/l	TM152	0.463 #	0.672 #	0.686 #	0.808 #		
Mercury (diss.filt)	<0.01 µg/l	TM183	<0.01 #	<0.01 #	<0.01 #	<0.01 #		
Nitrite as NO2	<0.05 mg/l	TM184	<0.05 2 #	<0.05 2 #	<0.05 2 #	<0.05 2 #		
Sulphate	<2 mg/l	TM184	3.8 #	<2 #	<2 #	2.1 #		
Phosphate (ortho) as PO4	<0.05 mg/l	TM184	<0.05 @ #	<0.05 @ #	<0.05 @ #	<0.05 @ #		
Nitrate as NO3	<0.3 mg/l	TM184	<0.3 #	<0.3 #	0.64 #	0.588 #		
pH	<1 pH Units	TM256	8.12 #	7.85 #	7.77 #	7.79 #		

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SDG:	130706-25	**Location:**	Yzermyn Coal Mine	**Order Number:**	DU6624
Job:	H_WSP_BRY-31	**Customer:**	WSP Environment & Energy Africa	**Report Number:**	234042
Client Reference:	24514	**Attention:**	Yusuf Simjee	**Superseded Report:**	

PAH Spec MS - Aqueous (W)

Results Legend
- # ISO17025 accredited.
- M mCERTS accredited.
- aq Aqueous / settled sample.
- diss.filt Dissolved / filtered sample.
- tot.unfilt Total / unfiltered sample.
- * Subcontracted test.
- ** % recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery.
- (F) Trigger breach confirmed
- 1-5&+§@ Sample deviation (see appendix)

Customer Sample R	WQ1	WQ2	WQ3	WQ4		
Depth (m)	-	-	-	-		
Sample Type	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)		
Date Sampled	06/07/2013	03/07/2013	06/07/2013	03/07/2013		
Sample Time	-	-	-	-		
Date Received	06/07/2013	03/07/2013	06/07/2013	03/07/2013		
SDG Ref	130706-25	130706-25	130706-25	130706-25		
Lab Sample No.(s)	7733856	7733094	7733857	7733093		
AGS Reference	EW	EW	EW	EW		

Component	LOD/Units	Method	WQ1	WQ2	WQ3	WQ4		
Naphthalene (aq)	<0.1 µg/l	TM178	<0.1 @ #	<0.1 @ #	<0.1 @ #	<0.1 @ #		
Acenaphthene (aq)	<0.015 µg/l	TM178	<0.015 @ #	<0.015 @ #	<0.015 @ #	<0.015 @ #		
Acenaphthylene (aq)	<0.011 µg/l	TM178	<0.011 @ #	<0.011 @ #	<0.011 @ #	<0.011 @ #		
Fluoranthene (aq)	<0.017 µg/l	TM178	<0.017 @ #	<0.017 @ #	<0.017 @ #	<0.017 @ #		
Anthracene (aq)	<0.015 µg/l	TM178	<0.015 @ #	<0.015 @ #	<0.015 @ #	<0.015 @ #		
Phenanthrene (aq)	<0.022 µg/l	TM178	<0.022 @ #	<0.022 @ #	<0.022 @ #	<0.022 @ #		
Fluorene (aq)	<0.014 µg/l	TM178	<0.014 @ #	<0.014 @ #	<0.014 @ #	<0.014 @ #		
Chrysene (aq)	<0.013 µg/l	TM178	<0.013 @ #	<0.013 @ #	<0.013 @ #	<0.013 @ #		
Pyrene (aq)	<0.015 µg/l	TM178	<0.015 @ #	<0.015 @ #	<0.015 @ #	<0.015 @ #		
Benzo(a)anthracene (aq)	<0.017 µg/l	TM178	<0.017 @ #	<0.017 @ #	<0.017 @ #	<0.017 @ #		
Benzo(b)fluoranthene (aq)	<0.023 µg/l	TM178	<0.023 @ #	<0.023 @ #	<0.023 @ #	<0.023 @ #		
Benzo(k)fluoranthene (aq)	<0.027 µg/l	TM178	<0.027 @ #	<0.027 @ #	<0.027 @ #	<0.027 @ #		
Benzo(a)pyrene (aq)	<0.009 µg/l	TM178	<0.009 @ #	<0.009 @ #	<0.009 @ #	<0.009 @ #		
Dibenzo(a,h)anthracene (aq)	<0.016 µg/l	TM178	<0.016 @ #	<0.016 @ #	<0.016 @ #	<0.016 @ #		
Benzo(g,h,i)perylene (aq)	<0.016 µg/l	TM178	<0.016 @ #	<0.016 @ #	<0.016 @ #	<0.016 @ #		
Indeno(1,2,3-cd)pyrene (aq)	<0.014 µg/l	TM178	<0.014 @ #	<0.014 @ #	<0.014 @ #	<0.014 @ #		
PAH, Total Detected USEPA 16 (aq)	<0.247 µg/l	TM178	<0.247 @	<0.247 @	<0.247 @	<0.247 @		

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CERTIFICATE OF ANALYSIS

SDG:	130706-25	**Location:**	Yzermyn Coal Mine	**Order Number:**	DU6624
Job:	H_WSP_BRY-31	**Customer:**	WSP Environment & Energy Africa	**Report Number:**	234042
Client Reference:	24514	**Attention:**	Yusuf Simjee	**Superseded Report:**	

Table of Results - Appendix

Method No	Reference	Description	Wet/Dry Sample [1]	Surrogate Corrected
TM022	Method 2540D, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part120 1981 BS EN 872	Determination of total suspended solids in waters		
TM090	Method 5310, AWWA/APHA, 20th Ed., 1999 / Modified: US EPA Method 415.1 & 9060	Determination of Total Organic Carbon/Total Inorganic Carbon in Water and Waste Water		
TM107	ISO 6060-1989	Determination of Chemical Oxygen Demand using COD Dr Lange Kit		
TM120	Method 2510B, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part 9:1970	Determination of Electrical Conductivity using a Conductivity Meter		
TM123	BS 2690: Part 121:1981	The Determination of Total Dissolved Solids in Water		
TM152	Method 3125B, AWWA/APHA, 20th Ed., 1999	Analysis of Aqueous Samples by ICP-MS		
TM178	Modified: US EPA Method 8100	Determination of Polynuclear Aromatic Hydrocarbons (PAH) by GC-MS in Waters		
TM183	BS EN 23506:2002, (BS 6068-2.74:2002) ISBN 0 580 38924 3	Determination of Trace Level Mercury in Waters and Leachates by PSA Cold Vapour Atomic Fluorescence Spectrometry		
TM184	EPA Methods 325.1 & 325.2,	The Determination of Anions in Aqueous Matrices using the Kone Spectrophotometric Analysers		
TM256	The measurement of Electrical Conductivity and the Laboratory determination of pH Value of Natural, Treated and Wastewaters. HMSO, 1978. ISBN 011 751428 4.	Determination of pH in Water and Leachate using the GLpH pH Meter		

[1] Applies to Solid samples only. DRY indicates samples have been dried at 35°C. NA = not applicable.

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CERTIFICATE OF ANALYSIS

SDG:	130706-25	**Location:**	Yzermyn Coal Mine	**Order Number:**	DU6624
Job:	H_WSP_BRY-31	**Customer:**	WSP Environment & Energy Africa	**Report Number:**	234042
Client Reference:	24514	**Attention:**	Yusuf Simjee	**Superseded Report:**	

Test Completion Dates

Lab Sample No(s)	7723035	7723036	7723037	7723038
Customer Sample Ref.	W01	W02	W03	W04
AGS Ref.	EW	EW	EW	EW
Depth				
Type	LIQUID	LIQUID	LIQUID	LIQUID
Anions by Kone (w)	18-Jul-2013	18-Jul-2013	18-Jul-2013	18-Jul-2013
COD Unfiltered	13-Jul-2013	13-Jul-2013	13-Jul-2013	13-Jul-2013
Conductivity (at 20 deg.C)	09-Jul-2013	09-Jul-2013	09-Jul-2013	09-Jul-2013
Dissolved Metals by ICP-MS	17-Jul-2013	17-Jul-2013	17-Jul-2013	17-Jul-2013
Mercury Dissolved	11-Jul-2013	11-Jul-2013	11-Jul-2013	11-Jul-2013
Nitrite by Kone (w)	10-Jul-2013	10-Jul-2013	10-Jul-2013	10-Jul-2013
PAH Spec MS - Aqueous (W)	18-Jul-2013	18-Jul-2013	18-Jul-2013	18-Jul-2013
pH Value	09-Jul-2013	09-Jul-2013	09-Jul-2013	09-Jul-2013
Suspended Solids	09-Jul-2013	09-Jul-2013	09-Jul-2013	09-Jul-2013
Total Dissolved Solids	09-Jul-2013	09-Jul-2013	09-Jul-2013	09-Jul-2013
Total Organic and Inorganic Carbon	11-Jul-2013	11-Jul-2013	11-Jul-2013	11-Jul-2013

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Appendix

General

1. Results are expressed on a dry weight basis (dried at 35°C) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH4 by the BRE method, VOC TICS and SVOC TICS.

2. Samples will be run in duplicate upon request, but an additional charge may be incurred.

3. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 2 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALcontrol Laboratories reserve the right to charge for samples received and stored but not analysed.

4. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

5. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

6. When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005) which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as "Not detected". If no asbestos fibre types are found all will be reported as "Not detected" and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible. The quantity of asbestos present is not determined unless specifically requested.

7. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

8. If appropriate preserved bottles are not received, preservation will take place on receipt. However, the integrity of the data may be compromised.

9. NDP -No determination possible due to insufficient/unsuitable sample.

10. Metals in water are performed on a filtered sample, and therefore represent dissolved metals -total metals must be requested separately.

11. Results relate only to the items tested.

12. LODs for wet tests reported on a dry weight basis are not corrected for moisture content.

13. **Surrogate recoveries** -Most of our organic methods include surrogates, the recovery of which is monitored and reported. For EPH, MO, PAH, GRO and VOCs on soils the result is not surrogate corrected, but a percentage recovery is quoted. Acceptable limits for most organic methods are 70 -130 %.

14. **Product analyses** -Organic analyses on products can only be semi-quantitative due to the matrix effects and high dilution factors employed.

15. Phenols monohydric by HPLC include phenol, cresols (2-Methylphenol, 3-Methylphenol and 4-Methylphenol) and Xylenols (2,3 Dimethylphenol, 2,4 Dimethylphenol, 2,5 Dimethylphenol, 2,6 Dimethylphenol, 3,4 Dimethylphenol, 3,5 Dimethylphenol).

16. Total of 5 speciated phenols by HPLC includes Phenol, 2,3,5-Trimethyl Phenol, 2-Isopropylphenol, Cresols and Xylenols (as detailed in 15).

17. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

18. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

19. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

20. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

21. For all leachate preparations (NRA, DIN, TCLP, BSEN 12457-1, 2, 3) volatile loss may occur, as we do not employ zero headspace extraction.

22. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

23. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

Sample Deviations

1	**Container with Headspace provided for volatiles analysis**
2	**Incorrect container received**
3	**Deviation from method**
4	**Holding time exceeded before sample received**
5	**Sampled on date not provided**
•	**Sample holding time exceeded in laboratory**
@	**Sample holding time exceeded due to sampled on date**
&	**Sample Holding Time exceeded - Late arrival of instructions.**

Asbestos

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using ALcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than:

Trace - Where only one or two asbestos fibres were identified.

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.

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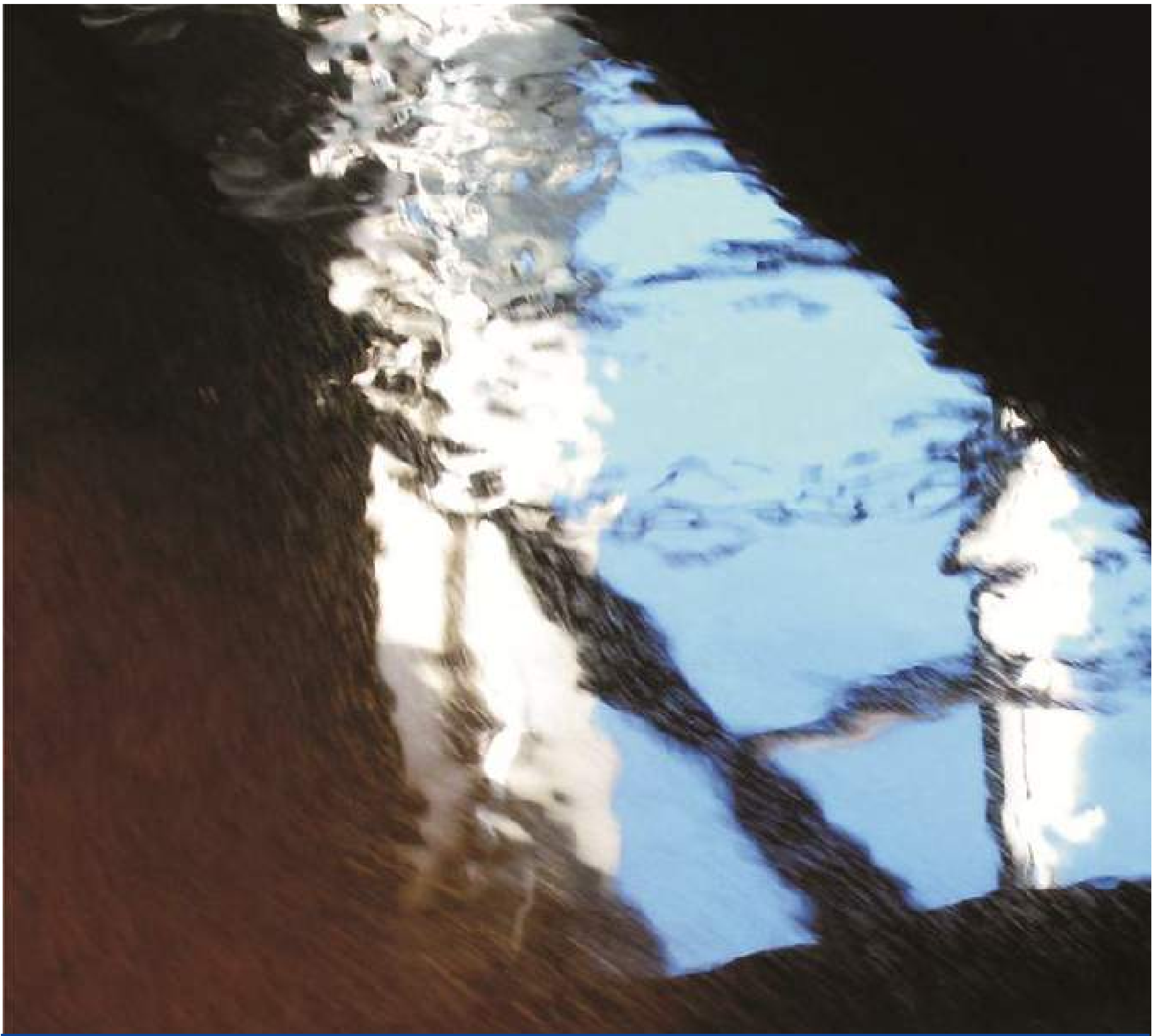

PROPOSED YZERMYN UNDERGROUND COAL MINE - STORM WATER MANAGEMENT PLAN

Atha-Africa Ventures (Pty) Ltd

2013/08/02

Quality Management

Issue/revision	Issue 1	Revision 1	Revision 2	Revision 3
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PROPOSED YZERMYN UNDERGROUND COAL MINE - STORM WATER MANAGEMENT PLAN

Atha-Africa Ventures (Pty) Ltd

2013/08/02

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Table of Contents

1 Introduction and Terms of Reference

WSP Environment & Energy (WSP) was appointed by Atha-Africa Ventures (Pty) Ltd (Atha) to undertake an Environmental and Socio-economic Impact Assessment (ESIA), with all associated specialist studies, in support of a Mining Right Application for a proposed underground coal mine located within a prospecting right in the Dirkiesdorp area in Mpumalanga Province. The ESIA aims to fulfil the requirements of the Equator Principles and International Finance Corporation (IFC) standards and guidelines.

As part of the required specialist studies, a conceptual Storm Water Management Plan has been requested, and this report serves to fulfil this requirement.

2 Approach

To appropriately manage the storm water by the proposed mine development, a Storm Water Management Plan (SWMP) was devised. The objective of the SWMP is to prevent pollution of the receiving watercourses through the appropriate separation of clean and dirty water on the site. The development of the SWMP took into account the following guidelines:

- Department of Water Affairs and Forestry (DWAF) Government Notice No. 704 (GN704) *Guideline Document for the Implementation of Regulations on use of Water for Mining and Related Activities Aimed at the Protection of Water Resources.*
- The following DWAF Best Practice Guidelines (BPGs):
  - G1 - Storm Water Management;
  - A4 - Pollution Control Dams; and,
  - A5 - Water Management for Surface Mines.

These documents support Section 26 of the National Water Act (Act No. 36 of 1998) which regulates any activity that may have an impact on a water resource, and the conservation and protection of this water resource. The main principles adopted in these documents include:

- Confine or divert any unpolluted water to a clean water system, and polluted water to a dirty water system;
- Clean and dirty water systems should be designed and constructed to prevent cross-contamination between the clean and dirty water systems;
- Clean and dirty water systems should contain the 50 year storm event, and should not lie within the 100 year flood line or within a horizontal distance of 100m from any watercourse; and,
- Maintenance of the storm water management infrastructure.

2.1 Desktop Review and Gap Analysis

A desktop review was conducted to determine the local and regional geo-environmental characteristics (i.e. climate, hydrology, landuse, vegetation, geology and soils). This review included the following information sources:

- Available documentation to define the hydrological and climatic conditions:
  - Water Research Commission (WRC), 1994. The Surface Water Resources of South Africa, 1990, Volume VI, Eastern Escarpment (WRC Report No 298/6.1/94).
- Relevant mapping of the area to define the landuse, vegetation, geology and soils:

- Department of Agriculture, Forestry and Fisheries (DAFF), 2006 Landuse Geology, and Land-Type Mapping in GIS Shapefile Format; and,
- Mucina, L. & Rutherford, M.C. (eds), Reprint 2011. The Vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria;

- Proposed development plan, incorporating proposed infrastructure and contour elevations (at a 2m contour interval):
  - Constructive Consulting Engineering cc., Yzermyn Project. Drawing Number: Site-1. Revision: 1. Dated 01-07-2013.
- Telephonic discussion with Piet van der Linde, Senior Mining Engineer at Mindset Mining Consultants (Pty) Ltd., responsible for the mine planning.

2.2 Site Walkover

A site walkover was conducted by Andrew Gemmell and Ayanda Mthalane of WSP on the 1st of July 2013. The objective was to groundtruth the information gathered during the desktop review, focussing on the proposed extent of the mine area. The observations made included the following:

- Topography;
- Soil type and depth;
- Vegetation type and density;
- Landuse; and,
- Surface cover (i.e. rocks and bedrock outcrops).

2.2 Conceptual Storm Water Management Plan

Clean and dirty water catchments were discretised based on the development plan provided. This took into account the landuse and surface flow directions determined from the site walkover and desktop study.

Based on the discretised catchments, storm water management infrastructure (including channels, pipes, berms, sediment traps and reservoirs) was placed to ensure appropriate management of clean and dirty storm water runoff according to the requirements outlined in the GN704 guideline and BPGs.

2.3 Numerical Modelling

Numerical modelling was undertaken to determine both the required sizings of the transfer infrastructure (i.e. pipes and channel) as well as the required sizings of the Pollution Control Dam (PCDs).

2.3.1 Transfer Infrastructure Sizing

The *HydroCube* storm water drainage model was used to size the proposed storm water management infrastructure. *HydroCube* is a hydrological rainfall-runoff numerical simulation model suitable for application to both rural and urban environments.

HydroCube is an update of the *HydroSim* model, which has been verified using data from several test catchments nationally and internationally. *HydroCube* can be used to determine the design requirements for various drainage elements as well as analyse the performance of existing drainage systems. *HydroCube* requires a number of input parameters for each of the elements, including:

- Mean Annual Precipitation (MAP) of the region;
- Catchment characteristics including catchment area, overland flow length, slope, impervious areas, surface cover and soils; and,
- Proposed drainage infrastructure characteristics, including channels, pipes and reservoirs. .

Based on the modelled results, sediment traps were designed to prevent sedimentation of the reservoirs used to contain dirty water.

2.3.2 Pollution Control Dam Sizing

To calculate the required reservoir sizings, the SCS-SA hydrological model was used to determine the one day design rainfall runoff for the 50 year storm event. The SCS model is based on the United States Department of Agriculture's Soil Conservation Service (SCS) model, adapted for use in South Africa.

3 Background Information

3.1 Project Description

The proposed mine area is centred approximately at global coordinates 27.214° south and 30.312° east and is located 10km south-west of Dirkiesdorp and 23km north-east of Wakkerstroom in the Mpumalanga Province (**Figure 1**).

3.2 Description

The proposed development plan is represented in **Appendix A** and can be summarised as follows:

- The downcast mine adit is located to the south-east of the proposed development footprint, out of which runs a stockpile conveyor leading to the Run of Mine (ROM) stockpile, processing plant and primary and secondary stockpiles. The stockpile areas are expected to be underlain by hardstand.
- East of the stockpiles is located the administrative and operations area, including the office block, ablutions, workshop, oil store, gas/chemical store, wash bay and associated silt trap, parking areas and sewage plant. The majority of the proposed administration area is expected to be covered by hardstand.
- West of the stockpiles is the proposed Water Treatment Plant (WTP) and PCD.
- A road is proposed to lead from the existing road located adjacent to the northern boundary of the site. A weigh bridge and office is proposed on the portion of this access road north-east of the administration area.
- A Co-Disposal Facility (referenced as a discard dump on the development plan) is proposed north of the mine and administration area. No design was given for this facility, but in line with other coal mine co-disposal facilities, it is expected that this facility will comprise an above-ground reservoir constructed from coarse coal discard, and used to contain slurry derived from the processing plant (including coal wash water).
- As indicated in the available mine plan, a cut-off trench is proposed to surround the proposed mine area, forming the boundary. This acts to prevent clean water entering the mine area and dirty water from leaving the mine area.

3.3 Climate and Hydrology

The site falls within the W51A Quaternary Catchment, within the Assegaai River catchment. The climatic conditions and runoff amounts for this quaternary catchment are presented in **Table 1**. The Mean Annual Precipitation (MAP) for the area is 922mm with a Mean Annual Evaporation (MAE) of 1,400mm. This results in a Mean Annual Runoff (MAR) of 87.6 million m^3 (WRC, 1994).

Table 1 Quaternary catchment information (WRC, 1994)

Quaternary Catchment	Area (km^2)	MAP (mm)	MAE (mm)	MAR (mm)	MAR (m^3)
W51A	624	922	1,400	140	87,600,000

Rain-gauges located in close proximity to the site were selected from the database compiled by the Institute for Commercial Forestry Research (ICFR), and School of Bioresources Engineering and Environmental Hydrology (BEEH) associated with the University of the KwaZulu-Natal. The Dirkiesdorp rain-gauge (0407730W) was considered representative based on the record length, altitude and distance from the site (**Table 2**).

Table 2 Rainfall station summary (ICFR, 2004)

Station Name	Station Number	Longitude	Latitude	Distance from site (km)	Record (years)	Reliable data (%)	Patched data (%)	MAP (mm)	Altitude (mamsl)
Dirkiesdorp	0407730W	30.401	27.167	10	96	34.1	67.7	586	1,350

The mean annual precipitation (MAP) for the Dirkiesdorp station is 586mm. The MAP in the vicinity of the proposed mine (586mm) is notably less than the MAP for the quaternary catchment (922mm). This is expected to be due to terrain differences within the quaternary catchment that leads to rainfall variability; however, given the proximity of the Dirkiesdorp station to the site (with the station located 10km to the north-east) and the similar altitudes between the site (1440m above mean sea level) and station (1,350m above mean sea level), the MAP of this station is considered representative of the site and was used for the numerical modelling.

Table 3 represents the average monthly rainfall expected for the station. The wet season runs from October to March. . The wet season runs from October to March. The expected monthly evaporation for the area is given in **Table 4**.

Table 3 Rainfall monthly averages for Dirkiesdorp rain gauge (after WRC, 1994

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Rainfall (mm)	62	89	96	95	79	65	34	13	7	8	10	28

Table 4 Evaporation monthly averages (after WRC, 1994)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Evaporation (mm)	137	143	153	154	131	127	99	82	69	78	100	127

A non-perennial watercourse is located approximately 100m to the west of the mine property boundary and a perennial watercourse is located approximately 300m to the east (**Figure 2**).

3.4 Landuse, Vegetation and Soils

The site walkover identified the current landuse within and surrounding the proposed mine areas as grassland used for cattle grazing. Based on Mucina and Rutherford (2006) this grassland comprises Wakkerstroom Montane Grassland and Paulpietersburg Moist Grassland.

An informal unpaved farm road passes through the eastern extremity of the proposed mine area, with an unnamed unpaved district road lying adjacent to the northern boundary. A rural homestead is located at the eastern boundary of the proposed mine, comprising ten structures, with limited subsistence cropping.

Rock outcrops are located on the western and southern boundaries of the proposed mine area. The site walkover identified sandy soils within the proposed mine area, with a total soil depth of between 0.5m and 1.0m underlain by a sandstone bedrock.

4 Conceptual Storm Water Management Plan

Based on the proposed development plan (**Appendix A**), both dirty and clean water is expected to be from the mine area. To ensure that this storm water is adequately contained and routed a conceptual Storm Water Management Plan (SWMP) was developed and is presented in **Appendix B**.

The SWMP represents the clean and dirty water catchments and the expected surface flow directions. In addition, the SWMP represents the channels (prefix "C"), pipes (prefix "P") and reservoirs (prefix "R") used to manage the surface runoff for each catchment (prefix "K"). The proposed cut-off trenches as included within the mine development plan were incorporated into the SWMP.

The storm water management infrastructure for the identified clean and dirty areas is described in the following subsections.

4.1 Clean Areas

Based on the conceptual SWMP (**Appendix B**), the following areas have been classified as clean areas:

- Catchment K1

  Clean water runoff from upgradient of the proposed mine area (K1) flows northward via the natural topography and reports to the portion of the diversion trench located south-west of the proposed mine area. The contributing catchment comprises grassland and rocky outcrops. Based on the topography, flow within this portion of the diversion channel (C1) is then routed in a westerly and north-westerly direction.

- Catchment K2

  This catchment comprises the south-western portion of the mine area that remains undeveloped. Runoff from this catchment is expected to follow the natural topography and report to the south-western portion of the diversion trench (C2) that flows in a northerly direction.

- Catchment K3

  This portion of the mine area is largely undeveloped; however the water treatment plant is located within this area. It has been assumed that no dirty stormwater runoff is generated from the treatment plant. Based on the natural topography, surface runoff is expected to flow in a north-westerly direction. To prevent clean water reporting to the proposed PCD (R1), it is proposed that this runoff is redirected in a westerly direction via channel C3, reporting to the western portion of the diversion trench (C4.2) that flows in a north-westerly direction.

- Catchment K4

  Catchment K4 is located down gradient (i.e. north) of the PCD associated with the mine processing area (R1). Based on the topography, flow is expected in a north-westerly direction. Since K4 remains undeveloped, it is proposed that Channel C4.1 is used to direct clean runoff in a westerly direction to the north-western portion of the diversion trench (C5) that flows in a northerly direction.

  To transfer dirty water from the mine processing area (K12 and K13) to the PCD it is proposed that a subsurface pipe (P13) is used to route flow beneath this clean catchment.

- Catchment K5 and K6

Catchment K5 and K6 are the portions of undeveloped land between the north-western portion of the Co-Disposal Facility and the diversion trench.

Clean water from Catchment K5 is expected to flow westerly and report to the north-western portion of the diversion trench (C5) that directs flow in a northerly direction. Clean water in Catchment K6 is expected to flow in a north-westerly direction and report to the north-western portion of the diversion trench (C6.1) that flows in a westerly direction.

All clean water flow from Catchments K1, K2, K3, K4, K5 and K6 and routed via the diversion trench is proposed to be released to the environment via Channel C6.2, approximately 100m away from a watercourse west of the mine area.

- Catchment K7

  This catchment comprises grassland and rocky outcrops, and clean water runoff in this area is expected to report to the portion of the diversion trench located south of the proposed mine area (C7) which is expected to direct flow in an easterly direction based on the topography.

- Catchment K8

  Catchment K8 contains the bus parking area and otherwise undeveloped land. It is expected that runoff from these areas will be clean; hence is directed to the eastern portions of the diversion trench (C8) that flows in a northerly direction.

- Catchment K9

  This catchment includes the office block, office parking, weigh bridge and sewage plant. It has been assumed that the sewage plant is properly operated and maintained; hence no dirty water is expected from these areas. It is proposed that the runoff reports to a channel (C9) that routes water to the eastern portion of the diversion trench (C10) that directs flow in a northerly direction. A pipe (P9) associated with Channel C9 is proposed to route flow beneath the roadway.

- Catchment K10 and K11

  Catchment K10 and K11 are the portions of undeveloped land located between the north-eastern portions of the diversion trench and Co-Disposal Facility. Runoff from Catchment K10 flows in a north-easterly direction and reports to the north-easterly portion of the diversion trench (C10) that is expected to route flow in a northerly direction. Clean water in Catchment K11 is expected to flow in a north-easterly direction and contribute to the north-eastern portion of the diversion trench (C11.1) that flows in an easterly direction.

It is proposed that all clean water flow from Catchments K7, K8, K9, K110 and K11 is routed via the diversion trench (C7, C8 and C10) and is released to the environment via Channel C11.2, approximately 300m away from a watercourse east of the proposed mine area.

4.2 Dirty Areas

The following areas have been classified as dirty areas as per the conceptual SWMP (**Appendix B**):

- Catchment K12

  This catchment contains the stockpile conveyor that runs from the mine to the stockpile areas and processing plant. In addition, the gas/chemical store, oil store, workshop and wash bay and associated silt trap is located within this catchment. Based on the development plan, this area is expected to be built on a platform, covered by hardstand.

  Due to the expected coal dust generation from the stockpile conveyor, as well as the potential for hydrocarbon spills to arise from the workshop and wash bay area, this catchment has been classified as dirty.

It is proposed that surface runoff is directed to a channel located to the north of this area (C12) which directs flow to a sediment trap and PCD (R1), with the sediment trap serving to prevent sedimentation of the reservoir. To prevent dirty stormwater from entering the adjacent clean area (K8), a berm on the eastern boundary of this area is proposed.

Dirty runoff from the mine adit is expected to flow directly into the adit itself. As a result, this water will be managed as part of underground mine water management and is not considered further.

- Catchment K13

  This catchment contains the Run of Mine (ROM) stockpile, wash plant and primary and secondary stockpiles. Due to the potential for seepage from these stockpiles to pollute the groundwater resource, it is proposed that these areas are covered in hardstand.

  Runoff from the coal stockpiles is expected to be dirty due to elevated suspended solids, and various dissolved contaminants including metals and sulphates.

  To contain this dirty runoff, it is proposed that runoff is directed to the PCD (R1) via a channel and pipe located on the northern boundary of this area (C13 and P13 respectively). A berm is proposed on the western boundary of this catchment to prevent the movement of water between this catchment and the adjacent clean water catchments (K3 and K4).

- Catchments K14, K15, K16 and K17

  These catchments contain the Co-Disposal Facility. The surface runoff from the side slopes of the Co-Disposal Facility is expected to be dirty during the initial stages of its operation since it will contain entrained sediments from unvegetated materials, leading to an increased suspended solids load, including coal fines. To contain this dirty water, it is proposed that runoff from this dump is routed to channels that divert flow to a sediment trap and reservoir. Based on the mine development plan, only one pollution control dam is proposed. However, the topography indicates that the Co-Disposal Facility is located on a ridge. As a result, it is considered prudent to divert this flow to pollution control dams on either side of this ridge (R2 and R3).

  To account for the flow directions expected from the Co-Disposal Facility, the Co-Disposal Facility area has been divided into four catchments (K14, K15, K16 and K17) that direct flow to channels C14, C15, C16.1 and C17.1 respectively. The runoff from the eastern portion of the dump will report to PCD R2; whilst runoff from the western portion of the dump will report to PCD R3. To ensure no sediment build-up within these PCDs, each will have a sediment trap associated with their inlet.

  Given the high sulphides expected in the stored slurry material, there is the potential for acidic conditions to develop within the facility. As a result, it is proposed that this facility is underlain by a suitable impervious layer (e.g. HDPE liner). Since seepage is expected from this facility, it has been assumed that the seepage will be collected in the storm water channels associated with the facility (i.e. C14, C15, C16.1 and C17.1 that will act as toe drains).

5 Numerical Modelling

The SWMP was assessed in terms of the 50 year recurrence interval storm event to determine the peak flow conditions for each of the drainage elements, and the capacity of these elements to contain the calculated flow; in line with GN704 requirements. Owing to the expected response time for the proposed mine area, a one hour (i.e. sixty minute) storm duration was utilised in the modelling to determine the infrastructure sizing.

The MAP applied in the modelling was 586mm, based on the Dirkiesdorp rain gauge (0407730W) (**Table 2**). The catchment characteristics applied in the modelling are outlined in **Table 5**. The flow routing is represented in **Appendix C**. The model outputs are summarised in **Appendix D**.

5.1 Channel and Pipe Sizings

The channel design requirements to transfer the fifty year recurrence storm event runoff are outlined in **Table 6**. This includes the proposed channel material, slope, widths and depths. The constructed channel capacity should be at least the peak flow expected for the 50 year storm.

The proposed pipe lengths, diameters, slopes and material are outlined in **Table 7**. Pipe P9, passing beneath the roadway, can be substituted by a culvert of equivalent capacity.

5.2 Pollution Control Dam Sizings

Since the design and construction details of the Co-Disposal facility are unknown at this stage, the following key assumptions have been made regarding the sizings of the associated PCDs:

- The sizing of the PCD associated with the plant area and stockpiles assumes that the site is completely impervious with no stockpiles in place. This represents a worst case scenario;
- The side walls will be fully constructed use waste rock prior to its commissioning;
- The slopes of the side walls will mirror the angle of repose (i.e. ~30 degrees);
- The material comprising the walls will be compacted during placement;
- The extent of the Co-Disposal Facility and associated walls is represented in the conceptual Stormwater Management Plan (**Appendix B**); and,
- The freeboard associated with the Co-Disposal facility will be adequate to contain at least the 50 year storm event (i.e. no breaching).

The catchment parameters utilised in the SCS model are presented in **Table 8**. The PCDs, sized based the one day design rainfall for the 50 year storm event, are summarised in **Table 9**.

The volume of seepage reporting to PCD R2 and R3 from the Co-Disposal Facility is unknown since design details such as liner and wall material, and the volume and water content of the slurry are unknown. Therefore, the seepage volumes reporting to the PCDs have not been factored into the final PCD volumes reflected in **Table 9**.

This sizing is based on the assumption that the PCDs will be appropriately managed to ensure that this capacity is available at the time of the storm to allow for containment of the 50 year stormflow volume. To manage the volume of water within the PCDs, the option exists to pump water between dams. The dirty water may be used as process water (dependant on required water quality) or as dust suppression within the dirty catchments. Furthermore, the dirty water could be transferred to the Co-Disposal facility depending on the level of freeboard. These options needs to be further considered in the water management strategy developed for the mine.

5.3 Sediment Trap

To maintain capacity, sediment traps are proposed at the inlet of the PCDs to prevent sedimentation of the facilities. The required sediment trap sizings are outlined in **Table 10**. The 10 year storm was used to size the sediment trap as this is a better representation of the expected flow velocities during normal operation. The design of the sediment trap is presented in **Appendix E**.

The design of the sediment trap incorporates "duty and standby" channels. For rainfall events not exceeding the 10 year storm event, flow will be diverted to one side of the trap, leaving the other dry. Once sediments have accumulated within a channel in the sediment trap, this portion of the trap can be isolated to allow water to be drained, and the remaining silt and debris to be removed while the other channel is operational. The isolation of each channel within the sediment trap is achieved using penstocks across the width of the sediment trap channel. These penstocks would not reach the full height of the sediment trap, so in the storm event exceeding the 10 year storm event, both channels would be flooded, thereby allowing a capacity approaching the 50 year storm event design. This will reduce the risk of overtopping of the structure and associated local flooding.

It is expected that sediment will accumulate within the drainage pipe associated with the sediment trap; therefore, access is provided to remove accumulated sediments through mechanical means (i.e. rodding or high pressure water jets).

Table 5 Catchment characteristics utilised in the stormwater management numerical modelling

	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13	K14	K15	K16	K17
Area (ha)	2.64	7.03	6.36	2.96	0.56	1.33	2.10	7.58	7.36	2.05	1.08	2.01	6.03	3.73	3.29	1.66	2.07
Catchment Length (m)	201	488	430	75	36	37	250	211	487	383	57	304	173	35	35	35	35
Average Slope (m/m)	0.130	0.094	0.093	0.080	0.110	0.054	0.088	0.095	0.037	0.071	0.053	0.013	0.104	0.550	0.550	0.550	0.550
Impervious (%)	5	2	5	2	2	2	10	4	5	4	2	100	100	5	5	5	5
Pervious Surface	Short veld grass	Short veld grass	Short veld grass	Short veld grass	Short veld grass	Short veld grass	Short veld grass	Short veld grass	Short veld grass	Short veld grass	Short veld grass	Short veld grass	Short veld grass	Gravel	Gravel	Gravel	Gravel
Impervious Surface	Rock	Rock	Rock	Rock	Rock	Rock	Rock	Asphalt	Asphalt	Rock	Rock	Concrete	Concrete	Rock	Rock	Rock	Rock
Surface Material	Soil					Sand						Sand/Gravel					

Table 6 Characteristics and required capacity of the channels used in the stormwater management plan

	C1	C2	C3	C4.1	C4.2	C5	C6.1	C6.2	C7	C8	C9	C10	C11.1	C11.2	C12	C13	C14	C15	C16.1	C16.2	C17.1	C17.2
Channel Length (m)	413	304	300	649	192	330	703	25	117	835	472	397	580	33	136	336	1102	878	384	50	487	40
Base Width (m)	0.55	0.60	0.45	0.40	0.80	0.85	0.40	0.75	0.40	0.80	0.45	0.90	0.50	0.90	0.60	0.80	0.50	0.50	0.45	0.60	0.40	0.60
Wall Slope	90^{o}	90^{o}	45^{o}	45^{o}	90^{o}	90^{o}	90^{o}	90^{o}	90^{o}	90^{o}	45^{o}	90^{o}	90^{o}	90^{o}	90^{o}	90^{o}	45^{o}	45^{o}	45^{o}	45^{o}	45^{o}	45^{o}
Material	Earth														Sulphate resistant concrete							
50 Year Storm Maximum Flow Depth (m)	0.50	0.56	0.43	0.40	0.89	1.02	0.49	0.89	0.36	0.70	0.38	0.93	0.37	1.14	0.52	0.84	0.68	0.66	0.51	0.71	0.52	0.77
50 Year Storm Velocity (m/s)	2.96	5.87	2.16	2.71	4.45	4.94	3.50	7.13	3.72	4.76	2.08	4.54	2.60	4.07	2.75	7.10	6.75	6.06	3.49	2.70	4.40	2.76
50 Year Storm Peak Flow (m^3/s)	0.79	1.98	1.19	1.17	3.15	4.28	0.57	4.77	0.54	2.59	0.97	3.78	0.43	4.16	0.85	4.69	2.99	2.62	1.43	3.89	1.79	4.41
Capacity (m^3/s)	0.80	1.98	1.20	1.16	3.15	4.30	0.55	4.78	0.54	2.58	0.97	3.80	0.41	4.16	0.86	4.75	5.62	4.97	2.50	3.94	3.11	4.57

Table 7 Characteristics and required capacity of the pipes used in the stormwater management plan

	P9	P13
Length (m)	44	46
Slope (m/m)	0.045	0.044
Material	Concrete	
Designed Diameter (m)	0.53	1.05
Peak Flow (m^3/s) (50 YRP)	0.97	4.69
Velocity (m/s) (50 YRP)	5.20	7.79

Table 8 Pollution control dam sizings

	R1	R2	R3
Contributing Catchment Area (km^2)	0.0805	0.0495	0.0579
Hydraulic Length (m)	385	38	38
Average Slope (%)	1	55	55
Coefficient of Initial Abstraction	0.1	0.1	0.1
SCS Initial Curve No.	98	72	72
SCS Soil Group	D	A	A
Soil	Shallow Clay	Deep Sand	Deep Sand
Vegetation Cover Class	Sparse	Sparse	Sparse
Design Rainfall Station	Wakkerstroom (4072618A)		
Design Rainfall Station MAP (mm)	674	674	674
Catchment Lag Time (hr)	0.49	0.13	0.13
Design Daily Rainfall Depth (mm)	130	130	130

Table 10 Sizings of Pollution Control Dams

	R1	R2	R3
50 Year 1 Day Design Stormflow Volume (m^3)	10,500	3,700	4,300

Table 10 Sediment trap sizings

	R1	R2	R3
1:10 Year Inflow (m^3/s)	2.6	2.3	2.6
Width (m)	10.0	10.0	10.0
Depth (m)	2.0	2.0	2.0
Length (m)	19.5	17.5	20.0
Channel Velocity (m/s)	0.13	0.11	0.13
Retention at Peak Flow (seconds)	65	58	67

6 Recommendations

Based on observations made during the development of the SWMP, the following recommendations can be made. These incorporate measures outlined in the DWA Best Practice Guidelines as well as on-site observations.

- To prevent cross-contamination, it must be ensured that there is no handling and disposal of any coal and other substances (hydrocarbons, chemicals etc.) that may give rise to pollution within designated clean areas. If necessary, this material must be placed in waste skips and formalised bunded areas.
- The PCD R1 has the potential to lie within 100m of a wetland, whilst R3 has the potential to lie within 100m of the watercourse. Should this be the case, appropriate authorisation will need to be sought, or the location of the PCDs altered.
- According to the GN704 requirements, all PCDs should be constructed to allow for 800mm freeboard above the full supply level.
- Since groundwater impacts are expected, the PCDs should be lined to limit impacts to the important regional groundwater and surface water resources, as per the best practice guidelines for pollution control dams (BPG - A4). In addition, the Co-Disposal facility should be constructed on an impermeable liner, designed to take into account the expected water quality of the seepage.
- The pipes, channels, sediment traps, and pollution control dams need to be constructed to facilitate routine maintenance (i.e. simple, effectual housekeeping). Concrete channels and pipes used to transfer runoff with a high sulphate content need to be constructed using sulphate resistant concrete.
- All pipes and channels must be checked after any major rainfall events to ensure that there are no blockages and that the water flow will not be restricted in any way.
- Sediment that accumulates within pipes, channels and retention facilities (i.e. sediment traps and PCDs) needs to be removed directly after storm events to ensure the design capacity is maintained. Should sediments be expected to contain contamination, this sediment must be appropriately handled and disposal should be undertaken to an appropriate waste disposal facility.
- Erosion protection will be required at the outlet of the clean water channels to the environment. Erosion protection can take the form of gabions or geotextiles.

7 References

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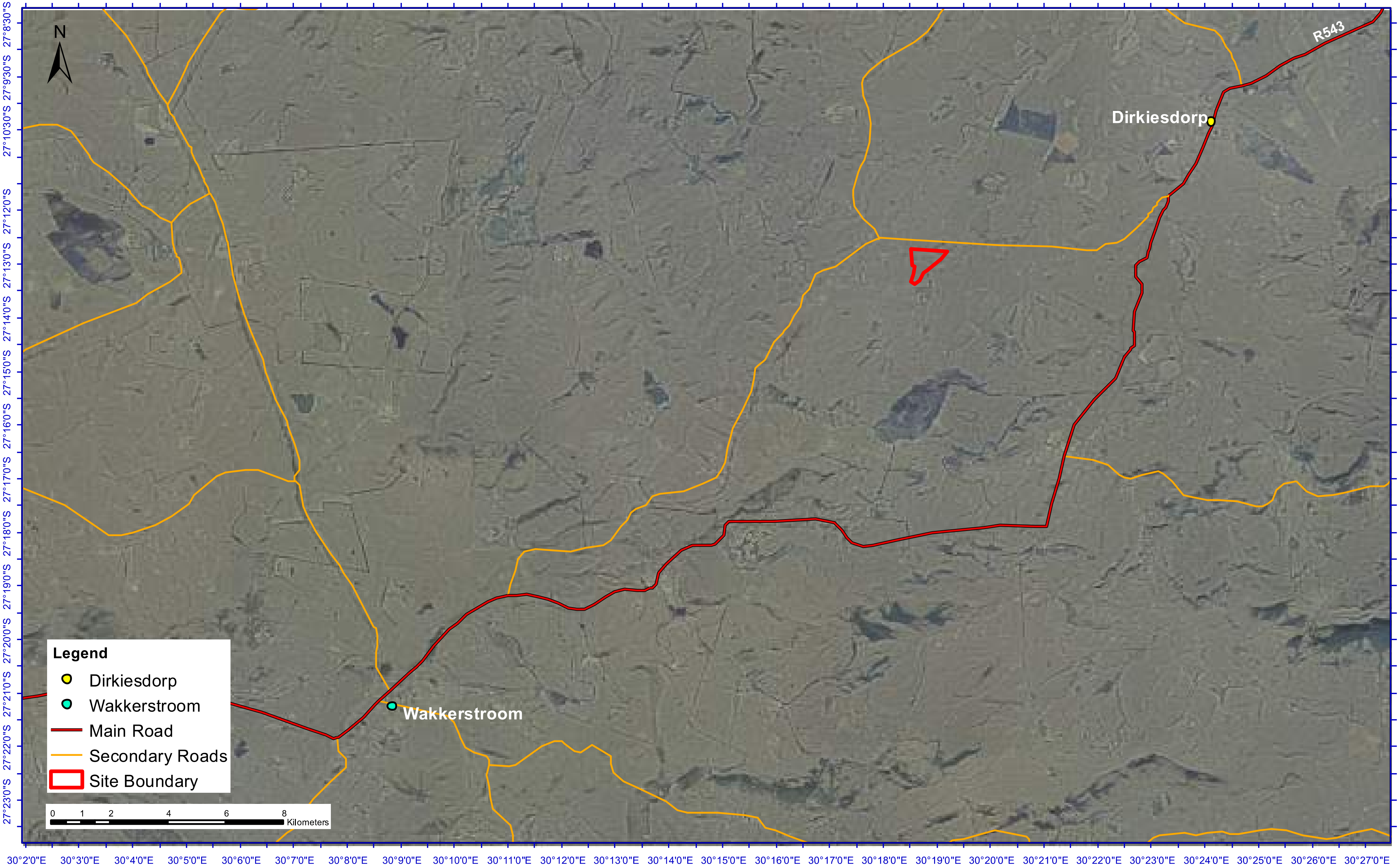
Figures



Atha-Africa Ventures (Pty) Ltd.

Location Map

Data Source:
South African Department of
Rural Development and Land Reform -
Chief Directorate: National Geo-spatial Information

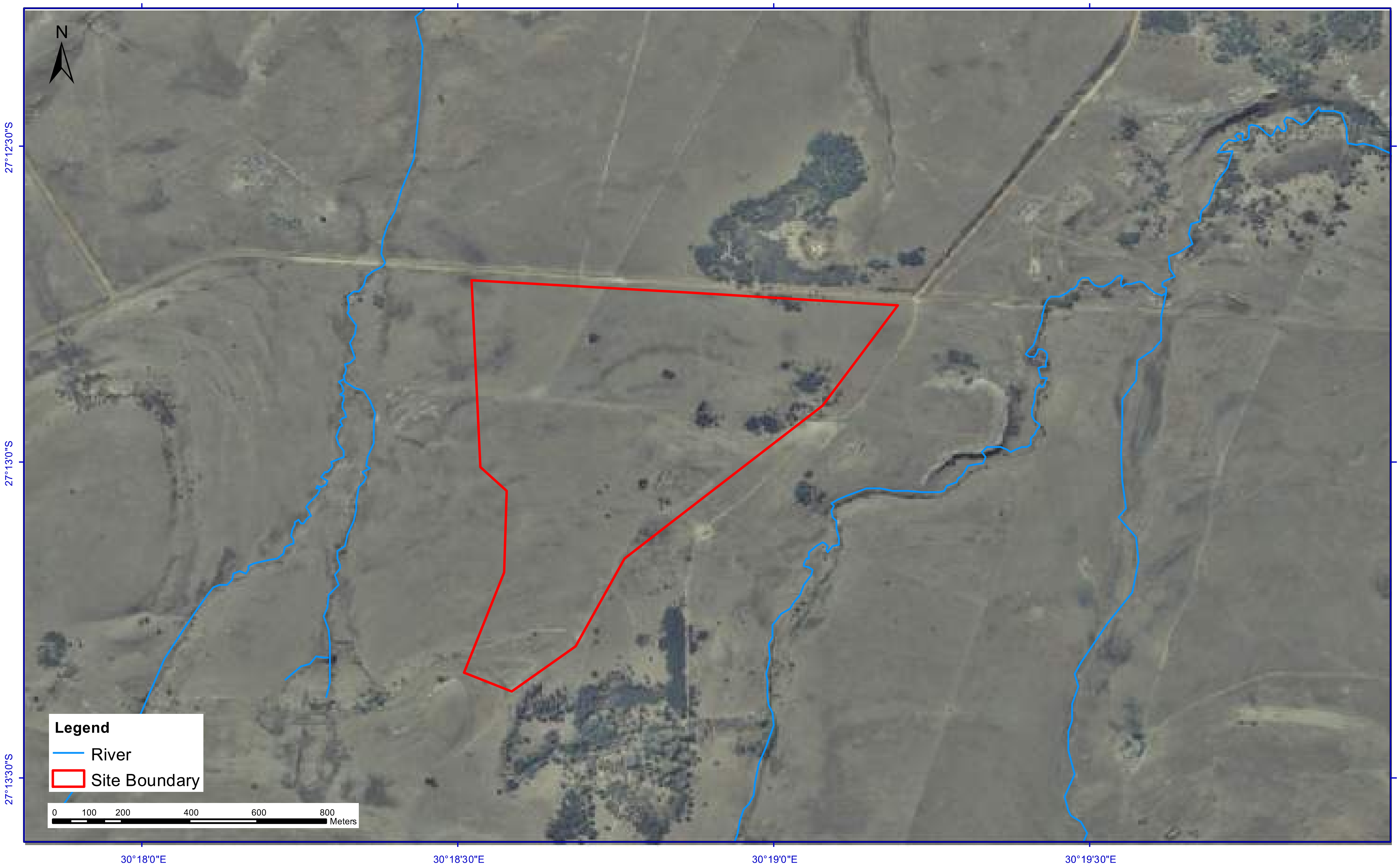
Projection Geographic - WGS1984

Project:	Project Name
Project No:	24514-04
Drawn by:	A. Mthalane
Reviewed by:	A. Gemmell

Date:
30 July 2013

Figure No.
1

www.wspenvironmental.co.za

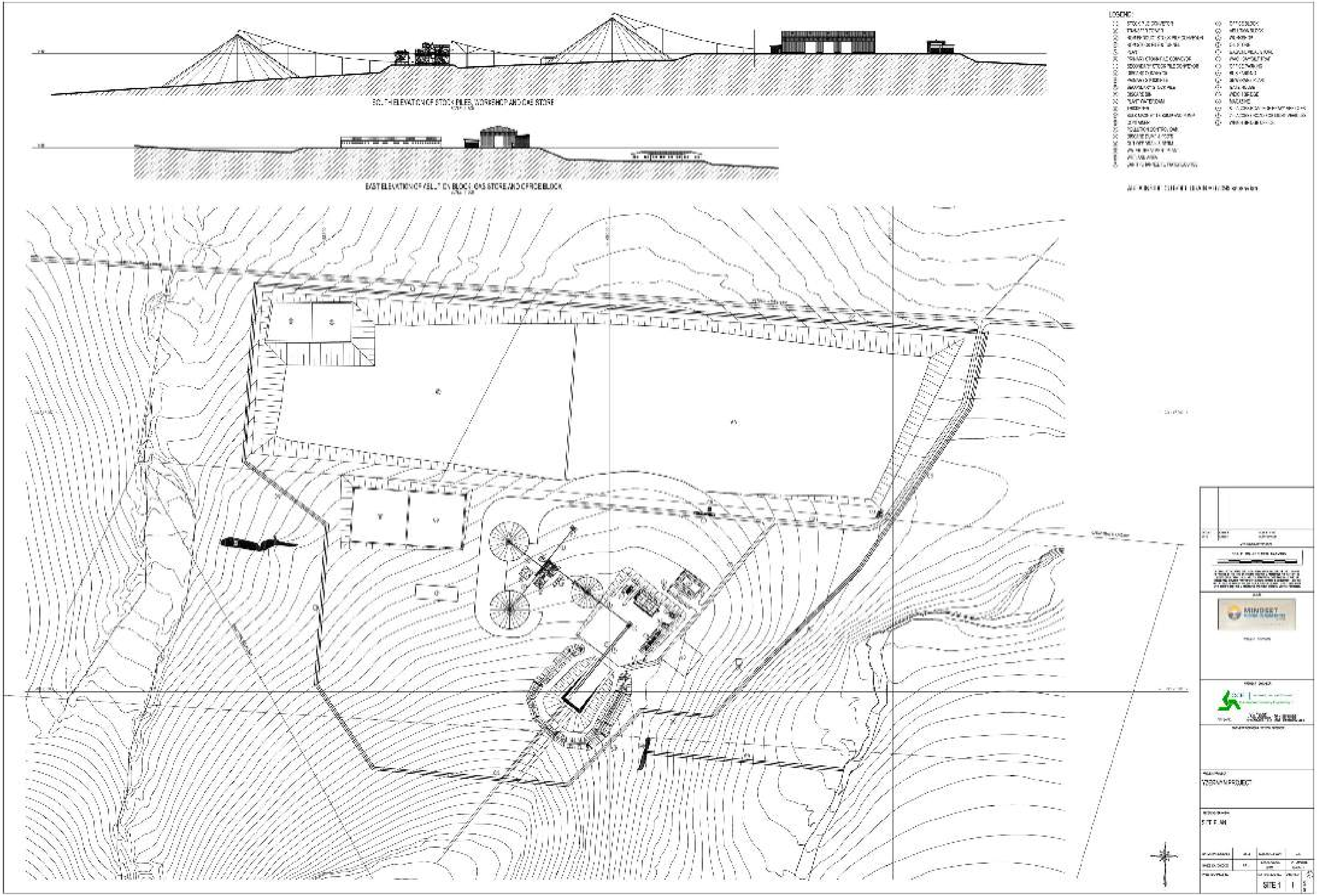


Atha-Africa Ventures (Pty) Ltd

Site Boundary Map

Data Source: South African Department of Rural Development and Land Reform - Chief Directorate: National Geo-spatial Information	**Project:** Project Name	**Date:** 30 July 2013	WSP
	Project No: 24514-04	**Figure No.** 2	www.wspenvironmental.co.za
	Drawn by: A. Mthalane		
Projection Geographic - WGS1984	**Reviewed by:** A. Gemmell		

Appendix A - Mine Development Plan



LEGEND:
SITE PLAN
SITE 1

Appendix B - Conceptual Storm Water Management Plan


C6.2
C6.1
K6
C17.2
C17.1
K17
K16
C16.1
K11
C11.1
C11.2
C16.2
R3
Sedi. Trap
Sedi. Trap
R2
K5
C5
C14
C10
K10
C15
K14
K15
C4.1
K4
C4.2
R1
Sedi. Trap
P13
C13
C9
P9
K9
C3
K13
K12
K3
C2
K2
C8
K8
C1
C7
K1
K7
Clean Channel
Dirty Channel
Dirty Water Pipe
Clean Water Pipe
Berm
Surface Flow Direction
Areas That Do Not Contribute Directly To Surface Flow (Excluding Seepage From Discard Dump)

Appendix C - Flow Routing

Project number: 24514
Dated: 2013/08/02
Revised:

H3 Simulation Connectivity

Infiltration Model: Areal Reduction: None Mean Annual Precipitation: 0 (mm) Project: YzermynSWMF26'07 2013/07/31

Rainfall Type: Chicago IDF Type: User Time To Peak Ratio: 0.00 Region: Coastal Stormwater Management Plan

Routes in Network	Sequence	Node ID	Drain To	Overflow	Weighted Flows
Route Sequence No:	**1**				
	1	K1	C1	<NONE>	0
	2	C1	C2	<NONE>	1
Route Sequence No:	**2**				
	1	K10	C10	<NONE>	0
Route Sequence No:	**3**				
	1	K11	C11.1	<NONE>	0
	2	C11.1	C11.2	<NONE>	1
Route Sequence No:	**4**				
	1	K12	C12	<NONE>	0
	2	C12	C13	<NONE>	1
Route Sequence No:	**5**				
	1	K13	C13	<NONE>	0
	2	C13	P13	<NONE>	3
	3	P13	R1	<NONE>	4
	4	R1	<NONE>	<NONE>	5
Route Sequence No:	**6**				
	1	K14	C14	<NONE>	0
	2	C14	C17.2	<NONE>	1
Route Sequence No:	**7**				
	1	K15	C15	<NONE>	0
	2	C15	C16.2	<NONE>	1
Route Sequence No:	**8**				
	1	K16	C16.1	<NONE>	0
	2	C16.1	C16.2	<NONE>	1
	3	C16.2	R2	<NONE>	4
	4	R2	<NONE>	<NONE>	5
Route Sequence No:	**9**				
	1	K17	C17.1	<NONE>	0
	2	C17.1	C17.2	<NONE>	1
	3	C17.2	R3	<NONE>	4
	4	R3	<NONE>	<NONE>	6
Route Sequence No:	**10**				
	1	K2	C2	<NONE>	0
	2	C2	C4.2	<NONE>	3
Route Sequence No:	**11**				
	1	K3	C3	<NONE>	0
	2	C3	C4.2	<NONE>	1
	3	C4.2	C5	<NONE>	6
Route Sequence No:	**12**				

Registered to 2684403707

H3 Simulation Connectivity

Infiltration Model: Areal Reduction: None Mean Annual Precipitation: 0 (mm) Project: YzermynSWMP26'07 2013/07/31

Rainfall Type: Chicago IDF Type: User Time To Peak Ratio: 0.00 Region: Coastal Stormwater Management Plan

Routes in Network	Sequence	Node ID	Drain To	Overflow	Weighted Flows
	1	K4	C4.1	<NONE>	0
	2	C4.1	C5	<NONE>	1
Route Sequence No:	**13**				
	1	K5	C5	<NONE>	0
	2	C5	C6.2	<NONE>	9
Route Sequence No:	**14**				
	1	K6	C6.1	<NONE>	0
	2	C6.1	C6.2	<NONE>	1
	3	C6.2	<END>	<NONE>	25
Route Sequence No:	**15**				
	1	K7	C7	<NONE>	0
	2	C7	C8	<NONE>	1
Route Sequence No:	**16**				
	1	K8	C8	<NONE>	0
	2	C8	C10	<NONE>	3
Route Sequence No:	**17**				
	1	K9	C9	<NONE>	0
	2	C9	P9	<NONE>	1
	3	P9	C10	<NONE>	2
	4	C10	C11.2	<NONE>	8
	5	C11.2	<END>	<NONE>	23

Registered to 2634403707

Appendix D - Model Outputs

Model: Professional HQ3.005

H3 Simulation Maxima

Report Date: 2013/07/31

Rainfall Type: Triangular Areal Red: Not Spec. M.A.P 556 (mm) | Project No/Name Yzermyn SWMP2640

I.D.F Type: HRU/78 Time To Peak 0.35 Total Area(ha): 59.849 | Stormwater Management Plan

Multiple RI used for Analysis - The Simulation Maxima can ONLY be used to Identify Problem Areas

Output Summary for year recurrence Interval 1: 50

Node ID	Inlet Peak(m3)	Store(m3)	Velocity (m/s)	Haz Rate Factor	MaxDepth(m)	Ex Q(m/s)	Resize	Resize Cap	St Dur
Element Type: Catchments									
K1	0.80			Low					24
K10	0.29			Low					35
K11	0.45			Low					23
K12	0.86			Low					23
K13	4.28			Low					14
K14	5.61			Low					5
K15	4.96			Low					5
K16	2.50			Low					5
K17	3.11			Low					5
K2	1.21			Low					35
K3	1.20			Low					35
K4	1.21			Low					23
K5	0.32			Low					14
K6	0.61			Low					15
K7	0.54			Low					32
K8	2.08			Low					31
K9	0.97			Low					35
Element Type: Channels									
C1	0.00		2.96	134 High	0.4985		0.499	0.796	24
C10	0.00		4.54	414 High	0.9016		0.902	3.800	31
C11.1	0.00		2.60	99 High	0.3718		0.372	0.406	23
C11.2	0.00		4.07	497 High	1.1067		1.107	4.159	31
C12	0.00		2.75	130 High	0.5186		0.519	0.857	23
C13	0.00		7.10	535 High	0.8351		0.835	4.749	14
C14	0.00		6.75	357 High	0.6797		0.560	5.620	5
C15	0.00		6.06	320 High	0.6599		0.560	4.966	5
C16.1	0.00		3.49	191 High	0.5063		0.506	2.501	5
C16.2	0.00		2.70	221 High	0.7141		0.714	3.944	11
C17.1	0.00		4.40	253 High	0.5153		0.515	3.113	6
C17.2	0.00		2.76	219 High	0.7670		0.767	4.573	6

Model Professional HQ3.005

H3 Simulation Maxima

Report Date: 2013/07/31

Rainfall Type: Triangular   Areal Red: Not Spec   M.A.P: 586 (mm)   Project No/Name: YzermynSWMP26/0

I.D.F Type: HRU/78   Time To Peak 0.35   Total Area(ha): 59.349   Stormwater Management Plan

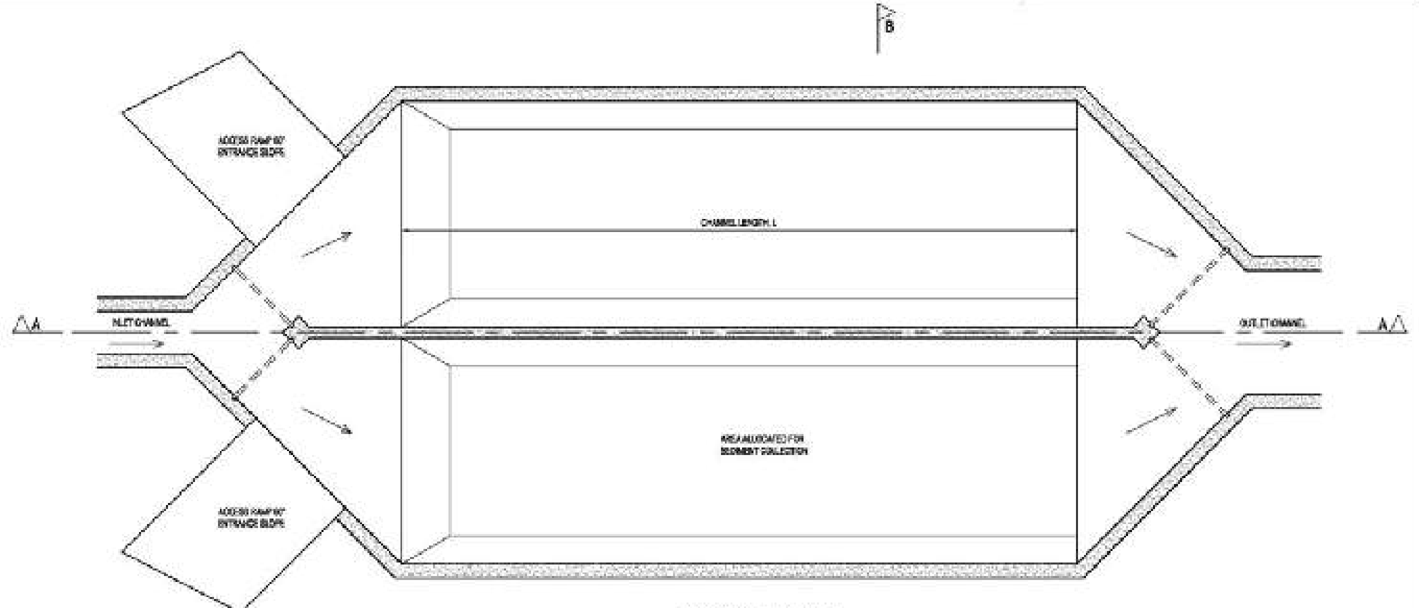
Multiple RI used for Analysis - The Simulation Maxima can ONLY be used to Identify Problem Areas

Node ID	Inlet Peak(m3)	Store(m3)	Velocity (m/s)	Haz Rate Factor		MaxDepth(m)	Ex Q(m/s)	Resize	Resize Cap	St Dur
C2	0.00		5.97	310	High	0.5625		0.563	1.953	31
C3	0.00		2.10	97	High	0.4263		0.426	1.198	35
C4.1	0.00		2.71	104	High	0.3973		0.397	1.156	23
C4.2	0.00		4.46	400	High	0.8930		0.893	3.148	35
C5	0.00		4.94	532	High	1.0233		1.023	4.296	31
C6.1	0.00		3.50	146	High	0.4693		0.469	0.550	15
C6.2	0.00		7.13	667	High	0.8930		0.893	4.778	31
C7	0.00		3.72	124	High	0.3602		0.360	0.536	32
C8	0.00		4.76	294	High	0.6992		0.699	2.578	31
C9	0.00		2.09	81	High	0.3840		0.384	0.970	35
Element Type: Pipes										
P13	0.00		7.79		Low			1.050	5.650	14
P9	0.00		6.20		Low			0.626	1.063	35
Element Type: Reservoirs										
R1	0.00	4617			Low					35
R2	0.00	2903			Low					35
R3	0.00	3480			Low					35

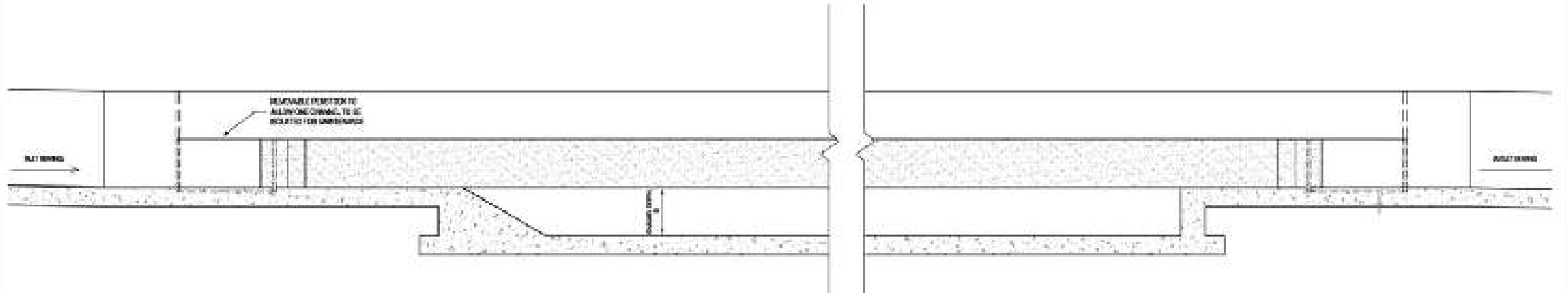
Page No: 2   2384403707

Appendix E - Sediment Trap Design

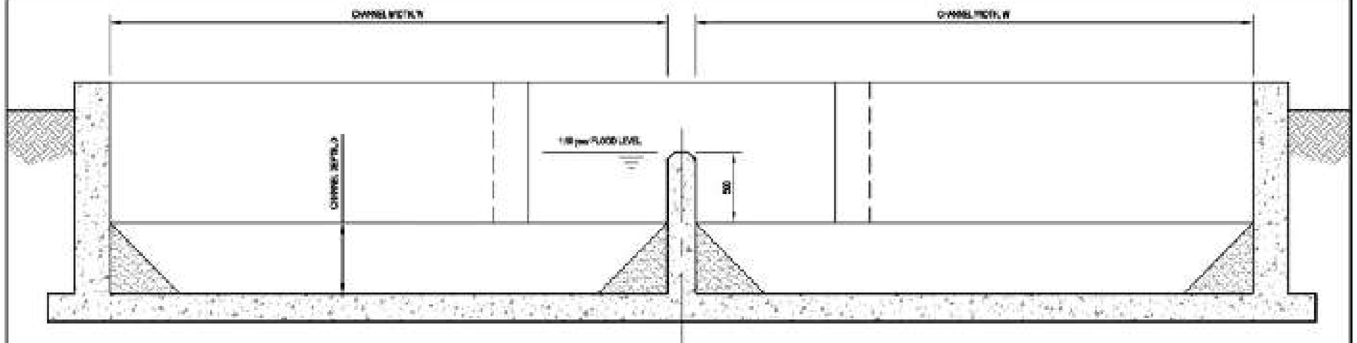
Project number: 24514
Dated: 2013/08/02
Revised:



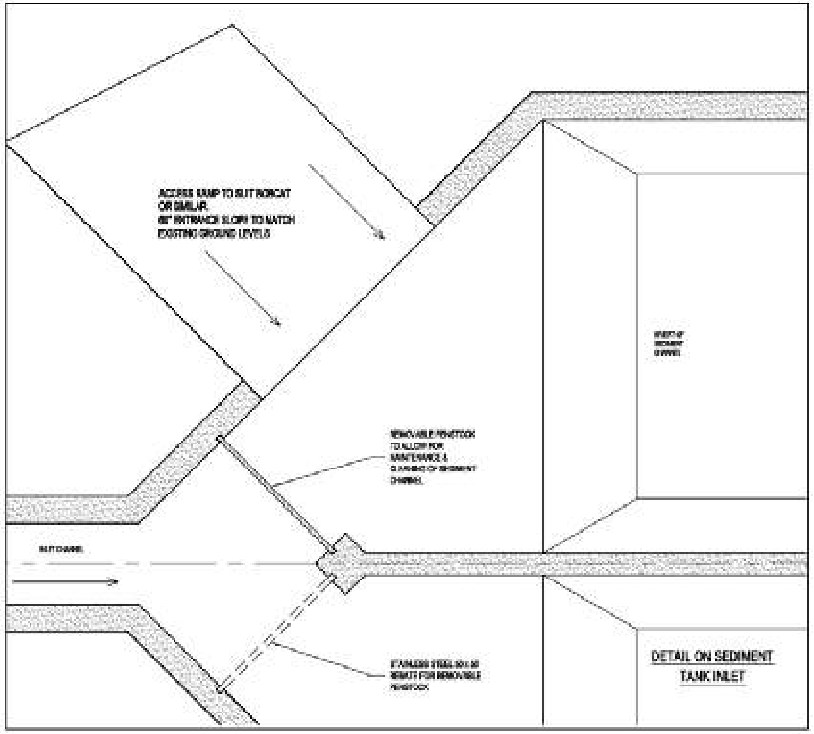
PLAN ON SEDIMENT TRAP

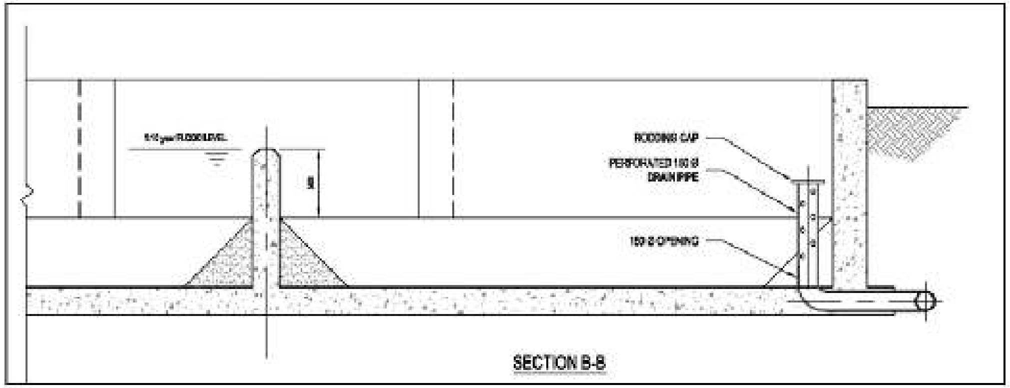


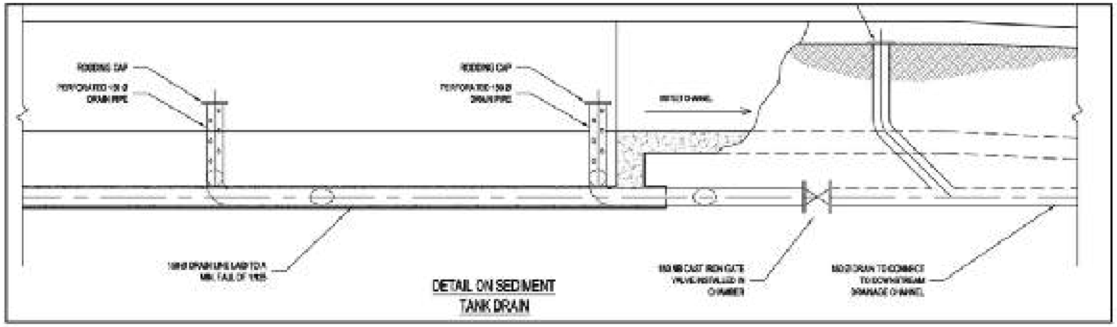
SECTION A-A

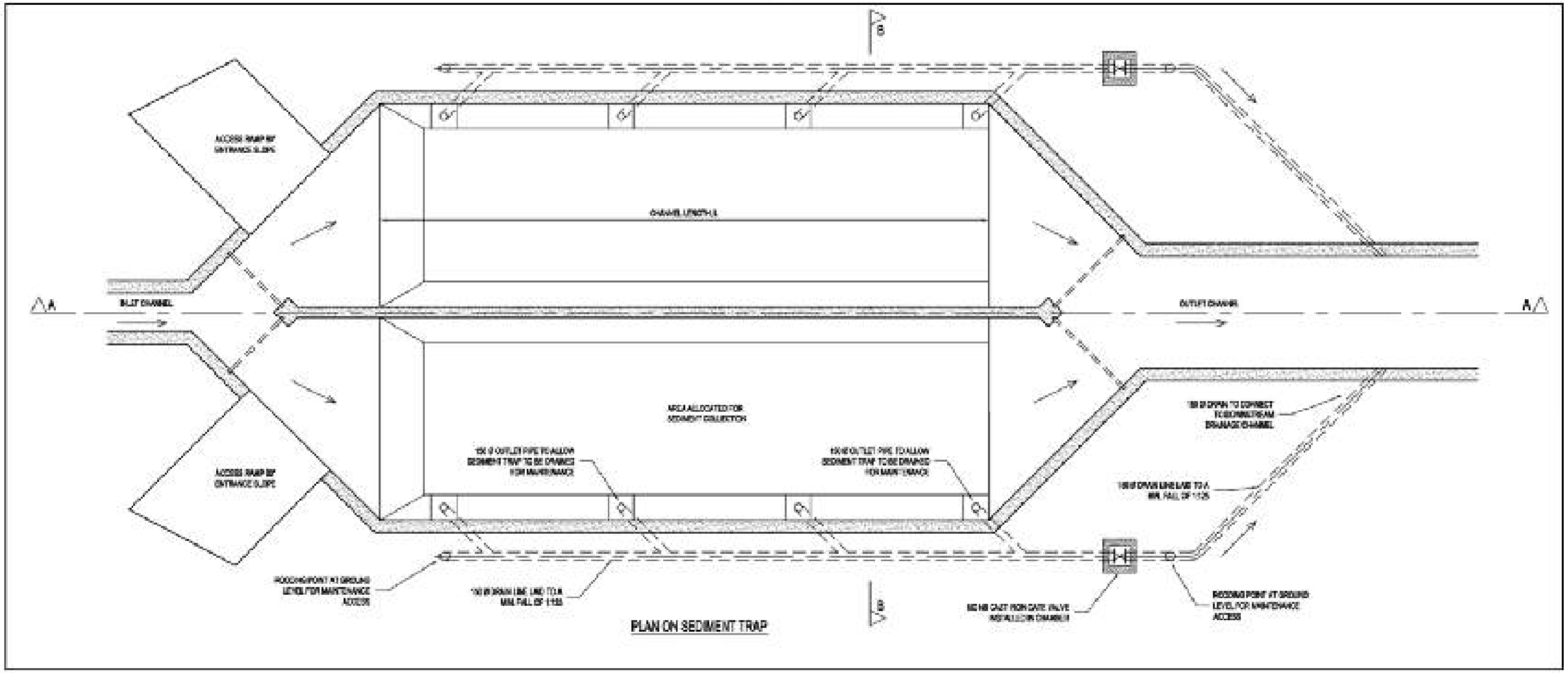


SECTION B-B


ACCESS RAMP TO SUIT BOBCAT OR SIMILAR.
60° ENTRANCE SLOPE TO MATCH EXISTING GROUND LEVELS
REMOVABLE PENSTOCK TO ALLOW FOR MAINTENANCE & CLEANING OF SEDIMENT CHANNEL
INLET CHANNEL
STAINLESS STEEL 50 X 50 REBATE FOR REMOVABLE PENSTOCK
DETAIL ON SEDIMENT TANK INLET


RODDING CAP
PERFORATED 150 Ø DRAIN PIPE
150 Ø OPENING
SECTION B-B


RODDING CAP
PERFORATED 150 Ø DRAIN PIPE
RODDING CAP
PERFORATED 150 Ø DRAIN PIPE
OUTLET CHANNEL
150 Ø DRAIN LINE LAID TO A MIN. FALL OF 1:125
150 NB CAST IRON GATE VALVE INSTALLED IN CHAMBER
150 Ø DRAIN TO CONNECT TO DOWNSTREAM DRAINAGE CHANNEL
DETAIL ON SEDIMENT TANK DRAIN


B
ACCESS RAMP 60° ENTRANCE SLOPE
CHANNEL LENGTH, L
A
INLET CHANNEL
OUTLET CHANNEL
A
AREA ALLOCATED FOR SEDIMENT COLLECTION
ACCESS RAMP 60° ENTRANCE SLOPE
150 Ø OUTLET PIPE TO ALLOW SEDIMENT TRAP TO BE DRAINED FOR MAINTENANCE
150 Ø OUTLET PIPE TO ALLOW SEDIMENT TRAP TO BE DRAINED FOR MAINTENANCE
150 Ø DRAIN TO CONNECT TO DOWNSTREAM DRAINAGE CHANNEL
150 Ø DRAIN LINE LAID TO A MIN. FALL OF 1:125
RODDING POINT AT GROUND LEVEL FOR MAINTENANCE ACCESS
150 Ø DRAIN LINE LAID TO A MIN. FALL OF 1:125
150 NB CAST IRON GATE VALVE INSTALLED IN CHAMBER
RODDING POINT AT GROUND LEVEL FOR MAINTENANCE ACCESS
B
PLAN ON SEDIMENT TRAP

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Groundwater Impact Assessment

Socio-economic Impact Assessment

YZERMYN UNDERGROUND COAL MINE

Specialist Study: Socio-economic

2013/08/19

Quality Management

Issue/revision	Issue 1	Revision 1	Revision 2	Revision 3
Remarks	Socio-Economic Draft			
Date	19 August 2013			
Prepared by	Danielle Michel			
Signature				
Checked by	Hilary Konigkramer			
Signature				
Authorised by	Kim Allan / Brent Holme			
Signature				
Project number	24514			
Report number				
File reference				

Yzermyn Underground Coal Mine

Specialist Study: Socio-economic

2013/08/19

Client

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Danielle Michel

Table of Contents

Abbreviations

ABET	Adult Basic Education and Training
ADI	Area of Direct Influence
AII	Area of Indirect Influence
CEO	Chief Executive Officer
CDW	Community Development Worker
EIA	Environmental Impact Assessment
GGP	Gross Geographic Product
HIV/AIDS	Human Immunodeficiency Virus Infection / Acquired Immunodeficiency Syndrome
HDSA	Historically Disadvantaged South Africans
IDP	Integrated Development Plan
IFC	International Finance Corporation
KZN	KwaZulu-Natal
NGO	Non-governmental organisation
RDP	Reconstruction and Development Programme
SIA	Social Impact Assessment
SoER	State of the Environment Report
SDF	Spatial Development Frameworks
TIA	Traffic Impact Assessment

Executive Summary

Atha Africa Ventures (Pty) Ltd (Atha) propose to develop an underground coal mine between the towns of Piet Retief and Volkrust in the Mpumalanga Province of South Africa, 21km north east of the town of Wakkerstroom and 13 km south west of Dirkiesdorp. The proposed Yzermyn Underground Coal Mine intends to use mechanical methods, together with labour, to extract thermal coal from two seams located within the target area. Although the proposed project is still in its planning phases, there are potentially 576 employment opportunities during the construction and operational phases, and the anticipated lifespan of the mine is calculated at present to be approximately 15 years.

The proposed project site is characterised as a privately owned, rural agricultural land use, with scattered rural homestead settlements and extensive livestock grazing. The Wakkerstroom area is recognised as an international birding site, and remains sparsely developed, catering predominantly for tourism. Other key features of the area include extensive rural settlements to the east (Dirkiesdorp and KwaNgema), the two large towns of Piet Retief (to the northeast) and Volksrust (to the southwest), and agricultural and commercial forestry.

The objective of the SIA was to provide detail of the socio-economic baseline conditions, within the proposed site and surrounding related areas, in order to assess the potential direct, indirect and cumulative impacts of the proposed Yzermyn Underground Coal Mine. The SIA study comprised three phases: a desktop assessment of the local and regional context; site visits, preliminary stakeholder engagement and investigation into the local context and potential socio-economic impacts of the project; and the impact assessment component, which was aimed at establishing the significance of the potential identified socio-economic impacts, and providing relevant social management and mitigation measures.

The SIA study revealed a variety of social issues raised by key stakeholders. These included: land owners; surrounding farmers; general/ local stakeholders; NGOs; local government departments, representatives from local municipalities, and ward councillors and ward committees. One of the key aspects was the high level of contention in terms of mining activities within the local area, with high biodiversity value areas and a conflict in terms of lack of economic development, and the largely tourism and agricultural-based local economy. The local and regional government drive for development and service provision often seems to contrast with the rural nature of the area and the key activities and sense of place.

The overall socio-economic impact of the proposed Yzermyn Underground Coal Mine is likely to be directly related to a number of factors including: the impact of the mine on natural resources (and local livelihoods); the degree to which local communities are involved, trained and employed by Atha within the mine operations; and the social upliftment that the mine provides to local communities (including schools, infrastructure and other amenities).

The low skills level within the local communities is indicative that the skills that are required by Atha for the mine are unlikely to be found within the local communities. It is therefore imperative that Atha actively engage in a process of skills development to ensure that local individuals (identified through the Department of Labour and other organisations) are eligible for employment opportunities. This will ensure that local communities benefit directly from the mine. Without these measures, this project is unlikely to be socio-economically sustainable within the vulnerable socio-economic landscape which currently exists within the proposed project area.

There are, therefore, a number of positive socio-economic impacts that could result from the proposed project, including the potential for employment of local communities and skills development opportunities, as well as development of social facilities and local development potential. There are however, also a number of negative impacts anticipated as a direct and indirect result of the proposed mine. These could include a change in sense of place, loss of environmental and economic assets, and social conflict.

The overall impact of the proposed mine, if mitigated correctly, could be positive for the local socio-economic environment. These management and mitigation measures will require dedicated resources from Atha to ensure they are effective. These measures also need to be implemented prior to the commencement of the construction phase, and carried out throughout the operational and closure phases of the mine to minimise negative socio-economic impacts, and maximise positive impacts.

1 Introduction

Atha Africa Ventures (Pty) Ltd (Atha) propose to develop an underground coal mine close to the town of Wakkerstroom in the Mpumalanga Province of South Africa. The proposed project is known as the Yzermyn Underground Coal Mine. Atha obtained the prospecting right to an area of 8,360 hectares and has completed detailed exploration drilling. Following detailed exploration, a feasible target area has been identified which comprises approximately 2,500 hectares.

1.1.1 Project Overview

The proposed Yzermyn Underground Coal Mine intends to use mechanical methods, together with labour, to extract thermal coal from two seams located within the target area. Although the proposed project is still in its planning phases, there are potentially 576 employment opportunities during the construction and operational phases, and the anticipated lifespan of the mine is calculated at present to be approximately 15 years. The prospecting area falls, approximately halfway between the towns of Volksrust and Piet Retief within the Province of Mpumalanga. The target area is located within the Pixley Ka Seme Local Municipality; however the site is proposed to be accessed through the nearby town of Dirkiesdorp, which is located within the Mkhondo Local Municipality. For this reason, the Environmental Impact Assessment (EIA), and the Social Impact Assessment (SIA) must take both local municipalities into consideration.

1.1.2 Target Area Overview

The proposed project site is characterised as a privately owned, rural agricultural land use, with scattered rural homestead settlements and extensive livestock grazing. The Wakkerstroom area (located 21 km southwest of the site) is recognised as an international birding site, and remains sparsely developed, catering predominantly for tourism. Other key features of the area include extensive rural settlements to the east (Dirkiesdorp and KwaNgema), the two large towns of Piet Retief (to the northeast) and Volksrust (to the southwest), and agricultural and commercial forestry. Further detail is provided in **Section 2** below.

2 Methodology

2.1 Aim and Objectives

The objective of the SIA was to provide detail of the socio-economic baseline conditions, within the proposed site and surrounding related areas, in order to assess the potential direct, indirect and cumulative impacts of the proposed Yzermyn Underground Coal Mine.

2.2 Approach

The SIA study comprised three phases in order to facilitate the environmental authorisation requirements and the SIA process. Firstly a prefeasibility phase, which comprised a desktop assessment of the local and regional context, and identified potential socio-economic impacts of the proposed project. Secondly, a scoping phase, which included site visits, preliminary stakeholder engagement and investigation into the local context and potential socio-economic impacts of the project.

The third and final phase was the impact assessment component, which was aimed at establishing the significance of the potential identified socio-economic impacts, and providing relevant social management and mitigation measures to minimise the significance of the potential impacts. The combination of these phases provided the necessary information for the SIA and the Environmental and Social Impact Assessment (ESIA).

2.3 Preliminary Assessment

The preliminary assessment, including the desktop analysis and site visit, captured the majority of the background information for the local context, including municipal expectations and local stakeholder opinions.

A variety of secondary data sources were identified and considered during the background information review, including:

- Gert Sibande District Municipality (2011) Final Integrated Development Plan, 2011/12 to 2013/14;
- Gert Sibande District Municipality Spatial Development Framework (April 2009);
- Pixley Ka Seme Local Municipality (2011) Integrated Development Plan 200 – 2012;
- Mkhondo Local Municipality (2011) Draft Integrated Development Plan: 2011-2016;
- Statistics South Africa (2011) Census 2011;
- Statistics South Africa (2007) Community Survey; and
- Mpumalanga Department of Economic Development, Environment, Conservation and Tourism (2003) Mpumalanga State of the Environment Report.

The objective of the site visit was to ground-truth background information and to engage with local stakeholders. Limited primary data was collected during the screening study and took the form of initial (informal) discussions with local stakeholders, including

- Dirkiesdorp ward councillor (Mkhondo Local Municipality);
- Nico DenOutsten – CEO Themba Trust;
- Community member – Dirkiesdorp;
- Mr Chris Smit - Local Historian, Wakkerstroom; and
- Mr John Birchmore - Wakkerstroom Shop Owner.

In addition to discussion with local stakeholders, interaction with other members of the WSP Project Team added value in terms of understanding the project concept and local context.

It should be noted that subsequent to the first two phases of the SIA, a draft mining plan, the Social and Labour Plan (SLP) and other pertinent information was made available. These documents, combined with the background knowledge gained in the first two phases provide a context of the assessment phase contained within this report.

2.4 Data Collection

Primary data collection was deemed necessary to contribute to the evaluation of the potential impacts of the proposed Yzermyn Underground Coal Mine. Primary data was collected through a process of interviews with key local stakeholders so as to determine the magnitude and extent of the socio-economic impact at a local level. The aim was to obtain data which will assist with the identification and description of the key socio-economic issues and impacts associated with the project.

WSP developed a range of questionnaires, which were implemented through an interview process with the representatives of local organisations, authorities, land occupiers and other key stakeholders. All interviews and discussions were documented and kept on record for assessment and identification of the key socio-economic issues. The following stakeholders were consulted with:

- Pixley ka Seme Local Municipality
  - Technical Services
  - Community Services
  - Integrated Development Plan (IDP) Manager
  - Ward Councillor and Ward Committee – Ward 10

- Mkhondo Local Municipality
  - Public Participation Executive
  - Community Development Worker (CDW)
  - Co-ordinator for the Ngema Trust
- Farm Tenants
- Themba Trust - Chairperson Owen Pols (Dirkiesdorp)
- Department of Labour (Piet Retief)

Representatives from the following homesteads were interviewed to determine the livelihoods and capture the key issues and concerns of this community (**Table 1)**:

Table 1. Farm tenants within target area

Farm	Family Name	
Vaalbank 24HT	Mazibuko	
Yzermyn 96 HT	Makhubu	
Zoetfontein 94HT	Makhambi Gule	
Kromhoek 93 HT	Mbatha Mhlambi Ndlangamandu	Malinga Twala

2.5 Data Analysis

The socio-economic issues were analysed from the information collected through the primary data collection and desktop phases. The issues were considered in two streams. The first of these was the potential negative issues associated with the solar project and associated infrastructure. The second would be to look at the potential positive issues associated with the development.

2.6 International Finance Corporation Performance Standards

The International Finance Corporation (IFC) developed a Sustainability Policy and set of Performance Standards on Social and Environmental Sustainability (in force from July 2006, latest version 1 January 2012) to provide a benchmark for best practice and as a safeguard for investment.

During the environmental screening exercise, the need for an ESIA was identified. The ESIA will conform to the IFC standards in the event that the developer, Atha wishes to pursue donor funding for the project.

There are eight IFC Performance Standards. Of particular relevance to the social aspects of the study are the following performance standards:

1. Social and environmental assessment and management system
2. Labour and working conditions
3. Pollution Prevention and abatement
4. Land acquisition and involuntary resettlement
5. Indigenous peoples

6. Cultural Heritage

The performance standards outline the applicability and scope of assessment or planning required.

2.7 Impact Assessment

Potential socio-economic impacts associated with the project have been evaluated using a recognised risk assessment methodology. This methodology has been developed to ensure all procedures for the investigation, assessment and communication of the potential consequences or impacts of activities on the environment as set out in National Environmental Management Act (107 of 1998) (NEMA), Section 24(4b) are met. In addition, the impact assessment methodology must ensure that all information requirements of the environmental impact assessment (EIA) Regulations of 2010, with specific reference to Sections 22(2)(i) and 31(2)(l) are provided and it is aligned with the IFC performance standards. In order to assess the significance as objectively as possible, the following method has been used:

▪ SENSITIVITY of the impact ▪ DURATION of the impact ▪ EXTENT of the impact	**Consequence**	**Significance**
▪ FREQUENCY of the ACTIVITY ▪ FREQUENCY of the OCCURRENCE (PROBABILITY) of the impact	**Likelihood**	

This system derives environmental significance on the basis of the consequence of the impact on the environment and the likelihood of the impact occurring, as described **Appendix A.**

2.8 Reporting and Recommendations

This SIA report provides a culmination of the above phases. The report includes an assessment of the key socio-economic impacts associated with the proposed project, as well as the “no-go” alternative. The report makes recommendations for mitigation measures to be considered in the design and operation of the project. These recommendations are in line with the IFC requirements for social consultation, risk avoidance and management measures.

2.9 Assumptions and Limitations

It is assumed that the potential impacts relating to other specialist studies (including biodiversity, traffic, soil, land capability and land use, and noise, air quality, visual, surface and ground water) will be addressed by the relevant specialist studies. It is assumed that these studies will assess the significance the potential impacts, and provide suitable management and mitigation measures that will consider the local communities in terms of the sustainable local development and will not impact on their quality of life, health or rights. These studies are referred to within the SIA report for this purpose.

Limited surveys and interviews were conducted, due to the extensive stakeholder engagement process associated with the ESIA process. The risk of over-consultation and stakeholder fatigue resulted in limitations to the extent of the SIA primary data collection process. The information and data collected, is considered sufficient for this level of assessment. Further detailed studies have been recommended where necessary.

3 Baseline Description

3.1 Provincial Overview

The Mpumalanga Province is geographically split into the Highveld and the Lowveld by the northern reaches of the Drakensberg Mountain range. Agriculture is one of the largest economic sectors in Mpumalanga, covering 68% of the land use in the province, and producing a variety of products, including sugar cane, sunflower seed, sorghum, vegetables, cotton and maize. The Highveld produces mainly legumes and summer cereals, while the Lowveld provides subtropical and citrus fruit and sugar (State of the Environment Report (SoER), 2005).

Manufacturing is the largest economic sector in Mpumalanga, contributing almost 25% of the Gross Geographic Product (GGP) (SoER, 2005). This sector comprises predominantly of Sasol's coal refining activities and chemical operations in the southern Highveld, however, chrome alloy and steel manufacturing also occurs in this area. The Lowveld is dominated by agricultural product manufacturing, including food and related industries, sugar mills, paper and pulp and other forestry related activities (SoER, 2005).

The mining sector is another important primary sector activity, providing over 20% of the GGP and 6% of the employment in the province. The main mining sector is coal, with large resources situated in the western and south-western regions, while gold, iron ore, chrome, alusite, magnitie and vanadium contribute significantly towards the mining sector (Stats SA, 2007).

The province is one of South Africa's major commercial forestry areas, producing 4.7% of the provincial GGP. The SoER (2005) indicates that forestry employs approximately 4% (36 000 people) of the economically active population of the province, and 200 000 people are indirectly reliant on the industry. Mpumalanga is also a significant contributor toward the production of electricity, due to its large coal deposits and subsequent location of coal-fired power stations in the province (SoER, 2005).

Tourism in Mpumalanga is a key economic activity for the province and South Africa, as Mpumalanga is an established tourism area due to the existence of tourism facilities, such as Kruger National Park, the Blyde River Canyon, Pilgrim's Rest and private game reserves, and is growing as an eco-tourism destination (Gert Sibande Integrated Development Plan (IDP), 2012).

3.2 District Overview

The Gert Sibande District Municipality is located in the southern part of the Mpumalanga Province. It is comprised of seven local municipalities: Albert Luthuli MP301; Msukaligwa MP302; Mkhondo MP303; Pixley ka Seme MP304; Lekwa MP305; Dipaleseng MP306; Govan Mbeki MP307.

The population is 1,043,194, comprised of 88.6% Black African, 9% White, and 1% each Indian/ Asian and Coloured (Stats SA, 2011). The proximity of the district to KwaZulu-Natal (KZN) and Swaziland has resulted in 60% of the population being isiZulu-speaking, and 12.9% Swazi-speaking.

The district is comprised mainly of Highveld grasslands, and drops into the Lowveld regions towards the south and east. The area has a strong mineral potential, as well as tourism and biodiversity attributes. The municipality plays host to a number of large economic activities, including mining, agriculture and tourism. The key economic sectors of the district are: Manufacturing (Sasol); Mining (coal, gold, quarry); Energy Generation and Supply; Agriculture (crops and livestock); and Services (**Table 2**) (Gert Sibande IDP, 2011).

Table 2. Sectoral Contribution of the Gert Sibande District Municipality of Regional Economy (Gert Sibande IDP, 2011)

Sectoral Contribution to the Regional Economy	2006	2007	2008	2009
Agriculture	3.9%	4.6%	3.6%	3.5%
Mining	22.7%	23.5%	30.0%	28.8%

Manufacturing	18.4%	17.7%	15.8%	14.6%
Electricity	5.0%	4.9%	4.4%	4.8%
Construction	2.2%	2.5%	2.6%	2.9%
Trade	10.9%	10.5%	10.4%	10.7%
Transport	8.6%	8.0%	7.2%	7.6%
Finance	12.8%	13.2%	12.0%	12.0%
Community services	15.4%	15.1%	14.0%	15.1%

3.3 Local Overview

3.3.1 Population

The proposed target area falls within the Pixley Ka Seme and Mkhondo Local Municipalities. According to Statistics South Africa (Stats SA) Census 2011, the municipalities collectively have 255,217 people living in an area of 4 868 km^2, (population density of 52/ m^2). This density is relatively low, and is likely to be the result of large areas of extensive farming activities in the area. The population structure is 'bottom heavy' – with the 75% of the population being under 35 years old (**Figure 1**). The gender profile of the local municipality indicates that there are a higher number of females than males - 52.3% and 47.7% respectively (Stats SA, 2011). This is likely to indicate an out-migration of males to major economic centres for employment, specifically Gauteng.

Figure 1. Population Profile for Pixley Ka Seme and Mkhondo Local Municipalities (Source: Stats SA, 2011)

3.3.2 Education

The education levels within the area are considered low (relative to highly urbanised municipalities), with 38.6% having some form of secondary education, 14.2% having completed grade 12 (or equivalent), and only 1.5% having tertiary education (Stats SA, 2011). This is likely to be indicative of the predominantly rural nature of the local municipalities.

3.3.3 Income and Employment

As with education levels, income levels are low, with 43.9% of the population having no income (including non-economically active), and 39.1% earning less than R1,600 per month (Stats SA, 2011). The unemployment levels are high, with 36% of the population within both municipalities being unemployed, and 46.5% of the potential labour force being unemployed within the relevant local wards (wards 1, 2, and 3 of Pixley ka Seme, and wards 5 and 10 of Mkhondo. As a result, it is likely that a significant percentage of the population rely on social grants for household income. **Figure 2** indicates the levels of income in 2011 within Pixley ka Seme and Mkhondo local municipalities.

Figure 2. Income Levels for the Municipalities within the Project Area (Source: Stats SA, 2011)

3.3.4 Occupation and Key Economic Activities

Occupation profiles within the area are mostly undefined, with 29% not being classified under the Census listings (Stats SA, 2007). This is likely due to the ad hoc nature of many of people's employment. The remainder of employment sectors are as provided in **Table 3.** (Note: 2007 Stats SA Community Survey data was used, as 2011 data was not available, as this was not included in the 2011 census).

Table 3. Occupation Sectors within the Local Municipalities (Stats SA, 2007)

Occupation	Number	% of Population
Legislators; senior officials and managers	497	1%
Professionals	42	0%
Technicians and associate professionals	60	0%
Clerks	222	0%
Service workers; shop and market sales workers	354	1%
Skilled agricultural and fishery workers	148	0%
Craft and related trades workers	359	1%
Plant and machine operators and assemblers	151	0%
Elementary occupations	496	1%
Occupations unspecified and not elsewhere classified	17724	29%

Occupation	Number	% of Population
Not applicable	39587	65%
Institutions	1668	3%

3.3.5 Housing and Services

The type of housing in the area varies, with one third being traditional dwellings (structures made of natural/ traditional materials), and 64.7 % being brick structures on separate stands (Stats SA, 2011). The service levels within the municipalities are relatively high, with 76.6% having access to piped water, either in their dwelling or near to their property (Stats SA, 2011).

According to Stats SA (2011), 73.2% of the households have access to electricity (for lighting, 45.1% for cooking and 35.4% for heating). Other sources of fuel include wood with approximately 50% of households using wood for cooking and heating) and coal (Stats SA, 2011). Refuse removal services are generally poor, as only 43.6% of households have their refuse removed by the local municipality, and 37% have their own refuse dump for disposal (Stats SA, 2011). Sanitation services are varied, as only 47.4% have access to flushing toilets, 34% have access to pit toilets, and 16% have no access to toilet facilities (Stats SA, 2011).

(a) Health

The number of healthcare facilities within both the Pixley ka Seme and Mkhondo local municipalities is low. The IDP's of both municipalities indicate low access to facilities, and a need to provide better facilities to their populations. **Table 4** indicates the type and number of health facilities available within the both local municipalities.

Table 4. Healthcare Facilities Available within Local Municipalities (Gert Sibande IDP, 2012)

Health Facilities	Pixley Ka Seme	Mkhondo
Private Hospital	None	None
Private Doctors	10	12
Primary Health Clinic	7	5
Mobile Clinics	2	1
Government Hospital	2	1
Dentist	2	3

Health related issues such as of Human immunodeficiency virus infection/ acquired immunodeficiency syndrome (HIV/ AIDS) are aggravated by poor living conditions. The Mkhondo Local Municipality (Mkhondo IDP, 2011) provides the following reasons for the high rate of HIV/ AIDS infection rates in the region (the Pixley Ka Seme IDP does not provide this detail):

- Cultural structure: the area is highly influenced by cultures where it is still common to find women being disempowered, making them unable to exercise their right to consent to sexual activity. Polygamy and superstitious beliefs are also common factors that contribute, albeit to a lesser extent, to the spread of HIV/ AIDS.
- Religious situation: although the majority of churches, which has a vast influence in the community, discourage pre-marital sex, it is a subject that is not general discussed.
- Social security: child support grants are often seen as a means to an income, which leads to unprotected sexual activity with the intention of becoming pregnant. Similarly, for an individual to qualify for a Reconstruction and Development Programme (RDP) (or low-cost) house, that individual has to have dependents, leading again to unprotected sexual activity with the intention of becoming pregnant.

Furthermore, some women and even children may become inclined to become sex-workers in order to secure some form of income.

3.4 Area of Influence

The proposed Yzermyn Underground Coal Mine will have an influence at two levels from a socio-economic perspective. The first level has a narrow focus and can be referred to as the Area of Direct Influence (ADI). This is related directly to the project site and the socio-economic context and issues related to this. The second level refers to the broader Area of Indirect Influence (AII), which can be up to a regional or national level. The areas of influence (both direct and indirect) are identified in accordance with the geographic and social environment in which the project is proposed to be undertaken, and on which it will potentially impact.

- **Area of Direct Influence** - The ADI has been defined as the area extending to a distance of approximately ***20 km*** from the boundary of the target area. This ADI has been selected as it encompasses the likely directly affected communities associated with the project and its location. This is based on the understanding of the local social networks and dynamics, and reflects the communities and receptors which are likely to be directly affected by the project.
- **Area of Indirect Influence** - The proposed mining project is likely to have a socio-economic impact beyond the ADI. Indirect socio-economic impacts have the potential to extend up to **60 km** from the site, to the areas of Piet Retief and Volksrust. There are a number of settlements within a 60 km radius of the site, which may be influenced by the proposed project. The settlements of Amersfoort and Driefontein fall within the 60 km radius, however it is unlikely that these communities will be affected by the mining activities. This is because they are geographical separated from the site (i.e. not connected by road or proximity, as are the other settlements), and so are therefore excluded from the study area. Potential impacts on these key communities illustrated in **Figure 3** have therefore not been assessed as part of this study.

In addition to the AII, there is the potential for further indirect socio-economic effects of the proposed project to impact on a regional (Mpumalanga) and national scale. These have not been detailed within this study; however these have been taken into consideration on a broad level.

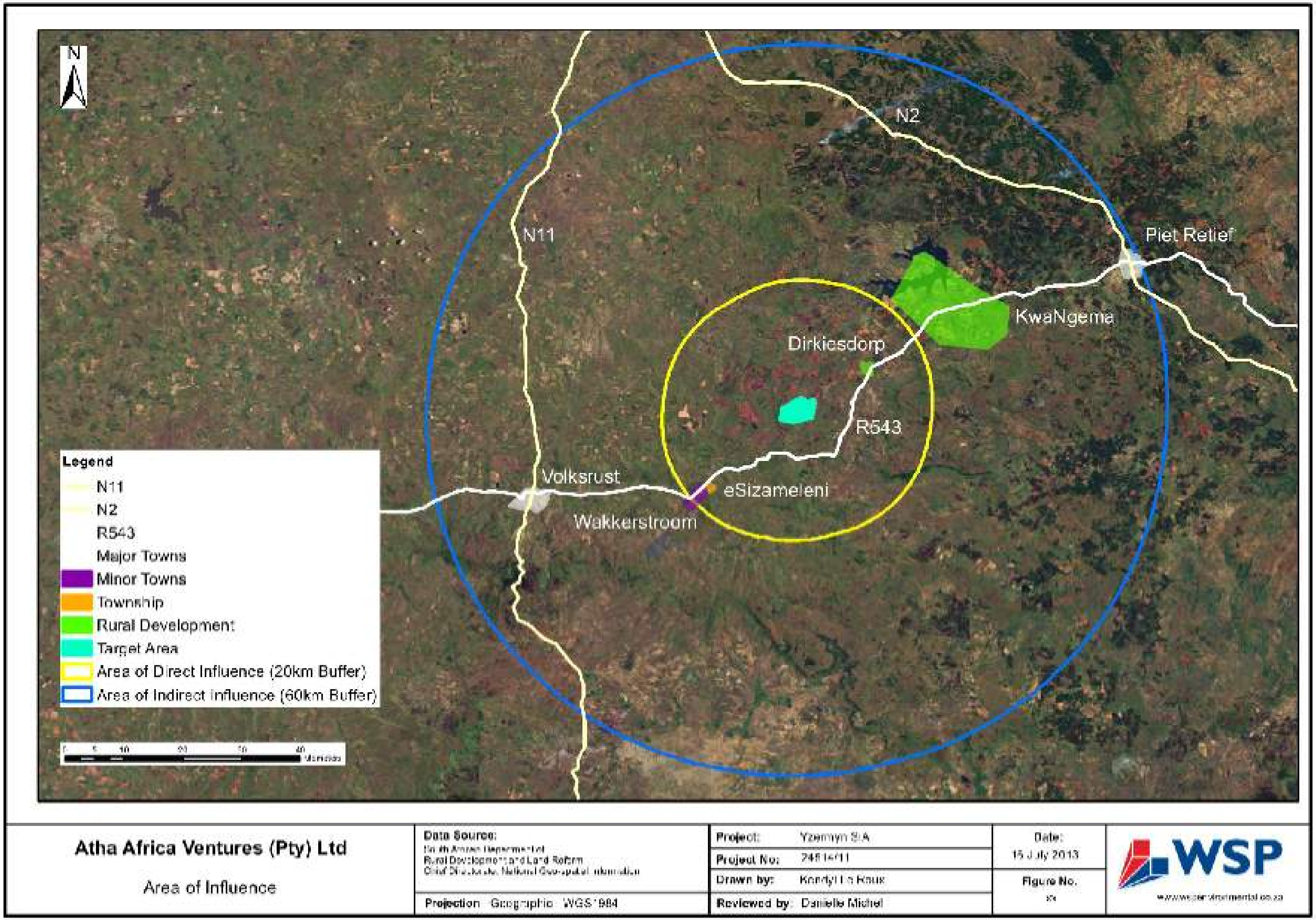

Figure 3. **Settlements Surrounding the proposed Yzermyn Underground Coal Mine Target Area considered as ADI and AII**

Table 5 provides an overview of the key communities (and associated proximities) related to the proposed project within the ADI and the AII.

Table 5. Overview of Settlements related to the Proposed Project

Town	Distance from site	Description	Population Description
Yzermyn Farm Community	0 - 2 km	Scattered traditional homestead settlement.	160[1]
Dirkiesdorp	15 km north-east	Small rural town, surrounded by scattered rural settlement.	11865[2]
KwaNgema	25 km north-east	Large scattered rural settlement, with Black African rural / traditional population.	
Wakkerstroom	17 km south-west	Rural service centre town. Caters mainly for tourism and farming community, middle to high income population.	6852[3]
eSizameleni		Township associated with Wakkerstroom	
Piet Retief	50 km north-east	First order major urban centre. Regionally, economically and logistically significant.	9166[2]
eThandakukhanya		Medium sized township associated with Piet Retief.	6957[2]
Volksrust	40 km south-west	Second order town. Regionally and logistically significant.	7867[3]
Vukuzakhe		Township associated with Volksrust	7554[3]

Source: [1] According to information gathered through surveys [2] Mkhondo IDP 2012/13; [3] Stat SA 2011 Census

The key nine communities listed in **Table 5** are significant to the socio-economic assessment. These are described in further detail below. Information has been sourced from site visits, surveys, interviews, observations and secondary sources (e.g. IDPs, Spatial Development Frameworks (SDF) and maps).

In addition to these communities, the following settlements are present within the AII:

- ***Groenvlei*** - 18 km south;
- ***Daggakraal*** – 20 km north west;
- ***Amersfoort*** – 45 km north west; and
- ***Driefontein*** - 25 km north east.

These are not considered key communities within this SIA, as they are unlikely to be affected by the proposed mine, and have not emerged as significant from a socio-economic impacts perspective through the SIA.

3.4.1 Farm Tenants (Yzermyn Farm Community)

The proposed mining site contains approximately eight scattered homesteads, occupied by Black African, low-income families. These settlements are typical of a traditional Zulu homestead, one main building/ structure, and several smaller rondavels or structures for other family members (**Figure 4**). Between eight and 30 people live within (or are supported by) a single homestead.

The structures are made in a “wattle and daub” manner, from wooden poles and clay sourced locally, and built by female members of the homestead. There are no municipal services to these remote locations, and all households rely on wood (sourced from the surrounding veld) for cooking and heating, river or springs for water, and have dug their own pit latrines for sanitation. They rely on local transport (taxis or hired vans) for transport to Dirkiesdorp or Wakkerstroom in order to buy supplies and to access healthcare facilities.

These households generally rely on limited income from a single member of the family working on the host farm (herdsmen or tractor drivers), as well as social grants (child and/or pension), and with some households receiving some income from members who work in cities (e.g. Piet Retief or Johannesburg). The average total income per household (based on the limited questionnaire) is R2 200 per month, ranging from R800 for 15 person household to R3 500 for a 30 person household. Each household is allowed up to 15 head of cattle by their host land owners (farmer), which are kept at the homestead in a kraal and grazed on the surrounding farm land.

This community is vulnerable from a livelihood perspective, as they do not have access to finances or other resources should their current income come to an end (i.e. farm work) or access to natural resources, such as water and grazing land, be prevented. There is a low level of education within these families, with a limited number of the children (aged around 7 to 16 years) currently traveling 15 km to Dirkiesdorp for schooling. It appears that few of the adults in this community have had formal education beyond primary schooling. The community expressed a need for a primary school closer to the homesteads, however perhaps improved school transport would assist this community to make sure of other schools in the area. In addition, better access to healthcare and basic services are required for this community.

In addition to these eight homesteads within (or immediately adjacent to) the target area, there are several homesteads scattered on the farms outside of the target area, specifically along access roads (although some of this land is government owned). These homesteads were not surveyed; however most appeared to be characterised as described above.

Figure 4. Examples of Farm Tenants

3.4.2 Dirkiesdorp

Dirkiesdorp is defined as a rural node by the Mkhondo Municipality IDP (2011). It is a sprawling formal rural centre, which converges along the R543, half way between the towns of Wakkerstroom and Piet Retief (**Figure 5**). WSP was informed that the town of Dirkiesdorp was established in the 1980s, when a local farmer opened a drug and alcohol abuse rehabilitation centre for Black African people living in the vicinity of his farm (*pers. comm.* Themba Trust, March 2012).

In 1985, the Themba Trust (a non-profit organisation opened in 1983 by a Lutheran missionary) opened an agricultural high school for boys, and in 1996 bought a piece of land nearby to start a separate boarding school for girls (*pers. comm.* Themba Trust, March 2012). The schools have subsequently consolidated to form a mixed-gender school, which is rented by, and teachers are paid for by, the Department of Education. The Trust has also set up a number of other social and educational facilities within Dirkiesdorp, including a crèche, and training and skills development centres. The Themba Trust also owns a number of plots of land and buildings in the town, which are rented out to local entrepreneurs for a tuck shop, bakery, second hand shop, computer classes and by the Department of Health as a clinic.

The residents near the centre of Dirkiesdorp have access to basic municipal and community services including water points within some houses or within properties, pre-paid electricity, and some water-borne sewerage. Social facilities include a police station, clinic, social centre for the elderly, and a secondary and high school. Further out from the centre of the town, houses access boreholes and rivers for water, make use of pit latrines, for sanitation and wood for heating and cooking. The town is considered safe by local residents (*pers. comm.* Dirkiesdorp resident, March 2012), with relatively little crime compared to more urban areas.

The extended Dirkiesdorp area is comprised predominantly of large family (traditional Zulu) homesteads, with some individual houses. The dwellings are constructed from a variety of materials, ranging from permanent brick structures to “wattle and daub” traditional mud structures.

The employment levels are very low in Dirkiesdorp (*pers. comm*. Themba Trust, March 2012). HIV and AIDS,, and related health impacts, are key health concerns in the community. According to the Themba Trust, the HIV infection rates are high. This is likely to be due to the low levels of education and employment in the community. Another social issue highlighted during the study was alcoholism, which was stated as a concern by one of the community members interviewed (*pers. comm.* Dirkiesdorp resident, March 2012). Once again, the low level of employment could be a direct cause of this issue. Income is likely to come from working on nearby farms and towns, but mainly through social grants and a limited percentage through entrepreneurial enterprises, such as a road-side tuck shop, hair salon, and taverns (*pers. comm*., Dirkiesdorp resident, March 2012).

Figure 5. Out-lying areas and centre of the town of Dirkiesdorp

3.4.3 KwaNgema

The KwaNgema settlement is located midway between Piet Retief and Dirkiesdorp. This is a large, sprawling community, without a key central point (**Figure 6**). It is comprised predominantly of scattered traditional homesteads. KwaNgema, however, appears to be more established, with larger, cohesive homesteads, which include visible small-holdings for subsistence crop farming. This community appears to have a stronger focus on agriculture activities, specifically crop and cattle rearing.

Little evidence of social services or municipal services was observed within the settlement. There is limited electricity and water supply services (Mkhondo IDP, 2012). According to the Mkhondo Local Municipality IDP (2011), there are severe service backlogs in this area (especially with regards to the provision of electricity). Comments within the IDP by communities indicate that housing is insufficient, with a number of people living in shacks and mud huts. Water is trucked in by the municipality, however is limited and does not reach all areas of the settlement. The roads in this area are also poor, being comprised of gravel, which is not graded regularly, resulting in the roads often being impassable. The IDP (2011) also highlights the need for crèches, schools, community halls, healthcare, houses and many other social and basic services to be provided to the KwaNgema area.

Figure 6. Example of homesteads and shop at KwaNgema

3.4.4 Wakkerstroom / eSizameleni

Wakkerstroom is classed as a third order service centre, or minor node, within the local municipality (Pixley ka Seme IDP, 2011). The town is a small rural centre, located on the R543 (28km from Volksrust, on the road between Volksrust and Piet Retief) (**Figure 7**). Wakkerstroom performs a service function to the agricultural and tourism sectors in the immediate area. The town comprises approximately 344 households, with sufficient potable water supply, sanitation, electricity (prepaid or full connection), and refuse removal (Pixley ka Seme IDP, 2011). The town has not been fully developed, with a large number of vacant residential stands within its boundaries.

The tourism sector forms a significant role within the local economy of Wakkerstroom, due to the historical, archaeological, scenic and ecological features in the area. The area between Wakkerstroom and the farm, on which the proposed Yzermyn Underground Coal Mine is proposed, is an internationally recognised birding site with four endemic species, as well as an ecological corridor (Pixley Ka Seme IDP, 2011). Historically, Wakkerstroom was a British fortification during the Anglo-Boer War, and a base for the British to transit into the former Transvaal, and a number of other historical features, such as bushman paintings are located in this area (*pers. comm.* Mr Smit).

Business within the town is limited to a few independent restaurants and retail outlets in the centre of the town, and a number of governmental buildings. In terms of social services, Wakkerstroom has a police station, magistrate court, library, old age home, cemetery, a primary and secondary school, guest houses, and religious centres (churches).

Immediately northwest of town of Wakkerstroom is the eSizameleni Township (**Figure 8**), which is comprised of approximately 1642 households (Pixley Ka Seme IDP, 2011). This settlement is characterised by medium-density, low to middle income housing (predominantly RDP housing), limited formal and informal businesses (retail), and limited social services. This township has access to water, sanitation, electricity and refuse removal, as well as a cemetery, secondary school, primary school, crèche and churches (Pixley Ka Seme IDP, 2011).

Figure 7. Library and church at Wakkerstroom

Figure 8. Road to and houses at eSizameleni

3.4.5 Volksrust / Vukuzakhe

Volksrust forms the largest urbanised area within the Pixley ka Seme Local Municipality. Volksrust is a medium-sized town, with 2819 households (Pixley Ka Seme IDP, 2011).

The Pixley Ka Seme IDP (2011) classifies Volksrust as a second order service centre settlement. It has relatively good access to basic services, with potable water (including local water treatment), water-borne sanitation (local waste water treatment), electricity, and refuse removal to most households (Pixley ka Seme IDP, 2011).

The strategic location of the town on the N11 (between Ladysmith and Limpopo) has resulted in the town that services not only the agriculture and rural settlements in the area, but major transport and logistics routes, as well as tourists passing through the area. The town is also the head office of the Pixley ka Seme Local Municipality, and the largest retail centre after Newcastle (50 km away).

Vukuzakhe township is located to the west of Volksrust, and is comprised of and 3709 households (Pixley ka Seme IDP, 2011). This settlement is comprised predominantly of RDP housing, and has an acceptable level of access to services (including water, sanitation and electricity).

3.4.6 Piet Retief / eThandakukhanya

The large town of Piet Retief is a first order urban node, located on the N2 in the centre of the Mkhondo Local Municipality, and is the seat of the local municipality (Mkhondo IDP, 2011). The greater Piet Retief area (Wards 7, 10 and 14) has a population of 22,229 (Stats SA, 2011). The town is well serviced, with all households receiving basic services (electricity, water, sanitation, and refuse removal).

Piet Retief plays a significant role in the local and regional context in terms of service provision, including a logistics and transport hub (road and rail), and the centre of local branches of national businesses (specifically forestry and agriculture related). The town also plays a role in terms of tourism and other service (tertiary) sector industries (e.g. real estate, legal, etc.) as it provides support to businesses in the area.

eThandakukhanya, the township associated with Piet Retief, is located on the outskirts of the town, on south western side. This is largely a dormitory town, but with access to municipal services (water, electricity, refuse removal) and social services (healthcare, policing) (Mkhondo IDP, 2011). This settlement relies heavily on Piet Retief, as well as forestry, mining and agricultural activities in the area for income.

3.5 Community Organisation of Key Communities

The site and the study area fall within the Gert Sibande District Municipality, over the Mkhondo and Pixley ka Seme local municipalities. Outside of towns and urban areas, the extensive rural landscape is managed through these municipalities; however traditional leadership plays a role.

There is a local headman or "chief" (based near Dirkiesdorp), however there does not appear to be substantial traditional community or following. The community appears divided, as although they are predominantly Zulu-speaking (due to the town's proximity to the KZN border), there are a number of Swazi and other families and individuals who live within these settlements. The following two towns are detailed in terms of their local leadership structures, as these are the primary ADI settlements. The settlements within the AII are managed by the local municipalities, and therefore have not been detailed.

- **Dirkiesdorp** - The Dirkiesdorp community falls under the Mkhondo Local Municipality, and the local ward councillor is responsible for the implementation of services and communication between the community and the municipality. The strongest leadership/ town management in Dirkiesdorp, however, appears to have emerged from the Themba Trust, as they provide facilities and guidance for schools and entrepreneurs in the local area. This is, however, a non-governmental organisation (NGO), and therefore cannot be engaged directly (pers. comm. Mkhondo Local municipality, December 2012). Due to its peripheral location, the Mkhondo Local Municipality indicated that the Gert Sibande District Municipality has been responsible for this area, including provision of municipal services.
- **Wakkerstroom** does not have specific community leadership, however the population of the town appears to have been historically well organised and independent, and therefore there are strong community representatives, as well as support from environmental NGOs. Wakkerstroom falls within the Pixley Ka Seme Local Municipality to the west of the Mkhondo Local Municipality. The local ward councillor and committee are therefore responsible for implementation of service delivery and communication with the local municipality.

3.6 Key Stakeholders

The SIA process identified a number of the key communities that could be affected by the proposed mine. These include as primary receptors the rural towns of Dirkiesdorp and Wakkerstroom, and, to a lesser extent, the larger regional centres of Piet Retief and Volksrust.

The following stakeholders, including local communities, municipal and provincial authorities, NGO, and community services, have been identified as key stakeholder for the SIA process:

a) Local:

- Surrounding land owners and farmers;
- Farmworkers and tenants on the Yzermyn and surrounding farms;

- Ward Councillors: Ward 10 of Pixley Ka Seme Local Municipality and Ward 3 of Mkhondo Local Municipality;
- Local community representatives (Dirkiesdorp, Wakkerstroom);
- Themba Trust (local NGO);
- Environmental NGO's (including Birdlife Africa and World Wildlife Fund); and
- Pixley ka Seme and Mkhondo local municipalities.

b) Regional

- Department of Labour, Piet Retief.

4 Summary of Findings, Issues and Perceptions

4.1 Key Stakeholder Viewpoints

The proposed project area is contentious in terms of mining, with high biodiversity value areas and a conflict in terms of lack of economic development and the largely tourism and agricultural-based local economy. The local and regional government drive for development and service provision often seems to contrast with the rural nature of the area and the key activities and sense of place.

This was reflected by the variety of responses from different stakeholders, and particularly the viewpoints of local communities. Two distinct social viewpoints emerged through the SIA processes from the local communities:

- Firstly, the historically disadvantaged communities (including Yzermyn Farm Community, Dirkiesdorp, eSizameleni) viewed the proposed mine as providing opportunities and development to the local communities, through employment, skills development and infrastructure upgrades. These communities expressed their support for the mining development, if labour and services were sourced locally, and if the mine supported local services and infrastructure development.
- Conversely, the community of Wakkerstroom were of the opinion that the proposed mine will have a significant negative impact on the natural environment. They expressed the opinion that this would result in a loss of biodiversity and water resources, which will ultimately disrupt the natural processes (including local wetlands, birding sites, and scenic vistas), resulting in a negative impacts on the local agriculture and tourism industries, sense of place, as well as other aspects such as a decrease in property values and loss of heritage value. In addition, this community expressed the option that the mine will negatively impact the roads, cause long-term social issues (e.g. loss of employment and social decay), and that could have a permanent and severe impact on the local social environment. They expressed opposition to the mining development on this basis.

The above issues are understood to represent the broad positions of different communities noted during the study. This conflict in perceptions, understanding and motivation seem to be directly related the historical background and location of each group, and how these affect the perceptions of each group.

4.2 Key Stakeholder Issues and Perceptions

The SIA study revealed a variety of social issues raised by key stakeholders. These included: land owners; surrounding farmers; general/ local stakeholders; NGOs; local government departments, representatives from local municipalities, and ward councillors and ward committees. The following key issues were identified through the analysis are listed in **Table 6**. A full list of issues raised, per sector, is provided in **Appendix B**. The key issues are discussed below.

Table 6. Key stakeholder issues and concerns

Socio-economic	Social	Physical environment
■ Labour and employment; ■ Skills development; ■ Procurement and Local Economic Development (LED); and ■ Local economic impact.	■ Social environment; ■ Potential influx of job; ■ Infrastructure and services; ■ Impact on homesteads; and ■ Health and safety.	■ Decreased water quality and quantity; ■ Increase surface water (dewatering); ■ Loss of farm land; ■ Decreased local air quality; ■ Loss of wetlands and biodiversity, and ■ Visual impacts.

4.3 Key Socio-Economic Findings

It is anticipated that up to 576 employees will be appointed for the operational phase of the proposed mine. **Table 7** provides an overview of the total number of employees anticipated for the first ten years of the mine life. This is likely to include contract and direct employees.

Table 7. Mine Employee Summary (WSP(a), 2013)

Category	No. of Positions		
	Year 1	Year 2	Years 3-10
Senior Management	5	6	7
Professional qualified and experienced specialist and mid-management	8	12	15
Skilled technical and academically qualified workers, junior management, supervisors, foreman and superintendents	67	94	137
Semi-skilled and discretionary decision making	200	313	417
Total	**280**	**425**	**576**

The local population appear to be predominantly unskilled, as is reflected by the low employment status and employment sectors (**Table 8**). Few people from Wards 1, 2 and 3 of the Mkhondo Local Municipality (covering Dirkiesdorp and Driefontein), are employed in the formal sector (4.8%), and the majority (89.3%) fall under the "Not applicable" section (i.e. potentially seasonal workers, or not working in a recognised sector).

Table 8. Summary of employment sectors in Wards 1, 2, and 3 of Mkhondo (Stats SA, 2011)

Type of sector	No.	%
In the formal sector	1,908	4.8%
In the informal sector	1,475	3.7%
Private household	685	1.7%
Do not know	187	0.5%
Unspecified	0	0.0%
Not applicable	35,330	89.3%
Total	**39,584**	**100%**

The Department of Labour (regional base in Piet Retief) undertook a skills audit of the Dirkiesdorp and Driefontein areas, which illustrated the number of skilled people within these areas (**Table 9**). In comparison to **Table 8**, these numbers reflect a low number of people potentially seeking employment, although a substantial number of potential employees (permanent or contract) who could be sourced locally. Note: no data for the Wakkerstroom area was available at the time of the study. A skills audit for the Wakkerstroom/ eSizameleni area is, however, being undertaken by the Department of Labour.

Table 9. Summary of Skills Audit (Department of Labour, 2013)

Skills Level	Number	Area
General workers	187	Dirkiesdorp and Driefontein
Technicians	2	Driefontein
Drivers and Operators	33	Dirkiesdorp and Driefontein
Trade Workers	26	Dirkiesdorp and Driefontein
Professionals	1	Driefontein

Skills Level	Number	Area
Administrative	23	Dirkiesdorp and Driefontein
Sales and Services	26	Dirkiesdorp and Driefontein
Managers	Nil	-
Total skills available	298	

The Historically Disadvantaged South African (HDSA) local communities expressed enthusiasm for the mine and the potential for job opportunities and skills development. The lack of skills and education in this rural area was highlighted as a key issue, namely the lack of skills within the local area, which the mine would need to address. Communities, local leadership and the Department of Labour indicated skills development should be implemented prior to the commencement of any mining related activities, so as to allow local individuals the opportunity to develop the necessary mining-related skills.

In addition, these stakeholders also indicated the need for local economic development. There is a need for local businesses and entrepreneurs to be developed in order to stimulate local growth. Stakeholders expressed that the proposed project could assist through prioritising local labour and local procurement.

Issues were also raised around the loss of tourism and farming in the area due to the mining activities. This was raised as a concern as a result of mining activities, change in nature of the area, loss of groundwater, and increased traffic.

In addition, a number of local stakeholders expressed the need for the proposed mine will employ most of their unskilled to skilled labour force from the local area (particularity from Dirkiesdorp and eSizameleni). The proposed mine will, in terms of the Minerals Resources and Petroleum Development Act (No. 28 of 2002) (MPRDA), consider local areas as potential labour sending area first, specifically Dirkiesdorp, Driefontein (not directly assessed within the SIA but within the ADI) and Wakkerstroom/ eSizameleni. It was noted, however, that the majority of labour and employees are likely to come from outside the ADI due to the lack of skills locally. These areas may include other areas of Mpumalanga, as well as other provinces, such as Gauteng and the North West, as these are known centres of mining.

4.4 Key Social Issues and Findings

The Wakkerstroom community expressed a strong view that the proposed mining activities will significantly change their sense of place, as the mine will affect the local biodiversity and water resources, resulting in a negative impact on property values and tourism within the Wakkerstroom area. This was not highlighted as a key issue for the Dirkiesdorp or other communities in the immediate areas, but rather a positive change including local development and general social upliftment as a result of the mining activities.

Most communities and local municipalities expressed concern regarding the potential influx of job seekers and labour into the area, which could affect accessibility to social and basic services, specifically healthcare, housing, water and sanitation.

The local municipality expressed concern that mining operations, and their associated activities (e.g. presence of trucks), as well as labour and staff, could have an impact on the local social environment. Specific concern was raised with regards to the impact on roads and water resources. The municipality indicated that the mine would need to facilitate upgrades to existing road systems, as well as assist the municipality with providing local social facilities, such as schools and water treatment facilities.

A number of local stakeholders and municipalities highlighted a range of social and infrastructure projects that are required for the upliftment and general improvement of access to basic and social services in the local area (within the ADI).

According to the SLP (WSP(a), 2013), Atha has selected a number of potential projects for intervention, including assisting the local municipalities with funding for projects, local mobile clinics, educational facilities, business support, and a rural Information, Communication and Telephony (ICT) centre. Most of these projects are an integral part of the District and Local Municipal IDP's, and are likely to provide direct services to the local area. The perception amongst many local stakeholders that the mine is going to provide road infrastructure, houses, and other facilities, is, however, unlikely to be realised.

One of the key localised social impacts identified through surveys of farm tenants, was the potential impacts on the homesteads within, and adjacent to, the mine target area. Potential issues raised included cracking of houses, health and safety (associated with trucks on the nearby access road), dust and noise emissions, and how these may impacts on the neighbouring communities.

4.5 Key Physical Environmental Issues

One of the key issues raised by local communities was the potential impact of the mine on water resources in the area, including surface and ground water. This included the dewatering of the mine and loss of groundwater resources, Acid Mine Drainage, as well as pollution of rivers and increased river discharge sue to dewatering.

Farmers and local residents expressed the concern for the loss of farmland as a result of the mining activities, not only within the target area, but also adjacent to the site. The farm tenants indicated their concern for dust emissions, and how this may affect their health and households.

The Wakkerstroom community, together with NGO representatives, were particularity concerned about the potential loss of biodiversity, specifically habitats of endemic bird species, including large wetland areas. This concern was not only with regards to the intrinsic value of these species and habitats, but as mentioned above, the loss of tourism and associated economic and social impacts. The visual impact of the mine was also a concern for these stakeholders, as the potential impact of mining operations on tourism and the overall sense of place could affect the local economy and social environment.

5 Impacts Assessment

5.1 Construction Phase Impacts

5.1.1 Increased health and safety risk

The proposed construction phase is likely to produce noise emissions (mainly from blasting, construction and trucks) and dust emissions (mainly from blasting, trucks on unpaved roads, and ore processing), as well as a number of other possible health and safety risks to the local communities, as outlined below.

- **Noise** – In accordance with the Noise Impact Assessment (WSP (c), 2013) (NIA), the area of potential impact during the construction phase is likely to be limited to the immediate area (within proximity to the operational area and adit), specifically the homestead closest to the entrance and operational areas. Noise emissions are likely to be of low significance during the construction phase (WSP (c), 2013).
- **Air Emissions** – In accordance with the Air Quality Impact Assessment (WSP (b), 2013) (AQIA), there are likely to be a number of construction-related activities that may generate particulate matter. This will affect the sensitive receptors immediate adjacent to the operational area and the (unpaved) access road to the site. The AQIA indicates that this is unlikely to have significant impacts on these receptors, due to the temporary nature of the construction phase, and the local climatic conditions topography. Despite this the AQIA has provided recommendation measures that will be required during the construction phase.
- **Traffic** - The presence of trucks could also pose a safety risk to local farm tenants and Dirkiesdorp residents, as individuals (especially children) use the main access road as route to Dirkiesdorp, between homesteads, and to local schools. Large trucks and increase traffic in general could potentially result in an increased number of accidents resulting in injury or even mortality. This will potentially be limited to the preferred access road between Dirkiesdorp and the proposed mine entrance. Refer to Traffic Impact Assessment (TIA) for impact assessment and mitigation and management recommendations (WSP (d), 2013).

- **Communicable Diseases** - The potential influx of labour and job-seekers into the ADI could result in health concerns around communicable diseases, such as HIV/ AIDS and Tuberculosis (TB). There are currently high rates of HIV/ AIDs and related diseases within the ADI, which could further increase with the presence of additional people to the area. This is likely to be limited during construction, with approximately 70 potential employees/staff onsite, however, must be managed. Education and awareness campaigns are vital to managing and mitigating this risk to the local communities, as it has been indicated that labour is likely to be housed within the existing communities possibly within the larger towns of Piet Retief and Volksrust. Refer to **Section 5.7.3** for mitigation measures.
- **Crime** - There is the potential for crime events to increase within the local area, with additional, non-residents being present in the local environment. This is likely, however, to be restricted during the construction phase, as the number of people and access to the site will be limited to less than 100 people. It is recommended that education and awareness campaigns are developed and implemented prior to the construction phase, and security is maintained within the mining area as a preventative measure. Refer to **Section 5.7.3** for mitigation measures

5.1.2 Social tension and disruption due to construction activities and labour force

The presence of non-residents, perceived “outsiders” and contractors within the local environment could cause localised social tension due to the rural nature of the ADI, and the change in nature of the area during construction. The opposition expressed by certain local communities and stakeholders, could result in conflict causing disruption to the local communities and the construction operations.

It is recommended that these types of potential conflict be managed through a grievance mechanism and on-going communications with local stakeholders, as outlined in **Section 5.7.5** of this report.

5.1.3 Damage and disruption to homesteads

It was not anticipated that there would be a requirement to relocate any of the farm tenants that are located near or on the site. The site visit and surveys revealed, however, that there is one homestead located approximately 500 m from the proposed adit entrance, and approximately 100 m from the main access road to the target area (family name - Mkhubu). The mining activities are likely to have direct negative impact on this homestead, in terms of vibrations (cracking of houses), dust, noise, safety and visual impacts. These consequences could potentially have a significant impact on the family that resides within this homestead, as well as on their cattle, corps, and quality of life. This is an unacceptable risk to this homestead, which needs to be mitigated, should the mine commence.

Although the mine will not physically displace this homestead (i.e. it is not located within the target area), it is in close proximity to the main operations area, and there is a possibility that these activities will significantly affect this homestead and family in its current location.

Resettlement of this family is recommended, which requires a separate Resettlement Plan in terms of the IFC performance standard (5) for Land Acquisition and Involuntary Resettlement. This requires consideration of subsistence livelihoods, social networks and wider community structures. A household asset register was not undertaken during the SIA, however it is recommended that one is undertaken for the Resettlement Plan, and this family be relocated to another area of the same farm (or alternative site within proximity as appropriate), and/or suitable compensation is provided (in accordance with the Resettlement Plan). Resettlement is required to be undertaken during the preconstruction phase, so as to minimise potential social impacts. Refer to **Section 5.7.6** for mitigation measures.

Relocation of a single household is unlikely to have a significant impact on the farm tenant community or the individuals within the household. This is because, although farm tenants appear to be inter-reliant, should suitable relocation within proximity to the other farm tenants be undertaken, the impact is greatly reduced. The negotiation and compensation process, as well as potential conflict from neighbouring families (i.e. the perceived need for compensation to other families) needs to be managed effectively. This could be undertaken through good communications and engagement forums, commencing prior to the construction phase. Refer to **Section 5.7.5** for communications strategies.

5.1.4 Creation of employment opportunities

It is anticipated that approximately 70 employment opportunities, with approximately 60 being skilled (operators) and 10 management (supervisory) opportunities, will be generated through the construction phase. Skilled labour is likely to be sourced from outside the ADI, either regionally or nationally. In addition, management level staff are likely to be sourced in India (Atha's current mining operations), and brought into manage local operations and transfer skills to local employees/ trainees on an on-going basis.

Although there may be a small number of additional unskilled opportunities (e.g. security, community liaisons, general labourers and cleaners) that could arise, there is unlikely to be significant opportunities for the local population to be employed during the construction phase, and the opportunities are likely to be temporary.

During the SIA it was noted that there is a high level of unemployment on a local level (within the ADI). Given the potential impacts on the local area, employment (especially unskilled and semi-skilled) should be sourced locally where possible. Employment of youth, women and disabled (currently underrepresented in mining and employment sectors in general), should be included in development of skills and opportunities for employment.

In order to ensure that the local communities benefit from the proposed project, it is recommended that skills development and training is implemented by Atha prior to the construction phase (preconstruction), as described in **Sections 5.7.1 and 5.7.2**. This should be aimed at ensuring that the individuals within the local communities have the skills required for the mining construction phase.

5.1.5 Growth in skills and business development

The proposed mine is unlikely to provide significant skills development opportunities during the construction phase of the project. The limited number of employees during this phase, and the specialist requirements, means that experienced contractors are likely to be sourced from outside the local area to undertake construction activities.

As discussed in **Section 5.1.4** above, in order to ensure that the local communities benefit from the proposed project, it is recommended that skills development and training is implemented by Atha prior to the construction phase (preconstruction), as described in **Sections 5.7.1 and 5.7.2**.

The degree to which downstream economic impacts provide local stimulus to the economy is based on the degree to which value added services can be locally sourced. There may be an opportunity for business and entrepreneurial development within the local area. Atha and its contractors will require services and materials for the construction phase of the proposed mine. There is an opportunity to source these at a local or regional level. It is recommended Atha prioritise local procurement through ensuring that internal procurement policies, as well as agreements with contractors and sub-contractors, include the following conditions such as:

> "*The procurement of goods and services must be localised wherever feasible and practical. If possible the tender should demonstration of how this will be achieved."*

Further mitigation measures, including mentorship programmes, structured programmes for suppliers and the appointment of an Enterprise Development Manager are discussed within **Section 5.7.6**.

5.2 Operational Phase Impacts

5.2.1 Increased Employment opportunities

It is anticipated that up to 576 employees will be appointed for the operational phase of the proposed mine. These opportunities are likely to include: senior management; professional qualified and experienced specialist and mid-management; skilled technical and academically qualified workers, junior management, supervisors, foreman and superintendents; and semi-skilled and discretionary decision making.

The SIA revealed that there are a high number of unemployed people in the immediate areas (namely the area encompassing Dirkiesdorp, Wakkerstroom, Piet Retief and Volksrust), as well as throughout the Mkhondo and Pixley ka Seme local municipalities. As mentioned previously, there are low skills levels within the ADI. And therefore the local population may not meet the labour requirements of the mine.

In accordance with the MRPDA, mining operators are required to develop and submit an SLP as part of the application for mining rights. Atha must, therefore, ensure that labour is source locally where feasible for the operational phase. The local area from which local labour should be sourced should target the Dirkiesdorp and Wakkerstroom / eSizameleni area, as well as the greater Mkhondo and Pixley ka Seme local municipalities. The Gert Sibande District Municipality region should, however, also be considered part of the local labour sending area. A small number of opportunities may be sourced from the immediate area; however these are likely to be mainly unskilled, such as security and cleaning staff. Priority must, therefore, be given to local labour, and skills development must be promoted at a local level (as described in **Section 5.7.1** below).

In order to meet the skills requirements for the mine, skills development initiatives will need to be provided to promote the expansion of the required skills in the local context. There is currently very low skilled labour force present within the ADI, as discussed in **Section 5.4.1** above. Due to the limited numbers of unskilled, semi-skilled and skilled employment opportunities, the proposed mine will offer little or no economic benefit for the local area without skills development. It is recommended that Atha prioritise the development of skills within local communities at a planning stage to ensure that local community member have an opportunity to apply for the available positions within the mine. Where possible this should be implemented as follows:

- Identify positions available;
- Identify, through discussions with the local communities, individuals with the interest and aptitude for the proposed positions; and
- Provide skills training to individuals to potentially take up positions during the operational phase.

Atha is required to provide portable skills development (other than mining) and basic education and further education opportunities to employees, and potentially local communities. The SLP outlines a skills development programme, including Adult Basic Education and Training (ABET), core skill training, external learnerships, internal learnerships, portable skills, bursaries, internships, portable / marketable skills, mining sector skills, basic education and further education and training. Although these are focussed on internal (employee) training, there is an opportunity for the mine to develop local skills for working within the mine and supporting services sectors.

The promotion of education through providing facilities (as discussed in the SLP under local economic development initiatives) is likely to assist Atha is supporting the development of skills within the local area. The provision of these facilities is vital to improving the social impact of the proposed project. Without sufficient skills training and awareness of what skills are necessary, there are unlikely to be any skilled labour to supply the mine. These facilities must, however, be run by accredited organisations, such as Further Education and Training (FET) College.

Refer to **Section 5.7.1** for further measures regarding skills development.

5.2.2 Local economic development

There are a number of opportunities for the proposed mine to contribute towards the development of local services and business development through the prioritisation of local procurement for the provision of services to the mine (e.g. transport, provision of materials, catering, cleaning, etc.). Atha must, through the establishment of internal and contractor policies, prioritise local business in procurement procedures, and where possible, provide entrepreneurial development initiatives to stimulate local economic and business development.

The presence of the mine could also result in secondary investment in the local area, through the development of infrastructure, and tertiary sector services (e.g. retail, banking, etc.). It is however, imperative that the local community, organisations, leadership and government are involved in the development and procurement, in order to maximise local benefits from the mine for the local communities. **Section 5.1.5** outlines the required procedure to be followed. Key actions should include:

- Atha must ensure equitable procurement opportunity development, as per their SLP;
- Discussions with local leadership and business forums regarding project supplier requirements and opportunities,
- Identification of potential partnership and supplier businesses in the local area;

- Notifying local leadership and business forums of availability of tenders for appointment; and
- Investigate local entrepreneurial development opportunities (e.g. to supply the mine, such as bakery, vegetables, and transport companies), and which could be sustainable entities in the long-term.

According to the SLP (WSP (a), 2013), Atha has selected the following potential projects for intervention:

- Existing municipal cooperative initiatives funding assistance;
- Sponsorship of local mobile clinics;
- Sinethemba Agricultural & Technical Secondary School;
- Small Enterprises Development Agency (SEDA) office establishment (Small to Medium Enterprises support); and
- Establishment of a rural Information, Communication and Telephony (ICT) centres.

In addition, refer to **Sections 5.7.3 and 5.7.4** for complementary measures.

5.2.3 Impact on water levels and water quality

In accordance with the surface and ground water specialist studies (WSP (e) and (f), 2013), the impact on ground water and surface water is unlikely to be significant within the target area, the immediately surrounding area, or on a regional scale. The quantity of surface water flowing into the local environment is likely to decrease in summer due to activities onsite and diversion of contaminated stormwater runoff into pollution control dams, and increase slightly in winter (from normal volumes) due to the increased runoff from increased hard standing. This is, however, unlikely to affect local users, as although there may be a decrease in seepage near to the adit or entrance, there is unlikely to be significant impacts on the springs and streams that are used by local farm tenants (located approximately 3km from the adit).

The low impacts on surface and groundwater resources are, however, directly dependant on the management of mine water and activities within the mining operations. The recommendations of the surface and ground water specialist studies (WSP (e) and (f), 2013) must, therefore be implemented. It is the responsibility of Atha to ensure that these activities are managed effectively, and they are responsible for the long-term monitoring and management of water resources. In the event that any impacts on water quantity or quality are encountered, Atha is responsible for ensuring that communities receive adequate potable water supply, and that long-term impacts are prevented, managed and mitigated.

5.2.4 Livelihood displacement

Economic displacement refers to the removal of livelihoods and income for the local population. This is likely to take a number of forms as a result of the mining operations, including:

- **Loss of agricultural land** - There is the potential for farmers and tenants to be impacted by the loss of grazing land due to the proposed project. The mine is however, proposed to be underground, and the target area is relatively small (in comparison to the remaining available farmlands), and there unlikely to have a significant impact on the farming activities in the area. It is likely that sufficient grazing will be available for commercial and subsistence purposes.
- **Loss of stock** due to theft which could result from the increase in people in the area and lack of security afforded by existing structures on farms (i.e. fencing, surveillance, etc.). This could become an issue if left unabated, and should be managed through community engagement and the establishment of the community forum.
- **Decrease in property values**, especially with regards to farm lands within the local area due to the potential for a loss of natural aesthetic, decreased availability of fresh water (ground and surface), and perceptions regarding the change in nature of the area.
- **Decreased tourism** and potential loss of income and employment due to a reduction in eco-tourism associated with wetlands, birding and natural aesthetics of the local area.

The potential loss of natural resources relates directly to the loss of economic and livelihood sustainability, due to the direct relationship between the local communities and the local natural environment, as listed above. It is imperative that, in order to offset any potential economic or livelihood loss within the local socio-economic landscape, local communities will need to be uplifted, up-skilled and employed by the mining operations. Refer to **Section 5.7.1, 5.7.2, and 5.7.4** for mitigation and management measures. In addition, recommendations of other specialist studies need to be implemented in order to prevent and minimise any potential impacts on the physical environment (as per **Section 5.7.7**), and good community engagement practices must be followed (refer to Section 5.7.5) to ensure issues are managed effectively.

5.2.5 Regional economic contribution

The proposed mine is likely to contribute to the local, regional (District Municipality/Mpumalanga) and national economies in the form of tax revenue, and expenditure on business services in local and regional economies. The provision of materials, and direct and indirect (e.g. accommodation, retail, and manufacture of goods) services from within the district municipality, has the ability to generate growth in the regional economy.

The level of regional economic contribution is likely to be limited, as the size of the mine and its operations are considered moderate in terms of other regional and national economic contributions. Indirect regional contributions are likely to come through the development of regional skills and employment opportunities, and the sourcing of materials and services from within the region. This could be further enhanced by ensuring the local and/or regional procurement of good and services and employment, as well as ensuring that the mine's activities stimulate the local economy, which could in turn contribute on a larger scale (refer to **Sections 5.7.1 and 5.7.2**).

5.2.6 Increased health and safety risk

There is the potential for the proposed mining operations to result in an increased health and safety risk at a local level. This is likely to be a result of a number of factors, including the following:

- **Traffic** – There is likely to be a distinct increase in traffic (predominantly large trucks transporting coal to Piet Retief) along the mine access road through Dirkiesdorp and along the R543 towards Piet Retief. The (TIA) indicates approximately 240 trucks per day will travel along these roads during peak operational phase. The presence of these trucks, as well as smaller vehicles, could result in an increase in potential pedestrian injuries and fatalities in the Dirkiesdorp area. Refer to the TIA (WSP (d), 2013) for management and mitigation recommendations, and **Section 5.7.3** for Health and Safety Awareness requirements.
- **Blast/vibration** – The risk from blasts and vibration as a result of mining activities could result in the collapse of mud structures on homesteads adjacent to the target area, and injury to the occupants or exposure to the elements. A Resettlement Plan is recommended to remove the closest to the target area, and on-going communications through a Community Liaison Forum to manage any unforeseen impacts (Refer to **Section 5.7.5**). According to Mindset Mining Consultants (Pty) Ltd, due to the stable characteristics of the geology surrounding the site, blast and vibration impacts are considered to be negligible.
- **Noise and dust** – There is the potential for the operational phase to cause notable noise and particulate matter emissions from blasting, material removal, coal removal, crushing and screening activities, ventilation shafts, stockpiles, loading activities (with the use of bulldozers or other machinery) and trucks (WSP (b) and (c), 2013). The impact of these emissions are predicted to be medium to high and localised to the area immediately adjacent to the operational area and access road (WSP (b) and (c), 2013). These emissions could result not only in a nuisance factor for local residents, but also health impacts from inhalation and exposure over long periods of time. The AQIA and the NIA provide mitigation measures for the operational phase, so as to reduce these potential emissions (WSP (b) and (c), 2013). Note that it is proposed that the access road be surfaced after three years of operation, as the number of trucks traveling to the site is likely to increase significantly once the mine is in full operation.
- **Influx of population** – the influx of labour and job-seekers into the ADI could result in health concerns around communicable diseases, such as HIV/ AIDS and TB. There are currently high rates of HIV/ AIDs and related diseases within the ADI, which could further increase with the presence of additional people to the area. Education and awareness campaigns are vital to managing and mitigating this risk to the local

communities, as it has been indicated that labour is likely to be housed within the existing communities possibly within the larger towns of Piet Retief and Volksrust. Refer to **Section 5.7.3**. Atha will be required to comply and revise the SLP on a regular basis.

- **Fire** – the risk of fire was noted to be high within the ADI, due to the presence of grasslands and dry, windy winter conditions. There is a risk from the mining operation through the potential for thermal coal product to self-combust, and the additional risk from employees and contractors using fires for cooking or warmth, could increase this risk. This could potentially affect the surrounding farmers and farm tenants and their livelihoods (grazing, crops and cattle). Education and awareness training is vital to ensuring that this risk is minimised from the mining operations. Refer to **Section 5.7.3**.
- **Crime** – the increase in the number of people within the ADI could increase the potential risk of crime and theft within the local area. This could include the theft of livestock (from farmers and farm tenants), theft of personal belongings, as well as physical harm or other criminal offences. It is recommended that education and awareness campaigns are developed and implemented prior to the construction phase, and security is maintained within the mining area as a preventative measure. Refer to **Section 5.7.3**.

5.2.7 Change in sense of place

The communities closest to the proposed site, namely Wakkerstroom, Dirkiesdorp and KwaNgema, are characterised by limited development and are predominantly rural in nature. The sense of place appears to be particularly significant to the Wakkerstroom community, as it was indicated during the ESIA process that a number of people have moved to Wakkerstroom for the quality of life and scenic surrounds. Both Dirkiesdorp and KwaNgema are rural settlements, with a dependence on agricultural activities and employment on local farms. The residents of these two settlements are therefore inherently tied to the local area.

It is likely that the nature of the area will be changed due to the proposed mining activities. Factors that may contribute towards this include visual and aesthetic changes to the site, dust, noise and other physical environmental changes, as well as increased traffic, influx of employees and job-seekers, and development in these areas as a result of their proximity to the mine. In addition, cultural and political conflicts could result from the in-migration of labourers, which could affect settlements in close proximity to the mine. The possible transient nature of some of the mine labour and the associated social issues (such as alcohol abuse, influx of sex workers, and potential social unrest) could change the nature of the nearby settlements.

The change in sense of place for the local communities (specifically Dirkiesdorp) could be managed through the implementation of education and awareness campaigns, and the promotion of positive local development (Refer to **Section 5.7.2**.). The impact is unlikely to be mitigated completely, and is likely to change the nature of the area is likely to be changed for the duration of the project, and beyond the lifetime of the mine.

The Wakkerstroom community is unlikely to be directly affected by the proposed mine. The impact on biodiversity could, however, limit the tourism within the area. This could result in decrease in local income, a change in economic activities, out-migration of residents, and potentially the degradation of the local aesthetic and culture. This could have a long-term to permanent impact on the town of Wakkerstroom. It is recommended that the Wakkerstroom community be represented on the Community Forum (to be established by Atha in the preconstruction phase), and through this, and the Grievance Mechanisms, work with Atha to maintain the local environment and tourism economy and related activities, so as to ensure these do not degrade over the lifetime of the mine (refer to **Section 5.7.5**).

5.2.8 Increase in social conflict

The potential for influx of labour and job seekers into the ADI could result in social changes such as conflict for resources, conflict of cultures, and a change in nature of the area resulting in social change and potential for disputes. Atha has indicated that outside labour is likely to be housed within the existing communities, possibly within the larger towns of Piet Retief and Volksrust. The local communities are, however, likely to be targeted by jobs seekers for housing, due to their proximity to the site.

Housing with the larger towns for labour and staff is likely to be absorbed by the existing and future development of these urban areas. The influx of jobseekers into smaller communities (e.g. Dirkiesdorp, KwaNgema and Wakkerstroom), could create a shortage of housing and conflict over resources (as these are currently deficient in some of these areas).

In addition, labour conflict with the mining company, regarding aspects such as wages and resources, could result in local social unrest. This could potentially adversely impact the local population should this not be managed properly. Conflict management by the mine (i.e. managing labour demands, issues and communications) is therefore a key aspect to preventing long-term social unrest.

The above issues need to be managed through the implementation of grievance mechanisms and community forum (as per **Section 5.7.5**). These methods could be used to manage any conflict and develop strategies for Atha and other stakeholders to manage the short- to long-terms impacts.

5.3 Closure and Decommissioning Phase impacts

5.3.1 Reduction in employment opportunities and associated decline in economic activities

The mine is proposed to have a lifespan of approximately 15 years. The closure of the mine will result in the loss of an estimated 576 direct jobs, and associated indirect employment through contractors and service providers for the mine, as well as affect the increased local population indirectly. The reduction in economic activities within the area is particularly significant for the local population (within the ADI) as they are currently reliant subsistence agriculture and seasonal farm and mining work. In addition, locally sourced employees may not be able to move to other areas for mining employment (should this be an option). The loss of employment could, therefore, impact the socio-economic environment through the loss of income and livelihoods, and affect this may have on the local economic and quality of life for local populations.

The decreased in employment can be managed through an appropriate mine downscaling and closure plans (as per the SLP (WSP (a), 2013). These plans should ensure that portable/ marketable skills and training is provided to mine staff, so as to ensure that individuals are more likely to gain employment or opportunities elsewhere following mine closure. In addition, providing employees with clear and transparent information on the planned closure could allow individuals to plan and implement personal strategies for furthering their employment opportunities (within mining or other sectors).

5.3.2 Change of economy back to subsistence and agriculture

There is the potential need for the local population of farm tenants (and Dirkiesdorp to a smaller extent) to shift back to subsistence agriculture to sustain household livelihoods following closure. This is likely to impact on spending power of these families, as well as their ability to provide for the household. This should be investigated further in the Mine Closure Plan (as per the SLP (WSP (a), 2013). Once again, skills development and training is likely to play a significant role in the local population’s ability to recover following the closure of the Mine.

5.4 Residual Impacts

5.4.1 Re-adjustment of local economy

The return of the local economy to agriculture and tourism is likely to take up to 10 years (or longer depending on the degree of impact of the mine on the local physical environment). The grazing lands lost to the mining activities are likely to recover with time, and assuming the land does not subside, the majority of the target area could be returned to full grazing capacity within a five year timeframe, although this is dependent on the full rehabilitation of the site.

The overall impact on grazing land and other social resources is likely to be low, but only if Atha ensure these issues are managed through the mine closure and rehabilitation plan, to prevent long-term or permanent impacts (refer to recommendations in surface and ground water impact assessment - WSP (b) and (c), 2013).

Tourism currently plays a key role in the local economy, specifically in the Wakkerstroom area. Tourism is also a key economic and social development goal for the Gert Sibande District Municipality, as well as the local municipalities. Tourism activities in the local area rely predominantly on the natural environment of the Wakkerstroom area, and include outdoor adventure, birding and cultural/heritage tourism. The extent to which the mine impacts on the sense of place (**Section 5.2.7**) of the surrounding area and changes local physical environment, could therefore have an effect on local tourism-related businesses and have implications for the local economy. Should the operational phase have an impact on tourism, there is likely to be a slow recovery period for this industry in the local area. In order to mitigate against this, the management measures provided in **Section 5.7.2 and 5.7.5** must be implemented, together with rehabilitation and management measures required by all other specialist studies.

5.4.2 Improved health and safety

The co-disposal discard dump for the mine is proposed to be located outside of the original target area, and is likely to remain onsite in the long-term (excess of 20 years), and will need to be managed to ensure acid mine drainage, and water and soil resources are not contaminated. This could be a long-term health and safety risk if not managed correctly (refer to management recommendations of the groundwater study – WSP (f), 2013)

Following the closure of the mine, it is anticipated that noise and dust emissions will cease, resulting in a minor improvement of health and quality of life. Atha must, however, ensure these issues are managed through the mine closure and rehabilitation plan, to prevent long-term or permanent impacts (refer to recommendations in surface and ground water impact assessment - WSP (e) and (f), 2013).

5.4.3 Improved aesthetics and sense of place

There is likely to be a permanent change in sense of place for the farm tenant community, even as the mine becomes inactive. This is however dependant on the closure and rehabilitation plans and implementation. Atha must ensure that the site is rehabilitated to a reasonable level (i.e. closer to its original state), to ensure that any potential negative impacts during the operational phase are reduced in the long-term.

There may be certain enduring impacts, such as economic and infrastructure development, and potentially loss thereof, following closure. These should be managed through the implementation of long-term plans in collaboration with the local municipalities, through the SLP Closure Plan (WSP (a), 2013).

5.5 Cumulative Impacts

A cumulative impact assessment of the proposed mine is considered within the context of similar the land uses within the study are. There appear to be two mines within proximity to the proposed target area. The Savmore Colliery underground coal mine (owned by Kangra) located approximately 20km north east of the site, and approximately 35km west of Piet Retief. There also appears to be an opencast coal mine located between the proposed target area and Piet Retief (46km north west of the target area and 5km from Piet Retief), seemingly owned or operated by Jindal Mining SA.

The SIA study indicated that there are few people from the within the ADI employed by these mines (approximately two known, and 30 to 40 potentially employed by existing mining operations[1]) within the ADI. The mine employees are likely to be accommodated in Piet Retief (Jindal Mining and Kangra) and Driefontein (Kangra).

There may be some overlap between the Kangra mine and the proposed Yzermyn mine, as both are likely to draw employees and labour from the Driefontein area. And with the proposed expansion of the Kangra mine (ERM, April 2013), there could be a cumulative increase in the number of job seekers coming into the area.

[1] Determined through Department of Labour skills audit and interviews with local stakeholders

The Cumulative impact on the socio-economic environment is unlikely to be significant on a regional level due to the existence of labour sending areas such as Driefontein and Piet Retief in proximity to both mines. The local impact is, however likely to be of high significance, due to the low level of employment and low household income within the Mkhondo Local Municipality, especially around the Dirkiesdorp and Driefontein areas.

It is unknown as to the extent of the cumulative biophysical environmental impacts on the socio-economic environment, however due to the location and distance (greater than 20km) of the existing mines in relation to the proposed target area, biophysical issues such as surface water are unlikely to be significant from a cumulative perspective (WSP (e), 2013). The overall socio-economic impact is therefore likely to be of moderate significant given the local high impact and the lower regional impact.

5.6 No-Go Option

The current land use consists of extensive grazing lands for livestock. The no-go project alternative will maintain the status quo from social and economic perspective. This alternative is likely to be sustainable in the short- to medium-term, however is unlikely to provide the local economic development to the ADI that the proposed project is likely to bring.

In terms of the need for employment creation, rural development and increased access to basic services throughout South Africa (National Planning Commission, 2011), there is the potential for the following impacts to occur as a result of the no-go option:

5.6.1 Loss of employment opportunities and skills development

Should the proposed development not proceed, there will be a loss of potential employment opportunities and associated skills development at a local and regional level. This is likely to affect the regional employment opportunities, however, the total number of employment opportunities are not significant from a regional perspective, and therefore the loss is likely to be of low significance when considered in isolation (i.e. not in conjunction with skills development and training).

5.6.2 Loss of local economic and services development

The loss of local investment, development of social infrastructure and secondary economic development as a result of the mine not proceeding, could affect the long-term socio-economic environment of the local communities (within the ADI). This loss could be moderately significant to the local population, as development and services are urgently required.

5.6.3 Maintain sense of place and local tourism

Should the status quo remain, there is likely to be an on-going development of tourism and related activities within the Wakkerstroom area. This will continue to provide employment and income for the local population. This is likely to have a positive impact on the sense of place for local residents, and maintain quality of life for a limited portion of the population.

5.7 Recommendations

The SLP (WSP (a), 2013) provides for the social requirements in terms of the MRPDA, including housing, nutrition, ABET and portable skills development initiatives during the lifetime of the mine. There are, however, a number of socio-economic recommendations that have emerged from the SIA, which must be implemented prior to commencement of the construction phase, as well as throughout the operational and closure of the mine. These recommendations are outlined below.

5.7.1 Local procurement, skills development and economic development initiatives

Yzermyn SLP must provide for the development and sourcing of local partnerships, suppliers and small business and local economic development opportunities. Specific actions further to the SLP should include:

- *Equity or joint venture partners*
  - Offer mentorship to equity and joint venture (JV) empowerment partners
- *Suppliers of goods and services*
  - Offer internal mentorship programmes to all suppliers, including marketing
  - Structured programme for all suppliers (including development of internal management and quality control procedures);
- *Actively inform all its HDSA suppliers of company tenders that may be of interest to them*
- *Small business and local economic development*
  - Promote identification of local enterprises, identify opportunities for these enterprises and provide support through the appointment of an Enterprise Development Manager; and
  - Mentorship of small, local businesses wishing to solicit trade from the mine through the appointment of a Business Development Officer (BDO) to facilitate local procurement.
- *Appointment of an Enterprise Development Manager to local supplier development programme.*

These structures provide an environment that is more conducive for local entrepreneurs to become aware of opportunities and develop skills within their businesses to meet the demands of the local mining operations. In addition, specific measures should include:

- Discussions with local leadership and business forums regarding project supplier requirements and opportunities,
- Identification of potential partnership and supplier businesses in the local area, and
- Notifying local leadership and business forums of availability of tenders for appointment.

5.7.2 Skills Development and Training

Skills training must be developed to ensure that benefits to the local community are maximised, given the current low level of skills in the local area. The SLP (WSP (a), 2013) indicates that skills training will be undertaken for internal (staff and employees) through the following actions:

- Planned Training;
- Integrating ABET with Career Progression;
- Incentivising Employees for ABET Training;
- Learnerships;
- Portable Skills Programme;
- Core Skills Training; and
- Commitment to Comply with Skills Development Programme.

In order to develop skills within the local communities, Atha has indicated that the following training facilities will be put in place for the benefit of external individuals (members of the local community).

- Sinethemba Agricultural & Technical Secondary School;
- Establish SEDA Office; and
- Establish a rural ICT centres.
- Training centres for skills training and ABET within the mine

It is recommended that Atha put in place the above skills development schemes for employees within existing operations, as well as external opportunities for skills development through mentorship programmes.

In addition Atha is required engagement with the local community to ensure:

1. Local labour is maximised where ever possible;
2. Skills are transferred to local labour force; and
3. The tangible benefits are felt by the community.

Atha is, however, not solely responsible for skills development in this area. There are a number of other role players which could provide skills development, including the Department of Labour. The community engagement structures described in **Section 5.7.3** should be used to advance the potential opportunities to develop skills training and transfer programmes.

5.7.3 Local Education and Awareness

It is recommended that Atha facilitate basic awareness training through relevant organisations (e.g. Department of Labour), tertiary education institutions (FET College), and community structures (Community Trusts, Ward councillors and schools). Examples of education and awareness materials could include posters, information sharing sessions and skills development workshops, aimed at youth, women, and unemployed. This should allow individuals to become aware of the skills required for the proposed mine prior to the construction and operational phases, and provide Atha with the opportunity to identify local skills and labour opportunities.

In addition, it is recommended that Atha host open days (or similar relevant events) to communicate with local businesses and entrepreneurs within the AII. This should allow potential services providers to opportunity to understand the needs of the mine in terms of services and materials, to understand what is required to become a registered service provider, and promote communications between local business and the Atha.

5.7.4 Social infrastructure

A number of the communities within the study area lack basic services, including housing, water, and electricity. There is an opportunity for Atha to assist the local municipalities in providing these services and infrastructure. It is recommended that Atha discuss opportunities with the relevant local authorities (within collaborative governance structures), such as:

- ***Constructing housing*** for labour and staff (in conjunction with the local municipalities), which would be handed over to the local municipalities or relevant communities after the mine has downscaled or closed;
- Following closure of the mine, Atha could hand over the mine's ***water treatment facilities*** to the local municipality/ies for use in providing water to local communities.
- Provision of ***health facilities*** at the mine for staff (permanent and contract) to promote good health and health awareness programmes.

5.7.5 Grievance mechanisms and community forum

One of the key requirements of the IFC Performance Standards on Environmental and Social Sustainability is the implementation of a 'Grievance Mechanism' for the duration of the construction and operational phases of the project. This provides a means for the affected stakeholder to communicate any issues or grievances with Atha. The aim of this forum will be to[2]:

1) Receive and register external communications from the public;
2) Screen and assess the issues raised and determine how to address them;
3) Provide, track, and document responses (if any); and

[2] IFC Performance Standards on Environmental and Social Sustainability (January, 2012)

4) Adjust the management programme to meet/ respond to the issues raised.

It is recommended that a Community Forum be established, in order to meet the above requirement. This forum would need to:

- Include members of key potentially affected communities, including at least the surrounding farmers, farm tenants (or representative); the local ward councillors, and representatives of disadvantaged communities in the ADI;
- Be managed by Atha, but chaired by a member of the community;
- Develop a constitution by which the forum will be run;
- Have meetings once every quarter during the construction, operational and closure phases of the project;
- Be held in an accessible place for the members involved (or transport provided by Atha);
- Ensure that issues raised are considered and mitigation/ management measures put in place, as appropriate;
- All issues raised are recorded on a complaints register; and
- All members of the potentially affected public are made aware of the key contact person and contact details.

5.7.6 Resettlement Plan

It is recommended that a Resettlement Plan be developed for the homestead closest to the proposed adit entrance. The Resettlement Plan must be undertaken in terms of the IFC performance standard (5) for Land Acquisition and Involuntary Resettlement.

The following issues must be understood in order to inform the Resettlement Plan:

- The livelihood of the homestead/ family;
- Availability of other land on the same farm, need to be negotiated with the land owner;
- Socio-economic relationships with other farm tenants and within the family;
- Improve, or restore, the livelihoods and standards of living of displaced persons; and
- Improve living conditions among physically displaced persons through the provision of adequate housing with security of tenure at resettlement sites.

5.7.7 Other specialist studies

In order to mitigate against social impacts of changes to the physical environment, it is necessary to refer to specialist studies conducted as part of the ESIA process. These studies and impacts assessments include:

- Social and Labour Plan – including Closure Plan;
- Groundwater;
- Hydrology and surface water;
- Soils and agriculture;
- Traffic;
- Air quality and noise; and
- Visual.

Each of these studies provides recommendations related to the health and safety, sense of place and/ or quality of life for the local residents and stakeholders. It is vital that these are implemented in order to achieve prevention and minimisation of potential impacts during the construction, operational and closures/ decommissioning phases.

5.8 Impact Rating

Table 10 provides an overview of the socio-economic impacts rating. The full impacts rating table can be found in **Appendix C**.

Table 10. Socio-economic Impacts Rating

PHASE	REF NO.	IMPACT DESCRIPTION	POSITIVE / NEGATIVE	ENVIRONMENTAL SIGNIFICANCE (WITHOUT MITIGATION)	ENVIRONMENTAL SIGNIFICANCE (WITH MITIGATION)
1. CONSTRUCTION	1.1	Increased health and safety risk	Negative	Medium	Low Medium
	1.2	Social tension and disruption due to construction activities and labour force	Negative	Medium High	Low Medium
	1.3	Damage and disruption to homestead	Negative	Medium High	Low
	1.4	Creation of Employment Opportunities	Positive	Low	Medium
	1.5	Growth in skills development	Positive	Low	Medium
2. OPERATIONAL	2.1	Increased Employment opportunities	Positive	Low Medium	Medium
	2.2	Local economic development	Positive	Low Medium	Medium
	2.3	Impact on water levels and water quality	Negative	Medium	Low Medium
	2.4	Economic displacement	Negative	Medium High	Low Medium
	2.5	Economic growth and local economic development	Positive	Low	Low Medium
	2.6	Increased health and safety risk	Negative	Medium High	Low
	2.7	Change of sense of place	Negative	Medium	Low Medium
	2.8	Increase in social conflict	Negative	Medium	Low
3. CLOSURE AND DECOMMISSIONING	3.1	Reduction in employment opportunities and associated decline in economic activities	Negative	Medium High	Low
	3.2	Change of economy back to	Negative	Medium High	Low Medium

PHASE	REF NO.	IMPACT DESCRIPTION	POSITIVE / NEGATIVE	ENVIRONMENTAL SIGNIFICANCE (WITHOUT MITIGATION)	ENVIRONMENTAL SIGNIFICANCE (WITH MITIGATION)
		subsistence and agriculture			
4. CUMULATIVE IMAPCTS	***None have been determined within this study***				
5. NO-DEVELOPMENT	5.1	Loss of employment opportunities and skills development	Negative	Low Medium	n/a
	5.2	Loss of local economic and services development	Negative	Low	n/a
	5.3	Maintenance sense of place and local tourism	Positive	Medium	n/a

5.9 Mitigation Measures

Table 11 provides an overview of mitigation measures, required actions and responsible parties for each of the socio-economic issues raised in **Section 5.1 – 5.6.**

Table 11. Key Management and mitigation socio-economic measures

Impacted Environment	Management Measure Ref.	Management Recommendations	Action Ref.	Required Action	Responsible Party	Phase
Socio-economic	1.1 Increased health and safety risk	Health and Safety Education and Awareness	1.1	Development of youth and community awareness programme for health and safety (e.g. open days, posters, communication sessions) (***Section 5.7.3*** *Local Education and Awareness)*	Atha – Human Resources Department (HR) In conjunction with local municipal and community leadership	Pre-construction
	1.2 Social tension and	Establish Grievance Mechanism and Community Forum	1.2	Establish Grievance mechanism, including telephone hotline, issues records and management procedures.	Atha – HR and Community Engagement	Pre-construction

Impacted Environment	Management Measure Ref.	Management Recommendations	Action Ref.	Required Action	Responsible Party	Phase
	disruption due to construction activities and labour force			(***Section 5.7.5*** *Grievance Mechanisms & Community Forum)*	Department (CED)	
			1.3	Establish Community Forum (As per Section 2.5.3 of SIA) (***Section 5.7.5*** *Grievance Mechanisms & Community Forum)*	Atha – HR and CED	Pre-construction
	1.3 Damage and disruption to homestead	Resettlement of individual homestead near entrance	1.4	Undertake an assets register	Atha – HR and CED - Resettlement Plan must be developed by independent practitioner	Pre-construction
			1.5	Develop Resettlement Plan (***Section 5.7.6*** *Resettlement Plan)*	Atha – HR and CED - Resettlement Plan must be developed by independent practitioner	Pre-construction
	1.4 Creation of Employment Opportunities	Education and Awareness for Skills and Business Development	1.6	Development local awareness training through local community and organisations, including Department of Labour, Schools and FET College. (***Section 5.7.1*** *Local procurement, skills development and economic development initiatives)*	Atha – HR and CED in conjunction with community and Department of Labour	Pre-construction / Construction
			1.7	Host local business / service provider events. (***Section 5.7.2*** *Skills Development and Training)*	Atha – HR and CED in conjunction with community and local business forums	Pre-construction / Construction
	1.5 Growth in skills development	Development of training and education facilities for skills development and training	1.6	Development local awareness training through local community and organisations, including Department of Labour, Schools and FET College. (***Section 5.7.1*** *Local procurement, skills development and economic*	Atha – HR and CED in conjunction with community and Department of Labour	Pre-construction / Construction

Impacted Environment	Management Measure Ref.	Management Recommendations	Action Ref.	Required Action	Responsible Party	Phase
				development initiatives)		
			1.7	Host local business / service provider events. (***Section 5.7.2** Skills Development and Training)*	Atha – HR and CED in conjunction with community and local business forums	Pre-construction / Construction
			1.8	Develop facilities for skills development and training. **Section 5.7.4** Social infrastructure)	Atha – HR and CED in conjunction with community and local business forums	Pre-construction / Construction
	2.1 Increased Employment opportunities	Provide opportunities for local employment and skills development	1.6	Development local awareness training through local community and organisations, including Department of Labour, Schools and FET College. (***Section 5.7.1** Local procurement, skills development and economic development initiatives)*	Atha – HR and CED in conjunction with community and Department of Labour	Operational
			1.7	Host local business / service provider events. (***Section 5.7.2** Skills Development and Training)*	Atha – HR and CED in conjunction with community and Department of Labour	Operational
			1.8	Maintain facilities for skills development and training. **Section 5.7.4** Social infrastructure)	Atha – HR and CED in conjunction with community and local business forums	Operational
	2.2 Local economic development	Provide opportunities for local employment and skills development	1.1	Development of youth and community awareness programme for health and safety (e.g. open days, posters, communication sessions) (***Section 5.7.3** Local Education and Awareness)*	Atha – Human Resources Department (HR) In conjunction with local municipal and community leadership	Operational
			1.8	Maintain facilities for skills development	Atha – HR and CED	Operational

Impacted Environment	Management Measure Ref.	Management Recommendations	Action Ref.	Required Action	Responsible Party	Phase
				and training. **Section 5.7.4** Social infrastructure)	in conjunction with community and local business forums	
	2.3 Impact on water levels and water quality	Ensure surface and ground water resource quantity and quality does not impact on local communities	1.9	Refer to specialist studies – Ground and surface water (**Section 5.7.7** Other specialist studies)		
	2.4 Economic displacement	Ensure local skills development and employment of local individuals (to offset any potential loss to local livelihoods)	1.6	Development local awareness training through local community and organisations, including Department of Labour, Schools and FET College. *(**Section 5.7.1** Local procurement, skills development and economic development initiatives)*	Atha – HR and CED in conjunction with community and Department of Labour	Pre-construction / Construction
			1.7	Host local business / service provider events. *(**Section 5.7.2** Skills Development and Training)*	Atha – HR and CED in conjunction with community and local business forums	Pre-construction / Construction
			1.8	Develop facilities for skills development and training. **Section 5.7.4** Social infrastructure)	Atha – HR and CED in conjunction with community and local business forums	Pre-construction / Construction
	2.5 Regional economic contribution	Contribution to regional economy through situation of local socio-economic environment.	1.6	Development local awareness training through local community and organisations, including Department of Labour, Schools and FET College. *(**Section 5.7.1** Local procurement, skills development and economic development initiatives)*	Atha – HR and CED in conjunction with community and Department of Labour	Pre-construction / Construction
			1.7	Host local business / service provider events. *(**Section 5.7.2** Skills Development and*	Atha – HR and CED in conjunction with community and local	Pre-construction / Construction

Impacted Environment	Management Measure Ref.	Management Recommendations	Action Ref.	Required Action	Responsible Party	Phase
				Training)	business forums	
	2.6 Increased health and safety risk	Health and Safety Education and Awareness	1.1	Development of youth and community awareness programme for health and safety (e.g. open days, posters, communication sessions) *(**Section 5.7.3** Local Education and Awareness)*	Atha – Human Resources Department (HR) In conjunction with local municipal and community leadership	Operational
	2.7 Change of sense of place	Maintain or enhance sense of place / quality of life	1.8	Maintain facilities for skills development and training. **Section 5.7.4** Social infrastructure)	Atha – HR and CED in conjunction with community and local business forums	Operational
			1.2	Establish Grievance mechanism, including telephone hotline, issues records and management procedures. *(**Section 5.7.5** Grievance Mechanisms & Community Forum)*	Atha – HR and Community Engagement Department (CED)	Pre-construction
			1.9	Refer to specialist studies – All studies (**Section 5.7.7** Other specialist studies)		
	2.8 Increase in social conflict	Manage social conflict	1.2	Establish Grievance mechanism, including telephone hotline, issues records and management procedures. *(**Section 5.7.5** Grievance Mechanisms & Community Forum)*	Atha – HR and Community Engagement Department (CED)	Pre-construction
	3.1 Reduction in employment opportunities and associated decline in economic	Manage skills and employment to reduce impact on local vulnerable communities	1.9	Refer to specialist studies – SLP (**Section 5.7.7** Other specialist studies)	Atha – HR and CED	Closure and Decommissioning

Impacted Environment	Management Measure Ref.	Management Recommendations	Action Ref.	Required Action	Responsible Party	Phase
	activities					
	3.2 Change of economy back to subsistence and agriculture	Manage skills and employment to reduce impact on local vulnerable communities	1.9	Refer to specialist studies - SLP (**Section 5.7.7** Other specialist studies)	Atha – HR and CED	Closure and Decommissioning

6 Conclusions

The overall socio-economic impact of the proposed Yzermyn Underground Coal Mine is likely to be directly related to a number of factors including: the impact of the mine on natural resources (and local livelihoods); the degree to which local communities are involved, trained and employed by Atha within the mine operations; and the social upliftment that the mine provides to local communities (including schools, infrastructure and other amenities).

The low skills level within the local communities is indicative that the skills that are required by Atha for the mine are unlikely to be found within the local communities. It is therefore imperative that Atha actively engage in a process of skills development to ensure that local individuals (identified through the Department of Labour and other organisations) are eligible for employment opportunities. This will ensure that local communities benefit directly from the mine. Without these measures, this project is unlikely to be socio-economically sustainable within the vulnerable socio-economic landscape which currently exists within the proposed project area.

There are, therefore, a number of positive socio-economic impacts that could result from the proposed project, including the potential for employment of local communities and skills development opportunities, as well as the development of social facilities and local development potential. There are however, also a number of negative impacts anticipated as a direct and indirect result of the proposed mine. These could include a change in sense of place, loss of environmental and economic assets, and social conflict.

The overall impact of the proposed mine, if mitigated correctly, could be positive for the local socio-economic environment. These management and mitigation measures will require dedicated resources from Atha to ensure they are effective. These measures also need to be implemented prior to the commencement of the construction phase, and carried out throughout the operational and closure phases of the mine to minimise negative socio-economic impacts, and maximise positive impacts.

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Appendix A. Impacts Rating Methodology

WSP Impacts Rating Methodology

The potential environmental impacts will be evaluated according to their severity, duration, extent and significance of the impact. Furthermore, cumulative impacts will also be taken into consideration. WSPs risk assessment methodology will be used for the ranking of the impacts.

This system derives environmental significance on the basis of the consequence of the impact on the environment and the likelihood of the impact occurring. Consequence is calculated as the average of the sum of the ratings of severity, duration and extent of the environmental impact. Likelihood considers the frequency of the activity together with the probability of an environmental impact occurring.

The following tables (**Table 1** to **Table 8**) describe the process in detail:

Table 1: Assessment and Rating Sensitivity

Rating	Description
1	Negligible/ non-harmful/ minimal deterioration (0 – 20%)
2	Minor/ potentially harmful/ measurable deterioration (20 – 40%)
3	Moderate/ harmful/ moderate deterioration (40 – 60%)
4	Significant/ very harmful/ substantial deterioration (60 – 80%)
5	Irreversible/ permanent/ death (80 – 100%)

Table 2: Assessment and Rating of Duration

Rating	Description
1	Less than 1 month/ quickly reversible
2	Less than 1 year/ quickly reversible
3	More than 1 year/ reversible over time
4	More than 10 years/ reversible over time/ life of project or facility
5	Beyond life of project of facility/ permanent

Table 3: Assessment and Rating of Extent

Rating	Description
1	Within immediate area of activity
2	Surrounding area within project boundary
3	Beyond project boundary
4	Regional/ provincial
5	National/ international

Consequence is calculated as the average of the sum of the ratings of severity, duration and extent of the environmental impact.

Table 4: Determination of Consequence

Determination of Consequence (C)	(Severity + Duration + Extent) / 3

- Likelihood

Table 5: Assessment and Rating of Frequency

Rating	Description
1	Less than once a year
2	Once in a year
3	Quarterly
4	Weekly
5	Daily

Table 6: Assessment and Rating of Probability

Rating	Description
1	Almost impossible
2	Unlikely
3	Probable
4	Highly likely
5	Definite

Likelihood considers the frequency of the activity together with the probability of the environmental impact associated with that activity occurring.

Table 7: Determination of Likelihood

Determination of Likelihood (L) =	(Frequency + Probability) / 2

- Impact Significance

Impact significance is the product of the consequence and likelihood values.

Table 8: Determination of Environmental Significance

Environmental Significance (Impact) = C × L	Description
L (1 – 4.9)	Low environmental significance
LM (5 – 9.9)	Low to medium environmental significance
M (10 – 14.99)	Medium environmental significance
MH (15 – 19.9)	Medium to high environmental significance
H (20 – 25)	High environmental significance. Likely to be a fatal flaw.

Appendix B. Stakeholder Issues Review

I. SITE STAKEHOLDERS

Stakeholder	Theme	Potential Socio-economic Impacts
Land Owners	*Labour & Employment*	• May be forced to retrench staff
	Social	• Decreased personal quality of life and for the town
	Economic	• Decrease in property values • Loss of income for farms
Surrounding Farmers	Physical Environment	• Potential decrease in ground water (impact on springs and boreholes) • Decreased land capability on farms • Loss of ecosystem services (wetlands, rivers) • Decrease in water quality and quantity • Long-term impact on Natural (World) heritage site • Loss of natural intrinsic value • Unsatisfactory rehabilitation (long-term impacts) • Lack of accountability to mining company
	Labour & Employment	• Loss of farm labour to mine • Impact on local farming labour force • Forced retrenchment of labour
	Social	• Objection and Opposition to mine • Consideration of areas of archaeological/historical value • Loss of sense of place • Loss of livelihood (farms, tourism) • Increased traffic • Health Impacts (air quality) – human and cattle • Influx of people/labour • Long-term impacts on local communities – employment/ income / livelihoods • Impact on Human rights • Health and safety - fire • Need for Consultation with local communities
	Infrastructure and services	• Decreased access to basic services (water) • Decreased road quality • Opportunity to provide services and infrastructure
	Economic	• Stock theft • Decreased tourism – Loss of endemic bird species • Loss of income and employment (to farmers) • Negative impact on local economy • Negative impact on regional economy

Stakeholder	Theme	Potential Socio-economic Impacts
		• Decreased property values • Risk to farmers (loss of income/economic viability) • Financial impact on local government • National economic benefit • Long-term financial impacts to farmers (maintenance) • Ability of government to follow up with international company
Farm Tenants	*Employment Opportunities*	• Increased employment opportunities • Use of external labour vs. local labour • Must employ local community on farm (before outside labour) • Responsibility of company to train community to provide necessary skills for the mine • Enthusiastic about employment potential • Start date of mining • Life of mine
	Impact on homesteads	• Possible resettlement of houses/homestead • Compensation for resettlement • Blasting cause cracking of houses • Graves affected • Proximity to entrance – how will this impact the homestead
	Health and safety	• Dust from mine and truck • Potential for accidents from trucks • Young children use roads – accidents • Proximity to entrance
	Infrastructure & Services	• Need electricity for houses • Need sanitation, roads and other infrastructure. • How will the mining company improve the farm community- they are very poor
Traditional Authorities - Chief for Mabona area / jurisdiction	*Infrastructure & Services*	• Clinic - Need a higher standard, permanent clinic / healthcare centre • Roads - require upgrading (current and future) • Water and sanitation – currently no municipal supply • Housing – need formal housing (currently mud and wood) • Sports facilities – none in Dirkiesdorp
	Employment and Skills Development	• General employment needed • Skills development is needed • Improved access to education
	Entrepreneurial support	• Support for local businesses and investment • Shops, banks, etc. – general development
	Health and safety	• Mining will increase traffic and therefore risk to children and livestock • May need to fence the road (R543)

II. LOCAL STAKEHOLDERS

Stakeholder	Theme	Comment
Community members (including Wakkerstroom, Dirkiesdorp, and Businesses)	*Physical Environment*	• Decrease in groundwater quantity • Environmental services impacts (wetlands, surface and groundwater, etc.) • Increase in surface water quantity (as a result of dewatering) • Decrease in surface water quality • Surface and ground water impacts • Acid mine Drainage • Long-term impacts – water treatment required
	Labour & Employment	• Increased employment opportunities • Opportunities for employment • Opportunities for skills development • Need to offer employment to local population • Development of opportunities for women, youth and disabled • Identify skills development requirements prior to commencement
	Social Development	• Safety requirements • Community engagement in planning phase • Upgrade and new schools required • Need for youth bursaries • Determine and development of local community needs • Level of development of social development initiatives, basic services by the mine • Social development initiatives • Opportunities for local stakeholders to invest in mine • Traffic impact • Local benefits • Influx of people • Management of social unrest • Requirement to consider full socio-economic impacts • Need for infrastructure
	Economic	• Local Procurement opportunities • Business and procurement opportunities (transport) • Local government economic impacts – infrastructure maintenance and development • Mine ownership
Non-Governmental Organisations	**Physical Environment**	• Pollution and disruption to ecosystems • Ecological and intrinsic value Water production area • Subsistence (ground) • Decrease in groundwater quantity • Ground and surface water impacts • Air quality

	Labour & Employment	• Skills development opportunities • Displacement of local employment
	Social	• Crime alleviation • Education facilities and opportunities • Archaeological, cultural and historic value • Sustainable Development • Long-term employment following closure • Long-term sustainable employment • Need of local opportunities • Lack of understanding of long-term impacts
	Economic	• Loss of eco-tourism and related employment • Impact on Livestock • Disapproval for international investment over local benefits

III. LOCAL GOVERNMENT

Stakeholder	Theme	Comment
Pixley Ka Seme Local Municipality	*Infrastructure and Services*	• Roads - Impact on roads (from large trucks). - Need to upgrade roads • Health - Potential for influx of people - Poor healthcare services - Need to provide basic services (through Dept. of Health) • Education - not enough schools - just providing schools is not sufficient - provide training to teachers - specialist teachers for mining-related opportunities (math & science) - mobile services needed - library and science laboratories • Legacy Projects - assist with municipality with projects - provide services to the local communities – e.g. give sewage treatment facilities to local municipality
	Local Procurement: – Local Economic Development & investment	• total economic impact • procure services locally will have a greater impact than just employment • Local economic investment - encourage local investment and use of local suppliers
	Skills development	• economic skills needs to be sustainable • Need to discuss with municipality • provide marketable skills to local people

Stakeholder	Theme	Comment
		• Municipality must be involved in SLP and ABET programme development.
	Potential influx of job-seekers	• Influx can lead to social unrest • There needs to be joint management of new people coming into the area and the impacts on the local communities. • Need to ensure there is a "Plan B" to manage the impacts of this influx – what will the mine to assist the municipality?
Pixley Ka Seme Local Municipality – Ward 5 Councillor and Ward Committee	*Infrastructure and Services needs*	• Schools - The current secondary schools is overcrowded (grade 8 – 12) - Need another secondary school • Roads • Houses • Foot Bridge- going to school • Housing: - If people from outside the area came to live in Wakkerstroom, where do you think they will live? - Representatives said they could rent rooms in existing houses, • Health facilities – improve local facilities and provide additional • Recreational facilities - Soccer fields - Netball and Volleyball courts
	Employment and Skills development requirements	• Youth/ Young adult education • General skills development - Mine related and portable/marketable skills • Further Education and Training (FET) Colleges
Mkhondo Local Municipality	*Ward 3 – Social needs:*	• Water • Roads • Electricity • Clinic • Pedestrian bridge
	Environmental factors	• Surface water is known to be an issue • Acid mine drainage
	Employment & Skills development	• General • Youth • Women empowerment specifically in mining operations
Department of Labour	*Labour & Employment*	• Database of the local cv's available. • Prioritisation of local employment • Prioritisation of local development, employment and skills development

Stakeholder	Theme	Comment
	Social	• Engagement with local communities during SLP required • Need for local development (from mining)
	Economic	• Requirement to identify and engage with local business opportunities • Compensation of farmers •

Appendix C. Impacts Rating

SOCIO-ECONOMIC ENVIRONMENT											
		A	B	C	D	E	F	G	(DxG)	(DxG)	
Ref No.	Impact Description	Severity/Sensitivity	Duration	Extent	Consequence (A+B+C)/3	Frequency	Probability	Likelihood (E+F)/2	Environmental Significance (Without Mitigation)	Environmental Significance (With Mitigation)	
Construction phase											
1.1	Increased health and safety risk	4.0	4.0	3.0	3.7	5.0	3.0	4.0	**14.7**		**Negative**
		2.0	4.0	3.0	3.0	3.0	3.0	3.0		**9.0**	
1.2	Social tension and disruption due to construction activities and labour force	3.0	4.0	3.0	3.3	5.0	4.0	4.5	**15.0**		**Negative**
		2.0	4.0	3.0	3.0	3.0	2.0	2.5		**7.5**	
1.3	Damage and disruption to homestead	4.0	5.0	3.0	4.0	5.0	4.0	4.5	**18.0**		**Negative**
		2.0	2.0	3.0	2.3	1.0	2.0	1.5		**3.5**	
1.4	Creation of Employment Opportunities	1.0	3.0	3.0	2.3	3.0	1.0	2.0	**4.7**		**Positive**
		2.0	4.0	3.0	3.0	5.0	4.0	4.5		**13.5**	
1.5	Growth in skills development	1.0	3.0	3.0	2.3	3.0	1.0	2.0	**4.7**		**Positive**
		2.0	5.0	3.0	3.3	4.0	4.0	4.0		**13.3**	
Operational Phase											
2.1	Employment Opportunities and Skills Development	1.0	4.0	3.0	2.7	4.0	2.0	3.0	**8.0**		**Positive**
		2.0	4.0	3.0	3.0	4.0	4.0	4.0		**12.0**	
2.2	Local economic development	1.0	3.0	3.0	2.3	4.0	2.0	3.0	**7.0**		**Positive**
		2.0	5.0	3.0	3.3	4.0	3.0	3.5		**11.7**	

2.3	Impact on water levels and water quality	1.0	5.0	3.0	3.0	5.0	2.0	3.5	10.5		Negative
		1.0	4.0	3.0	2.7	3.0	1.0	2.0		5.3	
2.4	Livelihood displacement	4.0	5.0	4.0	4.3	4.0	4.0	4.0	17.3		Negative
		2.0	4.0	3.0	3.0	2.0	2.0	2.0		6.0	
2.5	Regional economic contribution	1.0	3.0	3.0	2.3	1.0	2.0	1.5	3.5		Positive
		2.0	4.0	3.0	3.0	3.0	3.0	3.0		9.0	
2.6	Increased health and safety risk	4.0	5.0	4.0	4.3	5.0	4.0	4.5	19.5		Negative
		2.0	2.0	3.0	2.3	2.0	2.0	2.0		4.7	
2.8	Change of sense of place	3.0	4.0	4.0	3.7	4.0	3.0	3.5	12.8		Negative
		2.0	4.0	3.0	3.0	2.0	2.0	2.0		6.0	
2.9	Increase in social conflict	4.0	4.0	3.0	3.7	3.0	3.0	3.0	11.0		Negative
		1.0	1.0	3.0	1.7	1.0	2.0	1.5		2.5	
Closure and Decommissioning Phase											
3.1	Reduction in employment opportunities and associated decline in economic activities	3.0	5.0	3.0	3.7	4.0	4.0	4.0	14.7		Negative
		2.0	3.0	3.0	2.7	1.0	2.0	1.5		4.0	
3.2	Change of economy back to subsistence and agriculture	5.0	5.0	3.0	4.3	4.0	4.0	4.0	17.3		Negative
		2.0	5.0	3.0	3.3	2.0	2.0	2.0		6.7	
Cumulative / Residual											
4.1	Re-adjustment of local economy	3.0	5.0	3.0	3.7	5.0	3.0	4.0	14.7		Negative
		1.0	4.0	2.0	2.3	3.0	2.0	2.5		5.8	
4.2	Improved Health and Safety	3.0	5.0	3.0	3.7	5.0	3.0	4.0	14.7		Negative
		1.0	4.0	2.0	2.3	3.0	2.0	2.5		5.8	
4.3	Aesthetics and sense of place	3.0	5.0	3.0	3.7	5.0	3.0	4.0	14.7		Negative

		1.0	4.0	2.0	2.3	3.0	2.0	2.5		5.8	
No-Development											
5.1	Loss of employment opportunities and skills development	1.0	4.0	3.0	2.7	4.0	2.0	3.0	**8.0**	**n/a**	**Negative**
5.2	Loss of local economic and services development	1.0	3.0	3.0	2.3	1.0	2.0	1.5	**3.5**	**n/a**	**Negative**
5.3	Maintenance sense of place and local tourism	3.0	4.0	4.0	3.7	4.0	3.0	3.5	**12.8**	**n/a**	**Positive**

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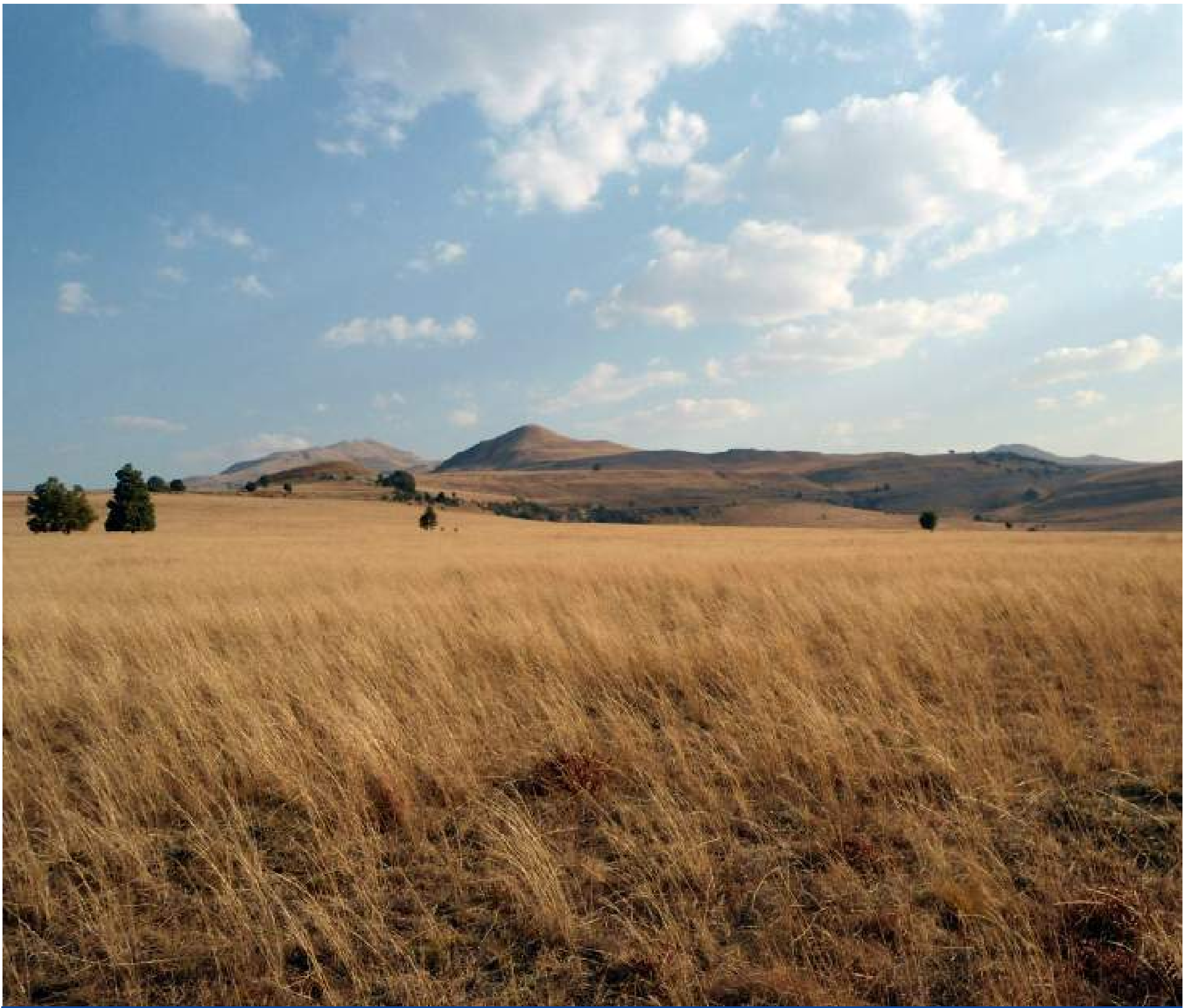
Soils, Land Use and Land Capability Assessment

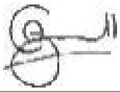
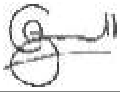


PROPOSED YZERMYN UNDERGROUND COAL MINE - LAND USE, SOIL AND LAND CAPABILITY ASSESSMENT

Atha-Africa Ventures (Pty) Ltd

2013/08/23

Quality Management

Issue/revision	Issue 1	Revision 1	Revision 2	Revision 3
Remarks	Draft Report	Final Report		
Date	August 2013	August 2013		
Prepared by	A. Gemmell	A. Gemmell		
Signature				
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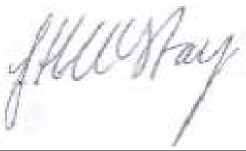
Signature				
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PROPOSED YZERMYN UNDERGROUND COAL MINE - LAND USE, SOIL AND LAND CAPABILITY ASSESSMENT

Atha-Africa Ventures (Pty) Ltd

2013/08/23

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1 Introduction and Scope of Work

WSP Environment & Energy (WSP) was appointed by Atha-Africa Ventures (Pty) Ltd (Atha) to undertake an Environmental and Socio-Economic Impact Assessment (ESIA), with all associated specialist studies in support of a Mining Right Application for a proposed underground coal mine located within a prospecting right in the Dirkiesdorp area in the Mpumalanga Province. The ESIA aims to fulfil the requirements of the Equator Principles and International Finance Corporation (IFC) standards and guidelines.

As part of the specialist studies, WSP carried out a soil, land capability and land use assessment to determine the potential impacts of the project. This incorporates the following stages:

- Desktop review to determine baseline environmental conditions within the prospecting right;
- Groundtruthing of the desktop study within the identified mining impact area; and,
- Impact assessment and identification of mitigation measures.

2 Project Description

Atha has been granted the prospecting rights to an 8360 ha coal prospect area, comprising 10 farms some 58 km south-west of Piet Retief in the Mpumalanga Province (**Figure 1**). A two-phased approach has been suggested, with the first phase being aimed at bringing a target area of some 2500 hectares into production, while the remainder of the area is to further explored and developed.

The proposed project mine area contained within the prospecting right (**Figure 2**) is named Yzermyn Underground Coal Mine after the farm of the same name incorporated into the project area (Farm Yzermyn 96, Portion 1 and remaining extent). Atha has appointed Mindset Mining Consultants (Pty) Ltd (Mindset) to undertake the project planning, engineering and development of the mine and to manage the mining right application process.

It is anticipated that the mine will produce approximately 1.8 million tonnes per annum from eight underground sections with a washing plant onsite. On the basis of the indicated reserves, the initial life of mine is calculated to approximately 15 years, with the potential for extension based on resources in the remaining areas.

It is anticipated that the coal will be transported to a coal wash plant on the surface that will be crushed and washed prior to transportation offsite. The wash plant is designed to maximise the recovery of sellable coal and minimise the discard quantity. Discard from wash plant will be deposited on the discard dump and the washed coal will be stockpiled. Provision has been allowed for discard disposal whilst the product will be transported by road to the existing Piet Retief Coal Siding (operated by Jindal) near Piet Retief for dispatch to Richards Bay Coal Terminal. The haul route will take the unpaved road through the village of Dirkiesdorp, which is situated about 13km from the proposed mine site.

The proposed development plan is represented in **Appendix A** and can be summarised as follows:

- The mine adit is located to the south-east of the proposed development footprint, from which runs a stockpile conveyor leading to the Run of Mine (ROM) stockpile, processing plant and primary and secondary stockpiles. The stockpile areas are expected to be underlain by hardstanding.
- East of the stockpiles is located the administrative and operations area, including the office block, ablutions, workshop, oil store, gas/chemical store, wash bay and associated silt trap, parking areas and sewage plant. The majority of the proposed administration area is expected to be covered by hardstanding.
- West of the stockpiles is the proposed Water Treatment Plant (WTP) and Pollution Control Dam (PCD).

- An access road is proposed to lead from the existing road located adjacent to the northern boundary of the site. A weigh bridge and office is proposed on the portion of this access road north-east of the administration area.
- A co-disposal facility (referenced as a discard dump on the development plan) is proposed north of the mine and administration area. No design was given for this facility, but in line with other coal mine co-disposal facilities, it is expected that this facility will comprise an above-ground reservoir constructed from coarse coal discard, and used to contain slurry derived from the processing plant (including coal wash water).
- As indicated in the available mine plan, a cut-off trench is proposed to surround the proposed surface infrastructure area, forming the boundary. This acts to prevent clean water entering the mine area and dirty water from leaving the mine area.

3 Assumptions and Limitations

The desktop study is reliant on various published data sources (aerial imagery, mapping and previous reporting) which have been assumed to be accurate.

The groundtruthed information is valid only for the mine area specified in the development plan, and cannot be considered applicable to the wider prospecting area.

4 Approach

4.1 Desktop Review

A desktop review was conducted to determine the local and regional geoenvironmental characteristics. This review included the following information sources:

- Available documentation to define the hydrological and climatic conditions:
  - Water Research Commission (WRC), 1994. The Surface Water Resources of South Africa, 1990, Volume VI, Eastern Escarpment (WRC Report No 298/6.1/94 and 298/6.2/94).
- Relevant documentation and mapping for the area to define the regional setting, topography, geology, vegetation, soils, land capability, grazing capacity and land use, including:
  - Competent Persons Report, Compiled by Mindset Mining Engineers (Pty) Ltd, 2013
  - Jeffrey, L. 2005. Challenges associated with further development of the Waterberg Coalfield. *The Journal of The South African Institute of Mining and Metallurgy* **105**.
  - WRC, 1997. GIS mapping Associated with the South African Atlas of Agrohydrology and Climatology (WRC report TT82/96).
  - Mucina, L. & Rutherford, M.C. (eds), Reprint 2011. The Vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria;
  - Department of Agriculture, Forestry and Fisheries (DAFF), 2006. Geology, Land-Type, Land Capability, Grazing Capacity and Land Use Mapping in GIS Shapefile Format;

- Topographical Mapping of South Africa in 1:50,000 Scale (2730AC – Wakkerstroom and 2730AD – Vredehof); and,
- Google Earth imagery, dated 28th January 2011 to 10th April 2013.

- Proposed surface infrastructure development plan:
  - Constructive Consulting Engineering cc., Yzermyn Project. Drawing Number: Site-1. Revision: 1. Dated 01-07-2013.
- Relevant Legislation
  - Conservation of Agricultural Resources Act (No. 43 of 1983).

4.2 Site Assessment

A site walkover was conducted by Andrew Gemmell and Ayanda Mthalane of WSP on the 1st and 2nd of July 2013. The objective was to groundtruth the information gathered during the desktop review, focussing on the proposed extent of the mine area. Observations made included the following:

- Topography;
- Vegetation type and health;
- Surface water, including wetlands;
- Soil properties (depth, colour, texture, structure), investigated through the advancement of soil profiles to a maximum depth of 1.0m;
- Soil classification based on the South African Soil Classification System (published by the Soil Classification Working Group, 1991);
- Land capability factors (including vegetation type, topography, topsoil texture, depth, permeability class) guided by the Soil Potential and Land Capability determination method as outlined by Manson *et al.* (1995); and,
- Land use.

4.3 Impact Assessment

The methodology utilised to assess the environmental impacts (**Appendix B**) are summarised in **Table 1**. The consequence of the environmental impact is determined based on the expected severity, duration and extent; the impact likelihood is determined based on the frequency and probability of the impact. The environmental significance is then determined based on the consequence and likelihood. The environmental significance is used to guide the required management and mitigation measures to limit these impacts.

Table 1: Summary of Environmental Impact Assessment methodology

■ SEVERITY of the impact ■ DURATION of the impact ■ Spatial scale (EXTENT) of the impact	**Consequence**	**Significance**
■ FREQUENCY of the activity ■ PROBABILITY of the impact	**Likelihood**	

5 Legislation Context

The objectives of the soil, landuse and land capability assessment is to identify soils, land capability and grazing capacity that should protected. These objectives are broadly contained within the Conservation of Agricultural Resources Act (No. 43 of 1983).

The objectives of this act are to "*provide for the conservation of the natural agricultural resources of the Republic by the maintenance of the production potential of land, by the combating and prevention of erosion and weakening or destruction of the water sources, and by the protection of the vegetation and the combating of weeds and invader plants".*

Given the applicability of the Act, this was used to guide the assessment of the soil, landuse and land capability within the proposed mine impact area so as to best conserve the natural resources.

6 Environmental Setting

The expected baseline environmental condition within the prospecting right was obtained from the desktop review.

6.1 Climate and Hydrology

The proposed mine area and prospecting right falls within the W51A Quaternary Catchment, within the Assegaai River catchment. The climatic conditions and runoff amounts for this quaternary catchment are presented in **Table 2**. The Mean Annual Precipitation (MAP) for the area is 922mm with a Mean Annual Evaporation (MAE) of 1,400mm. This results in a Mean Annual Runoff (MAR) of 87.6 million m^3 (WRC, 1994).

Table 2: Quaternary catchment information (WRC, 1994)

Quaternary Catchment	Area (km^2)	MAP (mm)	MAE (mm)	MAR (mm)	MAR (m^3)
W51A	624	922	1,400	140	87,600,000

Rain-gauges located in close proximity to the site were selected from the database compiled by the Institute for Commercial Forestry Research (ICFR), and School of Bioresources Engineering and Environmental Hydrology (BEEH) associated with the University of the KwaZulu-Natal. The Dirkiesdorp rain-gauge (0407730W) was considered representative based on the record length, altitude and distance relative to the site (**Table 3**).

Table 3: Rainfall station summary (ICFR, 2004)

Station Name	Station Number	Longitude	Latitude	Distance from site (km)	Record (years)	Reliable data (%)	Patched data (%)	MAP (mm)	Altitude (mamsl)
Dirkiesdorp	0407730W	30.401	27.167	10	96	34.1	67.7	586	1,350

The mean annual precipitation (MAP) for the Dirkiesdorp station is 586mm. The MAP in the vicinity of the proposed mine (586mm) is notably less than the MAP for the quaternary catchment (922mm); expected to be due to terrain differences within the quaternary catchment that leads to rainfall variability. **Table 4** represents the average monthly rainfall expected for the station. The wet season runs from October to March. The expected monthly evaporation for the area is given in **Table 5**.

Table 4: Rainfall monthly averages for Dirkiesdorp rain gauge (after WRC, 1994

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Rainfall (mm)	62	89	96	95	79	65	34	13	7	8	10	28

Table 5: Evaporation monthly averages (after WRC, 1994)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Evaporation (mm)	137	143	153	154	131	127	99	82	69	78	100	127

The Assegaai River passes through the northern extremity of the prospecting right (**Figure 1**). Various watercourses originate within the prospecting right and contribute to the Assegaai River. In the vicinity of the proposed surface infrastructure area, some groundwater seep areas are evident. These contribute to a non-perennial watercourse located approximately 100m to the west of the proposed mine extent and a perennial watercourse is located approximately 300m to the east (**Figure 2**).

6.2 Topography

The topography of the prospecting right comprises rolling hills, with steeper slopes approaching 20% in the south-western portions.

The highest elevations (1,900m to 2,300m above mean sea level) are located within the southern part of the prospecting right. The slopes become less steep (approximately 5%) within the north-eastern part of the prospecting right where the lowest elevation is 1415m.

Within and immediately surrounding the proposed mine area the topography is moderate to steep (5% to 10%, with the terrain being steeper towards the watercourses to the east and west. Rock outcrops are located adjacent the southern boundary of the mine area.

6.3 Geology

The proposed Yzermyn Underground Coal Mine is located within the Vryheid Formation of the Karoo Supergroup, on the northern boundary of the Utrecht Coalfield. Primary economic coal seams formed in the Utrecht Coal field are the Alfred and Dundas seams. Numerous dolerite intrusions (dykes and sills) intrude the Vryheid Formation, influencing the stratigraphy of the area and quality of the coal (Competent Persons Report, 2009). According to Jeffrey (2005), the Utrecht Coalfield has seams rich in moderately good coking coal and require little beneficiation. The Lower Dundas seam rank varies from medium volatile bituminous to anthracitic, with the coal mined as a source of bituminous coal in the north eastern sector of the coalfield and as anthracite in the southern sector. However, the sulphur content can be high (in excess of one per cent).

The Gus seam is subdivided into three coal quality zones with the upper part comprising mainly dull coal, the central part predominantly bright coal and the bottom section mainly poor quality coal with shale partings. The seam has been noted to have elevated methane gas concentration. The Alfred seam is of better quality in the Utrecht Coalfield, particularly towards the bottom portion of the seam. The seam is generally high in ash and sulphur content but beneficiation can produce relatively high quality, low ash coal with low sulphur and phosphorus (Jeffrey, 2005).

According to the Competent Persons Report (2013), the Alfred and Dundas coal seams are of economic significance with each seam thickness averaging around 1.65m with suitable qualities within the target area.

6.4 Soils

Based on the soil class mapping, (DAFF, 2012) (**Figure 3**) the soils to the south of the prospecting right, located on the crest of the steep hills, are defined as non-soil land classes which will limit land use options. Land-type mapping for these soils indicates that the rock dominates. Based on the expected geology for the site, where soils are present, these typically comprise sandy clays of a depth ranging between 200mm and 400mm.

Within the lower elevations, on the mid-slopes of the hills, the soil classes indicate freely drained, structureless soils. Although having favourable physical properties, the soils have the potential for excessive drainage (i.e. high permeability), high erodibility, and low natural fertility. The land-type mapping for these soils indicates that these soils typically comprise sandy clays and clays, with some rock present. Soil depths typically range from 450mm to 1,200mm, with Hutton soil forms dominating. The soils within the proposed surface infrastructure area include these soils.

Within the north-western portion of the prospecting right where the terrain remains hilly, although not as steep as the southern portions, the crests and upper slopes are dominated by soils with minimal development. These soil classes are also present within the valley bottoms adjacent to watercourses. Shallow soils and rocky outcrops dominate within these areas, and the soil classes indicate undifferentiated shallow soils which will limit the land use options. Based on land-type mapping, the soils are dominated by sandy clays and sandy clay loams, with soil depths ranging from 50mm to 500mm. Typical soils are Hutton, Mispah, Glenrosa and Shortlands.

6.5 Land Capability

Land capability classes are interpretive groupings of land units with similar potentials and continuing limitations or hazards. Whilst social and economic variables are not specifically included, consideration is given to:

- The risks of land damage from erosion and other causes; and
- The difficulties in land use owing to physical land characteristics, including climate.

There are eight land classes, denoted by Roman numerals. Classes I to IV are suitable for arable land, Classes V to VII are suitable as grazing land, and Class VIII is not considered suitable for agriculture, with the use being limited to recreation, wildlife, water supply or aesthetic purposes.

Adjacent to the Assegaai River to the west of the prospecting right, the land capability is Class VII (DAFF, 2012) (**Figure 4**). Land in Class VII has very severe limitations that make it unsuited to cultivation and that restrict its use largely to grazing, woodland or wildlife. Restrictions are severe because of one or more continuing limitations that cannot be corrected. Due to the proximity to the watercourses, the limitation is expected to be due primarily to soil wetness and the clayey soils.

On the crests and upper slopes of the hills present within the central and eastern portions of the prospecting right the land capability is classified as Class VI Land in Class VI has severe limitations that make it generally unsuitable to cultivation and limits its use largely to pasture and range, woodland or wildlife. The limitations are expected to be primarily due to the steep slope and shallow nature of the soils and, as such, cannot be easily corrected.

On the lower slopes of the hills the land capability is classed as Class III. Land in Class III has severe limitations that reduce the choice of plants or require special conservation practices. The presence of clayey soils within this area may be the limiting factor for cultivation. The proposed surface infrastructure area comprises land within this capability.

Within the south-eastern extremity of the prospecting right, the land capability is Class II. Land in Class II has some limitations that reduce the choice of plants or require moderate conservation practices. The land may be used for the cultivated crops and, although some limitations exist, management practices are easy to apply.

6.6 Grazing Capacity

The grazing capacity is defined as the area of land required to maintain a single animal unit without causing deterioration in soil or vegetation condition (a decrease in basal cover, or a change in species composition or vigour of the veld plants). The area required for one animal unit varies considerably and is determined primarily by the veld type, the condition of the veld and the topography. An Animal Unit (AU) is equivalent to a mammal of conventional quadruped shape which has a mass of 450kg (i.e. the size of an average steer).

The majority of the prospecting right has a grazing capacity ranging from less than 4ha/AU to 10ha/AU, considered excellent to good. The grazing capacity of the surface infrastructure area where the soil will get disturbed is expected to have a grazing capacity of 5ha/AU to 7ha/AU, considered excellent (**Figure 5).**

6.7 Land Use

The land use within the prospecting right, determined in 2000 by DAFF (**Figure 6**), indicates that the majority of the area is comprised of unimproved (natural) grassland.

Based on Mucina and Rutherford (2006) (**Figure 7**), the general natural vegetation within the prospecting right is dominated by Wakkerstroom Montane Grassland. In the lower lying areas adjacent to watercourses Paulpietersburg Moist Grassland is present. Patches of thicket and bushland are present on the north and south facing slopes adjacent to the Assegaai River within the northern extremity of the prospecting right. In addition, isolated patches of thicket and bushland as well as indigenous forest are present within river valleys to the north-east and south-east of the prospecting right. Mucina and Rutherford (2006) indicate that the indigenous forest is comprised of Northern Afrotemperate Forest. Pine plantation forestry is present on a portion of land to the north-west of the prospecting right, with cultivated temporary commercial dryland agriculture present within isolated portions of the prospecting right.

The land use within the proposed surface infrastructure area comprises unimproved grassland dominated by Wakkerstroom Montane Grassland and Paulpietersburg Moist Grassland.

7 Site Assessment

The site assessment was undertaken to groundtruth the information obtained through the desktop study, with specific focus on the expected mine impact area (**Figure 2**).

7.1 Land Use

The site walkover identified the current landuse within the proposed surface infrastructure area as being grassland used for cattle grazing. Isolated thicket comprising predominantly black wattle is located to the north-east of the footprint. Formalised fencing is in place to demarcate the grazing areas. An informal unpaved farm road passes through the eastern extremity of the site, with an unnamed unpaved district road making up the north boundary of the surface infrastructure area. A rural homestead is located at the eastern boundary, comprising ten structures, with limited subsistence cropping. Rock outcrops are located on the western and southern boundaries of the proposed mine area.

7.2 Soil

Due to the uniformity in topographical units, vegetation type and slope the soils within the proposed surface infrastructure area, the impact area are not expected to vary significantly. As a result, only five sampling locations were explored (**Figure 2**). Soil logs are presented in **Appendix C**. The soil properties within the surface infrastructure area can be broadly be described as follows:

- The topsoil extends to a depth of between 0.2m to 0.3m below ground level (bgl) and is characterised by light brown, loose, fine to medium grained sands. Grass roots were predominantly within this portion of the profile.
- The subsoil is characterised by yellow-brown, loose fine to medium grained sands, extending to a depth of 0.5m to 1.0m.
- Practical refusal was encountered on light grey to pink and orange, medium to coarse grained sandstone (Vryheid Formation) at depths ranging from 0.5m to 1.0m.

Based on the South African Soil Taxonomic System, the soils are classified as the Clovelly Soil Form. The soils are expected to be of the Twyfelaar Soil Family, given the high rainfall (MAP greater than 850mm) and sandy nature of the soils, expected to lead to non-luvic and dystrophic soil properties (i.e. leached soils which are low in clays). The observed soils differ from the land-type mapping, which indicated that sandy clays and clays are expected. This may be due to localised variability in the soil properties that is not included in the more generalised land-type maps.

It is notable that at the north-western and south-easterly extremities of the proposed surface infrastructure area, saturated soil conditions were noted in the upper profile, evident of hillseep wetland conditions. The approximate locations are represented in **Figure 2**.

7.3 Land Capability

Based on the methodology for Soil Potential and Land Capability determination outlined by Manson *et al.* (1995), with information obtained from both the desktop study and site walkover, the various inputs to the Land Capability determination can be summarised as follows:

- **Vegetation Type:** Wakkerstroom Montane Grassveld;
- **Topography:** An average of approximately 9.6% based on 1:50 000 topographical mapping;
- **Topsoil Texture:** 0% to15% clay, based on in-field estimation methods;
- **Depth:** Between 0.5 and 1.0m total thickness; and,
- **Permeability Class:** The permeability is rapid (i.e. between 1 and 3 seconds), hence Class 6 permeability.

Based on these characteristics, the Land Class of the majority of the site is defined as Class IV. This represents a lower land capability as measured during the desktop study (Class III). Land with this classification is expected to have severe permanent limitations or hazards and is suitable for occasional row-cropping in long ley rotations (i.e. once every 4-6 years), with complex and intensive protection measures and practices required during cultivation (Manson *et al*; 1995). The following notable exceptions to this Land Class were encountered:

- Due to the wetland conditions noted within the north-western and south-easterly extremities of the site (**Figure 2**), the Land Class is downgraded to Class Vb in these specific areas. Areas with this Land Class are best left under permanent vegetation, according to Manson *et al*; (1995).
- A rocky outcrop present at the head to the wetland located to the north-west of the site (**Figure 2**), was noted, hence the Land Class is downgraded to Class VI in this specific area. Areas with this Land Class do not promote cultivation.

Given these limitations, the agricultural land use is best suited to grazing. Based on the desktop study, the grazing capacity of the surface infrastructure area is considered 'excellent' on a regional scale.

8 Impact Assessment

The objectives of the Conservation of Agricultural Resources Act (No. 43 of 1983) is to conserve the natural agricultural resources by combating and preventing erosion and the weakening or destruction of the water sources, and by the protection of the vegetation and the combating of weeds and invader plants. This Act was used to guide the impact assessment. It was assumed that the land will be utilised for grazing, as is currently practiced.

The impacts expected during the Construction, Operational and Decommissioning/Rehabilitation phases are outlined in the following sections, with the calculations summarise in **Table 6**. Based on these impacts, mitigation measures are outlined to reduce the environmental significance of the impact (**Table 7**).

8.1 Construction Phase

During the construction of the mine and associated infrastructure, there is expected to be the reworking of the soils (i.e. cut and fill, blasting, land levelling and foundation excavations) and associated vegetation removal. This is expected to occur over the extent of the proposed development area, including the mine adit, administration area and parking, plant area and stockpile area, pollution control dams, stormwater infrastructure and the co-disposal facility. The approximate extent of this impact is 0.6km^2. This has the potential to lead to the following impacts:

- Damage or removal of vegetation cover through construction activities and vehicle and foot traffic;
- Erosion of unvegetated soils during rainfall events due to the sandy soil properties and the moderate to steep topography encountered at the site;
- Compaction of soils due to foot and vehicle traffic, leading to increased runoff;
- Loss of fertile topsoil due to poor stockpiling practices;
- Spills of hydrocarbons from heavy machinery; and,
- Additions of carbonaceous material (as well as explosive residues) to the soil, derived from fly rock during the blasting of the mine adit.

The loss of soils (including the fertile topsoil) and any contamination arising from the construction activities has the potential to reduce the land capability related to grazing. This will be further exacerbated by the promotion of weed and invader species encroachment due to soil disturbance. There is also expected to be water quality impacts to the adjacent watercourses due to contributions of runoff arising from the construction site, including an increase in turbidity due to erosion from the construction site, as well as contributions of hydrocarbons from any onsite spills.

To limit these impacts, the following is recommended (with the required actions and responsible parties detailed in **Table 7**):

- Large areas of soil excavation should be phased to limit the erosion potential during rainfall events (more common between September to February). Construction activities outside of the designated development areas should be limited.
- Excavated soils should be appropriately stored in stockpiles which are protected from erosion (i.e. through use of vegetation cover in the case of long-term stockpiles). The topsoil (upper 0.2m to 0.3m) is expected to have a higher fertility than the subsoil horizons and holds the vegetation seed bank; hence the topsoil should be kept separate from the subsoils. This should be guided by a soil stripping plan and approapriate soil stripping logs. The soil stockpile height and slopes need to be maintained within safe limits.
- No waste material must be placed on the soil stockpiles, and equipment movement on the stockpiles must be limited.
- Due to the potential for soil compaction due to vehicles, traffic should be limited to existing or proposed roadways as far as possible. The construction of roads should be limited in width and length as far as is practical to limit impacts.
- Vegetation removal should be kept to a minimum and limited to the area of development. Where an impact to the vegetation outside of the development footprint occurs, rehabilitation measures need to be undertaken to maintain the baseline vegetation population and health. Weed and invader species growth needs to be appropriately managed within the surface infrastructure area to maintain the baseline vegetation health.
- Soil contamination needs to be limited through appropriate onsite environmental management practices, including:
  - Drip trays must be placed beneath parked machinery;
  - Machinery to be checked for leaks of hydraulic fluids and fuels;
  - All vehicles and equipment must be serviced regularly and logs kept on site.
  - Ensure that diesel tanks are bunded and underlain by impervious materials to ensure that any spills are contained.
  - The prescribed procedure for major spillage must be kept on site, including an incident reporting and remediation log.
  - If necessary, polluted soils must be classified as waste and be discarded at an appropriate permitted waste site. After removal of the contaminated soils, the affected areas must be rehabilitated.

Based on the Risk Assessment methodology (**Appendix B**), the following can be noted:

- The reduction in land capability related to grazing is expected to have a **medium to high** environmental significance, both with and without mitigation measures.
- The reduction in surface water quality during construction is expected to have a **medium** environmental significance. Should mitigation measures be implemented, the environmental significance is expected to be reduced to **low to medium**.

8.2 Operational Phase

During the operation of the mine, there is expected to be the potential for the following impacts to the soils and associated land capability:

- Increased runoff from impervious areas (i.e. compacted soils, roads, hardstanding) leading to erosion of the adjacent land;
- Disturbances to the soil, leading to invader and alien species growth; and,
- Pollution of soils through spills from machinery and any stored chemicals. Impacts of stored coal and Co-Disposal Facility and associated pollution control dams in polluting the soils through acid mine drainage. This has the potential to lead to groundwater and surface water impacts.

Any erosion or contamination arising from the site activities has the potential to reduce the land capability, as well as lead to impacts to the adjacent watercourses. To limit these impacts, the following is recommended (with the required actions and responsible parties detailed in **Table 7**):

- To appropriately manage stormwater, the Stormwater Management Plan developed as part of the specialist studies for this project needs to be implemented. This includes the required infrastructure sizings for pipes, channels and reservoirs, as well as recommendations for erosion control at the releases of clean water to the environment. This also includes the management requirements for the co-disposal discard facility.
- Erosion observed should be rehabilitated, with mitigation measures adopted in high risk areas (i.e. gabions gabion mattresses in erosion gullies).
- Areas of alien and invader plant species proliferation needs to be actively managed.
- Impacts that are expected to lead to long term degradation of soil quality (i.e. soil contamination) needs to be limited through appropriate onsite management measures. This includes the proper handling and storage of hazardous materials, the use of hardstanding in areas where spillages are possible, the use of bunding around storage of hazardous materials (i.e. fuel storage tanks), and proper upkeep of machinery and vehicles.
- Waste oil and grease must be contained in suitable containers at designated collection points. Notices must be erected at these points giving instructions on the procedure for waste oil discharge and collection.
- A waste management plan must be put in place that takes account of the domestic waste collection in marked bins in a designated area and collection of waste by a recognized contractor for disposal at a registered facility off site.

Based on the Risk Assessment methodology (**Appendix B**), the following can be noted:

- The reduction in land capability related to grazing due to erosion during the operational phase is expected to have a **medium** environmental significance. The environmental significance is expected to be reduced to **low** should the mitigation measures outlined be adopted.
- The reduction in soil, groundwater and surface water quality surface water quality is expected to have a **medium to high** environmental significance. Should mitigation measures be implemented, the environmental significance is expected to be reduced to **low**.

8.3 Decommissioning and Rehabilitation Phase

During the closure and rehabilitation of the mine and associated infrastructure, there is expected to be excavations, leading to the reworking of soils. This is expected to lead to similar impacts as during the construction phase, including a reduction in land capability and water quality of the receiving watercourses due to erosion and contamination arising from the decommissioning activities, and the promotion of weeds and invader plants due to soils and vegetation impacts. As with the construction phase, the approximate extent of this impact is 0.6km^2

To limit these impacts, the following is recommended (with the required actions and responsible parties detailed in **Table 7**):

- The decommissioning and rehabilitation measures should be phased to limit areas of bare soil.
- The stockpiled soils should be returned to the impacted land to reinstate the land capability, with topsoil being returned as the top layer. The soil properties and characteristics (e.g. permeability) representative of baseline conditions should be maintained to limit long-term impacts.
- Due to the compaction of soils due to vehicles, traffic should be limited to existing or proposed roadways as far as possible.
- Vegetation should be reintroduced as soon as possible to limit erosion. Weed and invader species growth needs to be appropriately monitored and managed. The vegetation type and health should be rehabilitated to baseline conditions wherever possible to ensure that the long term grazing capacity of the land is maintained.
- Soil contamination (e.g. hydrocarbons from heavy machinery) needs to be limited through appropriate on-site environmental management practices using the same mitigation measures as recommended for the construction phase (Section 8.1).

Despite rehabilitation, it is expected that the co-disposal facility and associated PCDs will remain in place due to the carbonaceous material contained within. The area of this facility is 0.4km^2 and is expected to remain unsuitable for grazing beyond the lifespan of the mine. Based on the Risk Assessment methodology (**Appendix B**), the following can be noted:

- There is not expected to be any significant reduction in land capability during the decommissioning and rehabilitation phase, with the exception of the relatively small area containing the co-disposal facility. As a result, the impacts are expected to be **low**. The objective would be to restore the land to a land capability resembling the baseline conditions as close as can practically be achieved.
- The reduction in surface water quality during the decommissioning and rehabilitation phases is expected to have a **medium** environmental significance. Should mitigation measures be implemented, the environmental significance is expected to be reduced to **low to medium**.

8.4 Cumulative Impacts

Cumulative impacts are the combined, incremental effects of human activity that pose an environmental risk. They result when the effects of an action are added to, or interact with, other effects in a particular place and within a particular time.

With regards to the impacts to soil and land capability, the following can be noted:

- The landuse surrounding the surface infrastructure area and within the prospecting right is largely grassland, with limited urban development. As a result, the cumulative impact to the land capability due to the proposed mine is expected to be limited.
- The proposed mine has the potential to impact the local and regional water quality. Limited cultivated agri-culture is located within the hydrological catchments in the vicinity of the proposed surface infrastructure area. This agriculture has the potential to increase sediments and nutrients within the watercourses due to runoff. Although these are no other mines noted within the contributing catchment, this runoff, in combina-

tion with the runoff from the Dirkiesdorp Township, is also expected to lead to a reduction in water quality. However, given the limited extent of these anthropogenic impacts, the cumulative impact of the proposed mine on the water quality is expected to be limited.

9 Conclusion

Through the development of the proposed underground coal mine, there are expected to be impacts to the land capability (including the use for grazing) limited to surface infrastructure development . In addition, there are expected to be a reduction in the soil, surface water quality due to contamination.

During the construction phase, the reduction in land capability is expected to have a **medium to high** environmental significance, both with and without the mitigation measures recommended being implemented. The reduction in surface water quality is expected to have a **medium** environmental significance; however, should mitigation measures be implemented, the environmental significance is expected to be reduced to **low to medium**.

During the operational phase, the reduction in land capability is expected to have a **medium** environmental significance; however, is expected have a **low** environmental significance should the mitigation measures outlined be adopted. Due to contamination arising from the site operations, there is the potential for soil, groundwater and surface water quality surface water quality, with a **medium to high** environmental significance expected; however, should mitigation measures be implemented, the environmental significance is expected to be reduced to **low**.

There is not expected to be any further reduction in land capability during the decommissioning and rehabilitation phases; hence, these impacts are expected to be **low**. The reduction in surface water quality during decommissioning and rehabilitation phases is expected to have a **medium** environmental significance; reduced to a **low to medium** environmental significance should mitigation measures be implemented.

Table 6: Risk assessment

			A	B	C	D	E	F	G	(DxG)	(DxG)
Phase	**Impact Description**	**Mitigation Measure**	**Severity**	**Duration**	**Extent**	**Consequence (A+B+C)/3**	**Frequency**	**Probability**	**Likelihood (E+F)/2**	**Environmental Significance (Without Mitigation)**	**Environmental Significance (With Mitigation)**
Soils, Land Use and Land Capability											
Construction	Reduction in land capability (grazing potential)	Limit construction extent, stockpile excavated soils, limit soil compaction and limit vegetation impacts.	4	5	2	3.7	5	5	5	**18.3**	
			4	4	1	3	5	5	5		**15**
	Reduction in surface water quality	Limit on-site contamination sources and erosion.	2	3	3	2.7	4	4	4	**10.7**	
			1	2	3	2	3	3	3		**6**
Operation	Reduction in land capability (grazing potential) due to erosion and alien invader plant species proliferation	Runoff from impervious areas should be managed to limit erosion. Observed erosion should be rehabilitated. Alien invasives need to be actively managed to prevent their spread,	3	5	3	3.7	3	3	3	**11**	
			2	2	2	2	1	2	1.5		**3**
	Pollution of soils, groundwater and surface water.	Limit release of contamination sources.	4	5	3	4	5	4	4.5	**18**	
			2	3	2	2.3	1	2	1.5		**3.5**
Decomm. / Rehab	Reduction in land capability (grazing potential)	Phase decommissioning and rehabilitation to limit erosion, ensure soils and vegetation reinstated to conditions as close to baseline as possible, limit soil contamination	1	2	2	1.7	1	2	1.5	**2.5**	
			1	1	1	1	1	1	1		**1**
	Reduction in surface water quality	Limit erosion and soil contamination	2	3	3	2.7	4	4	4	**10.7**	
			1	2	3	2	3	3	3		**6**

Table 7: Mitigation measures

Impacted Environment	Management Measure Ref.	Management Recommendations	Action Ref.	Required Action	Responsible Party	Phase
Soils and Land Capability (incl. Grazing Potential	1.1	Large areas of soil excavation should be phased to limit the erosion potential. Activities outside of the designated development areas should be limited.	1.1	The construction plan should take into account these recommendations. This should be incorporated into an EMPR and implemented by on-site contractor.	WSP, mine planner, on-site contractor, Environmental Compliance Officer (ECO)	Pre-construction/ Construction
	1.2	Excavated soils should be appropriately stored in stockpiles which are protected from erosion. Topsoil should be kept separate from the subsoils. Compaction and contamination of the soil stockpiles must be limited	1.1			
	1.3	Traffic should be limited to existing or proposed roadways as far as possible. The construction of roads should be limited in width and length as far as is practical.	1.1			
	1.4	Vegetation removal should be kept to a minimum and limited to the area of development.	1.1			
	1.5	Rehabilitation measures need to be conducted and weed and invader species growth needs to be appropriately managed within the surface infrastructure area to maintain the baseline vegetation health.	1.2	This should be incorporated into an EMPR and implemented by on-site contractor.	WSP, on-site contractor, ECO.	Pre-construction/ Construction
	1.6	Soil contamination needs to be limited through appropriate on-site environmental management practices.	1.2			
	1.7	The Storm Water Management Plan developed as part of this project needs to be implemented	1.3	Measures outlined in the Stormwater Management Plan needs to be implemented.	WSP, mine planner, on-site contractor, Environmental Compliance Officer (ECO)	Operation
	1.8	Erosion observed should be rehabilitated, with mitigation measures adopted in high risk areas.	1.2			Operation
	1.9	Soil contamination needs to be limited through appropriate on-site management measures. This includes the development of a waste management plan.	1.1			Operation

Impacted Environment	Management Measure Ref.	Management Recommendations	Action Ref.	Required Action	Responsible Party	Phase
	11.10	Areas of alien invasive plant species proliferation needs to be actively managed	1.2			Operation/ Decommissioning/ Post-closure
	1.11	The decommissioning and rehabilitation measures should be phased to limit areas of bare soil.	1.4	The rehabilitation and decommissioning plan should take into account these recommendations. This should be incorporated into an EMPR and implemented by on-site contractor.	WSP, mine planner, on-site contractor, Environmental Compliance Officer (ECO)	Decommissioning/ Post-closure
	1.12	The stockpiled soils should be returned to the impacted land to reinstate the land capability, with topsoil being returned as the top layer. The soil properties and characteristics (e.g. permeability) representative of baseline conditions should be maintained	1.4			Decommissioning/ Post-closure
	1.13	Due to the compaction of soils due to vehicles, traffic should be limited to existing or proposed roadways as far as possible.	1.4			Decommissioning/ Post-closure
	1.14	Vegetation should be reintroduced as soon as possible to limit erosion. The vegetation type and health should be rehabilitated to baseline conditions. Weed and invader species growth needs to be appropriately monitored and managed.	1.4			Decommissioning/ Post-closure
	1.15	Soil contamination needs to be limited through appropriate on-site environmental management practices.	1.2			Decommissioning/ Post-closure

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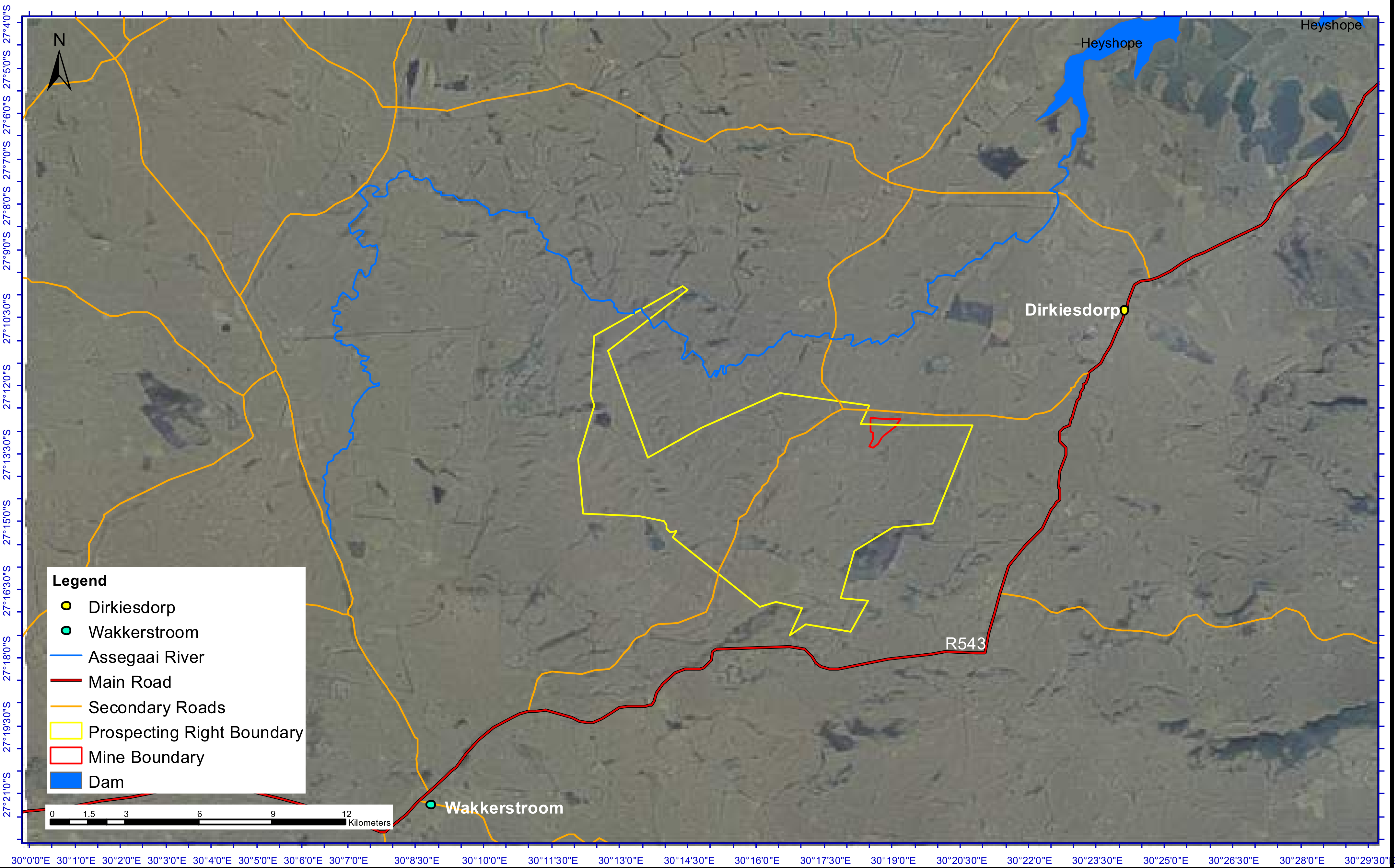
Figures



Atha-Africa Ventures (Pty) Ltd.

Locality Map

Data Source:
South African Department of Rural Development and Land Reform - Chief Directorate: National Geo-spatial Information

Projection Geographic - WGS1984

Project: Yzermyn Soil Land Use + Land Capability Assessmen

Project No: 24514-03

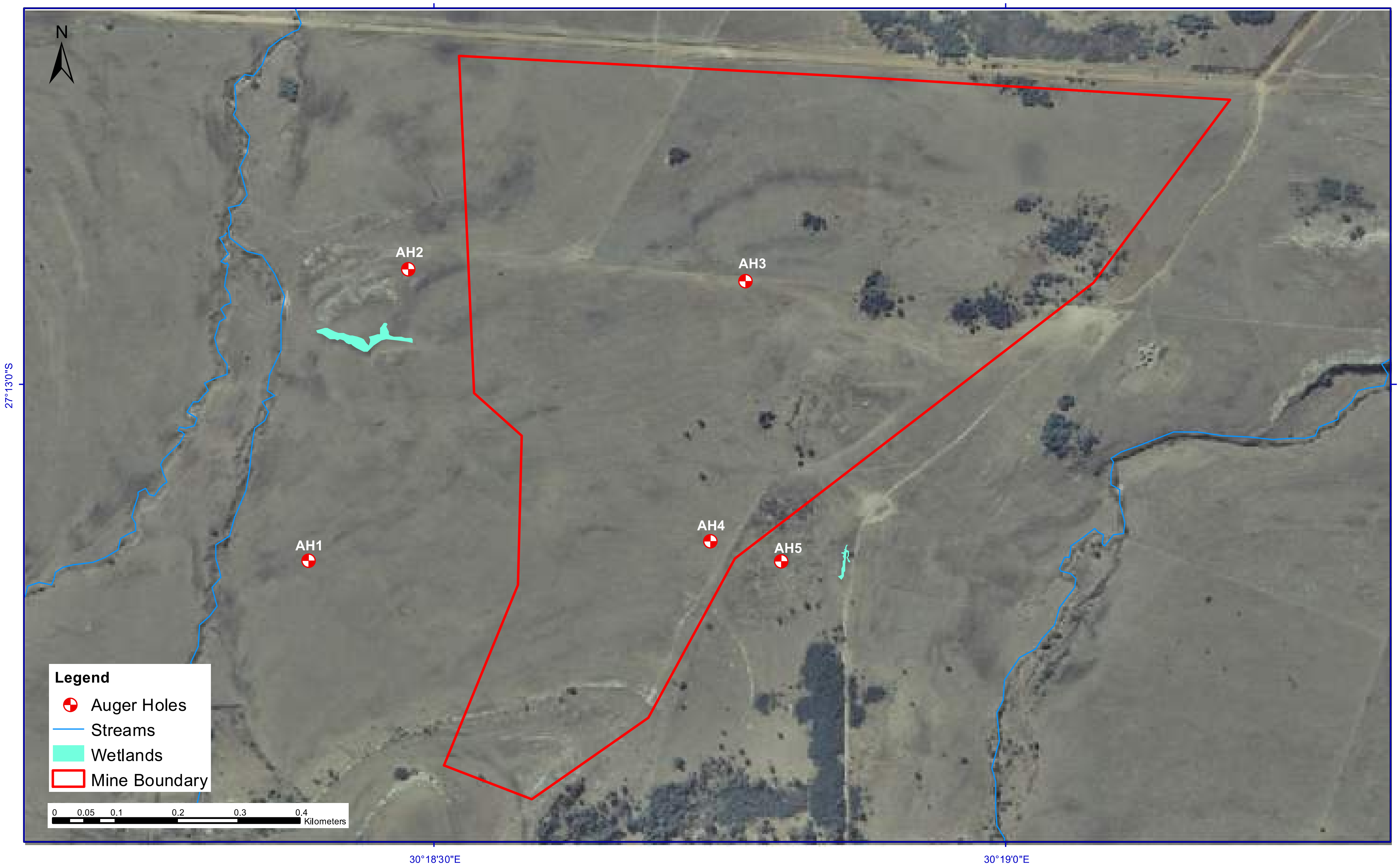
Drawn by: A. Mthalane

Reviewed by: A. Gemmell

Date: 05 August 2013

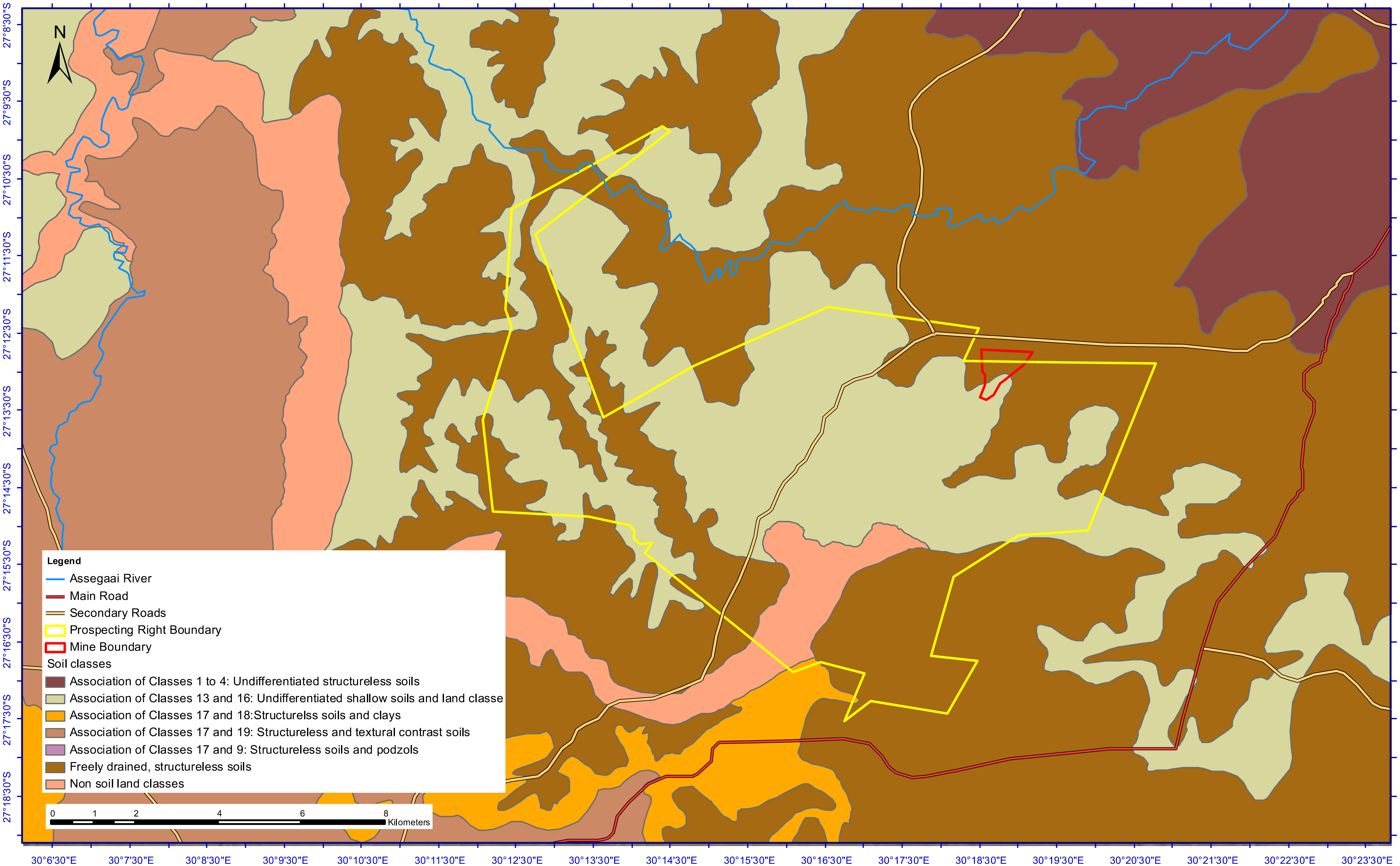
Figure No. 1

www.wspenvironmental.co.za

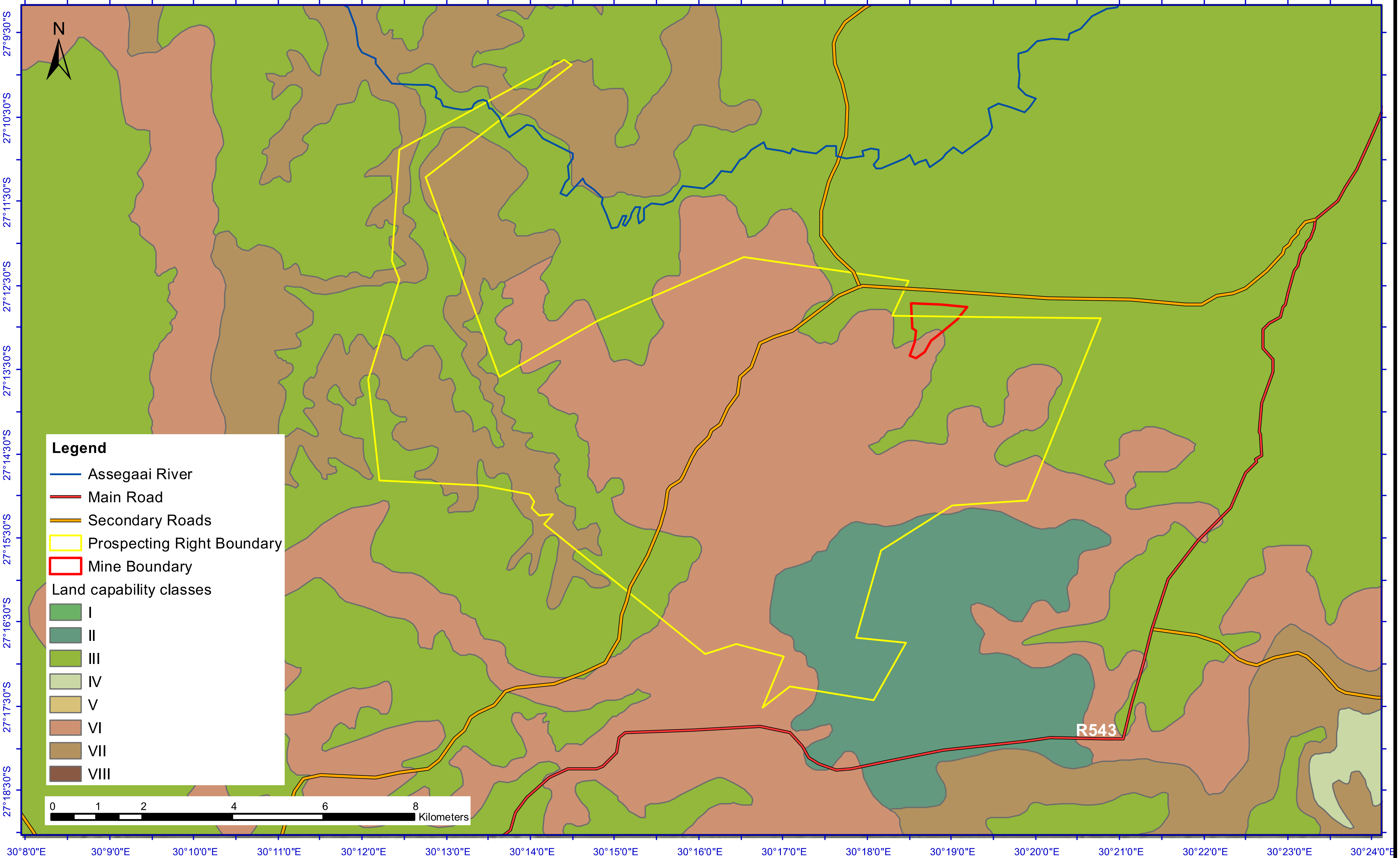


Atha-Africa Ventures (Pty) Ltd Mine Area	**Data Source:** South African Department of Rural Development and Land Reform - Chief Directorate: National Geo-spatial Information	**Project:** Yzermyn Soil Land Use + Land Capability Assessmen	**Date:** 05 August 2013
		Project No: 24514-03	
		Drawn by: A. Mthalane	**Figure No.** 2
	Projection Geographic - WGS1984	**Reviewed by:** A. Gemmell	

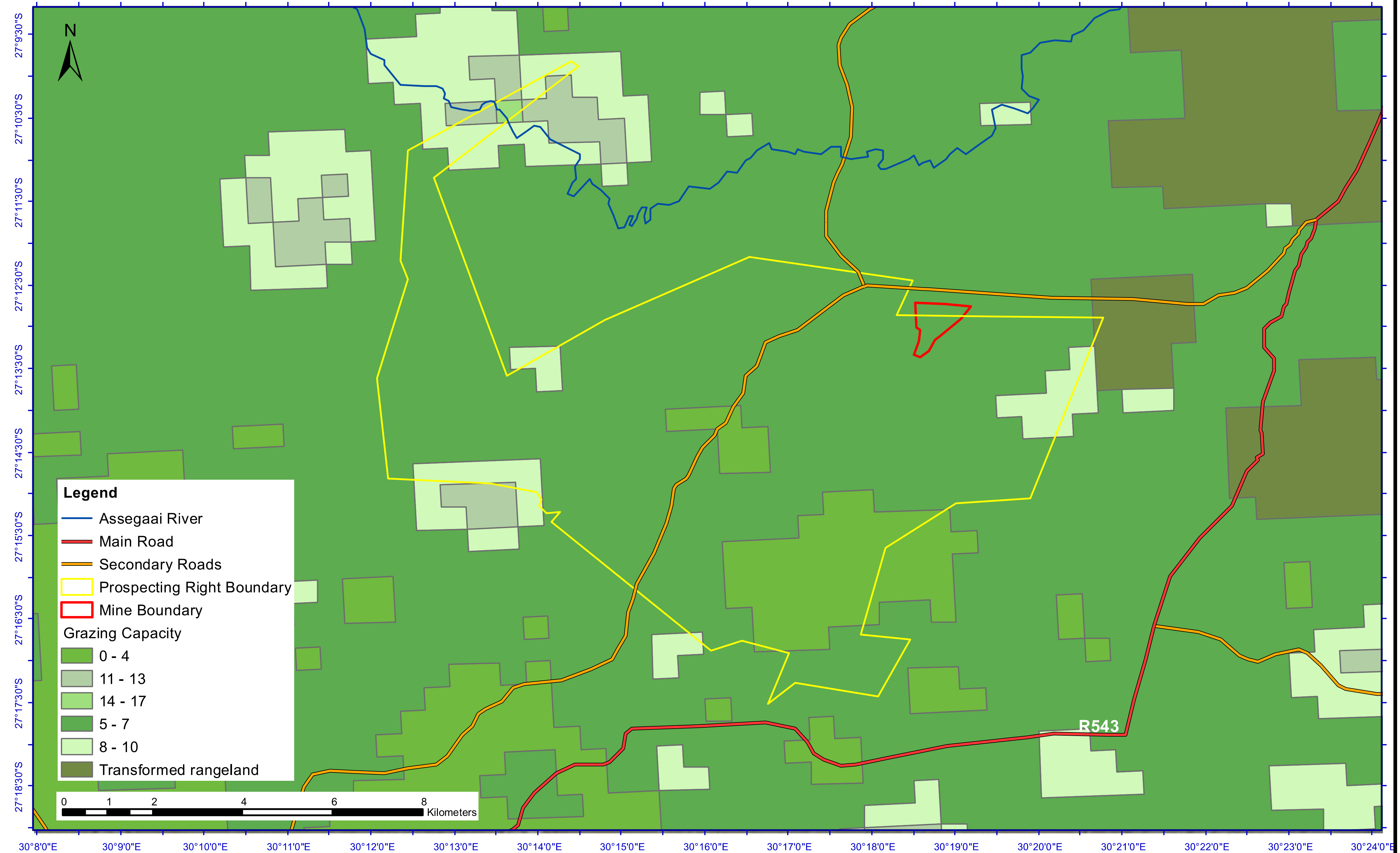
www.wspenvironmental.co.za



Atha-Africa Ventures (Pty) Ltd Soil Classes	**Data Source:** South African Department of Rural Development and Land Reform - Chief Directorate: National Geo-spatial Information	**Project:** Yzermyn Soil Land Use + Land Capability Assessment	**Date:** 05 August 2013	WSP www.wspenvironmental.co.za
		Project No: 24514-03		
		Drawn by: A. Mthalane	**Figure No.** 3	
	Projection Geographic - WGS1984	**Reviewed by:** A. Gemmell		



Atha-Africa Ventures (Pty) Ltd Land Capability Classes	**Data Source:** South African Department of Rural Development and Land Reform - Chief Directorate: National Geo-spatial Information	**Project:** Yzermyn Soil Land use + Land Capability Assessment	**Date:** 05 August 2013	WSP www.wspenvironmental.co.za
		Project No: 24514-03		
		Drawn by: A. Mthalane	**Figure No.** 4	
	Projection Geographic - WGS1984	**Reviewed by:** A. Gemmell		



Atha-Africa Ventures (Pty) Ltd

Land Grazing Capacity

Data Source:
South African Department of
Rural Development and Land Reform -
Chief Directorate: National Geo-spatial Information

Projection Geographic - WGS1984

Project: Yzermyn Soil Land Use + Land Capability Assessmen

Project No: 24514-03

Drawn by: A. Mthalane

Reviewed by: A. Gemmell

Date:
05 August 2013

Figure No.
5

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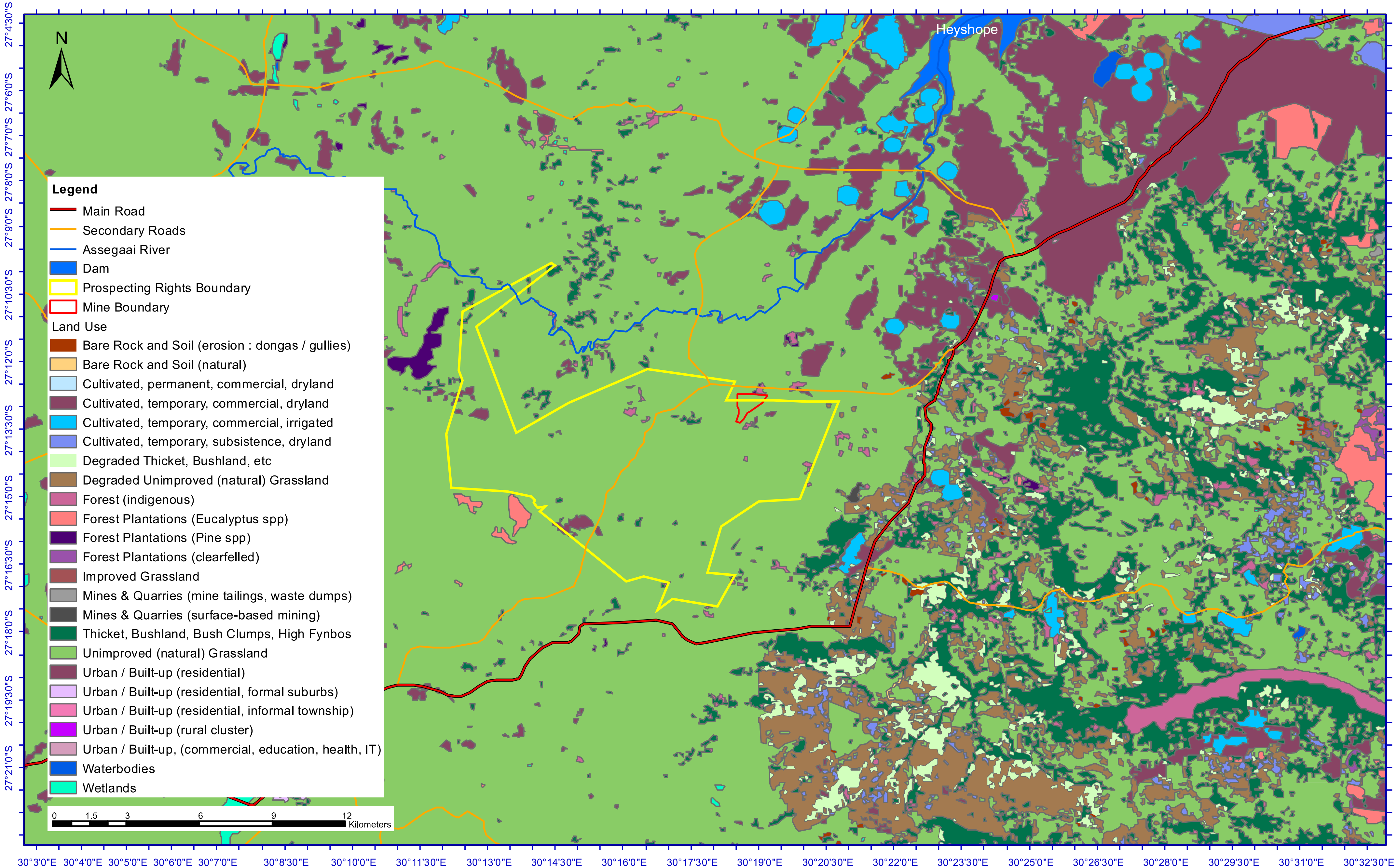
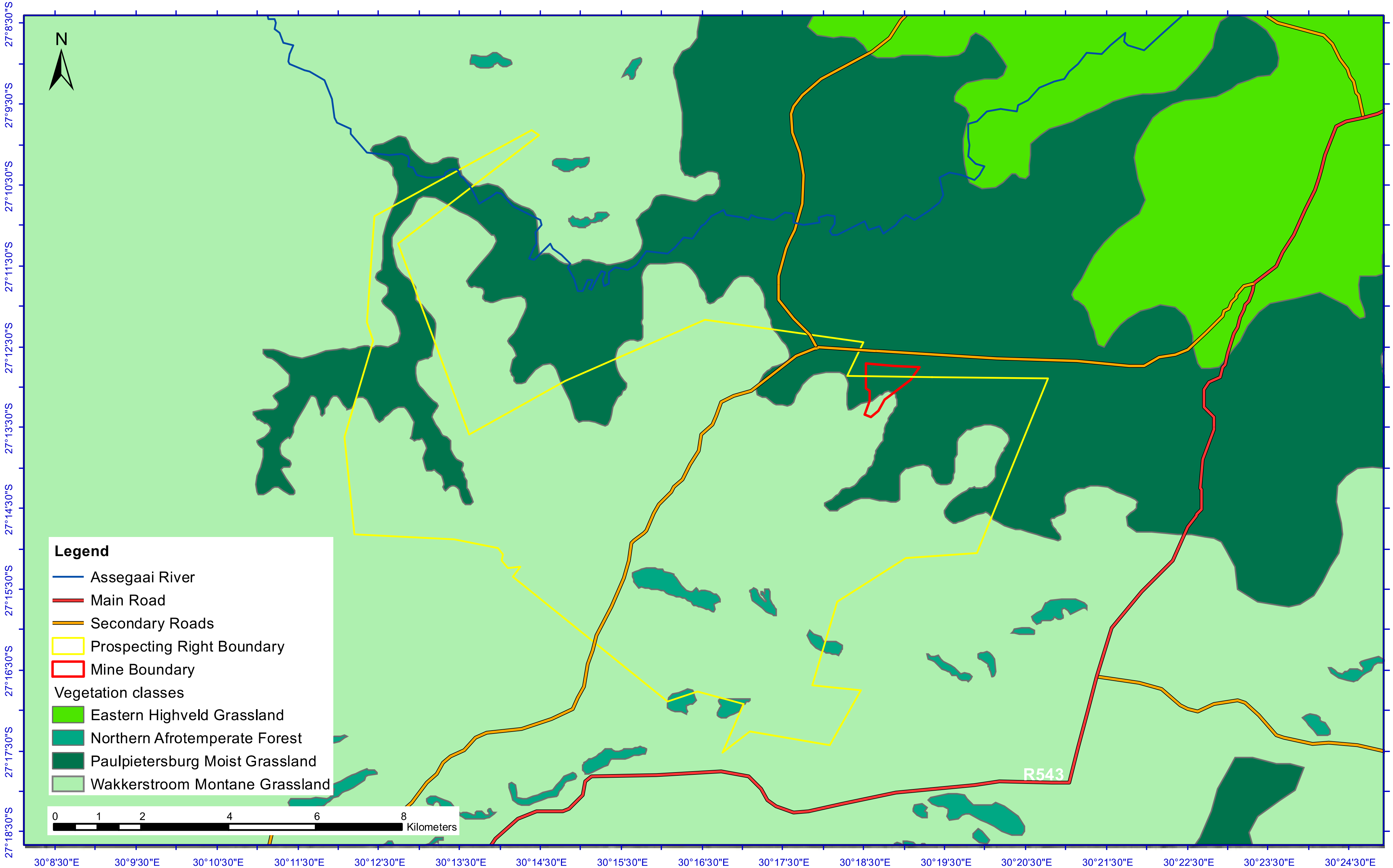


Atha-Africa Ventures (Pty) Ltd. Land Use Map	**Data Source:** South African Department of Rural Development and Land Reform - Chief Directorate: National Geo-spatial Information	**Project:** Yzermyn Soil Land Use and Land Capability Assessment	**Date:** 07 August 2013
		Project No: 24514-03	
		Drawn by: A. Mthalane	**Figure No.** 6
	Projection Geographic - WGS1984	**Reviewed by:** A. Gemmell	

www.wspenvironmental.co.za



Atha-Africa Ventures (Pty) Ltd

Vegetation classes

Data Source:
Mucina and Rutherford, 2006

Projection Geographic - WGS1984

Project: Yzermyn Soil Land Use + Land Capability Assessmen

Project No: 24514-03

Drawn by: A. Mthalane

Reviewed by: A. Gemmell

Date: 05 August 2013

Figure No. 7

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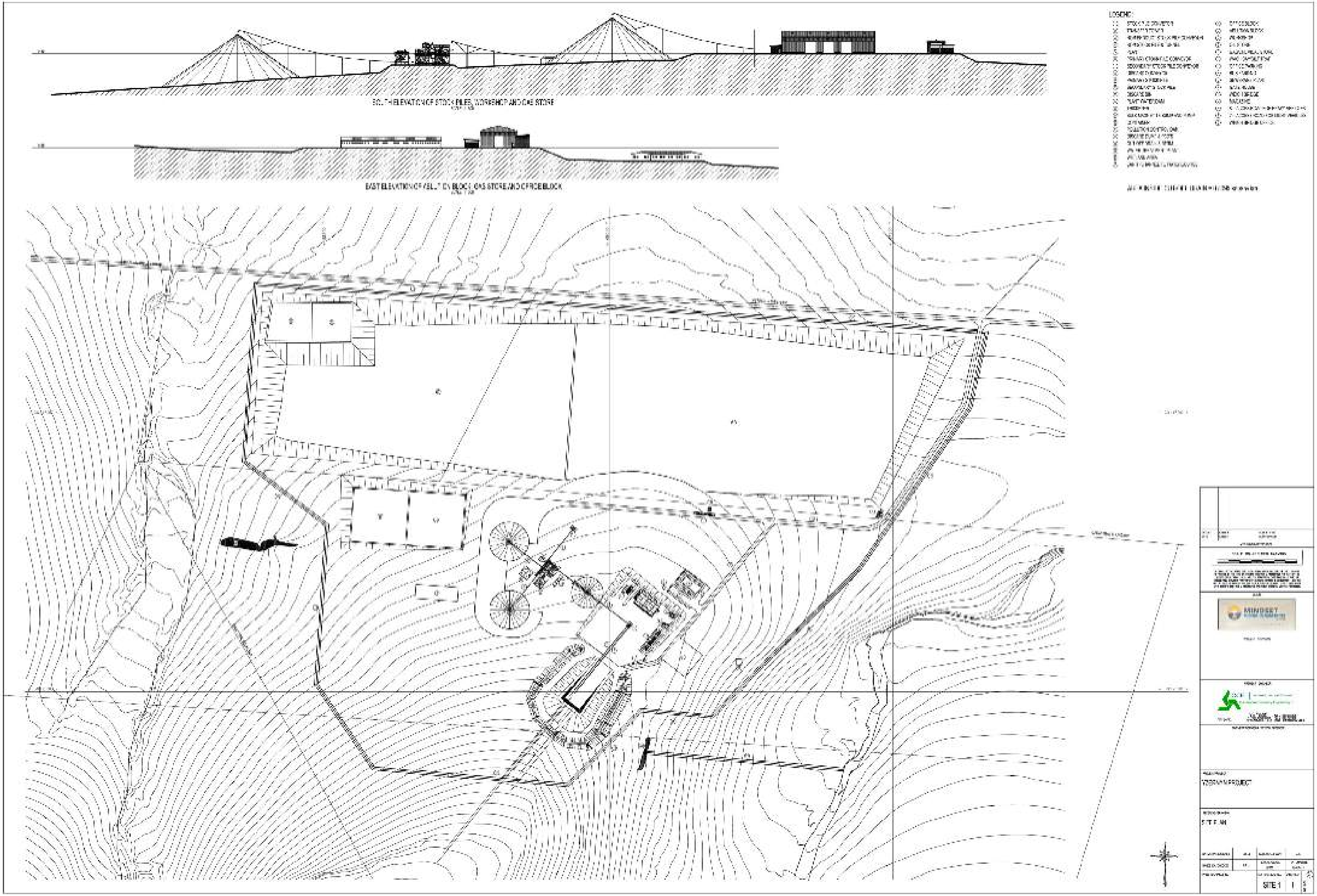
Appendix A: Development Plan


LEGEND:
SITE 1

Appendix B: Impact Assessment Methodology

WSP Impacts Rating Methodology

The potential environmental impacts will be evaluated according to their severity, duration, extent and significance of the impact. Furthermore, cumulative impacts will also be taken into consideration. WSPs risk assessment methodology will be used for the ranking of the impacts.

This system derives environmental significance on the basis of the consequence of the impact on the environment and the likelihood of the impact occurring. Consequence is calculated as the average of the sum of the ratings of severity, duration and extent of the environmental impact. Likelihood considers the frequency of the activity together with the probability of an environmental impact occurring.

The following tables (**Table 1** to **Table 8**) describe the process in detail:

Table 1: Assessment and Rating Sensitivity

Rating	Description
1	Negligible/ non-harmful/ minimal deterioration (0 – 20%)
2	Minor/ potentially harmful/ measurable deterioration (20 – 40%)
3	Moderate/ harmful/ moderate deterioration (40 – 60%)
4	Significant/ very harmful/ substantial deterioration (60 – 80%)
5	Irreversible/ permanent/ death (80 – 100%)

Table 2: Assessment and Rating of Duration

Rating	Description
1	Less than 1 month/ quickly reversible
2	Less than 1 year/ quickly reversible
3	More than 1 year/ reversible over time
4	More than 10 years/ reversible over time/ life of project or facility
5	Beyond life of project of facility/ permanent

Table 3: Assessment and Rating of Extent

Rating	Description
1	Within immediate area of activity
2	Surrounding area within project boundary
3	Beyond project boundary
4	Regional/ provincial
5	National/ international

Consequence is calculated as the average of the sum of the ratings of severity, duration and extent of the environmental impact.

Table 4: Determination of Consequence

Determination of Consequence (C)	(Severity + Duration + Extent) / 3

- Likelihood

Table 5: Assessment and Rating of Frequency

Rating	Description
1	Less than once a year
2	Once in a year
3	Quarterly
4	Weekly
5	Daily

Table 6: Assessment and Rating of Probability

Rating	Description
1	Almost impossible
2	Unlikely
3	Probable
4	Highly likely
5	Definite

Likelihood considers the frequency of the activity together with the probability of the environmental impact associated with that activity occurring.

Table 7: Determination of Likelihood

Determination of Likelihood (L) =	(Frequency + Probability) / 2

- Impact Significance

Impact significance is the product of the consequence and likelihood values.

Table 8: Determination of Environmental Significance

Environmental Significance (Impact) = C × L	Description
L (1 – 4.9)	Low environmental significance
LM (5 – 9.9)	Low to medium environmental significance
M (10 – 14.99)	Medium environmental significance
MH (15 – 19.9)	Medium to high environmental significance
H (20 – 25)	High environmental significance. Likely to be a fatal flaw.

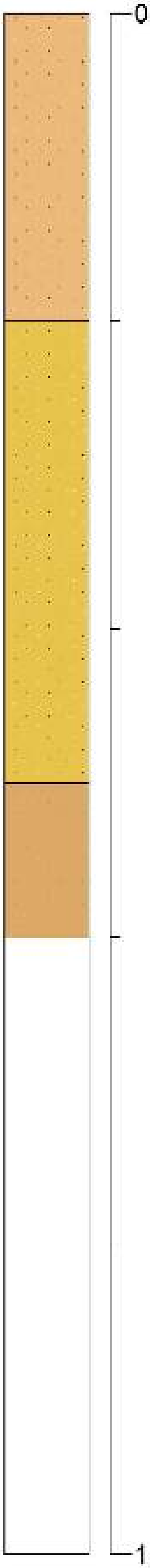
Appendix C: Soil Profile Logs

SOIL PROFILE

PROJECT: Yzermyn Soil Land Use and Land Capability Assessment
PROJECT NO: 24514-3 DATE: 01 July 2013
LOGGED BY: Andrew Gemmel HOLE NO: AH1
DRILLING METHOD: Hand Auger HOLE COORDINATES (Lat , Long): 27.21922 S; 30.30649 E
Based on GPS reading

WSP ENVIRONMENTAL

DEPTH (m)	DESCRIPTIONS	PID Peak (ppm)
0	Dry, loose apedal, light brown fine to medium SAND.	
	Dry, loose apedal, yellow brown fine to medium SAND.	
	Dry, loose apedal, yellow brown fine to medium SAND with red streaks.	
	End of exploratory hole due to refusal on light grey weathered sandstone (ECCA AND BEAUFORT GROUP).	
1		



NOTE: - Refusal on weathered stone at 0.6m.

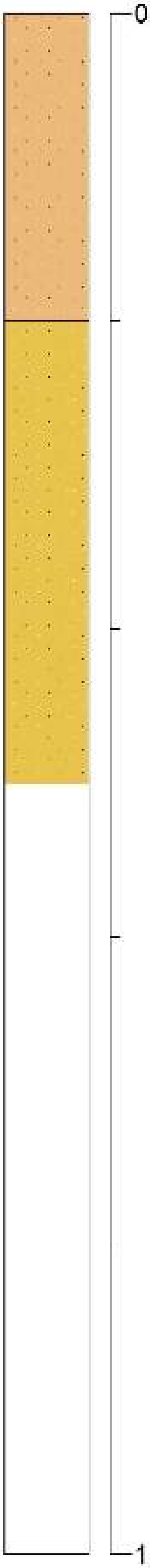
DISTURBED SAMPLE UNDISTURBED SAMPLE WATER TABLE PERCHED WATER TABLE

SOIL PROFILE

PROJECT:	Yzermyn Soil Land Use and Land Capability Assessment		
PROJECT NO:	24514-3	DATE:	01 July 2013
LOGGED BY:	Andrew Gemmel	HOLE NO:	AH2
DRILLING METHOD:	Hand Auger	HOLE COORDINATES (Lat , Long): Based on GPS reading	27.21497 S; 30.30794 E

WSP ENVIRONMENTAL

DEPTH (m)	DESCRIPTIONS	PID Peak (ppm)



Dry, loose apedal, light brown fine to medium SAND.

Very Moist, apedal, yellow brown fine to medium SAND.

End of exploratory hole due to refusal on orange + white mix weathered sandstone (ECCA AND BEAUFORT GROUP).

NOTE: - Refusal on weathered stone at 0.5m.

◌ DISTURBED SAMPLE   ⊔ UNDISTURBED SAMPLE   ▼ WATER TABLE   ⩗ PERCHED WATER TABLE

SOIL PROFILE

PROJECT: Yzermyn Soil Land Use + Land Capability Assessment

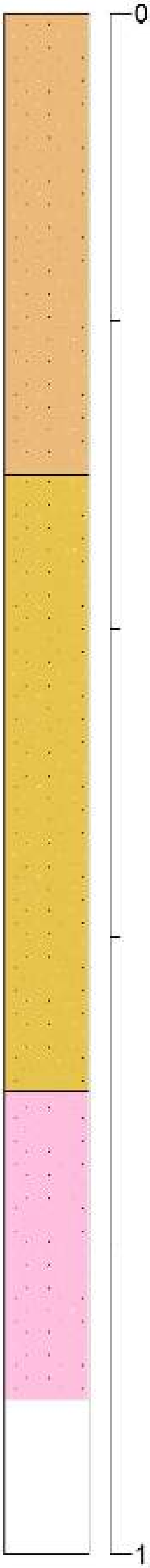
PROJECT NO: 24514-3 DATE: 01 July 2013

LOGGED BY: Andrew Gemmel HOLE NO: AH3

DRILLING METHOD: Hand Auger HOLE COORDINATES (Lat , Long): 27.21514 S; 30.31286 E
Based on GPS reading

WSP ENVIRONMENTAL

DEPTH (m)	DESCRIPTIONS	PID Peak (ppm)



Dry, loose apedal, light brown fine to medium SAND.

Moist, apedal yellow brown fine to medium SAND.

Very Moist, apedal pink fine to medium SAND.

End of exploratory hole due to refusal on pink sandstone (ECCA AND BEAUFORT GROUP).

NOTE: Refusal on sandstone at 0.9m.

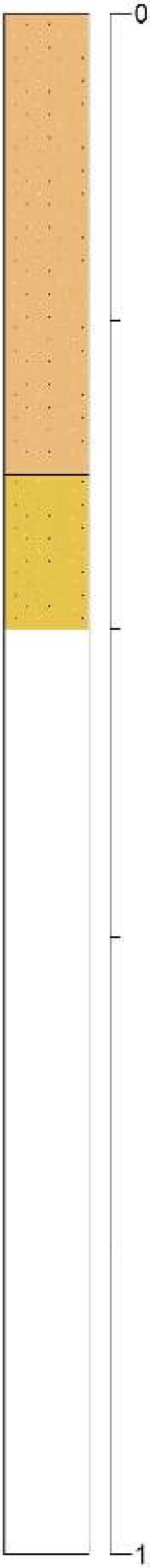
DISTURBED SAMPLE   UNDISTURBED SAMPLE   WATER TABLE   PERCHED WATER TABLE

SOIL PROFILE

PROJECT:	Yzermyn Soil Land Use + Land Capability Assessment		
PROJECT NO:	24514-3	DATE:	01 July 2013
LOGGED BY:	Andrew Gemmel	HOLE NO:	AH4
DRILLING METHOD:	Hand Auger	HOLE COORDINATES (Lat , Long): Based on GPS reading	27.21893 S; 30.31235 E

WSP ENVIRONMENTAL

DEPTH (m)	DESCRIPTIONS	PID Peak (ppm)



Dry, loose apedal, light brown fine to medium SAND.

Dry, loose apedal, yellow brown to medium SAND.

End of exploratory hole refusal on sandstone (ECCA AND BEAUFORT GROUP).

NOTE: Refusal on sandstone at 0.4m.

◯ DISTURBED SAMPLE   ☐ UNDISTURBED SAMPLE   ▼ WATER TABLE   ⩡ PERCHED WATER TABLE

PROJECT:	Yzermyn Soil Land Use + Land Capability Assessment		
PROJECT NO:	24514-3	DATE:	01 July 2013
LOGGED BY:	Andrew Gemmel	HOLE NO:	AH5
DRILLING METHOD:	Hand Auger	HOLE COORDINATES (Lat , Long): Based on GPS reading	27.21923 S; 30.31338 E

WSP ENVIRONMENTAL

DEPTH (m)	DESCRIPTIONS	PID Peak (ppm)
0	Dry, loose apedal, light brown fine to medium SAND.	
	Very moist ,apedal, yellow brown fine to medium SAND.	
	Wet, apedal, yellow brown fine to medium SAND	
1	End of exploratory hole.	
	Very Moist, apedal, yellow brown fine to medium SAND.	

NOTE: End of exploratory hole at 1m.

○ DISTURBED SAMPLE ☐ UNDISTURBED SAMPLE ▼ WATER TABLE ▽ PERCHED WATER TABLE