DIGBY WELLS
ENVIRONMENTAL

BASIC ASSESSMENT FOR THE PROPOSED GOUDKOPPIES WATER PIPELINE

Aquatic Ecology Assessment

Project Number:

ERG3057

Prepared for:

ERGO MINING (PTY) LTD

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Name	**Responsibility**	**Signature**	**Date**
Christian Fry	Report Compiler		December 2014
Russell Tate	Reviewer		December 2014
Phil Patton Pr.Sci.Nat.	Reviewer		December 2014

EXECUTIVE SUMMARY

Digby Wells Environmental has been requested by Ergo Mining (Pty) Limited to complete a basic aquatic assessment of the river systems associated with the proposed Goudkoppies pipeline. The aim of this study is to establish basic aquatic conditions for the proposed Goudkoppies pipeline project.

The study area is located within the Upper Vaal Water Management Area within the C22A quaternary catchment. The aquatic systems associated with the study area are the Diepkloofspruit, Baileyspruit and a further two unnamed tributaries of the Klip River. Accredited River Health Programme techniques where applied with relevant desktop information to conduct a basic assessment of the sites associated with the proposed project.

Baseline conditions revealed that the current state of the aquatic ecosystems associated with the Diepkloofspruit is Class D (largely modified) and for the Baileyspruit and two tributaries Class E (seriously modified). The seriously modified status of the aquatic biota is a result of water quality impacts emanating from urban/industrial runoff and effluent containing solid waste and sewage resulting in the extensive deterioration of available aquatic habitat and water quality.

Based on the impact assessment completed for the proposed pipeline, the most significant impacts would occur during the construction phase, however are considered minor. Mitigation measures during the construction phase include that pipeline construction should be limited to areas where modified environments exist, he pipelines should be constructed over existing water crossings (as proposed) and the use of heavy machinery adjacent to the water crossings should be limited where possible. It is further proposed that the portion of the pipeline crossing the wetland areas is a continuous length of pipeline, i.e. contain no flanges such as to minimise leakages.

Based on the potential of impacts during the construction phase on aquatic biota the following conclusions can be drawn. The impact before mitigation actions are implemented was found to be minor. The minor rating was determined due to the short duration of the impacts compounded by the low severity of the impacts. After mitigation actions the impact of the construction phase of the proposal were found to be low. Important mitigation actions to consider would be the effective management of hydrocarbons, as described in Section 9.2.2, and the minimisation of vegetation removal.

Based on the outcome of the basic assessment for aquatic ecology it can be concluded that the proposed pipeline will have minimal impacts to local aquatic communities in the long term, if mitigation measures are applied.

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1 Introduction

In 1994, the national Department of Water Affairs & Forestry (DWAF) initiated the South African River Health Programme (RHP). The initiative was aimed at gathering information on the ecological state of river ecosystems in South Africa in order to positively manage these natural resources (DWAF, 2011). In 1998 the National Water Act, 1998 (Act No. 36 of 1998) (NWA), through the provision of an ecological reserve, sought to ensure the water required to maintain aquatic ecosystem integrity is available. The proposed strategy includes the protection of water resources in order to ensure their ability to support utilisation for the benefit of current and future generations; and the utilisation of water resources in the most efficient and effective manner, within the constraints set by the requirements for protection (DWAF, 2011).

An increase in anthropogenic activities in river catchments has placed great pressures upon local aquatic ecology (Van Vuren *et al.,* 1994). Activities such as mining have the potential to disrupt and modify associated aquatic conditions (Van Vuren *et al*., 1994). These anthropogenic activities have potential impacts on the habitat and physicochemical components of aquatic ecosystems, and have shown to alter the ecology of freshwater systems (De Klerk *et al.,* 2012). Certain stressors in the environment have been shown to affect freshwater biota in specific ways and therefore can serve as effective indicators of changes in the aquatic environment (Zhou *et al.,* 2008). Due to the importance and use of aquatic biota as indicators of integrity, it is important to monitor aquatic conditions of potential ecological degradation (Dickens and Graham, 2002).

In order to achieve the effective management of South African freshwater resources the monitoring of aquatic ecosystems needs to be conducted. Through these monitoring studies the level of pollutants and the effects of anthropogenic activities can be determined.

This study aims at establishing baseline aquatic conditions in the aquatic systems associated with the proposed Goudkoppies water pipeline and to assess the potential impacts of the proposed project. This was achieved through a basic literature review and data collected from a single site visit.

2 Study Area

The proposed Goudkoppies water pipeline is located within the urban area of Soweto, situated in the Gauteng Province (Figure 2-1). The proposed pipeline bisects a number of water courses, including the Diepkloofspruit, Baileyspruit and a further two unnamed tributaries proximate to the Diepkoof tailings facility. The project area is situated within the Upper Vaal Water Management Area (WMA08), with the associated aquatic ecosystems located within the quaternary catchment C22A, and falls under the Klip sub-quaternary catchment and flows west into the Klip River and eventually into the Vaal system roughly 72 km downstream.

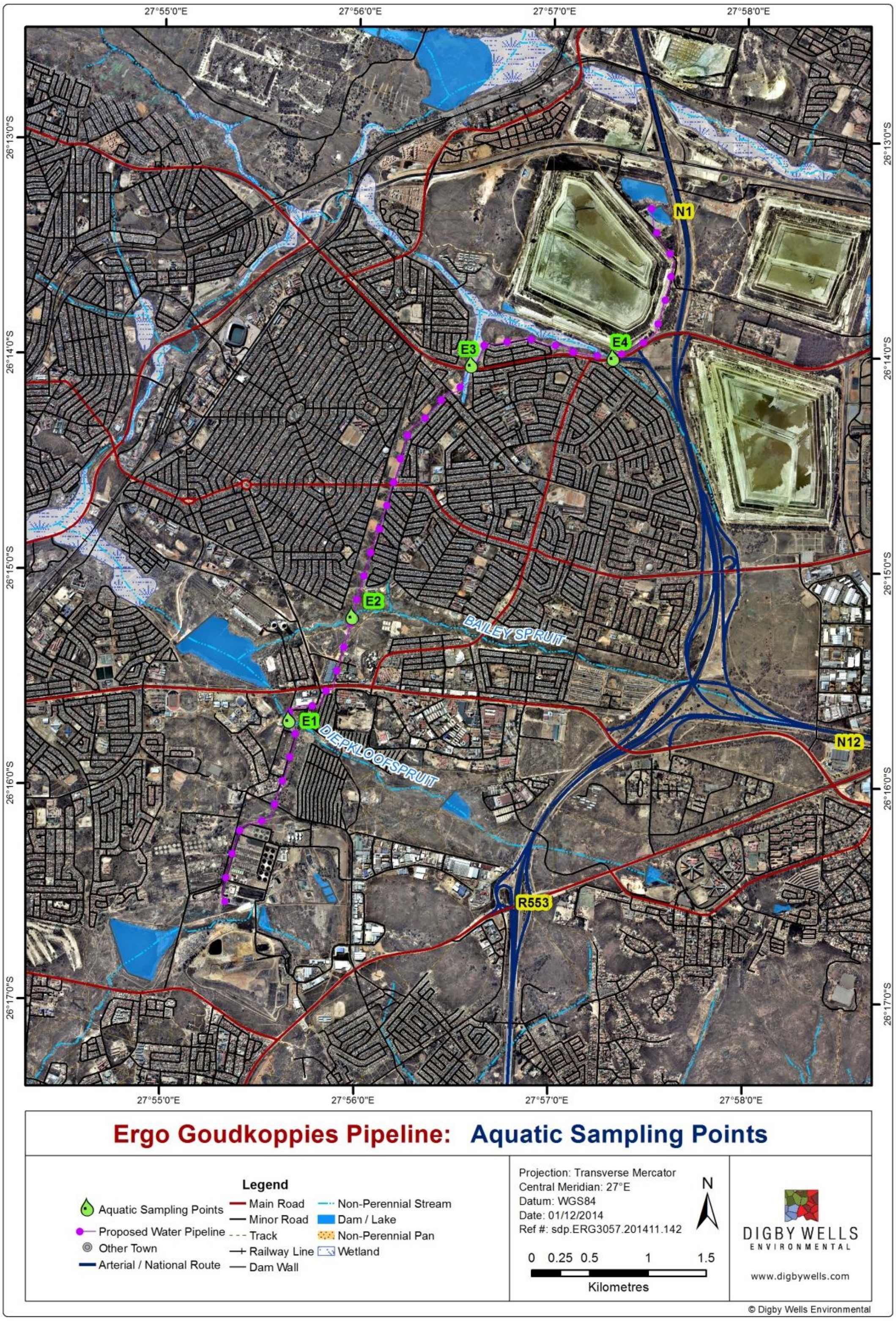

Figure 2-1: Map illustrating project area and aquatic sampling points.

Table 2-1: Description of the sites sampled for the proposed Goudkoppies water pipeline.

Photo	Site name	Coordinates	Description
	E1	26°15'41.61"S 27°55'39.18"E	Site E1 is located on the Diepkloofspruit, and was characterised by a channelled system with a large amount of riparian vegetation.
	E2	26°15'12.66"S 27°55'58.55"E	Site E2 is located on the Baileyspruit, and was characterised as run-riffle-run with a large amount of riparian vegetation. The site had a strong odour of raw sewage and a large amount of solid waste.
	E3	26°14'2.21"S 27°56'34.82"E	Site E3 is located south of the Soweto highway along an existing servitude. The site presented normal riverine habitat, with stones in current and good riparian vegetation. However a large amount of domestic (sewerage) and solid (pollution) waste was present.

Photo	Site name	Coordinates	Description
	E4	26°13'59.97"S 27°57'18.60"E	Site E4 was located on a tributary running underneath the Soweto highway and adjacent to the Diepkoof tailings facility. Habitat was considered poor however a large amount of exotic riparian vegetation was present.

3 Study Limitations

- Fish were not sampled/assessed;
- No *ex situ* water quality analyses conducted;
- Only a single survey was conducted; and
- Survey was conducted at the beginning of the high flow.

4 Desktop Review of the C22A Catchment

According to DWA 2013, the Present Ecological Status (PES) of the catchment area is considered a Class E, or seriously modified (Table 4-1). The overall state of the catchment is a result of extensive loss of natural habitat, biota and basic ecosystem function. Impacts identified by DWA (2013) for the reach, include: urban runoff (from Roodepoort and Soweto), mining areas, Olifantsfontein and other waste water treatment works, siltation, road crossings and increased flows. A summary of available desktop data is given in Table 4-1 (DWA, 2013).

Table 4-1: Current status of the C22A-01315 catchment area based on available desktop information (DWA, 2013).

Catchment	C22A-01315
Present Ecological Status	Class E (Seriously modified)
Ecological Importance	Moderate
Ecological Sensitivity	Moderate

The PES according to DWA (2013) of the Klip instream habitat is considered to be largely impacted, meaning modification is frequently present and the habitat quality, diversity, size and variability in almost the whole of the defined area are affected. Furthermore, flow and habitat modifications are considered to be high, based on the presence of weirs, dams, water abstraction, and sewage releases. According to relevant desktop information (DWA, 2013) in terms of water quality there are serious impacts throughout the catchment, bar minor areas.

The Ecological Importance (EI) of the sub-quaternary reach is considered to be moderate (Table 4-1). The moderate EI is a result of the natural vegetation and habitat integrity within the riparian-wetland in the reach, as well as the riparian wetland continuity, providing an essential ecological corridor. Invertebrate taxa species richness is considered moderate, however the data is based mostly on assumptions and as a result low confidence is placed in this data. The Ecological Sensitivity (ES) for the Sub Quaternary Reach (SQR) is considered to be moderate. This sensitivity was given due to the presence of relatively tolerant invertebrate species, with moderate specific preferences to flow and water quality modification. Furthermore, high tolerance of stream size sensitivity and riparian-wetland vegetation to water level changes (DWA, 2013).

5 Expected Fish Species

Expected fish species list for the C22A catchment area was generated according DWAF (2013) (Table 5-1).

Table 5-1: Expected fish species for the Klip River system, catchment C22A (DWAF, 2013).

Fish species	Common name
Austroglanis sclateri	Rock Catfish
Barbus anoplus	Chubbyhead Barb
Barbus neefi	Sidespot Barb
Barbus paludinosus	Straightfin Barb
Clarius gariepinus	Sharptooth Catfish
Cyprinus carpio	Carp
Gambusia affinis	Mosquito Fish
Labeobarbus aeneus	Smallmouth Yellowfish
Labeobarbus kimberleyensis	Largemouth Yellowfish
Labeo capensis	Mudfish
Labeo umbratus	Moggel

Fish species	Common name
Micropterus salmoides	Largemouth Bass
Pseudocrenilabrus philander	Southern Mouthbrooder
Tilapia sparrmanii	Banded Tilapia

6 Methodology

Individual biophysical components of the river systems in the study area were assessed. These biophysical attributes were considered by implementing selected tools or indices that refer to selected drivers and biological responses of an aquatic ecosystem. Methodologies formulated by the RHP (RHP, 2001) were implemented. The selected drivers and biological responses include:

The abiotic driver assessment:

- *In situ* water quality (DWAF, 1996);

The biotic response indicator assessment:

- South African Scoring System 5 (SASS5);

According to Kleynhans and Louw (2007), the directional change in the attributes of the drivers and biota is referred to as a trend. Generally, an assessment may be approached from a driver perspective (Kleynhans & Louw, 2007). The driver components will be considered in order to determine the degree of contribution towards the current state of the biological communities.

A single survey of the aquatic systems associated with the proposed Goudkoppies pipeline was conducted on the 30th of November 2014.

6.1 Water Quality

The physical, chemical, biological and aesthetic properties of water determines its fitness for various usages and the health and integrity of the aquatic ecosystem (DWAF, 1996). Various water quality parameters were taken *in situ*, including pH, temperature (°C), conductivity (µS/cm), oxygen content (mg/l) and oxygen saturation (DO %) using calibrated water quality meters (Extech DO700 water quality meter).

6.2 Aquatic Invertebrate Assessment

Macroinvertebrate assemblages are good indicators of localised conditions as many benthic macroinvertebrates have sedentary characteristics with relatively long lives (±1 year) (Barbour *et al*., 1999). Macroinvertebrates are useful for their ability to integrate pollution effects over time, their detectable response to environmental impacts as well as the easy field sampling techniques involved in their collection. Benthic macroinvertebrate assemblages are made up of species that constitute a broad range of trophic levels and pollution tolerances, thus providing strong information for interpreting cumulative effects (Barbour *et al*., 1999). The assessment and monitoring of benthic macroinvertebrate communities forms an integral part of the monitoring of the health of an aquatic ecosystem.

6.2.1 South African Scoring System

The SASS5 is the current index being used to assess the status of riverine macroinvertebrates in South Africa. According to Dickens and Graham (2002), the index is based on the presence of aquatic invertebrate families and the perceived sensitivity to water quality changes of these families. Different families exhibit different sensitivities to pollution, these sensitivities range from highly tolerant families (e.g. Muscidae and Psychodidae) to highly sensitive families (e.g. Oligoneuridae). SASS results are expressed both as an index score (SASS score) and the Average Score Per recorded Taxon (ASPT value).

Sampled invertebrates were identified using the Aquatic Invertebrates of South African Rivers Illustrations book, by Gerber and Gabriel (2002). Identification of organisms was made to family level (Thirion *et al*., 1995; Dickens & Graham, 2002; Gerber & Gabriel, 2002).

Based on the location of the sites, all SASS5 and ASPT scores are compared with the SASS5 Data Interpretation Guidelines (Dallas, 2007) for the Highveld Lower ecoregion. This method seeks to develop biological bands depicting the various ecological states and is derived from data contained within the Rivers Database. The table and figure below illustrate the biological banding and classification (Table 6-1 and Figure 6-1).

Table 6-1: Highveld lower biological banding (Dallas, 2007)

Class	SASS 5 Score	ASPT	Condition
A	>123	>5.6	Natural/unmodified
B	83 – 122	4.9 – 5.6	Minimally modified
C	64 – 82	4.7 – 4.8	Moderately modified
D	51 – 63	4.3 – 4.6	Largely modified
E	<50	<4.2	Seriously modified

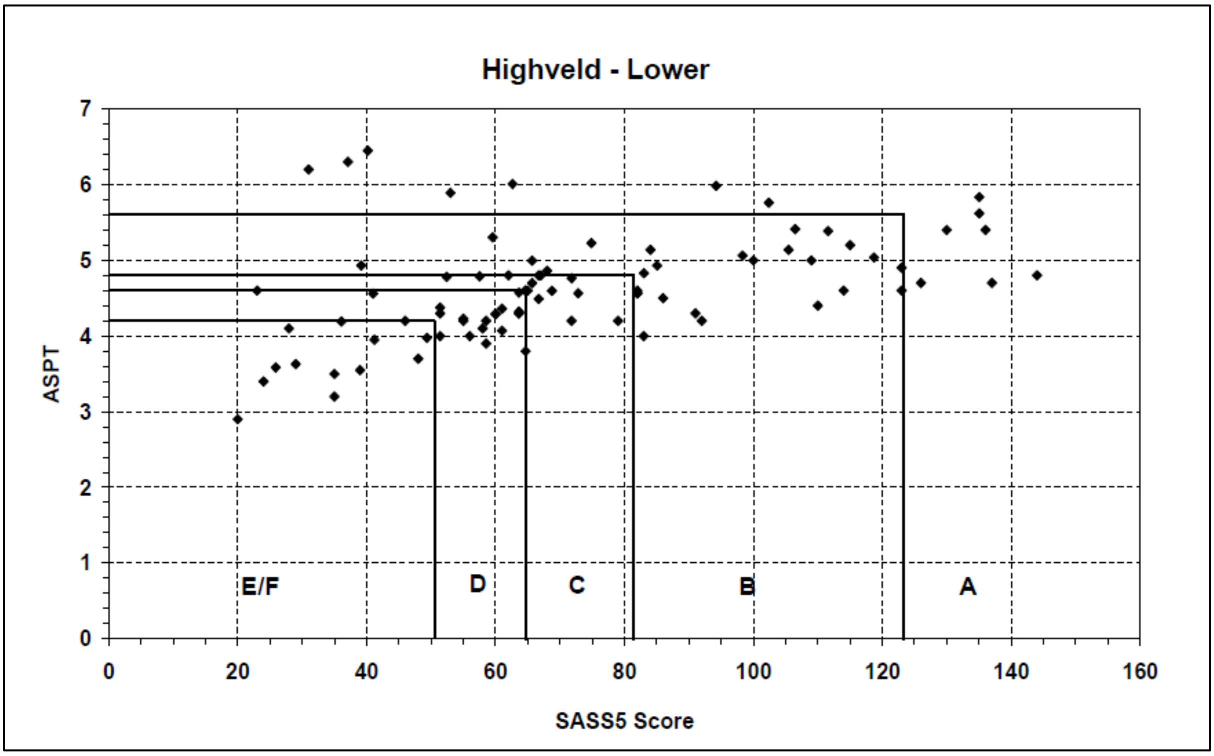

Figure 6-1 Biological Bands for the Highveld Lower ecoregion, calculated using percentiles.

7 Results

7.1 Water Quality

The *in situ* water quality results are presented in Table 7-1. Several water quality parameters tested during the survey exceeded recommended guidelines stipulated by DWAF, 1996 at numerous sites. pH Levels fell within the recommended levels, and conductivity levels exceeded guideline levels at site E4. Low dissolved oxygen (DO) levels were observed at sites E1, E2, and E3.

Table 7-1 *In situ* water quality results

	E1	E2	E3	E4	Guideline
pH	7.7	7.94	7.94	6.88	6.5 – 9
Temperature (°C)	19.5	18.1	18.7	17.8	5 – 30

	E1	E2	E3	E4	Guideline
Conductivity (µS/cm)	294	470	520	859	< 700
DO (mg/l)	4.98	4.3	4.28	5.82	> 5
DO (% saturation)	52.2	45.0	47.5	61.6	60 – 120
Red shading indicates levels exceeding recommended guidelines Recommended guidelines are sourced from DWAF, 1996.					

7.2 Aquatic Invertebrates

Methods used by the RHP were utilised during the current survey, the results are given under the various sub-headings below.

7.2.1 South African Scoring System

Standard methods of the SASS5 protocol were applied during the current invertebrate sampling. Results of the SASS5 scores are given in Table 7-2. Macroinvertebrate family groups found at the four sites are listed in Table 7-3.

Table 7-2: SASS5 scores for the aquatic sampling points associated with the proposed pipeline.

Site	E1	E2	E3	E4
SASS Score	38	3	3	7
Taxa	9	2	2	2
ASPT	4.2	1.5	1.5	3.5
Category	**D**	**E**	**E**	**E**

Based on the results of the SASS5 assessment, the SASS5 scores ranged from a low of 3 to a high of 38 within the associated systems. The number of taxa at the sites ranged from 2 to 9 with the ASPT ranging between 1.5 and 4.2.

Table 7-3: Table listing macroinvertebrates recorded at the various sites within the C22A catchment.

Taxon	E1	E3	E4	E7
Baetidae (Mayflies)	✓	•	•	•
Chironomidae (Midges)	✓	✓	✓	✓
Corixidae* (Water boatmen)	✓	•	•	•
Culicidae* (Mosquitoes)	✓	•	✓	•
Dytiscidae/Noteridae* (Diving beetles)	✓	•	•	✓
Hirudinea (Leeches)	✓	•	•	•
Hydroptilidae	✓	•	•	•
Oligochaeta (Earthworms)	✓	•	•	•
Simuliidae (Blackflies)	✓	•	•	•
Syrphidae (Rat tailed maggots)	•	✓	•	•
Number of taxa	**9**	**2**	**2**	**2**
*Air-breathing macroinvertebrates				

Aquatic macroinvertebrates found at all sites were predominantly species highly tolerant to pollutants. The number of taxa at the four sites were lower than expected based on similar reaches (DWAF, 2013).

7.3 Biotopes (Macroinvertebrate habitat availability)

Table 7-4: Biotope types present at the four sites.

Biotopes	E1	E2	E3	E4
Stones in current	2	3	2	1
Stones out of current	1	1	1	0
Bedrock	0	0	0	0

Aquatic Vegetation	2	3	2	2
Marginal Vegetation In Current	2	2	2	2
Marginal Vegetation Out Of Current	2	1	1	1
Gravel	1	1	2	1
Sand	1	2	1	0
Mud	1	2	1	1
Biotope Score (%)	**26.7**	**33.3**	**26.7**	**17.8**

Site habitat types were characteristically flowing with poor diversity and a large amount of riparian vegetation (predominantly the exotic reed species; *Phragmites australis* at sites E3 and E4). A large amount of solid waste was observed at sites E2, E3 and E4.

8 Discussion

8.1 Expected Fish Species

A single red-data species is expected within the C22A catchment area, *Labeobarbus kimberleyensis* (DWAF, 2013; Government Gazette, 2013). The species may occur within the catchment area and potential contamination of the aquatic systems may affect the species further downstream.

8.2 Water Quality

According to the *in situ* water quality results (Table 7-1), the water courses associated with the proposed Goudkoppies pipeline are in an impacted state. The pH levels at the various sites were within guideline levels and would not negatively affect local aquatic biota.

Conductivity levels at sites E1, E2, and E3 all fell within the guideline levels, indicating low dissolved salt concentrations within these systems, and at levels which would not impact on local aquatic biota. Site E4 had conductivity levels of 859.0 µS/cm, which exceed guideline levels (DWAF, 1996) and will have a negative impact on aquatic biota.

Dissolved oxygen (DO) levels at sites E1, E2, and E3 exceeded guideline levels (DWAF, 1996) and would negatively affect local aquatic biota. Dissolved oxygen levels at E4 fell within guideline levels. These low DO levels may be attributed to a high chemical/biological oxygen demand within the aquatic systems due to eutrophication.

8.3 Aquatic Macroinvertebrates

Aquatic macroinvertebrates were sampled according to standard SASS5 techniques (Dickens and Graham, 2002). Various macroinvertebrate groups were represented at the sites with the dominant taxa being Chironomidae. The macroinvertebrate assemblages sampled at the sites are considered pollution tolerant species such as Syrphidae. According to the SASS5 results, with data interpreted according to the lower Highveld biological bandings, sites E1 was categorised as Class D, indicating largely modified conditions. Sites E2, E3, and E4 were categorised as Class E, indicating seriously modified conditions. Results from the SASS5 assessment indicate impacted states of all four sites. Biotope scores were low at all four sites indicating a lack of available macroinvertebrate habitat diversity. Algae was present at sites E2 and E3 suggesting eutrophic conditions.

9 Environmental Impact Assessment

Activities occurring as a result of the proposal are described in Table 9-1.

Table 9-1: Activities planned for the proposed Goudkoppies pipeline.

Activity	Description
Construction Phase	
1	Employment of workers.
2	Construction of pipelines (aboveground over aquatic crossings).
3	Operation of construction machinery and vehicles.
4	Temporary storage of construction materials and hazardous material.
Operational Phase	
5	Operation of pipes.
Decommissioning and Rehabilitation	
6	Decommissioning activities: Demolition of temporary infrastructure such as: screens and pipelines.
7	Rehabilitation of the project area.
Post-Closure	
8	Post-Closure rehabilitation and monitoring.

9.1 Current Impacts and Issues

The current land use associated with the upper reaches of the Klip River has extensively modified the aquatic ecosystem contained therein. The sources of modification can be separated into aquatic habitat modifying activities and water quality modification activities. The dominant modifying features are given below:

- Pollutants/toxicants from urban runoff and dump sites;
- Effluent (Sewage and industrial);
- Agricultural (subsistence and livestock);
- Industrial runoff (mine tailings);
- Riparian modification (Alien vegetation and incising of river channel); and
- Instream modification (barriers, canalisation and water crossings).

9.2 Impacts of the Proposed Project

The major concerns relating to potential impacts on aquatic ecology associated with the project would be the further degradation of water and habitat quality of the aquatic systems associated with the project area. The downstream habitat impacts of the proposal would be seen to be limited due to the large wetland systems located in the upper Klip River system.

The impact of the proposed project has been separated into the different phases of the project namely construction.

9.2.1 Potential Impacts of the Construction Phase

The potential impacts on aquatic ecology of the construction phase arise from activities including:

9.2.1.1 *Construction of pipelines*

The routes for pipelines are located on existing servitudes and therefore would have a limited impact on aquatic biota during the construction phase. In addition to this, the pipeline infrastructure is planned to be above ground at aquatic crossings and therefore vegetation removal will be limited. Although these impacts are limited, the proposed pipeline route does cross several watercourses on existing crossing's and thereby presents lowered potential risks. These potential risks would include the compaction of soils adjacent the stream resulting in increased runoff and associated habitat modification. In addition, risks associated with construction activities include the spillage of hydrocarbons resulting in the possible introduction of toxicants into the local aquatic ecosystem.

9.2.1.2 *Temporary storage of construction materials and hazardous substances such as oil and lubricants*

The storage of soils and construction materials may pose a risk, due to the possibility of the substances entering into the aquatic environment via surface runoff. Based on the extent of the riparian habitat and wetland systems associated with the project area, this above risk is considered to be low. The storage of fuels, oils and lubricants should be controlled (to avoid spillages), however should spillage or leakage occur they still do pose a risk of contaminating the water course.

9.2.2 Mitigation Measures for the Construction Phase

The following mitigation measures should be implemented for the duration of the construction phase.

1. The removal of vegetation should be limited to the construction footprint and should be completed in a systematic fashion; additional vegetation removal surrounding the construction site should be limited. Vegetation removal should be limited as much as possible when operating in close proximity to riparian zones as delineated in the wetland assessment. Eroded sediments should be captured; this can be completed

through the use of screening nets and paddocks in drainage channels where construction is occurring or along roadways.

2. Pipeline construction should be limited to areas where modified environments exist. The pipelines should be constructed over existing water crossings (as proposed). The use of heavy machinery adjacent the water crossings should be limited where possible. It is further proposed that the portion of the pipeline crossing the wetland areas is a continuous length of pipeline, i.e. contain no flanges.
3. All hydrocarbons should be stored away from riparian systems, the changing of oil and lubricants as well as the filling of fuels should be completed at a designated workshop with adequate surface water collection facilities. Building materials should be stored away from riparian/wetland areas so as to reduce potential runoff entering the aquatic systems. On site hydrocarbon spill kits should be present on site should a spillage occur. Furthermore, temporary storage areas should be bunded and lined.

9.2.3 Potential Impacts of the Operation Phase Proposed Project

The potential impacts arising from the operation phase on aquatic ecology would arise from the following activities:

9.2.3.1 Operation of pipelines

The operation of the pipelines would involve the pumping of the treated effluent. The water contained in the pipelines can therefore be considered potentially toxic to aquatic biota. The risk then associated with the operation of the pipelines would be “burst” pipelines resulting in spillages.

9.2.4 Mitigation Measures for the Operational Phase

It is reiterated that the potential risks of water quality deterioration are high. The following mitigation measures should be implemented for the duration of the operational phase:

1. The pipelines should be monitored regularly to ensure a quick response, should a spillage occur. Cut off valves should be used in the pipeline to avoid further spillage should a burst occur. An emergency procedure should also be in place should a spillage occur.

The potential effect of pipelines during the operation phase is seen to be minor before mitigation and low after mitigation with the dominant risk being spillages.

10 Conclusion

According to the assessment of the aquatic systems associated with the proposed Goudkoppies pipeline, the four sites are in a seriously impacted state. Baseline conditions revealed that the current state of the aquatic ecosystems associated with the Diepkloofspruit is Class D (largely modified) and for the Baileyspruit and two tributaries Class E (seriously modified). The seriously modified status of the aquatic biota is a result of water quality impacts emanating from urban/industrial runoff and effluent containing solid waste and sewage resulting in the extensive deterioration of available aquatic habitat and water quality.

Based on the impact assessment completed for the proposed pipeline project, the most significant impacts would occur during the construction phase, however these are considered minor. Mitigation measures included in the pipeline construction should be limited to areas where modified environments exist. The pipelines should be constructed over existing water crossings (as proposed). The use of heavy machinery adjacent the water crossings should be limited where possible. It is further proposed that the portion of the pipeline crossing the wetland areas is a continuous length of pipeline, i.e. contain no flanges.

Based on the potential of impacts of the construction phase on aquatic biota the following conclusions can be drawn. The impact before mitigation actions are implemented was found to be minor. The minor rating was determined due to the short duration of the impacts compounded by the low severity of the impacts. After mitigation actions the impact of the construction phase of the proposal were found to be low. Important mitigation actions to consider would be the effective management of hydrocarbons and the minimisation of vegetation removal.

Based on the outcome of the basic assessment for aquatic ecology it can be concluded that the proposal will have minimal impacts to local aquatic communities in the long term, if the mitigation recommendations are applied.

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To:	Riaan Swemmer	**Date:**	5th December 2014
From:	Wayne Jackson	**Proj #:**	ERG3057
RE:	**Soils Basic Assessment Input**		

Dear Riaan Swemmer,

1 Methodology

1.1 Scoping Phase

Existing Land Type data was used to obtain generalized soil patterns and terrain types for the project site. Land Type data exists in the form of published 1:250 000 maps. These maps indicate delineated areas of similar terrain types, pedosystems (uniform terrain and soil pattern) and climate (Land Type Survey Staff, 1972 - 2006)

These maps are general guidelines of what soils can be expected in the area.

1.2 Environmental Impact Assessment

The impact rating process is designed to provide a numerical rating of the various environmental impacts identified by use of the Input-Output model. As discussed above, it has to be stressed that the purpose of the Basic Assessment process is not to provide an incontrovertible rating of the significance of various aspects, but rather to provide a structured, traceable and defendable methodology of rating the relative significance of impacts in a specific context. This gives the project proponent a greater understanding of the impacts of his project and the issues which need to be addressed by mitigation and also give the regulators information on which to base their decisions.

The significance rating process follows the established impact/risk assessment formula:

Significance = Consequence x Probability

Where

Consequence = Severity + Spatial Scale + Duration

And

Probability = Likelihood of an impact occurring

The matrix calculates the rating out of 147, whereby Severity, Spatial Scale, Duration and Probability are each rated out of seven as indicated in Table 1-1. Weighting can be applied to the various parameters.

Impacts are rated prior to mitigation and again after consideration of the mitigation measure proposed in the Environmental Management Plans (EMP). The significance of an impact is then determined and categorised into one of four categories, as indicated in Table 1-3, which supports Table 1-2. Management actions will be assigned for all identified impacts.

A neutral impact implies that it causes the area to return to a pre-project state. This is not regarded as positive, as there would be no need for this activity if the operation was not carried out.

Table 1-1Impact assessment parameter ratings

Rating	Severity		Spatial scale	Duration	Probability
	Environmental	**Social, cultural and heritage**			
7	Very significant impact on the environment. Irreparable damage to highly valued species, habitat or eco system. Persistent severe damage.	Irreparable damage to highly valued items of great cultural significance or complete breakdown of social order.	International The effect will occur across international borders.	Permanent: No Mitigation No mitigation measures of natural process will reduce the impact after implementation.	Certain/ Definite. The impact will occur regardless of the implementation of any preventative or corrective actions.
6	Significant impact on highly valued species, habitat or ecosystem.	Irreparable damage to highly valued items of cultural significance or breakdown of social order.	National Will affect the entire country.	Permanent: Mitigation Mitigation measures of natural process will reduce the impact.	Almost certain/Highly probable It is most likely that the impact will occur.
5	Very serious, long-term environmental impairment of ecosystem function that may take several years to rehabilitate.	Very serious widespread social impacts. Irreparable damage to highly valued items.	Province/ Region Will affect the entire province or region.	Project Life The impact will cease after the operational life span of the project.	Likely The impact may occur.
4	Serious medium term environmental effects. Environmental damage can be reversed in less than a year.	On-going serious social issues. Significant damage to structures / items of cultural significance.	Municipal Area Will affect the whole municipal area.	Long term 6-15 years	Probable Has occurred here or elsewhere and could therefore occur.
3	Moderate, short-term effects but not affecting ecosystem function. Rehabilitation requires intervention of external specialists and can be done in less than a month.	On-going social issues. Damage to items of cultural significance.	Local Local extending only as far as the development site area.	Medium term 1-5 years	Unlikely Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur.
2	Minor effects on biological or physical environment. Environmental damage can be rehabilitated internally with/ without help of external consultants.	Minor medium-term social impacts on local population. Mostly repairable. Cultural functions and processes not affected.	Limited Limited to the site and its immediate surroundings.	Short term Less than 1 year	Rare/ improbable Conceivable, but only in extreme circumstances and/ or has not happened during lifetime of the project but has happened elsewhere. The possibility of the

Rating	Severity		Spatial scale	Duration	Probability
					impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures
1	Limited damage to minimal area of low significance, (eg ad hoc spills within plant area). Will have no impact on the environment.	Low-level repairable damage to commonplace structures.	Very limited Limited to specific isolated parts of the site.	Immediate Less than 1 month	Highly unlikely/None Expected never to happen.

Table 1-2Probability Consequence Matrix

Significance										
		Consequence (severity + scale + duration)								
		1	3	5	7	9	11	15	18	21
Probability / Likelihood	1	1	3	5	7	9	11	15	18	21
	2	2	6	10	14	18	22	30	36	42
	3	3	9	15	21	27	33	45	54	63
	4	4	12	20	28	36	44	60	72	84
	5	5	15	25	35	45	55	75	90	105
	6	6	18	30	42	54	66	90	108	126
	7	7	21	35	49	63	77	105	126	147

Table 1-3Significance threshold limits

Significance		
High	108- 147	
Medium-High	73 - 107	
Medium-Low	36 - 72	
Low	0 - 35	

2 Soil Scoping Results

The land type map as presented in Plan 1 and the dominating soils for each land type is described in the following sections

2.1 Dominant soils expected within land type Ba36

The project area is dominated by the Ba36 land type which is expected to have a split between shallow rocky soils as described in Table 2-1 and red/yellow well drained soils described in Table 2-2.

Table 2-1 the dominant properties for land type Ba36 for shallow soils.

Properties	Value
Dominant Soil	Shallow rocky soils (Mispah/ Glenrosa) (40%)
Slope	6.5 %
Texture	Undifferentiated (<10%;>55%)
Depth	< 400 mm
Erosion Hazard	E4 - The soils have a low to moderate erodibility hazard
Land Capability	Class VI (Moderate Grazing)

2.1.1 Mispah (Ms)

The Mispah soil for is a shallow Orthic A horizon on hard rock. These soils occur on rocky outcrops or steep slopes.

Table 2-2 Dominant properties for land type Ba36 for red/yellow well drained soils.

Properties	Value
Dominant Soil	Red/yellow well drained soils (Hutton/Clovelly/Glencoe) (45%)
Slope	5.5 %
Texture	Undifferentiated (<10%;>55%)
Depth	> 600 mm
Erosion Hazard	E3 - The soils have a low to moderate erodibility hazard
Land Capability	Class III (Moderate Cultivation)

2.1.2 Hutton (Hu)

The Hutton soil form consists of an Orthic A, Red apedal B, and an unspecified C horizon which could be hard rock, saprolite, or unknown as no limiting layer was identified. These soils are freely drained and as a result can be slightly acidic due to the low cation exchange capacity (CEC) and thus the low base status. These soils are prime soils for irrigated crop production; however they are marginal to good in dry land conditions. Figure 2-1 shows a typical Hutton soil profile.

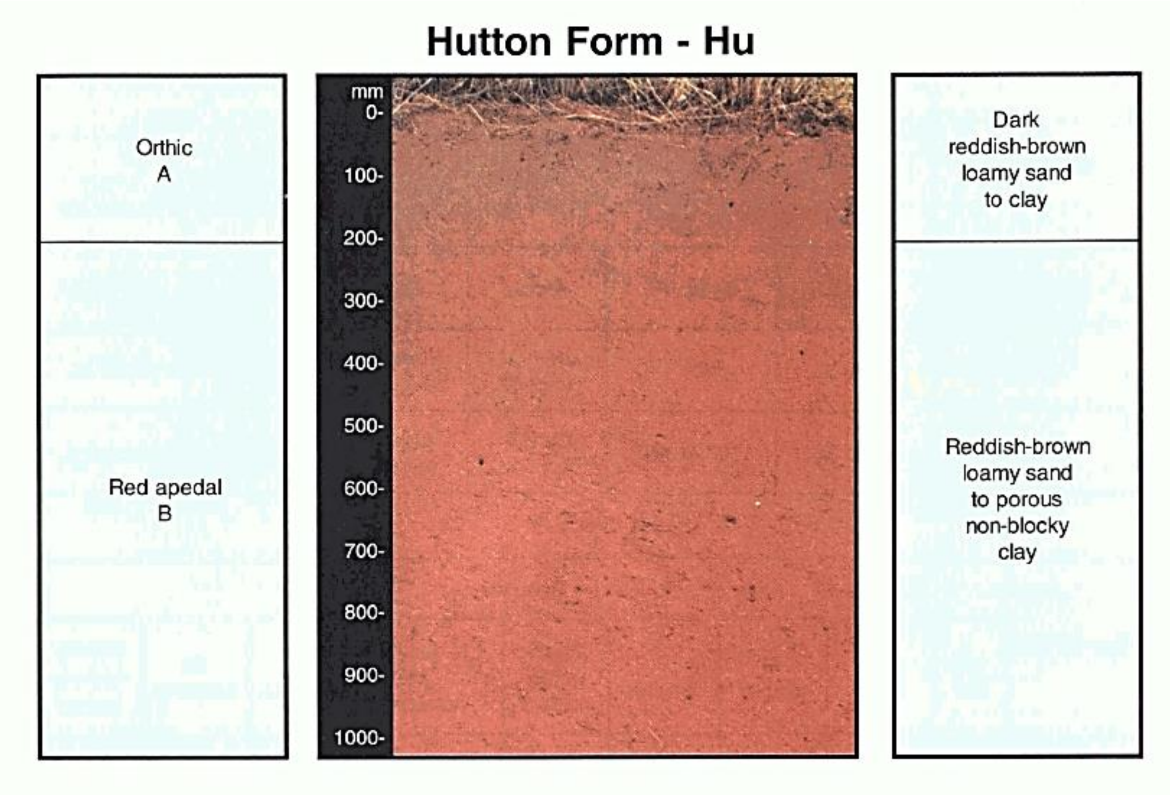


Figure 2-1 shows a typical cross section of the Hutton Soil Form (Soil Classification Working Group, 1991)

2.1.3 Clovelly (Cv)

The Clovelly soil consists of an Orthic A horizon, overlying a yellow brown apedal B horizon. Both the A and B horizons have good internal drainage properties allowing free draining, see Figure 2-2.

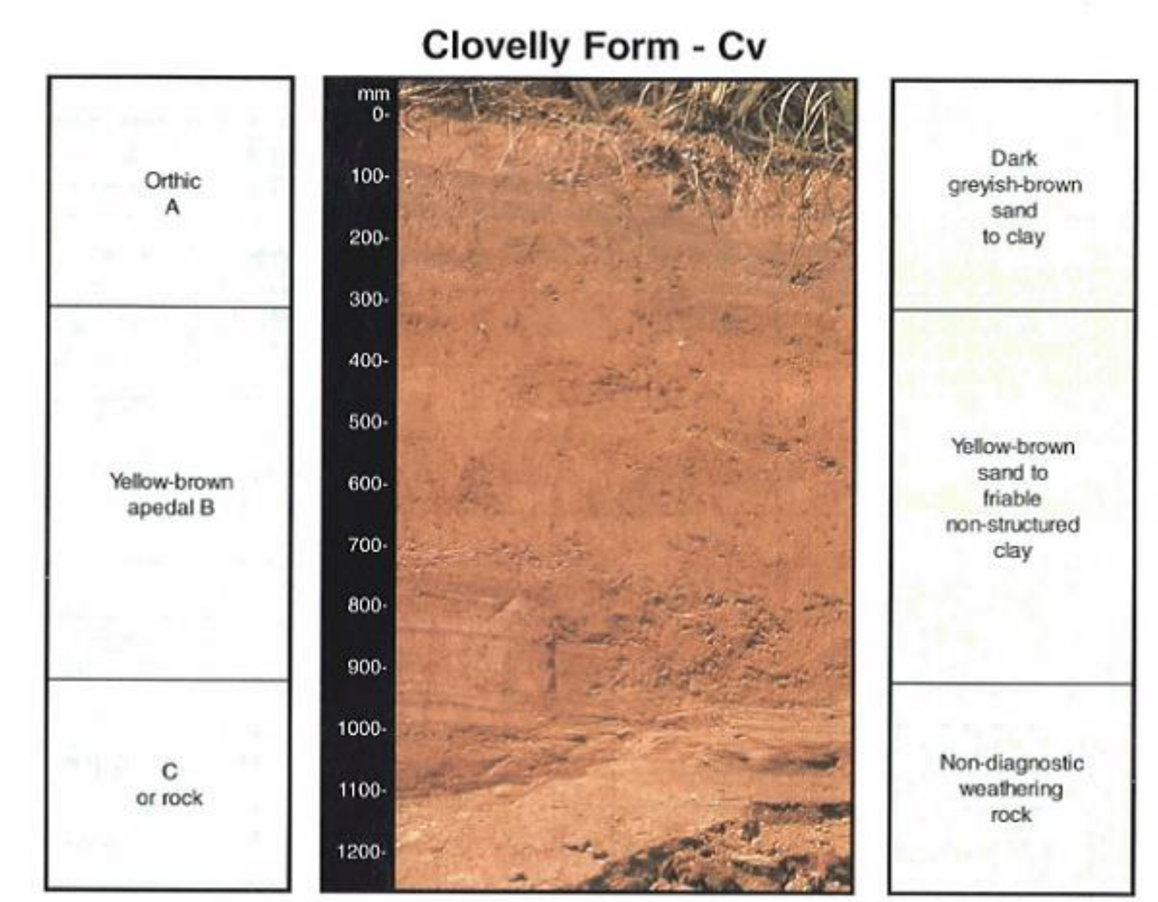


Figure 2-2 shows a typical cross section of the Hutton Soil Form (Soil Classification Working Group, 1991)

2.2 Dominant Soils expected within land type Ib43

The project area has a small portion Ib43 land type, which is expected to mainly have Mispah soils and rocky outcrops. The land type properties are summarised in Table 2-3.

Table 2-3 Dominant properties for land type Ib43

Properties	Value
Dominant Soil	Shallow rocky soils (Mispah/Glenrosa) (75%)
Slope	25 %
Texture	Undifferentiated
Depth	< 400 mm
Erosion Hazard	E7 - The soils have a high erodibility hazard

Land Capability	Class VIII (Wilderness)

2.2.1 Mispah (Ms)

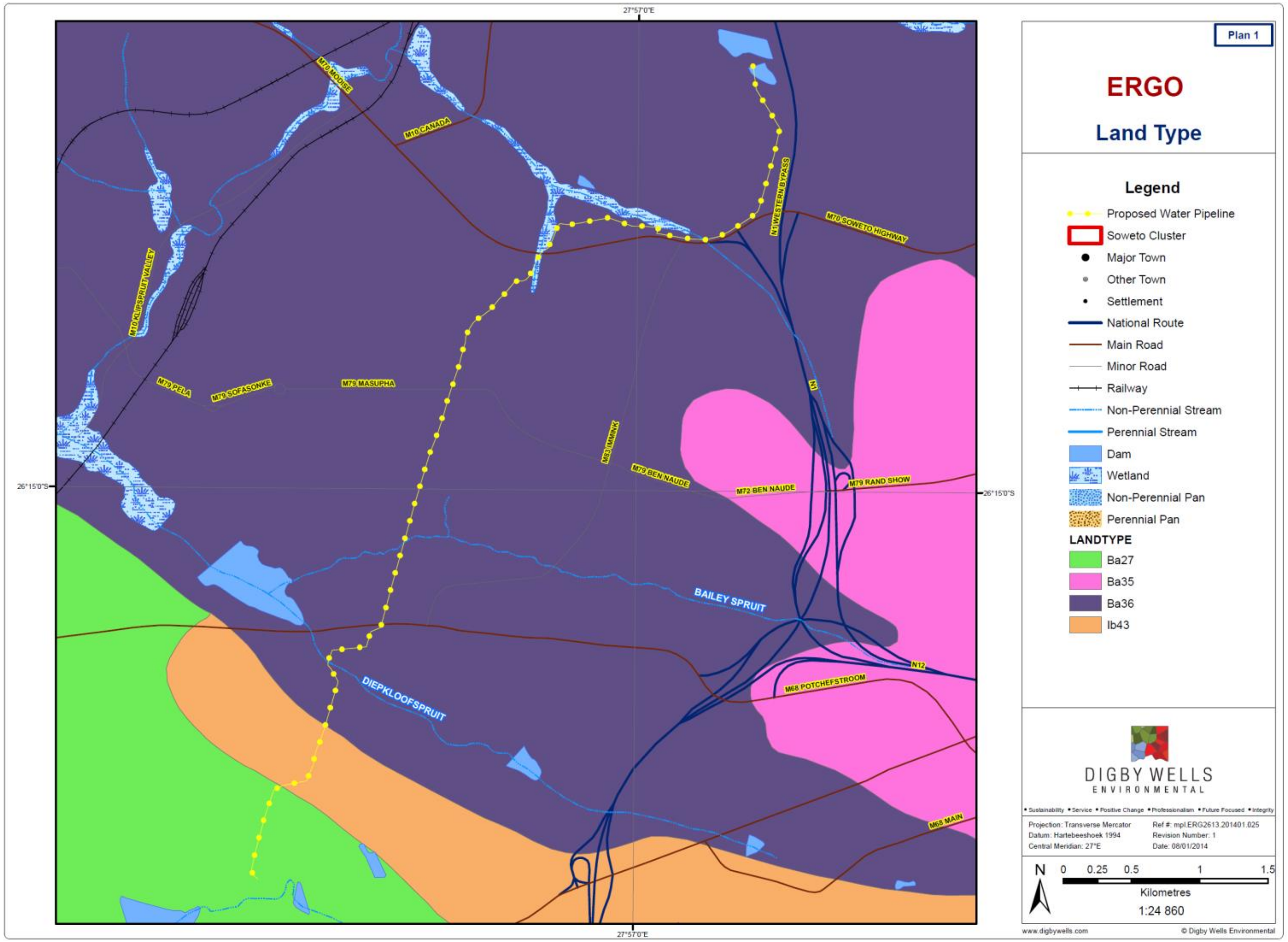
The Mispah soil for is a shallow Orthic A horizon on hard rock. These soils occur on rocky outcrops or steep slopes.

2.3 Dominant Soils expected within land type Ba27

The project area has a small portion Ba27 land type, which is expected to mainly have Mispah soils and rocky outcrops. The land type properties are summarised in Table 2-3.

Table 2-4 Dominant properties for land type Ba27

Properties	Value
Dominant Soil	Shallow rocky soils (Mispah/Glenrosa) (45%)
Slope	5 %
Texture	Undifferentiated
Depth	< 400 mm
Erosion Hazard	E3 - The soils have a low to moderate erodibility hazard
Land Capability	Class VI (Moderate Grazing)



Plan 1 the land type map for the Goudkoppies area (Land Type Survey Staff, 1972 - 2006)

3 Potential Environmental Impacts

3.1 Construction Phase

During the construction phase the work carried out will mainly be the construction of the proposed pipeline. This will entail the clearing of areas and the disturbance of the topsoil through excavations. The topography and natural drainage lines will be disturbed. The overall impact will be loss of topsoil as a result of erosion and possible contamination of the soil by hydrocarbon spills due to the excavation activities. Soil compaction caused by heavy vehicles and machinery along the pipeline route could also be a problem.

3.2 Operational Phase

Soil erosion through wind and storm water run-off, and soil pollution by means of hydrocarbon contamination from the maintenance of the pipeline, may be encountered during the operational phase. Water runoff from roads must be controlled and managed by means of proper storm water management facilities in order to prevent soil erosion.

4 Impact Assessment

The environmental impact assessment is designed to identify impacts related to various mining activities and how to mitigate these impacts. However with the correct mitigation measures being put in place these impacts can be reduced.

4.1 Construction Phase

During the construction phase the impacts that are associated with the movement of heavy machinery, removal of topsoil, incorrect stockpiling/stripping procedures, and hydrocarbon spills are centred on the following:

- The loss of topsoil as a resource;
- Compaction and Erosion; and
- Hydrocarbon spills.

4.1.1 Impact: loss of topsoil as a resource

Criteria	Details / Discussion
Description of impact	When topsoil is removed from a soil profile, the profile loses effective rooting depth which is one of the main criteria regarding capability classification. The main issue regarding the loss of topsoil is that, when the topsoil is gone it is a long term loss to the environment. Topsoil will be removed in the trenching of the pipeline.

Criteria	Details / Discussion				
Mitigation required	■ The topsoil (30cm) will be stripped separately and placed on the one side of the trench; ■ While the subsoil is to be stripped after and place on the opposite side of the trench; ■ The topsoil will be stripped by means of an excavator bucket, ■ Topsoil is to be stripped when the soil is dry and not wet, as to reduce compaction; ■ Soil is to be stripped according to the soil management plan and stockpiled accordingly; ■ Subsoil will be placed back into the trench first with the topsoil placed on top of the subsoil; ■ The handling of the stripped topsoil will be minimize to ensure the soil's structure does not deteriorate; and ■ Compaction of the removed topsoil will be avoided;				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	2 (Limited)	6 (Permanent: Mitigation)	5 (Very Serious)	7 (Certain)	91 (Medium-High)
Post-Mitigation	2 (Limited)	5 (Project Life)	3 (Moderate)	3 (Unlikely)	30 (Low)

4.1.2 Impact: Compaction & Erosion

Criteria	Details / Discussion				
Description of impact	Compaction occurs when heavy machinery drives over soils and compresses them. Erosion is grouped with compaction as compacted areas increase the erosion hazards that are present by reducing vegetation cover and increasing runoff potential.				
Mitigation required	■ Limit access to one route; ■ Only stockpile to 2m and don't drive on topsoil stockpiles; ■ Deep rip compacted areas after construction to allow for natural vegetation regrowth; ■ Ensure proper storm water management designs are in place; and ■ If erosion occurs, corrective actions must be taken to minimize any further erosion from taking place;				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*

Criteria	Details / Discussion				
Pre-Mitigation	1 (Very Limited)	7 (Permanent)	7 (Very Serious)	6 (very Likely)	90 (Medium-High)
Post-Mitigation	1 (Very Limited)	3 (Medium Term)	3 (Moderate)	4 (Probable)	28 (Low)

4.1.3 Impact: Hydrocarbon Pollution

Criteria	Details / Discussion				
Description of impact	Hydrocarbon spills occur when using heavy machinery, as they all use oils and diesel to run. There is a chance of these breaking down and/or leaking. Hydrocarbons have a devastating effect on the soil quality.				
Mitigation required	■ Prevent any spills from occurring; ■ If a spill occurs it is to be cleaned up immediately and reported to the appropriate authorities; ■ Use of spill kits in areas where vehicles are serviced; ■ All vehicles are to be serviced in a correctly bunded area or at an off-site location; and ■ Leaking vehicles will have drip trays place under them where the leak is occurring.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	1 (Very Limited)	7 (Permanent)	7 (Very Serious)	6 (very Likely)	90 (Medium-High)
Post-Mitigation	1 (Very Limited)	1 (Immediate)	7 (Very Serious)	5 (Likely)	45 (Medium - Low)

4.2 Operational Phase

During the operational phase the impacts that are associated with the operation of the pipeline are centred on the following:

- Compaction and Erosion; and
- Pipeline spills.

4.2.1 Impact: Compaction & Erosion

Criteria	Details / Discussion				
Description of impact	Compaction occurs when heavy machinery drives over soils and compresses them. Erosion is grouped with compaction as compacted areas increase the erosion hazards that are present by reducing vegetation cover and increasing runoff potential. This will occur with regards to servitude maintenance.				
Mitigation required	■ Limit access to one route; ■ Ensure proper storm water management designs are in place; and ■ If erosion occurs, corrective actions must be taken to minimize any further erosion from taking place;				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	1 (Very Limited)	7 (Permanent)	7 (Very Serious)	6 (very Likely)	90 (Medium-High)
Post-Mitigation	1 (Very Limited)	3 (Medium Term)	3 (Moderate)	4 (Probable)	28 (Low)

4.2.2 Impact: Pollution

Criteria	Details / Discussion				
Description of impact	During the operation of the pipeline a spill could occur and have a significant impact on the soil.				
Mitigation required	■ Prevent any spills from occurring; ■ Maintain the pipeline in a good condition; and ■ If a spill occurs it is to be cleaned up immediately and reported to the appropriate authorities;				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	1 (Very Limited)	7 (Permanent)	7 (Very Serious)	4 (Probable)	60 (Medium-Low)
Post-Mitigation	1 (Very Limited)	1 (Immediate)	7 (Very Serious)	3 (Unlikely)	27 (Low)

5 Conclusions

The project site has been impacted on significantly already and the majority of the soils in the area is shallow and of a rocky nature. These soils are often on steep slopes and as a result the expected land capability for these areas are relatively low with a predominantly a Grazing capability.

The pipeline will be constructed within an existing servitude for powerlines and other underground services.

Even though the land capability might be low, the main concern from a soils perspective is the erosion hazard. If any erosion occurs the area will lose the little topsoil that is available and its ability to rehabilitate as well. Erosion must be prevented.

6 References

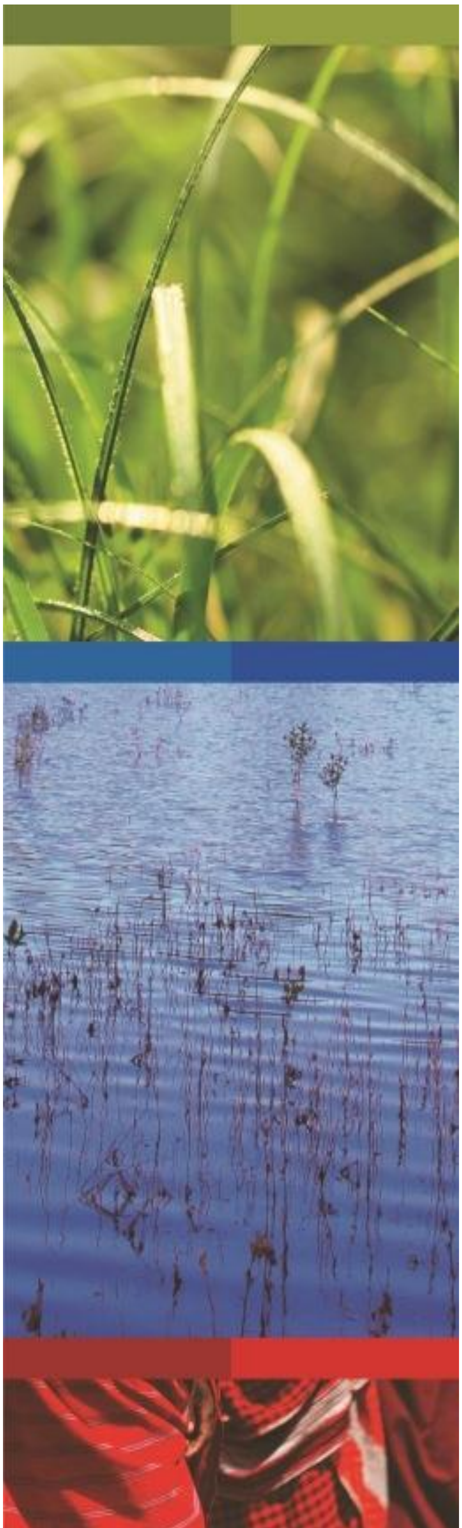
Land Type Survey Staff. (1972 - 2006). *Land types of South Africa; Digital Map (1:250 000 scale) and Soil Inventory Database.* Pretoria: ARC-Instatute for Soil, Climate, and Water.

Soil Classification Working Group. (1991). *Soil Classification A Taxonomicsystem for South Africa.* Pretoria: The Department of Agriculturel Development.

Regards,

Wayne Jackson

Soil Scientist



Basic Assessment Report for Ergo Goudkoppies Pipeline

Wetland Basic Assessment Report

Project Number:

ERG3057

Prepared for:

ERGO Mining Pty (Ltd)

December 2014

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This document has been prepared by Digby Wells Environmental.

Report Type:	**Wetland Basic Assessment Report**
Project Name:	**Basic Assessment Report for Ergo Goudkoppies Pipeline**
Project Code:	**ERG3057**

Name	**Responsibility**	**Signature**	**Date**
Ndumiso Dlamini	Report Compiler		December 2014
Crystal Rowe	1st Review		December 2014
Brett Coutts	2nd Review		December 2014

EXECUTIVE SUMMARY

Wetlands are sensitive ecosystems that perform many complex functions including the maintenance of water quality, carbon storage, stream-flow regulation, flood attenuation, various social benefits as well as the maintenance of biodiversity (Kotze *et al.,* 2007).

Digby Wells Environmental (Digby Wells) was commissioned by Ergo Mining (Pty) Ltd (Ergo) to complete a wetlands assessment for a proposed treated waste water pipeline that is intended to run from Pimville to Diepkloof, Soweto.

The proposed pipeline has the following specifications:

- 6 km in length buried at a depth of no more than 3 m;
- Welded with High Density Polyethylene (HDPE);
- Internal diameter of 500 mm; and
- Capacity of 231 litres per second.

The site visit to assess the wetlands on the pipeline route was conducted in November 2014. The DWAF guidelines (DWAF 2005) for the delineation of wetlands describe four properties that are considered in the procedure to determine the boundaries of a wetland. These properties are listed and describe briefly below:

- Terrain Unit Indicator – helps to identify those parts of the landscape where wetlands are more likely to occur;
- Soil Form Indicator – identifies the soil forms, which are associated with prolonged and frequent saturation;
- Soil Wetness Indicator – identifies the morphological “signatures” developed in the soil profile as a result of prolonged and frequent saturation; and
- Vegetation Indicator – identifies hydrophilic vegetation associated with frequently saturated soils.

A basic Present Ecological State (PES) assessment was completed for the wetlands associated with the crossings of the pipeline.

The wetland areas on the pipeline route were identified at points where the pipeline crossed streams. The pipeline route intersected watercourses (streams) four times along its path and the sites are numbered in ascending order from the point of origin of the pipeline

The wetlands were delineated using the four properties and classified using the hydro-geomorphic approach. The wetland vegetation indicator species most prominent were *Phragmites australis* (Giant Reed). *Imperata cylindrica* (Cottonwool Grass). The wetlands identified along the pipeline route were identified as valley bottom wetlands, with a channel.

The Present Ecological State (PES) of all the sites is varied from a low D to an E/F at site E4; this confirms that the wetlands along the pipeline route are largely impacted upon by

anthropogenic impacts, such as development that has occurred in close proximity to these wetlands

The pipeline route is situated in an existing servitude that runs through a highly developed urban environment, thus the servitude and surrounding area has been impacted upon already. This places the wetlands in this area under significant anthropogenic pressure.

Minimal impacts are expected due to the construction of the proposed pipeline, since the pipeline will be above-ground over wetland crossings, as a result of some wetland soil being excavated. The presence of heavy vehicles and machinery may result in soil compaction, which could lead to damming and reduce infiltration water through the wetland and potential spill of hydrocarbons in the wetland areas.

The impacts brought about by the operation of the proposed pipeline are considered negligible; in the event that the pipeline had to burst and water would escape from the pipeline as this is treated water.

The impacts during the decommissioning phase would be similar to the construction phase impacts. Thus overall impact during this phase would be of a low significance, even potentially a positive impact such as improved wetland functionality, after rehabilitation has occurred.

The construction of the proposed pipeline seems to have minimal impact to the already impacted wetlands and, in following the recommendations, should have less of an impact on the overall habitat of the wetland areas. Based on the assessment conducted, the following is recommended:

- Figure 7-1 below shows the proposed alternate route for the pipeline so as to minimise the footprint of the pipeline within wetland areas;
- Where construction does take place within wetland areas it is recommended that topsoil management be a priority;
- Prevent unnecessary erosion;
- Minimise areas of disturbance to a minimum and avoid extensive clearing of vegetation, if possible; and
- Where possible the vegetation must be kept intact within the soil and replanted as such. The topsoil layer is 30 cm deep with a quartzite under layer; making the wetland areas, assessed, highly susceptible to erosion should vegetation cover be absent. (Ergo Goudkoppies Soils Assessment, Digby Wells).

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1 Introduction

Wetlands are sensitive ecosystems that perform many complex functions including the maintenance of water quality, carbon storage, stream-flow regulation, flood attenuation, various social benefits as well as the maintenance of biodiversity (Kotze *et al.,*2007). The Ramsar Convention on Wetlands refers to wetlands as one of the most important life support systems on earth owing to the services provided. Wetlands are defined according to the National Water Act, 1998 (Act 36 of 1998) (NWA) as: *"land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."*

Wetlands in South Africa however, are poorly conserved owing primarily to a general underestimation of the ecological and economic importance of these systems (Swanepoel and Barnard, 2007). It is approximated that between 35-50% of all the wetland areas within South Africa have been destroyed as a result of anthropogenic stressors (Swanepoel and Barnard, 2007) and a cumulative loss of these important systems is on-going. Some of the major contributing factors to the decline of wetlands in South Africa include mining, industrial and agricultural activities as well as poor treatment of waste water from industry and mining (Oberholster *et al.*, 2011).

The major threats to wetlands in Gauteng include the construction of residential and commercial developments (DWAF 1996). Large areas of wetland have been completely cleared and destroyed for this purpose. Furthermore, indirect impacts on wetlands from leaching of treated sewage water can result in undesirably high nitrate concentrations. This can be the cause of eutrophication and algal blooms, resulting in the water becoming toxic in extreme cases.

The purpose of this document is to serve as a wetland delineation for the wetlands associated with the proposed treated effluent water pipeline from Pimville to Diepkloof, Soweto. Wetland boundaries were determined at four crossing points where the proposed pipeline intersected streams. Standardised South African methodology was employed for the purposes of this study using the procedure for identification and delineation of wetlands and riparian areas described by DWAF (2005).

2 Terms of Reference

Digby Wells Environmental (Digby Wells) was commissioned by Ergo Mining (Pty) Ltd to complete a wetlands assessment for a proposed treated waste water pipeline that is intended to run from Pimville to Diepkloof, Soweto. The wetlands assessment will be in partial fulfillment for the requirements for a Water Use License Application (WULA). This report is designed to define wetland areas of interest and to report observations from field investigation undertaken during November 2014. This survey supports the following regulations and regulatory procedures:

- Sections 19 and 21 of the National Water Act, 1998 (Act No. 36, 1998) (NWA);

- Section 24 of the Constitution – Environment (Act No. 108 of 1996), and;
- Section 5 of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended.

2.1 Locality

The proposed pipeline will travel from Ergo Mining's Goudkoppies Waste Water Treatment Works (WWTW) to the Crown Tailings Complex, where it will be utilised for dust suppression purposes. The pipeline will start in Pimville and end in Diepkloof, Soweto under Municipality of Johannesburg City in the Gauteng Province. Figure 2-1 shows the local setting and the proposed treated waste water pipeline. The proposed has the following specifications:

- 6 km in length buried at a depth of no more than 3 m;
- Welded with High Density Polyethylene (HDPE);
- Internal diameter of 500 mm; and
- Capacity of 231 litres per second.

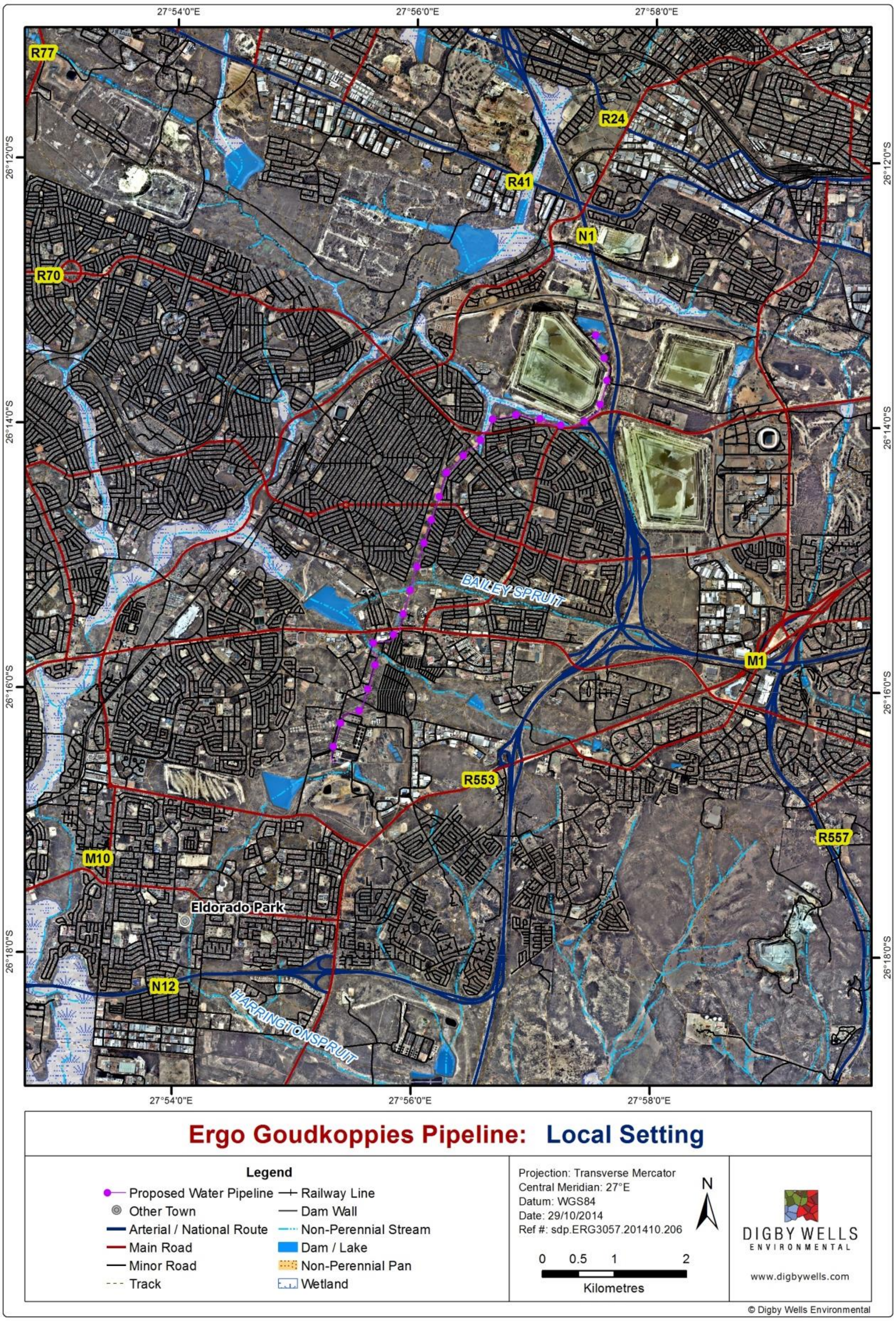

Figure 2-1: The local setting and route of the Goudkoppies Pipeline

3 Methodology

3.1 Wetland Delineation and Classification

The site visit to assess the wetlands on the pipeline route was conducted in November 2014. The DWAF guidelines (DWAF 2005) for the delineation of wetlands describe four properties that are considered in the procedure to determine the boundaries of a wetland. These properties are listed and describe briefly below:

- Terrain Unit Indicator – helps to identify those parts of the landscape where wetlands are more likely to occur;
- Soil Form Indicator – identifies the soil forms, which are associated with prolonged and frequent saturation;
- Soil Wetness Indicator – identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation; and
- Vegetation Indicator – identifies hydrophilic vegetation associated with frequently saturated soils.

The identified wetlands were classified, temporarily, according to their Hydro-geomorphic (HGM) Unit attributes based on the revised system, proposed by Brinson (1993) and Marneweck and Batchelor (2002), by Kotze *et al*. (2004). The HGM Unit system of classification for wetlands considers geomorphology; water movement into, through and out of a wetland; and landscape/topographic setting, together termed geomorphic setting (as represented in Table 3-1 below:

Table 3-1: Wetland Hydro-geomorphic units (modified from Brinson 1993; Kotze 1999 and Marneweck and Batchelor 2002)

Floodplain		Valley bottom areas with a well-defined stream channel stream channel, gently sloped and characterised by floodplain features such as oxbow depression and natural levees and the alluvial (by water) transport and deposition of sediment , usually leading to a net accumulation of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.
Valley bottom with a channel		Valley bottom areas with a well-defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterized by the net accumulation of alluvial deposits or may have steeper slopes and be characterised by the net loss of sediment. Water inputs from the main channel (when channel banks overspill) and from adjacent slopes.

Valley bottom without a channel		Valley bottom areas with no clearly defined stream channel, usually gently sloped and characterised by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from the channel entering the wetland and also from adjacent slopes.
Hillslope seepage linked to a stream channel		Slopes on hillsides, which are characterised by colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow and outflow is usually via a well-defined stream channel connecting the area directly to a stream channel.
Isolated hillslope seepage		Slopes on hillsides that are characterised by colluvial transport (transported by gravity) movement of materials. Water inputs are from sub-surface flow and outflow either very limited or through diffuse sub-surface flow but with no direct link to a surface water channel.
Pan/Depression		A basin-shaped area with a closed elevation contour that allows for the accumulation of surface water (ie. It is inward draining). It may also receive subsurface water. An outlet is usually absent and so this type of wetland is usually isolated from the stream network.

3.2 Wetland Present Ecological State

A basic Present Ecological State (PES) assessment was completed for the wetlands associated with the crossings of the pipeline. The PES tool incorporates hydrology, water quality, geomorphology, as well as biota (Kleynhans1996, 1999). A score is calculated based on a standard rating system as represented in Table 3-2

Table 3-2: Interpretation of PES ratings

Category	PES Rating	Description
A	5	Unmodified, natural.
B	4	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.
C	3	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.
D	2	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.
E	1	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions are extensive.

Category	PES Rating	Description
F	0	Critically / Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.
Sources: Kleynhans (1996); Kleynhans (1999)		

3.3 Impact Assessment

Digby Wells understands that this project is the construction of a pipeline that will run underground for the majority of its route, with exception to wetland crossings where it will cross over the surface. The impact assessment associated with the wetlands along the pipeline route (study area) includes construction phase impacts. The methodology used to assess the impacts on the wetlands within the study area is described in Table A-1.

A clearly defined rating scale is used to assess each impact in terms of severity, spatial extent and duration (which determines the consequence) and in terms of the frequency of the activity and the frequency of the related impact (which determines the likelihood of occurrence). The overall impact significance (Table A-2), is then determined via a significance rating matrix utilising the scores obtained for consequence and likelihood of occurrence, in order to assign a final impact rating.

4 Findings

4.1 Drainage and Quaternary Catchments

The study area falls within the C22A Quaternary Catchment, also known as the Klip River Catchment, shown in Figure 4-1. This catchment is seen to be on of South Africa's most heavily impacted river system. The Klip River flows through the southern parts of Johannesburg (Soweto), one of the most developed urban areas in Africa. This places the catchment under pressure from anthropogenic impacts as well as agricultural and subjects the river to many different types of pollution.

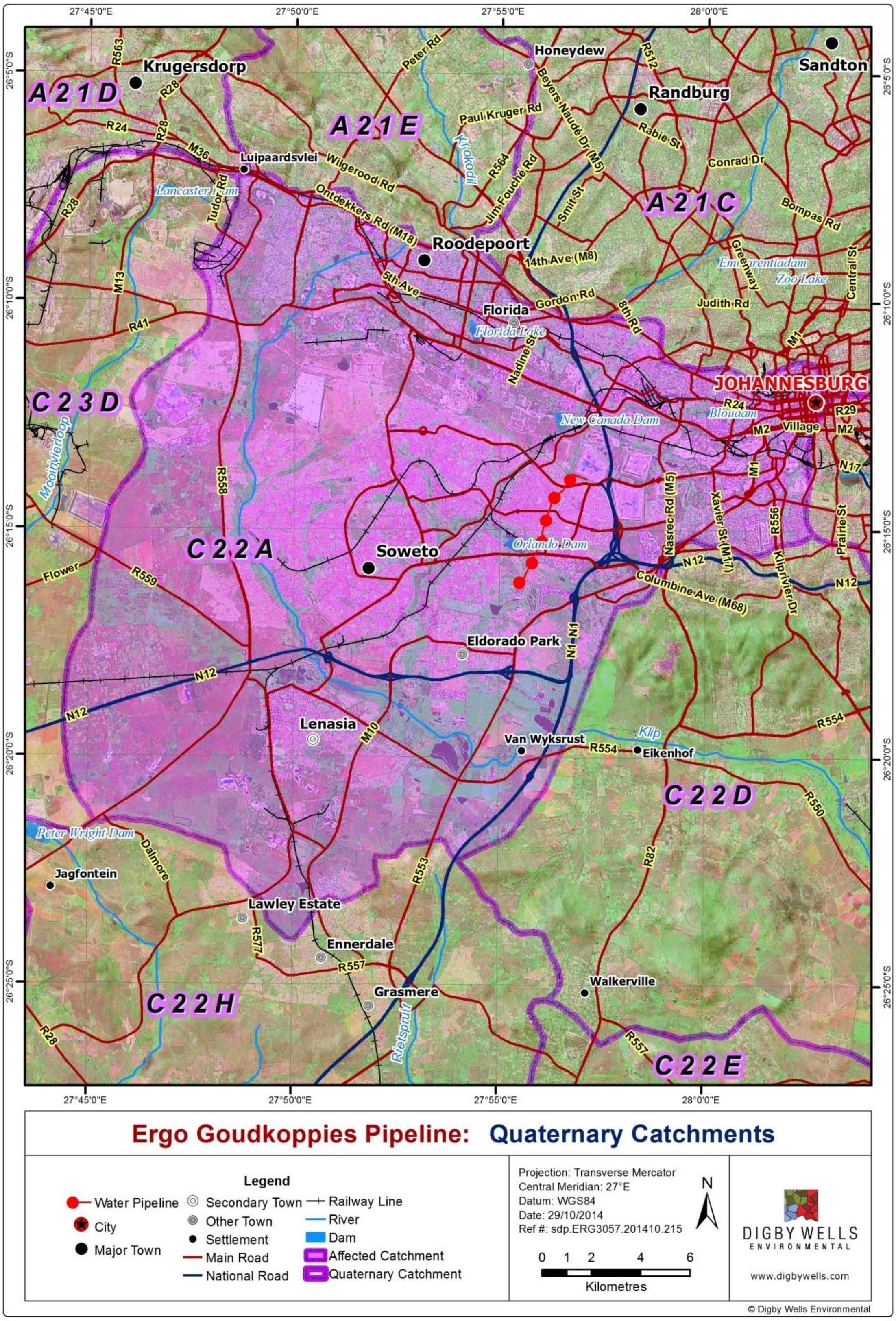

Figure 4-1: Quaternary catchments for the greater study area

4.2 National Freshwater Ecosystems Priority Areas (NFEPA)

The National Freshwater Ecosystem Priority Areas (NFEPA), the strategic spatial priorities for conserving the country's freshwater ecosystems and supporting sustainable use of water resources, were considered to evaluate the importance of the wetland areas located within the project area (Nel *et al.,* 2011).

Spatial layers used include the wetland classification and ranking. The NFEPA wetlands have been ranked in terms of importance in the conservation of biodiversity. Table 4-1below indicates the criteria which were considered for the ranking of wetland areas. Table 4-1 represents the NFEPA wetlands identified on site. Not all of the wetland areas present on site have been identified by NFEPA and this may be attributed to the large-scale desktop nature of the NFEPA assessment. The first and second (South to North) crossings intersect wetlands that have been allocated a NFEPA ranking of 6, indicating that although these wetlands have been recognised by NFEPA, they are not regarded for their importance for the maintenance of biodiversity. The third wetland crossing has been allocated a rank of 5, which means that this wetland has been demarcated as a Working for Wetlands site and is intended to be rehabilitated.

Table 4-1: NFEPA wetland classification ranking criteria

Criteria	Rank
Wetlands that intersect with a RAMSAR site.	1
Wetlands within 500 m of an IUCN threatened frog point locality; Wetlands within 500 m of a threatened waterbird point locality; Wetlands (excluding dams) with the majority of their area within a sub-quaternary catchment that has sightings or breeding areas for threatened Wattled Cranes, Grey Crowned Cranes and Blue Cranes; Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands of exceptional Biodiversity importance, with valid reasons documented; and Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands that are good, intact examples from which to choose.	2
Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands of biodiversity importance, but with no valid reasons documented.	3
Wetlands (excluding dams) in A or B condition AND associated with more than three other wetlands (both riverine and non-riverine wetlands were assessed for this criterion); and Wetlands in C condition AND associated with more than three other wetlands (both riverine and non-riverine wetlands were assessed for this criterion).	4
Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing Impacted Working for Wetland sites.	5
Any other wetland (excluding dams).	6

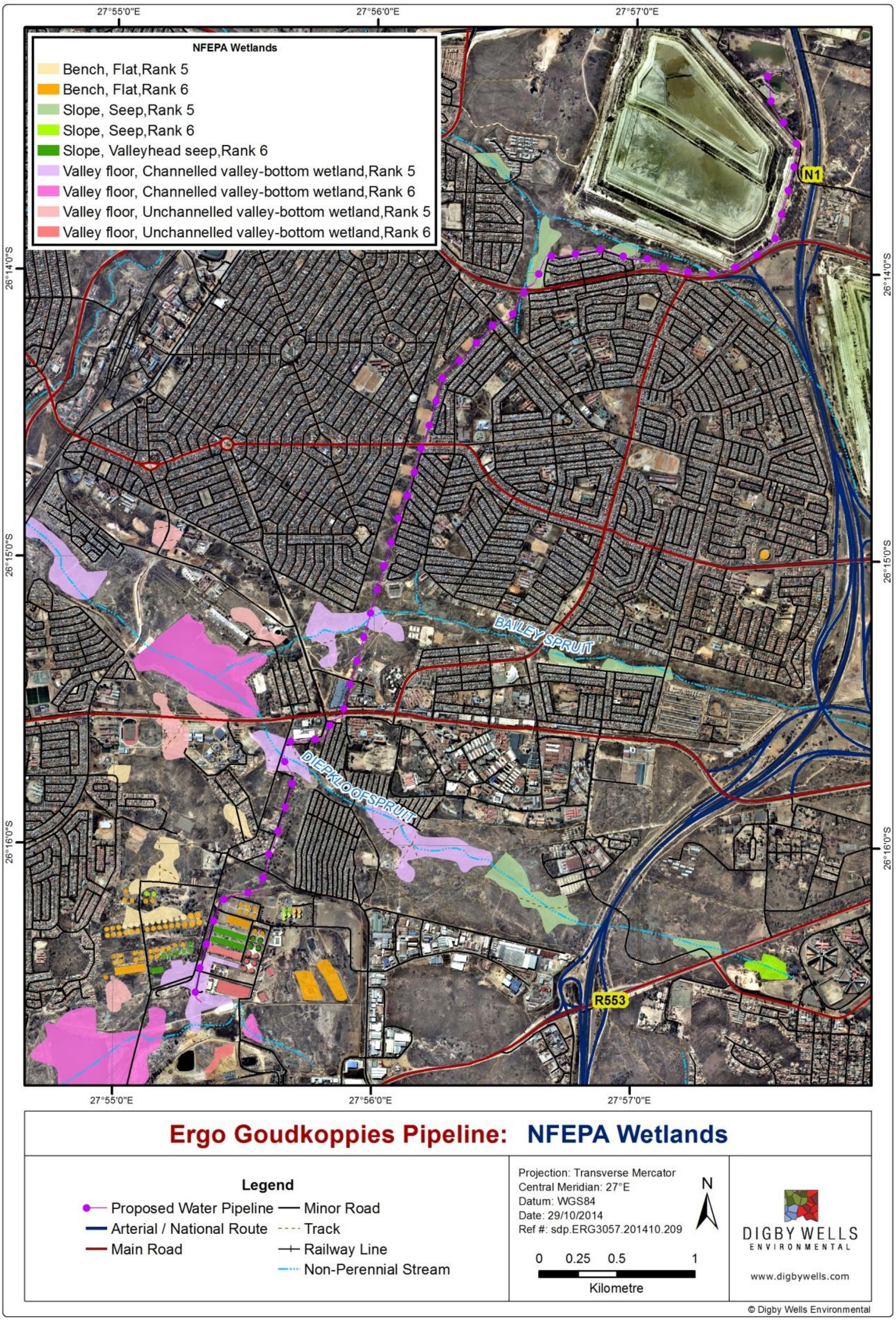

Figure 4-2: The Ergo Goudkoppies Pipeline route in relation to NFEPA wetlands

4.3 Wetland Delineation and Classification

The wetland areas on the pipeline route were identified at points where the pipeline crossed streams. The pipeline route intersected watercourses (streams) four times along its path and the sites are numbered in ascending order from the point of origin of the pipeline. Figure 4-3 shows the sites, E1, E2, E3 and E4 and Figure 4-4 showing the location of the sites.

Figure 4-3: Wetland crossings along the pipeline route (a) Site E1 (b) Site E2 (c) Site E3 (d) Site E4

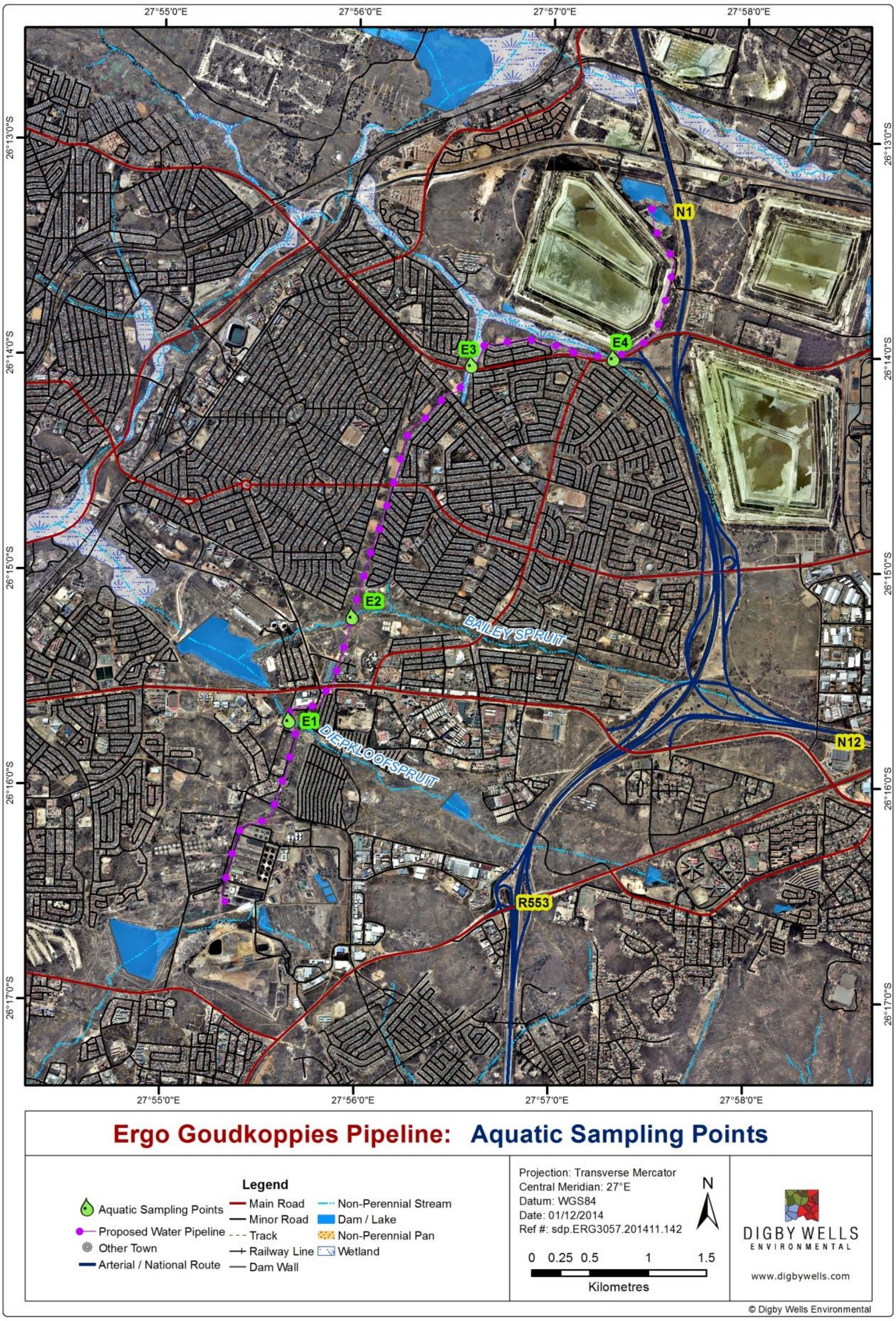

Figure 4-4: Aquatic sampling points where wetlands were delineated

The wetlands were delineated using the four properties as described in section 3.1 and classified using the hydro-geomorphic approach. The wetland vegetation indicator species most prominent were *Phragmites australis* (Giant Reed). *Imperata cylindrica* (Cottonwool Grass). Figure 4-5 shows the wetland vegetation Indicators. The vegetation of the area is described in Ergo Goudkoppies Fauna and Flora Report, Digby Wells.

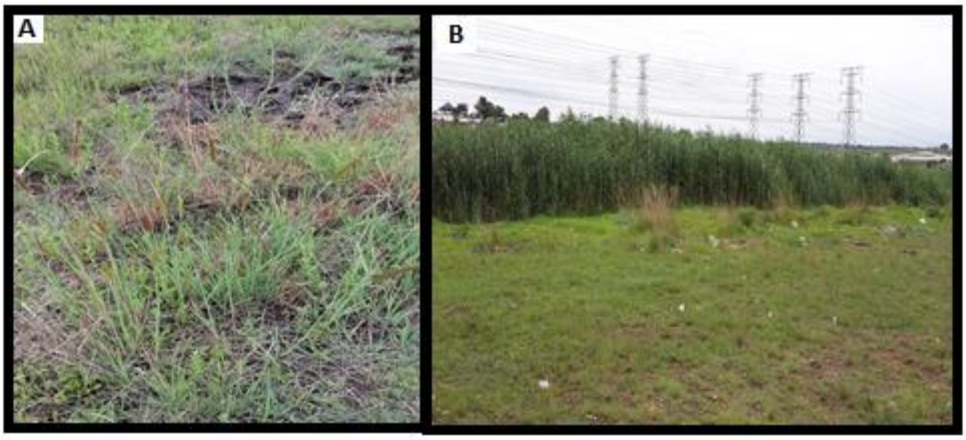

Figure 4-5: Wetland vegetation (a) *Imperata cylindrica* (b) *Phragmites australis*

The soil form indicator for wetlands, formation of mottles in soils that are saturated for prolonged periods, was identified (Figure 4-6 (b). It is important to note that in most areas along the pipeline route, the soils were underlain by a quartzite layer at 25-30cm deep. The quartzite layer in the wetland areas did not permit augering deeper than 30cm, however mottles were present, seen below in Figure 4-6 (a & b).

Figure 4-6: Soil form indicator (a) The quartzite layer at 30 cm (b) mottles in the soil

The wetlands identified along the pipeline route were identified as valley bottom wetlands, with a channel as defined in Table 3-1. Channelled valley bottom wetlands lie in a mostly flat or slightly sloped plain and obtain water mainly through the channel as surface water in flood events or diffuse through the soil. Figure 4-7 shows the wetland delineation.

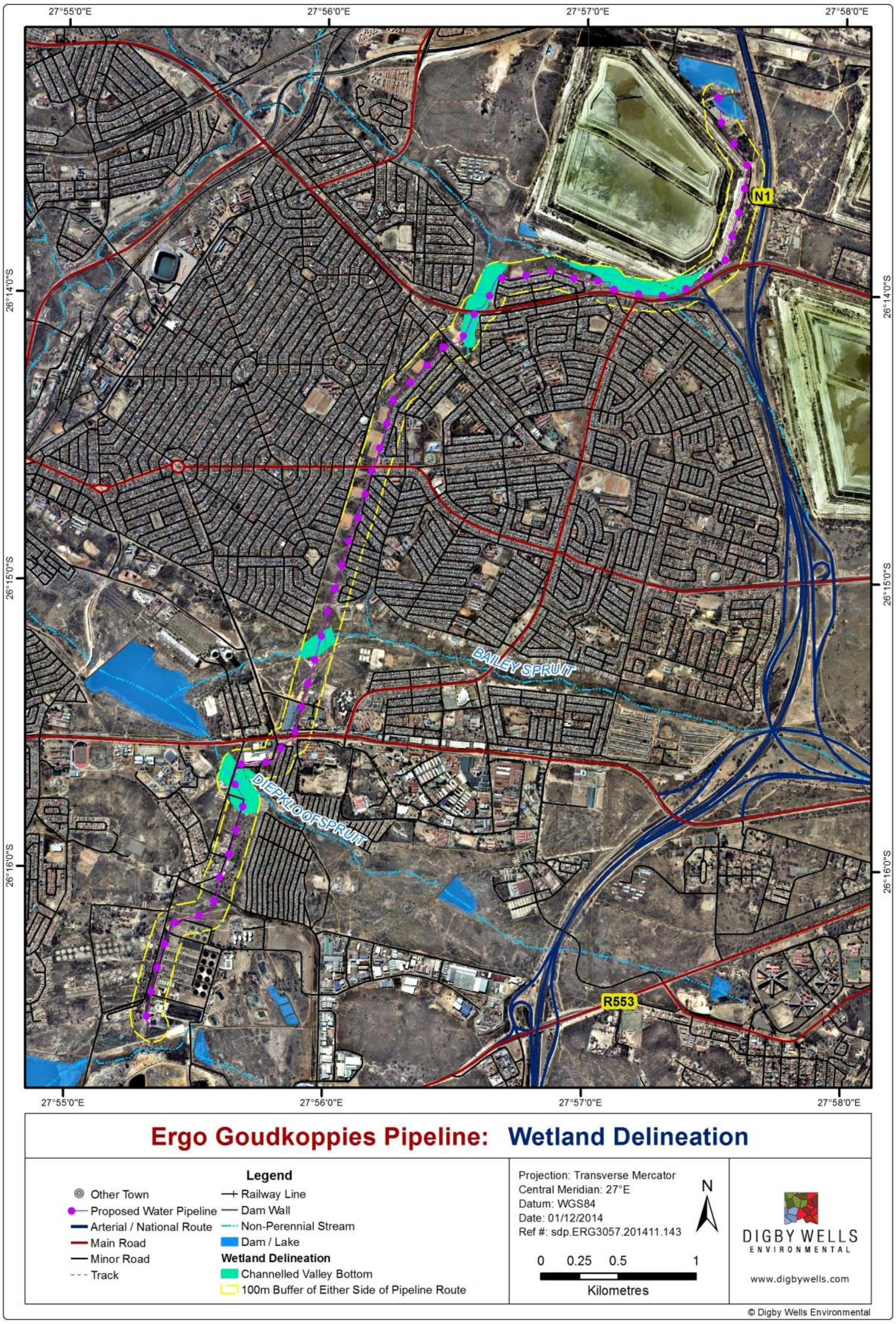

Figure 4-7: Wetland delineation with 100m buffer zone around pipeline

4.4 Present Ecological State (PES)

Removal of natural vegetation and loosening of surface sediments due to construction and developments is regarded as the most significant impact on site (Figure 5-1). Susceptibility to erosion and increased run-off are the major expected consequences of construction (altered topography) in wetlands.

Disturbance to the soil typically results in establishment of alien plants species. Wetland vegetation, such as sedges and hydrophyllic grasses, serves the important function of slowing down flow of water through the wetland due to the surface roughness. The type of wetland that was assessed made it simpler to assess the hydrology of the wetlands as it was a result of the channel. The PES of each site was assessed individually and results summarised in Table 4-2 below:

Table 4-2: The PES Scores for each delineated wetland

Wetland	PES Score
E1	D
E2	D
E3	E
E4	E/F

The Present Ecological State (PES) of all the sites is varied from a low D to an E/F at site E4; this confirms that the wetlands along the pipeline route are largely impacted upon by anthropogenic impacts, such as development that has occurred in close proximity to these wetlands. The channels, to a large extent, remain unaltered and water flows steadily (the aquatic properties are described in the Ergo Goudkoppies Pipeline Aquatic Assessment, Digby Wells), however, the wetlands have been altered to largely homogenous *Pennisetum clandestinum* vegetation with *Phragmites australis* in the areas bordering the channels. Patches of *Imperata cylindrica* are found in sewerage water logged areas.

5 Impact Assessment

5.1 Current Impacts

The pipeline route is situated in an existing servitude that runs through a highly developed urban environment, thus the servitude and surrounding area has been impacted upon already. This places the wetlands in this area under significant anthropogenic pressure. The isolated and connected seep-like areas may arise from sewerage overflow and may result in the sewerage like odour of the water.in the wetland systems. The erection of roads and dumps in the area has left the wetland surface soil exposed to erosion and together with other impacts have left the wetland catchments susceptible to being invaded by alien plants.

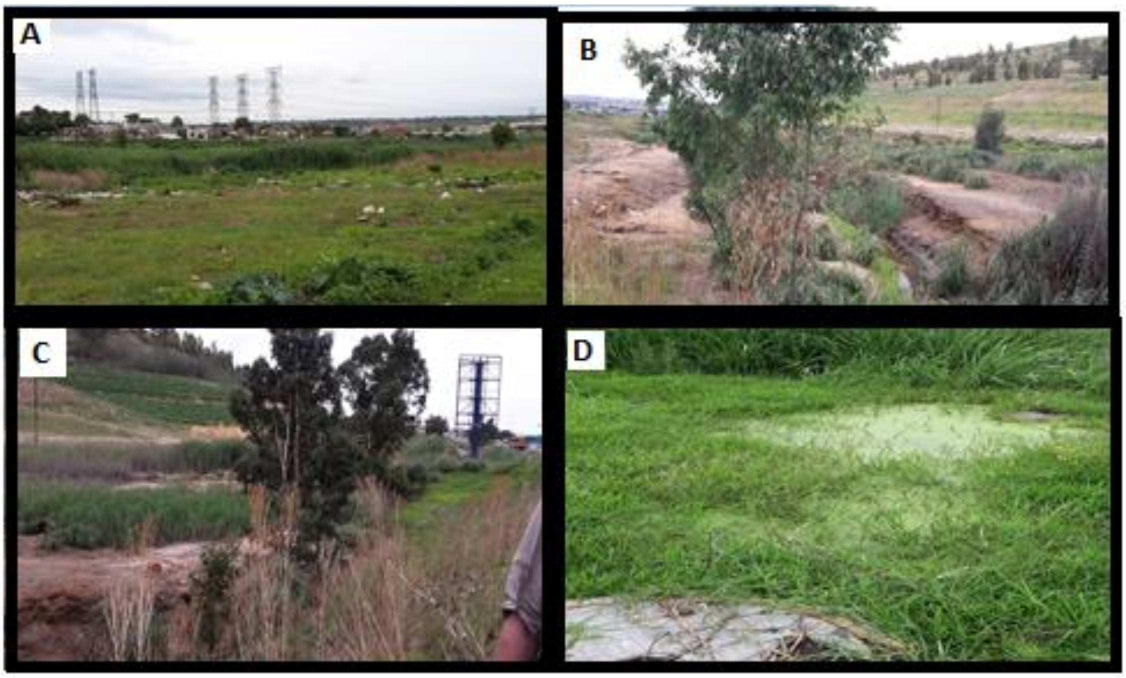

Figure 5-1: The impacts on the wetlands (a) pollution (b) and (c) erosion and alien invasive plants (d) possible overflow from the sewerage

5.2 Impacts of the Proposed Pipeline

The proposed pipeline is to be an underground pipeline; this means the removal of topsoil and digging of trenches. The impacts due to the construction of the proposed pipeline are discussed below. No impacts are anticipated due to the operation of the pipeline since the water being transported through the pipeline will be treated.

5.2.1 Construction phase

Minimal impacts are expected due to the construction of the proposed pipeline, since the pipeline will be above-ground over wetland crossings, as a result of some wetland soil being excavated. The presence of heavy vehicles and machinery may result in soil compaction, which could lead to damming and reduce infiltration water through the wetland and potential spill of hydrocarbons in the wetland areas. These impacts are considered to be minor and can be mitigated against if the appropriate mitigations are adopted to minimise exposed surfaces, erosion, soil compaction and hydrocarbon spillages. It is expected that there may be a slight loss of wetland areas as a result of construction activities, however it is suggested that the footprint of construction areas at the crossings be reduced as far as possible.

Table 5-1: Major Impacts in Construction Phase

Issue 1	**Direct loss of wetland area**				
Parameters	***Severity***	***Spatial scale***	***Duration***	***Probability***	***Significance***
Impact 1	***Channelled valley bottoms***				
Construction Phase					
Pre-mitigation	Moderate(3)	Municipal Area (4)	Immediate (1)	Likely(5)	Medium-Low (40)
Post-mitigation	Minor (2)	Local (3)	Immediate (1)	Likely(5)	Medium-Low (30)
Issue 2	**Contamination from Hydrocarbon spills**				
Parameters	***Severity***	***Spatial scale***	***Duration***	***Probability***	***Significance***
Impact 1	***Channelled valley bottoms***				
Construction Phase					
Pre-mitigation	Moderate(3)	Municipal Area (4)	Immediate (1)	Unlikely(3)	Low (24)
Post-mitigation	Minor (2)	Municipal Area (4)	Immediate (1)	Unlikely(3)	Low (21)

Mitigation

Vehicles and machinery to be operated in wetland areas should be free of leaks, where unavoidable, drip trays should be used. This construction is in an urban setting, no refuelling should take place in wetland areas. Construction footprint should be as small as possible and avoid clearing areas unnecessarily.

It is recommended that construction take place during the dry season to minimise the impact on wetland areas. Where the pipeline crosses over wetland areas, a single pipeline should be used (no flanges) to prevent possible leaks within wetland areas.

5.2.2 Operational Phase

The operation of the proposed pipeline and potential impacts is considered negligible in the event that the pipeline had to burst and water would escape from the pipeline as this is treated water, that would not impact on the receiving environment as this water should be of a quality suitable for irrigation (dust suppression) as this is what it is proposed that the water will be used for.

Mitigation

The treated water that may leak from the pipeline may have a negligible impact on the terrestrial qualities of the wetland; however, the aquatic life may be impacted upon as described in the Aquatic Report. It is there recommended that the pipeline be constructed as a continuous pipeline of wetland crossings and regular monitoring of pipeline be performed.

5.2.3 Decommissioning Phase

The impacts during the decommissioning phase would be similar to the construction phase impacts. Thus overall impact during this phase would be of a low significance. Decommissioning activities overall, considering rehabilitation may have an overall positive impact as rehabilitation may assist in improving wetland areas and functionality overall, through the removal of alien invasive plant species and removal of the pipeline which may impede the flow of water through the soil; however small the contribution could be considered as a positive impact.

5.3 Cumulative Impacts

The pipeline route is in an existing servitude that is utilised by power providers and municipal bodies. The wetlands are under pressure from anthropogenic uses and impacts, municipal usage and impacts as well as developmental and agricultural impacts. It is recommended that the proposed pipeline not add any pressures to the already heavily impacted wetlands ad that if possible after construction activities have taken place areas of disturbance as a result of construction activities are rehabilitated. This may even assist in improving the overall state of wetlands within the area to a small degree.

6 Discussion

Ergo Mining has proposed to construct an underground treated effluent pipeline. The proposed pipeline route is in an existing servitude route and intersects watercourses (wetlands) at for crossings. The wetlands intersected are heavily impacted upon as they are in an urban environment encompassed by housing developments and roads. The wetlands were identified as channelled valley bottom wetlands; these wetlands have a developed channel (stream) running through the bottom of the wetland.

The construction of the proposed pipeline seems to have minimal impact to the already impacted wetlands and in following the recommendations should have less of an impact on the overall habitat of the wetland areas.

7 Recommendations

- Figure 7-1 below shows the proposed alternate route, still within the servitude, for the pipeline so as to minimise the footprint of the pipeline within wetland areas
  - The suggested alteration at the first crossing is to avoid unnecessary wetland area damage and possible interference with the sewerage systems as shown in Figure 5-1 (d);
  - The alteration at the third crossing seeks to avoid unnecessary impacts within the wetland and provides a shorter distance crossing over a wetland;
- Where construction does take place within wetland areas it is recommended that topsoil management be a priority;
- Minimise areas of disturbance to a minimum and avoid extensive clearing of vegetation, if possible; and
- Where possible the vegetation must be kept intact within the soil and replanted as such. The topsoil layer is 30 cm deep with a quartzite under layer; making the wetland areas, assessed, highly susceptible to erosion should vegetation cover be absent. (Ergo Goudkoppies Soils Assessment, Digby Wells).

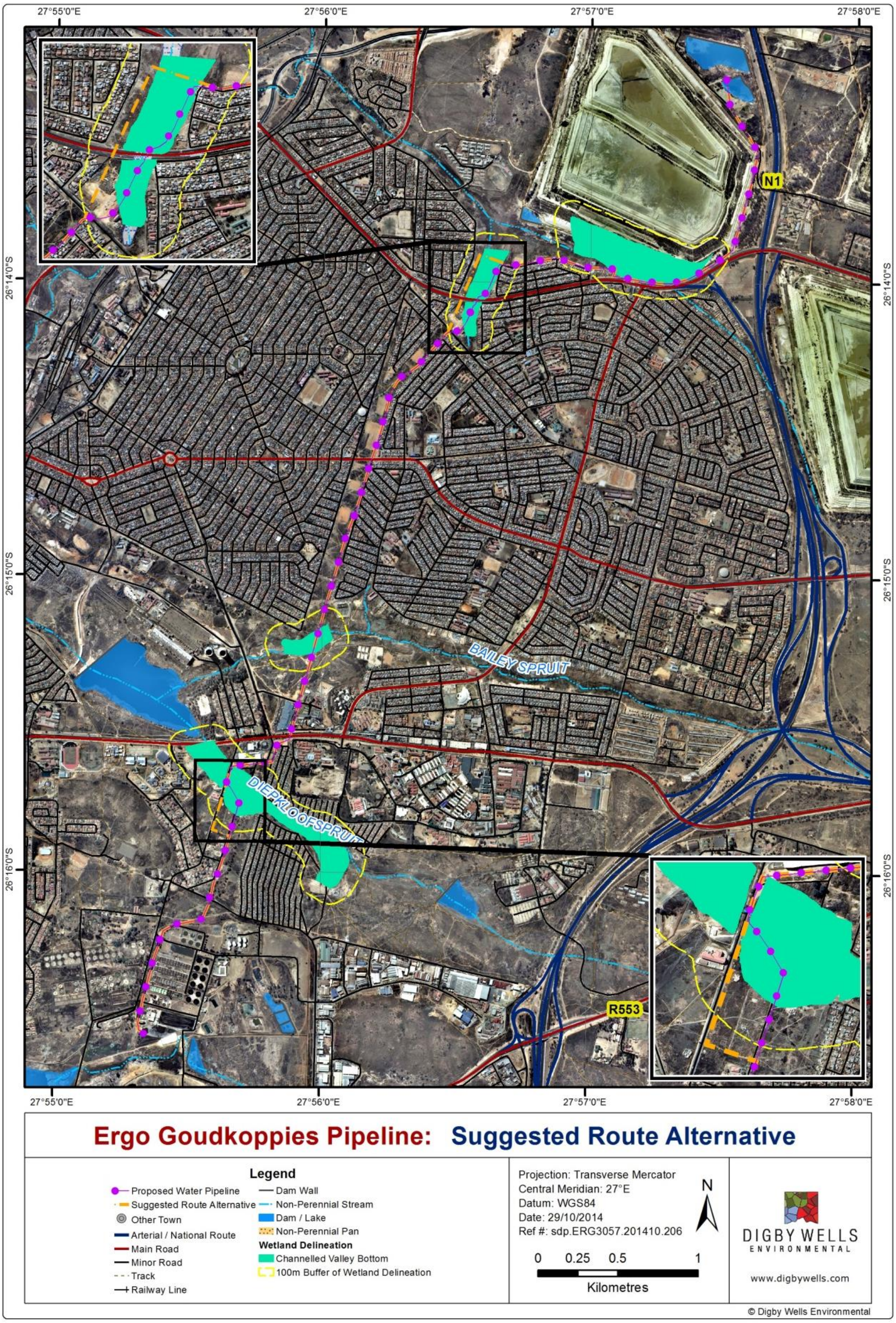

Figure 7-1: Suggested alternate route

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Appendix A: Impact Assessment Scoring Table

Table A-1: Impact assessment Methodology

Rating	Severity	Spatial scale	Duration	Probability
7	Very significant impact on the environment. Irreparable damage to highly valued species, habitat or eco system. Persistent severe damage.	International The effect will occur across international borders	Permanent: No Mitigation No mitigation measures of natural process will reduce the impact after implementation.	Certain/ Definite. The impact will occur regardless of the implementation of any preventative or corrective actions.
6	Significant impact on highly valued species, habitat or ecosystem.	National Will affect the entire country	Permanent: Mitigation Mitigation measures of natural process will reduce the impact.	Almost certain/Highly probable It is most likely that the impact will occur.
5	Very serious, long-term environmental impairment of ecosystem function that may take several years to rehabilitate	Province/ Region Will affect the entire province or region	Project Life The impact will cease after the operational life span of the project.	Likely The impact may occur.
4	Serious medium term environmental effects. Environmental damage can be reversed in less than a year	Municipal Area Will affect the whole municipal area	Long term 6-15 years	Probable Has occurred here or elsewhere and could therefore occur.
3	Moderate, short-term effects but not affecting ecosystem functions. Rehabilitation requires intervention of external specialists and can be done in less than a month.	Local Local extending only as far as the development site area	Medium term 1-5 years	Unlikely Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur.
2	Minor effects on biological or physical environment. Environmental damage can be rehabilitated internally with/ without help of external consultants.	Limited Limited to the site and its immediate surroundings	Short term Less than 1 year	Rare/ improbable Conceivable, but only in extreme circumstances and/ or has not happened during lifetime of the project but has happened elsewhere. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures

Rating	Severity	Spatial scale	Duration	Probability
1	Limited damage to minimal area of low significance, (e.g. ad hoc spills within plant area). Will have no impact on the environment.	Very limited Limited to specific isolated parts of the site.	Immediate Less than 1 month	Highly unlikely/None Expected never to happen.

Table A-2: Significance Categories

Significance										
	Consequence (severity + scale + duration)									
		1	3	5	7	9	11	15	18	21
Probability / Likelihood	1	1	3	5	7	9	11	15	18	21
	2	2	6	10	14	18	22	30	36	42
	3	3	9	15	21	27	33	45	54	63
	4	4	12	20	28	36	44	60	72	84
	5	5	15	25	35	45	55	75	90	105
	6	6	18	30	42	54	66	90	108	126
	7	7	21	35	49	63	77	105	126	147

Significance		
High (Major)	108- 147	
Medium-High (Moderate)	73 - 107	
Medium-Low (Minor)	36 - 72	
Low (Negligible)	0 - 35	