Appendix O
Wetland Delineation Report

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AQUATIC ECOLOGICAL ASSESSMENT AND WETLAND DELINEATION OF THE OF THE AQUATIC RESOURCES ON A PORTION OF PORTION 62 0F THE FARM WITPORTJE 117 IR

PREPARED FOR

Eco Assessments

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1. INTRODUCTION

Scientific Aquatic Services (SASS) was requested to assess and characterise the aquatic and riparian areas in the vicinity of the proposed development on a portion of Portion 62 of the farm Witportje 117 IR. The riparian areas of the drainage lines and any wetlands identified on site were also to be delineated, along with a suitable buffer zone. The purpose of the report is to define the extent and location of the aquatic resources on the subject property and to provide a summary of the aquatic ecological status of these resources prior to the proposed construction activities associated with the development and to allow informed decision making by the authorities, developers and environmental assessment practitioner.

The property is represented graphically on the South Africa 1:50 000 2628 AD map. The proposed development is bordered on the eastern boundary by an unnamed tributary of the Rietspruit. On the western side of the property, there is a drainage line which receives seepage water from the gold tailings dam to the north. Although the feature has water augmented form an anthropogenic source, it does support wetland vegetation types and as such, was delineated.

The aquatic resources on the subject property form part of the C22C quaternary catchment. The systems on the subject property form part of the headwaters of the Rietspruit. This catchment, therefore, forms part of the Vaal River water management area.

2. METHODOLOGY

2.1 Visual assessment

The site was investigated in order to identify visible impacts on the site, with specific reference to impacts from surrounding activities. Both natural constraints placed on ecosystem structure and function, as well as anthropogenic alterations to the system, was assessed by observing conditions and relating them to professional experience. Photographs of each site were taken to provide visual indications of the conditions at the time of assessment. Factors which were noted in the site-specific visual assessments included the following:

- Instream and riparian habitat diversity;
- Stream continuity;
- Erosion potential;
- Depth flow and substrate characteristics;
- Signs of physical disturbance of the area;

- Other life forms reliant on aquatic ecosystems and
- Signs of impact related to water quality.

2.2 Biota specific water quality

On-site testing of biota specific water quality variables took place. Parameters measured include pH, electrical conductivity, dissolved oxygen concentration and temperature. The results of on-site biota specific water quality analyses were used to aid in the interpretation of the data obtained by the biomonitoring. Results are discussed against the guideline water quality values for aquatic ecosystems (DWAF 1996 vol 7).

2.3 Habitat integrity

It is important to assess the habitat of each site, in order to aid in the interpretation of the results of the community integrity assessments by taking habitat conditions and impacts into consideration. The general habitat integrity of the site should be discussed based on the application of the Intermediate Habitat Integrity Assessment for (Kemper; 1999). The Intermediate Habitat Integrity Assessment (IHIA) protocol, as described by Kemper (1999), should be used for site specific assessments. This is a simplified procedure, which is based on the Habitat Integrity approach developed by Kleynhans (1996). The IHIA is conducted as a first level exercise, where a comprehensive exercise is not practical. The Habitat Integrity of each site should be scored according to 12 different criteria which represent the most important (and easily quantifiable) anthropogenically induced possible impacts on the system. The instream and riparian zones should be analysed separately, and the final assessment should be made separately for each, in accordance with Kleynhans' (1999) approach to Habitat Integrity Assessment. Data for the riparian zone are, however, primarily interpreted in terms of the potential impact on the instream component. The assessment of the severity of impact of modifications is based on six descriptive categories with ratings. Analysis of the data should be carried out by weighting each of the criteria according to Kemper (1999). By calculating the mean of the instream and riparian Habitat Integrity scores, an overall Habitat Integrity score can be obtained for each site. This method describes the Present Ecological State (PES) of both the in-stream and riparian habitats of the site. The method classifies Habitat Integrity into one of six classes, ranging from unmodified/natural (Class A), to critically modified (Class F).

Table 1: Classification of Present State Classes in terms of Habitat Integrity [Based on Kemper 1999]

Class	Description	Score (% of total)
A	Unmodified, natural.	90-100
B	Largely natural, with few modifications. A small change in natural habitats and biota may have taken place but the basic ecosystem functions are essentially unchanged.	80-90
C	Moderately modified. A loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	Extensively modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Critically modified. Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances, basic ecosystem functions have been destroyed and the changes are irreversible.	<20

2.4 Aquatic macro-invertebrates

Due to the lack of suitable habitat and sampling conditions, the SASS index was not applied to the site. Samples of the macro-invertebrate community were, however, observed in order to allow interpretations to be made on the diversity, sensitivity and abundance of the aquatic communities present.

2.5 Wetland delineation

For the purposes of this investigation, a wetland was defined according to the definition in the National Water Act 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 in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."

Wetland delineation took place according to the method presented in the final draft of "A practical field procedure for identification and delineation of wetlands and riparian areas" published by the department of Water Affairs and Forestry in February 2003. The foundation of the method is based on the fact that wetlands have several distinguishing factors including the following:

- The presence of water at or near the ground surface
- Distinctive hydromorphic soils
- Vegetation adapted to saturated soils
- The presence of alluvial soils in stream systems

By observing the evidence of these features, in the form of indicators, wetlands can be delineated and identified. If the use of these indicators and the interpretation of the findings are applied correctly, then the resulting delineation can be considered accurate (DWAF 2003).

Wetlands can be divided into three zones (DWAF 2003). The permanent zone of wetness is nearly always saturated. The seasonal zone is saturated for a significant part of the rainy season and the temporary zone surrounds the seasonal zone and is only saturated for a short period of the year, but is saturated for a sufficient period of time, under normal circumstances, to allow for the formation of hydromorphic soils and the growth of wetland vegetation. The objective of this study was to identify the outer boundary of the temporary zone and then to identify a suitable buffer zone around the wetland area.

During the assessment the following wetland indicators were used:

- Terrain units were used to identify parts of the landscape where wetlands were more likely to form.
- The proposed development site consists of a disturbed grassland vegetation community. Vegetation was generally used as the primary indicator of the wetland temporary zone boundary, although in some areas historical disturbance (the presence of a tailings dam) has altered the vegetation composition and made it inaccurate to rely on vegetation as the sole indicator of wetland conditions.
- The soil form was considered as an indicator to define the wetland boundary. For the soil form indicator, the presence of gleyed soils (most of the iron has been leached out of the soil leading to a greyish/greenish/bluish colour) and mottling (created by a fluctuating water table) were investigated to aid in identifying areas with wetland characteristics where no indication of a temporary wetland zone could be identified from the vegetation. Soil forms were, however, of limited use in the delineation process due to significant past impacts on soil conditions (the presence of the tailings dam) and other soil disturbances.
- Soil wetness was also considered during the delineation process

2.6 Assumptions and limitations

The following points serve to indicate the assumptions and limitations of this study:

- ***Reference conditions are unknown:*** The composition of aquatic biota in the study area prior to major disturbance is unknown. For this reason, reference conditions are hypothetical, and are based on professional judgement and/or inferred from limited data available.

- ***Temporal variability:*** The data presented in this report are based on a single site visit, undertaken in summer (18 December 2008). The effects of natural seasonal and long term variation in the ecological conditions and aquatic biota found in the streams are, therefore, unknown.
- ***Ecological assessment timing:*** Aquatic and terrestrial ecosystems are dynamic and complex. It is likely that aspects, some of which may be important, could have been overlooked. A more reliable assessment of the biota would require seasonal sampling, with sampling being undertaken under both low flow and high flow conditions.
- ***Disturbance of the riparian zone:*** The riparian areas have been transformed by past anthropogenic activities such as digging drainage channels, filling in of historical streams and the presence of a large tailings dam. Wetland indicators such as terrain units, soils forms and vegetation composition are all affected by these disturbances and will result in a degree of inaccuracy.

3. RESULTS

3.1 Visual assessment

Figure 1: Local view showing surface water present in the eastern drainage feature. This wetland has been called Wetland 1.

Figure 2: Local view showing the abundance of sedges and water loving wild flowers found adjacent to the eastern drainage feature. This wetland has been called Wetland 1.

Figure 3: Local view showing the vegetation found in the floodplain of the river that flows to the east of the assessment site. The vegetation found here was indicative of clay soil and most conditions. Overall, this section in moderate ecological condition. This area has been called wetland 2.

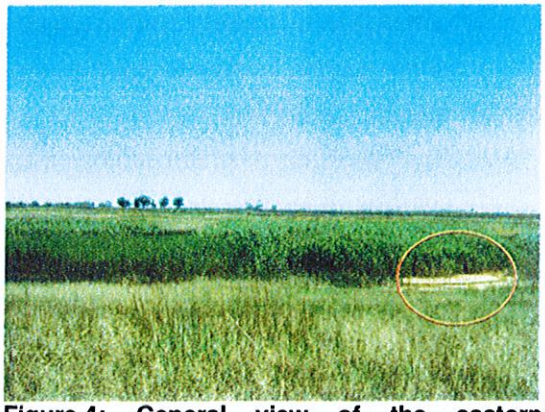

Figure 4: General view of the eastern drainage feature indicating sedimentation caused by tailings deposition (circled in red). This area has been called wetland 2.

Figure 5: Local view overlooking the narrow channel found in the west of the assessment site. No water was observed in the channel, although water loving grass species such as *Setaria spachelata* and *Andropogon appendiculatus* were prevalent. This area has been called wetland 3. .

Figure 6: Historical maps indicated a stream found immediately adjacent to the western side of the tailings dam. No such channel was observed during the assessment and the vegetation found in the area was typical of an area that has been critically transformed with an extremely low diversity of indigenous species and an abundance of exotic species.

Table 2: Visual description of the Rietspruit in the vicinity of the proposed development site

ASPECT	
Surrounding features	The area is located in a fairly remote area. However, to the north of the site there are extensive suburban areas. Immediately adjacent to the feature, there is a disused gold tailings dam which has a probable impact on the physico-chemical characteristics of the system.
Significance of the point	The site serves to indicate the aquatic ecological integrity of the unnamed tributary of the Rietspruit prior to the proposed development taking place.
Riparian zone characteristics	Wetland 1: The stream found has been artificially formed due to the digging of a channel next to the adjacent road. The stream itself is ca. 2m wide, while the adjacent wetland is ca. 30m wide. The stream is dominated by reeds, particularly *Typha capensis*, while the wetland is dominated by sedges and water loving herbaceous species such as *Berkeya radula* and *Nidorella anomala*. Wetland 2: This wetland is the floodplain of the permanent river found to the east of the assessment site. At its widest, the floodplain extents ca. 100m from the river, but narrows substantially to ca. 20m as it runs next to the tailings dam. Within the stream, *Phragmites australis* is prevalent, with exotic species such as *Populus x canescens* and *Salix mucronata* being found on its banks. Within the floodplain, water loving grass species such *Agrostis lachnantha, Paspalum dilatatum, Hyparrhenia tamba* are commonly encountered. Indigenous herbaceous species associated with moist condition, e.g. *Berkeya radula*, are also prevalent here. Wetland 3: A ca. 10m wide channel is found here. However, no water was observed here in the assessment, although grasses associated with moist conditions, e.g. *Setaria spachelata* and *Andropogon appendicultus*, were observed. Moving out of the channel, exotic species such as *Verbena bonariensis* and *Pseudognaphalium luteo-album* completely dominates the landscape.
Depth and flow characteristics	Wetland 1: The stream is feed from an unidentified source coming from the neighbouring property (the course could not be determined, as a 3m high wall surrounded this neighbouring property). However, likely sources are a combination of surface runoff and the tailings dam. The stream varies from a small trickle to a 2m wide, 1m deep stream. Higher up the stream flows steadily, but once in the excavated channel, it slows down, even pooling in some sections. Wetland 2. The river to the east of the assessment site is more perennial in nature. However, once it is adjacent to the tailings dam, severe sedimentation has occurred and dramatically slowed the flow through the stream. Wetland system 3 was dry at the time of assessment
Water clarity	Flow in the systems was clear at the time of assessment.
Signs of pollution	The site shows evidence of impact by from the adjacent tailings dam, with clear evidence of sedimentation within wetland 2, with the source of the material being fines. Sedimentation has significantly altered the substrate of the channel and led to the proliferation of *Phragmites australis*. To the west of the tailings dam, streams that were historically indicated are no longer found, probably as a result of earthworks associated with the tailings dam. However, the presence of the tailings dam has a resulted in a more diffuse distribution of water, with signs of moisture being found almost along its entire length. The combination on disturbance and extra moisture has result in some exotic species such as *Verbena bonariensis* and *Pseudognaphalium luteo-album* being extremely abundant.

3.2 Biota specific water quality

The table below records the biota specific water quality of the assessment site.

Table 3: Biota specific water quality data along the main drainage feature

SITE	COND mS/m	pH	D. O. mg/l	TEMP °C
Riet1	326.8	5.78	4.2	19.8

Key findings

- Dissolved salt concentrations can be considered to be significantly elevated from the natural conditions expected in the system. Some addition of salts to the Rietspruit from the upstream residential areas as well as, more significantly, the adjacent tailings dam complex. The high dissolved salt content is likely to lead to significant impairment of the aquatic community both from osmotic stress, as well as impacts from particular toxicants at excessively high levels.
- pH is low, most likely as a result of AMD seepage from the adjacent tailings complex. The low pH is likely to lead to significant impairment of the aquatic community.
- Some impact on dissolved oxygen levels is evident, which is most likely as a result of the urban runoff and diffuse sources of contamination further up in the catchment. This is likely to affect the aquatic community to some degree.
- Temperature can be regarded as normal for the time of year and time of day during which the assessment took place.

3.2.1 Habitat integrity

Table 4: Results of the application of the IHI index to the site

Weights	14	13	13	13	14	10	9	8	6		
REACH	Water abstraction	Flow modification	Bed modification	Channel modification	Water quality	Inundation	Exotic macrophytes	Exotic fauna	Solid waste disposal	Total Score (%)	Classification
RIET 1	0	6	34	24	24	7	0	0	3	40	D Largely modified
None	*small*		*Moderate*			*Large*				*Serious*	*Critical*

Riparian Zone Habitat Integrity

Weights	13	12	14	12	13	11	12	13		
REACH	Vegetation removal	Alien encroachment	Bank erosion	Water abstraction	Flow modification	Channel modification	Water quality	Inundation	Total Score (%)	Classification
RIET 1	0	9	0	0	16	24	8	3	71	C Moderately modified
None	*small*		*Moderate*			*Large*			*Serious*	*Critical*

REACH	*INSTREAM HABITAT*	*RIPARIAN ZONE*	*IHI SCORE*	*CLASS*
RIET 1	40	71	*56*	D Largely modified

From the results of the application of the IHIA to the Riet1 site, it is evident that there is significant impact on the Rietspruit instream habitat. Overall, the site achieved a 40% score for

instream integrity and a 71% score for riparian zone integrity. The site obtained an IHIA rating of 56%, which indicates largely modified (class D conditions).

The most significant instream impacts were bed and channel modification, along with impacts on water quality. Smaller impacts from flow modification and inundation were also observed.

Riparian impacts were again most significantly expressed as flow channel and water quality modification. Some impact from exotic vegetation encroachment and inundation were also noted.

Riparian zone impacts were limited to moderate impacts from alien vegetation encroachment and channel modification. Small impacts from indigenous vegetation removal flow modification and water quality were evident. Overall, the site achieved a 90% score for riparian zone integrity. The site obtained an IHIA rating of 74%, which indicates Moderately modified (class C conditions).

3.3 Aquatic macro-invertebrates

From the assessment of the aquatic macro-invertebrates in the system, typical taxa, known to occurring in still waters or slow flowing streams, were observed. Members of the Order *Odonata* and *Coleoptera* were particularly well represented, both in terms of diversity and abundance.

From the results it was, however, evident that more sensitive taxa such as the *Lestidae* family of damselflies were absent. This serves as an indication that some impairment of the aquatic community, due to reduced water quality, is deemed likely.

With the significant deposition of tailings on the stream bed, significant historical impacts on the aquatic community are deemed likely. Significant alterations to the stream substrate are deemed likely, which would have led to significant reductions in the aquatic community diversity and sensitivity over time.

3.4 Wetland habitat and functionality

Four wetland systems were observed during the December 2008 field visit and they will each be individually discussed.

3.4.1 Wetland 1

This wetland is found in the north of the assessment site. A channel has been artificially dug next to a road and has water flowing into from the neighbouring property. The source of this stream could not be identified, given that a large wall prevented investigating the surrounding areas. However, the most likely source is a combination of surface water runoff and seepage water from the tailings dam on the neighbouring property. Within the channel, water appears to be constantly available and has allowed for the establishment of reeds, particularly *Typha capenis*. The wetland zones found next to the stream are characterised by the presence of the exotic tree *Eucalyptus camaldulensis*, rubble from construction activities, and disturbed grassland. The majority of the disturbance is located in the northern half of this wetland. The southern half of the wetland is dominated by sedges and water loving herbaceous species such as *Nidorella anomala* and *Berkeya radula*. It should also be noted that the wetland was only found to the west of the channel, with the eastern bank consisting of a road and disturbed veld. Overall, the presence of exotics in the wetland, the rubble and construction in the adjacent veld and the low indigenous diversity are indicative of the ecosystem whose ecological integrity has been degraded. It would best be described as a system which is highly modified with an extensive loss of natural habitat, biota and basic ecosystem function.

3.4.2 Wetland 2

This wetland is a portion of the floodplain which neighbours the river flowing to the east of the assessment site. As such, it is dominated by species associated with clay soil and moist conditions, e.g. grass species such as *Agrostis lachnantha, Eragrostis capensis, Eragrostis gummiflua, Eragrostis trichophora* and *Themeda triandra,* and herbaceous species such as *Berkeya radula, Nidorella anomala* and *Haplocarpha scaposa*. The dominance of species such as *Themeda triandra,* which is common in undisturbed veld, indicates that this section of the floodplain is still in relatively good condition. The habitat in this section indicates a loss and change of natural habitat and biota, but the basic ecosystem functions are still predominantly unchanged. However, once the Rietspruit flows next to the tailings dam, exotic species such as *Verbena bonariensis* become more prevalent, and the grass species observed, such as *Cortaderia selloana,* are indicative of a more disturbed environment.

3.4.3 Wetland 3

Historically, a stream was found to the west of the tailings dam most likely originating from tailings seepage or at a minimum significantly recharged by seepage from the tailings dam. The

vegetation that dominated this area was exotic species such as *Verbena bonariensis* and *Pseudognaphlium luteo-album.* The dominant grass species here, e.g. *Cynodon dactylon,* are also indicative of disturbance. The presence of such species can mostly likely be attributed to increased wetness from seepage from the tailings dam, rather than a natural wetland system that may have historically been found here. Some impact one the vegetation due to impacts on soil chemistry is also deemed likely.

Further west the channel is found. Although no water was observed in the channel, indigenous water loving grass species, e.g. *Setaria spachelata* and *Andropogon appendiculatus,* and herbaceous species, e.g.. *Nidorella anomala,* were abundant. However, overall there was a low diversity of indigenous species as well as an abundance of exotic species, particularly *Verbena bonariensis* and *Pseudognaphlium luteo-album.* This area of the feature can be considered to have suffered a large loss of natural habitat, biota and basic ecosystem functions.

3.4.4 Wetland 4 (Pans)

Three endorheic pans were observed almost in the centre of the subject property. These pans have generally been significantly affected by alien encroachment, with special mention of *Verbena bonariensis* and *Bidens Formosa.* Other significant impacts observed include disturbance of the pan substrate, as well as frequent veld fires impacting the vegetation.

3.5 Wetland delineation

Upon the assessment of the area, the various wetland vegetation components were assessed. Dominant species were characterised as either riparian species or terrestrial species. The riparian species were then further characterised as permanent, seasonal, or temporary zone species. This characterisation is presented in the table below.

Table 5: Dominant terrestrial and wetland species noted during the assessment of the wetland and riparian areas

Terrestrial species	Temporary zone species	Seasonal zone species	Permanent zone species
Hyparrhenia hirta *Conyza podocephala* *Vernonia oligocephala* *Eragrosits curvula* *Eragrostis rotifer* *Heteropogon contortus* *Pseudognaphalium luteo-album** *Verbena bonariensis**	*Themeda triandra* *Berkeya radula* *Eragrosits capensis* *Eucalyptus camaldulensis** *Eragrostis gumminflua* *Eragrosits racemosa* *Eragrostis trichophora* *Pseudognaphalium lutwo-album** *Nidorella anomala* *Haplocarpha scaposa*	*Paspalum diilatatum** *Agrostis lachnantha* *Settaria spachelata* *Imperata cylindrica* *Cyperus* sp.	*Typha capensis* *Phragmites australis* *Juncus* sp.

	Andropogon appendiculatus *Cynodon dactylon* *Hyparrhenia tamba* *Verbena bonariensis**		

* Exotic species

- Four wetlands were noted. Wetland 1 consists of an extensive unchannelled valley bottom wetland which becomes channelled in some sections towards the south. Wetland 2 is the floodplain of the stream flowing to the east of the assessment site and can be considered to be a channelled valley bottom wetland. Wetland 3 is the remains of a historical stream found in area originating from tailings seepage. The channel observed here did not have flowing water and probably flows immediately after heavy rains. .
- The presence of a tailings dam has altered the integrity of wetland 2 and 3. Severe sedimentation is observed in river to east of the tailings dam. With regards to wetland 3, the integrity of the wetland system here has been severely degraded by the altering of the terrain. In addition, water leaking from the tailings dam results in moist conditions in areas that would have historically been terrestrial zones. In these areas, the vegetation that has been allowed to flourish is exotic species, particularly *Verbena bonariensis* and *Pseudonaphalium luteo-album*. After establishing in these recruitment areas they have often invaded the natural wetland areas.
- Based on the findings of this report, it is deemed necessary that a 30m buffer be maintained around all the wetland features as described in this document, which remains undeveloped as private or public open space.

The figures below serve to conceptually present the location of the wetland boundary on the property, as well as the 30 meter buffer zone in relation to the proposed development layout. Please also refer to the associated digital files presenting the wetland boundary and buffer zone to allow for further planning of the layout of the proposed development.

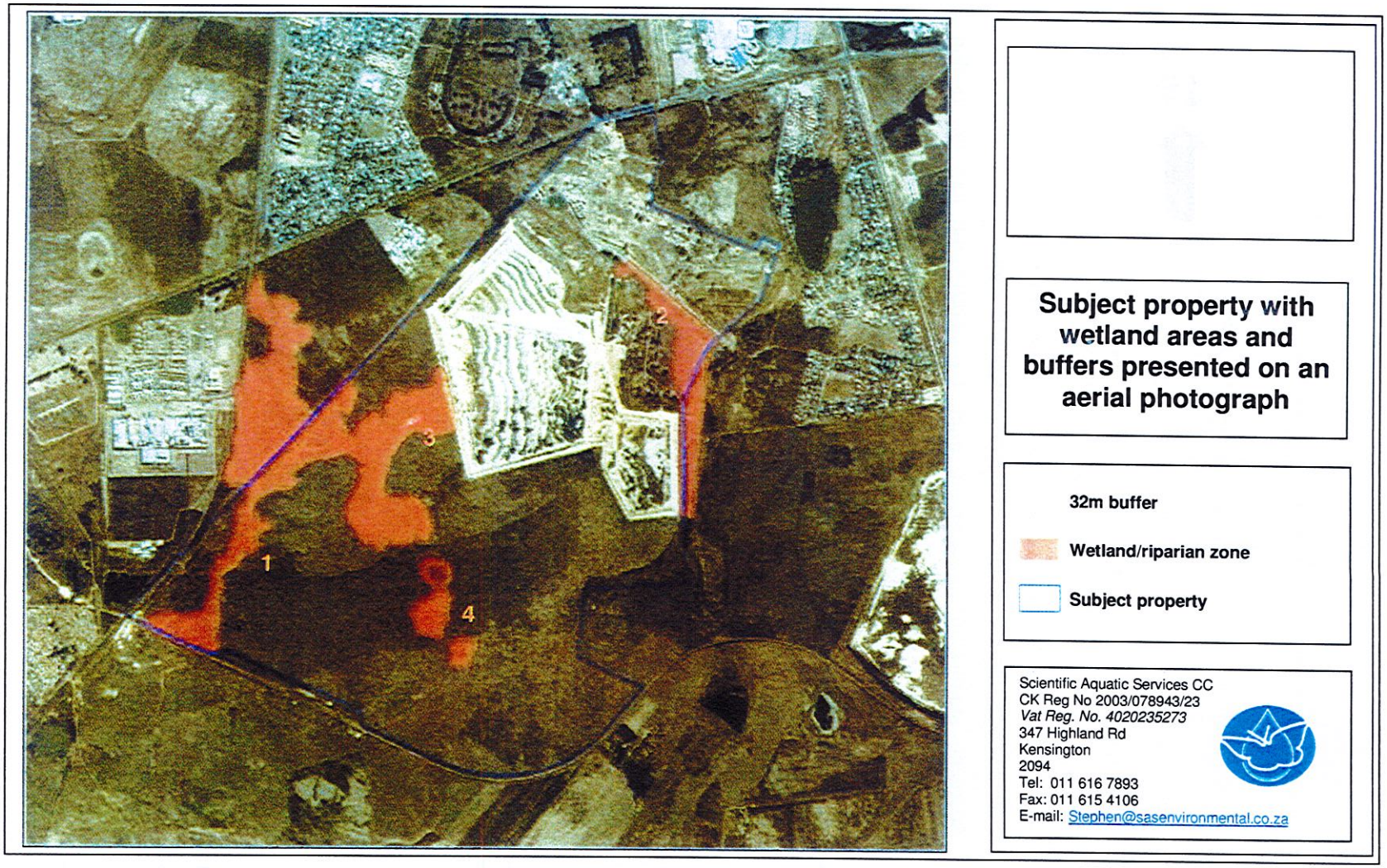

Figure 7: Subject property with wetland areas and buffers presented on an aerial photograph

3.6 Mitigation recommendations

The points below serve to summarise the measures deemed necessary in order to ensure protection of the wetland, riparian and aquatic resources and to ensure the safe design of the proposed development.

- No development within the wetland areas and their associated buffers should be permitted.
- Connectivity between the pans and the western main wetland system should be maintained by either a private or public open space linkage.
- Adequate stormwater management must be incorporated into the design of the proposed development in order to prevent erosion:
    - Sheet runoff from paved surfaces and access roads needs to be curtailed.
    - Runoff from paved surfaces should be slowed down by the strategic placement of berms.
    - As much vegetation growth as possible should be promoted within the proposed development area in order to protect soils and to reduce the percentage of the surface area which is paved. In this regard, special mention is made of the need to use indigenous vegetation species as the first choice during landscaping.
    - Attenuation of storm water runoff should take place at strategic points to prevent erosion and incision of the wetland features due to the increased runoff from the paved surfaces.
- During construction, erosion berms should be installed to prevent gully formation and further sedimentation of the Rietspruit. The following points should serve to guide the placement of erosion berms:
    - Where the track has slope of less than 2%, berms every 50m should be installed.
    - Where the track slopes between 2% and 10%, berms every 25m should be installed.
    - Where the track slopes between 10%-15%, berms every 20m should be installed.
    - Where the track has slope greater than-15%, berms every 10m should be installed.
- It must be insured that connectivity of the wetland feature to the wetland features beyond the subject property boundary, are maintained.

- All areas affected by construction should be rehabilitated upon completion of the construction phase of the development. Areas should be reseeded with indigenous grasses, as required.
- No dumping or stockpiling should be permitted within the wetland areas and associated buffer areas.
- During the construction phase, no vehicles should be allowed to indiscriminately drive through the wetland areas.
- Ongoing removal of alien vegetation stands, which show signs of dominance or active recruitment, should take place throughout the construction and operational phase of the development.
- Fires within the wetland and associated buffer zone must be prevented at all times throughout the life of the development.

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Appendix P
Archaeological Impact Assessment Report