Wetland Delineation and Impact Assessment for the Proposed Montanaspruit Improvement Project

For:

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DOCUMENT SUMMARY DATA

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TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

INDEMNITY AND CONDITIONS RELATING TO THIS REPORT

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken and Wetland Consulting Services (Pty.) Ltd. and its staff reserve the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

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1. BACKGROUND INFORMATION

Wetland Consulting Services (Pty) Ltd. (WCS) was appointed by Delia de Lange of TGM Environmental Services cc to conduct a wetland delineation and assessment study for the proposed Montanaspruit Improvement Project. The wetland assessment study is required as a specialist wetland report to accompany the environmental authorisation applications for the proposed development.

It is understood that ***the activities associated with the Montanaspruit Improvement Project had been previously applied for and authorised***, but that the environmental authorisation had lapsed as the activities were never commenced with. All activities applied for as part of the current application had also been applied for as part of the original application. However, it was noted during a review of the previous application and supporting documents that no wetland delineation study had previously been undertaken for the affected reach of the Montanaspruit, though a detailed assessment was done for the reach immediately downstream, which will also be subjected to similar measures as proposed in the Montanaspruit Improvement Project.

The requirement to establish the existence and/or extent of wetlands within the proposed development site is based on the legal requirements contained in both the National Environmental Management Act (NEMA) and the National Water Act. Given the stringent legislation regarding developments within or near wetland areas, it is important that these areas are identified and developments planned sensitively in order to avoid and minimize any potential impacts to the wetland.

2. SCOPE OF WORK

The scope of work for the project was as follows:

- Collation and re-familiarization with existing data;
- Site visit to delineate wetland boundaries in the field using the 2005 DWA wetland delineation guidelines;
- Updating the delineation and capturing the wetland boundaries in shapefile format;
- Undertake a functional assessment (WET-EcoServices) of all wetlands within the study area;
- Undertake a PES and EIS assessment of all wetlands within the study area to reflect current conditions on site;
- Identify likely impacts to wetlands and recommend required mitigation and management measures; and
- Compilation of a detailed wetland delineation and assessment specialist report for inclusion in the various required environmental authorisation applications.

3. LIMITATIONS & ASSUMPTIONS

Wetland boundaries reflect the ecological boundary where the interaction between water and plants influences the soils, but more importantly the plant communities. The depth to the water table where this begins to influence plant communities is approximately 50 centimetres. This boundary, based on plant species composition, can vary depending on antecedent rainfall conditions, and can introduce a degree of variability in the wetland boundary between years and/or sampling period.

The study area is characterised by black vertic clay soils. Such soils show typical soil wetness indicators (e.g. mottling) only poorly, if at all. The soils on site could thus not be reliably used to delineate wetland boundaries. Extensive use was thus made of the landform setting and vegetation of the wetlands to determine boundaries. Where disturbed, the vegetation zonation was sometimes indistinct, reducing the confidence in the delineation. However, in such a scenario, the precautionary approach was adopted. The accuracy of the delineated wetland boundaries is however considered suitable for the purpose of this report.

Due to the scale of the remote imagery used (1:10 000 orthophotos and Google Earth Imagery), as well as the accuracy of the handheld GPS unit used to delineate wetlands in the field, the delineated wetland boundaries cannot be guaranteed beyond an accuracy of about 20m on the ground. Should greater mapping accuracy be required, the wetlands would need to be pegged in the field and surveyed using conventional survey techniques.

In addition, it is recognised that the passage of time may affect the information and assessment provided in this report. WCS's opinions are therefore based upon the information that was made available to WCS and which existed at the time of compiling this report.

4. DETAILS OF SPECIALIST

4.1 DETAILS OF THE SPECIALIST WHO PREPARED THE REPORT

Table 1. Details of the Specialist

Project Consultancy	Wetland Consulting Services
Company Registration	1998/17216/07
Professional Affiliation	South African Council for Natural Scientific Professions (SACNASP)
Contact Person	Mr Dieter Kassier (Pr. Sci. Nat.)
Physical Address	Room S153, Building 33, CSIR, Meiring Naude Road, Brummeria, 0184
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Fax Number	+27 12 349 2993
E-mail	dieterk@wetcs.co.za

4.2 Expertise of the Specialist

4.2.1 Qualifications of the Specialist

Dieter Kassier holds the following degrees:

- B.Sc. from UNISA (2007) Environmental Management (Zoology Stream).
- B.Sc. (Hons) from the NWU Potchefstroom Campus (2012) in Environmental Science: Aquatic Ecosystem Health.

Dieter Kassier holds a Professional Registration with SACNASP since 2014 – 400254/14. He is registered in two fields:

- Environmental Science
- Ecological Science

4.2.2 Past Experience of the Specialist

Dieter Kassier, Wetland Ecologist, Holds a B.Sc. degree in Environmental Management (with specialisation in Zoology) from the University of South Africa (UNISA) as well as a BSc degree (Hons – with distinction) in Aquatic Ecosystem Health from the University of the North West (Potchefstroom Campus). After 5 years working within the field of nature conservation and tourism in the Limpopo Lowveld and a short stint as an environmental consultant. Dieter joined Wetland Consulting Services in 2007 and is based in Pretoria. Over the past few years he has gained extensive experience in the delineation and assessment of wetlands and riparian zones and the development of mitigation and management measures for the purposes of Environmental Impact Assessments in a wide range of projects, with special emphasis on coal mining in the Mpumalanga Coalfields and infrastructure developments within the greater Gauteng region. In addition, his work has entailed the GIS mapping and classification of wetlands for various Environmental Management Frameworks (EMF's) and the City of Johannesburg wetland management plan. Dieter has also been involved in the compilation of several Biodiversity Action Plans and Biodiversity Assessments where in addition to the specialist wetland work, he has provided input for faunal studies and has undertaken avifauna surveys. Dieter is a Registered Natural Scientist (SACNASP) (Environmental Science), and a member of the South African Wetland Society.

5. DECLARATION OF INDEPENDENCE

I, **Dieter Kassier,** as the appointed specialist hereby declare/affirm the correctness of the information provided as part of the application, and that:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- am aware that it is an offence in terms of Regulation 48 to provide incorrect or misleading information and that a person convicted of such an offence is liable to the penalties as contemplated in section 49B(2) of the National Environmental Management Act, 1998 (Act 107 of 1998).

Signature of the specialist

Wetland Consulting Services (Pty) Ltd

Name of company

9 October 2019

Date

6. STUDY AREA

The affected reach of the Montanaspruit extends upstream and downstream of the Tsamma Street bridge across the Montanaspruit, roughly 500m and 600m respectively, and falls within the suburb of Doornpoort. The N4 freeway crosses the Montanaspruit approximately 1 km to the north. The location and extent of the study area is further indicated in Figure 1. To give effect the 500m Regulated Area around a wetland defined in GN509, a 500m buffer around the affected reach of the Montanaspruit has also been indicated.

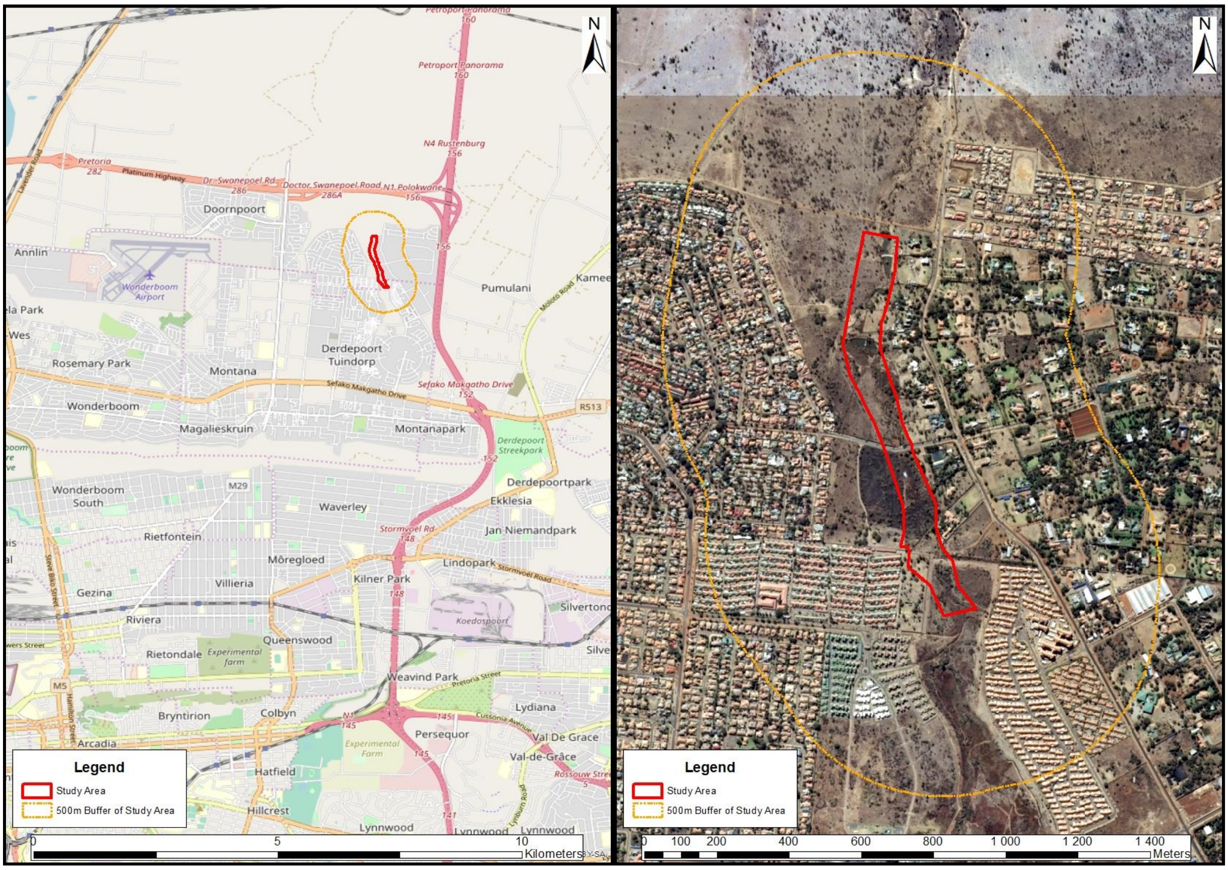


Figure 1: Maps showing the location of the study area (left) and the study area overlain on aerial imagery (right).

6.1 Catchments

The study area is located in the Limpopo Catchment (Primary Catchment A), and more specifically quaternary catchment A23E. Catchment A23E is drained by the Apies River (PES C/D, moderately to largely modified, Nel *et.al* 2011) and its tributaries.

Quaternary catchment A23E receives 674mm mean annual precipitation, of which 29.3 mm contributes to runoff annually.

Information regarding catchment size, mean annual rainfall and runoff for the quaternary catchment is provided in the table below (Middleton, B.J., Midgley, D.C and Pitman, W.V., 1990).

Table 2: Table showing the size, mean annual precipitation and run-off of the quaternary catchment (Middleton, B.J., Midgley, D.C and Pitman, W.V., 1990).

Quaternary Catchment	Catchment Surface Area (ha)	Mean Annual Rainfall (MAP) in mm	Mean Annual Run-off (MAR) in mm	MAR as a % of MAP
A23E	44 078	674	29.3	4.35 %

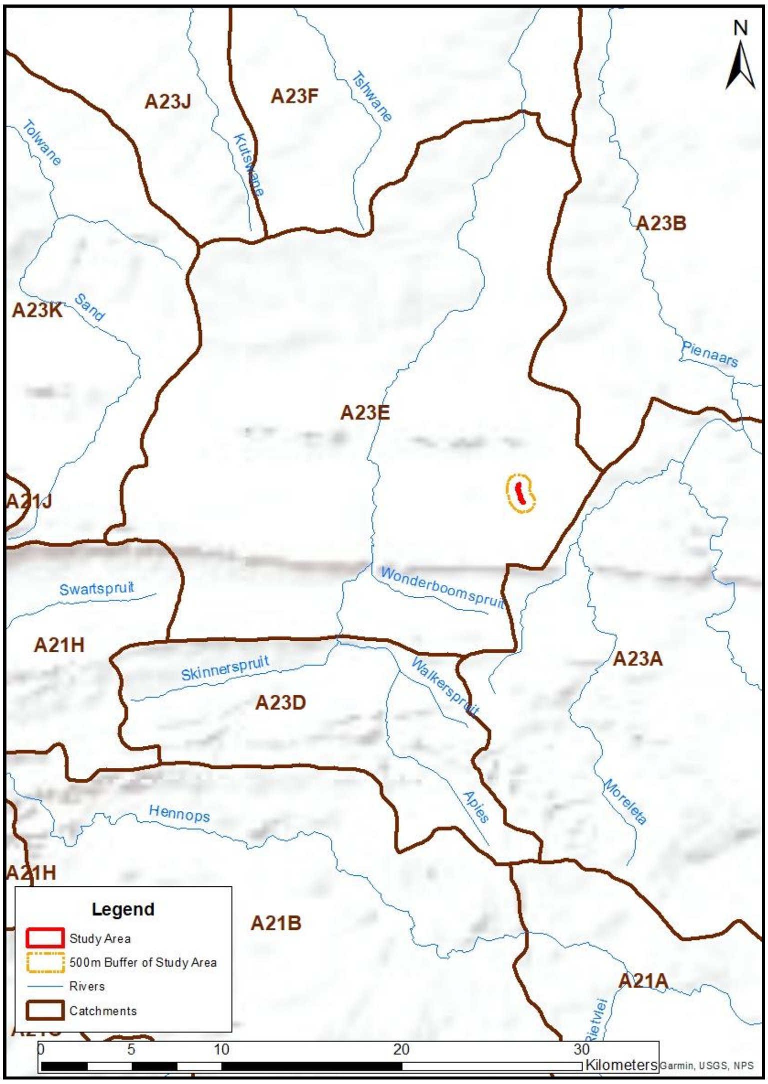


Figure 2: Map showing the approximate location of the study area in relation to the quaternary catchment, with principle rivers.

6.2 Vegetation

A number of vegetation classification systems have been compiled for South Africa. According to the most recent vegetation classification of the country however, "*The Vegetation of South Africa,* *Lesotho and Swaziland*" (Mucina and Rutherford, 2006), the study area falls within the Savanna Biome, Central Bushveld Bioregion. At a finer level, the study area is classed as Marikana Thornveld.

Marikana Thornveld (SVcb 6) is found primarily in the North-West and Gauteng Provinces. It occurs on plains from the Rustenburg area in the west, through Marikana and Brits to the Pretoria area in the east. Altitudes range from about 1 050 to 1 450 m. Mucina and Rutherford, (2006) list the Marikana Thornveld as being Endangered, with less than 1% having statutory conservation, with a required target of 19%.`The landscape features valleys with open *Acacia karroo* woodlands, and slightly undulating plans and occasional lowland hills. Drainage lines feature more dense growth of shrubs, also on rocky outcrops and termite mounds, and other habitats protected from fire.

Marikana Thornveld is listed as *Vulnerable* in the National List of Ecosystems that are Threatened and in Need of Protection (GN1002 of 2011).

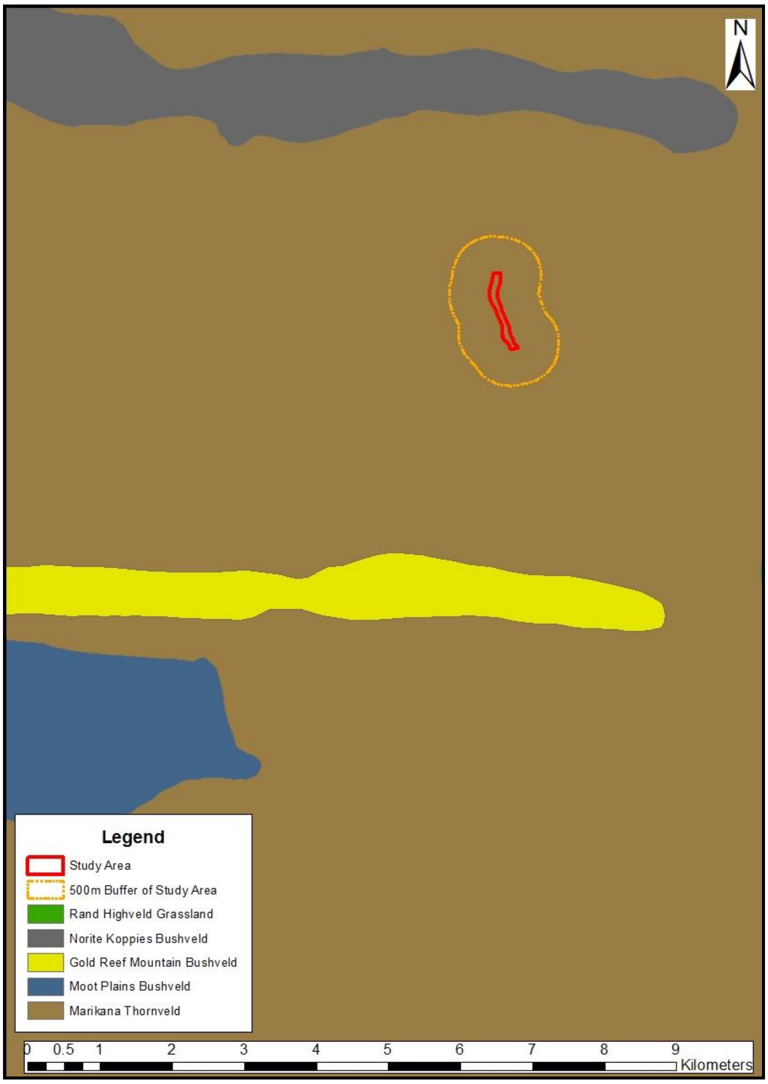


Figure 3: Map showing the vegetation types of the area.

6.3 National Freshwater Ecosystem Priority Areas

The Atlas of Freshwater Ecosystem Priority Areas in South Africa (Nel *et al*, 2011) (The Atlas) which represents the culmination of the National Freshwater Ecosystem Priority Areas project (NFEPA), a partnership between SANBI, CSIR, WRC, DEA, DWA, WWF, SAIAB and SANParks, provides a series of maps detailing strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources. Freshwater Ecosystem Priority Areas (FEPA's) were identified through a systematic biodiversity planning approach that incorporated a range of biodiversity aspects such as ecoregion, current condition of habitat, presence of threatened vegetation, fish, frogs and birds, and importance in terms of maintaining downstream habitat. The Atlas incorporates the National Wetland Inventory (SANBI, 2011) to provide information on the distribution and extent of wetland areas.

Based on The Atlas, no wetland FEPA's occur on site or in close proximity to the site. In fact, the NFEPA database indicates no wetlands occurring on site, though the database is known to be incomplete as it was compiled at a high level, incorporating mostly desktop and remote sensing data. The study area is also not located within the catchment of a river FEPA.

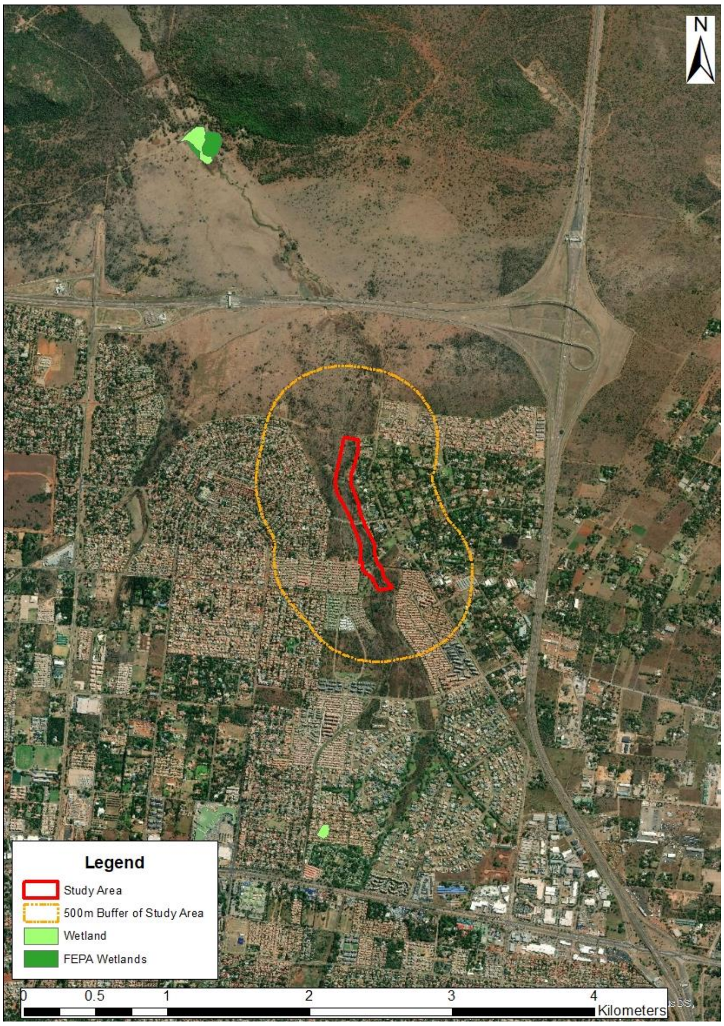


Figure 4. Map showing and extract of the NFEPA wetland dataset for the study area and surrounds.

6.4 Provincial Conservation Plan

An assessment of the Gauteng Biodiversity Conservation Plan database indicates that an Ecological Support Area (ESA) is associated with the full length of the Montanaspruit on site and stretches the full length of the project study area. A Critical Biodiversity Area (CBA) occurs roughly 500m to the north.

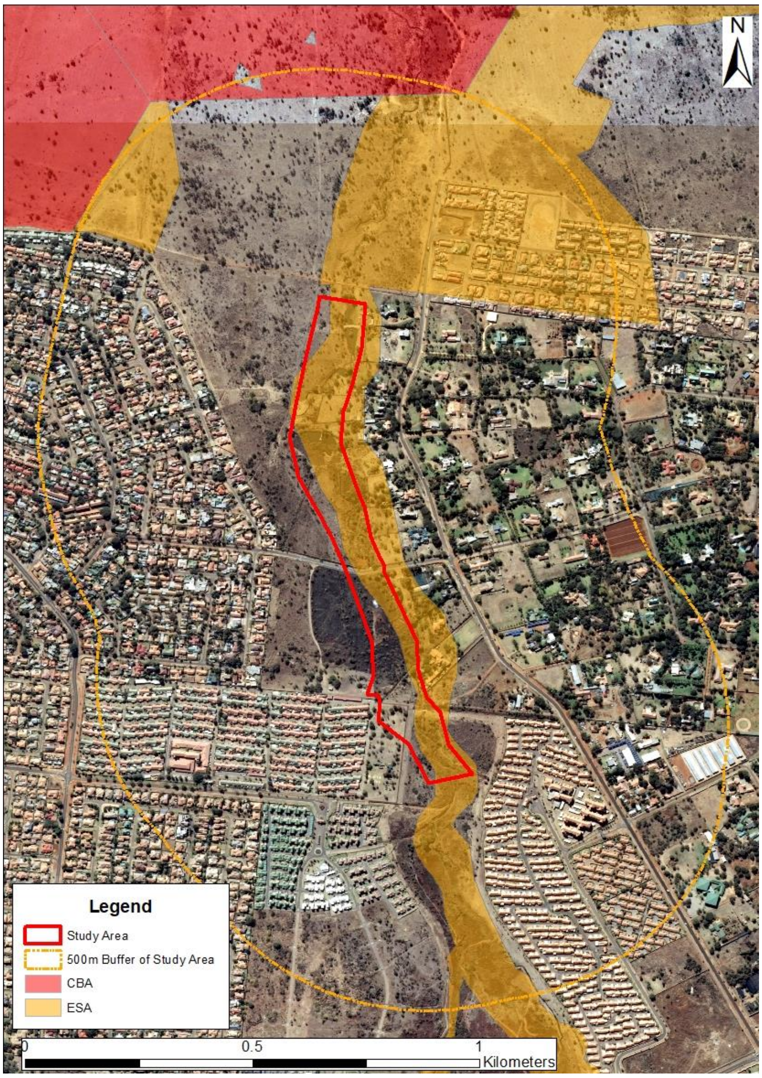


Figure 5. Extract of the Gauteng C-Plan V3.3 terrestrial ecosystem assessment showing ESA's – Ecological Support Areas – within the project study area.

7. APPROACH

7.1 Wetland Delineation and Classification

The National Water Act, Act 36 of 1998, defines wetlands as follows:

> *"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."*

The presence of wetlands in the landscape can be linked to the presence of both surface water and perched groundwater. Wetland types are differentiated based on their hydro-geomorphic (HGM) characteristics; i.e. on the position of the wetland in the landscape, as well as the way in which water moves into, through and out of the wetland systems. A schematic diagram of how these wetland systems are positioned in the landscape is given in the figure below.

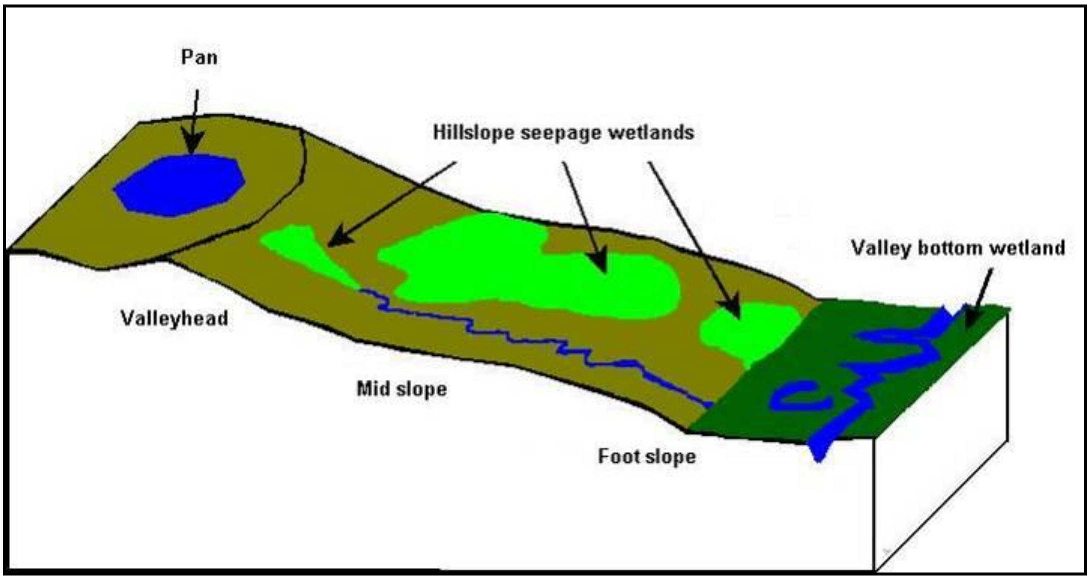


Figure 6: Diagram illustrating the position of the various wetland types within the landscape.

Use was made of 1:50 000 topographical maps, 1:10 000 orthophotos and Google Earth Imagery to create digital base maps of the study area onto which the wetland boundaries could be delineated using ArcMap 9.0. A desktop delineation of suspected wetland areas was undertaken by identifying rivers and wetness signatures on the digital base maps. All identified areas suspected to be wetlands were then further investigated in the field.

Wetlands were identified and delineated according to the delineation procedure as set out by the "*A Practical Field Procedure for the Identification and Delineation of Wetlands and Riparian Areas*" document, as described by DWAF (2005) and Kotze and Marneweck (1999). Using this procedure, wetlands were identified and delineated using the Terrain Unit Indicator, the Soil Form Indicator, the Soil Wetness Indicator and the Vegetation Indicator.

For the purposes of delineating the actual wetland boundaries use is made of indirect indicators of prolonged saturation, namely wetland plants (hydrophytes) and wetland soils (hydromorphic soils), with particular emphasis on hydromorphic soils. It is important to note that under normal conditions hydromorphic soils must display signs of wetness (mottling and gleying) within 50cm of the soil surface for an area to be classified as a wetland (*A practical field procedure for identification and delineation of wetlands and riparian areas*, DWAF).

The delineated wetlands were then classified using a hydro-geomorphic classification system based on the system proposed by SANBI (2009).

7.2 Functional Assessment

A functional assessment of the wetlands on site was undertaken using the level 2 assessment as described in "Wet-EcoServices" (Kotze et al., 2007). WET-EcoServices is a tool developed to qualitatively assess the goods and services that individual wetlands provide so as to aid informed planning and decision making (Kotze *et al*., 2009). The tool is described as follows:

> "*WET-EcoServices* is used to assess the goods and services that individual wetlands provide, thereby aiding informed planning and decision making. It is designed for a class of wetlands known as palustrine wetlands (i.e. marshes, floodplains, vleis or seeps). The tool provides guidelines for scoring the importance of a wetland in delivering each of 15 different ecosystem services (including flood attenuation, sediment trapping and provision of livestock grazing). The first step is to characterise wetlands according to their hydro-geomorphic setting (e.g. floodplain). Ecosystem service delivery is then assessed either at Level 1, based on existing knowledge or at Level 2, based on a field assessment of key descriptors (e.g. flow pattern through the wetland)." (Kotze et al., 2009)

7.3 Present Ecological State and Ecological Importance & Sensitivity

A present ecological state (PES) and ecological importance and sensitivity (EIS) assessment was conducted for every hydro-geomorphic wetland unit identified and delineated within the study area. This was done in order to establish a baseline of the current state of the wetlands and to provide an indication of the conservation value and sensitivity of the wetlands in the study area.

For the purpose of this study, the tool WET-Health Version 2 was used to assess the present ecological state of the valley bottom wetlands. A WET-Health level 1b assessment was conducted to provide a relatively rapid assessment of the health and impacts affecting the wetlands (Macfarlane, et al., December 2018).

The scoring system as described in the document "Manual for the Rapid Ecological Reserve Determination of Inland Wetlands (Version 2.0)" (DWA, 2013) was applied for the determination of the IS of the wetlands.

The results of the assessments are reflected in the placement of each wetland unit/riparian zone into a category based on the assessment scores. A description of the PES and IS categories are provided in Tables 1 and 2 respectively.

Table 1: Description of the PES categories.

Description	Combined impact score	PES Category
Unmodified, natural.	0-0.9	A
Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1-1.9	B
Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact	2-3.9	C
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4-5.9	D
The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6-7.9	E
Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8 - 10	F

Table 2: Description of the IS categories.

Wetland Importance and Sensitivity categories	Range of Median	Recommended Ecological Management Class
Very high Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers.	>3 and <=4	A
High Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.	>2 and <=3	B
Moderate Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.	>1 and <=2	C
Low/marginal Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.	>0 and <=1	D

8. FINDINGS

8.1 Wetland Delineation and Classification

The site visit was undertaken on 18 July 2019. The purpose of the visit was to identify and delineate wetland habitat within the project study area and to collect the required field data for the required ecological assessments.

A single wetland system was identified on site – a channelled valley bottom wetland associated with the Montanaspruit – which traverses the study area from south to north. The delineated wetland habitat, illustrated in Figure 8, covers 12.6 hectares. This includes several small instream dams (5 dams were observed**,** 1 of which was breached, inundating a total of approximately 0.54 hectares).

The wetland and adjacent areas is characterised by vertic clay soils mostly black in colour but grading to red-brown in some areas away from the wetland. The soils show wetness indicators (mottling) only poorly, and the delineation was based mostly on vegetation and landform. The wetland is characterised by a scattering of woody trees and shrubs interspersed with grasses typical of wetland areas on vertic clay soils in Marikana Thornveld, including *Imperata cylindrica* (most abundant upstream of Tsamma Street) and *Dichanthium anulatum*, as well as scattered *Cyperus sexangularis*. Within the channel obligate wetland species such as *Typha capensis* occur. Typical indigenous trees included *Vachellia karroo, Rhus lancea* and *Gymnosporia buxifolia*, while the alien species *Sesbania punicea, Melia azedarach* and *Tipuana tipu* were also observed.

Upstream of Tsamma Street the wetland is characterised by a clearly incised channel of around 1.5 to 3 m deep. A number of fences cross the wetland and in the extreme upper reach a number of footpaths were observed, presumably for adjacent residents to use the area recreationally. A number of stormwater trenches discharge into the wetland. Just upstream of Tsamma Street a rectangular excavation was observed within the wetland channel – a review of historical aerial imagery indicates some localised modification of the channel occurred several years ago, likely to reduce flooding and erosion in close proximity to infrastructure on the eastern bank of the wetland.

Figure 7. Typical wetland habitat upstream of Tsamma Street.

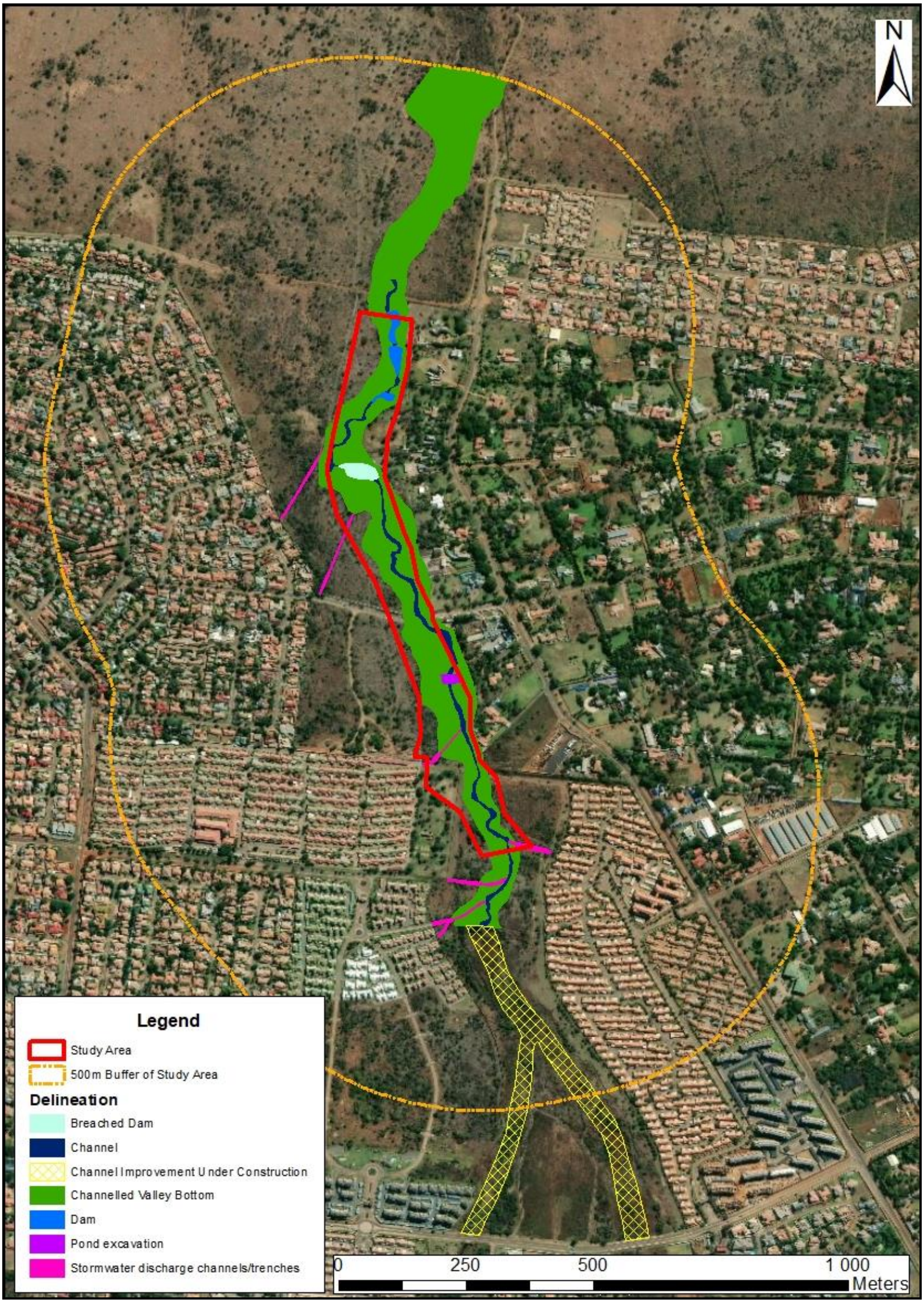


Figure 8: Map showing the extent of the delineated and classified wetlands on site.

Downstream of Tsamma Street the wetland is less incised. A series of small instream dams occur in this reach of the wetland. These dams have likely limited channel incision along this reach, but probably contribute to exacerbating the flooding problems. The largest of the dams, the one nearest to Tsamma Street, was observed to be breached near its western edge, resulting in accelerated erosion around the edge of the dam wall. Along the downstream boundary of the study area a farm track crosses the wetland. Flows pass over the road surface and then enter a deeply incised channel again immediately downstream of the study area.

Figure 9. Typical wetland habitat downstream of Tsamma Street showing a number of the small dams.

Immediately upstream of the study area construction activity is currently taking place within the Montanaspruit watercourse and wetland habitat, presumably in an attempt to confine floodlines. See photographs in Figure 10. All vegetation has been cleared from the active channel and the channel has been significantly widened. Flows pass through the construction site resulting in elevated sediment loads and turbidity downstream across the project study area.

Figure 10. Photographs of construction activity within the Montanaspruit immediately upstream of the project study area.

The catchments of the channelled valley bottom wetland is largely urbanised and the system receives significant volumes of stormwater. This is clearly evident on site, with at least 6 stormwater trenches discharging into the wetland within the study area.

The sub-catchment of the wetland system on site extends from the Magaliesberg ridge in the south and slopes in a northerly direction (see Figure 11 below). Within the study area the slope of the catchments and the watercourses decreases and the study area is largely flat with a slope of about 0.6 % along the watercourse, whereas the upper reaches of the subcatchment are characterised by progressively steeper slopes:

- 1.5 % slope between the study area and Sefako Makgatho Drive;
- 4.7 % slope between Sefako Makgatho Drive and upper limit of urban developments; and
- 34.6 % upslope of urban development edge – the Magaliesberg Ridge.

The steep, rocky slopes of the Magaliesberg ridge that form the upper reach of the catchment are expected to result in high velocity runoff, with a larger percentage of rainfall contributing to runoff, though this is a natural phenomenon given the steep slopes and extensive rocky outcrops that limit infiltration.

The mid slopes of the catchment, between the Magaliesberg Ridge and the study area, have been virtually completely urbanised, with significant densification having occurred in recent times as agricultural small holdings are converted to high density housing developments. The increase in hardened surfaces resulting from this urbanisation will have resulted in increased surface runoff being generated from these areas as rainfall can no longer infiltrate the soil profile but rather is captured in stormwater systems and discharged into watercourses. Under natural conditions, the infiltration of rainfall into the soils is expected to have been an important process in these mid slopes of the catchment, especially in those areas characterised by more sandy, colluvial soils derived from the quartzite ridge. Exacerbating the increased surface runoff resulting from urbanisation is the straightening and canalisation of numerous watercourses within the middle reaches of the catchment (see Figure 11). These further contribute to increasing flow velocities and flood peaks in watercourses. As a result flooding problems are experienced along the lower reaches of the Montanaspruit within the project study area.

The flat slope within the study area results in the high velocity flows from the upper catchment slowing down on site and spreading out. The expansive clay nature of the soils within the study area prevents significant infiltration of runoff and rainwater into the soils as the clays expand when wet to become almost impermeable. Significant infiltration is thus only expected to occur at the beginning of the wet season when the soils are still dry and cracked. Once wet and expanded, flows discharging onto these soils are likely to pass over the soils and be discharged into downstream reaches.

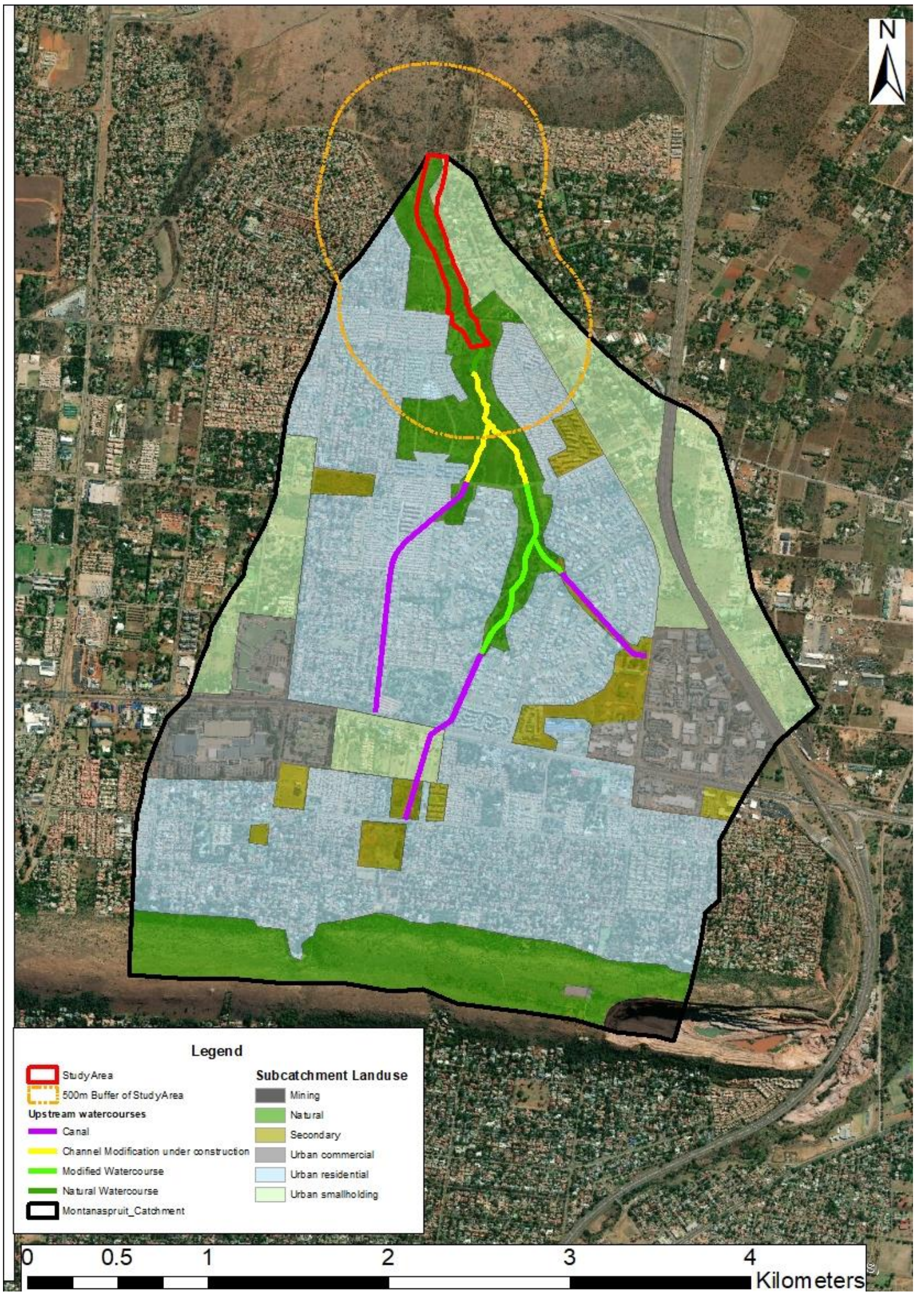


Figure 11. Map showing the study area relative to the affected sub-catchment as well as showing upstream watercourses and landuse within the catchment.

8.2 Functional Assessment

Numerous functions are typically attributed to wetlands, which include nutrient removal (and more specifically nitrate removal), sediment trapping (and associated with this is the trapping of phosphates bound to iron as a component of the sediment), stream flow augmentation, flood attenuation, trapping of pollutants and erosion control. Many of these functions attributed to wetlands are wetland type specific and can be linked to the position of wetlands in the landscape as well as to the way in which water enters and flows through the wetland. Thus not all wetlands can be expected to perform all functions, or to perform these functions with the same efficiency.

A Level 2 WET-EcoServices assessment was undertaken for the wetlands within the study area. In interpreting the results of the WET-EcoServices assessment, the following must be borne in mind:

- *The level of services delivered is based on current as well as future potential benefits* (i.e. a wetland might have high ability to perform a service such as trapping pollutants but is currently afforded little opportunity to perform the service due to a lack of pollutants within the wetland catchment, resulting in an intermediate score);
- *WET-EcoServices scores make no reference to the size of the wetland* (i.e. a 3ha wetland and a 300ha wetland might both score 3 for flood attenuation. Given the size of the wetlands in question, the overall importance of flood attenuation performed by the 300ha wetland is obviously greater than for the 3ha wetland);
- *Scores between different hydro-geomorphic wetland units (i.e. different wetland types) should not be compared directly.*

The results of the WET-EcoServices assessment for the channelled valley bottom wetland on site are illustrated in the radial plot in Figure 12.

The channelled valley bottom wetland obtained generally moderate scores for the functions associated with water quality maintenance, including sediment trapping, phosphate trapping, nitrate removal and toxicant removal. The regular occurrence of sewage leaks and surcharges within the catchment, as well as the inputs of urban stormwater into the wetland emphasise the importance of the wetland in contributing to the improvement of water quality.

The wetland is also considered moderately important from a flood attenuation perspective. This function is attributable in part to the landscape position of the wetland and the flat slopes that characterise the study area. The importance of the flood attenuation function is elevated by the changes in catchment flow characteristics due to urbanisation within the catchment which has led to increased flow volumes and velocities and elevated flood levels.

High scores were also obtained for the function of biodiversity support for both wetlands. In this regard natural vegetation supported by the wetland and the linear nature of the wetland allow the wetland to act as an important ecological corridor through the largely transformed urban environment.

Direct human use benefits – No evidence was observed within the wetland on site of any use being made of the wetlands for crop production, though limited livestock grazing is likely to occur in places. The wetland is not known to support any cultural practices. The wetland is however used recreationally with a number of pathways and benches observed within the wetland and immediate adjacent area.

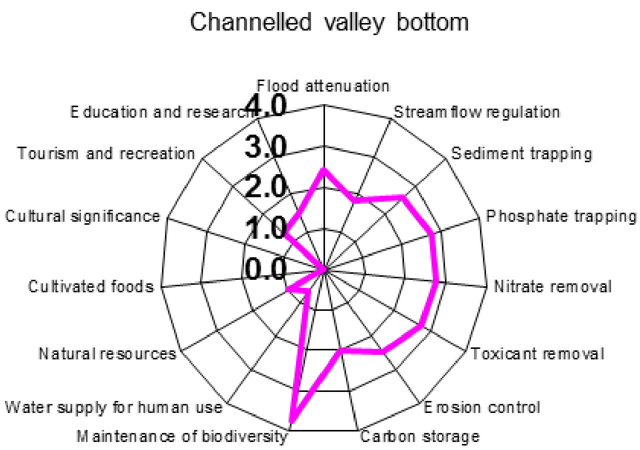


Figure 12. Results of the WET-EcoServices assessment for the wetland.

8.3 Present Ecological Status (PES) Assessment

The main wetland system on site is a the valley bottom wetland that drains across the site from south to north. This wetland receives flows from and upstream catchment that has been largely transformed by urbanisation. The impact of urbanisation is an increase in hardened impermeable surfaces, resulting in decreased infiltration of rainfall into the soil and increased runoff. The run-off from urban areas is collected in storm water drains and trenches and released as point source discharges into the valley bottom wetlands. This decreases the time to flow concentration and increases peak flow volumes and velocities within the valley bottom wetland, leading to an increase in the risk of erosion and flooding. Stormwater run-off from urban areas generally also results in decreased water quality, which is further exacerbated by surcharging sewers draining into the stormwater system and into wetlands.

On site the effect of urbanisation in the upstream catchment is evidenced by at least 6 stormwater trenches that release water into the wetland, while numerous stormwater trenches and canals also enter the watercourse upstream of the study area. The resultant completely altered hydrology leads to changes within the wetland ecosystem, such as erosion of the stream channel, and its functioning.

There have also been direct disturbance of the wetland vegetation on site through clearing of vegetation. A map of disturbance units within the wetland is provided below in Figure 13.

As a result of the above impacts, the wetland on site is considered ***MODERATELY MODIFIED (PES category C)***.

Table 3. Summarised results of the PES assessment.

	Wetland PES Summary			
Wetland name	**Montanaspruit**			
Assessment Unit	**1**			
Wetland area (Ha)	9.0 Ha			
PES Assessment	HYDROLOGY	GEOMORPHOLOGY	WATER QUALITY	VEGETATION
Impact Score	5.2	2.0	2.3	4.2
PES Score (%)	48%	80%	77%	58%
Ecological Category	**D**	**C**	**C**	**D**
Combined Impact Score	3.6			
Combined PES Score (%)	64%			
Combined Ecological Category	**C**			
Hectare Equivalents	5.7 Ha			
Confidence	Moderate: Based on once-off field assessment and refined landcover mapping			

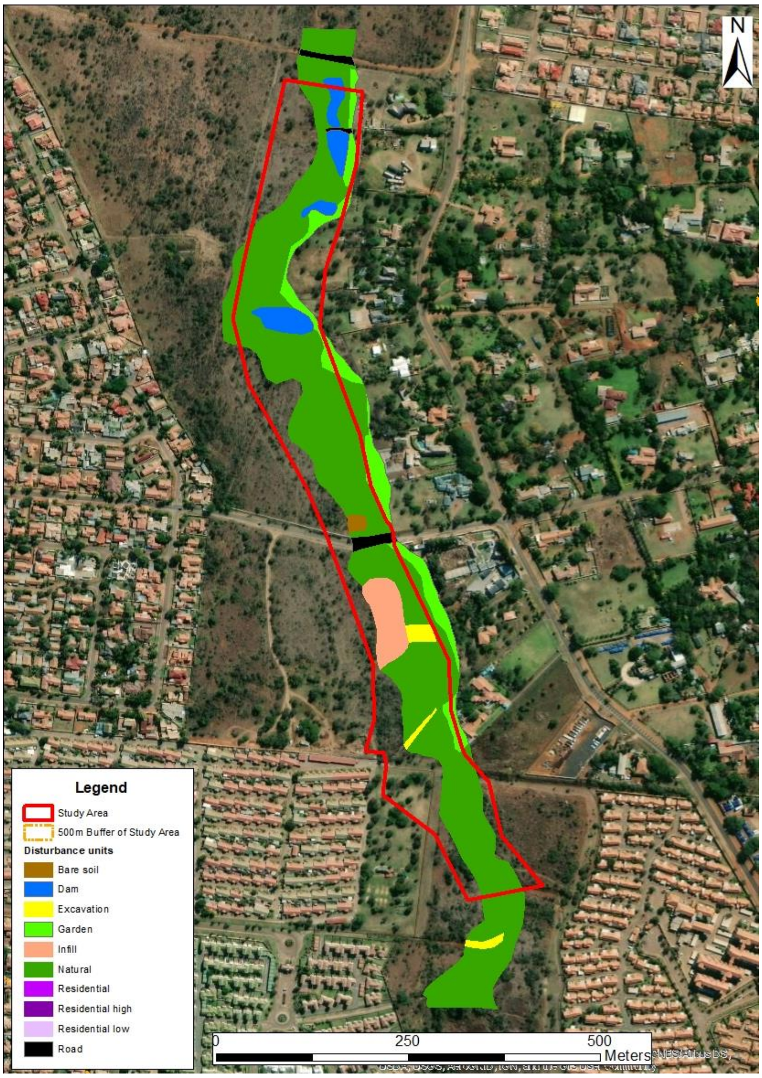


Figure 13. Map of disturbance units identified within the wetland.

8.4 Wetland Importance and Sensitivity (IS)

Ecological Importance and Sensitivity is a concept introduced in the reserve methodology to evaluate a wetland in terms of:

- Ecological Importance;
- Hydrological Functions; and
- Direct Human Benefits

The scoring assessments for these three aspects of wetland importance and sensitivity have been based on the requirements of the NWA, the original Ecological Importance and Sensitivity assessments developed for riverine assessments (DWAF, 1999), and the work conducted by Kotze *et al* (2008) on the assessment of wetland ecological goods and services (the WET-EcoServices tool). Based on this methodology, an EIS assessment was undertaken for all the delineated wetlands on site, with the results discussed and summarised below.

The channelled valley bottom wetland within the study area is considered of HIGH (B) importance and sensitivity. The high rating is due to the location of the wetland within the Marikana Thornveld vegetation type (Mucina et al. 2005) which is classed as vulnerable with high conservation value, as well as the classification of the habitat associated with the watercourse as an Ecological Support Area. The high importance is further underlined by the degree of transformation that has already occurred in the upstream catchment and the continuing development pressures on the surrounding areas. The wetland also plays an important role in sustaining biodiversity, while also contributing functions such as sediment trapping, flood attenuation and some degree of water quality improvement.

9. IMPACT ASSESSMENT

The proposed Montanaspruit Improvement Project involves two main activities:

- New bridge for the Tsamma Street stream crossing; and
- Channel improvement for the affected reach of the Montanaspruit

Each of these two components is briefly described below, with descriptions sourced from the DESIGN DEVELOPMENT REPORT FOR MONTANA SPRUIT CHANNEL IMPROVEMENT – PHASE 1 (Ditlou Nevhutalo Consortium, September 2018).

9.1 Montanaspruit Channel Improvement

The motivation for the proposed channel improvement is based on the risk of flooding in the Doornpoort area near Tsamma Street bridge during heavy rainstorms. The potential consequences of such flooding are highlighted by Ditlou Nevhutalo Consortium (September 2018) to include:

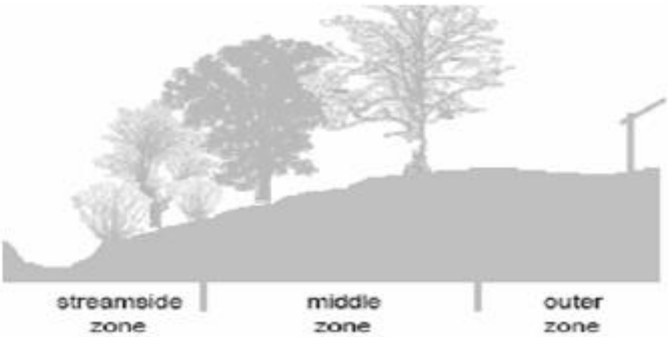
- Flooding will persist during big storm events.
- Development in the area will be hindered.

- The existing drainage system will not provide the flood protection standard required for future development.
- Further development will increase the frequency, severity and extent of flooding.
- Damage to properties, blockage of roads and accesses, nuisance to the public and risk to lives will remain.

To address the flooding risk, the Montanaspruit Improvement Project has been proposed to attempt to contain the 1:50 and 1:100 year floodlines within the determined specified limits

The Ditlou/Nevhutalu Consortium (September 2018) have analysied the hydrological modelling of the stream and have proposed the following interventions:

- Channelize the Montana Spruit by changing the existing channel through excavating & shaping and widening of the stream.
- The overall objective of any natural stream channelisation improvement design should be to provide enough space to meet flood conveyance targets, increase vegetation in the channel, improve habitat conditions, and improve water quality in the stream.
- The horizontal alignments decided for the proposed Montanaspruit Improvements will follow the existing stream bed line.
- The natural low flow area of the stream will be kept and all improvements will be above the water level of the low flow. This option is preferred because it does not disturb flow and natural ecological activities in the main stream influence.
- A berm will be constructed at the old age home to prevent any flood water from entering the estate. The floodline will not encroach onto the berm, the berm is just a precautionary measure implemented to prevent any flood damage.
- A well-designed stream channelization will typically have three zones on either side of the watercourse: a streamside zone, a middle zone, and an outer zone.



- To enhance the ecological conditions, natural bedding and excavated stream flood banks will be re-vegetated.
- To make the proposed stream more environmentally friendly, the stream banks will be lined with natural substrates to provide a suitable environment similar to the existing main stream condition.
- The cross-sectional area of the stream channel will be widened by excavating one or both banks outwards to provide a larger cross-section for flow conveyance.

A map of the proposed interventions associated with the Montanaspruit Improvement Project is shown in Figure 15. A number of the existing dams will be retained, while a number of shallow attenuation ponds will be added to the systems within the proposed widened channel. These shallow attenuation ponds will not be directly linked to the stream channel and will receive water only when the stream channel overtops, i.e. during flood events. Two further shallow attenuation ponds are proposed outside the channel improvement footprint. In addition to contributing to flood attenuation, the various proposed attenuation ponds will contribute to habitat diversity within the greater system by providing seasonal open water habitats.

It is important to note that similar channel improvement projects have already been implemented in the Montanaspruit system upstream of the currently proposed reach, e.g. within the Zambezi Country Estate (see aerial photograph in Figure 14). Construction is also currently underway within the Montanaspruit immediately upstream of the currently affected reach (Figure 10), and is furthermore proposed, and already authorised, for the reach immediately downstream of the current study area.

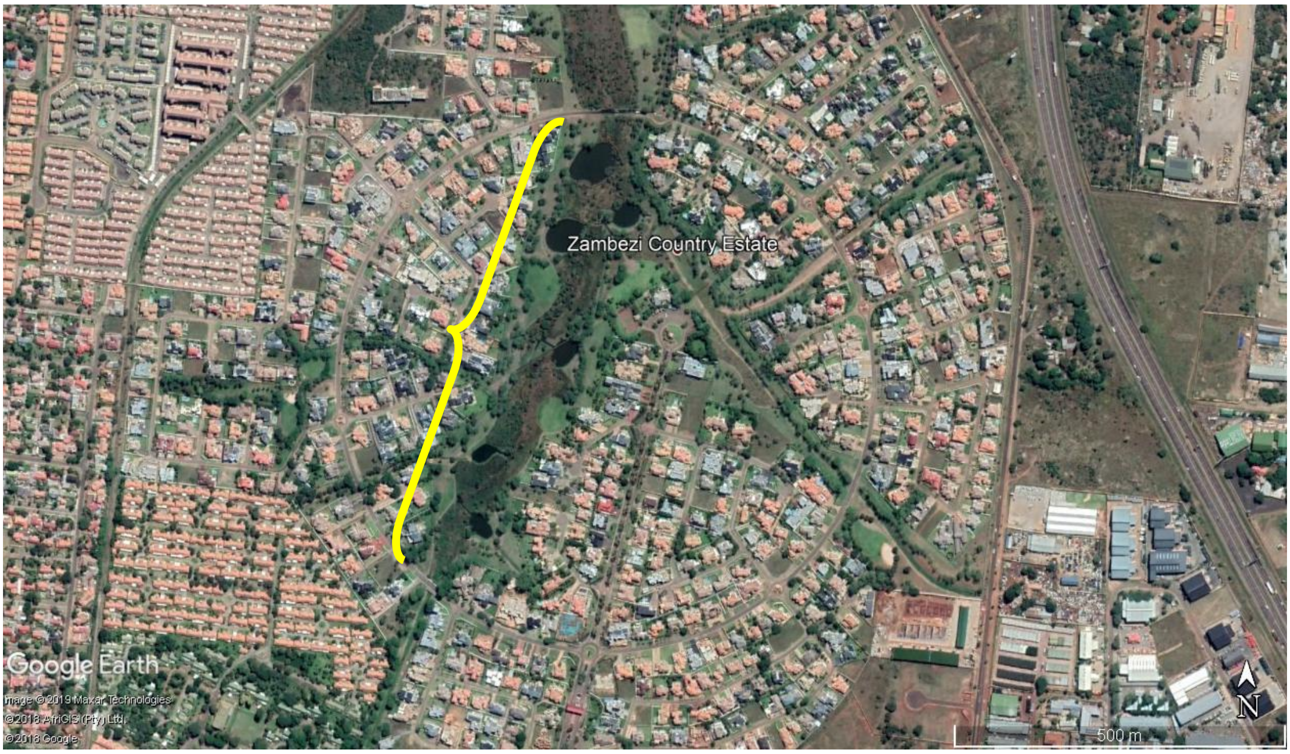


Figure 14. Aerial view of the Zambezi Country Estate where channel improvement of the Montanaspruit with a number of small attenuation ponds was implemented several years ago.

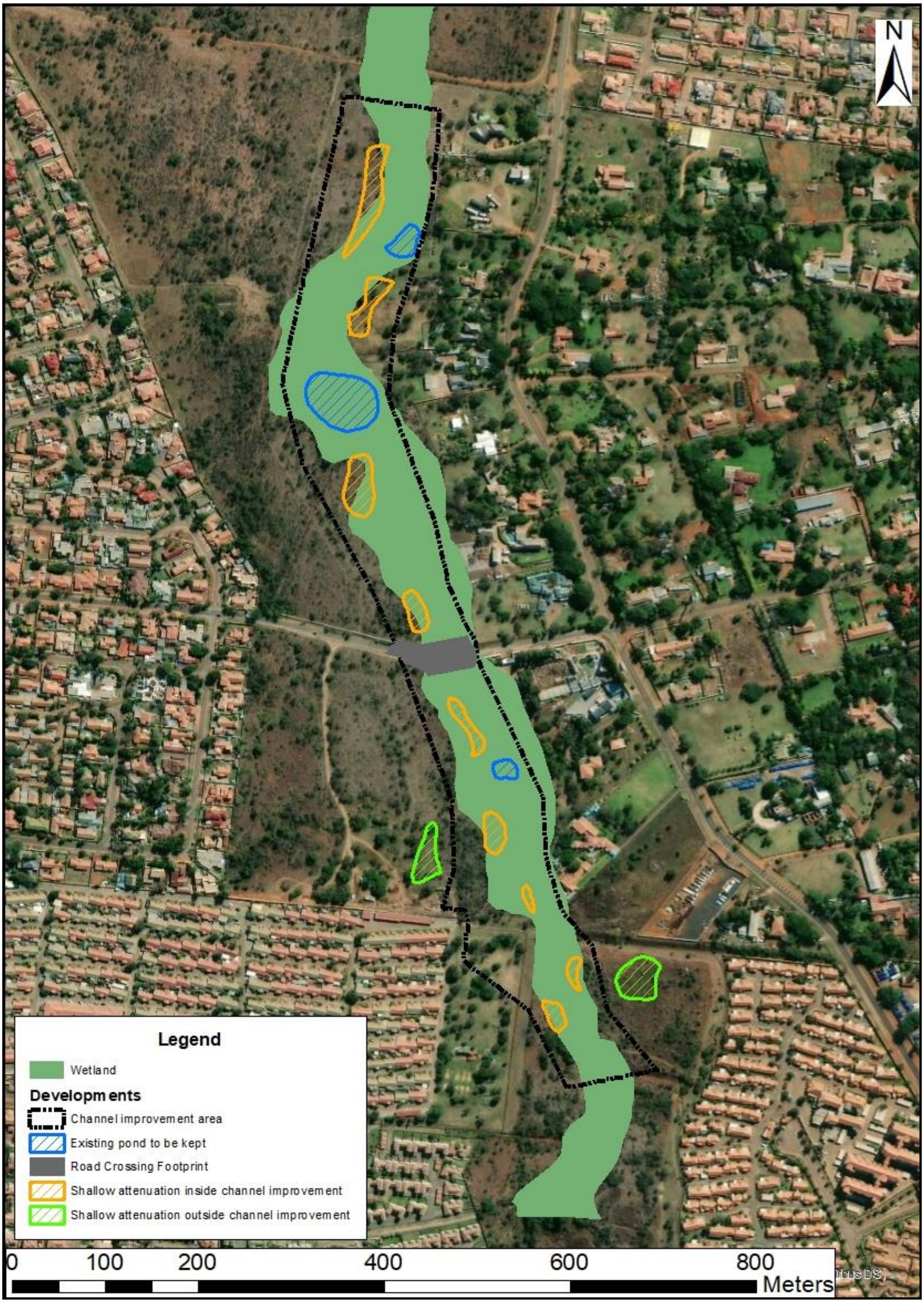


Figure 15. Map showing the proposed channel improvement interventions in relation to the wetland habitat within the study area.

9.2 Tsamma Street Bridge

As part of the Montanaspruit Improvement Project the existing bridge of the Montanaspruit at Tsamma Street will need to be replaced. The proposed changes are described by Ditlou Nevhutalo Consortium (September 2018) as follows:

> *The existing Tsamma Street will be reconstructed on the same horizontal alignment as before. The vertical alignment will be changed to lower the road and accommodate the culvert crossing. The lowering of the road is also required to ensure that the 1:100-year flood can overtop the road without the flood lines encroaching against the buildings on adjacent land.*
>
> *The roadway will be 6.0m wide consisting of 2 x 3,0m lanes in each direction. The higher side of the road will have a 400mm sloping kerb with a 2m wide paved walkway and the lower side will have a 400mm sloping kerb. The road will have a 3% crossfall with the natural slope to improve on the channel flow and to drain surface water away.*

The proposed bridge structure will consist of a series of 20 portal culverts (1500 x 450), resulting in a total crossing width of 36 meters (which is significantly wider than the existing 6 x 450 pipe culverts). The culverts will be installed on a cement slab. A number of similar bridge structures (with slightly differing dimensions) exist within the area already, including upstream of the project study area over the Montanaspruit at Bougainvillea Drive (see photo in Figure 18).

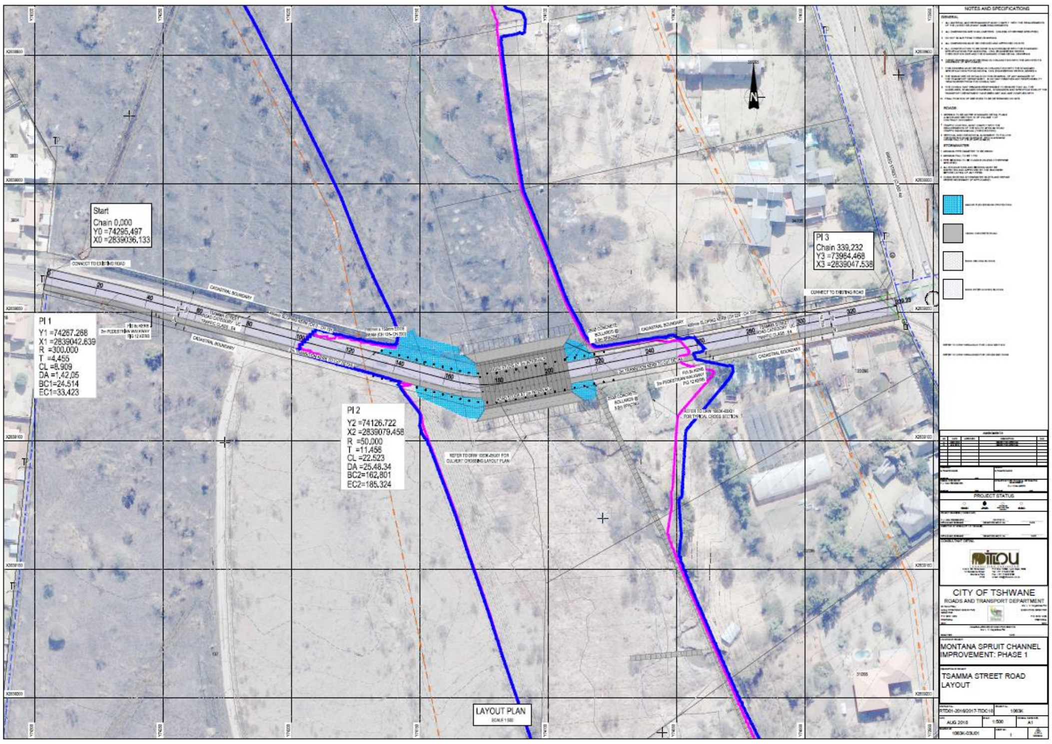


Figure 16. Tsamma Street culvert crossing layout.

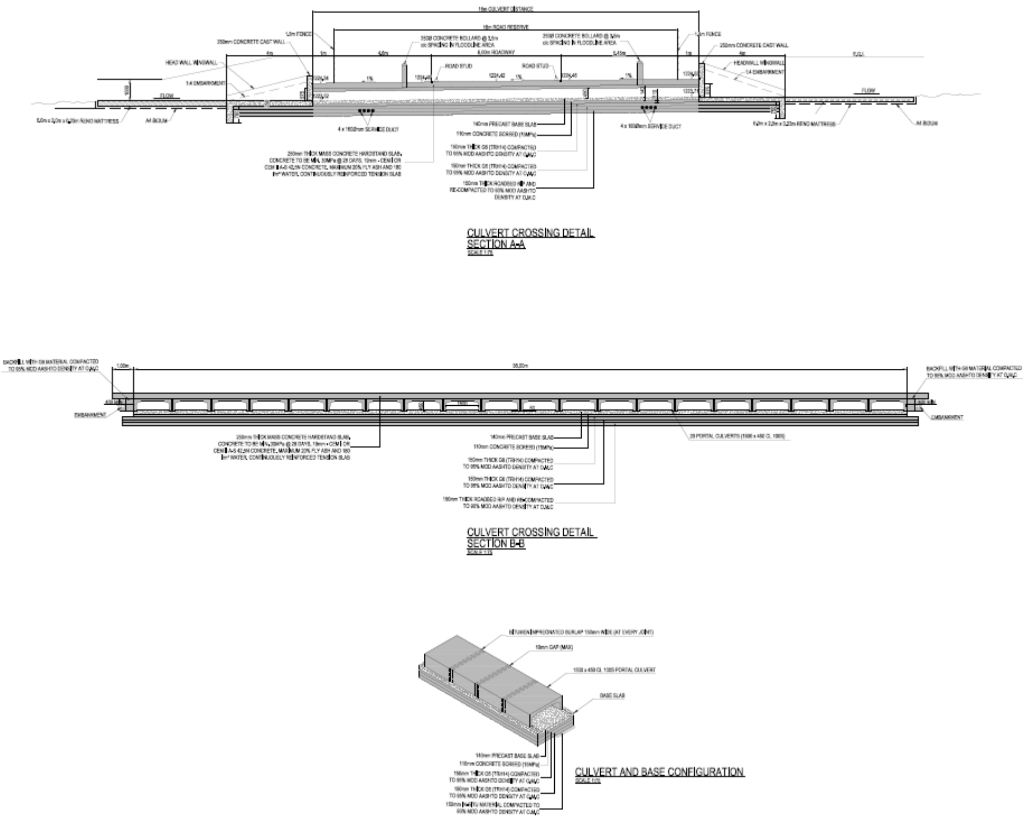


Figure 17. Tsamma Road culvert crossing.

Figure 18. Photo of an existing bridge along Bougainvillea Drive to the south of the site. The proposed Tsamma Road Bridge will be very similar to this bridge.

9.3 Expected Impacts to Wetlands

Although the proposed interventions, both the new Tsamma Street bridge and the Montanaspruit Improvement Project, will doubtless result in long-term positive impacts to the Montanaspruit system from a flow management perspective, and probably also from a biodiversity support perspective as greater habitat diversity is provided, there are likely to be definite short-term negative impacts associated with especially the construction of the proposed interventions. These impacts are likely to include:

- **Disturbance and loss of wetland habitat and biota** – construction activities will result in the removal of extensive areas of wetland and riparian vegetation, resulting in the loss and displacement of fauna utilising these habitats. Although natural vegetation will be re-established following completion of construction, there is likely to be a lengthy period during and following construction where the disturbed footprints will be largely bare of vegetation.
- **Increased erosion and sedimentation** – removal of vegetation and disturbance of soils during the construction phase will expose these soils to erosion, leading to accelerated soil loss and deposition of these soils in downstream environments, leading to knock-on impacts beyond the direct footprint of the proposed project.
- **Water quality deterioration** – water quality deterioration is likely to predominantly take the form of increased turbidity. Turbidity impacts of the current, upstream construction activity is clearly evident across the full reach of the assessed wetland area. In addition, use of machinery in wetlands could lead to spills and leaks of hydrocarbons into the wetland and stream.
- **Increase in alien vegetation** – Disturbances associated with construction activities and removal of vegetation could create ideal conditions for pioneer and alien species to become established. Establishment of alien species could lead to the exclusion of indigenous species and impoverishment of the habitat provided.
- **Habitat fragmentation** – construction of a road across a wetland typically leads to fragmentation of habitat. However, in the case of the new proposed Tsamma Street Bridge, the increased size and width of the bridge will likely slightly reduce the habitat fragmentation already in place.

From a wetland and aquatic ecology perspective, the key considerations that should inform the road crossing design to minimise habitat fragmentation are as follows:

- Flow connectivity has to be maintained across the width of the wetland habitat and care must be taken to avoid impoundment of flows upslope and concentration of flows downslope of the crossing so as to avoid erosion; and
- The crossing structure must be suitably designed to allow for the movement of both land-based and aquatic fauna. This will require the crossing structure to be of sufficient height to allow small mammals to cross underneath the bridge and ideally to have a natural soil or rock base. Where a cement base is needed to the structure, such a cement base should utilise a rough finish (e.g. wire brush finish) to ensure aquatic macroinvertebrates will be able to cross over the cement.

In our opinion the proposed structure (described in Section7.2 above) suitably provides for flow and habitat connectivity and is a significant improvement over the existing Tsamma Street bridge which only utilises 6 x 450 pipe culverts. The bridge will not exacerbate existing habitat fragmentation concerns brought about by the existing road crossing and surrounding developments, but will likely reduce fragmentation somewhat. A 36 m bridge will allow for flow connectivity across most of the wetland habitat, while the 450 mm height of the bridge will be the same as the existing pipe culvert diameter and should allow sufficient space for small mammals such as cane rat and mongoose to cross underneath the road. Given existing fragmentation of the habitat by for example the N4 (which crosses the wetland via a series of low box culverts) and the close proximity to urban areas, there is unlikely to be a need to make allowance for large mammals to cross underneath the bridge. The proposed bridge will be similar in nature to an existing bridge already constructed along Bougainvillea Drive to the south (see Figure 18).

9.4 Recommended Mitigation & Management Measures

In order to reduce the likely construction phase impacts, the following mitigation recommendations should be considered for inclusion in the construction method statements:

- The propose Montanaspruit Improvement Project should tie into the upstream channel improvement project currently under construction. Currently it appears from the layout plans that a short reach of the stream will not be addressed by either project. It must be ensured that this will not compromise either of the channel improvement project. The same applies to the proposed downstream channel improvement project
- Construction should ideally commence at the upstream end and progress downstream. This will ensure that ongoing construction activities will not continuously disturb and impact on sections of the stream already completed.
- Construction should ideally take place during low-flow periods. Unprotected bare soils during flood events could lead to severe erosion and soil loss. Construction should therefore ideally take place in winter.
- Construction activity must be carefully planned and supervised to allow the project schedule to be implemented without undue delays. A scenario of incomplete or partially completed work left standing for extended periods must be avoided.
- The existing channel of the stream should be retained intact as far as possible. This will limit direct disturbance of sediments within the flow path, resulting in reduced turbidity issues.
- Disturbed areas should be re-vegetated as soon as possible following completion of construction activities.
- Only locally occurring indigenous species should be used for revegetation.
- A monitoring plan must be established and implemented (for a minimum of 5 years after construction) to ensure successful re-establishment of vegetation and to ensure that any erosion damage is quickly identified and repaired.
- An alien vegetation management plan must be developed and implemented. For a minimum period of 5 years following completion of construction all invasive alien vegetation observed on site should be controlled and removed.
- Allowance will also need to be made for the environmentally friendly introduction of stormwater into the improved channel to ensure that no erosion occurs at discharge points.
- For the Tsamma Street Bridge it is it is recommended that rock-packed mattresses be installed immediately upslope and downslope of the bridge to ensure that no erosion occurs.

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