MANAGING WETLANDS

IN THE UPPER TSITSA RIVER (T35 A-E)

TSITSA PROJECT

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EXECUTIVE SUMMARY

Rural communities depend heavily on the natural environment in which they are situated. Thus the quality of natural capital, such as soil, vegetation and wetlands, make up a significant component of their rural livelihoods. Ecosystem goods and services is the term used to describe the benefits that are derived from the landscape. The quality and quantity of the ecosystem goods and services that are provided by any given landscape is directly related to the quality and extent of the natural resources. Maintaining, improving and protecting the ecosystems goods and services delivery is crucial for the sustainability of the socio-ecological system.

In the Upper Tsitsa River catchment sedimentation is a significant problem, especially in terms of the proposed Ntabalenga dam. The high sediment loads have implications for both upstream and downstream users; upstream as they are losing excessive volumes of valuable soil and have poorer water quality in nearby streams and rivers; and downstream users as their water quality and water infrastructure is threatened. The key ecological infrastructures identified as sediment traps in the catchment were wetlands. In addition man-made structures that act as sediment traps included smaller earth dams, and restoration structures such as gabions, silt fences, ponds and soil sausages.

The wetlands were mapped on high resolution aerial images. A degradation (current state), vulnerability to further degradation and restoration prioritisation score was assigned to each wetland. Erosional features that threated wetlands, such as headward erosion, were mapped as key intervention points. The philosophy behind the prioritisation of wetlands in Catchment T35 A-E supports avoiding further or future degradation instead of focusing on degraded systems that have lost their functionality (Millennium Ecosystem Assessment, 2005). The wetlands were divided into three priority classes namely; high, medium and low. High priority wetlands are those wetlands that were assessed to have a low to moderate degradation score and showed a moderate to high vulnerability to erosion. Moderate priority wetlands are those wetlands that were assessed to have a low to moderate degradation score and showed a low to moderate vulnerability to erosion. Low priority wetlands are those wetlands that were assessed to be highly degraded and showed a low to high vulnerability to erosion. A subset of these features was groundtruthed and the spatial data sets were updated after the field visit.

The results showed that there are a total of 2 808 wetlands covering a total area of 7 629.2 ha, ranging from larger valley bottom wetlands to smaller hillslope seep wetlands. The valley bottom wetland types had the largest in extent, of which the un-channelled valley bottom wetlands were the most common type. In Catchment T35 A-E the greatest proportion of wetlands were in a poor condition (assigned a moderate to high degradation and vulnerability score), making them susceptible to further degradation. In terms of wetland prioritisation, less than a quarter of the wetlands found in the area fall within the high restoration priority category. This is due to the high level of degradation of the wetlands, making them less cost effective to restore.

There are 170 existing wetland rehabilitation structures in the greater T35 catchment, however, only 6 are found within the Upper Tsitsa River catchment.

For the 2017/2018 Wetland Projects planning cycle associated with the Working for Wetlands Programme for the Eastern Cape 11 wetlands were identified. Six of these fall within the Tsitsa Catchment (T35 A-E) under the Gatberg Wetland Project (Working for Wetland Programme, 2018).

Wetlands are among the world's most important, but most threatened, environmental resources. The need for their wise use and conservation stems from the recognition of the high value goods and services which these ecosystems provide to society.

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1.1. BACKGROUND TO EXISTING WETLAND DATASETS

Wetland definition

The only legislated definition of wetlands in South Africa is contained within the National Water Act (Act No. 36 of 1998) (NWA) where wetlands are defined 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 adapted to life in saturated soil." This definition is consistent with more precise working definitions of South African wetlands and therefore includes only a subset of ecosystems encapsulated in the Ramsar definition.

1.1.1. Wetlands in South Africa

It has been estimated that originally over 10 % of the Republic of South Africa (RSA) was covered by wetlands; however, this figure decreases significantly every year owing to unsustainable land-use practices (Department of Environmental Affairs, 2018b). It is estimated that a significant proportion of South Africa's wetlands have been destroyed through drainage of wetlands for crops and pastures, poorly managed burning regimes, overgrazing, disturbances to wetland soils, vegetation clearing as well as industrial and urban development (including mining activities) (Department of Environmental Affairs, 2018b).

Although wetlands are high-value ecosystems that make up only a small fraction of the country, they rank among the most threatened ecosystems in South Africa. According to a CSIR study (Nel & Driver, 2012) South Africa's remaining wetlands were identified as the most threatened of all South Africa's ecosystems, with 48 % of wetland ecosystem types being critically endangered, 12 % endangered and 5 % vulnerable. Only 11 % of wetland ecosystem types are well protected, with 71 % not protected at all.

The remaining wetland systems suffer severe erosion and sedimentation, alien plant species and aquatic fauna infestations, unsustainable exploitation, artificial drainage and damming, and pollution. The continued degradation of wetlands will impact on biodiversity, ecological function, and the provision ecosystems services with subsequent impacts on livelihoods and economic activity, as well as health and well-being of communities. In the absence of functional wetlands, the carbon cycle, the nutrient cycle and the water cycle would be significantly altered (mostly adversely).

Wetlands are important sinks that can store sediment, carbon, water and nutrients, and provide grazing, craft materials and biodiversity when functioning properly. Wetland restoration includes grazing management to reduce continuous grazing and trampling, stabilising gully head erosion, revegetating areas prone to erosion and building structures to lift the base level to enhance self-stabilisation (Department of Environmental Affairs, 2018b).

1.1.2. National and regional data sets

According to Eco-Pulse's (2015) national data sets catchment T35 has a medium to very high biodiversity value, medium to high functional value (demand) and a low to moderate rehabilitation potential.

Spatial data supplied by SANBI that was considered in the compiling of this report included:

- The National Spatial Biodiversity Assessment (Nel & Driver, 2012);
- National Freshwater Ecosystem Priority Area (NFEPA) threatened wetland vegetation;
- NFEPA wetland layer;

- National Protected Areas Expansion Strategy (NPAES) focus areas;
- Eastern Cape Biodiversity Conservation Plan for aquatic ecosystems (Berliner & Desmet, 2007);

Unfortunately due to the coarse scale of these data sets it could not be used in the assessment or prioritisation process of the wetlands in T34 A-C.

1.1.3. Wetland vegetation types

According to Nel *et al.,* (2011) there are six wetland vegetation types that occur in upper Tsitsa River catchment (T35 A-E; Table 1). Three of these are classified as critically endangered and two are classified as endangered. Hence, most of the wetland vegetation types in the catchment are classified in the two highest categories of risk of extinction. Furthermore, the level of formal protection offered to these systems is non-existent for all of the wetland vegetation types. This highlights the urgent need to ensure that some of these systems are protected. It must be noted that the SANBI data is at a regional scale and as such the prioritisation process did not use this data.

TABLE 1: Wetland vegetation types based on NEFPA (2011)

Wetland vegetation type	Threat category	Protection status
Drakensberg Grassland Group 3	Critically endangered	Not protected
Drakensberg Grassland Group 5	Critically endangered	Not protected
Sub-Escarpment Grassland Group 5	Endangered	Not protected
Sub-Escarpment Grassland Group 6	Least threatened	Not protected
Sub-Escarpment Grassland Group 7	Endangered	Not protected
Sub-Escarpment Savanna	Critically endangered	Not protected

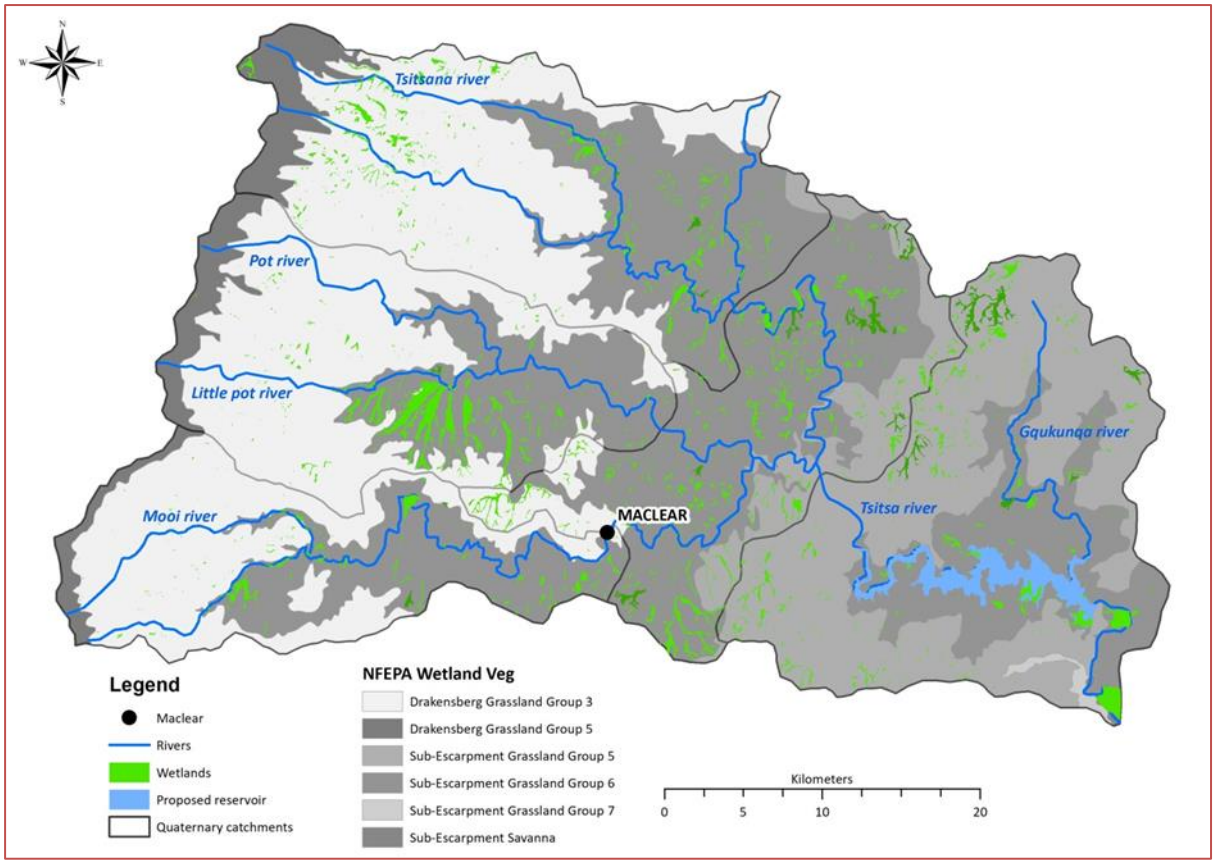

FIGURE 1: Wetland vegetation types in catchment T35 A-E

1.1.4. Wetland Ecosystem Services

Wetland ecosystems provide a variety of ecological and social services which benefit people, society and the economy at large (Department of Environmental Affairs, 2018b):

- Wetlands offer services such as water provision, regulation, purification and groundwater replenishment which are vital in addressing objectives of water security and water for food security;
- Wetlands play a critical role in improving the ecological health of an ecosystem by performing multiple functions that include flood control, water purification, sediment and nutrient retention and export, recharge of groundwater, as well as acting as vital habitats for diverse plant and animal species;
- Wetlands provide ecological infrastructure, replacing the need for municipal infrastructure by providing the same or better benefit at a fraction of the cost;
- Wetlands sinks (water and sediment) in the landscape, which offers the dual benefit of flood control as well as a means of purification;
- Wetlands function as valuable open spaces and create recreational opportunities for people that include hiking, fishing, boating, and bird-watching;
- Many wetlands also have cultural and spiritual significance for the communities living nearby. Commercially, products such as reeds and peat are also harvested from wetlands.

Wetlands are thus considered to be critically important ecosystems as they provide both direct and indirect benefits to the environment and society.

WET-EcoServices, a South African based wetland ecosystem services manual designed for inland palustrine wetlands, i.e. marshes, floodplains, vleis and seeps. It has been developed to help assess the goods and services that individual wetlands provide in order to allow for more informed planning and decision-making (Kotze *et al.,* 2009) .

In a Level 1 assessment, ecosystem services are assigned to a particular wetland based on existing knowledge of the features associated with different hydrogeomorphic (HGM) types since different HGM types generally offer different ecosystem services.

No one particular HGM unit type is considered to be more valuable than another type for biodiversity, cultural benefits or provisioning benefits.

Wetland ecosystem services cannot be guaranteed to be identified correctly from aerial photographs. A level 2 assessment should be done in order to generate a better understanding of the ecosystem services that wetlands provide in the catchment.

TABLE 2: Preliminary rating of the hydrological benefits likely to be provided by a wetland based on the HGM type (based on Kotze *et al.,* 2009)

HGM type	Regulatory benefits potentially provided by wetland							
	Flood Attenuation		Stream flow regulation	Enhancement of water quality				
	Early wet season	Late wet season		Erosion control	Sediment trapping	Phosphates	Nitrates	Toxicants
Floodplain (F)	++	+	0	++	++	++	+	+
Valley bottom with a channel (CVB)	+	0	0	++	+	+	+	+
Valley bottom without a channel (UVB)	+	+	+(?)	++	++	+	+	++
Hillslope seep (H)	+	0	+	++	0	0	++	++
Isolated hillslope seep (IH)	+	0	0	++	0	0	++	+
Depression/pan (D)	+	+	0	0	0	0	+	+

Rating:
0 Benefit unlikely to be provided to any significant extent
\+ Benefit likely to be present at least to some degree
++ Benefit very likely to be present (and often supplied at a high level)

1.1.5. Limitations and assumptions

The wetland information provided in this report was compiled using existing wetland datasets and available information. Wetlands were digitised off aerial images at a catchment scale and assigned one HGM type per wetland. A detailed categorisation of the wetlands was therefore not possible and only a broad level estimated categorisation map was produced. They can only be used as a general indication of the expected integrity/health status of the wetlands in a particular area or region. Detailed

PES assessments will therefore always replace any of the categories indicated as these are derived from surrogate indicators.

Given these limitations, on site verifications and assessments of the wetlands in the catchments must be undertaken. These assessments should include accurate verification of HGM units, site specific assessments of ecosystems services that may be provided by wetlands and assessment of the present ecological state of the wetlands.

2. WETLANDS IN THE UPPER TSITSA CATCHMENT (T35 A-E)

2.1. Digitising and classifying wetlands

2.1.1. Digitising

Wetlands in Catchment T35 A-E were identified and digitised using 2015 digital aerial photographs. Aerial photographs were made available by the Rhodes University Geography Department who source the images from National Geo-Spatial Information, Cape Town. These photographs have a suitable resolution (1: 10 000 ortho-photos, with 50 cm resolution) in the area of interest. To aid in the identification of wetlands digitising was performed using a high definition screen with a clear display. This aided identifying changes in vegetation type (grasses to wetland vegetation) to distinguish wetlands from drainage lines with more moist soils. Both wetlands and hillslope seeps were identified as integral parts of the landscape in Catchment T35 A-E.

2.1.2. Classifying

2.1.2.1. Wetland type

Wetland types were identified based on the Hydrogeomorphic types (HGM units) of WET-EcoServices booklet for wetland management (Kotze *et al.,* 2009; Table 3). It was deemed that the HGM units based on WET- EcoServices were sufficient for displaying and understanding the characteristics of the wetlands occurring in catchment T35 A-E.

Central to WET-EcoServices is the characterisation of hydrogeomorphic (HGM) types, which have been defined based on the geomorphic setting of the wetland in the landscape, topography, hydrology (water source- surface water dominated or sub-surface water dominated); how water flows through the wetland (diffusely or channelled) and how water exits the wetland. The rationale behind characterising the hydrogeomorphic types of a wetland is that areas belonging to the same HGM type and falling within a similar geological and climatic setting are likely to have a similar structure and exhibit similar processes. Thus HGM types provide a useful way of delimiting broad units of assessment (Kotze *et al.,* 2009).

Wetland types cannot be guaranteed to be identified correctly from aerial photographs.

TABLE 3: Definition of HGM units (Kotze *et al.,* 2009)

Wetland type	Description
Floodplain (F)	Valley bottom areas with a well define stream channel, gently sloped and characterised by floodplain features such as oxbow depressions. Water input from the main channel (when the bank overtops) or from adjacent slopes.
Valley bottom with a channel (CVB)	Valley bottom areas with a well-defined stream channel but lacking characteristic floodplain features. Water input can be from the river channel (when the bank overtops) or from adjacent slopes.
Valley bottom without a channel (UVB)	Valley bottom areas with no clearly defined stream channel. Water input can be from channels entering the wetland or from adjacent slopes.
Hillslope seepage linked to a stream channel (H)	Slopes on hillsides. Water inputs mainly from sub- surface flow and the outflow is via a clearly defined channel connecting the area directly to a stream channel.
Isolated hillslope seepage	Slopes in hillsides. Water inputs mainly from sub- surface flow with a limited outflow with no direct link of surface water to a stream channel.
Depression/ pans (D)	Basin shaped area with a closed elevation contour that allows for the accumulation of surface water. Outlet is usually absent and therefore this type is usually isolated from the stream channel network.

In Catchment T35 A-E 2808 wetlands with a total area of ~7 630 ha were identified and digitised. Wetlands occur throughout the catchment, despite the steep topography, from the top of the escarpment to the lower landscapes near the bottom of the catchment (Figure 2). The wetlands were mostly located in waterlogged pockets associated with drainage lines or depressions on gentle slopes where sediment is deposited and water is stored.

Identified wetlands ranged from large valley bottom wetlands to smaller depression/pans and hillslope seeps. Wetlands cover approximately 4 % of the total catchment area. Seeps are the dominant wetland type within the catchment followed by valley bottom wetlands without a channel (UVB) (Figure 3). Valley bottom wetlands without a channel (UVB) make up the greatest surface area covered by wetlands (Figure 4). The majority (91 %) of the wetland area classified have HGM units that are good sediment traps when in a functional state.

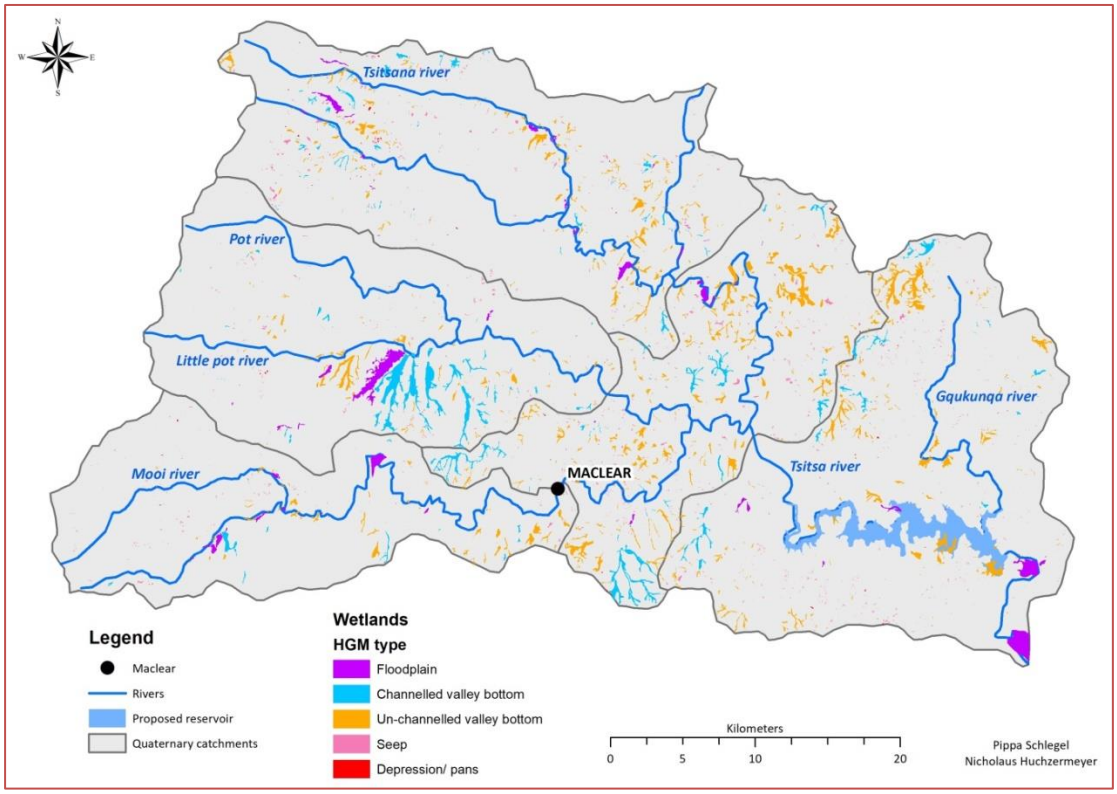

FIGURE 2: Locations of each wetland with its corresponding HGM unit type in catchment T35 A-E

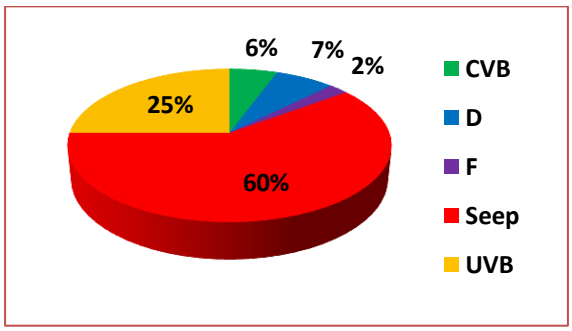

FIGURE 3: Number of each wetland type (CVB= channelled valley bottom; D= depressions/ pans; F= floodplain; Seeps= hillslope seeps and isolated hillslope seeps; UVB= un-channelled valley bottom)

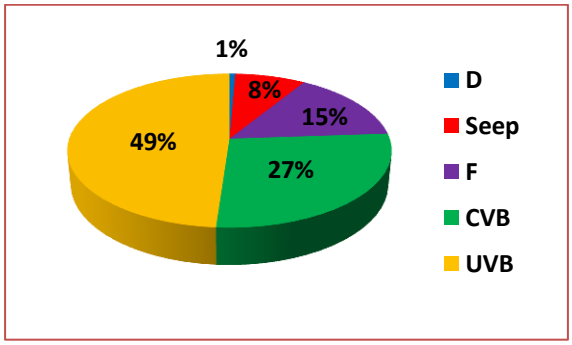

FIGURE 4: Percentage area out of the total wetland area covered by each HGM unit type

2.2. Vulnerable wetlands

Wetlands are important sinks that can store sediment, carbon, water and nutrients, and provide grazing, craft materials and biodiversity when functioning properly. Wetland restoration includes grazing management to reduce continuous grazing and trampling, stabilising gully head erosion, revegetating areas prone to erosion and building structures to lift the base level to enhance self-stabilisation.

2.3. Headward erosion nick points

A total of 5 754 points of headward erosion nick points, signs of use (livestock paths) and culverts from roads were identified from aerial photographs in and around the wetlands (Figure 5).

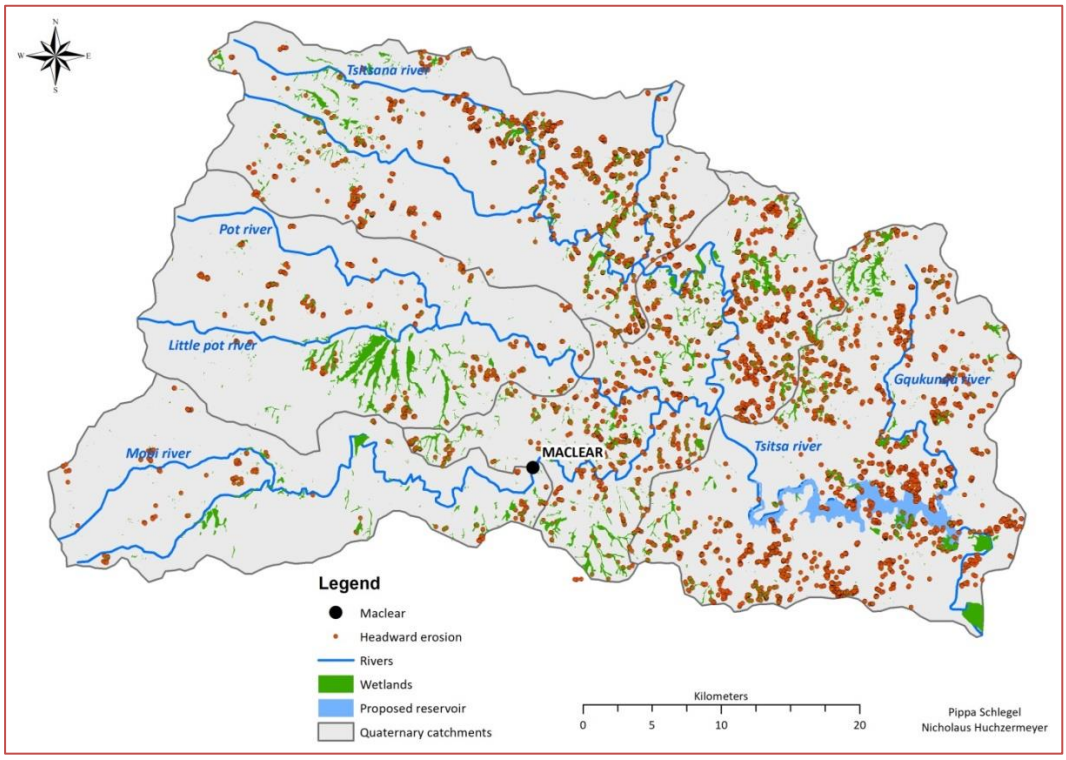

FIGURE 5: Location of erosion points in and around wetlands in Catchment T35 A-E

2.4. Degradation

Each wetland was assigned a degradation code (Schlegel et al., 2018). The degradation code was divided into three classes as explained in Table 4. The degradation code speaks to the current condition of the wetland.

TABLE 4: Degradation code assigned to each wetland found in CatchmentT35 A-E (Schlegel *et al.,* 2018)

Degradation code	Description
Near 'pristine' (1)	A wetland exhibiting good vegetation cover, with no erosion or anthropogenic impacts.
Stable (2)	A wetland that is being used (for example, livestock tracks) but shows little or no erosion within the wetland.
Degraded (3)	A wetland that is affected by erosion.

A total of 1 144 wetlands showed little or no degradation, 1 355 showed moderate degradation and 309 showed abundant degradation. In total wetlands exhibiting low degradation make up 17 % of the wetlands in catchment (T35 A-E), moderately degraded wetlands make up 62 % and highly degraded wetlands make up 20 % (Figure 6). This shows that the greatest proportion of wetlands is moderately degraded, and thus could be restored to a better functional state thereby providing more ecosystem services. The wetlands in the upper catchment were generally in a good to moderate condition, whereas the wetlands in the middle and lower catchment were in a moderate to degraded state (Figure 6). Present ecosystem services are likely to be compromised in the middle and lower catchment, consequently local land users are not benefitting from fully functional wetlands. The higher levels of degradation in the middle and lower catchment could be a consequence of anthropogenic pressure (grazing, increased runoff, ploughing, etc.) and landscape setting (erodible soils, general landscape incision, etc.) of the lower and middle catchment. The poor sediment retention by these degraded wetlands is evident as sediment loads are high in the Tsitsa River and sediment is mostly sourced from the middle and lower catchment (see Le Roux, 2017).

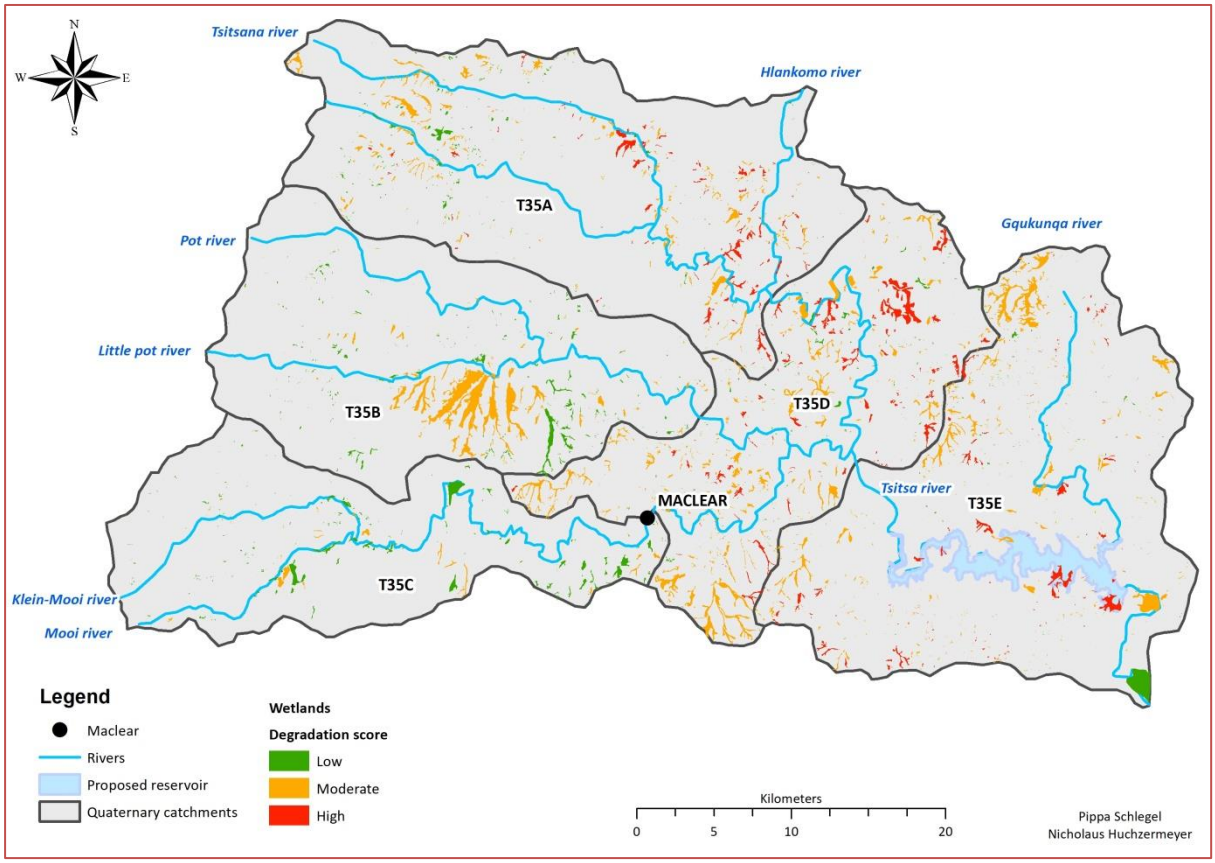

FIGURE 6: Location of wetlands with their corresponding degradation status in Catchment T35 A-E

TABLE 5: Summary of the degradation status of wetlands in Catchment T35 A-E

Degradation	Number of wetlands	Area (ha)	Percent (%) area of wetlands
Catchment		201601.4	
All wetlands	2808	7 629.2	
Low	1144	1314.7	17
Moderate	1355	4758.9	62
High	309	1555.6	20

2.5. Vulnerability

The vulnerability of the wetland is a subset of its degradation. Once the degradation code was assigned to a wetland then the vulnerability of the wetland was accessed (Table 6).

TABLE 6: Vulnerability code assigned to each wetland found in Catchment T35 A-E (Schlegel *et al.*, 2018)

Degradation code	Vulnerability code	Description
Near 'pristine' (1)	Low (1)	Unlikely to degrade
	Moderate (2)	Erosional headcut encroaching on the wetland
	High (3)	n/a
Stable (2)	Low (1)	Used but unlikely to degrade
	Moderate (2)	Used and erosional headcut encroaching the wetland
	High (3)	Abundant and obvious erosion around the wetland
Degraded (3)	Low (1)	n/a
	Moderate (2)	Erosion visible in wetland, however, vegetation cover evident and little to no active erosion
	High (3)	Abundant erosion around and within in the wetland

A total of 1 576 wetlands exhibited low vulnerability to erosion, 1 572 exhibited moderate vulnerability to erosion and 1 338 were identified as being highly vulnerable to erosion (Table 7). Wetlands in the middle and lower catchment were more vulnerable compared to wetlands in the upper reaches of the catchment (Figure 7). Overall wetlands exhibiting low vulnerability to erosion make up 26 % of the wetlands found in catchment T35 A-E, those exhibiting moderate vulnerability make up 50 % and highly vulnerable wetlands make up 24 %. Wetlands with large surface areas show the highest vulnerability to erosion. Smaller wetland systems, such as depression wetlands, show little vulnerability to erosion, due to factors such as location, vegetation cover and slope. This shows that high proportions of the wetlands are categorised as vulnerable and are likely to degrade in the future. Intervention and improved landscape management is needed to maintain and improve the current functioning of the wetlands. This will ensure ecosystem services for local land users.

TABLE 7: Summary of the vulnerability of wetlands, irrespective of wetland type or degradation, in Catchment T35 A-E

Vulnerability	Number of wetlands	Area (ha)	Percent (%) area of wetlands
Catchment		201601.4	
All wetlands	2808	7 629.2	
Low	1576	1954	26
Moderate	1572	3831.8	50
High	1338	1843.4	24

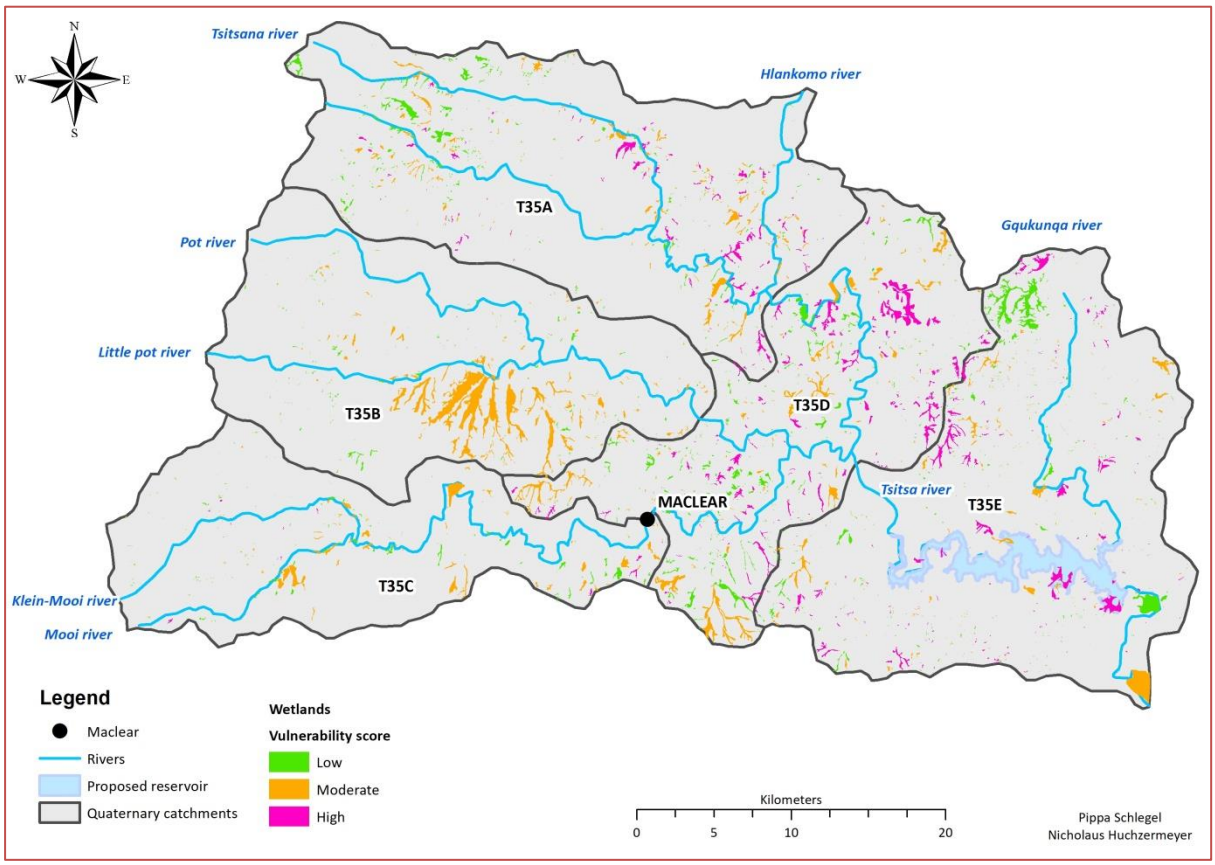

FIGURE 7: Location of wetlands with their corresponding vulnerability status in Catchment T35 A-E

3. PAST WETLAND REHABILITATION IN THE CATCHMENT

There are 170 existing wetland rehabilitation structures in the greater T35 catchment. However, out of those 170 only 6 are found in the Upper Tsitsa catchment (T35 A-E) and only in sub-catchment T35 C (Figure 8).

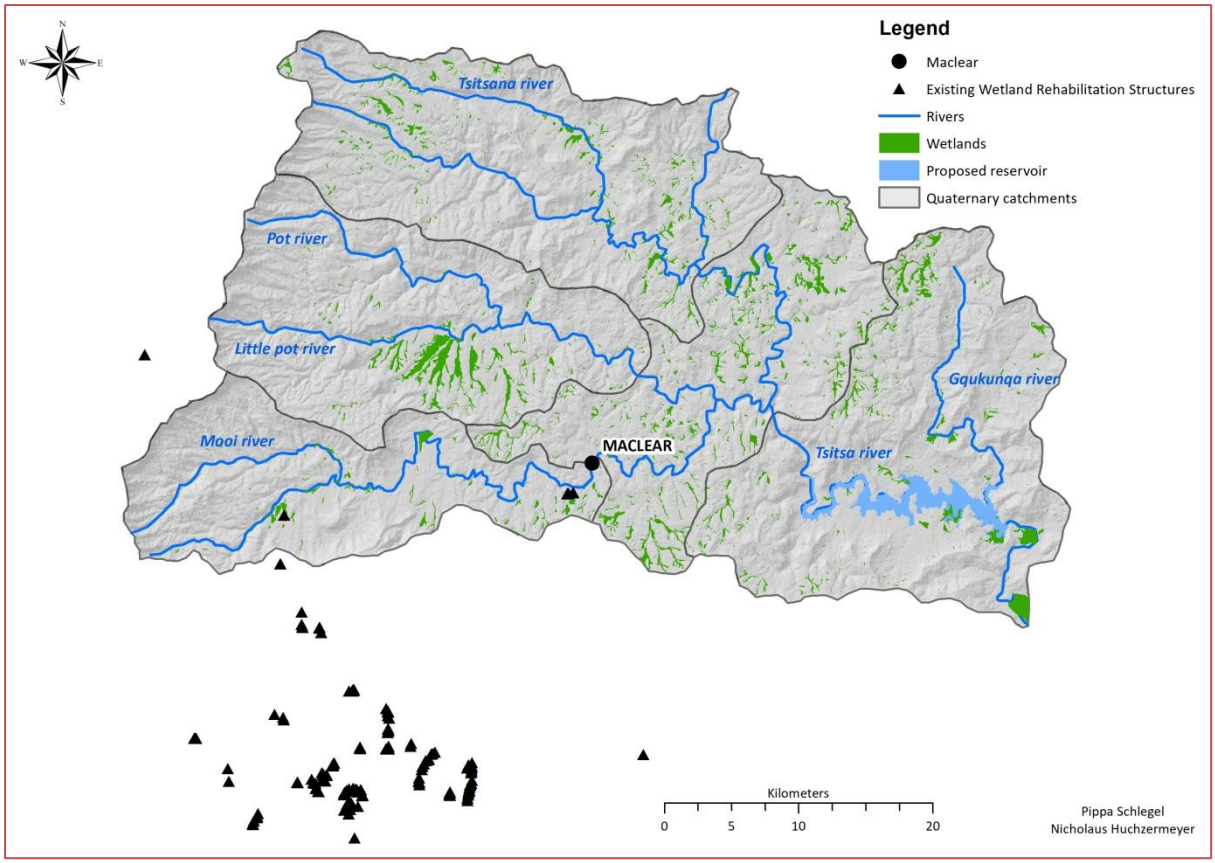

FIGURE 8: Existing wetland rehabilitation structures in the greater T35 Catchment

4. PLANNED WETLAND REHABILITATION IN THE CATCHMENT

For the 2017/2018 Wetland Projects planning cycle associated with the Working for Wetlands Programme for the Eastern Cape 11 wetlands were identified. Six of these falls within the Tsitsa Catchment (T35 A-E) under the Gatberg Wetland Project (Working for Wetland Programme, 2018: Table 8). Implementations of these interventions are likely to happen in 2019.

TABLE 8: Location of the identified wetlands within the Gatberg Wetland Project (Working for Wetland Programme, 2018)

Wetland Number	Wetland Name	Latitude	Longitude
T35C-02	Prentjiesberg 2	-31.095031047	28.333341881
T35C-03	Glen Cullen 1	-31.108745093	28.217601964
T35C-04	Glen Cullen 2	-31.057107905	28.217700967
T35D-01	Fairlight 1	-31.123095016	28.378301963
T35D-02	Fairlight 2	-31.115320755	28.393076536
T35D-03	Fairlight 3	-31.112990900	28.399917055

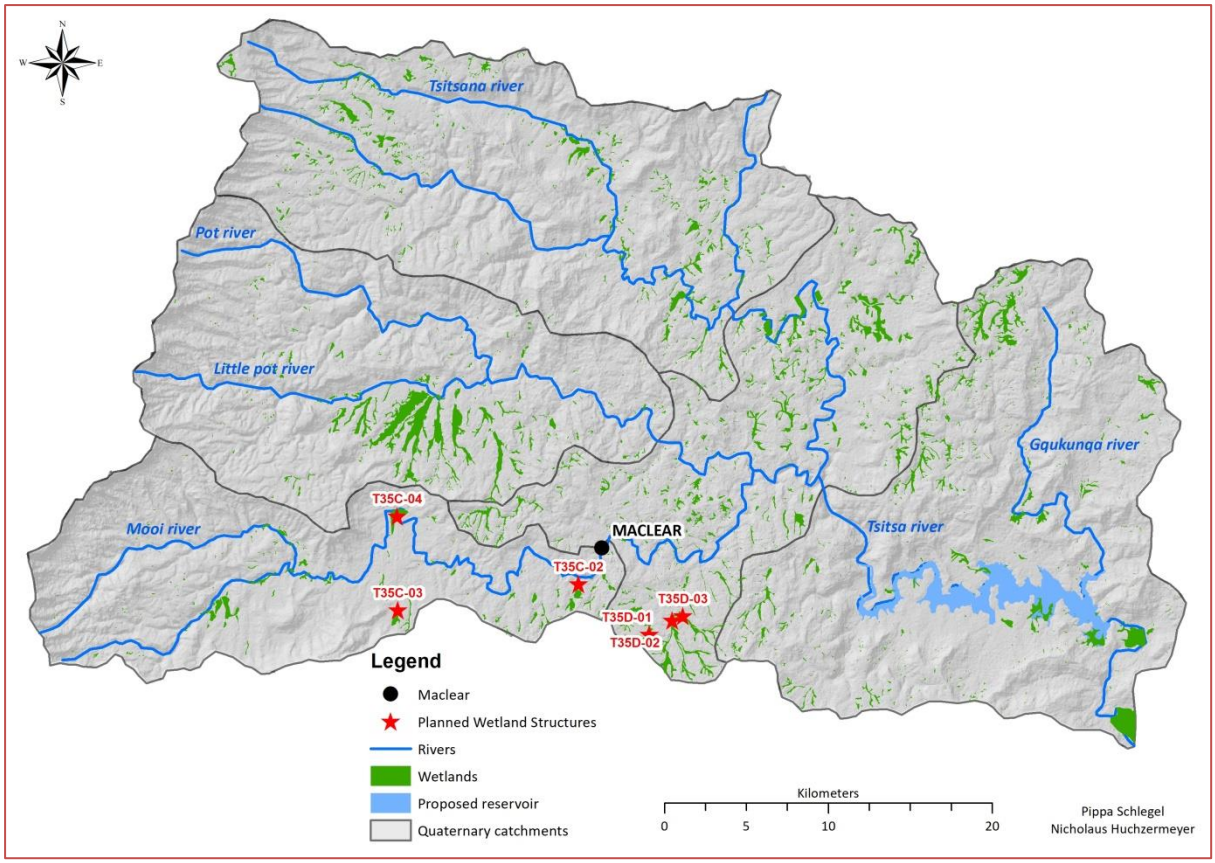

FIGURE 9: Wetlands identified for rehabilitation in the Gatberg Wetland Project (Working for Wetlands, 2018)

4.1. Prioritisation of wetlands for engineering designs

The "priority" as depicted in the table below indicates the relative importance of each wetland within the wetland project (Gatberg Wetland Project) as a whole. Based on the wetland status quo reports conducted, the current progress of implementation within the project and the order of implementation of the rehabilitation interventions detailed in the following sections, the wetlands have been prioritised for rehabilitation in the following order (Working for Wetland Programme, 2018: Table 9):

TABLE 9: Prioritisation of the wetlands identified within the Gatberg Wetland Project (Working for Wetland Programme, 2018)

Priority	Wetland number	Wetland name	Rationale
1	T35C-02	Prentjiesberg 2	Rehabilitation is already under way in this wetland. During the implementation process a number of additional problems that require intervention measures were identified. This wetland is given a high priority as the proposed work will allow continuation of current rehabilitation work. The system would further contribute to the regional improvement of wetlands in the upstream catchment of the proposed Ntabelanga Dam.
1	T35C-03	Glen Cullen 1	There is likely to be a high return on investment and the wetland has excellent potential for gains in functional equivalents. The number of person days for employment is high. The system would further contribute to the regional improvement of wetlands in the upstream catchment of the proposed Ntabelanga Dam.
4	T35C-04	Glen Cullen 2	Lateral flows on to this floodplain terrace have been intercepted and diverted. A large area of wetland can be improved using mostly earthworks. The system would further contribute to the regional improvement of wetlands in the upstream catchment of the proposed Ntabelanga Dam.
2	T35D-01	Fairlight 1	Cranes were observed mating at the head of the system. Biodiversity value is therefore high. The system would further contribute to the regional improvement of wetlands in the upstream catchment of the proposed Ntabelanga Dam.
3	T35D-02	Fairlight 2	The wetland offers important habitat for cranes. The biodiversity value is therefore high. The system would further contribute to the regional improvement of wetlands in the upstream catchment of the proposed Ntabelanga Dam.
5	T35D-03	Fairlight 3	The wetland offers important habitat for cranes. The biodiversity value is therefore high. The system would further contribute to the regional improvement of wetlands in the upstream catchment of the proposed Ntabelanga Dam.

Details on rehabilitation designs are given in Appendix B and estimated costings are given in section 6.

5. SCOPING: INTEGRATED WETLAND MANAGEMENT

5.1. Wetland prioritisation

The philosophy behind the prioritisation supports avoiding further or future degradation instead of focusing on rehabilitating degraded systems that have lost their functional state (Millennium Ecosystem Assessment, 2005). This will entail addressing the drivers of degradation, such as over grazing, increased storm-water flows, etc., and rehabilitation interventions.

Biophysical data sources considered in deriving the prioritisation included, the degradation code and the vulnerability code assigned to each wetland. Degradation speaks to the present state of the

wetland (functioning) and the vulnerability code speaks to the probable future deterioration (loss of functioning if no mitigation steps are taken) of the wetlands.

The priorities of wetlands in Catchment T35 A-E were ranked as follows (Schlegel *et al.,* 2018; Table 10):

1. High priority: Wetlands that were characterised as being low to moderately degraded and having a moderate to high vulnerability code;
2. Moderate priority: Wetlands that were characterised as being low to moderately degraded and having a low to moderate vulnerability code;
3. Low priority: Wetlands that were characterised as highly degraded with low to high vulnerability score.

TABLE 10: Wetland prioritisation classes (Schlegel *et al.,* 2018)

Priority Level 1				
Vulnerability		Degradation		
		Low	Moderate	High
	High	High		
	Moderate		Moderate	Low
	Low			

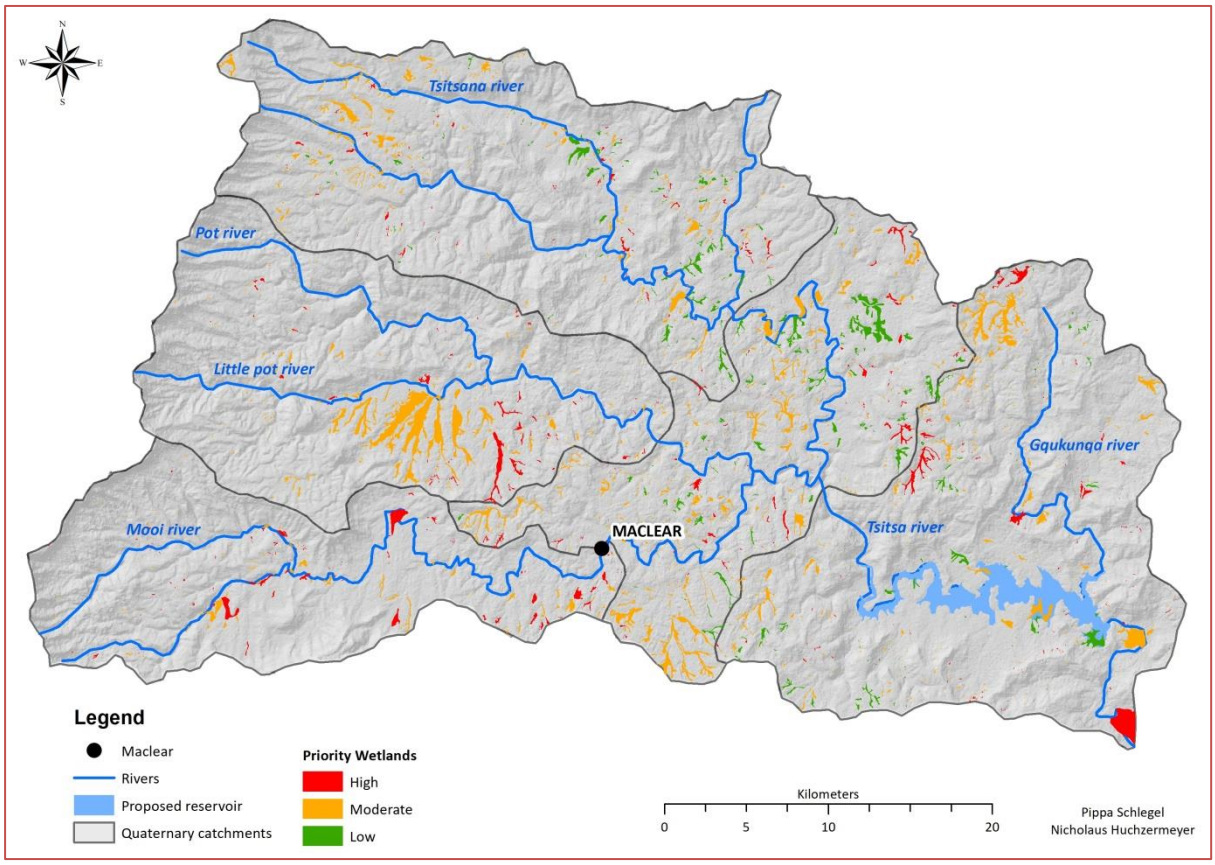

FIGURE 10: Location of prioritised wetlands in Catchment T35 A-E

Table 11 below summarises the different mapped HGM unit types according to their prioritisation score. A total of 578 wetlands were identified as high priority, 1 972 wetlands as moderate priority and 258 wetlands were identified as highly degraded and were scored as low priority. These wetlands of differing priority class are scattered throughout the catchment, thus restoration would not just target a specific area in the catchment. High priority wetlands cover an area of 1 456 ha, moderate priority wetlands cover and area of 4 800 ha and low priority wetlands cover and area of 1 373 ha. A total of 14 % of floodplain wetlands are scored as a high priority, 81 % as a moderate priority and 4.7 % of floodplains wetlands have a low priority. A total of 24 % of valley bottom wetlands with a channel are scored as high priority, 62 % as moderate priority and 13 % as low priority. A total of 21 % of valley bottom wetlands without a channel are scored as high priority, 60 % are scored as moderate priority and 19 % are scored as low priority. Due to the abilities of floodplain and valley bottom wetlands to act as sediment traps; restoration and land management efforts should concentrate on these as the highest priority HGM unit type. A total of 11 % of depression/pan wetlands are scored as high priority, 88 % as moderate priority and 0.5 % as low priority. A total of 21 % of seeps are scored as high priority, 73 % as moderate priority and 6 % as low priority. In order to improve the function of the wetlands in catchment T35 A-E to provide ecosystem services to local land users a mixture of restoration efforts and landscape management efforts needs to be put in place.

TABLE 11: Table summarising wetland prioritisation information

			Priority Score											
Wetland HGM unit type	Number of wetlands	Wetland area (ha)	High priority				Moderate priority				Low priority			
			Number of wetlands	Wetland area (ha)	Percent (%) of HGM unit	Percent (%) area of HGM unit covered	Number of wetlands	Wetland area (ha)	Percent (%) of HGM unit	Percent (%) area of HGM unit covered	Number of wetlands	Wetland area (ha)	Percent (%) of HGM unit	Percent (%) area of HGM unit covered
Floodplain (F)	64	1150.8	9	306.5	14.1	26.6	52	810.6	81.3	70.4	3	33.7	4.7	2.9
Valley bottom with a channel (CVB)	157	2076.7	38	412.2	24.2	19.9	98	1484.6	62.4	71.5	21	179.9	13.4	8.7
Valley bottom without a channel (UVB)	702	3728.1	151	601.5	21.5	16.1	419	2036.6	59.7	54.6	132	1090	18.8	29.2
Seep	1690	622.1	358	128.4	21.2	20.6	1231	424.5	72.8	68.2	101	69.3	6	11.1
Depression/ pans(D)	195	51.5	22	7.8	11.3	15.1	172	43.4	88.2	84.3	1	0.3	0.5	0.6

Social input on selecting priority wetlands included inputs from community mapping of important wetlands and grazing areas. These are shown by the black circles in Figure 11.

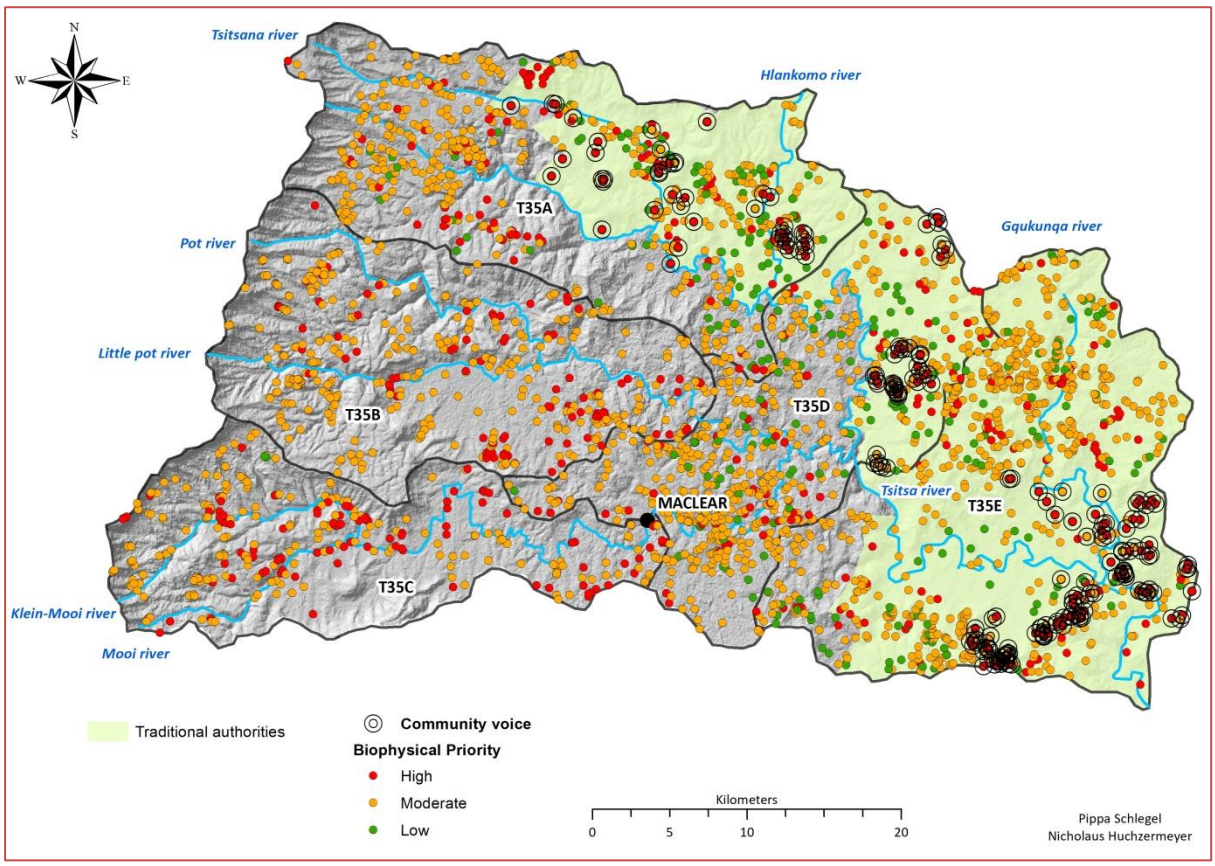

FIGURE 11: Priority wetlands in Catchment T35 A-E (biophysical priority and community voice- black circles)

5.1.1. Un-channelled valley bottom wetlands

Un-channelled valley bottom wetlands were selected out of the wetlands layer to target for wetland rehabilitation. Un-channelled valley bottom wetlands were chosen due to their ability to perform multiple ecosystem services especially those of sediment trapping, erosion control and water trapping (Figure 12).

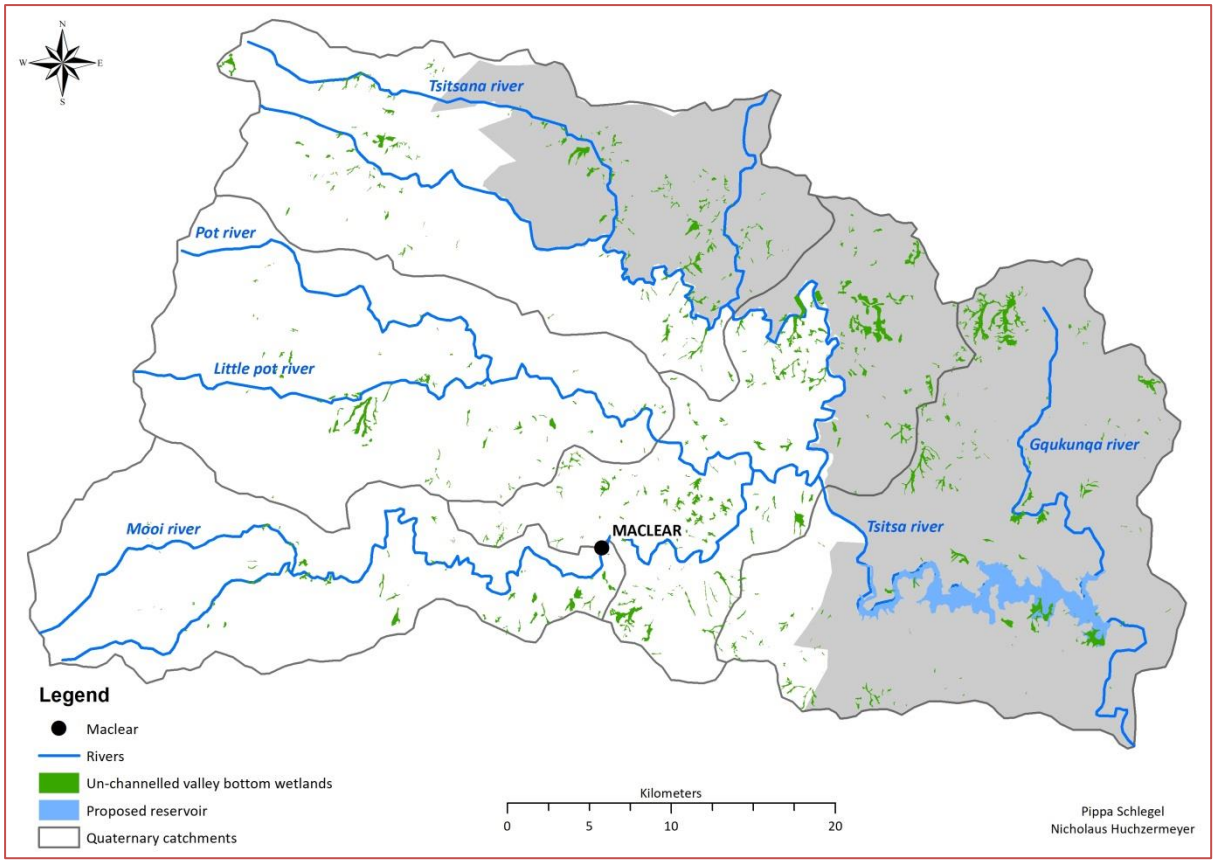

FIGURE 12: Un-channelled valley bottom wetlands found in Catchment T35 A-E

5.1.2. Priority zones: mini-catchments

The integrated planning follows the Sustainable Land Management (SLM) thinking where the first priority is to avoid further degradation, followed by a reduction in degradation and lastly the rehabilitation or reversing of degradation (Cowie et al., 2018). Avoiding and reducing degradation addresses drivers and pressures related to degradation, whereas reversing land degradation improves the state of the ecological infrastructure and ecosystem goods and services. As resources are limited, the Tsitsa Project will focus on selected smaller hydrological catchments where drivers and pressures can be targeted in combination with restoring ecological infrastructure.

Priority catchments were selected based on stream order, susceptibility for large gully erosion and community voice inputs (Figure 13; see the integrated SLM and restoration plan for the Tsitsa Project).

The Tsitsa Project approach is to prevent gully erosion or productive landscape units, such as wetlands. Wetlands serve as important sediment and water buffers in the landscape, this especially true of valley floor wetlands. Due to these factors wetlands are associated with a multitude of ecosystem benefits both direct and indirect that support local livelihoods.

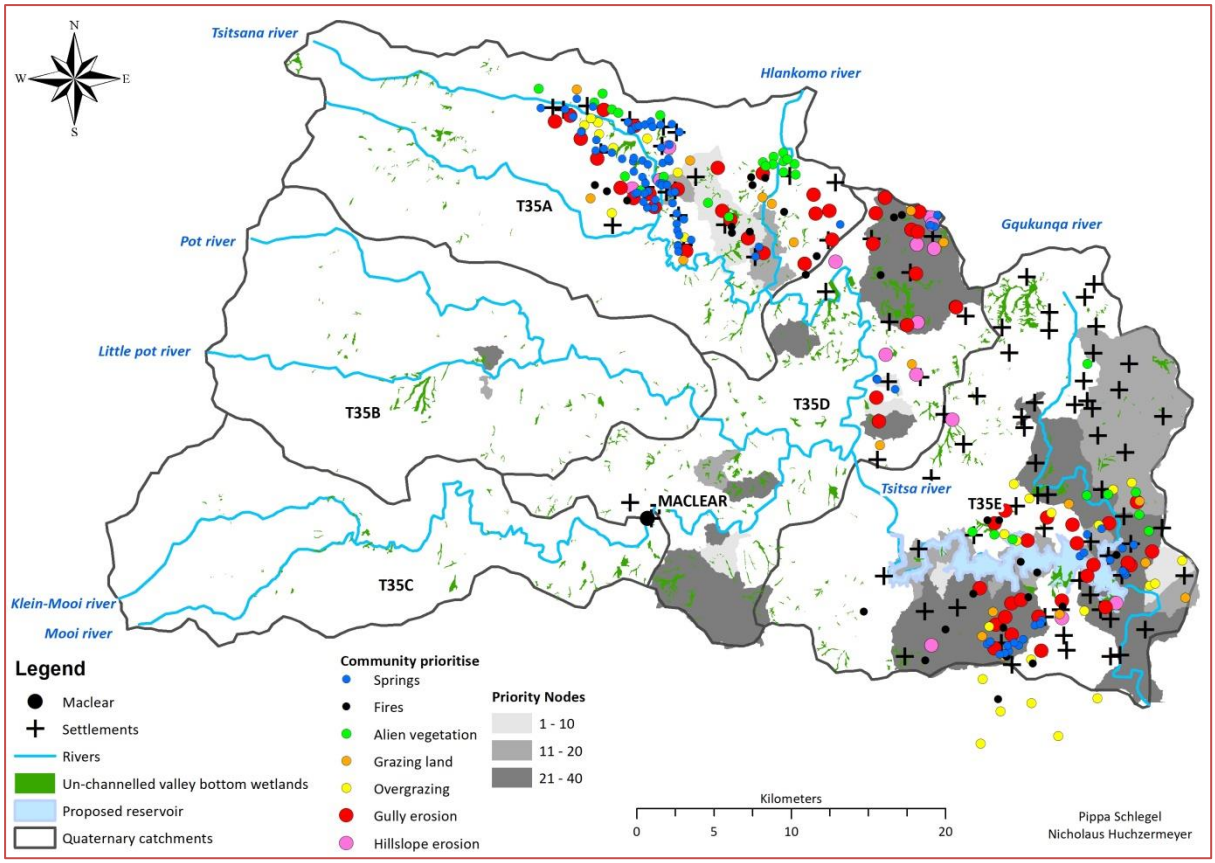

FIGURE 13: Location un-channelled wetlands and community voice (problems and important features)

5.1.3. 20 larger wetlands scoped for rehabilitation

Out of the valley floor wetlands un-channelled valley bottom wetlands were identified as the highest priority for restoration because of their high sediment and water buffering benefits. 20 wetlands were chosen based on our best integration of their biophysical priority, wetland type (un-channelled valley floor wetlands), and community voice and restoration feasibility (Figure 14). Some of the wetlands fall outside the focus nodes due to the above criteria. These 20 wetlands will be put forward for the upcoming restoration planning. Details on wetland size, location, land ownership and restoration needs are detailed in Appendix A and estimated costs are given in section 7.

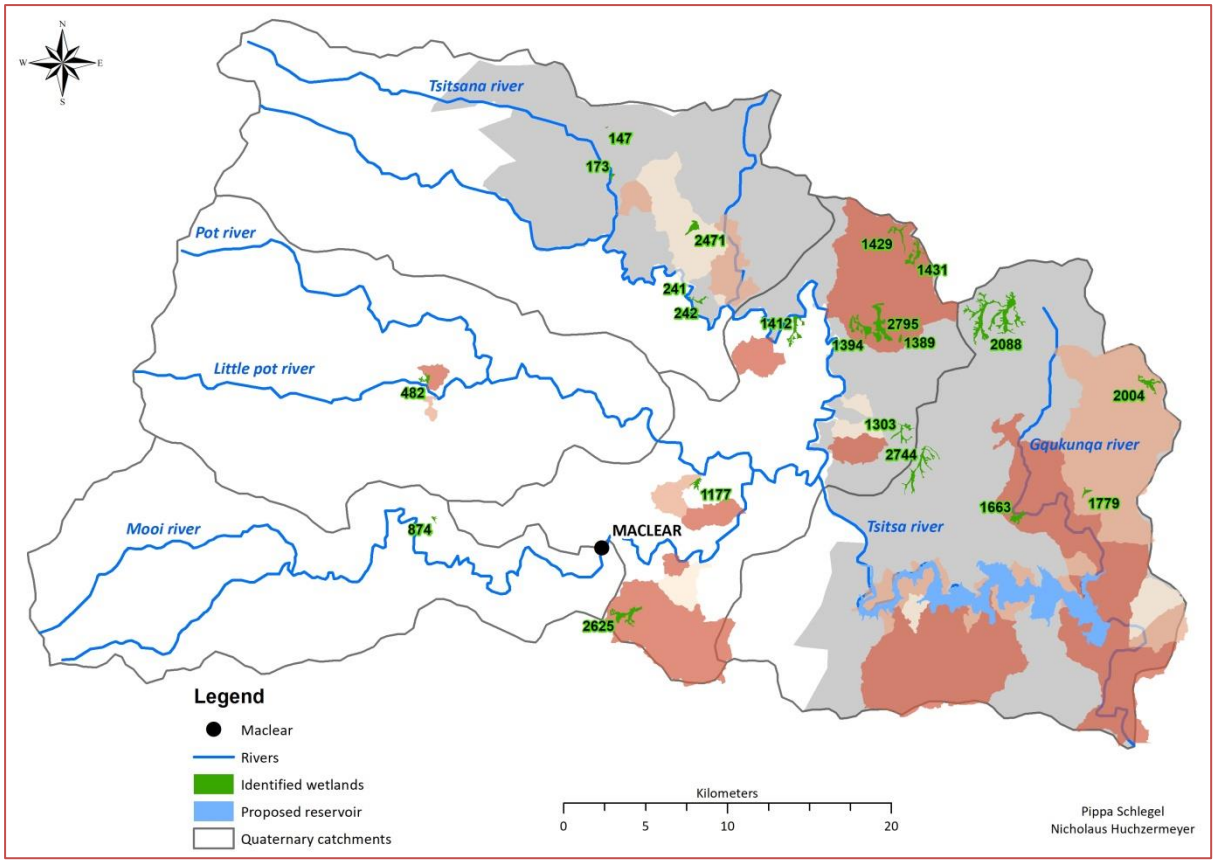

FIGURE 14: Location of wetlands scoped for rehabilitation

6. ESTIMATED COSTS

The costings of the planned interventions for T35 A-E are estimated at R6.2 Mil (Table 12). This work will include several hard structures and softer options such as plugging drains. This planning is undergoing an EIA and will be implemented in 2019.

TABLE 12: Estimated costs for wetland restoration for 2019

Wetland Name	Wetland Number	Land ownership	Extension of previous work	Estimated Costs
Prentjiesberg 2	T35C-02	Private	Yes	R403,113.13
Glen Cullen 1	T35C-03	Private	No	R1,049,567.32
Glen Cullen 2	T35C-04	Private	No	R3,082,656.70
Fairlight 1	T35D-01	Private	No	R391,398.85
Fairlight 2	T35D-02	Private	No	R509,899.22
Fairlight 3	T35D-03	Private	No	R813,271.22
	Available budget total			R4,397,778.00
	Estimated total costs			R 6,249,926.44

The next round of wetlands identified for detailed planning is presented in Figure 13. Current cost estimates for these 20 wetlands total R14.5 mil excluding inflation or management costs. These calculations are based on minimal hard structures (only critical positions that will have significant geomorphological impact) and more soft options. The soft options that do not need EIA approval and can be implemented when budgets allow (~R9 mil). Future budgets should include maintenance of these interventions, such as grazing management. The wetland restoration should be integrated with SLM and restoration work within the wetland catchment to improve ecosystem services that will allow for more sustainable wetland restoration, such as less flashy runoff due to poor vegetation cover and high landscape connectivity.

TABLE 13: Estimated need for interventions and possible costs for the 20 wetlands selected for the next planning phase – implemented 2020 onwards (calculations exclude inflation and maintenance costs)

						Intervention need						Estimated cost			
						% of wetland area needing treatment				Trigger EIA		No EIA needed			
Wetland no	Quaternary	Land ownership	Area (ha)	Priority level	Engineered structures	No engineer	Soft options % of area	Clearing	Grazing	Hard engineering	Soft engineering	Soft options	AIP clearing	Grazing management	Total Cost
147	T35A	Traditional	1	High	3	10%	10%	0%	100%	R 300 000	R 2 560	R 6 100	R -	R 72	**R 308 732**
173	T35A	Traditional	6	High	0	0%	20%	5%	100%	R -	R -	R 73 200	R 4 500	R 432	**R 78 132**
242	T35A	Traditional	12,9	Moderate	1	10%	20%	0%	100%	R 100 000	R 33 024	R 157 380	R -	R 929	**R 291 333**
2471	T35A	Traditional	5	Moderate	0	20%	10%	5%	100%	R -	R 25 600	R 30 500	R 3 750	R 360	**R 60 210**
482	T35B	Private	17,4	Moderate	0	20%	20%	5%	100%	R -	R 89 088	R 2212 280	R 13 050	R 1 253	**R 315 671**
874	T35C	Private	5	High	1	0%	10%	0%	50%	R 100 000	R -	R 30 500	R -	R 180	**R 130 680**
1177	T35D	Private	19,1	High	1	20%	30%	0%	100%	R 100 000	R 97 792	R 349 530	R -	R 1 375	**R 548 697**
1303	T35D	Traditional	35	High	1	15%	20%	0%	100%	R 100 000	R 134 400	R 427 000	R -	R 2 520	**R 663 920**
1389	T35D	Traditional	7,5	High	1	10%	20%	0%	100%	R 100 000	R 19 200	R 91 500	R -	R 540	**R 211 240**
1394	T35D	Traditional	61	Moderate	2	10%	20%	5%	100%	R 200 000	R 156 160	R 744 200	R 45 750	R 4 392	**R 1 150 502**
1412	T35D	Private	50	Moderate	2	5%	20%	0%	50%	R 200 000	R 64 000	R 610 000	R -	R 1 800	**R 875 800**
1429	T35D	Traditional	27	High	1	25%	20%	0%	100%	R 100 000	R 172 800	R 329 400	R -	R 1 944	**R 604 144**
1431	T35D	Traditional	44	High	2	20%	20%	5%	100%	R 200 000	R 225 280	R 536 800	R 33 000	R 3 168	**R 998 248**
2625	T35D	Private	72	Moderate	0	10%	10%	5%	50%	R -	R 184 320	R 439 200	R 54 000	R 2 592	**R 680 112**
2795	T35D	Traditional	106,9	Moderate	1	20%	20%	0%	100%	R 100 000	R 547 328	R 1304 180	R -	R 7 697	**R 1 959 205**
1663	T35E	Traditional	34	High	0	20%	20%	5%	100%	R -	R 174 080	R 414 800	R 25 500	R 2 448	**R 616 828**
1779	T35E	Traditional	12	High	0	10%	20%	10%	100%	R -	R 30 720	R 146 400	R 18 000	R 864	**R 195 984**
2004	T35E	Traditional	42	Moderate	1	20%	20%	5%	100%	R 100 000	R 215 040	R 512 400	R 31 500	R 3 024	**R 861 964**
2088	T35E	Traditional	261	Moderate	2	10%	10%	0%	100%	R 200 000	R 668 160	R 1592 100	R -	R 18 792	**R 2 479 052**
2744	T35E	Traditional	81	High	3	10%	20%	0%	100%	R 300 000	R 207 360	R 988 200	R -	R 5 832	**R 1 501 392**
									Total	**R 2 200 000**	**R 3 046 912**	**R 8 995 670**	**R 229 050**	**R 60 214**	**R 14 531 846**

6.1. Protecting seeps

Seep wetlands were identified by various communities as being significant water sources and that animal grazing threaten the water quality and geomorphic stability of the seeps. These seeps will be protected from trampling by fencing the spring off with easy pedestrian access. Controlled grazing will be allowed based on community decisions. The grazing within the fenced area will be managed by the users of the spring. Erosional features will be treated with soft rehabilitation options to slow storm flows down and re-establish a dense vegetation cover. Costs per spring are summarised in Table 14. Protecting 90 of seeps as indicated by the communities will cost approximately R3 mil.

TABLE 14: Estimated costs related to spring protection (average spring area of 0.4 ha or 40 x 100 m)

Activity		Total
Fencing (280m)	R3000/100m	R 8 400
Soft engineering rehabilitation (Sausages 150m)	R8000/100m	R 12 000
Re-sloping (20m) and reseeding (0.01ha)	1280/m for re-sloping and R15 000/ha for reseeding	R 12 950
Total per seep		R 33 350
Number of seeps Identified by communities?	90 number	R 3 001 500

7. IMPLEMENTATION AND MONITORING

The wetland interventions that need technical engineering type building requirements will be implemented by Joe Gqabi District Municipality under Working for Wetlands. Other softer options will be done by the respective implementing agents as assigned by DEA NRM, possibly under Working for Ecosystems or Working for Wetlands.

Routine monitoring will be done by citizen technicians on a monthly basis to relay and erosional or grazing issues to the catchment coordinator. These check-ups will include fixed point photography, notes on sedimentation and erosion, signs of grazing, trampling and any changes in biodiversity (cranes nesting, new frogs, new invertebrates, new plants etc.). Detailed monitoring will be done on an annual basis to assess wetland functionality, confirm changes in biodiversity and geomorphic and hydrological functionality. These detailed monitoring criteria are given in the Biophysical Monitoring plan (Schlegel *et al.,* 2018).

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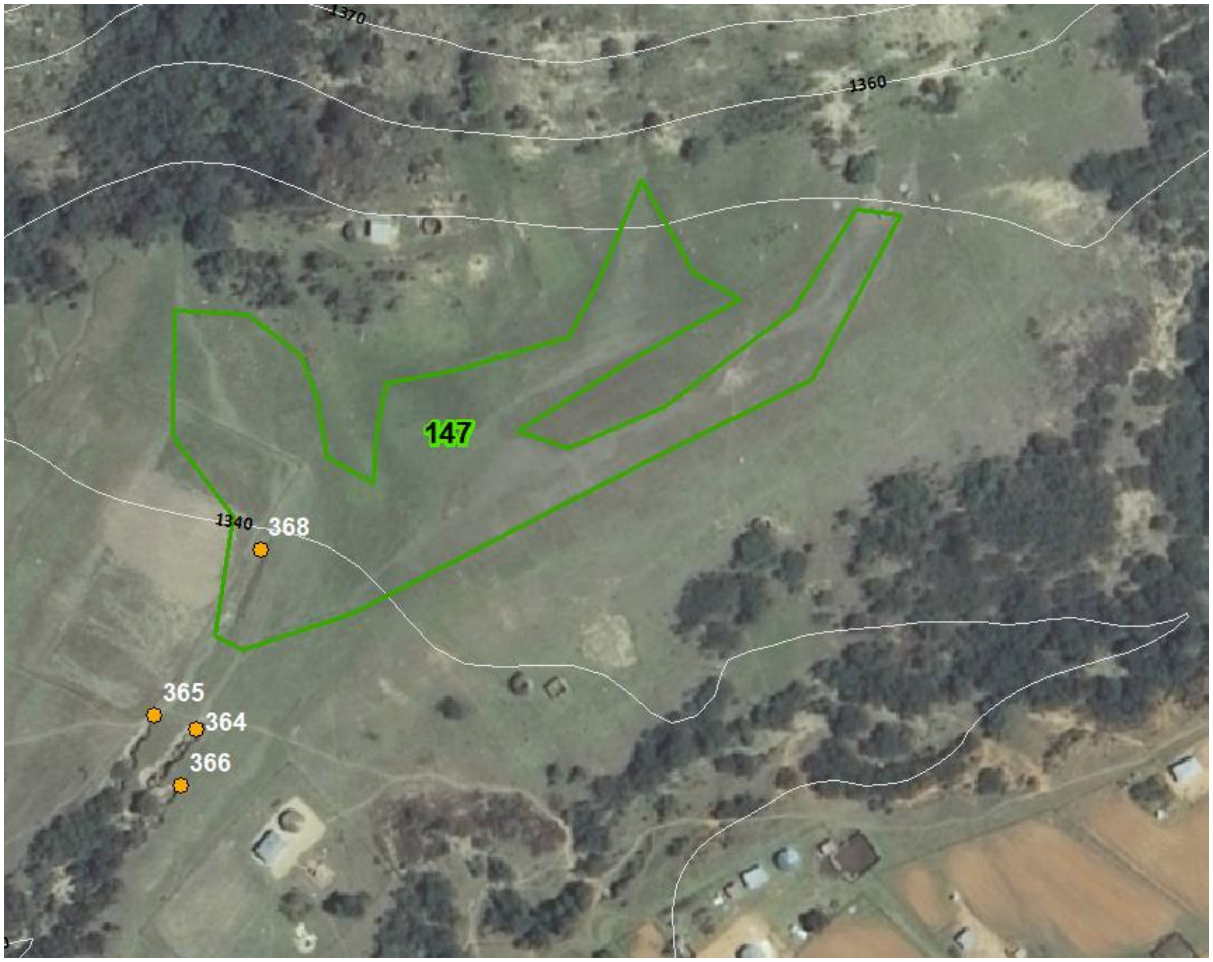
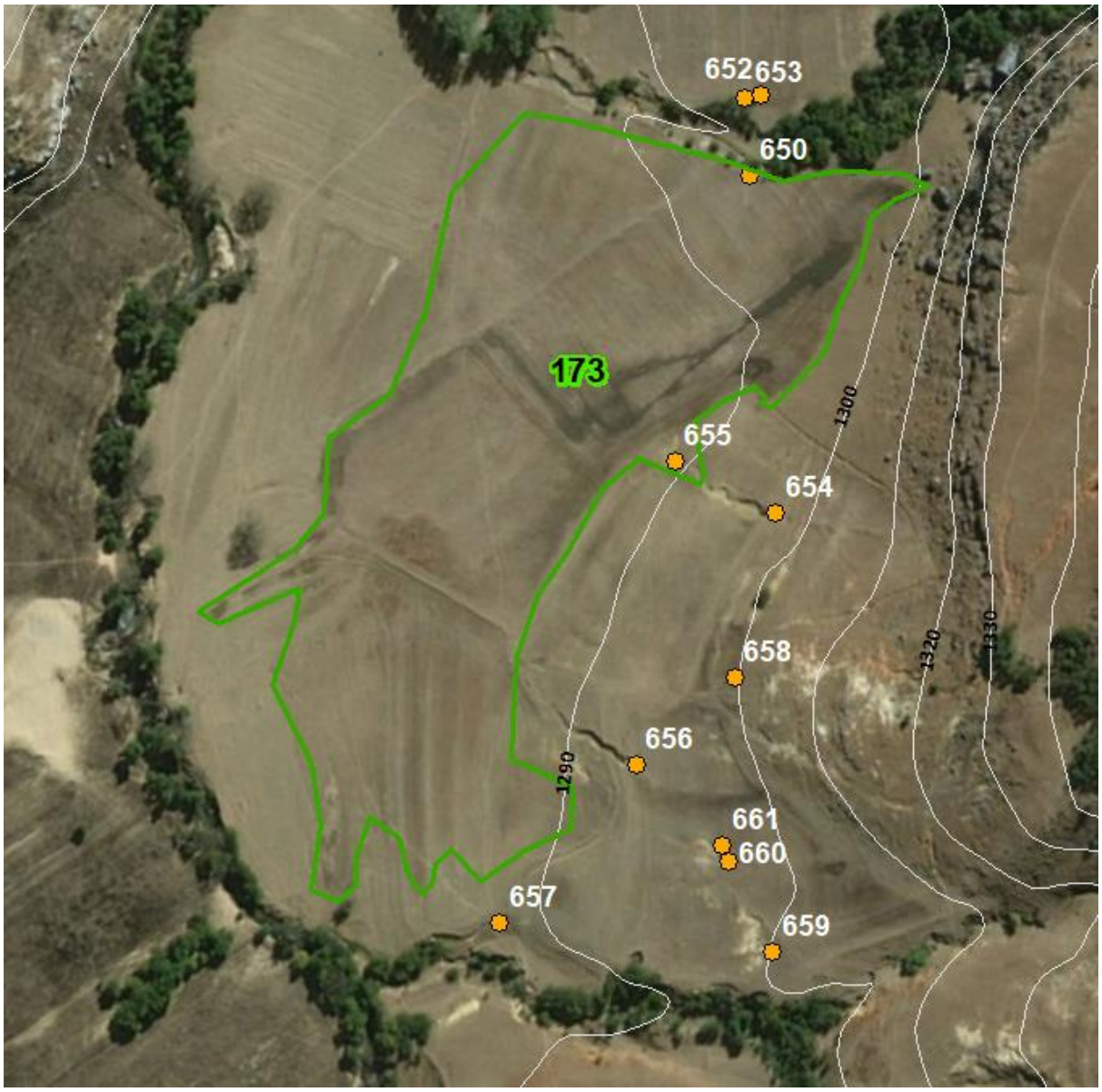
APPENDIX A

Wetland 147



Quaternary catchment	**T35A**
Coordinates	-30.844 S; 28.353 E
Wetland type	Un-channelled valley bottom
Wetland area	1 ha
Degradation	Moderate
Vulnerability	High
Priority	High
Land ownership	Traditional authority
Threat	3 head-cuts encroaching the toe of the wetlands Over-grazing Alien vegetation Hydrological connectivity
Restoration needed in wetland	Head-cut control- drop inlets needed at points 364-366 Grazing management Soft options along shallow gully walls and drainage lines
Restoration needed in wetland catchment	Grazing management Alien clearing Hydrological connectivity

Wetland 173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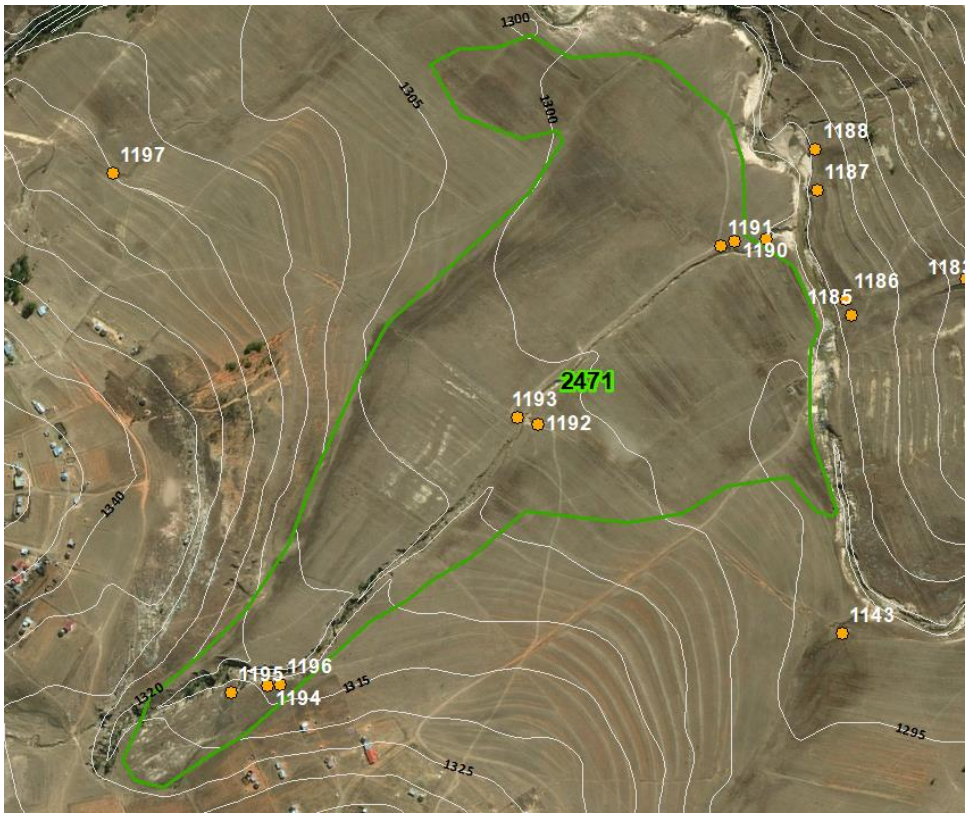
Quaternary catchment	**T35A**
Coordinates	-30.871 S; 28.356 E
Wetland type	Un-channelled valley bottom
Wetland area	6 ha
Degradation	Moderate
Vulnerability	High
Priority	High
Land ownership	Traditional
Threat	Headward gully erosion, agriculture, road run-off, livestock paths, agricultural drains Over-grazing Abandoned cultivated fields Increased hydrological connectivity in catchment
Restoration needed in wetland	Grazing management Livestock crossings through wetland Re-vegetate abandoned cultivated fields Soft structures and re-sloping along shallow erosional features
Restoration needed in wetland catchment	Grazing management Decreased hydrological connectivity related to livestock track runoff and bare fields Road run-off control structure Alien vegetation clearing Road run-off management

Wetland 2471



Quaternary catchment	**T35A**
Coordinates	-30.898 S; 28.409 E
Wetland type	Un-channelled valley bottom
Wetland area	5 ha
Degradation	Moderate
Vulnerability	Moderate
Priority	Moderate
Land ownership	Traditional
Threat	Headward gully erosion, agriculture, livestock paths Over-grazing Abandoned cultivated fields Increased hydrological connectivity in catchment
Restoration needed in wetland	Grazing management Livestock crossings through wetland Re-vegetate abandoned cultivated fields Soft structures and re-sloping along shallow erosional features
Restoration needed in wetland catchment	Grazing management Decreased hydrological connectivity related to livestock track runoff and bare fields Alien vegetation clearing Road run-off management

Wetland 242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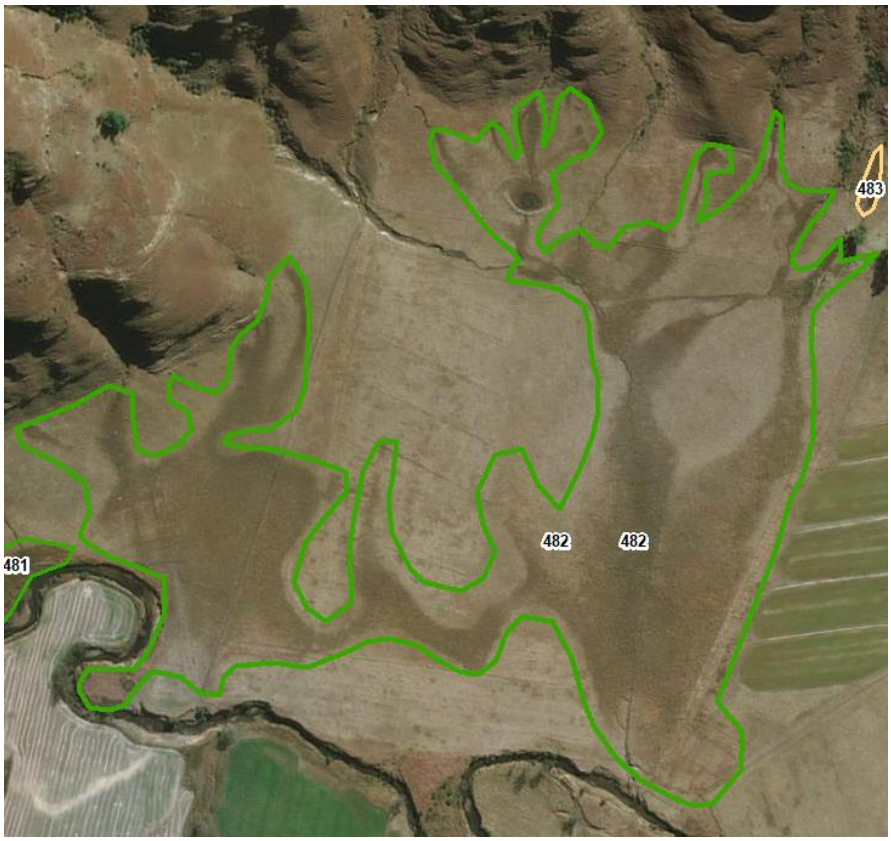
Quaternary catchment	**T35A**
Coordinates	-30.939 S; 28.409 E
Wetland type	Un-channelled valley bottom
Wetland area	12.9 ha
Degradation	Mod
Vulnerability	High
Priority	Mod
Land ownership	Traditional
Threat	Headcut erosion, agriculture, livestock paths Over-grazing Abandoned cultivated fields Increased hydrological connectivity in catchment
Restoration needed in wetland	Headcut control Point 924 Grazing management Livestock crossings through wetland Soft structures and re-sloping along shallow erosional features
Restoration needed in wetland catchment	Grazing management Decreased hydrological connectivity related to livestock track runoff Alien vegetation clearing

Wetland 482

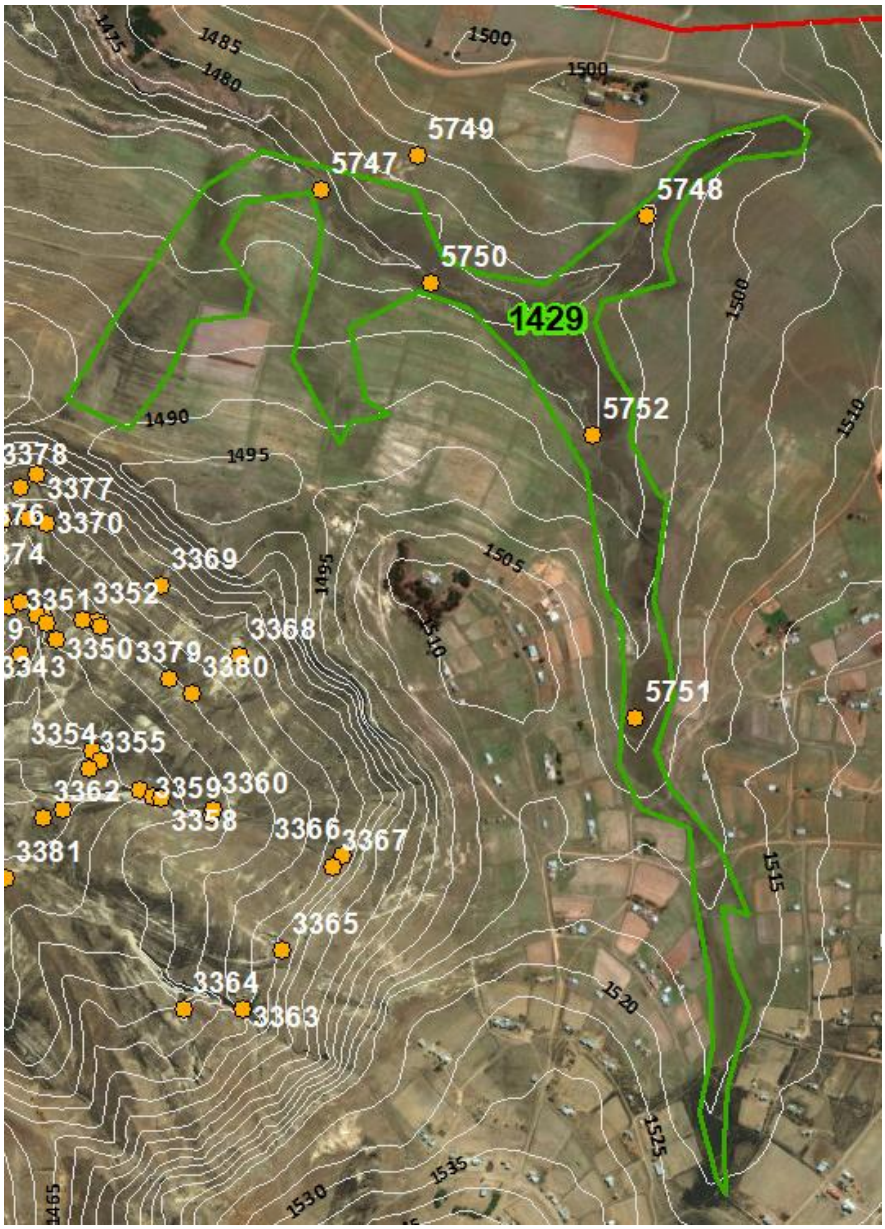


Quaternary catchment	**T35B**
Coordinates	-30.983 S; 28.237 E
Wetland type	Un-channelled valley bottom
Wetland area	17.4 ha
Degradation	Moderate
Vulnerability	Moderate
Priority	Moderate
Land ownership	Private
Threat	Drains, agriculture, livestock paths Over-grazing Abandoned cultivated fields Increased hydrological connectivity in catchment
Restoration needed in wetland	Grazing management Livestock crossings through wetland Soft structures and re-sloping along shallow erosional features
Restoration needed in wetland catchment	Grazing management Decreased hydrological connectivity related to livestock track runoff Alien vegetation clearing

Wetland 874

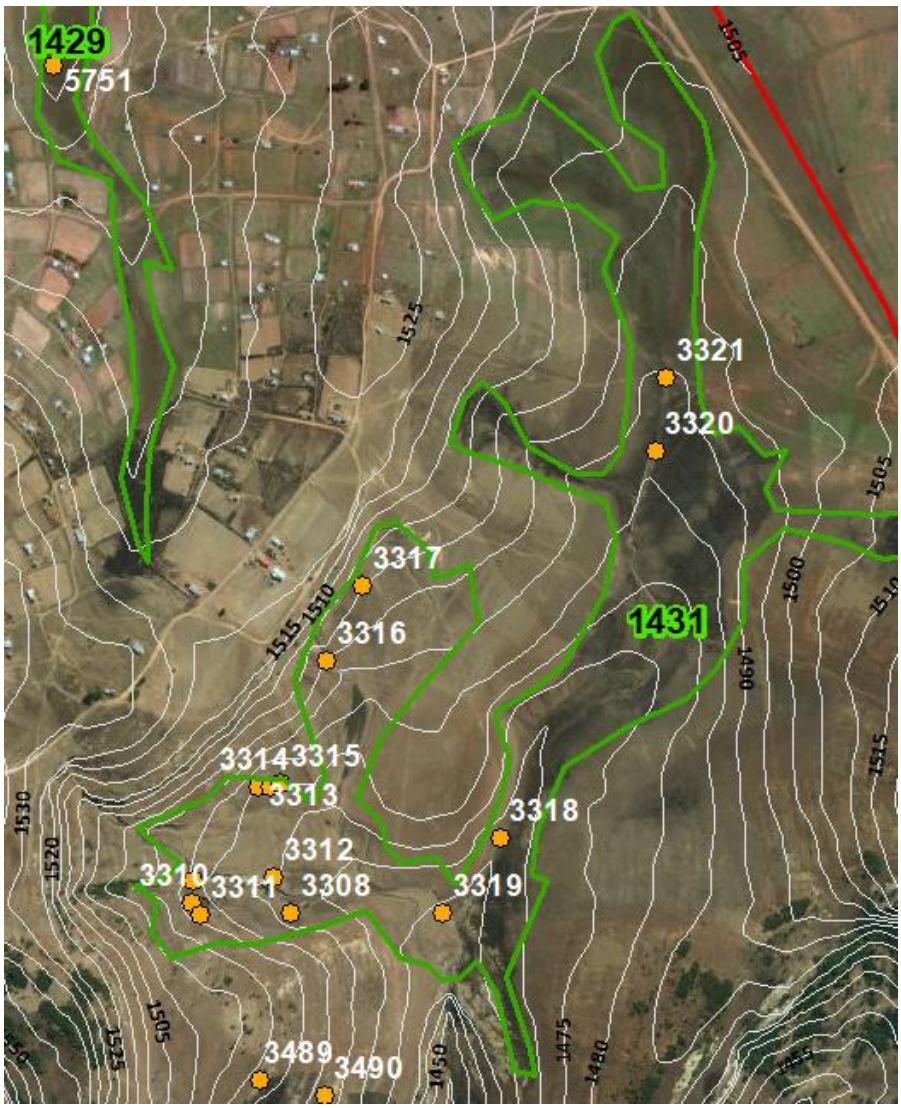
Quaternary catchment	**T35C**
Coordinates	-31.059 S; 28.241 E
Wetland type	Un-channelled valley bottom
Wetland area	5 ha
Degradation	Moderate
Vulnerability	High
Priority	High
Land ownership	Private
Threat	Headward gully erosion, Increased hydrological connectivity in catchment
Restoration needed in wetland	Headcut control structure at 5743 Soft structures and re-sloping along shallow erosional features
Restoration needed in wetland catchment	Decreased hydrological connectivity

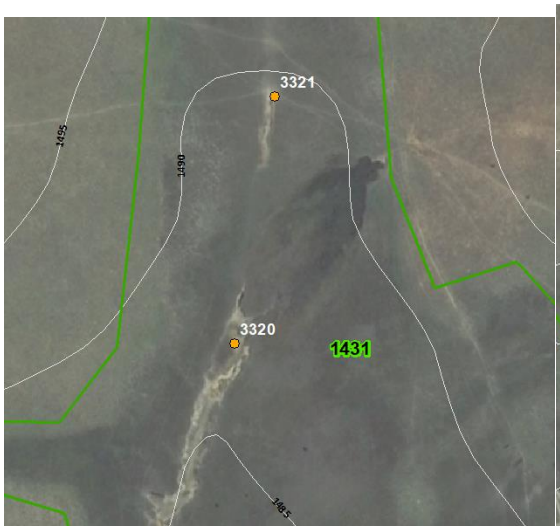
Wetland 1429

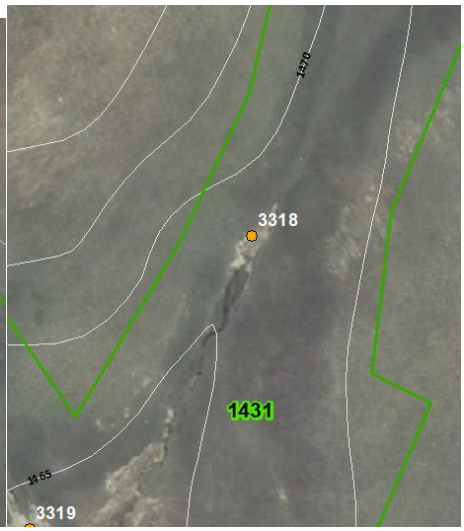


Quaternary catchment	**T35D**
Coordinates	-30.901 S; 28.538 E
Wetland type	Un-channelled valley bottom
Wetland area	27 ha
Degradation	Moderate
Vulnerability	Low
Priority	High
Land ownership	Traditional authority
Threat	Incised channel, road runoff Over-grazing Increased hydrological connectivity in catchment
Restoration needed in wetland	Baselevel control structure 40 m upstream of Point 5747 Grazing management Livestock crossings through wetland Soft structures and re-sloping along shallow erosional features
Restoration needed in wetland catchment	Grazing management Alien clearing Hydrological connectivity related to road and livestock runoff

Wetland 1431

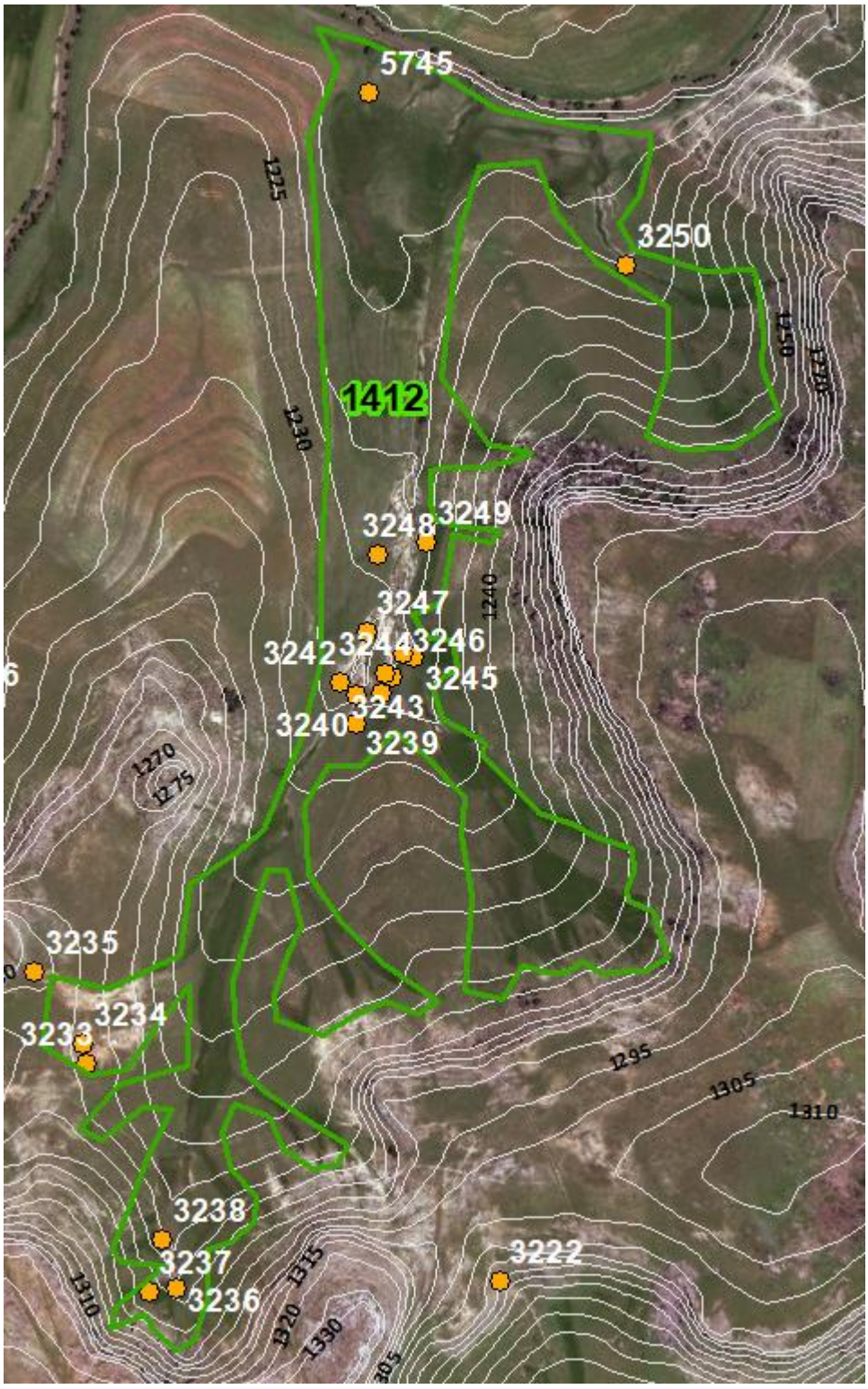






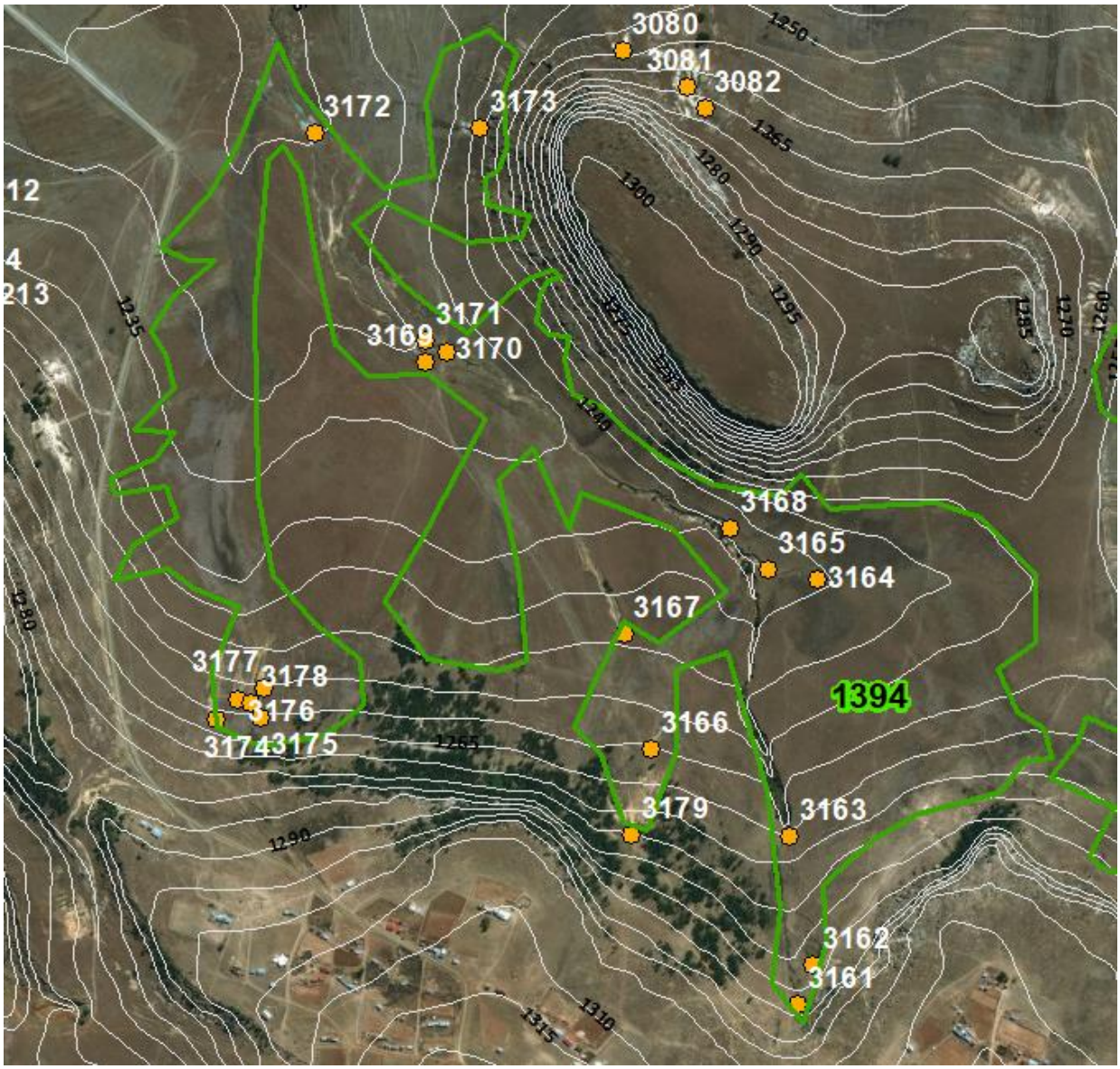
Quaternary catchment	**T35D**
Coordinates	-30.918 S; 28.549 E
Wetland type	Un-channelled valley bottom
Wetland area	44 ha
Degradation	Moderately
Vulnerability	Moderate
Priority	High
Land ownership	Traditional boundary-
Threat	Incised channel, road runoff Over-grazing Increased hydrological connectivity in catchment
Restoration needed in wetland	Baselevel control structure at Point 3321 and 3318. Revegetate abandoned fields Grazing management Livestock crossings through wetland Soft structures and re-sloping along shallow erosional features
Restoration needed in wetland catchment	Grazing management Decreased hydrological connectivity related to road and livestock track runoff AIP management

Wetland 1412



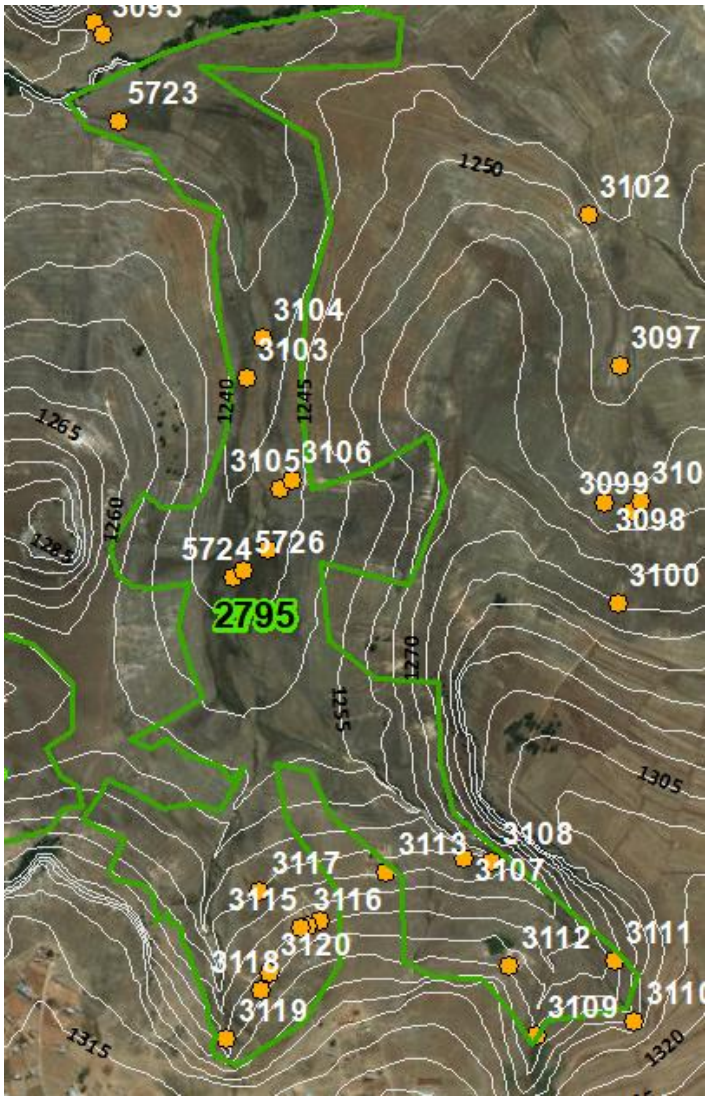
Quaternary catchment	**T35D**
Coordinates	-30.952 S; 28.473 E
Wetland type	Un-channelled valley bottom
Wetland area	50 ha
Degradation	Moderate
Vulnerability	High
Priority	Moderate
Land ownership	Private
Threat	Headward gully erosion, agriculture Over-grazing Increased hydrological connectivity in catchment
Restoration needed in wetland	Headcut control structure below Point 3239 and Point 5745 Grazing management Livestock crossings through wetland Soft structures and re-sloping along shallow erosional features
Restoration needed in wetland catchment	Grazing management Decreased hydrological connectivity related to livestock track runoff Alien vegetation clearing

Wetland 1394



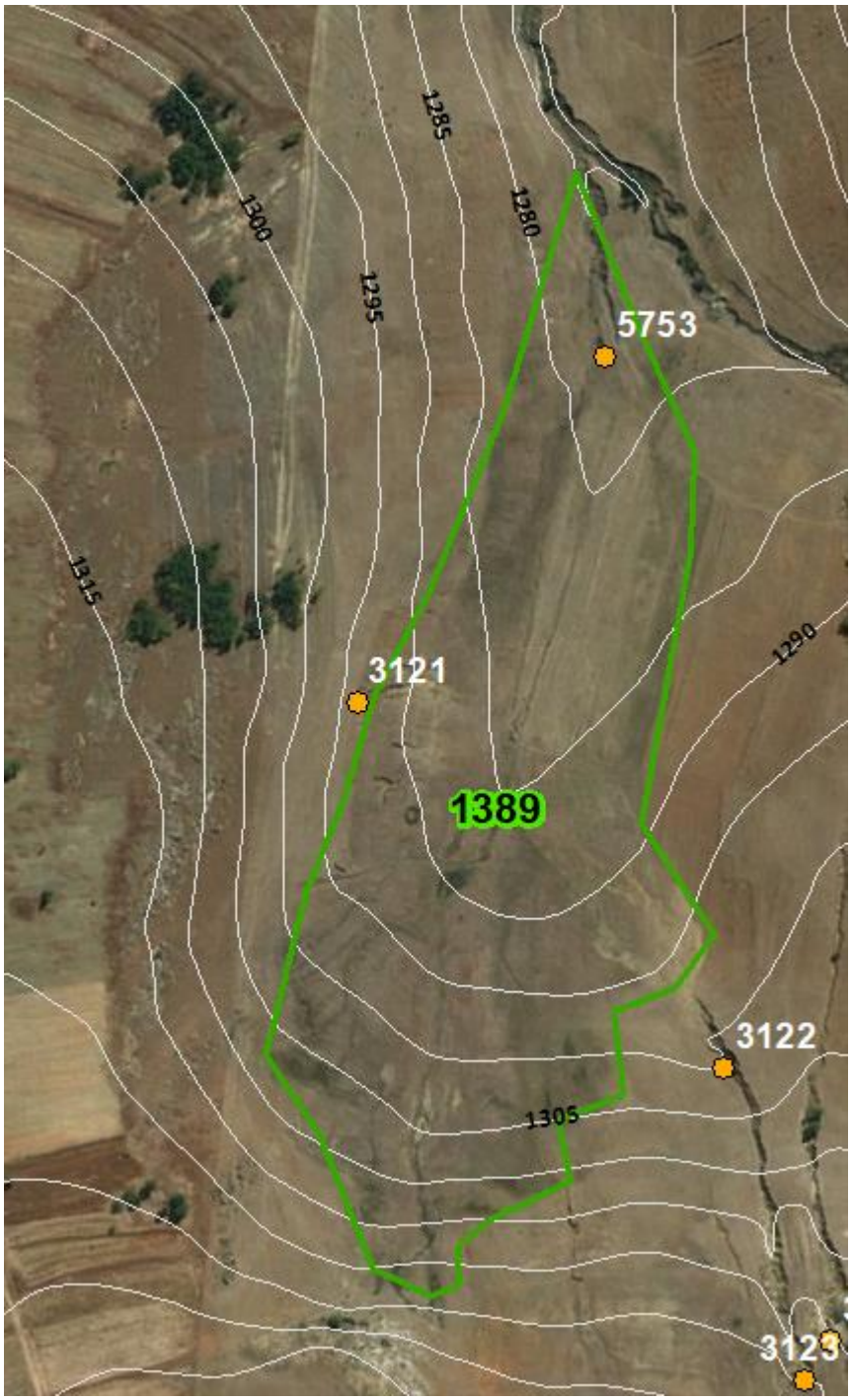
Quaternary catchment	**T35D**
Coordinates	-30.956 S; 28.517 E
Wetland type	Un-channelled valley bottom
Wetland area	61 ha
Degradation	Moderate
Vulnerability	High
Priority	Moderate
Land ownership	Traditional
Threat	Agricultural drains, headward gully erosion Over-grazing Alien Vegetation Increased hydrological connectivity in catchment
Restoration needed in wetland	Headcut control structure at Point 3172 and 3169 Grazing management Livestock crossings through wetland Soft structures and re-sloping along shallow erosional features
Restoration needed in wetland catchment	Grazing management Decreased hydrological connectivity related to road and livestock track runoff AIP management

Wetland 2795



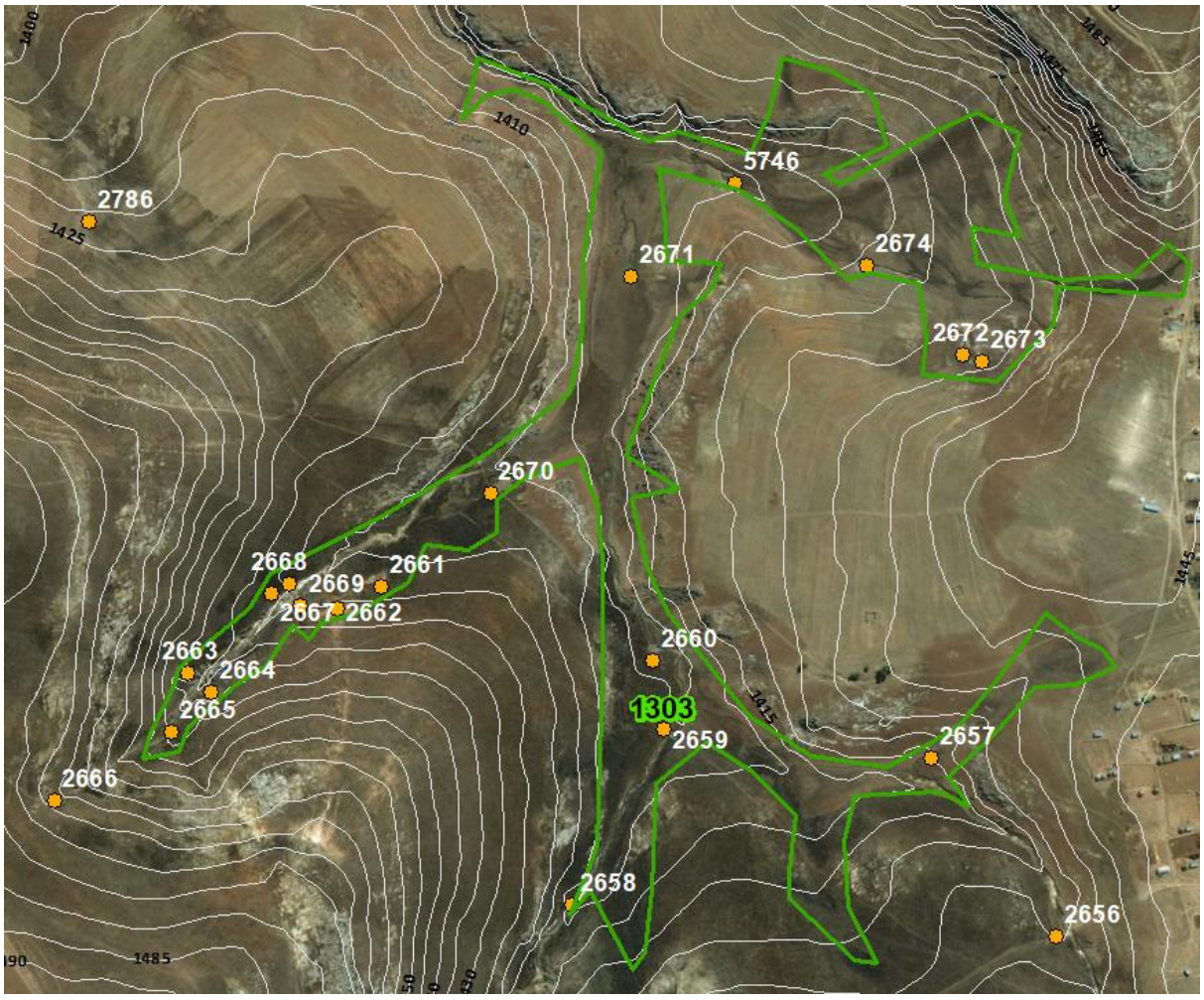
Quaternary catchment	**T35D**
Coordinates	-30.944 S; 28.526
Wetland type	Un-channelled valley bottom
Wetland area	106.9 ha
Degradation	Moderate
Vulnerability	High
Priority	Moderate
Land ownership	Traditional
Threat	Agricultural drains, headward gully erosion Over-grazing Increased hydrological connectivity in catchment
Restoration needed in wetland	Headcut control structure at Point 5723 and Grazing management Livestock crossings through wetland Soft structures and re-sloping along shallow erosional features
Restoration needed in wetland catchment	Grazing management Decreased hydrological connectivity related to road and livestock track runoff AIP management

Wetland 1389



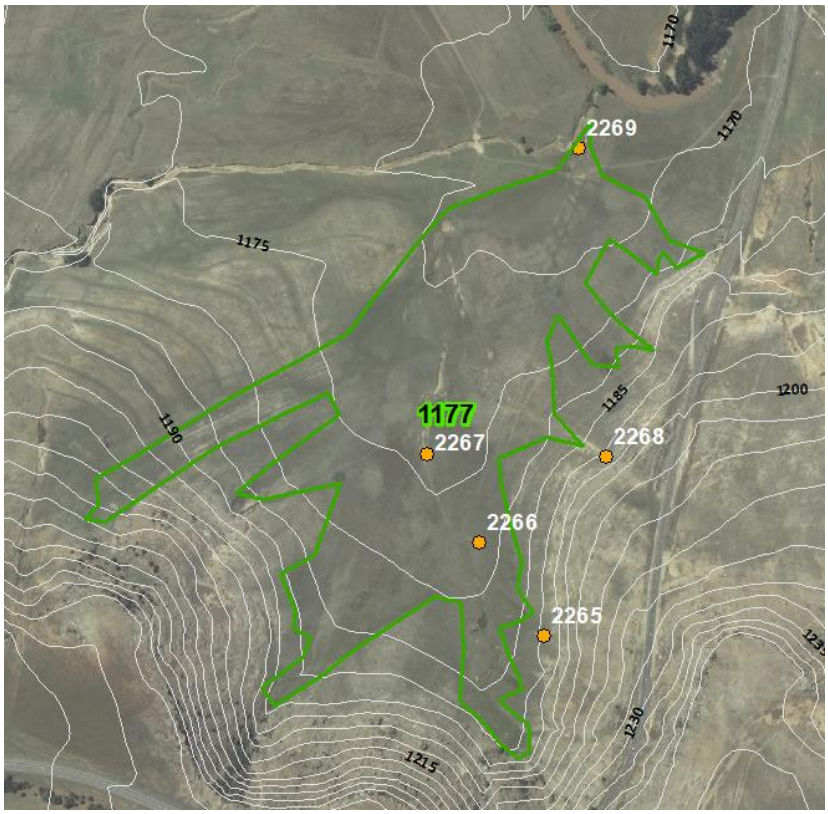
Quaternary catchment	**T35D**
Coordinates	-30.962 S; 28.539 E
Wetland type	Un-channelled valley bottom
Wetland area	7.5 ha
Degradation	Moderate
Vulnerability	High
Priority	High
Land ownership	Traditional authority
Threat	Agricultural drains, headward gully erosion Over-grazing Increased hydrological connectivity in catchment
Restoration needed in wetland	Headcut control structure at Point 5753. Revegetate abandoned fields Grazing management Livestock crossings through wetland Soft structures and re-sloping along shallow erosional features
Restoration needed in wetland catchment	Grazing management Decreased hydrological connectivity related to road and livestock track runoff AIP management

Wetland 1303



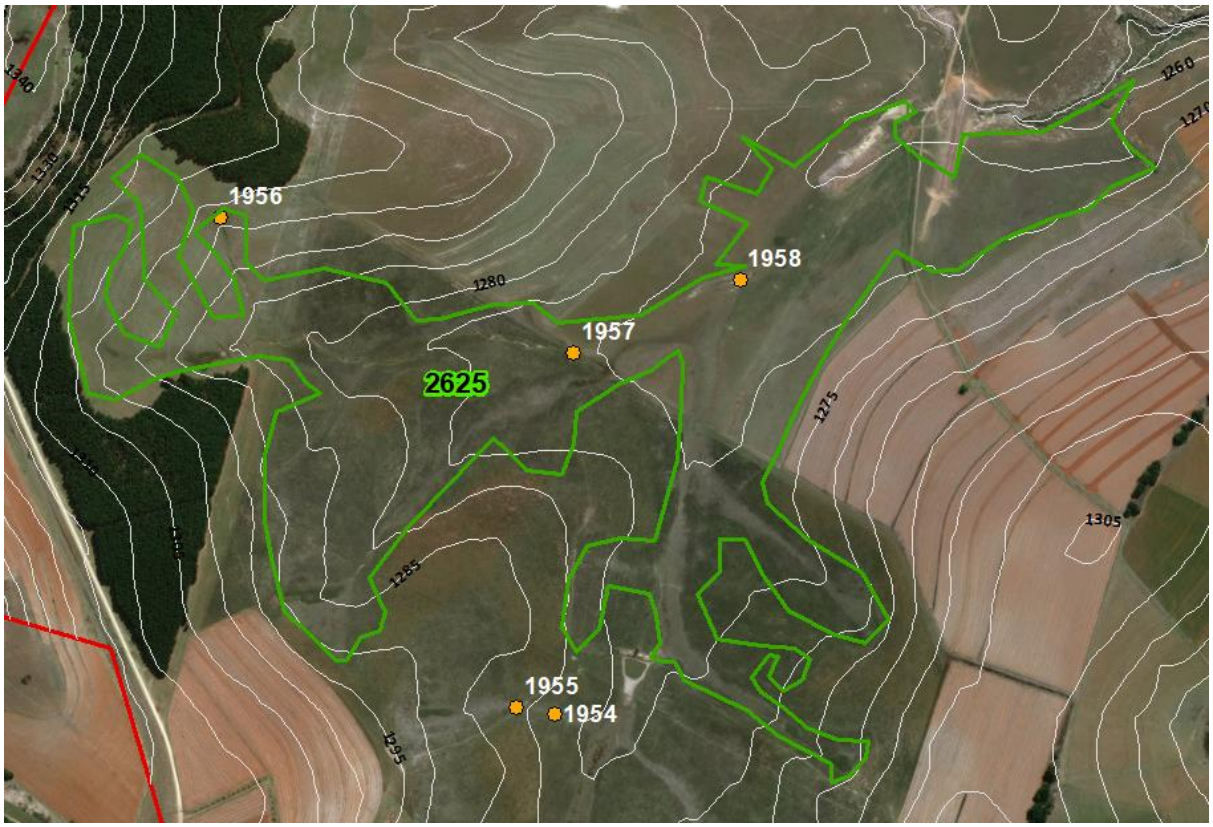
Quaternary catchment	**T35D**
Coordinates	-31.009 S; 28.542 E
Wetland type	Un-channelled valley bottom
Wetland area	35 ha
Degradation	Moderate
Vulnerability	High
Priority	High
Land ownership	Traditional
Threat	Headward gully erosion, agriculture, road run-off, livestock paths Over-grazing Abandoned cultivated fields Increased hydrological connectivity in catchment
Restoration needed in wetland	Headcut control structure Point 5746 Grazing management Livestock crossings through wetland Re-vegetate abandoned cultivated fields Soft structures and re-sloping along shallow erosional features
Restoration needed in wetland catchment	Grazing management Decreased hydrological connectivity related to livestock track runoff and bare fields Alien vegetation clearing Road run-off management

Wetland 1177



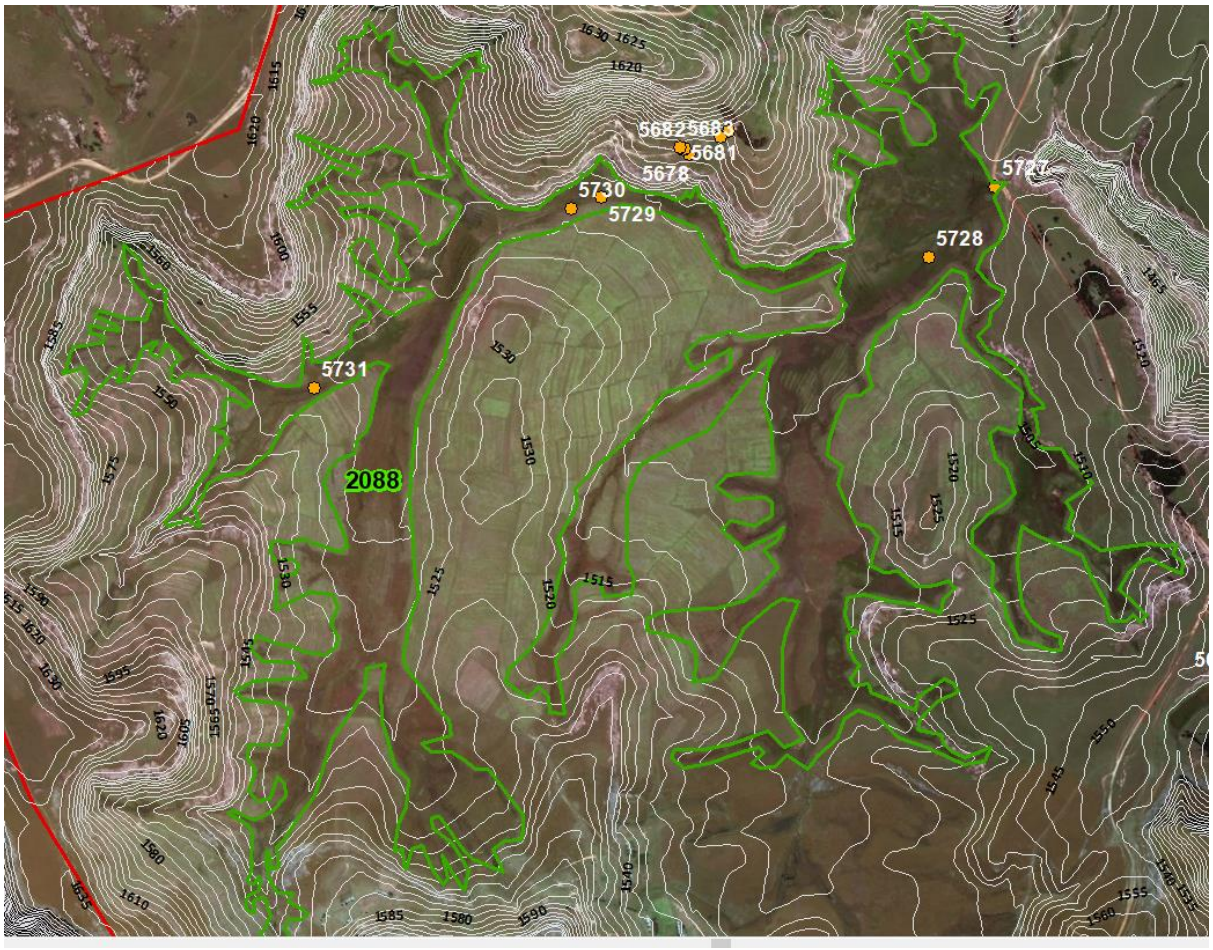
Quaternary catchment	**T35D**
Coordinates	-31.038 S; 28.411 E
Wetland type	Un-channelled valley bottom
Wetland area	19.1 ha
Degradation	Moderate
Vulnerability	High
Priority	High
Land ownership	Private land
Threat	Agricultural drains, headward gully erosion Over-grazing Increased hydrological connectivity in catchment
Restoration needed in wetland	Headcut control structure at Point 2269 Grazing management Livestock crossings through wetland Soft structures and re-sloping along shallow erosional features
Restoration needed in wetland catchment	Grazing management Decreased hydrological connectivity related to road and livestock track runoff AIP management

Wetland 2625



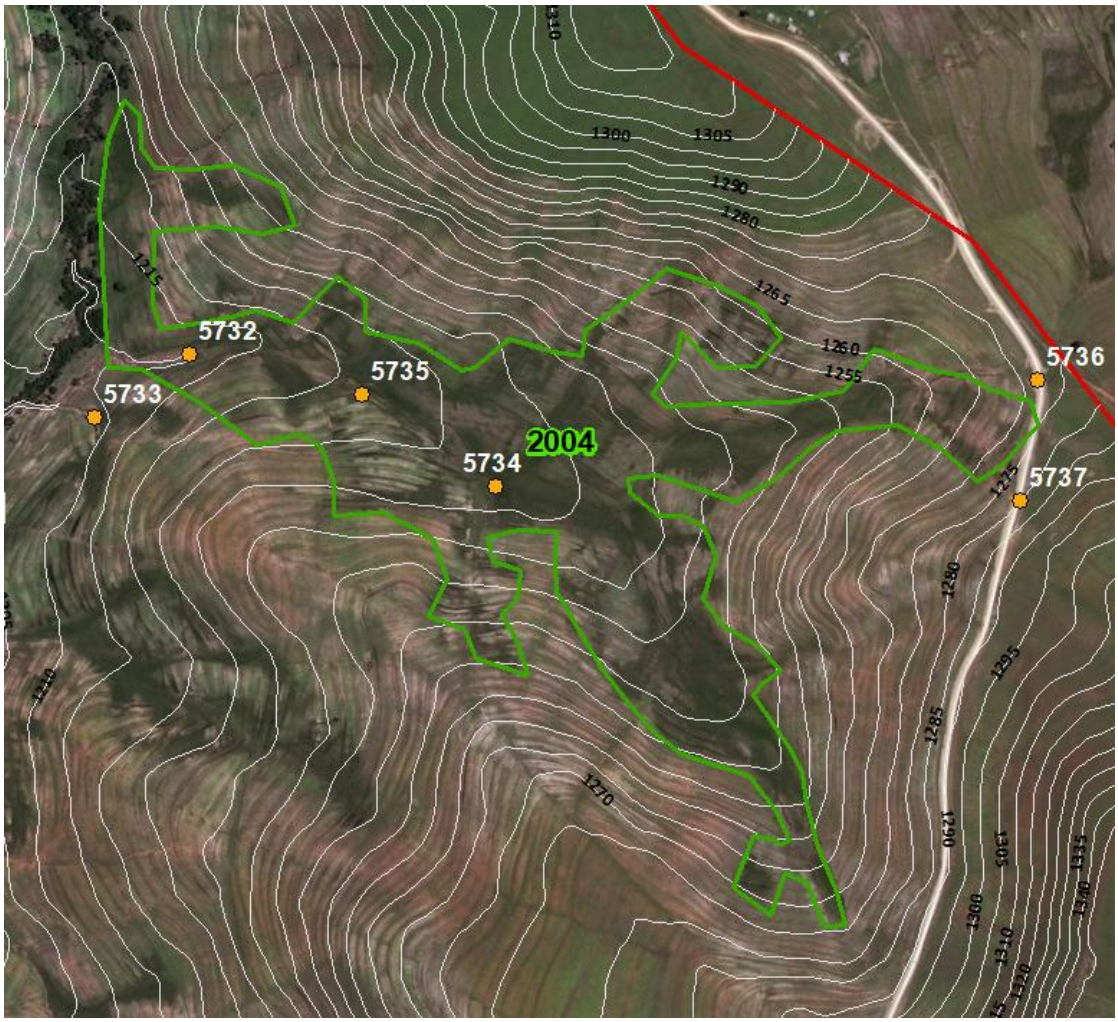
Quaternary catchment	**T35D**
Coordinates	-31.112 S; 28.363 E
Wetland type	Un-channelled valley bottom
Wetland area	72 ha
Degradation	Moderate
Vulnerability	Moderate
Priority	Moderate
Land ownership	Private
Threat	Headward gully erosion, road run-off, agriculture Over-grazing Increased hydrological connectivity in catchment
Restoration needed in wetland	Grazing management Livestock crossings through wetland Soft structures and re-sloping along shallow erosional features
Restoration needed in wetland catchment	Grazing management Decreased hydrological connectivity related to livestock track runoff Alien vegetation clearing

Wetland 2088



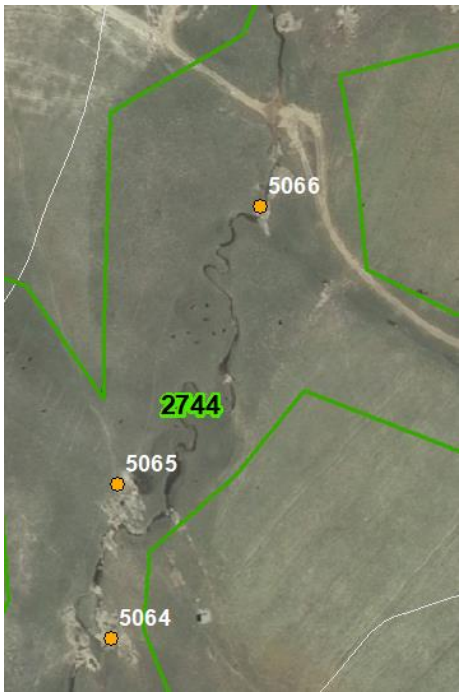
Quaternary catchment	**T35E**
Coordinates	-30.943 S; 28.611 E
Wetland type	Un-channelled valley bottom
Wetland area	261 ha
Degradation	Moderate
Vulnerability	Low
Priority	Moderate
Land ownership	Traditional
Threat	Agricultural drains, headward gully erosion, road run-off Over-grazing Alien Vegetation Increased hydrological connectivity in catchment
Restoration needed in wetland	Base level control structure at Point 5727 and 5729 Grazing management Livestock crossings through wetland Soft structures and re-sloping along shallow erosional features
Restoration needed in wetland catchment	Grazing management Decreased hydrological connectivity related to road and livestock track runoff AIP management

Wetland 2004



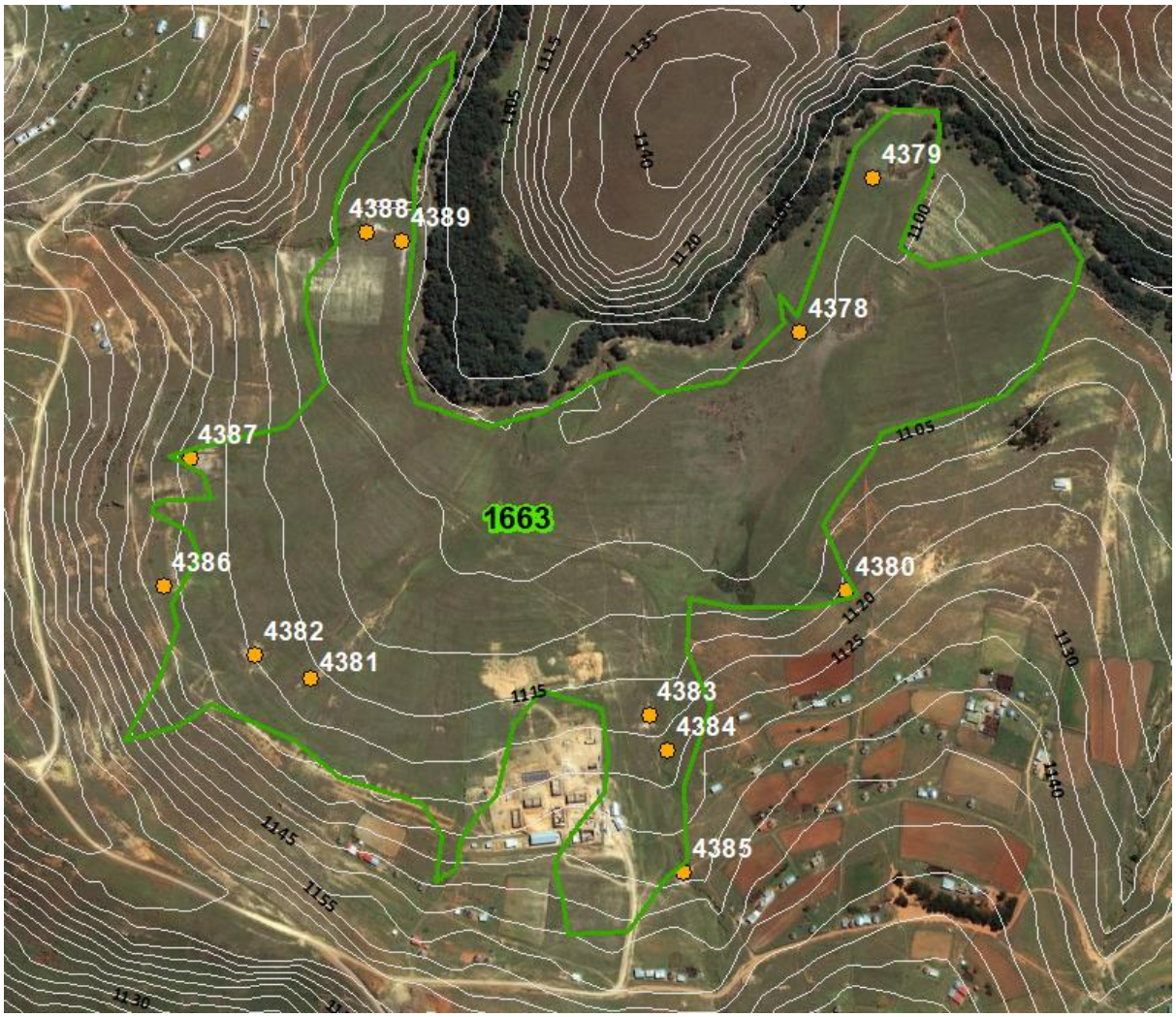
Quaternary catchment	**T35E**
Coordinates	-30.985 S; 28.695 E
Wetland type	Un-channelled valley bottom
Wetland area	42 ha
Degradation	Moderate
Vulnerability	Moderate
Priority	Moderate
Land ownership	Traditional
Threat	Headward gully erosion, agriculture, road run-off Over-grazing Increased hydrological connectivity in catchment
Restoration needed in wetland	Headcut control structure at Point 5732 Grazing management Livestock crossings through wetland Re-vegetate abandoned cultivated fields Soft structures and re-sloping along shallow erosional features
Restoration needed in wetland catchment	Grazing management Decreased hydrological connectivity related to livestock track runoff and bare fields Alien vegetation clearing Road run-off management

Wetland 2744



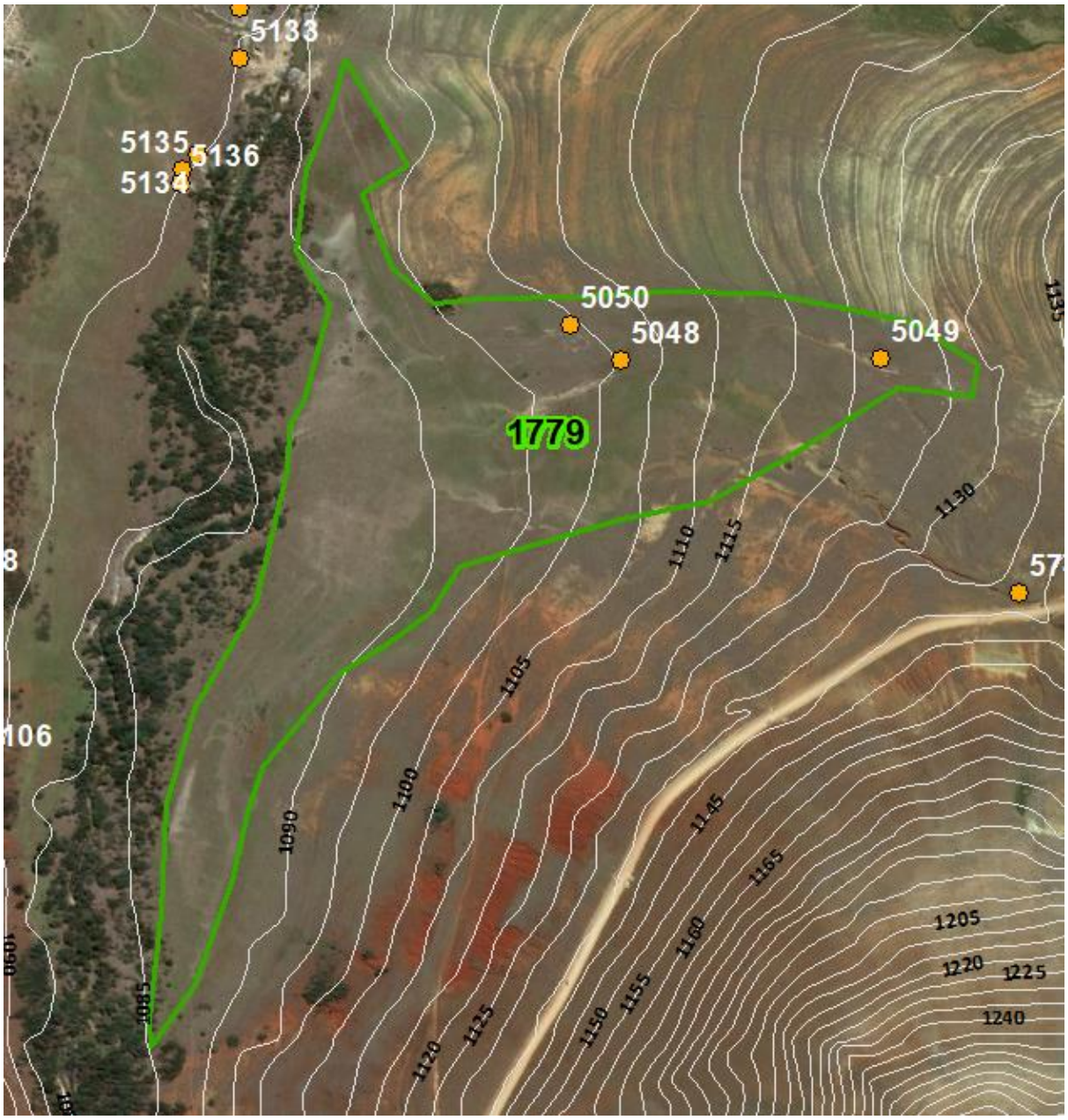
Quaternary catchment	**T35E**
Coordinates	-31.022 S; 28.556 E
Wetland type	Un-channelled valley bottom
Wetland area	81 ha
Degradation	Moderate
Vulnerability	High
Priority	Moderate
Land ownership	Traditional
Threat	Headward gully erosion, road run-off, agriculture Over-grazing Increased hydrological connectivity in catchment
Restoration needed in wetland	Base level control structure below Point 5066, possibly base level control structure upstream Point 5061 Headcut control structure Point 5067 Grazing management Livestock crossings through wetland Re-vegetate abandoned cultivated fields Soft structures and re-sloping along shallow erosional features
Restoration needed in wetland catchment	Grazing management Decreased hydrological connectivity related to livestock track runoff Re-vegetate abandoned cultivated fields

Wetland 1663



Quaternary catchment	**T35E**
Coordinates	-31.061 S; 28.615 E
Wetland type	Un-channelled valley bottom
Wetland area	34 ha
Degradation	Moderate
Vulnerability	Moderate
Priority	High
Land ownership	Traditional
Threat	Headward gully erosion, agriculture, road run-off, livestock paths Over-grazing Abandoned cultivated fields Increased hydrological connectivity in catchment
Restoration needed in wetland	Grazing management Livestock crossings through wetland Re-vegetate abandoned cultivated fields Soft structures and re-sloping along shallow erosional features
Restoration needed in wetland catchment	Grazing management Decreased hydrological connectivity related to livestock track runoff and bare fields Alien vegetation clearing Road run-off management

Wetland 1779



Quaternary catchment	**T35E**
Coordinates	-31.045 S; 28.658 E
Wetland type	Un-channelled valley bottom
Wetland area	12 ha
Degradation	Moderate
Vulnerability	High
Priority	High
Land ownership	Traditional
Threat	Headward gully erosion, agriculture, road run-off, livestock paths Over-grazing Abandoned cultivated fields Increased hydrological connectivity in catchment
Restoration needed in wetland	Grazing management Livestock crossings through wetland Re-vegetate abandoned cultivated fields Soft structures and re-sloping along shallow erosional features
Restoration needed in wetland catchment	Grazing management Decreased hydrological connectivity related to livestock track runoff and bare fields Road run-off control structure Alien vegetation clearing Road run-off management

APPENDIX B

GroundTruth wetland rehab design document. We can put this in as pdf in the final pdf doc – will need to have that doc and Appendix B as pdf to zip them all together.