MOKOLO & CROCODILE (WEST) WATER AUGMENTATION PROJECT (MCWAP): PHASE 1.

WETLANDS & WATERCOURSE CROSSINGS SURVEY

Prepared for:

Nemai Consulting
c/o Donavan Henning
PO Box 1673, Sunninghill, 2157.
Tel: +27 (0) 11 781 1730
donanvanh@nemai.co.za

Report author: **Mathew Ross (*Pr Sci Nat*); Tahla Ross.**

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Declaration

This report has been prepared according to the requirements of Section 33 (2) of the Environmental Impact Assessments Regulations, 2006 (GNR 385). We (the undersigned) declare the findings of this report free from influence or prejudice.

Report Authors:

Mathew Ross *Pr Sci Nat* (Ecological Sciences) 400061/09

(MSc (Aquatic Health) (RAU);
Currently completing PhD (Aquatic Health), University of Johannesburg).

Field of expertise:

Wetland delineations and ecology, aquatic and wetland fauna & flora, terrestrial biodiversity, fish ecology, fishway evaluations, aquatic biomonitoring and wetland habitat evaluations.

____________________ Date: __6 June 2010______

Mathew Ross

Tahla Ross

(MSc) (Zoology) (RAU);
Currently completing PhD (Zoology), University of Johannesburg).

Field of expertise:

Biomonitoring and wetland evaluations, aquatic ecology, aquatic & terrestrial fauna and flora, avifaunal specialist.

____________________ Date: __6 June 2010______

Tahla Ross

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1. INTRODUCTION & TERMS OF REFERENCE.

1.1. Background.

The current shortage in the supply of electricity in the country necessitates ESKOM to fast track the building of further power stations. As a result, ESKOM started construction of the new Medupi Power Station during 2007, in the Lephalale (Ellisras) area, which lies within the Mokolo catchment. This development will require expansion of the coal mining activities as well as other consequential secondary and tertiary developments. There is also a strong likelihood for the development of further power stations in the area as well as petro-chemical industries. These developments are driven by the presence of extensive coal reserves in this area and are expected to result in a sharp increase in water requirements. Therefore, DWAE (Department of Water Affairs and Environment) commissioned the Mokolo Crocodile (west) Water Augmentation Project (MCWAP) to establish how these demands can be met within the very challenging timeframes.

The infrastructure options considered to augment water supply to the Lephalale area include the following:

1. *Phase 1:* Augment the supply from Mokolo Dam; and
2. *Phase 2:* Transfer scheme from the Crocodile River (west) to the Lephalale area.

MCWAP requires authorisation in terms of the national Environmental Management Act, 1998 (Act 107 of 1998). Separate assessments will be undertaken, in accordance with the Environmental Impact Assessment (EIA) Regulations (Government Notice No. R385, R386 and R387), for phases 1 and 2 of the project. The motivation for separating the EIA's is to minimise risks and to prioritise Phase 1 of the project (Nemai Consulting, Terms of Reference document, Sept 2009).

1.2. Terms of Reference.

Nemai Consulting requested Enviross CC to undertake an ecological survey that encompassed the wetland and watercourse crossings for the PHASE 1 section of the proposed MCWAP (Mokolo and Crocodile River (west): Water Augmentation Project).

The proposed pipeline development originates at the Mokolo Dam and runs westwards and then northwards towards Lephalale (Figure 1). From there it runs westwards towards Steenbokpan. This report details the findings of the wetland and watercourse crossing impact survey for the *Phase 1: Augmentation of the supply from Mokolo Dam* section.

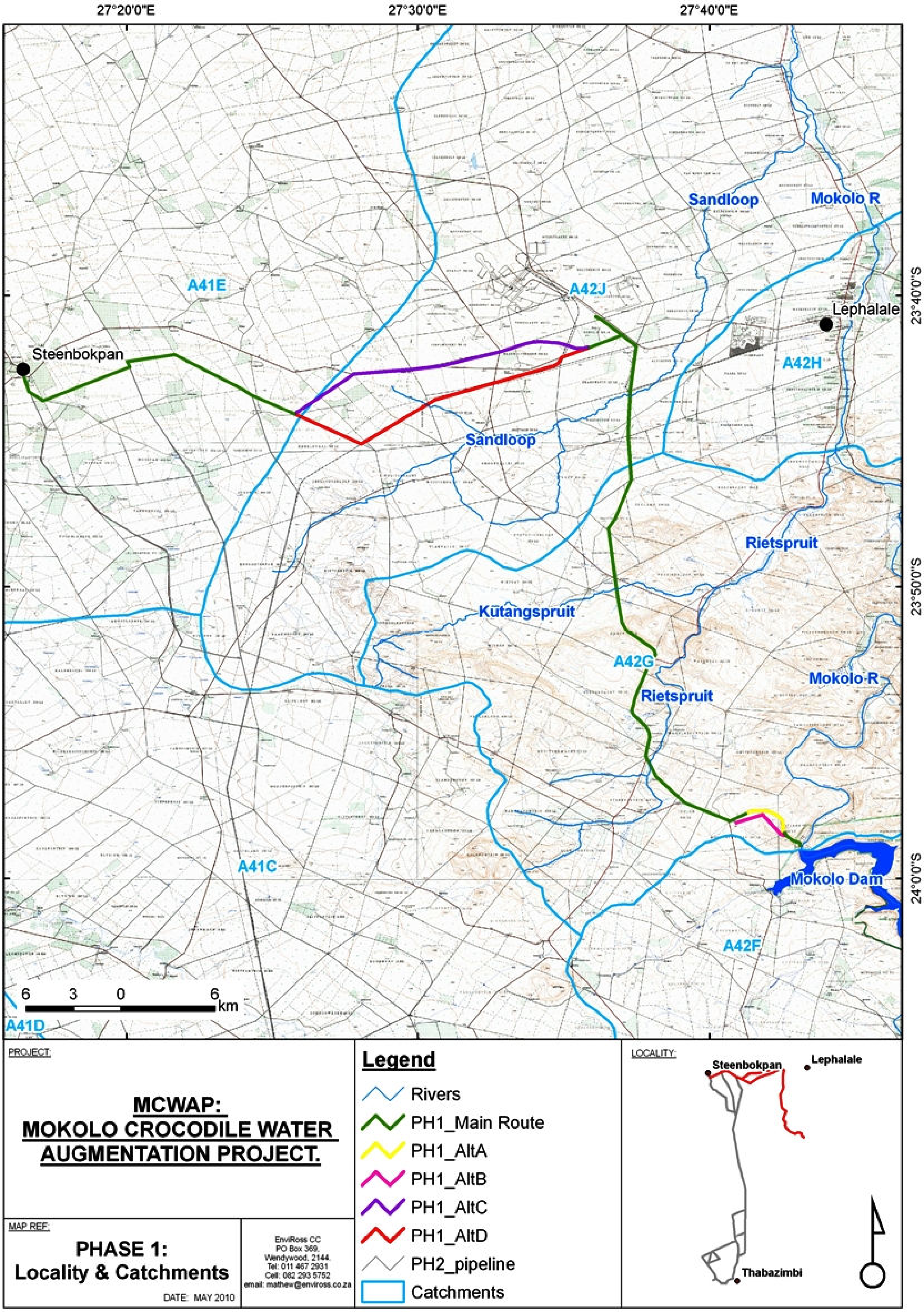

Figure 1: Locality of PHASE 1 of the proposed pipeline section, showing the catchment areas and major watercourses.

1.3. Catchment and project area descriptions.

The survey area is situated in Limpopo Province, within the north-western area of South Africa, between Mokolo Dam, Lephalale (Ellisras) and Steenbokpan. It falls within the Limpopo (A) Primary Catchment. The Water Management Areas (WMAs) for the Phase 1 section include A41E, A42G and A42J (Figure 1). The major watercourse crossings pertaining to the Phase 1 pipeline are the Sandloop, Rietspruit, Mokolo River and the Kutangspruit. According to SANBI-GIS (South African National Biodiversity Institute – Global Information Systems) database resources, all the rivers affected by the proposed pipeline development within these catchment areas are regarded as being in a "C" *Ecostatus* category. This translates to rivers with ecological integrity regarded as being "moderately modified".

Land use within the area is characterised by large farms, where mostly game farming is practiced. Cattle and sheep are also raised within the area. Large-scale agronomy is not a dominant feature within the area due to the topography, water supply and soils, which generally render the practice not economically viable.

2. SCOPE OF WORK.

As all wetlands are automatically designated as ecologically sensitive areas, they have to be delineated so as to enable appropriate conservation buffers to be allocated to each wetland associated with a proposed pipeline alignment route. This is regardless of their present ecological state (PES). Even though conservation buffer zones are standardised by DWAE, provincial authorities have refined the buffer requirements according to the wetland type and present ecological condition of the wetland. Therefore, some wetland buffers have been extended further than the 32m DWAE-endorsed buffer zones as a protection factor for wetlands that have retained a good PES. Wetland delineation procedures are done in accordance to DWAE guidelines for the delineation of wetlands and riparian zones (2005) by looking at terrain, soil form, soil wetness and vegetation unit indicators to delineate permanent, seasonal and temporary zones of the wetlands. An obligatory conservation buffer is then to be allocated from the outer edge of the *temporary zones* of the wetlands.

This entailed the scrutiny of the various watercourse crossing points for the presence of wetlands, the delineation of wetlands if they are identified and the general ecological state of the wetlands in order to identify any potential ecological impacts that the proposed pipeline route would have on the wetlands. If it was determined that the pipeline route traverses ecologically sensitive wetlands, then a possible alternative alignment was to be recommended. Where route alternatives were offered, a comparative analysis of the various routes was also to be undertaken.

All watercourse crossing points were also to be investigated to determine what the potential impacts of the proposed development activities would be on the overall ecological integrity of the watercourses and downstream habitats.

Mitigation measures were to be recommended on completion of the survey to negate the potential overall ecological impacts on the receiving environment.

3. METHODS OF INVESTIGATION.

3.1. Wetlands.

The wetland delineation assessment includes review of topographical maps and aerial photographs and an 'on-site' evaluation of the wetland condition and associated vegetation structure condition. This includes the general aquatic ecological integrity of the wetland itself as well as the identification of any sensitive biota that are potentially dependant on the wetland (if applicable).

The wetland delineation procedure takes into account (according to DWAE guidelines for wetland delineations, 2005) the following habitat attributes to determine the limitations of the wetland:

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

According to the wetland definition used in the National Water Act, vegetation is the primary indicator, which must be present under normal circumstances. However, in practise the soil wetness indicator tends to be the most important, and the other three indicators are used in a confirmatory role. The reason is that vegetation responds relatively quickly to changes in soil moisture regime or management and may be transformed; whereas the morphological indicators in the soil are far more permanent and will hold the signs of frequent saturation long after a wetland has been drained (perhaps several centuries) (DWAF, 2005).

3.1.1. Terrain Unit Indicator (TUI).

The TUI takes into consideration the topography of the area to determine the areas most likely to be able to support a wetland (DWAE, 2005). These include depressions and channels where water would be most likely to accumulate. This is done with the aid of topographical maps, aerial photographs and engineering and town planning diagrams (these are most often used as they offer the highest degree of detail needed to accurately delineate the various zones of the wetland).

3.1.2. Soil Form Indicator (SFI).

The SFI takes into account the identification of hydromorphic soils that display unique characteristics resulting from prolonged and repeated saturation. This ongoing saturation leads to the soil eventually becoming anaerobic and therefore a change in the chemical characteristics of the soil. Certain soil components, such as iron and manganese, which are insoluble under aerobic conditions, become soluble when the soil becomes anaerobic, and can thus be leached out of the soil profile. Iron is one of the most abundant elements in soils, and is responsible for the red and brown colours of many soils. Once most of the iron has been dissolved out of the soil as a result of the prolonged anaerobic conditions, the soil matrix is left a greying, greenish or bluish colour, and is said to be “gleyed”. A fluctuating water table, common in wetlands that are seasonally or temporarily saturated, results in alternation between aerobic and anaerobic conditions in the soil. Aerobic conditions in the soil leads to the iron returning to an insoluble state and being deposited in the form of patches or mottles within the soil. Recurrence of this cycle of wetting and drying over many decades concentrates these insoluble iron compounds. Thus, soil that is gleyed and has many mottles may be interpreted as indicating a zone that is seasonally of temporarily saturated (DWAF, 2005).

Soil samples are taken periodically in a line running perpendicular to the permanent water zone until the outer limits of this zone are identified. This normally coincides with a particular contour level, but transformations and modifications to the landscape often lead to the zone limits not conforming to this theory. Soil samples are taken using a Dutch-type soil auger to a depth of 500mm or by digging an inspection pit with a garden spade. The soil sample is then examined for indications of soils particular to the characteristics described above.

3.1.3. Soil Wetness Indicator (SWI).

In practise, this indicator is used as the primary indicator. The colour of various soil components are often the most diagnostic indicator of hydromorphic soils. Colours of these components are strongly influenced by the frequency and duration of soil saturation. Generally, the higher the duration and frequency of saturation in a soil profile, the more prominent grey colours become in the soil matrix. Coloured mottles, another feature of hydromorphic soils, are usually absent in permanently saturated soils, and are at their most prominent in seasonally saturated soils, becoming less abundant in temporarily saturated soils, until they disappear altogether in dry soils (DWAE, 2005). This indicator is also identified by taking a soil sample using a Dutch-type soil auger to a depth of 500mm. The soil sample is then examined for indications of soils displaying these characteristics.

3.1.4. Vegetation Indicator (VI).

Vegetation is a key component of the wetland definition in the National Water Act (Act No 36 of 1998). However, using vegetation as a primary indicator requires undisturbed conditions and expert knowledge (DWAE, 2005). As a result of this, greater emphasis is often placed on the SWI. Nonetheless, plant community structure analyses are still viewed as helpful guides to finding the boundaries of wetlands. Plant communities undergo distinct changes in species composition along the wetness gradient from the centre of the wetland to the edge, and into adjacent terrestrial areas. This change is species composition provides valuable clues for determining the wetland boundary, and wetness zones. When using vegetation indicators for delineation, emphasis is placed on the group of species that dominate the plant community, rather than on individual indicator species (DWAE, 2005).

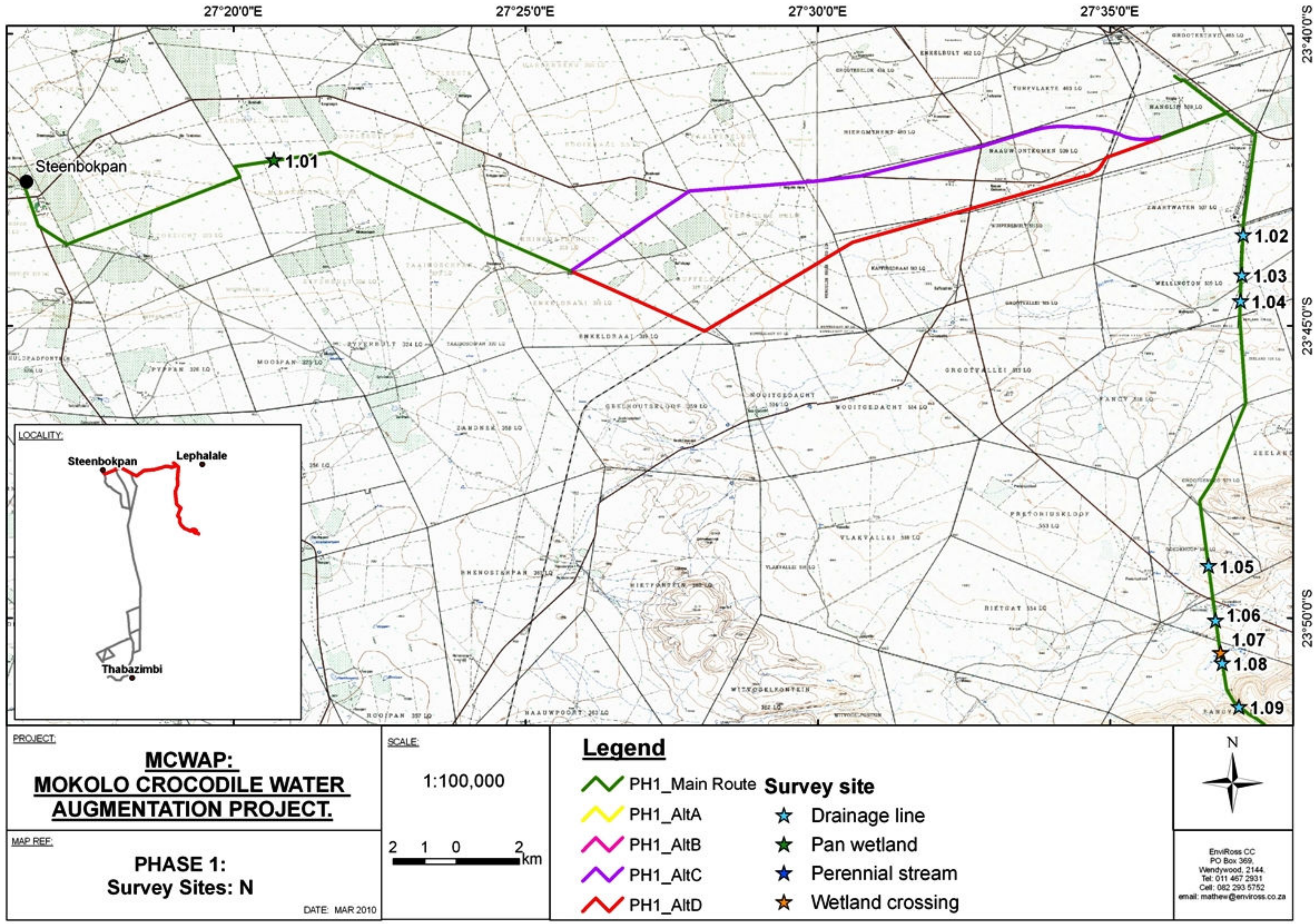

Figure 2: Watercourse crossing points that were surveyed for the northern section of the Phase 1 pipeline.

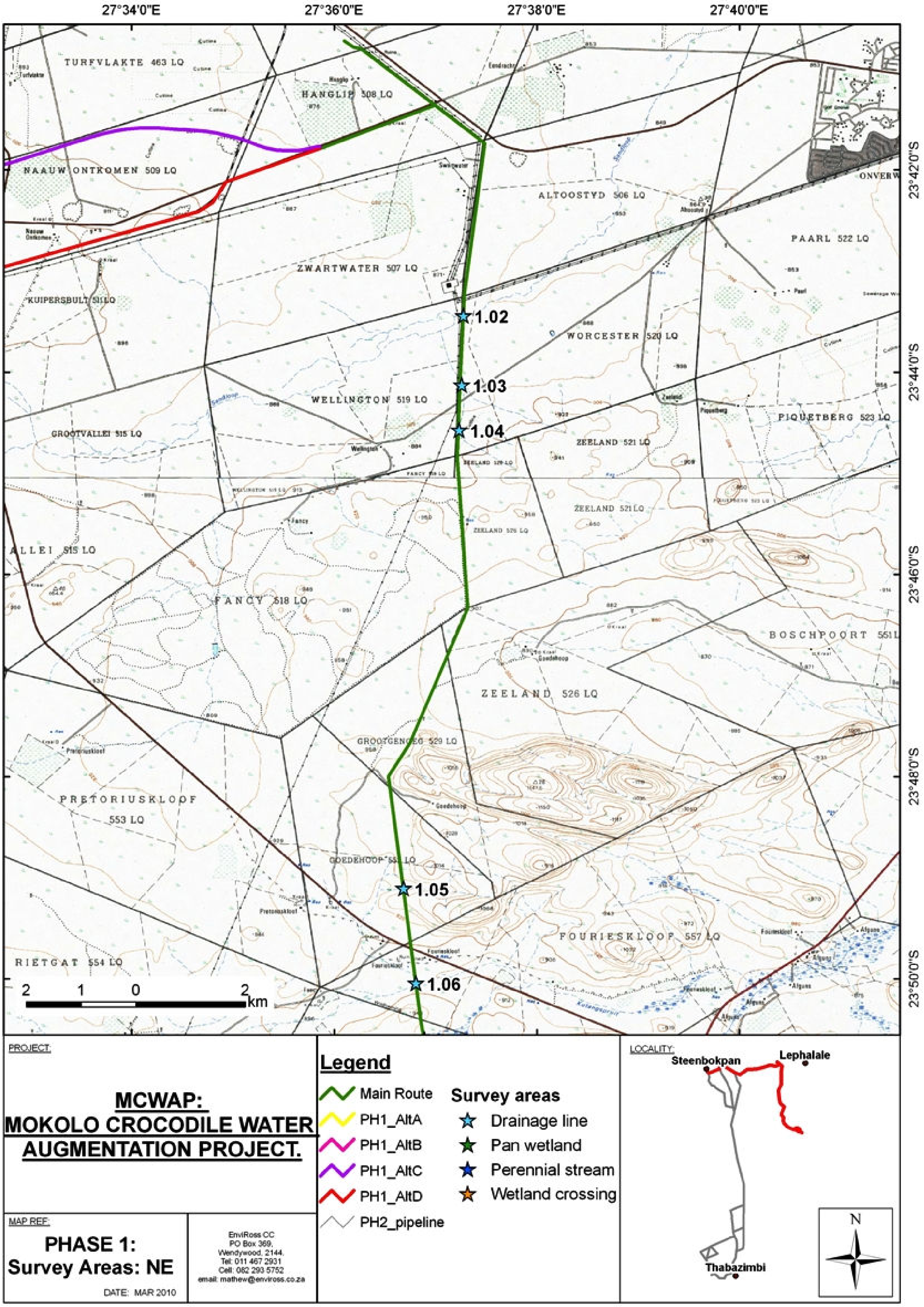

Figure 3: Watercourse crossing points that were surveyed for the north-eastern section of the Phase 1 pipeline.

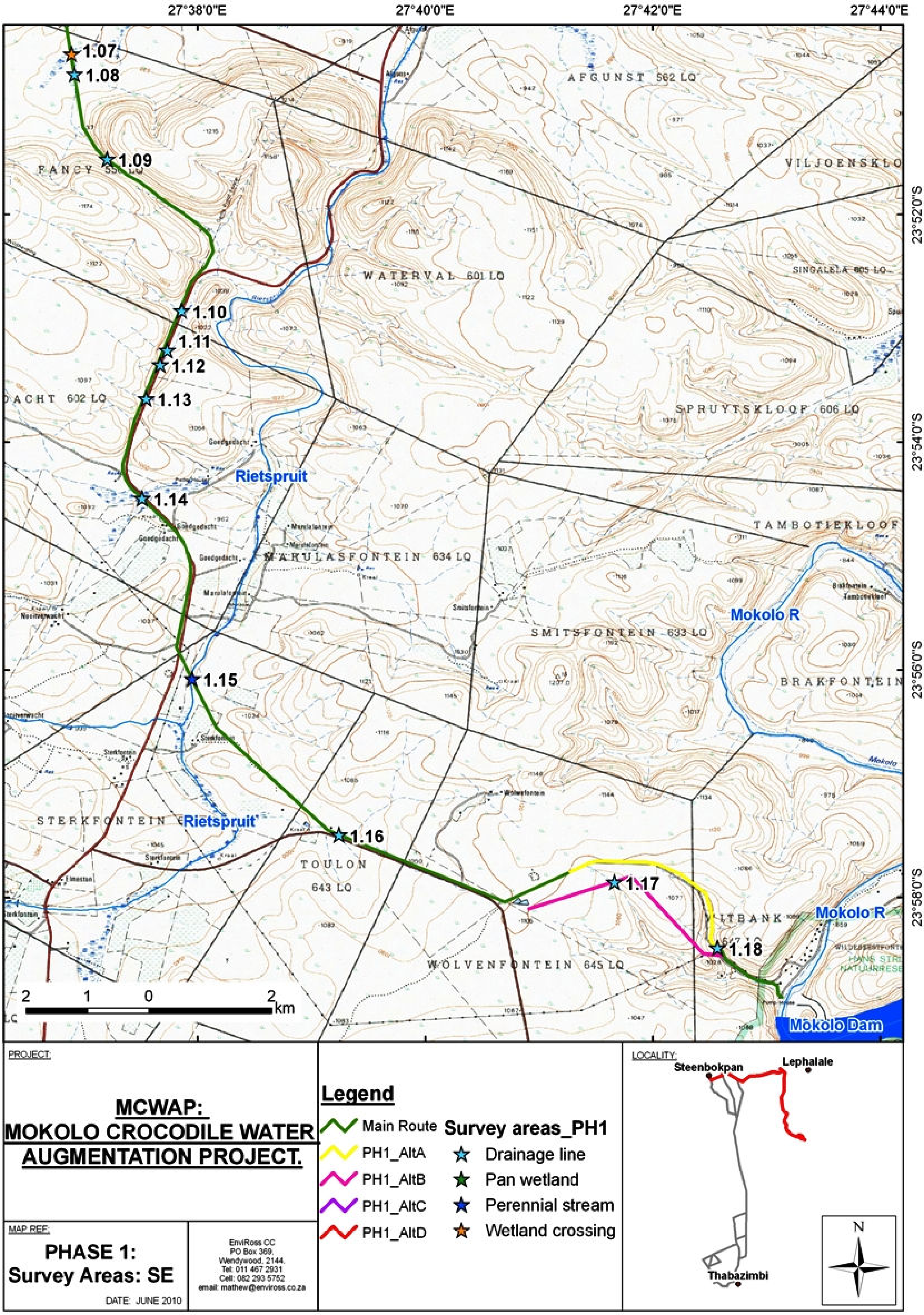

Figure 4: Watercourse crossing points that were surveyed for the southern section of the Phase 1 pipeline.

3.2. Watercourse Crossings.

All watercourse crossings for the Phase 1 pipeline that were indicated on the 1:50000 topographical maps were examined during the field assessment. Observations and site photographs were taken to evaluate the potential overall impacts of the proposed pipeline crossing at each point.

3.3. Standard Conservation Buffers.

As wetlands and aquatic habitats are regarded as inherently ecologically sensitive habitat units, the designation of conservation buffers allows for the protection of this habitat unit that could potentially emanate from terrestrial-based activities.

According to DWAE (2005), a conservation buffer of 32m is applicable to all wetlands taken from the outside of the temporary zones. Further general guidelines, however, state that a 50m buffer be designated to wetlands outside of the urban edge. Furthermore, the entire catchment area of pan wetlands should be designated as ecologically sensitive (GDARD, 2009). Guideline values are taken from the Gauteng provincial wetland buffer guidelines as these are, nationally, the most comprehensive.

For the wetlands and watercourses pertaining to the Phase 1 MCWAP pipeline development, it is recommended that the designated conservation buffers comply with the following general guidelines:

- Ecologically sensitive pan wetlands – 100m conservation buffer from the outside of the temporary zones of the wetland;
- Non-ecologically sensitive pan wetlands (wetlands that have suffered transforming impacts) – 50m conservation buffer from the outside of the temporary zones of the wetland;
- Linear wetlands (i.e. those associated with watercourses) – 50m conservation buffer from the outside of the temporary zones of the wetland;
- Rivers and streams (Perennial and non-perennial) – 50m conservation buffer from the outside of the temporary zones of the wetland;
- Drainage lines (that do not support aquatic or wetland habitat) – no conservation buffer necessary, but mitigation measures will be required to manage potential emergent impacts.

4. Broad Ecological Description of Proposed Pipeline Alignment Route and Immediate Surrounding Area.

The dominant veld type of the northern and central sections of the pipeline are dominated by *Limpopo Sweet Bushveld,* with a narrow band of *Waterberg Mountain Bushveld* occurring within the central areas. The southern area is dominated by *Central Sandy Bushveld*. This is part of the *Central Bushveld* bioregion that falls within the *Savanna* biome. The region has a relatively dry climate and the soils are predominantly deep and sandy. The persistence of surface water in the form of pan wetlands is therefore relatively rare. When pan wetlands do occur, they are dominated by open grasslands. Established riparian vegetation within the area forms part of *Sub Tropical Alluvial Vegetation*. All of these vegetation types are regarded as being *Least Threatened* due to the steep topographies and difficult terrains that makes largescale transformation of the vegetation units for agronomy impracticable. The flatter areas that incorporate the *Central Sandy Bushveld* vegetation unit occurring within the southern sections are more amenable to agronomy and therefore are regarded as *Vulnerable* due to the already-transformed areas that have been utilised for urban, agricultural and commercial areas (Mucina & Rutherford, 2006).

The areas immediately surrounding the proposed pipeline route remains largely open, with limited agricultural practices having transformed the floral community structures. Game-farming is popular within the area, which generally plays a role in conserving the vegetation. Cattle and sheep farming were also observed to be a popular land use, but have collectively had little impacts on the natural areas due to the limited extent of this farming practice. Vegetation units along the proposed pipeline route were observed to have retained relatively good ecological integrity. There is an existing water pipeline that runs for some of the alignment route of the new proposed pipeline and therefore localised transformation of the habitat occurred to clear the servitude to accommodate the existing pipeline.

The wetlands within the area originate close by within the hills and mountains, where lateral seepages are the main source of water to the streams. The area is relatively high up in the catchment and therefore the water is of good ecological quality. The soils have a high sand content, which means that they are highly dispersive (erodible). This should be borne in mind during the construction and reinstatement phases of the proposed development activities.

5. RESULTS & DISCUSSIONS.

The watercourse crossings for the proposed Phase 1 pipeline were categorised according to the habitat unit that they were associated with. These included:

- Drainage lines;
- Perennial streams;
- Pan wetlands; and
- Wetland crossings.

The crossing points (labels) coincide with those mapped, with the habitat unit and farm details being presented in Table 1. These categories will be dealt with separately for the sake of readability.

Table 1: Details of the watercourse crossing points for the proposed Phase 1 pipeline.

Label/Crossing points	Habitat description	Property detail
1.01	Pan wetland	Zandbult 300LQ
1.02	Drainage line	Boundary_Wellington 519LQ and Worcester 520LQ
1.03	Drainage line	Boundary_Wellington 519LQ and Worcester 520LQ
1.04	Drainage line	Boundary_Wellington 519LQ and Worcester 520LQ
1.05	Drainage line	Goedehoop 552LQ
1.06	Drainage line	Goedehoop 552LQ
1.07	Wetland crossing	Fancy 556LQ
1.08	Drainage line	Fancy 556LQ
1.09	Drainage line	Fancy 556LQ
1.10	Drainage line	Fancy 556LQ
1.11	Drainage line	Goedgedacht 602LQ
1.12	Drainage line	Goedgedacht 602LQ
1.13	Drainage line	Goedgedacht 602LQ
1.14	Drainage line/Wetland	Goedgedacht 602LQ
1.15	Perennial stream/Wetland	Sterkfontein 642LQ
1.16	Drainage line/Wetland	Toulon 643LQ
1.17	Drainage line	Wolvenfontein 645LQ
1.18	Drainage line/Seasonal stream	Witbank 647LQ

5.1. Drainage lines.

The majority of the water crossings pertaining to Phase 1 of the MCWAP pipeline comprised of drainage lines emanating from nearby hills and mountains (Table 1). The vast majority of these drainage lines were observed to be drainage channels that carried surface water runoff during rainfall events and did not represent any established aquatic or wetland systems. Where the proposed pipeline alignment follows alongside a roadway, the majority of these drainage channels occur as culvert drains that merely allow for free drainage within the road reserve and do not represent ecologically sensitive habitats (Figure 5).

Figure 5: Drainage channels where the proposed pipeline alignment occurs alongside a roadway, which incorporated culvert drains that allowed for free drainage of water within the road reserves.

Impacts emanating from the proposed pipeline crossings at these points will be limited to the potential creation and aggravation of existing soil erosion. Many of these drainage lines fall within areas of steep topography and therefore surface water runoff occurs at a relatively high velocity during rainfall events. Disturbances of the rock and soil layers, together with vegetation stripping will lead to the occurrence of soil erosion and aggravate existing soil erosion potential within the area. If left unabated, this will eventually lead to gulley formation that will require costly follow-up procedures to mitigate if allowed to occur. This was observed within certain areas along the existing pipeline (Figure 6) and illustrates the importance of managing for soil erosion both during and directly after the construction phase. Follow-up monitoring is then also important to identify any emerging problematic areas.

Figure 6: Soil erosion that is enhancing gulley formation at a drainage line that was observed along the existing pipeline (taken at point 1.05 – *Goedehoop 552LQ*). Areas such as these will require the implementation of follow-up mitigation measures to stabilise and manage the emerging problem. This can readily be avoided with correct site reinstatement following the construction phase.

5.2. Perennial & Non-perennial streams.

The only perennial streams associated with the Phase 1 pipeline are associated Rietspruit complex within the southern area of the proposed pipeline alignment. This complex of streams has a strong associated with wetlands and will therefore be dealt with under section *5.4. Wetland crossings*.

There was a mountain stream that was identified on the *Farm Witbank 647LQ* that flows for the majority of the year, only drying up for short periods during the dry season (Figure 7). This is therefore a semi-permanent system and cannot be regarded as a strictly perennial stream. The stream does, however, support an ecologically significant kloof habitat unit downstream that has been reported to incorporate plant species of conservational significance. The preservation of the ecological integrity and functionality of this steam is therefore imperative to conserving the habitat downstream of the proposed crossing site. The stream bed is predominantly bedrock and the disturbance of these bedrock layers will affect the hydrology and water quality of the system downstream. It is therefore recommended that this stream be crossed at a point where it has not developed into a kloof habitat and where the stream is the narrowest. The proposed crossing point coincides with an existing powerline servitude and is considered as the ideal crossing point (Figure 8). It is recommended that a bridge structure to support the crossing above the stream bed be implemented, which would not disturb the stream bed, rather than entrenching the pipeline through it. This should be done in a manner that will not impede the natural flow of water and take into consideration the potential force of floodwaters carried by the stream in order to retain structural integrity during flooding events. Further recommendations if this proposal is regarded as being non-feasible from a technical perspective are presented under section *7: General Conclusions & Recommendations*.

Figure 7: The mountain stream on the farm *Witbank 647LQ*.

Figure 8: The proposed pipeline alignment route that follows the existing powerline servitude.

5.3. Pan wetlands.

This habitat unit was representative of ephemeral wetlands with isolated catchment areas. These wetlands were delineated and associated conservation buffer zones designated to them if it was found that the proposed pipeline alignment would impinge on the ecological integrity of these pan wetlands.

There was only one pan wetland that was identified that could potentially be impacted by the proposed alignment of the Phase 1 pipeline. This was identified on the *Farm Zandbult 300LQ* (label 1.01) using the 1:50000 topographical maps of the area. Upon closer inspection, it was found that the boundaries of this wetland occur a distance from the proposed pipeline route and will therefore not be impacted if the present proposed pipeline route is followed.

5.4. Wetland crossings.

Watercourse crossing points that were surveyed as wetland crossings were points 1.07 (a tributary of the Kutangspruit), 1.14 (Rietspruit), 1.15 (Rietspruit) and 1.16 (a tributary of the Rietspruit). These points will be described individually. The position of these points in relation to the proposed pipeline alignment is shown in Figure 4.

5.4.1. Tributary of the Kutangspruit (1.07).

This occurred on the *Farm Fancy 556LQ* (Label 1.07). This wetland was part of an unchannelled valley-bottomed wetland that formed part of the feeder headwaters of the nearby Kutangspruit, which flowed into the Rietspruit located further to the northeast. This was a temporary wetland area that was fed through lateral seepage zones as well as surface water drainage during times of high rainfall and the water table has risen. The very sandy and deep soils meant that surface water rarely persisted throughout the season and therefore, in order to allow for permanent water for livestock, the landowner had excavated a depression within the wetland (Figure 9).

Figure 9: Excavation of the wetland crossing point (point 1.07) on the farm *Fancy 556LQ* that was excavated to enhance the persistence of surface water.

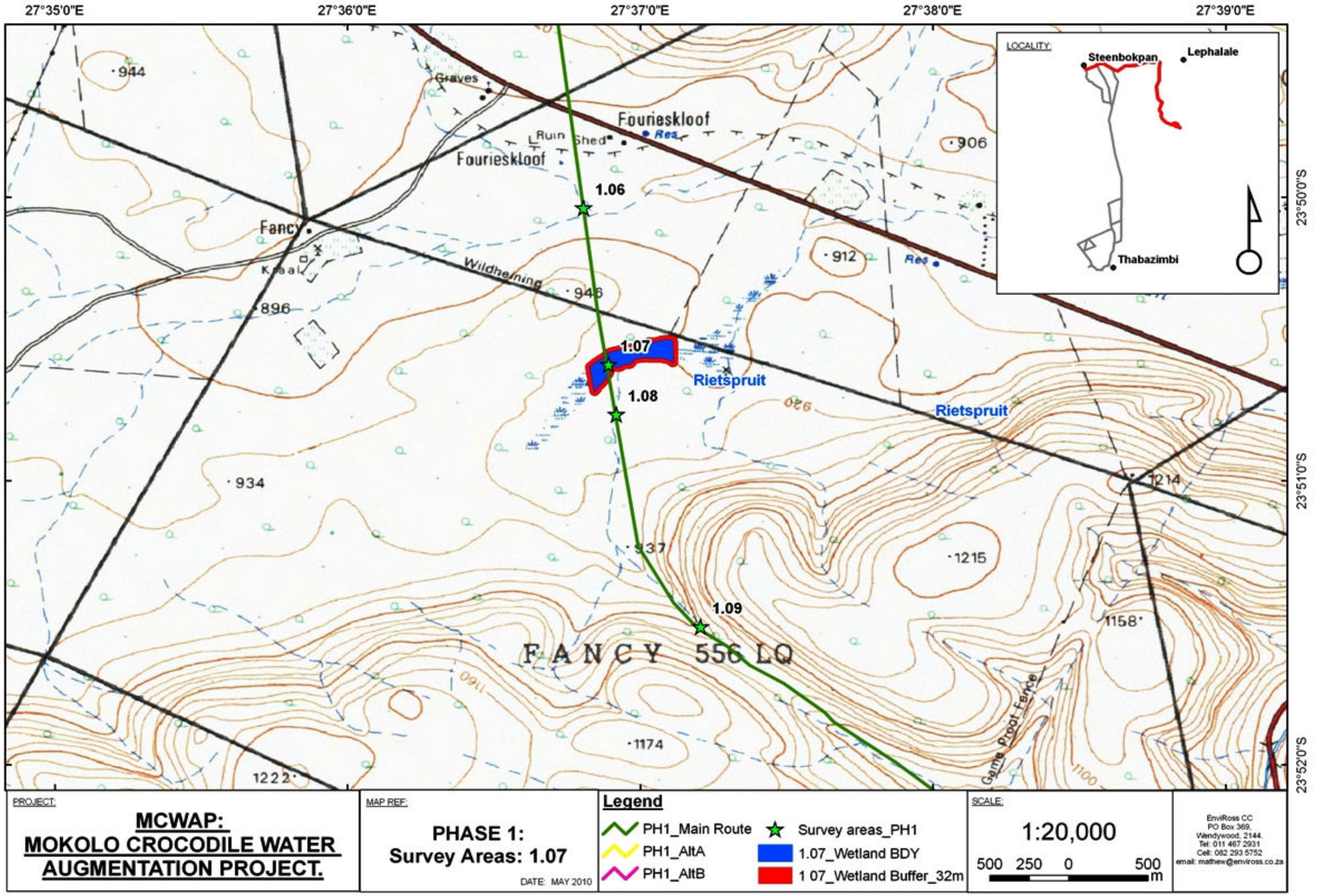

Figure 10: The extent of the wetlands, the associated buffer zone and the interaction with the proposed pipeline alignment route on the farm *Fancy 556LQ* (point 1.07).

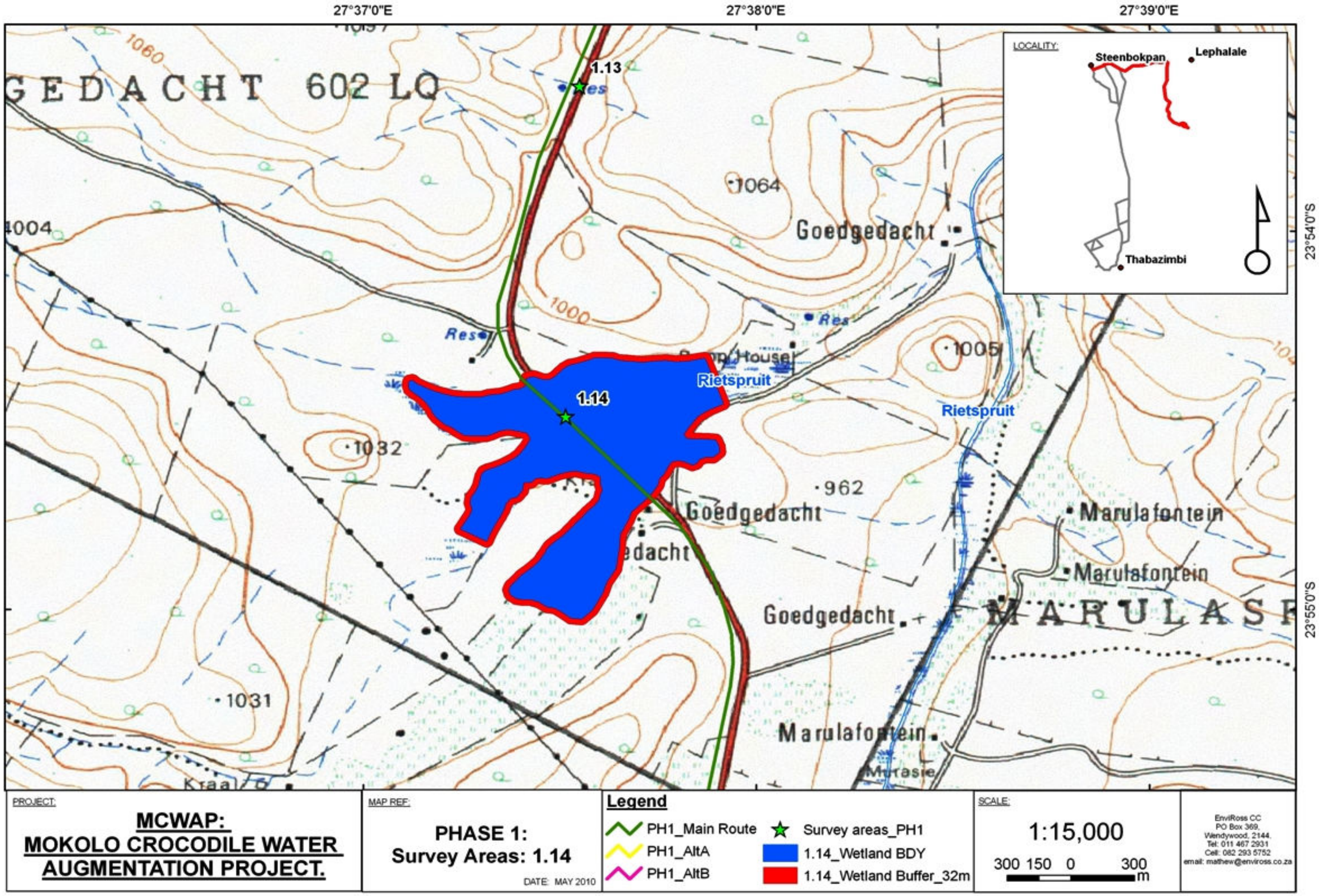

Figure 11: Wetland areas and conservation buffer zones applicable to Survey site 1.14.

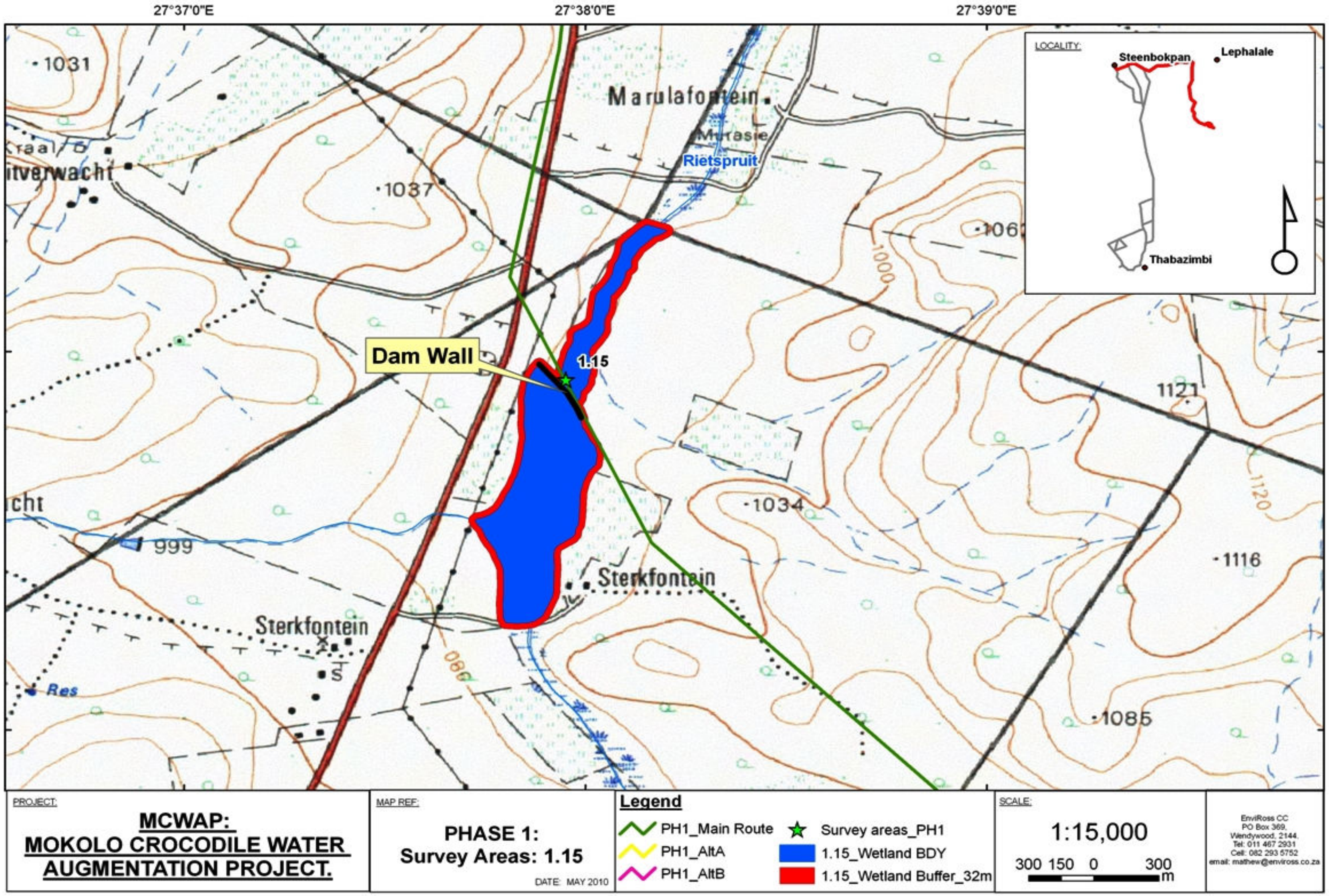

Figure 12: Wetland zones and buffers pertaining to Survey site 1.15, showing the approximate extent of a dam that had been constructed within the near past.

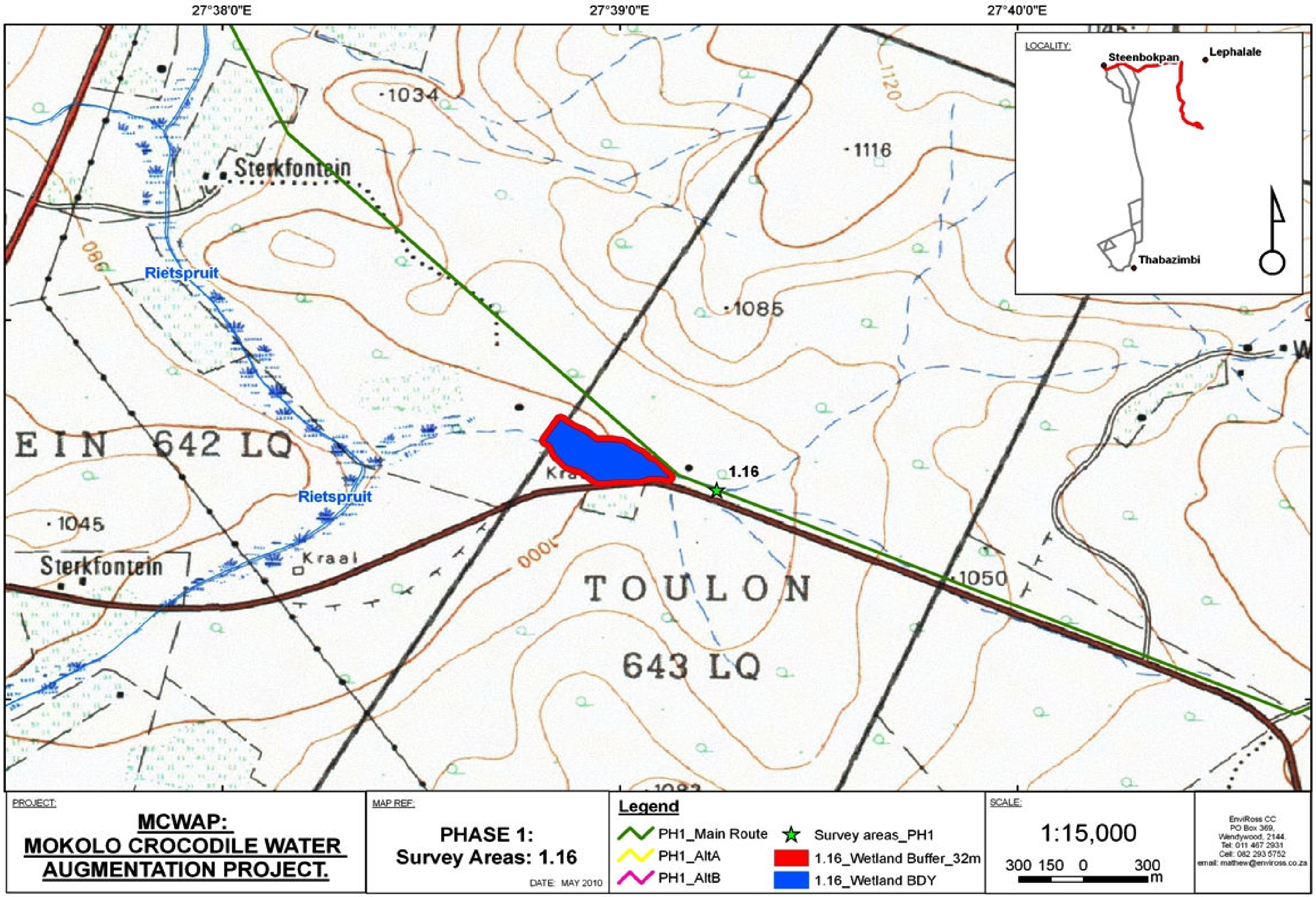

Figure 13: Wetlands and associated buffer zones applicable to Survey site 1.16.

The removal of the majority of the porous course upper sand layers, thereby exposing the soil layers with higher clay content, meant that surface waters were inhibited from percolating into the soils. This did, however, subsequentially mean that lateral movement of water within the soils was enhanced and the wetland drained prematurely towards and into the depression. This had the effect of drying up the wetlands downstream of the excavation that was reiterated by the encroachment of terrestrial floral species within the wetland habitat. Cattle drinking, trampling and contamination by livestock excrement had impacted the water quality within the depression. The outer edges of this wetland were delineated and a 50m conservation buffer designated to it. It was not regarded as an ecologically sensitive wetland and therefore an alignment shift of the pipeline to accommodate the wetland is not thought to be necessary. This is reiterated by the fact that another bulk water pipeline exists in association within this alignment route and the habitat unit has therefore already undergone a degree of transformation.

The designation of the buffer zones is therefore done so that ecologically sensitive construction procedures can be implemented to preserve the hydrological functionality of the wetland. Some recommendations include that no dumping of soils or excess building rubble take place within the buffer zones and that indiscriminate destruction of vegetation be discouraged within this area. The reinstatement of the correct soil layers to preserve the hydrological functionality of this wetland once again become pertinent to the conservation of this habitat unit and that cognisance of correct site reinstatement be taken to abate the formation of potential future soil erosion.

5.4.2. Rietspruit (1.14).

There were two streams associated with this crossing point that were indicated to fall outside of the proposed pipeline route to the north, however, a wetland survey was undertaken in order to determine if the proposed development would impinge on any wetlands not indicated in mapping resources or if the allocated buffer zones to these wetlands would be impinged upon by the pipeline construction.

The two converging perennial streams (known as Riet 1 and Riet 2, respectively) that flow from the west form part of the Rietspruit and join this river within close proximity to the R510. The farm where Survey point 1.14 is located is a small-scale sheep farm. Some bush has been cleared in order to improve the grazing potential of the farm, however, naturally grassland-dominated areas were found to generally incorporate wetlands. The site is located high up in the catchment, and, together with the topography of the area, hillside seepage wetlands were expected to be relatively common. The streams were found to be supplemented by an extensive seepage zone that would indeed be impacted upon by the pipeline construction activities. There was a high degree of iron oxide precipitate observed within the water, indicating that the channels are heavily supplemented by seepage zones. The position in the catchment also meant that these streams and wetlands had retained good water quality. The streams and associated flood zones were generally dominated by reeds (*Phragmites mauritianus*), sedge and grass species. The channels were generally inundated with vegetation due to the small volume of water within the channel as well as the general lack of floodwaters. The slow-flowing water and high degree of vegetation cover has allowed for a system that supports an exceptionally high diversity and density of various frog species. This also is attributed to the good water of the system.

Figure 14: Riverine and wetland habitat associated with survey area 1.14.

Some cattle activity within the riparian zones meant that a small degree of erosion was evident, but not thought to be significant. The general inundation of the channels with vegetation also meant that the potential for soil erosion is low. Besides having been slightly impacted by cattle and sheep grazing, the streams and wetlands within this area had retained a good PES, with wetland functionality having been retained.

Another section of the same wetland system located further to the south-east was also identified during the field survey. This wetland is fed through a ground and hillside seepage, but can be categorised as temporary. The source of this wetland area is located to the nearby south. The presence of wetland features necessitated the allocation of conservation buffers. It was found that the pipeline did impinged on this wetland and associated buffer zone. Ecologically sensitive construction methods and appropriate mitigation measures (see section 7) could see this impact being negated and rendered insignificant.

Figure 15: Various views of the temporary wetland area located to the southeast of the main wetland complex.

General recommendations:

It was found that wetlands associated with this area and their associated buffer zones would be impacted by the proposed pipeline alignment. The wetlands that would be affected were observed to be temporary in nature and only of moderate slope. There is also not a high volume of water passing through these wetlands. This means that soil erosion potential is low. Impacts within this wetland area can therefore be readily mitigated to lessen any ecological impacts.

In order to minimise any ecological impacts emanating from the construction activities within these wetland zones, the following points should be taken into consideration. These points can be treated as general mitigation measures which would be applicable to all three survey areas:

- Vehicular movement should be restricted to a single access roadway only;
- A roadway through the wetland zones will have to be established in order to excavate a trench for the pipeline. For the sections within the wetland zones, a geotextile should be laid down, which should be covered with a layer of soil. Thick wooden planks should then cover this. The wooden planks allow for the distribution of the vehicle's weight, reducing the compaction of the wetland soils;

- The soil that is removed during the excavations should be stored in the layers in which they were removed. The storage of this soil should also be done on a geotextile so as to not smother the vegetation and to allow for a quicker recovery of the affected vegetation;
- Upon completion of the laying of the pipeline, the soil should be replaced in the trench in the layer order in which they were removed. It is important to realize that wetland functionality relies substantially on movement of soil water. The movement of this water is largely dependent on the soil types and characteristics. By altering the soil layers and other characteristics means that sol water would be inhibited from moving laterally, thereby cutting off the water supply to the wetland;
- After filling in the trench, the affected area should be carefully reinstated to avoid channel formation through surface water favouring excavated areas. The bare soil should then be revegetated with species specific to the area;
- The temporary roadway can then be removed and upon lifting of the basal geotextile layer, the wetland vegetation should restore itself relatively quickly;
- No dumping of any materials or storage of any equipment should be allowed within the wetland zones;
- The construction teams should be prohibited from unnecessary destruction of riparian vegetation;
- Earthmoving equipment and vehicles should be serviced and inspected regularly to allow for the timeous identification of any fluid leaks. Hydrocarbon contamination of wetland habitat is rated as a high impact;
- The construction area footprint should be maintained at a bare minimum to minimise the potential ecological impacts.

5.4.3. Rietspruit (1.15).

Survey site 1.15 was located on the Rietspruit itself, with the proposed pipeline alignment going through a dam that had been constructed within the watercourse. This dam was observed to have been constructed in the recent past. It is a shallow dam, being indicated by the emergent vegetation that had established within it. There was a high degree of water lilies (*Nymphaea mexicana*) – an exotic species, which could become problematic if allowed to escape into natural watercourses.

Figure 16: Various views of the impoundment at Survey site 1.15.

The water quality within the dam was observed to be good and a healthy population of fish, dominated by *Oreochromis mossambicus* (Mozambique tilapia) was also observed. The construction of the dam has led to a decline in overall ecological integrity of the system due to the dam wall posing an impassable migratory barrier to aquatic organisms. Below the dam, the watercourse is largely inundated with reeds and grasses. The relatively small volume of water passing through the channel and the obvious lack of frequent flooding events allows for vegetation to inundate the channels. This is a natural feature of these streams and allows for good habitat quality for sensitive and other amphibian species. Further downstream of the dam, the landowner has removed soil from the watercourse to allow for pools to form. This was sporadically done.

Figure 17: Sporadic excavations of the watercourse that have led to establishment of deeper pools and fish that were sampled from these pools.

Sampling of fish species within these pools was undertaken as well as recoding of certain *in situ* water quality parameters at two points along the stream. These results are presented in Table 2.

Table 2: *In situ* water quality parameters taken at two points along the Rietspruit downstream of the dam.

Site	°C	pH	DO %	DO mg/l	EC µS/cm	TDS ppm
Upstream	24.78	6.19	48.2	3.59	71	35
Downstream	23.60	6.23	78.1	5.95	64	32

There was an unusually low pH value recorded for the sites. This is attributed to the natural chemistry of the water within the area and is not regarded as being a limiting factor to supporting aquatic organism. The oxygen content at the upstream site is also regarded as being low. This is attributed to the water having just been released from the impoundment as well as the relatively high water temperature. A high level of iron oxide precipitate within the water could also mean that there is a high chemical oxygen demand at this site – also a natural feature of channels fed by lateral seepage zones. This improves substantially downstream.

Three species of fish were sampled, namely *Tilapia sparrmanii* (Banded tilapia), *Oreochromis mossambicus* (Mozambique tilapia) and *Barbus trimaculatus* (Threespot barb).

General recommendations:

The same mitigation points as for Survey point 1.14 can be applied to this survey area to mitigate the impacts associated with the pipeline construction.

The Rietspruit can therefore be said to have retained a good PES and therefore it is recommended that the pipeline crossing point be undertaken at a point of the least ecological impact. There is an existing pipeline crossing the Rietspruit downstream of the dam wall. There is then a vehicular bridge associated with this existing pipeline. It is recommended that the pipeline cross at this point as the bridge is a semi-permanent feature that could be lifted with minimal site disturbances, and reinstated to accommodate a new pipeline.


Figure 18: The existing pipeline servitude at Survey site 1.15.

5.4.4. Tributary of the Rietspruit (1.16).

Survey point 1.16 included perennial streams that were fed by groundwater within the close proximity. These streams were fed by lateral seepage zones (evident by the high inclusion of iron oxide precipitates within the water). These streams have a very small catchment area and therefore do not readily flood during rainfall events. Therefore vegetation is allowed to inundate the watercourse, providing important habitat for (especially) numerous frog species. This section of the proposed pipeline route is a cattle farm and the cattle have had a moderate impact on the ecological integrity of the streams.

Historical activities within the watercourse slightly downstream have included excavations within the watercourse to allow for an impoundment of water. A dam wall had also been constructed within the watercourse which had failed, leading to the incision of the riverbanks within the river segment and siltation of the habitat downstream.

Figure 19: Various views of the wetlands associated with Survey point 1.16.

Figure 20: Views of the existing pipeline servitude at Survey point 1.16.

In order to minimise the impact of the pipeline construction on these wetland areas, it is recommended that the proposed pipeline run parallel to the existing pipeline within the area.

General recommendations:

There were sensitive wetlands located within this survey area that fed perennial streams. There is an existing pipeline that is located on slightly higher ground. There is also an existing servitude roadway associated with this pipeline which means that natural vegetation has already been removed to accommodate it. It is highly recommended that this proposed alignment remain as closely associated to the existing pipeline as possible to reduce the impact on the wetlands within the area. The same mitigation points as for Survey site 1.14 can be applied to this survey area to mitigate the impacts associated with the pipeline construction.

6. COMPARISON OF ALTERNATIVES.

6.1. Rising Main – Mokolo Dam to Wolvenfontein Balancing Dams.

Table 3: Alternative comparisons for the "Rising Main – Mokolo Dam to Wolvenfontein Balancing Dams".

Alternatives	Advantages	Disadvantages
A (northern alignment)	• Follows an existing roadway.	• Topographical features will require large amount of earth works. • Blasting to accommodate trenching will impact on sensitive kloof habitat unit associated with alignment route.
B (southern alignment)	• Will impinge less on sensitive mountain streams. • Will not impinge on downstream sensitive kloof habitat particular to Alt A. • This alternative will occur on a greater amount of flatter topography, thereby decreasing the potential for soil erosion. • Much of the proposed alternative follows an existing powerline servitude.	• Comparatively - None

There is therefore the choice of Alternative B within this area as the alternative that is seen to impinge on the localised aquatic systems the least within the area.

6.2. Gravity Line – Matimba Power Station to Steenbokpan.

Table 4: Alternative comparisons for the "Gravity Line – Matimba Power Station to Steenbokpan".

Alternatives	Advantages	Disadvantages
C (northern alignment)	• Equally amenable from a wetland and Aquatic perspective.	• Equally amenable from a wetland and Aquatic perspective.
D (southern alignment)	• Equally amenable from a wetland and Aquatic perspective.	• Equally amenable from a wetland and Aquatic perspective.

7. GENERAL CONCLUSIONS & RECOMMENDATIONS.

A field survey was undertaken between October 2009 and March 2010 that assessed the general ecological impacts of the proposed Phase 1 section of the pipeline associated with the MCWAP. From available mapping resources, all watercourse crossings and associated wetland areas were identified and assessed during the field survey.

The alignment alternative B (on the farms *Witbank 647LQ* and *Wolvenfontein 645LQ*) is considered the best alignment option from an aquatic ecological perspective.

The choice between the alternative alignment routes of C or D is considered to be open to which ever alternative is the most technically and socio-economically viable option. Neither of these alternative options pose any significant risks to the aquatic environment.

A bridge structure is recommended for the stream crossing on the farm *Witbank 647LQ.* This stream is considered an ecologically sensitive stream system and therefore it is recommended that streambed disturbances be limited as far as possible. If this recommendations are not technically feasible at this point, however, the following recommendations should be taken into consideration:

- River bank erosion protection upstream and downstream of the river crossing during construction period should be implemented;
- The preconstruction profile of the water course area that is to be impacted on should be surveyed and recorded on a drawing for future reinstatement reference;
- Prevention measures to ensure that the river water quality is not altered by increased suspended solids, pollution and significant changes in pH resulting from concrete spillages should be implemented;
- Dewatering activities are to be controlled and the water released is to be filtered to remove suspended solids and to remove potential pollutants such as hydraulic oils. Pumping and

dewatering should be directed through a retention and settlement pond system. Construction water should not be allowed to be discharged directly into the water resource;

- Measures to prevent pollution of the watercourse should be implemented. Store fuel and servicing and re-fuelling equipment in a manner that prevents fuel and equipment fluids from entering the water body;
- Measures to minimize sediment from entering the water body should be implemented;
- Stabilizing all disturbed areas to negate the future potential occurrence of soil erosion.

The persistence of the wetlands within the area is reliant on the retention of the correct soil layers. Excavations and the subsequent disturbances of the natural soil stratification will affect the natural hydrology of the wetlands and therefore impact on the overall future ecological integrity of these wetlands. Correct reinstatement of these soil layers is therefore absolutely imperative to retention of the wetland ecosystem functionality.

In order to minimise any ecological impacts emanating from the construction activities within the wetland zones along the pipeline route, the following points should be taken into consideration. These points can be treated as general mitigation measures which would be applicable to all wetland areas:

- Vehicular movement should be restricted to a single access roadway only;
- A roadway through the wetland zones will have to be established in order to excavate a trench for the pipeline. A servitude roadway already exists due to the existing water pipeline along this route. Vehicular movement should be limited only to this roadway.
- For the sections within the wetland zones that require fresh excavations, bog mats should be used for access roadways for earthmoving equipment. This would allow for the distribution of the vehicle’s weight, reducing the compaction of the wetland soils and also allow for relatively easy rehabilitation of the wetland habitat by allowing for the retention of the vegetation structures;
- The soil that is removed during the excavations should be separated according to their differing characteristics and stored in the layers in which they were removed. The storage of this soil should also be done on a geotextile so as to not smother the vegetation and to allow for a quicker recovery of the affected vegetation. This is important as the area is regarded as being generally arid and the regeneration of vegetation is therefore slow;
- Upon completion of the laying of the pipeline, the soil should be replaced in the trench in the layer order in which they were removed. It is important to realise that wetland functionality relies substantially on the lateral movement of soil water and that this movement of this water is largely dependent on the soil types and characteristics. By

altering the soil layers and other characteristics, the soil water would be inhibited from moving laterally, thereby cutting off the water supply to the wetland;

- After filling in the trench, the affected area should be carefully reinstated to avoid channel formation through surface water favouring excavated areas. The bare soil should then be revegetated with species from the surrounding area – seeded or planted;
- The temporary roadway can then be removed and upon lifting of the basal geotextile layer, the wetland vegetation should restore itself relatively quickly;
- No dumping of any materials or storage of any equipment should be allowed within the wetland zones;
- The construction teams should be prohibited from unnecessary destruction of riparian vegetation;
- Earthmoving equipment and vehicles should be serviced and inspected regularly to allow for the timeous identification of any fluid leaks. Hydrocarbon contamination of wetland habitat is rated as a high impact;
- The construction area footprint should be maintained at a bare minimum to negate the potential ecological impacts.

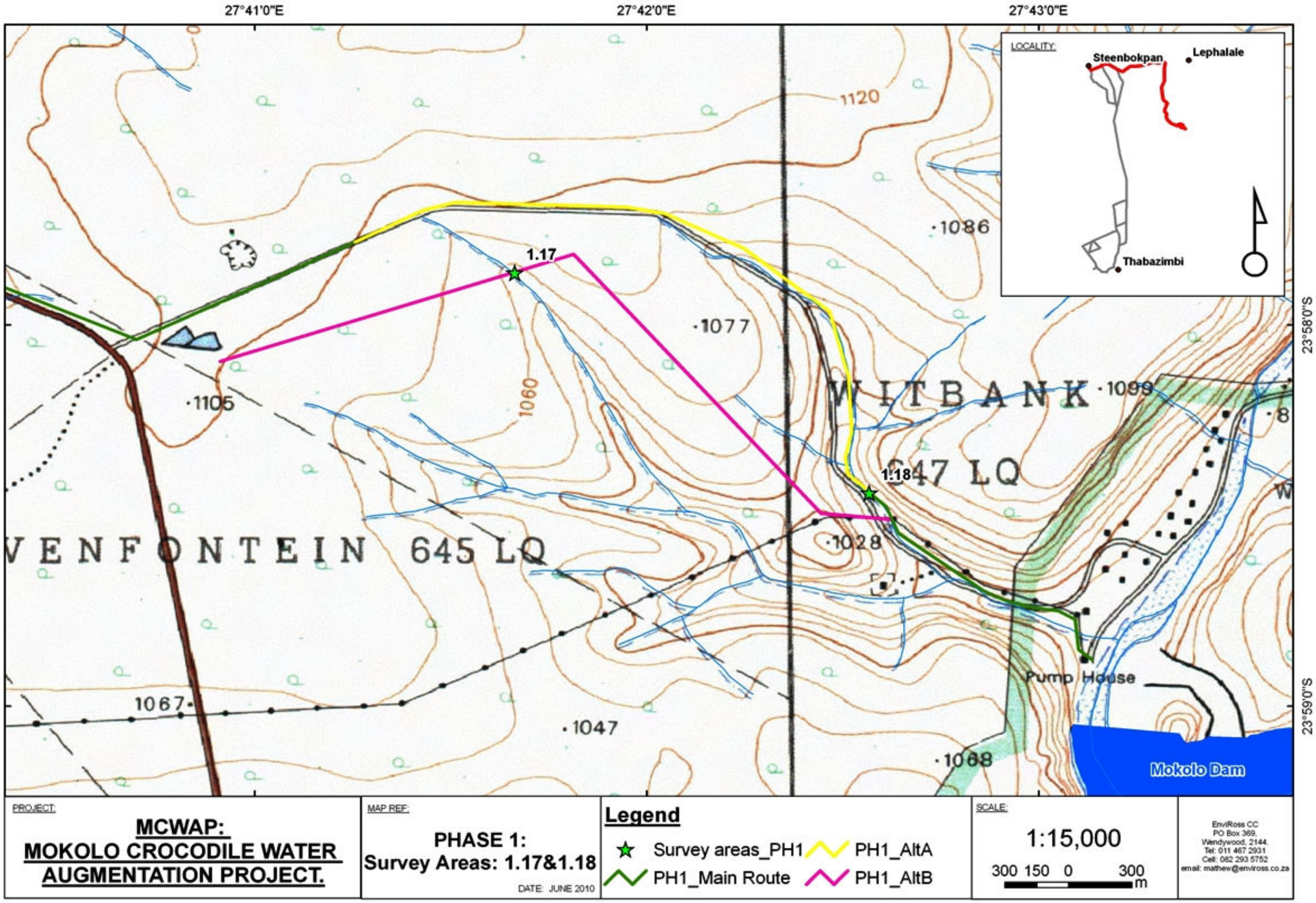

Figure 21: The proposed alignment routes within the southern section of the Phase 1 pipeline route on the farm *Witbank 647LQ* and Wolvenfontein 645LQ.

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APPENDIX A – ENVIRONMENTAL MANAGEMENT PLAN (EMP) PERTAINING TO THE MITIGATION OF THE ECOLOGICAL IMPACTS AFFECTING THE OVERALL ECOLOGICAL INTEGRITY FOR THE PROPOSED MCWAP PHASE 1 PIPELINE DEVELOPMENT.

All quoted literature references are listed under section 8. References*.*

A1. INTRODUCTION.

The current shortage in the supply of electricity in the country necessitates ESKOM to fast track the building of further power stations. As a result, ESKOM started construction of the new Medupi Power Station during 2007, in the Lephalale area, which lies in the Mokolo catchment. This development will require expansion of the coal mining activities as well as other consequential secondary and tertiary developments. There is also a strong likelihood of further power stations in the area as well as petro-chemical industries. These developments are driven by the presence of extensive coal reserves in this area and are expected to result in a sharp increase in water requirements. Therefore, the DWAE commissioned the Mokolo Crocodile (west) Water Augmentation Project (MCWAP) to establish how these demands can be met within the very challenging timeframes.

The infrastructure options considered to augment water supply to the Lephalale area include the following:

1. *Phase 1:* Augment the supply from Mokolo Dam; and
2. *Phase 2:* Transfer scheme from the Crocodile River (west) to the Lephalale area.

MCWAP requires authorisation in terms of the national Environmental Management Act, 1998 (Act 107 of 1998). Separate assessments will be undertaken, in accordance with the Environmental Impact Assessment (EIA) Regulations (Government Notice No. R385, R386 and R387), for phases 1 – 3 of the project. The motivation for separating the EIA's is to minimise risks and to prioritise Phase 1 of the project (Nemai Consulting, Terms of Reference document, Sept 2009). *This report details the findings pertaining to Phase 1 of the proposed development activities*.

An ecological survey was undertaken in order to ascertain the extent of the potential impacts of the proposed pipeline development on wetlands and watercourses along its proposed alignment route.

As part of this assessment, an impact evaluation had to be provided and mitigation measures provided for, to aid in abating these ecological impacts as part of an Environmental Management Plan (EMP).

This proposed EMP provides general mitigation measures aimed at abating the expected impacts imposed on the overall ecological functionality of the various activities and, in doing so, to preserve the ecological integrity of wetland and watercourse features pertaining to the proposed route, whilst retaining the functionality of the infrastructure. This will be applicable for both the *Construction* and *Operation* phases of the proposed development.

The impacts on the environment can only be minimized by the dedicated and sincere implementation of the EMP by the *Contractor*. The *Client* will be responsible for ensuring compliance by the *Contractor*, during the construction phase, with the findings of the EMP. Compliance with the EMP must be audited monthly during the construction phase and following completion of the project.

A1.1. Project activities.

The proposed project involves the excavation of a trench and the laying of a water delivery pipeline, together with associated infrastructure (e.g. valve chambers, etc.). This entails the establishment of the construction camps, the servitude, stripping of vegetation within the servitude, trenching excavations for the pipeline and construction of the actual pipeline.

These construction activities will be done with the aid of earth-moving equipment and other heavy machinery that will impinge on the ecological integrity of the localised habitat units and overall ecological integrity throughout the site. The vegetation within the footprint of the infrastructure development will be maintained in order to abate infrastructural damage risks and therefore will be disturbed in perpetuity as part of the management phase.

A1.2. Construction phase.

The main construction activities will include the following main activities:

- Site preparation (removal of all vegetation within the servitude area);
- Establishment of contractors' and construction camps;
- Earthworks (excavations, etc.); and
- Construction of the infrastructure.

It is presumed that this process will have a life-cycle of more than one year.

A1.3. Operations (Management) phase.

The operations phase for a pipeline of this nature has an indefinite timeframe and incorporates the following main activities:

- Maintenance of vegetation within the servitude footprint as well as maintenance of an area surrounding the various supplementary infrastructure;
- General maintenance of the infrastructure, including sediment scouring, access roadways and a degree of mechanical maintenance of the infrastructure itself.

A2. ENFORCEMENT

The responsibility for enforcing the implementation of the EMP lies with the client. It is the responsibility of the Environmental Control Officer (ECO) to monitor the Principal Contactor.

The ECO is responsible for the following:

- To monitor the execution of the mitigation measures, and to ensure the safeguarding of the environment;
- To facilitate communication between I&AP's (Interested and Affected Parties), Consultants and the Contractor;
- To inspect the construction site on a weekly basis, and to prepare a monitoring report, which will be forwarded to the project team, the applicable municipal representatives and representatives from the I&APs (i.e. community members).
- To train the Contractor, Site Agent, Construction Supervisor and Safety Officer on the mitigation measures, and to verify that the Contractor's employees have undergone induction on these measures.

The abovementioned monitoring report will include a **checklist** and an **issues list**. The checklist will be completed by awarding the following scores, based on the level of compliance

COMPLIANCE SCORES	DESCRIPTION
1	Task not achieved
2	Task 20% completed
3	Task 50% completed
4	Task 80 % completed
5	Task 100% completed

Where non-compliance is encountered (i.e. COMPLIANCE SCORE < 5), the significance of the associated impact will be recorded, based on the following guidelines:

IMPACT SCORES	IMPACT
1	**Low** – mitigation not needed
2	**Medium** – mitigation should be considered
3	**High** – mitigation compulsory

The issues list will highlight the most pertinent issues that require mitigation, and provide the deadline for compliance. The following EMP has been compiled to potentially mitigate against any general negative impacts identified during the initial reconnaissance survey.

A3. MITIGATION MEASURES.

In the EMP tables below, general mitigation measures are provided for the planning phase, while specific measures are listed to address the identified environmental impacts during the construction and operation stages of the project. This EMP should be made binding to the contract.

- **PROJECT PHASE:** PLANNING

Environmental Consideration	Mitigation Measures	Responsible Party
EMP Induction	Introduce the ECO* to the Project Team.	Project Manager
	Training of the Contractor's employees on the EMP and RoD.	ECO
	Explanation of environmental monitoring protocol to the Project Team by the ECO.	ECO
	All correspondence from ECO must be filed and kept onsite.	Project Manager
Construction Camp	Make provision for enough chemical toilets for all employees.	Project Manager; Contractor
	In consultation with the ECO, establish a suitable site for a construction camp.	
Waste	Identify suitable landfill, which will accept the type of waste material to be generated.	Project Manager; Contractor
Soil	Identify suitable site/burrow pit (if applicable) to obtain soil. All new borrow pits, or extensions to existing pits, require an Environmental Management Programme Report (EMPR) in terms of the Minerals Act (Act no. 50 of 1991).	Project Manager
Social	Labour intensive methods must be used where feasible, cost effective and not time constraining.	Contractor
	Local labour should be employed were possible.	Contractor
	Local suppliers must be used, as far as possible.	Contractor

- * ECO – Environmental Control Officer

A4. SIGNIFICANCE RATINGS OF PERCEIVED ENVIRONMENTAL IMPACTS.

The significance rating (SP) is calculated by the following formula:

SP = Consequence X Probability

Where: Consequence = (S + D + I + E) – R

S= Spatial extent
D=Duration
I=Intensity
E=Effects on important ecosystems
R=Reversibility

Rating scores for the various aspects are presented in Table 5. Table 6 presents the outcomes of the perceived ecological impacts on the conservation of important habitat units and therefore the retention of floral species biodiversity and conservation for the duration of the construction and management phases of the proposed development both before and after the implementation of mitigation measures.

All of the perceived impacts are viewed as being of *low* to *medium* significance before mitigation. All impacts identified can be effectively reduced or negated through implementation of appropriate mitigation measures.

The general mitigation measures proposed for the purpose of limiting the general wetland and watercourse ecological impacts within the area applicable to the construction and operations phases of the proposed MCWAP Phase 1 pipeline development activities are presented in Table 7.

Table 5: Rating scores for the various factors used for calculating the significance rating of a particular impact.

Spatial extent		Duration		Intensity		Effects on important ecosystems		Reversibility		Probability	
Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score
Site specific	1	Short (0-15yrs)	1	Low	1	None	1	Irreversible	0	Improbable	1
Local	2	Medium (2-15yrs)	2	Medium	3	Negligible	2	Largely irreversible	1	Possible	2
Regional	3	Long (16-30yrs)	3	High	5	Insignificant	3	Somewhat reversible	2	More than likely	3
National	4	Discontinuous	4			Significant	4	Largely reversible	3	Highly probable	4
International	5	Permanent	5			Vast	5	Totally reversible	4	Definite	5

Table 6: Significance assessment of the perceived major environmental impacts pertaining to a development of this nature and general ecological and habitat conservation both *before* and *after* mitigation measures that are applicable to the proposed development activities.

Potential environmental impact	Project activity or issue	Environmental significance *before* mitigation								Environmental significance *after* mitigation as per EMP							
		S	D	I	E	R	P	Conf	SP	S	D	I	E	R	P	Conf	SP
PRECONSTRUCTION & CONSTRUCTION PHASES																	
Aquatic habitat destruction.	Trenching through watercourses destroying aquatic habitat.	2	5	3	4	2	4	Med	**48**	1	1	1	1	4	1	Low	**0**
Wetland habitat destruction.	Trenching through wetlands destroying wetland habitat through landscaping and soil disturbances. Construction activities altering soil conditions, hydrological features & topography from the movement of heavy machinery, leading to loss of wetland functionality.	2	5	3	4	2	4	Med	**48**	1	1	1	2	4	2	Low	**2**
Impacts on aquatic and wetland-dependent fauna & flora.	Destruction of habitat leading to displacement of habitat – dependent biodiversity.	2	4	3	4	2	4	Med	**44**	1	1	1	1	4	2	Low	**0**
Water quality impacts	Soil erosion and inappropriate on-site sewerage management leading to contamination of nearby wetlands and watercourses. This will affect sensitive wetland-dependent faunal species.	2	1	1	3	2	2	Low	**10**	1	1	1	1	4	1	Low	**0**
Soil contamination	Pollution of soils due to oil/fuel leaks & wastes that will affect floral species.	2	2	1	3	1	3	Low	**21**	1	1	1	1	4	1	Low	**0**
Soil erosion	Erosion of stockpiled topsoil & disturbance of soils due to vegetation stripping leading to habitat inundation and potential smothering of wetland species and other vegetation.	2	1	1	3	2	3	Low	**15**	1	1	1	2	3	1	Low	**2**

Potential environmental impact	Project activity or issue	Environmental significance *before* mitigation								Environmental significance *after* mitigation as per EMP							
		S	D	I	E	R	P	Conf	SP	S	D	I	E	R	P	Conf	SP
MANAGEMENT PHASE																	
Biodiversity impacts	Exotic vegetation encroachment following soil disturbances leading to displacement of habitat-dependent fauna and flora biodiversity.	1	4	3	1	3	4	Low	24	1	1	1	1	4	2	Low	0

[Significance of Environmental Impact (SP) = Consequence x Probability (P), where Consequence = Spatial extent (S) + Duration (D) + Intensity (I) + Effects on important ecosystems (E)) - Reversibility (R). SP ratings: 0-33 (Low), 34-74 (Medium), 75-100 (High)

• PROJECT PHASE: CONSTRUCTION

Table 7: Mitigation measures proposed for the *Construction phase* of the proposed development activities.

Environmental Consideration	Environmental Impacts	Mitigation Measures	Time Frames	Responsible Party
Flora	• Damage to wetland and aquatic habitat lading to displacement of habitat-dependent species; • Transformation of vegetation community structures that will lead to displacement of habitat-dependent species; • Soil disturbances that allow for the establishment of exotic vegetation.	• Movement of personnel and machinery to be limited to the areas designated for the established access roadways and construction footprint area; • No movement of personnel or machinery to take place within the wetland areas in order for this ecologically sensitive habitat unit to retain its features; • Any recruitment of exotic vegetation to be managed on an ongoing basis until indigenous pioneering vegetation has dominated the disturbed areas. These species should be limited to naturally-occurring species representative of the vegetation type for the locality. Ongoing monitoring of exotic vegetation recruitment should be undertaken and any recruitment controlled; • Dumping or storage of topsoil must not be done on established wetland areas and wetland vegetation, but should remain within designated areas; • Workers and machinery to remain inside construction footprint. All labourers to be informed of disciplinary actions for the wilful damage to plants; • Indiscriminent damage of vegetation to be avoided.	Continuous throughout the construction phase.	Contractor

Environmental Consideration	Environmental Impacts	Mitigation Measures	Time Frames	Responsible Party
Fauna	• Wetland and aquatic habitat destruction leading to displacement of faunal species.	• Important habitat to faunal conservation within the area (i.e. wetland and riparian habitat) should be avoided; • Movement of personnel and machinery to be limited to the areas designated for the established servitude area; • No movement of personnel or machinery to take place within the wetland areas in order for this ecologically sensitive habitat unit to retain its features; • Dumping or storage of topsoil must not be done on established wetland areas, but should remain within the construction footprint. • Workers and machinery to remain inside construction footprint. All labourers to be informed of disciplinary actions for the wilful damage to habitat. • Indiscriminent damage of the environment to be avoided.	Continuous throughout the construction phase.	Contractor
Wetlands & Aquatic habitats	• Wetland habitat being impacted upon by the development activities; • Wetlands being impacted upon by soil compaction from heavy machinery.	• Wetland habitat should be avoided when designing the layout plan; • If wetland sections are to be crossed for vehicular access, this should be limited to existing roadways. No further roadways should be established within wetland habitat.	In the construction phase and then in the management phase if found to be necessary	Contractor
	• Soil erosion leading to siltation of the aquatic habitat.	• Soil erosion to be actively managed, but the nature and localised extent of the development largely renders this impact highly improbable.		
	• Impacts on sensitive aquatic environments.	• Soil erosion leading to siltation of the aquatic environment is probably the only impact that could potentially occur. The proposed site locality and its relation to sensitive aquatic habitats largely renders this impact as improbable.		

Environmental Consideration	Environmental Impacts	Mitigation Measures	Time Frames	Responsible Party
Soil	• Pollution of soil will adversely affect vegetation and habitat integrity.	• The source of the pollution must immediately be identified and rectified; • Polluted soils should be immediately cleaned and transferred to an appropriate registered landfill site; • Subsequentially removed soils should be replaced with unpolluted soils of similar geological, chemical and pedological characteristics.	Following the construction phase.	Contractor
	• Compaction of soils leading to lowered potential for re-vegetation	• Soil should be shallow-ripped and scoured prior to replanting and placing of a geotextile layer (on steep topographies) to avoid soil erosion. • Heavy machinery should be limited to designated roadways.	Following the construction phase	Contractor
	• Destruction of wetland habitat through servitude roads running through wetlands and destroying wetland vegetation. • Wetland functionality loss through the reinstatement of the incorrect soil layers, which will impact on wetland floristic features.	• Wetland habitat should be avoided as far as possible during the construction of lines as access roads can cause major damage to these sensitive systems (van Rooyen, 2004). • Soil that is removed for any excavations should be placed in the layers that it was removed and replaced according to the layers that it was removed.	Following any construction activities that would affect soil profiling within wetland zones	Contractor

• **PROJECT PHASE:** OPERATION

Where applicable, the mitigation measures for the construction phase will be carried forward to the operations phase.

A5. CONCLUSION.

The Contractor can use **Appendix A** as a standalone document, as the mitigation measures contained therein address the potential negative impacts associated with the project. Following the recruitment of the aforesaid mitigation measures, no impacts with a significance rating of 1 or higher are perceived to remain.