MOKOLO & CROCODILE (WEST) WATER AUGMENTATION PROJECT: DEBOTTLENECKING PIPELINE SECTION, LEPHALALE.

WETLAND DELINEATION AND ECOLOGICAL 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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EnviRoss CC

CK: 2007/051532/23
VAT: 4810234999
PO Box 369, Wendywood, 2144.
Tel/Fax: +27 11 465 2931
Cell: +27 82 293 5752
e-mail: mathew@enviross.co.za

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

____________________ Date: 29 October 2009

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: 29 October 2009

Tahla Ross

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1. INTRODUCTION & TERMS OF REFERENCE.

Nemai Consulting requested Enviross CC to undertake a wetland delineation survey and wetland ecological survey for the areas pertaining to the debottlenecking section for the proposed MCWAP (Mokolo and Crocodile River (west): Water Augmentation Project).

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 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, 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. *De-bottlenecking* of an existing pipeline, owned by Exxaro;
2. *Phase 1:* Augment the supply from Mokolo Dam; and
3. *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).

1.2. Terms of Reference.

There were three major areas of concern that had been previously identified along the debottlenecking section of the pipeline. These three areas were to be the focal point of the survey (Figure 1).

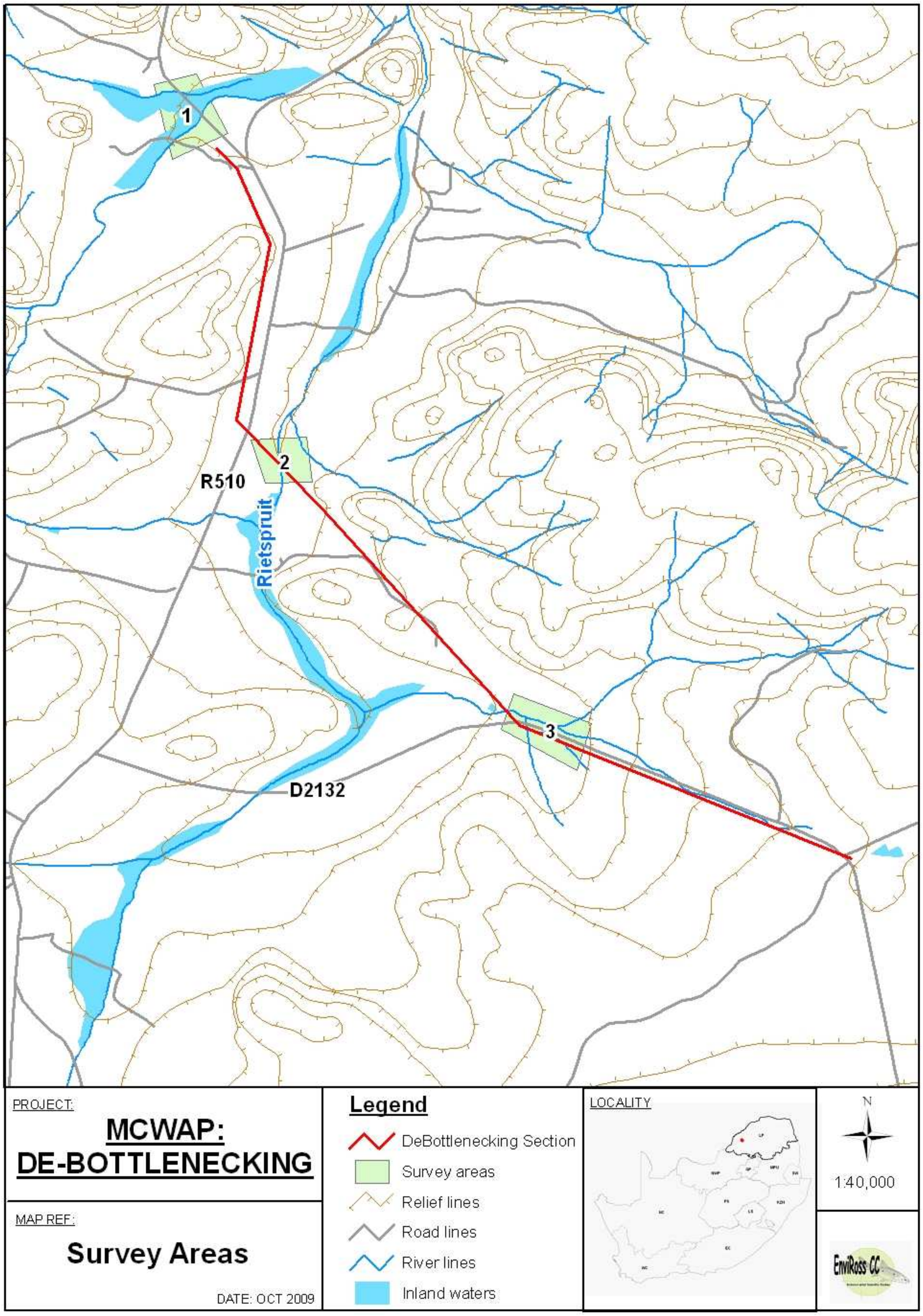

Figure 1: Locality of the proposed debottlenecking section, showing the three designated survey areas.

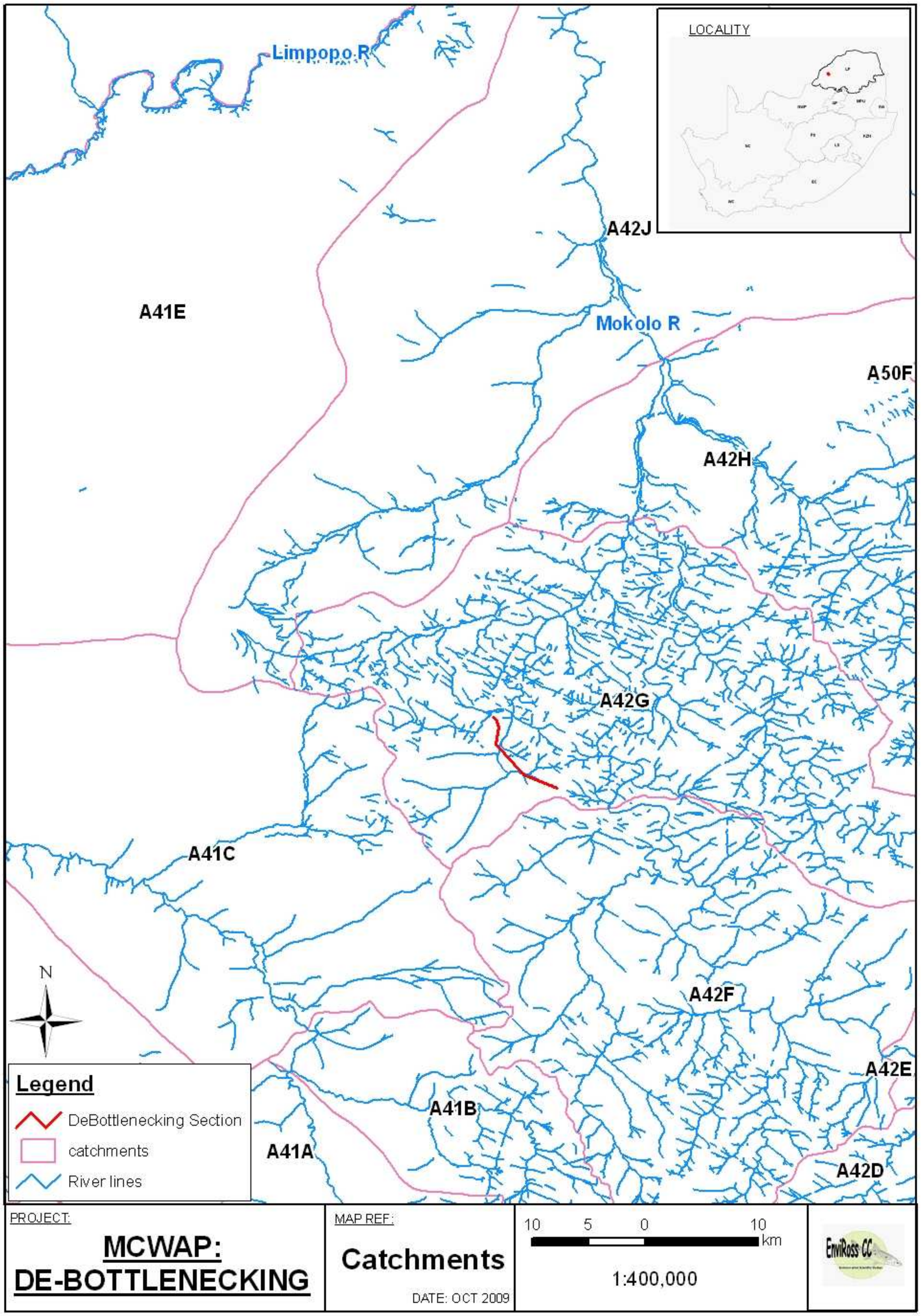

Figure 2: Catchment information of the surrounding area.

The delineation of the outer edges of the wetlands pertaining to the proposed development sites will enable the allocation of appropriate conservation buffer zones. Provincial-specific wetland conservation buffer zones could not be ascertained at the time of the survey, so the national guidelines were implemented. This translates to a standard 32m conservation buffer that extends from the outer edge of the temporary zone of the wetlands. 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.

The three major survey areas will be dealt with and described separately for the sake of readability.

1.3. Catchment and project area descriptions.

The survey area falls within Limpopo Province, within the north-western area of South Africa, approximately 25km south of Lephalale (Ellisras). It falls within the Limpopo (A) Primary Catchment and the Mokolo River (A42) Tertiary Catchment. The Water Management Area (WMA) for the debottlenecking section is A42G, which covers approximately 1,206km^2 (Figure 2).

The area is characterized 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 that generally make it 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 development area. This is to be done in accordance to DWAF 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 three survey areas 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.

3. METHODS OF INVESTIGATION.

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 DWAF guidelines for wetland delineations, 2005) the following 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 DWAF (2005), a conservation buffer of 32m is applicable to all wetlands taken from the outside of the temporary zones.

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. 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 (DWAF, 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).

3.2. 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. The soil sample is then examined for indications of soils particular to the characteristics described above.

3.3. 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 (DWAF, 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.

3.4. Vegetation Indicator (VI).

Vegetation is a key component of the wetland definition in the National Water Act. However, using vegetation as a primary indicator requires undisturbed conditions and expert knowledge (DWAF, 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 (DWAF, 2005).

4. Ecological Description of Proposed Development Site and Surrounding Area.

The dominant veld type of the surrounding area is *Central Sandy Bushveld*. This is a Central Bushveld bioregion that falls within the Savanna biome. It is a *Vulnerable* vegetation type. The northern end of the proposed line falls within *Waterberg Mountain* Bushveld – a vegetation type regarded as being *Least* threatened. Wetlands within the area would have features of *Lowveld Alluvial Vegetation* (Mucina & Rutherford, 2006).

The areas surrounding the proposed pipeline route remains 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. Vegetation units along the proposed pipeline route were observed to have retained relatively good ecological integrity.

The wetlands within the area originate close by within the hills and mountains, where laterally 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 erodible soils. This should be born in mind during the construction and reinstatement phases of the proposed development activities.

5. RESULTS & DISCUSSIONS.

The survey of the proposed pipeline route was focused on three key areas indicated in Figure 1. These three sites will be described individually.

5.1. Survey Area 1.

There were two streams associated with Survey Area 1 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 Area 1 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 does indeed would 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* sp.), 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 and exceptionally high diversity and density of various frog species. This also is attributed to the good water of the system.

Figure 3: Riverine and wetland habitat associated with the most northern stream crossings.

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 categorized 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 impinged on this wetland and associated buffer zones. Ecologically sensitive construction methods and appropriate mitigation measures (see section 6) could see an insignificant impact on the ecological functionality of this wetland emanating from the development activities.

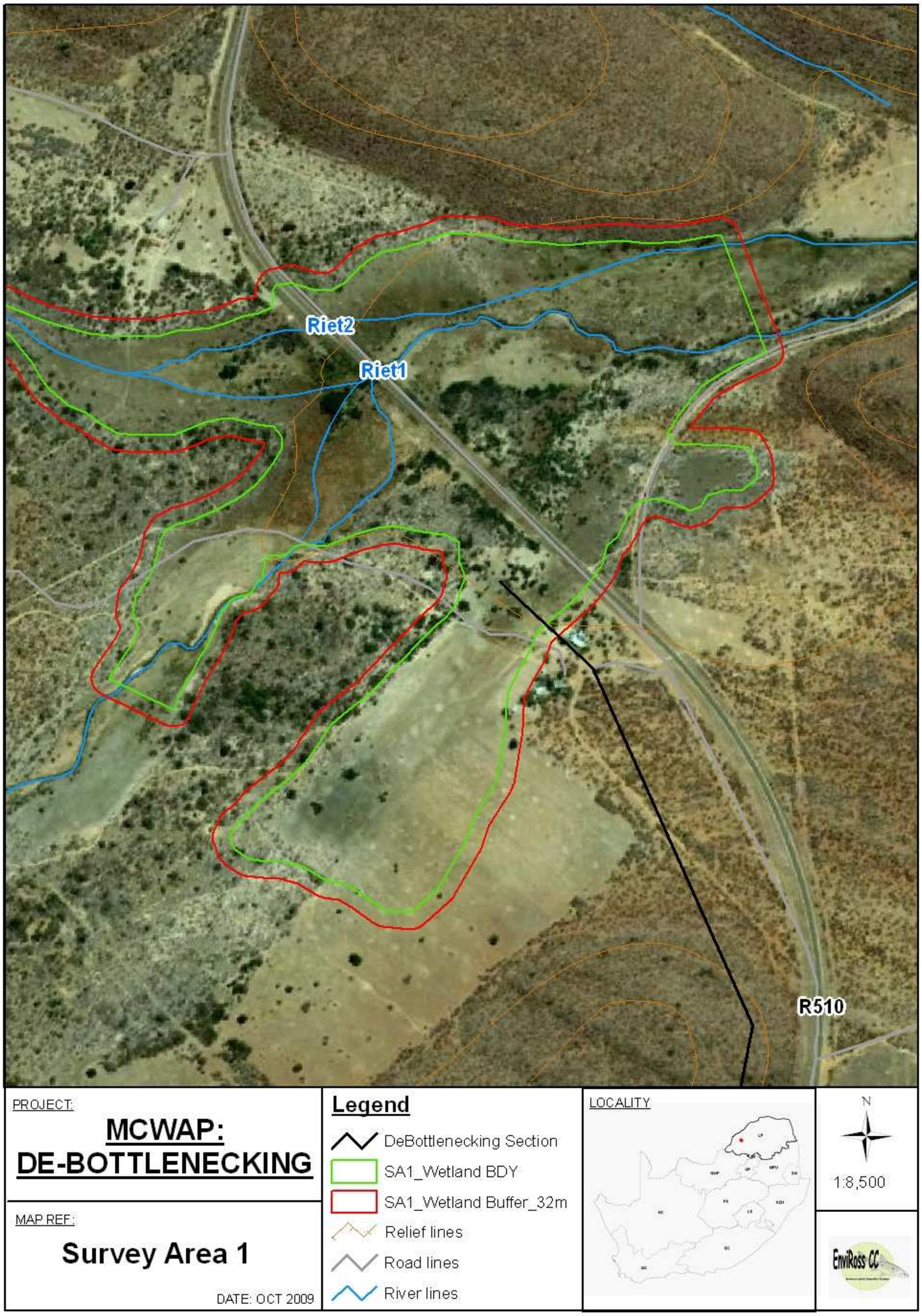

Figure 4: Wetland areas and conservation buffer zones applicable to Survey Area 1.

Figure 5: Various views of the temporary wetland area located to the southeast of the main wetland complex.

5.2. Survey Area 2.

Survey Area 2 was located on the Rietspruit itself, with the proposed pipeline alignment going through a dam that had been constructed along the watercourse. This dam was observed to have been constructed in the recent past. It is a shallow dam, being indicated by the vegetation that had established within it. There was a high degree of water lilies (*Nymphaea mexicana*) – an exotic species that could become problematic if allowed to escape into natural watercourses.

Figure 6: Various views of the impoundment at Survey Area 2.

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 7: 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 taking of *in situ* water quality. Three species of fish were sampled, namely *Tilapia sparrmanii* (Banded tilapia), *Oreochromis mossambicus* (Mozambique tilapia) and *Barbus trimaculatus* (Threespot barb). The water quality was taken at two points along the stream. These results are presented in Table 1.

Table 1: 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 no 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. This improves substantially downstream.

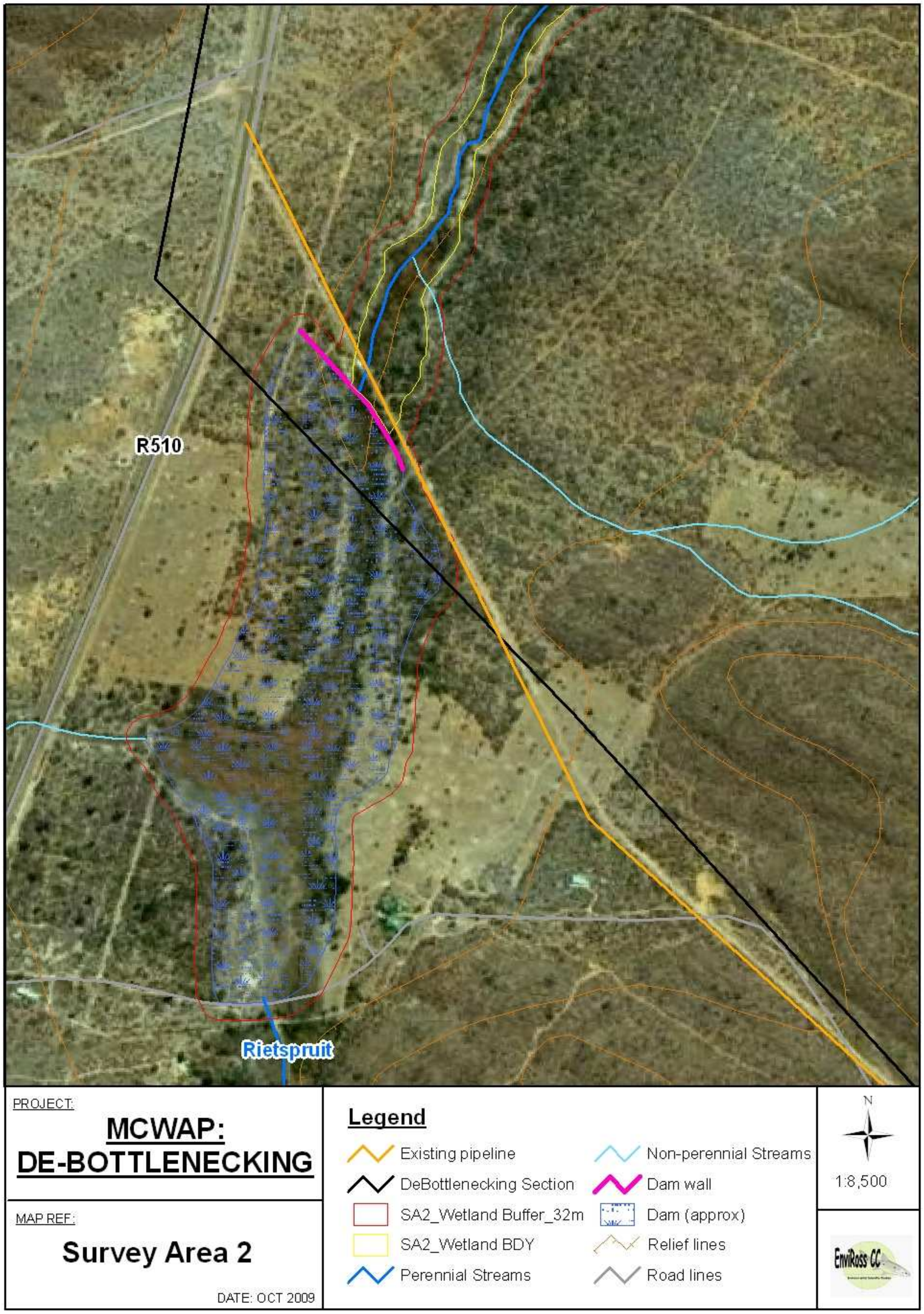

Figure 8: Wetland zones and buffers pertaining to Survey Area 2, showing the approximate extent of a dam that had been constructed within the near past. The proposed alignment as well as an alternative alignment are also shown.

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. This is indicated in Figure 8.

Figure 9: The existing pipeline servitude at Survey Area 2.

5.3. Survey Area 3.

Survey Area 3 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.

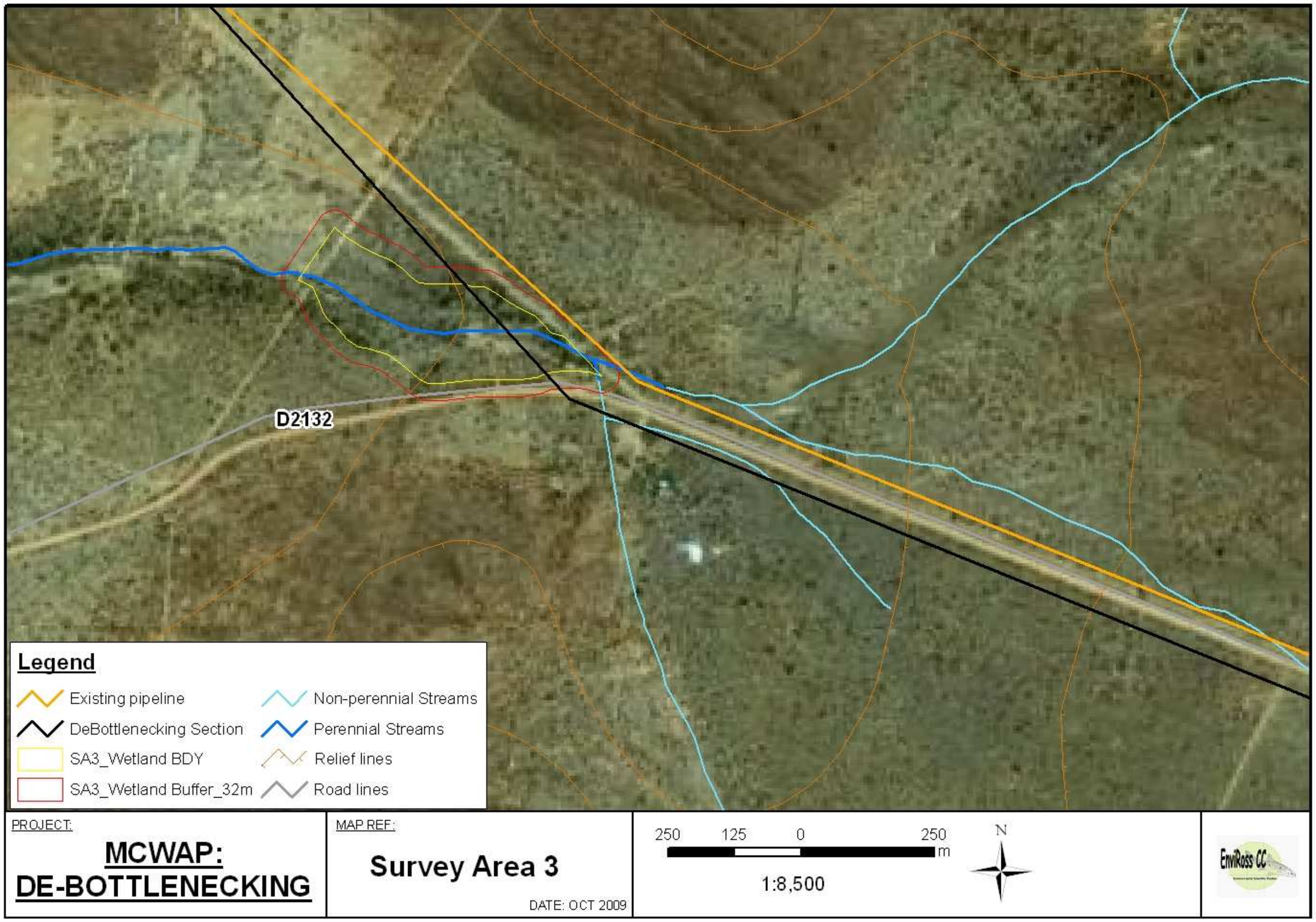

Figure 10: Wetlands and associated buffer zones applicable to Survey Area 3.

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.

Figure 11: Various views of the wetlands associated with Survey Area 3.

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 in the area. This alternative alignment is indicated in Figure 10.

Figure 12: Views of the existing pipeline servitude at Survey Area 3.

6. GENERAL CONCLUSIONS & RECOMMENDATIONS.

A field survey was undertaken during October 2009 that assessed the general ecological impacts of the proposed de-bottlenecking section of the pipeline associated with the MCWAP. From available mapping resources, three focal points were chosen. These areas were thought to be the most pertinent to wetlands and rivers within the 9km stretch of pipeline.

Survey Area 1:

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 no high volumes 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.

Survey Area 2:

The proposed alignment route presently goes directly through a dam. It is proposed that the alignment be shifted to run parallel to an existing pipeline that runs below the dam wall in association with an existing roadway. This is perceived to be the alignment route of least impact to the Rietspruit. The same mitigation points as for Survey Area 1 can be applied to this survey area to mitigate the impacts associated with the pipeline construction.

Survey Area 3:

There were sensitive wetlands located within this survey area that fed perennial streams. Once again, 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 alternative alignment be considered to reduce the impact on the wetlands within the area. The same mitigation points as for Survey Area 1 can be applied to this survey area to mitigate the impacts associated with the pipeline construction.

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