REPORT

WETLAND ASSESSMENT: ZEUS – KENDAL - KUSILE 400KV TRANSMISSION LINES

Prepared For:

ESKOM HOLDINGS

***Submitted To**:*

Environmental Impact Management Services (PTY) LTD.

Leaders in Environmental Management

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INDEMNITY AND CONDITIONS RELATING TO THIS REPORT

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1. BACKGROUND

Wetland Consulting Services (Pty) Ltd were appointed by EIMS to conduct a detailed wetland assessment study along the proposed route of a 400kV Kendal Zeus Kusile transmission line. In order to negate or mitigate the impacts associated with the construction and maintenance of the transmission lines, it is necessary to determine the distribution of freshwater aquatic habitat within the proposed route. The objectives of the study are:

- To identify, map and describe the wetland and riparian systems intercepted by the respective transmission line routes. This will indicate the environmentally preferred route, as well as inform the position of hard infrastructure associated with the lines;
- To identify the key ecological drivers of the respective wetland and riparian systems based on their hydro-geomorphological classification;
- To provide recommendations on the positioning of access infrastructure for the construction and maintenance phases of the development, with the overriding goal being the responsible management of the environmental resources associated with the development.

The wetland delineation undertaken as part of this report will be used to inform final alignment plans for the transmission line and to determine the extent of sensitive areas and recommended re-alignment and provide appropriate mitigation measures thereafter. The requirement to establish the existence and/or extent of wetlands on these properties is based on the legal requirements contained in both NEMA as well as the Water Act which make it an offense to affect a wetland without the necessary authorization.

2. APPROACH AND METHODS

The route requires assessment is approximately 120 km in length. A combination of desktop assessment supplemented by ground-truthing was considered appropriate to achieving the objectives of the study economically and efficiently. The approach adopted is described in detail as follows.

2.1 Desktop Delineation

A desktop assessment was conducted of the proposed powerline routes, with wetland and riparian units crossed by the powerline identified using a range of tools, including:

- 1: 50 000 topographical maps;
- S A Water Resources;
- Recent, relevant aerial and satellite imagery, including Google™ Earth.

All areas suspected of being wetland and riparian habitat based on the visual signatures on the digital base maps were mapped using ArcView.

2.2 Ground Truthing

The wetland identified during the desktop assessment was ground- truthed, and the boundaries determined according to *A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas- Edition 1* (DWAF, 2005).
Using this procedure, wetlands are identified and delineated using:

- The terrain unit indicator;
- The soil form indicator;
- The soil wetness indicator; and
- The vegetation indicator.

The riparian habitat was classified in accordance with the stream channel classification within DWAF (2005), and the edge identified as the point near the edge of the macro channel bank where there is a distinct difference between the riparian vegetation and the adjacent terrestrial vegetation. The riparian unit is further characterised by alluvial deposits and the topographic unit.

2.3 Hydro-geomorphic Setting

A classification system has recently been proposed, and widely accepted, that recognises the link between wetland types to water and their geomorphological position in the landscape, commonly referred to as the hydro-geomorphic (HGM) approach. This approach is based on three fundamental factors that influence how wetlands function, namely:

- Position in the landscape (geomorphic setting);

- Water source (hydrology); and
- The flow and fluctuation of the water once in the wetland (hydrodynamics).

The HGM approach classifies wetlands based on their differences in functioning, and importantly defines the functions that each class of wetland is likely to perform. The approach has been modified for use locally by Marneweck and Batchelor (2002) and Kotze, Marneweck, Batchelor, Lindley and Collins (2004), and has recently been proposed as the basis of inland wetland classifications in South Africa (Ewart-Smith *et al*., 2006). Each wetland system encountered was classified accordingly, and the subsequent information assimilated to produce a Geographical Information System (GIS) coverage of the wetland habitat within the boundary of the development corridor.

2.4 Wetland Functional Assessment

The functional assessment technique, WET-Eco-Services, developed by Kotze *et al* (2009) was used to provide an indication of the ecological benefits and services provided by the wetlands within the site. This technique consists of assessing a combination of desktop and infield criteria in order to identify the importance and level of functioning of the wetland units within the landscape.

2.5 Present Ecological State (PES)

For the purpose of this study, the scoring system as described in the document "*Resource Directed Measures for Protection of Water Resources. Volume 4. Wetland Ecosystems*" (DWAF, 1999) was applied for the determination of the PES and EISC. Two tools have been developed to facilitate the derivation of scores, namely the Index of Habitat Integrity (IHI) developed by Rountree et al, 2009, and Wet-Health, developed by Macfarlane et al., 2008. Both these tools have limitations in that they were developed primarily to assess conditions of floodplain and valley bottom wetlands and hillslope seepage wetlands linked to drainage lines. The former tool was developed to provide a rapid assessment of the Present Ecological Status (PES) specifically for application in reserve studies, while the latter tool was developed to support the Working for Wetlands program. The objective of the latter tool was to provide a semi quantitative assessment of the state of wetland prior to rehabilitation, and one post rehabilitation to demonstrate "improvement". The intention in defining the health category (PES) of a wetland is to provide an indication of the current "condition" of a wetland in order to inform a management class. The latter provides the guidelines against that inform water quality and quantity required to maintain or improve the quality of the water resource.

An attempt was made to apply the tool Wet-health to provide an indication of the departure of the classified systems from an un-impacted state.

Wet-Health comprises three modules, a hydrological, geomorphological and vegetation module, each one providing indicators that collectively contribute to determining the overall PES. This tool was applied in a modified form to the watercourses present on the site, as they have evolved from the requirement to establish a Reserve in order to maintain or improve the state of a water resource.

Table 1: A description of the descriptions and associated impact score ratings used to inform the "health" of the characteristics of a wetland (Macfarlane et al., 2008.)

Impact Category	Description	Impact Score Rating
None	No discernible modification or the modification is such that it has no impact on wetland integrity	0-0.9
Small	Although identifiable, the impact of this modification on wetland integrity is small.	1-1.9
Moderate	The impact of this modification on wetland integrity is clearly identifiable, but limited.	2-3.9
Large	The modification has a clearly detrimental impact on wetland integrity. Approximately 50% of wetland integrity has been lost.	4-5.9
Serious	The modification has a clearly adverse effect on this component of habitat integrity. Well in excess of 50% of the wetland integrity has been lost.	6-7.9
Critical	The modification is present in such a way that the ecosystem processes of this component of wetland health are totally / almost totally destroyed.	8-10

2.6 Ecological Importance and Sensitivity (EIS)

The procedure for the determination of Resource Directed Measures for wetland ecosystems (DWAF, 1999) focuses on the biotic component of wetlands and tends to underplay the value of the water that the wetlands reflect. The overall ecological importance and sensitivity of the wetlands is based primarily on the range of goods and services provided by them, including biodiversity support, use by people and livestock, and hydrological importance. The following were considered in assessing the Ecological Importance & Sensitivity (EIS) of the wetlands along the routes:

- Ecological importance, typically considering aspects such as whether the wetland supports red data species, populations of unique species, the protection status of the wetland, its uniqueness and size and the sensitivity of the wetland to perturbation.

- Hydrological functions such as flood attenuation, contaminant transformation, stream flow regulation, carbon sequestration and storage
- Direct human benefits such as provision of harvestable products, source of water, recreation and tourism, cultural rites.

The recently published NFEPA database was considered in this assessment.

Table 2: Table showing the rating scale used for the EIS assessment.

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

3. ASSUMPTIONS AND LIMITATIONS

The following assumptions were made regarding the study:

- The transmission line corridor was assumed to be approximately 55m wide (27.5m on either side of the provided route based on the servitude information provided);
- There is a degree of flexibility available in the positioning of the powerline pylons within the servitude;
- The development is a linear feature, and the nature of the disturbance associated with it is spatially and temporally limited;

4. RESULTS

4.1 Site Characteristics

The route to be evaluated is situated approximately 120km from Zeus Sub-station to Kendal Power station in Mpumalanga Province (refer to **Figure 1**). The routes traverse agricultural lands, mining areas and around urban developed areas (Embalenhle township), with the terrain consisting of flats and undulating hills bisected by valleys containing substantial wetland systems.

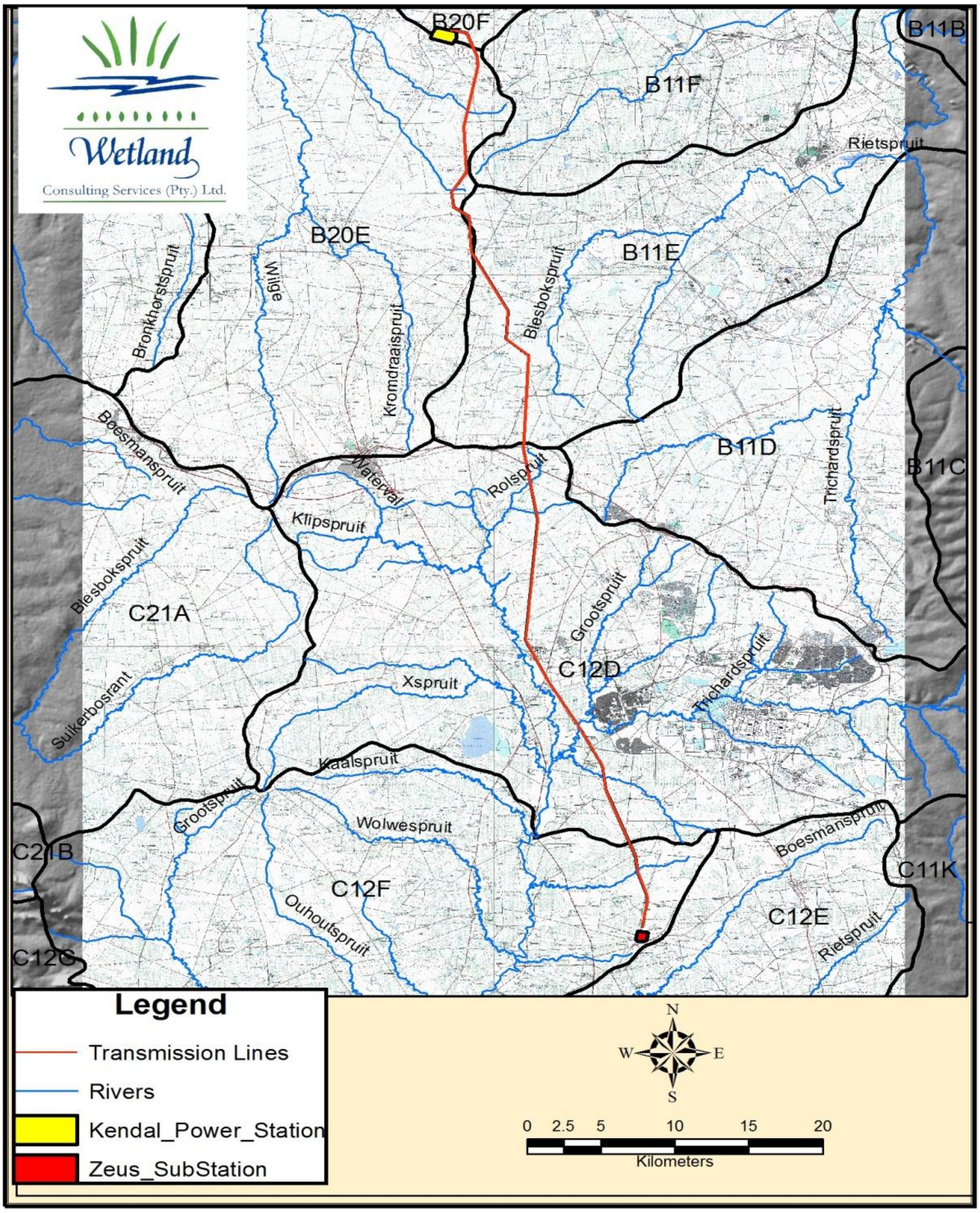


Figure 1: Locality of the Kendal - Zeus – Kusile 400Kv Transmission Line Route

4.2 National Freshwater Ecosystem Priority Areas

The recently published Atlas of Freshwater Ecosystem Priority Areas in South Africa (Nel *et al*, 2011) (The Atlas) which represents the culmination of the National Freshwater Ecosystem Priority Areas project (NFEPA), a partnership between SANBI, CSIR, WRC, DEA, DWA, WWF, SAIAB and SANParks, provides a series of maps detailing strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources. Freshwater Ecosystem Priority Areas (FEPA's) were identified through a systematic biodiversity planning approach that incorporated a range of biodiversity aspects such as ecoregion, current condition of habitat, presence of threatened vegetation, fish, frogs and birds, and importance in terms of maintaining downstream habitat. The Atlas incorporates the National Wetland Inventory (SANBI, 2011) to provide information on the distribution and extent of wetland areas. An extract of the NFEPA database is illustrated in Figure 2 below.

From the figures it is clear that there is Freshwater Ecosystem Priority Areas (FEPA) in the form of wetland areas occurring within the proposed route and it also appears that there is a lack of information on the southern section comparing to the northern section. Therefore much emphasis will be to undertake verification and field delineation and assessments to create more reliable baseline data to inform decision on site in addition to readily available information.

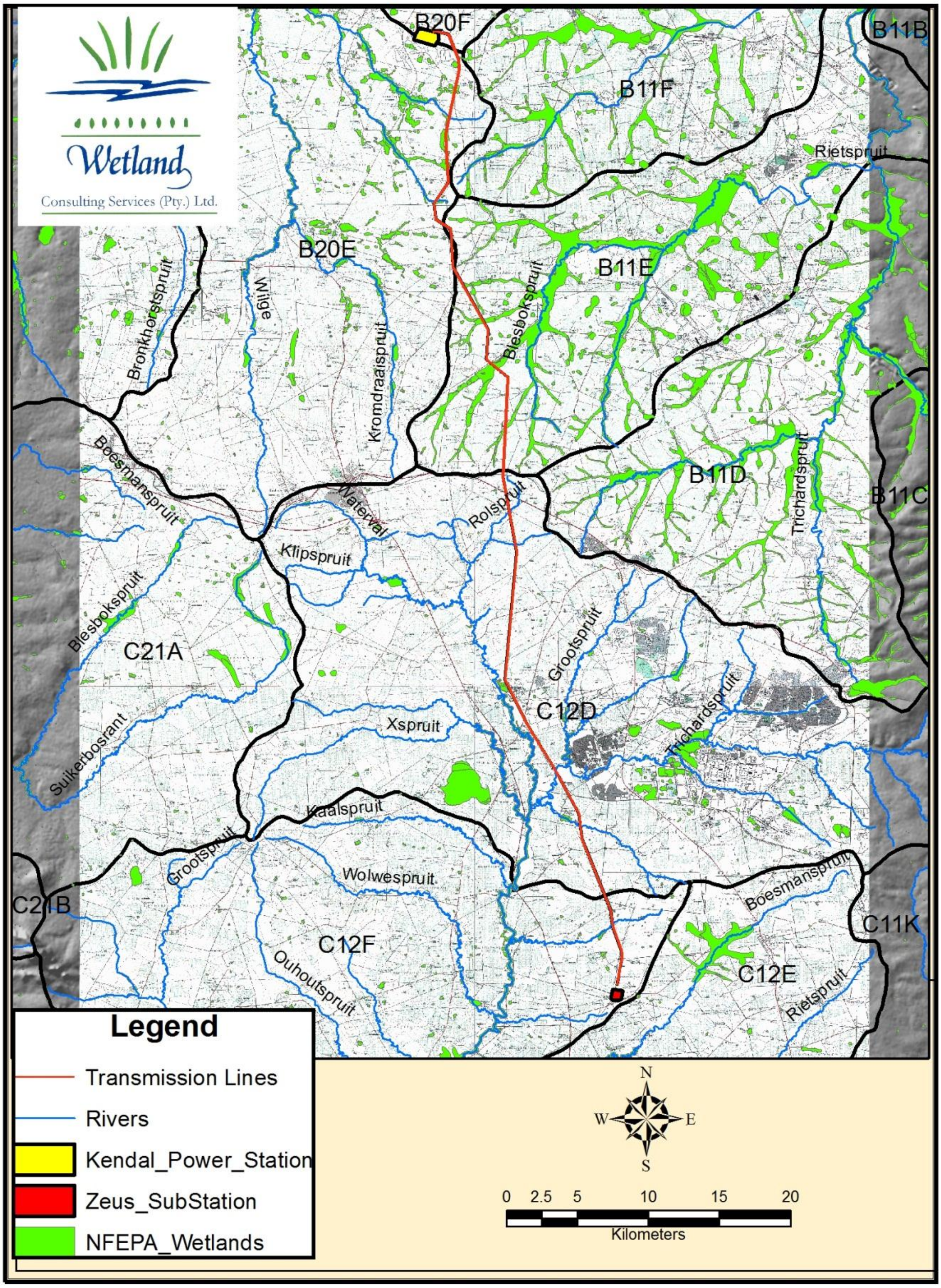


Figure 2: Extract of the Atlas of Freshwater Ecosystem Priority Ares in South Africa (Nel *et al*., 2011) – North Section

4.3 Wetland delineation and classification

A site visits were undertaken to identify and delineate wetlands within a radius of 500m of the proposed transmission line, as shown in Figure 3 below.

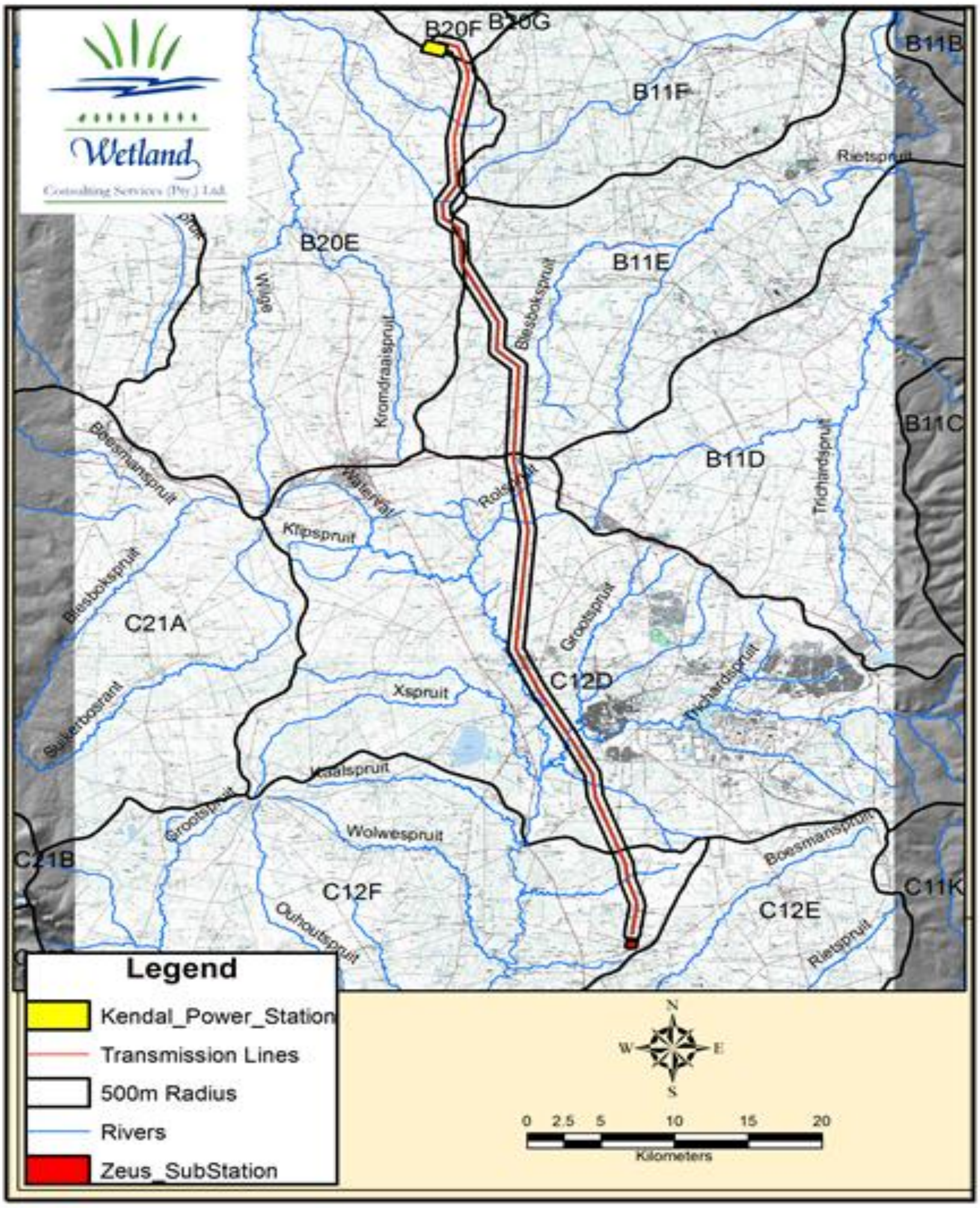


Figure 3: Map indicating surveyed area within a radius of 500m of the Transmission line

Within a radius of 500m five types of watercourse[1] were identified, namely:

[1] Watercourse means –
(a) a river or spring;
(b) a natural channel in which water flows regularly or intermittently;
(c) a wetland, lake or dam into which, or from which, water flows; and
(d) any collection of water which the Minister may, by notice in the *Gazette*, declare to be a water course, and a reference to a water course includes, where relevant, its bed and banks.
(Definition taken from the National Water Act, Act 36 of 1998)

- Channelled Valley Bottom wetlands;
- Floodplains
- Un-channelled Valley Bottom wetlands;
- Hillslope seepage wetlands; and
- Pans (depressions)

Table 3: Hydro-geomorphic classification system (adapted from Brinson, 1993; Kotze, 1999; and Marneweck and Batchelor, 2002).

Hydro-geomorphic Type	Description
Channelled Valley Bottom	Valley bottom areas with a well-defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterised by the net accumulation of alluvial deposits or may have steeper slopes and be characterised by the net loss of sediment. Water inputs from the main channel and adjacent slopes.
Unchannelled Valley Bottom	Valley bottom areas with no clearly defined stream channel usually gently sloped and characterised by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from channel entering the wetland and also from adjacent slopes.
Floodplains	Valley bottom areas with a well-defined stream channel gently sloped and characteristic by floodplain features such as oxbow depressions and natural levees and the alluvial (by water) transport and deposition of sediments, usually leading to a net accumulation of sediments. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.
Hillslope Seepage	Slopes on hillsides which are characterised by the colluvial movement of materials. Water inputs are mainly from subsurface flow and outflow can be via a well-defined stream channel connecting the area directly to a stream channel or outflow can be through diffuse subsurface and/or surface flow but with no direct surface water connection to a stream channel.
Pans (depressions)	A basin shaped areas with a close elevation contour that is not connected via an outlet to the drainage network. Inputs are variable including groundwater, rainfall and lateral flows and outputs mostly evapo- transpiration unless it's a leaking system.

Photographs below indicate some of the Hydro-geomorphic classification types of wetland recorded on site.

Channelled Valley Bottom wetlands;


Floodplains


Un-channelled Valley Bottom wetlands;


Hillslope seepage wetlands; and


Pans (depressions)

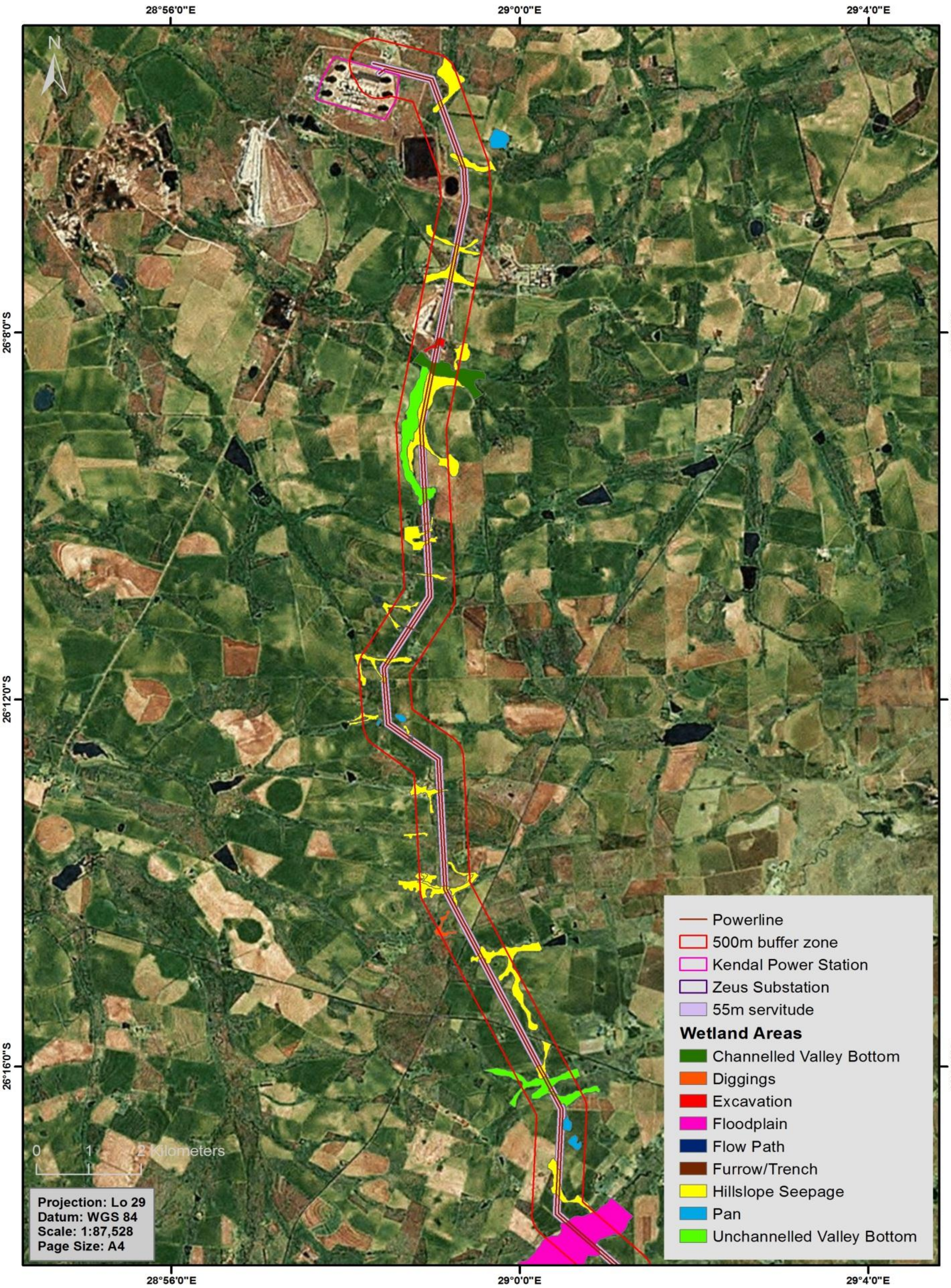



Figure 4: Maps showing the verified, delineated and classified wetlands along transmission line – Northern section

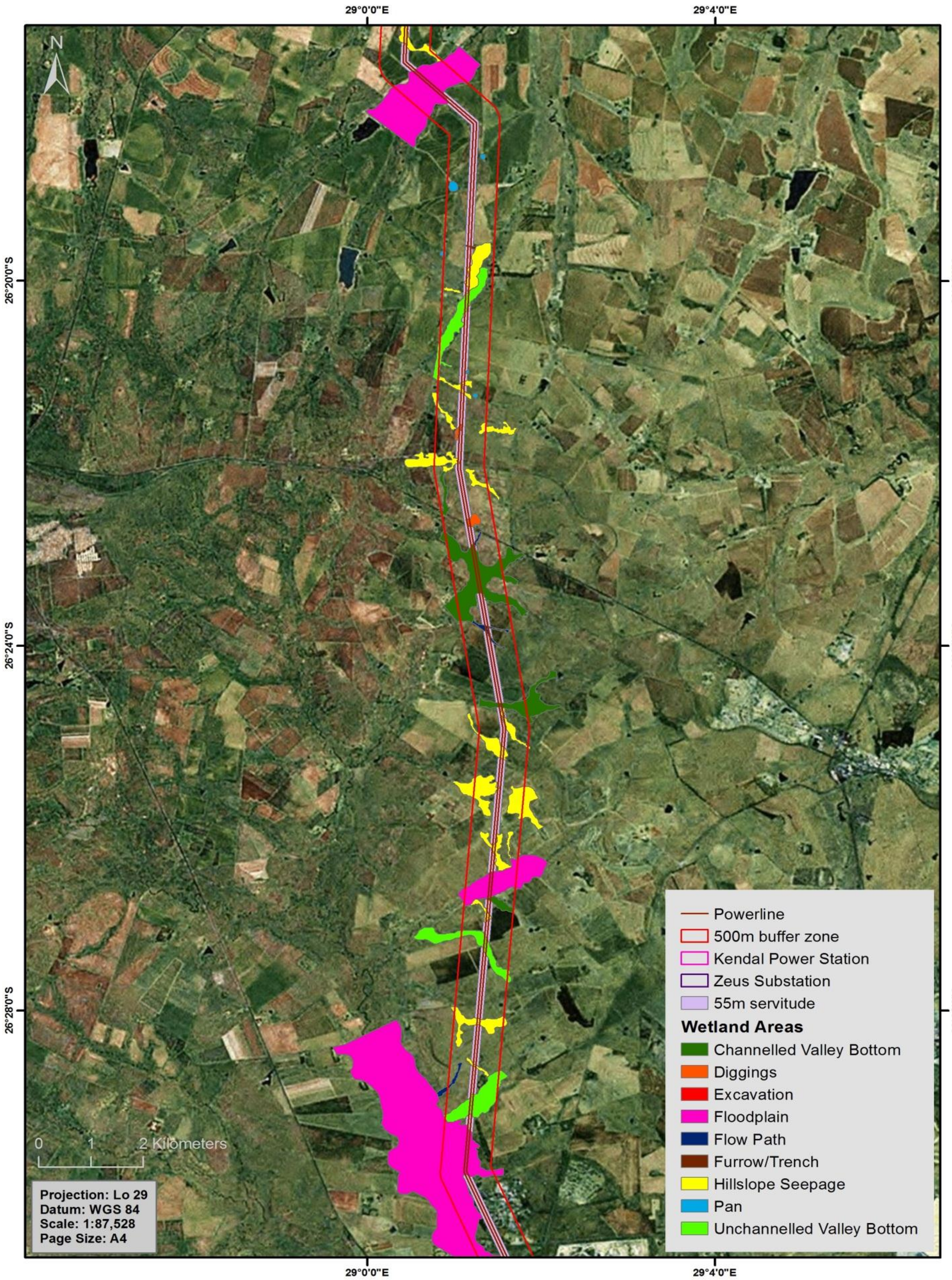


Figure 5: Maps showing the verified, delineated and classified wetlands along transmission line – Middle section

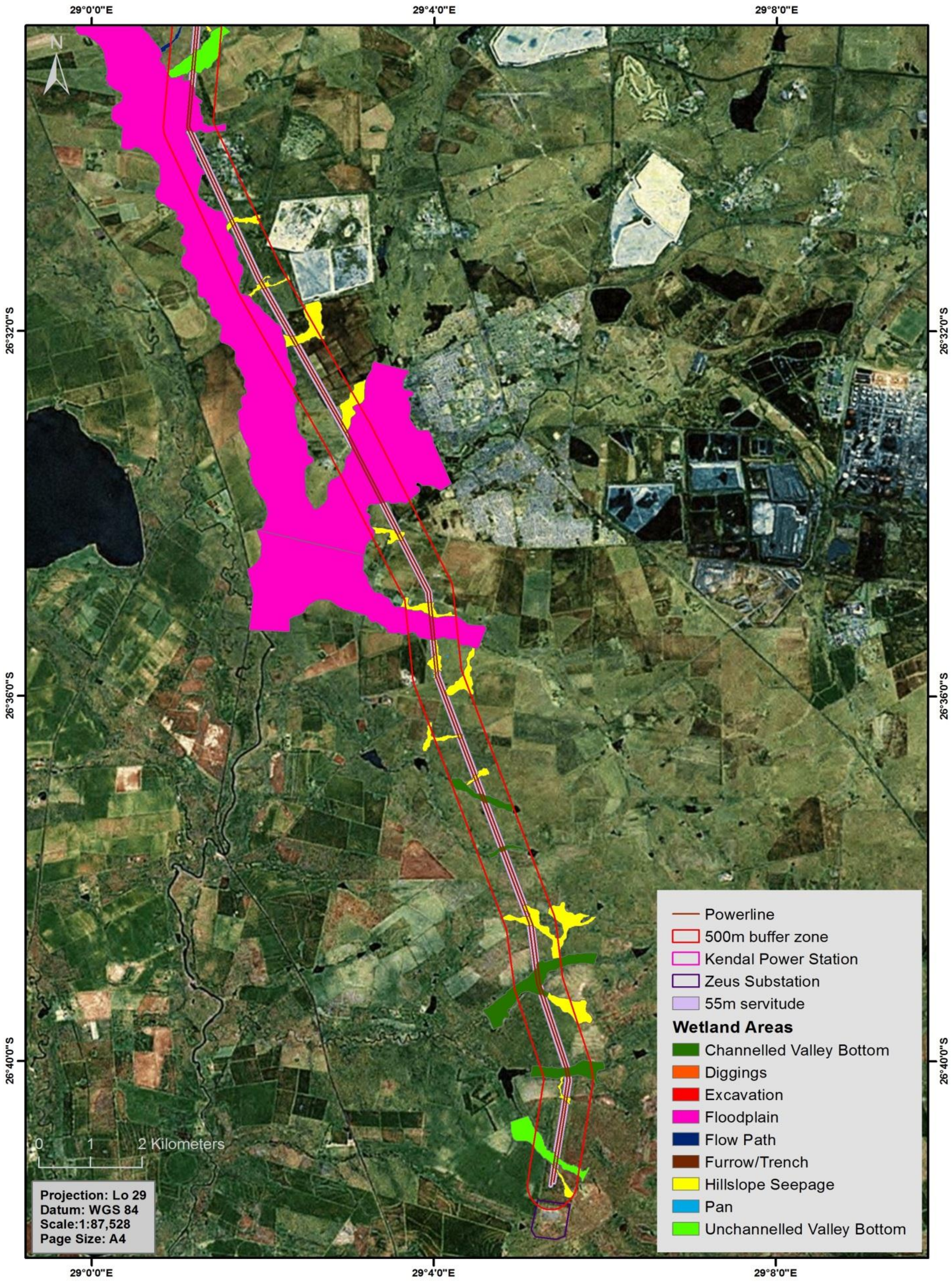


Figure 6: Maps showing the verified, delineated and classified wetlands along transmission line – southern section.

4.4 Wetland Functional Assessment

Wetlands support a number of functions that include biodiversity support, nutrient removal, and more specifically nitrate removal, sediment trapping, and associated with this trapping of phosphates bound to iron as a component of the sediment, and flow regulation. Many of these functions linked to wetlands are wetland type specific and can be linked to the position of wetlands in the landscape as well as to the way in which water enters and flows through the wetland. For the purpose of this study a Wet-Eco-Services tool ((Kotze, Marneweck, Batchelor, Lindley and Collins, 2004) was applied for four different types of wetland systems occurring within the study area. This tool enables one to make relative comparisons of systems based on a logical framework that measures the likelihood that a wetland is able to perform certain functions.

4.4.1 Channelled valley bottom wetlands

The functions performed by this wetland type include:

- Biodiversity support. The presence of valley bottom wetlands, or for that matter any wetland affords habitats that otherwise would not be available. Associated with these habitats are plant and animal species adapted to these conditions.
- Flood attenuation. Valley bottom wetlands are often indicated as effective systems for flood attenuation. One of the reasons for this include a reduction in velocities as water over tops the banks, thus increasing the cross sectional area over which the water has to pass, as well as increasing the roughness due to plants .
- Sediment trapping, principally during high flow events when flood waters over top the banks resulting in flow retardation. When this occurs flow rates drop which in turn reduces the capacity of the water to transport sediments. This precipitates on the margins of the channel.
- Phosphate removal. There is some evidence that phosphates bound to soil particles are transported into wetlands during rainfall events as well as through dry deposition as dust. As a consequence both sediments and the adsorbed phosphates deposit in the wetlands where the phosphate may be released following prolonged saturation, following the onset of anaerobic conditions.
- Nitrate reduction. Nitrate reduction may occur in channelled valley bottom wetlands during low flow periods when there is a better chance of the nitrates contacting reduced zones (vegetated sections) within the wetland. Contact time and carbon availability both have an influence on the rate at which nitrates are reduced.

In summary, typical functions associated with channelled valley bottom wetlands include water quality improvement, particularly with respect to sediment, phosphate and nitrate nitrogen removal and flood attenuation. As a consequence of these attributes, valley bottom wetlands are accreting systems; with the result that the position of the channel can vary flood flows seek out the paths of least resistance through the wetland.

4.4.2 Floodplains

Floodplains generally receive most of their water during high flow events when water overtops the stream banks. They are considered to be important for flood attenuation because of nature of the vegetation and topographic setting that they occupy. Flood attenuation is likely to be high early in the season until the flood plain soils are saturated and oxbows and other depressions are filled. Floodplain with course sediments could contribute significantly to streamflow and groundwater recharge. Phosphorus and any toxicants bound to trapped sediments is therefore likely to be effectively retained on the floodplains, and this a key mechanism through which wetlands trap phosphorus. The concentration of nutrients in flood waters entering the floodplain is often low due to dilution effects. However, the behaviour of nitrogen is oxbows and depressions is likely to be similar to that in pans, with cycling between dissolves and organic forms and with some removal from the water through de-nitrification

4.4.3 Unchannelled valley bottom wetlands

Un-channelled valley bottom wetlands reflect conditions where surface flow velocities are such that they do not, under existing flow conditions, have sufficient energy to transport sediment to the extent that a channel is formed. In the study site and along powerline route they are located primarily in the upper reaches of the streams. In addition to the biodiversity associated with these systems it is expected that they play an important role in retaining water in the landscape as well as in contributing to influencing water quality through for example mineralization of rain water. These wetlands could be seen to play an important role in nutrient removal, including ammonia through adsorption onto clay particles. The interflow component undoubtedly contributes to the base flow component in the streams and in farm dams where these flows have been intercepted.

4.4.4 Hillslope seepage wetlands

Hillslope seepage wetlands recorded along the routes are predominantly associated with the weathering of various geological formations mainly sandstone and Shale derived soils in the catchment and typically reflect the presence of seasonal, shallow interflow. As is the case of the other wetland types, hillslope seepage wetlands support plants in particular, and associated insects, birds and small mammals adapted to the seasonal moisture regime. In addition hill slope seeps support conditions that facilitate both sulphate and nitrate reduction as interflow emerges through the organically rich wetland soil profile, and are thus thought to contribute to water quality improvement. They typically represent low energy environments where soil moisture conditions remain for an extended period following the cessation of rains. As hillslope seepage wetlands, for the most part, are dependent on the presence of an aquiclude, either a hard or soft plinthic horizon, they are not generally regarded as significant sites for groundwater recharge (Parsons, 2004). However, by retaining water in the landscape and then slowly releasing this water into adjacent valley bottom or floodplain wetlands, hillslope seepage wetlands may contribute to stream flow augmentation, especially during the rainy season and early dry season.

4.4.5 Pans

Given the position of most pans within the landscape, which is usually isolated from any stream channels, the opportunity for pans to attenuate floods is fairly limited, though some run-off is stored in pans. Pans are also not considered important for sediment trapping, as many pans are formed through the removal of sediment by wind when the pan basins are dry. Some precipitation of minerals and de-nitrification is expected to take place within pans, which contributes to improving water quality, though accumulated salts and nutrients can be transported out of the system and deposited on the surrounding slopes by wind during dry periods. An important function performed by pans is the support of faunal and floral biodiversity, which is enhanced by the diversity in habitat types offered by different pans. In addition there is some albeit thin evidence that some pans act as “leaking” reservoirs in the landscape and thus regulate the flow of downstream feeding watercourse.

4.5 Present Ecological Status and Ecological Importance and Sensitivity

4.5.1 Present Ecological Status

All of the wetlands within the study area have been impacted upon to some degree. No pristine wetlands were found to occur within the study area. For the greater part of the study area the predominant land use surrounding the wetlands is mining and associated activities, power generations and supply infrastructures; road infrastructures including farm roads; impoundments, agriculture, consisting of grazing on both natural grasslands and improved pastures, and dry land. There is evidence that these activities have influenced primarily the vegetation but also the runoff characteristics of the landscape. In particular, cultivation within the wetland boundaries, especially the hillslope seepage wetlands, has impacted on the wetlands. The consequences of these changes in land use on wetlands is that most show signs of modification, but they, and the water that they reflect, continue to support wetland associated functions including biodiversity support, sediment trapping and in the case of floodplains and valley bottom systems, flood attenuation.

The PES score was based on obvious visible physical disturbance as well as observed hydrological changes and these were area weighted and every wetland is rated on a scale of A to F, with A being a natural or un-impacted wetland and F being a completely modified and altered wetland.

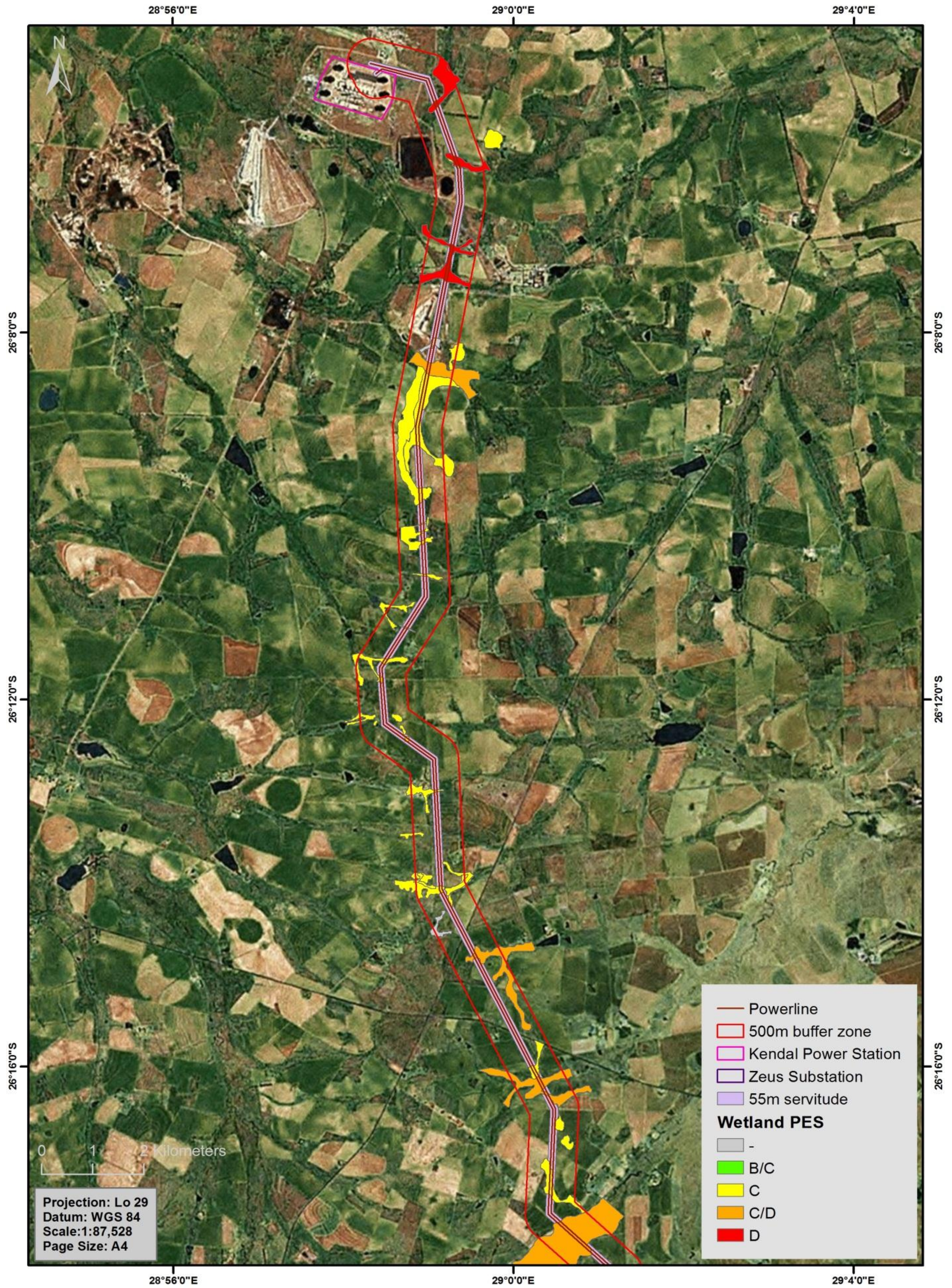


Figure 7: A map indicating PES assessment results of the watercourse along the transmission line – Northern Section

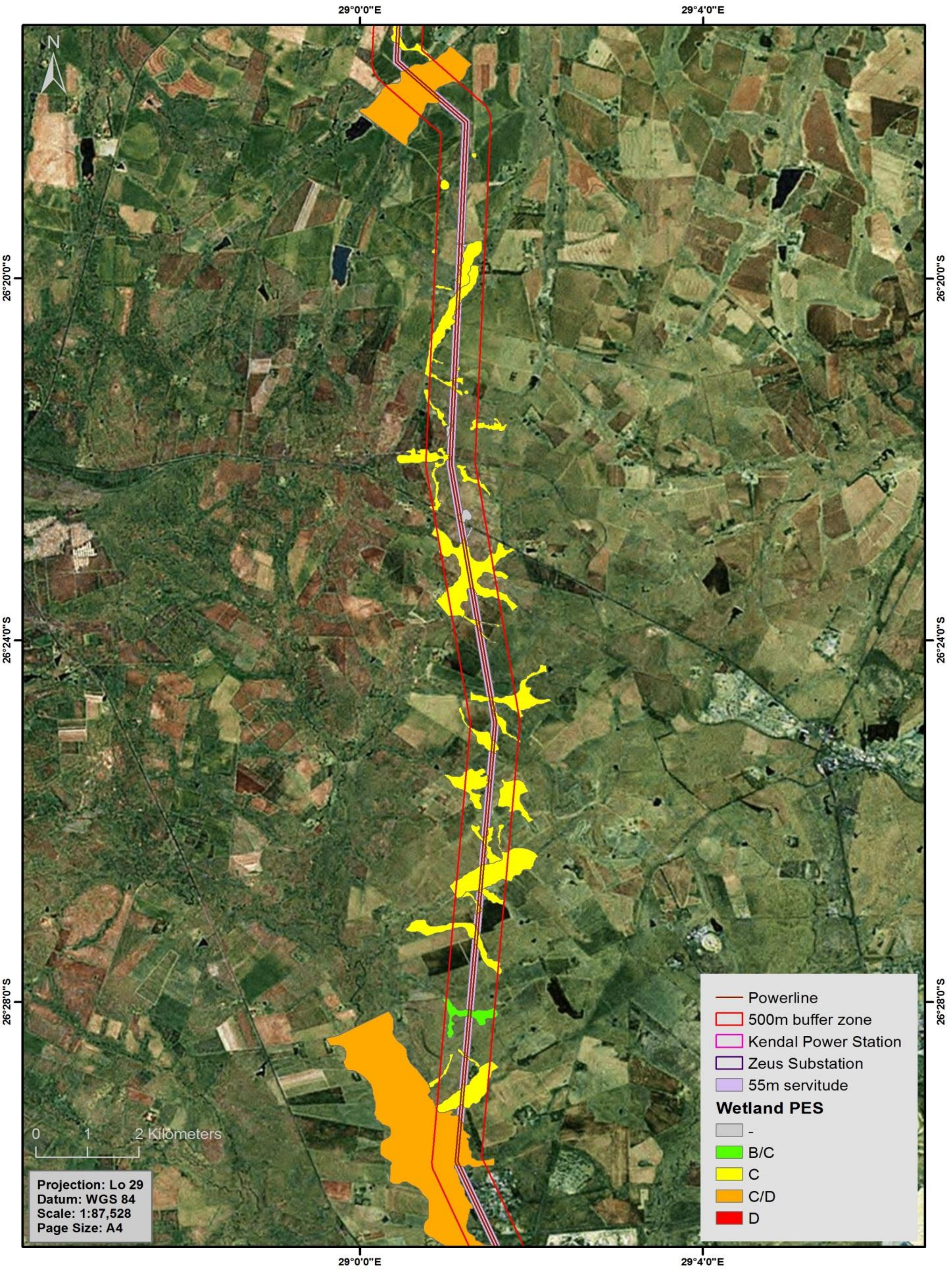


Figure 8: A map indicating PES assessment results of the watercourse along the transmission line – Middle Section

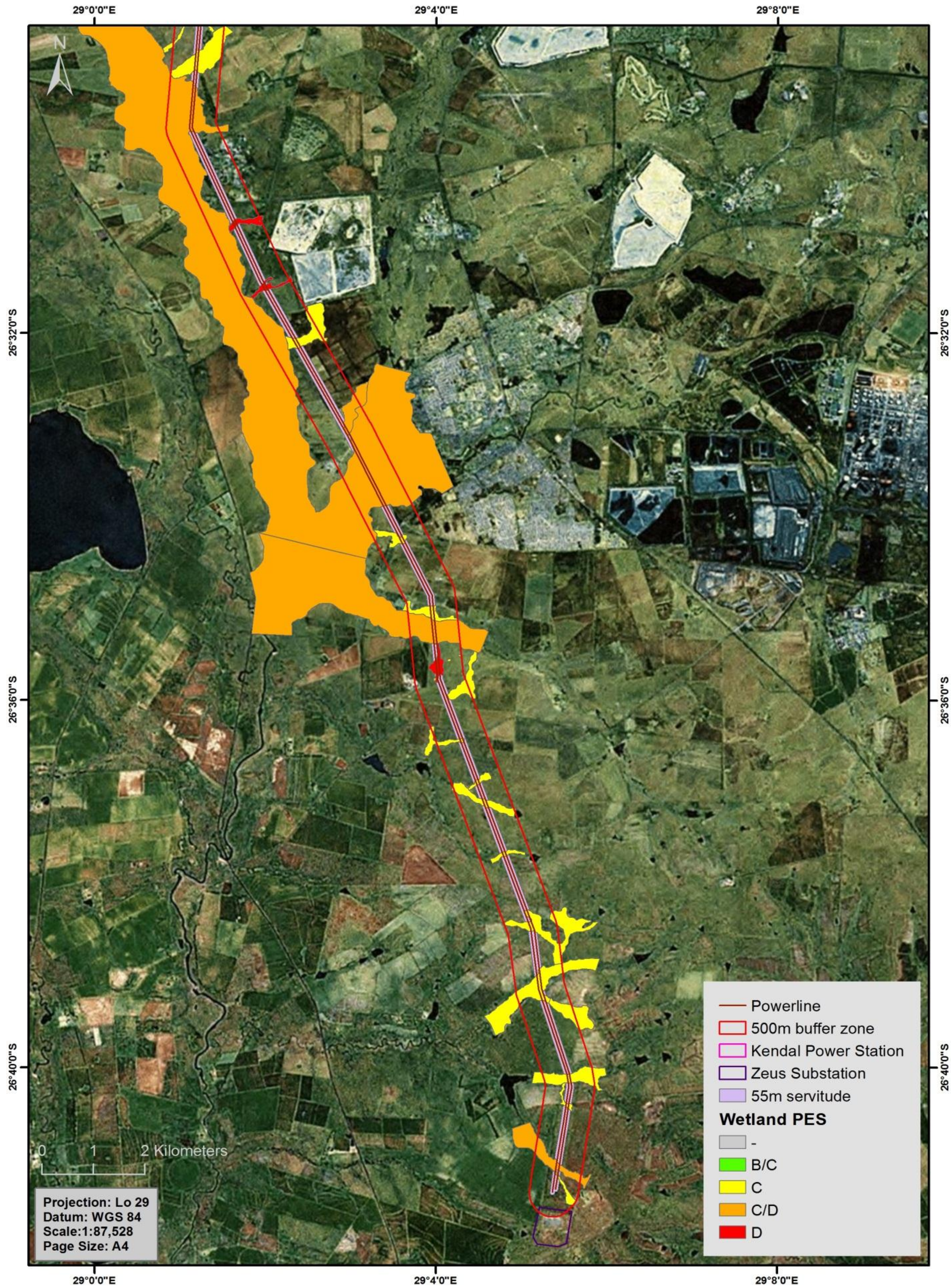


Figure 9: A map indicating PES assessment results of the watercourse along the transmission line – Southern Section

4.5.2 Ecological Importance and Sensitivity

Half of the transmission line falls with the Olifants River Primary catchment and other half within the Vaal River Primary catchment. Wetlands and rivers within the Olifants River Catchment upstream of Loskop Dam have been greatly impacted upon by various activities, which include mining, power stations, water abstraction, urbanization, agriculture etc. As a result of these impacts serious water quality concerns and also water quantity concerns have been raised within the sub-catchment. Given this situation, and the fact that wetlands can support functions such as water purification and stream flow regulation, a high importance and conservation value is placed on all wetlands and rivers within the catchment that have as yet not been seriously modified. Added to this, the study site is located at the top of four quaternary catchments, and as such all water draining to these catchments is being regulated by the wetland and rivers within the study area. The wetlands within the upper Vaal river section is still relatively un-impacted but however with mining activities approaching Secunda and surrounding areas, the future is unknown and it is most important to protect these system given that they form part of a larger water supply system to the Gauteng and surrounding i.e. the Vaal dam system .

It is these considerations that have informed the scoring of the systems in terms of their ecological importance and sensitivity. It should be mentioned that at present there is no generally applied method that has been developed for wetlands to inform this rating, however WCS has developed a simple scoring system based on the RDM methods as applied to river systems in order to provide a first order assessment of the desired management class in order to maintain the goods and services provided by the wetlands. The results of the assessment and rankings based on our current understanding of the wetlands are illustrated in Figure 10.

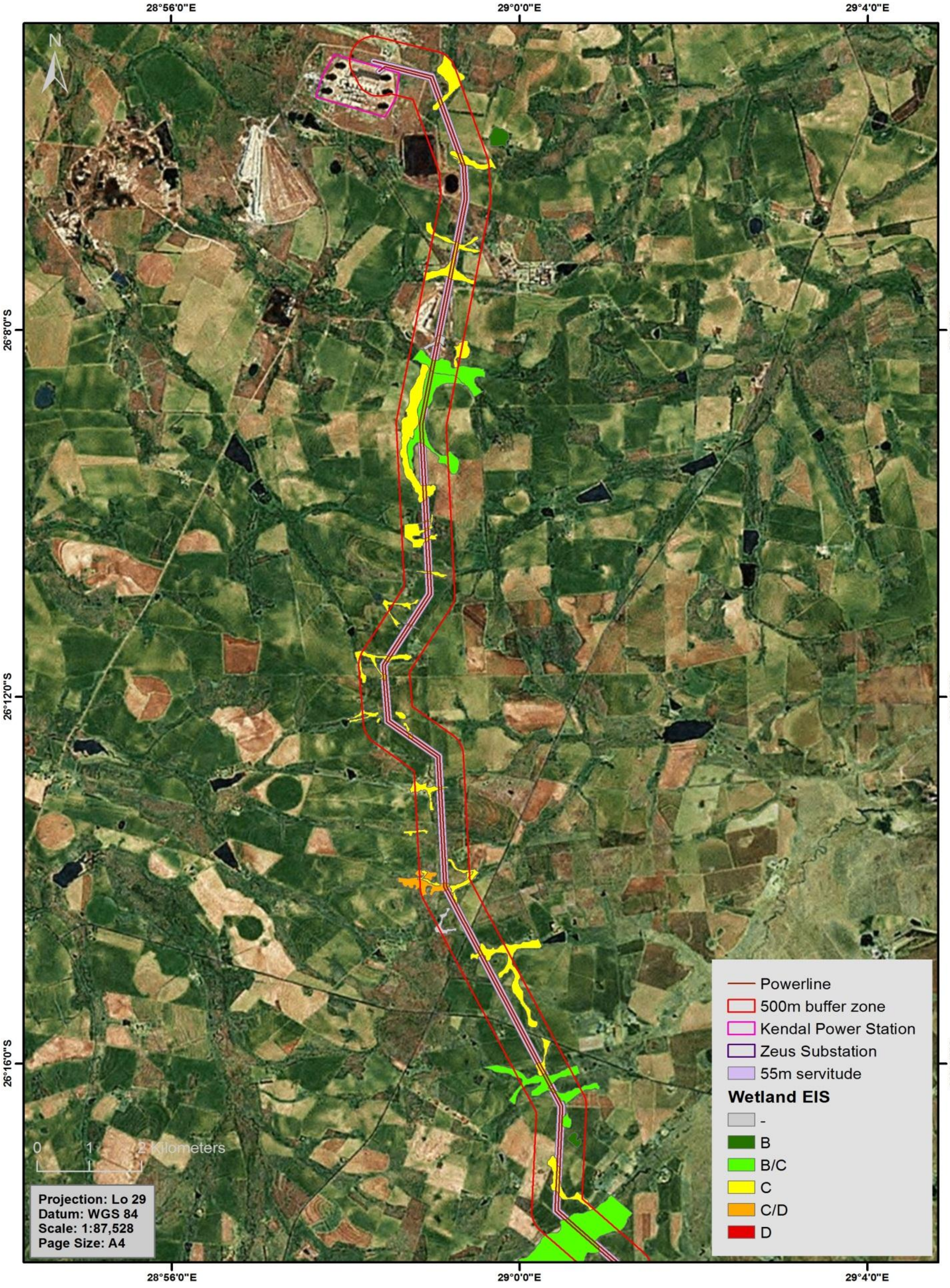


Figure 10: A map indicating EIS assessment results of the watercourse along the transmission line – Northern Section

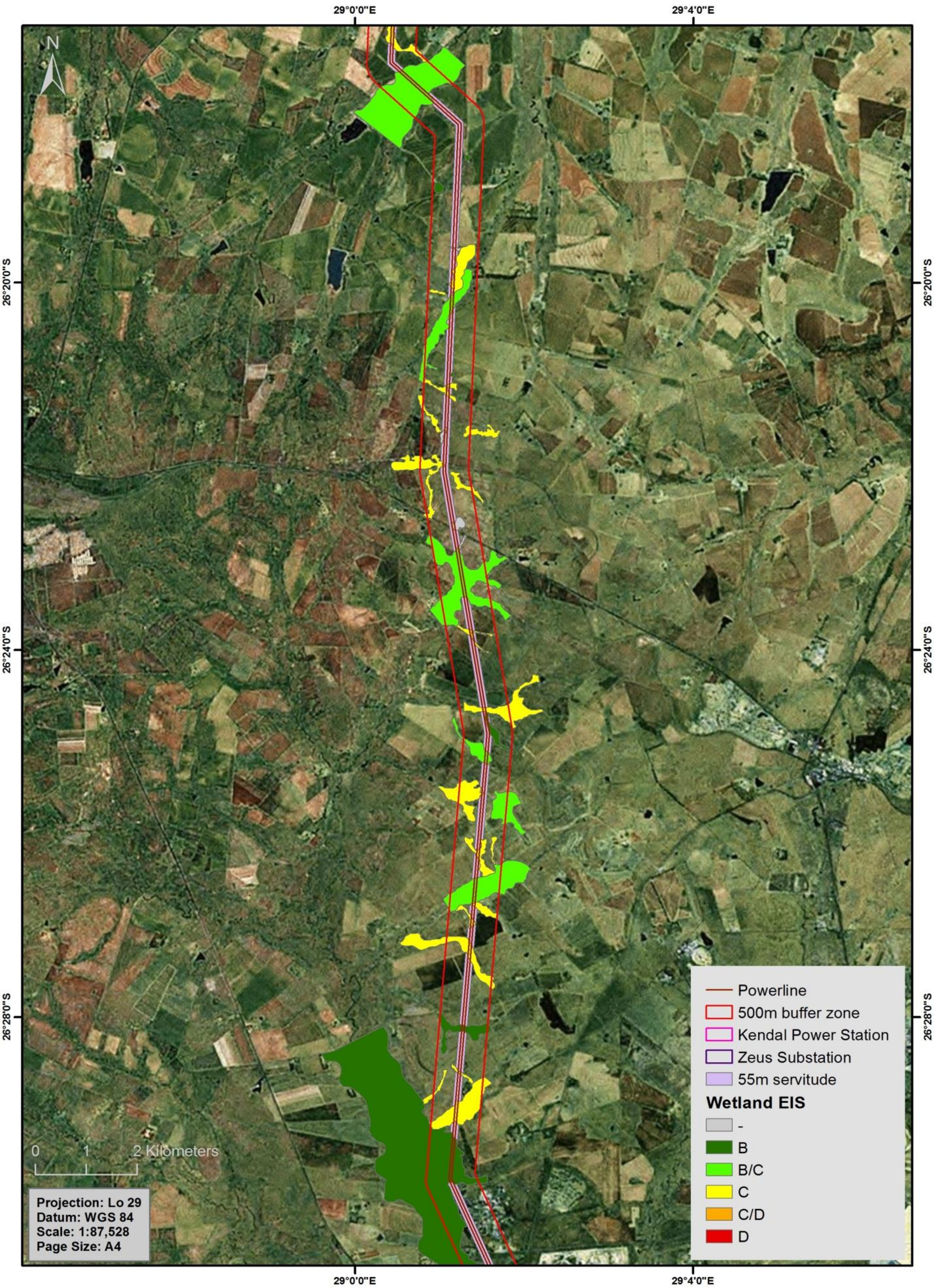


Figure 11: A map indicating EIS assessment results of the watercourse along the transmission line – Middle Sections

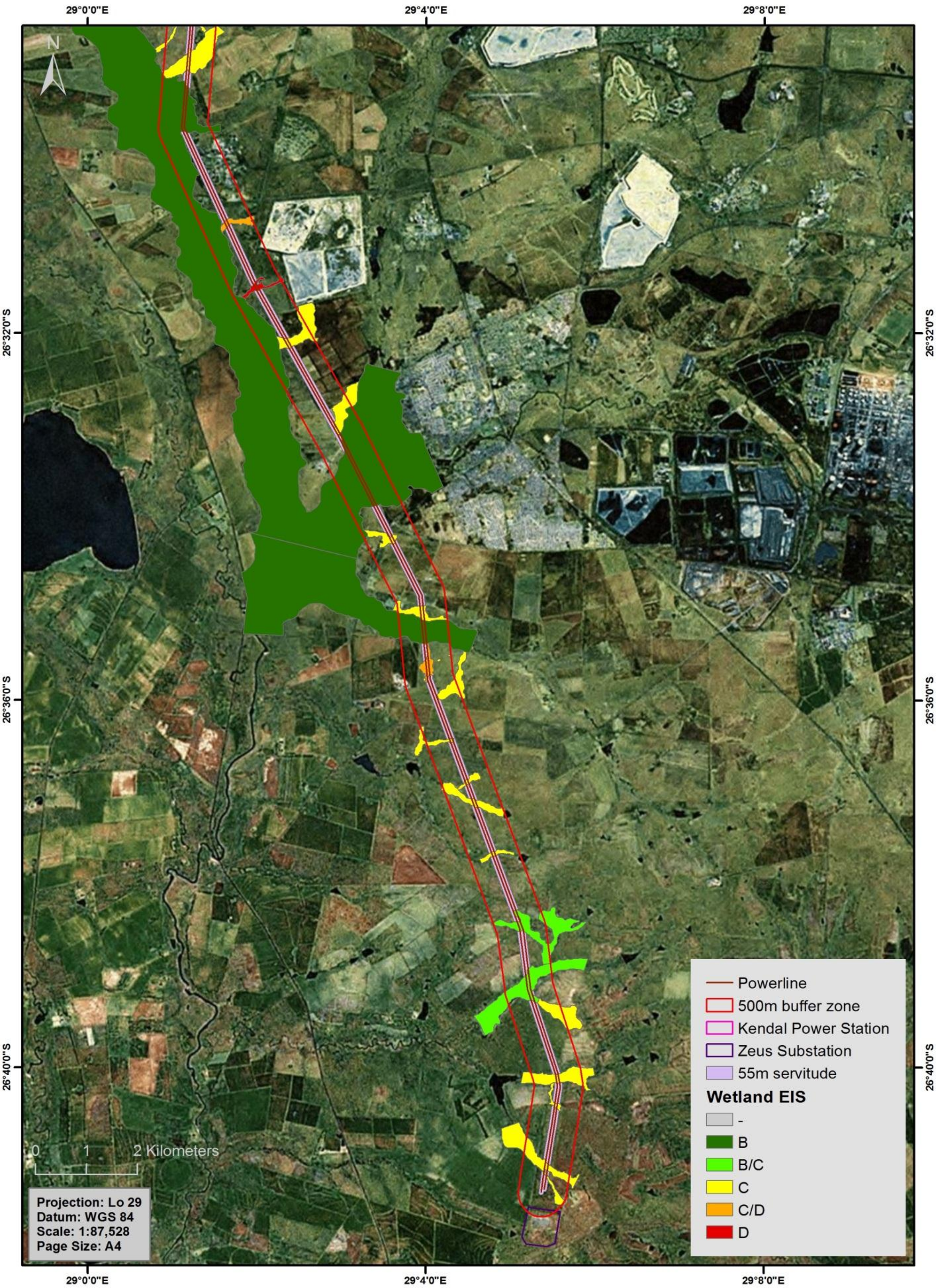


Figure 12: A map indicating EIS assessment results of the watercourse along the transmission line – Southern Section

5. POTENTIAL IMPACTS AND THEIR MITIGATION

5.1 Proposed Activities Description

The proposed activities consist of the installation and construction the Zeus-Kendal-Kusile 400Kv transmission lines. The proposed transmission lines consist of two powerlines running parallel to each other and as well as the associated supporting towers. The towers positions, as well as the staking tables indicating types of towers to be used were provided by Eskom.

The proposed towers positions were then overlaid on the delineated watercourses on site as indicated in Figures 13, 14 and 15. Table 4 below indicates towers that directly impact on and/or are within the delineated watercourses on site.

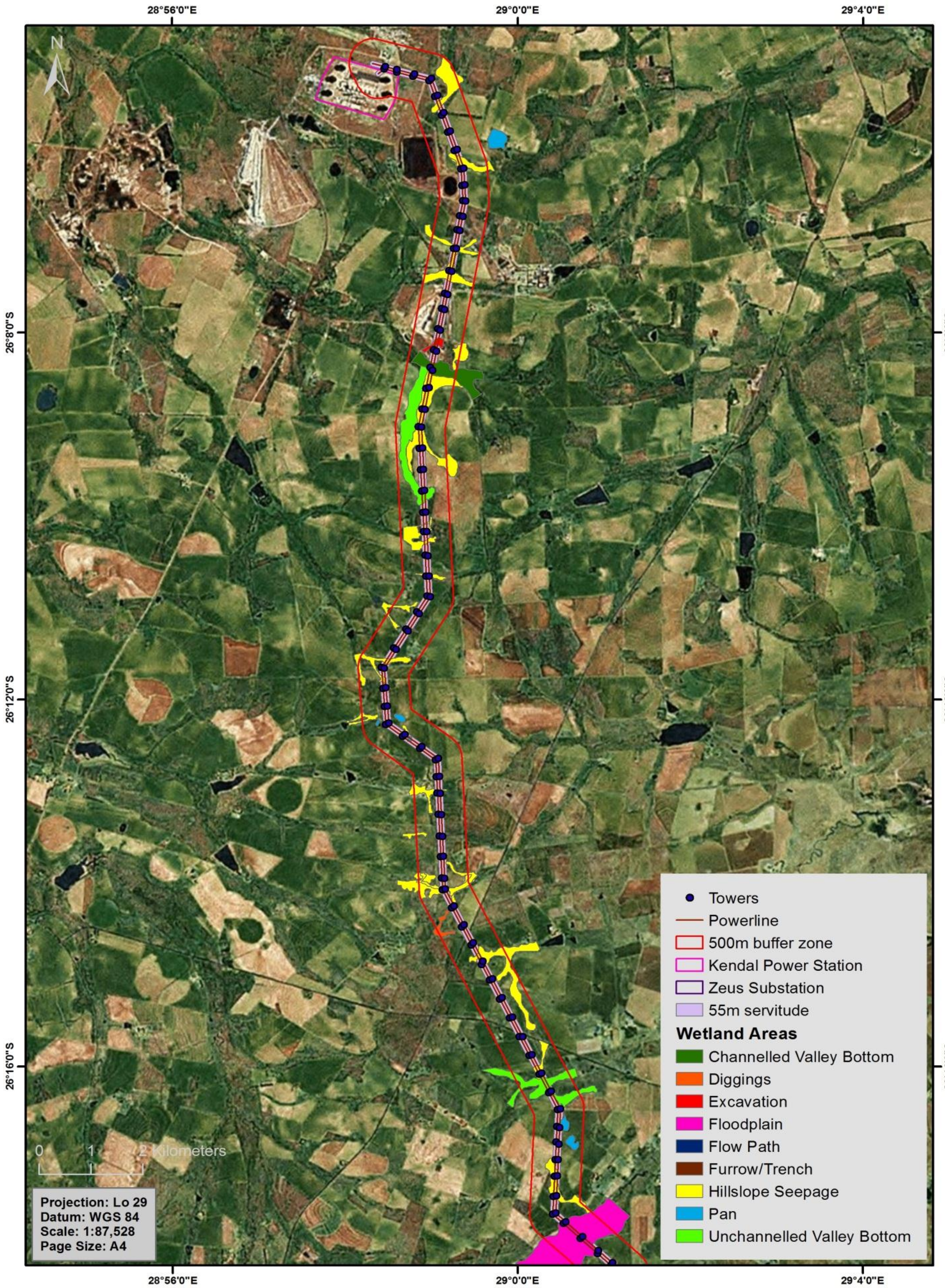


Figure 13: A map indicating position of the proposed towers in relation to the delineated watercourses – Northern Section

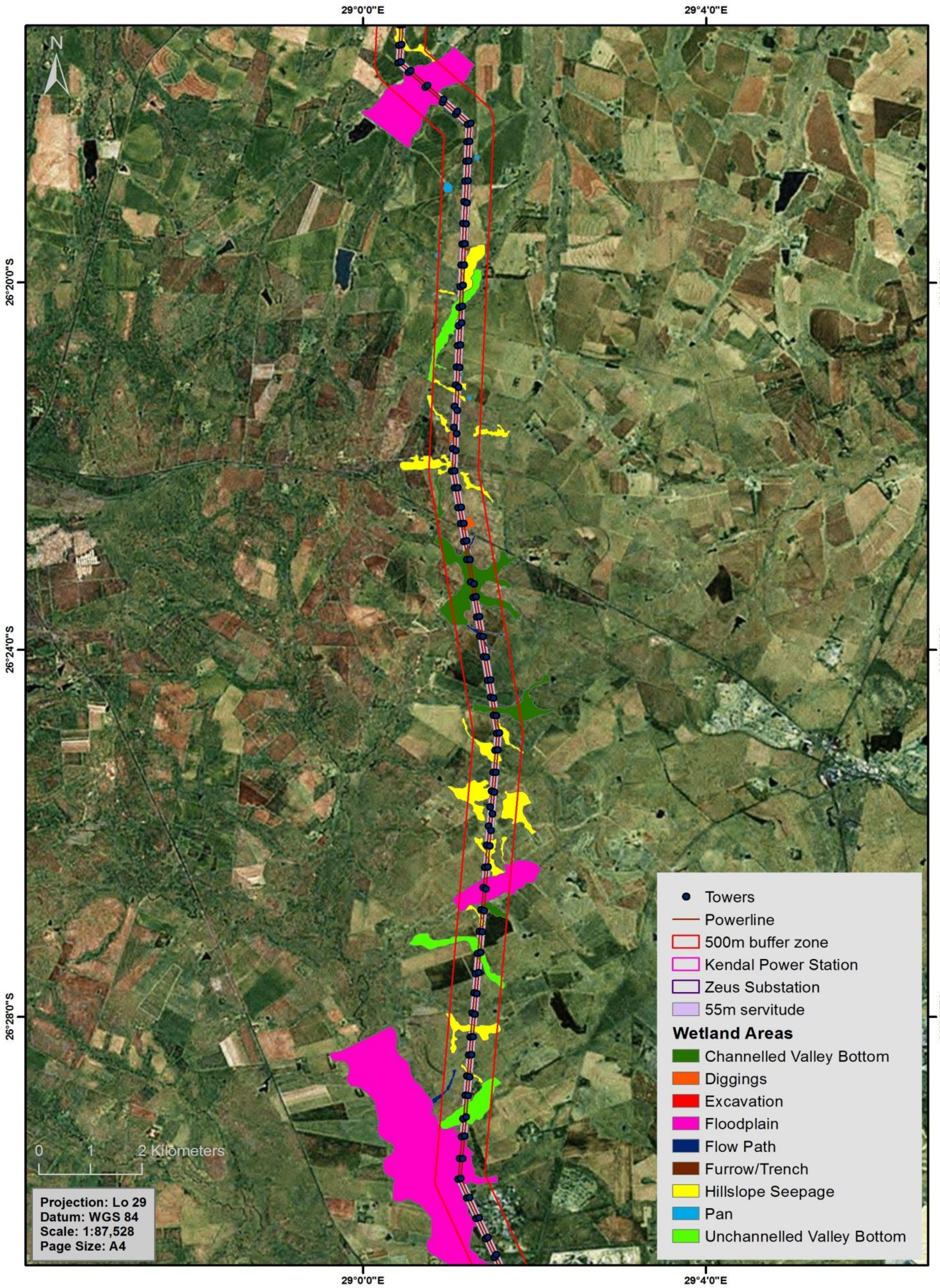


Figure 14: A map indicating position of the proposed towers in relation to the delineated watercourses – Middle Section

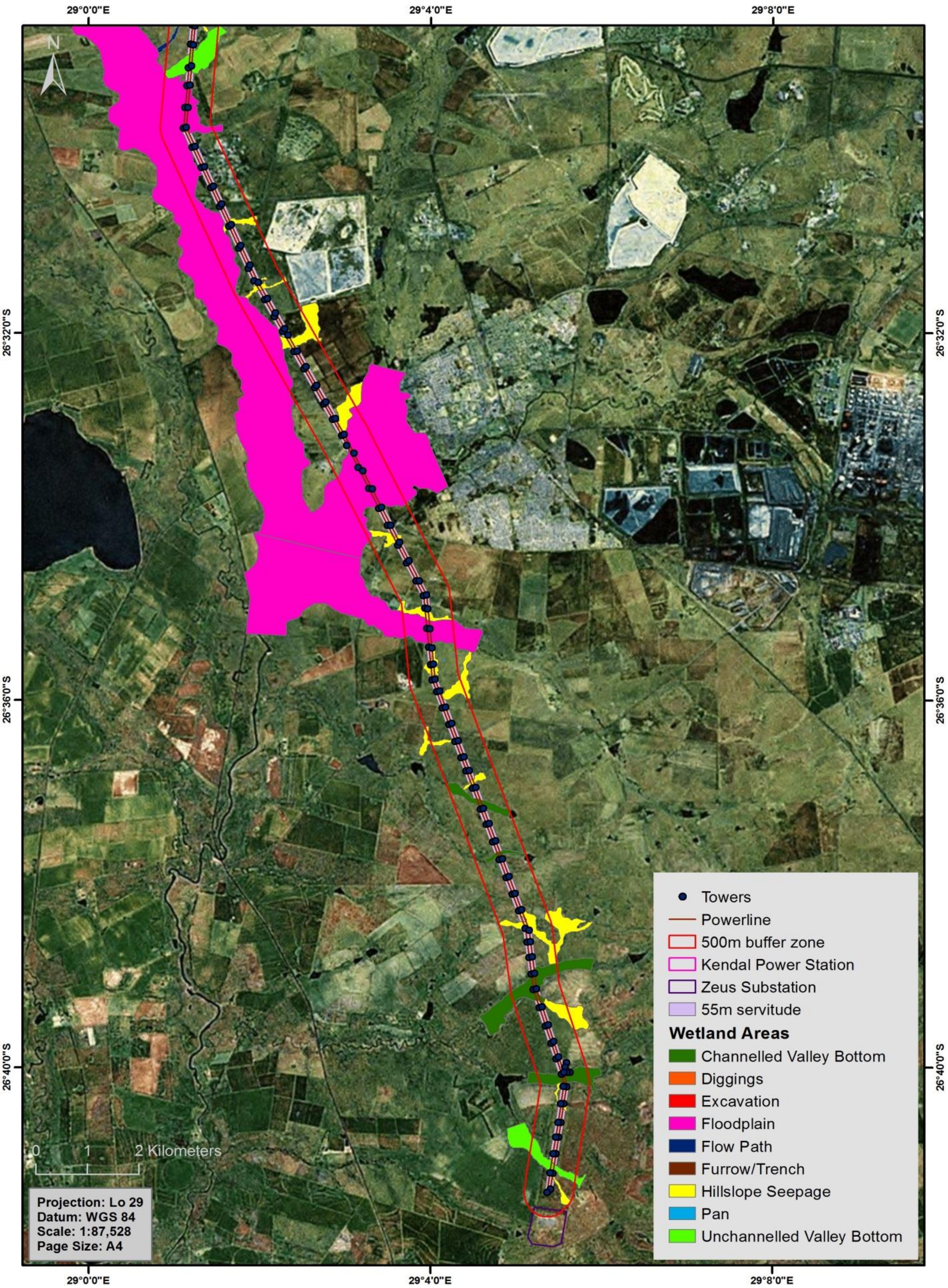


Figure 15: A map indicating position of the proposed towers in relation to the delineated watercourses – Southern Section

Table 4: A table indicating the names and positions of the towers impacting and/or within the watercourses delineation on site (extracted from staking information from Eskom)

Structure	X__Easting	Y__Northing	Structur_1
1 Sol Zeus 48	9226.357000	-2951435.342000	518C 0 - 45 degree strain
2 Sol Zeus 50	9170.374000	-2951432.622000	529 A Crossrope Structure
1 Sol Zeus 46	9342.569000	-2950801.558000	518C 0 - 45 degree strain
Ke-Ze 175	8637.543000	-2949138.068000	518C 0 - 45 degree strain
Ku - Ze 233	8691.450000	-2949126.057000	518C 0 - 45 degree strain
Ku - Ze 232	8654.063000	-2948812.169000	529 A Crossrope Structure
Ku - Ze 229	8550.388000	-2947941.745000	518C 0 - 45 degree strain
Ke-Ze 171	8478.427000	-2947904.834000	518C 0 - 45 degree strain
Ke-Ze 160	7119.297000	-2944144.614000	529 A Crossrope Structure
Ku - Ze 218	7172.420000	-2944129.693000	529 A Crossrope Structure
Ke-Ze 155	6641.982000	-2942601.768000	529 A Crossrope Structure
Ku - Ze 213	6696.073000	-2942589.896000	529 A Crossrope Structure
Ku - Ze 211	6625.700000	-2941880.870000	529 A Crossrope Structure
Ke-Ze 153	6569.295000	-2941869.440000	529 A Crossrope Structure
Ku - Ze 210	6585.862000	-2941479.496000	529 A Crossrope Structure
Ke-Ze 152	6529.308000	-2941466.565000	529 A Crossrope Structure
Ku - Ze 206	6035.730000	-2940138.687000	529 A Crossrope Structure
Ku - Ze 203	5506.499000	-2939065.019000	529 A Crossrope Structure
Ke-Ze 145	5440.077000	-2939054.665000	529 A Crossrope Structure
Ku - Ze 202	5325.495000	-2938697.809000	529 A Crossrope Structure
Ke-Ze 144	5234.240000	-2938637.076000	529 A Crossrope Structure
Ku - Ze 201	5151.308000	-2938344.431000	529 A Crossrope Structure
Ke-Ze 143	5013.337000	-2938188.923000	529 A Crossrope Structure
Ku - Ze 200	4964.724000	-2937965.902000	518C 0 - 45 degree strain
Ku - Ze 190	3292.600000	-2934910.485000	518C 0 - 45 degree strain
Ke-Ze 130	2725.339000	-2933786.625000	529 A Crossrope Structure
Ku - Ze 187	2766.869000	-2933744.917000	529 A Crossrope Structure
Ke-Ze 125	1839.764000	-2931802.319000	518C 0 - 45 degree strain
Ku - Ze 182	1895.712000	-2931793.253000	518C 0 - 45 degree strain
Ku - Ze 181	1929.384000	-2931389.820000	529 A Crossrope Structure
Ke-Ze 124	1874.366000	-2931387.746000	529 A Crossrope Structure
Ke-Ze 123	1910.425000	-2930955.708000	529 A Crossrope Structure
Ke-Ze 122	1941.086000	-2930588.344000	529 A Crossrope Structure
Ku - Ze 179	1999.166000	-2930553.737000	529 A Crossrope Structure
Ke-Ze 114	2218.361000	-2927266.223000	529 A Crossrope Structure
Ku - Ze 171	2275.555000	-2927242.241000	529 A Crossrope Structure
Ku - Ze 168	2381.702000	-2925970.455000	529 A Crossrope Structure
Ke-Ze 111	2328.978000	-2925940.890000	529 A Crossrope Structure
Ku - Ze 159	2586.192000	-2922480.448000	529 A Crossrope Structure
Ku - Ze 155	2324.605000	-2920888.354000	529 A Crossrope Structure

Ku - Ze 153	2193.299000	-2920089.191000	529 A Crossrope Structure
Ku - Ze 152	2150.563000	-2919829.086000	518H 42m
Ke-Ze 95	2088.425000	-2919790.130000	529 A Crossrope Structure
Ke-Ze 94	2014.316000	-2919339.083000	529 A Crossrope Structure
Ku - Ze 151	2069.961000	-2919338.522000	518D 45 - 70 degree strain
Ke-Ze 92	1895.040000	-2918613.135000	529 A Crossrope Structure
Ke-Ze 85	1797.825000	-2915826.946000	529 A Crossrope Structure
Ke-Ze 82	1849.967000	-2914637.706000	529 A Crossrope Structure
Ke-Ze 81	1866.295000	-2914265.299000	529 A Crossrope Structure
Ku - Ze 138	1922.264000	-2914244.414000	529 A Crossrope Structure
Ku - Ze 137	1940.762000	-2913822.531000	529 A Crossrope Structure
Ke-Ze 69	1207.633000	-2909834.686000	529 A Crossrope Structure
Ku - Ze 126	1252.423000	-2909801.123000	529 A Crossrope Structure
Ke-Ze 68	882.882000	-2909537.381000	529 A Crossrope Structure
Ku - Ze 125	926.592000	-2909502.829000	529 A Crossrope Structure
Ku - Ze 123	748.569000	-2908977.117000	529 A Crossrope Structure
Ke-Ze 65	711.222000	-2908583.305000	529 A Crossrope Structure
Ke-Ze 60	601.160000	-2906904.529000	529 A Crossrope Structure
Ke-Ze 59	413.775000	-2906532.330000	529 A Crossrope Structure
Ku - Ze 116	464.156000	-2906510.088000	529 A Crossrope Structure
Ke-Ze 49	-1452.851000	-2902824.673000	518C 0 - 45 degree strain
Ku - Ze 106	-1398.493000	-2902810.334000	518C 0 - 45 degree strain
Ke-Ze 44	-1549.451000	-2900874.131000	529 A Crossrope Structure
Ku - Ze 88	-1710.001000	-2896516.362000	529 A Crossrope Structure
Ke-Ze 31	-1765.175000	-2896514.026000	529 A Crossrope Structure
Ke-Ze 29	-1809.349000	-2895620.638000	529 A Crossrope Structure
Ku - Ze 86	-1754.362000	-2895619.131000	529 A Crossrope Structure
Ke-Ze 27	-1849.933000	-2894799.846000	529 A Crossrope Structure
Ku - Ze 84	-1795.335000	-2894790.443000	529 A Crossrope Structure
Ku - Ze 81	-1858.464000	-2893513.626000	518C 0 - 45 degree strain
Ke-Ze 24	-1913.718000	-2893509.839000	518C 0 - 45 degree strain
Ku - Ze 80	-1791.054000	-2893155.997000	529 A Crossrope Structure
Ke-Ze 23	-1845.578000	-2893148.340000	529 A Crossrope Structure
Ke-Ze 22	-1768.523000	-2892739.539000	529 A Crossrope Structure
Ku - Ze 79	-1709.441000	-2892723.019000	529 A Crossrope Structure
Ku - Ze 78	-1643.262000	-2892371.921000	529 A Crossrope Structure
Ke-Ze 21	-1688.928000	-2892317.269000	529 A Crossrope Structure
Ku - Ze 73	-1267.954000	-2890380.814000	529 A Crossrope Structure
Ke-Ze 16	-1320.887000	-2890364.715000	529 A Crossrope Structure
Ku - Ze 72	-1181.304000	-2889921.115000	529 A Crossrope Structure
Ke-Ze 15	-1236.848000	-2889918.866000	529 A Crossrope Structure

In total there are **81 towers** within delineated watercourses. Figures 16, 17 and 18 below indicate affected towers positions in relation to watercourses.

There will be **a 55m wide** servitude along the transmission line and it will be utilized for the construction of the powerline and later for maintenance. During construction the contractors do use a wider servitude at other places depending on the landscape of the area. These will be areas where temporary access roads will be opened especially when there are no existing roads, but these roads will be closed after construction and the area rehabilitated. The only roads that will remain will be the road under the powerline that will be used for maintenance.

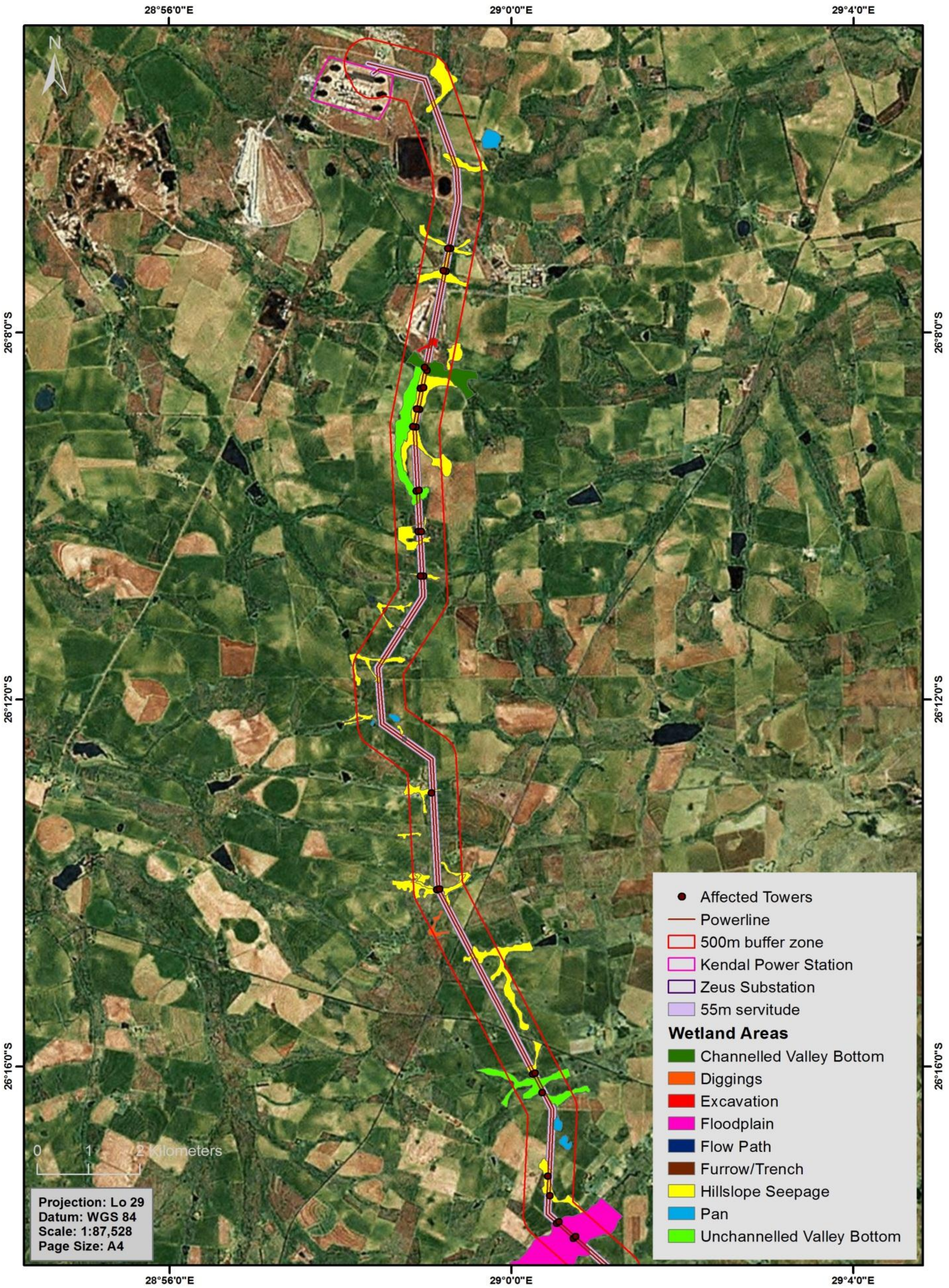


Figure 16: A map indicating position of affected towers in relation to the delineated watercourses within 55m servitude – Northern Section

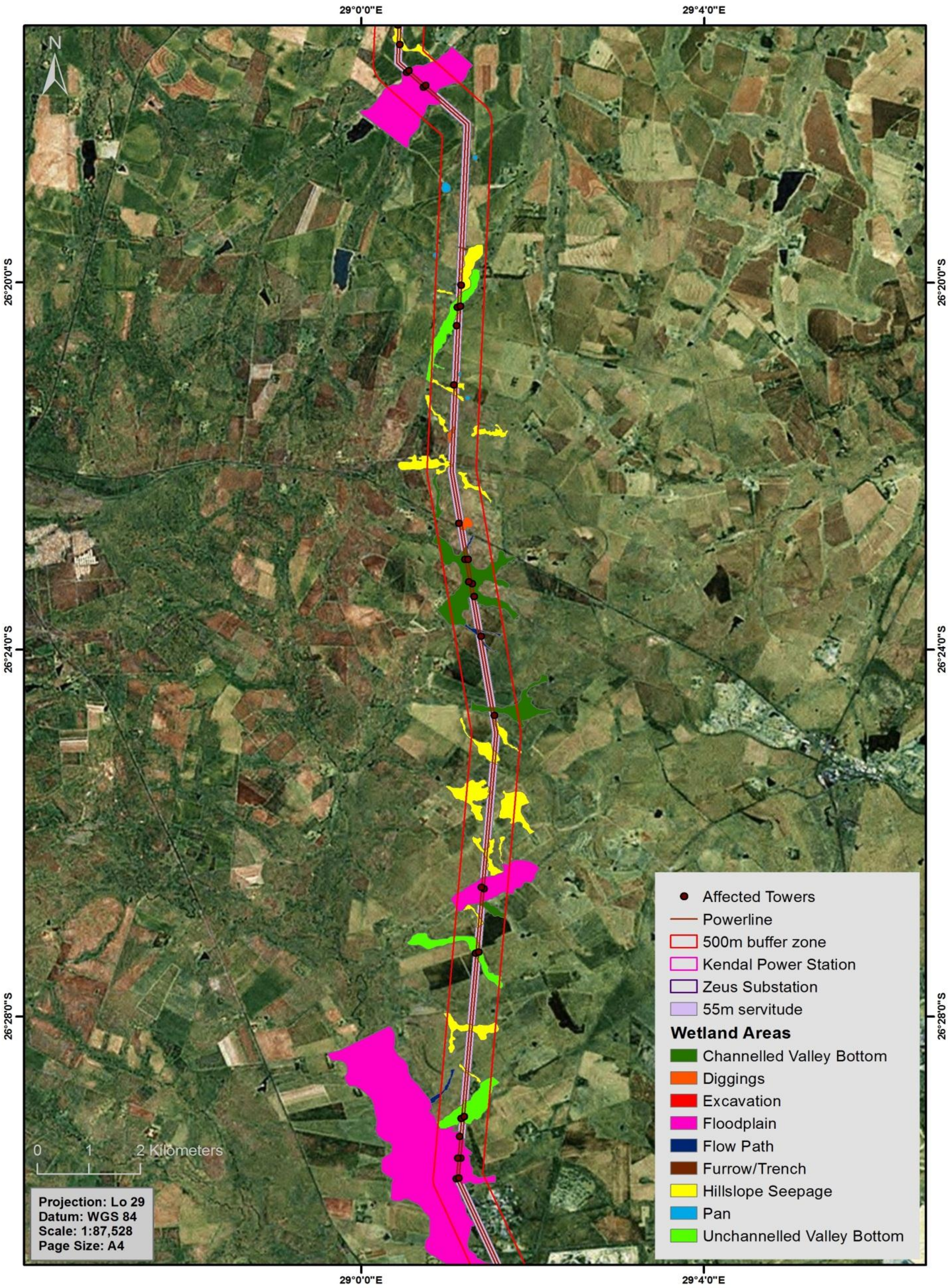


Figure 17: A map indicating position of affected towers in relation to the delineated watercourses within 55m servitude – Middle Section

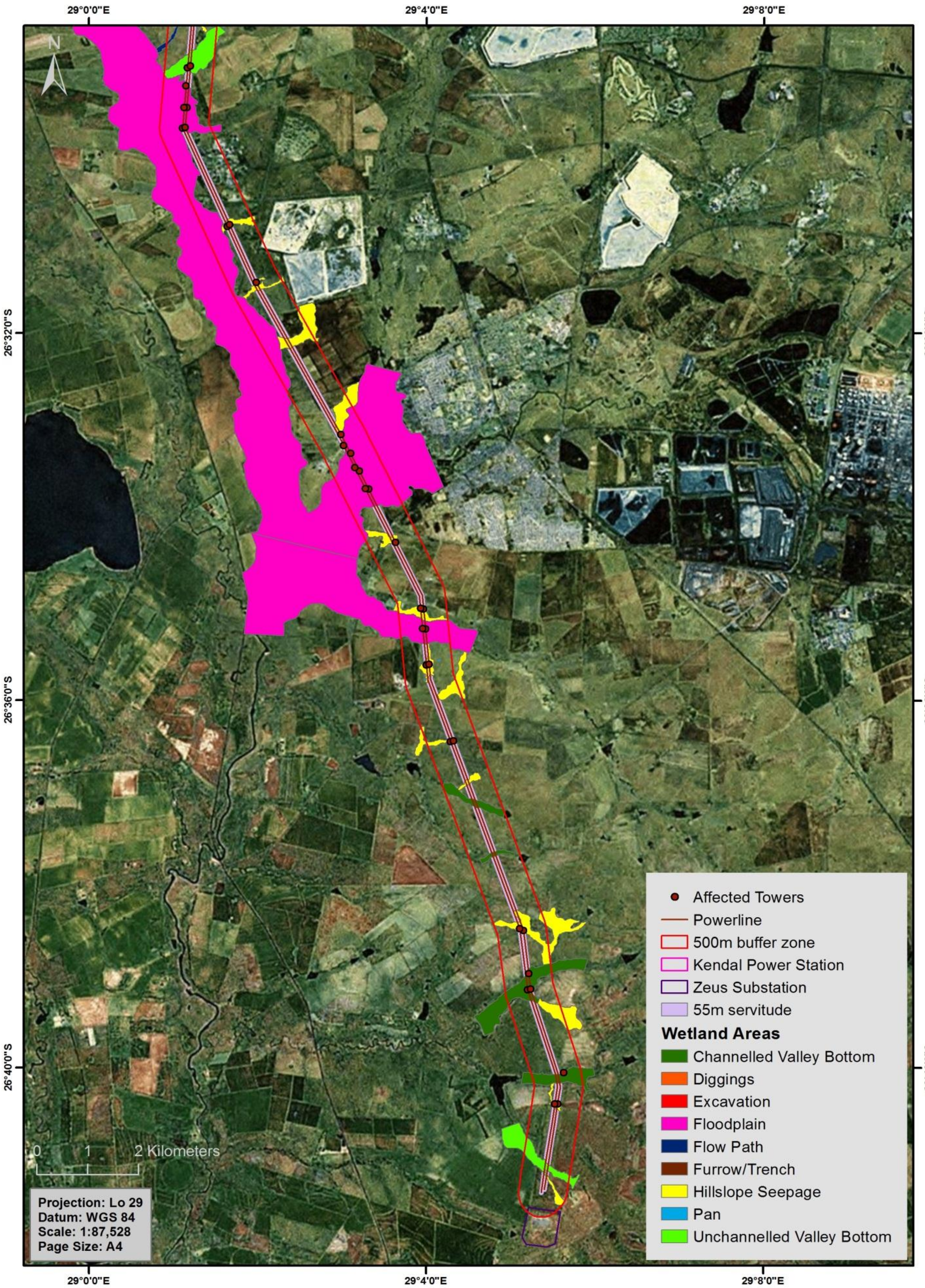


Figure 18: A map indicating position of affected towers in relation to the delineated watercourses within 55m servitude – Southern Section

5.2 Impact Assessment

It is customary to differentiate between impacts that occur during the construction phase and those that will take place and persist into the operational phase. In this specific case all of the major impacts will take place during the construction phase, with some of the impacts continuing into the operational phase.

The following impacts are not expected to be significant, provided that construction takes place in winter when most of the wetlands are dry. The following impacts are expected as a consequence of the proposed transmission line:

- Loss and destruction of vegetation and wetland habitat within the pylon footprint and during construction;
- Soil compaction and increased risk of soil erosion due to machinery and vehicles used during construction and during routine maintenance in the operational phase;
- Obstruction and hazard to birds utilizing the wetland areas.

There are no other alternative routes and/or tower positions provided for assessment, but it is however assumed that any recommendations of moving of towers should be restricted to within the approved servitude and should that be not sufficient, then on-site mitigation measures should be provided.

The impacts as indicated include local removal of vegetation and exposure of the soil to erosion., Associated with the latter, is a potential impact on water quality, particularly reflected as a change in the transparency of the water, or turbidity especially for towers within permanently wet areas.

As most, but not all of the wetlands along both routes are seasonally wet, with surface flow limited to relatively extreme events, the impacts on the downstream environment arising from sediment mobilisation is expected to be low except if towers are located in permanent wet areas. Recommendations have been made to relocate most of the towers that are located in permanent wet areas to avoid any sediment mobility, sedimentation and turbidity. The relatively low slopes associated with most of the crossings serve to reduce the impacts. The following sections provide recommendations to reduce and/or minimise impacts and well as additional mitigation measures to be implemented on sites.

5.3 Recommendations

It is acknowledged that from a technical point of view some of the towers cannot be moved or repositioned without impacting on the entire alignment. The consequence of this would be to redesign the entire transmission line. From a legal and registered servitude point of view the redesign of the entire transmission line might not be feasible. Based on these concerns, the proposed alignment was evaluated and two options were identified as follows:

1. **Option 1:** to identify towers that could not be possibly repositioned without interfering with the entire line and thus trigger a redesign of the entire transmission line; and
2. **Option 2:** to identify towers that can be repositioned and provide their new positions relative to the water resources impacts point of view.

The consequences of the above evaluation would be as follows:

a) For towers that fall under Option 2, both repositioning and on-site mitigation measures would be required; and
b) For towers that fall under Option 1, only on-site mitigation measures would be required.

Detailed on-site mitigation measures are outline in the following sections. It is important that for all towers that cannot be repositioned, that installation and construction of these only take place during drier low flow, winter period in order to ensure that the disturbances and impacts are minimal and contained on site

5.3.1 Option 1:

Table 5 below indicates all the towers that fall within option 1. These only include the towers that are in the bends and as indicated, on-site mitigation measures are required for these towers as repositioning of these might require redesign of the entire transmission line.

Table 5: A table indicating towers that could not possible be repositioned without affecting the entire transmission line. (Extracted from original staking information from Eskom)

Structure	X__Easting	Y__Northing	Structur_1
1 Sol Zeus 46	9342.569000	-2950801.558000	518C 0 - 45 degree strain
Ke-Ze 175	8637.543000	-2949138.068000	518C 0 - 45 degree strain
Ku - Ze 233	8691.450000	-2949126.057000	518C 0 - 45 degree strain
Ku - Ze 229	8550.388000	-2947941.745000	518C 0 - 45 degree strain
Ke-Ze 171	8478.427000	-2947904.834000	518C 0 - 45 degree strain
Ke-Ze 125	1839.764000	-2931802.319000	518C 0 - 45 degree strain
Ku - Ze 182	1895.712000	-2931793.253000	518C 0 - 45 degree strain
Ke-Ze 49	-1452.851000	-2902824.673000	518C 0 - 45 degree strain
Ku - Ze 106	-1398.493000	-2902810.334000	518C 0 - 45 degree strain

Note:* *The shaded towers are within permanent wet wetland area and ideally these will need to be moved but given that there are in the bend no specific recommendations have been made in this report with respect to them. It is however recommended that the design engineer should consider moving these towers on the basis of access during construction and from a wetland impact management point of view.

5.3.2 Option 2:

It is understood that repositioning of towers is restricted to within the registered servitude. From a wetland impact management point of view, Table 8 below indicate list of towers that are eligible for repositioning and/or relocation. Feasibility of these will need to be further assessed by a design engineer. It is anticipated that from a design perspective some of the configurations may not be feasible. In these instances on-site mitigation measures **must** be adhered to. It is also important to note that for these particular towers longitudinal driving through a wetland is not allowed during construction. Wetland areas must be approached at an angle (ideally perpendicular) to a direct area where the tower will be position to limit the extent of unnecessary impacts within the wider wetland area.

It must also be noted that in some instances when more than two towers are within a broader wetland system and positioned longitudinal to the system, from a wetland impact management point of view, the reconfiguration of towers may be required. This might include reducing number of towers traversing the watercourses i.e. by removing some of the proposed towers and/or using higher/taller tower structures that may allow wider spanning. The objective of this will be to ensure that multiple impacts from individual towers are reduced and/or minimised and only localised impacts from the reduced number of towers are mitigated. Table 6 below indicates a list of towers recommended for removal to minimise multiple localised impacts.

Table 6: A table indicating a list of towers recommended for removal (Source: Extracted from staking tables provided by Eskom)

Structure	X__Easting	Y__Northing	Structur_1
Ku - Ze 203	5506.499000	-2939065.019000	529 A Crossrope Structure
Ke-Ze 145	5440.077000	-2939054.665000	529 A Crossrope Structure
Ku - Ze 201	5151.308000	-2938344.431000	529 A Crossrope Structure
Ke-Ze 143	5013.337000	-2938188.923000	529 A Crossrope Structure
Ke-Ze 122	1941.086000	-2930588.344000	529 A Crossrope Structure
Ku - Ze 179	1999.166000	-2930553.737000	529 A Crossrope Structure
Ku - Ze 152	2150.563000	-2919829.086000	518H 42m
Ke-Ze 95	2088.425000	-2919790.130000	529 A Crossrope Structure
Ke-Ze 59	413.775000	-2906532.330000	529 A Crossrope Structure
Ku - Ze 116	464.156000	-2906510.088000	529 A Crossrope Structure
Ku - Ze 80	-1791.054000	-2893155.997000	529 A Crossrope Structure
Ke-Ze 23	-1845.578000	-2893148.340000	529 A Crossrope Structure
Ke-Ze 22	-1768.523000	-2892739.539000	529 A Crossrope Structure
Ku - Ze 79	-1709.441000	-2892723.019000	529 A Crossrope Structure

The following table indicate the list of three sets of new towers recommended, final approval to be communicated with the design engineer. This is aimed at allowing for reconfiguration and further minimisation of multiple impacts due to towers on watercourses on site.

Table 7: A table indicating a list of proposed new towers and positions

Structure	Proposed Changes	X_coord	Y_coord
Ke-Ze 15a	New Tower	28.98713739520	-26.12058560990
Ku-Ze 72a	New Tower	28.98766632070	-26.12071131360
Ke-Ze 22a	New Tower	28.98202107950	-26.14501860830
Ke-Ze 79a	New Tower	28.98252865190	-26.14515963450
Ke-Ze 58a	New Tower	29.00334278170	-26.26658228920
Ku - Ze 115a	New Tower	29.00386178730	-26.26642091670

As indicated above in some sections some towers may be required to be repositioned and/or relocated to minimise impacts. The following table indicates a list the remaining towers that are recommended for relocation and repositioning. It should also be noted that even with the proposed reconfigurations there will be some towers that it would not be possible to totally be removed from wetland areas as delineated. It is therefore important to note that proposed configurations should go hand in hand with the proposed on-site mitigation measures.

Table 8: A table indicating proposed repositioning and relocation of towers and as well as recommendations and their proposed new positions

Structure	Proposed Changes	X_coord	Y_coord
Ke-Ze 15	90-100m North along line	28.987861556600	-26.117192921200
Ku-Ze 72	90-100m North along line	28.988390472600	-26.117268359300
Ke-Ze 16	220m South along line	28.986385340500	-26.124078816700
Ku-Ze 73	220m South along line	28.986914272600	-26.124279917500
Ke-Ze 21	120m North along line	28.983349531400	-26.138675400200
Ku-Ze 78	170m North along line	28.983896126400	-26.138781185200
Ke-Ze 27	70m North along line	28.981471826900	-26.161567654200
Ku-Ze 84	70m North along line	28.982057605000	-26.161497246700
Ke-Ze 29	15m North along line	28.981917286900	-26.169442104800
Ku-Ze 86	30m North along line	28.982453773200	-26.169280809500
Ke-Ze 31	15m South along line	28.982363093100	-26.177720010400
Ku - Ze 88	15m South along line	28.982899586000	-26.177768483500
Ke-Ze 44	15m South along line	28.984503880900	-26.217108493800
Ke-Ze 60	30 m North along line	29.005884375400	-26.271148680500
Ke-Ze 65	210m North along line	29.007245436700	-26.284702796500
Ku - Ze 122	210m North along line	29.007746631700	-26.284751178100
Ku-Ze 123	60m South along line	29.007460615100	-26.290673070100
Ke -Ze 66	40m South along line	29.006923594500	-26.290640825300
Ke-Ze 68	25m North along line	29.008629808200	-26.295005045500
Ku - Ze 125	25m North along line	29.009061699900	-26.294689854100
Ke-Ze 69	Modify to High Tower	29.012085435300	-26.297878356800
Ku - Ze 126	Modify to High Tower	29.012537896200	-26.297563153300
Ku - Ze 137	85m South along line	29.019434323800	-26.334640485500
Ke-Ze 80	60m South along line	29.018858236700	-26.334622023500
Ke-Ze 81	150m South along line	29.018653224000	-26.339186351300
Ku-Ze 138	170m South along line	29.019188180200	-26.339186280600
Ke-Ze 82	30m South along line	29.018550716100	-26.341496322400
Ku - Ze 139	85m South along line	29.019126828100	-26.341459168700
Ke-Ze 85	15m North along line	29.018058497900	-26.351785514400
Ke-Ze 92	40m North along line	29.018922695700	-26.376723965800
Ku - Ze 149	40m North along line	29.019498982200	-26.376686810700
Ku-Ze 153	25m South along line	29.022033196500	-26.390620261800
Ke-Ze 98	160m North along line	29.022507716200	-26.396189258500
Ku - Ze 155	150m North along line	29.023104724100	-26.396356013000
Ku - Ze 159	170m North along line	29.025676898400	-26.410459911700
Ke-Ze 102	160m North along line	29.025079842300	-26.410422940000
Ke-Ze 111	210m North along line	29.023542047500	-26.441420017500
Ku - Ze 168	260m North along line	29.024118623100	-26.441234534100
Ke-Ze 114	145m South along line	29.022144577300	-26.456473670100
Ku - Ze 171	180m South along line	29.022680099800	-26.456603356900

Ku - Ze 178	100m South along line	29.020362585200	-26.481941584300
Ke-Ze 121	115m South along line	29.019805323000	-26.481965543100
Ke-Ze 123	75m North along line	29.019249034600	-26.487840194000
Ke-Ze 130	30m South along line	29.027402429600	-26.514307820000
Ku - Ze 187	30m South along line	29.027853566900	-26.513854007200
Ke-Ze 142	50m South along line	29.049606636800	-26.552386713400
Ku - Ze 200	50m South along line	29.050012094900	-26.552121297200
Ke - Ze 144	100m South along line	29.053053135900	-26.557576302000
Ku - Ze 206	40m South along line	29.060761188200	-26.571662489300
Ke-Ze 152	65m North along line	29.065521257000	-26.582812370800
Ku - Ze 210	70m North along line	29.066079024100	-26.582835993200
Ke-Ze 155	180m North along line	29.066509255700	-26.591967517500
Ku-Ze 213	180m North along line	29.067013846400	-26.591824000800
Ke-Ze 160	55m South along line	29.071672197000	-26.607940725000
Ku-Ze 218	55m South along line	29.072203416700	-26.607797176700
Ke-Ze 174	100m North along line	29.086234246500	-26.648886655500
Ku-Ze 232	100m North along line	29.086818786900	-26.648743020800
2 Sol Zeus 50	30m North along line	29.092178695500	-26.673013373000
1 Sol Zeus 48	30m North along line	29.092678759100	-26.673102885300
1 Sol Zeus 46	20m North	29.093809321700	-26.667406274600

5.4 Mitigation measures

In cases where repositioning and/ relocation is not possible the following mitigation measures must be put in place and form part of the overall EMP of the project. It is reiterated that even for towers where repositioning and/or relocation is possible, proposed mitigation measures below are still applicable in disturbed areas.

5.4.1 Fencing or demarcation of construction area

Prior to any construction activities especially in towers within demarcated wetland areas, limits of construction related activities must be clearly demarcated so as to avoid unnecessary direct impacts to the vegetation beyond the limits of construction.

5.4.2 Re-vegetation/ rehabilitation

Re-vegetation should ideally commence as soon as construction activities have ceased. The areas where vegetation is disturbed must be landscaped and re-vegetated with indigenous species similar to the surrounding areas. Seeding with an appropriate seed mix (consult local vegetation experts) should be implemented if there is a qualified opinion, from a botanist, that vegetation cannot recover by itself. The use of a creeping stoloniferous grass such as kweek, *Cynodon dactylon* could be considered to help stabilise the disturbed soils. Once the initial rehabilitation has been completed the wetland especial where towers are installed (around the base) should be checked for erosion at the end of the following summer. If erosion is observed, appropriate action should be taken to limit its extent.

5.4.3 The eradication of invasive plant species.

Alien plants are likely to colonise the areas disturbed during the construction process. Areas disturbed during the construction process should be checked on a 6 monthly basis and any undesirable plants encountered in the areas immediately around the towers' positions should be removed, ideally by hand so as to reduce the risk of herbicides being transferred further into the wetlands.

5.4.4 Soil compaction and increase risks of erosion:

Sediment transport during the construction period is likely to be high especially in areas where towers are inside permanent wet areas. Efforts must be made to limit sediment transport beyond the limits of the construction site. Various methods are available to achieve this. It is important to note that erosion control/protection interventions/structures must be inspected regularly and replaced if any are found to be worn out or damaged. If sediments accumulate, the erosion barriers must be cleaned regularly. Erosion protection structures including Reno mattresses must be considered around the base of the tower to limit any scouring and side cutting erosion around the structure if the structure is within permanent wet area. During construction, no construction vehicles should traverse the wetland and riparian zone and no construction materials should be stored or dumped within the wetland area. The movement of construction vehicles within the wetland (if cannot be absolutely avoided) should be kept to the absolute minimum required given the position of this tower. The vehicles should not in any way travel longitudinal to the wetland area as that will create preferential flow path then erosion.

It is also recommended that after completion of construction activities all areas of compacted soils will need to be ploughed so as to break up the compacted soil surface and landscaped to approximate the natural slope or ground level of the area (if necessary). This will aid infiltration and decrease run-off, while also creating conditions for vegetation to re-establish in these areas around towers. The ploughed areas will need to be monitored for signs of erosion until these areas have re-vegetated. Should erosion occur, an appropriate erosion control measures will need to be implemented as indicated above. It is recommended that all material stockpiles, temporary construction access routes must ploughed and re-vegetated upon completion of construction activities and alien vegetation regrowth in these areas must be monitored..

5.4.5 Maintenance of servitude

Existing informal road networks observed on site should be used as service roads wherever possible. Construction of new roads should be avoided at all times where possible to limit any additional impacts that could be avoided on site. If practically possible (i.e. while considering all safety aspects), no burning of the servitude should take place within the wetland areas. Rather, vegetation in these areas should be cut using manual cutting, brush cutting (labour intensive method) especially at the crossings, and mechanical methods through the entire servitude such as slashers, mowers etc. Cutting of vegetation should be done in the winter months, outside the breeding season of wetland dependant birds (should winter breeding birds occur in the area, this must be taken into consideration prior to any burning). In the instance that burning of the servitude is required; it should be undertaken in the winter months and should at all times be done under careful supervision to prevent the spread of veld fires.

5.4.6 Protection of large wetlands' birds

Stringing power lines across wetlands could result in an obstruction and hazard to larger water birds that could fly into the power lines. The impact of the proposed powerline on birdlife will need to be assessed in detail as well mitigation measures by a qualified avifauna specialist as part of this EIA being undertaken for this project. As such, the impact is not assessed in this report for all three alternatives.

A summary of the construction related impacts and suggested mitigation measures as indicated above to reduce the significance of the impacts is presented in Table 9.

Table 9: A summary of the impacts that might be expected during the construction and operational of the 400KV transmission line in so far as it relates to watercourses' crossings.

Potential Impact	Project Activity	Environmental significance before mitigation								Mitigation	Environmental significance after mitigation							
		M	R	D	E	C	P	TOTAL	S		M	R	D	E	C	P	TOTAL	S
Construction Phase																		
Loss and destruction of vegetation and wetland habitat on towers' footprints	Site clearance, foundations and footprint and construction of towers	3	3	5	1	2	5	**70**	**Moderate**	Temporary fencing of construction to limit footprint, Landscaping, re-vegetation of disturbed areas	3	2	2	2	3	1	**12**	**Low**
Soil compaction and increase risk of erosion and possible Deterioration in surface water quality due to increased turbidity and Sedimentation for towers within permanent wet areas	Vegetation clearance Construction of towers within wet areas, and Access roads for Construction of towers	5	3	3	2	3	5	**80**	**High**	Sediment and erosion control measures, Landscaping, plough and re-vegetate disturbed areas	4	2	2	2	3	4	**52**	**Moderate**
Accidental spills due to use of machinery (cranes, trucks and etc.) during construction activities	Construction of culverts	3	2	2	2	3	3	**36**	**Low**	Environmental awareness training for contractors Emergency Preparedness Plan	3	2	2	2	3	1	**12**	**Low**

Potential Impact	Project Activity	Environmental significance before mitigation								Mitigation	Environmental significance after mitigation							
		M	R	D	E	C	P	TOTAL	S		M	R	D	E	C	P	TOTAL	S
Operational Phase																		
Hardened of surface, risk to erosion and preferential flow paths due to road for maintenance within servitude	Access roads and Routine maintenance of transmission line	5	4	5	2	3	4	**76**	**High**	Regular checks and maintenance of servitude, keep access road as informal as possible and use existing roads as far as possible to limit construction of new roads	4	2	2	2	3	4	**52**	**Moderate**
Increased alien invasive vegetation	Disturbance of soils	3	3	4	2	3	5	**75**	**Moderate**	Annual checks of invasive vegetation, to be controlled and removed before seeding	3	3	4	2	3	2	**30**	**Low**
Obstruction and hazard to birds utilizing wetland areas and watercourses on sites	NOT ASSESSED – Birds specialist will assess this impact																	

S = (M+R+D+E+C) P

6. RECOMMENDED MONITORING PROTOCOL

6.1 Erosion control and vegetation establishment:

Fixed point photography should be used to provide a graphic record of the vegetation establishment and plant community changes, and is also the suggested method for monitoring erosion.

Erosion nick points should be timeously identified and remediation action taken. In particular, any obstructions to flow (such as trapped litter or branches) should be cleared to prevent an increase in erosive forces around the obstruction/towers. It is recommended that these surveys be conducted quarterly during the construction phase and biennially thereafter for a minimum of 5 years or until such time as systems appear to be well stabilised.

6.2 Alien vegetation monitoring:

An on-going alien vegetation removal programme should be implemented during and after construction. Alien removal should consider water quality concerns associated with removal of vegetation within a water course (i.e. only approved herbicides or mechanical measures may be used). Biennial monitoring inspections should identify target areas for clearing. This includes monitoring of temporary road areas, stockpiles and etc. that have been ploughed.

6.3 Water quality:

It is recommended especially that in areas where towers are inside wetland areas and cannot be relocated, that turbidity be monitored during construction using a hand held turbidity meter. Turbidity levels should not exceed pre activity turbidity levels by more than 25%. Post construction the site should be surveyed and checked for signs of erosion including bank collapse biennially thereafter until banks are well stabilized. Eroding areas should be mapped, reported and stabilized.

7. CONCLUSION

All of the wetlands recorded on site have been impacted upon and degraded by various anthropogenic activities as mentioned. These have resulted in wetland systems that varies from largely natural, moderately to largely modified. As such, the construction of the proposed transmission line is expected to further advance the significance of the impacts. Therefore, especially during the construction phase particular emphases and care must be given to system that are relatively intact. Several mitigation measures have been proposed to mitigate against these impacts.

An assessment of all proposed towers indicated the following possibilities:

1. Towers that cannot be repositioned without affecting the entire alignment;
2. Possibility of removing some of the proposed towers to minimise anticipated impacts;
3. Possibility of introducing new towers to maintain reconfiguration of transmission line; and
4. Possibilities of re-positioning some of the proposed towers and implementation of onsite mitigation measures.

The assessment of the towers also indicated that reconfiguration of the towers as recommended does not place all the towers outside wetland areas due to restricted movement within the approved servitude. Based on the assessment and recommendations a set of proposed final configuration of towers was developed. Their feasibility will however need to be discussed and agreed upon with the design engineer taking all other design factors into account. Although it is understood, as mentioned, that moving towers located in bends will trigger redesign of sections of the transmission lines, from the proposed final configuration it is strongly advised that towers Ku-Ze 182 & Ke-Ze 125 must be reassessed, as this pair is located within the permanent wet wetland area. No *specific recommendations have been made in this report for these towers, given that they are located in a bend. It is however recommended that the design engineer consider moving these towers on the basis of access during construction and from wetland impact management point of view*

It should also be noted that towers within wetlands and/or riparian areas will require a Water use Licence, as any activity which directly impacts a wetland and riparian areas is only permissible under authorisation of a Water Use Licence under Section 21 (c) & (i) of the National Water Act (Act 36 of 1998). Wetlands and riparian areas are protected under the National Water Act as part of the water resource, and any activity that alters the bed, banks, course or characteristics of a watercourse[2] or that impedes or diverts the flow of water in a watercourse[1] is subject to authorisation under a Water Use Licence.

8. REFERENCES

DEPARTMENT OF WATER AFFAIRS AND FORESTRY (2005). A Practical Field Procedure for Identification and Delineation of Wetland and Riparian areas. Edition 1, September 2005. DWAF, Pretoria.

DWAF (2007). Manual for the assessment of a Wetland Index of Habitat Integrity for South African floodplain and channelled valley bottom wetland types by M. Rountree (ed); C.P. Todd, C. J. Kleynhans, A. L. Batchelor, M. D. Louw, D. Kotze, D. Walters, S. Schroeder, P. Illgner, M. Uys. and G.C. Marneweck. Report no. N/0000/00/WEI/0407. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria, South Africa.

EWART-SMITH, J.L., OLLIS, D.J., DAY, J.A. AND MALAN, H.L. 2006. National Wetland Inventory: Development of a Wetland Classification System for South Africa. *WRC Report No. KV 174/06*. Water Research Commission, Pretoria.

KOTZE, D.C., MARNEWECK, G.C., BATCHELOR, A.L., LINDLEY, D.S. AND COLLINS, N.B. 2007. Wet-Ecoservices: A technique for rapidly assessing ecosystem services supplied by wetlands. Unpublished Water Research Commission Report.

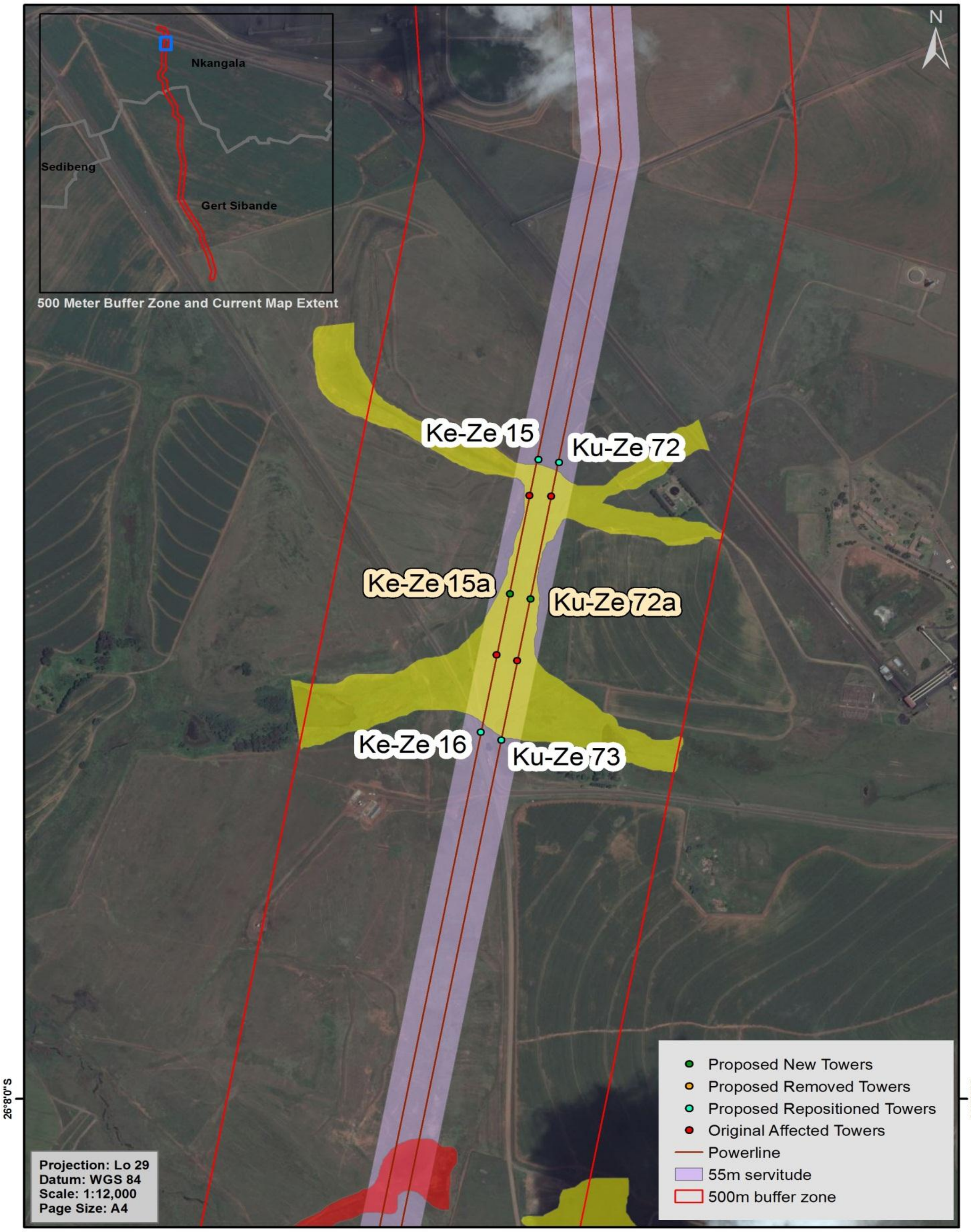
MACFARLANE DM, KOTZE DC, ELLERY W N., WALTERS D., KOOPMAN, V., GOODMAN P., GOGE C., 2008. Wet-Health A rapid Technique for Assessing Wetland Health. WRC Report TT 340/08

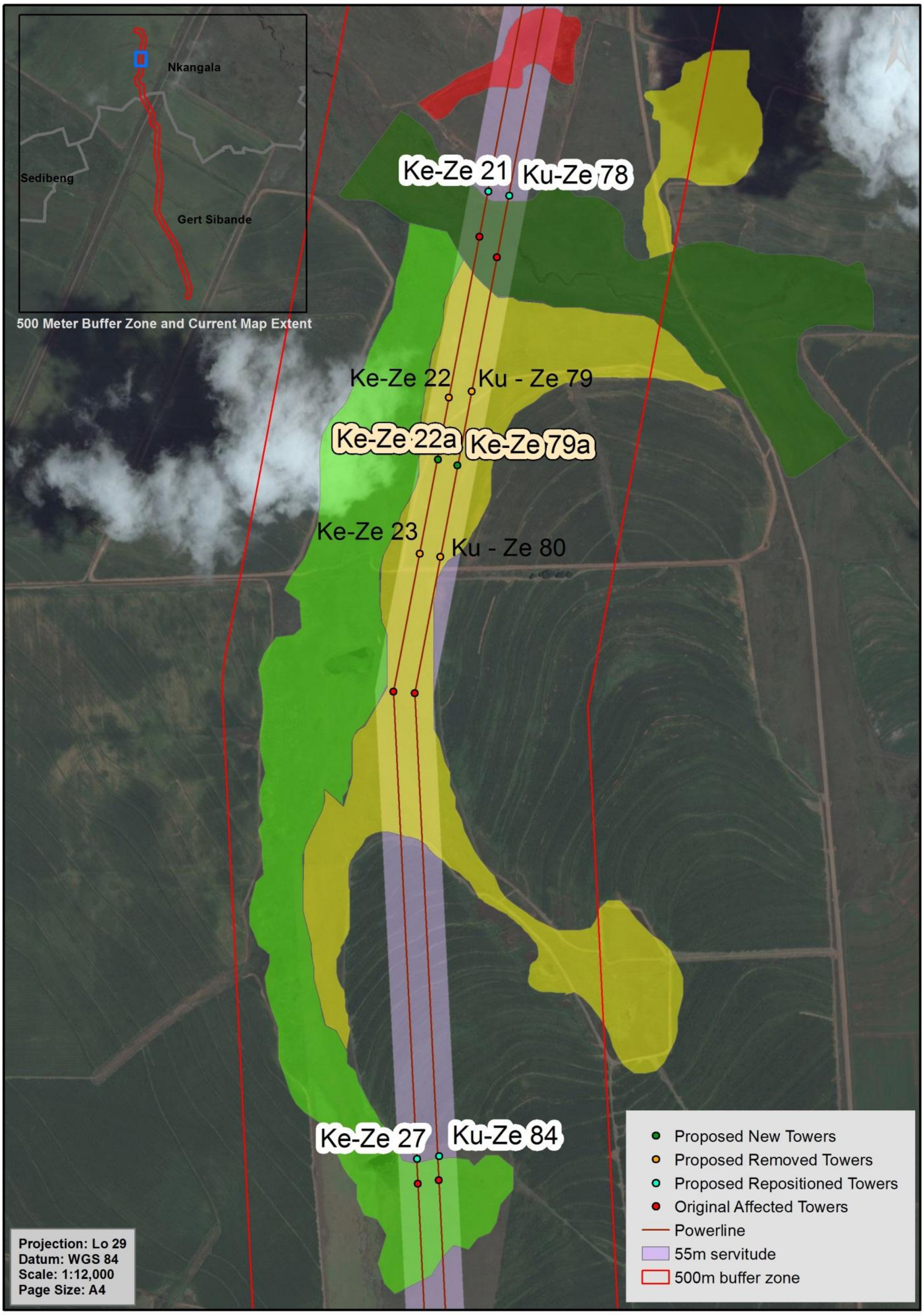
MARNEWECK, G.C. AND BATCHELOR, A. 2002. Wetland inventory and classification. In*: Ecological and economic evaluation of wetlands in the upper Olifants River catchment*. (Palmer, R.W.,Turpie, J., Marneweck, G.C and Batchelor (eds.). Water Research Commission Report No. 1162/1/02.

RAMSAR, 15 January 2003. Principals and guidelines for wetland restoration

[2] The National Water Act defines a water course as follows: "watercourse" means - (a) a river or spring; (b) a natural channel in which water flows regularly or intermittently; (c) a wetland, lake or dam into which, or from which, water flows; and (d) any collection of water which the Minister may, by notice in the Gazette, declare to be a water course, and reference to a watercourse includes, where relevant, its bed and banks.

9. APPENDIX 1: MAPS SHOWING PROPOSED RECOMMENDATIONS IN SECTION 5.3

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Ke-Ze 79a
Ke-Ze 23
Ku - Ze 80
Ke-Ze 27
Ku-Ze 84
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Proposed Removed Towers
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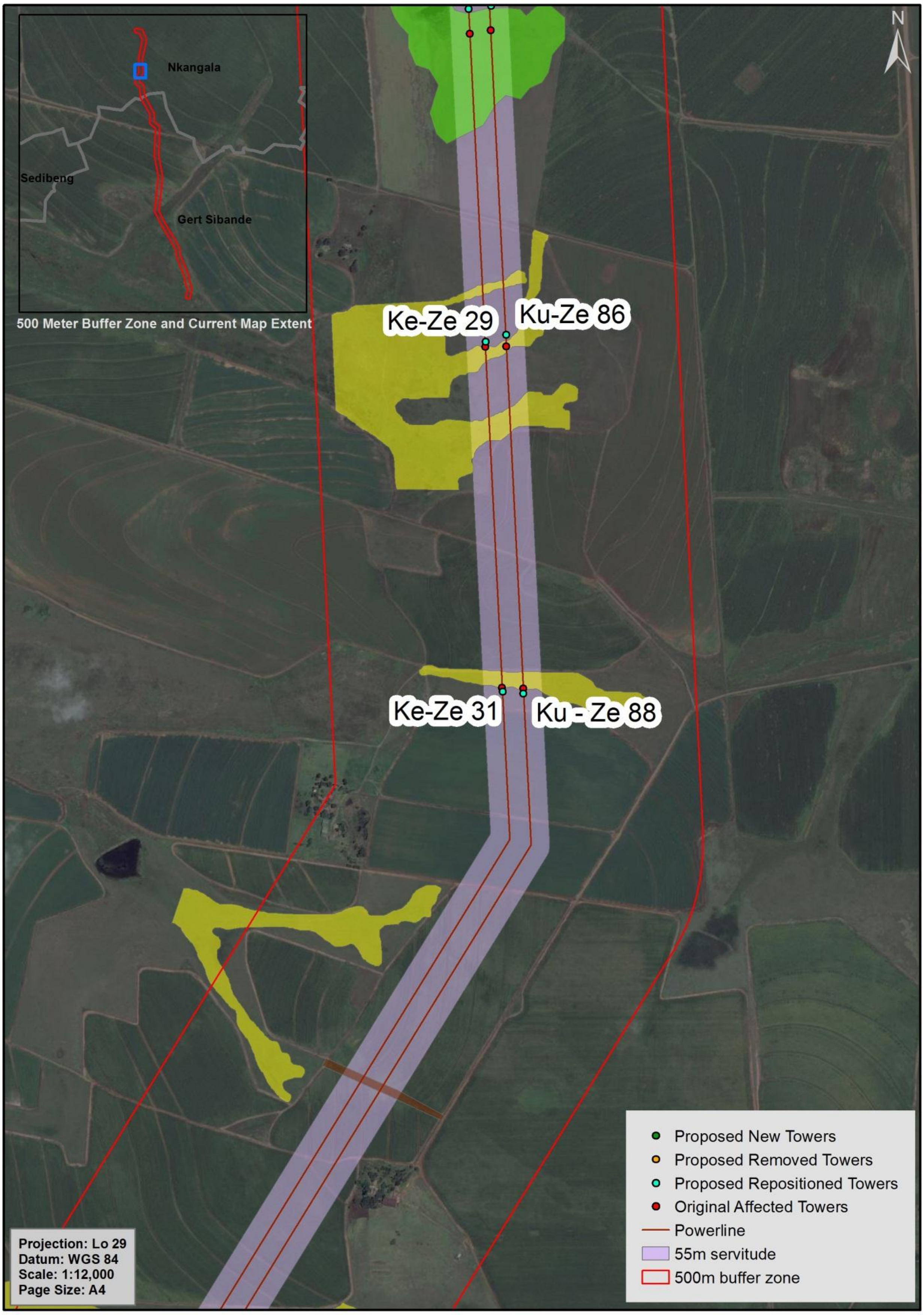
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Proposed Removed Towers
Proposed Repositioned Towers
Original Affected Towers
Powerline
55m servitude
500m buffer zone


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Sedibeng
Gert Sibande
500 Meter Buffer Zone and Current Map Extent
Ke-Ze 44
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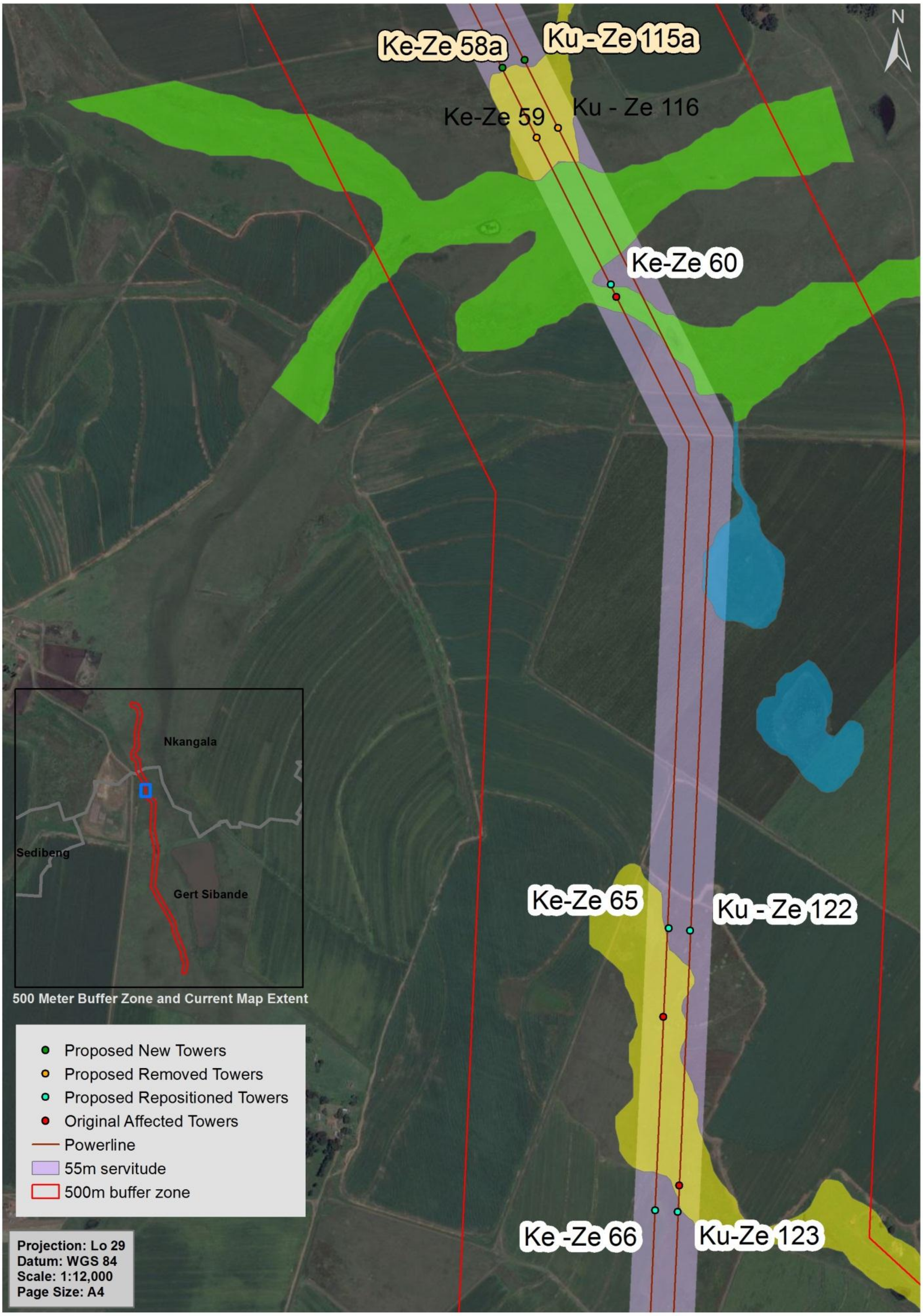
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Nkangala
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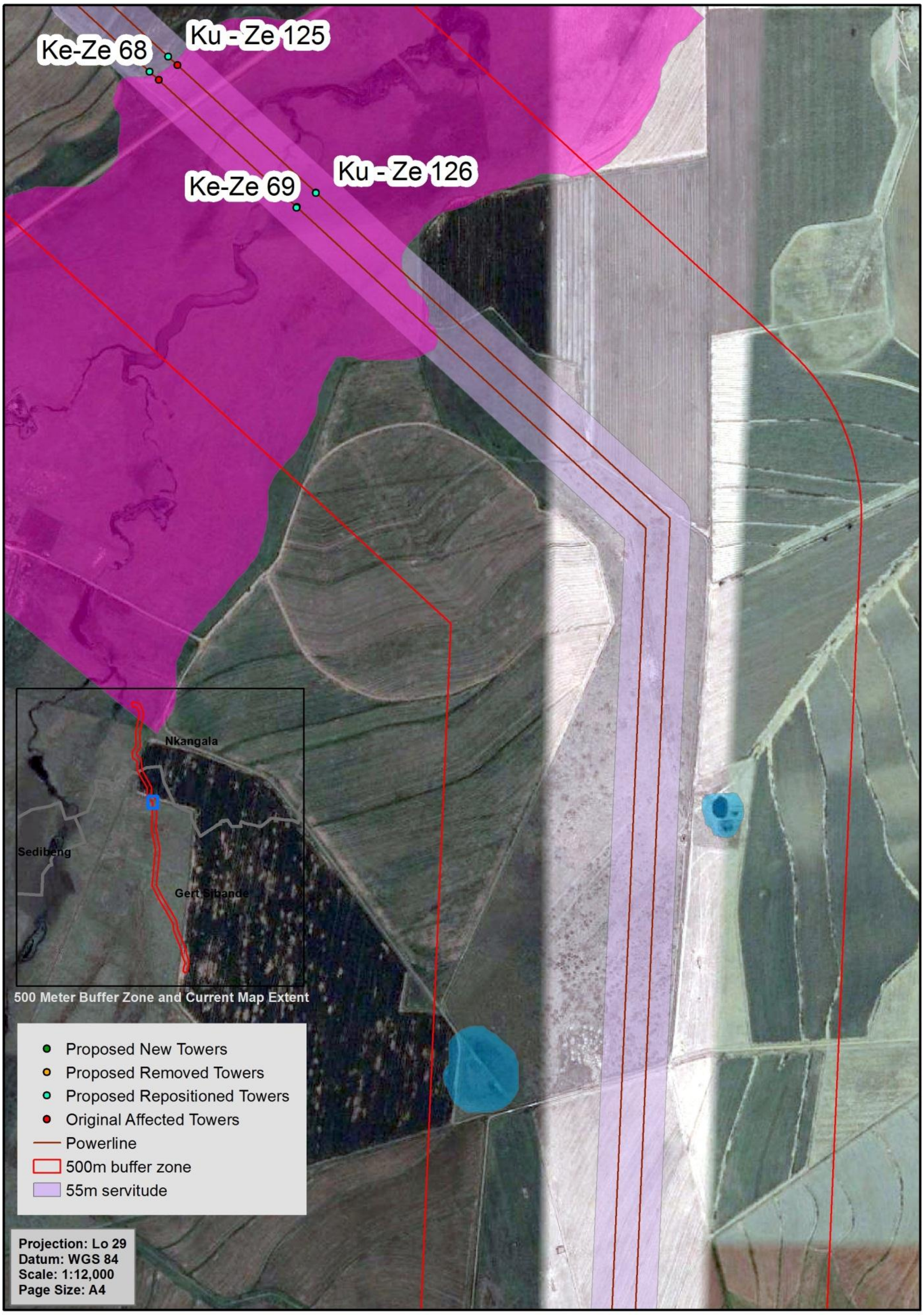
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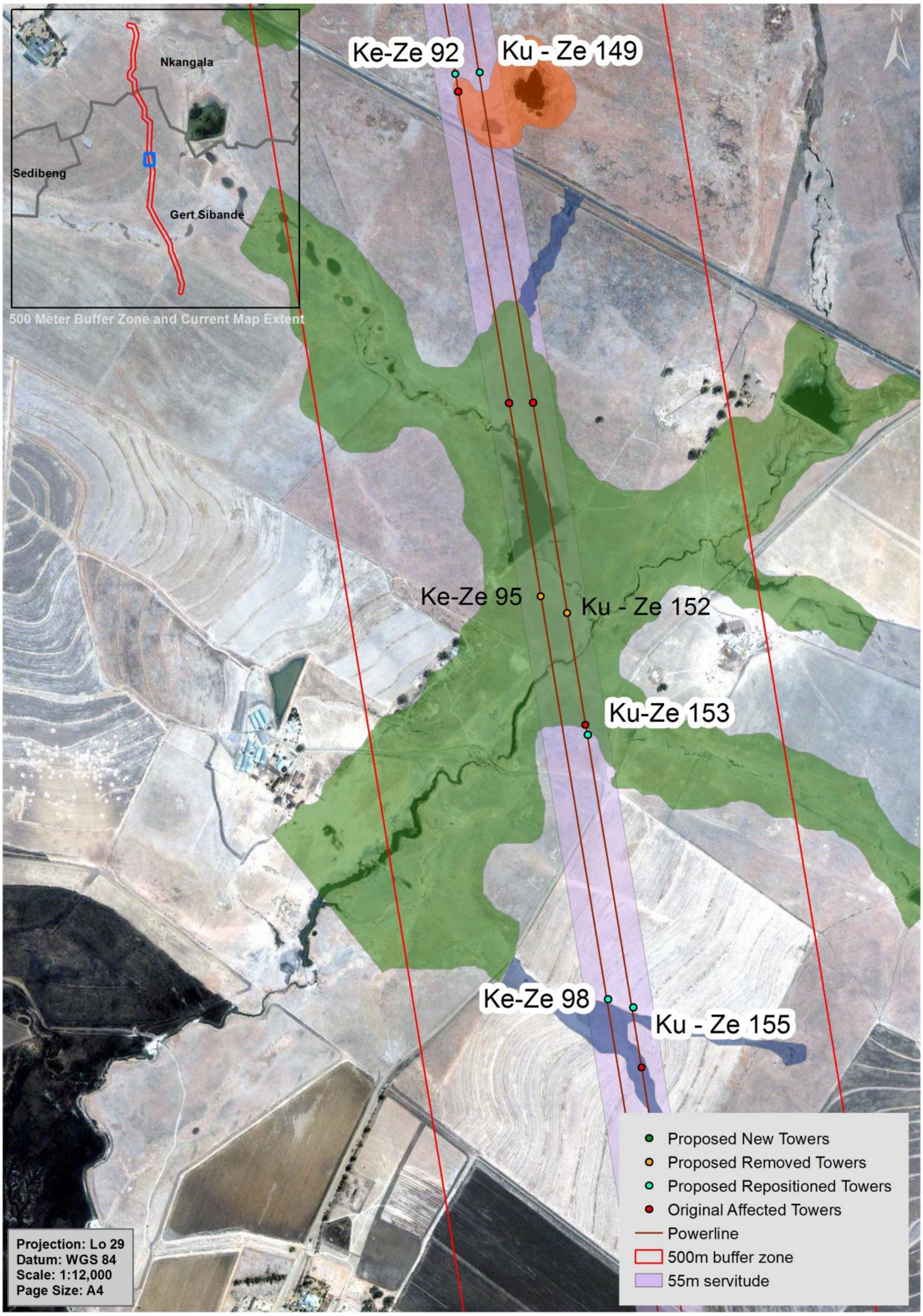
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Ku - Ze 155
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Proposed Removed Towers
Proposed Repositioned Towers
Original Affected Towers
Powerline
500m buffer zone
55m servitude


Nkangala
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Ke-Ze 98
Ku - Ze 155
Ke-Ze 102
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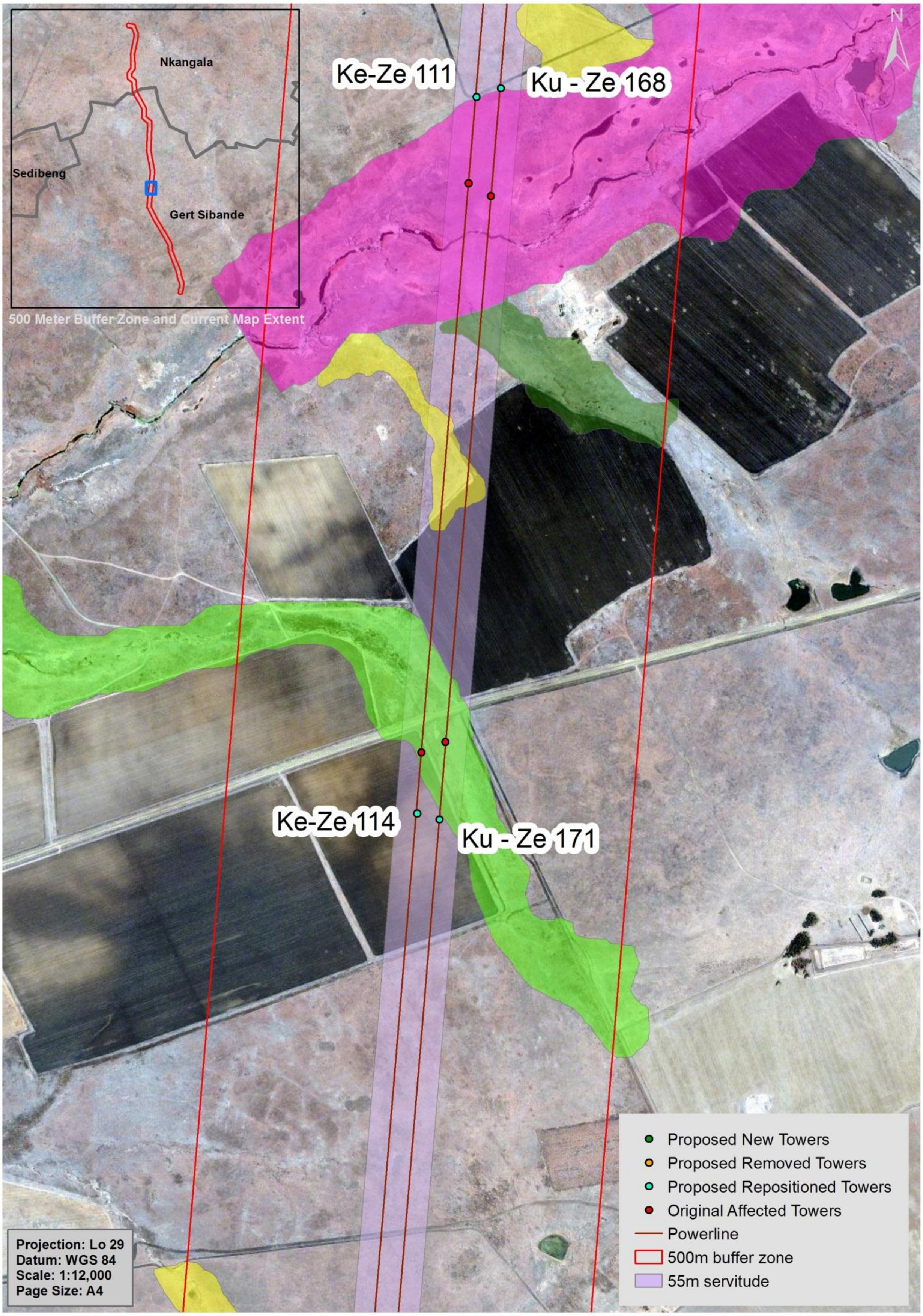
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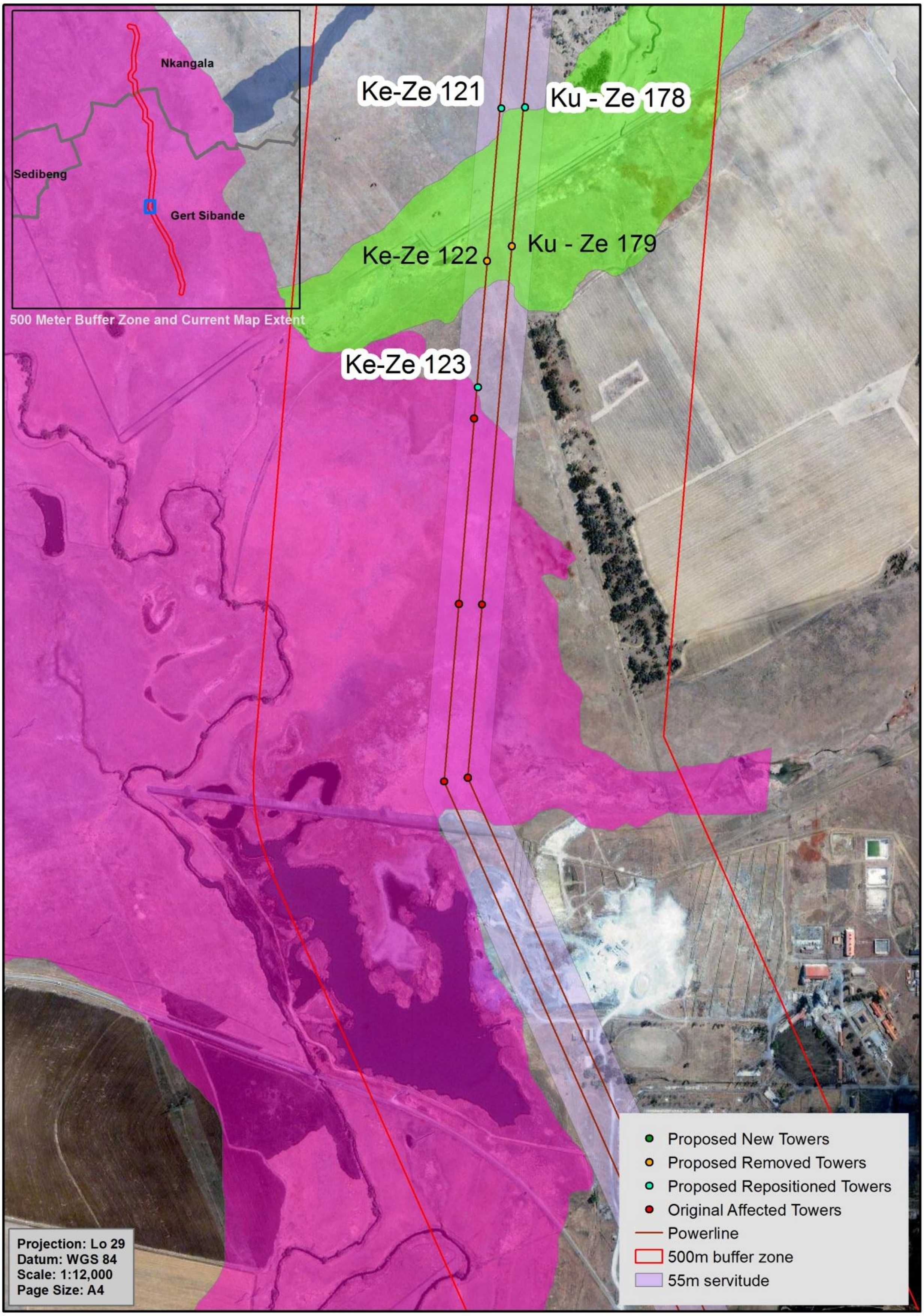
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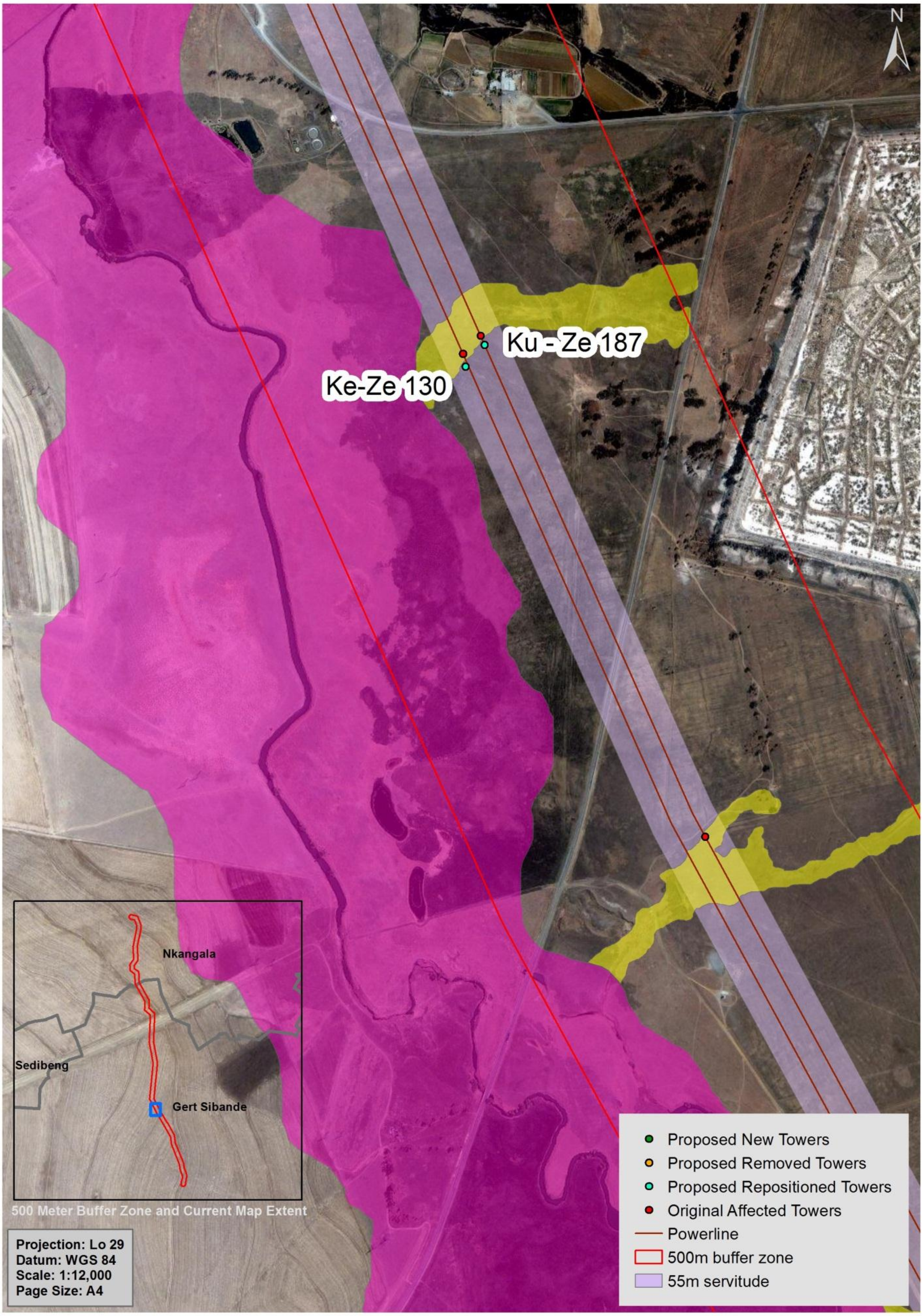
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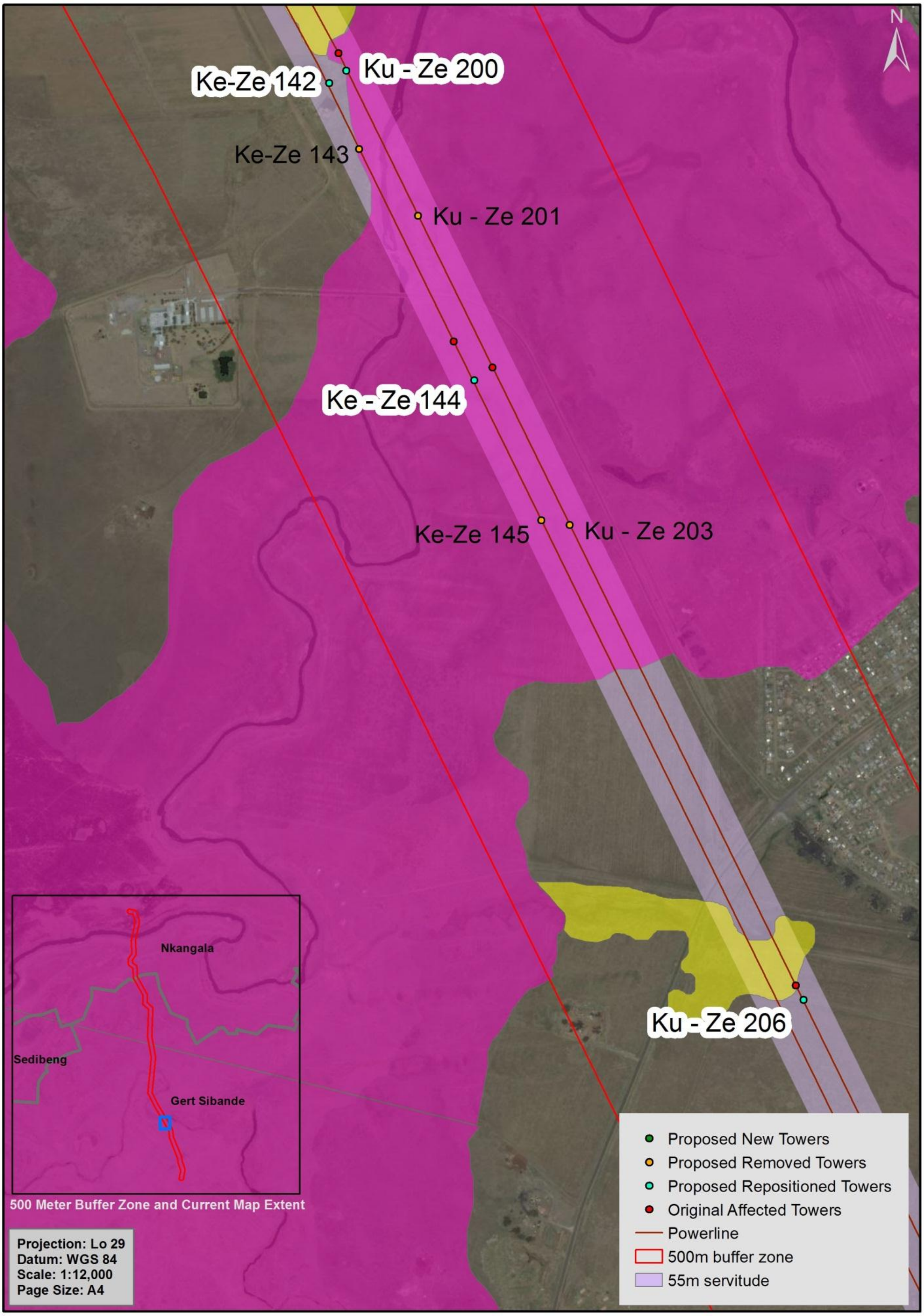
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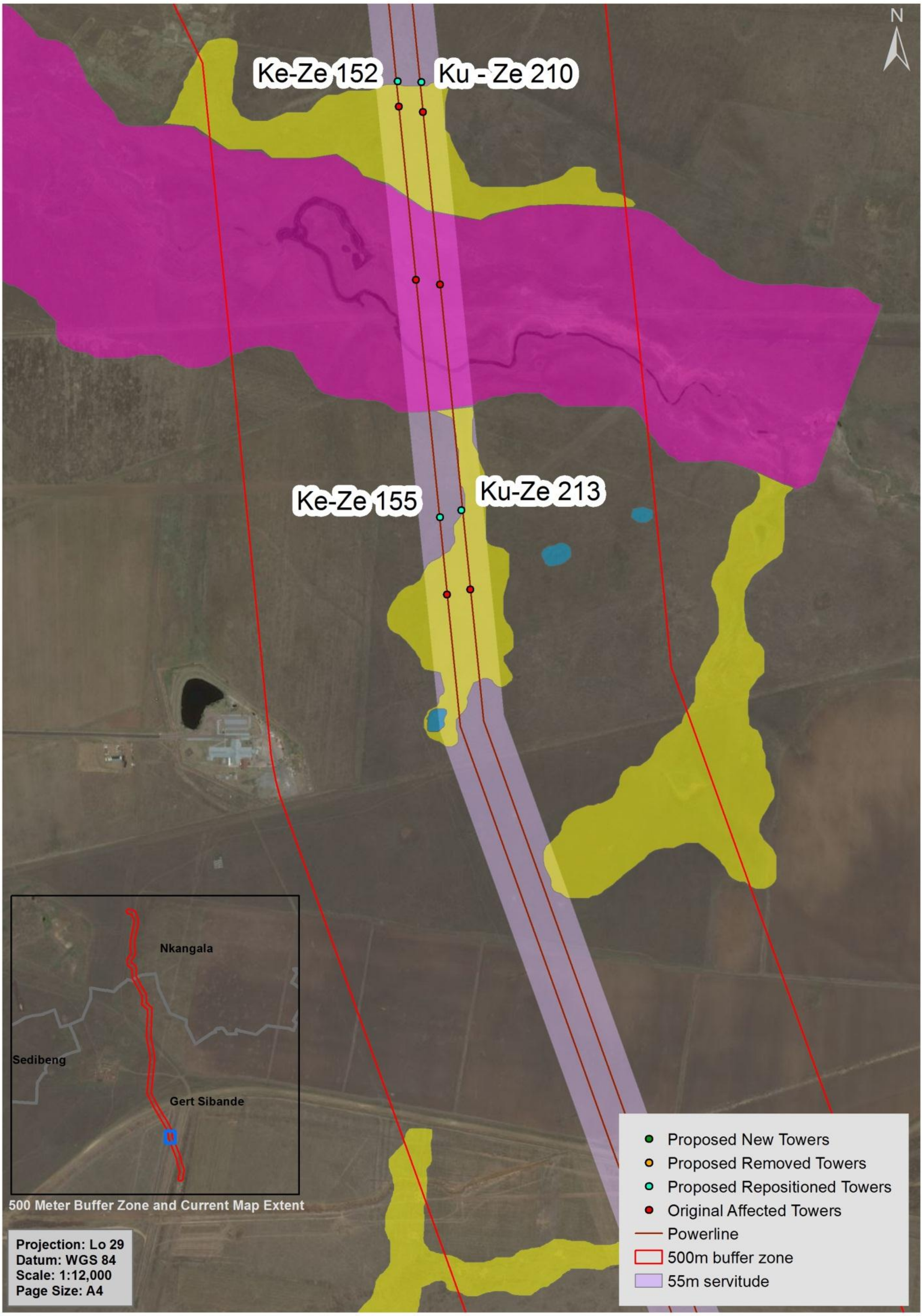
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55m servitude


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Ke-Ze 160
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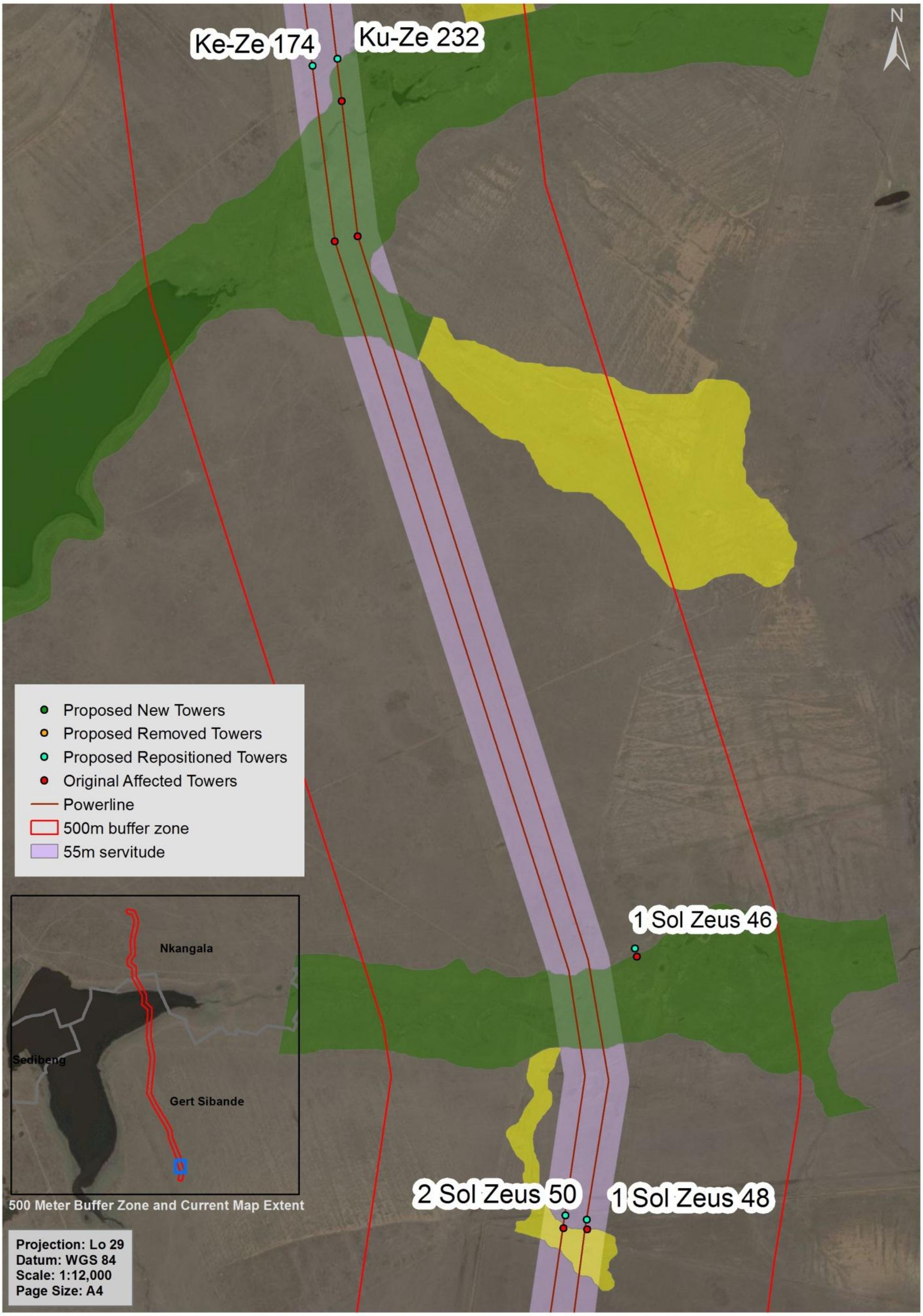
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