6.2 AFFECTED PROPERTIES AND LAND OWNERS

The properties and landowner details that will be affected at Site 1 and 3 are documented in Table 6-1.

Table 6-1: Properties and Land Owners Affected if Site 1 is developed for the Camden Ash Disposal Facility Expansion Project

Site	Farm Name	Portion No	Registered Land Owner
1	Uitkomst 292 IT	18	Catharina Elizabeth du Toit
3A	Uitkomst 292 IT	10	Lodewyk Johannes de Jager
	Uitkomst 292 IT	2	Lood de Jager Trust
3B	Mooiplaats 290 IT	14	Willem Nicolaas Van der Wath
	Uitkomst 292 IT	18	Catharina Elizabeth du Toit

6.3 FOOTPRINT AND LIFESPAN OF THE FACILITY

The new ash disposal site will need to cater for an estimated 12,86 million m^3 of ash up to 2023, plus 5 years contingency (2028). Additional structures *inter alia* AWRD and channels, roads, pipelines and fences will also increase the footprint of the project. A breakdown of the footprint of the project is shown in Table 6-2 and is represented graphically in Figure 6-1and Figure 6-2 for each alternative respectively.

Table 6-2: Footprint (in hectares) of each site alternative for the Camden Ash Disposal Facility Expansion Project

Project Component	Site 1 (ha)	Site 3A +3B (ha)
Ash Disposal Facility	154,00 ha	193,40 ha
Ash Return Water Dam	8,10 ha	14,00 ha
Pipelines for slurry deposition	1,20 ha	2,76 ha
Pipelines for return water	3,00 ha	1,47 ha
Dirty water containment canals and trenches	1,80 ha	3,98 ha
Storm water cut-off trenches / channels	0,70 ha	2,11 ha
Access Roads and Access Control	1,60 ha	5,44 ha
Relocation of transmission lines	25,60 ha	9,25 ha
Areas between facilities and infrastructure	20,68 ha	34,00 ha
Total	**216,68 ha**	**266,44 ha**

6.4 HEIGHT OF THE FACILITY

According to Eskom policy the height of a facility and the rate of rise are critical to ensure that an ash disposal site is operated safely and efficiently. It is envisaged that the rate of rise will not exceed the current 3 m per annum. The new facility will be ~36 m high at its highest point once fully constructed. Figure 6-3 provides a photograph of the current disposal site from high point in the terrain.

Figure 6-3: View of the sides of the existing ash disposal site

6.5 SOURCES OF WASTE

The waste that requires disposal on the ash disposal facilities originates from two main sources:

- Camden Power Station: fly ash and coarse ash from coal burning operations (this currently contains blow down water from the cooling towers, which is used to transport the ash; and
- Camden Power Station Reverse Osmosis (RO) / ash water treatment plant: brine salts.

The ash and brine received by the current ash disposal facilities is transported via pipelines to the ash disposal facility from the various source areas. The wet ash in slurry form is pumped to the ash containment facility, where some water is evaporated and some is retained through penstocks. Surplus water that does not evaporate drains to the De Jagers pan, through penstocks, from where the water is abstracted and treated through a RO plant. The clean water from the RO plant is taken to the power station where it is reused. The concentrated brine from the RO plant is discharged back into the Ash water return lines to the station Ash water high level reservoir on site, to be used for ash removal from boilers ash and dust hoppers and subsequently forms part of the ash water that assists with the transportation of ash slurry to the ash disposal facility. The pipelines (Figure 6-4) are placed strategically from the source areas in the power station and the RO plant.

Figure 6-4: Transportation (red) and disposal (yellow) at current ash disposal facilities.

6.6 VOLUMES OF WASTE

6.6.1 Ash Volumes

The volumes of ash vary from month-to-month, however a detailed register of all the ash disposed at the existing facility is kept at the power station. The current site is authorised to receive a maximum of 3 421 000 m^3 of slurry a year. It is anticipated that the new site will have to take the same consistency and composition of ash for the estimated life of the facility, which is estimated for another 19 years from 2014 to 2033.

6.6.2 RO Plant Brine Volumes

Once the treatment plant is operational at 85% recovery rate, it will produce ~500 m^3 of brine per day. It is envisaged that the water treatment plant will only be operative for three years (I. Hodgskin, 2011). This volume of brine waste stream is considered negligible at 5% of the total waste stream per annum to be disposed of on the proposed ash disposal facility, and will only constitute a total of 4.25% of the total waste stream over the19 year life of the facility.

6.7 WASTE CHARACTERISATION

Waste in South Africa is currently classified in terms of the Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste 2nd Ed. (1998). The methods for characterisation / classification of waste in South Africa is currently under review, and at the time that this report was being written it was anticipated that the draft Revised Waste Classification and Management Regulations would be imminently promulgated.

As such the EAP has undertaken to have the waste classified by a specialist consultant in terms of both the Minimum Requirements (DWAF, 1998a) as well as the draft Revised Waste Classification and Management Regulations, these are discussed separately below. For more detailed information please refer to the Waste Classification Report undertaken by Jones and Wagener Consulting Engineers (J&W) in Appendix J

6.7.1 Minimum Requirements (DWAF, 1998a)

The ash from Camden Power Station was classified in terms of the Minimum Requirements (DWAF, 1998a) and the letters from the Department of Environment and Tourism (DEAT), titled “Waste Delisting Procedure”, signed by their Director General, dated April 2008 and June 2009 respectively (DEAT, 2009). The hazard rating in this report is therefore in compliance with the Minimum Requirements as amended by the DEAT. The ash was hazard rated based on the leach results of the South African ARLP (Acid Rain Leach Procedure) only.

The ARLP is used in cases where non-organic waste is mono-disposed or disposed with other waste not containing bio-degradable organic waste or in cases where a waste is to be used in an application where the chances of organic acid generation are minimal, such as road building and brick making.

The concentrations of the hazardous substances in the leach solutions were compared to the Acceptable Risk Levels (ARL) for the aquatic environment as listed in the Minimum Requirements or as identified by J&W. The ARL is, expressed in parts per million (ppm) or mg/ℓ = 0.1 x LC_{50} (mg/ℓ)[5]. Where the concentration in the leach solution is greater than the ARL, the waste is classified as hazardous for that particular substance. The most hazardous substance dictates the Hazard Rating of the waste. Four Hazard Rating classes are specified in the Minimum Requirements ranging from Hazard Group 1 (Extreme Hazard) to Hazard Group 4 (Low Hazard).

The waste has been classified and hazard rated based on the most hazardous constituent of concern in the ash. Furthermore, the monthly loading rate, i.e., the amount of waste that can be disposed of in tons / hectare / month, has also been calculated, namely:

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[5] The factor of 0.1 is calculated from a cross section of typical dose response data, with a typical slope of dose response curves. From an exposure 10 times lower than the LC50, approximately 0,00034% or one in 300 000 of a population exposed to the contaminant, is likely to die (DWAF, 1998a).

- *Monthly loading rate = Allowable dose per month (g/ha/month)/Concentration in leach solution, where allowable dose per month = ARL/0.66* [6]

The allowable maximum load per hectare for lined waste disposal facilities is again calculated from the dose as:

- *Total load (ton/hectare) = 100 x dose (g/ha/month)/mg of most hazardous substance per kilogram of waste*

or, for unlined waste disposal facilities as:

- *Total load (ton/hectare) = 10 x dose (g/ha/month)/mg of most hazardous substance per kilogram of waste*

A waste can be delisted to general waste in cases where the:

- Concentration in the leach solution < ARL for Hazard Group 2, 3 or 4 substances, or
- Concentration in the leach solution < 0.1 x Hazard Group 1, or
- An allowable load of [(ARL/0.66) / (Measured concentration)] is not exceeded.

<u>Primary Hazard Rating of the Camden Power Station Dry Ash</u>

Based on the Minimum Requirements approach a waste is first categorised based on the industry type. In this case the waste is ash /brine originating from the wet-ash process at the Camden Power Station for the generation of electricity. The ash is therefore classified as potentially hazardous, as the Energy Industry was identified in the Minimum Requirements as an industry generating potentially hazardous waste (DWAF, 1998a).

The next step in the primary hazard rating involves a Total Concentration (TC) analysis to determine the chemicals of concern. The TC analysis indicates that the dry ash contains between 6.86 and 7.03 % iron and between 488 and 508 mg/kg manganese, which, in terms of the Minimum Requirements, results in the ash being classified as potentially hazardous. Both iron and manganese are listed as potentially hazardous wastes in terms of the Minimum Requirements, as they have the potential to leach out of the ash it may therefore cause negative impacts in the environment.

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[6] The factor 0.66 is derived from the ratio of the substance in a weight of underground body of water (DWAF, 1998). A correction factor of a 1000 was applied by the DWAF to obtain g/ha/month instead of mg/ha/month – this was never fully explained in the Minimum Requirements.

Secondary Hazard Rating of the Camden Power Station Dry Ash

As discussed above the Primary Hazard Rating is potentially hazardous, based on the industry type and TC values of Iron and Manganese in the waste stream, and therefore a secondary hazard rating was undertaken. The results of the Secondary Hazard Rating indicated that the dry ash is a Hazard Group 1 or extreme hazardous waste due to the hexavalent chromium concentration (Cr VI) in the ARLP leach solution being greater than its ARL value.

These results indicate that disposal of the ash should be onto a facility that complies with the most stringent barrier (liner) performance requirements of a H:H waste disposal facility, as per the Minimum Requirements (DWAF, 1998a).

The monthly loading rate based on the ARLP concentrations of hexavalent chromium present in the ash is only 75 tons / ha / month. The size of the ash disposal facility will determine the total amount of ash that can be disposed of per month.

Ms I. Hodgskin of the power station reported that 1.6 million tons of dry ash is deposited per annum. The monthly disposal rate will therefore be 133 333 tonnes, which requires a disposal site of 1 778 hectares in size. Clearly this is not achievable as the anticipated ash disposal facility size is only 100 hectares. This demonstrates that the loading rate principle of the Minimum Requirements is not practical. However, the actual leachate (seepage water) from the existing ash disposal facility was also analysed, and as the seepage water represents the actual impact on the environment, the seepage water was therefore used as the basis for the classification.

Waste Classification in terms of the DWAF Minimum Requirements Methodology (1998a)

Based on the DWAF's Minimum Requirements waste classification methodology and when subjected to an ARLP, the Camden Ash is classified as a Hazard Group 1 waste. This is caused by the concentration of leachable chrome VI (Hazard Group 1) being higher than its ARL, which means that the waste cannot be delisted to a general waste. Hazard Group 1 wastes need to be disposed of on H:H waste disposal facilities.

However, when considering the quality of the ash seepage water not one of the elements of concern was detected at a concentration higher than its respective ARL value. Therefore the ash and ash carrier water can be delisted to a general waste as per the Minimum Requirements for disposal purposes. Although delisted liquid waste should be disposed of on landfills with H:H Lagoon barrier systems, the ash and ash carrier can be disposed of on a G:L:B^{+} waste disposal facility, provided the seepage water (leachate) head can be maintained at equal or less than 300mm on top of the barrier layer and the drainage piping system on the barrier is of adequate size, spacing and strength to ensure atmospheric pressure within the drainage system for the service life of the landfill.

The RO brine was classified as a Hazard Group 2 waste or High Hazard Waste due to the lead concentration in the brine being greater than its ARL value. The brine has to be disposed of on a hazardous lagoon (H:H lagoon).

Should consideration be given to the co-disposal of the ash and brine on a single facility, disposal should be acceptable on a H:H waste disposal facility with a H:H barrier system. This barrier system is required as the brine was classified as a Hazard Group 2 waste, which requires disposal on a H:H waste disposal facility.

The landfill class for disposal of the wastes based on the Minimum Requirements are summarised in Table 6-3 below. A recommended barrier system is also given. Descriptions of the various barrier systems considered are given separately in this report in Section 6.7.3.

Table 6-3: Waste Type and Class of Landfill Required based on Minimum Requirements

Waste	Type of Waste	Disposal Scenario	Class of Landfill	Recommended Barrier System
Ash + Ash Carrier Water	Delisted	Mono-disposal	$G:L:B^+$	$*G:L:B^+$
Brine from Water Treatment Plant	Hazard Group 2 Waste	Mono-disposal	H:H Lagoon	H:H Lagoon
Ash + Ash Carrier Water + Reverse Osmosis Brine	Hazard Group 2 Waste	Co-disposal	H:H	H:H
*** Provided there is no significant water head (>300mm) on the barrier system and the drainage piping system on the barrier is of adequate size, spacing and strength to ensure atmospheric pressure within the drainage system for the service life of the landfill**				

6.7.2 Draft Revised Waste Classification and Management Regulations

In terms of the DEA's proposed Revised Waste Classification and Management Regulations for disposal, the Camden Ash was subjected to a Total Concentration (TC) extract and a Deionised (DI) water leach. Two samples were used in the assessment, namely dusting ash (fine ash) and ashing ash (coarse ash). In addition, the water leaching from the current ash disposal facility was also analysed and compared to the respective Leach Concentration Thresholds (LCT) values.

Based on the analysis both the fine and coarse ash samples are classified as Type 3 wastes requiring disposal on a Class C landfill. This is because the TC of arsenic, barium, copper, lead and zinc where higher than their respective TC Threshold (or TCTi) values. In addition, the leach concentrations (LC) of barium, chromium, hexavalent chromium and molybdenum were also higher than their respective LCTi values for the fine ash. The coarse ash sample also classified as a Type 3 waste because of the boron, mercury, molybdenum, Total Dissolved Salts (TDS) and sulphate LC values being higher than their respective LCTi values. In addition, the TDS concentration of the DI water leach solutions in both cases is greater than the LCTi value of 250mg/ℓ. The leachate from the existing site also classifies as a Type 3 waste because of the barium, sulphate, chloride and TDS concentrations being higher than their respective LCTi values. This is considered the true classification of the ash waste, as the leachate (seepage water) constitutes actual field conditions.

The Camden Power Station ash should therefore be disposed of on a facility that has been designed and constructed as a Class C landfill (DEA, 2011b). Class C landfills are very similar in design to the current G:L:B+ landfills, with the major difference being the HDPE layer added to the barrier system. This barrier system is considered appropriate for the wet ash disposal facility provided the seepage water (leachate) head can be maintained at equal or less than 300mm on top of the HDPE barrier layer and the drainage piping system on the barrier is of adequate size, spacing and strength to ensure atmospheric pressure within the drainage system for the service life of the landfill.

As the water treatment plant was not operational on the day that the samples were collected, the classification was undertaken on a modelled value provided by Eskom. When using the DEA draft Revised Waste Classification and Management Regulations, the brine classifies as a Type 3 waste due to the boron, mercury, chloride, TDS and sulfate concentrations of the modelled brine solution being greater than their respective LCTi values. Type 3 wastes should be disposed of on Class C landfills, but in the case of the brine, which is a liquid, the brine will have to be disposed of in a hazardous waste lagoon disposal facility complying with the design requirements as given in the Minimum Requirements (DWAF, 1998a).

In the case that the brine is co-disposed with the ash on the new ash disposal facility, a Class C landfill barrier is considered appropriate for the ash disposal facility. It is a requirement that liquid waste should be disposed of in hazardous lagoon facilities, but provided the seepage water (leachate) head can be maintained at equal or less than 300mm on top of the primary HDPE barrier layer and the drainage piping system on the barrier is of adequate size, spacing and strength to ensure atmospheric pressure within the drainage system, a Class C barrier system is considered suitable for the co-disposal of the ash and brine.

Table 6-4 below summarises the classification of the ash and brine water based and also indicates the barrier systems required for the various disposal scenarios.

Table 6-4: Waste Type and Class of Landfill Required based on the DEA draft Revised Waste Classification and Management Regulations (2011)

Waste	Type of Waste	Disposal Scenario	Class of Landfill / Barrier System
Ash + Ash Carrier Water	Type 3: Low Risk Waste	Mono-disposal	Class C*
Brine from Water Treatment Plant	Type 3: Low Risk Waste but a liquid	Mono-disposal	H:H Lagoon
Ash + Ash Carrier Water + Reverse Osmosis Brine	Type 3: High Risk Waste	Co-disposal	Class C*
* **Provided there is no significant water head (>300mm) on the barrier system and the drainage piping system on the barrier is of adequate size, spacing and strength to ensure atmospheric pressure within the drainage system for the service life of the landfill**			

6.7.3 Barrier System Design

It should be noted that ash disposal facilities are not a new solution for ash management and Eskom has developed this technology for a number of their power stations between 1960 and 1980, however, the installation of a barrier system or "lining of the ash disposal facilities" is a new requirement (since 1998). This poses new challenges to the operating methods of ash disposal facilities. With the introduction of a barrier system the management of compartments becomes critical, as it will not be practical to install the barrier system for the entire facility on initiation as the risk of liner damage will be too high. This is discussed in more detail in Section 7.2.10 of this report, which details the installation of the barrier system.

In addition the design of the barrier system is determined by the classification of the waste, as discussed in summary in Section 6.7 above, and in more detail in the Waste Classification Report (attached as Appendix J).

The design specifications for the barrier system will this also differ, depending on the classification system used. The EAP has provided the specifications for both the Minimum Requirements (DWAF, 1998a) and the draft Revised Waste Classification and Management Regulations separately below. The barrier system utilised will be dependent on the WML and EA conditions issued, and the relevant legislation promulgated at the time of construction.

<u>Minimum Requirements (DWAF, 1998a)</u>

In terms of the Minimum Requirements (DWAF, 1998a) a H:H Lagoon Barrier System is required. The typical cross section of the H:H Lagoon Barrier System is given in Figure 6-5 below.

An HDPE sheet is used for the geo-membrane, and river sand is proposed for the cushion layer. Grade A4 bidim is proposed for the geotextile layer. The barrier system also calls for a

900 mm clay layer. Large quantities of clay are not available on site. Importation of clay is possible however may not be economically viable.

The following are alternatives to the clay liner:

- HDPE;
- Geosynthetic Clay liner (GCL); and
- Bauxite.

These options need to be investigated during detailed design of the facility.

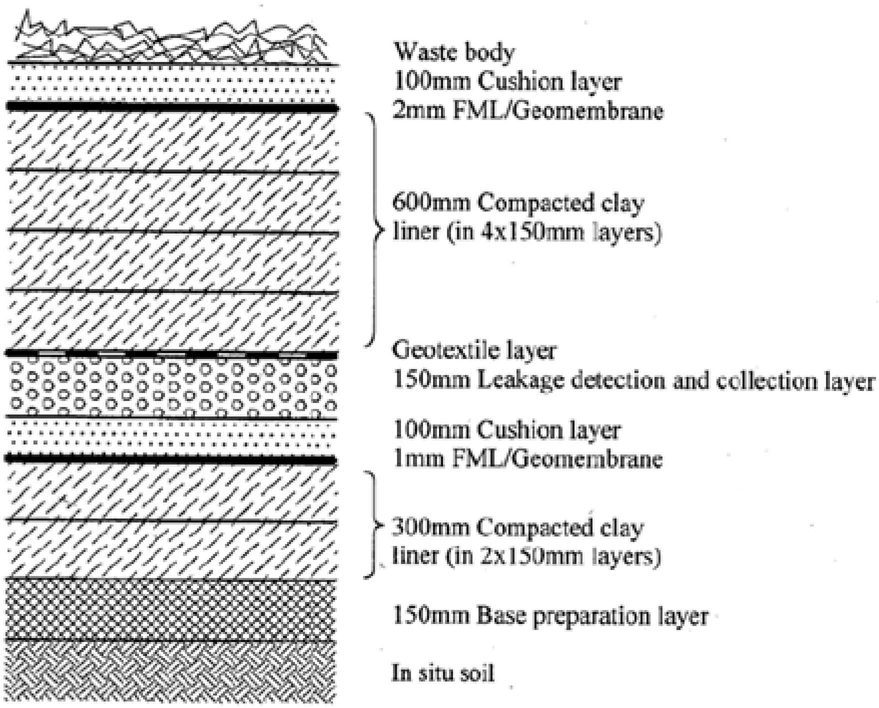

Figure 6-5: H:H Lagoon Barrier System

Draft Revised Waste Classification and Management Regulations

The Waste Classification report proposes a Class C barrier, show in Figure 6-6 below, as per the DEA's regulations (not promulgated as yet) for both the co-disposal as well as mono-disposal of ash.

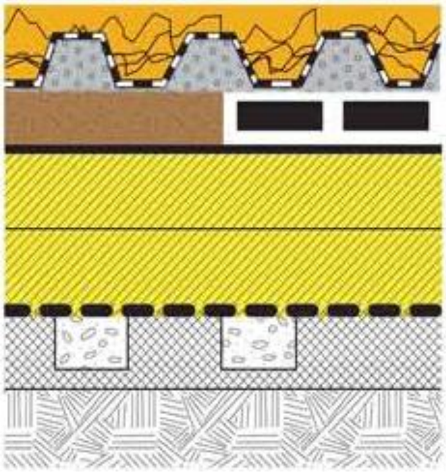

Figure 6-6: Proposed Class C landfill barrier system (DEA, 2011)

6.8 CLEAN AND DIRTY WATER SEPARATION AND CONTAINMENT INFRASTRUCTURE

6.8.1 Clean Water Separation Infrastructure

An upstream concrete lined channel shall be constructed to divert clean water around the proposed facility and discharge into the natural environment. The channel will be sized to accommodate the 1:100 year storm event. The sites have been positioned such that the "clean" area between the natural watershed and the proposed facility is as small as possible. The proposed sizes of the trapezoidal channel, with side slopes of 1.5:1 (h:v) and base width of 1 m, required for each alternative are listed in Table 6-5. The location of the proposed clean water diversion channel is shown on Figure 6-1 and Figure 6-2 for each alternative respectively.

Table 6-5: Sizing of Clean Water Diversion Trench

Site No	"Clean" Area (ha)	Flow Rate (m^3/s)	Channel Length (m)	Channel Height (mm)	Channel Top Width (mm)
1	30.1	11.0	2100	800	3400
3A	13.1	10.1	1700	700	3100
3B	28.2	11.4	1800	700	3100
3B	27.5	10.4	1200	700	3100

6.8.2 Dirty Water Containment Infrastructure

Solution trench

Dirty water run-off generated off the side slopes of the ash disposal facility will drain into a suitably sized "solution trench" running around the facility. This trench will be designed to receive and convey run-off generated after a 50 year storm event. The solution trench will also receive discharge from the leachate collection system and this flow has also been included in the sizing of the infrastructure. Conceptual sizes of the trapezoidal channels, with side slopes of 1.5:1 (h:v) and base width of 1 m, required are listed for each alternative in Table 6-6. The location of the proposed dirty water trenches is shown Figure 6-1 and Figure 6-2 for each alternative respectively.

Table 6-6: Sizing of Solution Trenches

Site No	Channel ID	Flow Rate (m^3/s)	Channel Length (m)	Channel Height (mm)	Channel Top Width (mm)
1	A	3.7	850	500	2,500
	B	8.3	1,900	700	3,100
	C	14.4	900	900	3,700
	D	18.6	1,650	1,000	4,000
3A	A	6.3	1,700	500	2,500
	B	13.7	800	800	3,400
	C	5.9	580	500	2,500
	D	3.4	730	500	2,500
3B	A	7.5	1,300	600	2,800
	B	2.6	400	400	2,200
	C	6.6	700	600	2,800
	D	16.9	1,150	900	3,700
	E	22.9	570	1,000	4,000
	F	10.5	350	700	3,100

Ash Water Return Dam

Water draining from the deposited wet ash will be recycled via a system consisting of an Ash Water Return Dam (AWRD) and drains that collect the runoff from the ash disposal facility (containment dam) prior to pumping the water to the power station or RO plant for treatment or reuse.

For the foreseeable future water from the AWRD will be sent to the RO Plant, where it will be treated, clean water will be sent to the power station for reuse; while brine will be combined with the ash slurry for transportation of ash to the proposed ash disposal facility. As a barrier system will be installed at the new facility it is anticipated that no water will be lost through seepage, but may be lost through evaporation, and as such a closed loop system is formed.

The placement and size of the AWRD and associated infrastructure is shown in Figure 6-1 and Figure 6-2 for each alternative respectively, and detailed sizing is provided in Table 6-7.

All dirty water run-off generated within the footprint area of the waste disposal facility will be captured in the new AWRD. Although Government Notice 704 (GN704) stipulates that the AWRD shall be sized to accommodate the 50 year 24 hour storm event, this is based on the assumption that the AWRD is empty prior to this storm event. However, this is rarely the case and a more realistic approach should be adopted. It is Best Practice to undertake continuous modelling (a daily time step model) of the system in order to ascertain a more realistic capacity of the dam. This method takes into account the operating philosophy of the facility as well any abstractions from the dam including evaporation.

At this stage of the project, as is typical, only conceptual engineering is undertaken and it is therefore necessary to make certain assumptions in order to determine the size of the AWRD and associated facilities. At a later stage detailed design engineering will be undertaken, and the final plans submitted to the Department of Water Affairs (DWA) for approval. The assumption was made that the AWRD will be 25% full prior to the 1 in 50 year storm event. The table below gives the proposed sizes of the AWRD for Site 1.

Table 6-7: Sizing of Return Water Dam

Site No	"Contaminated" Area (ha)	Crest Height (mamsl)	AWRD Size (m^3)
1	198.0	1 663,65	174 800
3A	162.3	1 669,80	153 400
3B	214.5	1 682,55	180 600

Stormwater captured at the Ash Dam pool level will be conveyed to the AWRD via penstocks. The penstocks and the discharge pipes will be designed such that the flow is attenuated at the pool level and drained over a 24 hour period (with two penstock inlets in operation) to the AWRD.

A silt trap will be installed to remove silt from the decanted water before is enters the lined return water dam. The amount of silt in the water will need to be determined and will provide input into the detailed sizing and cleaning frequency of the silt trap. Refinement to fit within the property boundary and accommodate the silt trap at the inflow section will form part of the next design phase.

A well prepared and compacted base is essential for the liner. The liner requirement for the AWRD is the same for the ash facility.

6.8.3 Leachate Collection and Management

The leachate collection system will comprise of a toe drain as well as a main drain system. A leachate collection system will be designed such that a maximum leachate head of 300 mm will be maintained over the liner system. The leachate will be drained to the solution trench, discussed below, which ultimately discharges to the AWRD. The solution trench and AWRD is shown in Figure 6-1 and Figure 6-2 for each alternative respectively.

The leachate collection system will be designed using a cuspated drain with geomesh above to ensure structural integrity of the system. This will be located above the liner system. The permeability of the leachate collection system varies between 3 to 20 m per year. Based on this, a conservative drainage rate of 5mm/h was assumed in order to determine the size of cuspated drain required for the leachate collection system. Conceptual flows draining to the AWRD via the solution trenches indicated in the previous section (Section 6.8.2) is indicated in the Table 6-8 below.

Table 6-8: Leachate Flow Rates

Site No	Max Area for Leachate (ha)	Flow Rate (m^3/s)
1	154	2.2
3A	101	1.4
3B	92	1.3

6.8.4 Surface- and Ground- water monitoring

On-going monitoring of the storm water drainage features, relevant surface water resources, and groundwater monitoring boreholes will be undertaken; if necessary additional groundwater monitoring boreholes will be installed for monitoring. The location of monitoring points are shown on Figure 6-1 and Figure 6-2 for each alternative respectively.

6.9 PIPELINES

6.9.1 Slurry pipelines

Once the existing ashing facility has reached its design capacity, the slurry pipeline will be discontinued to the discharge point at the existing facility. The pipeline will be extended from the existing facility to the new facility by a 6 mm thick, 350 mm diameter steel pipeline. This will be installed above surface and fixed to concrete plinths. The sections of the existing pipeline no longer required will be dismantled and the areas impacted will be rehabilitated. The length of the pipeline to Site 1 will be 6,07 km by comparison to the 10,32 km of pipeline to be used for Site 3. The placement of these pipelines is shown on Figure 6-1 and Figure 6-2.

6.9.2 Return water pipelines

The existing ash return water pipeline from De Jagers Pan will need to remain in place after the existing facility has reached its design capacity. This will be required in order to manage stormwater that either runs off the contaminated terrain and side slopes of the facility or any stormwater that recharges through the facility before it is capped.

A new return water pipeline will need to be installed from the new AWRD back to the power station. A 400 mm diameter High Density Polyethylene (HDPE) pipeline with a rating of PE80 PN 12.5 will be installed. This pipeline will be buried within a trench approximately 1.5 m deep.

The length of the pipeline to Site 1 will be 5,2 km by comparison to the 7,27 km of pipeline to be used for Site 3. The placement of these pipelines is shown on Figure 6-1 and Figure 6-2.

6.10 ACCESS ROADS, FENCING, AND ACCESS CONTROL

The site will be accessed from the existing access roads located on the north eastern boundary of the site. The current gravel access road is in a fair condition and does not require any upgrade.

A new access road to the facility will be constructed for vehicle access. This new road will be taken from the existing site access road, and will circumvent the entire facility, located at the toe of the ash disposal facility. The road will have no servitude. The proposed access road will consist of a gravel base with a stabilised wearing course.

The length of the road for Site 1 will be 5,5 km by comparison to the 51,59 km of road required for Site 3.

In order to ensure safety and to prevent illegal dumping the site will be secured by means of a 1,8 m high diamond mesh fence along the entire perimeter. Access will be gained through an access control point monitored by a security guard. This person can also be the existing security guards on site. Access can also be managed through station access processes.

The existing and proposed access roads, as well as fences and access control points is shown on Figure 6-1 and Figure 6-2.

6.11 RELOCATION OF TRANSMISSION LINES AND OTHER INFRASTRUCTURE

There are no pipelines visible on either of the footprints of the site and the roads were restricted to informal tracks. This will not need relocation. Three 400kV transmission lines will need realignment around the facility at Site 1. Three 400kV transmission lines will require relocation at Site 3.

There is sufficient area around each of the new facility to accommodate the relocation of these transmission lines. The details of the area for power line relocation for both Sites 1 and 3 are given in Table 6-9 below. The proposed route for realignment is shown on Figure 6-1 and Figure 6-2 for each alternative respectively.

Table 6-9: Details or the areas earmarked for Transmission Line Relocation

Site No	Centre Line Ref. Point	X Coordinate (DD)	Y Coordinate (DD)	No of Tx Lines	Servitude Required	Available Corridor
Transmission Line 1 (located south west of Site 1)						
	Tx-1-A	30.056797	-26.606486	1	55 m	100 m
	Tx-1-B	30.062546	-26.609482	1	55 m	100 m
	Tx-1-C	30.069527	-26.605117	1	55 m	100 m
Transmission Line 2 (located north east of Site 1)						
1	Tx-2-A	30.06287	-26.5932	2	110 m	200 m
	Tx-2-B	30.06894	-26.5924	2	110 m	200 m
	Tx-2-C	30.08074	-26.5989	2	110 m	200 m
	Tx-2-D	30.08122	-26.6044	2	110 m	200 m
	Tx-2-E	30.08076	-26.6046	2	110 m	200 m
	Tx-2-F	30.08032	-26.5991	2	100 m	200 m
	Tx-2-G	30.06875	-26.5927	2	100 m	200 m
	Tx-2-H	30.06261	-26.5936	2	100 m	200 m
Transmission Line 3 (located North of Site #A						
3A	Tx-3-A	30.06436	-26.624	2	110 m	200 m
	Tx-3-B	30.06667	-26.6218	2	110 m	200 m
	Tx-3-C	30.06947	-26.6239	2	110 m	200 m
	Tx-3-D	30.06461	-26.6243	2	110 m	200 m
	Tx-3-E	30.06678	-26.6223	2	110 m	200 m
	Tx-3-F	30.06932	-26.6242	2	110 m	200 m
Transmission Line 4 (located east Site 3A)						
3A	Tx-4-A	30.07957	-26.6293	1	110 m	200 m
	Tx-4-B	30.08289	-26.6323	1	110 m	200 m
	Tx-4-C	30.07883	-26.6347	1	110 m	200 m
	Tx-4-D	30.07957	-26.6293	1	110 m	200 m

6.12 CONTRACTORS CAMP

A contractor’s camp of 50m x 50m (2500 m^2) will be established. The contractor’s camp will be for:

- The location of the contractors site office and first aid station (containers, park-homes or similar type structure that can be removed will be used);
- Parking of vehicles (including heavy vehicles for construction purposes);
- Storage of equipment and construction materials;
- Safe storage of dangerous goods (including hydrocarbons and chemicals that may be required during construction, that will be stored in properly designed, ventilated, secured, and bunded storage facilities);
- Storage of potable water (a jojo tank or similar type temporary structure of about ~2000 litres will be installed for the duration of the construction phase); and
- Temporary ablution facilities will be established that consist of portable toilets or a conservancy tank will be used.

The location of the proposed contractor's camp is shown on Figure 6-1 and Figure 6-2 for each alternative respectively.

6.13 CAPPING OF THE ASH DISPOSAL SITE

The permit / license for the existing ash dam require rehabilitation of the facility through capping with soil material in order to cover the waste, and successful re-vegetation of rehabilitated areas of the site. This process has to date been very successful as illustrated in Figure 6-7 below, and the current practice will be continued at regardless of which site is selected for development..

The method's for capping and revegetation of the facility are addressed in more detail in Section 7.4.1 of this report, and is operationalized through the EMP[7] and the Operations Manual[8] for the Camden Ash Facility Expansion project. These reports are published separately, but have been made available for stakeholder review prior to finalisation.

Figure 6-7: Capping on the existing ash disposal site in the foreground

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[7] Zitholele Consulting (Pty) Ltd. (2012) *Draft Environmental Management Programme for the Camden Ash Disposal Facility Expansion Project*. Project No: 12670. (Referred to in this report as the Draft EMP for this project).

[8] Zitholele Consulting (Pty) Ltd. (2012) *Draft Conceptual Design Report for the Extension of the Ash Dam at Camden Power Station*. Project No: 12670. (Referred to in this report as the Draft Operations Manual or Conceptual Engineering Report).

7 DESCRIPTION OF DEVELOPMENT ACTIVITIES

The construction, operation and closure activities of this project are discussed below according to the following phases: Pre-construction; Construction and Remediation; Operation and Consecutive Rehabilitation; Decommissioning and Closure of the Facility.

7.1 THE PRE-CONSTRUCTION PHASE

7.1.1 Land Purchases and Negotiation

Once EA has been obtained Eskom's detailed negotiators will commence negotiation to purchase the land earmarked for the development.

7.1.2 Appointment of Contractor

After all land has been acquired and all the internal tendering processes have been satisfied, Eskom will appoint the construction contractor. The anticipated appointment date is early 2014.

7.1.3 Construction Schedule

The construction schedule will be determined prior to construction in consultation with the appointed contractor. The current timeframe for construction is estimated to be 12 – 24 months. It is envisaged that the proposed ash disposal facility must be ready to receive ash from the power station by the middle of the year 2015.

7.1.4 Installation of surface water / groundwater monitoring points

Monitoring will be commenced ahead of construction at all monitoring points designated by the DWA. The recommended monitoring points are shown in Figure 7-1. As the proposed boreholes are new monitoring points these will be drilled and suitably sleeved with PVC. Adequate borehole head protection will be installed.

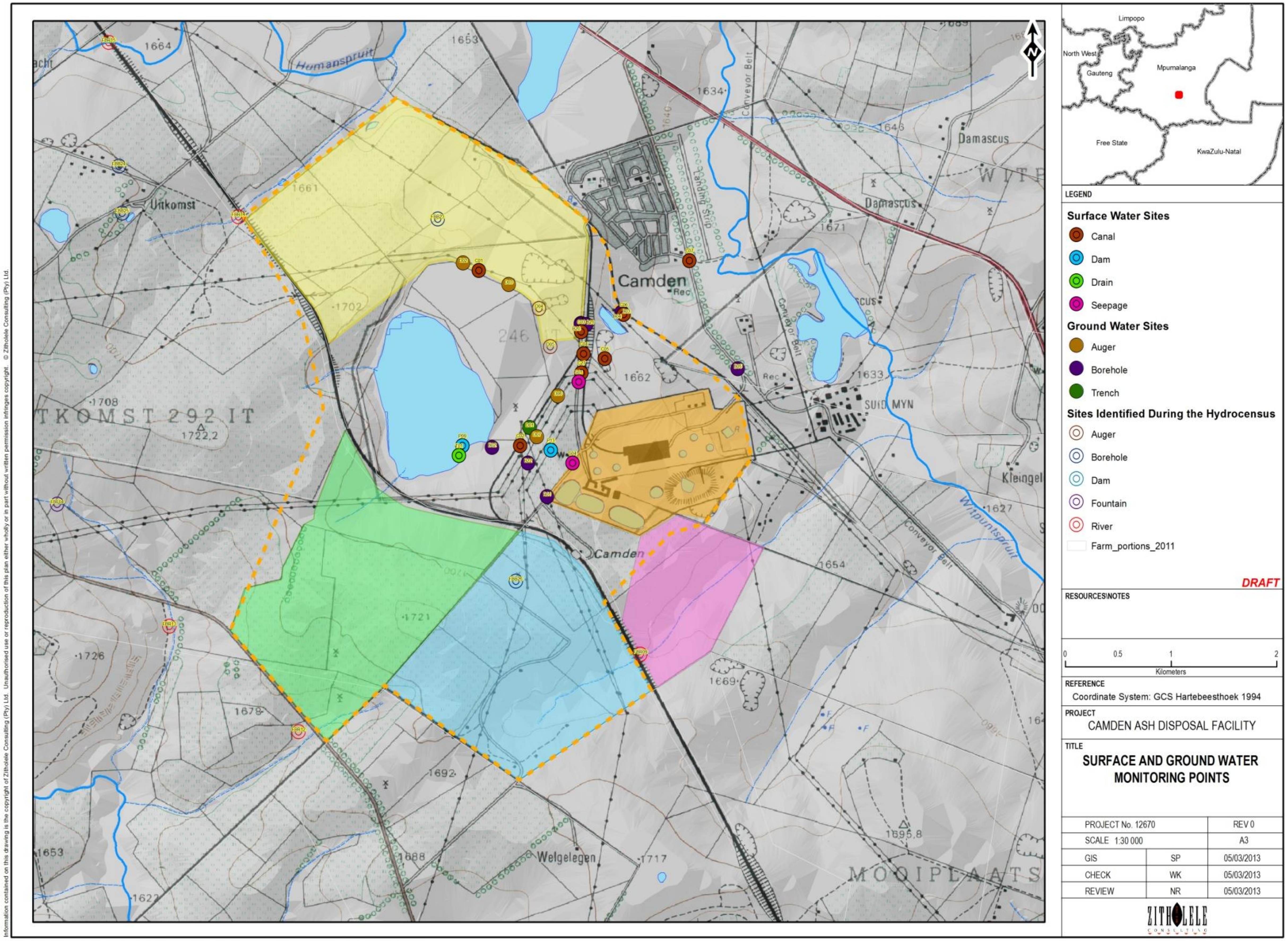

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Figure 7-1: Proposed location of monitoring boreholes

7.2 THE CONSTRUCTION AND REMEDIATION PHASE

7.2.1 Obtaining the Environmental Authorisation

Obtaining the EA / WML and WUL will signal the commencement of the project construction phase. If a positive EA is obtained, the construction of the ash disposal facility and rerouting of transmission lines will be undertaken over a period of 12 - 24 months. The activities undertaken during the construction phase are discussed below.

7.2.2 Installation of fences and access control

The construction area will be secured with a fence installed at the outset of construction phase.

7.2.3 Site preparation and clearance for contractor's camp

An area will be cleared for the siting of a contractor's camp. The position of these potential contractors camps are show on Figure 6-1 and Figure 6-2 for each alternative respectively. The location has been selected because of its ease of access, central proximity, and currently disturbed status. Preparation of this area will include vegetation clearing, compaction, installation of bunded areas for hydrocarbon storage, establishment of temporary offices / storage facilities (such as containers or park homes), chemical toilets (portable / conservancy tanks), potable water storage, and fences and access control. This area will be rehabilitated as per the EMP requirements post construction.

The location of the facility is shown in Figure 6-1 and Figure 6-2 for the respective sites.

7.2.4 Erection of camp sites for the contractors' workforce

Contractors will not house their workforce on site.

7.2.5 Vegetation clearing to facilitate access and construction activities

Vegetation must be cleared to facilitate access, construction and safe operation. Where protected indigenous vegetation needs to be removed it must be replanted so as to minimise impacts to the environment. Search and rescue activities may be required for any protected species if found on site during clearing. Where protected species are identified a permit will be obtained for their relocation prior to any vegetation clearing activities commencing.

7.2.6 Establishing of access roads

Once the contractor is established on site the access roads to the construction site will be established. Each road alignment will first be walked to ensure that site sensitivities are accounted for and avoided / planned for wherever encountered. Each road will then be cleared of vegetation, graded, and where necessary a nominal wearing course of gravel may be imported and/or the road may be compacted for added stability. This will be determined during the detailed engineering phase of the project. All materials used in the development of access roads will be inert and non-carbonaceous material. The road will be developed taking into account proper storm water management measures, including upslope cut-off drains, and/or mitre drains where required.

7.2.7 Site services

Apart from the access roads, no other services are envisaged for the proposed development. Portable chemical toilets will be used during the construction phase, and a reserve water tank of 2500 litres will supply potable water requirements at the construction camp as required.

7.2.8 Relocation of existing services – 400kV power lines

In order for the ash disposal facility to be constructed the existing power lines that traverse the site will need to be relocated (as mentioned in Section 6.11). First the new power lines will be constructed, and then a switch will be made between the existing line and the new power line, and thereafter the existing line will be dismantled. The power line construction will consist of the following activities:

- *Corridor walk-down:* To ensure that all site specific sensitivities are avoided for location of the pylon. During this process the exact co-ordinates of the proposed pylons will be established.
- *Vegetation clearance:* A 55 metre (22.5 metres on either side of the power line) servitude is required for the proposed 400kV power line, tall trees will be cleared along the entire length of the servitude (the vegetation will also be maintained by Eskom in the operational phase of the project).
- *Pylon footings:* During construction the route will be surveyed, pegged and the soil nominations undertaken for each of the potential pylon foundations. The first step is the excavation of the pylon foundations, the reinforcing thereof and finally the concreting of the foundations. The equipment required to excavate the foundations can be manual labour, a TLB or in the case of hard rock – a drill rig will be required. The concrete will have to be transported via concrete trucks to the required locations.
- *Steelwork structures:* After the foundations and footings have been installed the construction team will transport the various steel parts of the towers to the site and start erection of the pylons. The pylons will be erected in piece-meal, i.e., in segments. This process again requires a lot of manual labour and often mobile cranes are used to assist with the erection of the towers.
- *Stringing:* Once the towers are erected the stringing of the conductor cable/s commences, from tower to tower and the line is tensioned as per the requirements.

- *Switching the feed:* Once the power line has been erected the feed will be switched from the current line to the new facility.

Once stringing and tensioning is complete the line is considered constructed, where after it will be tested prior to being commissioned.

7.2.9 Pipeline construction

Slurry pipeline

The slurry pipeline to the new facility will be constructed in advance, to ensure that it is online and ready for operation once the existing facility reaches capacity. The construction activities for the pipeline will be similar to those documented above for the construction of the power lines, and will consist of the following: route walk down, identification of plinth positions, soil nominations at plinth positions, excavation for foundations, reinforcing and concreting of foundations (installation of concrete plinths), assembling and installation of pipelines on plinths, connection to pumping source, and inspection of the pipeline prior to commissioning.

It should be noted that the new pipeline for this facility will be taken off the existing pipeline, which will be retained until neither pipeline is required any longer (at this stage it is estimated that this will occur at the end of the life of this new ash disposal facility).

Return water pipeline

The new return water pipeline will need to be installed from the new AWRD back to the power station. The construction activities for the pipeline will include a route walk down, detailed geotechnical along route alignment, 1,5m excavation of the trench, temporary stockpiling of soils, placement of a nominal gravel bedding inside of the trench, installation of the HDPE pipeline, testing of the pipeline for leaks, replacement and profiling of stockpiled soils, and seeding and re-vegetation.

The existing return water pipelines will be retained as they are essential to the management of water levels in the De Jagers pan, which has been used as the return water dam for the existing ash disposal facility. This infrastructure is independent from this proposed Camden Ash Disposal Facility Expansion Project, and is therefore not addressed in this study. Installation of clean and dirty water separation and containment infrastructure

Clean Water Separation Channel

The detailed construction of the clean water channel will be undertaken during the detailed design phase of the project, and will be informed by the geotechnical conditions along the channel alignment. For the purpose of this assessment it has been assumed that construction will include the following activities:

- The channel position will be surveyed and pegged;
- Walk down of the proposed alignment to identify site specific sensitivities and concerns;
- Geotechnical study will be undertaken along the route to determine founding conditions;
- Vegetation will be cleared;
- The channel will be excavated;
- Where necessary material will be imported and/or the area compacted to improve stability;
- The concrete lining will be installed;
- The area will be profiled to tie into the adjacent terrain, ensuring that suitable measures are taken to avoid damming up of water on surface, and erosion at discharge points.

Dirty Water Solution Trench

The solution trench will be constructed in the same manner as described above for the clean water separation channel, with the exception that the solution trench will not be discharged to the environment. The dirty water contained in the solution trench will be discharged to the AWRD, from where it will be taken to the power station for re-use.

Ash Water Return Dam

The AWRD will be constructed using conventional construction equipment “plant” and methods. The sequence of construction will likely be as follows: the area earmarked for development will be surveyed and pegged; a detailed geotechnical study will then be undertaken; vegetation clearing will take place followed by topsoil stripping and stockpiling; the dam area will then be excavated and profiled as required; inert material will then be used to construct the dam wall (where insufficient material occurs on site the material required will be imported); once the dam wall and profile has been created the barrier system (including leak detection system) will be installed; the AWRD pipelines will be installed to the facility; and the final profiles will then be established and the remaining area of the dam will be re-vegetated.

Leachate Collection and Management

As previously mentioned the leachate collection system will comprise of a toe drain as well as a main drain system. The system will be designed using a cuspated drain with geomesh above to ensure structural integrity of the system. This will be located above the liner system.

Surface and Groundwater Monitoring Points

During the construction phase on-going monitoring and reporting will be undertaken at designated monitoring points.

7.2.10 Barrier System Installation

The footprint area of the ash disposal facility was determined for both Site 1 and 3 using 8 m height intervals. This was done in order to propose an optimal way of constructing the liner system for the facility without creating delays in the deposition of the ash. It was assumed that the installed liner system must create adequate storage capacity for at least three years of operation. This proposed exercise is carried forward to the staged costing of the facility and the applicable operating costs. The liner installation for Site 1 and Site 3 are each discussed separately below.

Site 1: Liner installation details

A graphical model of the 8 m height intervals as discussed above for Site 1 is shown in Figure 7-2 ; whilst Table 7-1 below summarises what is indicated graphically and provides a time line context.

Table 7-1: Liner Required for Site 1

Step No	Elevation	Footprint	Acc. Foot	Volume	Year	
	mamsl	m^2	m^2	m^3	From	To
1	1669.3	241,800	241,800	468,700	2015	2015
2	1677.3	675,400	917,200	4,425,200	2015	2016
3	1685.3	438,300	1,355,500	12,570,500	2016	2021
4	1693.3	181,200	1,536,700	22,192,100	2021	2028
5	1701.3	6,800	1,543,500	31,134,600	2028	2033

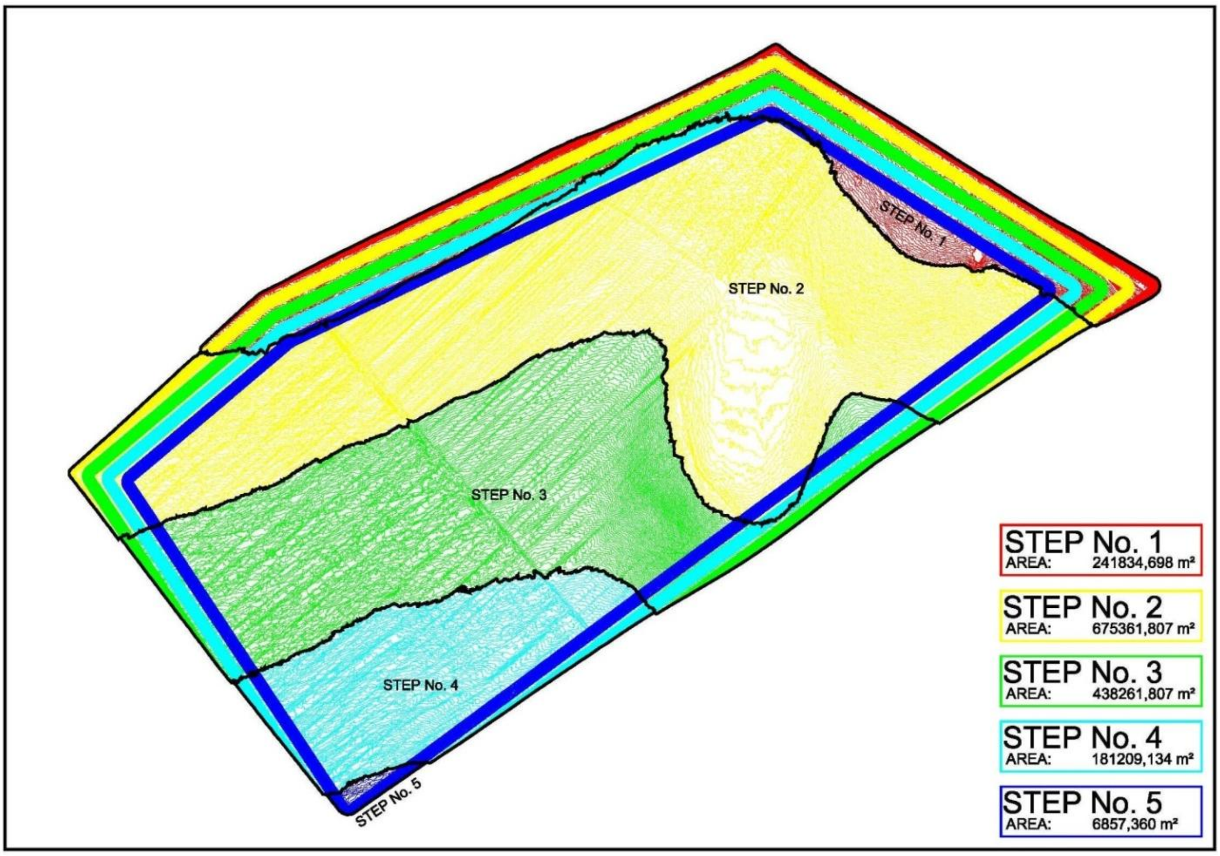

Figure 7-2: Phased Installation of Liner System for Site 1

In order to achieve liner preparation for a minimum of three years, and due to the small quantities of the remaining footprint area, it is proposed that liner construction be undertaken in two phases as shown in Table 7-2.

Table 7-2: Phased Installation of Liner System at Site 1

Site No	Phase	Liner Area (m^2)	Year (From)	Year (To)
1	I	1,355,459	2015	2021
	II	188,066	2021	2033

Site 3: Liner installation details

A graphical model of the 8 m height intervals as discussed above for Site 3 is shown in Figure 7-3 and Figure 7-4, whilst Table 7-3 and Table 7-4 below summarises what is indicated graphically and provides a time line context.

Table 7-3: Liner required for Site 3A

Step No	Elevation	Footprint	Acc. Foot	Volume	Year	
	mamsl	m^2	m^2	m^3	From	To
1	1673.5	36,840	36,840	98,292	2015	2015
2	1681.5	579,830	616,670	906,215	2015	2015
3	1689.5	406,408	1,023,078	3,161,205	2015	2015
4	1697.5	239,347	1,262,425	6,876,435	2015	2018
5	1705.5	231,275	1,493,700	12,080,773	2018	2021
6	1713.5	68,722	1,562,422	17,379,228	2021	2024

Table 7-4: Liner required for Site 3B

Step No	Elevation	Footprint	Acc. Foot	Volume	Year	
	mamsl	m^2	m^2	m^3	From	To
1	1693	58,233	58,233	934,204	2015	2015
2	1701	258,371	316,604	3,950,256	2015	2016
3	1709	301,265	617,869	8,731,753	2016	2019
4	1717	303,477	921,346	13,995,091	2019	2022

In order to achieve liner preparation for a minimum of three years, and due to the small quantities of the remaining footprint area, it is proposed that liner construction be undertaken in two phases for Site 3A and Site 3B respectively as shown in Table 7-5.

Table 7-5: Phased Installation of Liner System at Site 3A and Site 3B

Site No	Phase	Liner Area (m^2)	Year (From)	Year (To)
3A	I	1,262,425	2015	2018
	II	299,997	2018	2024
3B	I	617,869	2015	2019
	II	303,477	2019	2022

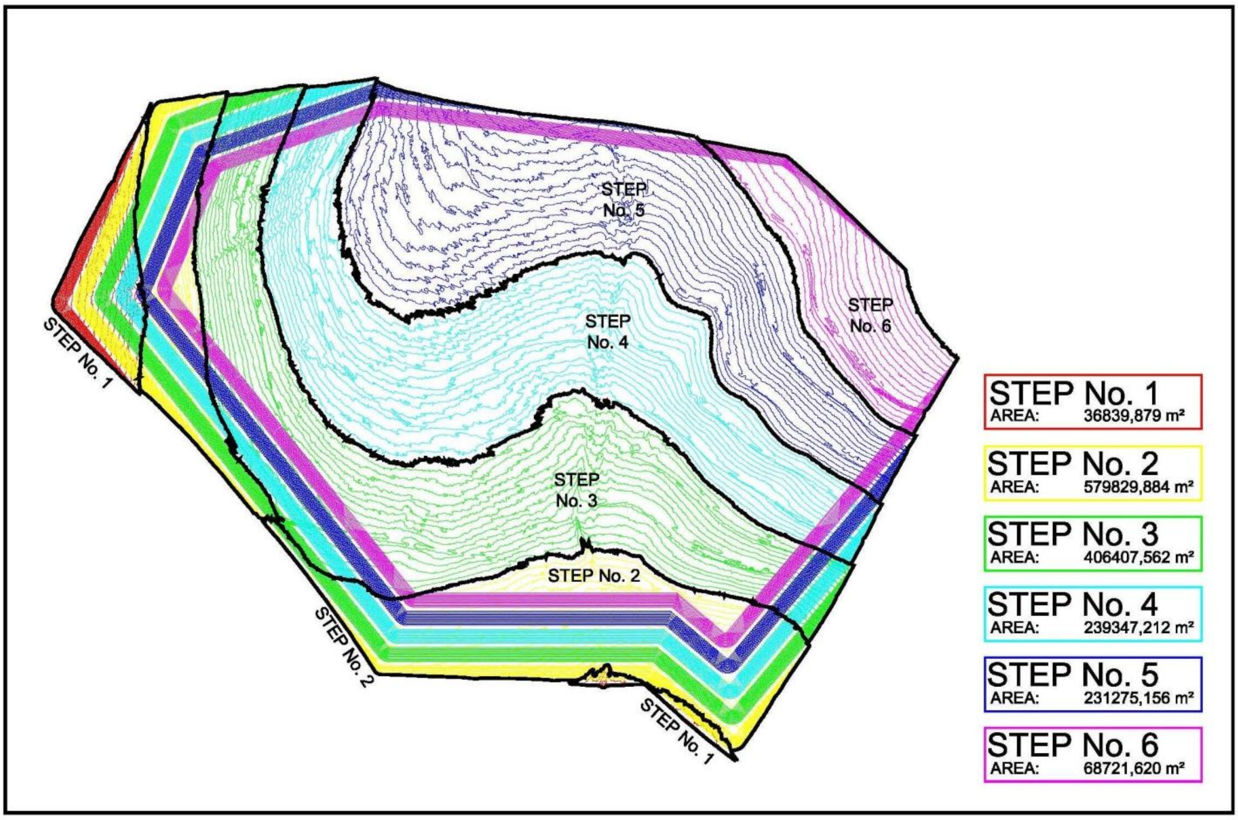

Figure 7-3: Phased Installation of Liner System for Site 3A

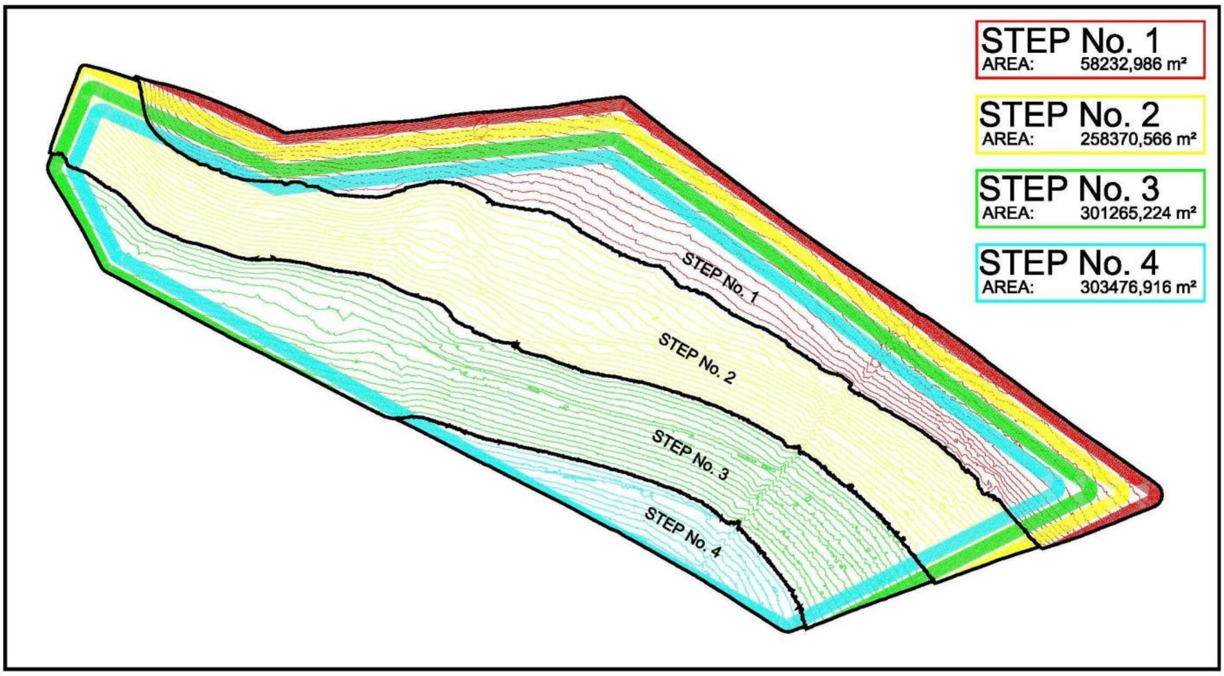

Figure 7-4: Phased Installation of Liner System for Site 3B

7.2.11 Construction of the starter wall for the first compartment

Once all the protective measures are installed such as the: clean and dirty water separation and containment infrastructure and the barrier system, then the starter wall for the first compartment can be constructed.

Initial deposition needs to be contained using a starter earth wall for each compartment, built to a height that allows for a 3,0 m/year rise in the ash disposal facility. The construction of the starter wall for the first compartment is seen as part of the construction phase of the project; thereafter any additional starter walls will be considered part of the operational procedures of the facility.

7.2.12 Remediation of construction activities

Rehabilitation of disturbed areas

Once construction is completed, rehabilitation / remediation of affected areas will be undertaken to obtain the following objectives:

- A sustainable topographic profile, tied into the adjacent vegetation in such a manner that erosion is controlled;
- A sustainable vegetation layer, free of alien invasive species; and
- A litter free environment where all construction waste has been suitably removed to a licensed facility.

The ECO / WMCO appointed to monitor the construction phase will delineate all areas requiring rehabilitation / remediation activities and will be responsible for signing off that these areas have been suitably rehabilitated as per the methods identified in the EMP and the Method Statement from the Contractor. The following areas have been identified at this juncture as areas that will require rehabilitation / remediation post construction:

- The contractors hard park / construction camp / lay down area;
- Any access roads not remaining for the operational phase maintenance and servicing of infrastructure;
- The return water pipeline surface area and servitude;
- The decommissioned slurry pipeline and adjacent servitude; and
- The dismantled power line servitude including old tower positions and service roads.

The methods for rehabilitation / remediation will be confirmed on site, based on the extent and type of impact, and will be in compliance with the approved EMP for the project. It is envisaged that rehabilitation / remediation activities will include at a minimum:

- Profiling of the terrain to ensure that it is free draining, and ties into the existing terrain without causing erosion;
- Soil amelioration and improvement will be undertaken to promote establishment of a sustainable vegetation layer;
- Seeding of the area will be undertaken with an appropriate seedmix to ensure that a sustainable vegetation cover is established;
- Water off? the area, usually in the first two years, during dry spells to ensure vegetation cover is properly established is common; and
- Alien invasive control is practiced to ensure that the area is maintained in a weed free condition.

Signing off by affected Landowners upon completion of the construction and rehabilitation

Once rehabilitation / remediation activities have been completed the area will be audited by the ECO / WMCO and a close out audit produced. The audit report will be submitted to the DEA and the affected landowners (if other than Eskom) for review and approval.

Once the construction is finished, it will be signed off as complete, and will be handed over to Eskom for Operation.

7.3 THE OPERATIONAL PHASE

The operations of the project facilities and all of its components are described in detail in the Operations Manual. A summary description is given below.

7.3.1 Taking over the facility from the Contractor

Eskom will take ownership of the ash disposal facility from the Contractor (if separate from Eskom) upon completion of construction phase as described in the preceding section (section 7.2.12).

7.3.2 Access roads, fences, and access control

Access roads and fences (including those for the relocated 400kV power line and all associated pipeline servitudes) retained for the operational phase will be inspected regularly. Roads must be maintained according to the original design and construction specification. This includes cross slopes, road bed and wearing surface material, layer thickness and compaction of the layers.Periodic maintenance will be undertaken (as required) and will include: grading and profiling; importation of additional wearing course were required; debriding of storm water infrastructure such as cut-off / mitre drains; vegetation clearing (including firebreaks) and alien invasive control, repairing of fences; and litter collection and clean up.

7.3.3 Site services

Apart from the access roads and fences, no other services are envisaged for the new development.

7.3.4 Relocated 400kV power lines

The power line and its servitude will be inspected quarterly. Periodic maintenance on the line and servitude will be governed by the existing Operational EMP. Maintenance of the power line and servitude will be the same as what is envisaged for access roads and fences above.

During operations, Eskom requires access to the servitude for maintenance activities. Maintenance activities are specialised and are, therefore, carried out by Eskom employees. During the operational life of the power line, there will be no people housed along the servitude.

7.3.5 Pipelines

Slurry pipelines

Regular inspections of the pipelines will be undertaken to ensure the integrity of the pipelines is retained and identify any leaks / damage that may have occurred. In addition to the general maintenance described for the access roads and fences above, maintenance on the pipeline will likely include the periodic flushing of the pipeline, replacement of pipe segments, and cleaning of spills / leaks that occur.

Depending on the size of the spill / leak that may occur, this will immediately be contained and then cleaned up manually by hand and shovel or a TLB (or similar type tracked equipment). The collected spill material will be loaded on to a suitably designed vehicle and disposed of at the waste disposal facility.

Return water pipeline

General maintenance of the pipeline servitude (such as vegetation clearing, alien invasive control, and repairs to fencing etc) will therefore also include maintenance of the flow meters to be placed at the pumping and discharge points of the pipeline, and monthly balancing of the flow meter results to ensure that the pipeline is not leaking. Maintenance inspections will also include observations to determine if surface evidence such as undue greening of the veld can be observed.

In the event that any pipeline leaks occur, pumping through this pipeline will be ceased, the position of the leak will be established, the area will be excavated and the extent of the leak investigated, appropriate measures to repair the damage to the pipeline will be undertaken, and the excavated soils will be returned. The area will again be profiled and re-vegetated. Monitoring of the area will continue as before.

7.3.6 Clean and dirty water separation and containment infrastructure

Clean Water Separation Channel

The clean water separation channel will be inspected prior to the rainy season each year, and fortnightly during the rainy season and after severe storms. Maintenance of the clean water separation channel will include debriding of the channel (cleaning of litter and vegetation that may have become overgrown), repairing of the channel as may be required, correction of any erosion identified, and control of alien invasive species.

Dirty Water Solution Trench

A regular monthly inspection of the solution trench shall be carried out to determine whether the trench has become choked by sediment or vegetation, or has been seriously eroded. Any damage shall be repaired as soon as possible. Grass and weeds growing through the concrete joints of the concrete lining shall be removed as soon as possible. Any trench crossings shall not encroach into the trench where the flow can be obstructed. Any seepage of water through the soil into the trench shall be noted, recording both the approximate flow rate and the location and repaired. The Ash Plant Manager must be notified of any such events. Any increase in the wetted area and/or flow from the toe of the ash dam is to be treated as an early indication that the filter drains are malfunctioning.

Return Water Dam

The most typical failure of AWRD's include seepage / pipelines; overtopping and erosion; and structural failures. These can all be managed or avoided entirely through a regular inspection and maintenance programme. This will form the basis of on-going operations and management of the AWRD.

Leachate Collection and Management

Once installed the leachate collection system will be between the waste body and the liner. Maintenance of the solution trench will be critical to ensure on-going operation of the leachate system occurs unhindered.

Surface and Groundwater Monitoring Points

During the construction phase on-going monitoring and reporting will be undertaken at designated monitoring points.

7.3.7 Barrier System Maintenance

Once installed the barrier system will be inspected monthly in advance of deposition of waste. Any damage to the barrier system will be repaired immediately and prior to any waste being placed on the area. Once the area has been covered with waste it is assumed that the integrity of the barrier system is intact, and will operate for the life of the facility.

7.3.8 Ash disposal

The ash slurry will be pumped from the power station to a central distribution point situated at a high point on the southern perimeter of the ash disposal facility (as shown in Figure 6-1 and Figure 6-2). From the distribution point the fly ash and the coarse ash are channelled through various open trenches and allowed to gravitate into the appropriate paddocks.

As indicated the initial deposition needs to be contained using a starter earth wall for each compartment. This initial deposition area is thus very small and grows as the compartment basin fills. Due to the small area the rate of rise is initially high. The ash does not have enough time to consolidate and gain sufficient strength to support itself. Therefore a starter wall is built to a height where the rate of rise is 3,0 m / year.

A transition from open end deposition to a spiggotting or daywall method is required once the starter wall height is reached. This is required for two reasons:

- Firstly the ash cannot be gravitated to the upper compartment from the level of the distribution box; and
- Secondly, at this point the ash may be used to build walls in an upstream direction.

Spiggotting in a cycle around the entire perimeter of each compartment allows the walls to be built in a stable way and enables proper pool and freeboard control.

Spiggotting allows for the slurry to be deposited in thin layers, which are then allowed to dry out and consolidate. A specified cycle time is allowed between the layers which is dependent on the geometry of the deposit and consolidation parameters. The deposit thus gains sufficient strength and rises continuously. An increase of 2,0 m in height over a year period was accepted for this study.

7.3.9 Dewatering of the ash slurry

Water on top of the ash dam will be decanted from the pool using penstocks. Up to two temporary penstock inlets per compartment in the initial phases will be required. A permanent penstock, central to each compartment will then be installed and operated for the life of the facility.

In developing this solution various operational aspects were assumed which help reduce risks associated with the operation of the ash disposal facility and reduce potential environmental impacts. These include, inter alia:

- The pool will be operated at a minimum level; i.e. water will not be stored on the ash disposal facility (containment dam except during major storm events, in which case the water will be decanted as quickly as the penstock will safely allow. If water is stored on the facility the facility dam will need to be licensed as a water dam with the dam safety office according to regulation 1560 of the National Water Act (1998).
- More than one compartment allows flexibility in terms of deposition if a compartment requires maintenance.

A penstock consists of a vertical decant tower and an inclined horizontal conduit. The penstock's function is to remove the free water from the top surface of the ash disposal facility, thereby recovering the water for re-use in the next cycle of ashing. The penstock has been designed to decant all the water from the ashing operations and is also capable of removing the storm water from a 1 in 50 year 24 hour storm in 96 hours (3389 m^3 /s) off the facility with one penstock functioning, or 48 hours with two penstocks functioning.

Penstocks are a very important part of an ash disposal facility but are notoriously unreliable. For this reason most slimes dams have two penstocks. Should a penstock fail and need replacement, ashing could continue without disruption using the other penstock. There are currently two penstocks on either side of the dividing wall of the ash disposal facility. Theoretical calculations show that the concrete penstock rings can safely carry the forces resulting from an ash height of 24m. The rings will experience crushing failure from 35m of ash onwards.

In order to reduce the risk of cavity formation in the future, it is important to double wrap the vertical sections of the penstock decant tower with a U24 geotextile once the rings have been placed.

7.4 REHABILITATION AND DECOMMISSIONING PHASE

7.4.1 Consecutive capping and rehabilitation of ash disposal facility

Rehabilitation of the ash disposal facility will commence during the operational phase and continue consecutively with operation, ensuring that that the footprint for rehabilitation post operation is reduced. The methods for rehabilitation will be confirmed on site, and will be in compliance with the approved EMP for the project. It is envisaged that rehabilitation activities will include at a minimum:

- Profiling of the terrain to ensure that it is free draining, and ties into the existing terrain without causing erosion;

- Soil amelioration and improvement prior to placement will be undertaken to promote establishment of a sustainable vegetation layer;
- The improved soil will be placed in a 200 – 300 mm thick layer capping over the ash body;
- Seeding of the area will be undertaken with an appropriate seed mix to ensure that a sustainable vegetation cover is established;
- Water of the area, usually in the first two years, during dry spells to ensure vegetation cover is properly established is common; and
- Alien invasive control is practiced to ensure that the area is maintained in a weed free condition.

7.4.2 Rehabilitation of disturbed areas

Areas earmarked for rehabilitation

Once the ash disposal facility has reached capacity it will be finally capped as per the procedure documented above. It is envisaged that some of the associated infrastructure will then no longer be required, and will need to be dismantled and the area disturbed will need to be rehabilitated. It is envisaged that the following infrastructure will require dismantling and rehabilitation at closure of the facility:

- Any access roads not remaining for long term maintenance of the facility;
- The return water pipeline surface area and servitude; and
- The slurry pipeline and servitude.

This will be done in line with relevant legislation at the time of decommissioning of said infrastructure. Present legislation would require that an EIA be undertaken for the decommissioning of the aforementioned infrastructure.

Rehabilitation of disturbed areas

The following is assumed regarding the decommissioning and rehabilitation of infrastructure:

- The physical removal of the infrastructure would entail the reversal of the construction process;
- A rehabilitation programme would need to be agreed upon with the landowners (if applicable) before being implemented; and
- Materials generated by the decommissioning process will be disposed of according to the Waste Hierarchy i.e. wherever feasible materials will be reused, then recycled and lastly disposed of. Materials will be disposed of in a suitable manner, in a suitably licensed facility.

The primary objectives of the rehabilitation process will be to obtain the following objectives:

- A sustainable topographic profile, tied into the adjacent vegetation in such a manner that erosion is controlled;
- A sustainable vegetation layer, free of alien invasive species;
- Where feasible / possible pre-construction land use will be re-established; and
- A litter free environment where all construction waste has been suitably removed to a licensed facility.

The methods for rehabilitation / remediation will be confirmed on site, based on the extent and type of impact, and will be in compliance with the approved EMP for the project. It is envisaged that rehabilitation / remediation activities will include at a minimum:

- Profiling of the terrain to ensure that it is free draining, and ties into the existing terrain without causing erosion;
- Soil amelioration and improvement will be undertaken to promote establishment of a sustainable vegetation layer;
- Seeding of the area will be undertaken with an appropriate seedmix to ensure that a sustainable vegetation cover is established;
- Water of the area, usually in the first two years, during dry spells to ensure vegetation cover is properly established is common; and
- Alien invasive control is practiced to ensure that the area is maintained in a weed free condition.

<u>Signing off of all rehabilitated areas upon completion</u>

Once rehabilitation / remediation activities have been completed the area will be audited by an independent competent person and a close out audit produced. This will be submitted to the DEA and the affected landowners for review and approval. Once approval has been obtained the decommissioning will be signed off as complete.

8 DESCRIPTION OF RECEIVING ENVIRONMENT

8.1 CLIMATE

The project area falls within the highveld climate classification of Viterito (1987), and can thus expect warm, wet summers, and mild, dry winters, with equivalent evaporation depths exceeding precipitation. Regular dust storms can also be expected during periods of prolonged dry weather. Average annual rainfall for the highveld decreases from 900 mm in the east to 650 mm in the west, with approximately 85% falling between October and April. In the vicinity of Camden Power Stations the estimated rainfall from showers and thunderstorms is about 726 mm/year and the evaporation 1400 mm/year, based on available records for Nooitgedacht – Agriculture College (442811) a South African Weather Bureau meteorological station about 17 km to the northwest of the area (See Figure 8-1 below). The water balance in the area plays a major role in the possible impacts on especially surface water but also groundwater. It is evident that the evaporation exceeds the precipitation by a large margin. The area thus has a water deficit and a negative water balance in general.

Average daily maximum temperatures vary from 25ºC in January to 16ºC in June, but in extreme cases these may rise to 34 and 23ºC, respectively. In comparison, average daily minima of 13 and 0ºC can be expected, with temperatures falling to 5 and –10ºC, respectively, on unusually cold days (See Figure 8-2 below).

For the entire study area there is a daily swing between berg and in-shore air movement. The main direction of air movement is from the south-west alternating with winds from the north-east. The south-westerly winds are often associated with cold fronts that are preceded by warm fronts. The hot air ahead of cold fronts is often the cause of veld fires in winter when the veld is dry.

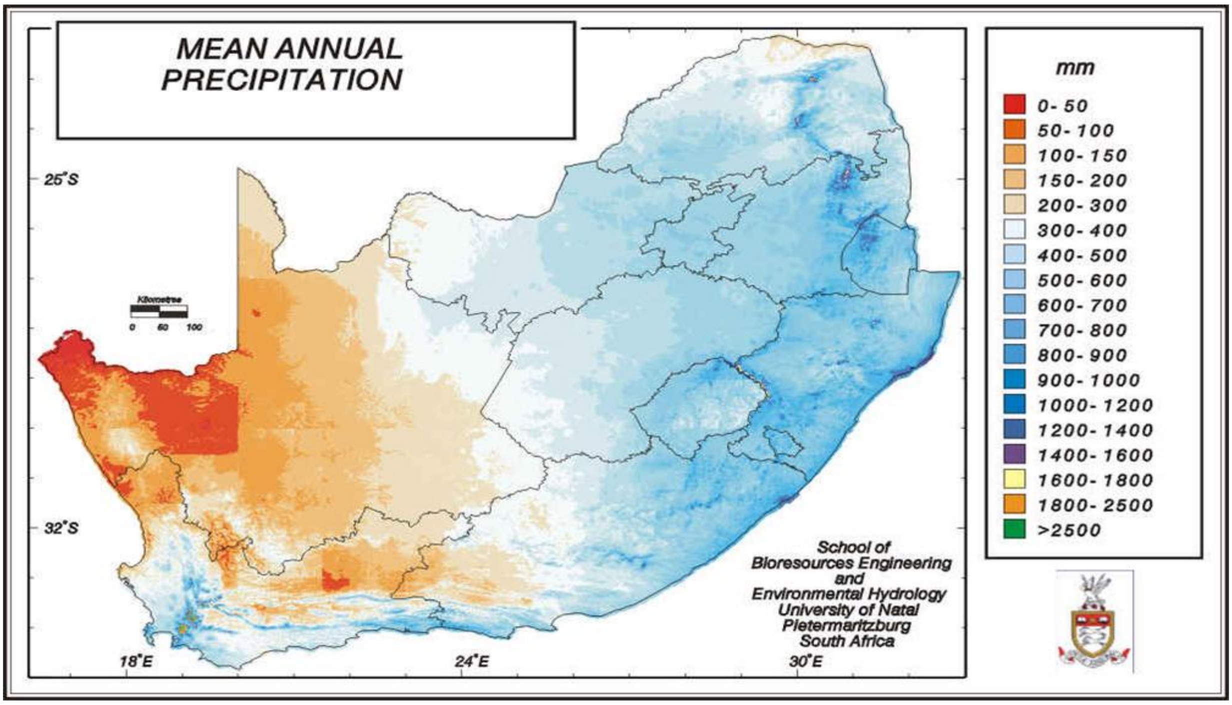

Figure 8-1: Mean annual Precipitation of Ermelo District

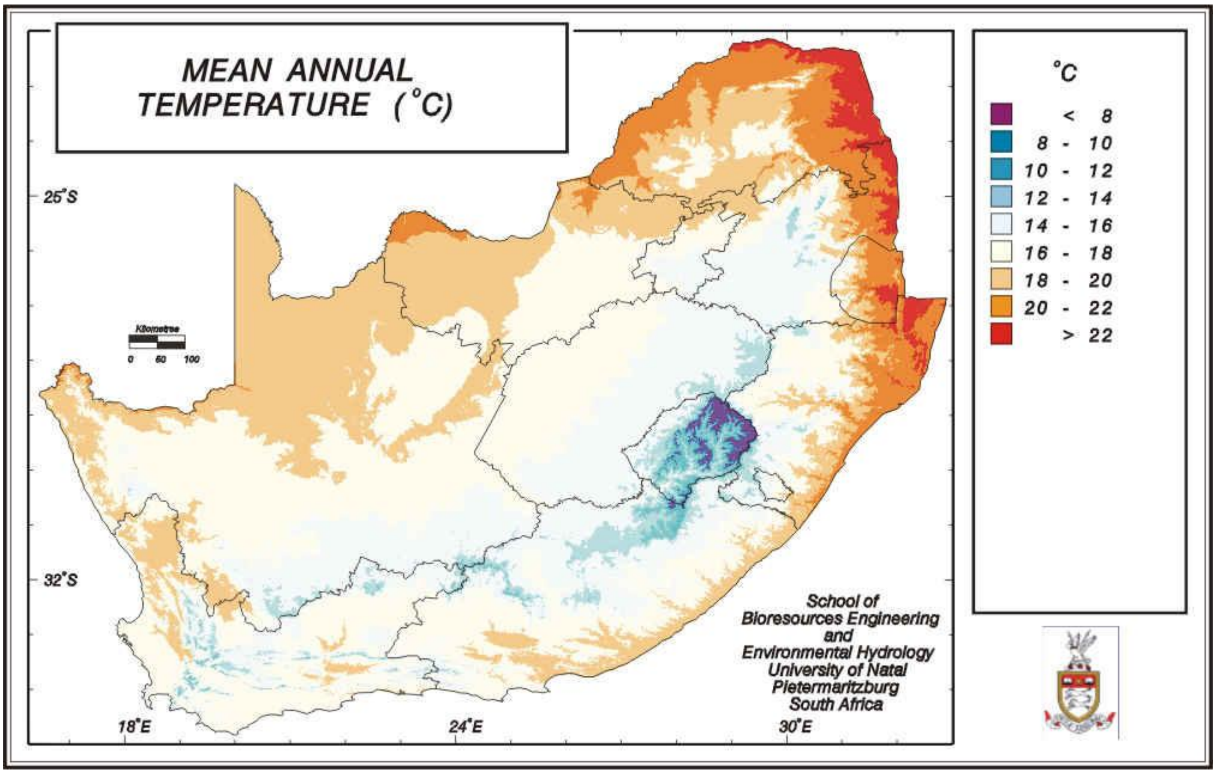

Figure 8-2: Mean annual Temperature of Ermelo District

8.2 GEOLOGY

8.2.1 Methodology and Data Sources

The geological analysis was undertaken through desktop evaluation using a Geographic Information System (GIS) and relevant data sources (April 2009). The geological data was taken from the Environmental Potential Atlas Data from the Department of Environmental Affairs (DEA).

8.2.2 Regional Description

The site falls within the Carboniferous to early Jurassic aged Karoo Basin, a geological feature that covers much of South Africa. Sediments in this part of Mpumalunga Province fall within the Permo-Triassic aged Northern facies of the Ecca Series, forming part of the Karoo sequence (Truswell, 1977). Sediments of the Vryheid formation comprise the local geology. The sediments of the Vryheid Formation were deposited in a fluvio-deltaic environment where swamps and marshes existed, in which peat accumulated. Shales, mudstones, siltstones and sandstones constitute the bulk of the formation, with interlayering of these sediments throughout. The coal seams have relatively high dirt content. Coal measures currently mined in the area form part of the Highveld Coal Field.

Late Triassic to Middle Jurassic aged Dolerite sills and feeder dykes are common in the Karoo Basin, which intruded the Vryheid Formation. Numerous minor faults, many of which are water bearing, interrupt the coal seams. Small fracture zones, which frequently are associated with the upper and lower contacts of sills, also are commonly water bearing, and occur throughout the power station area. Previous investigations identified the presence of a near surface, slightly weathered to fresh dolerite sill. The extent of the sill is, however, unknown.

The type and distribution of site soils appears to be, in part, controlled by parent rock material. Soils overlying doleritic material are typically highly plastic and dark brown to black in colour, while those on Karoo sediments are typically lighter in colour and moderate to highly reactive in character. Shrinkage cracks can, however be expected to develop in site soils irrespective of parent material during periods of prolonged dry weather.

8.2.3 Study area Description

The two candidate sites identified all fall within the sediments of the Vryheid Formation consisting of grit, sandstone, shale and coal seams. Dolerite intrusions form a major part of candidate site 2. Large sacrificial deposits of ferricrete are visible on the ground with outcrops visible on the north eastern side of candidate site 3.

8.3 TOPOGRAPHY

8.3.1 Data Collection

The topography data was obtained from the Surveyor General's 1:50 000 toposheet data for the region. Contours were combined from the topographical mapsheets to form a combined contours layer. Using the GIS the contour information was used to develop a digital elevation model of the region as shown in Figure 8-3 below.

8.3.2 Regional Description

The study area ranges from 1 620 Metres Above Mean Sea Level (mamsl) to 1 760 mamsl. The highest parts of the study area are northern west of the site and the lowest parts are in the south eastern portions of the study area, south of the Vaal River. The topogrpahy is undulating with shallow incised valleys where the main watercourses flow. Several pans are found throughout the area, especially on the sandstone geology. Figure 8-3 provides an illustration of the topography of the site.

8.3.3 Study area Description

The study area drains towards the southeast where the water is intercepted by the Vaal River. The topography at Alternative 1 is relatively flat and rolling, gently sloping to existing site in the south. Alternatives 2 and 3 are located south of the De Jagers Pan, which is a natural pan/depression in the landscape. Both Alternatives 2 and 3 drain northwards to the depression as they are located on relatively steep slopes.

8.3.4 Sensitivities

Sensitivities associated with the topography are mainly in the form of ridges, which do not occur on any of the alternatives. Other associated impacts include the visibility and drainage of the sites, which will be assessed in more detail in the following sections.

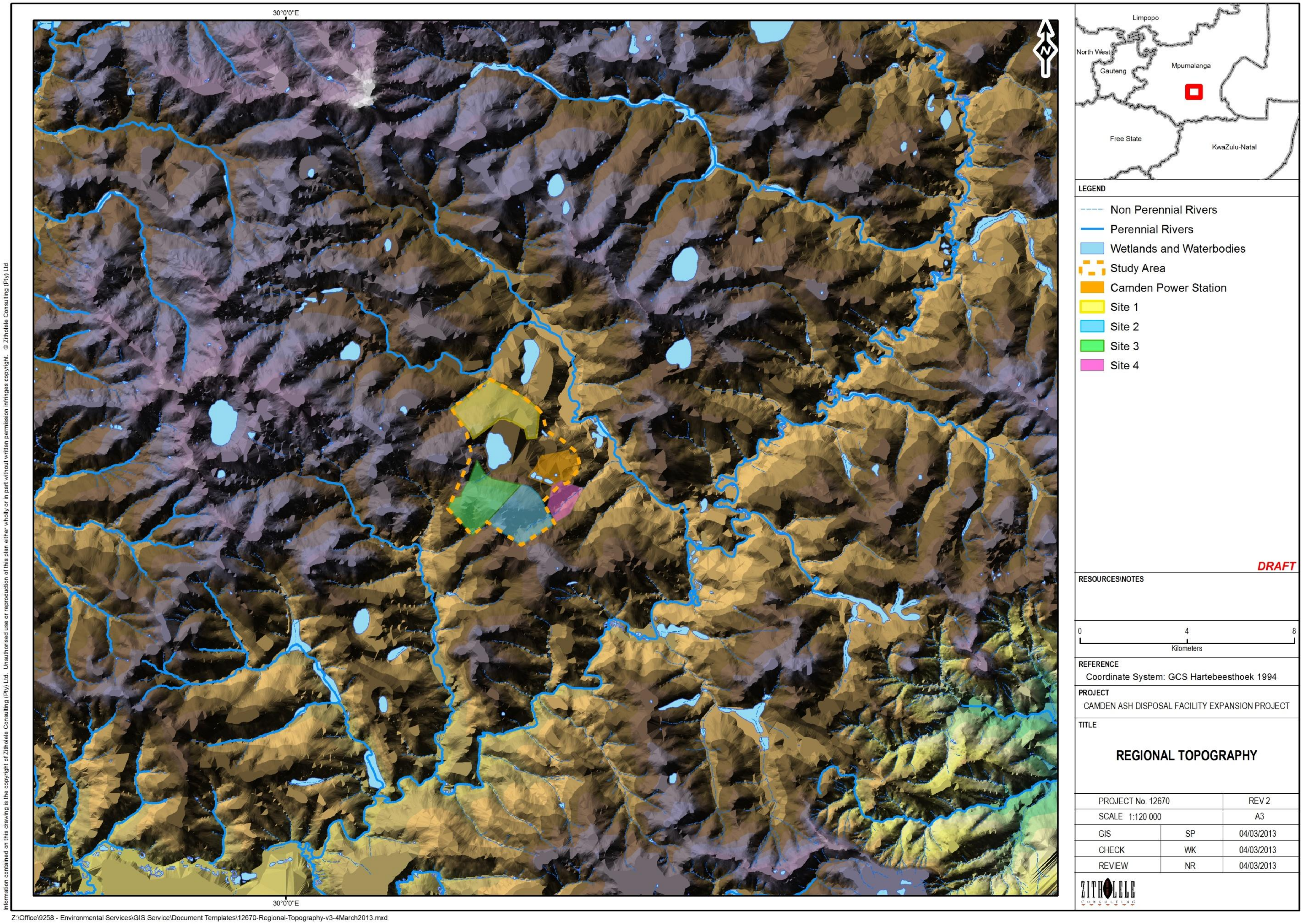

Figure 8-3: Regional topography

8.4 SOILS

8.4.1 Data Collection

A site visit was conducted from October 2011 – February 2012. Soils were augered at 150m intervals over the proposed alternative sites using a 150 mm bucket auger, up to refusal or 1.2 m. Soils were identified according to Soil Classification; a taxonomic system for South Africa (Memoirs on the Natural Resources of South Africa, no. 15, 1991). The following soil characteristics were documented:

- Soil horizons;
- Soil colour;
- Soil depth;
- Soil texture (Field determination);
- Wetness;
- Occurrence of concretions or rocks; and
- Underlying material (if possible).

8.4.2 Regional Description

From the available literature as well as the observations during the site investigation, it is apparent that all three sites are underlain by siltstone, mudstone and sandstone that belong to the Vryheid Formation of the Ecca Group, Karoo Supergroup.

Generally these geological structures will decompose in-situ, forming residual soils that may be silty and clayey, with the possibility of expansive soil being present. These soils are often blanketed by a considerable thickness of transported soils of colluvial origin that consist of silty and clayey fine sands.

8.4.3 Study area Description

During the site visit large quantities of soil forms were identified. The soils forms were grouped into management units and are described in detail in the sections below and Figure 8-5 illustrates the location of the soil types. The management units are broken up into:

- Agricultural Soils;
- Shallow Soils;
- Transitional and Poor Transitional Soils; and
- Disturbed Soils / Hard Rock.

8.4.4 Shallow (Rocky) Soils

The rocky soils are generally shallow and overlie an impeding layer such as hard rock or weathering saprolite. These soils are not suitable for cultivation and in most cases are only usable as light grazing. The main soil form found in rocky soils was the Mispah and Dresden soil forms as described below.

Mispah soil form

The Mispah soil form is characterised by an Orthic A – horizon overlying hard rock. Mispah soil is horizontally orientated, hard, fractured sediments which do not have distinct vertical channels containing soil material. There is usually a red or yellow-brown apedal horizon with very low organic matter content. Please refer to Figure 8-4 for an illustration of a typical Mispah soil form.

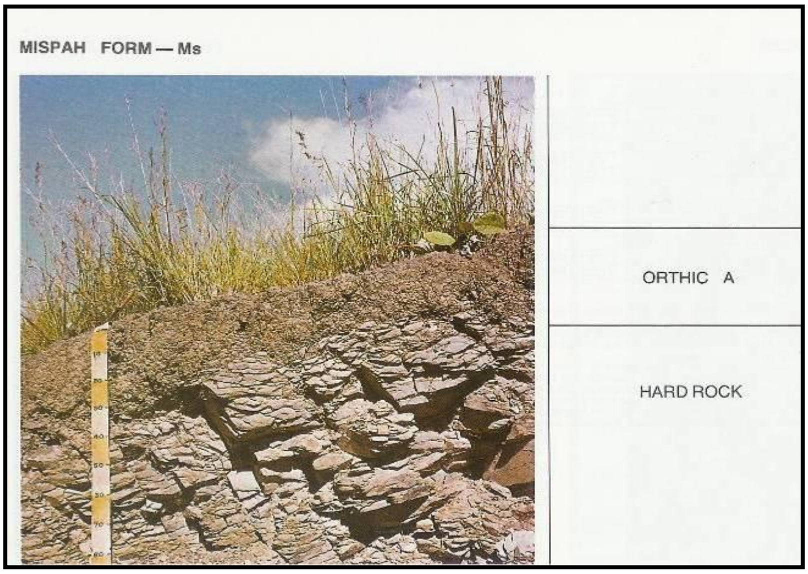

Figure 8-4: Mispah soil form (Soil Classification, 1991).

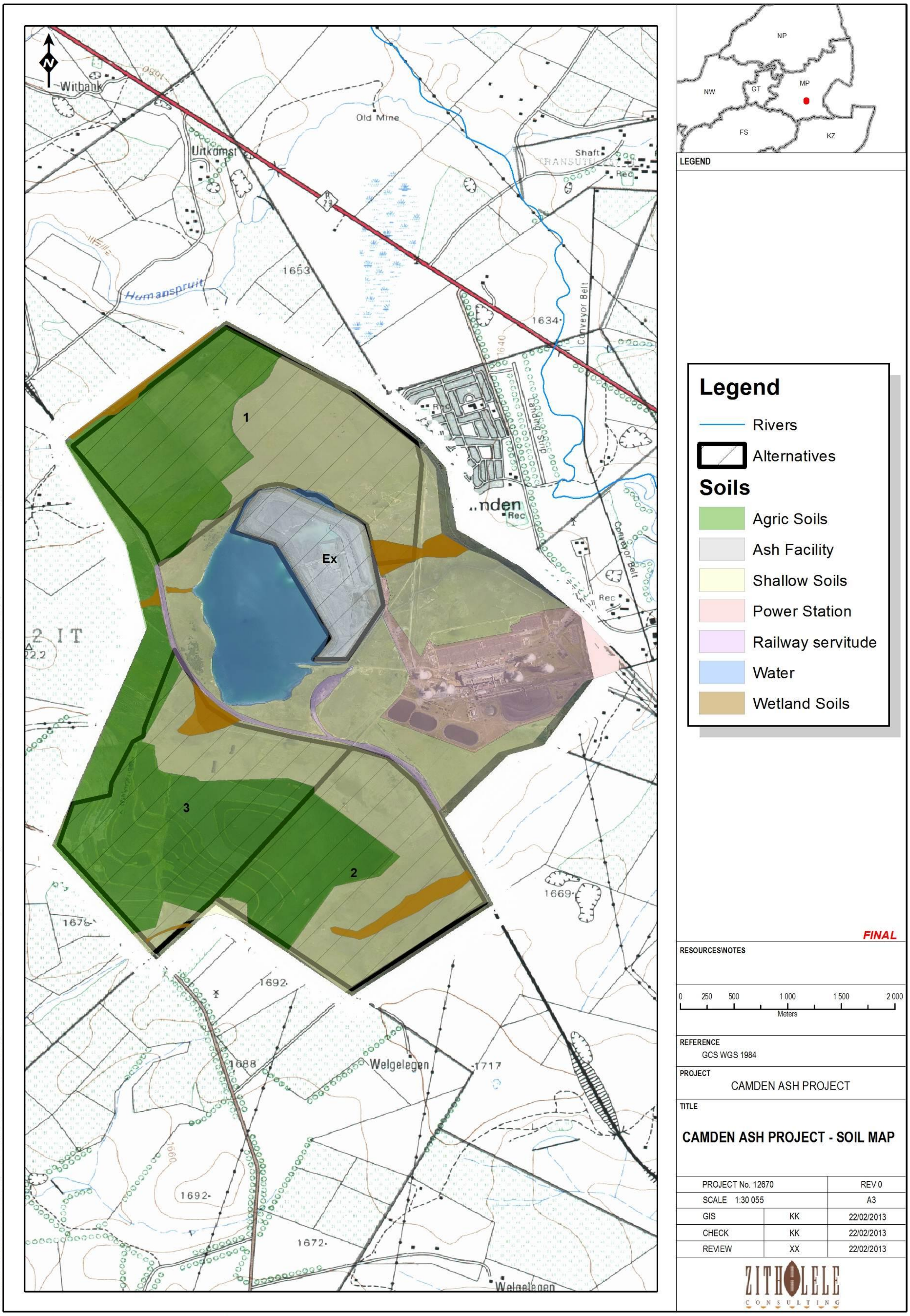

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Figure 8-5: Soil Type Map

Dresden Soil Form

The Dresden soil form is typified by an Orthic A-horizon over a Hard Plinthic B-horizon. The Hard Plinthic B-horizon develops when a Soft Plinthic horizon is subjected to a prolonged dry period and the accumulated Fe and Mn colloidal matter hardens, almost irreversibly. This B-horizon has similar characteristics to hard rock and has a very low agricultural potential, refer to Figure 8-6 for an illustration.

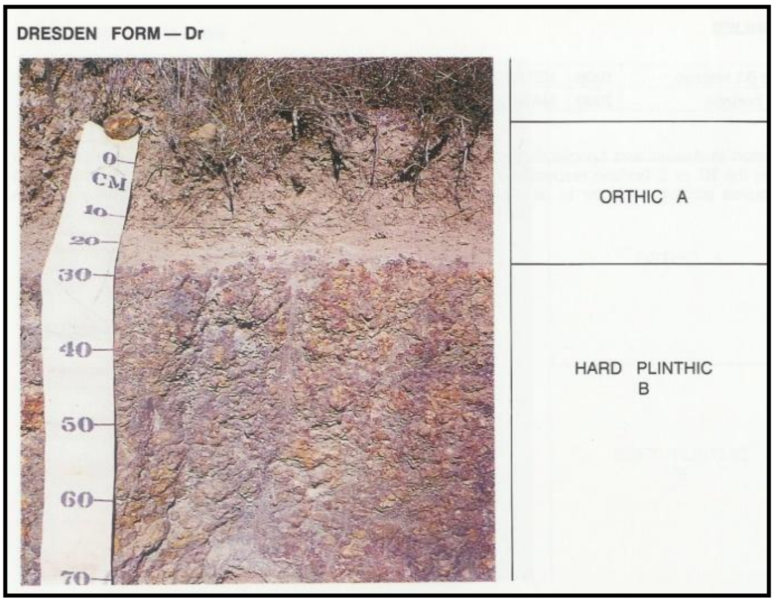

Figure 8-6: Dresden Soil Form (Soil Classification, 1991)

8.4.5 Agricultural Soils

The agricultural soils found on site support an industry of commercial maize/legume production. These soils include Hutton, Clovelly and Avalon. These soils have deep yellow-brown B-horizons with minimal structure. These soils drain well and provide excellent to moderate cultivation opportunities. Each of the soils are described in more detail below.

Clovelly Soil Form

Clovelly soils can be identified as an apedal “yellow” B-horizon as indicated in Figure 8-7. These soils along with Hutton soils are the main agricultural soil found within South Africa, due to the deep, well-drained nature of these soils. The soils are found on the valley slopes of the site.

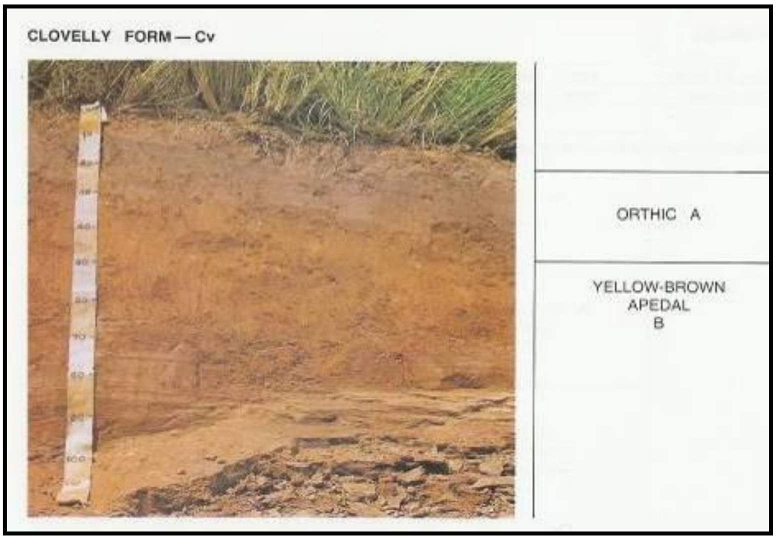

Figure 8-7: Clovelly soil form (Soil Classification, 1991)

Avalon Soil Form

The Avalon soil form is characterised by the occurrence of a yellow-brown apedal B-horizon over a soft plinthic B – horizon (See Figure 8-8). The yellow-brown apedal horizon is the same as described for the Clovelly soil form and the plinthic horizon has the following characteristics:

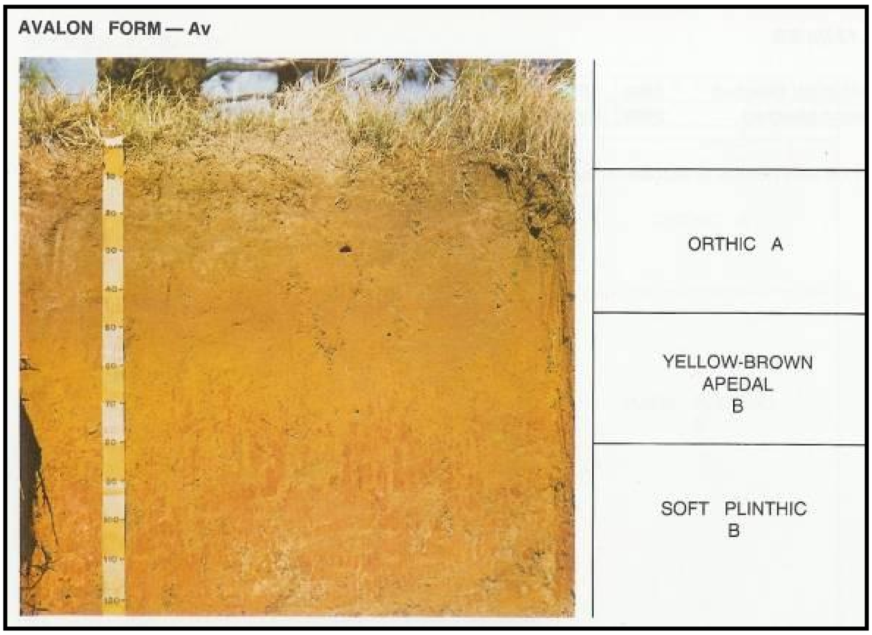

Figure 8-8: Avalon Soil Form (Soil Classification, 1991)

- Has undergone localised accumulation of iron and manganese oxides under conditions of a fluctuating water table with clear red-brown, yellow-brown or black strains in more than 10% of the horizon;
- Has grey colours of gleying in or directly underneath the horizon; and
- Does not qualify as a diagnostic soft carbonate horizon.

These soils are found between lower down the slopes than the Clovelly soils and indicate the start of the soils with clay accumulation.

Hutton Soil Form

Hutton's are identified on the basis of the presence of an apedal (structureless) "red" B-horizon as indicated in Figure 8-9. These soils are the main agricultural soil found in South Africa, due to the deep, well-drained nature of these soils.

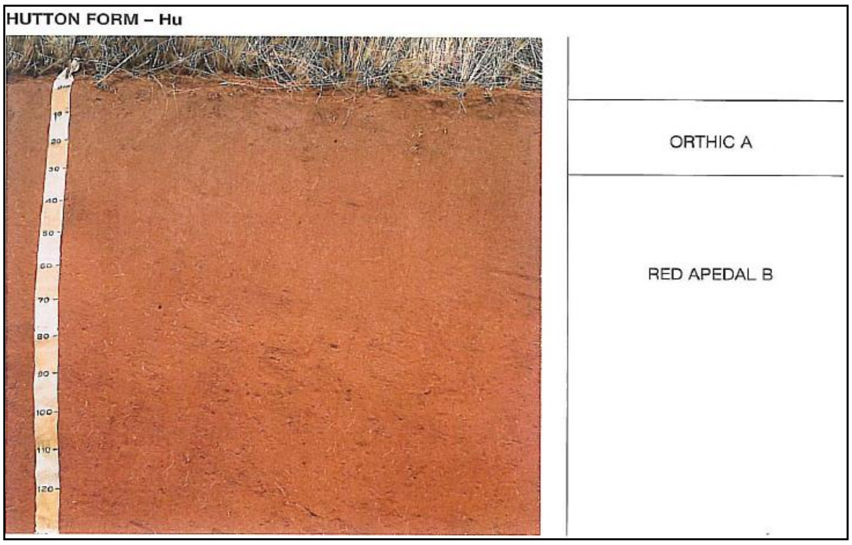

Figure 8-9: Hutton Soil Form (Soil Classification, 1991)

8.4.6 Transitional Soils

The transitional soil management unit comprises the soils found between clay soils and the agricultural soils. These soils often have signs of clay accumulation or water movement in the lower horizons. These soils are usually indicative of seasonal or temporary wetland conditions. The main soil forms found in transitional soils were Wasbank, Longlands and Westleigh, each form is described below.

Longlands Soil Form

The Longlands soil forms are all typified by an eluvial (E) horizon over a soft plinthic horizon (as described above). The E-horizon is a horizon that has been washed clean by excessive water movement through the horizon and the plinthic horizon as undergone local accumulation of colloidal matter (refer photo below). Please refer to Figure 8-10 and Figure 8-11 for an illustration of this soil form.

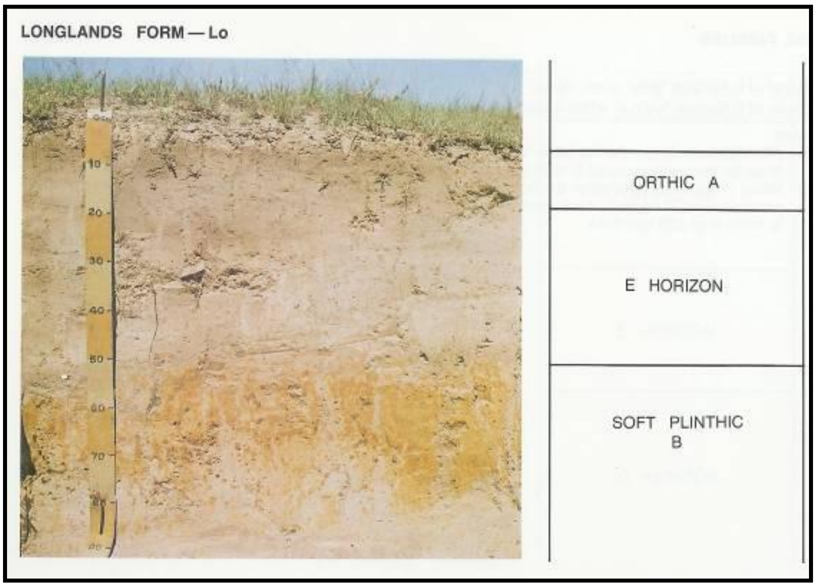

Figure 8-10: Longlands Soil Form (Soil Classification, 1991)

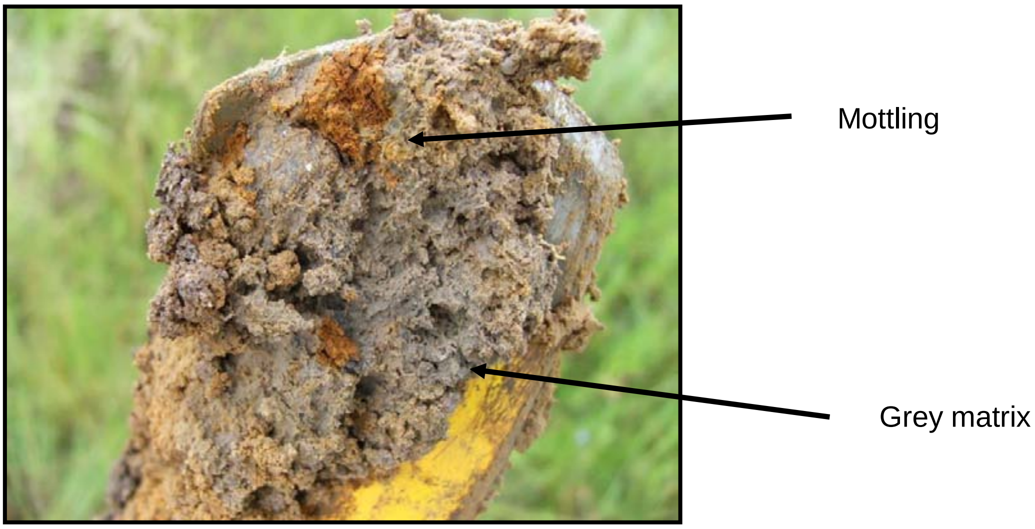

Figure 8-11: Soft plinthic B-horizon

Wasbank Soil Form

The Wasbank soil form is found in close proximity to the Longlands soil form and is typified by an Orthic A-horizon over an E-horizon (as described above) over a Hard Plinthic B-horizon. The Hard Plinthic B-horizon develops when a Soft Plinthic horizon is subjected to a prolonged dry period and the accumulated colloidal matter hardens, almost irreversibly. The Wasbank soil form is illustrated in Figure 8-12.

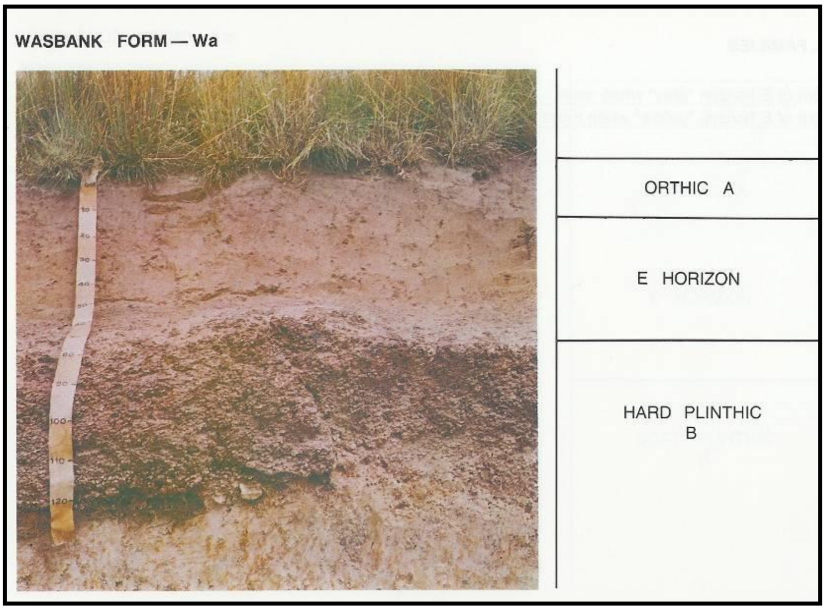

Figure 8-12: Wasbank Soil Form (Soil Classification, 1991)

Westleigh Soil Forms

Westleigh soils are characterised by an orthic A-horizon over a soft plinthic B-horizon and is found in areas between good agricultural soils and clay soils and the movement of water determines the characteristics of the soil. Refer to Figure 8-13 for an illustration.

Figure 8-13: Westleigh Soil Form (Soil Classification 1991)

8.4.7 Clay Soils

The clay soil management unit is found in areas where clays have accumulated to such an extent that the majority of the soil matrix is made up of clay particles. These soils are usually indicative of seasonal or permanent wetland conditions. The main soil forms found in clay soils were Katspruit and Willowbrook, each form is described below. These soils are saturated with water and must be noted to be unstable for construction and are sensitive. Although clay is required as part of the liner of the proposed ash facility, building on top of clay is never recommended as the material can shift, crack and is generally regarded as unstable.

Katspruit Soil Form

The Katspruit soil form is most commonly found in areas of semi-permanent wetness. The soil is made up of an Orthic A-horizon over a diagnostic G-horizon and is indicated in Figure 8-14. The G-horizon has several unique diagnostic criteria as a horizon, namely:

- It is saturated with water for long periods unless drained;
- Is dominated by grey, low chroma matrix colours, often with blue or green tints, with or without mottling;
- Has not undergone marked removal of colloid matter, usually accumulation of colloid matter has taken place in the horizon;
- Has a consistency at least one grade firmer than that of the overlying horizon;
- Lacks saprolitic character; and
- Lacks plinthic character.

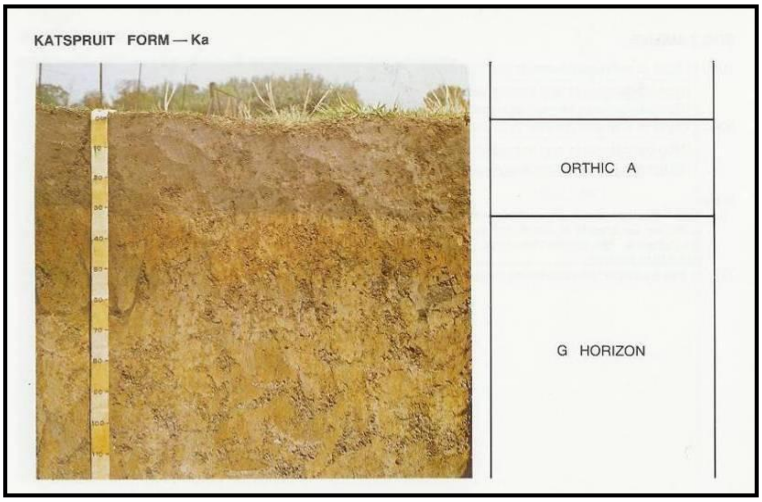

Figure 8-14: Katspruit Soil form (Soil Classification, 1991)

Willowbrook Soil Form

Willowbrook soils are characterised by Melanic A-horizon over a G-horizon. The G-horizon is invariably firm or very firm and its characteristics are described above. Refer to Figure 8-15 for an illustration. The Melanic horizon has several unique diagnostic criteria as a horizon, namely:

- Has dark colours in the dry state.
- Lack slickensides that are

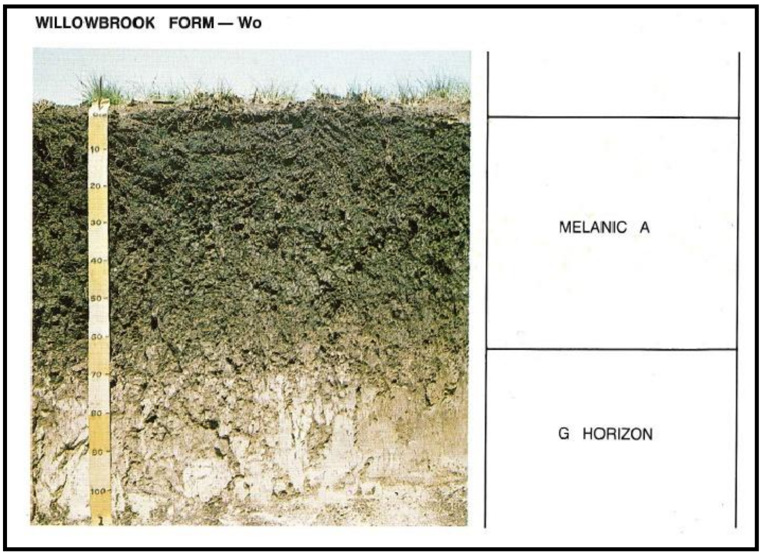

Figure 8-15: Willowbrook Soil Form (Soil Classification 1991)

diagnostic of vertic horizons.

- Has less organic carbon than required for diagnostic organic O horizon.
- Has structure that is strong enough so that the major part of the horizon is not both massive and hard or very hard when dry.

8.4.8 Disturbed Soils

The disturbed soil management unit is found in areas where human disturbance has influenced the soil that developed on site. This is the case at dumping sites, roadsides, beneath buildings and mined areas. Refer to Figure 8-16 for an illustration.

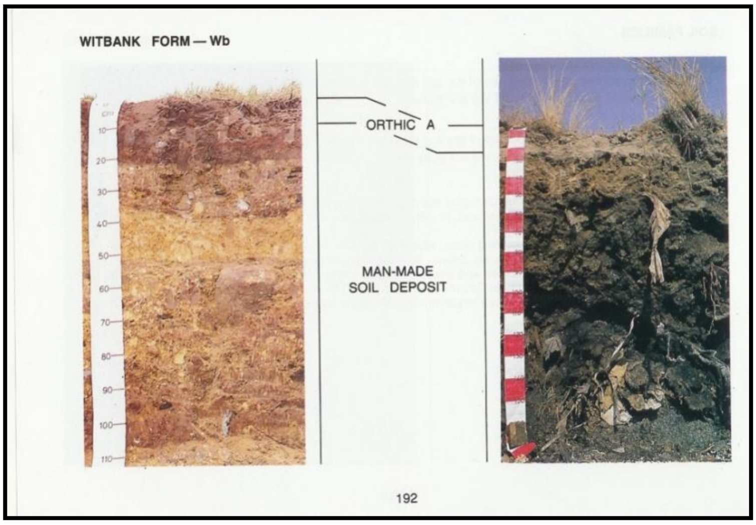

Figure 8-16: Witbank Soil Form (Soil Classification 1991)

8.5 AGRICULTURAL POTENTIAL (LAND CAPABILITY)

8.5.1 Data Collection

A literature review was conducted in order to obtain any relevant information concerning the area, including information from the Environmental Potential Atlas (ENPAT), Weather Bureau and Department of Agriculture. Results from the soil study were taken into account when determining the agricultural potential also known as the land capability of the site. The land capability assessment methodology as outlined by the National Department of Agriculture was used to assess the soil's capability to support agriculture on site. (Refer to Table 8-1 and Figure 8-17 below)

8.5.2 Regional Description

The regional land capability is mostly Class II or IV soils with few limitations. This is evident in the large number of cultivated lands found in the region. In the areas where the soil is too shallow or too wet to cultivate, livestock are grazed.

8.5.3 Study area Description

According to the land capability methodology, the potential for a soil to be utilised for agriculture is based on a wide number of factors. These are listed in Table 8-1 below along with a short description of each factor.

Table 8-1: Agricultural Potential criteria

Criteria	Description
Rock Complex	If a soil type has prevalent rocks in the upper sections of the soil it is a limiting factor to the soil's agricultural potential
Flooding Risk	The risk of flooding is determined by the closeness of the soil to water sources.
Erosion Risk	The erosion risk of a soil is determined by combining the wind and water erosion potentials.
Slope	The slope of the site could potentially limit the agricultural use thereof.
Texture	The texture of the soil can limits its use by being too sandy or too clayey.
Depth	The effective depth of a soil is critical for the rooting zone for agricultural crops.
Drainage	The capability of a soil to drain water is important as most grain crops do not tolerate submergence in water.
Mechanical Limitations	Mechanical limitations are any factors that could prevent the soil from being tilled or ploughed.
pH	The pH of the soil is important when considering soil nutrients and hence fertility.
Soil Capability	This section highlights the soil type's capability to sustain agriculture.
Climate Class	The climate class highlights the prevalent climatic conditions that could influence the agricultural use of a site.
Land Capability / Agricultural Potential	The land capability or agricultural potential rating for a site combines the soil capability and the climate class to arrive at the sites potential to support agriculture.

The soils identified in Section 8.4 above were classified according to the methodology proposed by the Agricultural Research Council – Institute for Soil, Climate and Water (2002). The criteria mentioned above were evaluated in the Table 8-2 below. The site is made up of several land capability classes, namely Class II, III, IV, V, VI and VII. The Class II - III soils are suitable for cultivation and can be used for a range of agricultural applications in the case of Class II. Class IV – V soils have features that reduce their potential for agricultural use, this can be flood hazards, erosion risk, texture or drainage. The Class VI and VII soils have continuing limitations that cannot be corrected; in this case rock complexes, flood hazard, stoniness, and a shallow rooting zone constitute these limitations. Table 8-2 illustrates the various land capability units within the study area.

Table 8-2: Land Capability of the soils within the study area

Soil	Good Agricultural	Agricultural	Transitional	Poor Transitional	Shallow Soil	Disturbed / Hard Rock
% on Site	8	28	12	40	11	1
Rock Complex	None	None	None	None	Yes	None
Flooding Risk	No	Moderate	Moderate	Moderate	No	Very Limiting
Erosion Risk	Low	Moderate	High	High	High	Very Low
Slope %	3.9	3.7	3.7	3.7	4.0	0.5
Texture	Loam	Loam	Loam	Clay/Clayey Loam	Sandy Loam	Rock/Sandy
Effective Depth	> 100 cm	> 60 cm	> 60 cm	< 60 cm	< 60 cm	< 10 cm
Drainage	Good	Imperfect	Imperfect	Poor	Poorly drained	Poorly drained
Mech Limitations	None	None	None	None	Rocks	Rocks
pH	> 5.5	> 5.5	> 5.5	> 5.5	> 5.5	> 5.5
Soil Capability	Class II	Class III	Class IV	Class V	Class VI	Class VIII
Climate Class	Mild	Mild	Mild	Mild	Mild	Mild
Land Capability	Class II – Arable Land	Class III – Moderately Arable Land	Class IV – Poor Arable Land	Class V – Good Grazing Land	Class VI – Moderately Grazing Land	Class VII – Wildlife

No limitation	Low	Moderate	High	Very Limiting

For an illustration of the land capability please refer to Figure 8-17.

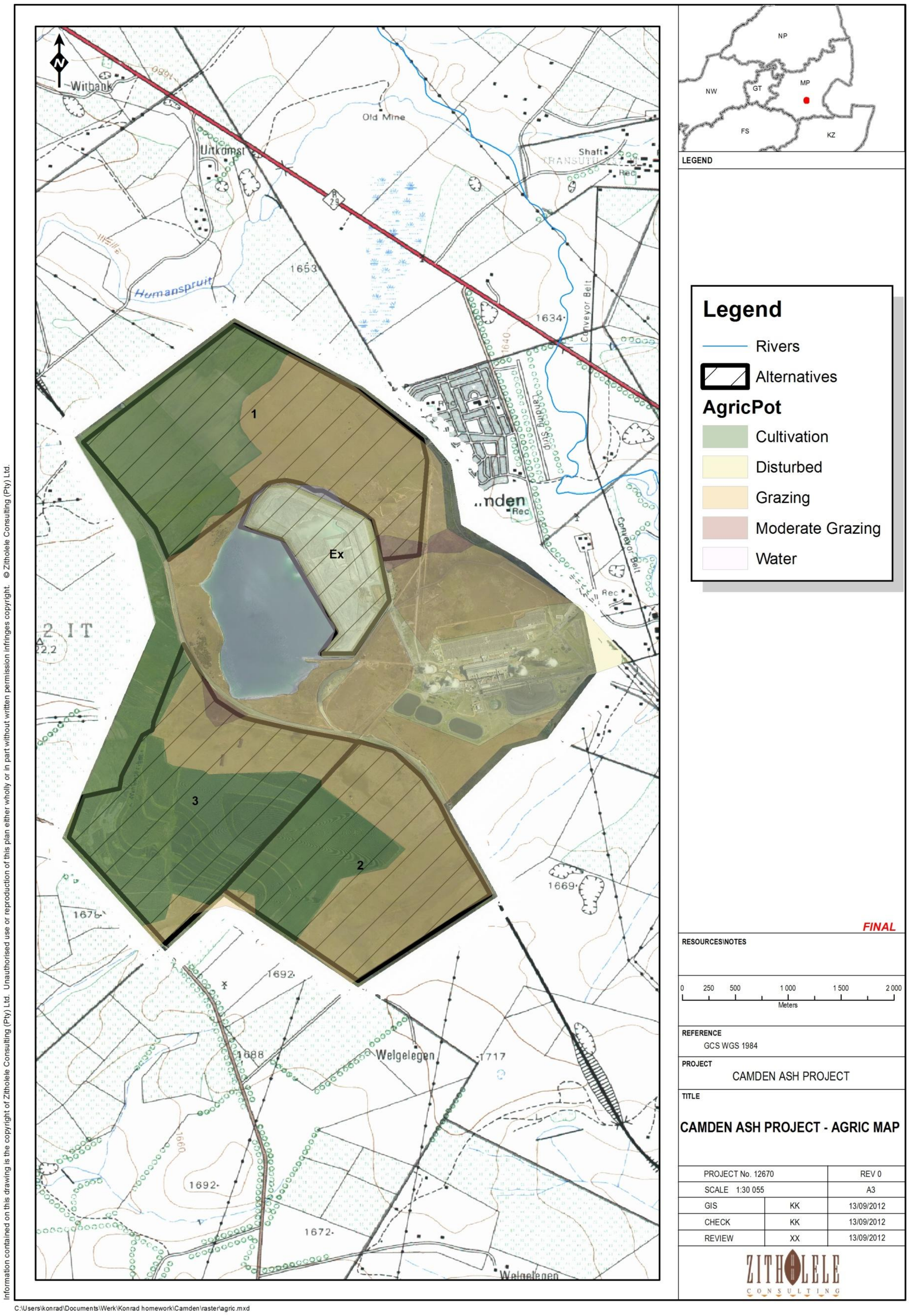

Figure 8-17: Agricultural Potential

8.6 SURFACE WATER

8.6.1 Data Collection

The surface water data was obtained from the Department of Water Affairs National database of Freshwater Ecosystem Priority Areas (FEPAs) for river ecosystems and wetlands. The data used included catchments, wetlands, water bodies, river alignments and ecological status of these sources.

8.6.2 Regional Description

The main drainage features of the area are the Witpuntspruit which drains south-eastwards to the Vaal River, which is located some 6 km from Camden Power Station. Several unnamed tributaries are also found in the area. In addition to the streams, several wetlands and pans can also be found in the region as illustrated in Figure 8-18 below. The streams and their associated pans and wetlands support a number of faunal and floral species uniquely adapted to these aquatic ecosystems, and therefore all surface water bodies are earmarked as sensitive features and should be avoided as far as possible.

8.6.3 Study area Description

From Figure 8-18 below, it is evident that there are water bodies or streams in close proximity to the study area. The De Jagers Pan is a natural depression/pan that is located adjacent to the existing ash disposal site. This pan is used as a return water dam as part of the approved water management system for the station. In addition to the pan there are small non-perennial drainage lines on all three alternative sites. In order to identify the exact location and status of these features a wetland and riparian delineation study was undertaken as described in Section 8.6.4 below.

8.6.4 Sensitivities

All the surface water features are seen as sensitive and should be avoided by the ash disposal site. A detailed delineation study was undertaken to determine the extent of the surface water features. The results of the delineation are shown in Figure 8-18. A summary of the wetland and surface water delineation study is provided below, and more detailed description is included in the attached Biophysical Specialist Study (refer to Appendix I).

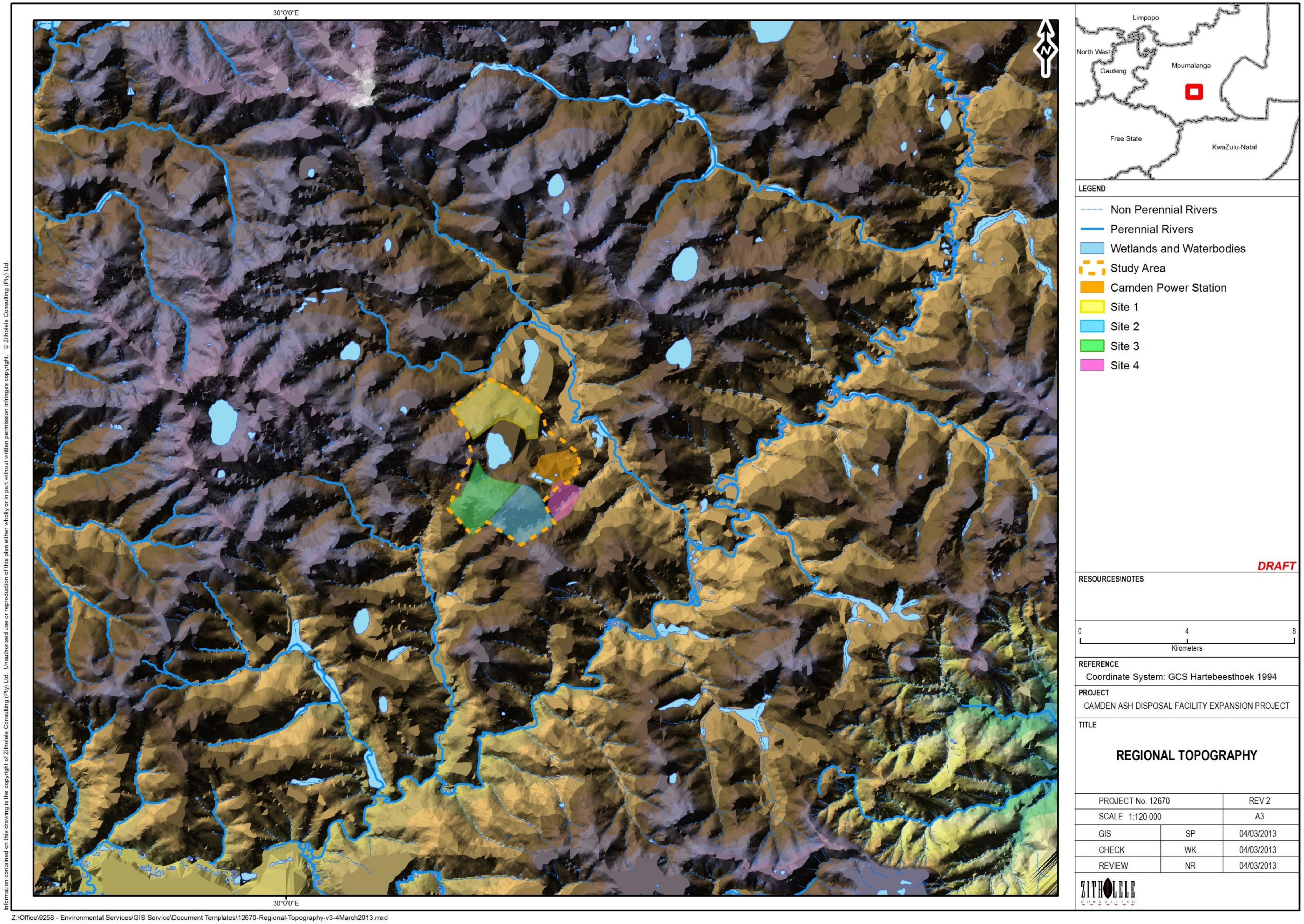

Figure 8-18: Wetland and surface water

Riparian Zones vs. Wetlands

Wetlands

The riparian zone and wetlands were delineated according to the Department of Water Affairs (DWA, previously known as the Department of Water Affairs and Forestry -DWAF) guideline, 2003: A practical guideline procedure for the identification and delineation of wetlands and riparian zones. According to the DWA guidelines *a wetland* is defined by the National Water Act as:

"land which is transitional between terrestrial and aquatic systems where the water table is usually at or near surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."

In addition the guidelines indicate that wetlands must have one or more of the following attributes:

- Wetland (hydromorphic) soils that display characteristics resulting from prolonged saturation;
- The presence, at least occasionally, of water loving plants (hydrophytes); and
- A high water table that results in saturation at or near surface, leading to anaerobic conditions developing in the top 50 centimetres of the soil.

During the site investigation the following indicators of potential wetlands were identified:

- Terrain unit indicator;
- Soil form indicator;
- Soil wetness indicator; and
- Vegetation indicator.

Riparian Areas

According to the DWA guidelines *a riparian area* is defined by the National Water Act as:

"Riparian habitat includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas"

The difference between Riparian Areas and Wetlands

According to the DWA guidelines the difference between a wetland and a riparian area is:

"Many riparian areas display wetland indicators and should be classified as wetlands. However, other riparian areas are not saturated long enough or often enough to develop wetland characteristics, but also perform a number of important functions, which need to be safeguarded… Riparian areas commonly reflect the high-energy conditions associated with the water flowing in a water channel, whereas wetlands display more diffuse flow and are lower energy environments."

Delineation

The site was investigated for the occurrence / presence of wetlands and riparian areas, using the methodology described in Section 3.8.2 above and described in more detail in the DWA guidelines.

Terrain Unit Indicator

The topography of the site is described in Section 8.3 of this report and is also shown in Figure 8-3. According to the DWA guidelines the valley bottom is the terrain unit where wetlands are most likely to occur, but the occurrence of wetlands is not excluded from any of the other terrain units.

The bulk of the area drains towards De Jager's Pan, which represents the valley bottom, and this is the area in which most wetlands are expected.

Soil Form Indicator

Of the soils identified the clay and transitional soils could potentially be wetland soils as they have clay accumulation. The clay soils are mostly typical of the permanent and seasonal wetland zone while the transitional soils can be found in temporary wetland zones.

Soil Wetness Indicator

The soils on site were subjected to a soil wetness assessment. If soils showed signs of wetness within 50 cm of the soil surface, it was classified as a hydromorphic soil and divided into the following zones:

Temporary Zone

- Minimal grey matrix (<10%);
- Few high chroma mottles; and

- Short periods of saturation.

Seasonal Zone

- Grey matrix (>10%);
- Many low chroma mottles present; and
- Significant periods of wetness (>3 months / annum).

Permanent Zone

- Prominent grey matrix;
- Few to no high chroma mottles;
- Wetness all year round; and
- Sulphuric odour.

Vegetation Indicator

The vegetation units on site are described in Section 8.7.2 below and illustrated in Figure 8-20. The vegetation found in the moist grassland vegetation unit has species present to indicate the presence of wetlands

Delineated Wetlands and Buffer Zones

According to the methodology that was followed for delineation of wetlands by DWA, there are wetlands present on site. It should however be noted that several of the so-called wetlands could also be classified as riparian zones as they follow the drainage path of the perennial and non-perennial streams on each of the alternative sites. All the area’s identified above perform critical ecosystem functions and also habitat for sensitive species. It was suggested by the specialist that a 50 m and 100 m buffer be placed from the edge of the temporary zone in order to sufficiently protect the wetlands and riparian zones.

Figure 8-19 below illustrates the various wetland and riparian zones as well as the buffers placed along the edge of the temporary zone.

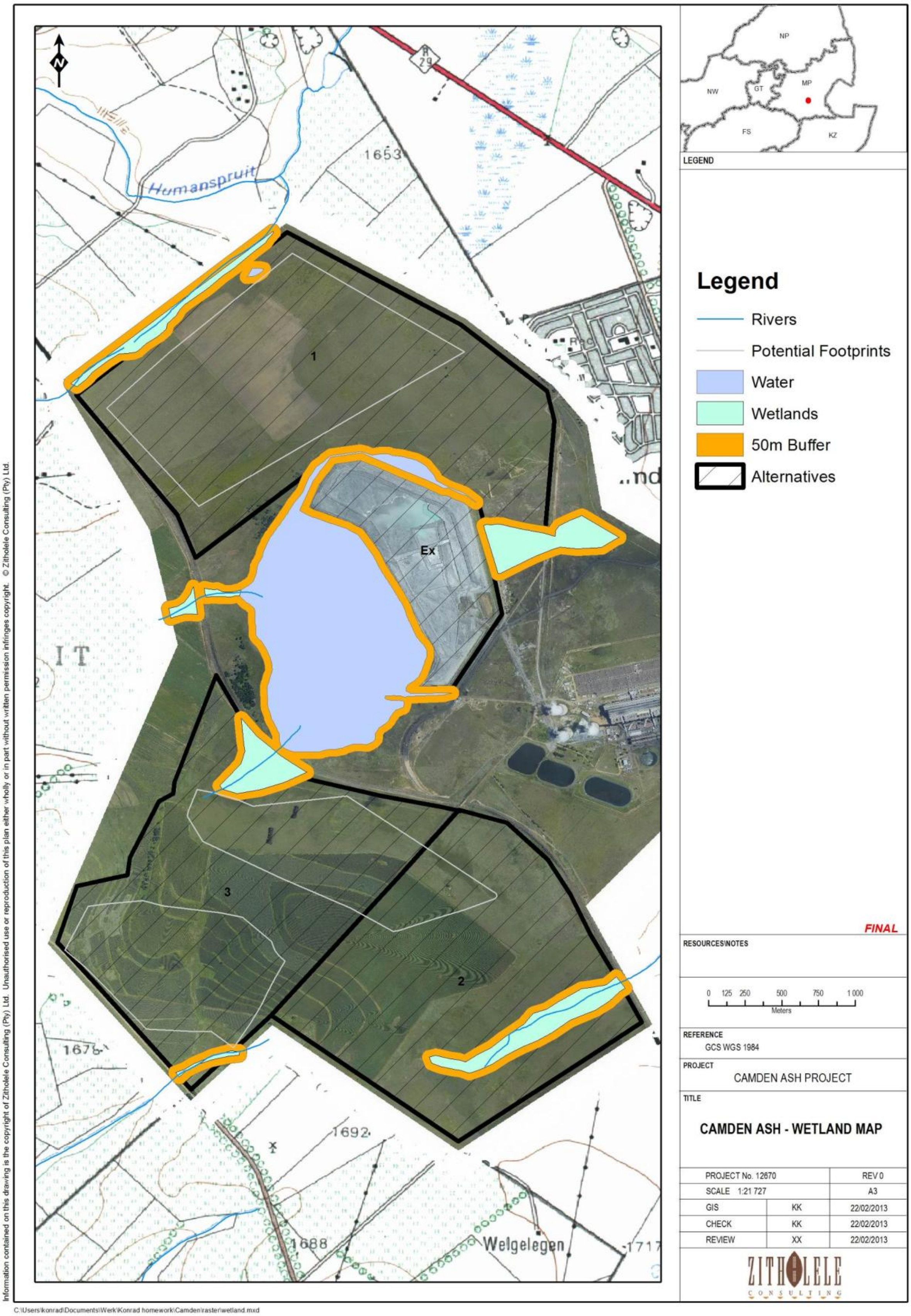

Figure 8-19: Wetlands and Riparian Zones including buffer

8.7 TERRESTRIAL ECOLOGY

8.7.1 Data Collection

A literature review of the faunal and floral species that could occur in the area was conducted. C-Plan data provided from the Mpumalanga provincial department was used to conduct a desktop study of the area. This data consists of terrestrial components; ratings provide an indication as to the importance of the area with respect to biodiversity.

The study involved extensive fieldwork, a literature review and a desktop study utilizing GIS. Site investigations were conducted from October 2011 to March 2012, from spring to summer. The area within the servitude was sampled using transects placed at 100 m intervals. At random points along these transect an area of 20 m x 20 m was surveyed. All species within the 20 m x 20 m quadrant were identified, photographed and their occurrence noted. Sensitive features such as ridges or wetlands were sampled by walking randomly through the area concerned and identifying all species within the area.

The floral data below is taken from The Vegetation of South Africa, Lesotho and Swaziland (Mucina and Rutherford (2006)). Also, while on site, the following field guides were used:

- Guide to Grasses of Southern Africa (Van Oudtshoorn,F, (1999));
- Field Guide to Trees of Southern Africa (Van Wyk, B and Van Wyk,P (1997));
- Field Guide to the Wild Flowers of the Highveld (Van Wyk,B and Malan,S, (1998));
- Problem Plants of South Africa (Bromilow,C, (2001)); and
- Medicinal Plants of South Africa (Van Wyk,B.E, Van Oudtshoorn,B and Gericke,N, (2002))

Species lists were obtained from the SIBIS (*South African National Biodiversity Institute - Accessed through the SIBIS portal, sibis.sanbi.org, 2012-01-25)*. In addition the following faunal guides were used on site and while compiling this report:

- Die Natuurlewe van Suider-Afrika, ‘n veldgids tot diere en plante van die streek (Carruthers,V, (1997));
- Birds of Southern Africa (Sinclair,I (1994));
- Smithers’ Mammals of Southern Africa, a field guide (Ed. Peter Apps, (2000));
- Sasol Owls and Owling in Southern Africa (Tarboton, W and Erasmus, R (1998));
- Bats of Southern Africa (Taylor, P.J, (2000)).

8.7.2 Vegetation

Regional Description

The area under investigation is located within the Grassland Biomes. Each biome comprises several bioregions which in turn has various vegetation types within the bioregion. The Grassland Biome is represented by Mesic Highveld Grassland and Inland Azonal Vegetation bioregions as described below. These descriptions are adapted from Mucina and Rutherford, 2006.

Mesic Highveld Grassland

Mesic Highveld Grassland is found mainly in the eastern, high rainfall regions of the Highveld, extending all the way to the northern escarpment. These are considered to be "sour" grasslands and are dominated by primarily andropogonoid grasses. The different grassland types are distinguished on the basis of geology, elevation, topography and rainfall. Shrublands are found on outcrops of rock within the bioregion, where the surface topography creates habitat in which woody vegetation is favoured above grasses.

Inland Azonal Vegetation

The Azonal Vegetation bioregion is characterised by those vegetation units that is associated with inland water features such as riparian and wetland vegetation. Along the proposed route only one vegetation type was identified, namely Eastern Temperate Freshwater Wetlands.

Study area Description

The vegetation types identified on site are indicated in Figure 8-20 below and described in detail below.

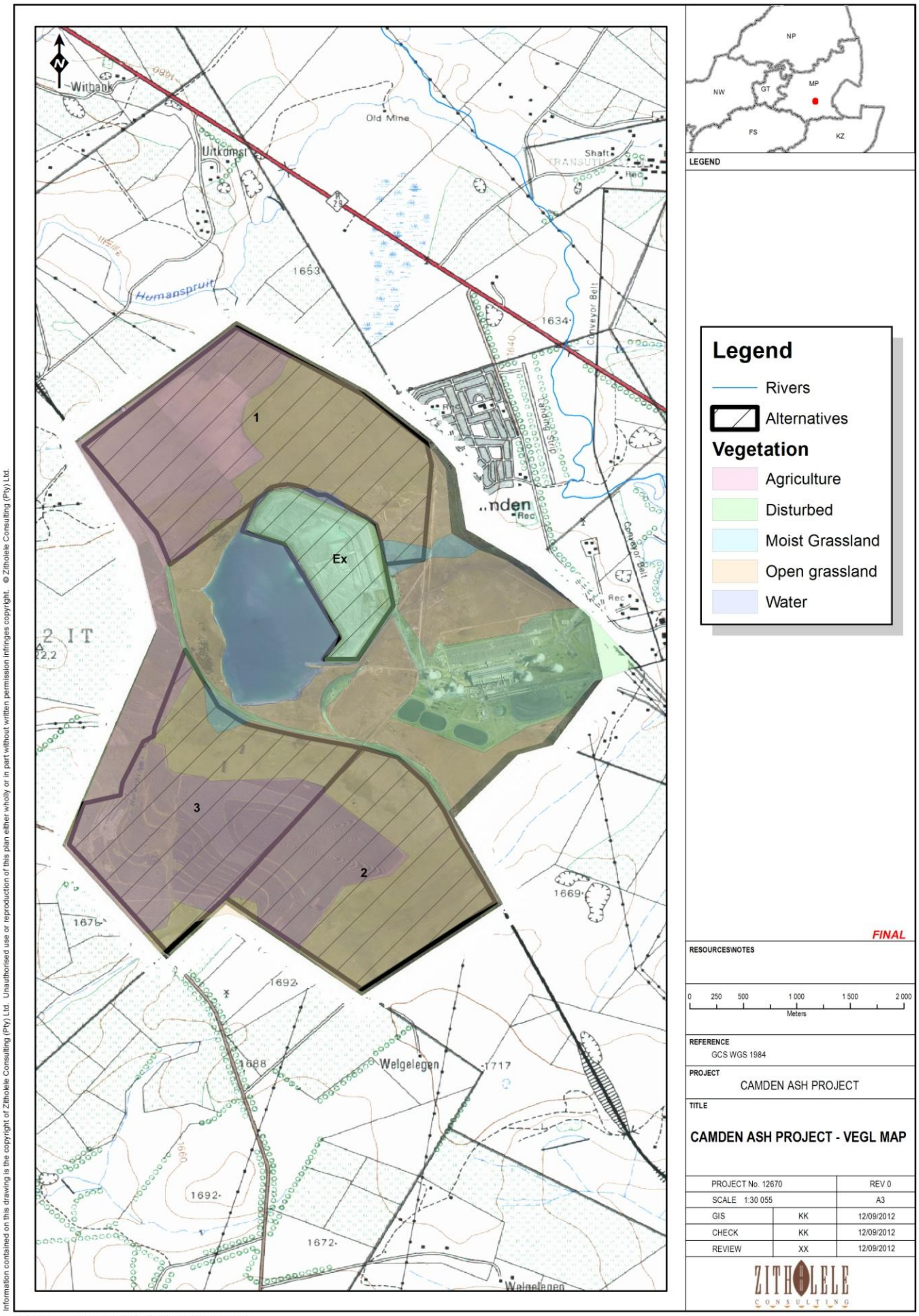

Figure 8-20: Vegetation map of the study area

Eastern Temperate Freshwater Wetlands

This vegetation unit is found throughout the Northern Cape, Eastern Cape, Free State, North-West, Gauteng, Mpumalanga and KwaZulu-Natal Provinces as well as in the neighbouring Lesotho and Swaziland. It is based around water bodies with stagnant water (lakes, pans, periodically flooded vlei's, and edges of calmly flowing rivers) and embedded within the Grassland Biome. These water bodies support zoned systems of aquatic and hygrophillous vegetation of temporary flooded grasslands and ephemeral herblands.

Due to the recent efforts of organisations such as Ramsar, this vegetation unit is now 4.6 % conserved and rated as least threatened. The following alien species are encountered in this type of wetland: *Bidens bidentata, Cirsium vulgare, Conyza bonariensis, Oenothera rosea, Physalis viscosa, Plantago lanceolata, Rumex crispus, Sesbania punicea, Schkuhria pinnata, Stenotaphrum secundatum* (native on South African coast, alien on Highveld*), Trifolium pratense, Verbena bonariensis, V. brasiliensis, and Xanthium strumarium*.

In terms of the vegetation on site, there are 3 distinct areas within the study area that fall into this vegetation unit. The first is De Jager's Pan (shown in Figure 8-21), the large pan in the centre of the site. This pan is classified as a wetland and wetlands are of a more permanent nature and occur in low-lying areas such as tributaries of streams and rivers. Here hydrophytes are found. Typical plants are the Orange River Lily (*Crinum bulbispermum*), bulrush (*Typha capensis*) and reeds (*Phragmites australis*), sedges of the *Cyperus, Fuirena and Scirpus* genera also occur. Due to the use of the pan as a dirty water return dam for the power station over the 40 odd years of operation, the vegetation around the pan has been disturbed as the water quality was reduced.

Figure 8-21: De Jager's Pan with the existing ash facility in the foreground

The other two areas (shown in Figure 8-22) are the inflow into the pan from the south and the man-made outflow to the north-northeast of the pan and existing ash disposal site. These areas around drainage lines/seepage areas were also added to this unit because of the similar vegetation that occur in these areas. The seepage area is seasonally wet and is found to the south of the site, where the bowl-shaped topography drains to a central point that enters under the Richard Bay railway line and drains into the pan. These areas are usually covered by hygrophytes such as sedges and reeds. The dominant sedge in the study area is *Juncus rigidus*. Sometimes bulrush (*Typha capensis*) and reeds (*Phragmites australis*) also occurs. The photos below show these areas.

Figure 8-22: Moist Grassland found at the bottom of the southern slopes prior to joining De Jager's Pan