Annexure B

Annexure B.1

Process followed to reach the proposed preferred activity, site and location

Annexure: Assessment of Alternatives

The purpose of this Annexure is to provide the information required by Annexure 2(h)(v) of Government Notice Regulation 983 of 2014, which entails full description of the process followed to reach the proposed preferred **activity**, **site** and **location** within the site, including:

- The impacts and risks identified for each alternative, including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts-
  - Can be reversed;
  - May cause irreplaceable loss of resources; and
  - Can be avoided, managed or mitigated.

In addition to the site selection process described in Section two of the scoping report[1] the below tables provide a description of the process followed to reach the proposed preferred activity, site and location. The method of assessment is provided below and is aligned with the methodology which will be used to undertake the assessment of impacts in the EIA phase, however the scoping phase assessment is done comparatively i.e. alternatives assessed against each other whereas the assessment in the EIA phase will be done for the preferred alternative against the "no-go" alternative.

For each impact, the **EXTENT** (spatial scale), **MAGNITUDE** and **DURATION** (time scale) would be described. These criteria would be used to ascertain the **SIGNIFICANCE** of the impact, firstly in the case of no mitigation and then with the most effective mitigation measure(s) in place. The mitigation described in the EIR would represent the full range of plausible and pragmatic measures but does not necessarily imply that they would be implemented

The tables on the following pages show the scale used to assess these variables, and defines each of the rating categories.

[1] AURECON.2016. Integrated Environmental Impact Assessment Process: Proposed Extension of Ash Dam Facility, Kriel Power Station, Mpumalanga: Scoping Report. Report No. 11081/113084

Table 1 | Assessment criteria for the evaluation of impacts

Criteria	Category	Description
Spatial influence of impact	**Regional**	Beyond a 10 km radius of the candidate site.
	Local	Between 100m and10 km radius of the candidate site.
	Site specific	On site or within 100 m of the candidate site.
Magnitude of impact (at the indicated spatial scale)	**High**	Natural and/ or social functions and/ or processes are *severely* altered
	Medium	Natural and/ or social functions and/ or processes are *notably* altered
	Low	Natural and/ or social functions and/ or processes are *slightly* altered
	Very Low	Natural and/ or social functions and/ or processes are *negligibly* altered
	Zero	Natural and/ or social functions and/ or processes remain *unaltered*
Duration of impact (temporal)	**Construction period**	From commencement up to 2 years of construction
	Short Term	Between 2and 5 years after construction
	Medium Term	Between 5 and15 years after construction
	Long Term	More than 15 years after construction

The **SIGNIFICANCE** of an impact is derived by taking into account the temporal and spatial scales and magnitude. The means of arriving at the different significance ratings is explained in Table 2.

Table 2 | Definition of significance ratings

Significance ratings	Level of criteria required
High	• High magnitude with a regional extent and long term duration • High magnitude with either a regional extent and medium term duration or a local extent and long term duration • Medium magnitude with a regional extent and long term duration
Medium	• High magnitude with a local extent and medium term duration • High magnitude with a regional extent and construction period or a site specific extent and long term duration • High magnitude with either a local extent and construction period duration or a site specific extent and medium term duration • Medium magnitude with any combination of extent and duration except site specific and construction period or regional and long term • Low magnitude with a regional extent and long term duration
Low	• High magnitude with a site specific extent and construction period duration • Medium magnitude with a site specific extent and construction period duration • Low magnitude with any combination of extent and duration except site specific and construction period or regional and long term • Very low magnitude with a regional extent and long term duration
Very low	• Low magnitude with a site specific extent and construction period duration • Very low magnitude with any combination of extent and construction or short term duration
Neutral	• Zero magnitude with any combination of extent and duration

Once the significance of an impact has been determined, the **PROBABILITY** of this impact occurring as well as the **CONFIDENCE** in the assessment of the impact, would be determined using the rating systems outlined in Lastly, Table 7 gives an indication to the extent to which the impact is mitigatable.

Table 3 and Table 4, respectively. It is important to note that the significance of an impact should always be considered in concert with the probability of that impact occurring. The **REVERSIBILITY** of the impact is estimated using the rating system outlined in Table 5 and the **RESOURCE IRREPLACEABILITY** refers to the "Loss of resource" and thus the degree to which a resource is permanently affected by the activity, i.e. the degree to which a resource is irreplaceable outlined in Table 6. Lastly, Table 7 gives an indication to the extent to which the impact is mitigatable.

Table 3 | Definition of probability ratings

Probability ratings	Criteria
Definite	Estimated greater than 95 % chance of the impact occurring.
Probable	Estimated 5 to 95 % chance of the impact occurring.
Unlikely	Estimated less than 5 % chance of the impact occurring.

Table 4 | Definition of confidence ratings

Confidence ratings	Criteria
Certain	Wealth of information on and sound understanding of the environmental factors potentially influencing the impact.
Sure	Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact.
Unsure	Limited useful information on and understanding of the environmental factors potentially influencing this impact.

Table 5 | Definition of reversibility ratings

Reversibility ratings	Criteria
Irreversible	The activity will lead to an impact that is in all practical terms permanent.
Reversible	The impact is reversible within 2 years after the cause or stress is removed.

Table 6 | Definition of Irreplaceable ratings

Irreplaceable ratings	Criteria
Low	Where the activity results in a loss of a particular resource but where the natural, cultural and social functions and processes are not affected.
Medium	Where the loss of a resource occurs, but natural, cultural and social functions and processes continue, albeit in a modified way
High	Where the activity results in an irreplaceable loss of a resource.

Table 7 | Definition of mitigation

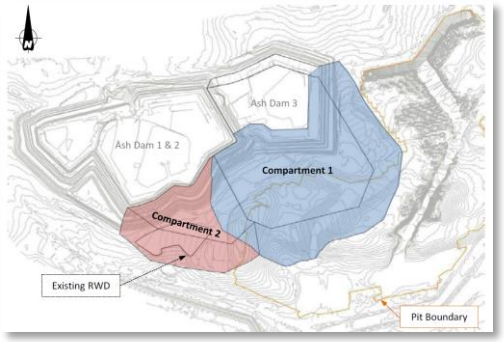
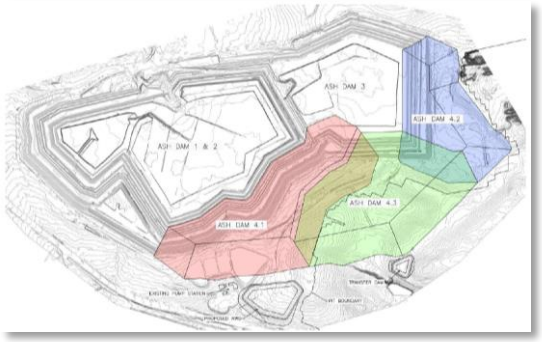
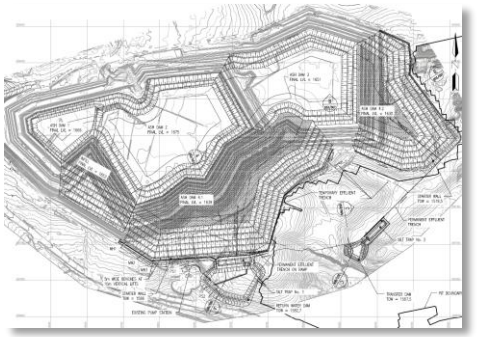
Mitigatable ratings	Criteria
Low	Low extent to which impacts can be mitigated
Medium	Medium extent to which impacts can be mitigated
High	High extent to which impacts can be mitigated

1 Location Alternatives

	Alternative Site 10	Alternative Site 16N
Short description	Site 10 is brownfield site immediately adjacent the existing Kriel Ash Disposal Facility. (Also see Section 2 in the Scoping Report no.: 113084 / 11081) Latitude 26°16'33.37"S; Longitude 29°12'9.46"E 	Site 16N is a greenfield site approximately 12km from Kriel Power Station. (Also see Section 2 in the Scoping Report no.: 113084 / 11081) Latitude 26°11'26.43"S; Longitude 29°14'35.50"E 
Description of alternative specific attributes (environmental / socioeconomic / Technical and financial)	Site 10 partially overlies a backfilled open cast mine pit (Kriel Colliery Pit 1) and is further bordered by this pit to the east. The Provincial Road R547 (Evander-Kriel) is located to the south, Matla Power Station to the west and the Kriel Power Station to the north.	Site 16N overlies unmined ground that is mostly used for agriculture with some remnants of natural vegetation. It's bordered by the Steenkoolspruit to the east, agricultural land and a valley ridge to the north and south and to the west agricultural land that is underlain by the Kriel Colliery Coal fields.
List of potential negative impacts and risks	**Construction phase impacts on the biophysical and social environments:** • Disturbance of flora and fauna; • Sedimentation and erosion of water ways; • Increase in traffic volumes; • Storage of hazardous substances on site; • Increased risk of fire; • Pollution (noise, air and water); and • Dust impacts. **Operational phase impacts on the biophysical environment:** • Impact on the terrestrial fauna and flora; • Impact on aquatic flora and fauna; • Impact on groundwater resources; and • Impact on air quality. **Operational phase impacts on the social environment:** • Visual impacts; • Impact on heritage resources; • Noise impacts; • Impact on the local economy;	**Construction phase impacts on the biophysical and social environments:** • Disturbance of flora and fauna; • Sedimentation and erosion of water ways; • Increase in traffic volumes; • Storage of hazardous substances on site; • Increased risk of fire; • Pollution (noise, air and water); and • Dust impacts. **Operational phase impacts on the biophysical environment:** • Impact on the terrestrial fauna and flora; • Impact on aquatic flora and fauna; • Impact on groundwater resources; and • Impact on air quality. **Operational phase impacts on the social environment:** • Visual impacts; • Impact on heritage resources; • Noise impacts; • Impact on the local economy;

	Alternative Site 10		Alternative Site 16N	
	• Impact on agriculture and other land uses in the study area; • Impact on traffic; • Impact on existing infrastructure and services; and • Impact on health and safety of workers and others in the area.		• Impact on agriculture and other land uses in the study area; • Impact on traffic; • Impact on existing infrastructure and services; and • Impact on health and safety of workers and others in the area.	
List of potential positive impacts (comparative between alternatives)	• Smaller impact on traffic • Reduced disturbance to fauna and flora • Reduced visual impact • Reduced dust impact • Reduced impact on existing infrastructure and services • Reduced construction and operational cost requirements		• None	
Comparative Cumulative Assessment of Impacts (without mitigation)				
Impact nature	Positive	Negative	N/A	Negative
Duration	Long term	Long term	N/A	Long term
Extent	Local	Local	N/A	Regional
Magnitude	Medium	Medium	N/A	High
Probability	Definite	Definite	N/A	Definite
Confidence	Sure	Sure	N/A	Sure
Reversibility	Irreversible	Irreversible	N/A	Irreversible
Resource irreplaceability	N/A	Medium	N/A	Medium
Mitigatable	Medium	Medium	N/A	Medium
Significance	Medium	Medium	N/A	High
List of potential mitigations	The most significant mitigation measure to be undertaken with regards to location alternatives is to choose the location with the least amount of potential issues and risks. Once the location is chosen, the mitigation measures undertaken will relate to the layout of the proposed ash dams (AD4.1 and AD4.2) and the type of activity that takes place. These will be incorporated in the EMP during the EIA Phase to inform construction and operational phase activities.			
Conclusion				
Ranked preference	Preferred			
Motivation for preferred alternative	Upon consideration of various technical, financial and environmental criteria (see Section 2 of the Scoping Report (report no.: 113084 / 11081) for extensive explanation of process follow), the logical preferred location to expand the Ash Disposal Facility would be to do so adjacent to the existing ash dam complex. The above comparative cumulative assessment of potential impacts further supports the preference of Site 10. In addition Site 10 has the advantage of: • Being located relatively close to the Kriel Power Station and therefore requires less capital costs. • No need to construct on Greenfield site (or other site located further from Kriel Power Station). • Being underlain by natural ground with no instability concerns (AD 4.1 and AD 4.2). • A Best practical use of Brownfields area with limited future land use. • Facilitating ongoing operation at current Ash Disposal Facility which means Kriel Power Station can function until its predicted end of life. It must however be noted that all potential impacts will be assessed separately in detail during the EIA phase.			

2 Layout Alternatives

	Ash Dam 4 Concept 2014 (A)	Ash Dam 4 Concept 2016 (B)	Ash Dam 4 Concept 2016 revised (C)
Short description	Site 10 divided into Compartment 1 to the east and Compartment 2 to the west. Figure 3-3 	Site 10 divided into three ash dams namely AD4.1, AD4.2 and AD4.3. Figure 3-4 	Site 10 divided into two ash dams namely AD4.1 and AD4.2. Figure 3-5 
Description of alternative specific attributes (environmental / socioeconomic / Technical and financial)	The two compartments on Site 10 partially overlies a backfilled open cast mine pit (Kriel Colliery Pit 1) and is further bordered by this pit to the east.	One of the three proposed ash dams on Site 10, AD4.3, partially overlies a backfilled open cast mine pit (Kriel Colliery Pit 1) and is further bordered by this pit to the east.	Of the two proposed ash dams on Site 10, none overlies the backfilled open cast mine (Pit 1). AD4.2 do however border the backfilled Kriel Colliery open cast mine (Pit 1) to the east.

	Ash Dam 4 Concept 2014 (A)	Ash Dam 4 Concept 2016 (B)	Ash Dam 4 Concept 2016 revised (C)
List of potential negative impacts and risks	**Construction phase impacts on the biophysical and social environments:** • Disturbance of flora and fauna; • Sedimentation and erosion of water ways; • Increase in traffic volumes; • Storage of hazardous substances on site; • Increased risk of fire; • Pollution (noise, air and water); and • Dust impacts. **Operational phase impacts on the biophysical environment:** • Impact on the terrestrial fauna and flora; • Impact on aquatic flora and fauna; • Impact on groundwater resources; and • Impact on air quality. O**perational phase impacts on the social environment:** • Visual impacts; • Noise impacts; • Impact on agriculture and other land uses in the study area; and • Impact on health and safety of workers and others in the area.	**Construction phase impacts on the biophysical and social environments:** • Disturbance of flora and fauna; • Sedimentation and erosion of water ways; • Increase in traffic volumes; • Storage of hazardous substances on site; Increased risk of fire; • Pollution (noise, air and water); and Dust impacts. **Operational phase impacts on the biophysical environment:** • Impact on the terrestrial fauna and flora; • Impact on aquatic flora and fauna; • Impact on groundwater resources; and Impact on air quality. **Operational phase impacts on the social environment:** • Visual impacts; • Noise impacts; • Impact on agriculture and other land uses in the study area; and • Impact on health and safety of workers and others in the area.	**Construction phase impacts on the biophysical and social environments:** • Disturbance of flora and fauna; • Sedimentation and erosion of water ways; • Increase in traffic volumes; • Storage of hazardous substances on site; Increased risk of fire; • Pollution (noise, air and water); and • Dust impacts. **Operational phase impacts on the biophysical environment:** • Impact on air quality. **Operational phase impacts on the social environment:** • Visual impacts; and • Noise impacts.
List of potential positive impacts	• None.	• None.	• No risk of liner damage due to subsidence; • Less risks of impacts on aquatic systems and water quality; and • Reduced footprint (fauna, flora and agricultural land).

Comparative Cumulative Assessment of potential Impacts (without mitigation)						
Nature	N/A	Negative	N/A	Negative	Positive	Negative
Duration	N/A	Long term	N/A	Long term	Long term	Long term
Extent	N/A	Regional	N/A	Regional	Local	Local
Magnitude	N/A	Medium	N/A	Medium	Medium	Medium
Probability	N/A	Probable	N/A	Probable	Probable	Probable
Confidence	N/A	Unsure	N/A	Unsure	Unsure	Unsure
Reversibility	N/A	Irreversible	N/A	Irreversible	Irreversible	Irreversible
Resource irreplaceability	N/A	Medium	N/A	Medium	N/A	Medium
Mitigatable	N/A	Medium	N/A	Medium	Medium	High

	Ash Dam 4 Concept 2014 (A)		Ash Dam 4 Concept 2016 (B)		Ash Dam 4 Concept 2016 revised (C)	
Significance	N/A	High	N/A	High	Medium	Medium to High
List of potential mitigations	The most significant mitigation measure to be undertaken with regards to layout alternatives is to choose the layout with the design that poses the least amount of potential issues and risks, i.e. by excluding the backfilled areas over Kriel Colliery Pit 1 which are included in Ash Dam 4 Concept 2014 (A) and Ash Dam 4 Concept 2016 (B). Once the layout is chosen mitigation measure undertaken will relate to the type of activity (i.e. wet ashing vs. dry ash stacking) that takes place. Once the activity type has been finalised the EMP, which forms part of the EIA Phase, will inform construction and operational phase mitigations. Layout alternatives, also known as design alternatives, are mitigated by optimising the design which will be done through the EIA phase for the preferred alternative.					
Conclusion						
Ranked preference					Preferred	
Motivation for preferred alternative	Site 10 has a three comparatively significant advantages nl. no risk of liner damage due to subsidence; less risks of impacts on aquatic systems and water quality; and reduced footprint which in this case translates into a lower potential impact on fauna, flora and agricultural land. Site 10 was however in question because of geotechnical stability relating to potential subsidence of underlying strata i.e. the required liners were at risk. The layout was thus changed from what was proposed in 2014 (A) to the 2016 designs (B and C) with three dams. The third dam nl. AD4.3 has been identified as a potential option if it can be proven (by means of a MTE) that the underlying backfilled area is stable. Since further geotechnical studies have been undertaken by J&W (2016) Site 10 (AD 4.1 and AD4.2) has been proven to be technically feasible and thus these two ash dams (AD4.1 and AD4.2) are the preferred options (C). AD4.3 does thus not form part of the preferred alternative (C).					

3 Activity Alternatives

	Option 1 – Wet Ashing (current ashing option)		Option 2 – Dry Ash Stacking	
Short description	Wet ash dams are constructed by means of development in an upstream direction commonly referred to as the daywall system.		Dry stacking by conveyors and stackers to transport and deposit the coarse and fine ash in a conditioned state.	
Description of alternative specific attributes (environmental / socioeconomic / Technical and financial)	The wet ash dams are constructed by means of development in an upstream direction commonly referred to as the daywall system. The daywall method works on the premisses that a starter wall is built prior to deposition of ash.		The method of dry stacking utilises conveyors and stackers to transport and deposit the coarse and fine ash in a conditioned state. The method adopted for this concept is radial stacking (opposed to parallel stacking) whereby the conveyors rotate about one central point as the advancing face progresses from the start to finish points of the facility.	
List of potential negative impacts and risks	• Impact on groundwater resources; • Visual impacts; • Noise impacts; • Sedimentation and erosion of water ways; • Pollution (noise, air and water); and • Dust impacts.		• Impact on groundwater resources; • Visual impacts; • Noise impacts; • Impact on the economy; • Impact on existing infrastructure and services; • Impact on health and safety of workers and others in the area; • Sedimentation and erosion of water ways; • Pollution (noise, air and water); and • Dust impacts.	
List of positive impacts	• Lower risk of impact on health and safety of workers and others in the area because it's a known technology (the workers at the plant know how systems run and potential issues). • Impact on the economy will be lower because of lower capital costs.		• None.	
List of potential mitigations	The most significant mitigation measure to be undertaken with regards to activity alternatives is to choose the activity with the least amount of potential issues and risks. Once the activity is chosen mitigation measure undertaken will relate to the implementation of the EMP which forms part of the EIA will inform construction and operational phase mitigations.			
Comparative Cumulative Assessment of potential Impacts (without mitigation)				
Nature	Positive	Negative	N/A	Negative
Duration	Long term	Long term	N/A	Long term
Extent	Large	Large	N/A	Large
Magnitude	Medium	High	N/A	High
Probability	Medium	High	N/A	High
Confidence	Unsure	Unsure	N/A	Unsure
Reversibility	Irreversible	Irreversible	N/A	Irreversible
Resource irreplaceability	N/A	Medium	N/A	Medium
Mitigatable	Medium	Medium	N/A	Medium
Significance	Medium	Medium	N/A	High
Conclusion				
Ranked preference	Preferred			

	Option 1 – Wet Ashing (current ashing option)	Option 2 – Dry Ash Stacking
Motivation for preferred alternative	The dry option will require substantial modification in plant and is substantially more expensive (nearly three times the capital cost) than that of the wet option based on net present value calculated in 2014. Operational cost of dry stacking is slightly cheaper than wet ash, but over the operational period of the power station would not nearly abate the capital cost required to make the transition from wet to dry ash infrastructure. Furthermore, the dry ashing option would require additional investigation into a number of concerns including the stability of the advancing face on the liner system (due to the steep declines in natural ground and the angle of repose slope that the stacker forms, which could be unstable and needs to be buttressed by placing a layer of ash that is trucked and placed into position). In addition, a complex arrangement of the mechanical stacking equipment due to the irregular shape of the site would be required. This is further burdened by the fact that little flexibility exists to extend ash deposition beyond the current life of power plant due to the in-situ density of the dry ash which is approximately 20% less than the wet ash. Based on the above factors and the decided positive that wet ashing would be using a technology that is known and familiar to employees of the Kriel Ash Disposal Facility and that wet ashing is decidedly the preferred alternative.	