Appendix F – Comparison with current Work Plan

Appendix F1 – Yallourn comparison with current Work Plan Pit Lake

Appendix F2 – Yallourn comparison with current Work Plan Partial Backfill Below the Water Table

Appendix F3 – Hazelwood comparison with current Work Plan Pit Lake

Appendix F4 – Hazelwood comparison with current Work Plan Partial Backfill Below the Water Table

Appendix F5 – Loy Yang comparison with current Work Plan Pit Lake

Appendix F6 – Loy Yang comparison with current Work Plan Partial Backfill Below the Water Table

Appendix F1 - Yallourn Work Plan Comparsion Pit Lake

Risk Issue	Design Control (secondary control activities in blue)	Activity	Assumptions	Work Plan Currency	Impact/ dependence on other mines	Info Gaps	Further Research
Landform Stability (Collapse)	Placement of overburden (mine waste material), interseam materials and fill over batters to contribute to weight balance.	Overburden (mine waste material) placement. Utilizing available mine waste material, which will be spread as uniformly as practical and as low as possible across the pit floor. Can only be implemented once mine has reached depth.	Overburden and interseam materials will be placed directly in pit as soon as operations allow Ex-pit OB dumps and ex-pit overheight materials will not be required to achieve weight balance Weight requirements will vary across batters based on specific geology and risk Placement ofavailable OB material on floor and betters is sufficient to achieve weight balance in short and medium term Overlying water provides residual weight balance Quality control of fill placement and slope construction within specified tolerance limits.	Yes	Nil	Weight balance not currently fully understood with respect to fill/water correlations. Tolerance limits for construction of cover not fully understood Need to understand what the required long term FoS is for weight balance.	Site specific studies required to investigate and understand weight balance requirements with respect to overburden placement and filling Work plan requirement to include detailed basis of design for individual batters
	Controlled repressurisation of the aquifer to achieve weight balance	Sequential cessation of dewatering	The rate at which you allow the aquifers to repressurise is dependent upon the rate at which the lake fills. Conservative management of water during transition state to minimise impact on the batters.	Yes	High	Weight balance not currently fully understood with respect to fill/water consideration and impacts from other sites.	
	Design and construction of slopes to suitable gradient	Reshaping of selected batters for a safe and stable outcome.	Covering the batters for fire control will be done as a concurrent activity. Final batter angle will be dependent upon the requirement for cover to manage fire risk. Increase FoS, especially near rivers, townships and other infrastructure.	No	Low	More research needed to understand what safe and stable means in terms of geology, gw, geotech etc.	Understand the variability of the FoS for different batters. What is an appropriate long term FoS/ stability for the landform.

	Water management (water addition) to achieve weight balance.	Surface water injection from flooding (i.e. diverting flood waters) Surface water injection from water entitlement (i.e. neighbouring rivers, power station) Water injection from dewatering.	Licences and approvals are available. Will require on going top up/ maintenance of water level in the long term. Conservative management of water during transition state to minimise impact on the batters. Water level maintained above / or below the toe of batter.	Yes	Moderate	Final long term water balance unknown. Water volume required unknown. Weight balance not currently fully understood with respect to fill/water consideration and impacts from other sites.	Discussion with community to understand their expectations of the landform - i.e. decide how fast the lake should be filled. Understand and optimise water availability across the mines.
	Buttressing of selected high risk batters prior to pit filling.	Buttressing selected batters to maintain safe and stable landform.	e.g. township and Maryvale coalfield batters.	Yes	Nil		Geotech risk assessment of batter stability,
	Installation of pressure relief wells / horizontal drains in high risk areas of pit cut back	Pressure relief wells	Gravity fed drainage of batters. In particular the upper batters. Drain into the lake.	Partial - no long term plan for drains	Nil	We don't know how long the drains will last, and the WQ discharging.	Developing a standardised approach for dealing with drains. Could be established across all 3 mines.
	Source additional overburden, interseam and fill materials off site from other mite sites	Additional overburden sourcing	Not required for pit lake option at Yallourn.	No	Yes		
	Design of drainage diversion and control on above water level batters	Construction of levees and Drainage diversion to specific ARI.	There will be some level of event which cannot be contained, and will enter the pit at some point. Diverted into natural systems and away from pits.	Yes	Nil	Extent to which pits may be used for flood control needs to be understood.	
	Infiltration control.	Low perm materials placed on uppermost surface batters to avoid water entering.	Compatible with proposed final landuse. Controlled drainage to and away from the pit is achieved.	Yes	Nil	Long term maintenance of cover (100 yrs.+) has not been investigated.	
Groundwater	Diversion of the shallow GW or SW prior to entering the pit, and treatment of it.	Construction of horizontal drains and collection system with pumping. Bunding for SW.	Control only required if WQ unsuitable for pit lake. Combination of gravity fed and active system.	No	Nil	Uncertainty regarding WQ objectives for the pit lake	
	Treatment of water either prior to entering pit, or acidic water.	Water treatment to required standard for either offsite discharge or onsite retention.	WQ is of unacceptable quality.	No	Nil	Uncertainty regarding WQ objectives for the pit lake	
	Maintain appropriate salinity for end landuse.	Install and maintain pumping system to control salinity.	Top up of lake level will be required to maintain weight balance. Create a flow through, or increase mixing rate. Could discharge hypersaline water offshore.	No	Nil	Salt balance unknown for pit lake.	Develop WQ model or framework for pit lake.
	Treatment of the pit lake water or restore and maintain appropriate WQ	Installation of water treatment plant.	WQ is of unacceptable quality.	No	Low	WQ requirements of various landuses.	
	Regulate and limit landuse adjacent to the pit, i.e. nothing that may introduce critical contaminants.	Buffer zone establishment	Compatible with proposed final landuse.	Yes	Low	Final landuse unknown.	

	Appropriate allocations maintained for GW during pit filling.	Regional regulation of GW allocations in accordance with pit lake requirements.	There is a regional framework for GW allocation. There is controlled management and transfer of allocations to future land users and owners.	Yes	High	Recharge demands and impacts on GW use outside of mines needs to be understood. (e.g. Oil and Gas)	
	Appropriate allocations maintained for GW post pit filling.	Regional regulation of GW allocations in accordance with pit lake requirements.	There is a regional framework for GW allocation. There is controlled management and transfer of allocations to future land users and owners.	No	High	Recharge demands and impacts on GW use outside of mines needs to be understood. (e.g. Oil and Gas)	
	Ensure that fundamental design parameters involving other water elements are robust enough to cope with variability/ changes.	Base initial designs on climate change prediction data (allow for future ppt and evap demand)	Other primary controls are dependent upon water availability and balance.	No	High	Regional climate change prediction dataset.	Agreement of base case for climate change prediction data.
Surface Water	Maintenance of good water quality in the pit lake for discharge.	Water treatment	WQ is of unacceptable quality for discharge. There is a WQ standard for the lake.	No	Low	WQ behaviour of the pit lakes is unknown.	
	Maintenance of good surface water quality in the lake for landuses.	Installation of water treatment plant.	WQ is of unacceptable quality.	No	Low	WQ requirements of various landuses.	
	Design of surface water management facilities around the pit which drain away from pit.	Construction of horizontal drains and collection system with pumping. Bunding for SW.	Control only required if WQ unsuitable for pit lake. Combination of gravity fed and active system.	No	Nil	Uncertainty regarding WQ objectives for the pit lake	
	Bunding around pit and running pit with freeboard.	Bunding	The lake is running at a level which has a risk of overtopping.	No	Low	Lake water level	
	Management of excess water between available storage areas i.e. other pits.	Establishment and maintain existing distribution system between the pits.	Existing distribution system is adequate.	No	High	Uncertainty regarding purpose and use of lakes during flood events.	
	Appropriate allocations maintained for SW during pit filling.	Regional regulation of SW allocations in accordance with pit lake requirements.	There is a regional framework for SW allocation. There is controlled management and transfer of allocations to future land users and owners.	Yes	High	Recharge demands and impacts on SW use outside of mines needs to be understood.	
	Appropriate allocations maintained for SW post pit filling.	Regional regulation of SW allocations in accordance with pit lake requirements.	There is a regional framework for SW allocation. There is controlled management and transfer of allocations to future land users and owners.	No	High	Recharge demands and impacts on SW use outside of mines needs to be understood.	
	Ensure that fundamental design parameters involving other water elements are robust enough to cope with variability/ changes.	Base initial designs on climate change prediction data (allow for future ppt and evap demand)	Other primary controls are dependent upon water availability and balance.	No	High	Regional climate change prediction dataset.	Agreement of base case for climate change prediction data.

	Minimise the area that is lost to the surrounding catchments, i.e. external areas surrounding pit reshaped rehabbed, to minimise lake catchment. Create a controlled system.	Reshaping and establishment of drainage, in the buffer zone and lease area.	Achievement of upper batter slope gradients to meet stability criteria.	No	Low	Further research is needed to understand what safe and stable means in terms of geology, gw, geotech etc.	Understand the variability of the FoS for different batters. What is an appropriate long term FoS/ stability for the landform.
	Import material for reshaping	Additional overburden sourcing	Additional materials can be accessed from ex-pit overburden storage areas (i.e. locally sourced)	No	Low		
Biodiversity	Revegetation planning commensurate with final landuse and stability/ GW requirements.	Revegetation	The biodiversity outcomes for the region are understood and are achievable in the buffer zones.	Yes	Nil	The final landuse is unknown.	
	Consider using natural soil improvement agents to improve the soil microbial condition and nutrient load	Soil treatment	Topsoil or alternative growth media insufficient or of poor quality.	No	Nil	The final landuse is unknown.	
Fire risk	Coal face must be covered or capped to prevent exposure	Overburden placement Those below final water table should be stabilised and covered for duration of pit filling. Layer compacted with low perm material to prevent aeration (spontaneous combustion)	Use 2ms for fire cover	No	Nil	More research into cover would be beneficial	
	Programmed maintenance of the cover/ capping, including: monitoring, top up of the cover.	Cover maintenance	Cover will require ongoing maintenance to maintain its integrity.	No	Nil	More research into cover would be beneficial	
	Use of shallow rooted species for vegetation to prevent breach of the cover.	Lake edge revegetation	The interaction between vegetation landuse and stability can be achieved.	No	Nil	Risk of subterranean fire unknown.	
	Erosion prevention to avoid cover breach.	Design of a shallower slope and use of erosion prevention measures. Battering of coal slope prior to placement of cover to achieve consistent (minimum) level of cover.	Erosion control is suitable for the long term and able to deal with a number of erosion events.	No	Nil		
	Control activities e.g. vehicle use in areas where there are coal seams or public access to rehabbed (high risk) areas	Buffer zone establishment	Compatible with proposed final landuse. Cover control has been applied.	Yes	Nil	Final landuse unknown.	
	Include (and maintain) fire breaks in revegetation design	Fire breaks	Control applied to exposed/ covered batters only.	No	Nil	Final landuse unknown.	
	Cover with water (i.e. fill lake to maximum extent)	Aquifer repressurisation Surface water injection	There is an adequate and suitable water supply. This is an alternative control to cover if feasible.	No	Moderate	Current knowledge would indicate that this is not possible, however further work is required to confirm.	

	Maintenance of water level using controlled surface water addition	Surface water addition	SW is available.	No	Moderate		
Statutory	Establish baseline statutory requirements.	Prepare a Regulatory impact statement.	Current legislation will change over the short to medium term.	No	Nil		
	Zoning - planning or environmental, which enables the final landform to be created as envisaged (exemption or approval?)	Land re-zoning	Current legislation causes heavy burden on landform design, or is inconsistent with the landform	No	Nil		
Future beneficial land use	Regular and transparent engagement with the community in regards to landform.	Community engagement	Change in community values and expectations.	Yes	Nil		
	Establishment of regional body to oversee rehabilitation activities across the LaTrobe Valley.	Regional committee establishment and review of potential landuses	Committee established at a Government level.	No	Moderate		

Appendix F2 - Yallourn comparsion with current Work Plan - Partial Backfill Below the Water Table

Risk Issue	Design Control (secondary control in blue)	Activity	Assumptions	Work Plan Currency	Impact/ dependence on other mines	Information gaps	Further action for consideration
Landform Stability (Collapse)	Placement of overburden (mine waste material), interseam materials and fill over batters to contribute to weight balance.	Overburden (mine waste material) placement. Differential backfilling across floor and batters to create multi-level in-pit landform with some AWT and some BWT areas such that AWT batters are sloped as shallow as possible	Overburden and interseam materials will be placed directly in pit as soon as operations allow Ex-pit OB dumps and ex-pit overheight materials will not be required to achieve weight balance Weight requirements will vary across batters based on specific geology and risk Placement of available OB material on floor and betters is sufficient to achieve weight balance in short and medium term Overlying water provides residual weight balance Quality control of fill placement and slope construction within specified tolerance limits.	Yes	Nil	Weight balance not currently fully understood with respect to fill/water correlations. Tolerance limits for construction of cover not fully understood Need to understand what the required long term FoS is for weight balance.	Site specific studies required to investigate and understand weight balance requirements with respect to overburden placement and filling Work plan requirement to include detailed basis of design for individual batters
	Controlled repressurisation of the aquifer to achieve weight balance	Sequential cessation of dewatering	The rate at which you allow the aquifers to repressurise is dependent upon the rate at which the lake fills. Conservative management of water during transition state to minimise impact on the batters.	Yes	High	Weight balance not currently fully understood with respect to fill/water consideration and impacts from other sites.	
	Design and construction of slopes to suitable gradient	Reshaping of selected batters for a safe and stable outcome. Use of buffer zone material to achieve shallower slopes on upper overburden and coal batters	Covering the batters for fire control will be done as a concurrent activity. Final batter angle will be dependent upon the requirement for cover to manage fire risk. Increase FoS, especially near rivers, townships and other infrastructure.	No	Low	Further research to better understand what safe and stable means in terms of geology, gw, geotech etc.	Understand the variability of the FoS for different batters. What is an appropriate long term FoS/ stability for the landform.
	Water management (water addition) to achieve weight balance.	Surface water injection from flooding (i.e. diverting flood waters) Surface water injection from water entitlement (i.e. neighbouring rivers, power station) Water injection from dewatering.	Licences and approvals are available. Will require on going top up/ maintenance of water level in the long term. Conservative management of water during transition state to minimise impact on the batters. Water level maintained above / or below the toe of batter.	Yes	Moderate	Final long term water balance unknown. Water volume required unknown. Weight balance not currently fully understood with respect to fill/water consideration and impacts from other sites.	Discussion with community to understand their expectations of the landform - i.e. decide how fast the lake should be filled. Understand and optimise water availability across the mines.
	Buttressing of selected high risk batters prior to pit filling.	Buttressing selected batters to maintain safe and stable landform.	e.g. township and Maryvale coalfield batters.	Yes	Nil		Geotech risk assessment of batter stability,

	Installation of pressure relief wells / horizontal drains in high risk areas of pit cut back	Pressure relief wells	Gravity fed drainage of batters. In particular the upper batters. Drain into the lake.	Partial - no long term plan for drains	Nil	We don't know how long the drains will last, and the WQ discharging.	Developing a standardised approach for dealing with drains. Could be established across all 3 mines.
	Source additional overburden, interseam and fill materials off site from other mite sites	Additional overburden sourcing	Not required for pit lake option at Yallourn.	No	Yes		
	Design of drainage diversion and control on above water level batters	Construction of levees and Drainage diversion to specific ARI.	There will be some level of event which cannot be contained, and will enter the pit at somepoint.	Yes	Nil	Extent to which pits may be used for flood control needs to be understood.	
	Infiltration control.	Low perm materials placed on uppermost surface batters to avoid water entering.	Compatible with proposed final landuse. Controlled drainage to and away from the pit is achieved.	Yes	Nil	Long term maintenance of cover (100 yrs.+) has not been investigated.	
Groundwater	Diversion of the shallow GW or SW prior to entering the pit, and treatment of it.	Construction of horizontal drains and collection system with pumping. Bunding for SW.	Control only required if WQ unsuitable for pit lake. Combination of gravity fed and active system.	No	Nil	Uncertainty regarding WQ objectives for the pit lake	
	Treatment of water either prior to entering pit, or acidic water.	Water treatment to required standard for either offsite discharge or onsite retention.	WQ is of unacceptable quality.	No	Nil	Uncertainty regarding WQ objectives for the pit lake	
	Maintain appropriate salinity for end landuse.	Install and maintain pumping system to control salinity.	Top up of lake level will be required to maintain weight balance. Create a flow through, or increase mixing rate. Could discharge hypersaline water offshore.	No	Nil	Salt balance unknown for pit lake.	Develop WQ model or framework for pit lake.
	Treatment of the pit lake water or restore and maintain appropriate WQ	Installation of water treatment plant.	WQ is of unacceptable quality.	No	Low	WQ requirements of various landuses.	
	Regulate and limit landuse adjacent to the pit, i.e. nothing that may introduce critical contaminants.	Buffer zone establishment	Compatible with proposed final landuse.	Yes	Low	Final landuse unknown.	
	Appropriate allocations maintained for GW during pit filling.	Regional regulation of GW allocations in accordance with pit lake requirements.	There is a regional framework for GW allocation. There is controlled management and transfer of allocations to future land users and owners	Yes	High	Recharge demands and impacts on GW use outside of mines needs to be understood. (e.g. Oil and Gas)	
	Appropriate allocations maintained for GW post pit filling.	Regional regulation of GW allocations in accordance with pit lake requirements.	There is a regional framework for GW allocation. There is controlled management and transfer of allocations to future land users and owners	No	High	Recharge demands and impacts on GW use outside of mines needs to be understood. (e.g. Oil and Gas)	
	Ensure that fundamental design parameters involving other water elements are robust enough to cope with variability/ changes.	Base initial designs on climate change prediction data (allow for future ppt and evap demand)	Other primary controls are dependent upon water availability and balance.	No	High	Regional climate change prediction dataset.	Agreement of base case for climate change prediction data.
Surface Water	Maintenance of good water quality in the pit lake for discharge.	Water treatment	WQ is of unacceptable quality for discharge.	No	Low	WQ behaviour of the pit lakes is unknown.	
	Maintenance of good surface water quality in the lake for landuses.	Installation of water treatment plant.	WQ is of unacceptable quality.	No	Low	WQ requirements of various landuses.	
	Design of surface water management facilities around the pit which drain away from pit.	Construction of horizontal drains and collection system with pumping. Bunding for SW.	Control only required if WQ unsuitable for pit lake. Combination of gravity fed and active	No	Nil	Uncertainty regarding WQ objectives for the pit lake	
	Bunding around pit and running pit with freeboard.	Bunding	The lake is running at a level which has a risk of overtopping.	No	Low	Lake water level	
	Management of excess water between available storage areas i.e. other pits.	Establishment and maintain existing distribution system between the pits.	Existing distribution system is adequate.	No	High	Uncertainty regarding purpose and use of lakes during flood events.	

	Appropriate allocations maintained for SW during pit filling.	Regional regulation of SW allocations in accordance with pit lake requirements.	There is a regional framework for SW allocation. There is controlled management and transfer of allocations to future land users	Yes	High	Recharge demands and impacts on SW use outside of mines needs to be understood.	
	Appropriate allocations maintained for SW post pit filling.	Regional regulation of SW allocations in accordance with pit lake requirements.	There is a regional framework for SW allocation. There is controlled management and transfer of allocations to future land users and owners.	No	High	Recharge demands and impacts on SW use outside of mines needs to be understood.	
	Ensure that fundamental design parameters involving other water elements are robust enough to cope with variability/ changes.	Base initial designs on climate change prediction data (allow for future ppt and evap demand)	Other primary controls are dependent upon water availability and balance.	No	High	Regional climate change prediction dataset.	Agreement of base case for climate change prediction data.
	Minimise the area that is lost to the surrounding catchments, i.e. external areas surrounding pit reshaped rehabbed, to minimise lake catchment. Create a controlled system.	Reshaping and establishment of drainage, in the buffer zone and lease area.	Achievement of upper batter slope gradients to meet stability criteria.	No	Low	Further research is needed to understand what safe and stable means in terms of geology, gw, geotech etc.	Understand the variability of the FoS for different batters. What is an appropriate long term FoS/ stability for the landform.
	Import material for reshaping	Additional overburden sourcing	Additional materials can be accessed from ex-pit overburden storage areas (i.e. locally sourced)	No	Low		
Biodiversity	Revegetation planning commensurate with final landuse and stability/ GW requirements.	Revegetation	The biodiversity outcomes for the region are understood and are achievable in the buffer zones.	Yes	Nil	The final landuse is unknown.	
	Consider using natural soil improvement agents to improve the soil microbial condition and nutrient load	Soil treatment	Topsoil or alternative growth media insufficient or of poor quality.	No	Nil	The final landuse is unknown.	
Fire risk	Coal face must be covered or capped to prevent exposure	Overburden placement Those below final water table should be stabilised and covered for duration of pit filling. Layer compacted with low perm material to prevent aeration (spontaneous combustion)	2ms of cover	No	Nil	Depth of cover would benefit from further research	
	Programmed maintenance of the cover/ capping, including: monitoring, top up of the cover.	Cover maintenance	Cover will require ongoing maintenance to maintain its integrity.	No	Nil	Depth of cover would benefit from further research	
	Use of shallow rooted species for vegetation to prevent breach of the cover.	Lake edge revegetation	The interaction between vegetation landuse and stability can be achieved.	No	Nil	Risk of subterranean fire unknown.	
	Erosion prevention to avoid cover breach.	Design of a shallower slope and use of erosion prevention measures. Battering of coal slope prior to placement of cover to achieve consistent (minimum) level of cover.	Erosion control is suitable for the long term and able to deal with a number of erosion events.	No	Nil		
	Control activities e.g. vehicle use in areas where there are coal seams or public access to rehabbed (high risk) areas	Buffer zone establishment	Compatible with proposed final landuse. Cover control has been applied.	Yes	Nil	Final landuse unknown.	
	Include (and maintain) fire breaks in revegetation design	Fire breaks	Control applied to exposed/ covered batters only.	No	Nil	Final landuse unknown.	
	Cover with water (i.e. fill lake to maximum extent)	Aquifer repressurisation Surface water injection	There is an adequate and suitable water supply. This is an alternative control to cover if feasible.	No	Moderate	Current knowledge would indicate that this is not possible, however further work is required to confirm.	
	Fill pit faster with surface water addition	Surface water addition		No	Moderate		

	Maintenance of water level using controlled surface water addition	Surface water addition	SW is available.	No	Moderate		
Statutory	Establish baseline statutory requirements.	Prepare a Regulatory impact statement.	Current legislation will change over the short to medium term.	No	Nil		
	Zoning - planning or environmental, which enables the final landform to be created as envisaged (exemption or approval?)	Land re-zoning	Current legislation causes heavy burden on landform design, or is inconsistent with the landform	No	Nil		
Future beneficial land use	Regular and transparent engagement with the community in regards to landform.	Community engagement	Change in community values and expectations.	Yes	Nil		
	Establishment of regional body to oversee rehabilitation activities across the LaTrobe Valley.	Regional committee establishment and review of potential landuses	Committee established at a Government level.	No	Moderate		

Appendix F3 – Hazelwood comparison with current Work Plan Pit Lake

Risk Issue	Design Control (secondary control activities in blue)	Activity	Assumptions	Does Design Control Exist in current Work Plan?	Impact/ dependence on other mines	Information Gaps	Consideration for future action
Landform Stability (Collapse)	Placement of overburden (mine waste material), interseam materials and fill over batters to contribute to weight balance.	Overburden (mine waste material) placement. Utilizing available mine waste material, which will be spread as uniformly as practical and as low as possible across the pit floor. Can only be implemented once mine has reached depth.	Overburden and interseam materials will be placed directly in pit as soon as operations allow Ex-pit OB dumps and ex-pit overheight materials will not be required to achieve weight balance Weight requirements will vary across batters based on specific geology and risk Placement of available of OB material on floor and batters is sufficient to achieve weight balance in short and medium term Overlying water provides residual weight balance Quality control of fill placement and slope construction within specified tolerance limits.	Yes	Nil	Weight balance not currently fully understood with respect to fill/water correlations. Tolerance limits for construction of cover not fully understood Need to understand what the required long term FoS is for weight balance.	Site specific studies required to investigate and understand weight balance requirements with respect to overburden placement and filling Work plan requirement to include detailed basis of design for individual batters
	Controlled repressurisation of the aquifer to achieve weight balance	Sequential cessation of dewatering	The rate at which you allow the aquifers to repressurise is dependent upon the rate at which the lake fills. Conservative management of water during transition state to minimise impact on the batters.	Yes	High	Weight balance not currently fully understood with respect to fill/water consideration and impacts from other sites.	
	Design and construction of slopes to suitable gradient	Reshaping of selected batters for a safe and stable outcome.	Covering the batters for fire control will be done as a concurrent activity. Final batter angle will be dependent upon the requirement for cover to manage fire risk. Increase FoS, especially near rivers, townships and other infrastructure.	No	Low	We need to understand what safe and stable means in terms of geology, gw, geotech etc.	Understand the variability of the FoS for different batters. What is an appropriate long term FoS/ stability for the landform.
	Water management (water addition) to achieve weight balance.	Surface water injection from flooding (i.e. diverting flood waters) Surface water injection from water entitlement (i.e. neighbouring rivers, power station) Water injection from dewatering.	Licences and approvals are available. Will require on going top up/ maintenance of water level in the long term. Conservative management of water during transition state to minimise impact on the batters. Water level maintained above / or below the toe of batter. Deep pit lake highly unlikely.	Yes	Moderate	Final long term water balance unknown. Water volume required unknown. Weight balance not currently fully understood with respect to fill/water consideration and impacts from other sites.	Discussion with community to understand their expectations of the landform - i.e. decide how fast the lake should be filled. Understand and optimise water availability across the mines.

	Buttressing of selected high risk batters prior to pit filling.	Buttressing selected batters to maintain safe and stable landform.	Not aware of any issues onsite.	Yes	Nil		Geotech risk assessment of batter stability,
	Installation of pressure relief wells / horizontal drains in high risk areas of pit cut back	Pressure relief wells	Gravity fed drainage of batters. In particular the upper batters. Drain into the lake.	Partial - no long term plan for drains	Nil	We don't know how long the drains will last, and the WQ discharging.	Developing a standardised approach for dealing with drains. Could be established across all 3 mines.
	Source additional overburden, interseam and fill materials off site from other mite sites	Additional overburden sourcing	Not required for pit lake option at Hazelwood	No	Yes		
	Design of drainage diversion and control on above water level batters	Construction of levees and Drainage diversion to specific ARI.	There will be some level of event which cannot be contained, and will enter the pit at some point. Diverted into natural systems and away from pits.	Yes	Nil	Extent to which pits may be used for flood control needs to be understood.	
	Infiltration control.	Low perm materials placed on uppermost surface batters to avoid water entering.	Compatible with proposed final landuse. Controlled drainage to and away from the pit is achieved.	Yes	Nil	Long term maintenance of cover (100 yrs.+) has not been investigated.	
Groundwater	Diversion of the shallow GW or SW prior to entering the pit, and treatment of it.	Construction of horizontal drains and collection system with pumping. Bunding for SW.	Control only required if WQ unsuitable for pit lake. Combination of gravity fed and active system.	No	Nil	Uncertainty regarding WQ objectives for the pit lake	
	Treatment of water either prior to entering pit, or acidic water.	Water treatment to required standard for either offsite discharge or onsite retention.	WQ is of unacceptable quality.	No	Nil	Uncertainty regarding WQ objectives for the pit lake	
	Maintain appropriate salinity for end landuse.	Install and maintain pumping system to control salinity.	Top up of lake level will be required to maintain weight balance. Create a flow through, or increase mixing rate. Could discharge hypersaline water offshore. Deep lake would be formed.	No	Nil	Salt balance unknown for pit lake.	Develop WQ model or framework for pit lake.
	Treatment of the pit lake water or restore and maintain appropriate WQ	Installation of water treatment plant.	WQ is of unacceptable quality.	No	Low	WQ requirements of various landuses.	
	Regulate and limit landuse adjacent to the pit, i.e. nothing that may introduce critical contaminants.	Buffer zone establishment	Compatible with proposed final landuse.	Yes	Low	Final landuse unknown.	
	Appropriate allocations maintained for GW during pit filling.	Regional regulation of GW allocations in accordance with pit lake requirements.	There is a regional framework for GW allocation. There is controlled management and transfer of allocations to future land users and owners.	Yes	High	Recharge demands and impacts on GW use outside of mines needs to be understood. (e.g. Oil and Gas)	
	Appropriate allocations maintained for GW post pit filling.	Regional regulation of GW allocations in accordance with pit lake requirements.	There is a regional framework for GW allocation. There is controlled management and transfer of allocations to future land users and owners.	No	High	Recharge demands and impacts on GW use outside of mines needs to be understood. (e.g. Oil and Gas)	

	Ensure that fundamental design parameters involving other water elements are robust enough to cope with variability/ changes.	Base initial designs on climate change prediction data (allow for future ppt and evap demand)	Other primary controls are dependent upon water availability and balance.	No	High	Regional climate change prediction dataset.	Agreement of base case for climate change prediction data.
Surface Water	Maintenance of good water quality in the pit lake for discharge.	Water treatment	WQ is of unacceptable quality for discharge. There is a WQ standard for the lake.	No	Low	WQ behaviour of the pit lakes is unknown.	
	Maintenance of good surface water quality in the lake for landuses.	Installation of water treatment plant.	WQ is of unacceptable quality.	No	Low	WQ requirements of various landuses.	
	Design of surface water management facilities around the pit which drain away from pit.	Construction of horizontal drains and collection system with pumping. Bunding for SW.	Control only required if WQ unsuitable for pit lake. Combination of gravity fed and active system.	No	Nil	Uncertainty regarding WQ objectives for the pit lake	
	Bunding around pit and running pit with freeboard.	Bunding	The lake is running at a level which has a risk of overtopping.	No	Low	Lake water level	
	Management of excess water between available storage areas i.e. other pits.	Establishment and maintain existing distribution system between the pits.	Existing distribution system is adequate.	No	High	Uncertainty regarding purpose and use of lakes during flood events.	
	Appropriate allocations maintained for SW during pit filling.	Regional regulation of SW allocations in accordance with pit lake requirements.	There is a regional framework for SW allocation. There is controlled management and transfer of allocations to future land users and owners.	Yes	High	Recharge demands and impacts on SW use outside of mines needs to be understood.	
	Appropriate allocations maintained for SW post pit filling.	Regional regulation of SW allocations in accordance with pit lake requirements.	There is a regional framework for SW allocation. There is controlled management and transfer of allocations to future land users and owners. Hazelwood will require make-up water allocations.	No	High	Recharge demands and impacts on SW use outside of mines needs to be understood.	
	Ensure that fundamental design parameters involving other water elements are robust enough to cope with variability/ changes.	Base initial designs on climate change prediction data (allow for future ppt and evap demand)	Other primary controls are dependent upon water availability and balance.	No	High	Regional climate change prediction dataset.	Agreement of base case for climate change prediction data.
	Minimise the area that is lost to the surrounding catchments, i.e. external areas surrounding pit reshaped rehabbed, to minimise lake catchment. Create a controlled system.	Reshaping and establishment of drainage, in the buffer zone and lease area.	Achievement of upper batter slope gradients to meet stability criteria.	No	Low		Understand the variability of the FoS for different batters. What is an appropriate long term FoS/ stability for the landform.
	Import material for reshaping	Additional overburden sourcing	Additional materials can be accessed from ex-pit overburden storage areas (i.e. locally sourced)	No	Low		
Biodiversity	Revegetation planning commensurate with final landuse and stability/ GW requirements.	Revegetation	The biodiversity outcomes for the region are understood and are achievable in the buffer zones.	Yes	Nil	The final landuse is unknown.	
	Consider using natural soil improvement agents to improve the soil microbial condition and nutrient load	Soil treatment	Topsoil or alternative growth media insufficient or of poor quality.	No	Nil	The final landuse is unknown.	

Fire risk	Coal face must be covered or capped to prevent exposure	Overburden placement Those below final water table should be stabilised and covered for duration of pit filling. Layer compacted with low perm material to prevent aeration (spontaneous combustion)	Atleast minimum of 2 ms covered	No	Nil	Depth of cover benefit from further research	
	Programmed maintenance of the cover/ capping, including: monitoring, top up of the cover.	Cover maintenance	Cover will require ongoing maintenance to maintain its integrity.	No	Nil	Depth of cover benefit from further research	
	Use of shallow rooted species for vegetation to prevent breach of the cover.	Lake edge revegetation	The interaction between vegetation landuse and stability can be achieved.	No	Nil	Risk of subterranean fire unknown.	
	Erosion prevention to avoid cover breach.	Design of a shallower slope and use of erosion prevention measures. Battering of coal slope prior to placement of cover to achieve consistent (minimum) level of cover.	Erosion control is suitable for the long term and able to deal with a number of erosion events.	No	Nil		
	Control activities e.g. vehicle use in areas where there are coal seams or public access to rehabbed (high risk) areas	Buffer zone establishment	Compatible with proposed final landuse. Cover control has been applied.	Yes	Nil	Final landuse unknown.	
	Include (and maintain) fire breaks in revegetation design	Fire breaks	Control applied to exposed/ covered batters only.	No	Nil	Final landuse unknown.	
	Cover with water (i.e. fill lake to maximum extent)	Aquifer repressurisation Surface water injection	There is an adequate and suitable water supply. This is an alternative control to cover if feasible.	No	Moderate	Current knowledge would indicate that this is not possible, however further work is required to confirm.	
	Maintenance of water level using controlled surface water addition	Surface water addition	SW is available.	No	Moderate		
Statutory	Establish baseline statutory requirements.	Prepare a Regulatory impact statement.	Current legislation will change over the short to medium term.	No	Nil		
	Zoning - planning or environmental, which enables the final landform to be created as envisaged (exemption or approval?)	Land re-zoning	Current legislation causes heavy burden on landform design, or is inconsistent with the landform	No	Nil		
Future beneficial land use	Regular and transparent engagement with the community in regards to landform.	Community engagement	Change in community values and expectations.	Yes	Nil		
	Establishment of regional body to oversee rehabilitation activities across the LaTrobe Valley.	Regional committee establishment and review of potential landuses	Committee established at a Government level.	No	Moderate		

Appendix F4 – Hazelwood comparison with current Work Plan Partial Backfill Below the Water Table

Risk Issue	Design Control (secondary control in blue)	Activity	Assumptions	Work Plan Currency	Impact/ dependence on other mines	Information gaps	Consideration for further action
Landform Stability (Collapse)	Placement of overburden (mine waste material), interseam materials and fill over batters to contribute to weight balance.	Overburden (mine waste material) placement. Differential backfilling across floor and batters to create multi-level in-pit landform with some AWT and some BWT areas such that AWT batters are sloped as shallow as possible	Overburden and interseam materials will be placed directly in pit as soon as operations allow Ex-pit OB dumps and ex-pit overheight materials will not be required to achieve weight balance Weight requirements will vary across batters based on specific geology and risk Placement of available OB material on floor and batters is sufficient to achieve weight balance in short and medium term Overlying water provides residual weight balance Quality control of fill placement and slope construction within specified tolerance limits. There is enough room and material to successfully secure the northern batters.	Yes	Nil	Weight balance not currently fully understood with respect to fill/water correlations. Tolerance limits for construction of cover not fully understood Need to understand what the required long term FoS is for weight balance.	Site specific studies required to investigate and understand weight balance requirements with respect to overburden placement and filling Work plan requirement to include detailed basis of design for individual batters
	Controlled repressurisation of the aquifer to achieve weight balance	Sequential cessation of dewatering	The rate at which you allow the aquifers to repressurise is dependent upon the rate at which the lake fills. Conservative management of water during transition state to minimise impact on the batters.	Yes	High	Weight balance not currently fully understood with respect to fill/water consideration and impacts from other sites.	
	Design and construction of slopes to suitable gradient	Reshaping of selected batters for a safe and stable outcome. Use of buffer zone material to achieve shallower slopes on upper overburden and coal batters	Covering the batters for fire control will be done as a concurrent activity. Final batter angle will be dependent upon the requirement for cover to manage fire risk. Increase FoS, especially near rivers, townships and other infrastructure.	No	Low	We need to understand what safe and stable means in terms of geology, gw, geotech etc.	Understand the variability of the FoS for different batters. What is an appropriate long term FoS/ stability for the landform.
	Water management (water addition) to achieve weight balance.	Surface water injection from flooding (i.e. diverting flood waters) Surface water injection from water entitlement (i.e. neighbouring rivers, power station) Water injection from dewatering.	Licences and approvals are available. Will require on going top up/ maintenance of water level in the long term. Conservative management of water during transition state to minimise impact on the batters. Water level maintained above / or below the toe of batter.	Yes	Moderate	Final long term water balance unknown. Water volume required unknown. Weight balance not currently fully understood with respect to fill/water consideration and impacts from other sites.	Discussion with community to understand their expectations of the landform - i.e. decide how fast the lake should be filled. Understand and optimise water availability across the mines.
	Buttressing of selected high risk batters prior to pit filling.	Buttressing selected batters to maintain safe and stable landform.	Further work is required on the northern batters.	No	Nil		Geotech risk assessment of batter stability,

	Installation of pressure relief wells / horizontal drains in high risk areas of pit cut back	Pressure relief wells	Gravity fed drainage of batters. In particular the upper batters. Drain into the lake.	Partial - no long term plan for drains	Nil	We don't know how long the drains will last, and the WQ discharging.	Developing a standardised approach for dealing with drains. Could be established across all 3 mines.
	Source additional overburden, interseam and fill materials off site from other mite sites	Additional overburden sourcing	Not required for pit lake option at Loy Yang.	No	Yes		
	Design of drainage diversion and control on above water level batters	Construction of levees and Drainage diversion to specific ARI.	There will be some level of event which cannot be contained, and will enter the pit at somepoint. Diverted into natural systems and away from pits.	Yes	Nil	Extent to which pits may be used for flood control needs to be understood.	
	Infiltration control.	Low perm materials placed on uppermost surface batters to avoid water entering.	Compatible with proposed final landuse. Controlled drainage to and away from the pit is achieved.	Yes	Nil	Long term maintenance of cover (100 yrs.+) has not been investigated.	
Groundwater	Diversion of the shallow GW or SW prior to entering the pit, and treatment of it.	Construction of horizontal drains and collection system with pumping. Bunding for SW.	Control only required if WQ unsuitable for pit lake. Combination of gravity fed and active system.	No	Nil	Uncertainty regarding WQ objectives for the pit lake	
	Treatment of water either prior to entering pit, or acidic water.	Water treatment to required standard for either offsite discharge or onsite retention.	WQ is of unacceptable quality.	No	Nil	Uncertainty regarding WQ objectives for the pit lake	
	Maintain appropriate salinity for end landuse.	Install and maintain pumping system to control salinity.	Top up of lake level will be required to maintain weight balance. Create a flow through, or increase mixing rate. Could discharge hypersaline water offshore.	No	Nil	Salt balance unknown for pit lake.	Develop WQ model or framework for pit lake.
	Treatment of the pit lake water or restore and maintain appropriate WQ	Installation of water treatment plant.	WQ is of unacceptable quality.	No	Low	WQ requirements of various landuses.	
	Regulate and limit landuse adjacent to the pit, i.e. nothing that may introduce critical contaminants.	Buffer zone establishment	Compatible with proposed final landuse.	Yes	Low	Final landuse unknown.	
	Appropriate allocations maintained for GW during pit filling.	Regional regulation of GW allocations in accordance with pit lake requirements.	There is a regional framework for GW allocation. There is controlled management and transfer of allocations to future land users and owners.	Yes	High	Recharge demands and impacts on GW use outside of mines needs to be understood. (e.g. Oil and Gas)	
	Appropriate allocations maintained for GW post pit filling.	Regional regulation of GW allocations in accordance with pit lake requirements.	There is a regional framework for GW allocation. There is controlled management and transfer of allocations to future land users and owners.	No	High	Recharge demands and impacts on GW use outside of mines needs to be understood. (e.g. Oil and Gas)	
	Ensure that fundamental design parameters involving other water elements are robust enough to cope with variability/ changes.	Base initial designs on climate change prediction data (allow for future ppt and evap demand)	Other primary controls are dependent upon water availability and balance.	No	High	Regional climate change prediction dataset.	Agreement of base case for climate change prediction data.
Surface Water	Maintenance of good water quality in the pit lake for discharge.	Water treatment	WQ is of unacceptable quality for discharge. There is a WQ standard for the lake.	No	Low	WQ behaviour of the pit lakes is unknown.	
	Maintenance of good surface water quality in the lake for landuses.	Installation of water treatment plant.	WQ is of unacceptable quality.	No	Low	WQ requirements of various landuses.	
	Design of surface water management facilities around the pit which drain away from pit.	Construction of horizontal drains and collection system with pumping. Bunding for SW.	Control only required if WQ unsuitable for pit lake. Combination of gravity fed and active system.	No	Nil	Uncertainty regarding WQ objectives for the pit lake	
	Bunding around pit and running pit with freeboard.	Bunding	The lake is running at a level which has a risk of overtopping.	No	Low	Lake water level	
	Management of excess water between available storage areas i.e. other pits.	Establishment and maintain existing distribution system between the pits.	Existing distribution system is adequate.	No	High	Uncertainty regarding purpose and use of lakes during flood events.	

	Appropriate allocations maintained for SW during pit filling.	Regional regulation of SW allocations in accordance with pit lake requirements.	There is a regional framework for SW allocation. There is controlled management and transfer of allocations to future land users and owners.	Yes	High	Recharge demands and impacts on SW use outside of mines needs to be understood.	
	Appropriate allocations maintained for SW post pit filling.	Regional regulation of SW allocations in accordance with pit lake requirements.	There is a regional framework for SW allocation. There is controlled management and transfer of allocations to future land users and owners.	No	High	Recharge demands and impacts on SW use outside of mines needs to be understood.	
	Ensure that fundamental design parameters involving other water elements are robust enough to cope with variability/ changes.	Base initial designs on climate change prediction data (allow for future ppt and evap demand)	Other primary controls are dependent upon water availability and balance.	No	High	Regional climate change prediction dataset.	Agreement of base case for climate change prediction data.
	Minimise the area that is lost to the surrounding catchments, i.e. external areas surrounding pit reshaped rehabbed, to minimise lake catchment. Create a controlled system.	Reshaping and establishment of drainage, in the buffer zone and lease area.	Achievement of upper batter slope gradients to meet stability criteria.	No	Low		Understand the variability of the FoS for different batters. What is an appropriate long term FoS/ stability for the landform.
	Import material for reshaping	Additional overburden sourcing	Additional materials can be accessed from ex-pit overburden storage areas (i.e. locally sourced)	No	Low		
Biodiversity	Revegetation planning commensurate with final landuse and stability/ GW requirements.	Revegetation	The biodiversity outcomes for the region are understood and are achievable in the buffer zones.	Yes	Nil	The final landuse is unknown.	
	Consider using natural soil improvement agents to improve the soil microbial condition and nutrient load	Soil treatment	Topsoil or alternative growth media insufficient or of poor quality.	No	Nil	The final landuse is unknown.	
Fire risk	Coal face must be covered or capped to prevent exposure	Overburden placement Those below final water table should be stabilised and covered for duration of pit filling. Layer compacted with low perm material to prevent aeration (spontaneous combustion)	Atleast minimum of 2ms of cover	No	Nil	Depth cover should be focus of further research	
	Programmed maintenance of the cover/ capping, including: monitoring, top up of the cover.	Cover maintenance	Cover will require ongoing maintenance to maintain its integrity.	No	Nil	Depth cover should be focus of further research	
	Use of shallow rooted species for vegetation to prevent breach of the cover.	Lake edge revegetation	The interaction between vegetation landuse and stability can be achieved.	No	Nil	Risk of subterranean fire unknown.	
	Erosion prevention to avoid cover breach.	Design of a shallower slope and use of erosion prevention measures. Battering of coal slope prior to placement of cover to achieve consistent (minimum) level of cover.	Erosion control is suitable for the long term and able to deal with a number of erosion events.	No	Nil		
	Control activities e.g. vehicle use in areas where there are coal seams or public access to rehabbed (high risk) areas	Buffer zone establishment	Compatible with proposed final landuse. Cover control has been applied.	Yes	Nil	Final landuse unknown.	
	Include (and maintain) fire breaks in revegetation design	Fire breaks	Control applied to exposed/ covered batters only.	No	Nil	Final landuse unknown.	
	Cover with water (i.e. fill lake to maximum extent)	Aquifer repressurisation Surface water injection	There is an adequate and suitable water supply. This is an alternative control to cover if feasible.	No	Moderate	Current knowledge would indicate that this is not possible, however further work is required to confirm.	
	Maintenance of water level using controlled surface water addition	Surface water addition	SW is available.	No	Moderate		
Statutory	Establish baseline statutory requirements.	Prepare a Regulatory impact statement.	Current legislation will change over the short to medium term.	No	Nil		
	Zoning - planning or environmental, which enables the final landform to be created as envisaged (exemption or approval?)	Land re-zoning	Current legislation causes heavy burden on landform design, or is inconsistent with the landform	No	Nil		
Future beneficial land use	Regular and transparent engagement with the community in regards to landform.	Community engagement	Change in community values and expectations.	Yes	Nil		
	Establishment of regional body to oversee rehabilitation activities across the LaTrobe Valley.	Regional committee establishment and review of potential landuses	Committee established at a Government level.	No	Moderate		

Appendix F5 – Loy Yang comparison with current Work Plan Pit Lake

Risk Issue	Design Control (secondary control activities in blue)	Activity	Assumptions	Is the design control in the current Work Plan?	Impact/ dependence on other mines	Information gaps	Consideration for further action
Landform Stability (Collapse)	Placement of overburden (mine waste material), interseam materials and fill over batters to contribute to weight balance.	Overburden (mine waste material) placement. Utilizing available mine waste material, which will be spread as uniformly as practical and as low as possible across the pit floor. Can only be implemented once mine has reached depth.	Overburden and interseam materials will be placed directly in pit as soon as operations allow Ex-pit OB dumps and ex-pit overheight materials will not be required to achieve weight balance Weight requirements will vary across batters based on specific geology and risk Placement of available OB material on floor and batters is sufficient to achieve weight balance in short and medium term Overlying water provides residual weight balance Quality control of fill placement and slope construction within specified tolerance limits.	Yes	Nil	Weight balance not currently fully understood with respect to fill/water correlations. Tolerance limits for construction of cover not fully understood Need to understand what the required long term FoS is for weight balance.	Site specific studies required to investigate and understand weight balance requirements with respect to overburden placement and filling Work plan requirement to include detailed basis of design for individual batters
	Controlled repressurisation of the aquifer to achieve weight balance	Sequential cessation of dewatering	The rate at which you allow the aquifers to repressurise is dependent upon the rate at which the lake fills. Conservative management of water during transition state to minimise impact on the batters.	Yes	High	Weight balance not currently fully understood with respect to fill/water consideration and impacts from other sites.	
	Design and construction of slopes to suitable gradient	Reshaping of selected batters for a safe and stable outcome.	Covering the batters for fire control will be done as a concurrent activity. Final batter angle will be dependent upon the requirement for cover to manage fire risk. Increase FoS, especially near rivers, townships and other infrastructure.	No	Low		Understand the variability of the FoS for different batters. What is an appropriate long term FoS/ stability for the landform.

	Water management (water addition) to achieve weight balance.	Surface water injection from flooding (i.e. diverting flood waters) Surface water injection from water entitlement (i.e. neighbouring rivers, power station) Water injection from dewatering.	Licences and approvals are available. Will require on going top up/ maintenance of water level in the long term. Conservative management of water during transition state to minimise impact on the batters. Water level maintained above / or below the toe of batter. Deep pit lake highly unlikely.	Yes	Moderate	Final long term water balance unknown. Water volume required unknown. Weight balance not currently fully understood with respect to fill/water consideration and impacts from other sites.	Discussion with community to understand their expectations of the landform - i.e. decide how fast the lake should be filled. Understand and optimise water availability across the mines.
	Buttressing of selected high risk batters prior to pit filling.	Buttressing selected batters to maintain safe and stable landform.	Not aware of any issues onsite.	Yes	Nil		Geotech risk assessment of batter stability,
	Installation of pressure relief wells / horizontal drains in high risk areas of pit cut back	Pressure relief wells	Gravity fed drainage of batters. In particular the upper batters. Drain into the lake.	Partial - no long term plan for drains	Nil	We don't know how long the drains will last, and the WQ discharging.	Developing a standardised approach for dealing with drains. Could be established across all 3 mines.
	Source additional overburden, interseam and fill materials off site from other mite sites	Additional overburden sourcing	Not required for pit lake option at Loy Yang.	No	Yes		
	Design of drainage diversion and control on above water level batters	Construction of levees and Drainage diversion to specific ARI.	There will be some level of event which cannot be contained, and will enter the pit at some point. Diverted into natural systems and away from pits.	Yes	Nil	Extent to which pits may be used for flood control needs to be understood.	
	Infiltration control.	Low perm materials placed on uppermost surface batters to avoid water entering.	Compatible with proposed final landuse. Controlled drainage to and away from the pit is achieved.	Yes	Nil	Long term maintenance of cover (100 yrs.+) has not been investigated.	
Groundwater	Diversion of the shallow GW or SW prior to entering the pit, and treatment of it.	Construction of horizontal drains and collection system with pumping. Bunding for SW.	Control only required if WQ unsuitable for pit lake. Combination of gravity fed and active system.	No	Nil	Uncertainty regarding WQ objectives for the pit lake	
	Treatment of water either prior to entering pit, or acidic water.	Water treatment to required standard for either offsite discharge or onsite retention.	WQ is of unacceptable quality.	No	Nil	Uncertainty regarding WQ objectives for the pit lake	
	Maintain appropriate salinity for end landuse.	Install and maintain pumping system to control salinity.	Top up of lake level will be required to maintain weight balance. Create a flow through, or increase mixing rate. Could discharge hypersaline water offshore. Deep lake would be formed.	No	Nil	Salt balance unknown for pit lake.	Develop WQ model or framework for pit lake.

	Treatment of the pit lake water or restore and maintain appropriate WQ	Installation of water treatment plant.	WQ is of unacceptable quality.	No	Low	WQ requirements of various landuses.	
	Regulate and limit landuse adjacent to the pit, i.e. nothing that may introduce critical contaminants.	Buffer zone establishment	Compatible with proposed final landuse.	Yes	Low	Final landuse unknown.	
	Appropriate allocations maintained for GW during pit filling.	Regional regulation of GW allocations in accordance with pit lake requirements.	There is a regional framework for GW allocation. There is controlled management and transfer of allocations to future land users and owners.	Yes	High	Recharge demands and impacts on GW use outside of mines needs to be understood. (e.g. Oil and Gas)	
	Appropriate allocations maintained for GW post pit filling.	Regional regulation of GW allocations in accordance with pit lake requirements.	There is a regional framework for GW allocation. There is controlled management and transfer of allocations to future land users and owners.	No	High	Recharge demands and impacts on GW use outside of mines needs to be understood. (e.g. Oil and Gas)	
	Ensure that fundamental design parameters involving other water elements are robust enough to cope with variability/ changes.	Base initial designs on climate change prediction data (allow for future ppt and evap demand)	Other primary controls are dependent upon water availability and balance.	No	High	Regional climate change prediction dataset.	Agreement of base case for climate change prediction data.
Surface Water	Maintenance of good water quality in the pit lake for discharge.	Water treatment	WQ is of unacceptable quality for discharge. There is a WQ standard for the lake.	No	Low	WQ behaviour of the pit lakes is unknown.	
	Maintenance of good surface water quality in the lake for landuses.	Installation of water treatment plant.	WQ is of unacceptable quality.	No	Low	WQ requirements of various landuses.	
	Design of surface water management facilities around the pit which drain away from pit.	Construction of horizontal drains and collection system with pumping. Bunding for SW.	Control only required if WQ unsuitable for pit lake. Combination of gravity fed and active system.	No	Nil	Uncertainty regarding WQ objectives for the pit lake	
	Bunding around pit and running pit with freeboard.		The lake is running at a level which has a risk of overtopping.	No	Low	Lake water level	
	Management of excess water between available storage areas i.e. other pits.	Establishment and maintain existing distribution system between the pits.	Existing distribution system is adequate.	No	High	Uncertainty regarding purpose and use of lakes during flood events.	
	Appropriate allocations maintained for SW during pit filling.	Regional regulation of SW allocations in accordance with pit lake requirements.	There is a regional framework for SW allocation. There is controlled management and transfer of allocations to future land users and owners.	Yes	High	Recharge demands and impacts on SW use outside of mines needs to be understood.	
	Appropriate allocations maintained for SW post pit filling.	Regional regulation of SW allocations in accordance with pit lake requirements.	There is a regional framework for SW allocation. There is controlled management and transfer of allocations to future land users and owners. Loy Yang will require make-up water allocations.	No	High	Recharge demands and impacts on SW use outside of mines needs to be understood.	

	Ensure that fundamental design parameters involving other water elements are robust enough to cope with variability/ changes.	Base initial designs on climate change prediction data (allow for future ppt and evap demand)	Other primary controls are dependent upon water availability and balance.	No	High	Regional climate change prediction dataset.	Agreement of base case for climate change prediction data.
	Minimise the area that is lost to the surrounding catchments, i.e. external areas surrounding pit reshaped rehabbed, to minimise lake catchment. Create a controlled system.	Reshaping and establishment of drainage, in the buffer zone and lease area.	Achievement of upper batter slope gradients to meet stability criteria.	No	Low	Better understand what safe and stable means in terms of geology, gw, geotech etc.	Understand the variability of the FoS for different batters. What is an appropriate long term FoS/ stability for the landform.
	Import material for reshaping	Additional overburden sourcing	Additional materials can be accessed from ex-pit overburden storage areas (i.e. locally sourced)	No	Low		
Biodiversity	Revegetation planning commensurate with final landuse and stability/ GW requirements.	Revegetation	The biodiversity outcomes for the region are understood and are achievable in the buffer zones.	Yes	Nil	The final landuse is unknown.	
	Consider using natural soil improvement agents to improve the soil microbial condition and nutrient load	Soil treatment	Topsoil or alternative growth media insufficient or of poor quality.	No	Nil	The final landuse is unknown.	
Fire risk	Coal face must be covered or capped to prevent exposure	Overburden placement Those below final water table should be stabilised and covered for duration of pit filling. Layer compacted with low perm material to prevent aeration (spontaneous combustion)	Use of 2ms needed	No	Nil	Depth of cover benefit from further research	
	Programmed maintenance of the cover/ capping, including: monitoring, top up of the cover.	Cover maintenance	Cover will require ongoing maintenance to maintain its integrity.	No	Nil	Depth of cover benefit from further research	
	Use of shallow rooted species for vegetation to prevent breach of the cover.	Lake edge revegetation	The interaction between vegetation landuse and stability can be achieved.	No	Nil	Risk of subterranean fire unknown.	
	Erosion prevention to avoid cover breach.	Design of a shallower slope and use of erosion prevention measures. Battering of coal slope prior to placement of cover to achieve consistent (minimum) level of cover.	Erosion control is suitable for the long term and able to deal with a number of erosion events.	No	Nil		
	Control activities e.g. vehicle use in areas where there are coal seams or public access to rehabbed (high risk) areas	Buffer zone establishment	Compatible with proposed final landuse. Cover control has been applied.	Yes	Nil	Final landuse unknown.	
	Include (and maintain) fire breaks in revegetation design	Fire breaks	Control applied to exposed/ covered batters only.	No	Nil	Final landuse unknown.	

	Cover with water (i.e. fill lake to maximum extent)	Aquifer repressurisation Surface water injection	There is an adequate and suitable water supply. This is an alternative control to cover if feasible.	No	Moderate	Current knowledge would indicate that this is not possible, however further work is required to confirm.	
	Maintenance of water level using controlled surface water addition	Surface water addition	SW is available.	No	Moderate		
Statutory	Establish baseline statutory requirements.	Prepare a Regulatory impact statement.	Current legislation will change over the short to medium term.	No	Nil		
	Zoning - planning or environmental, which enables the final landform to be created as envisaged (exemption or approval?)	Land re-zoning	Current legislation causes heavy burden on landform design, or is inconsistent with the landform	No	Nil		
Future beneficial land use	Regular and transparent engagement with the community in regards to landform.	Community engagement	Change in community values and expectations.	Yes	Nil		
	Establishment of regional body to oversee rehabilitation activities across the LaTrobe Valley.	Regional committee establishment and review of potential landuses	Committee established at a Government level.	No	Moderate		

Appendix F6 – Loy Yang comparison with current Work Plan Partial Backfill Below the Water Table

Risk Issue	Design Control (secondary control in blue)	Activity	Assumptions	Does the current work plan have the design controls?	Impact/ dependence on other mines	Information Gaps	Consideration for future action
Landform Stability (Collapse)	Placement of overburden (mine waste material), interseam materials and fill over batters to contribute to weight balance.	Overburden (mine waste material) placement. Differential backfilling across floor and batters to create multi-level in-pit landform with some AWT and some BWT areas such that AWT batters are sloped as shallow as possible	Overburden and interseam materials will be placed directly in pit as soon as operations allow Ex-pit OB dumps and ex-pit overheight materials will not be required to achieve weight balance Weight requirements will vary across batters based on specific geology and risk Placement of available OB material on floor and betters is sufficient to achieve weight balance in short and medium term Overlying water provides residual weight balance Quality control of fill placement and slope construction within specified tolerance limits.	Yes	Nil	Weight balance not currently fully understood with respect to fill/water correlations. Tolerance limits for construction of cover not fully understood Need to understand what the required long term FoS is for weight balance.	Site specific studies required to investigate and understand weight balance requirements with respect to overburden placement and filling Work plan requirement to include detailed basis of design for individual batters
	Controlled repressurisation of the aquifer to achieve weight balance	Sequential cessation of dewatering	The rate at which you allow the aquifers to repressurise is dependent upon the rate at which the lake fills. Conservative management of water during transition state to minimise impact on the batters.	Yes	High	Weight balance not currently fully understood with respect to fill/water consideration and impacts from other sites.	
	Design and construction of slopes to suitable gradient	Reshaping of selected batters for a safe and stable outcome. Use of buffer zone material to achieve shallower slopes on upper overburden and coal batters	Covering the batters for fire control will be done as a concurrent activity. Final batter angle will be dependent upon the requirement for cover to manage fire risk. Increase FoS, especially near rivers, townships and other infrastructure.	No	Low	More investigations needed to better understand what safe and stable means in terms of geology, gw, geotech etc.	Understand the variability of the FoS for different batters. What is an appropriate long term FoS/ stability for the landform.
	Water management (water addition) to achieve weight balance.	Surface water injection from flooding (i.e. diverting flood waters) Surface water injection from water entitlement (i.e. neighbouring rivers, power station) Water injection from dewatering.	Licences and approvals are available. Will require on going top up/ maintenance of water level in the long term. Conservative management of water during transition state to minimise impact on the batters. Water level maintained above / or below the toe of batter.	Yes	Moderate	Final long term water balance unknown. Water volume required unknown. Weight balance not currently fully understood with respect to fill/water consideration and impacts from other sites.	Discussion with community to understand their expectations of the landform - i.e. decide how fast the lake should be filled. Understand and optimise water availability across the mines.
	Buttressing of selected high risk batters prior to pit filling.	Buttressing selected batters to maintain safe and stable landform.		No	Nil		Geotech risk assessment of batter stability,
	Installation of pressure relief wells / horizontal drains in high risk areas of pit cut back	Pressure relief wells	Gravity fed drainage of batters. In particular the upper batters. Drain into the lake.	Partial - no long term plan for drains	Nil	We don't know how long the drains will last, and the WQ discharging.	Developing a standardised approach for dealing with drains. Could be established across all 3 mines.
	Source additional overburden, interseam and fill materials off site from other mite sites	Additional overburden sourcing	Not required for pit lake option at Loy Yang.	No	Yes		

	Design of drainage diversion and control on above water level batters	Construction of levees and Drainage diversion to specific ARI.	There will be some level of event which cannot be contained, and will enter the pit at somepoint.	Yes	Nil	Extent to which pits may be used for flood control needs to be understood.	
	Infiltration control.	Low perm materials placed on uppermost surface batters to avoid water entering.	Compatible with proposed final landuse. Controlled drainage to and away from the	Yes	Nil	Long term maintenance of cover (100 yrs.+) has not been investigated.	
Groundwater	Diversion of the shallow GW or SW prior to entering the pit, and treatment of it.	Construction of horizontal drains and collection system with pumping. Bunding for SW.	Control only required if WQ unsuitable for pit lake. Combination of gravity fed and active system.	No	Nil	Uncertainty regarding WQ objectives for the pit lake	
	Treatment of water either prior to entering pit, or acidic water.	Water treatment to required standard for either offsite discharge or onsite retention.	WQ is of unacceptable quality.	No	Nil	Uncertainty regarding WQ objectives for the pit lake	
	Maintain appropriate salinity for end landuse.	Install and maintain pumping system to control salinity.	Top up of lake level will be required to maintain weight balance. Create a flow through, or increase mixing rate. Could discharge hypersaline water offshore.	No	Nil	Salt balance unknown for pit lake.	Develop WQ model or framework for pit lake.
	Treatment of the pit lake water or restore and maintain appropriate WQ	Installation of water treatment plant.	WQ is of unacceptable quality.	No	Low	WQ requirements of various landuses.	
	Regulate and limit landuse adjacent to the pit, i.e. nothing that may introduce critical contaminants.	Buffer zone establishment	Compatible with proposed final landuse.	Yes	Low	Final landuse unknown.	
	Appropriate allocations maintained for GW during pit filling.	Regional regulation of GW allocations in accordance with pit lake requirements.	There is a regional framework for GW allocation.	Yes	High	Recharge demands and impacts on GW use outside of mines needs to be	
	Appropriate allocations maintained for GW post pit filling.	Regional regulation of GW allocations in accordance with pit lake requirements.	There is a regional framework for GW allocation.	No	High	Recharge demands and impacts on GW use outside	
	Ensure that fundamental design parameters involving other water elements are robust enough to cope with variability/ changes.	Base initial designs on climate change prediction data (allow for future ppt and evap demand)	Other primary controls are dependent upon water availability and balance.	No	High	Regional climate change prediction dataset.	Agreement of base case for climate change prediction data.
Surface Water	Maintenance of good water quality in the pit lake for discharge.	Water treatment	WQ is of unacceptable quality for discharge.	No	Low	WQ behaviour of the pit lakes is unknown.	
	Maintenance of good surface water quality in the lake for landuses.	Installation of water treatment plant.	WQ is of unacceptable quality.	No	Low	WQ requirements of various landuses.	
	Design of surface water management facilities around the pit which drain away from pit.	Construction of horizontal drains and collection system with pumping. Bunding for SW.	Control only required if WQ unsuitable for pit lake. Combination of gravity fed and active	No	Nil	Uncertainty regarding WQ objectives for the pit lake	
	Bunding around pit and running pit with freeboard.		The lake is running at a level which has a risk of overtopping.	No	Low	Lake water level	
	Management of excess water between available storage areas i.e. other pits.	Establishment and maintain existing distribution system between the pits.	Existing distribution system is adequate.	No	High	Uncertainty regarding purpose and use of lakes during flood events.	
	Appropriate allocations maintained for SW during pit filling.	Regional regulation of SW allocations in accordance with pit lake requirements.	There is a regional framework for SW allocation. There is controlled management and transfer of allocations to future land users and owners.	Yes	High	Recharge demands and impacts on SW use outside of mines needs to be understood.	
	Appropriate allocations maintained for SW post pit filling.	Regional regulation of SW allocations in accordance with pit lake requirements.	There is a regional framework for SW allocation. There is controlled management and transfer of allocations to future land users and owners.	No	High	Recharge demands and impacts on SW use outside of mines needs to be understood.	
	Ensure that fundamental design parameters involving other water elements are robust enough to cope with variability/ changes.	Base initial designs on climate change prediction data (allow for future ppt and evap demand)	Other primary controls are dependent upon water availability and balance.	No	High	Regional climate change prediction dataset.	Agreement of base case for climate change prediction data.
	Minimise the area that is lost to the surrounding catchments, i.e. external areas surrounding pit reshaped rehabbed, to minimise lake catchment. Create a controlled system.	Reshaping and establishment of drainage, in the buffer zone and lease area.	Achievement of upper batter slope gradients to meet stability criteria.	No	Low	We need to understand what safe and stable means in terms of geology, gw, geotech etc.	Understand the variability of the FoS for different batters. What is an appropriate long term FoS/ stability for the landform.

	Import material for reshaping	Additional overburden sourcing	Additional materials can be accessed from ex-pit overburden storage areas (i.e. locally sourced)	No	Low		
Biodiversity	Revegetation planning commensurate with final landuse and stability/ GW requirements.	Revegetation	The biodiversity outcomes for the region are understood and are achievable in the buffer zones.	Yes	Nil	The final landuse is unknown.	
	Consider using natural soil improvement agents to improve the soil microbial condition and nutrient load	Soil treatment	Topsoil or alternative growth media insufficient or of poor quality.	No	Nil	The final landuse is unknown.	
Fire risk	Coal face must be covered or capped to prevent exposure	Overburden placement Those below final water table should be stabilised and covered for duration of pit filling. Layer compacted with low perm material to prevent aeration (spontaneous combustion)	Use 2ms	No	Nil	Further research would beneficial	
	Programmed maintenance of the cover/ capping, including: monitoring, top up of the cover.	Cover maintenance	Cover will require ongoing maintenance to maintain its integrity.	No	Nil	Further research would beneficial	
	Use of shallow rooted species for vegetation to prevent breach of the cover.	Lake edge revegetation	The interaction between vegetation landuse and stability can be achieved.	No	Nil	Risk of subterranean fire unknown.	
	Erosion prevention to avoid cover breach.	Design of a shallower slope and use of erosion prevention measures. Battering of coal slope prior to placement of cover to achieve consistent (minimum) level of cover.	Erosion control is suitable for the long term and able to deal with a number of erosion events.	No	Nil		
	Control activities e.g. vehicle use in areas where there are coal seams or public access to rehabbed (high risk) areas	Buffer zone establishment	Compatible with proposed final landuse. Cover control has been applied.	Yes	Nil	Final landuse unknown.	
	Include (and maintain) fire breaks in revegetation design	Fire breaks	Control applied to exposed/ covered batters only.	No	Nil	Final landuse unknown.	
	Cover with water (i.e. fill lake to maximum extent)	Aquifer repressurisation Surface water injection	There is an adequate and suitable water supply. This is an alternative control to cover if feasible.	No	Moderate	Current knowledge would indicate that this is not possible, however further work is required to confirm.	
	Maintenance of water level using controlled surface water addition	Surface water addition	SW is available.	No	Moderate		
Statutory	Establish baseline statutory requirements.	Prepare a Regulatory impact statement.	Current legislation will change over the short to medium term.	No	Nil		
	Zoning - planning or environmental, which enables the final landform to be created as envisaged (exemption or approval?)	Land re-zoning	Current legislation causes heavy burden on landform design, or is inconsistent with the landform	No	Nil		
Future beneficial land use	Regular and transparent engagement with the community in regards to landform.	Community engagement	Change in community values and expectations.	Yes	Nil		
	Establishment of regional body to oversee rehabilitation activities across the LaTrobe Valley.	Regional committee establishment and review of potential landuses	Committee established at a Government level.	No	Moderate		