Tropicana Gold Project: Public Environmental Review

3. Proposal Justification and Alternatives Considered






INDEPENDENCE GROUP NL

360 environmental

3. PROPOSAL JUSTIFICATION AND ALTERNATIVES CONSIDERED

This chapter explains the rationale used by the Joint Venture, detailing constraints considered in the planning and design of the Project, provides Project justification including economic and social benefits, and details the alternatives considered.

3.1. RATIONALE OF THE JOINT VENTURE/ ETHOS OF PROPOSAL

The business principles and policies of each Joint Venture partner govern the environmental standards and philosophies adopted for the Tropicana Gold Project (the Project). These principles and policies combined with specific project commitments will ensure the Project achieves the designed level of environmental protection.

The Joint Venture has identified a series of design criteria for the Project that aim to establish a project for the future, these being:

- avoid all identified Indigenous heritage sites;
- avoid direct impacts to Declared Rare Flora;
- avoid impacts on Threatened and Priority Ecological Communities;
- minimise impacts to fauna protected under the State *Wildlife Conservation Act 1950* (WC Act) and Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- prevent wherever possible, impacts on Threatened and Priority Flora or listed fauna;
- avoid significant impacts on Priority Ecological Communities;
- design an energy and water efficient processing plant;
- optimise mining/ processing synergies that prevent or reduce rehandling;
- listen to, and incorporate stakeholder requirements into the Project;
- consider closure requirements during all design stages;
- limit the height of the waste landform to the maximum height of the surrounding environment;
- design waste landforms that blend into the natural environment;
- evaluate low carbon technology or equipment for inclusion in the Project;
- incorporate automation into processing plant and mining activities;
- design the infrastructure to cope with a 1:100 yr 72 hr rainfall event; and,
- ensure compliance with industry codes and recognised standards such as the International Cyanide Management Code, Australian Standards, Environmental Management System ISO14001 and Safety Management System OHSAS18001.

In the planning of the Project, the Joint Venture has put particular emphasis on minimising impacts on environmental constraints for the following reasons:

- Listed species or communities which are legally protected under State and Federal legislation (the WC Act and the EPBC Act respectively). Such as:
  - Threatened Ecological Communities (TECs);
  - Declared Rare Flora;
  - Threatened Fauna;
  - The protection of such species or communities under State or Federal Legislation subjects the assessment of a proposal to greater scrutiny;

- Species or communities recognised under the Department of Environment and Conservation (DEC) Priority scheme. If a species does not meet the criteria for listing as Threatened Fauna or Declared Rare Flora under the WC Act (e.g. due to lack of information) and is poorly known and/or conservation dependent, it may be classified as a Priority Species at the discretion of the DEC. Such as:
    - Priority Ecological Communities (PECs);
    - Priority Flora;
    - Priority Fauna Priority;
    - Priority species are not provided any extra protection to other native species in Western Australia. The listing of a species or a community as a Priority indicates that activities that may impact them are in need of special consideration.
- Other species that are new to science, or previously undescribed, or at the periphery of their known distribution, or have been identified as a range extension during the Joint Venture's surveys.

3.2. *Economic and Social Benefits*

Examining the construction phase and ongoing operation of the Project, Compelling Economics (Appendix 2-A4) assessed the potential economic and employment benefits of the Project to the Goldfields Region (defined by the combined boundaries of the Western Australian Local Government Areas (LGA) of Kalgoorlie-Boulder, Menzies, Coolgardie, Leonora and Laverton), Western Australia and Australia. The results of the analysis have been expressed in terms of direct and estimated indirect (flow-on) benefits for output, employment, wages and salaries and value-added. This economic benefits presented in this section are just one example of the potential benefits from the Project, the actual benefits will vary depending on the location of the majority of the labour-force.

The Joint Venture parent companies currently employ 372 people in the Goldfields Region. Of this workforce 60 people are engaged in exploration activities, 298 are in mining and a further 14 undertake administrative activities. AngloGold also has approximately 50 Perth based personnel. It is anticipated that the Project will boost employment in the Goldfields Region by a further 700 jobs during the construction phase and continue for a duration of 30 months and a further 407 direct ongoing jobs during the operation phase of the project.

Construction will start with approximately 100 people in 2010 and will peak in 2011 - 2012 at around 700 people. From the direct expansion in the economy under this scenario, flow-on industrial effects in terms of local purchases of goods and services are anticipated and it is estimated that these indirect benefits would result in the creation of a further 681 jobs. Therefore, for every 10 jobs created by the construction sector, a further nine to ten jobs could be generated in the broader community once the flow-on industrial effects are taken into consideration. In addition to this, if the workforce for construction is predominantly local (i.e. Goldfields), consumption related economic benefits are anticipated which are estimated to underpin the creation of a further 258 jobs. This resulted in a total estimate of approximately 1,640 positions being created in the Goldfields Region (Figure 3.1).

When considered in the context of the Western Australian economy, with its increased capacity to supply goods and services as inputs to production and service consumption demand, the increase in jobs as a result of the Project is greater. This results in a total estimate of approximately 2,322 jobs (Figure 3.2).

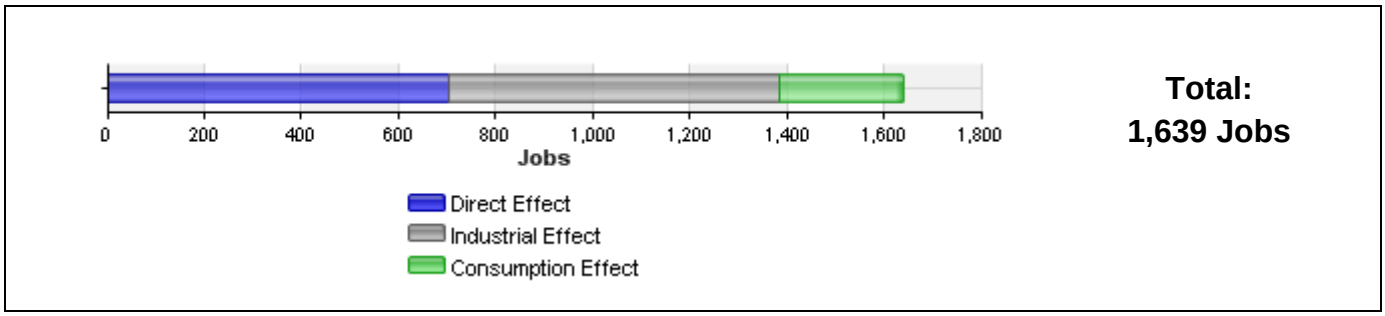

Figure 3.1: Construction Phase employment benefits, Goldfields Region.

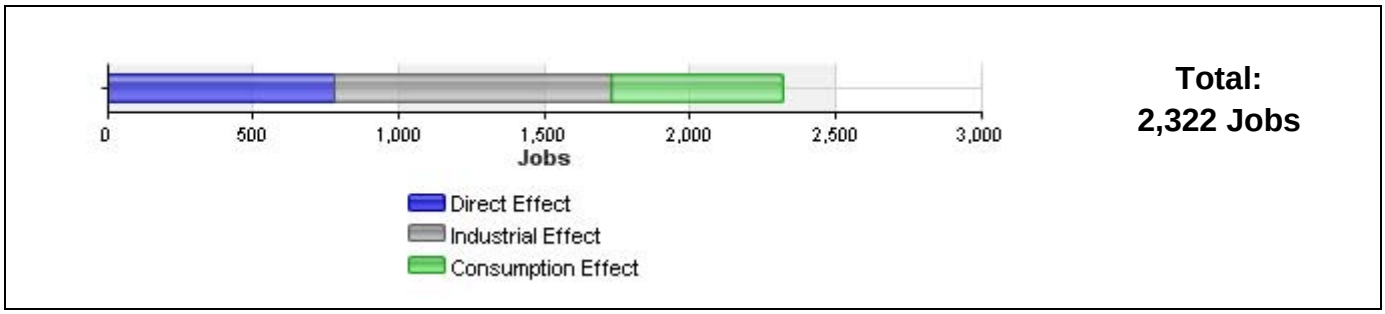

Figure 3.2: Construction Phase employment benefits, Western Australia.

Once the Project is at full production, it is anticipated to create up to 407 additional ongoing direct jobs in the Goldfields Region. Indirect benefit modelling indicates that for every 10 people directly employed by the Project up to a further seven jobs could be generated in the Goldfields Region. This equates to an estimate of 691 ongoing jobs during the operation phase of the Project (Figure 3.3). Further to the ongoing jobs created in the Goldfields Region, total employment benefits including all direct, industrial and consumption effects is estimated to increase employment in Western Australia by approximately 1,197 jobs (Figure 3.4).

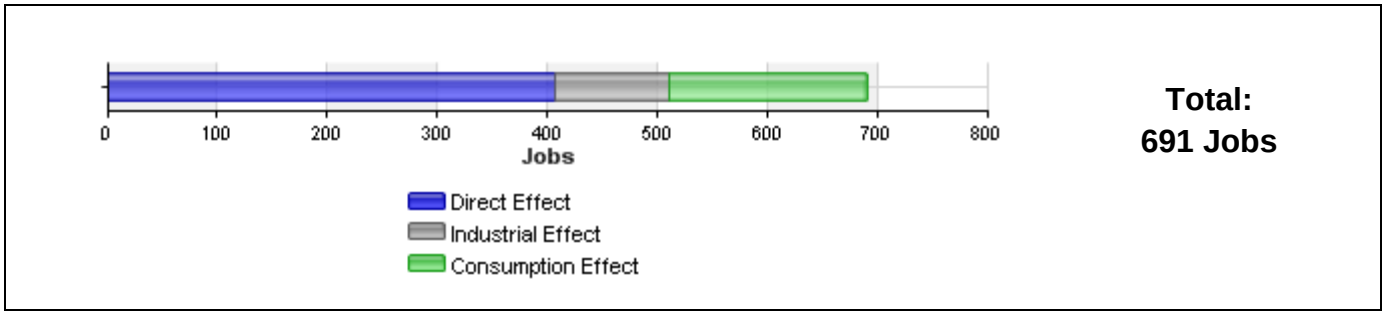

Figure 3.3: Operation Phase employment benefits, Goldfields Region.

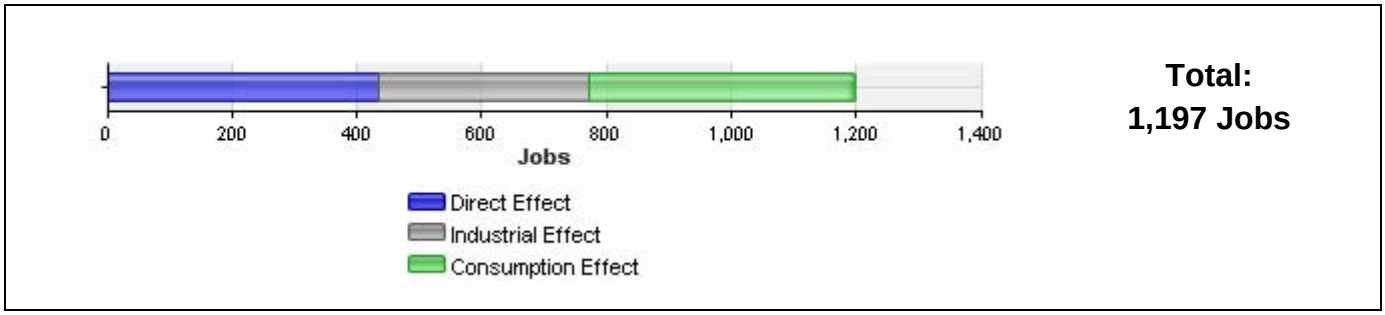

Figure 3.4: Operation Phase employment benefits, Western Australia.

Based on this level of employment in the gold mining sector in the Goldfields Region, economic modelling undertaken for this study estimates direct annual output at $485.6 million. Over a 10 year period this equates to a total project output of $4.85 billion at current prices; 6% higher than AngloGold Ashanti's current project output estimate of $4.56 billion, which could vary over time due to fluctuating gold prices and currency exchange rates.

Initially, the output benefits modeled under this scenario indicate the annual direct benefit for the Goldfields Region from the construction phase with a potential on-site workforce of up to 700 employees could be approximately $590 million (Figure 3.5) and the predicted value for the state could be around $840 million (Figure 3.6).

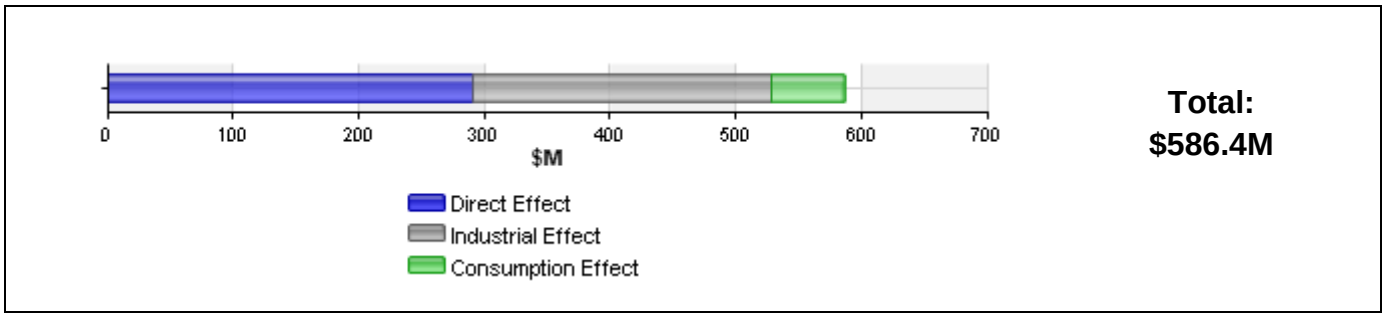

Figure 3.5: Construction Phase output benefits, Goldfields Region.

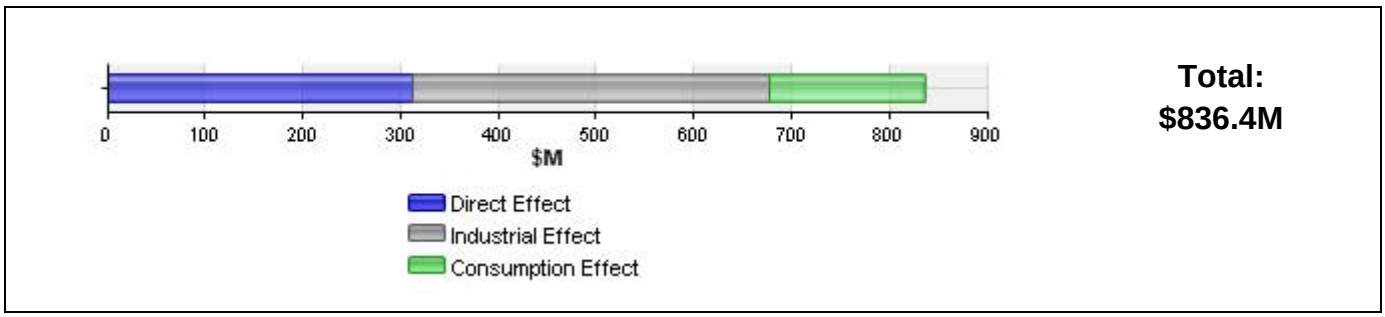

Figure 3.6: Construction Phase output benefits, Western Australia.

At full production, taking into account all direct and industrial and consumption flow-on benefits the Project is estimated to increase output in the Goldfields Region by up to $613.4 Million per annum and a further $313.8 Million per annum for Western Australia.

For a project of this scale the benefits will not be confined to the local region, but will extend into the broader Australian economy. The Project is anticipated to generate royalties for the Western Australian Government in the order of $100 million over the life of the project. It is also anticipated that the Project will contribute between $300,000 – 400,000 annually in rates to the Shire of Menzies and between $400,000 – 600,000 annually in rents to the Department of Mines and Petroleum.

3.3. ALTERNATIVES CONSIDERED

The Joint Venture has taken into account environmental constraints including clearing footprints, greenhouse gas emissions, alterations to biodiversity and/ or ecosystem function and overall efficiency when designing the Project layout (Table 3.1). There remains a degree of flexibility in the placement of infrastructure for the Project except for the position of the Resource Area, which is pre-determined by geology.

3.3.1. Minesite Location

The minesite is located within a tenement area that the Joint Venture has secured. The mine pit is located at the economic concentration of the gold therefore no other option was considered.

3.3.2. Communications

Five options were considered to provide the communications requirements to the Project (Table 3.1):

- satellite link;
- microwave;
- buried fibre optic cable via the TT Corridor; and,
- fibre optic co-installed with gas pipeline or grid power infrastructure along the Pinjin Road.

The buried fibre optic cable via the TT Corridor, or co-installed with gas or grid infrastructure in the Pinjin Infrastructure Corridor are preferred options. The TT Corridor is the preferred option as there are no existing communications services in the immediate vicinity of the Pinjin Corridor to connect into. If the Pinjin option was to be selected it would require the installation of an additional 100 km of fibre optic cable to Kalgoorlie, along with the additional clearing and permitting requirements for the extra disturbance. The buried fibre optic cable via the TT Corridor will require the clearing of a corridor width of approximately two metres, the cleared area will be revegetated post installation and no access track is required thereby reducing clearing impacts. If gas is to be implemented, there is no additional disturbance for optic fibre. Both alignments have been selected to avoid Declared Rare Flora (DRF), and minimise impacts to threatened fauna and fauna habitat. The satellite link while having the lowest impact and construction cost requires unacceptable compromises in its functionality. Microwave is a possible alternative technology with intermediate environmental impacts and performance.

3.3.3. Mine Access Road

The Pinjin option has been selected over the TT Corridor because it is shorter and thus has the lowest greenhouse footprint (a 380 km one way trip to Kalgoorlie over a 480 km one way trip). Both routes have been assessed for their potential to impact on the environmental values and appear to be very similar in this aspect. Both alignments have been selected to avoid DRFs to minimise impacts to threatened fauna and fauna habitat. The Pinjin option does however have the potential to improve access to the region; the TT Corridor could potentially increase access to the Plumridge Lakes Nature Reserve. Consultation with Indigenous communities in the region suggests that they would prefer that freight vehicles do not use the same road as they do when traveling to Kalgoorlie. This makes the TT option even less suitable.

3.3.4. Power Supply Options

A power station with an installed capacity of up to 40 MW is required for the Project. Several power supply options have been considered including; diesel, natural gas (reticulated), LNG and solar thermal. Consideration is also being given to diesel replacement such as biodiesel and modified waste oil. The power supply selected for the site will need to take into consideration the technical, economic and environmental risks associated with each option. The options considered by the Joint Venture were:

- generator fuelled with diesel;
- generator fuelled with waste oil;
- solar thermal;
- gas; and,
- grid power from Kalgoorlie.

Power options for the Project are constrained by the lack of regional infrastructure and supply shortages of gas and reticulated grid power within the region. New gas developments in the Northwest Shelf of Western Australia may address the current gas shortages in Western Australia making gas a viable option for the Project. The lack of capacity in existing grid infrastructure between Perth and Kalgoorlie, plus the lack of gas to generate additional power in Kalgoorlie compounded by the very high costs of powerline infrastructure between Kalgoorlie and the Operational Area prevent grid power being a viable option for the Project. Based on the current infrastructure and energy market constraints, on-site fossil fuel power generation is the only option that can be confidently implemented despite the high operating costs, uncertainty in oil prices, high emissions and emissions costs. Diesel substitutes, including waste oil, were assessed; however the application is likely to be limited by supply considerations.

Although gas is not currently considered to be viable, the Joint Venture will ensure that the power station is designed to be capable of running on gas (as well as other fossil fuels) should gas become available in the future. If gas does become available, additional surveys and approvals will be progressed outside of the current PER process.

The Joint Venture actively evaluated Solar Thermal Power for the Project. The technology is at a demonstration stage, and is not technically or commercially proven in an off-grid situation as would be required for the Project. Significant government grants, tax concessions and Renewable Energy Credits would be required for the technology to be economically viable for the Project. Given that the technology is yet to be proven in an off-grid application, the risk of failure is not acceptable for the Project. While Solar Thermal power has a low Greenhouse Gas emission, it requires substantial additional clearing for a solar field, is untested in a remote resources project therefore presents a considerable risk to the Project. The power supply options are compared in Tables 3.1 and 3.2.

3.3.5. Water Supply Options

The Joint Venture evaluated two potential water supply options, the Officer Basin Water Supply Area and the Minigwal Trough Water Supply Area. The Joint Venture plans to utilise the Minigwal Trough for water supply. The Officer Basin Water Supply Area is no longer considered a viable option due to its increased distance from the Operational Area, and thus increased clearing and pumping requirements. Therefore the environmental impact assessment for biological factors at the Officer Basin has not proceeded past a desktop assessment of flora and fauna (Appendix 2-D1). Selectionof the Minigwal Water Supply Area represents:

- a decreased clearing footprint;
- reduced impact to biodiversity values (i.e. designed to avoid critical areas);
- more efficient option i.e. reduced greenhouse emissions; and,
- economically preferred.

3.3.6. Mining Method

The Project plans to undertake open cut mining. The resource is a low grade deposit generally not suitable for underground mining. Some potential exists for future underground mining at depths below the limits of economic open pit mining, but is not considered in the scope of this PER.

3.3.7. Tailings Storage Facility

The preferred option for the Joint Venture is the Integrated waste landform tailings storage facility (Table 3.1). The Dune Tailings Storage Facility was initially preferred as the proposed design would use the natural slope in the recovery of water and would improve visual amenity. However, due to the biological significance of the sand dunes (presence of a number of Threatened Species) this option was disregarded. Of the remaining options

described in Table 3.1, the preferred tailings storage facility was found to require less energy to operate due to its closer proximity to the gold processing plant. The locations for each facility identified the integrated waste landform tailings storage facility as the least impact on listed flora and fauna habitat. By adopting this approach the site will have ready access to capping material at closure, reducing predicted closure costs, and reducing the number of separate manmade landforms established.

3.3.8. Waste Material Disposal

The preferred option for waste material disposal is the combination of inpit backfilling and surface waste landforms. This option focuses primarily on the construction of waste landforms but where appropriate inpit backfilling of mining voids.

The creation of a permanent pit void and surface waste landforms is necessary for the Project to be economically viable. Inpit backfilling risks sterilising further resource development opportunities that can occur with changing economic conditions. These considerations were weighed against the environmental impact of constructing waste landforms

3.3.9. Position of Airstrip

Two locations were considered for the airstrip, the current location of the exploration airstrip and one to the north, near the proposed Quarry. The northern option is preferred despite a greater clearing footprint. This option was selected as it has the lowest Greenhouse footprint with reduced travel distances, and from a safety perspective it will have lower traffic flow than the current option which has extensive internal site roads.

3.3.10. Village Locations

Three sites were considered for the accommodation village, northwest of the processing plant, a central option and a southern option. The northwest option was selected based on amenity and because it will be outside the World Health Organisation's ambient dust limits. The central and southern options were close to the plant and waste landform where noise and dust will generate amenity issues.

Table 3.1: Options for Key Utilities Considered by the Joint Venture-Preferred options are highlighted in Orange

Key Environmental Considerations		Communications				Mine Access Road	
		Microwave (including service track; west side)	Satellite	Fibre Optic - via TT Corridor	Fibre Optic – co-installed with infrastructure via Pinjin	Pinjin	TT Corridor
Clearing footprint	Area cleared	~ 50 ha	None	~ 50 ha (approximately 2 m corridor to be cleared and revegetated)	~ 100 ha	600 ha (including existing roads).	660 ha (including existing roads).
Loss or change to Biodiversity Values	Disruption to ecosystem functionality e.g. loss of corridors or keystone species	No disruption to ecosystem functionally expected.	None	Could temporarily affect ecosystem functionality	As per the road	Designed to avoid critical habitats such as dunes and will avoid remnant vegetation island in burnt areas	Designed to avoid critical habitats such as dunes and will avoid remnant vegetation island in burnt areas
	Biodiversity loss - impact on threatened flora species	Potentially adjacent to Yellow Sand PEC; 1 Declared Rare Flora & 13 Priority Flora.	None	Potentially adjacent to Yellow Sand PEC; 14 Priority plus 2 new species	Potentially adjacent to Yellow Sand PEC;1 Declared Rare Flora & 13 Priority Flora	Potentially adjacent to Yellow Sand PEC; 1 Declared Rare Flora & 13 Priority Flora.	Potentially adjacent to Yellow Sand PEC; 14 Priority plus 2 new species, Declared Rare Flora may occur on the dunes.
	Introduction or spread of weeds (new or existing)	Declared Plant present at Pinjin Station.	None	1 weed species on southern section	Declared Plant present at Pinjin Station	Declared Plant present at Pinjin Station.	1 weed species on southern section.
	Loss of fauna or fauna habitat.	Potential to remove threatened species and habitats	None	Sandhill Dunnart habitat present but no animals recorded; Marsupial Mole holes observed in dunes and sandy swales.	Sandhill Dunnart habitat present but no animals recorded; Marsupial Mole holes observed in dunes and sandy swales.	Sandhill Dunnart habitat present but no animals recorded; Marsupial Mole holes observed in dunes and sandy swales.	Sandhill Dunnart habitat present but no animals recorded; Marsupial Mole holes observed in dunes and sandy swales.
Improved access to the region	Increased risk of anthropogenic fires.	Metal towers can attract lightening.	None	Buried.	Buried.	From Pinjin to Operational Area use will be restricted to Project personnel, Kalgoorlie to Pinjin public road.	Transline to Operational Area will be 50 % joint use as it is upgrades of existing tracks, Kalgoorlie to Cable turn-off public road.
	Increased clearing impacts (e.g. off-track driving by tourists).	Will require tracks to each tower from the Pinjin Access Road.	None	Will be near the existing Cable Haul Road track for 50% then a new track required.	Pinjin to Operational Area will be a private road, illegal use if possible.	Pinjin to Operational Area will be a private road, illegal use if possible.	Transline to Operational Area will be 50 % joint use as it is upgrades of existing tracks.
	Other increased anthropogenic influences (e.g. increased litter).	During construction.	None	During construction.	During construction, Private road with limited users.	During construction, Private road with limited users.	During construction, Private road for 50 %, less ability to influence other users.
	Feral animal introduction or spread.	Feral goats and wild dogs present on Pastoral station along corridor.	None	Not likely to affect animal movement. Start point in VCL.	Possible that road will assist wild dog movement from Pinjin and camels from region.	Possible that road will assist wild dog movement from Pinjin and Camels from region.	Possible that road will assist wild dog movement from Pinjin and camels from region.
Greenhouse	Efficiencies.	-	-	-	-	4 hr trip	6 hr trip
	Transport of fuel to site.	-	-	-	-	380 km one-way trip.	480 km one-way trip.
	Infrastructure requirements (e.g. storage or piping).	Each tower will require a power supply	None	Booster required along TT Corridor.	Booster required along TT Corridor	-	-
	Greenhouse footprint.	-	-	-	-	Less than 150 t CO_{2-e} (Monthly freight footprint)	150 t CO_{2-e} (Monthly freight footprint)
Sustainability	Natural topography - flooding/droughts.	Tower positioned on topographic high points. Should not alter surface flows.	None	Once installed, no alteration to existing ground-level.	Once installed, no alteration to existing ground-level.	This route predominantly runs parallel with surface flows; creek crossing are required at the Pinjin end.	This route runs N-S, cutting across the natural sheet flows; no lake or clay-pan exist along the route.
	Economics.	Could potentially be shared with other users.	No synergies	Could potentially be shared with other users.	Could potentially be shared with other users.	-	-
	Availability of locally sourced inputs including labour and materials.	Specialist contractor required to install	Supplies available in the region	Supplies available in the region.	Supplies available in the region.	Local contractors available for road construction.	Local contractors available for road construction.
Future opportunities	Sandalwood resource.	-	None	Resource along the route.	Resource along the route.	Resource along the route.	Resource along the route.
Comment		Towers required either between Tropicana and Kalgoorlie or Laverton	Not suitable for Remote Control applications	Most direct route from existing fibre optic line	Significant number of stakeholders along proposed route. No suitable connection points are currently available at Pinjin so without the Gas line or Over head powerlines an addition ~100 km of disturbance would be required to connect to an existing system.	Most direct route.	Synergy option with communication system.
Preferred		Back-up option	No	Yes	Back-up option	Yes	No

Key Environmental Considerations		Power Supply					Water Supply	
		Diesel (or Diesel replacement)	Gas Pipeline	Gas transported by Road	Power line from Kalgoorlie	Solar thermal	Minigwal Trough	Officer Basin
Clearing footprint	Area cleared	2 ha	~ 510 ha	2 ha	~ 114 ha	~ 600 ha	~ 200 ha	~ 250 ha
Loss or change to Biodiversity Values	Disruption to ecosystem functionality e.g. loss of corridors or keystone species.	Same as access road.	Vegetation within a 15 m corridor removed. Grasses and ground covers can recolonise, trees inappropriate over the pipe. If gas option via Pinjin a limited amount of additional clearing will be required.	Same as access road.	Large trees removed, vegetation thinned.	Large trees and shrubs removed. Ground covers and much of the understorey would be retained.	Water is below 100 m and is hypersaline.	Water is plus 100 m and is saline.
	Biodiversity loss - impact on threatened species.	Same as access road.	One connection point on the GGT is near the Goongarrie National Park.	Same as access road.	Threatened Species population area likely to occur along the corridor.	Area selected is not known to be inhabited by Threatened Species.	4 Priority Flora Recorded; No threatened or priority ecological communities recorded; No TEC or PEC recorded.	1 Declared Rare Flora and 5 Priority Species predicted to occur in the area; No TEC or PEC recorded.
	Introduction or spread of weeds (new or existing).	Increased vehicle traffic increasing potential for weed vectors.	Route cross numerous pastoral leases with declared and other weeds species. Excavation equipment potentially spread weeds.	Increased vehicle traffic increasing potential for weed vectors.	Route cross numerous pastoral leases with declared and other weeds species. Excavation equipment potentially spread weeds.	Increased vehicle traffic increasing potential for weed vectors.	No weeds recorded in the area. Excavation equipment potentially spread weeds.	Pipeline corridor needs to cross MacKay's Creek weeds known in this area. Excavation equipment potentially spread weeds.
	Loss of fauna or fauna habitat.	Same as access road.	Potential to remove threatened species and habitats.	Same as access road.	Potential to remove threatened species and habitats	Area identified does not contain any critical fauna habitats or populations.	Sand dunes suitable for Marsupial Moles, Australian Bustards recorded along with Malleefowl mound.	Area predicted to have habitat suitable for Marsupial Mole, Mulgara, Malleefowl and a number of other protected species.
Improved access to the region	Increased risk of anthropogenic fires.	Road users can inadvertently cause a fire by discarding rubbish.	During construction.	Road users can inadvertently cause a fire by discarding rubbish	Overhead power lines can cause fires if not regularly cleaned.	During construction.	During construction.	During construction.
	Increased clearing impacts (e.g. off-track driving by tourists).	None.	During construction.	None.	During construction.	During construction.	Borefield access track does not connect to any other existing tracks.	Pipeline corridor cross exploration tenements held by other.
	Other increased anthropogenic influences (e.g. increased litter).	Road users can cause rubbish to be spread along the road route.	During construction.	Road users can cause rubbish to be spread along the road route.	During construction.	During construction.	Project personnel could cause rubbish to be spread along the pipeline route.	Project personnel could cause rubbish to be spread along the pipeline route.
	Feral animal introduction or spread.	Same as access road	Some new cleared area will be required allow easy access for feral animal.	Same as access road.	Same as access road.	-	Hypersaline water not suitable for animals.	Pipeline breathers could encourage camel activity.
Greenhouse	Efficiencies.	-	-	-	-	-	Reverse Osmosis reject rate likely to be 50%, reject water used in ore processing.	Reverse Osmosis reject rate likely to be between 25-50% because fresher water.
	Transport of fuel to site.	6 trucks/ week	None	5 trucks/ week	None	2 trucks/ week	Borefield 50 km from site	Borefield 100 km from site
	Infrastructure requirements	1-month supply required onsite	-	2-weeks supply required onsite	None	Back-up fossil Power station required	Mini power station required.	Mini power station required.
	Greenhouse footprint.	0.025 t CO_{2e} /t ore processes	0.018 t CO_{2e} /t ore processes	0.018 t CO_{2e} /t ore processes	0.029 t CO_{2e} /t ore (assuming coal based generation into grid)	0.005 – 0.017 t CO_{2e}/t ore (20 – 70% diesel back-up)	Borefield within 50 km of the Operational Area.	Over 100 km from Operational Area energy requirement large.
Sustainability	Natural topography - flooding/droughts.	None	Not built up so it should not hamper surface flows	None	Not built up so it should not hamper surface flows.	Minor changes to local drainage	Not built up so it should not hamper surface flows.	Needs to cross a major drainage feature.
	Economics.	Only viable option	Gas market constrained. Possible pipeline synergies with other mining operations	LNG not currently available.	High construction cost and operating costs due to line losses.	Demonstrated	Energy Saving by the reduced pumping requirements.	-
	Availability of locally sourced inputs including labour and materials.	Local suppliers available.	Local suppliers available.	Local suppliers available.	Local suppliers available.	~ 25% from local suppliers.	Local suppliers available.	Local suppliers available.
Future opportunities	Sandalwood resource.	Same as access road.	Possible resource present.	Same as access road.	Possible resource present.	No resource present.	-	-
Comment		Existing technology, but high operating cost.	Connection possible, supply not guaranteed.	LNG supply limited.	-	Untried technology off grid; technical and economic challenges.	Water quality between 35,000 - 70,000 mg/l TDS.	Better water quality, higher pumping requirements.
Preferred		Yes	No	No	No	No	Yes	No

Key Environmental Considerations		Mining Technology		Method/ Position of Tailings Storage Facility			
		Underground mining	Open pit mining	Dune tailings storage facility	Stand alone Central Tailings Disposal (CTD)	Stand alone paddock	Integrated Waste landform tailings storage facility
Clearing footprint	Area cleared	~ 50 ha	~ 400 ha	~ 300 ha	~ 450 ha	~ 350 ha	~ 350 ha
Loss or change to Biodiversity Values	Disruption to ecosystem functionality e.g. loss of corridors or keystone species	Access point are small and Ventilation Towers can have an adverse effect of adjacent vegetation.	Mining will review removal all vegetation in the void area.	Clearing will remove key stone species such as spinifex and marble gum.	Location affect by a fire in the last 5-years; mallee and mulga recovering.	Clearing will remove key stone species such as spinifex and marble gum.	Location affect by a fire in the last 5-years. Limited number of marble gums and spinifex is regenerating.
	Biodiversity loss - impact on threatened species	Access point can be position to prevent impacts.	Void will remove small populations of 4-5 priority flora species. No Declared Rare Flora impacted. No TEC or PEC within the mining area.	1 Declared Rare Flora species and 9 Priority Species plus one new species; Area potentially 'Yellow sandplain communities of the Great Victoria Desert' PEC.	1 or 2 Priority Species; edge of the facility interacting with unburnt intact vegetation.	5 Priority Species; Clay ecosystem recorded.	1 Priority Species and remnant vegetation islands.
	Introduction or spread of weeds (new or existing)	Unlikely that underground mining equipment could introduce or spread weeds.	Earthmoving equipment can introduce weed species if not clean. Four environmental weeds in the region but none known within the mining area.	Equipment if not clean can introduce weed species.	Equipment if not clean can introduce weed species.	Equipment if not clean can introduce weed species.	Equipment if not clean can introduce weed species.
	Loss of fauna or fauna habitat	Access point are small and Ventilation Towers can have an adverse effect of adjacent vegetation.	Proposed mining area does intercept Marsupial Mole Habitats.	Area known to be suitable habitat for the Marsupial Mole.	Location not in Marsupial Mole habitat. Size of cleared footprint would remove some Malleefowl or Mulgara habitat.	Position not in Marsupial Mole habitat, Will remove thickets of mulga and mallee's.	One of the three of the recorded Troglofauna species located in this area.
Greenhouse	Efficiencies	Poor resource exploitation. Ore/ Waste movement tend to be equal. Waste is generally not brought to the surface	Enables more resources to be mined	Incorporation into dune proposed to use natural slope.	Suitable location 4.5 km from Processing Plant increasing pumping costs; Material for rehabilitation would have to be hauled the 4.5 km.	Proposed location 5 km from Processing Plant increasing pumping cost; Rehabilitation material located within 2 km.	Close proximity to Processing Plant and waste landform.
	Interrelationships of infrastructure e.g. processing plant, pit void	Smaller processing plant required.	-	Processing Plant 3 km to the east.	Processing Plant 4.5 km to the south.	Processing Plant 5 km to north.	Processing Plant 2 km to the south.
	Greenhouse footprint	Footprint reduced because less waste is removed.	~ 37.5% of the project emissions.	Energy required to pump tailings to facility water partly recovered by gravity.	Energy required to pump tailings to facility and to recover water.	Energy required to pump tailings to facility and to recover water.	Energy required to pump tailing and to recover water less than other options.
Future opportunities	Accessibility of gold resource - future cutbacks to pit	Can sterilise open-cut resource.	Well designed project allow for future developments.	No impact.	No impact.	No impact.	No Impact.
	Accessibility of gold resource - potential for underground		Underground mining is feasible post Open-Cut Mining.	-	-	-	
	Sandalwood resource	-	Possible resource present.	No resource known.	Possible resource present.	Possible resource present.	No resource known.
Sustainability	Natural topography - flooding/droughts	Water will be diverted around the mining area	Water will be diverted around the mining area	Location has a small catchment, potential for a drought effect at the processing end of the facility.	Style of facility requires all surface flows to be diverted around the facility, which can cause a drought effect on the downstream side of the facility.	Diversion drains required around all side of the facility altering the natural surface flows, which can cause impacts on adjacent vegetation.	Diversion drain only required on the northern side once the waste landform has been commenced.
	Economics	Restricted to high grade resource.		Medium Rehabilitation cost due to location. Time between closure and rehabilitation ~ 2 yrs.	Rehabilitation cost high due to location and size. Time between closure and rehabilitation ~ 2 yrs.	Medium Rehabilitation cost due to location. Time between closure and rehabilitation up to 5 yrs	Rehabilitation cost lost due to proximity to rehabilitation material; Time between closure and rehabilitation up to 5 yrs.
Comment		Underground mining only would reduce minable resource.	-	Initially preferred, found to be inhabited by Threatened Species.	Bleed water management challenging and rehabilitation cost high.	Rehabilitation delayed due to un-consolidated tailings.	Avoids long term management of the tailings facility.
Preferred		No	Yes	No	No	No	Yes

Key Environmental Considerations		Waste Material Disposal			Position of Airstrip		Position of Village		
		Inpit	Surface waste landform	Combination of inpit and surface waste landform	North of the Mining Area.	Current location.	NW of Processing Plant.	Central option.	Southern option.
Clearing footprint	Area cleared	Waste dump footprint still would be partly cleared because inpit dumping would only occur near the completion of mining	~ 1,200 ha.	Less than 1,200 ha.	7.5 ha.	Additional 3 ha plus the establishment of a road to the airstrip	~ 13 ha	~ 13 ha	~ 13 ha
Loss or change to Biodiversity Values	Disruption to ecosystem functionality e.g. loss of corridors or keystone species	Clearing will remove key stone species such as spinifex and marble gum.	Clearing will remove key stone species such as spinifex and marble gum.	Clearing will remove key stone species such as spinifex and marble gum.	Soft grass plain with few and sparsely spaced shrubs.	Soft grass plain with few and sparsely spaced shrubs.	Surrounded by mallee Eucalypts; design would limit clearing	Area affected by fire in the last 10 yr; design would limit clearing	Adjacent to clay-pan, some spinifex and marble gum in the area; design would limit clearing
	Biodiversity loss - impact on threatened species	No Declared Rare Flora, 9 Priority species observed, No TEC nor PEC's,	No Declared Rare Flora, 9 priority species observed, No TEC nor PEC's,	No Declared Rare Flora, reduced impact on priority species if dune areas can be avoided; No TEC nor PEC's,	No known priority species; No TEC or PEC observed.	No known priority species; No TEC or PEC observed.	1 Priority species; Located in an area of relatively un-impacted eucalypt woodland	1 Priority species	Located in an area of relatively un-impacted eucalypt woodland
	Introduction or spread of weeds (new or existing)	Earthmoving equipment if not clean can introduce weed species. Four environmental weeds in the region but none known within the mining area.	Earthmoving equipment if not clean can introduce weed species. Four environmental weeds in the region but none known within the mining area.	Earthmoving equipment if not clean can introduce weed species. Four environmental weeds in the region but none known within the mining area.	Earthmoving equipment if not clean can introduce weed species. Four environmental weeds in the region.	Earthmoving equipment if not clean can introduce weed species. Four environmental weeds in the region.	No weeds recorded	No weeds recorded	No weeds recorded
	Loss of fauna or fauna habitat	Reduced footprint waste landform and the associated reduction in clearing of fauna habits.	Two of the proposed waste landforms cover sand dunes with evidence of Marsupial Mole activity. The eastern waste landform also contain a disused Malleefowl mound.	Reduced footprint waste landform and the associated reduction in clearing of fauna habits.	No threatened species habitats observed in area.	No threatened species habitats observed in area.	Within vegetation suitable for Malleefowl; no animals observed.	Area not suitable for known threatened species.	Area not suitable for known threatened species.
Greenhouse	Efficiencies	Dumping of all waste in the pit would require the majority of the waste to be rehandled with high greenhouse impacts and unviable project economics.	-	Inpit dumping into final pit voids with no rehandling of material can reduces fuel consumption during operation reduce rehabilitation requirements.	Use site power no need for a separate generator.	Will need own power supply.	-	-	-
	Interrelationships of infrastructure e.g. processing plant, pit void	Can sterilise future opportunities.	North dump designed to surround tailings storage facility. Reducing Greenhouse Gas emission hauling material for capping.	Can sterilise future mining opportunities	Synergies between borefield access and airstrip access; closer to village and main operation; ~ 8 km from plant.	Specific road required; no synergies with other activities; ~ 20 km east of project.	Synergies between borefield access and airstrip access.	Synergies between access road and village access.	Synergies between access road and village access.
	Greenhouse footprint	Increases the greenhouse footprint because waste would be handled twice.	-	Can reduces emissions if waste can be tipped directly into final pit void.	-	Extra fuel used travelling to and from airstrip.	Travel distance by road ~ 6 km.	Travel distance by road ~ 4 km.	Travel distance by road ~ 6 km.
Future opportunities	Accessibility of gold resource - future cutbacks to pit	Only a portion of the waste can be stored in pit without rehandling. Inpit dumping can sterilise cutback opportunities.	Waste landforms can sterilise cut back and compromise underground mining options.	Inpit dumping and waste landforms can sterilise cutback opportunities.	-	-	-	-	-
	Accessibility of gold resource - potential for underground	Inpit dumping sterilise underground resources.	No issue.	Inpit dumping can sterilise underground portal opportunities.	-	-	-	-	-
	Sandalwood resource	-	Possible resource present	Possible resource present	-	-	-	-	-
Sustainability	Natural topography - flooding/droughts	Same as the void	Will change natural surface flows that can cause indirect effects of adjacent uncleared vegetation.	Will change natural surface flow that can cause indirect effects of adjacent uncleared vegetation but less if foot print reduced.	Due to natural topography airstrip not likely to have an impact.	Due to natural topography airstrip not likely to have an impact.	Unlikely	Unlikely	Close to clay-pan; road could change surface flows into clay-pan.
	Economics	Project not viable.	-	Could reduce opportunities.	-	-			
Comment		A starter waste landform will be required; Limits future mining opportunities.	Waste landform slope optimised to ensure stability and visual amenity.	Provides a balance between minimising footprint and keeping the viability of future mining opportunities	-	Remove from other facilities, security could be a problem as the location is near the existing track to Laverton.	Location to be within 4-6 km of site to encourage staff to walk to work.	Close to the plant and waste landforms, noise and dust will be issues.	Close to the SW waste landform noise and dust will be issues.
Preferred		No	No	Yes	Yes	No	Yes	No	No

Table 3.2: Power Supply Options Considered. Preferred option is highlighted in Orange, most likely option highlighted Green

	Diesel	Waste-oil	Solar Thermal	Gas pipeline	LNG trucked	Power line from Kalgoorlie
Clearing footprint (hectares)	2 ha	2 ha	~ 600 ha	~ 510 ha Assuming the gas pipeline is 300 mm the service/ cleared corridor must be 15 m wide and will be ~ 340 km.	2 ha	~ 114 ha (380 km by 3 m)
Greenhouse t $CO_{2e/t}$ ore processed	0.025	0.029	0.005 – 0.017 (20 – 70 % diesel back-up). 0.007 (25 % Coal back-up).	0.018	0.018	0.029 (assuming coal based generation into grid)
Suitability of technology	Proven	Emerging technology at demonstration phase. Potential application as a diesel substitute.	Potential solar thermal technology being assessed has not been demonstrated at commercial in Australia or in any situation independent of the power grid.	Proven.	Proven.	Proven.
Security of supply/ availability of fuel source	Not constrained.	Potential difficulty in securing supply - the Project would consume most of the available waste-oil in Western Australia.	Security of supply related to incident solar radiation and plant design. Backup thermal and or electrical supply is required. Backup fuel sources may include diesel, waste oil, coal or a combination of fuels.	Domestic natural gas supply in WA is in chronic shortage. Additional supply and investment in pipeline infrastructure is required to provide reticulated gas to Tropicana. Gas supply may improve making gas a viable option.	No capacity from installed LNG facilities in Perth. No suitably located LNG projects underway.	Lack of grid capacity between Perth and Kalgoorlie. Lack of generation capacity in Kalgoorlie with installed generating capacity based on high cost gas with gas supply constraints.
Economics	High operating cost.	Availability of the required waste oil supply is not demonstrated. Cost of waste oil in quantities required is unknown.	Commercial and technical viability not demonstrated. Economics may be viable with supporting government grants, tax concessions and Renewable Energy Credits.	Shortages of available domestic gas supply are resulting in elevated gas prices. Currently not viable. May become viable with increased gas supply from new NW Shelf gas projects.	As for gas pipeline.	Not viable without new third party investment in transmission infrastructure between Perth and Kalgoorlie.
Other considerations		Waste-oil requirements for the Project would consume most of the available waste-oil in WA.	High technical risk, which could compromise the operation.			Transmission line losses.