2 Project Justification and Alternatives

2.1 Need for the Development

South East Queensland continues to face significant population and development pressure, and is the fastest growing region in Australia at present. A significant proportion of this growth centres on the greater Brisbane area. In the area including the former Pine Rivers and Redcliffe City Councils, major urban development has been identified, particularly through the advent of large communities such as North Lakes and Mango Hill, which is expected to continue and to be compounded through similar future development in the Griffin area, as well as through densification of the existing urban communities particularly around transport hubs. This growth is identified in the draft Pine Rivers Local Growth Management Strategy as well as the Pine Rivers Northern Growth Corridor Local Area Plans, which cover the areas of Griffin, Mango Hill and Dakabin.

The former Pine Rivers Shire Council is projected to accommodate an additional 29,200 dwellings and the former Redcliffe City Council an additional 6,900 dwellings by 2026 (SEQRP Oct 2006).

Demand for electricity is increasing by approximately five percent a year in the region bounded by Redcliffe in the east, North Pine River in the south, Lake Kurwongbah in the west and Burpengary in the north. This rate of growth is expected to increase in the coming years due to continued new residential development in the area and the proposed expansion of the Westfield shopping centre at North Lakes.

The existing 110/33kV substation at Hays Inlet is expected to experience quality of supply issues by the 2009/2010 summer if no action is taken. To meet this growing demand for electricity, ENERGEX proposes to duplicate the existing 110kV high voltage double circuit aerial sub-transmission line, with one circuit initially operating at 33kV, from Powerlink's South Pine substation at Brendale to ENERGEX's Hays Inlet substation on McKillop Street, Rothwell. The project also includes construction of a new 110 kV bulk supply substation at Dohles Rocks Road, Griffin, just east of the Bruce Highway.

Initially, one circuit of the double circuit 110kV high voltage sub-transmission lines will be operated at 33kV which will facilitate a separate 33kV injection into ENERGEX's Mango Hill substation by the summer of 2009/10, which will provide security of supply for future development in the Griffin, Murrumba Downs, North Lakes and Kallangur area.

2.2 Project Objectives

Under the terms of its distribution authority issued by the Queensland Government, ENERGEX has a statutory obligation to take all necessary steps to ensure a continued reliable electricity supply to the greater Brisbane Region. As a part of this obligation the following criteria were adopted:

- provide minimal capital and operating costs in accordance with the provision of the National Electricity Market (NEM)
- meet requirements for system security and reliability against credible contingencies as outlined in the NEM
- have minimal impact on the environment
- use existing state-owned land to minimise community and environmental impacts
- meet long-term electricity demand projections of the Pine Rivers and Redcliffe regions.

2.3 Corridor Selection and Alternatives

2.3.1 Background

ENERGEX is responsible for the delivery of safe, secure and reliable energy supply to the population of South East Queensland, representing a total of more than 2.8 million customers. ENERGEX has a commitment to the sustainable and balanced approach to the delivery of this supply, including the identification of powerline corridors and substation sites, and development and the design of infrastructure. The determination and development of these elements of infrastructure are guided by ENERGEX's Sustainability Assessment Framework, which presents a balanced and objective approach to corridor and site selection, involving assessment of identified options against environmental, economic and social factors.

2.3.2 South Pine to Hays Inlet Corridor Selection

In accordance with this approach, ENERGEX appointed independent consultants Urbis to undertake the South Pine – Hays Inlet Corridor Selection Report in April 2008, concluding in June 2008. The corridor selection process independently identified and subsequently assessed four corridor options. Each corridor option was dependant upon connection to the previously identified and proposed Griffin substation site, which is situated approximately in the centre of the line corridor. Each of the corridor options are described below:

Western Option 1 – following South Pine Road in a westerly direction through to the Caboolture Rail Line, and then proceeding along Queensland Rail Northern Rail Line before turning west and running along Narangba and Dohles Rocks Road into the identified Griffin substation site at Dohles Rocks Road. From Griffin the site extends north along the Bruce highway corridor prior to joining the proposed Redcliffe Rail Corridor and following a north-easterly direction to the Hays Inlet substation.

Western Option 2 – as per the alignment for Western Option 1 with the exception of the route following Gympie Road as opposed to the rail corridor.

Central Option – following the route of the existing easement containing the ENERGEX South Pine – Hays Inlet sub-transmission line from the South Pine Substation at Brendale, north through Strathpine, Murrumba Downs, Griffin and Mango Hill and terminating at ENERGEX's Rothwell substation.

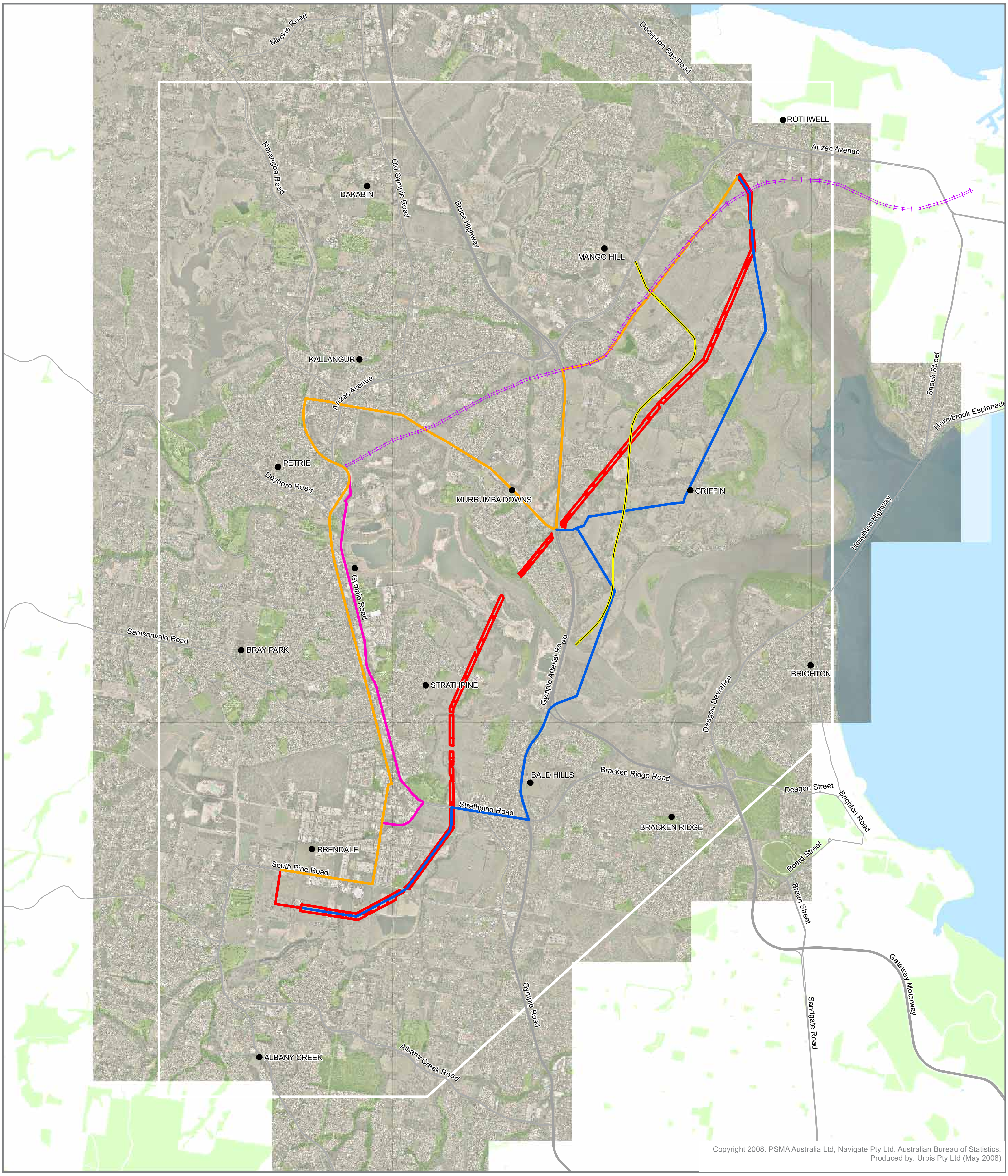
Eastern Option – following the Central Option corridor through to Strathpine Road, then turning east along Strathpine Road and then north adjacent to the Gympie Arterial Road. The corridor then traverses the Tinchi Timba Wetland, and continues north into the Griffin substation site. From the substation, the corridor continues in a northerly direction to the east of the urban development areas of Griffin and Mango Hill before re-connecting to the Central Option corridor and terminating at ENERGEX's Rothwell substation.

The locations of the four corridor options are shown in **Figure 2**.

2.3.3 Route Selection Guidelines

The general criteria used to determine potential corridor options within the study area are listed below, however it is noted that these issues are not intended to provide a complete list of matters considered. Determination of corridor options included field assessment and incorporated a multi-disciplinary approach, focussed on responsive analysis of localised issues balanced against regional needs. The general criteria used included:

- avoiding as far as possible residential areas
- minimising impacts on areas not previously impacted
- minimising the extent of vegetation clearing
- minimising crossings of watercourses



Legend

- Proposed Rail Corridor
- Proposed North South Arterial Road
- Central Corridor Option
- Eastern Corridor Option
- Western Corridor Option 1
- Western Corridor Option 2
- Existing Easement Option
- Open Space
- Waterbody
- Highway / Freeway
- Main Road

N

Scale 1:60,000 when printed at A3

0 1 2 4

Kilometres

Projection: GDA94 (MGA, Zone 56)

FIGURE 2 - CORRIDOR OPTIONS

energex positive energy

urbis

- minimising the number of property titles affected
- minimising the number of bends in the corridor
- minimising the length of the corridor
- minimising the cost of the corridor
- minimising the impact on State Forests and National Parks.

Information sources used in researching the constraints in the study area included:

- Pine Rives Planning Scheme 2006;
- Brisbane City Plan 2000;
- Redcliffe City Plan 2005;
- Draft Pine Rivers Local Growth Management Strategy;
- Pine Rivers Northern Growth Corridor Local Area Plans – Griffin, Mango Hill and Dakabin;
- Queensland Herbarium Regional Ecosystem mapping (version 5.0, December 2005);
- Queensland EPA Southeast Queensland Biodiversity Planning Assessment (release 3.5, December 2007);
- Queensland EPA Essential Habitat mapping (version 2.1, April 2007);
- Queensland Koala Conservation Plan 2006;
- Directory of Important Wetlands and RAMSAR sites.

2.3.4 Route Selection Criteria

The assessment criteria used for the assessment of the corridor options is based on the ENERGEX Sustainability Assessment Tool (SAT) which has been developed for studies such as these. These criteria are similar to the criteria used in the assessment of the preferred corridor in the Community Infrastructure Designation process.

The SAT provides for the consideration of three major 'Themes' under which detailed assessment is undertaken. These three themes are: Economic, Environmental & Social and combine to form a 'triple bottom line' evaluation process. Further, the implementation of these themes and their respective values within the assessment may be guided by the land use context of the study area defined. ENERGEX have developed a comparative weighting for a range of land use scenarios, reflecting appropriate variation in Theme weightings as shown in **Table 1**.

Table 1 – Sustainability Assessment Tool Weighting

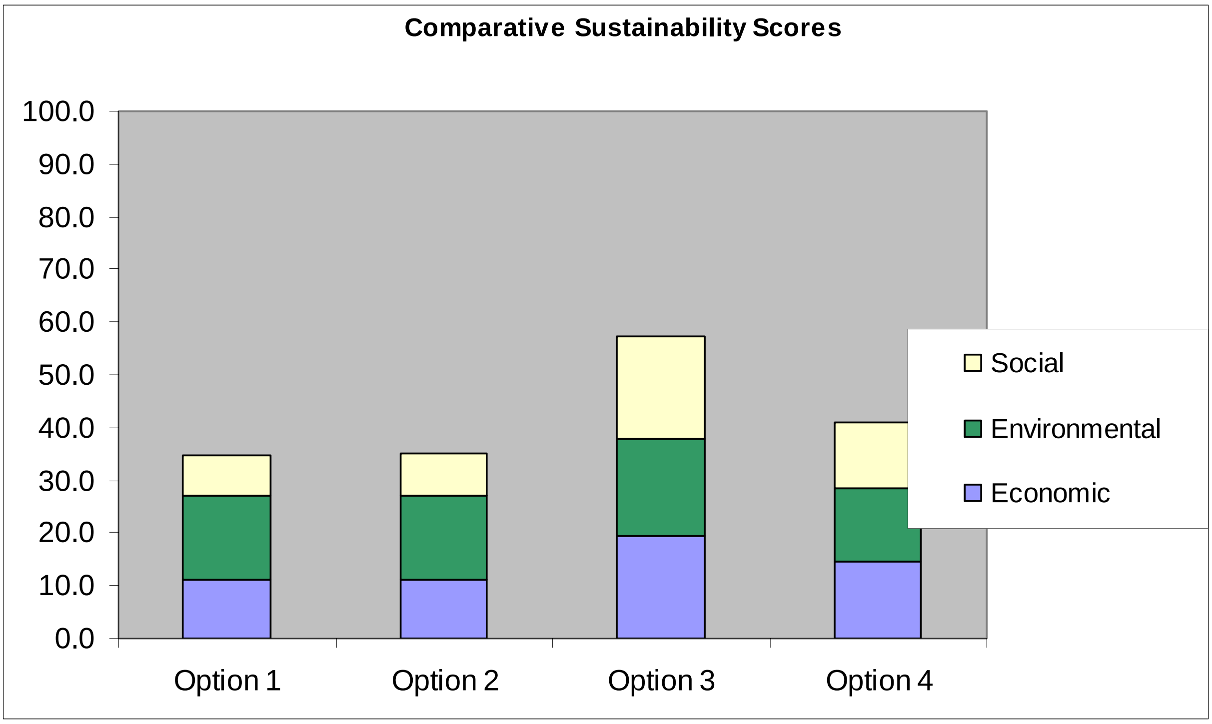
Theme	Urban	Semi Urban	Rural
Economic	30%	30%	30%
Environmental	30%	35%	40%
Social	40%	35%	30%

It is noted that the SAT considers urban land use to be defined as having any part of the proposed project within the Urban Footprint. The Rural context is applicable where the proposed project is located in farming or other areas of a rural nature whilst the Semi-Urban context contains areas outside the urban footprint but more populated than the rural zone and may be more environmentally modified.

Within the study area the subject of this assessment, a mix of highly urbanised and semi-rural land uses are identified, and the corridor options are located in each of these land use settings. It has therefore been considered most appropriate to utilise the Theme weightings as applied to the Semi-Urban setting as shown above.

The overall outcomes of the SAT Analysis are shown in **Figure 3** below.

Figure 3 – Comparative Sustainability Scores



Under each of the identified SAT Themes, detailed assessment is undertaken having regard to the following range of Aspects:

Economic

Capital and operational expenditure

Constructability

Environmental sustainability

Demand

Regulatory requirements

Long-term reliability

Network infrastructure

Access to services

Market presence

Environmental

Matters of National Environmental Significance

Conservation values

Biodiversity

Noise

Natural resources

Water quality

Soils and geology

Hazardous sites and activities

Natural hazards

Products and services

Energy management

Air quality

Social

Community health and safety

Occupational health and safety

Stakeholder engagement and participation

Community benefits

Community impacts

Property impacts

Cultural heritage

Visual amenity

Following completion of the SAT analysis, the final SAT table was subject to a process of rigorous sensitivity testing. This included:

- Application of several variations of Theme weightings, including both moderate and extreme variations to the balance between each weighting
- Within each 'Theme', a number of variation scenarios applied to the various weightings assigned to each 'Aspect' of the 'Theme' and
- Within the assessment table, application of "capping" of the values applied to the identified preferred corridor to a level commensurate with the next highest corridor option value.

Despite each variation applied, the identified Preferred Corridor remained the most suitable. The SAT analysis is therefore considered to provide a robust assessment of the corridor options.

2.3.5 Conclusion

The assessment of the corridor options utilising the Sustainability Assessment tool, and the detailed sensitivity testing undertaken following the initial assessment process clearly identified the use of the existing powerline corridor (the Central option) as the most appropriate option to provide the new electricity infrastructure. In summary the Central Option:

- Traversed the least distance at 16.5 km
- Impacted significantly less flora and fauna habitat as compared to the western option, particularly having regard to the Moreton Bay Marine Park and RAMSAR wetlands
- Ensured further minimisation of impacts on the community and biological environment through the capacity to utilise existing access tracks for construction and maintenance activities

- Impacted the least number of residents and businesses not previously impacted by powerline infrastructure and
- Required no property acquisition, and therefore presented no additional impact through fragmentation of land holdings.

Therefore it was recommended that the Central Option be adopted as the preferred corridor, and detailed assessment be pursued in accordance with the Community Infrastructure Designation process. The preferred corridor is shown in **Figure 1**.

The South Pine – Hays Inlet Corridor Selection Report is included as **Appendix C** to this IAR.

2.4 Powerline Alternatives

2.4.1 Underground Sub-Transmission Lines

In nearly all instances, aboveground installation of proposed sub-transmission line (either 132kV or 110kV) connections is carried out in preference to an underground equivalent. The main reason for this is that regulatory requirements prevent consideration of costly options such as undergrounding where there are feasible, less expensive alternatives. There are a number of other reasons for this decision, which include:

- A very high initial capital cost of underground installation and the high cost of repairing cable
- Technical issues including the longer operational time periods to repair or replace cable (a significant issue for a line that supplies an entire region)
- Environmental issues (overhead lines can sometimes be raised above sensitive vegetation minimising clearing, dependant on easement width, tower height and maximum vegetation height, as opposed to underground lines).

Regulatory Issues

ENERGEX is a monopoly provider of electricity distribution network services in South-east Queensland, and operates within the National Electricity Market in accordance with the National Electricity Rules. ENERGEX’s income is regulated by the Australian Energy Regulator (AER) to ensure that it does not misuse it monopoly market position. The National Electricity Rules require providers such as ENERGEX to comply with the AER’s Regulatory Test for each capital project above $1 million. The Regulatory Test sets out the method for ensuring that each capital project is necessary and financially prudent and efficient. For each ENERGEX project to comply with the Regulatory Test, the network provider **must choose the least cost option (that meets all other legislative requirements).** The AER can reject capital projects if they are found not to be in accordance with the Rules and the regulatory test. Otherwise non-conformance with the regulatory test guidelines would affect funding and subsequently electricity prices. There are **heavy fines that can be imposed on both ENERGEX and individual staff where there has been non-compliance with the Regulatory Test.**

At high voltages such as 110kV or 132 kV, the cost of an underground powerline is around 5 to 8 times the cost of a comparable overhead powerline. So in most situations where the statutory clearances under the *Electrical Safety Regulation 2002* can be obtained, an overhead sub-transmission line will pass the Regulatory Test, whereas an equivalent underground line would not.

Undergrounding low voltage distribution lines in a residential estate is not subject to the Regulatory Test as the cost of the undergrounding is more often borne by the developer and subsequently recouped after the sale of the estate.

Technical Issues

Underground powerline infrastructure while often required in urban areas for lower voltage distribution lines (eg. in new estates) is problematic for the 110kV sub-transmission lines. Unlike distribution lines, sub-transmission lines provide power to a large region of customers and require quick repairs in the event of a malfunction. Underground lines are harder to "fault find" and repair as the lines are encased in a special concrete backfill for protection and provide more equalised heat dissipation.

Underground cable repairs and jointing is a specialist activity that is technically challenging even under good conditions. These technical skills are usually in short supply in the market place which often necessitates mobilisation of specialists from the cable manufacturer which are all overseas based.

Small underground sections of powerlines also reduce the reliability of a powerline, which is not as vital for distribution lines, but is a significant impact on regionally important sub-transmission lines.

The adoption of a continuous overhead route also maintains an optimal integrity for the sub-transmission line from a reliability perspective and ensures that inspection, maintenance and repairs in the operational phase are cost effective. Introducing sections of underground within a sub-transmission line requires transition structures which are far more visually intrusive than normal pole/tower structures. They are also an inherent weak point in the system from a reliability point of view as they are more susceptible to damage.

Undergrounding high voltage powerlines such as 110kV and 132kV over long distances has technical disadvantages. The cable capacitance limits its ability to transfer power to about 15 to 20 kilometres. To counterbalance this effect a reactor station (in effect a mini-substation) is typically required about every 15 - 20km along the line route.

Undergrounding of 110kV cables is generally undertaken using a 'Trefoil' design, whereby the cables are laid in a triangular pattern. The proximity of the cables has the potential to cause problems through heat transfer when the feeder is under high-load, particularly at peak demand period. This limits the capacity of the line to accommodate peak customer demand. As an alternative, cables may be 'flat-laid' side by side along, allowing greater heat dispersion between cables. This option requires a wider trench arrangement, and therefore has the potential to cause significantly greater requirements for vegetation clearing.

Environmental Issues:

From an environmental aspect, underground installation is often mistakenly thought as requiring minimal vegetation clearing, when in fact it mostly requires similar amount of clearing, and in some situations, can lead to more significant impacts than the equivalent above-ground installation. Overhead lines can be raised above sensitive vegetation with clearing only required at proposed structure locations, dependant on maximum vegetation height, tower heights and easement widths. Underground sub-transmission lines have to be constructed using the "cut and cover" method, which requires clearing for the length of the cable and cleared areas for machine operation and spoil stockpiling. Other potential impacts from underground installation include:

Vegetation Clearing (Construction) Placing powerlines underground does not remove the need to clear vegetation. There is potentially more clearing required for the **construction** of an underground powerlines than for an overhead powerline. For an overhead line, vegetation towards the edge of the easement on either side can be retained, with clearing required in the centre of the easement and particularly around proposed pole locations. For an underground line the easement typically need to be cleared from edge to edge.

Vegetation Clearing (Operation / Maintenance) The **permanent** removal of all vegetation with roots that could damage the underground line is required for approximately 3m either of the centre of an underground power cable. Cable easements are normally totally cleared of vegetation for the life of the cable. This is necessary to ensure the cable is not damaged by tree roots, other vegetation or other activities. This may serve to limit the potential for significant revegetation measures to be undertaken within the easement area.

The carbon footprint of both the manufacturing and installation of underground lines is far higher than that of overhead solutions due to the significantly greater amount of energy and material used in its manufacture.

Increased erosion potential during construction as sections of the trench (possible up to 1 km or more) may be open for a period of weeks while the cable is installed, tested and then backfilled. A consequence of this can also be the temporary disruption to the community, due to access and traffic constraints. During construction, many parts of the open trench would have to be shored to prevent cave in and to maintain the stability of the cable during installation. This would require additional earthmoving equipment to install and remove the shoring which may cause additional damage in environmentally sensitive areas.

Potential Health Issues

Underground installation does not remove the electromagnetic fields (EMF) associated with the powerline. While underground installation screens the electric field, it does not screen magnetic fields which pass straight through the ground.

It is possible to reduce magnetic fields by ‘trefoiling’ the underground lines which ‘localises’ the magnetic fields due to the closer phase separation of the underground lines. However, as the cable is installed only 1 – 1.2 m below ground level, in the immediate area, magnetic fields are likely to be higher at ground level in comparison to fields from a similar over head installation (10-15m above ground).

2.4.2 Alternative Overhead Powerline Construction Options

A number of alternative overhead powerline construction methods have been considered following initial consultation activities undertaken by ENERGEX, including the following:

- Installation of all new feeders on the existing South Pine to Hays Inlet 110kV powerline
- Construction of a new powerline in the centre of the existing easement including the new 110kV double circuit line, and incorporating a replacement for the existing line allowing decommissioning of the existing line.

The installation of additional feeders on the existing South Pine to Hays Inlet towers in their current configuration would require the cross arm to support two sets of 110kV wires. The cross arms are not structurally capable of supporting the additional weight of a second set of 110kV feeders, nor to ensure appropriate separation of all wires under statutory provisions.

The construction of the additional circuit above the existing configuration would require the towers to be increased in height by approximately 12 metres. The resultant structural appearance would be significantly more visually intrusive to adjoining properties along the entire length of the corridor. Further, the installation of both 110kV feeders on a single line structure is not considered to be suitable in terms of security of supply, and in supporting the achievement of ENERGEX’s standard N-1 security of supply policy. In the event of failure of any one of the towers along the corridor, supply from both sets of feeders would be lost, resulting in loss of supply across the region with no immediate back up supply arrangement.

The construction of a new single line of towers in the centre of the easement as an alternative is in the first instance unsuitable due to the matters raised above with respect to ongoing security of supply standards, and the significantly larger series of structures that would be required. Further, new powerline infrastructure could not be constructed in the centre of the easement prior to the decommissioning and removal of the existing infrastructure in order to achieve statutory safety clearances.

The new powerline is required due to the existing high levels of demand driven by significant urban development in the region, and the limited capacity of the existing electricity infrastructure in the broader area to provide safe and secure supply. The removal of the critical existing 110kV powerline, representing the primary bulk supply link between Hays Inlet and South Pine substations, during construction of a new powerline, would result in extreme load imposts on the existing network, and potentially lead to supply losses, particularly in periods of high demand.

The construction of a single powerline along the existing easement would therefore only be able to be achieved through construction of a series of towers along the opposite side of the easement as currently proposed, however the required structures would be significantly larger than those intended to be installed at present, representing a greater impact on adjoining land owners.

It is therefore considered that the proposed design solution for the new 110kV feeder is the most appropriate option for the project.

2.5 Griffin Substation Site Identification and Alternatives

The Griffin substation will be constructed as a 'Bulk Supply' substation, initially providing a 110/33kV distribution component to the network. By 2015 it is planned that the substation will be augmented to include 33/11kV components. In determining the location for such substation sites, ENERGEX in the first instance identify the "theoretical optimum location' through a calculation based on the comparative loads each existing substation in the area is forecast to supply, and the distance between those substations. Through this process a 'search ring' for a new substation site in the Griffin area was identified, and subsequently identified on mapping under the Pine Rivers Shire Council Planning Scheme.

Selection of suitable sites is undertaken through comparative sustainability analysis in similar fashion to the process undertaken for new line corridors as detailed in 3.2 above. The following key elements in this site selection process are of particular relevance to the location of substation sites:

- Proximity to the existing network, which ensures that substations can be supplied as cost effectively as possible, and minimising any additional impact on surrounding land uses through the construction of additional supply infrastructure;
- Land use, including where possible locating in industrial or commercial areas, and where this is not possible due to network requirements and existing land use patterns, selection of the site with least overall impacts on the surrounding area;
- Consideration of future network requirements, including strategic locational opportunities such as the acquisition of large sites which can incorporate the full range of projected growth in demand on the network (for example the proposed future substation augmentation opportunities within the Griffin site).

In accordance with this approach, ENERGEX commissioned independent consultants Connell Wagner to undertake a site selection report to identify a site for the future Griffin substation.

- The site selection report included detailed review of the following matters:
- Review of aerial photography, cadastral mapping and town planning information
- Identification of suitable sized parcels for preliminary investigation drive-by.
- Drive-by investigation of sites identified in preliminary mapping investigations, and general drive through search area to identify any other suitable sites.
- Identification of other suitable sites not identified by mapping searches.
- Selection of sites for further investigation.
- Review of the selected sites including:
    - Ownership searches including registered proprietor details, lot sizes etc.
    - Town Planning enquiries including zoning and flooding.
    - Neighbourhood issues.

This process identified four site options within the Griffin area for the proposed substation.

The suitability of the four preferred sites were assessed utilising the ENERGEX criteria for substation site selection, which included criteria relating to technical, property, town planning, ecological and social factors. The proposed site was identified as the preferred site due, amongst other matters, to the proximity of the site to the existing powerline, the size of the lot and capacity to accommodate future augmentation and standard substation design packages, and the relatively flat and cleared nature of the site.

2.6 Alternative Power Sources

ENERGEX implements an ongoing program of identification and implementation of alternative solutions to the demand and supply issues. These options are considered through ENERGEX's network planning processes and include consideration of a range of demand side management and local generation opportunities.

Further, and in the course of the preparation of this report research was undertaken with respect to specific matters such as 'in-home' generation including 'cold pocket' nuclear reaction generation, and small scale localised power station development. These initiatives have generally been noted to be in their infancy as power alternatives, and are not feasible for broad scale introduction at this point in time. Such solutions would not be implementable in the time frames necessary for the electricity supply demand in the region.

It is considered through analysis of the existing and predicted demand for electricity supply in the area that no suitable alternative power source is capable of providing a satisfactory or timely solution to the need created by development in the region.