2. DESCRIPTION OF THE PROJECT

2.1. The Study Area

The Poseidon and Grassridge Substations lie approximately 100 km apart (as the crow flies), and are separated by a varying landscape ranging from open agricultural areas in the north, through the mountainous Zuurberg down towards the coastal plateau. In order to evaluate the sensitivity of the area between these two substations, as well as identify potential corridors for the establishment of a new Transmission line between these points, a broader study area was delineated for investigation. The broader study area (indicated by a dashed-green boundary line on Figure 2.1 overleaf) extends from Cookhouse in the north, through the Golden Valley, Middleton, Kommadagga, Ann's Villa, over the Zuurberg in the vicinity of the Addo Elephant National Park (AENP), past Paterson in the east, Colchester in the south, and to the Grassridge Substation near Coega.

The study area can be divided into the following distinct biotic regions:

2.1.1. Karoo Section

South of the Poseidon Substation, the first half of the study area traverses relatively flat country, broken in places by low hills, ridges and shallow valleys. Approximately 60 km south of the Poseidon Substation, the study area is bisected by the northern boundary of the proposed Greater Addo National Park (GANP).

This section is underlain by shales, sandstones, mudstones and tillites of the Beaufort, Ecca and Dwyka series of the Karoo System.

Current land-use in this section is agricultural, being dominated by the small-stock industry.

2.1.2. Zuurberg Section

The following 25 km traverses the foothills, ridges, peaks and valleys of the Zuurberg Mountains, and forms part of the area earmarked as the proposed GANP. This section, which is underlain mainly by quartzites and shales of the Witteberg Series of the Cape System, represents the eastern extension of the Cape Fold Belt, a major geological and geomorphological feature in the southern and south-western part of the sub-continent.

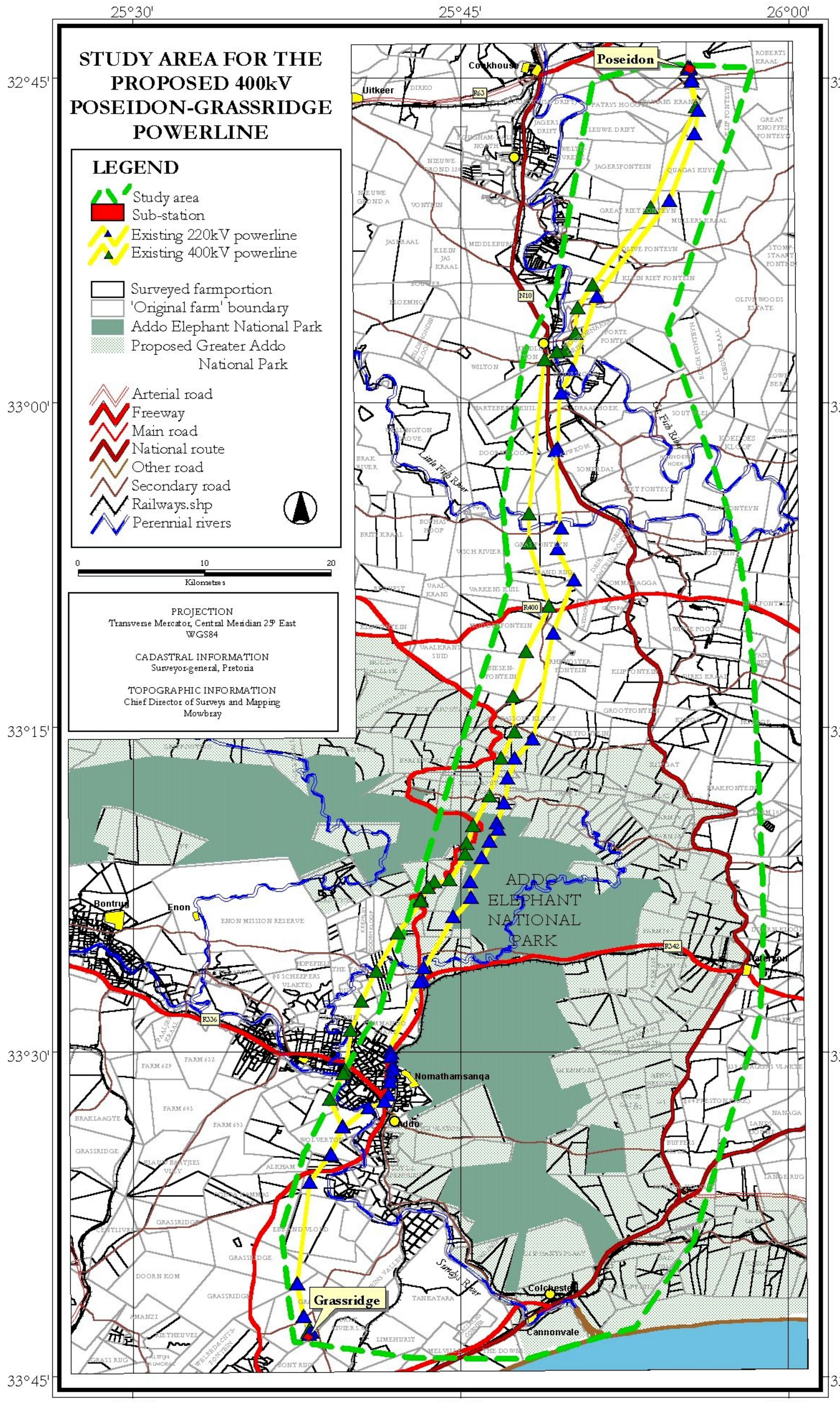

Figure 2.1: Map showing the study area and the location of the existing Transmission lines

Current land-use in this section is mainly (mixed) agricultural, with a narrow band forming part of the AENP.

2.1.3. Coastal Section

Descending from the mountainous area, the study area traverses the village of Addo, and the limestone plateau in the vicinity of the Grassridge Substation, which lies approximately 10 km inland from the coast. The study area also includes the coastal area in the vicinity of Colchester and the Sundays River mouth.

This section is formed by the African erosion surface, the Post-African surface (south of the Zuurberg Mountains) and neogene marine and coastal aeolian sediments down to the coast (Partridge and Maud, 1987). It is underlain by conglomerates, sandstones, shales and limestones of the Cretaceous System, with some superficial deposits of the Tertiary to Quaternary systems present in places.

Current land-use in this section of the study area is mainly agricultural (mixed stock and annual crops such as citrus).

2.2. Technical Details of the Tower and Transmission Line Designs

All components of a Transmission line are interdependent, but are distinct in the roles which they fulfil. These components include towers, foundations, insulators and hardware, and conductors.

2.2.1. Towers

Transmission lines are strung on in-line (suspension) towers and bend (strain) towers. Suspension towers are typically less cumbersome structures, which are less steel-intensive than bend towers. This makes them less visually intrusive, and cheaper to construct than strain towers. Therefore, Transmission line routes are planned with as few bends as possible.

The three basic tower constructions which are planned to be used for the Transmission line are:

- Self-supporting towers
- Cross-Rope Suspension (CRS) towers

- Compact Cross-Rope Suspension towers

- *Self-supporting towers*

  Older lines, such as the existing 220 kV Transmission line between Poseidon Substation and Grassridge Substation, were built using only self-supporting towers. These suspension towers are steel-intensive structures, and very heavy (up to 16 tons). The erection of these towers is time- and labour-intensive. These towers have small footprints (i.e. occupy small areas of land; typically 8 m x 8 m), and are approximately 33 m in height, on average. All strain towers (used on a "bend") are to be of this type (Figure 2.2).

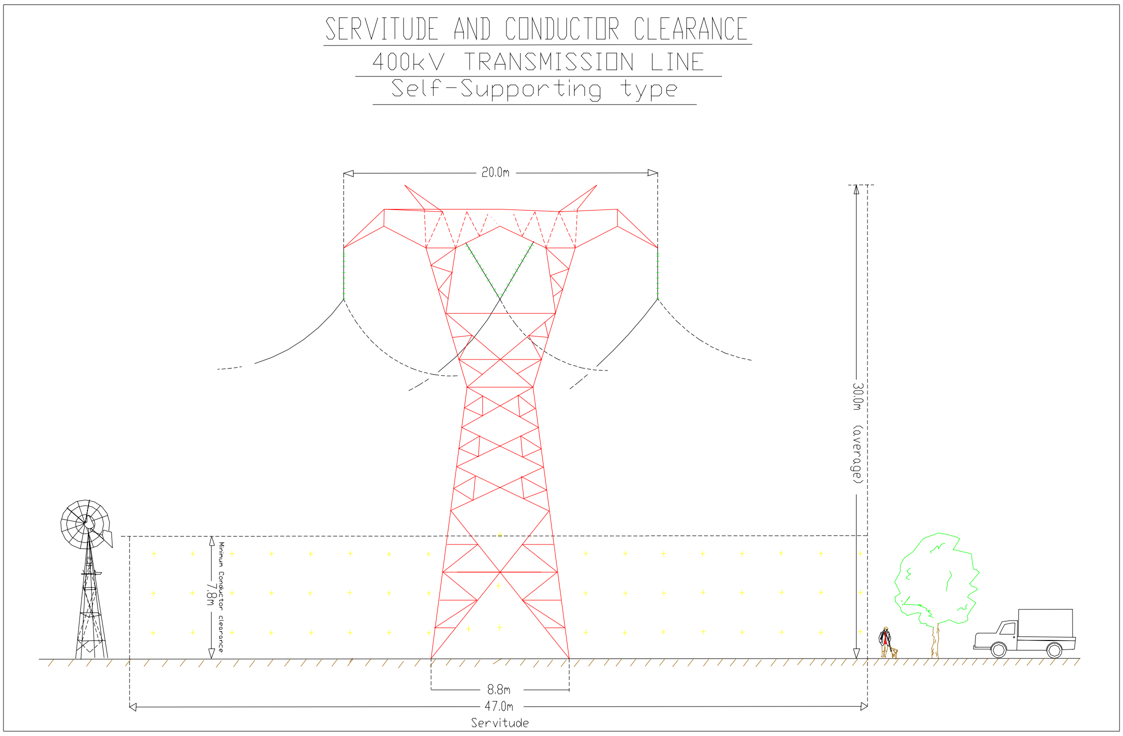

Figure 2.2: Diagrammatic representation of the self-supporting tower

- *Cross-Rope Suspension (CRS) towers*

  CRS towers were introduced in 1993, and are considerably lighter in weight than self-supporting towers, being only 4 tons on average. These towers are characterised by two steel vertical legs and a cross-rope forming the horizontal arm from which the conductors are suspended. Guys are used to securely anchor the structure (Figure 2.3). Being one of the least steel-intensive Transmission towers, they have lower visual impact, and are economical and quick to erect compared to the other tower types. The average distance between towers is required to be approximately 420 m. These towers are, on average, approximately 36 m in height, and occupy an average footprint area of 65 m x 35 m. It is, however, possible to conduct certain agricultural activities within this footprint area.

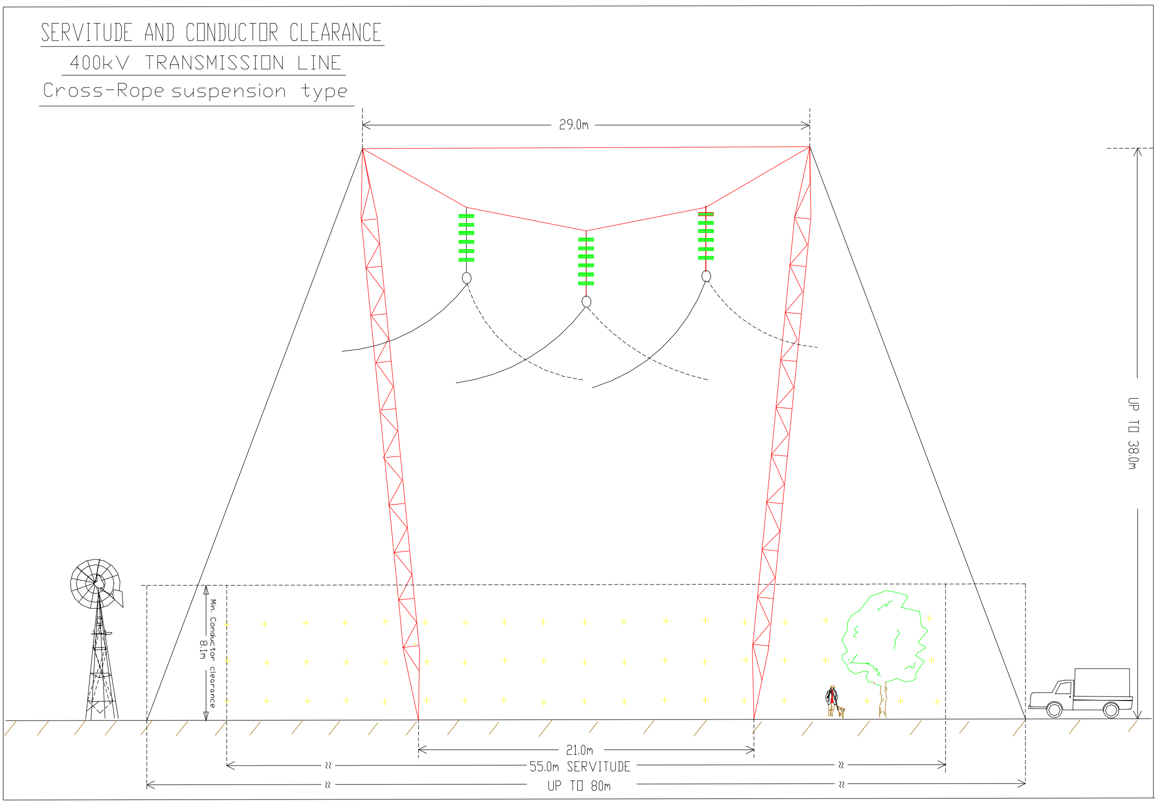

Figure 2.3: Diagrammatic representation of the cross-rope suspension tower

- *Compact Cross-Rope Suspension towers*

  A more compact variation of the CRS tower was developed in 1995, and occupies a smaller land area (50 m x 30 m on average). These towers are usually up to approximately 38 m in height. The conductors are suspended in a triangular configuration (Figure 2.4).

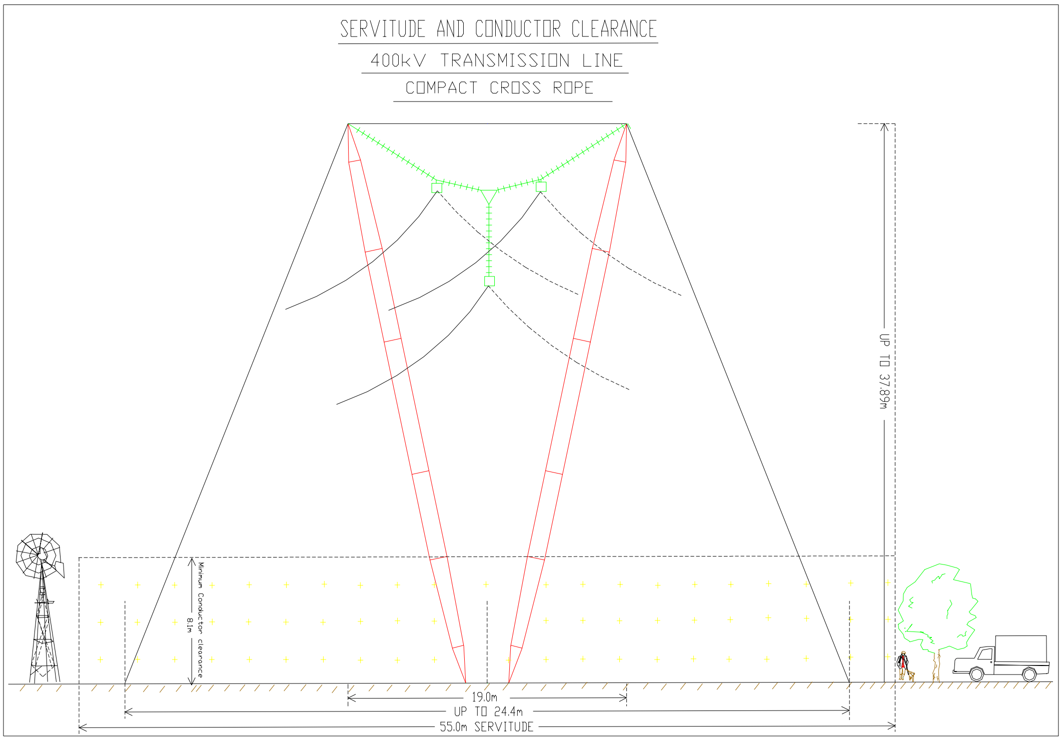

Figure 2.4: Diagrammatic representation of the compact cross-rope suspension tower

The main characteristics of the three tower types are summarised in Table 2.1.

Table 2.1: Summary of the main characteristics of the four tower types

Characteristics	Self-Supporting	Cross-Rope Suspension	Compact Cross-Rope Suspension
Weight	16 tons	4 tons	4 tons
Area	8 m x 8 m	65 m x 35m	50 m x 30m
Height	33 m	36 m	38 m
Cost	100%	70%	75%
Erection time	2 days	1 hour	1 hour
Inter-changeable?	Not at all	All parts common	All parts common

The terrain which is to be traversed may dictate the need for special design tower structures to be used (e.g. within mountainous areas characterised by steep slopes, or within areas of limited open space). The precise structures will be required to be designed upon finalisation of the Transmission line route.

2.2.2. Servitude Requirements

The servitude width for a 400 kV Transmission line is between 23,5 m and 27, 5 m from the centre line, depending on the tower type which is to be used. Any Transmission line running parallel to a 400 kV Transmission line must have a minimum separation of 35 m. Where towers are opposite one another, a minimum separation of 21 m is required in order to avoid any possible contact or shorts. The minimum horizontal clearance to any building, structures, etc not forming part of the Transmission line must be 3,2 m.

The minimum distance of a 400 kV Transmission line running parallel to proclaimed public roads must be 100 m from the centre of the Transmission line servitude to the centre of the road servitude. The minimum distance between any part of a tree or shrub and any bare phase conductor of a 400 kV Transmission line must be 3,2 m, allowing for the possible sideways movement and swing of both the above-mentioned. Clearance is to be maintained by the trimming of trees and shrubs.

2.2.3. Foundations

The choice of foundation is influenced by the type of terrain encountered, as well as the underlying geotechnical conditions. Geotevhnical requirements for all tower types are catered for by using various foundations systems, which are designed to withstand conditions varying from hard rock to waterlogged marshes. The main types of foundations include piles, pad-and-chimney, and anchors. The actual size and type of foundation to be installed will depend on the type of tower to be erected, and the actual sub-soil conditions. Strain towers require more extensive foundations for support than in-line suspension towers, which contributes to the construction expenses.

The construction of foundations is the slowest part of the line construction, and will be started some time ahead of tower erection. Prior to filling of the foundations and tower erection, excavated foundations are covered in order to safe-guard unsuspecting animals and people from injury (Photograph 2.1). The foundations also represent the biggest unknown in the cost and construction time, since access to the tower sites is required for earth-moving machinery and concrete. In the event of the site being inaccessible, foundations will be excavated by hand, and concrete delivered by helicopters (Photograph 2.2).

All foundations will be back-filled, stablised through compaction, and capped with concrete at ground level.

Photograph 2.1: Prior to filling of the foundations and tower erection, excavated foundations are covered in order to safe-guard unsuspecting animals and people from injury

Photograph 2.2: In the event of the site being inaccessible, concrete is delivered to the site by helicopters

2.2.4. Insulators and Hardware

The insulators and hardware are used to connect the conductors to the towers. The main types are glass, porcelain, and composite insulators.

Glass and porcelain have been used for many years, and are the most common. They are, however, heavy and susceptible to breakage by vandals, as well as contamination by pollution. Composite insulators have a glass-fibre core with silicon sheds for insulation. The composite insulators are light-weight and resistant to both vandalism and pollution. They are, however, more expensive than the more common glass insulators.

2.2.5. Conductors

The conductors are made of aluminium with a steel core for strength. Power transfer is determined by the area of aluminium in the conductors. Conductors are used singularly, in pairs, or in bundles of three, four or six. The choice is determined by factors such as audible noise, corona, and electro-magnetic field mitigation.

Many sizes of conductor are available, and the choice being based on the initial and life-cycle costs of different combinations of size and bundles. In coastal areas, the conductors usually have grease covering each internal layer, as this protects the steel core from corrosion.

The minimum vertical ground clearance of the largest phase conductor will be 10 m in all areas in normal weather conditions.

A maximum 8 m wide strip is to be cleared of all trees and shrubs down the centre of the Transmission line servitude for stringing purposes only. No bush clearing will be allowed within valleys, ravines, or other sensitive areas (Photograph 2.3), and alternate stringing methods will be implemented (Photograph 2.4).

Any tree or shrub in other areas which will interfere with the operation and/or reliability of the Transmission line will be trimmed or completely cleared.

Photograph 2.3: No bush clearing will be allowed within valleys, ravines, or other sensitive areas

Photograph 2.4: Alternate stringing methods, such as the use of a bow and arrow, will be implemented in sensitive areas

2.3. Construction Process

The proposed 400 kV Transmission line, of approximately 100 km in length, will be constructed in the following simplified sequence:

Step 1: Survey of the route
Step 2: Determination of the conductor type
Step 3: Selection of best-suited conductor, towers, insulators, foundations
Step 4: Design of line
Step 5: Issuing of tenders and award of contract
Step 6: Bush clearance and construction of access roads (where required)
Step 7: Construction of foundations
Step 8: Assembly and erection of towers
Step 9: Stringing of conductors
Step 10: Rehabilitation of disturbed area and protection of erosion sensitive areas
Step 11: Testing and commissioning
Step 12: Continued maintenance

2.3.1. Timing

In most cases, the construction will begin at one end and progress towards the other. However, if the construction time is limited within certain sensitive areas, work may begin at two or more points simultaneously.

Construction of the proposed new Transmission line between the Poseidon and Grassridge Substations will continue for a maximum of 18 months.

2.3.2. Bush Clearance

The minimum standards to be used for bush clearing for the construction of the proposed new Transmission line are listed in Table 2.2 overleaf (Eskom, 2000).

Table 2.2: Minimum standards to be used for bush clearing for the construction of a new Transmission line

Item	Standard	Follow up
Centre line of the proposed Transmission line	Clear to a maximum (depending on the tower type and voltage) of an 8 m wide strip of all vegetation along the centre line. Vegetation to be cut within 100 mm of the ground. Treat stumps with herbicide.	Re-growth shall be cut within 100 mm of the ground and treated with herbicide, as necessary.
Inaccessible valleys (trace line)	Clear a 1 m strip for access by foot only, for the pulling of a pilot wire by hand.	Vegetation not to be disturbed after initial clearing – vegetation to be allowed to regrow.
Access/service roads	Clear a maximum (depending on the tower type) 5 m wide strip for vehicle access within the maximum 8 m width, including de-stumping/cutting stumps to ground level, treating with a herbicide and re-compaction of soil.	Re-growth to be cut at ground level and treated with herbicide as necessary.
Proposed tower position and proposed support/stay wire position	Clear all vegetation within proposed tower position and within a maximum (depending on the tower type) radius of 5 m around the position, including de-stumping/cutting stumps to ground level, treating with a herbicide and re-compaction of soil. Allow controlled agricultural practices, where feasible.	Re-growth to be cut at ground level and treated with herbicide as necessary.
Indigenous vegetation within servitude area (outside of the maximum 8 m strip)	Area outside of the maximum 8 m strip and within the servitude area, selective trimming or cutting down of those identified plants posing a threat to the integrity of the proposed Transmission line.	Selective trimming
Alien species within servitude area (outside of the maximum 8 m strip)	Area outside of the maximum 8 m strip and within the servitude area, remove all vegetation within servitude area and treat with appropriate herbicide.	Cut and treat with appropriate herbicide.

In sensitive areas, it may be necessary to implement precautionary measures in order to ensure that particular plant species are not disturbed. The precise areas in which such measures may be required will be determined upon finalisation of the Transmission line route.

2.3.3. Access/Service Roads

Access/service roads will be required for the construction and maintenance phases. Where access roads exist, these would be used to minimise disturbance to the area. Where new access roads are required to be constructed, and it is feasible to do so, this would be required to be negotiated with the individual landowners concerned. Gates must be installed in all farm fences, boundary fences and game fences traversed by an access road. In areas where access roads are not considered viable, construction and/or maintenance on these portions of the line will be through the use of a helicopter.

2.3.4. Construction of Foundations

Foundations will most likely include the complete range of types due to the varying soil and rock types in the area. Foundations will be mechanically excavated where access to the tower sites is readily available, and dug by hand where access is poor (Photograph 2.5). The same will apply to the pouring of concrete required for the setting of the foundations.

Photograph 2.5: Where areas are inaccessible, foundations will be dug by hand

2.3.5. Erection of Towers and Stringing of Conductors

From the preliminary technical studies undertaken by Eskom, it is most probable that the CRS tower will be used for the majority of the in-line towers on the straight sections with sufficient servitude width. Either the standard or compact CRS towers will be used, depending on the system requirements. In congested areas (such as built-up areas, or rugged terrain areas), and those points where bends in the line are required, isolated self-supporting towers will be used.

The construction of any towers within the AENP will require special tower design in order to reduce the surface area required by the tower, and reduce visual impacts, where possible.

Insulators will be glass or composite, depending on the pollution levels and potential vandalism of the areas which the final route passes through.

Conductors will most likely be a triple bundle, with a conductor diameter of approximately 27 mm. Conductors are susceptible to corrosion within 50 km inland from the coast. Therefore, Transmission lines erected within the coastal zone will require precautions against the high corrosion potential.

2.3.6. Ongoing Maintenance

The standard life-span of a Transmission tower and associated components is approximately 20 – 25 years. During this period, ongoing maintenance is performed.