ALINTA LTD

DAMPIER-PERTH GAS PIPELINE COMMUNICATIONS SYSTEM

MICROWAVE SYSTEM UPGRADE DESIGN DOCUMENT

Prepared by

GIBSON QUAI - AAS PTY. LTD.

Level 2, 30 Richardson Street,
West Perth, Western Australia 6005

Tel: +61 8 9321 3166
Fax: +61 8 9321 3226
Email: perth@gqaas.com.au

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ABOUT THIS DOCUMENT

TITLE: Microwave System Upgrade Design Document

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AUTHORISED: Gary Worsdell

ABSTRACT: This document presents a feasibility study for upgrading the Alinta Dampier-Perth Gas Pipeline 7.5 GHz Microwave system to a 155 Mbit/s 6.7 GHz Microwave System.

DOCUMENT HISTORY

Rev	Date	Description	Author	Reviewed
A	23/08/2006	First draft	NP/BG	-
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EXECUTIVE SUMMARY

The existing microwave radio system which supports the Dampier to Bunbury Natural Gas Pipeline (DBNGP) is ageing and subject to potential failures. This microwave system is very important to the operation of the pipeline because it carries all of the important SCADA communications relating to the pumping and monitoring of the gas flows along the pipeline. Furthermore it carries operational voice traffic (telephony) and mobile radio traffic.

DBNGP communications consists of a 43 hop, NEC 7.5 GHz, 300 channel analogue microwave system utilising dual frequency horns on the microwave antennas. The second frequency was used to carry the Telstra 6.7 GHz, 960 channel analogue system, which was progressively decommissioned by Telstra during the period 1995 to 2003 and is no longer in operation.

The functional objectives of the new microwave radio system are:

a) To maintain communications with SCADA Remote Terminal Units (RTUs) which are located at sites along the pipeline and used to monitor and control the gas flow along the pipeline.

b) Provide corporate LAN and other communications circuits (phone and fax) for pipeline maintenance and operations personnel.

The 1340 km, 43 hop route for the replacement microwave radio system is proposed to follow the existing route from Karratha to Perth, with the following exception:

a) At Perth the system will terminate at Alinta premises in the Allendale building rather than at Western Power's depot at East Perth (R43). The final path from Gnangara (R42) to Allendale building in Perth city has the option of being a microwave link or optic fibre.

Subject to confirmation of mast loading, it is proposed to provide a split indoor/outdoor fully protected 155 Mbit/s bearer in the main plus protection configuration with frequency diversity and space diversity on all hops. This is referred to as 1+1 FD plus SD. In each direction of transmission there will be mast head mounted equipment:

It is proposed to use the existing Alinta shelter at all repeater sites, to provide a clean, dry and temperature regulated environment to ensure correct operation of the microwave system.

It is proposed that new DC power systems including DC regulation, AC rectifiers and back up batteries be provided at all repeater and terminal sites.

Due to the high cost of time and materials required to replace the solid parabolic antennas, GQ-AAS recommends and has assumed the re-use of the current antennas. Performance predictions indicate that antenna re-use is a feasible option.

The current microwave antennas are fitted with dual horns and in recent years, the cost to manufacture similar dual horn antennas to those employed in the current system has increased significantly (from approximately $6,000 each to $70,000+ each). GQ-AAS recommends and has assumed the re-use of the current antenna horns. Performance data compiled by GQ-AAS predicts that antenna horn re-use is a feasible option.

The shortage of equipment space will require an external battery cabinet to be installed at each site. This battery cabinet will house the backup batteries for the new equipment in the shelter

Western Power has indicated an interest in retaining the current 7.5 GHz portion of the microwave system south of, and including R29 Eradu, plus the single hop R0 to R1. Further Western Power wishes to use the mast at Wandana (R28) but does not require the analogue microwave radio system to be retained at that site.

It is envisaged that the new system will run in parallel to the old system for at least ninety (90) days during the cut over phase, and for a number of years for those sites which Western Power will be retaining (south of, and including R29 Eradu).

GQ-AAS recommends and assumes that the current waveguide, dehydrator and pressurisation equipment for the 6.7 GHz portion of the system will be decommissioned and recovered for those sites north of R29 Eradu. For those sites to be retained by Western Power, the 6.7 GHz waveguides should be removed.

As a result of the design and budgetary quotation works, GQ-AAS formed the following main conclusions:

a) Based on the design carried out by GQ-AAS, a reliable replacement microwave radio system can be engineered and implemented along the existing microwave radio route, to deliver a capacity of 155 Mbit/s which is approximately 7 times that provided by the existing system.

b) The new system will deliver circuits which are compatible with the existing interfaces, and compatible with proposed IP interfaces envisaged by TUSC for future networking of SCADA circuits.

c) The estimated cost of the replacement system based on a split mount configuration is $10 million. This is based on quotations from vendors and should be confirmed by formal tender.

1. INTRODUCTION

The existing microwave radio system which supports the Dampier to Bunbury Natural Gas Pipeline (DBNGP) is ageing and subject to potential failures. This microwave system is very important to the operation of the pipeline because it carries all of the important SCADA communications relating to the pumping and monitoring of the gas flows along the pipeline. Furthermore it carries operational voice traffic (telephony) and mobile radio traffic.

In March, Gibson Quai – AAS (GQ-AAS) delivered a strategic plan that made a number of recommendations in relation to the replacement of the old microwave radio system, including:

- The preferred replacement option is based around a 155 Mbit/s SDH[1] digital microwave radio along the pipeline.
- Monitor the development of third party or joint venture owned optical fibre options.
- Develop a costing model of the optic fibre option that shares the pipeline expansion trench.

This report provides a system design and refined budgetary cost estimate to replace the existing microwave radio system as per the SDH microwave recommendation above. This project does not cover the work associated with preparation of a tender document or assistance with a tender evaluation.

The logical next step is to prepare a tender document and seek tenders from the market based on the design as presented by this report.

Throughout the report, GQ-AAS has retained the naming and numbering convention for sites which form the existing system.

2. SCOPE OF WORK AND METHODOLOGY

The following scope of work sets out the activities undertaken to complete the SDH microwave system design. Some minor scope changes occurred during the project as indicated in the Comments column below.

SCOPE	COMMENT
• Developed system performance criteria including availability and bit error performance objectives.	
• Acquire information about work done by Telstra post original installation regarding structures, frequency changes, antenna change outs and receive signal levels (RSL) at time of decommissioning.	Not provided by Telstra at the time of preparation of this draft. GQ-AAS utilised anecdotal comments, Western Power and Alinta records, Alinta system performance and previous design data to form an opinion on design criteria.
• Path Engineering including path	

[1] SDH Synchronous Digital Hierarchy is an international standard for synchronous data transmission which provides faster and less expensive network interconnection than previous technologies. SDH uses Synchronous Transport Modules (STM) and in this case the selected rate is STM-1 (155 megabits per second).

SCOPE	COMMENT
profiles for every hop and checking of path clearances	
• Transmission Engineering including selection and reservation of frequencies and development of a preliminary frequency plan	
• Select industry equipment parameters including fade margins, performance prediction, complete frequency plan, overshoot and interference assessment, rainfall attenuation and prepared performance worksheets.	
• Negotiate acquisition of Telstra buildings and make arrangements for access to the buildings to assess their condition	Telstra indicated an intention to retain the Telstra shelter at each site. A decision was made to use the Alinta shelter plus supplementary battery shelter.
• Engage Western Power to provide internal and external plant/equipment condition report, including mast and tower condition.	
• Carry out site visits to examine existing equipment site condition and assess work required to upgrade old Telstra buildings.	
• Develop site by site data base	
• Design power supplies for each site	
• Build an equipment and activities schedule	
• Develop budgetary cost model	
• Prepare system design report	This document.

2.1 REFERENCE DOCUMENTATION

Reference documentation is tabulated in Appendix A.

3. EXISTING PIPELINE COMMUNICATIONS

The existing DBNGP communications consists of a 43 hop, NEC 7.5 GHz, 300 channel analogue microwave system with:

- Electric Power transmission (EPT) masts or towers with sufficient height to provide path clearance for a 6.7 GHz (960 channel system for Telstra) and 7.5 GHz (300 channel for Alinta /Western Power) systems.
- Dual Andrews microwave antennas (either 2.4 m or 3.7 m dishes) in each direction with dual frequency horns (6.7 GHz & 7.5 GHz) installed on every antenna for sites Yanyare (R2) to Muchea (R41). At Cajuput Well (R1) only the south facing antennas are dual frequency type. Similarly at Gnangara Road (R42) only the north facing antennas are dual frequency.
- Elliptical radio frequency (RF) feeder waveguides connecting each antenna and frequency horn to the radio transmitters/receivers with a dry air pressurisation system to minimise corrosion of the feeders and provide a means to monitor the integrity of the waveguides.
- Dual, passive thermal design, double skin equipment shelters – one for the Alinta microwave radio equipment and one for the Telstra microwave radio equipment.
- Dual high capacity, -24 VDC rectifier and battery power supply systems. Of the total 43 microwave radio repeater sites, primary power at 20 sites is generated with Closed Cycle Vapour Turbines (CCVT) providing -24 VDC and the remaining sites are powered from the Western Power AC grid. All sites have back up gas powered, auto start motor /alternator sets capable of generating 254 VAC.
- Pipeline SCADA[2] and operational mobile radio systems.
- Small Capacity analogue or digital radio spur systems at specific repeater sites.

The Telstra 6.7 GHz, 960 channel analogue system was progressively decommissioned by Telstra during the period 1995 to 2003 and is no longer in operation. However, the shelters and waveguide feeders (at most sites) are still installed at the sites.

[2] SCADA – Supervisory Control And Data Acquisition.

4. PROPOSED PIPELINE COMMUNICATIONS

This section proposes design objectives for the replacement microwave radio system and uses those objectives to develop path engineering, transmission engineering and system engineering for the new system.

4.1 PROPOSED DESIGN OBJECTIVES

4.1.1 Functional Objectives

The functional objectives of the new microwave radio system are:

a) To maintain communications with SCADA Remote Terminal Units (RTUs) which are located at sites along the pipeline and used to monitor and control the gas flow along the pipeline.

b) Provide corporate LAN and other communications circuits (phone and fax) for pipeline maintenance and operations personnel.

Operations and maintenance along the pipeline is provided through National Power Services (NPS, a wholly owned Alinta company). NPS personnel who provide operations and maintenance services use accommodation at pipeline compressor stations.

Communications facilities required at each of the 9 compressor stations north of Perth to support the maintenance crews consist of the following:

1. Voice services typically 4 or 5 telephones plus facsimile.
2. Access to corporate data applications including email.
3. Access to the Internet.
4. Access to the SCADA remote operator system.

To accommodate the above requirements, the new system will offer 4 Ethernet channels and a number of 2 Mbit/s data streams (E1 channels) depending on the site. The E1 channels will provide capability for digital (and analogue if required) circuits for telephone, facsimile, low speed data and other audio circuits. It is envisaged that one Ethernet channel will be used for SCADA, one channel for the corporate LAN, and one channel for IP voice requirements.

Implementing this configuration will allow Alinta to replace the RTUs with smaller Ethernet compatible devices as the RTUs reach end of life.

4.1.2 Availability/Unavailability Objective

Three availability (unavailability[3]) objectives are considered in this section:

a) Original design objective as required by SECWA and applied by Telecom in 1981 for the current microwave radio system.

b) Current operational objectives for delivery of services by Western Power to Alinta;

c) International objectives for design, operation and maintenance of digital microwave radio systems and as recommended by the ITU.

[3] Availability = 1 – unavailability and Unavailability = MTTR * FIT where
FIT is failures in Time as a rate per 1000 million hours for equipment modules and
MTTR is the Mean Time To Restore a service. MTTR includes notification of a fault, travel and repair.

These refer to the end to end availability of any circuit (voice or equivalent data circuit) and dependent on radio propagation, power supply and equipment reliability. For the purpose of this document, a circuit is either 4 kHz (0.3 to 3.4 kHz) in the analogue domain or 64 kbit/s in the digital domain.

The relative objectives are tabulated below in Table 1:

OBJECTIVE SOURCE	ANNUAL	MONTHLY UNAVAILABILITY
SECWA	99.99%	< 0.003%
Western Power / Alinta[4]		
Main radio bearer (FIT=1250, average MTTR 12 hours)	99.99%	Not defined
Priority voice frequency (VF) circuit drops (FIT=12500, average MTTR 24 hours)	99.9%	Not defined
Non priority voice frequency (VF) circuit drops (FIT=12500, average MTTR 168 hours)	Not defined	Not defined
DC secondary power supplies (FIT=1000, average MTTR 12 hours)	99.995%	Not defined
ITU-T	99.95%	< 0.006%

Table 1 Comparison of Availability objectives

It is noted that the Western Power objectives exclude loss of service due to propagation. These objectives cannot be adopted in the design of a replacement system where the equipment and frequency band are proposed to be changed, even though the path lengths and antenna heights are fixed.

The performance (BER bit error ratio) and availability objectives for digital radio-relay systems are specified in ITU-R (CCIR) Recommendations 594 and 557 respectively. These objectives refer to a 2,500 km 64 kbit/s Hypothetical Reference Digital Path (HRDP) as defined in ITU-R (CCIR) Recommendation 556.

The HRDP is considered to be unavailable if one or both of the following conditions occur in each of 10 or more consecutive seconds;

- The BER is greater than 10^{-3}
- The digital signal is interrupted.

The availability objective for the HRDP is 99.7% of the time measured over a period of at least one year. The 0.3% unavailability objective is usually equally allocated between propagation fading (0.1%), equipment failure (0.1%) and power supply (0.1%) outages.

[4] Reference Appendix 8.A, “Ownership, Management and Service Agreement for Dampier/ Perth/ Bunbury Microwave Radio System between Western Power and AlintaGas”

The 0.1% unavailability objective for the 2,500 km HRDP is subdivided for actual system in a linear proportion with distance (d);

0.1% x d/2500.

For the 1340 km DPNGP system this translates to an unavailability objective of 0.054%.

On consideration of the different objectives, GQ-AAS decided to adopt the original design objectives as follows:

OBJECTIVE	ANNUAL	MONTHLY UNAVAILABILITY
Availability	99.99%	< 0.003%

Table 2 Availability Objectives

This is the availability design objective that we have applied to the system design.

4.1.3 Performance Objective

The performance objectives for the HRDP apply to the periods when the HRDP is available. The objective is that BER is not to exceed 1 x 10^{-3} for more than 0.05% of any month. Again for an actual system this objective is subdivided in a linear proportion with distance (d);

0.05% x d/2500

For the 1340 km DPNGP system this translates to a BER 10^{-3} performance objective of 0.027% for any month.

4.2 PATH ENGINEERING

4.2.1 Route

The 1340 km, 43 hop route for the replacement microwave radio system is proposed to follow the existing route from Karratha to Perth, with the following exception:

a) At Perth the system will terminate at Alinta premises in the Allendale building rather than at Western Power's depot at East Perth (R43). The final path from Gnangara (R42) to Allendale building in Perth city has the option of being a microwave link or optic fibre.

The route map is shown below in Figure 4-1: Route Map.

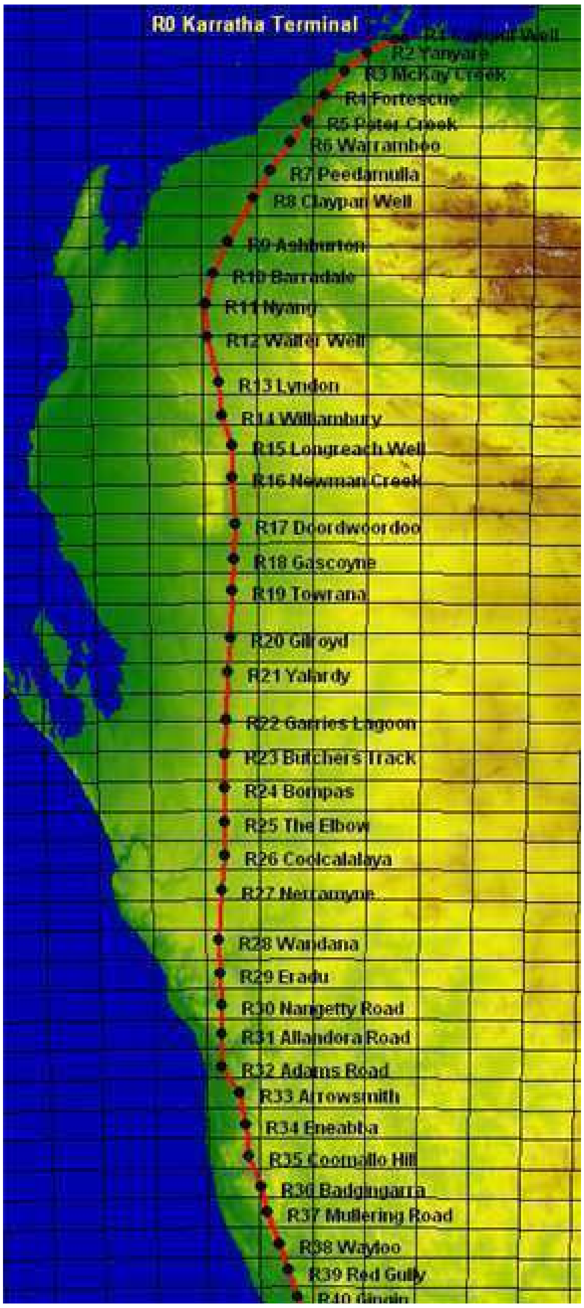

Figure 4-1: Route Map

4.2.2 Clearance Criterion

The clearance criterion adopted for the replacement microwave radio system is K=0.6 with 60% of the First Fresnel Zone at 6.7 GHz for each radio path. This is developed from the following analysis.

The original path engineering for the SECWA DBNGP 7.5 GHz and Telstra 6.7 GHz systems was dictated by the design requirements of the SECWA system in that the SECWA design determined the antenna sizes and mounting heights at each of the repeater sites. The original antenna heights were selected such that the noise (for the analogue system) and outage levels, during diffraction fading under sub-refractive conditions, were kept within acceptable limits. For the SECWA system the path clearances were set at antenna heights such that the diffraction loss (in excess of the free space path loss) should not exceed a value of 30 dB at an expected worst case K factor of 0.3.

Typical paths were modelled as a smooth earth and an equivalent and simplified clearance requirement was calculated to ensure the above diffraction loss target was met. At 7.5 GHz, this model translated into a path clearance of 60% of the first Fresnel Zone at a K factor of 0.50 for 32 km paths or K factor of 0.41 for 45 km paths. The equivalent clearance for Telstra's 6.7 GHz system was K=0.514 for 32 km paths and K= 0.416 for 45 km paths.

The clearances for 7.5 GHz and 6.7 GHz are very similar. In addition, there are now more accurate computerised terrain elevation databases available compared to the paper based maps available in 1981/82 when the DBNGP was originally designed. GQAAS has recalculated path clearances for each of the hops with a clearance objective of K=0.6 with 60% of the First Fresnel Zone.

We have calculated that the path clearance provided by the existing antenna mounting heights should be sufficient to ensure that outages due to sub-refractive fading are within the required availability objective.

The result of the revised path profiling is that all paths meet the required path clearance objective except for the following paths:

1. Warramboo (R6) – Peedamulla (R7)
2. Barradale (R10) – Nyang (R11)
3. Bompas (R24) – The Elbow (R25)
4. Arrowsmith (R33) – Eneabba (R34)
5. Eneabba (R34) – Coomallo Hill (R35)
6. Mullering Rd (R37) – Walyoo (R38)

That the antenna heights on the above paths do not meet the selected path clearance criterion of K=0.6 with 60% of the First Fresnel Zone, is due to the methodology applied in the SECWA design where each path was modelled as a smooth earth with a terrain relative level (RL) that is an average of the terrain irregularities. We have assessed that the infringement of the terrain obstructions into the above paths is not sufficient to degrade the overall system BER and outage performance.

4.2.3 Path Profiles

Path profiles have been plotted for all paths R0 to R42. The current path for R42 to the Allendale building is currently unknown and as such no profile was completed for this link.

Refer to Appendix D for detailed path profiles.

4.3 TRANSMISSION ENGINEERING

In this section, transmission engineering aspects are examined for a 43 hop, 155 Mbit/s bearer capacity, baseband repeating system to operate at 6.7 GHz between Karratha and Perth.

For all transmission analysis, the current link from R42 to R43 has been used in place of a possible link from R42 to the Allendale building.

In the portion from Eradu (R29) to Perth, the system is required to operate in parallel with the existing 7.5 GHz system for continued services to Western Power.

Two primary options are examined for the equipment arrangement - fully indoor or split mount (ODU/IDU), and two bearer capacity alternatives are considered to form a view on reliability.

The transmission aspects considered are as follows:

a) Performance objectives;

b) Circuit requirements;

c) Assessment of path engineering factors for any impact on reliability techniques such as vertical space diversity;

d) Selection of suitable equipment parameters;

e) Assessment of possible interference sources;

f) Nomination of a frequency and polarisation plan;

g) Prediction of faded and unfaded performance;

h) Comparison of predictions with objectives.

4.3.1 Performance objectives

The proposed performance objectives are as follows:

Availability
Any 64 kbit/s circuit shall have availability due to propagation, equipment and power annually of better than 99.99% and worst month availability of better than 99.997%

While the circuit is available, the circuit performance should be calculated as follows:

Errored seconds
0.32*d/2500 = 0.17%

Severely errored seconds

0.54*d/2500 = 0.29%

4.3.2 Circuit requirements - bearer capacity

The proposed bearer and circuit capacities are as follows:

4.3.2.1 End to end

The proposed bearer capacity is 155 Mbit/s SDH.

Only one bearer is required. For reliability reasons, the following bearer arrangements were considered:

- Protected with hot standby and space diversity (1+0, HSB, SD)

- Protected with frequency diversity and vertical space diversity (1+1, SD)

4.3.2.2 At Perth

Access is required to all circuits.

4.3.2.3 At each repeater site

a) 4 Ethernet channels

b) A minimum of one E1 (2 Mbit/s).

Standard repeater sites should have a shared E1 dropped out for access to 5 circuits. This would allow a single E1 to be shared between 6 different repeater sites.

4.3.2.4 At compressor stations:

a) 4 Ethernet channels

b) A minimum of one E1 (2 Mbit/s).

Compressor station adjacent sites should have a dedicated E1 with access to all 30 circuits

Communications facilities required at each of the 9 compressor stations north of Perth to support the maintenance crews consist of the following:

1. Voice services typically 4 or 5 telephones plus facsimile.
2. Access to corporate data applications including email.
3. Access to the Internet.
4. Access to the SCADA remote operator system.

4.3.2.5 At Karratha end (R0)

a) 4 Ethernet channels

b) A minimum of one E1 (2 Mbit/s).

The Karratha terminal will be at the joint radio Alinta/Western Power facility R0 adjacent to the Horizon depot. This facility has public carrier provided optical fibre.

Extension to Perth is proposed for a redundant circuit via the public network of SCADA circuits and capacity for alternate access to the corporate LAN. Two separate circuits, each of 128 kbit/s (ie total of 256 kbit/s) is proposed.

4.3.3 Path engineering factors

The site positions and antenna mounting heights are fixed. However improved terrain data is available since the original system design in 1981, so the potential for reflections and any influence on diversity spacing were examined.

4.3.3.1 Reflection Analysis

Reflection analysis for the 6.7 GHz system upgrade validated the potential for reflections on the following paths:

Cajuput Well to Yanyare

Fortescue to Peter Creek

Peter Creek to Warramboo

Peedamulla to Claypan Well

Nyang to Walter Well

Walter Well to Lyndon

Doordwoordoo to Gascoyne

Towrana to Gilroyd

Yalardy to Garries Lagoon

Butchers track to Bompas

Bompas to The Elbow

Red Gully to Gingin

Gingin to Muchea.

4.3.3.2 Space Diversity

Every repeater site has two antennas installed and can thus support vertical space diversity configurations. It was decided to adopt vertical space diversity on all hops for the following reasons:

a) Those paths which exhibit reflection fading;

b) Those additional paths which require vertical space diversity to counter multipath fading and achieve system design objectives.

Links R0 to R1 and R42 to Allendale (if a radio option is selected) will require new antennas as these links are only equipped with single frequency horns.

4.3.4 Performance prediction

To assess the likely performance of a replacement microwave system operating at 6.7 GHz with a bearer capacity of 155 Mbit/s, GQ-AAS used a software radio path analysis tool Pathloss version 4 by Contract Telecommunications Engineering of Canada. This tool is highly regarded in the radio industry.

4.3.4.1 Input parameters

For the purpose of predicting likely system performance the following equipment parameters were selected as indicative industry figures, and environmental figures based on geography:

Frequency	6700 MHz
Transmitter power	+29 dBm (Split IDU/ODU), +32 dBm (IDU)
Waveguide loss (dB/100m)	+5.10 dB
Filter + Circulator Loss	3.45 dB
Antennas gains	42 dB (2.4m), 45.3 dB (3.7m)
C factor (environmental factor used in prediction software tool for assessment of fading)	2

Average annual temperature	R00-R09: 24 deg C R09-R15: 23 deg C R15-R22: 22 deg C R22-R29: 21 deg C R29-R36: 20 deg C R36-R43: 19 deg C

4.3.4.2 Equipment arrangement – indoor or split mount

Separate performance predictions were carried out for the two equipment arrangements:

- Protected with hot standby and space diversity (1+0, HSB, SD)
- Protected with frequency diversity and vertical space diversity (1+1, SD)

4.3.5 Frequency and Polarisation Plan

The existing system follows the pipeline which has a straight portion between Doordwoordoo and Eradu. As noted in the original design and verified by field visit in August 2006, there is very little protection from unwanted signals along the route afforded by either the terrain or the vegetation.

Accordingly, it is proposed to adopt an 8 frequency plan in the section from Doordwoordoo and Eradu and 4 frequency plan for the remainder of the route.

The previous Telstra 6.7 GHz design was for a 1+3, 960 channel analogue bearer. It included a frequency and polarisation plan designed to ensure the 1+3 bearer configuration could be fully equipped for an analogue system. Digital radio systems have greater protection against co-channel and adjacent channel interference than analogue radio systems.

Since Telstra has de-commissioned their original 6.7 GHz system, it is proposed to re-use the Telstra frequency and polarisation plan.

A detailed preliminary frequency plan can be found in Appendix H.

4.3.6 Assessment of interference sources

4.3.6.1 Interference from within the system

The existing 7.5 GHz 300 channel analogue system will continue to be operated by Western Power for the sites between East Perth and Eradu. Also, the sites north of Eradu will have to operate for an interim period whilst the replacement 6.7 GHz, 155 Mbit/s system is commissioned. The frequency interference potential to the existing 7.5 GHz system is increased by replacing the 960 channel analogue system with a digital 155 Mbit/s system. However, there is sufficient frequency separation between the 6.7 GHz and 7.5 GHz band plans, including having the opposite transmit sense for the two frequency bands, that interference from the digital to the analogue system is predicted to be negligible.

Maintaining the existing frequency plan is essential to prevent interference to the existing 300 channel analogue system.

Note that though Telstra have decommissioned their 6.7 GHz, 960 channel analogue system they continue to hold and pay for some 6.7 GHz frequency allocations along the route (see Appendix H). Ongoing negotiations are required to be undertaken with Telstra to establish if they are prepared to release the remaining 6.7 GHz frequencies of their decommissioned analogue system. If Telstra is not prepared to release the frequencies then there are still sufficient available frequencies along the route to provide for the new digital system with the only penalty being the reduced frequency separation between the main and standby radio bearers that would may result a nominal decrease in the frequency diversity improvement than would otherwise be the case.

The polarisation and frequency sense at each site for the proposed digital bearer is fixed by the existing analogue systems and the existing 6.7 GHz antenna horns.

The proposed frequency and polarisation plan for the DPNGP microwave radio system upgrade is detailed in Appendix H.

4.3.6.2 Interference to/from outside of the system

A check of the ACMA frequency database for any new 6.7 GHz frequency interference sources indicated no additional potential interfering sites.

Further, Telstra has de-commissioned the West East 6.7 GHz system (Yokine-Sawyers Valley), the Karratha to Port Hedland 6.7 GHz system and the first hop of the Karratha to Paraburdoo 6.7 GHz system.

The earth station at Carnarvon has been decommissioned.
Earth stations at Gnangara do not interfere with and do not suffer interference from the existing DBNGP 6.7 GHz link.
A new earth station at New Norcia is not affected by the existing DBNGP 6.7 GHz link.

Due to the nominal north south alignment of the route, there is no potential infringement of the geostationary satellite orbit.

4.3.7 System Performance – Comparison with Objectives

The detailed Availability and BER performance predictions are included in Appendix E and Appendix F respectively. The calculations were based on two configuration options, split mount and fully indoor:

a. Split mount
Outdoor Unit (ODU), mast mounted, microwave RF repeaters with associated IF Indoor Units (IDU) installed in the existing equipment shelters. The RF ODUs include high power RF amplifiers producing 29dBm RF transmit power.

b. Fully indoor
Conventional IDU microwave RF repeaters connected to the antennas by elliptical microwave waveguides.

The advantages of the split mount, ODU/IDU option are:

- Reduces the RF power losses otherwise incurred with the long waveguides, resulting in higher Received Signal Levels (RSL) and larger fade margins. Therefore improved BER and availability performance are expected with the split mount version.
- Reduces the added maintenance costs resulting from maintaining the waveguide pressurisation systems.

- Less space is required in the equipment shelters and less heat load applied to the passive thermal shelter design.
- ODU/IDU systems are lower cost to purchase.

The disadvantages are:

- The nominal additional loading on the repeater masts/towers, of the ODU.
- More complex equipment maintenance, since riggers must be employed to changeover faulty ODU equipment.
- Since the ODU is mounted on the mast it is more susceptible to vandalism or attack. It is noted that there is no history of such problems on the existing pipeline system.

Based on the ODU/IDU equipment the predicted BER performance and availability are:

- availability is 99.99275% compared to the objective of 99.99%
- 1 x 10^{-3} BER (SES) performance is 0.0054% compared to the objective of 0.2876%. This is well within the objective.

Based on the IDU equipment alternative the predicted BER performance and availability are:

- availability is 99.9848% compared to the objective of 99.99%
- 1 x 10^{-3} BER (SES) performance is 0.0730% compared to the objective of 0.2876%.

4.4 SYSTEM ENGINEERING

4.4.1 System Bearer Configurations

Subject to confirmation of mast loading, it is proposed to provide a split indoor/outdoor fully protected 155 Mbit/s bearer in the main plus protection configuration with frequency diversity and space diversity on all hops. This is referred to as 1+1 FD plus SD.

In each direction of transmission there will be mast head mounted equipment:

a. A main plus protection transmitter and main plus protection receiver connected to the top antenna.

b. A main plus protection receiver connected to the lower antenna.

A block diagram of the proposed bearer configuration is provided below in Figure 4-2.

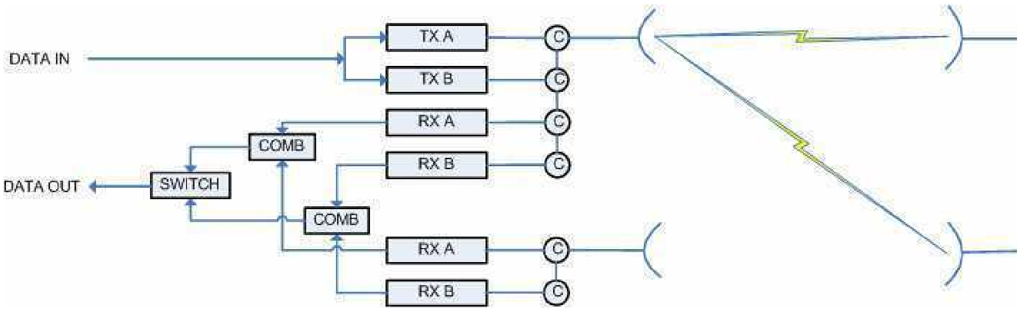

Figure 4-2: Block diagram of frequency and space diversity implemented at the physical layer of the DBNGP microwave system

This configuration is proposed for the following reasons.

Alinta's existing 7.5 GHz, 300 channel analogue system is configured as a dual frequency, dual path system with baseband switching where the main transmitter and receiver is connected to the main antenna and the standby transmitter / receiver is connected to the diversity antenna. This provides some level of frequency and space diversity and full equipment redundancy.

The original Telstra 6.7 GHz, 960 channel analogue system was configured with main and standby transmitters and receivers connected to the main antennas and, on a limited number of hops that required space diversity to improve BER performance or overcome path reflection issues, main and standby diversity receivers were connected to the diversity antenna with a hitless switch selecting the bearer with lowest noise.

The limited anecdotal bearer performance information that has been made available to GQ-AAS indicates that the Telstra system configuration provided a better performance than the 7.5 GHz system. This was supported in calculations for the new replacement system.

To ensure that the new system meets the BER performance objectives it is proposed that space diversity will be applied to all hops of the system.

4.4.2 Equipment Shelters

It is proposed to use the existing Alinta shelter at all repeater sites, to provide a clean, dry and temperature regulated environment to ensure correct operation of the microwave system.

The existing equipment shelters are of a dual skinned, passively cooled and thermally transparent design which negates the need for air-conditioning equipment to regulate the internal temperature.

These shelters are in excellent condition for their age and will continue to provide an adequate environment for the electronic equipment for many more years. The current state of these shelters can be attributed to the regular maintenance which has been performed and which should continue in order to guarantee the future state of all shelters.

Modification to the feeder entry window on some shelters may be required to allow for additional feeder ports (dependant on site). Sample site inspection indicated that additional equipment has been installed on some sites, utilising the spare feeder ports. At this time, it is envisaged that only minor works would be required such as drilling up to 4 holes 16 mm to 20 mm diameter in the existing entry window plate for gland type fittings.

4.4.3 Power Supply and Rectifiers

It is proposed that new DC power systems including DC regulation, AC rectifiers and back up batteries be provided at all repeater and terminal sites.

The existing primary power is either by mains 254 VAC, or by -24 VDC locally generated by a gas powered CCVT. The mains powered sites are in most instances located near compressor stations or close to cities or towns. CCVT powered sites are generally located in rural areas. The CCVT is capable of adjusting output to meet varying load requirements.

Backup power is currently provided in two stages. The first stage is through locally generated 254 VAC by normally stationary plant, and the second stage is designed to provide a 24 hour battery backup. The current backup batteries at sites north of Eradu are at end of life. Backup batteries have been recently replaced at sites south of and including Eradu however these are dimensioned for the existing microwave system which is required by Western Power to be retained in service for several years.

There is insufficient space in the existing Alinta shelter for new batteries co-resident with the existing equipment. Accordingly it is proposed that an external battery cabinet be provided at all sites.

4.4.4 Antennas

Due to the high cost of time and materials required to replace the solid parabolic antennas, GQ-AAS recommends and has assumed the re-use of the current antennas. Performance predictions indicate that antenna re-use is a feasible option.

The existing antennas were manufactured by Andrews and are primarily 2.4 m in diameter with a gain of 42 dBi at 6.7 GHz, however; there are a small number of sites with extended path lengths which implement 3.7 m antennas and have a gain of 45.3 dBi at 6.7 GHz.

According to the maintenance reports provided by CCR[5], these antennas are in good condition and hence suitable for continued use. The aviation orange paintwork is also in good order.

[5] Catalyst Communication Rigging, rigging company responsible for current external plant maintenance.

Links R0 to R1 and R42 to Allendale (if a radio option is selected) will require new antennas.

4.4.4.1 Antenna Horns

The current microwave antennas are fitted with dual horns and in recent years, the cost to manufacture similar dual horn antennas to those employed in the current system has increased significantly (from approximately $6,000 each to $70,000 each). GQ-AAS recommends and has assumed the re-use of the current antenna horns. Performance data compiled by GQ-AAS predicts that antenna horn re-use is a feasible option.

Alinta currently uses the 7.5 GHz part of the horn and previously Telstra made use of the 6.7 GHz part of the horn. The new Alinta system will utilise the 6.7 GHz part of the horn and use of the new system will run in parallel to the old system for a period of time.

According to the maintenance reports provided by CCR, the antenna horns are in good condition and hence suitable for continued use. Any of the 6.7 GHz diversity horns not used, or any horns which have had the waveguide removed since the original implementation date have been capped with a ferrite plug by Telstra to maintain pressurisation of the waveguide system.

Note that the dry air pressurisation extends from the Alinta side through the horn to the 6.7 GHz horn flange where a waveguide window is used to separate the two pressurisation systems.

Links R0 to R1 and R42 to Allendale (if a radio option is selected) will require new 6.7 GHz horns fitted to the new antennas.

4.4.5 Waveguide, Dehydrator, Pressurisation

GQ-AAS recommends and assumes that the current waveguide, dehydrator and pressurisation equipment for the 6.7 GHz portion of the system will be decommissioned and recovered for those sites north of R29 Eradu. For those sites to be retained by Western Power, the 6.7 GHz waveguides should be removed.

A split indoor/outdoor mounted system is favoured as the losses associated with fully indoor mount equipment plus waveguide are high and effective transmitted powers lower than that achievable by the use of split mount and coaxial cable (waveguide losses are approximately 3 dB greater). Furthermore, waveguide contributes an increased wind load on each mast/tower structure compared to suitable coaxial cable.

If a completely indoor system were to be implemented, the current condition of the waveguides would require them to be replaced at great expense. Currently, the 6.7 GHz portion of the microwave system is unused by Telstra. Ordinarily, this would make the waveguide available for reuse. In this case however, Telstra has removed the waveguide from several sites. Also, where the waveguide has not been removed and is no longer in use by Telstra, the dehydrators have been decommissioned and the valve to each waveguide has been closed. In essence, the waveguides between the waveguide window and the dehydrator valve are filled with stale air. In all likelihood, the waveguides are leaking and in dis-repair due to moisture contamination.

4.4.6 Mast Loading

The implementation of a split indoor/outdoor system will require a mast head assessment to be completed. The result of this assessment will be variable dependant on the supplier and equipment used. Preliminary investigations conducted by GQ-AAS indicate that the removal of the waveguide will offset a large proportion of the increased loading introduced by the mast mounted ODUs. It should also be noted that the original structure design made allowance for additional loading to be added.

Any changes to the mast loading will require mast assessment according to the current wind loading Australian Standards AS 1007.

4.4.7 External Plant and Battery Shelter

In view of the fact that any interruption to the pipeline communications system can have an adverse impact on the operation and management of the pipeline it is important that the changeover to the new communications system be seamless. Hence it will be necessary for the new system to be made fully operational before traffic is diverted from the old communications system to the new one.

It is envisaged that the new system will run in parallel to the old system for at least ninety (90) days during the cut over phase, and for a number of years for those sites which Western Power will be retaining (south of, and including R29 Eradu).

The shortage of equipment space will require an external battery cabinet to be installed at each site. This battery cabinet will house the backup batteries for the new equipment in the shelter. Additional external plant may be required to provide access from the battery backup to the main equipment shelter dependant on equipment and supplier selection.

Preliminary investigation by GQ-AAS and maintenance reports provided by CCR indicate that the remainder of external plant is suitable for reuse, and that no other external plant is required.

4.4.7.1 North of Eradu (R2 to R28)

North of Eradu (R29) and with the exception of R0 and R1, the existing system consisting of the microwave radio equipment, mobile radio equipment and power supply will be decommissioned. Western Power (Horizon) wish to retain the analogue microwave radio system between R0 and R1 for continuity of the link to S8 on the Burrup peninsular.

The remaining portion of the existing microwave radio and mobile radio equipment will not add to the power requirements of the new system.

The SCADA equipment that is currently operational will require power from the new power supply. Power allowances should be made for an additional SCADA module which converts the current RS232 interface into an Ethernet interface.

The microwave radio equipment used for Spur links is currently operational and will require power from the new power supply. It is envisaged that these spur links will be cut to the new power supply one site at a time.

To maximise utilisation of the space inside the shelters, it is envisaged that one bank of the wet cells and its storage cabinet will be removed from service. Removal of this bank will free up the necessary space for installation of the new microwave radio equipment, associated rectifiers, DC-DC converters and the mobile radio equipment in the space made spare. The new battery banks containing sealed batteries for the system will be placed outside in an external battery enclosure/shelter. All equipment from the existing system will be removed when required.

4.4.7.2 South of Eradu (R29 to Allendale Building) plus R0, R1

South of Eradu (R29) plus R0 to R1, the existing microwave radio system will be retained by Western Power. The system will be powered by currently installed power supply, negating the need to accommodate the new equipment in the power budget.

It should be noted that the battery banks at the sites south of and including Eradu have been upgraded to sealed battery units. It is envisaged that one bank of these new batteries will be relocated to an external battery enclosure/shelter where it shall remain in service for a number of years.

The new sealed batteries for the new system will be installed in the new external battery enclosure/shelter adjacent to the existing sealed batteries. These battery banks will run in parallel and independently.

The SCADA equipment that is currently operational will require power from the new power supply. Power allowances should be made for an additional SCADA module which converts the current RS232 interface into an Ethernet interface.

The microwave radio equipment used for Spur links is currently operational and will require power from the new power supply. It is envisaged that these spur links will be cut to the new power supply one site at a time.

South of Eradu, the existing mobile radio system shall be removed. The mobile radio system that is currently installed will not add to the power requirements of the new system.

4.4.8 Earthing

Preliminary investigation by GQ-AAS and maintenance reports provided by CCR indicate that the current earthing is suitable for reuse. Earthing should continue to be maintained and replaced as required.

Additional earthing will be required for the new battery cabinet.

4.4.9 Supervisory Equipment and NMS

A new Network Management system (NMS) is required for the replacement microwave radio equipment. The new NMS will replace the existing Granger equipment.

Alinta control operations and maintenance of the radio and transmission network from a central site. The central site shall be the Allendale building in the Perth CBD. To this end, the remote supervisory and telecontrol system unit shall be installed, allowing remote supervision and configuration at all sites of all able devices.

The control station shall be equipped with an individual display of alarm status at all sites, including itself, or alternatively, with a common display which can be accessed to display individual site alarm status from all sites.

Each site will be equipped with a minimum 32 alarm system.

4.4.10 Clock Synchronisation

To ensure stability at the SDH layer, it is proposed that synchronisation clocks will be required at Perth and at Karratha.

Clock synchronisation will be provided via GPS derived time signals.

5. SPECIAL CONSIDERATIONS

5.1.1 Terminal Link Karratha

An additional radio link from Cajuput Well (R1) to Karratha terminal (R0) has been included for the purpose of providing access to the public network at Karratha.

The need for this link requires further examination.

An alternative is extension by Telstra of the public network to Cajuput Well and is subject to quotation from Telstra.

Note that the existing 7.5 GHz link between Cajuput Well (R1) to Karratha terminal (R0) carries Alinta and Western Power circuits. Western Power, on behalf of Horizon, wish to retain the analogue microwave radio link between R0 and R1 for continuity of the link to S8 on the Burrup peninsular.

Also note that any 6.7 GHz microwave link between R0 and R1 will require new antenna and horn equipment.

5.1.2 Terminal link Perth

At Perth the optimum terminal is at Alinta premises in Allendale building, rather than at the existing Western Power facilities (R43) in East Perth.

The Alinta offices are on the south side of the Allendale main building and from a radio link perspective, obscured from a direct link to Gnangara (R42).

For the purpose of refining the replacement system budgetary costs, a radio link is proposed to Allendale main building and an extension by optical fibre provided between the main and south buildings to the Alinta offices.

An option to provide optical fibre from Alinta offices to Gnangara direct has not yet been costed and is subject to separate examination by others.

In the case where a microwave radio solution is selected it should be noted new 6.7 GHz antenna and horn equipment will be required.

5.1.3 Backup Routes

In the event of an outage between repeater sites, it is recommended that multiple backup routes be provided.

GQ-AAS recommends that these links be accessed over the public network from sites Karratha terminal R0 (or R1 Cajuput Well if suitable public network access to optical fibre is provided by Telstra at R1 and at R28 Wandana.

Proposed public network access is 256 kbit/s at Karratha as indicated in Section 5.1.1.

The same circuit capacity of 256 kbit/s can be obtained at Wandana which is adjacent to Telstra's Yuna East telephone exchange.

The proposed configuration is illustrated in Figure 5-1.

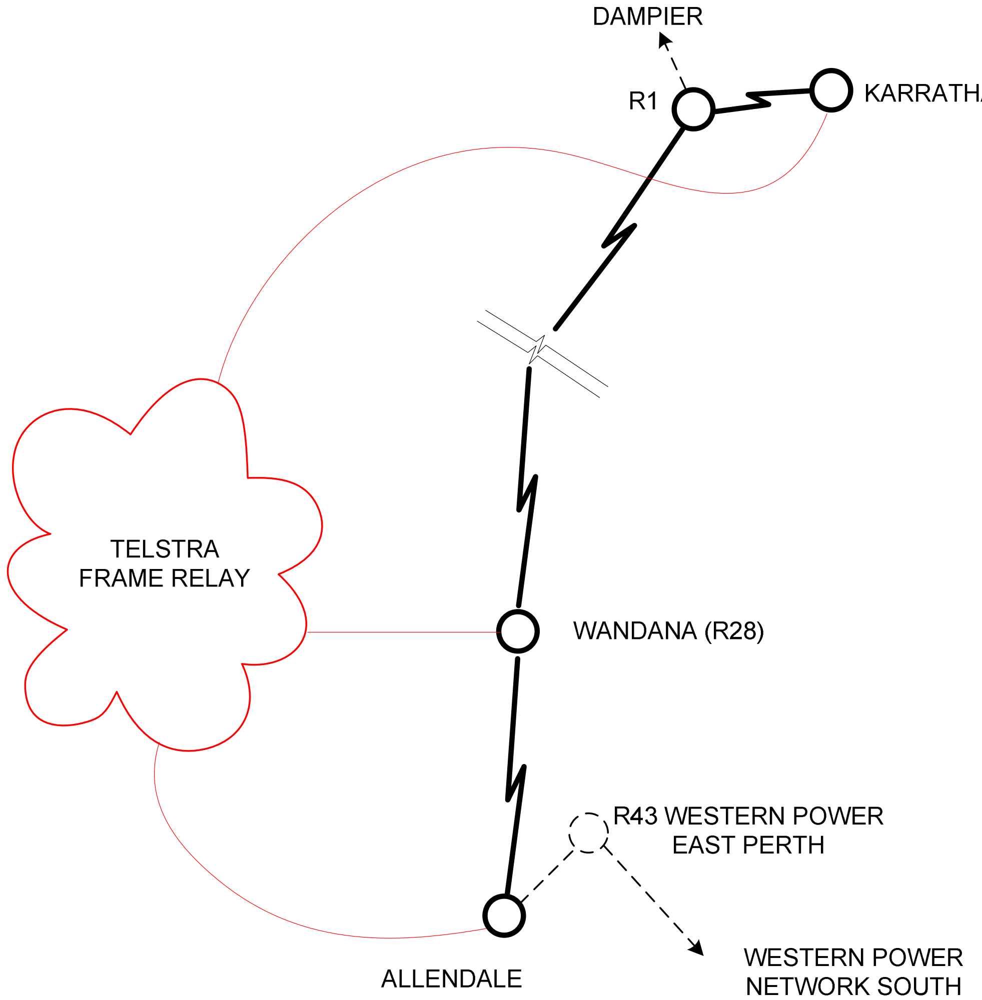

Figure 5-1 Proposed Network Configuration

5.1.4 Telstra ownership of 6.7 GHz frequencies

Telstra currently maintains licenses for a number of sites between R5 and R32.

GQ-AAS recommends taking steps to acquire these licenses as they represent the most efficient and frequency diverse configuration for the new system.

5.1.5 Telstra Retention of Shelters

Telstra has indicated that they wish to retain ownership of their equipment shelters along the entire length of the route.

5.1.6 Western Power Retention of Current 7.5 GHz System

Western Power has indicated an interest in retaining the current 7.5 GHz portion of the microwave system south of, and including R29 Eradu.

For these sites, it is envisaged that this portion of the system will run in parallel with the new system for a number of years.

5.1.7 7.5 GHz System Recovery

For sites north of R29 Eradu, with the exception of R0 and R1, and as part of the replacement works, the system bearer, multiplexer, waveguide and other equipment (including the VHF radio system) will be recovered and returned to Alinta for storage.

5.1.8 Western Power use of Wandana site

Western Power wish to continue use of the Wandana site for ongoing operational purposes.

Such use includes the mast and potentially portion of the shelter.

However Western Power does not require future use of the analogue microwave radio system at Wandana, and accordingly, the analogue equipment may be removed as indicated in section 5.1.7.

6. BUDGETARY COST ESTIMATES

GQ-AAS sought from representative suppliers, a budgetary quotation for the supply, installation, testing and commissioning of microwave communications equipment along the Dampier to Perth gas pipeline route.

A number of potential vendors were considered including Fujitsu, Alcatel, Comtel, Siemens, NEC, Nokia, Digital Microwave Corporation and Telstra.

GQ-AAS has no particular preference for vendor however for the purpose of this portion of the works, sought quotations from Fujitsu, Comtel, and NEC for the following reasons;

- The existing equipment was manufactured by NEC and NEC Australia has local knowledge of the Alinta system useful for providing a response with minimum explanation of the requirements;
- Comtel has personnel and access to other personnel with knowledge of the original systems, is currently providing microwave radio and optical fibre terminal equipment in WA and was willing to provide a quotation in a suitable timeframe;
- Fujitsu offered an unsolicited quotation.

Quotations were sought for the following components

- Systems Engineering *(Supplied, Tested and Commissioned)*
- Two configurations – fully indoor and split mount.
- Rigging Work
- Battery and other Equipment Relocation (Labour)
- Site Visits and Inductions
- Mast Head loading
- Full Shelter and supplementary shelter Options
- Ongoing Operating Costs / Maintenance

6.1 COMTEL

Comtel provided a fully costed quotation based on Ceragon equipment which is manufactured in Israel.

Comtel also performed some preliminary design analysis to judge the technical performance of their offer.

6.1.1 Indoor configuration

The fully indoor option is Ceragon FA3200 FR series 6.7 GHz in a “1+1” configuration with hot standby, high power transmitter and space diversity.

The main and protection transmitter and main receiver are connected to the top antenna and space diversity antenna connected to the lower antenna. New waveguide is offered.

SDH multiplex is Marconi OMS1200 type at Perth and Dampier, and OMS840 at all repeater sites. Low order multiplex is Nokia DM2+ at Perth, Dampier and all compressor sites and Nokia DB2-LP at all remaining sites.

6.1.2 Split mount configuration

The split mount option is Ceragon 1500SP split mount 6.7 GHz in a “1+1” configuration with hot standby and space diversity.

The main transmitter and main receiver are connected to the top antenna and protection transmitter and space diversity receiver connected to the lower antenna.

The outdoor units are connected to the indoor equipment by coaxial cable type Andrew LDF5-50 or similar.

SDH multiplex is Marconi OMS1200 type connected with short haul optical interface to the radio at baseband. Low order multiplex is Nokia DM2+ at Perth, Dampier and all compressor sites and Nokia DB2-LP at all remaining sites.

6.1.3 DC power

Comtel offered Eaton Powerware -24 VDC rectifier and battery back up.

6.1.4 Comments

The offered costing excludes detailed design by the vendor; only design verification services are offered.

The quotation includes 2 synchronisation clocks, spaced so that no sector is greater than 15 hops.

Equipment is rated to 50 deg C.

The fully indoor unit has fan cooling, which would require appropriate additional power.

6.2 FUJITSU

Fujitsu provided a partially costed quotation.

The quotations were for equipment only and excluded costs for installation, testing and commissioning.

6.2.1 Indoor configuration

The fully indoor option is Fujitsu FRX2E+ series 6.7 GHz in a “1+1” configuration with frequency and space diversity. The transmitter power is nominated at +32 dBm.

The main and protection transmitter and main receiver are connected to the top antenna and main and space diversity antenna connected to the lower antenna. New waveguide is proposed.

SDH and lower order multiplex is not defined.

6.2.2 Split mount configuration

The split mount option is Ceragon 1500HP split mount 6.7 GHz in a “1+1” configuration with hot standby and space diversity and non-hitless switching. The transmitter power is nominated at +30 dBm.

The main transmitter and main receiver are connected to the top antenna and protection transmitter and space diversity receiver connected to the lower antenna.

The outdoor units are connected to the indoor equipment by coaxial cable.

SDH multiplex and lower order multiplex is not defined.

6.2.3 DC power

Fujitsu offered a power system based on -48 VDC.

GQ-AAS note that this would require DC – DC converters for the primary supply which is -24 VDC at CCVT sites.

6.2.4 Comments

No price to recover equipment made spare.

Fujitsu offered frequency diversity on the fully indoor solution.

Power systems would be -48 VDC. No pricing information provided.

A pricing is provided for spares.

No temperature rating is indicated for the equipment.

No information is provided on the project timing.

6.3 NEC

NEC provided a near fully costed quotation for each of two configurations, indoor and split mount with multiplex, DC power and network management equipment.

The quotations were based on NEC equipment and provided on a turnkey basis.

The cost for external battery shelters and for recovery of the old Telstra waveguides and Alinta waveguides made spare were excluded.

6.3.1 Indoor configuration

The fully indoor option is NEC 5000 series 6.7 GHz in a twin path configuration with space diversity.

The main and protection transmitter and main receiver are connected to the top antenna and space diversity antenna connected to the lower antenna. New waveguide Andrew type EW63 is proposed.

SDH multiplex is V-Node S type connected with short haul optical interface to the radio at baseband. Low order multiplex is NEC DVM Plus 60 type.

6.3.2 Split mount configuration

The split mount option is NEC Pasolink NEO split mount 6.7 GHz in a twin path configuration with space diversity.

The main transmitter and main receiver are connected to the top antenna and protection transmitter and protection plus space diversity receiver connected to the lower antenna.

The outdoor units are connected to the indoor equipment by coaxial cable type 5D-FB.

SDH multiplex is V-Node S type connected with short haul optical interface to the radio at baseband. Low order multiplex is NEC DVM Plus 60 type.

6.3.3 DC power

NEC offered -48 VDC rectifier and battery back up which will require DC – DC converters for the primary supply.

6.3.4 Comments

Temperature specification is 45 deg C. NEC 5000 brochure indicates operational to 50 deg C. Mux is only 45 deg C

How to convert from -24 VDC supply to -48 VDC? NEC 5000 brochure indicates -24 VDC is an option.

Assumes existing DDF.

No pricing is offered for spares.

The offer indicates 4 months for equipment delivery and 7 months for installation.

6.4 SUMMARY OF BUDGETARY QUOTATIONS

Refer to the following Table 3.

ITEM	COMTEL	FUJITSU	NEC
Fully indoor	$8,924,899	$4,474,691 Note 1.	$13,559,298 Note 2.
Split mount	$6,561,391	$3,562,340 Note 1.	$7,325,958 Note 2.

Table 3 Comparison of Budgetary Cost Quotations

Notes

1. Equipment material cost only and excludes installation, testing and commissioning.
2. Excludes external battery shelter and cost of labour to recover old waveguide.

Each quotation omitted some elements; however the quotations provided essential budgetary pricing and timeframe feasibility information. Adjustments were made to the indicated prices to include all elements of a system replacement.

6.5 PROPOSED SYSTEM BUDGETARY PRICE

The adjusted system price for a replacement microwave radio system between Karratha and Allendale building is $10 million.

This value is to provide 155 Mbit/s using split mount configuration and assumes that masthead loading is within the existing structure capability. It comprises the following components:

Cost Item	Cost
Vendor System Design	$200,000
Vendor Project Management	$900,000
1+1 SDH Radio TX/RX (Split Mount)	$2,900,000
Feeders	$330,000
Multiplexing Equipment	$1,300,000
Clocks / Synchronisation	$25,000
Spares (Radio and MUX)	$100,000
Spares (Power)	$10,000
Power / Rectifiers / Batteries	$430,000
External Shelters	$328,000
Antennas at R0, R1, R42, Allendale	$100,000
Network Management System	$210,000
Public Network Interfaces at R1, R28 and Allendale	$20,000
SCADA / Ethernet Interfaces	$42,000
System Manual / Handbooks / Documentation	$90,000
Installation	$1,100,000
Integration and FAT	$250,000
Specialised Test Equipment G.826	$250,000
Masthead Loading Assessment	$30,000
Recover and Return Existing Equipment	$30,000
Alinta Overhead (License requirements for risk and planning)	$100,000
Engineering and Project Management	$250,000
Mobilisation / Demobilisation (3 off)	$90,000
Optical Fibre Allendale	$150,000
Training	$30,000
Total System Cost	**$9,265,000**
Total System Cost with 10% Contingency	**$10,191,500**

The alternative fully indoor equipment configuration is estimate at $18 million as follows.

Cost Item	Cost
Vendor System Design	$200,000
Vendor Project Management	$900,000
1+1 SDH Radio TX/RX (Indoor)	$6,100,000
Feeders / Waveguide	$2,800,000
Multiplexing Equipment	$2,000,000
Clocks / Synchronisation	$25,000
Spares (Radio and MUX)	$100,000
Spares (Power)	$10,000
Power / Rectifiers / Batteries	$1,300,000
External Shelters	$328,000
Antennas at R0, R1, R42, Allendale	$100,000
Network Management System	$540,000
Public Network Interfaces at R1, R28 and Allendale	$20,000
SCADA / Ethernet Interfaces	$42,000
System Manual / Handbooks / Documentation	$90,000
Installation	$1,100,000
Integration and FAT	$250,000
Specialised Test Equipment G.826	$250,000
Masthead Loading Assessment	$30,000
Recover and Return Existing Equipment	$30,000
Alinta Overhead (License requirements for risk and planning)	$100,000
Engineering and Project Management	$250,000
Mobilisation / Demobilisation (3 off)	$90,000
Optical Fibre Allendale	$150,000
Training	$30,000
Total System Cost	**$16,835,000**
Total System Cost with 10% Contingency	**$18,518,500**

The indoor configuration provides facilities which are in excess of Alinta's requirements and is judged to be excessive in terms of cost.

7. CONCLUSIONS

As a result of the design and budgetary quotation works, GQ-AAS formed the following main conclusions:

a) Based on the design carried out by GQ-AAS, a reliable replacement microwave radio system can be engineered and implemented along the existing microwave radio route, to deliver a capacity of 155 Mbit/s which is approximately 7 times that provided by the existing system.
The replacement system will use existing infrastructure at each site including the mast/ tower and antennas, Alinta shelter, primary power sources and standby alternator facility all of which were found during site visits to be in good condition.
New radio, multiplex, network management and battery rectifier equipment is required.
The design indicated that an end to end availability of 99.99% will be provided, by use of redundant equipment components, vertical space diversity on all radio hops and dual battery backed up power supplies.

b) The new system will deliver circuits which are compatible with the existing interfaces, and compatible with proposed IP interfaces envisaged by TUSC for future networking of SCADA circuits.

c) The estimated cost of the replacement system based on a split mount configuration is $10 million. This is based on quotations from vendors and should be confirmed by formal tender.
Several vendors are keen to implement the system on a turn key basis on behalf of Alinta.

Other less significant conclusions are as follows:

d) Ongoing negotiations are required to be undertaken with Telstra to establish if they are prepared to release the remaining 6.7 GHz frequencies of their decommissioned analogue system. This is not critical since adequate frequencies are available should Telstra decide not to relinquish their licenses.

e) The Telstra shelters at each site can not be used by Alinta since Telstra wishes to retain the shelters for as yet undefined purposes.

f) An external battery shelter is required at each site for two reasons; provide sufficient space in each Alinta shelter for provision of the new microwave radio equipment and to allow concurrent operation by Western Power of the old system between Perth and Eradu (near Geraldton). Western Power requested retention of the existing system for several years.

8. GLOSSARY OF TERMS

TERM	DEFINITION
AC	Alternating current.
ACMA	Australian Communications and Media Authority.
Analogue	A form of transmitting information characterised by continuously variable quantities. In the case of voice, speech is translated into electronic signals of different frequency and/or amplitude.
Bandwidth	The range of frequencies, expressed in Hertz (Hz), over which a spectrum user can transmit or receive radio signals. In general, the greater the bandwidth the more information that can be sent through the spectrum in a given amount of time.
Bit	A bit is the smallest possible piece of digital information and is a binary digit with a value of either a one or zero. Bits are used to store data on computers and to sequence digital transmissions.
BER	Bit error ratio.
Carrier	The holder of a general telecommunications licence in force under the *Telecommunications Act 1997*.
DC	Direct current.
dB	deciBel, a logarithmic unit used to describe a ratio. In this document the ratio is used in respect of power.
Digital	Digital is a way of encoding information. For example digital transmission is characterised by discrete bits of information in numerical steps.
DBNGP	Dampier Bunbury Natural Gas Pipeline
DPNGP	Dampier Perth Natural Gas Pipeline
E1	European defined interface for 2.048 Mbit/s.
Ethernet	Ethernet is a family of frame-based computer networking technologies for local area networks (LANs).
HRDP	Hypothetical Reference Digital Path defined in ITU documentation
IP	Internet protocol.
ITU	International Telecommunications Union, a division within the United Nations and established to standardise and regulate international radio and telecommunications
K factor	In tropospheric radio propagation, the ratio of the effective Earth radius to the actual Earth radius. K factor is a function of the quantity water vapour in the earth's atmosphere; typically the quantity diminishes with increased distance above the earth's surface and as a result the atmosphere tends to diffract or bend radio transmissions slightly towards the earth.
kHz	Kilo Hertz. A kilo Hertz is one thousand Hertz.
km	Kilometre.
Mbit/s	Mega bits per second. A Mega bit is one million bits.
MHz	Mega Hertz. A Mega Hertz one million Hertz.
Protocol	Rules for communication.
Public Switched Telephone	The Public Switched Telephone Network is the public

TERM	DEFINITION
Network (PSTN)	telecommunications network operated by a carrier and provides circuit-switched telephone services for fixed and mobile telephones.
Radio repeater	A communications device that amplifies a signal in order to extend the transmission distance.
R[x]	Radio repeater numbering commencing from Karratha (R0)
RF	Radio frequency
RSL	Receive Signal Level, usually measured in units of dBm
RTU	Remote Terminal Unit
SCADA	Supervisory Control And Data Acquisition.
SECWA	State Energy Commission of Western Australia.
TUSC	TUSC is a software services company within the Ericsson group and specialises in service management solutions. TUSC is responsible for facilities delivery of monitoring and operations of telemetry associated with the DBNGP.
Voice over Internet Protocol (VoIP)	Voice over IP (also called VoIP, IP Telephony, and Internet telephony) refers to technology that enables routing of voice conversations over the Internet or any other IP network. The voice data flows over a general-purpose packet-switched network, instead of the traditional dedicated, circuit-switched voice transmission lines. http://en.wikipedia.org/wiki/VoIP

APPENDICES

A. REFERENCE DOCUMENTATION

No.	DOCUMENT	DATE
1	Strategic Plan (prepared by Gibson Quai – AAS Pty Ltd)	March 2006
2	Dampier-Perth Pipeline Communications System, System Manual Volumes 1, 2 and 3 (prepared by Telecom, now Telstra).	V1 1981 V2 & V3 1984
3	Ownership, Management and Service Agreement for Dampier/ Perth/ Bunbury Microwave Radio System between Western Power and AlintaGas	30 December 1997
4	North-West Microwave Radio Communications System (Karratha- Perth) Transmission Engineering Report (prepared by Telecom, now Telstra)	June 1982
5	Mast /tower condition reports (prepared by Catalyst Communication Rigging Pty Ltd)	Various 2005, 2006
6	Outage performance statistics reports (prepared by Western Power)	2001 to 2005

B. FIELD REPORT

ALINTA LTD

DAMPIER-PERTH GAS PIPELINE COMMUNICATIONS SYSTEM

FIELD REPORT

Prepared by

GIBSON QUAI - AAS PTY. LTD.

Level 2, 30 Richardson Street,
West Perth, Western Australia 6005

Tel: +61 8 9321 3166
Fax: +61 8 9321 3226
Email: perth@gqaas.com.au

Reference: 61758

Dated: Sept, 2006

ABOUT THIS DOCUMENT

TITLE: Field Report

PROJECT NAME: Dampier-Perth Gas Pipeline Communications System

PROJECT NO: 61758

AUTHORISED: Gary Worsdell

ABSTRACT: This report details findings from visits to DBNGP Microwave sites by Gary Worsdell and Brett Gooden during the month of August 2006.

DOCUMENT HISTORY

Rev	Date	Description	Author	Reviewed
A	22/8/06	Draft	BG	GW

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1. INTRODUCTION

Gibson Quai – AAS has been commissioned by Alinta to design a replacement microwave system for the DBNGP. As certain elements of the current system may be retained for use in the new system, it was required that a number of sample sites be visited in order to ascertain that the current condition of the sites and that applicable equipment was suitable for reuse.

The site visits were conducted by Gary Worsdell and Brett Gooden during the week of 14 August, 2006.

2. SCOPE OF WORK / METHODOLOGY

2.1 SITE SELECTION

In order to gain a broad understanding of the current state of the various site configurations, a number of key sites were identified. The sites which were chosen and their specific attributes are listed as follows:

R0:

- No Telstra transmission equipment
- Tower type structure
- LB8-74, 2.4m dishes, single horn
- Current terminal Site

R1:

- Additional transmission equipment on mast
- Multiple dish types
- Both dual and single horn
- New terminal Site

R3:

- Multiple feeder types
- Taller than average mast height
- No expected additional transmission equipment

R5:

- Multiple diversity spacings
- Expected additional transmission equipment

R9:

- Tallest mast
- R8-R9 Longest hop
- Multiple dish sizes
- Adjacent to compressor station
- No expected additional transmission equipment

R10:

- Expected new amplifier
- Standard site

R40:

- Close to Perth
- Problematic history due to fog
- Attendance with riggers

R41:

- Close to Perth
- Standard site
- Attendance with riggers

2.2 METHODOLOGY

The methodology was similar at each site and consisted of the following general procedures:

- Gate access via provided keys
- Note GPS reading at mast
- Access to Alinta and Telstra shelters via provided keys
- Photograph layout of shelter, site and mast
- Note and photograph any equipment , shelter or structure in disrepair
- Note general reading values from equipment including:
  - Power supply voltage and current
  - Dehydrator pressure
  - TX/RX frequencies
  - Temperature
- Note and photograph any anomalies between actual and documented instances of site, mast and equipment configuration/layout (includes the following)
  - Waveguides
  - Waveguide ports into shelter
  - Circulators and filters
  - TX/RX equipment
  - Multiplexers
  - Power and Batteries
  - Dehydrator
  - Dishes
  - Mobile radio equipment
  - SCADA setup
  - Unspecified equipment

3. SITE INFORMATION

The following information was noted during the visit to each site.

3.1 R0

R0 KARRATHA							
GPS COORDS	**Zone:**	**50**		*	'	"	
	Easting:	0482619	Latitude:	20	45	45.80653	S
	Northing:	7704103	Longitude:	116	49	58.88340	E
FREQ	**TX** (MHz)	**RX** (MHz)					
A	7589	7428					
B	7645	7484					

- Likely requirement to relocate Telstra racks toward west. (ie door)
- Battery bank 22 cells [10 upper level and 12 lower]
- Battery bank currently in poor condition
- 48V setup
- Air conditioned
- Mobile radio equipment exists on site

3.2 R1

R1 CAJUPUT WELL							
GPS COORDS	**Zone:**	**50**		*	'	"	
	Easting:	0471837	Latitude:	20	45	58.63611	S
	Northing:	7703694	Longitude:	116	43	45.97006	E
FREQ	**TX** (MHz)	**RX** (MHz)					
A	7428	7589					
B	7484	7645					

- No mobile radio exists on site
- 60 channel spur exists (hot stand by) TX: 1832.5 MHz RX: 1769.5 MHz
- Dehydrator is located near the door
- Power supply is 24V with load of around 35A
- Batteries and cabinet are in poor condition. Evidence of leakage and condensation on door and floor
- Corroded uni-strut on sliding door and door lock in disrepair
- 60 TXB Alarm lit
- SCADA cabinet rather than free standing rack unit
- Waveguide to 6.7GHz horn remains
- No access to Telstra hut, lock has been changed from A-1

3.3 R3

R3 MCKAY CREEK							
GPS COORDS	Zone:	50		*	'	"	
	Easting:	0426479	Latitude:	21	2	30.90996	S
	Northing:	7673050	Longitude:	116	17	32.63557	E
FREQ	**TX** (MHz)	**RX** (MHz)					
A	7428 / 7484	7589 / 7645					
B	7428 / 7484	7589 / 7645					

- DC site with CCVT active
- Power is 25V at 21A
- Mobile radio exists uses yagis (154.575 MHz, 159.975MHz)
- Batteries in poor condition
- Some spare rack space available (A1, A3)
- Corrosion on uni-strut for door
- Waveguide to 6.7GHz horn have been recovered
- No access to Telstra hut, lock has been changed from A-1

3.4 R5

R5 PETER CREEK							
GPS COORDS	Zone:	50		*	'	"	
	Easting:	0391748	Latitude:	21	27	0.46738	S
	Northing:	7627673	Longitude:	115	57	19.01050	E
FREQ	**TX** (MHz)	**RX** (MHz)					
A	7428 / 7484	7589 / 7645					
B	7442 / 7498	7603 / 7659					

- AC mains powered site, CCVT no active
- Power is 25V at 25A
- 16m diversity spacing on south facing antennas
- 2 additional grid antennas exist on structure, directed toward Fortescue (Feeder attached to mast using electrical tape
- Huts are 1.2m above ground here
- Batteries are old but are in reasonable condition. Batteries are 12V and are sealed
- Red aviation light on this structure
- Vertical gantry is congested
- Site is adjacent to CS 1 and MLV 11-18
- Considerable construction activity nearby
- Waveguide to 6.7GHz horn remain
- No access to Telstra hut, lock has been changed from A-1

3.5 R9

R5 ASHBURTON							
GPS COORDS	Zone:	50		*	'	"	
	Easting:	0319552	Latitude:	22	28	23.12946	S
	Northing:	7513751	Longitude:	115	14	46.11745	E
FREQ	**TX** (MHz)	**RX** (MHz)					
A	7428 / 7484	7589 / 7645					
B	7428 / 7484	7589 / 7645					

- No SCADA rack or terminating frame inside shelter
- Power is 25V at 15A
- Batteries are in poor condition and are of the flooded type
- 12V sealed batteries under dehydrator have corroded terminals
- Telstra satellite earth station exists. Dish is approx 1.2m diameter
- Site is adjacent to CS 2
- 3.7m dishes for Claypan Well
- 2.4m dishes for Barradale
- Mast height of 130m
- No access to Telstra hut, lock has been changed from A-1

3.6 R10

R10 BARRADALE							
GPS COORDS	Zone:	50		*	'	"	
	Easting:	0305355	Latitude:	22	43	40.82975	S
	Northing:	7485345	Longitude:	115	6	16.93027	E

- New equipment cabinet exists (RKA3)
- CCVT powered site
- Power is 24.5V at 20A
- Main backup batteries are of the flooded type and in reasonable condition
- Batteries located under the dehydrator are +12V and sealed
- No diversity on either of the Telstra links
- Access to Telstra hut
- Equipment has been turned off in Telstra hut, most equipment has been recovered

3.7 R40

R40 GINGIN							
GPS COORDS	Zone:	50		*	'	"	
	Easting:	392100	Latitude:	31	19	57	S
	Northing:	13467008	Longitude:	115	51	57	E

- Standard Alinta site

- Telstra shelter has had all equipment decommissioned and turned off
- Some equipment in the Telstra shelter has been recovered for spares

3.8 R41

R41								
GPS COORDS	Zone:	50		*	'	"	
	Easting:	401307	Latitude:	31	34	09	S
	Northing:	13493152	Longitude:	115	57	36	E

- Standard Alinta site
- Telstra shelter is highly utilised
- Telstra shelter has CDMA installed
- Telstra shelter is currently having WCDMA commissioned

4. SITE ACCESS

4.1 JOB SAFETY ANALYSIS (JSA)

The JSA was a key component of gaining site access. The complete JSA can be found in Appendix A. It contains information regarding hazard assessments, notifications, safety equipment, vehicle checklists, and an in-detail travel itinerary.

Outlining the OHS requirements was a key requirement to gaining access to the sites. The site access matrix was developed using Western Power OHS handbook and can be found within the JSA (Appendix A).. The site access matrix covers WPC map types and work areas, Induction requirements, work permits, notification of intended works, key access, onsite contact procedures and safety equipment requirements.

4.2 INDUCTIONS

In order to gain access to the sites, inductions were required to be undertaken for both Alinta and Western Power.

Gary Worsdell and Brett Gooden attended the Alinta (DBNGP) induction at GHD house on 21 June 2006.

Gary Worsdell and Brett Gooden attended the Western Power Communications induction at Mt Claremont depot on 26 July 2006.

Further to these inductions, both Gary Worsdell and Brett Gooden were required to undertake an accredited defensive and 4x4 driving course. Gary Worsdell and Brett Gooden completed these requirements by undertaking the Driver Skills Australia program on 10 July, 2006.

4.3 ITINERARY

The site visits were divided into 2 components across 3 days. The first component involved accessing two sites (R40 and R41) close to Perth. These two sites were accessed on 15 August 2006 by Gary Worsdell and Brett Gooden in conjunction with Catalyst Communication Rigging personnel Pat Shinnick and Lee Blackley.

The second component involved accesses six sites across two days. Gary Worsdell and Brett Gooden flew to Karratha on 16 August 2006. R0, R1, R3 and R5 were situated between Karratha and Onslow and were visited on the first day. R9 and R10 were situated between Onslow and Carnarvon and were visited on the second day.

All site access travel was planned using access maps provided by Western Power. Access maps were verified using satellite imagery and travel to site was via a 4x4 vehicle.

The detailed travel itinerary can be found in the JSA (Appendix A).

4.4 PERMITS

GQ-AAS was required to submit a Communications System Planned Activity Request (CSPAR) document to Western Power for approval prior to visiting the sites. In total, two CSPARs were issued, however both bear the same CSPAR reference number. Copies of the CSPARs can be found in Appendix B.

CSPAR REF# C200806-1 was submitted on the 8 Aug 2006 and approved on the 10 August 2006. This CSPAR covered access to sites R40 and R41 on 15 August for Gary Worsdell and Brett Gooden. Catalyst Communication Rigging work detail for Pat Shinnick and Lee Blakey was also included on this CSPAR.

The second CSPAR REF# C220806-1 was submitted on the 9 Aug 2006 and approved on the 11 August 2006. This CSPAR covered access to sites R0, R1, R3, R5, R9 and R10 on 16 and 17 August for Gary Worsdell and Brett Gooden.

No work permits were required from Telstra or Alinta.

4.5 KEYS

As indicated by the Site Access Matrix, keys were required to be obtained from Alinta and Telstra.

The A1 key for the Telstra hut was collected on 1 August 2006.

The A2 key for the Alinta hut was collected from Moira D’Olimpio at Alinta Gas Transmission in Jandakot on 11 August 2006 and was return to Moira at the same location on 18 August 2006.

5. EXPENSES

The following expenses were incurred during the site visits:

Expense	Ex-GST Amount	Inc-GST Amount
Accommodation (Onslow) 17/08/2006	$245.45	$270.00
Accommodation (Carnarvon) 18/08/2006	$208.45	$229.30
Vehicle Hire	$1132.72	$1,245.99
Vehicle Fuel	$278.45	$306.30
Taxi	$80.02	$88.02
Consultant Vehicle Travel (147km@67c/km)	$89.53	$98.49
Air Fares	$701.40	$771.74
TOTAL		**$3,009.64**

6. SUMMARY

Completion of the site visits proved to be crucial to the integrity of the design of the microwave system upgrade. Understanding the current state of the system and equipment will allow provision to be made in those areas where the current state was different than previously believed.

Design variables which may be varied due to the information gathered at the sites include:

- Placement of equipment inside the shelters
- Reuse of the shelters
- Improved availability and BER
- Placement of external battery shelters
- Relocation of third party equipment
- Allowance for structure and shelter modifications
- Recovery of existing equipment
- Provision for third party equipment on structures
- Main and backup power requirements
- Replacement of existing equipment in disrepair

A. JSA / SITE ACCESS MATRIX

ALINTA

DBNGP MICROWAVE RADIO REPLACEMENT

SITE VISIT JOB SAFETY ANALYSIS

Prepared by

GIBSON QUAI-AAS PTY. LTD.

Level 2, 30 Richardson Street,
West Perth, Western Australia 6005

Tel: +61 8 9321 3166
Fax: +61 8 9321 3226
Email: perth@gqaas.com.au

Reference: 61758

Dated: August 2006

ABOUT THIS DOCUMENT

TITLE: Site Visit Job Safety Analysis

PROJECT NAME: Alinta DBNGP microwave radio replacement strategy

PROJECT NO: 61758

AUTHORISED: Gary Worsdell

ABSTRACT: This document provides an assessment of hazards and risks associated with conducting a visit to Alinta microwave radio sites along the Dampier to Bunbury Natural Gas Pipeline (DBNGP).

DOCUMENT HISTORY

Rev	Date	Description	Author	Reviewed
A	10/08/2006	First draft	GW	BG
B	18/08/2006	Revised	BG	GW

Quality System
Quality Endorsed Company

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HAZARD ASSESSMENT

Site Supervisor: **Gary Worsdell** (GQ-AAS)

Task: Site inspection visits to Alinta microwave radio sites Gingin (R40) and Muchea (R41) along the Dampier to Bunbury Natural Gas Pipeline (DBNGP) to assess the condition of shelters, masts/towers, radio equipment and accommodation.

Item	Description	Potential Hazard	Risk Level (high medium low)	Action Required
1	Travel to site	Long travel distance and tiredness Unfamiliar route Vehicle Breakdowns	Medium Low Medium	Plan route. Break driving into 2 hour segments Plan routes and travel time, appropriate maps, site access diagram, notification of expected arrival, expected departure. Organise second spare for vehicle. Bring Iridium satellite phone. Check condition of critical vehicle components before leaving and various stops during travel.
2	Site entry	Wildlife Condition of gate	Low	Increased awareness.
3	Climbing (nil by GQ-AAS personnel)	Fall. Personnel working above.	Low	All climbing by qualified riggers. Catalyst Communication Rigging engaged (2 personnel) for all climbing works. GQ-AAS to check relevant qualifications prior to any climbing. Personnel on ground to wear appropriate PPE.
4	Radio frequency radiation		Low	All works are inspection only. No equipments tests will be carried out. Work at heights to be carried out by qualified riggers. GQ-AAS to check Riggers awareness of RF exposure limits.

NOTIFICATIONS

Travel departure and arrival times be reported to the following departments as follows:

ALINTA

- 7:00am to 3.30pm

  Jandakot Depot (08) 9499 5100

- 3:30pm to 7:00am

  TSCC Control (08) 9492 3723

WESTERN POWER

- NMC (08) 9383 5858

TELSTRA

Before entering Telstra Huts where Telstra Mobile Communication Equipment exists:

- ISS Security Services (Contractors to Telstra) (1300 885 633)

The following information is required to be reported:

- Area of departure
- Area of intended arrival
- Intended arrival ETA
- Satellite Telephone #
- Vehicle Registration Number
- Names of personnel travelling in vehicle
- Names (and mobile #, vehicle details) of personnel travelling with us in other vehicle
- For trips longer than 2 hours, call in every 2 hours to advise progress
- Call to advise of change of initial ETA
- Arrive at specified area

PPE CHECKLIST

Gibson Quai – AAS personnel require the following PPE whilst on site:

- Safety Helmet
- Safety Boots
- Full Length Cotton Clothing

In addition to the above PPE, CCR personnel require the following PPE whilst on site and working in area:

- Full Arrest System
- Harness
- Protective Barrier and Signs
- RF Monitoring Device

Riggers should also ensure:

- All rigging personnel have rigger qualifications
- An onsite observer is present
- Adequate ground clearance

Other equipment includes:

- GPS device
- Compass
- Maps, (access and overall area)
- Binoculars
- Camera
- PC + Charger
- Iridium Satellite Phone + Charger. Tele number 0011 8816 3145 2177
- Mobile Phone + Charger, GW 0412 305 515 BG 0417 914 984
- Sufficient Water / Food
- Hat
- Sunglasses
- Sunscreen

VEHICLE CHECKLIST

The following items will be checked prior to departure at each location (where possible).

- Engine Oil
- Coolant
- Tyres / Tyre Pressure
- Belts
- Wiper Fluid
- Second Spare
- Any leaks / visible mechanical problems or damage

TRAVEL SCHEDULE AND ON SITE ROUTE PLAN / TIMETABLE

Date	Departing	Time	Arriving	Time	Route	Notes
			DAY ONE			
15/08	Perth	07:00	R41 Muchea (31°34'09.00"S, 15°57'37.00"E)	08:00	Gnangara Road West Swan Road Great Northern Highway Brand Highway Energy Place	
	R41 Muchea (31°34'09.00"S, 15°57'37.00"E)	11:30	R40 Gingin (Granville) (31°19'57.00"S, 115°51'57.00"E)	12:00	Brand Highway	
	R40 Gingin (Granville) (31°19'57.00"S, 115°51'57.00"E)	15:30	Perth	16:30	Brand Highway Great Northern Highway West Swan Road Gnangara Road	
			DAY TWO			
16/08	Perth Domestic Airport	05:35	Karratha Airport	07:35	QANTAS Flight 1908	QANTAS National Jet Systems
	Karratha Airport	08:00	R0 Karratha Terminal (20°45'45.76"S, 116°50'5.65"E)	08:30	Dampier Road Millstream Road Karratha Road 2.2km Right 1.1km In	AVIS 4x4 Rental Check for 2nd Spare 30km, 30 mins travel time
	R0 Karratha Terminal (20°45'45.76"S, 116°50'5.65"E)	10:30	R1 Cajuput Well (20°45'59.60"S, 116°43'49.97"E)	11:00	Left (E) 1.1km Right (S) 4.0km Right (W) NWC HWY 10km over train lines 6.1km Right (N) at OH powerlines 6km to Mast	26km, 25 mins travel time
	R1 Cajuput Well (20°45'59.60"S, 116°43'49.97"E)	12:30	R3 McKay Creek (21° 2'25.64"S, 116°17'36.50"E)	13:30	6km Right (W) onto NWC HWY 54km to Mast (Left of road)	60km, 60 min travel time

Date	Departing	Time	Arriving	Time	Route	Notes
	R3 McKay Creek (21° 2'25.64"S, 116°17'36.50"E)	15:00	R5 Peter Creek (21°26'60.00"S, 115°57'19.00"E)	15:30	30km Further Down NWC HWY Right (N) 6.4km to Mast	36km, 35 mins travel time
	R5 Peter Creek (21°26'60.00"S, 115°57'19.00"E)	16:30	Onslow Townsite	18:30	80km Further Down NWC HWY from Fortescue Right (NW) Into Onslow Mount Stuart Road for 80 km	160km, 2 hours travel time **Onslow Mackerel Motel** Cnr Second Ave & Third St Onslow 6710 Ph (08) 9184 6586 Fax(08) 9184 6583
DAY THREE						
17/08	Onslow Townsite	09:00	R9 Ashburton (22°28'18.01"S, 115°14'49.90"E)	11:00	80km from Onslow to NWC HWY 50km S down NWC HWY Right (W) 4.6km after Tom Price Turn 27km to Mast down road	160km, 2 hours travel time
	R9 Ashburton (22°28'18.01"S, 115°14'49.90"E)	12:30	R10 Barradale (22°43'35.51"S, 115° 6'22.65"E)	13:30	27km back to NWC HWY then Right (S) 50km to Turnoff, Right (N) 6km to Mast	80km, 1 hour travel time
	R10 Barradale (22°43'35.51"S, 115° 6'22.65"E)	15:30	Carnarvon Townsite	18:30	300km down NWC HWY, then Robinson into Carnarvon	300km, 3 hours travel time **BEST WESTERN HOSPITALITY INN** 6 West Street Carnarvon WU 6701 AU Phone: 61 99411600 FAX:61 99412405
DAY FOUR						
18/08	Carnarvon Airport	12:55	Perth	14:55	Skywest Air (AU) Flight 185	
	Perth Airport	15:30	Return Alinta Keys and Satellite Phone			

SITE ACCESS MATRIX

SITE ACCESS REQUIREMENTS

SITES	WPC MAPS	WPC WORK AREAS	INDUCTION REQUIREMENTS	WORK PERMIT	PRIOR NOTIFICATION	KEY REQUIREMENTS	SITE CONTACTS
TYPE 1: R0	3, 4	2.1A, 2.3, 3.1, 3.2	1. WPC Comms 2. Alinta DBNGP	1. CSPAR	1. WPC Comms 5days	1. Telstra Hut A1 2. Alinta Hut A2	NMC TTSC
TYPE 2: R1, R3, R5, R9, R10, R40, R41	3	2.1A, 2.2, 2.3	1. WPC Comms 2. Alinta DBNGP	1. CSPAR	1. WPC Comms 5days	1. Telstra Hut A1 2. Alinta Hut A2	NMC TTSC
TYPE 3: RIGGERS		2.1A, 2.1B	1. WPC Comms 2. Alinta DBNGP	1. CSPAR 2. Rigger Qual	1. WPC Comms 5days	NA	NMC TTSC

PPE REQUIREMENTS

SITES	Safety Helmet	Safety Footwear	Full Length Clothing	Full Arrest System	Harness	Rigger Qualifications	Protective Barrier / Signs	Observer	RF Radiation Hazard	RF Monitoring Device	Ground Safety Clearance
TYPE 1: R0	●	●	●	○	○	○	○	○	○	○	○
TYPE 2: R1, R3, R5, R9, R10, R40, R41	●	●	●	○	○	○	○	○	○	○	○
TYPE 3: RIGGERS	●	●	●	●	●	●	●	●	●	●	●

B. CSPAR

COMMUNICATIONS SYSTEM PLANNED ACTIVITY REQUEST

westernpower

TO: COMMUNICATIONS OPERATIONS Network Management Centre *Attention: Operations Officer* **Phone:** 08-9383-5858 or 1800-008-887 **Fax:** 08-9383-5800 **E-mail:** help.desk.communications.networks@westernpower.com.au	**FROM:** Brett Gooden **Company:** Gibson Quai – AAS Pty Ltd **Address:** Level 2, 30 Richardson Street, West Perth, WA, 6005 **Phone:** 08 9321 3166 **Fax:** 08 9321 3226 **E-mail:**

Approval is requested to carry out the following work:

Work Description: (Attach schedule of works if appropriate)

Inspection of microwave equipment in shelters and on structure.

Will be accompanied by a certified rigging team (Catalyst Communication Rigging).

Rigging team will be ascending structure for further inspections and will not be modifying the structure or any attached equipment in any way.

ON SITE WORK-TEAM DETAILS

Company or Work-Group	Staff Name(s):	Phone(s):
Gibson Quai – AAS Pty Ltd	Gary Worsdell	
Gibson Quai – AAS Pty Ltd	Brett Gooden	
Catalyst Communication Rigging	Pat Shinnick	
Catalyst Communication Rigging	Lee Blakey	

Work Start Date:	15 Aug 2006
Work End Date:	15 Aug 2006

Work Site(s):	R40 Gingin	R41 Muchea	

Service Outage? No **Note:** Please notify the Customer and provide service and outage authorisation details **below.**

Customer Notification(s) for work planned				Service(s) or CIRCID(s) affected			
Customer Contact:	**Phone:**	**Date Advised:**	**Permission (If Service Outage)**	**Service / CIRCID**	**Description**	**Outage Date**	**Outage Times**
			Yes / No				
			Yes / No				
			Yes / No				
			Yes / No				
			Yes / No				
			Yes / No				

Other Permits required? (Please attach)	No	**NB:** It is the responsibility of the requestor to ensure that all **Personnel** performing this work comply with relevant Safety **Regulations/JSA.**
JRA prepared?	NA	

The Checks hereunder only apply to work specific to Communications Networks Systems/Equipment:

† TNMS and/or STRIDE updates completed?	NA	**Equipment programming changes required?**	NA
SPF Isolation(s) required?	NA	**Note:** SPF Isolations only apply to sites S11, R52, R49, R154, and R157.	

NMC approval for the above work (NMC use only):

Risk Assessment:	Medium	**CSPAR REF No:**	C200806-1
Work Authorised:	Yes	**† TNMS Change No:**	
Comments:	1. All persons to have completed Alinta Induction Certification. 2. Job Risk or Job Safety Analysis is required to be prepared (CSPAR application indicates not required, however all on site visits/work require this process to be completed). 3. Contact Alinta Gas Control (09 9492 3723) and NMC (08 9383 5858) on arrival and departure for each site. 4. Keys to be obtained from Alinta if required		
Checked By:	E Needham **Date:** 10/8/2006	**Signature:**	

COMMUNICATIONS SYSTEM PLANNED ACTIVITY REQUEST

westernpower networks today & tomorrow

TO: COMMUNICATIONS OPERATIONS Network Management Centre *Attention: Operations Officer* **Phone:** 08-9383-5858 or 1800-008-887 **Fax:** 08-9383-5800 **E-mail:** help.desk.communications.networks@westernpower.com.au	**FROM:** Brett Gooden **Company:** Gibson Quai – AAS Pty Ltd **Address:** Level 2, 30 Richardson Street West Perth WA, 6005 **Phone:** 08 9321 3166 **Fax:** 08 9321 3226 **E-mail:**

Approval is requested to carry out the following work:

Work Description: (Attach schedule of works if appropriate)

Inspection of microwave equipment in shelters and around the structure.

ON SITE WORK-TEAM DETAILS

Company or Work-Group	Staff Name(s):	Phone(s):
Gibson Quai – AAS Pty Ltd	Gary Worsdell	
Gibson Quai – AAS Pty Ltd	Brett Gooden	

Work Start Date:	16 Aug 2006
Work End Date:	18 Aug 2006

Work Site(s):			
	R0 Karratha Term	R1 Cajuput Well	R3 McKay Creek
	R5 Peter Creek	R9 Ashburton	R10 Barradale

Service Outage? No **Note:** Please notify the Customer and provide service and outage authorisation details **below.**

Customer Notification(s) for work planned				Service(s) or CIRCID(s) affected			
Customer Contact:	**Phone:**	**Date Advised:**	**Permission (If Service Outage)**	**Service / CIRCID**	**Description**	**Outage Date**	**Outage Times**
			Yes / No				

Other Permits required? (Please attach)	No	**NB:** It is the responsibility of the requestor to ensure that all **Personnel** performing this work comply with relevant Safety **Regulations/JSA.**
JRA prepared?	NA	

The Checks hereunder only apply to work specific to Communications Networks Systems/Equipment:

† TNMS and/or STRIDE updates completed?	NA	**Equipment programming changes required?**	NA
SPF Isolation(s) required?	NA	**Note:** SPF Isolations only apply to sites S11, R52, R49, R154, and R157.	

NMC approval for the above work (NMC use only):

Risk Assessment:	Low	**CSPAR REF No:**	C220806-1
Work Authorised:	Yes	**† TNMS Change No:**	
Comments:	*1. All persons to have completed Alinta Induction Certification.* *2. Job Risk or Job Safety Analysis is required to be prepared (CSPAR application indicates not required, however all on site visits/work require this process to be completed).* *3. Contact Alinta Gas Control (09 9492 3723) and NMC (08 9383 5858) on arrival and departure for each site.* *4. Keys to be obtained from Alinta if required.*		
Checked By:	E Needham **Date:** 11/8/2006	**Signature:**	

For related procedures refer to CSP DMS#: 1436306

C. QUOTATION FROM VENDORS

BUDGETARY PRICING FOR

PERTH TO DAMPIER

SDH LONG HAUL MICROWAVE RADIO WITH SDH & PDH MULTIPLEXERS

Document No PBC1252

Issue Date 15th September 2006

Specialists in Advanced Telecommunications Technology

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CommTel Network Solutions Pty Ltd – ABN 77 158 472 388

46 Ovata Drive, Tullamarine, 3043, Victoria, Australia

WA Office, **Telephone: 08 9291 5100**, Fax : 08 9291 8027
HO, Telephone +61 3 9330 4722 – Facsimile +61 3 9330 4277

www.commtelns.com
Author: Greg Harris
Project Manager: Tony Green
Account Manager: Greg Harris
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DOCUMENT CONTROL

HISTORY

Revision	Controlled Status*	Issue date	Approval		Revised by	Changes
			Initials	Ref no		
A	Customer Approval	5/09/06	TG	MA384		First Issue

* Draft; Customer Approval; Construction; Verification; As built; Validation; Report; Tender

DISTRIBUTION

Internal	External
Project File – Tony Green	Gary Worsdell – Gibson Quai-AAS, Perth , WA
Account File – Greg Harris	

1 EXECUTIVE SUMMARY

It is with pleasure that CommTel Network Solutions' provide this proposal to Gibson Quai – ASS in response to an Expression of Interest and quote request for the Alinta, Perth to Dampier Microwave Radio replacement project.

The proposal is based on discussions held with Gary Worsdell and his team for the replacement of the existing 300 channel NEC analogue microwave system with a digital SDH microwave system in the 6.7Ghz band.

Included in this proposal are the following items offered by CommTel:-

- BoM and conceptual design
- Provision of Ceragon SDH Microwave Radio system
- Provision of Marconi SDH multiplexers
- Provision of the Nokia Dynanet PDH multiplexers
- Provision of new 24VDC power systems at all sites including external power shelters.
- Network management systems
- Recovery of waveguides and obsolete hardware including power systems.
- Installation and commissioning services for all equipment
- Training in Perth on the supplied products (Optional)

This proposal is budgetary as at this stage there are many unknowns and a list of assumptions has been provided in the Scope of Work section. Due to the number of assumptions the final price may vary between +- 15%

Technical Highlights

- SDH Radio with 1+1 HSB Space Diversity sub 50ms switching time
- Flexible 64k Cross-connect capability using DN2 and DB2 Nokia Multiplexers, which offer Y-Branch loop protection of critical 64k circuits
- All equipment rated for 50 Degrees with high MTBF
- Industry proven SDH Multiplexers from Marconi/Ericsson and PDH Multiplexers from Nokia operating in similar environments.
- Integrated NMS for complete network with remote access capability

CommTel has an extensive track record in Australia and Overseas with the implementation of large communications infrastructure projects especially in the Carrier, Rail, Mining and Utility sector. The products chosen are currently in use in similar environments and have been chosen as they provide a high availability infrastructure with full loop protection as required in this environment.

The budgetary price is based on the conceptual design provided in this document and the pricing basis can be found in the Commercial section of this document. For the purpose of this proposal we have selected certain vendor products however these may vary depending on the final tender document and detailed design requirements.

Two costed options have been provided:

- Option 1 – IDU and ODU
- Option 2 – All IDU with waveguide

Option 1 – IDU and ODU

ITEM	PRICE (ex GST)
1+1 SDH Radio	$2,688,000
SDH & PDH Mux	$1,257,000
NMS & Handbooks	$210,000
Feeders and accessories	$327,291
Masthead Loading Assessment	$30,100
System Manuals	$10,000
Power Systems	$429,800
Synchronisation Clocks	$25,000
Hardware Recovery	$278,200
Integration and FAT in Melbourne	$231,000
Installation and Commissioning	$1,075,000
TOTAL	**$6,561,391.00**

Option 2 – All IDU

ITEM	PRICE (ex GST)
1+1 SDH Radio	$3,864,000
SDH & PDH Mux	$1,257,000
NMS & Handbooks	$210,000
Waveguide and Dehydrators	$1,544,899
Masthead Loading Assessment	$30,100
System Manuals	$10,000
Power Systems	$429,800
Synchronisation Clocks	$25,000
Hardware Recovery	$278,200
Integration and FAT in Melbourne	$231,000
Installation and Commissioning	$1,075,000
TOTAL	**$8,954,999.00**

Prices quoted are Ex GST

CONTENTS

APPENDICES

2 INTRODUCTION

This document outlines CommTel Network Solutions' response to the Expression of Interest for the replacement of the Alinta, Perth to Dampier microwave system.

CommTel Network Solutions is an Australian-based Engineering organisation specialising in the engineering, supply, design and installation of advanced optical and radio communications technology. CommTel has an extensive track record in Australia and Overseas, including specific experience in the supply of Microwave radio systems for the rail, aviation, mining, utility and carrier sectors in Queensland, NSW, Victoria, SA, WA and overseas.

This proposal is budgetary based on the information provided by Gibson and Quai and is intended as a guide to allow a financial model to be developed to then take the proposal to the tender phase. CommTel and our partners would be pleased to participate in the Tender stage of this project if it is decided to proceed to the next phase.

Section 10 introduces recent key projects implemented by CommTel that display specific capabilities relevant to the Alinta project. Section 11 describes our quality system and our Health, Safety & Environment (HS&E) procedures.

3 REFERENCE DOCUMENTS

Documents used or referenced in the development of this proposal include:

- The letter dated 25th August 2006 from Gibson Quai-AAS titled "Microwave Design: Request for Budgetary Quotation"
- Teleconferences and various clarification emails.

4 SCOPE OF WORK

The SOW has been created based on the requirements as stated by GQ-AAS. The final SOW may differ based on the detailed design and final customer requirements.

4.1 Inclusions

Included in CommTel's scope of works are:

- BoM and conceptual design
- Provision of Ceragon SDH Microwave Radio system
- Provision of Marconi SDH multiplexers
- Provision of the Nokia Dynanet PDH multiplexers
- Provision of new 24VDC power systems at all sites including external power shelters.
- Network management systems
- Recovery of waveguides and obsolete hardware including power systems.
- Synchronisation clocks
- Installation and commissioning services for all equipment
- Integration and FAT in Melbourne including
- Training in Perth on the supplied products (Optional)

4.2 Exclusions

Excluded from CommTel's scope of works are:

- Design of channel plans (existing or to be revised)
- Provision of equipment shelters (existing)
- Detailed Design Services

4.3 Assumptions

The following assumptions have been made in providing this proposal.

SDH Microwave

- Radio path design is correct for the required availability
- Existing cable trays are available and suitable for the new RG214/LMR400, LDF450 feeders or waveguides.
- Tower access is available for the provision of tower mounted ODU
- Antenna and horn connections are in good working order
- 1+1 HSB with Space Diversity is required at all sites with baseband switching
- Ceragon 1500SP ODU's will be used for option 1 at all sites although the 1500HP unit can be substituted if final design shows a link availability issue.
- Existing site earthing is suitable for purpose and does not need to be upgraded
- After recovery of the 300 channel system the waveguide port will be sealed at the horn by us.

SDH Mux

- Dual core SDH mux is not required at the compressor and repeater sites. (can be supplied if required)
- All equipment must operate to +50 C or better
- 4 E1 services are suitable for all standard repeater sites
- 8 E1 services are suitable for all Compressor sites
- No more than 63 E1's will be required at the Perth terminal site
- Dual core protected mux required in Perth and Dampier
- The corporate LAN will utilise Ethernet directly from the SDH mux ports with a total capacity not exceeding 10Mbit shared.

PDH Mux

- Channel plan design has not been included in the pricing due to lack of information on requirements.

- 8 port V.24 card provided at each repeater site with basic functionality TX/RX
- 8 port 4 Wire E&M card provided at each repeater site
- 6 port 2 wire Voice card provided at each site for station phones
- Ethernet card provided at each site for SCADA connectivity (V24 card can be used as an alternate)
- Loop protection provided at channel level along the route to required services. It has been assumed that at each Compressor site PDH channel grooming will take place and provision made for loop protection at these intermediate sites as well as the terminal sites.
- Provision has been made for all services to terminate in Perth although it is known that some of the services will be omnibus and some inter site but with no channel plan this is difficult to determine.
- Up to 15 services per site have been provisioned (voice and data) Actual port capacity design based on 4 x DATA, 2 x 4 wire E&M, 2 x telephone and 1 x SCADA Ethernet at each site.
- PDH grooming mux (DN2) provided at R1 to allow loop protection via an alternate Carriers E1 services carrying critical channels. Up to 2 x E1's allowed for or 60 channels
- Ethernet loop protection available through an external router. This has not been costed.
- Perth terminal site has been provisioned for 630 channels (15ch/site x 42 sites) It is understood that this will be reduced but a worst case scenario has been costed.
- The SCADA system requires an Ethernet link from each of the Compressor sites. 9 EIU Ethernet interfaces provided in Perth.

Power Systems

- Site power supplies are 24VDC
- The existing thermo couple has the capacity to power the new hardware
- New batteries required at all sites for 24 hour backup. Without knowing the existing drain and what equipment will be remaining this has been estimated. A 300AH bank has been provisioned.

Civil Works

- No Air-conditioning at any site
- No upgrade to towers required

- All towers are safe to climb and inspections have been carried out on a regular basis
- Access is available for all sites on request

General

- Delays may be encountered due to Cyclone activity or adverse weather.
- Contractor will be providing all accommodation and it is assumed on site camping is allowable in caravans.
- Recovered equipment will be returned to Alinta in Perth for disposal by them. This includes recovered and decanted battery acid.
- Recovered equipment will be for disposal only not reuse.
- No Spares have been included
- No Order wire has been included

5 CONCEPTUAL DESIGN

5.1 SDH Radio Overview

The intention is to use the Ceragon 1500SP split SDH radio system with 2 x ODU's located on the tower behind the antenna and a single IDU with two independent SDH indoor modules for each link. Space diversity will be employed with baseband switching and the units will be configured in a 1+1 Hot Stand By (HSB) configuration. The Ceragon 1500HP (High Power) ODU could be used but preliminary design checks have shown that the SP radio is capable of achieving the required 99.999% availability on the longest hop.
To facilate the HSB 1+1 STM-1 protection an optical y-cable is used to connect from the two STM-1 interfaces on the radio to the single STM-1 interface on the SDH Multiplexer.

A second option has also been costed utilising the FA3200HP high power indoor unit with waveguide connection to the exising antenna. In this case the two RF units are rack mounted and an RF coupler is used to provide the Space Divercity at the RF level. These units come with fan units and their own rack and provide some operational advantages but at a higher cost. The same IDU is used for both options.

5.2 SDH Multiplexer Overview

A Marconi OMS840 SDH multiplexer will be installed at all repeater sites which will cater for 4 x E1 services and 4 x 10/100 Ethernet services for the corporate LAN. At the Perth and Dampier terminal site a Marconi OMS1200 chassis will be provided to cater for the 42 x E1 services (63 maximum), one from each site. This mux will be equipped with a redundant core and 2Mbit protection circuitry. All SDH mux interfaces will be optical MM with LC connectors.
At compressor sites an OMS850 will be provided which caters for 8 x E1 services and 4 x 10/100 Ethernet ports. This will allow for circuit grooming if required to manage the number of E1's traversing the link. It has been assumed that at some of these sites loop protection can be provided by interfacing into a Carriers network.

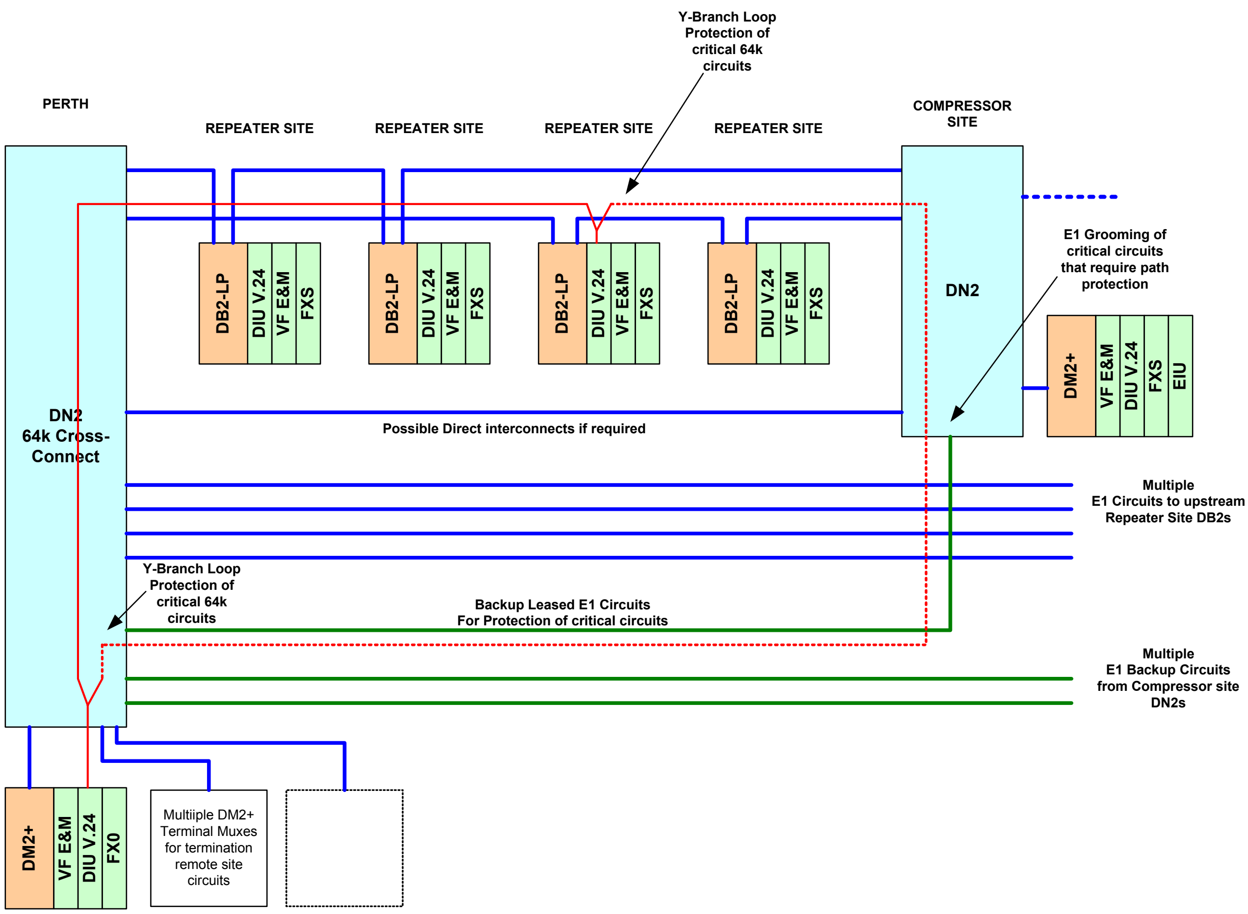
5.3 PDH Multiplexer Overview

The Nokia DB2 has been selected to provide the breakout of circuits at each repeater and DM2+ at the compressor sites. This will be coupled with a Nokia DN2 cross connect mux at the compressor sites, Perth and Dampier to allow grooming of the 64K services to reduce the overall E1 count, and allow management of the circuits requiring loop protection. Provision has been made for 2-wire voice service, 4 wire E&M services, Ethernet services and data services from all sites. If the new SCADA system does not use Ethernet then this card will not be required.

The DB2 and DN2 combination will allow for maximum flexibility in terms of 64k cross-connection and protection. However depending on the actual circuits required at tendering time, the architecture can possibly be simplified with more terminal multiplexers. All 2M Circuits are carried over the SDH Multiplexers and Radio, apart from any backup Lease Line 2M circuits.

5.3.1 64K Loop Protection

Use of the DB2-LP and DN2 will allow selected circuits to be loop protected via Y-Branches. The Y-branch allows point-to-point protection circuits to be configured offering switching time from 200-400ms. Typically less than 250ms can be expected.



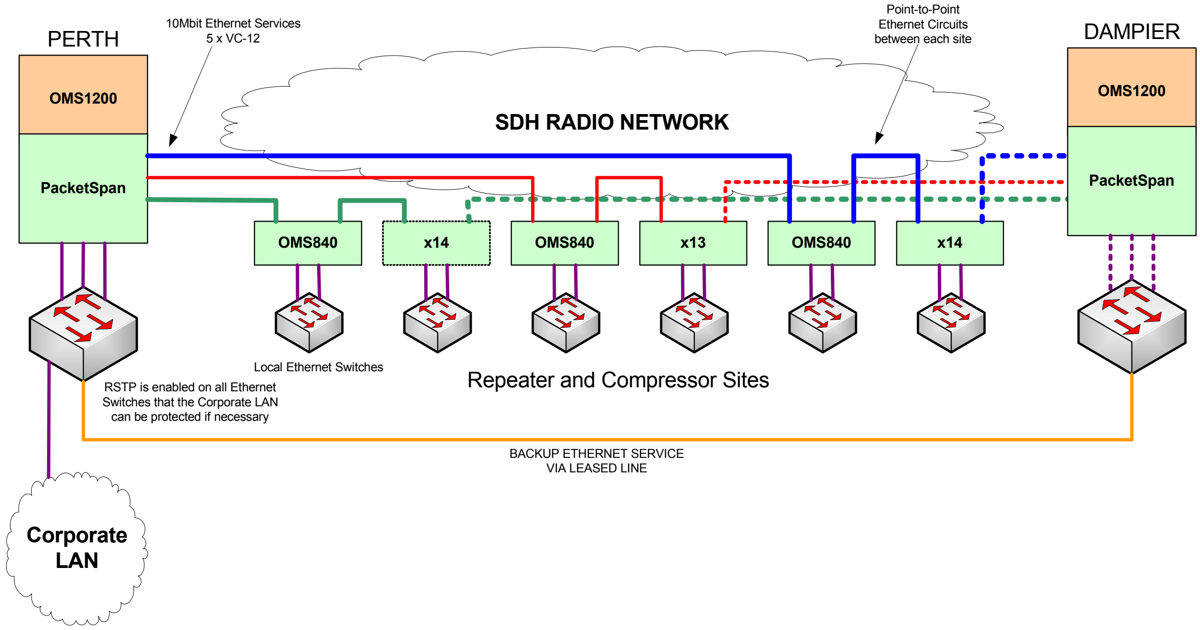
5.4 Corporate LAN Services

The corporate LAN will be distributed to each site utilising Ethernet Ports on the OMS840/850 and the PacketSpan card on the OMS1200.

Ethernet bandwidth between SDH multiplexers is configured as a point-to-point circuit. Each circuit can be allocated bandwidth from a single VC-12 2Mbit/s Throughput up to a VC-4 (100Mbit/s).

Compressor and Repeater sites will connect together using 10Mbit/s Circuits in a daisy chain fashion. The local Ethernet switch at each site will be used to join the Ethernet circuits between sites. Nominally the network will be broken up into 3 or 4 areas to reduce the number of Ethernet switches in each daisy chain.

Additionally, all the circuits will also be routed via Dampier so a backup circuit can be implemented in case of complete failure of the 1+1 radio path. RSTP can be utilised on all the switches to provide the loop protection.



5.5 Synchronisation Overview

Two GPS G.811 Clocks will be utilised to synchronise the Network. The clocks will be located at R13-Comp and R29-Comp Sites, to ensure that no SDH Multiplexer chain is longer than 15 nodes. This will ensure network stability at the SDH layer.

DN2 Multiplexers will be synchronised from the local SDH Multiplexer at each site. DB2-LP multiplexers synchronise from the incoming 2Mbit/s signal.

The SDH Radios are timing transparent.

5.6 Functional Site Overviews

5.6.1 Repeater Site

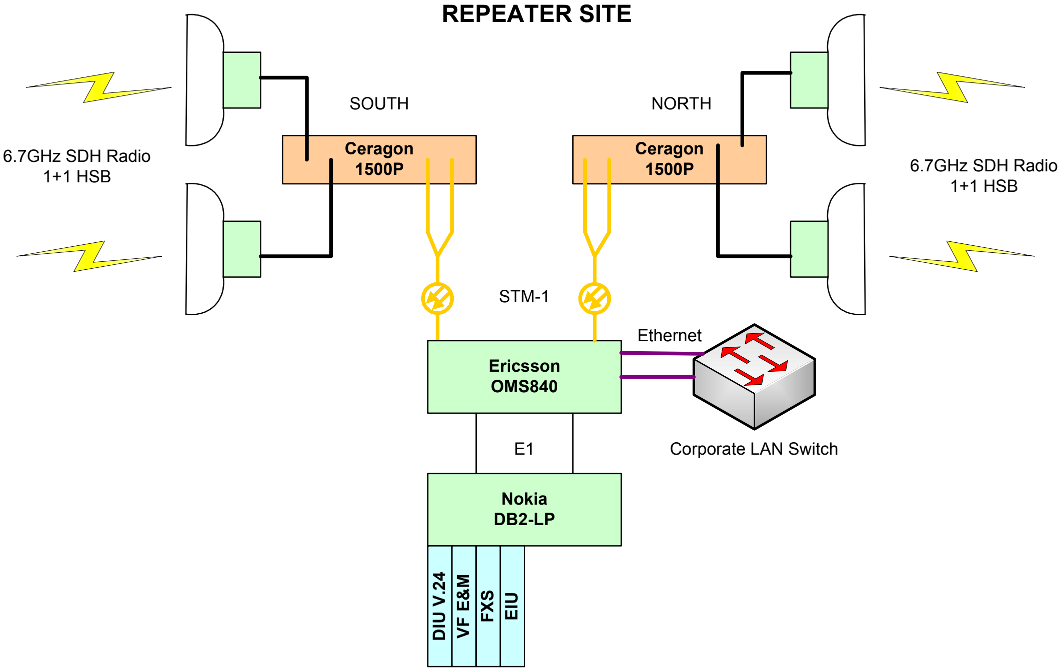


Figure 1 - Repeater Site Functional Overview

5.6.2 Compressor Site

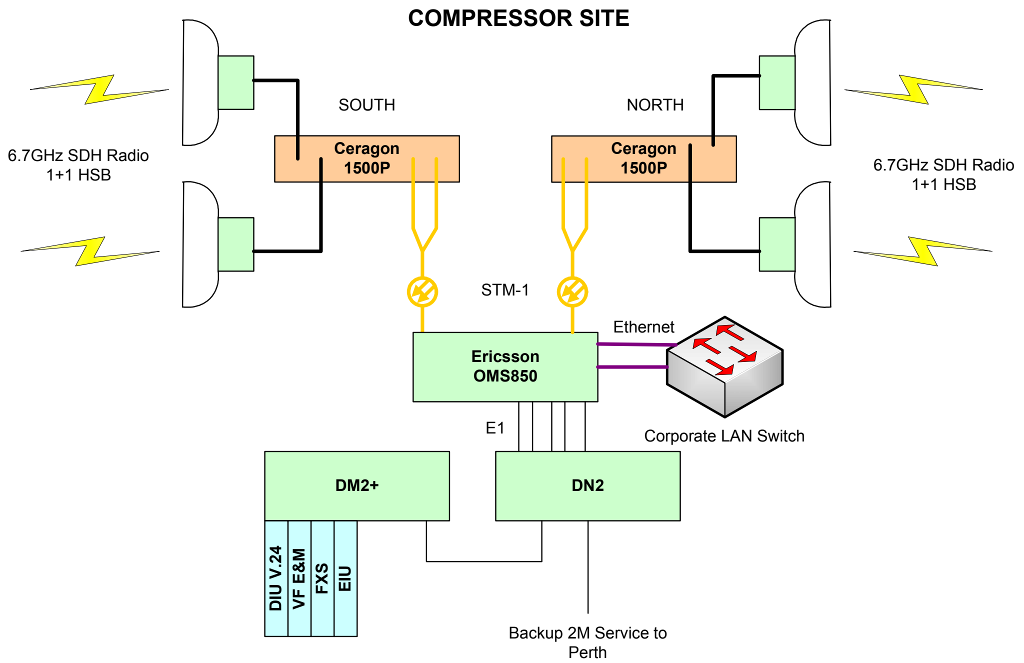
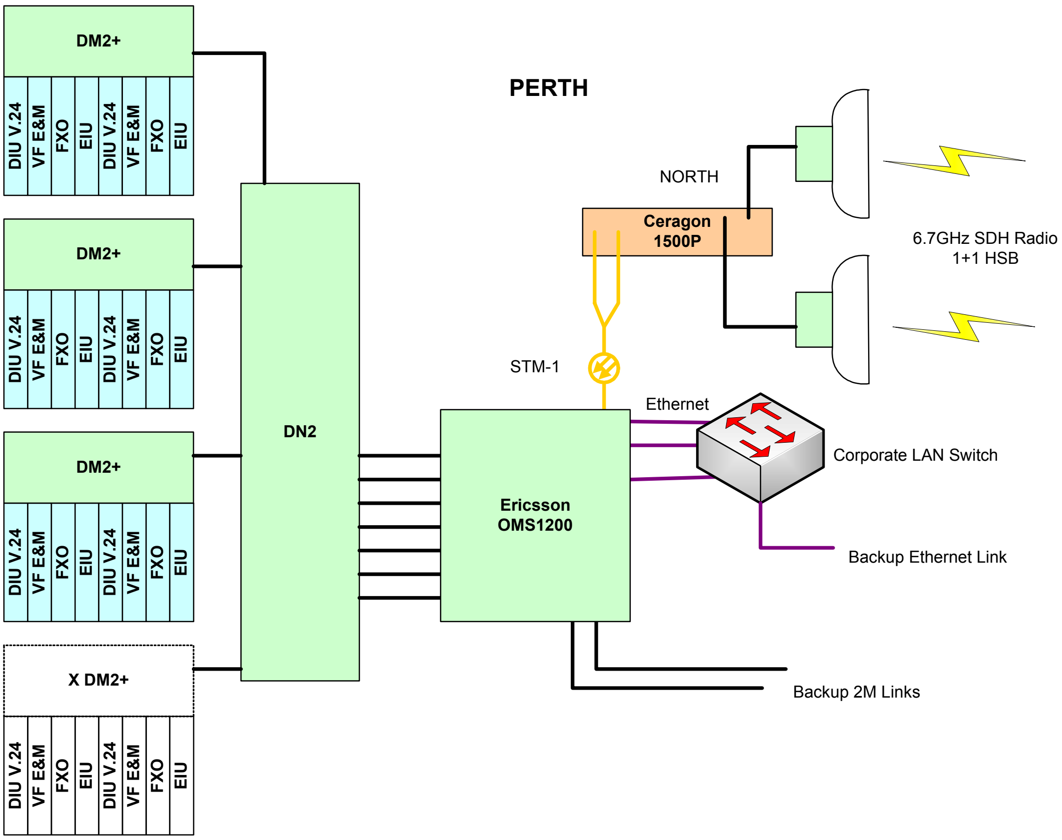


Figure 2 – Compressor Site Functional Overview

5.6.3 Perth Terminal Site



6 DETAILED DESCRIPTION OF EQUIPMENT

6.1 SDH Microwave Overview

Ceragon's FibeAir® product family of broadband wireless systems supports multiple capacities, frequencies, modulation schemes and configurations for various network requirements, using the same hardware and state-of-the-art technology.

Combining spectral efficiency, hardware efficiency, modularity, flexibility and upgradeability in a single, compact, and cost-effective 1U system, the FibrAir family is a breakthrough in the wireless point-to-point market.
This innovative family of products presents an easy method of "on the fly" wireless network upgrades in accordance with network expansion requirements. These optimised as-you-grow capacity capabilities of the FibeAir family are leveraging operators and Service Providers capital and operating expenses.

Frequencies and Modulations - Ceragon's FibeAir family supports the complete range of frequencies of 6 to 38 GHz and software configurable modulation schemes of 16, 32, 64, 128 and 256 QAM with versatile 28-56 MHz bandwidths.

Capacities - Ceragon's radios are upgradeable for capacities of 100 to 622 Mbps, using the same 1U IDU, supporting 1+0, 2+0, 4+0 (with optional XPIC, Cross Polarization Interference Canceller mechanism), 2+0 East-West, 1+1 HSB, and 1+1 HSB with space or frequency diversity mode. Point-to-point, ring, star, and cascaded chain topologies are all supported.

Topologies and Configurations - Each indoor unit (IDU) can host up to two carriers, each delivering 100, 112, 116, 155 or 311 Mbps, optimising the solution for every network topology and configuration. The two independent, hot-swappable carriers can be used for protection, diversity or double capacity.

High spectral efficiency is ensured by choosing the same frequency for double the capacity, due to the usage of both carriers for vertical and horizontal polarizations, implemented by a built-in XPIC mechanism.

East-West configurations for ring and cascaded topologies are also possible using the same method, whereby one carrier is directed to the east and the other to the west, reducing equipment and resource requirements in each node, which, in turn, increases network efficiency.

FibrAir can seamlessly integrate into any SDH, IP and ATM network, while supporting a wide variety of IP + TDM interfaces, including nxE1/T1, nxE3/DS3, nxSTM-1/OC-3, STM-4/OC-12, nxFE, and GigE.

6.1.1 SDH ADM Overview

The product family being offered is Marconi's OMS product range. The OMS product range is carrier grade and is used extensively in dedicated network and carrier applications around the world because of its feature rich hardware, high reliability and it conforms to all the relevant open standards.

A key example of Marconi's conformance to open standards is its support of the GFP protocol for its Ethernet interface cards. This is an open standard that will allow the mapping of Ethernet circuits between multiple vendors of SDH equipment that also conform to the GFP standard.

Figure 3 OMS1200

This family of SDH add/drop multiplexers includes variants supporting line rates from STM-1 to STM-64, the full range of tributary interfaces and a wide selection of expansion options. Therefore, if the Alinta network grows, there is a broad product range to choose from to meet the additional requirements.

CommTel's preferred option is based on the Marconi OMS1200 SDH node at the Perth terminal (refer to Figure 3) and the OMS840 and OMS850 at the repeater sites and compressor sites. This maintains a consistent approach across the entire network, thereby minimising spares and training requirements.

OMS840

Marconi/Ericsson is investing substantial further development into the OMS family. Below is a list of the new features and capabilities:

- STM-16 operation
- Further Ethernet functionality
  - Layer 2 Ethernet aggregation tributary card
  - 2 x GigE and 4 x FastE tributary card
  - Support for VLAN tagging, MPLS tagging, MAC switching
  - Point to multipoint EVPL, EVPLAN
  - 100 Mbps optical Ethernet interface
  - Mapping up to 4 x VC-4 bandwidth
- Extended sub-rack, supporting 252 x E1 and 5 tributary slots
- CWDM operation

6.2 Nokia Dynanet PDH Multiplexers

The Nokia Dynanet range of PDH equipment includes terminal multiplexers (DM2+), add/drop digital branching multiplex equipment (DB2 and all its variants) and the dynamic cross connect multiplex equipment (DN2). The common Dynanet range includes a range of chassis (both EMC and Non-EMC), power supply adaptors and various line protection equipment (CO2, CO8) and line terminals, optical, copper and radio.

The range also includes a wide variety of interface plug-in units including slow speed data, sub-rate data, VF E&M, FXO and FXS, ISDN, Ethernet. These units are characterised by the fact that once installed they are subordinate to the main multiplex unit.

The range also supports a number of special units including units, which deal with discrete inputs and outputs, analogue signals and other units that deal with management functions.

A typical Nokia node is characterised by a chassis into which all units are installed and in some cases, as mentioned, units are subordinate to the Multiplex equipment and for others just draw power, alarms and other signals from the backplane.

The main multiplex equipment normally is located in the chassis/shelf in the left most positions and all other subordinate units installed into the remaining slots but are not position dependent.

All unit interfaces are front entry and comply with ETSI standards. The chassis is specially designed to deal with these cables permitting the installation and removal of plug-in units as required.

6.2.1 Equipment EMC Subrack (21090.09)

The EMC subrack is used to house all Nokia Dynanet, Mux cards and line cards and supports 16 slots. The subrack is designed to be mounted into a standard ETSI 19” rack.

The subrack has to be powered by –20 …–72V DC power supply units. and the EMC subrack can be subdivided in to four separate sections using a hardware jumper.

Figure 4 Nokia EMC Subrack

6.2.2 NDU, Power Supply Nokia DC Unit (T37882.01)

The Power Supply Adapter is used for standalone subracks where an existing DC supply is available and provides filtered stored energy to the backplane. The NDU is installed in slot 17 of the chassis, with the NDU having an input voltage range between –20V DC to –72V DC, with a maximum current capacity of 5 amps over the voltage range.

The NDU serves as the interface point for up to 2 external central battery feeds, ring voltage and criterion/signaling voltages. Summary alarms from the 17 slot 19” subrack are presented at the NDU and are available as either voltage free contacts or ground contacts for station alarms.

6.2.3 Digital Branching Equipment (24002 & 24011)

The DB2 is one of the most flexible and versatile digital Add/Drop 2 Mbps multiplexers, some key features include:-

- Full add, drop, omni bus (VF and Data) from 3 x 2 Mbps directions.
- Internal Clocking prioritization from 5 separate input priorities.
- Full synchronization capability from multiple directions.
- Provides conditional branching capabilities therefore no external device or NMS needed to maintain redundant configurations.
- Can be selected as revertive or non-revertive state when protection switching is utilized.
- Fully managed.
- With minor firmware changes, the same hardware can be used in loop protected or 1+1 linear modes for various network architectures.

The DB2 consists of two modules, namely the B2 and the X2 units. As a pair they must be installed in specific locations (slots 1 and 2) of a 19” subrack to take advantage of the backplane and Associated VF and Data channel cards.

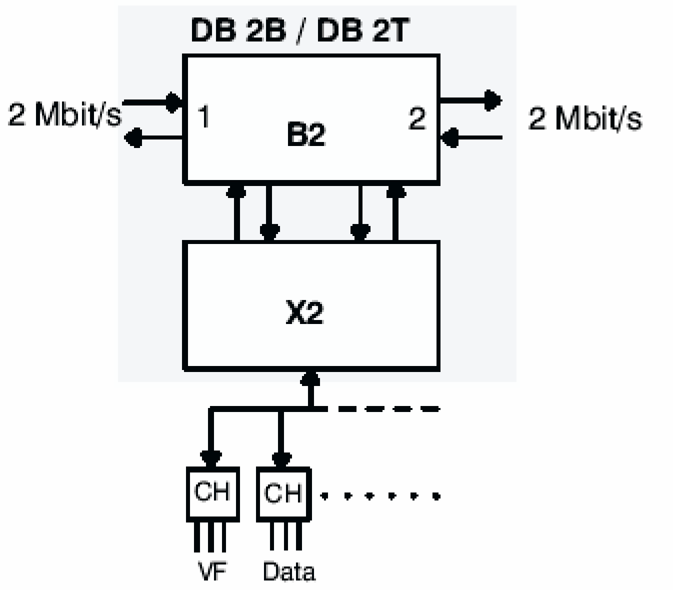


Figure 5, basic architecture of the DB2 Branching Multiplex Unit

6.2.4 DIU 2M n x 64K G.703 (24012)

The 24013 is a fractional E1 Data Interface Unit used for interconnecting other multiplex or E1 compatible equipment to the main E1 signal. This unit would be used to interconnect the spur sites.

6.2.5 DIU V.24/V.28 0.3…19.2K, async (24021)

The Nokia 24021 DIU card is used to interface Asynchronous V.24/V.28 data connections into a 2 Mbps signal.

This card provided the TX/RX functionality required for the SCADA operation. If handshaking is required and full signalling then the 24020 card can be used.

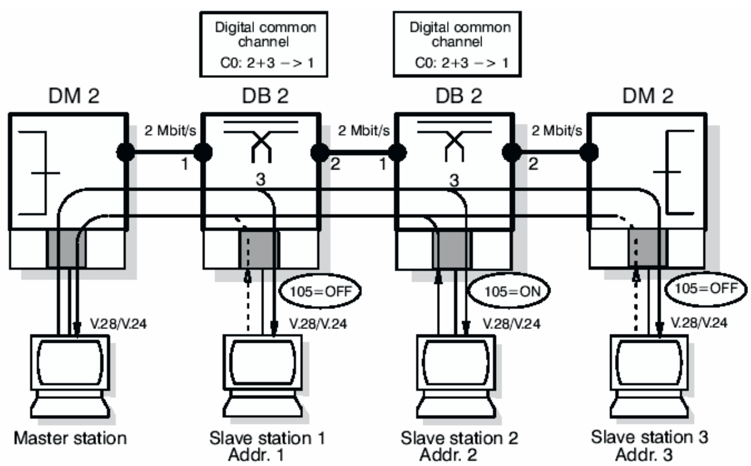


Figure 6, Sync/Async V.28 Omni Bus

6.2.6 VF 2W Telephone exchange end (21216)

The Sub/Exc channel unit has 6 x 2 wire VF channels and is installed at the exchange end of the 2 wire telephone circuit.

The Sub/Exc unit is generally paired with the Subscriber unit 21206 to provide a complete POTS extension.

6.2.7 VF 2W Telephone, subscriber end (21206)

The Sub/Sub channel unit has 6 x 2 wire VF channels and although generally associated with the exchange end card (21216), the subscriber Subs card can also be used in a Sub-to-Sub hotline mode. This mode does not require an exchange or PABX

6.2.8 Ring generator (T37885.02)

The Ring generator is generally associated with the 21206 Subscriber end card and provides a ring voltage upon command from any Dynanet Multiplex (up to 90VAC). The unit also supports ground key activation.

When ring enable (REN) is activated, the Ring Generator will work in standby mode, thus conserving station battery. The Multiplex will toggle the REN based on the incoming criterion signalling bits from the exchange or exchange end card and switch on the RG on command, once on, the ring voltage is present at the VF card. The ring generator is a universal product and it has a number of optional straps to comply with world standards.

It has the capacity to drive 60 extensions.

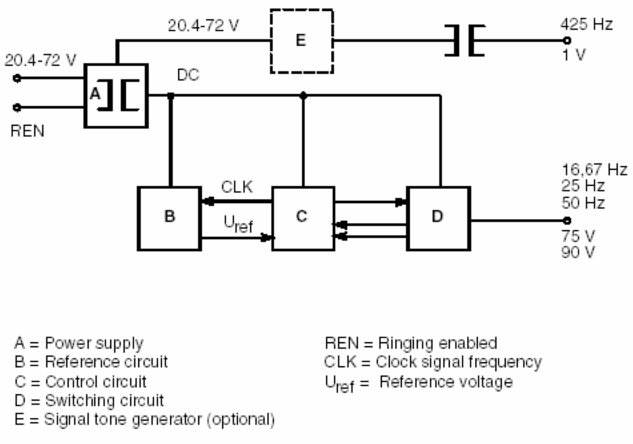


Figure 7, Ring Generator block diagram

6.2.9 VF 2W/4W Interface unit with E&M signalling (21236)

The VF E&M channel unit is an ITU-T compliant VF interface unit offering 8 x VF interfaces (2W/4W) each with two associated E&M signalling circuits.

Each voice channel uses A-Law companding according to G.712 and is widely used for many applications such as VF TX/RX and PTT to radio transceivers, Teleprotection signalling channel and VF modem applications.

Each Channel has a pair of E&M Signals (CAS) carried in timeslot 16, when installed in the Dynanet Multiplex product family, features such as Omni-Bus, and special VF branching and summing is possible, all associated signalling is carried to each channel through the PCM network.

Via software, each independent channel card be set for either 2 or 4 wire operation with PCM transmit and PCM receive level controls adjustable in 0.5dB steps., below are typical 2 and 4 wire input and output flows.

The E lead typical can sink a maximum current of 100 mA, this is sufficient to drive a 48 V DC relay.

6.2.10 Transmission Management Adaptor (21710.01)

The TMS Adaptor forms an integral part of the Nokia Transmission Management System. The Nokia TMS is used for the collection and processing of the data related to the operation of the telecommunications network. It also allows the manual control of equipment and system operations in the network by using the Transmission Management Computer or the Service Terminal.

The TMS Adaptor provides a means for the logical connection of two bus masters (i.e. Service Terminal, TMC, PC-TMC) to a single TMS Service Bus. Each Nokia transmission equipment also called Network Element (NE) contains one V.11 interface for use with Nokia TMS.

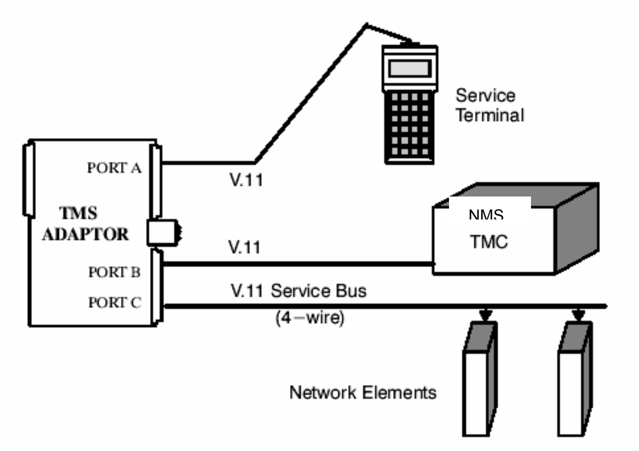


Figure 8, typical TMS Adapter configuration.

6.2.11 Supervisory substation (21705) (Optional)

The TC 21705 Supervisory Substation is designed for general use in a Transmission Management System (TMS). The substation is used to gather digital data, analog data and pulse rate data from variety of sources, and to provide digital outputs to control external equipment. This description is designed to provide some guidelines in using the substation and covers the basic functions of the substation, interfacing the substation to equipment. Moreover, it provides the service menus for operating and setting the substation from the Nokia Service Terminal TC 21700, or through the Remote Control and Measurement services of a Transmission Management Computer (TMC).NMS system.

6.2.12 DFX100/ ENT100/ESU (Optional)

This is a new card developed by CommTel that slots into the Dynanet subrack and draws power from the existing chassis. The DFX100 card provided 4 x G703/2M E1 services both Balanced and unbalanced , 4 x 10/100 Ethernet ports and a V11/X.21 sync/async port. The trunk port provides single fibre or dual fibre operation in short haul or long haul operation with loop protection if required. It has extended operational temperatures from -5C to +65C.

The Ethernet ports provide VLAN tagging, VLAN stacking 802.1p priority and the unit is managed via SNMP.

If additional Ethernet ports are required at a site then the ESU will provide a 12 port switch that plugs into the Nokia chassis drawing power from the backplane and providing a high temperature (+65C) robust industrial switch for station connections.

7 INTEGRATED NMS

Management of the network elements will be important as the network is required to monitor a critical gas infrastructure and is located in a remote and isolated region. CommTel have experience in providing integrated management systems for diverse equipment types.

It is intended to build a specific NMS for this application using modules commonly used by CommTel for the various network elements. The management package will include:-

- Castel Rock SNMPc
- Ceragon Ceraview (SDH Radio)
- Nokia DN2 Manager
- Nokia DB2 Manager
- Nokia MSTE
- Nokia Q1 Agent
- Marconi MV36 (SDH)
- Graphon Host

The above services will be run on several servers with a central SNMPc server providing a single unified user interface for all equipment types installed.

The SNMPc NMS Server will provide a single integrated NMS window for monitoring of the complete radio network, with complete alarm and configuration management. Each network element is represented by an individual icon on the NMS.

The NMS can either be viewed from the local terminal, or remotely accessed via Graphon Web clients. This allows any user with a PC and internet browser access to the NMS. Access can be fully controlled using security profiles.

The final NMS design will be provided during the tender process.

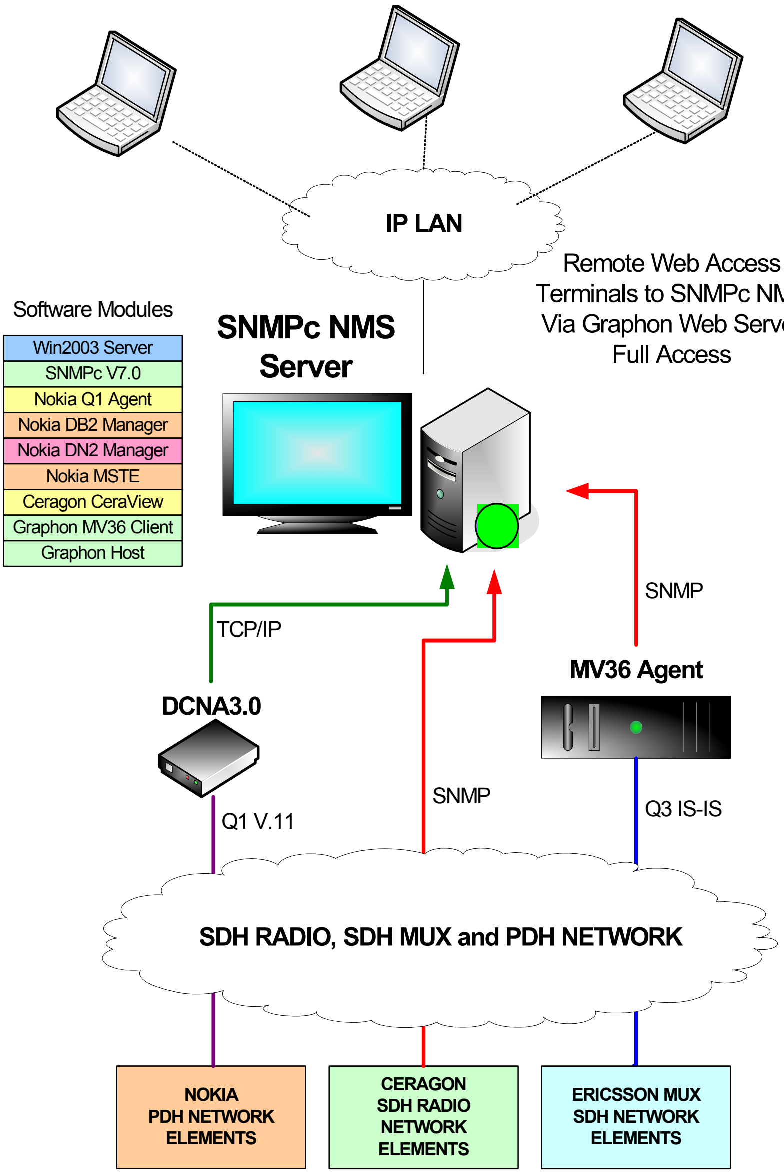


Figure 9 - NMS Architecture

8 PROJECT SERVICES

The services included in this budgetary offer by CommTel Network Solutions are as follows:-

- **Design Verification** – CommTel have included a Design Verification service to review and comment on the detailed design and the final bill of quantities. CommTel can supply the full design service if required but have not included pricing in this offer for the full design service.

- **Integration and Factory Testing** – CommTel will integrate the full SDH and PDH multiplexer system at our Tullamarine factory and fully string test the programmed system along with the Network Management system. The SDH Radios will be programmed and tested separately as point to point units. The system will be build up in the racks that will be installed on site. This means that all of the internal rack cabling will be completed and tested at the factory.
  After factory testing the equipment will be removed and packed for shipping. Each site will be individually packed and all cards will be labelled with their subrack and slot numbers from the factory test enabling quick and accurate assembly on site.
  At the completion of the factory testing a Site Folder will be created for each site. This will detail all the equipment for the site including all test results from the factory testing, including all settings and node configurations. A separate folder will be supplied for the Network Management System

- **Installation and Commissioning** – Due to the remoteness of the sites CommTel will undertake a preliminary site survey of all sites to establish the requirements for installation of the equipment. Individual site requirements will be documented and the installation plan established. This plan will be supplied to the customer for approval prior to the commencement of site works. We envisage that the current system will remain operational during the installation and commissioning of the new system.
  The Network Management System will be installed and commissioned at the same time as the radio network is installed and commissioned.

- **Decommissioning** – Once the new system has been fully commissioned and tested, as agreed with the customer, the existing system will be decommissioned at those sites required under the contract. All the removed equipment will be returned to the customers store as directed.

- **Documentation** – At the completion of the installation and testing CommTel will supply as-built documentation including all final test results.

9 CONTRACT TERMS & CONDITIONS

This offer is made, in principle, in accordance with CommTel Network Solutions Standard Conditions of Purchase, which are available upon request.

9.1 Budget Price

The Budgetary Price is offered in Australian Dollars, exclusive of GST. The Budgetary Price includes the hardware, service as described in the Scope of Work.

It is understood that the design and hence price will vary following the detailed design phase.

Option 1 – IDU and ODU

ITEM	PRICE (ex GST)
1+1 SDH Radio	$2,688,000
SDH & PDH Mux	$1,257,000
NMS & Handbooks	$210,000
Feeders and accessories	$327,291
Masthead Loading Assessment	$30,100
System Manuals	$10,000
Power Systems	$429,800
Synchronisation Clocks	$25,000
Hardware Recovery	$278,200
Integration and FAT in Melbourne	$231,000
Installation and Commissioning	$1,075,000
TOTAL	**$6,561,391.00**

Option 2 – All IDU with Waveguide

ITEM	PRICE (ex GST)
1+1 SDH Radio	$3,864,000
SDH & PDH Mux	$1,257,000
NMS & Handbooks	$210,000
Waveguide and Dehydrators	$1,544,899
Masthead Loading Assessment	$30,100
System Manuals	$10,000
Power Systems	$429,800
Synchronisation Clocks	$25,000
Hardware Recovery	$278,200
Integration and FAT in Melbourne	$231,000
Installation and Commissioning	$1,075,000
TOTAL	**$8,954,999.00**

9.2 Price Basis

The prices in the above section have been calculated based on the following summary of the Build of Material.

SDH Radio	Option 1 – IDU and ODU • Ceragon 1500SP 6.45 -7.1 Ghz STM1 radio with Ethernet wayside. • 2 x ODU connected to existing Antenna • Baseband combining with Space Diversity • 1+1 HSB configuration with 2 x IDM's • Optical MM STM1 interface • Power cabling, Optical splitters and Connectors Option 2 – IDU • Ceragon FA3200 FR indoor RF Units • Couplers with RF Space Diversity • 1+1 HSB configuration with 2 x IDM's • Optical MM STM1 interface • Power cabling, Optical splitters and Connectors

SDH Multiplexer	• Perth Terminal and Dampier will be Marconi (Ericsson) OMS1200 with Protected Core and protected 2Mbit services. Equipped for 63 E1's • Ethernet Aggregation card provided for Corporate Ethernet services at each terminal. • All software and backup software provided • Repeater sites will be Marconi OMS840 mux with 4 x E1 and 4 x Ethernet • No core redundancy at the repeater sites or compressor sites • Compressor sites will be OMS850 mux with 8 x E1's and 4 x Ethernet
PDH Multiplexer	• Nokia DM2+ terminal multiplexers used at Perth, Dampier and Compressor sites for all 64K channels • Nokia DB2-LP mux used at all repeater sites to provide loop protection • Nokia DN2 mux used in Perth, Dampier and at compressor sites for 64K channel and 2Mbit grooming. • Racks, Krone, and all cabling included
Services	• All Installation and commissioning costs include vehicle hire, freight of equipment to sites, recovery of all equipment and freight back to Perth, induction time, camping at sites in on site caravans. • Site installation involves 2 x 3 man teams • Integration and FAT will take place at CommTel's Tullamarine office. • All rigging allowances • All lightning protection, waveguide flanges, cable ties, cable clamps etc
Power	• Eaton Powerware power system provided at all sites • Repeater sites are equipped with an external battery

	shelter but if possible it is recommended to install the batteries inside the existing huts. This will save approx $2,000 per site and provide a better environment for the batteries. • 2 x Banks of 300AH have been catered for at all sites. • 3 power modules provided at all sites for 24 to 48V conversion. Any two will carry the load.

9.3 Validity Period

This budgetary pricing is valid for 60 days from issue.

9.4 Delivery

From acceptance of the BOM proposal delivery for hardware into CommTel's Store will be approximately 16 weeks. All products quoted include air freight.

9.5 Timing

It is understood that the project is required to be in operation by December 2007.

This is a very tight time schedule considering a typical project scope as listed below:

Tender process	1 Month
Detailed design	2 Months
Equipment Delivery	4 months
Integration and FAT	1 Month
Installation and SAT	4 months

This project will take approximately 12 months from award of contract to completion providing no adverse weather and no major equipment delays.

It may be possible to achieve but the timing is very tight.

10 TRACK RECORD

Below is a selection of key projects implemented in the last 2 years, which highlight CommTel capabilities that are relevant to the implementation of Alinta.

10.1 Turnkey delivery of an SDH/PDH network for Queensland Rail

CommTel Network Solutions was responsible for the design; supply, integration, commissioning, installation and training for the Queensland Rail (QR) SDH/PDH Trunk and Omnibus network, consisting of 121 SDH/PDH nodes. The network is used for the management and critical control of QR's railway, and delivers E1 and Ethernet services to each railway station.

The project was delivered to an aggressive schedule of 10 months from project kick-off.

10.2 Integration, FAT and delivery of a Marconi SDH network for Queensland Rail

CommTel Network Solutions was responsible for the supply, integration, string testing and FAT for the Queensland Rail (QR) SDH STM1 and STM4 network, consisting of 34 Marconi SMA 1/4UC nodes. The network is used as a core optical fibre backbone for transmission of trunk services for the QR rail system and supply of third party backhaul. This project included the supply and installation of the Marconi MV36 NMS system for 5-user concurrent access.

10.3 Hamersley Iron – Radio Railway Network

CommTel Network Solutions was responsible for the design, supply, integration and training for railway communication and signaling in the Pilbara mining region of Western Australia. The networks are used for the management and critical control of private railway infrastructure in this harsh environment. The supply includes Nokia PDH Dynanet, Marconi SDH Multiplexers and FlexiHopper PDH Radio equipment.

10.4 PTA - Perth to Mandurah Rail Link

CommTel Network Solutions is responsible for the BOM design, supply, FAT, NMS design and commissioning services for the new Perth to Mandurah rail link. This is a major project providing the backbone communications infrastructure for all signaling on the new line covering 40 stations. The equipment provided is the Nokia Dynanet PDH mux and Marconi SDH mux.

11 ACCREDITATION AND PROCEDURES

11.1 Quality Assurance

CommTel has implemented a quality system and is accredited to ISO9001: 2000 for Quality Assurance. Our most recent audit was in April 2004, where we retained our compliance without conditions.

11.2 Health, Safety and Environment (HS&E)

CommTel has developed its own HS&E policies, which are included in our Employee Policy Manual. However, it is recognised that specific projects, customers and locations present different HS&E issues. Therefore, it is our approach to work closely with our customers to establish and implement suitable HS&E procedures to protect personnel, particularly while on site and to ensure all appropriate precautions are taken to ensure an incident free project.

When working as part of a larger project, we adopt the project-specific HS&E policies and procedures, while maintaining compliance to our own policies and procedures. This was required with our work on the Nextgen Network.

Health and safety is a prominent aspect of project management today and one seriously considered in CommTel's project management culture.

APPENDIX A - LETTERS OF REFERENCE & CONTACTS

A.1 Letters of reference

NOKIA

To whom it may concern,

Nokia confirms that CommTel Network Solutions Pty Ltd – Australian Business Number [ABN: 082 636 017] is contracted to Nokia Australia Pty Ltd as a Value Added Reseller for a range of communications equipment and services including narrowband, broadband, Network Management Systems and technical support services.

CommTel has been Nokia's VAR in Australia since 1998, though the association with their management team spans more 15 years through working jointly on projects throughout Asia and the Pacific region. During this association CommTel have successfully implemented numerous telecommunication projects complementing the supply of Nokia's equipment with design engineering, project management, integration, testing, commissioning and after sales support services.

CommTel has exhibited to Nokia a high level professionalism in both technical and commercial matters and is approved to provide engineering and integration services for the Nokia equipment.

Further evidence of CommTel's capability as a quality provider of Nokia's equipment lies in the fact that CommTel were awarded the Nokia Dedicated Networks Division VAR of the Year award for Asia Pacific in 1999. Because of CommTel's success in Australia, Nokia has recently expanded CommTel's market region to include New Zealand and other Asia Pacific counties, as well as new market segment customers.

For and on behalf of Nokia Australia Pty Ltd

Robin H Cornish
National Account Manager

3rd December 2001

NOKIA NETWORKS
677 The Boulevard
Heidelberg Victoria 3084
Australia

Tel. +61 3 9279 2790
Fax +61 3 9279 2791
+61 3 9279 2792

Nokia Australia Pty Ltd
ACN 007 366 949

Shared Services
Telecommunications

GPO Box 1429
Brisbane Qld 4001

Floor 8 Railcentre 1
305 Edward Street
Brisbane Qld 4000

Telephone
(07) 3235 1439

Facsimile
(07) 3235 1909

E-Mail

To Whom it May Concern

COMMTEL NETWORK SOLUTIONS

QR has been purchasing Nokia PDH equipment since the late 1980's and Nokia / Marconi SDH equipment since the late 1990's. Since Commtel Network Solutions became a value added reseller for these products in Australia for some 5 years ago QR has been a customer of Commtel.

In January 2003 a contract was awarded to Commtel by QR for the supply and installation of SDH and PDH equipment at 108 sites in regional Queensland. This contract was awarded after an open tender process. Commtel's tender satisfied the specification and was quite innovative in some aspects particularly in the network management area. Commtel completed their works on time and installation was to a high standard.

QR would have no hesitation in using Commtel again to carry out similar works.

QR continues to work closely with Commtel to help to improve the QR network and to provide innovative solutions for opportunities external to QR.

Should you wish I am available for further comment on the above numbers.

Yours faithfully

Jeff Wimberley
Manager Telecommunications Business Development

22 June 2004

WestNetRail

2-10 Adams Drive
Welshpool WA 6106
GPO Box S1422
PERTH WA 6845
Telephone 08 9212 2501
Facsimile 08 9212 2920
WestNet Rail Pty Ltd ABN 42 094 721 301

Enquiries : H E De Jong

My Ref : Contract CT00760

Your Ref :

21 June 2004

To whom this may concern.

CommTel Network Solutions Pty Ltd was awarded the contract to supply SDH, PDH and NMS Telecommunications equipment and training to the WestNet Rail Project CT00760 via NDC from mid 2001 to mid 2003. Rail safety project spanned some 60 sites, and over 1100 km including Perth to Kalgoorlie and Perth to Picton with a total exceeding AU$2.0M. The systems are currently performing above expectation and provide not only critical train control data and train radio voice communications to all of WestNet Rails signalled lines but also carry the majority of our PABX network, corporate WAN/LAN and a variety of special services.

While price was an element in our decision making process, our decision to proceed with NDC and in particular CommTel, was also based on the companies capability including CommTel's extensive track record with our organisation and with our predecessor Westrail. CommTel's proven product reliability, features and interoperability, vast installed base nationwide in rail communications infrastructure and responsive support was and is highly rated. The CommTel products out scoured all others overall in a very competitive process (overseen by external government probity auditor) particularly for technical compliance, availability and system interoperability.

During the entire project, CommTel has shown the capacity and capability to deliver equipment and training on time and on budget. CommTel worked with WestNet Rail and was committed to delivering the best outcome for us.

WestNet Rail considers CommTel as its communications equipment supplier of choice, and is pleased to continue this relationship to assist with ongoing expansion works, upgrades, training and system support.

WestNet Rail has no hesitation in recommending CommTel Network Solutions Pty Ltd for any telecommunication infrastructure works for Railways in Australia. They have an exceptional depth of knowledge and extensive experience in rail communications, coupled with an extensive customer base in this industry.

Hessel (Hank) E De Jong
Telecommunications Projects Manager
WestNet Rail

FOXBORO
A SIEBE COMPANY

Foxboro Australia
(ACN 000 522 261)

Level 2 – 4 , 810 Elizabeth
WATERLOO NSW 2017
Australia

To Whom It May Concern

We at Foxboro confirm that CommTel Dedicated Network Solutions Pty Ltd have successfully engineered and integrated several telecommunications systems at their Systems Manufacturing & Integration Centre in Melbourne, Australia for Foxboro Australia.

The integration of these systems has occurred over the last three years and employed a variety of technologies and equipment including SDH, PDH, PABX, optical amplifiers, synchronization equipment and Network Management Systems.

Recent examples of systems successfully engineered, manufactured and integrated for Foxboro at CommTel's Integration Centre include; an SDH optical fibre based mesh distribution network for the Electricity Corporation of Saudi Arabia, an optical fibre telephony and SCADA network for the Sydney 2000 Olympics and a long-haul SDH optical network including STM-4 over a 170km optical section, also for the Electricity Corporation of Saudi Arabia.

During our association with CommTel we have consistently found them to be responsive and professional in both technical and commercial matters, such that they are our sole telecommuinications provider of choice for our international SCADA business.

Yours Sincerely

Randal Jitts
General Manager - SCADA

A.2 CommTel Network Solutions Contacts

A.2.1 Tony Green, Manager – Projects Group

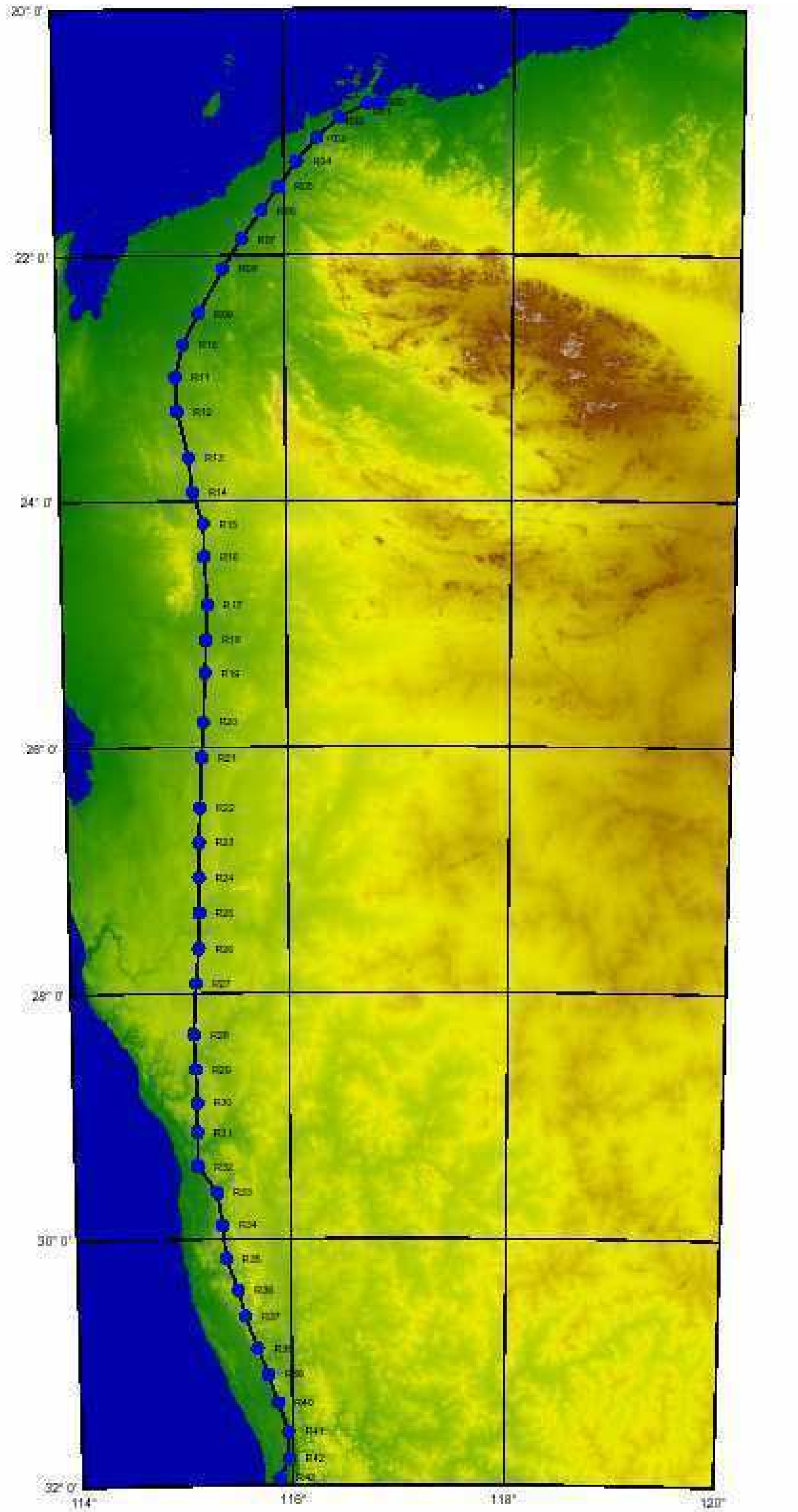
- 46 Ovata Drive, Tullamarine, Melbourne Australia. 3043
- Telephone: +61 3 9330 4722
- Fax: +61 3 9330 4277
- Mobile: +61 419 544 660
- E-mail: tonyg@commtelns.com

A.2.2 Greg Harris, Manager – Western Region

- 46 Ovata Drive, Tullamarine, Melbourne Australia. 3043
- Telephone: +61 8 9291 5100
- Fax: +61 8 9291 8027
- Mobile: +61 418 906 889
- E-mail: gregh@commtelns.com

APPENDIX B - RADIO PATH DESIGN CHECKS

B.1 Route Map

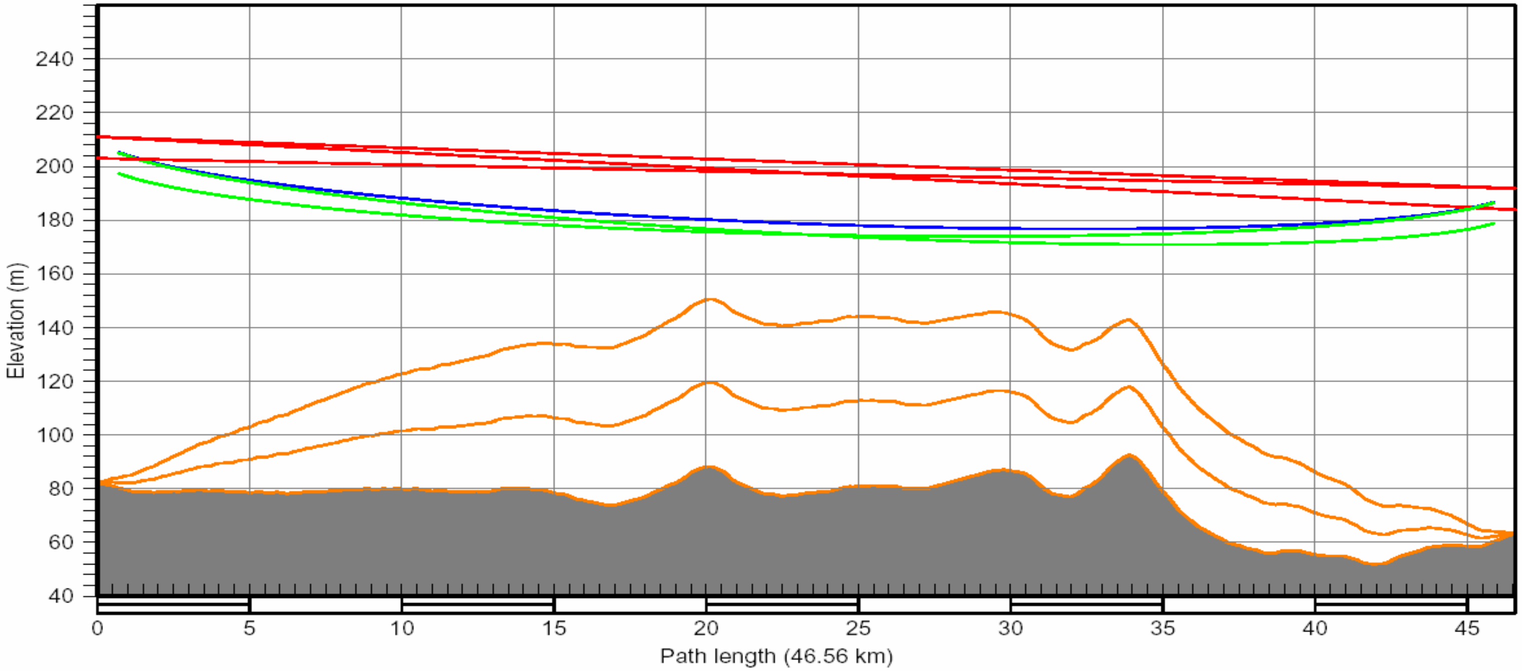


B.2 R8 to R9 Availability Report

	R08	R09
Elevation (m)	82.06	63.35
Latitude	22 06 26.00 S	22 28 23.00 S
Longitude	115 28 08.00 E	115 14 46.00 E
True azimuth (°)	209.50	29.58
Vertical angle (°)	-0.18	-0.13
Antenna model	UHP12-59W (R)	UHP12-59W (R)
Antenna height (m)	129.00	128.50
Antenna gain (dBi)	45.20	45.20
Antenna model	UHP12-59W (R)	UHP12-59W (R)
Antenna height (m)	121.00	120.50
Antenna gain (dBi)	45.20	45.20
Frequency (MHz)	6700.00	
Polarization	Vertical	
Path length (km)	46.56	
Free space loss (dB)	142.35	
Atmospheric absorption loss (dB)	0.43	
Field margin (dB)	1.00	
Main net path loss (dB)	53.38	53.38
Diversity net path loss (dB)	53.38	53.38
Radio model	FibeAir 1528P 6GHz U	FibeAir 1528P 6GHz U
TX power (watts)	0.40	0.40
TX power (dBm)	26.00	26.00
EIRP (dBm)	71.20	71.20
Emission designator	28M0D7W	28M0D7W
RX threshold criteria	BER 10-6	BER 10-6
RX threshold level (dBm)	-68.00	-68.00
Maximum receive signal (dBm)	-20.00	-20.00
Main RX signal (dBm)	-27.38	-27.38
Diversity RX signal (dBm)	-27.38	-27.38
Thermal fade margin (dB)	40.62	40.62
Dispersive fade margin (dB)	52.00	52.00
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	40.32	40.32
Geoclimatic factor	5.59E-06	
Path inclination (mr)	0.41	
Fade occurrence factor (Po)	1.89E-01	
Average annual temperature (°C)	20.00	
SD improvement factor	121.16	121.16
Worst month - multipath (%)	99.99999	99.99999
(sec)	0.38	0.38
Annual - multipath (%)	100.00000	100.00000
(sec)	1.56	1.56
(% - sec)	99.99999 - 3.12	
Rain region	C Temp. Maritime	
Flat fade margin - rain (dB)	40.62	
Annual multipath + rain (%-sec)	99.99999 - 3.12	

Wed, Sep 13 2006

B.3 R8-R9 Path Profile



R08	
Latitude	22 06 26.00 S
Longitude	115 28 08.00 E
Azimuth	209.50°
Elevation	82 m ASL
Antenna CL	129.0, 121.0 m AGL

Frequency (MHz) = 6700.0
K = 1.33, 0.67
%F1 = 100.00, 100.00

CommTel

R09	
Latitude	22 28 23.00 S
Longitude	115 14 46.00 E
Azimuth	29.58°
Elevation	63 m ASL
Antenna CL	128.5, 120.5 m AGL

Alinta Pipeline	Sep 13 06	

APPENDIX C - BUDGETARY QUOTATION SHEETS

MICROWAVE SYSTEM BUDGETARY QUOTATION

Site Code	Type of site	Mast/Tower Height (m)	Type	Distance to next site (km)	Antenna Height (m) North	Diversity Antenna Height (m) North	Feeder Length (m) North	Antenna Size (m) North	Antenna Height (m) South	Diversity Antenna Height (m) South	Feeder Length (m) South	Antenna Size (m) South	1+1 SDH Radio TX/RX	Waveguide (EWG-6H-A	Dehydrators	Mux	Power	Network Management System	System manual and handbooks	Site Installation	Recover existing equip	Integration and FAT	Clocks	**Total**
R0	Terminal	31	Tower	10.8	-	-	-	-	29.9	20.9	45	2.4												
R1-Dampier	Repeater	50	Mast	28.2	49	41	63	2.4	48.5	40.5	63	2.4	$46,000	$23,205	$3,882	$58,000	$9,400			$25,000	$10,700			$176,187
R2	Repeater	50	Mast	27.1	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$92,000	$23,205	$3,882	$20,000	$9,400			$25,000	$10,700			$184,187
R3	Repeater	110	Mast	29	108.5	100.5	123	2.4	108.5	100.5	123	2.4	$92,000	$40,521	$3,882	$20,000	$9,400			$25,000	$10,700			$201,503
R4	Repeater	110	Mast	28.2	108.5	108.5	123	2.4	108.5	108.5	123	2.4	$92,000	$40,521	$3,882	$20,000	$9,400			$25,000	$10,700			$201,503
R5-Comp	Repeater	50	Mast	25.7	48.5	40.5	63	2.4	48.5	32.5	63	2.4	$92,000	$23,205	$3,882	$37,000	$9,400			$25,000	$10,700			$201,187
R6	Repeater	50	Mast	31.5	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$92,000	$23,205	$3,882	$20,000	$9,400			$25,000	$10,700			$184,187
R7	Repeater	80	Mast	31.3	78.5	70.5	93	2.4	78.5	68.5	93	2.4	$92,000	$31,863	$3,882	$20,000	$9,400			$25,000	$10,700			$192,845
R8	Repeater	130	Mast	46.6	129	117	143	2.4	129	121	143	3.7	$92,000	$46,293	$3,882	$20,000	$9,400			$25,000	$10,700			$207,275
R9-Comp	Repeater	130	Mast	31.8	128.5	120.5	143	3.7	128.5	120.5	143	2.4	$92,000	$46,293	$3,882	$37,000	$9,400			$25,000	$10,700			$224,275
R10	Repeater	50	Mast	29.9	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$92,000	$23,205	$3,882	$20,000	$9,400			$25,000	$10,700			$184,187
R11	Repeater	50	Mast	30.4	48.5	40.5	63	2.4	48.5	32.5	63	2.4	$92,000	$23,205	$3,882	$20,000	$9,400			$25,000	$10,700			$184,187
R12	Repeater	80	Mast	43.3	79	71	93	2.4	79	66	93	3.7	$92,000	$31,863	$3,882	$20,000	$9,400			$25,000	$10,700			$192,845
R13-Comp	Repeater	130	Mast	31.2	129	121	143	3.7	129	117	143	2.4	$92,000	$46,293	$3,882	$37,000	$9,400			$25,000	$10,700		$12,500	$236,775
R14	Repeater	50	Mast	30	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$92,000	$23,205	$3,882	$20,000	$9,400			$25,000	$10,700			$184,187
R15	Repeater	80	Mast	29.6	78.5	70.5	93	2.4	78.5	70.5	93	2.4	$92,000	$31,863	$3,882	$20,000	$9,400			$25,000	$10,700			$192,845
R16	Repeater	110	Mast	43.4	108.5	100.5	123	2.4	108.5	100.5	123	3.7	$92,000	$40,521	$3,882	$20,000	$9,400			$25,000	$10,700			$201,503
R17-Comp	Repeater	110	Mast	32.1	109	101	123	3.7	109	101	123	2.4	$92,000	$40,521	$3,882	$37,000	$9,400			$25,000	$10,700			$218,503
R18	Repeater	31	Tower	29.4	30	16.3	45	2.4	30	20.9	45	2.4	$92,000	$18,010	$3,882	$20,000	$9,400			$25,000	$10,700			$178,992
R19	Repeater	110	Mast	44.6	108.5	100.5	123	2.4	108.5	101.5	123	3.7	$92,000	$40,521	$3,882	$20,000	$9,400			$25,000	$10,700			$201,503
R20	Repeater	110	Mast	31.7	108.5	101.5	123	3.7	108.5	100.5	123	2.4	$92,000	$40,521	$3,882	$20,000	$9,400			$25,000	$10,700			$201,503
R21-Comp	Repeater	110	Mast	45.3	108.5	100.5	123	2.4	108.5	98.5	123	3.7	$92,000	$40,521	$3,882	$37,000	$9,400			$25,000	$10,700			$218,503
R22	Repeater	110	Mast	31.5	108.5	100.5	123	3.7	108.5	100.5	123	2.4	$92,000	$40,521	$3,882	$20,000	$9,400			$25,000	$10,700			$201,503
R23	Repeater	50	Mast	31.5	48.5	40.5	63	2.4	48.5	32.5	123	2.4	$92,000	$31,863	$3,882	$20,000	$9,400			$25,000	$10,700			$192,845
R24	Repeater	80	Mast	31.8	78.5	70.5	93	2.4	78.5	70.5	93	2.4	$92,000	$31,863	$3,882	$20,000	$9,400			$25,000	$10,700			$192,845
R25-Comp	Repeater	60	Tower	32.2	58.5	50.5	75	2.4	58.5	50.5	75	2.4	$92,000	$26,668	$3,882	$37,000	$9,400			$25,000	$10,700			$204,650
R26	Repeater	50	Mast	31.5	48.5	36.5	63	2.4	48.5	40.5	63	2.4	$92,000	$23,205	$3,882	$20,000	$9,400			$25,000	$10,700			$184,187
R27	Repeater	130	Mast	46.1	129	121	143	2.4	129	121	143	3.7	$92,000	$46,293	$3,882	$20,000	$9,400			$25,000				$196,575
R28	Repeater	130	Mast	31.5	128.5	120.5	143	3.7	128.5	120.5	143	2.4	$92,000	$46,293	$3,882	$20,000	$9,400			$25,000				$196,575
R29-Comp	Repeater	80	Mast	30.2	78.5	70.5	93	2.4	78.5	70.5	93	2.4	$92,000	$31,863	$3,882	$37,000	$9,400			$25,000			$12,500	$211,645
R30	Repeater	80	Mast	26.2	78.5	70.5	93	2.4	78.5	70.5	93	2.4	$92,000	$31,863	$3,882	$20,000	$9,400			$25,000				$182,145
R31	Repeater	50	Mast	31.1	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$92,000	$23,205	$3,882	$20,000	$9,400			$25,000				$173,487
R32	Repeater	50	Mast	29.2	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$92,000	$23,205	$3,882	$20,000	$9,400			$25,000				$173,487
R33	Repeater	130	Mast	30	129	121	143	2.4	129	121	143	3.7	$92,000	$46,293	$3,882	$20,000	$9,400			$25,000				$196,575
R34-Comp	Repeater	130	Mast	30.2	128.5	120.5	143	3.7	128.5	120.5	143	2.4	$92,000	$46,293	$3,882	$37,000	$9,400			$25,000				$213,575
R35	Repeater	31	Tower	30.3	29.9	20.9	45	2.4	29.9	20.9	45	2.4	$92,000	$18,010	$3,882	$20,000	$9,400			$25,000				$168,292
R36	Repeater	80	Mast	24.4	30	22	45	2.4	78.5	70.5	93	2.4	$92,000	$24,937	$3,882	$20,000	$9,400			$25,000				$175,219
R37	Repeater	110	Mast	30.9	108.5	100.5	123	2.4	108.5	100.5	123	3.7	$92,000	$40,521	$3,882	$20,000	$9,400			$25,000				$190,803
R38	Repeater	110	Mast	25.9	108.5	100.5	123	3.7	108.5	100.5	123	2.4	$92,000	$40,521	$3,882	$20,000	$9,400			$25,000				$190,803
R39-Comp	Repeater	31	Tower	26.6	29.9	20.9	45	2.4	29.9	20.9	45	2.4	$92,000	$18,010	$3,882	$37,000	$9,400			$25,000				$185,292
R40	Repeater	50	Mast	27.7	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$92,000	$23,205	$3,882	$20,000	$9,400			$25,000				$173,487
R41	Repeater	50	Mast	23.7	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$92,000	$23,205	$3,882	$20,000	$9,400			$25,000				$173,487
R42	Repeater	80	Mast	19.6	78.5	70.5	93	2.4	78.5	70.5	93	2.4	$92,000	$31,863	$3,882	$20,000	$9,400			$25,000				$182,145
R43-Perth	Terminal	39	Ext T	39	38	30	49	1.8	-	-	-	-	$46,000	$9,712	$3,882	$226,000	$35,000	$210,000	$10,000	$25,000		$231,000		$796,594
													$3,864,000	**$1,377,973**	**$166,926**	**$1,257,000**	**$429,800**	**$210,000**	**$10,000**	**$1,075,000**	**$278,200**	**$231,000**	**$25,000**	**$8,924,899**

MICROWAVE SYSTEM BUDGETARY QUOTATION

Site Code	Type of site	Mast/Tower Height (m)	Type	Distance to next site (km)	Antenna Height (m) North	Diversity Antenna Height (m) North	Feeder Length (m) North	Antenna Size (m) North	Antenna Height (m) South	Diversity Antenna Height (m) South	Feeder Length (m) South	Antenna Size (m) South	1+1 SDH Radio TX/RX	Feeders (LDF4-50)	Masthead Loading Assessment	Mux	Power	Network Management System	System manual and handbooks	Site Installation	Recover existing equip	Integration and FAT	Clocks	**Total**
R0	Terminal	31	Tower	10.8	-	-	-	-	29.9	20.9	45	2.4												
R1-Dampier	Repeater	50	Mast	28.2	49	41	63	2.4	48.5	40.5	63	2.4	$32,000	$5,658	$700	$58,000	$9,400			$25,000	$10,700			$141,458
R2	Repeater	50	Mast	27.1	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$64,000	$5,658	$700	$20,000	$9,400			$25,000	$10,700			$135,458
R3	Repeater	110	Mast	29	108.5	100.5	123	2.4	108.5	100.5	123	2.4	$64,000	$9,477	$700	$20,000	$9,400			$25,000	$10,700			$139,277
R4	Repeater	110	Mast	28.2	108.5	108.5	123	2.4	108.5	108.5	123	2.4	$64,000	$9,477	$700	$20,000	$9,400			$25,000	$10,700			$139,277
R5-Comp	Repeater	50	Mast	25.7	48.5	40.5	63	2.4	48.5	32.5	63	2.4	$64,000	$5,658	$700	$37,000	$9,400			$25,000	$10,700			$152,458
R6	Repeater	50	Mast	31.5	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$64,000	$5,658	$700	$20,000	$9,400			$25,000	$10,700			$135,458
R7	Repeater	80	Mast	31.3	78.5	70.5	93	2.4	78.5	68.5	93	2.4	$64,000	$7,568	$700	$20,000	$9,400			$25,000	$10,700			$137,368
R8	Repeater	130	Mast	46.6	129	117	143	2.4	129	121	143	3.7	$64,000	$10,750	$700	$20,000	$9,400			$25,000	$10,700			$140,550
R9-Comp	Repeater	130	Mast	31.8	128.5	120.5	143	3.7	128.5	120.5	143	2.4	$64,000	$10,750	$700	$37,000	$9,400			$25,000	$10,700			$157,550
R10	Repeater	50	Mast	29.9	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$64,000	$5,658	$700	$20,000	$9,400			$25,000	$10,700			$135,458
R11	Repeater	50	Mast	30.4	48.5	40.5	63	2.4	48.5	32.5	63	2.4	$64,000	$5,658	$700	$20,000	$9,400			$25,000	$10,700			$135,458
R12	Repeater	80	Mast	43.3	79	71	93	2.4	79	66	93	3.7	$64,000	$7,568	$700	$20,000	$9,400			$25,000	$10,700			$137,368
R13-Comp	Repeater	130	Mast	31.2	129	121	143	3.7	129	117	143	2.4	$64,000	$10,750	$700	$37,000	$9,400			$25,000	$10,700			$157,550
R14	Repeater	50	Mast	30	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$64,000	$5,658	$700	$20,000	$9,400			$25,000	$10,700			$135,458
R15	Repeater	80	Mast	29.6	78.5	70.5	93	2.4	78.5	70.5	93	2.4	$64,000	$7,568	$700	$20,000	$9,400			$25,000	$10,700			$137,368
R16	Repeater	110	Mast	43.4	108.5	100.5	123	2.4	108.5	100.5	123	3.7	$64,000	$9,477	$700	$20,000	$9,400			$25,000	$10,700			$139,277
R17-Comp	Repeater	110	Mast	32.1	109	101	123	3.7	109	101	123	2.4	$64,000	$9,477	$700	$37,000	$9,400			$25,000	$10,700			$156,277
R18	Repeater	31	Tower	29.4	30	16.3	45	2.4	30	20.9	45	2.4	$64,000	$4,513	$700	$20,000	$9,400			$25,000	$10,700			$134,313
R19	Repeater	110	Mast	44.6	108.5	100.5	123	2.4	108.5	101.5	123	3.7	$64,000	$9,477	$700	$20,000	$9,400			$25,000	$10,700			$139,277
R20	Repeater	110	Mast	31.7	108.5	101.5	123	3.7	108.5	100.5	123	2.4	$64,000	$9,477	$700	$20,000	$9,400			$25,000	$10,700			$139,277
R21-Comp	Repeater	110	Mast	45.3	108.5	100.5	123	2.4	108.5	98.5	123	3.7	$64,000	$9,477	$700	$37,000	$9,400			$25,000	$10,700		$12,500	$168,777
R22	Repeater	110	Mast	31.5	108.5	100.5	123	3.7	108.5	100.5	123	2.4	$64,000	$9,477	$700	$20,000	$9,400			$25,000	$10,700			$139,277
R23	Repeater	50	Mast	31.5	48.5	40.5	63	2.4	48.5	32.5	123	2.4	$64,000	$7,568	$700	$20,000	$9,400			$25,000	$10,700			$137,368
R24	Repeater	80	Mast	31.8	78.5	70.5	93	2.4	78.5	70.5	93	2.4	$64,000	$7,568	$700	$20,000	$9,400			$25,000	$10,700			$137,368
R25-Comp	Repeater	60	Tower	32.2	58.5	50.5	75	2.4	58.5	50.5	75	2.4	$64,000	$6,422	$700	$37,000	$9,400			$25,000	$10,700			$153,222
R26	Repeater	50	Mast	31.5	48.5	36.5	63	2.4	48.5	40.5	63	2.4	$64,000	$5,658	$700	$20,000	$9,400			$25,000	$10,700			$135,458
R27	Repeater	130	Mast	46.1	129	121	143	2.4	129	121	143	3.7	$64,000	$10,750	$700	$20,000	$9,400			$25,000				$129,850
R28	Repeater	130	Mast	31.5	128.5	120.5	143	3.7	128.5	120.5	143	2.4	$64,000	$10,750	$700	$20,000	$9,400			$25,000				$129,850
R29-Comp	Repeater	80	Mast	30.2	78.5	70.5	93	2.4	78.5	70.5	93	2.4	$64,000	$7,568	$700	$37,000	$9,400			$25,000				$143,668
R30	Repeater	80	Mast	26.2	78.5	70.5	93	2.4	78.5	70.5	93	2.4	$64,000	$7,568	$700	$20,000	$9,400			$25,000				$126,668
R31	Repeater	50	Mast	31.1	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$64,000	$5,658	$700	$20,000	$9,400			$25,000				$124,758
R32	Repeater	50	Mast	29.2	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$64,000	$5,658	$700	$20,000	$9,400			$25,000				$124,758
R33	Repeater	130	Mast	30	129	121	143	2.4	129	121	143	3.7	$64,000	$10,750	$700	$20,000	$9,400			$25,000				$129,850
R34-Comp	Repeater	130	Mast	30.2	128.5	120.5	143	3.7	128.5	120.5	143	2.4	$64,000	$10,750	$700	$37,000	$9,400			$25,000				$146,850
R35	Repeater	31	Tower	30.3	29.9	20.9	45	2.4	29.9	20.9	45	2.4	$64,000	$4,513	$700	$20,000	$9,400			$25,000				$123,613
R36	Repeater	80	Mast	24.4	30	22	45	2.4	78.5	70.5	93	2.4	$64,000	$6,040	$700	$20,000	$9,400			$25,000				$125,140
R37	Repeater	110	Mast	30.9	108.5	100.5	123	2.4	108.5	100.5	123	3.7	$64,000	$9,477	$700	$20,000	$9,400			$25,000				$128,577
R38	Repeater	110	Mast	25.9	108.5	100.5	123	3.7	108.5	100.5	123	2.4	$64,000	$9,477	$700	$20,000	$9,400			$25,000				$128,577
R39-Comp	Repeater	31	Tower	26.6	29.9	20.9	45	2.4	29.9	20.9	45	2.4	$64,000	$4,513	$700	$37,000	$9,400			$25,000				$140,613
R40	Repeater	50	Mast	27.7	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$64,000	$5,658	$700	$20,000	$9,400			$25,000				$124,758
R41	Repeater	50	Mast	23.7	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$64,000	$5,658	$700	$20,000	$9,400			$25,000				$124,758
R42	Repeater	80	Mast	19.6	78.5	70.5	93	2.4	78.5	70.5	93	2.4	$64,000	$7,568	$700	$20,000	$9,400			$25,000				$126,668
R43-Perth	Terminal	39	Ext T	39	38	30	49	1.8	-	-	-	-	$32,000	$2,821	$700	$226,000	$35,000	$210,000	$10,000	$25,000		$231,000	$12,500	$785,021
													$2,688,000	**$327,291**	**$30,100**	**$1,257,000**	**$429,800**	**$210,000**	**$10,000**	**$1,075,000**	**$278,200**	**$231,000**	**$25,000**	**$6,561,391**

Attention: Gary Worsdell
State Manager WA
GIBSON QUAI – AAS PTY LTD

Microwave Design: REQUEST FOR BUDGETARY QUOTATION: Dampier to Perth Gas Pipeline Route

7/9/06

Dear Gary,

Thank you for this opportunity to provide a budgetary indicative estimate for the supply, installation, testing and commissioning of microwave communications equipment along the Dampier to Perth gas pipeline route. In this response, due to the time available, Fujitsu has supplied estimates on equipment, materials and related software/firmware only, services costs have not been included. We understand DBP's high network availability requirements and so Fujitsu has only chosen radios and muxes with field proven reliability and radios that feature the highest output power/gain available in their class.

Fujitsu has provided indicative budgetary estimates on two options and the pricing summary is given below. Refer to Appendix 1 for the associated pricing notes and the detailed spreadsheets for the full breakdown.

1) The Fujitsu FRX2E+ Fully Indoor 1+1 (+32dBm output power)
2) The Ceragon 1500HP Split System 1+1 (+30dBm output power)

Option 1 - MICROWAVE SYSTEM - FULLY INDOOR - INDICATIVE BUDGETARY ESTIMATE

(BASED ON THE FUJITSU FRX2E+ FULLY INDOOR RADIO SYSTEM)

1+1 SDH Radio TX/RX	Feeders	Mux	Power [Note 3]	Network Management System [Note 2]	System manual and handbooks [Note 1]	Recover existing equip	MUX+other installation material	**Total**
$2,874,223	**$1,061,769**	**$394,870**	**TBA**	**$35,024**	**$1,628**	**TBA**	**$107,177**	**$4,474,691**

Option 2 - MICROWAVE SYSTEM - SPLIT SYSTEM - INDICATIVE BUDGETARY ESTIMATE

(BASED ON THE CERAGON 1500HP SDH SPLIT SYSTEM RADIO)

1+1 SDH Radio TX/RX	Feeders	Mux	Power [Note 3]	Network Management System [Note 2]	System manual and handbooks [Note 4]	Recover existing equip	MUX+other installation material	**Total**	Masthead Loading Assessment [Note 1]
$2,817,293	**$206,348**	**$394,870**	**TBA**	**$35,024**	**$1,628**	**TBA**	**$107,177**	**$3,562,340**	**TBA**

As shown in the detailed tables attached in the spreadsheets, the price per terminal of each radio technology is essentially the same. The major difference between the options is extra cost of the FRX2E+ waveguides compared to the lower cost coax cable that is used for split system solutions.

However once installed, the fully indoor FRX2E+ system delivers a high return on this additional investment as the cost of maintenance for the fully indoor FRX2E+ is likely to be significantly lower. For example the high costs associated with personnel replacing split system ODU electronics atop 143m towers is only likely to increase over the next 10-15 years (eg workers compensation insurance premiums/skilled rigger rates).

In addition as the FRX2E+ can be configured (without additional waveguide) on installation for non service affecting expansion up to 7+1, (ie 1.2GBit/s - co-channel configuration) it provides a modestly priced "futures option" on the significant revenue that would accrue from the wholesale leasing of this 1Gbit/s surplus capacity to a carrier. As the expansion would simply require an additional plug in module for each 155Mbits of additional capacity, a simple low risk "pay as you go" financial model that immediately matches additional revenue, with the much lower "pay as you go" costs, is created.

To provide even higher radio path availability, an FRX2E+ +35dBm output power module may also be available by the time orders are placed for this project. Also note that one rack of the FRX2E+ supports up to STM-16 capacity.

Should DBP wish to explore the possibilities of offering leases on surplus 300M-1Gbits (or more) capacity between Perth and the rich mining areas of the North West, Fujitsu would be pleased to assist by leveraging its strong carrier relationships.

Alternatively the Ceragon split system offers the flexibility of varying the channel bandwidth (potentially lowering licensing fees) and direct IP transport. The Ceragon units can be also configured for fully indoor configurations however this solution would be more expensive that a fully indoor FRX2E+.

With both options, we look forward to refining our solutions as we better understand DBP's strategic directions for this asset.

For further comparison information and other options available, please refer to Appendix 2. Appendix 3 provides split system tower head load information. Please advise if there are other options you may require pricing for.

About Fujitsu

Fujitsu has supplied, deployed, commissioned and supported some of the largest backbone telecommunications projects in Australasia with a value exceeding $600m. Our customers include major carriers such as Optus, AAPT, BCL(NZ), Telecom NZ and utilities such as TransGrid (please refer to the OPGW case study provided) and Snowy Hydro. Our customers are supported by two fully equipment Australian laboratories and highly experienced engineers. We would be pleased to demonstrate the equipment we have offered.

Our Perth staff number more than 300 and in Australia, Fujitsu has more than 3000 staff delivering annual revenues that exceed $600M. Globally our consolidated revenues exceed US$45 billion, delivered by more than 157,000 staff.

In conclusion, Fujitsu is excited by the prospect of leveraging our experience in major radio and optic fibre backbone telecommunications projects to deliver, install /commission and then support over the long term, an ultra available, high capacity radio network for DBP. We believe that these radios are the best in their class for this application and we would be pleased to discuss our proposal face to face. We look forward to your questions.

Yours Sincerely

Paul Calligaro
Account Manager
Fujitsu Australia

Appendix 1 - Notes for Option 1 and Option 2, Indicative budgetary estimates

1) All prices listed are ex GST and in AUD.
2)"1+1 SDH Radio TX/RX" and “Mux” prices are based on an exchange rate of 1AUD= 0.74USD. The AUD prices of these items may vary in accordance with the AUD/USD exchange rate
3) Warranty on equipment/materials is 12 months.
4)The estimate above is for equipment, materials and related software/firmware licences only. NO SERVICES ARE INCLUDED.
5)All prices listed are indicative and are subject to change.

APPENDIX 2

COMMENTARY ON THE RADIO OPTIONS OFFERED AND RELATIONSHIP TO FEEDER INSTALLATION AND PRICES

Fujitsu has provided two responses as requested by Gibson Quai, as shown in the sheets completed.

However, there are additional options available and the implications of each choice may not be obvious. This note is intended to bring this to your attention.

Fujitsu has offered two different types of SDH radio equipment:

A) Fujitsu FRX2E+ SDH N+1 all-indoor radio system
B) Ceragon 1500HP SDH split system.

For the all-indoor option, Fujitsu has offered the Fujitsu FRX2E+ system. For the indoor-outdoor system, Fujitsu has offered the Ceragon 1500HP system. However, the feeder costs are very different for each option. In the case of the all-indoor option, this is composed of considerable quantities of waveguide and tower mounting accessories. In contrast, the split system with ODU being tower mounted uses only high performance coaxial cable and accessories which are much cheaper than waveguide. This explains the large difference in feeder costs.

However, there are a number of other scenarios that are worth bearing in mind

1. Ceragon 1500HP all-indoor

   The 1500HP is capable of being installed as an all-indoor installation as shown in Figure 1. This installation would require a feeder installation and material that is substantially the same as that current shown for the FRX2E+, involving waveguide runs and mounting material.

Fig 1. Ceragon 1500HP installed as an all-indoor installation

Consequently, an all-indoor Ceragon option would have feeder costs substantially the same as those of Option 1 - the fully indoor option, with the Ceragon equipment pricing likely to be substantially the same (transferring outdoor mounting components to indoor mounting components)

2. Future capacity needs and impact on additional equipment costs and feeder installation and costs

Consideration of future capacity needs, or a policy change which promotes the link to provide additional revenue, requires additional capacity and this influences the most efficient choice of radio technology when the feeder installation requirements are also considered together.

2.1 feeder issues and costs

We note the comment that the existing sites have dual-polarised antennas already mounted. Our current budgetary offer includes feeder components to cable only <u>one</u> polarisation. This is principally because only 1+1 capacity is required and consequently only one polarisation is required.

In the case of the FRX2E+, this 1+1 configuration is a frequency-diversity (2 channels) installation, with hitless switching. For the Ceragon, this is a Hot-standby configuration, using a single frequency (1 channel) and non-hitless switching.

A) FRX2E+

The FRX2E+ system is inherently designed as an N+1 system, up to STM16 (N=16), all in one rack. From an installation and feeder perspective there are two choices:

a) an Alternate-channel system will support up to 7+1 in a dual-polarised antenna configuration.
b) A Co-channel configuration supports up to 7+1 in a single-polarised antenna configuration.(this is one shelf)

The consequential aspect of the two choices above are

a) For either option above, up to 3+1 capacity, there would be no additional feeder installation costs.

b) For the Alt-channel option for capacity expansion greater than 3+1, the current feeder installation costs shown would double because a complete additional space diversity installation would be required to connect the 2nd polarisation.

c) For the Co-channel option, there would no additional feeder installation costs for any capacity expansion up to 7+1, because the current (single polarisation feeder) installation is adequate.

B) Ceragon 1500HP

The Ceragon system is capable of configurations of up to 2+2 (ie a fully redundant 2xSTM1 system).

However, to expand the capacity of a 1+1 system to the 2nd STM1 (ie 2+2) would require the current feeder installation to be doubled for the 2nd polarisation. This applies regardless of the choice of all-indoor or split with ODU outdoor mounted.

2.2 Equipment cost

The prices offered for the two radio technologies are essentially identical. However, the cost to undertake a +1 upgrade from 1+1 to 2+1 is very, very different.

As noted earlier, the FRX2E+ is built as an N+1 system, designed to support in-service incremental expansions, at incremental costs. A, +1 upgrade , (assuming the terminal is pre-equipped with additional filters) per terminal would be around AUS$12,000 (+GST)

In contrast, an expansion of the Ceragon would require complete duplication of the existing terminal (to create a 2+2 terminal)at AUS$32,000 because the architecture is so different.

Conclusion

As demonstrated in the pricing offer, there is around $900k difference in price of the radios with the feeders for a 1+1 system . However, if considered from the point of view of n x STM-1 future expansions, then fully indoor FRX2E+ system is much more cost effective.

For the sake of completeness and balance, recognising the RFP has yet to be issued, we make one further observation. Our response focuses on the required response based on using Fujitsu's own N+1 high capacity SDH radio technology for the all-indoor option, and Ceragon 1500HP for the IDU-ODU split system option.

Ceragon does offer an additional system – the newly released 3200T. This is an all indoor N+1 system architecture, with N up to 8. We will be pleased to provide further information on option over the next few weeks.

APPENDIX 3

CERAGON ODU – TOWER HEAD LOAD

The Ceragon ODU physical arrangements when mounted on a tower are shown in figure 2.

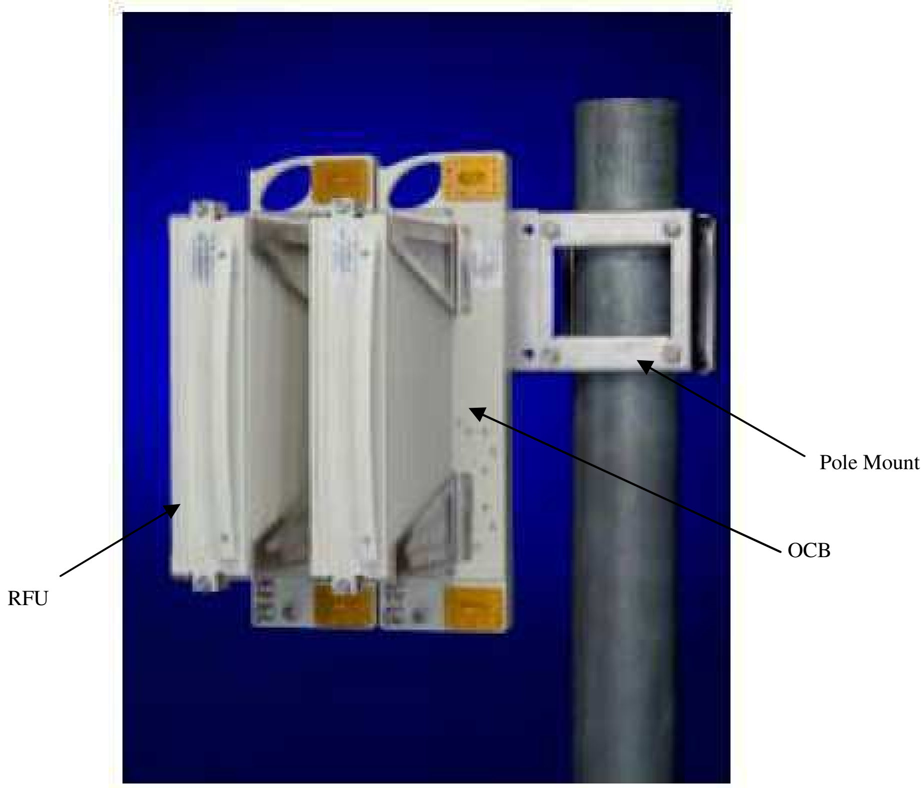


Fig 2: 1+1 with SD ODU's on outdoor pole mounting frame

The total weight involved in a 1+1 Outdoor tower mounting is

RFU weight (each): 7kg (2 required)
OCB weight(each): 10kg (2 required)
Pole mount: 4kg
Coupler (each): 1.5kg (2 required)

Total: 41 Kg per installation

The Physical dimensions of the RFU are 490mm High x 144mm Wide x 280mm Depth

Option 1 - MICROWAVE SYSTEM - FULLY INDOOR - INDICATIVE BUDGETARY ESTIMATE

(BASED ON THE FUJITSU FRX2E+ FULLY INDOOR RADIO SYSTEM)

Site Code	Type of site	Mast/Tower Height (m)	Type	Distance to next site (km)	Antenna Height (m) North	Diversity Antenna Height (m) North	Feeder Length (m) North	Antenna Size (m) North	Antenna Height (m) South	Diversity Antenna Height (m) South	Feeder Length (m) South	Antenna Size (m) South	1+1 SDH Radio TX/RX	Feeders	Mux	Power [Note 3]	Network Management System [Note 2]	System manual and handbooks [Note 1]	Recover existing equip	MUX+other installation material	**Total**
R0	Terminal	31	Tower	10.8	-	-	-	-	29.9	20.9	45	2.4	$32,889.60	$7,860.00	$6,296.00			$37.00		$1,781.00	$83,887.60
R1	Repeater	50	Mast	28.2	49	41	63	2.4	48.5	40.5	63	2.4	$65,779.20	$19,104.00	$6,435.00			$37.00		$1,781.00	$93,136.20
R2	Repeater	50	Mast	27.1	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$65,779.20	$19,104.00	$6,435.00			$37.00		$1,781.00	$93,136.20
R3	Repeater	110	Mast	29	108.5	100.5	123	2.4	108.5	100.5	123	2.4	$65,779.20	$30,384.00	$6,435.00			$37.00		$1,781.00	$104,416.20
R4	Repeater	110	Mast	28.2	108.5	108.5	123	2.4	108.5	108.5	123	2.4	$65,779.20	$30,384.00	$6,435.00			$37.00		$1,781.00	$104,416.20
R5	Repeater	50	Mast	25.7	48.5	40.5	63	2.4	48.5	32.5	63	2.4	$65,779.20	$19,104.00	$6,435.00			$37.00		$1,781.00	$93,136.20
R6	Repeater	50	Mast	31.5	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$65,779.20	$19,104.00	$6,435.00			$37.00		$1,781.00	$93,136.20
R7	Repeater	80	Mast	31.3	78.5	70.5	93	2.4	78.5	68.5	93	2.4	$65,779.20	$24,744.00	$6,435.00			$37.00		$1,781.00	$98,776.20
R8	Repeater	130	Mast	46.6	129	117	143	2.4	129	121	143	3.7	$65,779.20	$34,144.00	$6,435.00			$37.00		$1,781.00	$108,176.20
R9	Repeater	130	Mast	31.8	128.5	120.5	143	3.7	128.5	120.5	143	2.4	$65,779.20	$34,144.00	$6,435.00			$37.00		$1,781.00	$108,176.20
R10	Repeater	50	Mast	29.9	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$65,779.20	$19,104.00	$6,435.00			$37.00		$1,781.00	$93,136.20
R11	Repeater	50	Mast	30.4	48.5	40.5	63	2.4	48.5	32.5	63	2.4	$65,779.20	$19,104.00	$6,435.00			$37.00		$1,781.00	$93,136.20
R12	Repeater	80	Mast	43.3	79	71	93	2.4	79	66	93	3.7	$65,779.20	$24,744.00	$6,435.00			$37.00		$1,781.00	$98,776.20
R13	Repeater	130	Mast	31.2	129	121	143	3.7	129	117	143	2.4	$65,779.20	$34,144.00	$6,435.00			$37.00		$1,781.00	$108,176.20
R14	Repeater	50	Mast	30	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$65,779.20	$19,104.00	$6,435.00			$37.00		$1,781.00	$93,136.20
R15	Repeater	80	Mast	29.6	78.5	70.5	93	2.4	78.5	70.5	93	2.4	$65,779.20	$24,744.00	$6,435.00			$37.00		$1,781.00	$98,776.20
R16	Repeater	110	Mast	43.4	108.5	100.5	123	2.4	108.5	100.5	123	3.7	$65,779.20	$20,984.00	$6,435.00			$37.00		$1,781.00	$95,016.20
R17	Repeater	110	Mast	32.1	109	101	123	3.7	109	101	123	2.4	$65,779.20	$30,384.00	$6,435.00			$37.00		$1,781.00	$104,416.20
R18	Repeater	31	Tower	29.4	30	16.3	45	2.4	30	20.9	45	2.4	$65,779.20	$15,720.00	$6,435.00			$37.00		$1,781.00	$89,752.20
R19	Repeater	110	Mast	44.6	108.5	100.5	123	2.4	108.5	101.5	123	3.7	$65,779.20	$30,384.00	$6,435.00			$37.00		$1,781.00	$104,416.20
R20	Repeater	110	Mast	31.7	108.5	101.5	123	3.7	108.5	100.5	123	2.4	$65,779.20	$30,384.00	$6,435.00			$37.00		$1,781.00	$104,416.20
R21	Repeater	110	Mast	45.3	108.5	100.5	123	2.4	108.5	98.5	123	3.7	$65,779.20	$30,384.00	$6,435.00			$37.00		$1,781.00	$104,416.20
R22	Repeater	110	Mast	31.5	108.5	100.5	123	3.7	108.5	100.5	123	2.4	$65,779.20	$30,384.00	$6,435.00		$35,024.00	$37.00		$1,781.00	$104,416.20
R23	Repeater	50	Mast	31.5	48.5	40.5	63	2.4	48.5	32.5	123	2.4	$65,779.20	$19,104.00	$6,435.00			$37.00		$1,781.00	$93,136.20
R24	Repeater	80	Mast	31.8	78.5	70.5	93	2.4	78.5	70.5	93	2.4	$65,779.20	$24,744.00	$6,435.00			$37.00		$1,781.00	$98,776.20
R25	Repeater	60	Tower	32.2	58.5	50.5	75	2.4	58.5	50.5	75	2.4	$65,779.20	$21,360.00	$6,435.00			$37.00		$1,781.00	$95,392.20
R26	Repeater	50	Mast	31.5	48.5	36.5	63	2.4	48.5	40.5	63	2.4	$65,779.20	$19,104.00	$6,435.00			$37.00		$1,781.00	$93,136.20
R27	Repeater	130	Mast	46.1	129	121	143	2.4	129	121	143	3.7	$65,779.20	$34,144.00	$6,435.00			$37.00		$1,781.00	$108,176.20
R28	Repeater	130	Mast	31.5	128.5	120.5	143	3.7	128.5	120.5	143	2.4	$65,779.20	$34,144.00	$6,435.00			$37.00		$1,781.00	$108,176.20
R29	Repeater	80	Mast	30.2	78.5	70.5	93	2.4	78.5	70.5	93	2.4	$65,779.20	$24,744.00	$6,435.00			$37.00		$1,781.00	$98,776.20
R30	Repeater	80	Mast	26.2	78.5	70.5	93	2.4	78.5	70.5	93	2.4	$65,779.20	$24,744.00	$6,435.00			$37.00		$1,781.00	$98,776.20
R31	Repeater	50	Mast	31.1	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$65,779.20	$19,104.00	$6,435.00			$37.00		$1,781.00	$93,136.20
R32	Repeater	50	Mast	29.2	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$65,779.20	$19,104.00	$6,435.00			$37.00		$1,781.00	$93,136.20
R33	Repeater	130	Mast	30	129	121	143	2.4	129	121	143	3.7	$65,779.20	$34,144.00	$6,435.00			$37.00		$1,781.00	$108,176.20
R34	Repeater	130	Mast	30.2	128.5	120.5	143	3.7	128.5	120.5	143	2.4	$65,779.20	$34,144.00	$6,435.00			$37.00		$1,781.00	$108,176.20
R35	Repeater	31	Tower	30.3	29.9	20.9	45	2.4	29.9	20.9	45	2.4	$65,779.20	$15,720.00	$6,435.00			$37.00		$1,781.00	$89,752.20
R36	Repeater	80	Mast	24.4	30	22	45	2.4	78.5	70.5	93	2.4	$65,779.20	$15,720.00	$6,435.00			$37.00		$1,781.00	$89,752.20
R37	Repeater	110	Mast	30.9	108.5	100.5	123	2.4	108.5	100.5	123	3.7	$65,779.20	$30,384.00	$6,435.00			$37.00		$1,781.00	$104,416.20
R38	Repeater	110	Mast	25.9	108.5	100.5	123	3.7	108.5	100.5	123	2.4	$65,779.20	$30,384.00	$6,435.00			$37.00		$1,781.00	$104,416.20
R39	Repeater	31	Tower	26.6	29.9	20.9	45	2.4	29.9	20.9	45	2.4	$65,779.20	$15,720.00	$6,435.00			$37.00		$1,781.00	$89,752.20
R40	Repeater	50	Mast	27.7	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$65,779.20	$19,104.00	$6,435.00			$37.00		$1,781.00	$93,136.20
R41	Repeater	50	Mast	23.7	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$65,779.20	$19,104.00	$6,435.00			$37.00		$1,781.00	$93,136.20
R42	Repeater	80	Mast	19.6	78.5	70.5	93	2.4	78.5	70.5	93	2.4	$65,779.20	$24,744.00	$6,435.00			$37.00		$1,781.00	$98,776.20
R43	Terminal	39	Ext T	39	38	30	49	1.8	-	-	-	-	$32,889.60	$8,236.00	$98,922.00			$37.00		$30,594.00	$170,678.60
												Spares	$45,717.76	$6,425.00	$19,382.00						$71,524.76
													$2,874,223.36	**$1,061,769.00**	**$394,870.00**	**TBA**	**$35,024.00**	**$1,628.00**	**TBA**	**$107,177.00**	**$4,474,691.36**

NOTES:

Note 1: The pricing shown is for the MUX equipment.
For FRX2E+ Radio, Electronic Format (2 copies on 2 CD's) is provided free.
Paper copies in binder - AUS$60 per copy.

Note 2: NMS systems are for the whole network. This item is composed of:
Software: LoopView for MUX with Castle Rock SNMP2c Manager
Software: HP Network Node Manager
Hardware: 2 x (PC +Monitor+keyboard+mouse+Windows XP Pro) for
CastleRock and HPOV

Note 3: All systems require 48V DC. No power costs are shown because the
requirements and capabilities/limitations of any existing plant are not known.
We are happy to quote DC power plant and solar panel/rectifier systems based
on a requirements statement.

INDICATIVE ESTIMATE NOTES

A) ALL PRICES LISTED ARE EX GST
B)"1+1 SDH Radio TX/RX" PRICES ARE BASED ON AN EXCHANGE RATE OF 1AUD= 0.74 USD (BASE RATE).
C)"MUX" PRICES ARE BASED ON AN EXCHANGE RATE OF 1AUD= 0.74 USD (BASE RATE).
D)THE AUD PRICE OF THE "1+1 SDH Radio Tx/Rx" and the "Mux" may vary in accordance with the AUD/USD exchange rate
E)WARRANTY ON EQUIPMENT IS ONE YEAR
F)PRICING IS EQUIPMENT,MATERIALS AND RELATED SOFTWARE/FIRMWARE/LICENCES ONLY - NO SERVICES ARE INCLUDED
G) ALL PRICING IS INDICATIVE AND SUBJECT TO CHANGE

Option 2 - MICROWAVE SYSTEM - SPLIT SYSTEM - INDICATIVE BUDGETARY ESTIMATE

(BASED ON THE CERAGON 1500HP SDH SPLIT SYSTEM RADIO)

Site Code	Type of site	Mast/Tower Height (m)	Type	Distance to next site (km)	Antenna Height (m) North	Diversity Antenna Height (m) North	Feeder Length (m) North	Antenna Size (m) North	Antenna Height (m) South	Diversity Antenna Height (m) South	Feeder Length (m) South	Antenna Size (m) South	1+1 SDH Radio TX/RX	Feeders	Mux	Power [Note 3]	Network Management System [Note 2]	System manual and handbooks [Note 4]	Recover existing equip	MUX+other installation material	**Total**	Masthead Loading Assessment [Note 1]
R0	Terminal	31	Tower	10.8	-	-	-	-	29.9	20.9	45	2.4	$32,127.50	$1,990.00	$6,296.00			$37.00		$1,781.00	$85,285.00	
R1	Repeater	50	Mast	28.2	49	41	63	2.4	48.5	40.5	63	2.4	$64,255.00	$4,280.00	$6,435.00			$37.00		$1,781.00	$92,847.00	
R2	Repeater	50	Mast	27.1	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$64,255.00	$4,280.00	$6,435.00			$37.00		$1,781.00	$92,847.00	
R3	Repeater	110	Mast	29	108.5	100.5	123	2.4	108.5	100.5	123	2.4	$64,255.00	$5,252.00	$6,435.00			$37.00		$1,781.00	$93,819.00	
R4	Repeater	110	Mast	28.2	108.5	108.5	123	2.4	108.5	108.5	123	2.4	$64,255.00	$5,252.00	$6,435.00			$37.00		$1,781.00	$93,819.00	
R5	Repeater	50	Mast	25.7	48.5	40.5	63	2.4	48.5	32.5	63	2.4	$64,255.00	$4,280.00	$6,435.00			$37.00		$1,781.00	$92,847.00	
R6	Repeater	50	Mast	31.5	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$64,255.00	$4,280.00	$6,435.00			$37.00		$1,781.00	$92,847.00	
R7	Repeater	80	Mast	31.3	78.5	70.5	93	2.4	78.5	68.5	93	2.4	$64,255.00	$4,760.00	$6,435.00			$37.00		$1,781.00	$93,327.00	
R8	Repeater	130	Mast	46.6	129	117	143	2.4	129	121	143	3.7	$64,255.00	$5,572.00	$6,435.00			$37.00		$1,781.00	$94,139.00	
R9	Repeater	130	Mast	31.8	128.5	120.5	143	3.7	128.5	120.5	143	2.4	$64,255.00	$5,572.00	$6,435.00			$37.00		$1,781.00	$94,139.00	
R10	Repeater	50	Mast	29.9	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$64,255.00	$4,280.00	$6,435.00			$37.00		$1,781.00	$92,847.00	
R11	Repeater	50	Mast	30.4	48.5	40.5	63	2.4	48.5	32.5	63	2.4	$64,255.00	$4,280.00	$6,435.00			$37.00		$1,781.00	$92,847.00	
R12	Repeater	80	Mast	43.3	79	71	93	2.4	79	66	93	3.7	$64,255.00	$4,760.00	$6,435.00			$37.00		$1,781.00	$93,327.00	
R13	Repeater	130	Mast	31.2	129	121	143	3.7	129	117	143	2.4	$64,255.00	$5,572.00	$6,435.00			$37.00		$1,781.00	$94,139.00	
R14	Repeater	50	Mast	30	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$64,255.00	$4,280.00	$6,435.00			$37.00		$1,781.00	$92,847.00	
R15	Repeater	80	Mast	29.6	78.5	70.5	93	2.4	78.5	70.5	93	2.4	$64,255.00	$4,760.00	$6,435.00			$37.00		$1,781.00	$93,327.00	
R16	Repeater	110	Mast	43.4	108.5	100.5	123	2.4	108.5	100.5	123	3.7	$64,255.00	$4,440.00	$6,435.00			$37.00		$1,781.00	$93,007.00	
R17	Repeater	110	Mast	32.1	109	101	123	3.7	109	101	123	2.4	$64,255.00	$5,252.00	$6,435.00			$37.00		$1,781.00	$93,819.00	
R18	Repeater	31	Tower	29.4	30	16.3	45	2.4	30	20.9	45	2.4	$64,255.00	$3,980.00	$6,435.00			$37.00		$1,781.00	$92,547.00	
R19	Repeater	110	Mast	44.6	108.5	100.5	123	2.4	108.5	101.5	123	3.7	$64,255.00	$5,252.00	$6,435.00			$37.00		$1,781.00	$93,819.00	
R20	Repeater	110	Mast	31.7	108.5	101.5	123	3.7	108.5	100.5	123	2.4	$64,255.00	$5,252.00	$6,435.00			$37.00		$1,781.00	$93,819.00	
R21	Repeater	110	Mast	45.3	108.5	100.5	123	2.4	108.5	98.5	123	3.7	$64,255.00	$5,252.00	$6,435.00			$37.00		$1,781.00	$93,819.00	
R22	Repeater	110	Mast	31.5	108.5	100.5	123	3.7	108.5	100.5	123	2.4	$64,255.00	$5,252.00	$6,435.00		$35,024.00	$37.00		$1,781.00	$93,819.00	
R23	Repeater	50	Mast	31.5	48.5	40.5	63	2.4	48.5	32.5	123	2.4	$64,255.00	$4,280.00	$6,435.00			$37.00		$1,781.00	$92,847.00	
R24	Repeater	80	Mast	31.8	78.5	70.5	93	2.4	78.5	70.5	93	2.4	$64,255.00	$4,760.00	$6,435.00			$37.00		$1,781.00	$93,327.00	
R25	Repeater	60	Tower	32.2	58.5	50.5	75	2.4	58.5	50.5	75	2.4	$64,255.00	$4,472.00	$6,435.00			$37.00		$1,781.00	$93,039.00	
R26	Repeater	50	Mast	31.5	48.5	36.5	63	2.4	48.5	40.5	63	2.4	$64,255.00	$4,280.00	$6,435.00			$37.00		$1,781.00	$92,847.00	
R27	Repeater	130	Mast	46.1	129	121	143	2.4	129	121	143	3.7	$64,255.00	$5,572.00	$6,435.00			$37.00		$1,781.00	$94,139.00	
R28	Repeater	130	Mast	31.5	128.5	120.5	143	3.7	128.5	120.5	143	2.4	$64,255.00	$5,572.00	$6,435.00			$37.00		$1,781.00	$94,139.00	
R29	Repeater	80	Mast	30.2	78.5	70.5	93	2.4	78.5	70.5	93	2.4	$64,255.00	$4,760.00	$6,435.00			$37.00		$1,781.00	$93,327.00	
R30	Repeater	80	Mast	26.2	78.5	70.5	93	2.4	78.5	70.5	93	2.4	$64,255.00	$4,760.00	$6,435.00			$37.00		$1,781.00	$93,327.00	
R31	Repeater	50	Mast	31.1	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$64,255.00	$4,280.00	$6,435.00			$37.00		$1,781.00	$92,847.00	
R32	Repeater	50	Mast	29.2	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$64,255.00	$4,280.00	$6,435.00			$37.00		$1,781.00	$92,847.00	
R33	Repeater	130	Mast	30	129	121	143	2.4	129	121	143	3.7	$64,255.00	$5,572.00	$6,435.00			$37.00		$1,781.00	$94,139.00	
R34	Repeater	130	Mast	30.2	128.5	120.5	143	3.7	128.5	120.5	143	2.4	$64,255.00	$5,572.00	$6,435.00			$37.00		$1,781.00	$94,139.00	
R35	Repeater	31	Tower	30.3	29.9	20.9	45	2.4	29.9	20.9	45	2.4	$64,255.00	$3,980.00	$6,435.00			$37.00		$1,781.00	$92,547.00	
R36	Repeater	80	Mast	24.4	30	22	45	2.4	78.5	70.5	93	2.4	$64,255.00	$3,980.00	$6,435.00			$37.00		$1,781.00	$92,547.00	
R37	Repeater	110	Mast	30.9	108.5	100.5	123	2.4	108.5	100.5	123	3.7	$64,255.00	$5,252.00	$6,435.00			$37.00		$1,781.00	$93,819.00	
R38	Repeater	110	Mast	25.9	108.5	100.5	123	3.7	108.5	100.5	123	2.4	$64,255.00	$5,252.00	$6,435.00			$37.00		$1,781.00	$93,819.00	
R39	Repeater	31	Tower	26.6	29.9	20.9	45	2.4	29.9	20.9	45	2.4	$64,255.00	$3,980.00	$6,435.00			$37.00		$1,781.00	$92,547.00	
R40	Repeater	50	Mast	27.7	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$64,255.00	$4,280.00	$6,435.00			$37.00		$1,781.00	$92,847.00	
R41	Repeater	50	Mast	23.7	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$64,255.00	$4,280.00	$6,435.00			$37.00		$1,781.00	$92,847.00	
R42	Repeater	80	Mast	19.6	78.5	70.5	93	2.4	78.5	70.5	93	2.4	$64,255.00	$4,760.00	$6,435.00			$37.00		$1,781.00	$93,327.00	
R43	Terminal	39	Ext T	39	38	30	49	1.8	-	-	-	-	$32,127.50	$2,022.00	$98,922.00			$37.00		$30,594.00	$171,732.00	
												Spares	$54,328.00	$2,272.00	$19,382.00						$89,566.00	
													$2,817,293.00	**$206,348.00**	**$394,870.00**	**TBA**	**$35,024.00**	**$1,628.00**	**TBA**	**$107,177.00**	**$3,562,340.00**	**TBA**

NOTES:

Note 1: Please see associated document "Ceragon-info.doc"

Note 2: NMS systems are for the whole network. This item is composed of:
Software: LoopView for MUX with Castle Rock SNMPc Manager
Software: HP Network Node Manager
Hardware: 2 x (PC -Monitor+keyboard+mouse+Windows XP Pro) for
CastleRock and HPOV

Note 3: All systems require 48V DC. No power costs are shown because the
requirements and capabilities/limitations of any existing plant are not known.
We are happy to quote DC power plant and solar panel/rectifier systems based
on a requirements statement.

INDICATIVE ESTIMATE NOTES

A) ALL PRICES LISTED ARE EX GST
B)"1+1 SDH Radio TX/RX" PRICES ARE BASED ON AN EXCHANGE RATE OF 1AUD= 0.74 USD (BASE RATE).
C)"MUX" PRICES ARE BASED ON AN EXCHANGE RATE OF 1AUD= 0.74 USD (BASE RATE).
D)THE AUD PRICE OF THE "1+1 SDH Radio Tx/Rx" and the "Mux" may vary in accordance with the AUD/USD exchange rate
E)WARRANTY ON EQUIPMENT/MATERIALS IS ONE YEAR
F)PRICING IS EQUIPMENT,MATERIALS AND RELATED SOFTWARE/FIRMWARE/LICENCES ONLY - NO SERVICES ARE INCLUDED
G) ALL PRICING IS INDICATIVE AND SUBJECT TO CHANGE

NEC

NEC Australia Pty. Ltd.
All correspondence should be addressed to:
Private Bag 1111
Mulgrave, Victoria, 3170

6th September, 2006.

GIBSON QUAI – AAS Consulting,
Level 2, 30 Richardson St.
West Perth WA 6005

Attention: Mr Gary Worsdell – State Manager, WA

Dear Gary,

Dampier to Perth Microwave Network - Request for Budgetary Quotation

NEC Australia is pleased to provide our response to your request for a budgetary quotation for the supply and implementation of a microwave radio communications system along the Dampier to Perth gas pipeline route.

NEC continues to be a world leader in the design and manufacture of high performance and extremely reliable microwave radio and multiplexer equipment and is pleased to offer both our new Pasolink NEO split system radio product, released to the overseas market last year, and our latest generation carrier grade 5000 Series all indoor radio trunk product. Also included is our SDH multiplexer, PDH multiplexer, DC Power supply system, network management system, delivery, installation, commissioning and project management providing to provide a full turn key solution.

Given that we have considerable expertise and experience in the area of radio link design, we offer our services to assist Gibson Quai – AAS to decide on the optimum radio link designs and system configuration to meet the competing drivers of cost and performance.

We have used our best efforts in pricing the equipment and are confident they are reasonably accurate. The prices for field work including delivery to site, site survey, installation, and commissioning have been conservatively estimated and require optimisation. We are confident in providing a cost reduction in the area of implementation given more time to refine our costings.

NEC is at Gibson Quai - AAS disposal to meet and discuss any aspect of our response. We would also be pleased to provide further information to Gibson Quai – AAS to assist with the preparation of your submission to Alinta.

Should you require clarification of any part of our budgetary quotation, please do not hesitate to contact myself on telephone number (03) 9264-3994 or mobile 0417-566-301.

Yours sincerely,

Mark Chadwick
Business Development Manager
Network System Solutions Group

Executive Summary

NEC offers two full turn key solutions for the Perth to Dampier 43 hop microwave system. One is based on indoor radio equipment and the other based on a split-type radio equipment. The table below shows a summary of our main equipment offer which includes project management, documentation, delivery, installation and commissioning. Figure 1 and Figure 2 shows a simple block diagram of the terminal and repeater site equipment connection. At this time we are unable to provide a quote for the battery shelter and services for equipment recovery, but we can provide this if still required.

Table 1. Summary of main equipment

Item	Equipment	Indoor Radio Proposal	Split-Type Radio Proposal	Term Site Qty	Rep Site Qty
1	Radio	NEC 5000 series SDH 6.7G Twinpath with SD	NEC NEO SDH 6.7G Twinpath with SD	1	2
2	Feeder	Andrew Waveguide	Coaxial Cable	2	4
3	Mux (SDH/E1)	NEC V-Node S	NEC V-Node S	1	1
4	Mux (E1/64kb)	NEC DVM Plus 60	NEC DVM Plus 60	11	1
5	Term DC Power	1200W (-48VDC)	1200W (-48VDC)	1	-
6	Rep DC Power	1200W (-48VDC)	700W (-48VDC)	-	1
7	NMS	NEC PC-MG	NEC PC-MG	1	1
8	Term Site Equip.	Figure 3	Figure 5		
9	Rep Site Equip.	Figure 4	Figure 6		

The following is a brief description of each equipment.

Radio Equipment

NEC 5000 Series Indoor Radio

This is NEC's latest generation indoor N+0/N+1 SDH radio equipment fitted into an ETSI style rack. Designed for high capacity carrier grade networks or 1+1/1+0 enterprise networks demanding high performance full indoor equipment. The offered equipment is a 6.7GHz (1+1) Twin-path with space diversity radio which provides high equipment and path availability. The main and protection transmitter and main receiver is connected to the top antenna and the space diversity receiver is connected to the bottom antenna. The radio is equipped with a protected baseband optical (short-haul) STM1 interface which provides two optical (2 x input / 2 x output) path ways to the SDH multiplex equipment. For further details, refer to the 5000 series document MTD-SY-014 and our catalogue.

NEC Pasolink NEO Split-Type Radio

This is NEC's latest generation split-type 1+0/1+1 SDH/PDH/Ethernet 19 inch rack mount radio equipment. Designed for 1+1/1+0 enterprise networks demanding a high performance with a wide range of traffic interfaces. The offered equipment is a 6.7GHz (1+1) Twin-path with space diversity radio which provides high equipment and path availability. The main and protection transmitter is connected to the top antenna and the protection (space diversity) transmitter and receiver is connected to the bottom antenna. The radio is equipped with a protected baseband optical (short-haul) STM1 interface which provides two optical (2 x input / 2 x output) path ways to the SDH multiplex equipment. For further details, refer to the NEO document MTD-PL-040 and our catalogue.

Feeder Equipment

Andrew Waveguide

For the indoor radio solution, NEC offers the Andrew 6.7GHz elliptical waveguide type EWP-63. This waveguide component also include all installation materials. Pressurisation equipment for the feeder is also supplied.

Coaxial Cable

For the split-type radio solution, NEC offers 5D-FB coaxial cable to connect between the IDU and ODU. For further details, refer to the NEO document MTD-PL-040, p36.

Multiplex Equipment

NEC V-Node S (SDH/E1)

This is NEC's highly reliable SDH multiplex 19 inch rack mount equipment which provides the conversion of the STM1 traffic (to/from the radio) into a E1 (2.048Mbps) which is then passed to the channel multiplex equipment (DVM Plus 60). The mux is fitted with a main and protection SDH interface to connect with the radio to provide high equipment reliability. For further details, refer to document V Node S DEX 6713.

DVM Plus 60 (E1/64kb)

This is a low order (2Mbps/30 channel) PDH multiplex 19 inch rack mount equipment which provides the 15 (64kbps) channels that will be connected to the site data distribution frame. For further details, refer to document DVM Plus 60.

DC Power Equipment

1200W (-48VDC)

This power system consists of a rectifier, batteries, controller and cabinet which delivers 1200W at -48VDC with 48 hours of battery backup.

700W (-48VDC)

This power system consists of a rectifier, batteries, controller and cabinet which delivers 700W at -48VDC with 48 hours of battery backup.

NMS Equipment

The radio, multiplex and power system will be monitored using the NEC PC-MG NMS and local craft terminal software. Refer to the PC-MG document for further details.

Project Management

NEC will provide configuration management, logistics, project management, engineering, documentation, regular reporting, attending scheduled meetings and will co-ordinate the site survey, delivery, installation and commissioning so as to ensure successful and timely completion of the project.

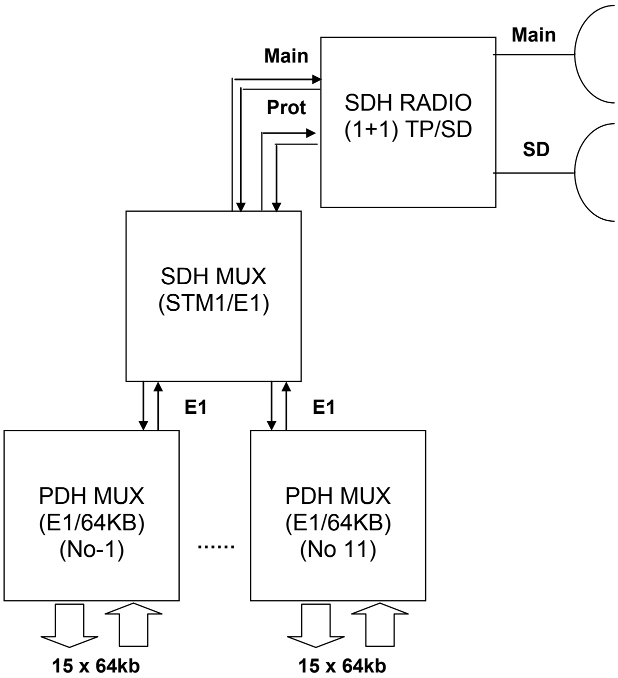


Figure 1 . Terminal site showing the SDH radio, SDH mux and PDH channel mux. The SDH radio and SDH mux will be connected via two pairs of SDH cable (main and protection) to provide high equipment reliability.

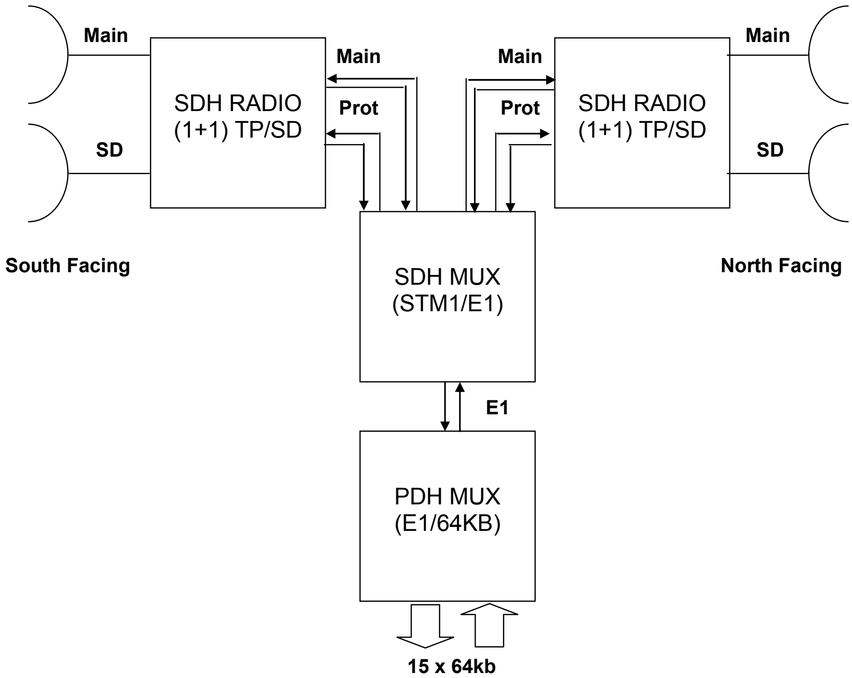
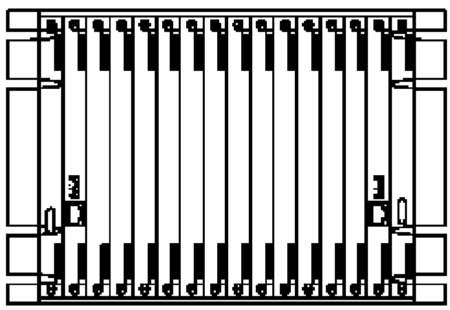


Figure 2 . Repeater site showing the SDH radio, SDH mux and PDH mux. The SDH radio and SDH mux will be connected via two SDH cable pairs (main and protection) to provide high equipment reliability.

Note: TP/SD means twin-path with space diversity.

North or South facing 5000 series 6.7GHz (1+1)
Twin-Path with Space Diversity radio

V-NODE S Mux, (STM1 /E1)



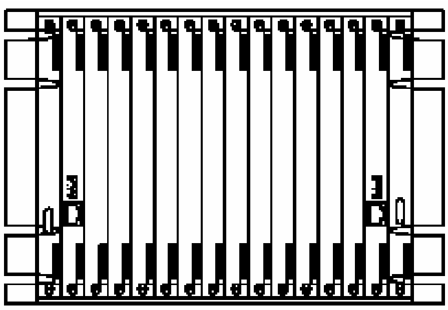
(11 x) DVM Plus 60 Mux (E1/64kb)

Figure 3 . Terminal site indoor radio and multiplex equipment .

South facing 5000 series 6.7GHz (1+1) Twin-Path with Space Diversity ODU

North facing 5000 series 6.7GHz (1+1) Twin-Path with Space Diversity ODU

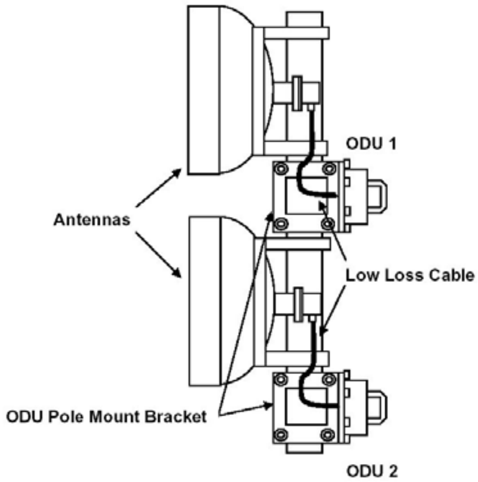
V-NODE S Mux, (STM1 /E1)

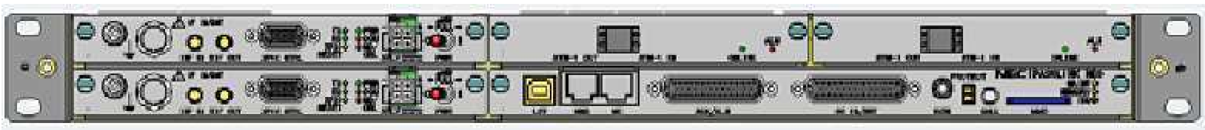


DVM Plus 60 Mux (E1/64kb)

Figure 4 . Repeater site indoor radio and multiplex equipment The SDH radio and SDH mux are fitted with dual optical interfaces (main and protection) to provide high equipment reliability.

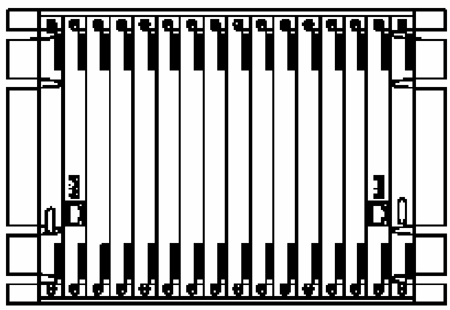
North or South facing NEO 6.7GHz (1+1)
Twin-Path with Space Diversity ODU





North or South facing NEO 6.7 GHz (1+1) Twin-Path with Space Diversity IDU

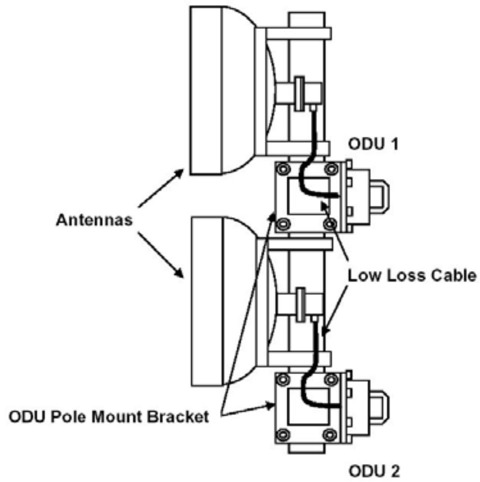
V-NODE S Mux, (STM1 /E1)



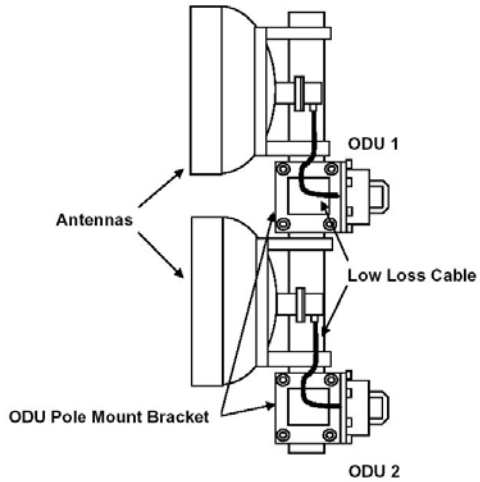
(11 x) DVM Plus 60 Mux (E1/64kb)

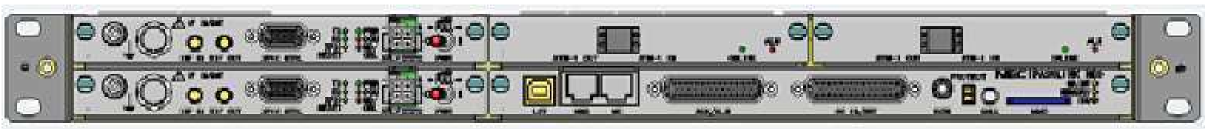
Figure 5 . Terminal site split-type radio and multiplex equipment . The SDH radio and SDH mux are fitted with dual optical interfaces (main and protection) to provide high equipment reliability.

South facing NEO 6.7GHz (1+1)
Twin-Path with Space Diversity ODU

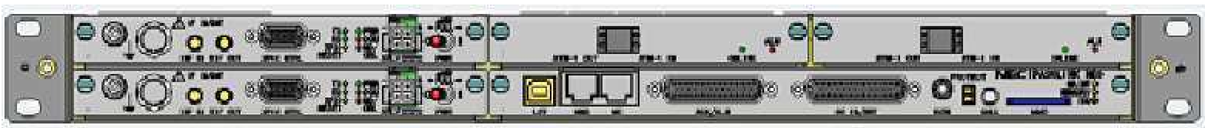


North facing NEO 6.7GHz (1+1)
Twin-Path with Space Diversity ODU



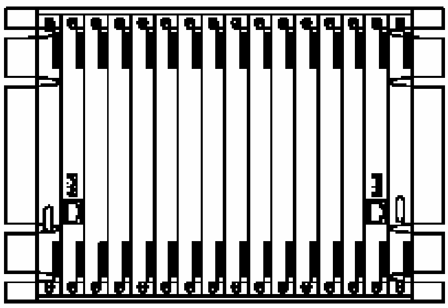


North facing NEO 6.7 GHz (1+1) Twin-Path with Space Diversity IDU



South facing NEO 6.7 GHz (1+1) Twin-Path with Space Diversity IDU

V-NODE S Mux, (STM1 /E1)



DVM Plus 60 Mux (E1/64kb)

Figure 6 . Repeater site split-type radio and multiplex equipment . The SDH radio and SDH mux are fitted with dual optical interfaces (main and protection) to provide high equipment reliability.

Assumptions

The following assumptions are made in the preparation of this quote.

1. The space inside the site building can accommodate the supplied radio, multiplex, power system and pressurisation equipment (for indoor radio equipment only).
2. The site buildings shall have door-ways that allow the equipment to be passed through and installed into the required room.
3. The site buildings are designed so that the internal temperature of the room shall not exceed 45 degrees Celsius when all the equipment is operating.
4. The site has 240 VAC power that shall provide sufficient power for the required − 48 VDC power system.
5. The site room shall have 240 VAC mains available for the connection of test equipment.
6. The existing main and space diversity antenna have clear line of sight between the sites with a minimum of 0.6 Fresnel at a Earth K factor of 1.
7. The towers and masts can be safely climbed to allow the installation of the feeder, out-door radio equipment and installation materials.
8. Each site radio building has a earth point to connect the supplied electronic equipment.
9. 19 inch racks are supplied by NEC for the mounting of the NEO (split-type) radio and multiplex equipment.
10. At each repeater site, a maximum of 15 channels (64kbps) will be connected to the existing site room data distribution frame (DDF).
11. At each terminal site, a maximum of 330 channels (64kbps) will be connected to the existing site room data distribution frame (DDF).
12. The supplied feeders shall be connected to the existing 6.7GHz main and space diversity antennas. The antennas shall be in working condition, operating within the manufacturers specifications, mounted and correctly pointing to the far-end site. The existing feeder gantry between the radio room to the top of the tower shall have sufficient space to lay down and fix the supplied feeder.
13. The antenna mounting poles have sufficient space to mount the out-door radio equipment.
14. The roads to the site shall be always accessible by car and truck .
15. Training, handbooks and spares are included in the prices.
16. The roll-out schedule for this project is approximately 4 months for the delivery of the equipment to site and 7 months for installation and commissioning.

SPLIT RADIO MICROWAVE SYSTEM BUDGETARY QUOTATION

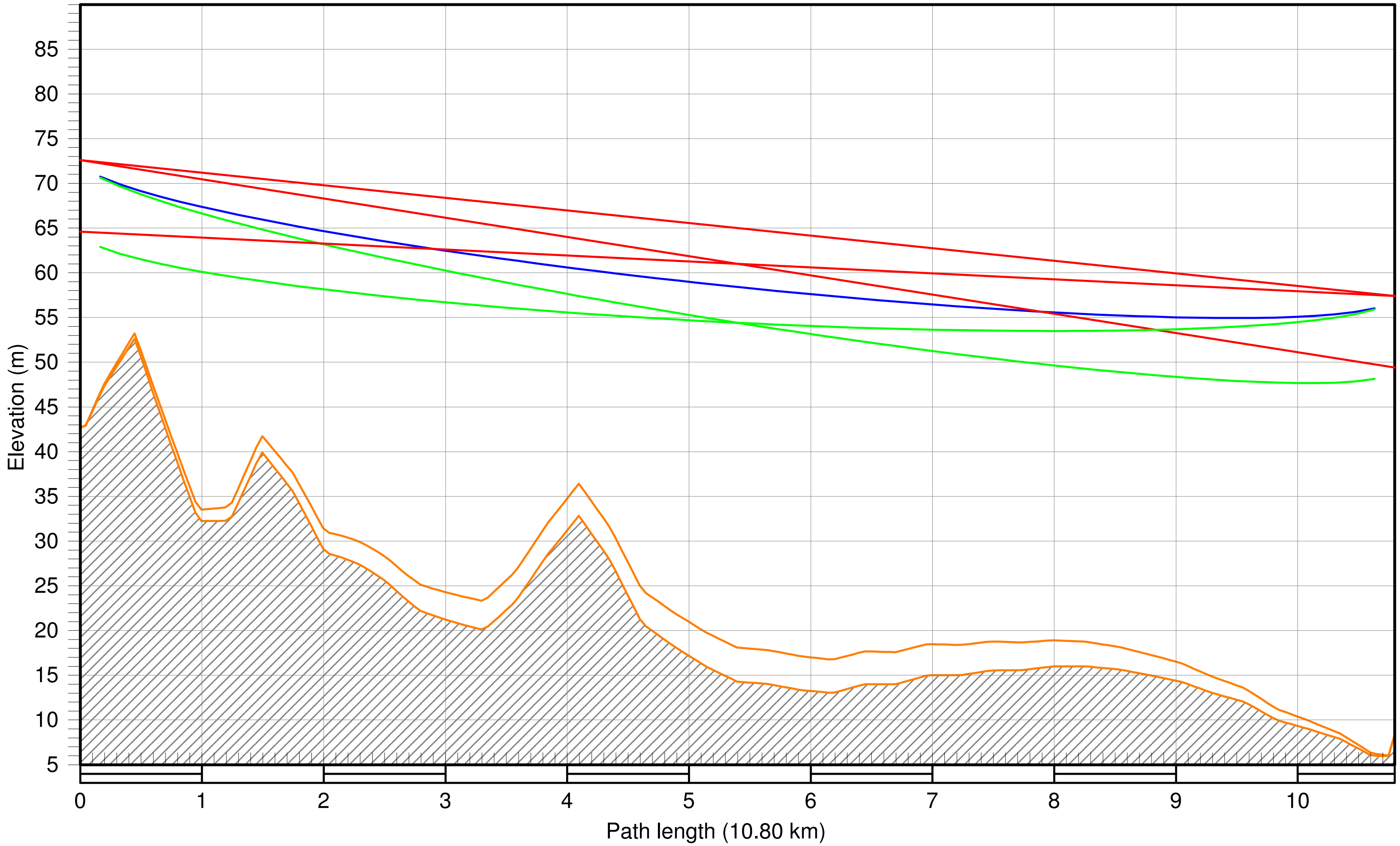
Site Code	Type of site	Mast/Tower Height (m)	Type	Distance to next site (km)	Antenna Height (m) North	Diversity Antenna Height (m) North	Feeder Length (m) North	Antenna Size (m) North	Antenna Height (m) South	Diversity Antenna Height (m) South	Feeder Length (m) South	Antenna Size (m) South	1+1 SDH Radio TX/RX	Feeders	Masthead Loading Assessment	Mux	Power	Network Management System	System manual and handbooks	Recover existing equip	Proj Mgmt	Total
R0	Terminal	31	Tower	10.8	-	-	0	-	29.9	20.9	45	2.4	$32,756.00	$15,580.00	$480.00	$152,928.00	$28,503.00	$3,699.57	$2,000.00		$19,582.73	$255,529.30
R1	Repeater	50	Mast	28.2	49	41	63	2.4	48.5	40.5	63	2.4	$56,152.00	$16,532.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$161,687.10
R2	Repeater	50	Mast	27.1	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$56,152.00	$16,532.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$161,687.10
R3	Repeater	110	Mast	29	108.5	100.5	123	2.4	108.5	100.5	123	2.4	$56,152.00	$17,588.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$162,743.10
R4	Repeater	110	Mast	28.2	108.5	108.5	123	2.4	108.5	108.5	123	2.4	$56,152.00	$17,588.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$162,743.10
R5	Repeater	50	Mast	25.7	48.5	40.5	63	2.4	48.5	32.5	63	2.4	$56,152.00	$16,532.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$161,687.10
R6	Repeater	50	Mast	31.5	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$56,152.00	$16,532.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$161,687.10
R7	Repeater	80	Mast	31.3	78.5	70.5	93	2.4	78.5	68.5	93	2.4	$56,152.00	$17,060.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$162,215.10
R8	Repeater	130	Mast	46.6	129	117	143	2.4	129	121	143	3.7	$56,152.00	$17,940.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$163,095.10
R9	Repeater	130	Mast	31.8	128.5	120.5	143	3.7	128.5	120.5	143	2.4	$56,152.00	$17,940.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$163,095.10
R10	Repeater	50	Mast	29.9	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$56,152.00	$16,532.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$161,687.10
R11	Repeater	50	Mast	30.4	48.5	40.5	63	2.4	48.5	32.5	63	2.4	$56,152.00	$16,532.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$161,687.10
R12	Repeater	80	Mast	43.3	79	71	93	2.4	79	66	93	3.7	$56,152.00	$17,060.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$162,215.10
R13	Repeater	130	Mast	31.2	129	121	143	3.7	129	117	143	2.4	$56,152.00	$17,940.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$163,095.10
R14	Repeater	50	Mast	30	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$56,152.00	$16,532.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$161,687.10
R15	Repeater	80	Mast	29.6	78.5	70.5	93	2.4	78.5	70.5	93	2.4	$56,152.00	$17,060.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$162,215.10
R16	Repeater	110	Mast	43.4	108.5	100.5	123	2.4	108.5	100.5	123	3.7	$56,152.00	$17,588.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$162,743.10
R17	Repeater	110	Mast	32.1	109	101	123	3.7	109	101	123	2.4	$56,152.00	$17,588.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$162,743.10
R18	Repeater	31	Tower	29.4	30	16.3	45	2.4	30	20.9	45	2.4	$56,152.00	$16,216.00	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$161,370.30
R19	Repeater	110	Mast	44.6	108.5	100.5	123	2.4	108.5	101.5	123	3.7	$56,152.00	$17,588.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$162,743.10
R20	Repeater	110	Mast	31.7	108.5	101.5	123	3.7	108.5	100.5	123	2.4	$56,152.00	$17,588.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$162,743.10
R21	Repeater	110	Mast	45.3	108.5	100.5	123	2.4	108.5	98.5	123	3.7	$56,152.00	$17,588.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$162,743.10
R22	Repeater	110	Mast	31.5	108.5	100.5	123	3.7	108.5	100.5	123	2.4	$56,152.00	$17,588.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$162,743.10
R23	Repeater	50	Mast	31.5	48.5	40.5	63	2.4	48.5	32.5	123	2.4	$56,152.00	$17,060.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$162,215.10
R24	Repeater	80	Mast	31.8	78.5	70.5	93	2.4	78.5	70.5	93	2.4	$56,152.00	$17,060.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$162,215.10
R25	Repeater	60	Tower	32.2	58.5	50.5	75	2.4	58.5	50.5	75	2.4	$56,152.00	$16,744.00	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$161,898.30
R26	Repeater	50	Mast	31.5	48.5	36.5	63	2.4	48.5	40.5	63	2.4	$56,152.00	$16,532.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$161,687.10
R27	Repeater	130	Mast	46.1	129	121	143	2.4	129	121	143	3.7	$56,152.00	$17,940.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$163,095.10
R28	Repeater	130	Mast	31.5	128.5	120.5	143	3.7	128.5	120.5	143	2.4	$56,152.00	$17,940.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$163,095.10
R29	Repeater	80	Mast	30.2	78.5	70.5	93	2.4	78.5	70.5	93	2.4	$56,152.00	$17,060.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$162,215.10
R30	Repeater	80	Mast	26.2	78.5	70.5	93	2.4	78.5	70.5	93	2.4	$56,152.00	$17,060.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$162,215.10
R31	Repeater	50	Mast	31.1	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$56,152.00	$16,532.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$161,687.10
R32	Repeater	50	Mast	29.2	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$56,152.00	$16,532.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$161,687.10
R33	Repeater	130	Mast	30	129	121	143	2.4	129	121	143	3.7	$56,152.00	$17,940.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$163,095.10
R34	Repeater	130	Mast	30.2	128.5	120.5	143	3.7	128.5	120.5	143	2.4	$56,152.00	$17,940.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$163,095.10
R35	Repeater	31	Tower	30.3	29.9	20.9	45	2.4	29.9	20.9	45	2.4	$56,152.00	$16,216.00	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$161,370.30
R36	Repeater	80	Mast	24.4	30	22	45	2.4	78.5	70.5	93	2.4	$56,152.00	$16,638.40	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$161,792.70
R37	Repeater	110	Mast	30.9	108.5	100.5	123	2.4	108.5	100.5	123	3.7	$56,152.00	$17,588.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$162,743.10
R38	Repeater	110	Mast	25.9	108.5	100.5	123	3.7	108.5	100.5	123	2.4	$56,152.00	$17,588.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$162,743.10
R39	Repeater	31	Tower	26.6	29.9	20.9	45	2.4	29.9	20.9	45	2.4	$56,152.00	$16,216.00	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$161,370.30
R40	Repeater	50	Mast	27.7	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$56,152.00	$16,532.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$161,687.10
R41	Repeater	50	Mast	23.7	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$56,152.00	$16,532.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$161,687.10
R42	Repeater	80	Mast	19.6	78.5	70.5	93	2.4	78.5	70.5	93	2.4	$56,152.00	$17,060.80	$480.00	$40,002.00	$23,238.00	$3,699.57	$2,000.00		$19,582.73	$162,215.10
R43	Terminal	39	Ext T	39	38	30	49	1.8	-	-	0	-	$32,756.00	$15,615.20	$480.00	$152,928.00	$28,503.00	$3,699.57	$2,000.00		$19,582.73	$255,564.50
													$2,423,896.00	**$749,579.20**	**$21,120.00**	**$1,985,940.00**	**$1,033,002.00**	**$162,781.00**	**$88,000.00**	**$0.00**	**$861,640.00**	**$7,325,958.20**

INDOOR MICROWAVE SYSTEM BUDGETARY QUOTATION

Site Code	Type of site	Mast/Tower Height (m)	Type	Distance to next site (km)	Antenna Height (m) North	Diversity Antenna Height (m) North	Feeder Length (m) North	Antenna Size (m) North	Antenna Height (m) South	Diversity Antenna Height (m) South	Feeder Length (m) South	Antenna Size (m) South	1+1 SDH Radio TX/RX	Feeders	Mux	Power	Network Management System	System manual and handbooks	Recover existing equip	Proj Mgmt	Total
R0	Terminal	31	Tower	10.8	-	-	0	-	29.9	20.9	45	2.4	$78,947.81	$52,054.47	$152,928.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$346,218.23
R1	Repeater	50	Mast	28.2	49	41	63	2.4	48.5	40.5	63	2.4	$140,735.62	$58,751.82	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$301,777.40
R2	Repeater	50	Mast	27.1	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$140,735.62	$58,751.82	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$301,777.40
R3	Repeater	110	Mast	29	108.5	100.5	123	2.4	108.5	100.5	123	2.4	$140,735.62	$67,178.26	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$310,203.84
R4	Repeater	110	Mast	28.2	108.5	108.5	123	2.4	108.5	108.5	123	2.4	$140,735.62	$67,178.26	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$310,203.84
R5	Repeater	50	Mast	25.7	48.5	40.5	63	2.4	48.5	32.5	63	2.4	$140,735.62	$58,751.82	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$301,777.40
R6	Repeater	50	Mast	31.5	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$140,735.62	$58,751.82	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$301,777.40
R7	Repeater	80	Mast	31.3	78.5	70.5	93	2.4	78.5	68.5	93	2.4	$140,735.62	$62,965.54	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$305,991.12
R8	Repeater	130	Mast	46.6	129	117	143	2.4	129	121	143	3.7	$140,735.62	$69,987.74	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$313,013.32
R9	Repeater	130	Mast	31.8	128.5	120.5	143	3.7	128.5	120.5	143	2.4	$140,735.62	$69,987.74	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$313,013.32
R10	Repeater	50	Mast	29.9	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$140,735.62	$58,751.82	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$301,777.40
R11	Repeater	50	Mast	30.4	48.5	40.5	63	2.4	48.5	32.5	63	2.4	$140,735.62	$58,751.82	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$301,777.40
R12	Repeater	80	Mast	43.3	79	71	93	2.4	79	66	93	3.7	$140,735.62	$62,965.54	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$305,991.12
R13	Repeater	130	Mast	31.2	129	121	143	3.7	129	117	143	2.4	$140,735.62	$69,987.74	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$313,013.32
R14	Repeater	50	Mast	30	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$140,735.62	$58,751.82	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$301,777.40
R15	Repeater	80	Mast	29.6	78.5	70.5	93	2.4	78.5	70.5	93	2.4	$140,735.62	$62,965.54	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$305,991.12
R16	Repeater	110	Mast	43.4	108.5	100.5	123	2.4	108.5	100.5	123	3.7	$140,735.62	$67,178.26	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$310,203.84
R17	Repeater	110	Mast	32.1	109	101	123	3.7	109	101	123	2.4	$140,735.62	$67,178.26	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$310,203.84
R18	Repeater	31	Tower	29.4	30	16.3	45	2.4	30	20.9	45	2.4	$140,735.62	$56,223.99	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$299,249.56
R19	Repeater	110	Mast	44.6	108.5	100.5	123	2.4	108.5	101.5	123	3.7	$140,735.62	$67,178.26	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$310,203.84
R20	Repeater	110	Mast	31.7	108.5	101.5	123	3.7	108.5	100.5	123	2.4	$140,735.62	$67,178.26	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$310,203.84
R21	Repeater	110	Mast	45.3	108.5	100.5	123	2.4	108.5	98.5	123	3.7	$140,735.62	$67,178.26	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$310,203.84
R22	Repeater	110	Mast	31.5	108.5	100.5	123	3.7	108.5	100.5	123	2.4	$140,735.62	$67,178.26	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$310,203.84
R23	Repeater	50	Mast	31.5	48.5	40.5	63	2.4	48.5	32.5	123	2.4	$140,735.62	$62,965.54	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$305,991.12
R24	Repeater	80	Mast	31.8	78.5	70.5	93	2.4	78.5	70.5	93	2.4	$140,735.62	$62,965.54	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$305,991.12
R25	Repeater	60	Tower	32.2	58.5	50.5	75	2.4	58.5	50.5	75	2.4	$140,735.62	$60,436.71	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$303,462.28
R26	Repeater	50	Mast	31.5	48.5	36.5	63	2.4	48.5	40.5	63	2.4	$140,735.62	$58,751.82	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$301,777.40
R27	Repeater	130	Mast	46.1	129	121	143	2.4	129	121	143	3.7	$140,735.62	$69,987.74	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$313,013.32
R28	Repeater	130	Mast	31.5	128.5	120.5	143	3.7	128.5	120.5	143	2.4	$140,735.62	$69,987.74	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$313,013.32
R29	Repeater	80	Mast	30.2	78.5	70.5	93	2.4	78.5	70.5	93	2.4	$140,735.62	$62,965.54	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$305,991.12
R30	Repeater	80	Mast	26.2	78.5	70.5	93	2.4	78.5	70.5	93	2.4	$140,735.62	$62,965.54	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$305,991.12
R31	Repeater	50	Mast	31.1	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$140,735.62	$58,751.82	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$301,777.40
R32	Repeater	50	Mast	29.2	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$140,735.62	$58,751.82	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$301,777.40
R33	Repeater	130	Mast	30	129	121	143	2.4	129	121	143	3.7	$140,735.62	$69,987.74	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$313,013.32
R34	Repeater	130	Mast	30.2	128.5	120.5	143	3.7	128.5	120.5	143	2.4	$140,735.62	$69,987.74	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$313,013.32
R35	Repeater	31	Tower	30.3	29.9	20.9	45	2.4	29.9	20.9	45	2.4	$140,735.62	$56,223.99	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$299,249.56
R36	Repeater	80	Mast	24.4	30	22	45	2.4	78.5	70.5	93	2.4	$140,735.62	$59,594.77	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$302,620.34
R37	Repeater	110	Mast	30.9	108.5	100.5	123	2.4	108.5	100.5	123	3.7	$140,735.62	$67,178.26	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$310,203.84
R38	Repeater	110	Mast	25.9	108.5	100.5	123	3.7	108.5	100.5	123	2.4	$140,735.62	$67,178.26	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$310,203.84
R39	Repeater	31	Tower	26.6	29.9	20.9	45	2.4	29.9	20.9	45	2.4	$140,735.62	$56,223.99	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$299,249.56
R40	Repeater	50	Mast	27.7	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$140,735.62	$58,751.82	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$301,777.40
R41	Repeater	50	Mast	23.7	48.5	40.5	63	2.4	48.5	40.5	63	2.4	$140,735.62	$58,751.82	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$301,777.40
R42	Repeater	80	Mast	19.6	78.5	70.5	93	2.4	78.5	70.5	93	2.4	$140,735.62	$62,965.54	$40,002.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$305,991.12
R43	Terminal	39	Ext T	39	38	30	49	1.8	-	-	0	-	$81,347.81	$50,295.12	$152,928.00	$28,503.00	$12,202.23	$2,000.00		$19,582.73	$346,858.88
													$6,071,191.66	**$2,761,496.05**	**$1,985,940.00**	**$1,254,132.00**	**$536,898.00**	**$88,000.00**	**$0.00**	**$861,640.00**	**$13,559,297.71**

7Sep06

D. SITE COORDINATES AND PATH PROFILES

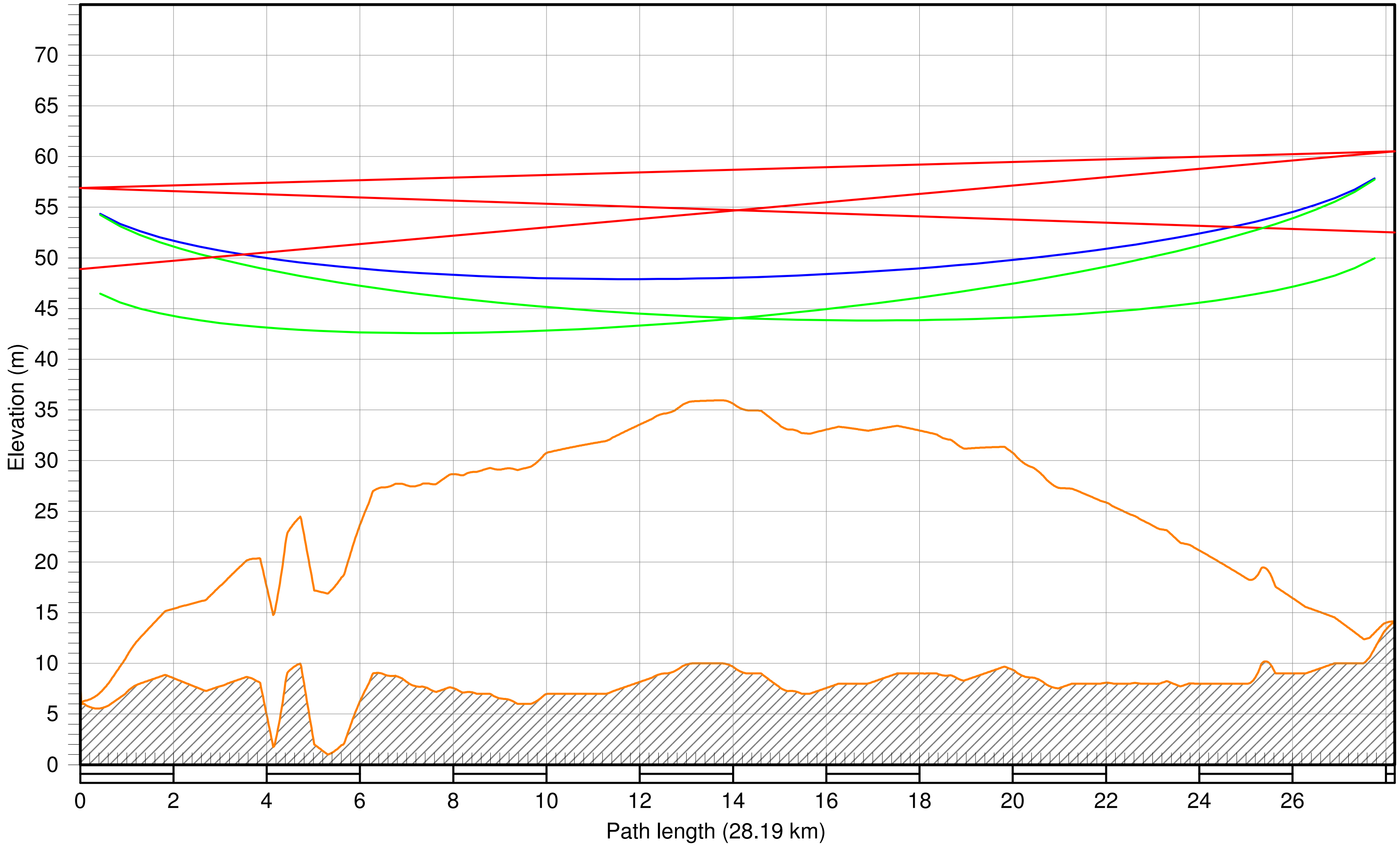


R0 Karratha Terminal	
Latitude	20 45 46.00 S
Longitude	116 49 59.00 E
Azimuth	268.02°
Elevation	43 m ASL
Antenna CL	29.9, 21.9 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R1 Cajuput Well	
Latitude	20 45 58.00 S
Longitude	116 43 46.00 E
Azimuth	88.06°
Elevation	8 m ASL
Antenna CL	49.0, 41.0 m AGL

Gibson Quai - AAS 61758

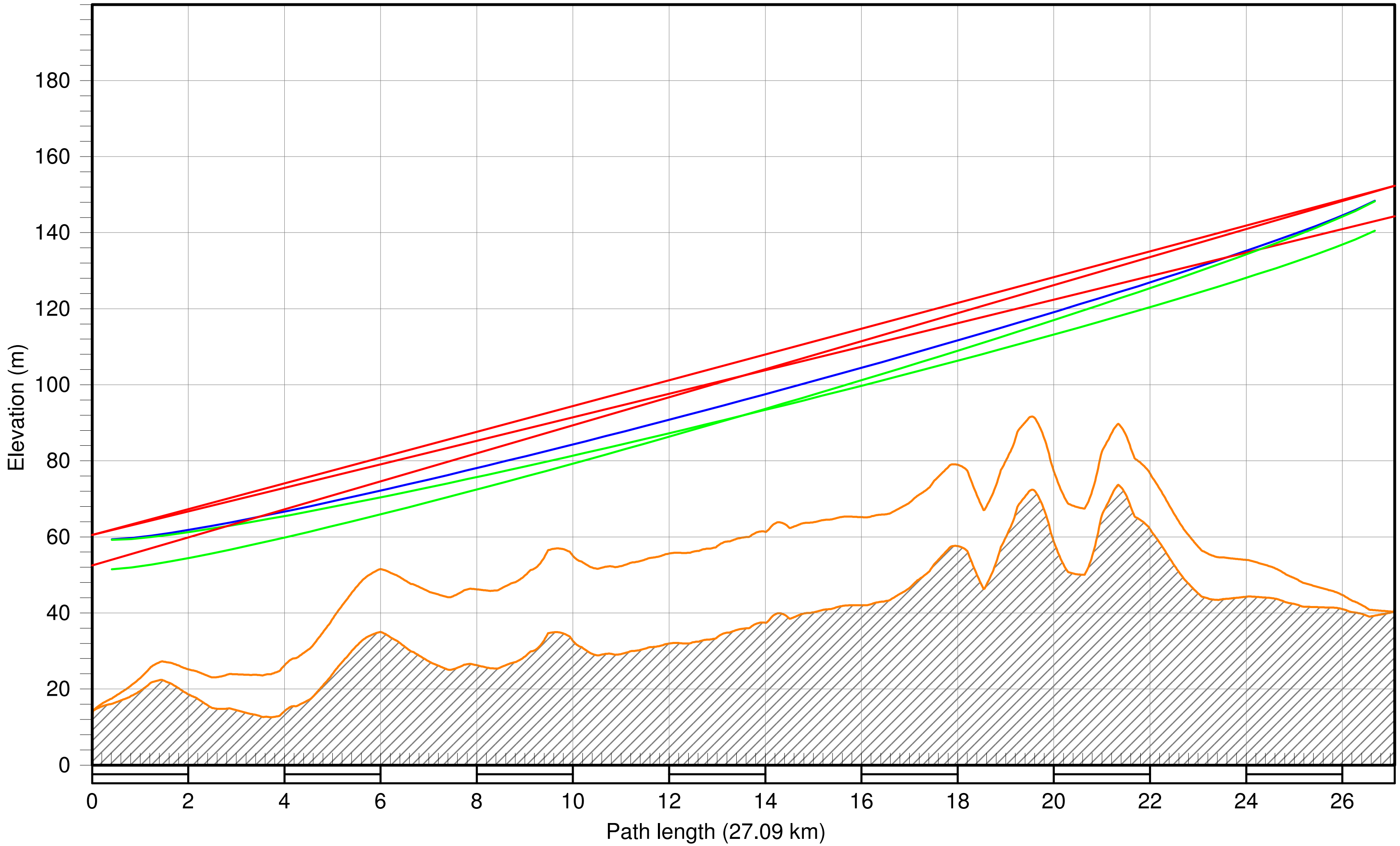


R1 Cajuput Well	
Latitude	20 45 58.00 S
Longitude	116 43 46.00 E
Azimuth	243.66°
Elevation	8 m ASL
Antenna CL	48.5, 40.5 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R2 Yanyare	
Latitude	20 52 44.00 S
Longitude	116 29 12.00 E
Azimuth	63.75°
Elevation	12 m ASL
Antenna CL	48.5, 40.5 m AGL

Gibson Quai - AAS 61758

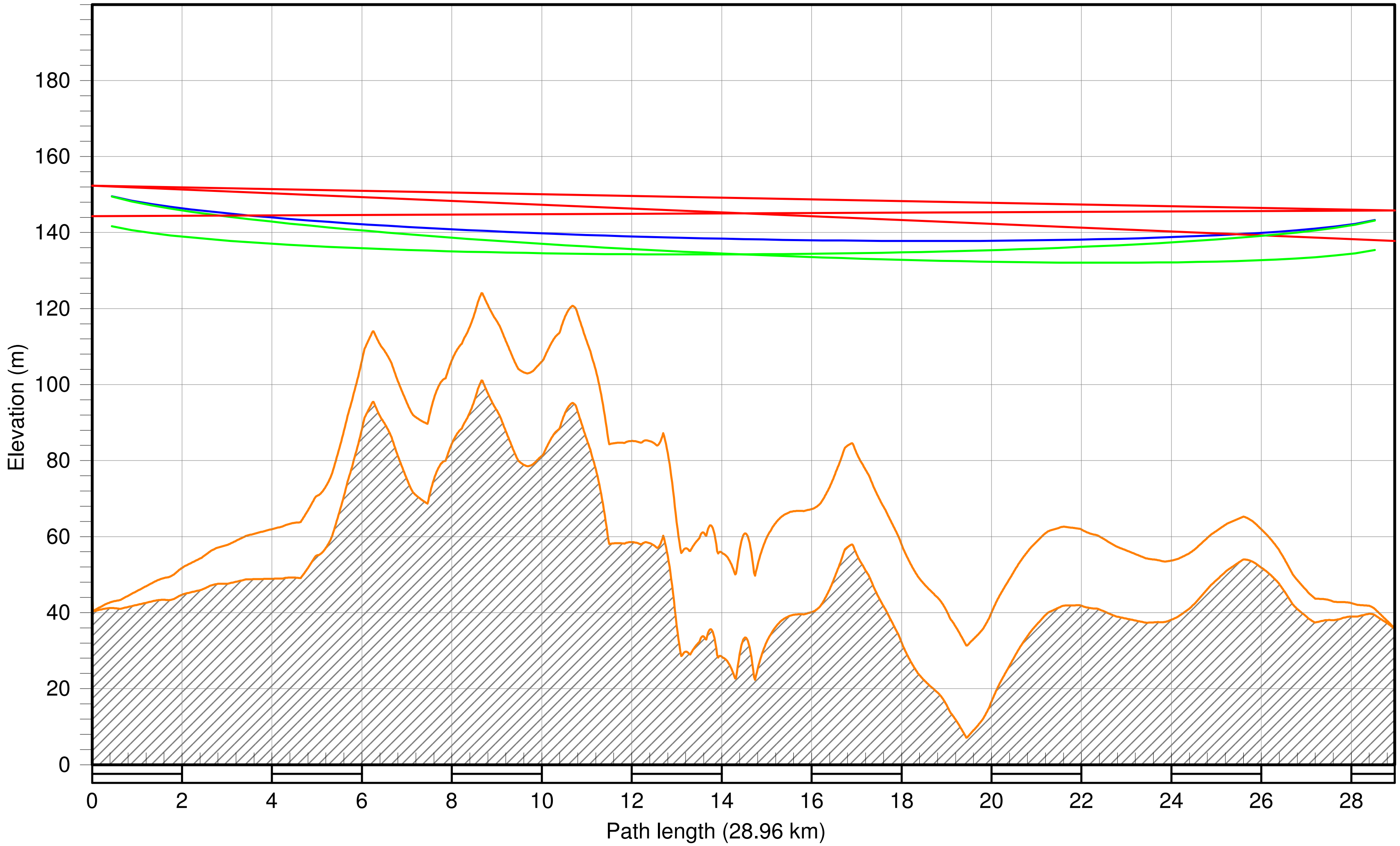


R2 Yanyare	
Latitude	20 52 44.00 S
Longitude	116 29 12.00 E
Azimuth	228.17°
Elevation	12 m ASL
Antenna CL	48.5, 40.5 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R3 McKay Creek	
Latitude	21 02 31.00 S
Longitude	116 17 33.00 E
Azimuth	48.24°
Elevation	44 m ASL
Antenna CL	108.5, 100.5 m AGL

Gibson Quai - AAS 61758

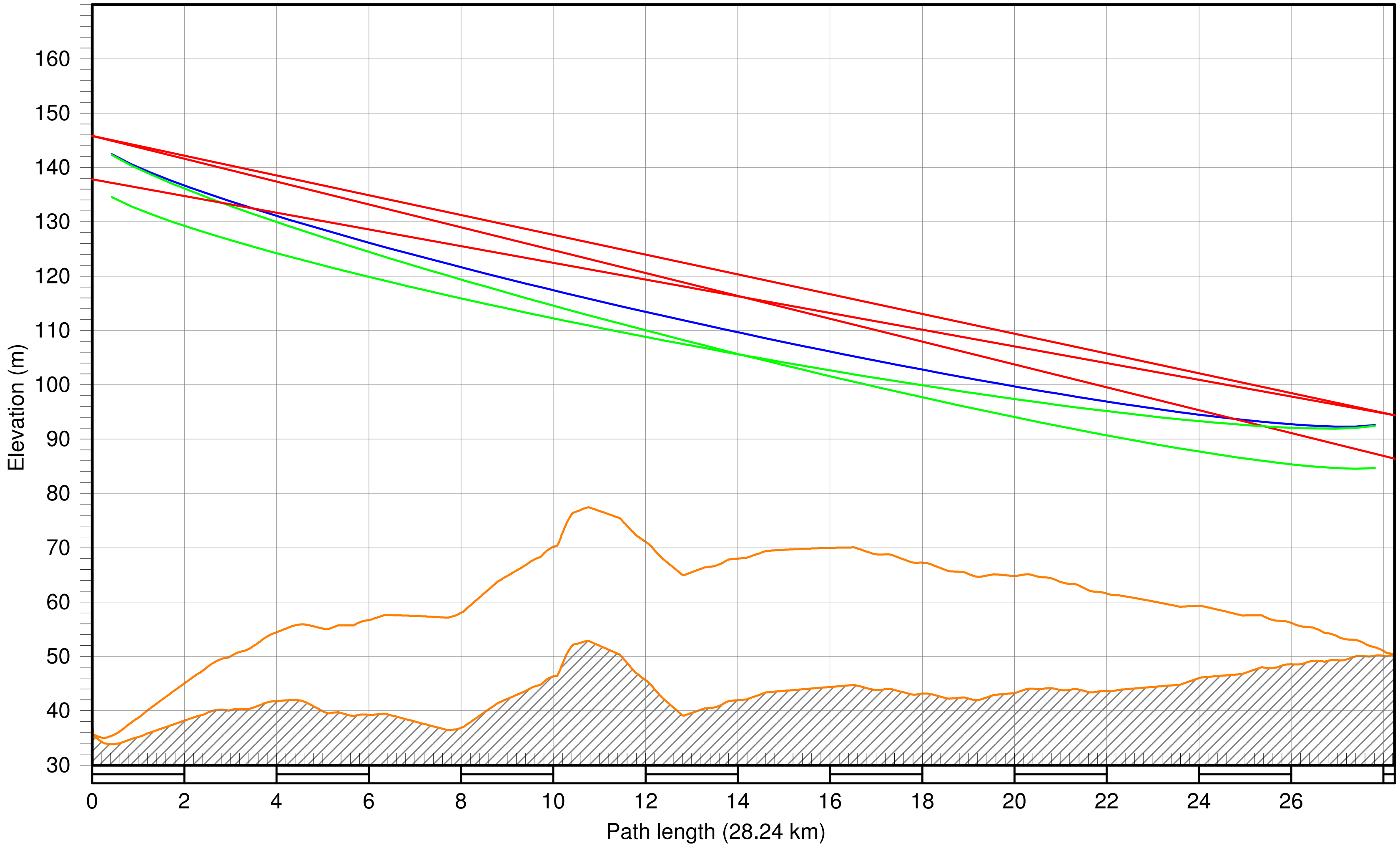


R3 McKay Creek	
Latitude	21 02 31.00 S
Longitude	116 17 33.00 E
Azimuth	220.10°
Elevation	44 m ASL
Antenna CL	108.5, 100.5 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R4 Fortescue	
Latitude	21 14 31.00 S
Longitude	116 06 46.00 E
Azimuth	40.16°
Elevation	37 m ASL
Antenna CL	108.5, 100.5 m AGL

Gibson Quai - AAS 61758

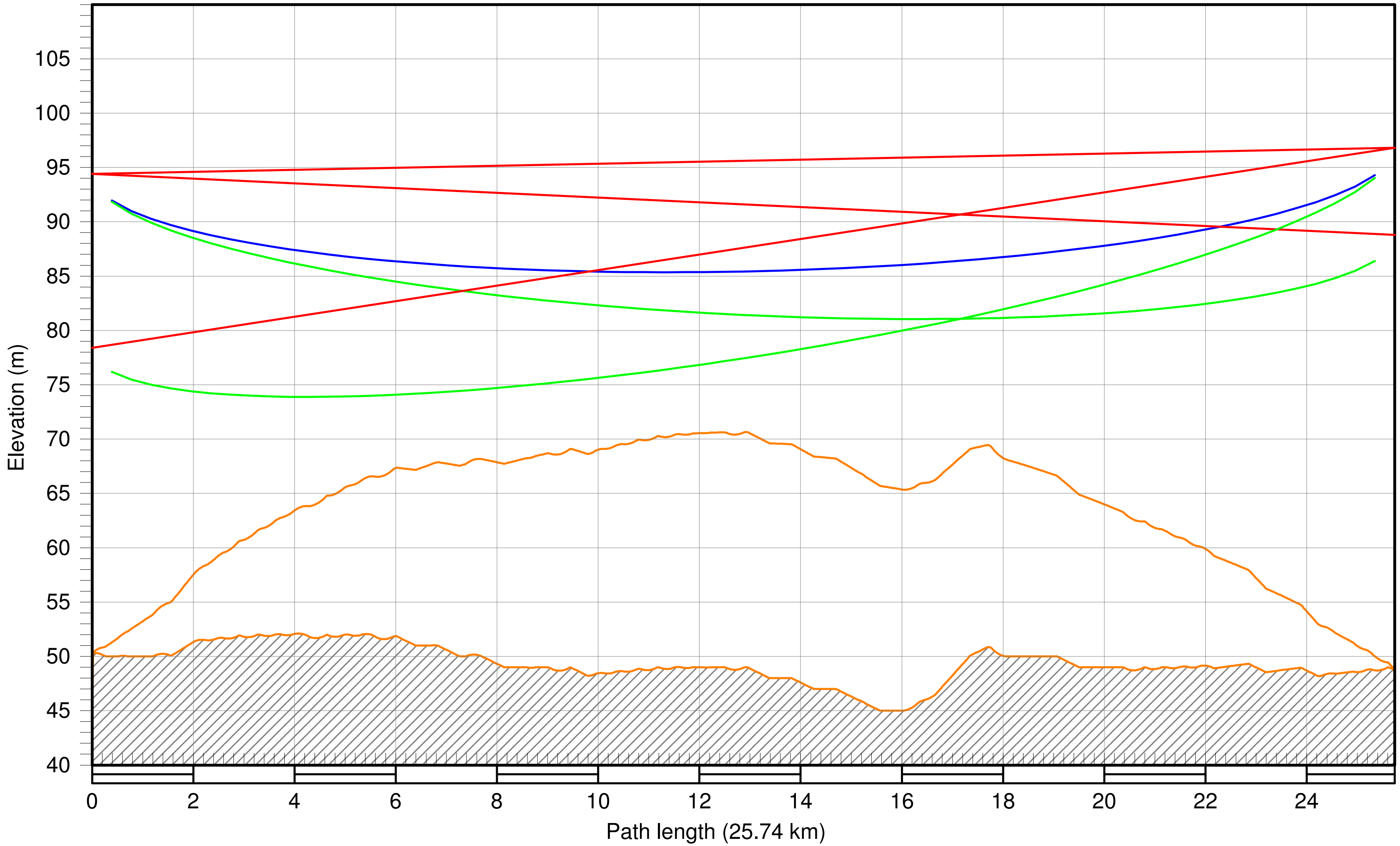


R4 Fortescue	
Latitude	21 14 31.00 S
Longitude	116 06 46.00 E
Azimuth	215.32°
Elevation	37 m ASL
Antenna CL	108.5, 100.5 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R5 Peter Creek	
Latitude	21 27 00.00 S
Longitude	115 57 19.00 E
Azimuth	35.37°
Elevation	46 m ASL
Antenna CL	48.5, 40.5 m AGL

Gibson Quai - AAS 61758

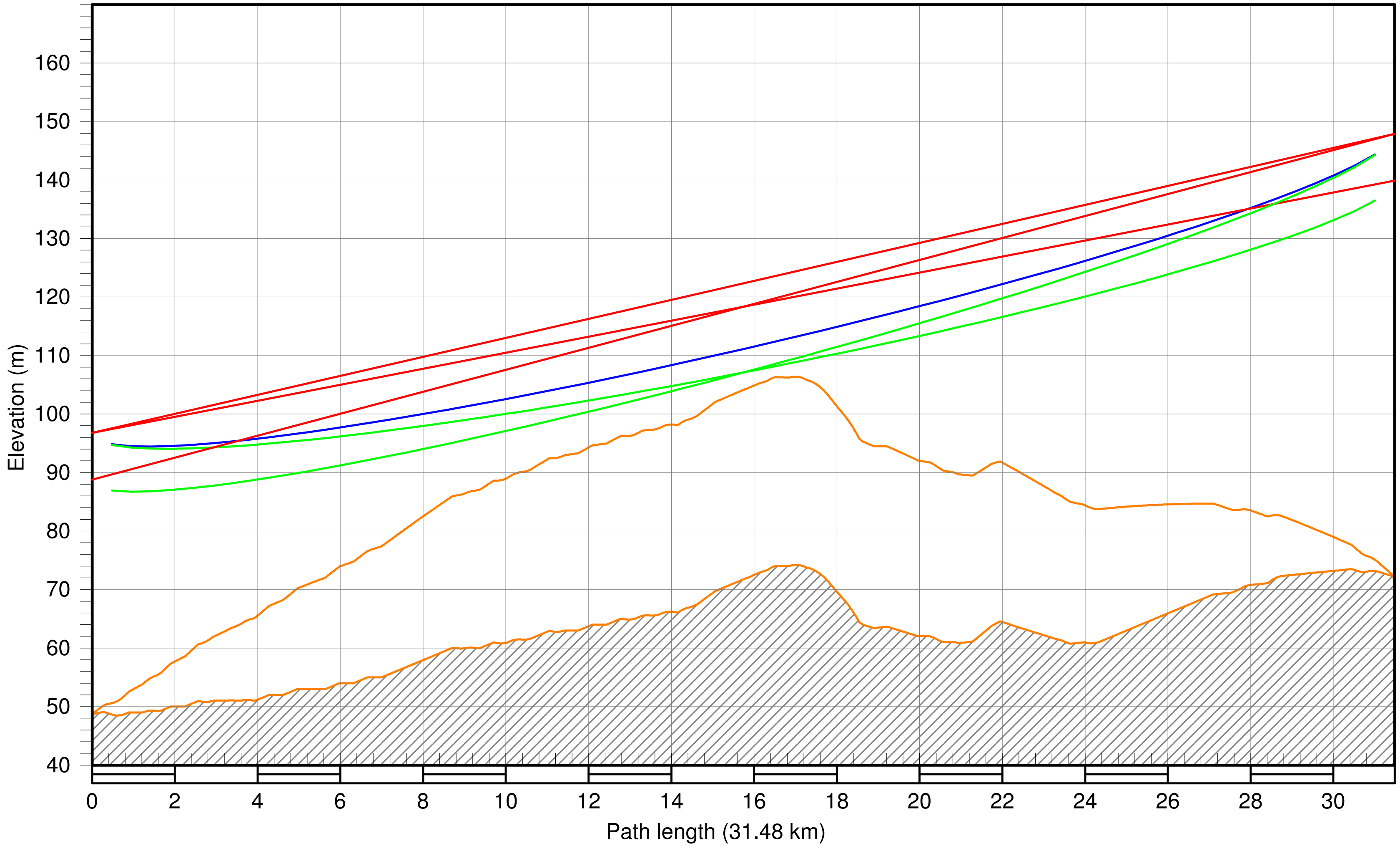


R5 Peter Creek	
Latitude	21 27 00.00 S
Longitude	115 57 19.00 E
Azimuth	216.31°
Elevation	46 m ASL
Antenna CL	48.5, 32.5 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R6 Warramboo	
Latitude	21 38 14.00 S
Longitude	115 48 29.00 E
Azimuth	36.37°
Elevation	48 m ASL
Antenna CL	48.5, 40.5 m AGL

Gibson Quai - AAS 61758

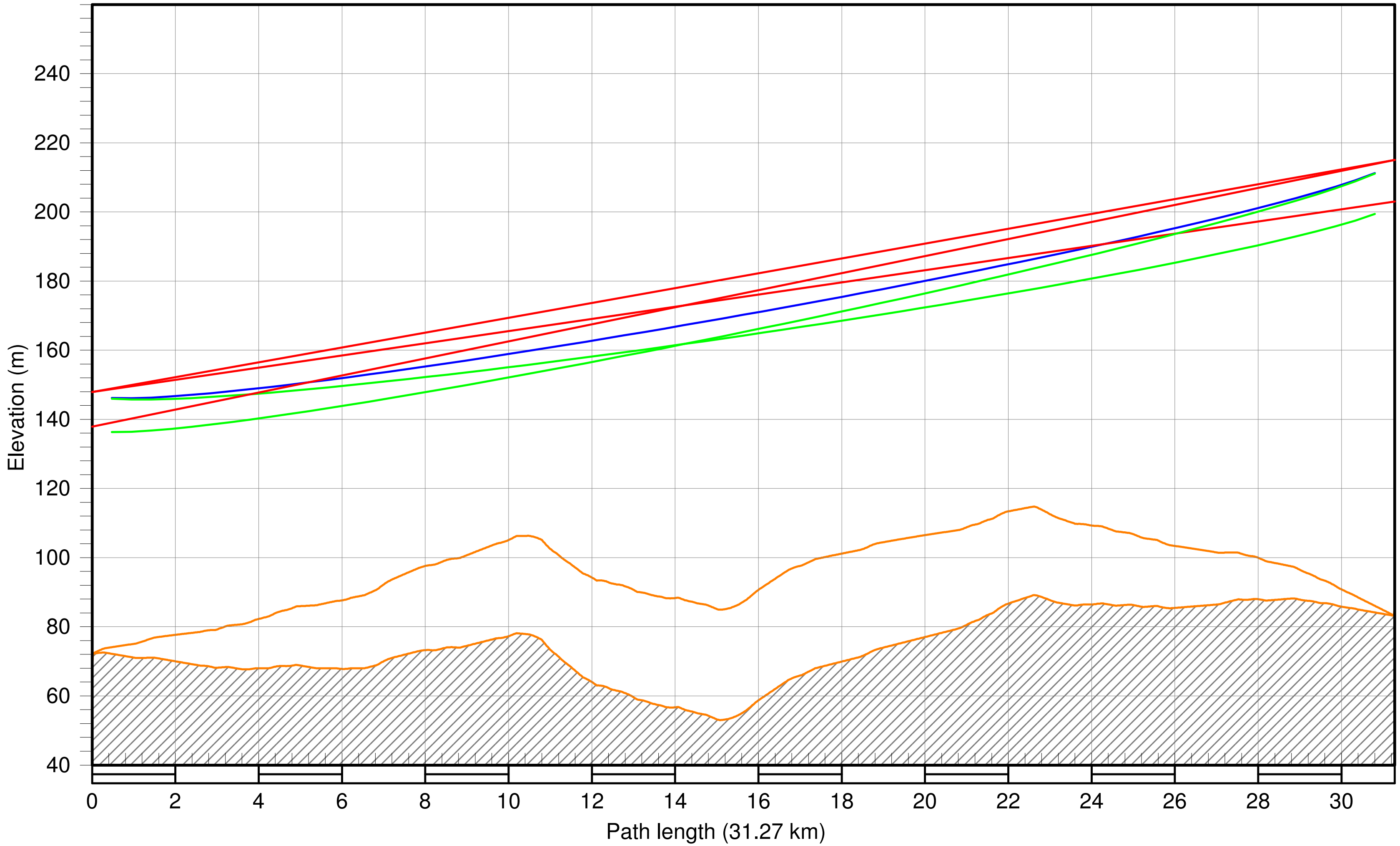


R6 Warramboo	
Latitude	21 38 14.00 S
Longitude	115 48 29.00 E
Azimuth	215.39°
Elevation	48 m ASL
Antenna CL	48.5, 40.5 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R7 Peedamulla	
Latitude	21 52 08.00 S
Longitude	115 37 54.00 E
Azimuth	35.46°
Elevation	69 m ASL
Antenna CL	78.5, 70.5 m AGL

Gibson Quai - AAS 61758



R7 Peedamulla

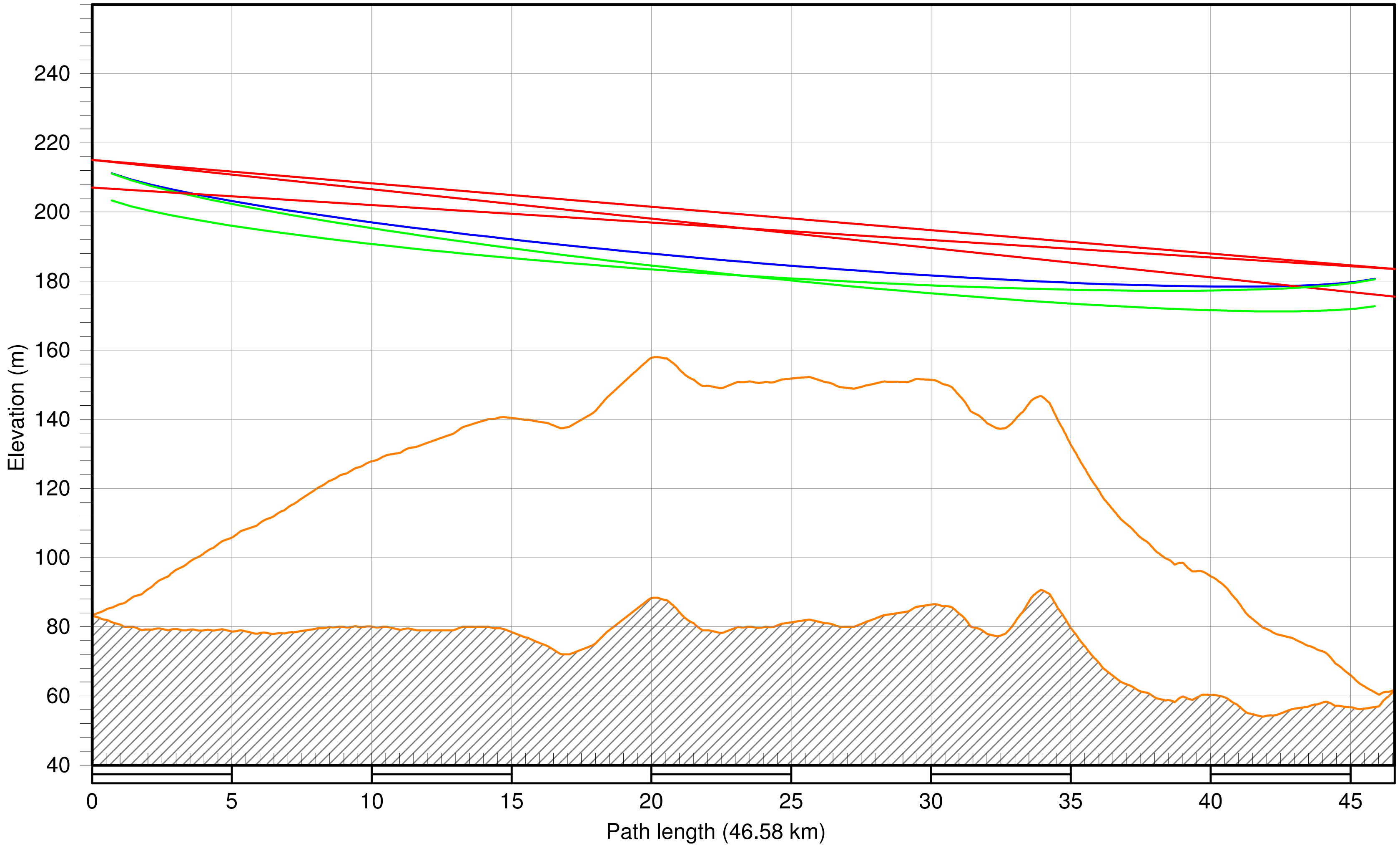
Latitude	21 52 08.00 S
Longitude	115 37 54.00 E
Azimuth	212.42°
Elevation	69 m ASL
Antenna CL	78.5, 68.5 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

Gibson Quai - AAS 61758

R8 Claypan Well

Latitude	22 06 26.00 S
Longitude	115 28 09.00 E
Azimuth	32.48°
Elevation	86 m ASL
Antenna CL	129.0, 117.0 m AGL

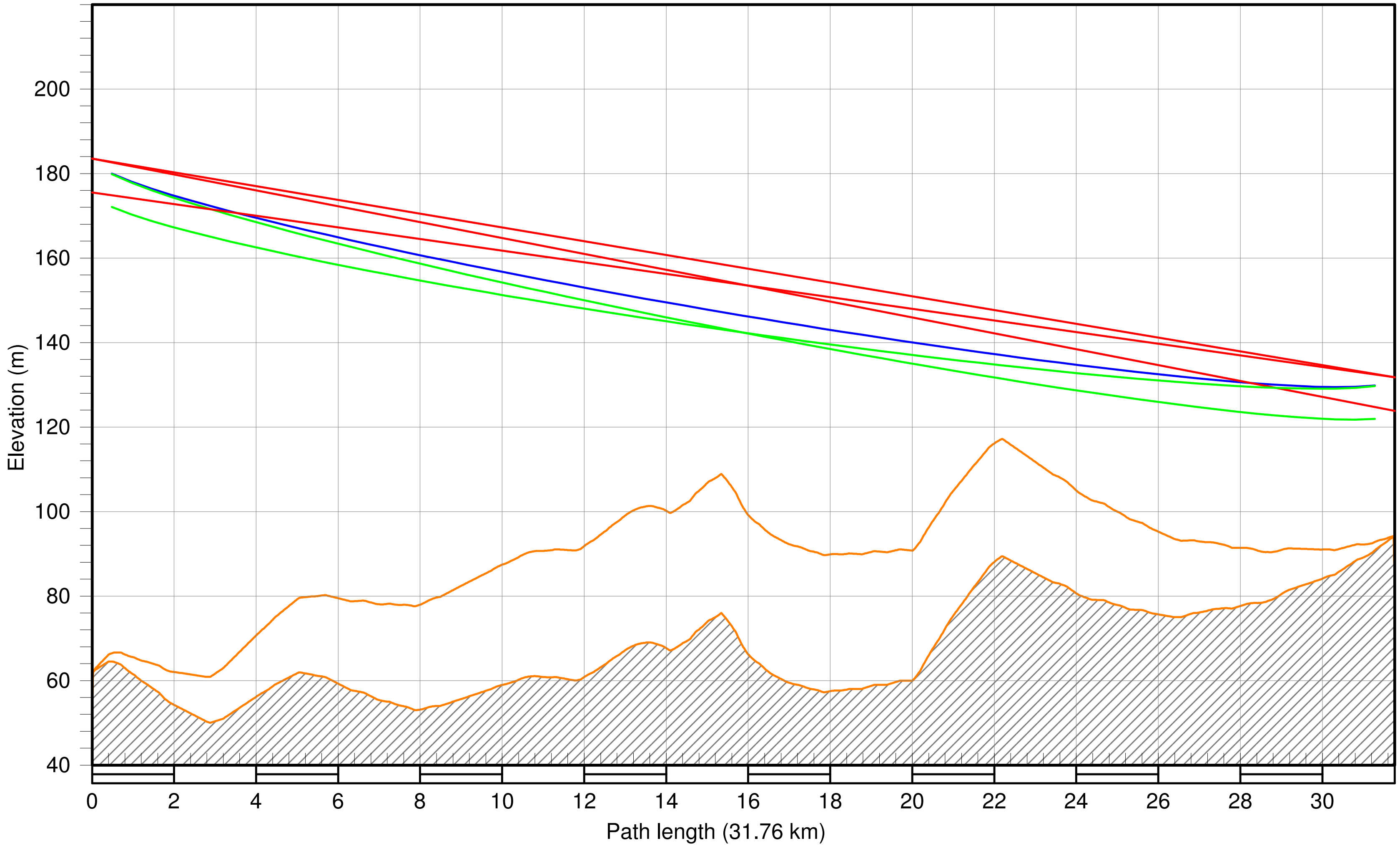


R8 Claypan Well	
Latitude	22 06 26.00 S
Longitude	115 28 09.00 E
Azimuth	209.53°
Elevation	86 m ASL
Antenna CL	129.0, 121.0 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R9 Ashburton	
Latitude	22 28 23.00 S
Longitude	115 14 46.00 E
Azimuth	29.61°
Elevation	55 m ASL
Antenna CL	128.5, 120.5 m AGL

Gibson Quai - AAS 61758

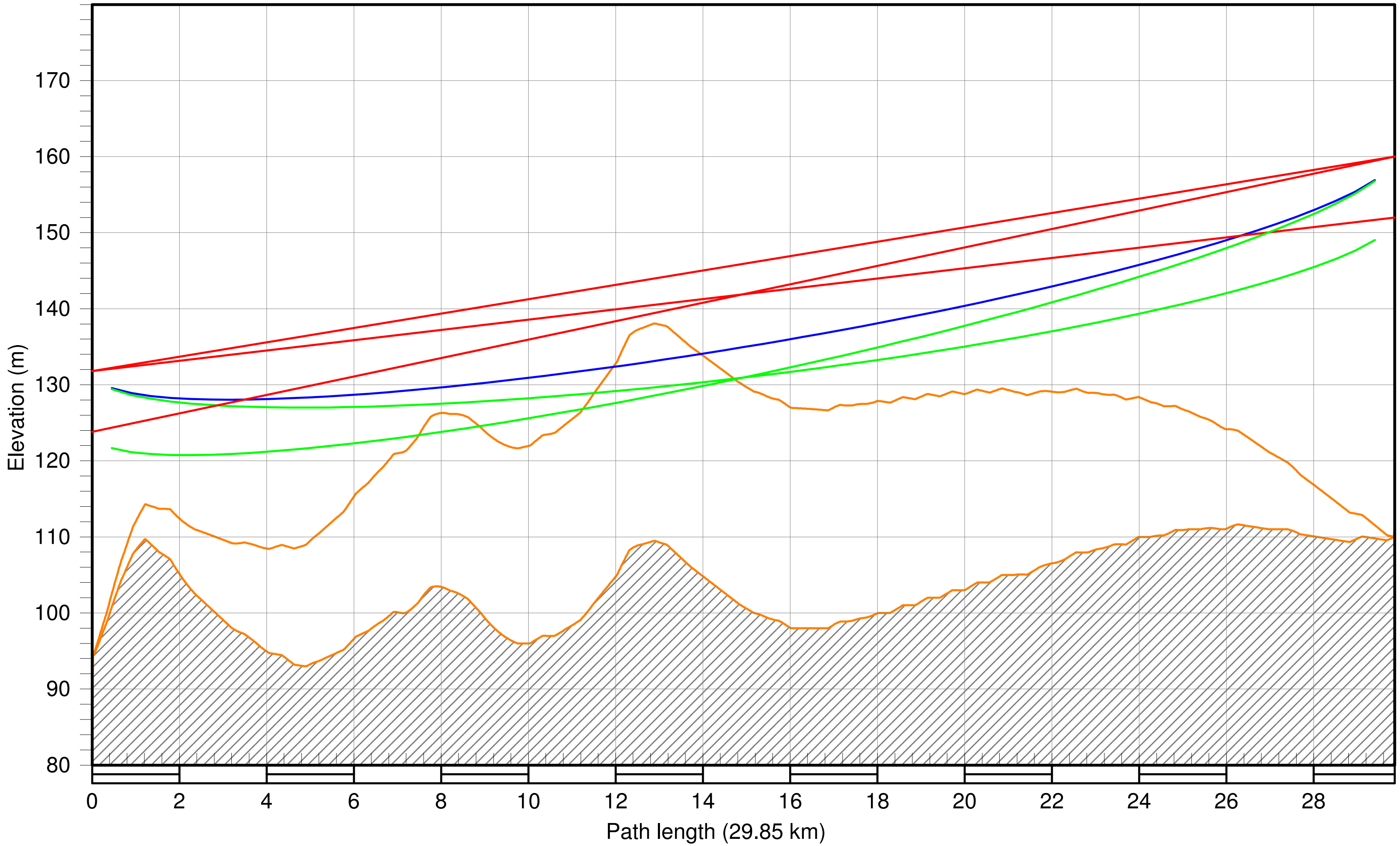


R9 Ashburton	
Latitude	22 28 23.00 S
Longitude	115 14 46.00 E
Azimuth	207.21°
Elevation	55 m ASL
Antenna CL	128.5, 120.5 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R10 Barradale	
Latitude	22 43 41.00 S
Longitude	115 06 17.00 E
Azimuth	27.27°
Elevation	83 m ASL
Antenna CL	48.5, 40.5 m AGL

Gibson Quai - AAS 61758



R10 Barradale

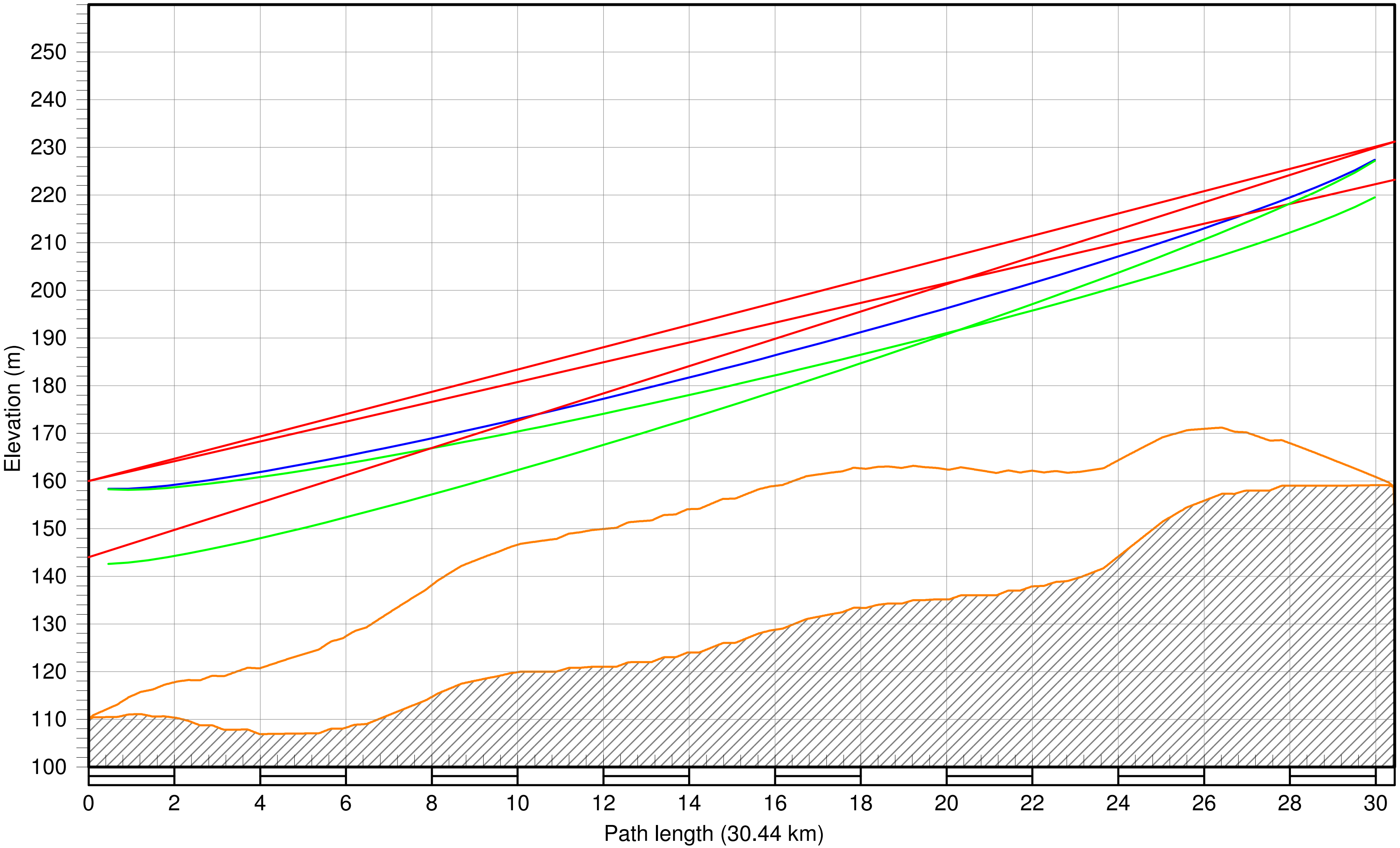
Latitude	22 43 41.00 S
Longitude	115 06 17.00 E
Azimuth	193.40°
Elevation	83 m ASL
Antenna CL	48.5, 40.5 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R11 Nyang

Latitude	22 59 25.00 S
Longitude	115 02 14.00 E
Azimuth	13.43°
Elevation	112 m ASL
Antenna CL	48.5, 40.5 m AGL

Gibson Quai - AAS 61758

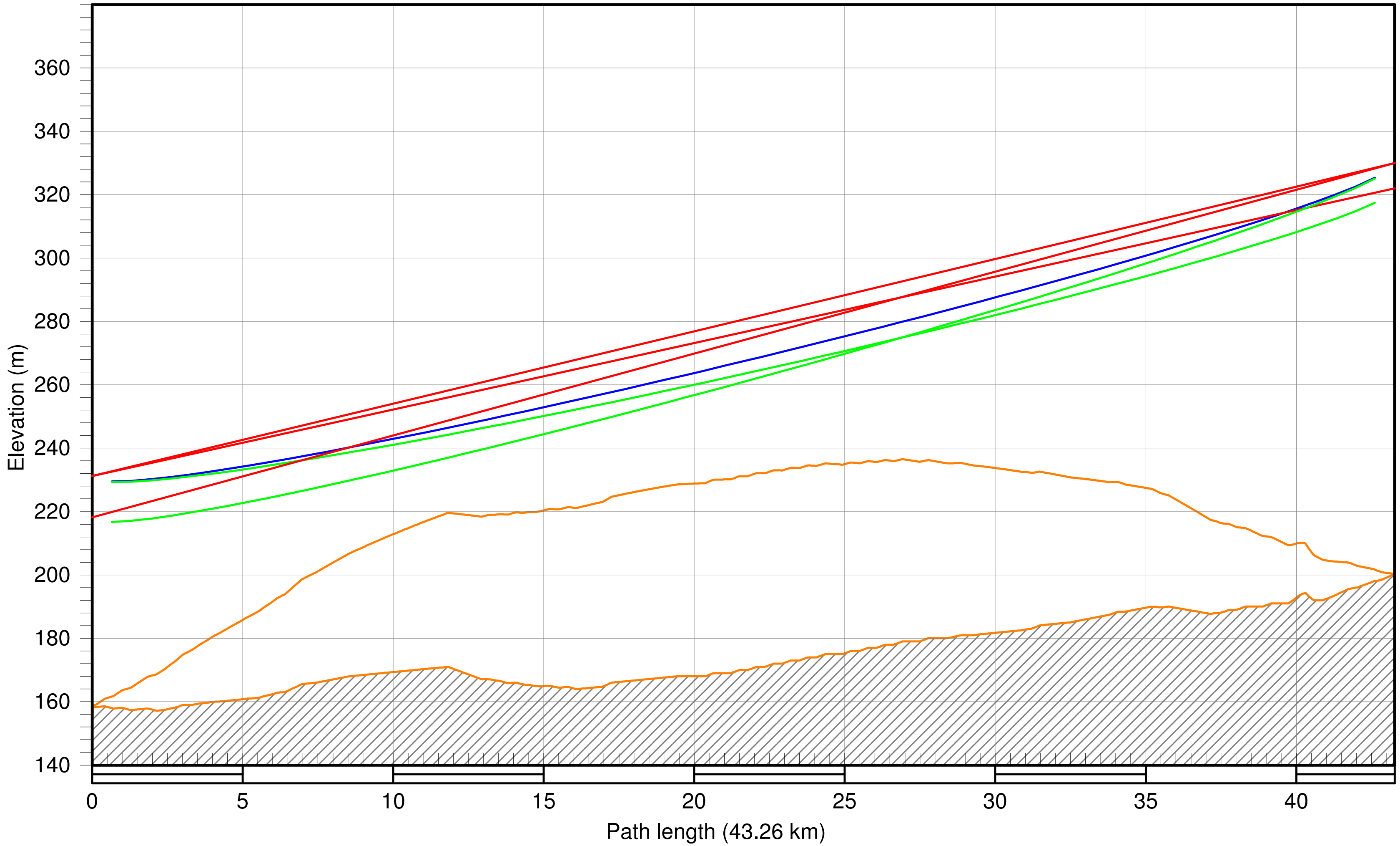


R11 Nyang	
Latitude	22 59 25.00 S
Longitude	115 02 14.00 E
Azimuth	178.18°
Elevation	112 m ASL
Antenna CL	48.5, 32.5 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R12 Walter Well	
Latitude	23 15 54.00 S
Longitude	115 02 48.00 E
Azimuth	358.18°
Elevation	152 m ASL
Antenna CL	79.0, 71.0 m AGL

Gibson Quai - AAS 61758

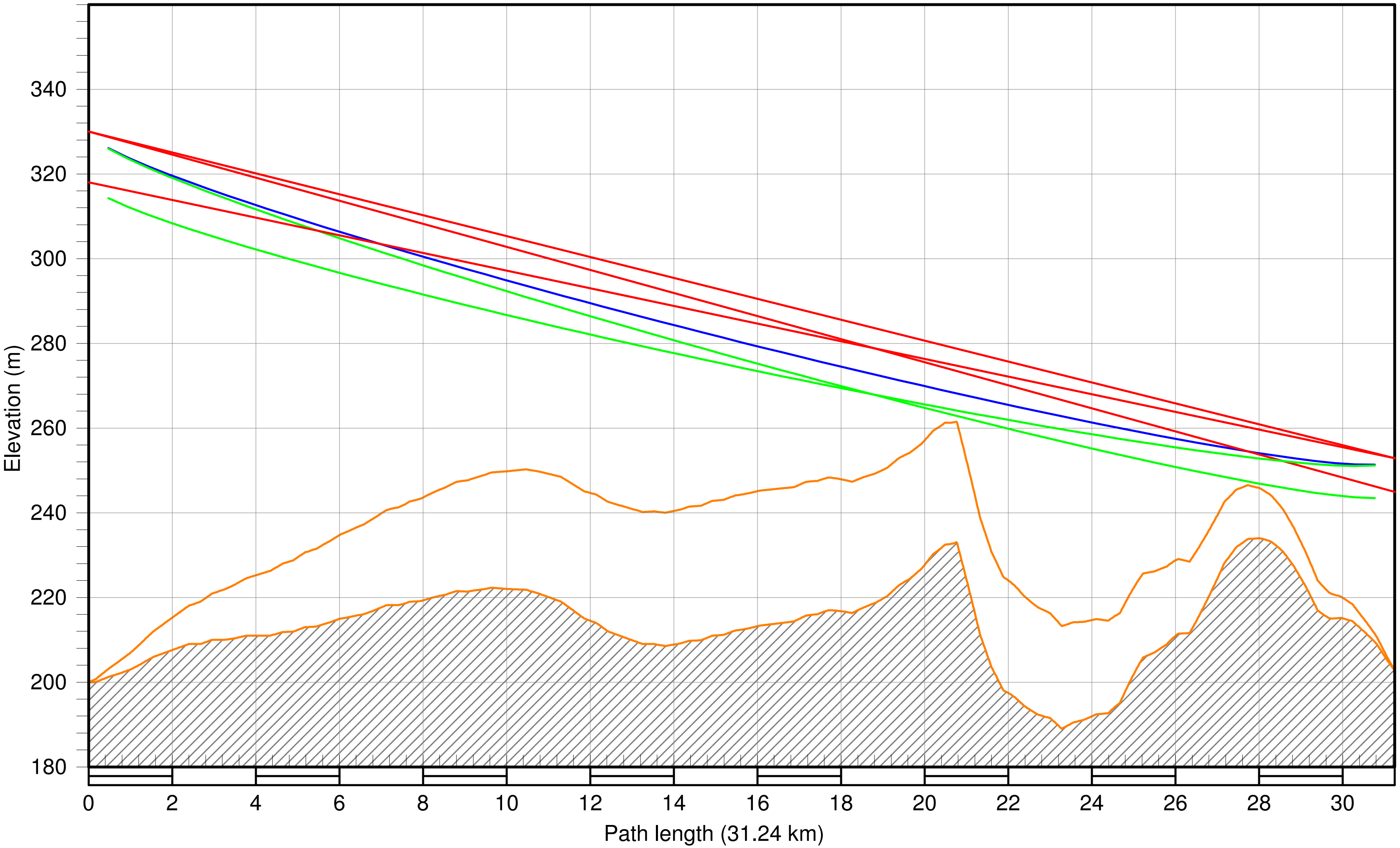


R12 Walter Well	
Latitude	23 15 54.00 S
Longitude	115 02 48.00 E
Azimuth	166.44°
Elevation	152 m ASL
Antenna CL	79.0, 66.0 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R13 Lyndon	
Latitude	23 38 41.00 S
Longitude	115 08 46.00 E
Azimuth	346.40°
Elevation	201 m ASL
Antenna CL	129.0, 121.0 m AGL

Gibson Quai - AAS 61758



R13 Lyndon

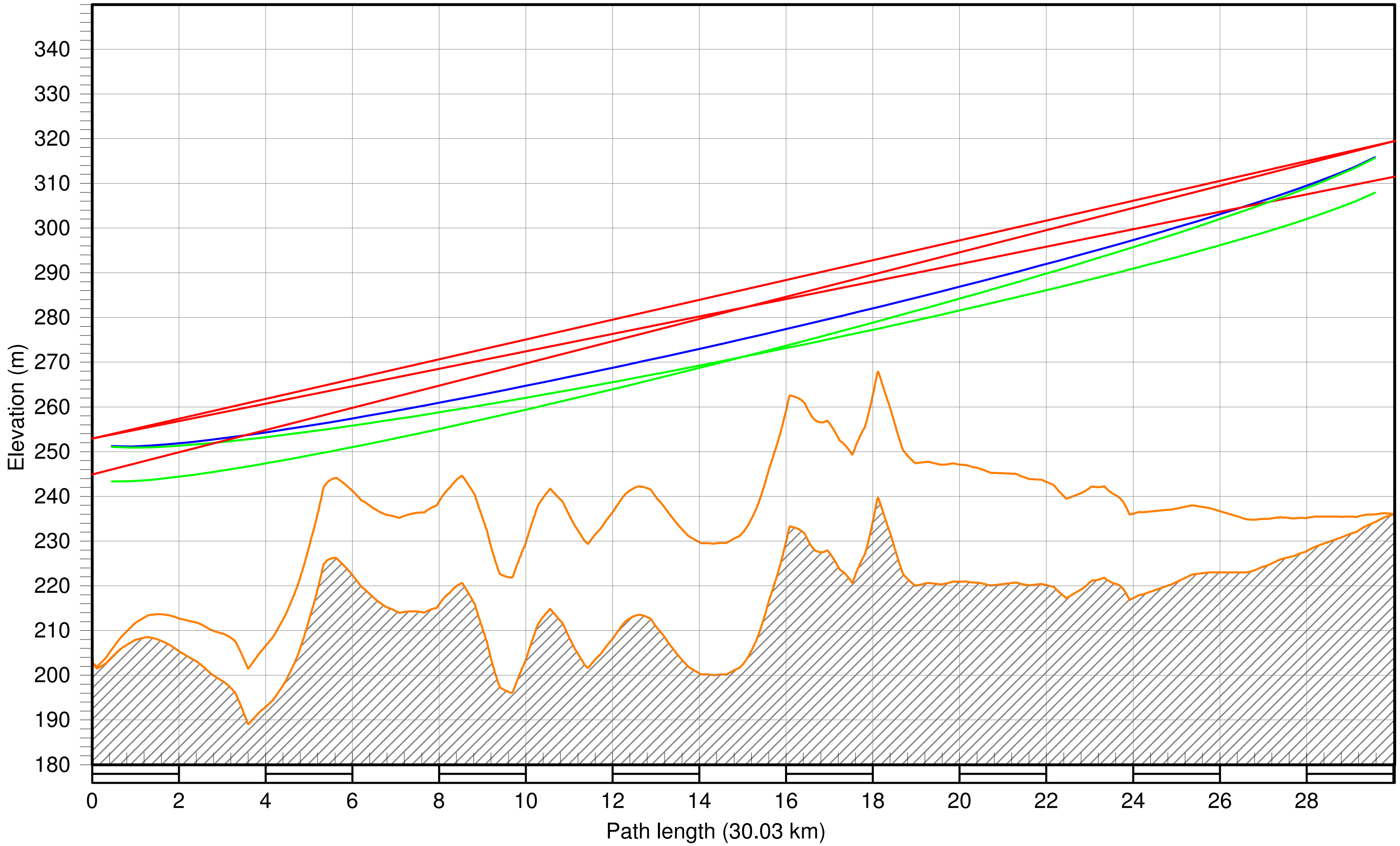
Latitude	23 38 41.00 S
Longitude	115 08 46.00 E
Azimuth	174.08°
Elevation	201 m ASL
Antenna CL	129.0, 117.0 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R14 Williambury

Latitude	23 55 31.00 S
Longitude	115 10 40.00 E
Azimuth	354.06°
Elevation	204 m ASL
Antenna CL	48.5, 40.5 m AGL

Gibson Quai - AAS 61758

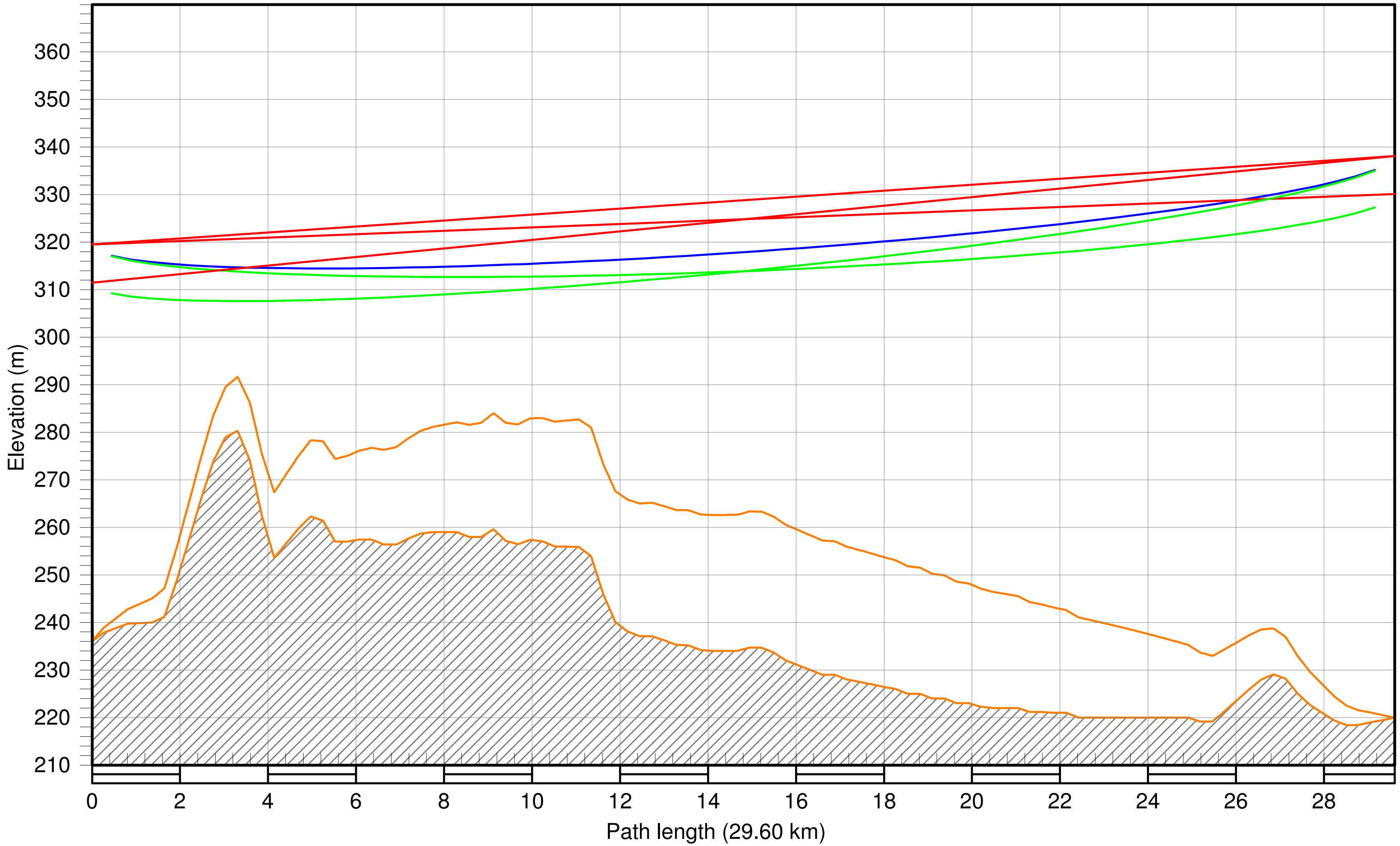


R14 Williambury	
Latitude	23 55 31.00 S
Longitude	115 10 40.00 E
Azimuth	162.55°
Elevation	204 m ASL
Antenna CL	48.5, 40.5 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R15 Longreach Well	
Latitude	24 11 02.00 S
Longitude	115 15 59.00 E
Azimuth	342.52°
Elevation	241 m ASL
Antenna CL	78.5, 70.5 m AGL

Gibson Quai - AAS 61758

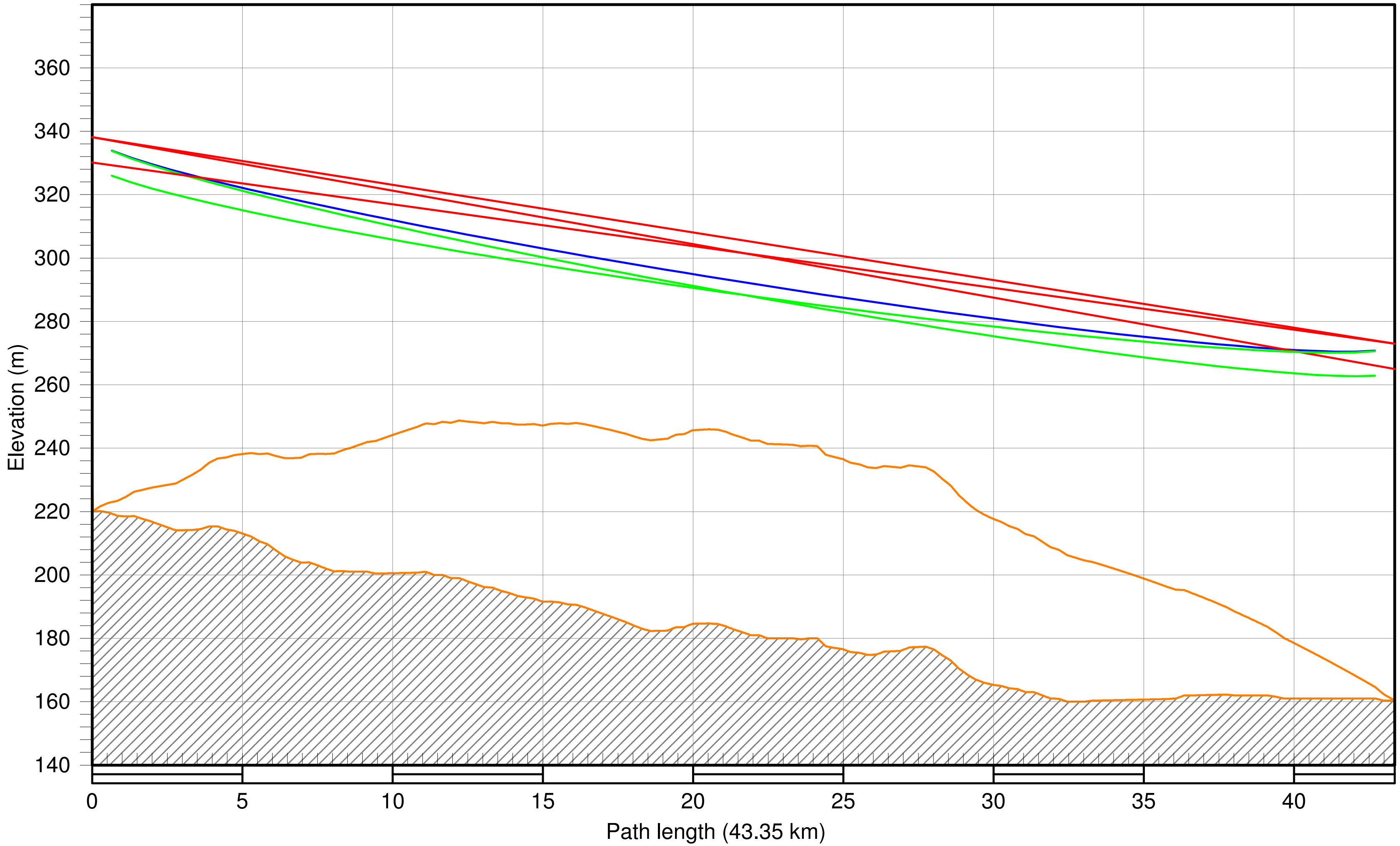


R15 Longreach Well	
Latitude	24 11 02.00 S
Longitude	115 15 59.00 E
Azimuth	178.80°
Elevation	241 m ASL
Antenna CL	78.5, 70.5 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R16 Newman Creek	
Latitude	24 27 04.00 S
Longitude	115 16 21.00 E
Azimuth	358.80°
Elevation	230 m ASL
Antenna CL	108.5, 100.5 m AGL

Gibson Quai - AAS 61758

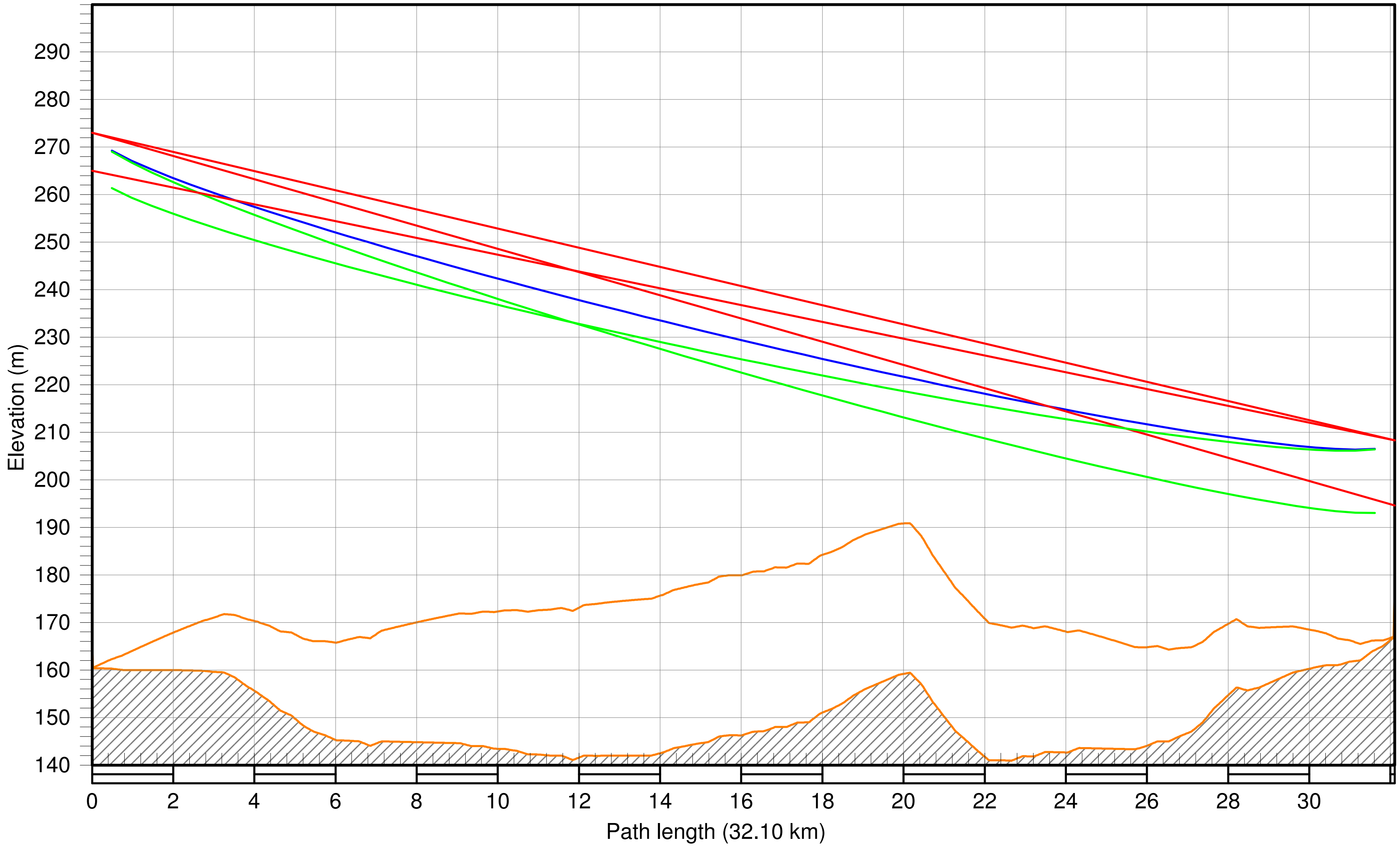


R16 Newman Creek	
Latitude	24 27 04.00 S
Longitude	115 16 21.00 E
Azimuth	177.03°
Elevation	230 m ASL
Antenna CL	108.5, 100.5 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R17 Doordwoordoo	
Latitude	24 50 31.00 S
Longitude	115 17 41.00 E
Azimuth	357.02°
Elevation	164 m ASL
Antenna CL	109.0, 101.0 m AGL

Gibson Quai - AAS 61758



R17 Doordwoordoo

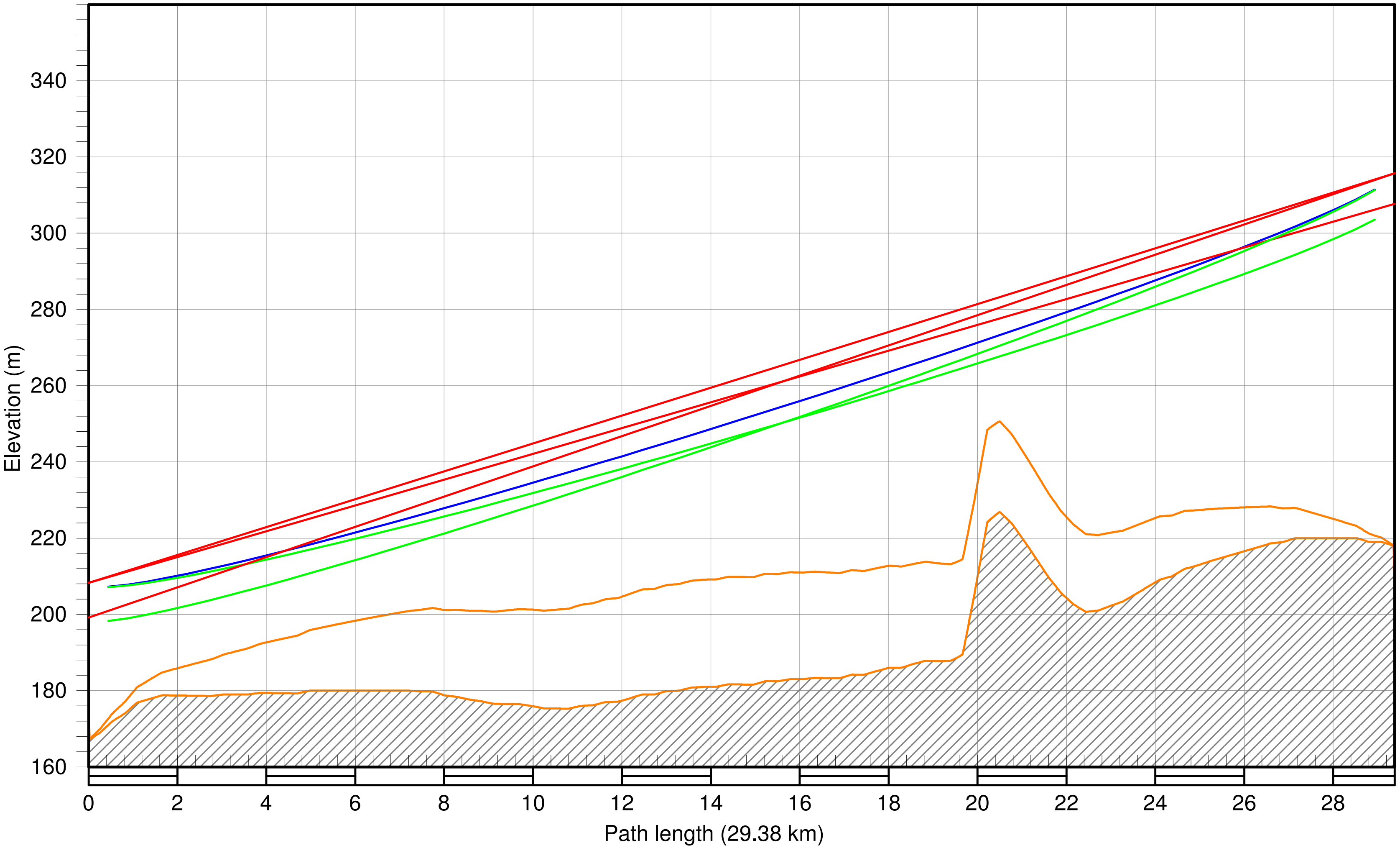
Latitude	24 50 31.00 S
Longitude	115 17 41.00 E
Azimuth	182.85°
Elevation	164 m ASL
Antenna CL	109.0, 101.0 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R18 Gascoyne

Latitude	25 07 53.00 S
Longitude	115 16 44.00 E
Azimuth	2.86°
Elevation	178 m ASL
Antenna CL	30.0, 16.3 m AGL

Gibson Quai - AAS 61758

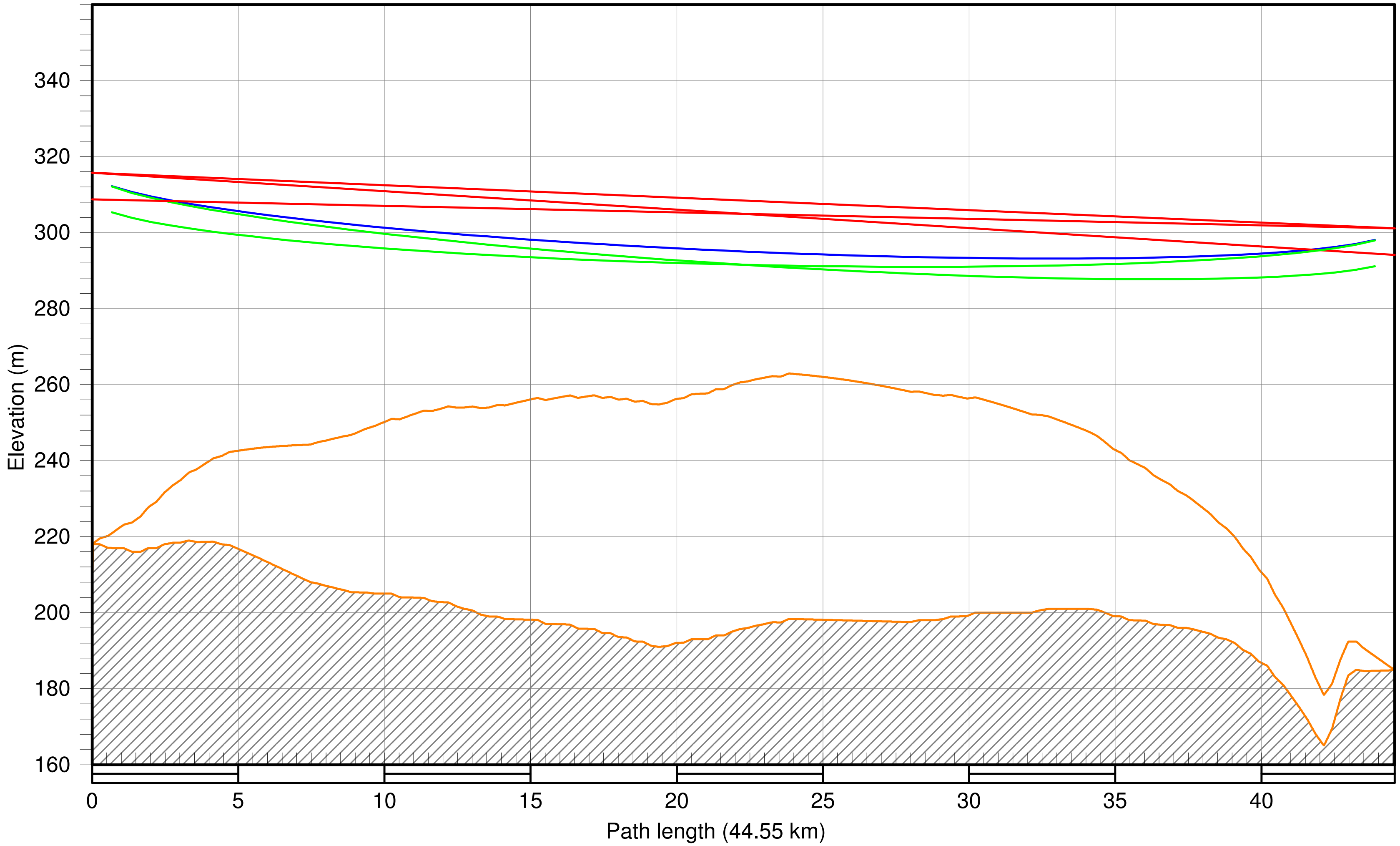


R18 Gascoyne	
Latitude	25 07 53.00 S
Longitude	115 16 44.00 E
Azimuth	182.40°
Elevation	178 m ASL
Antenna CL	30.0, 20.9 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R19 Towrana	
Latitude	25 23 47.00 S
Longitude	115 16 00.00 E
Azimuth	2.40°
Elevation	207 m ASL
Antenna CL	108.5, 100.5 m AGL

Gibson Quai - AAS 61758

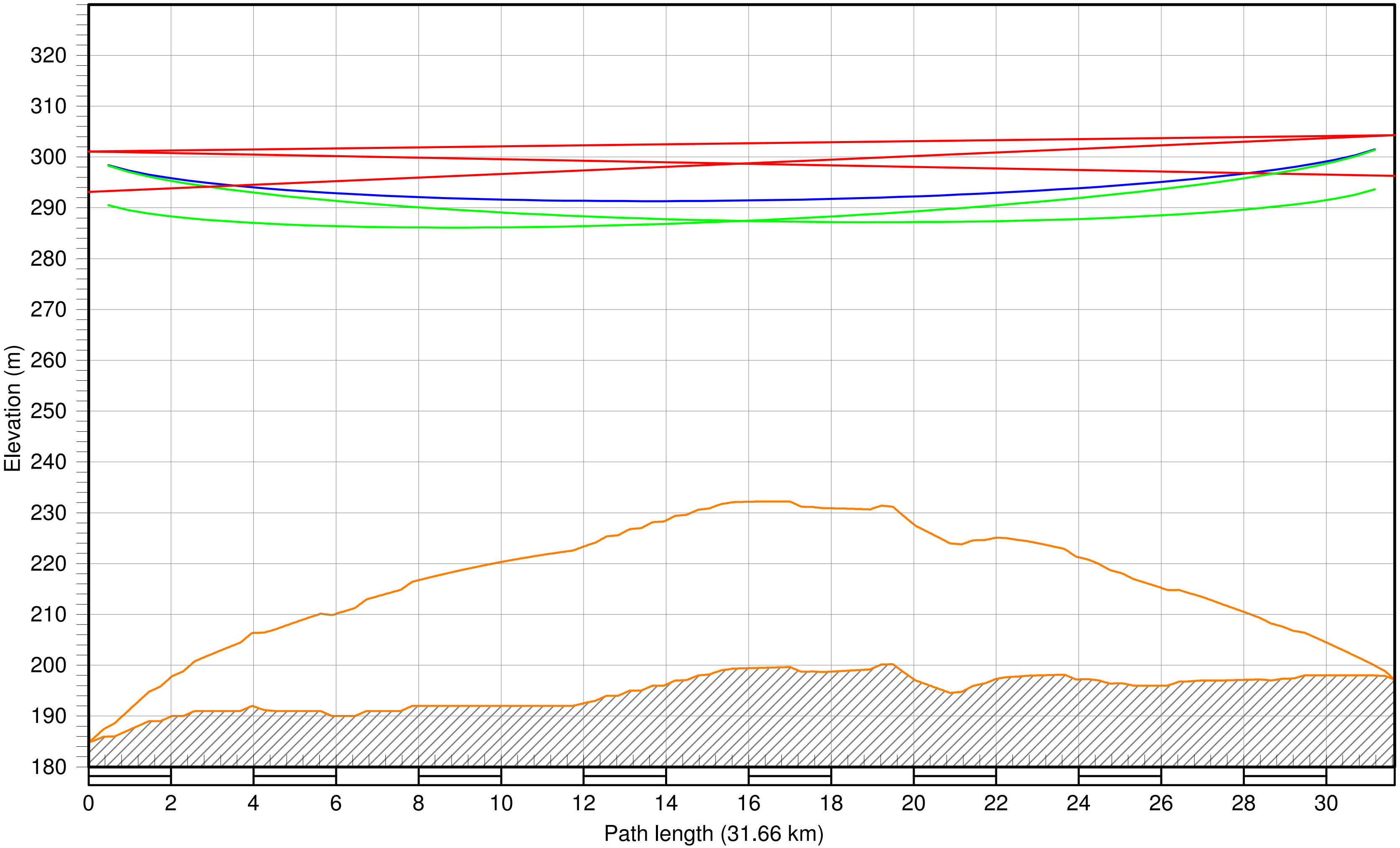


R19 Towrana	
Latitude	25 23 47.00 S
Longitude	115 16 00.00 E
Azimuth	182.90°
Elevation	207 m ASL
Antenna CL	108.5, 101.5 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R20 Gilroyd	
Latitude	25 47 53.00 S
Longitude	115 14 39.00 E
Azimuth	2.91°
Elevation	193 m ASL
Antenna CL	108.5, 101.5 m AGL

Gibson Quai - AAS 61758

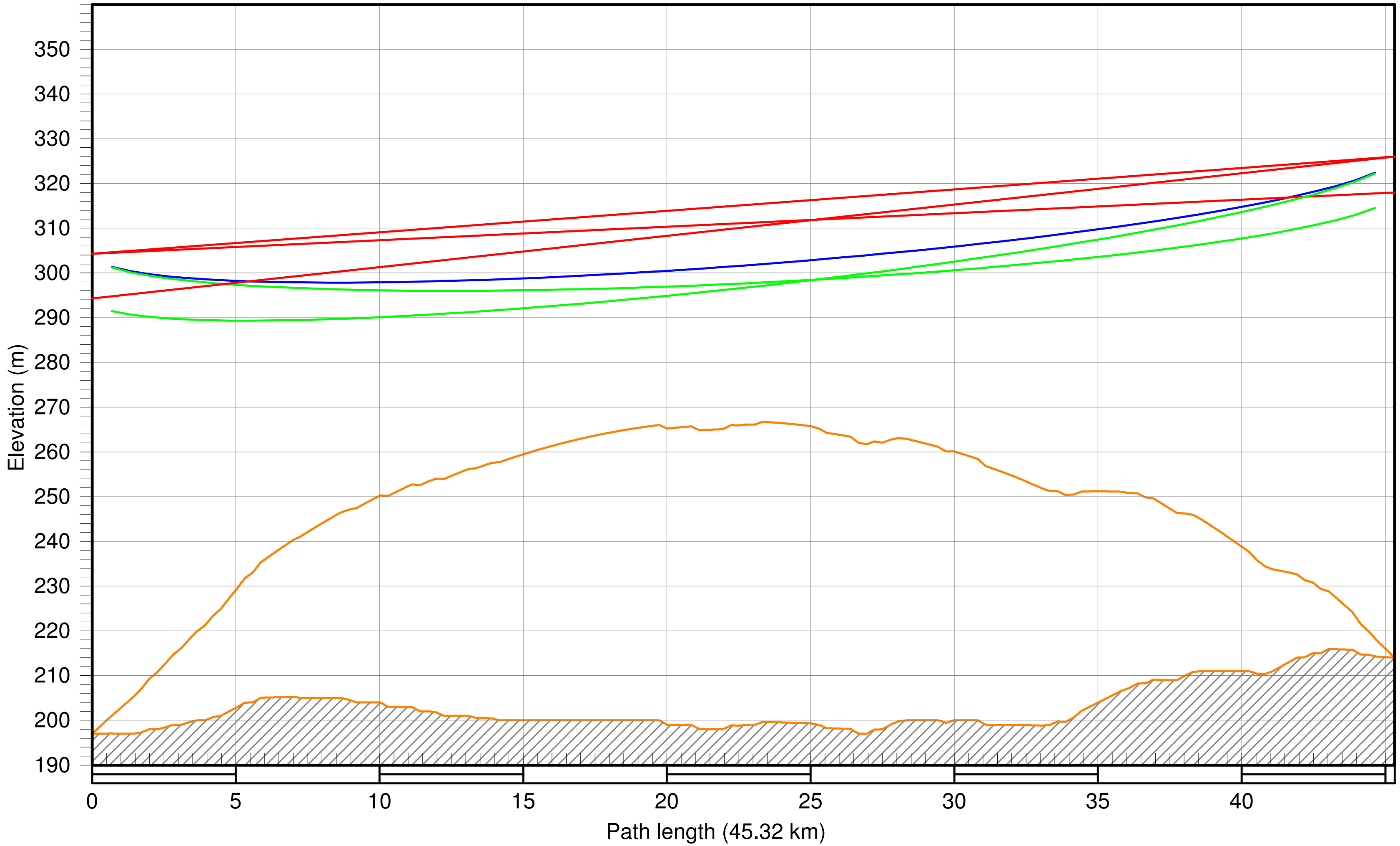


R20 Gilroyd	
Latitude	25 47 53.00 S
Longitude	115 14 39.00 E
Azimuth	183.22°
Elevation	193 m ASL
Antenna CL	108.5, 100.5 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R21 Yalardy	
Latitude	26 05 00.00 S
Longitude	115 13 35.00 E
Azimuth	3.23°
Elevation	196 m ASL
Antenna CL	108.5, 100.5 m AGL

Gibson Quai - AAS 61758



R21 Yalardy

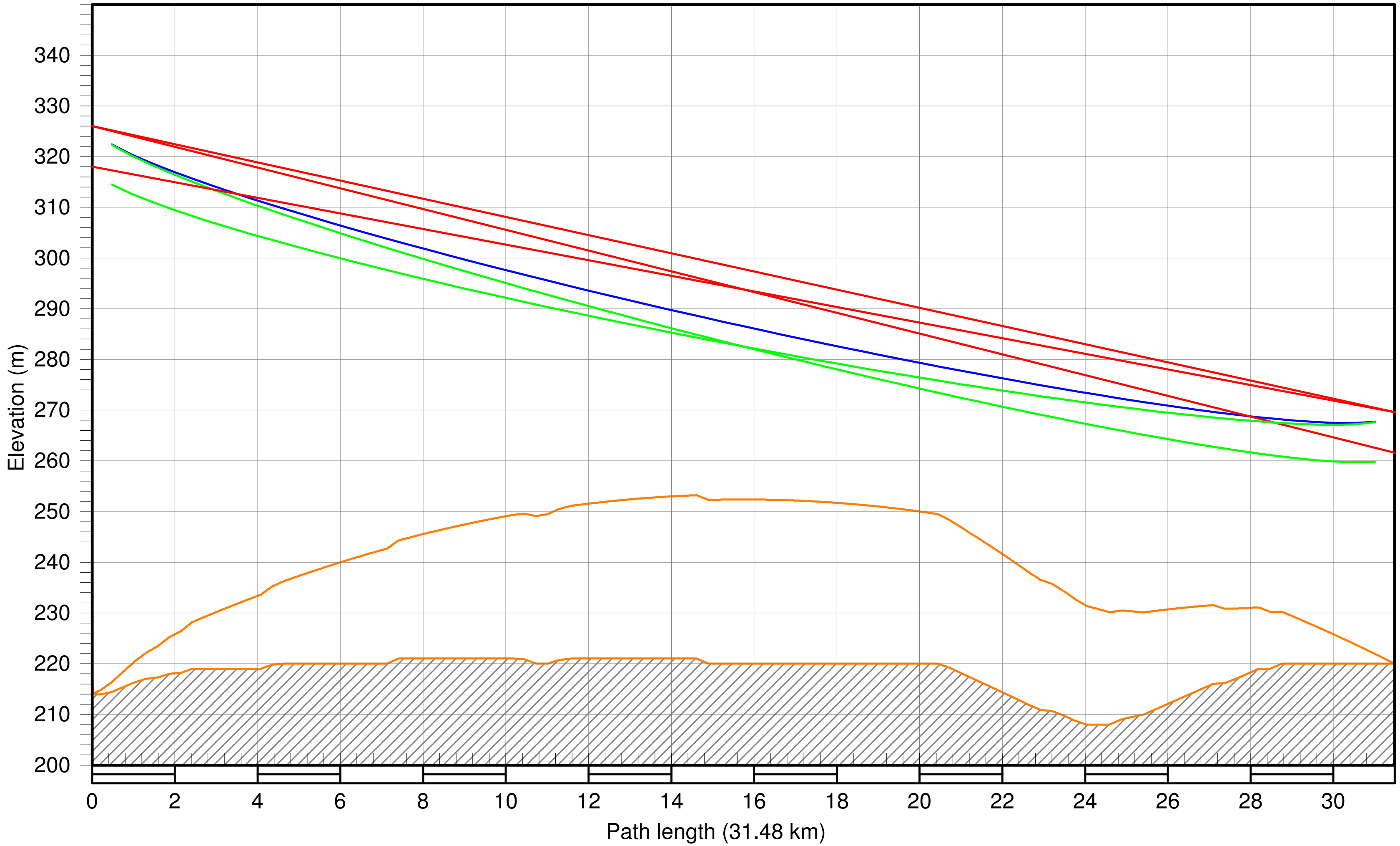
Latitude	26 05 00.00 S
Longitude	115 13 35.00 E
Azimuth	182.70°
Elevation	196 m ASL
Antenna CL	108.5, 98.5 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R22 Garries Lagoon

Latitude	26 29 31.00 S
Longitude	115 12 18.00 E
Azimuth	2.71°
Elevation	218 m ASL
Antenna CL	108.5, 100.5 m AGL

Gibson Quai - AAS 61758



R22 Garries Lagoon

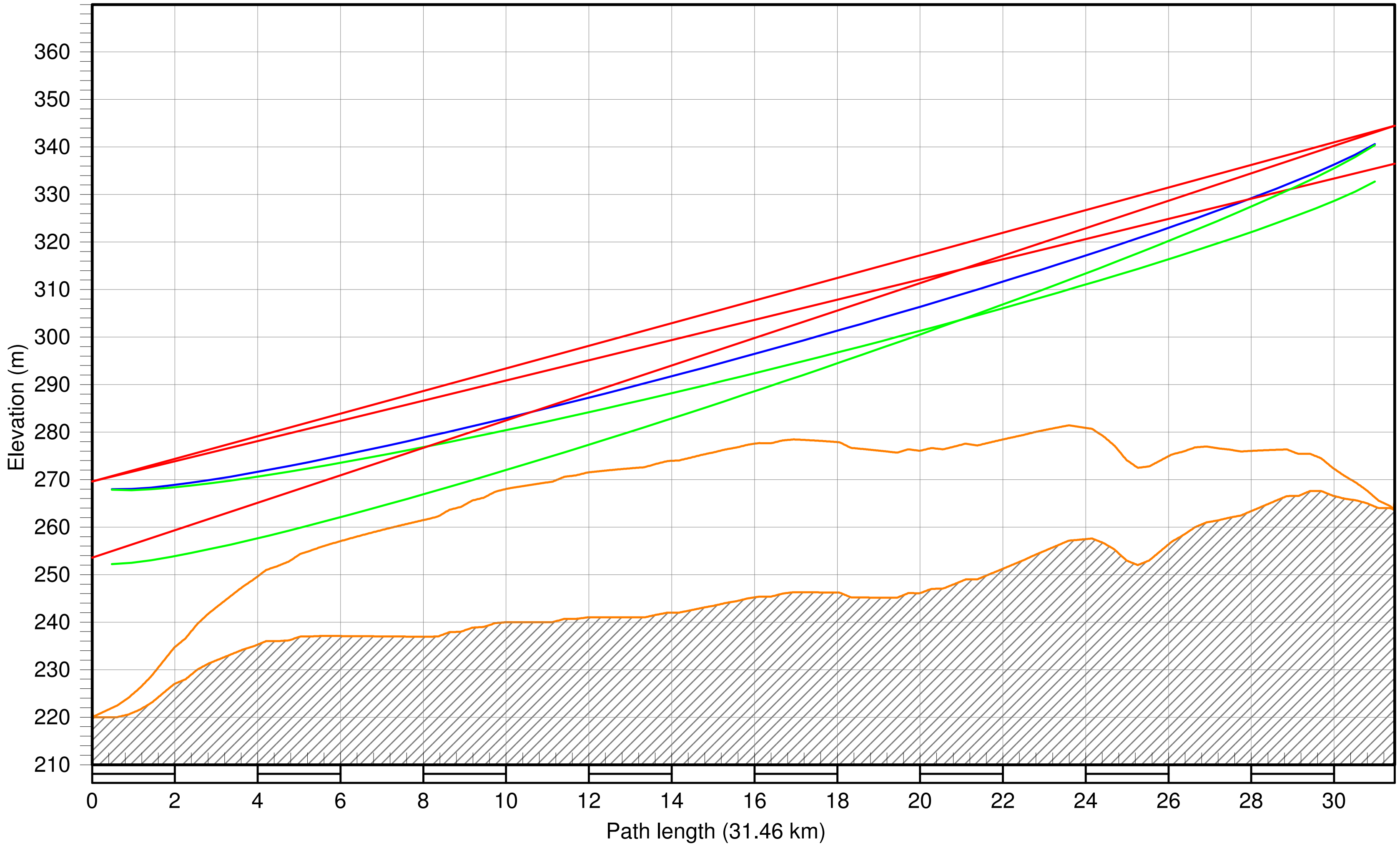
Latitude	26 29 31.00 S
Longitude	115 12 18.00 E
Azimuth	182.26°
Elevation	218 m ASL
Antenna CL	108.5, 100.5 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R23 Butchers Track

Latitude	26 46 33.00 S
Longitude	115 11 33.00 E
Azimuth	2.27°
Elevation	221 m ASL
Antenna CL	48.5, 40.5 m AGL

Gibson Quai - AAS 61758

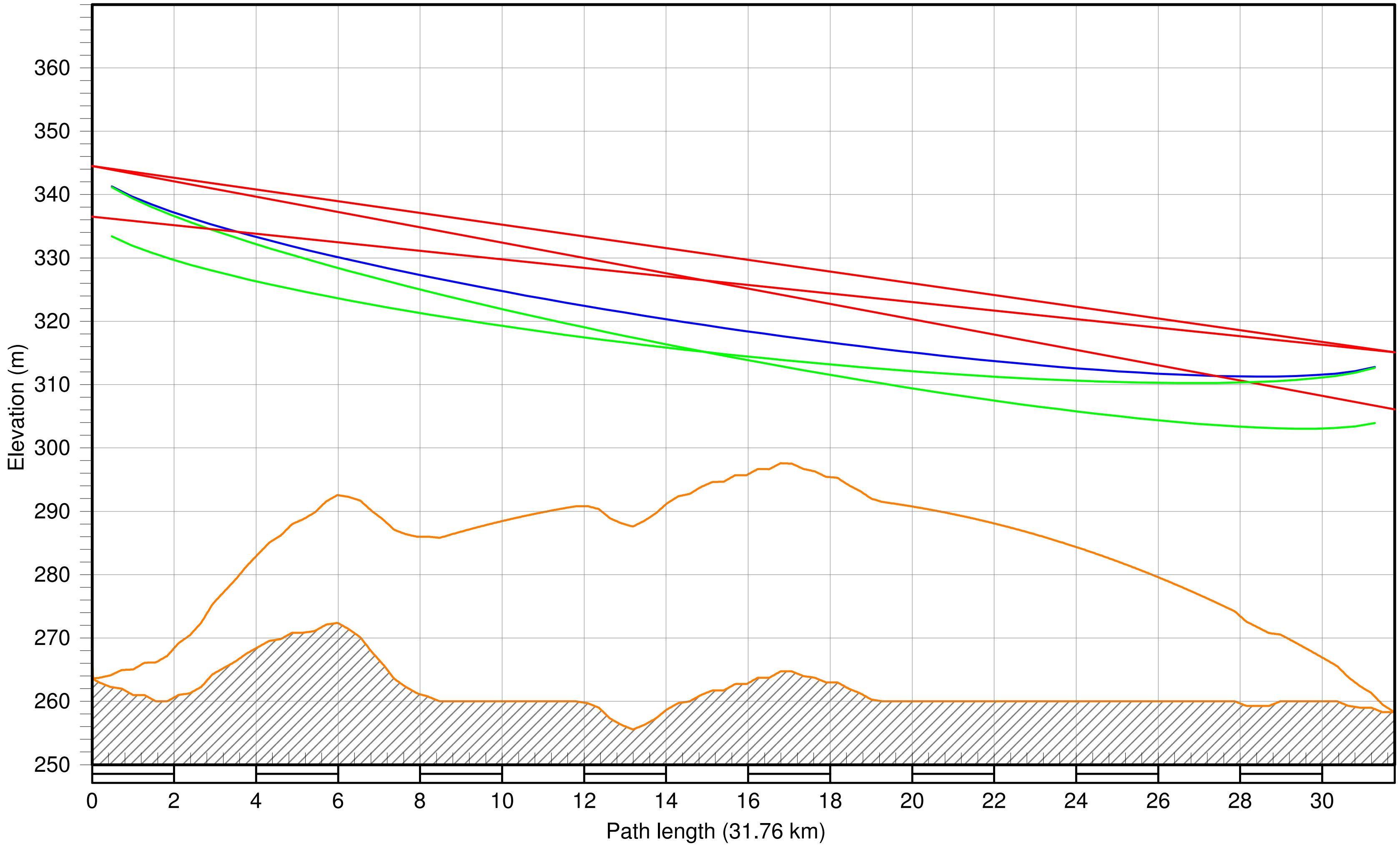


R23 Butchers Track	
Latitude	26 46 33.00 S
Longitude	115 11 33.00 E
Azimuth	181.00°
Elevation	221 m ASL
Antenna CL	48.5, 32.5 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R24 Bompas	
Latitude	27 03 35.00 S
Longitude	115 11 13.00 E
Azimuth	1.01°
Elevation	266 m ASL
Antenna CL	78.5, 70.5 m AGL

Gibson Quai - AAS 61758

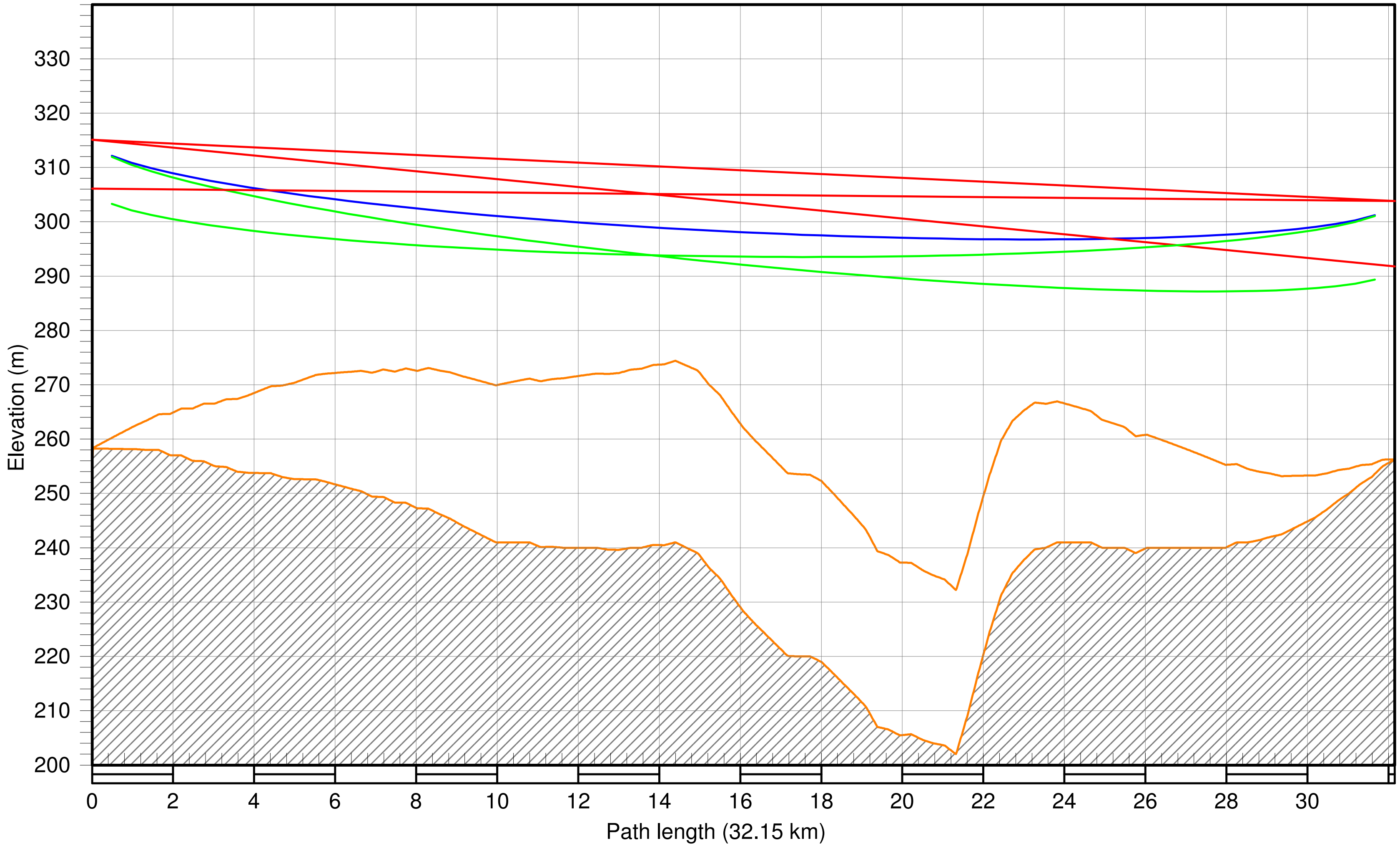


R24 Bompas	
Latitude	27 03 35.00 S
Longitude	115 11 13.00 E
Azimuth	180.00°
Elevation	266 m ASL
Antenna CL	78.5, 70.5 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

Gibson Quai - AAS 61758

R25 The Elbow	
Latitude	27 20 47.00 S
Longitude	115 11 13.00 E
Azimuth	0.00°
Elevation	256 m ASL
Antenna CL	59.0, 50.0 m AGL

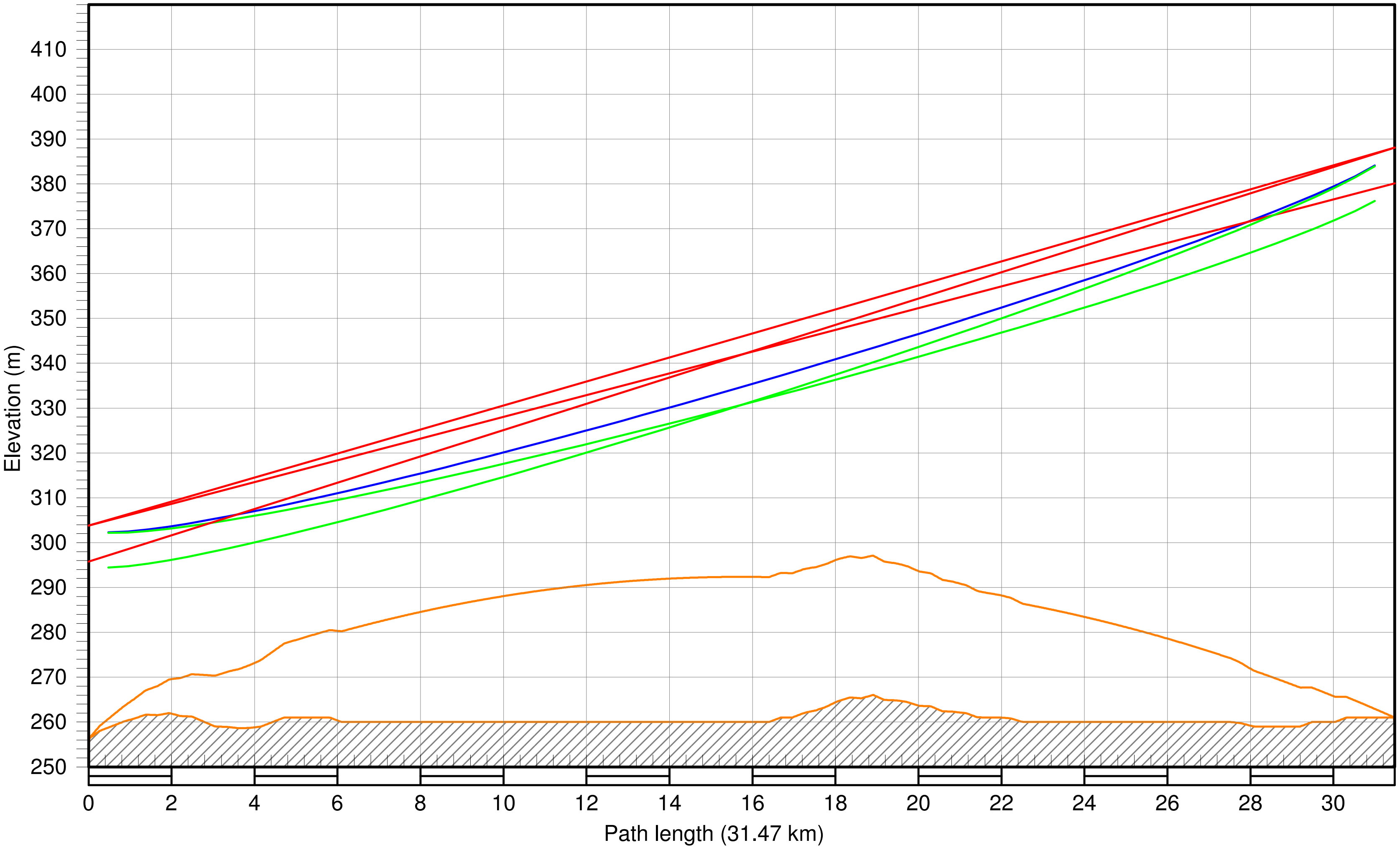


R25 The Elbow	
Latitude	27 20 47.00 S
Longitude	115 11 13.00 E
Azimuth	181.81 °
Elevation	256 m ASL
Antenna CL	59.0, 50.0 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

Gibson Quai - AAS 61758

R26 Coolcalalaya	
Latitude	27 38 11.00 S
Longitude	115 10 36.00 E
Azimuth	1.81 °
Elevation	255 m ASL
Antenna CL	48.5, 36.5 m AGL



R26 Coolcalalaya

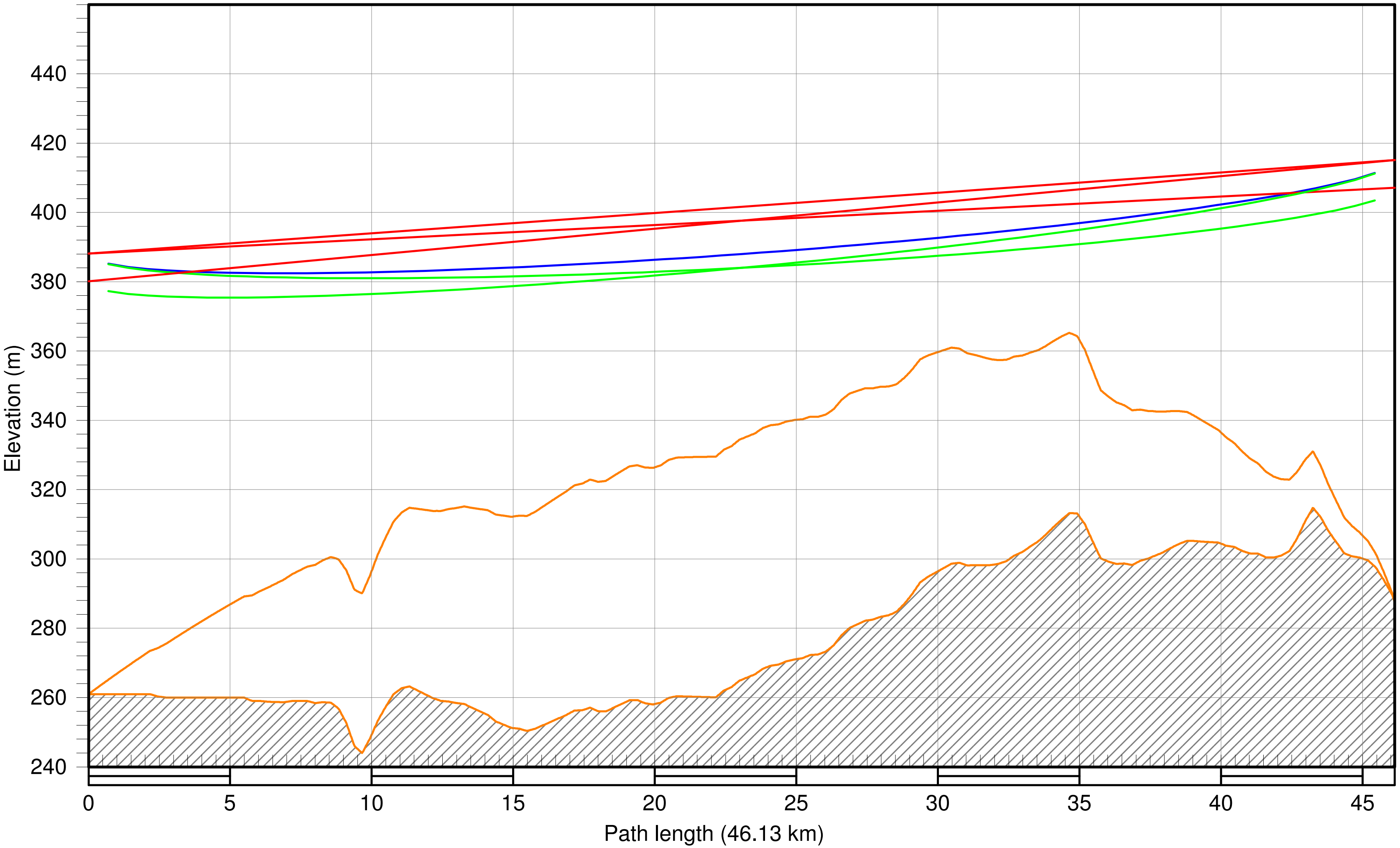
Latitude	27 38 11.00 S
Longitude	115 10 36.00 E
Azimuth	185.33°
Elevation	255 m ASL
Antenna CL	48.5, 40.5 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R27 Nerramyne

Latitude	27 55 09.00 S
Longitude	115 08 49.00 E
Azimuth	5.35°
Elevation	259 m ASL
Antenna CL	129.0, 121.0 m AGL

Gibson Quai - AAS 61758



R27 Nerramyne

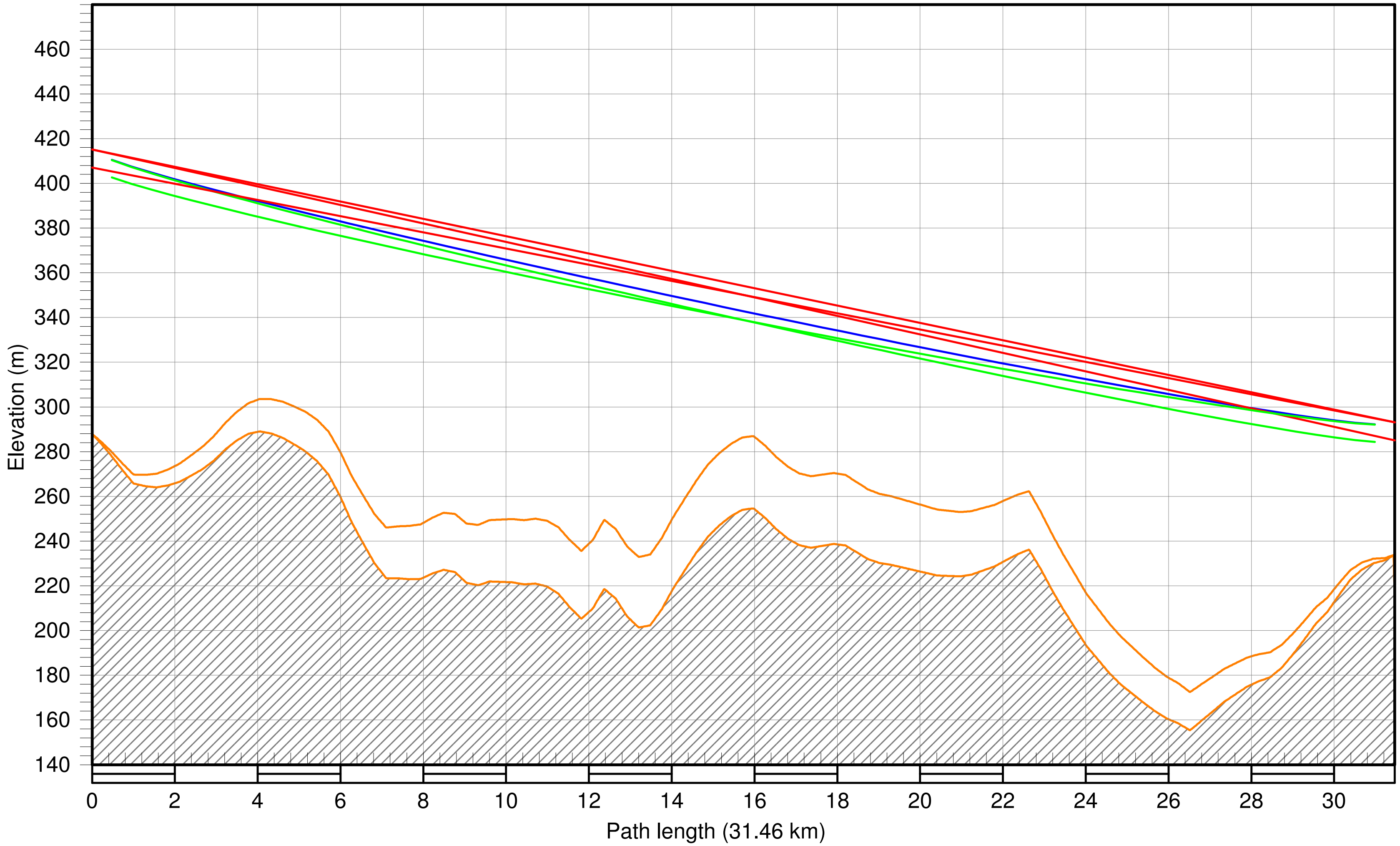
Latitude	27 55 09.00 S
Longitude	115 08 49.00 E
Azimuth	183.32°
Elevation	259 m ASL
Antenna CL	129.0, 121.0 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

Gibson Quai - AAS 61758

R28 Wandana

Latitude	28 20 05.00 S
Longitude	115 07 11.00 E
Azimuth	3.33°
Elevation	287 m ASL
Antenna CL	128.5, 120.5 m AGL

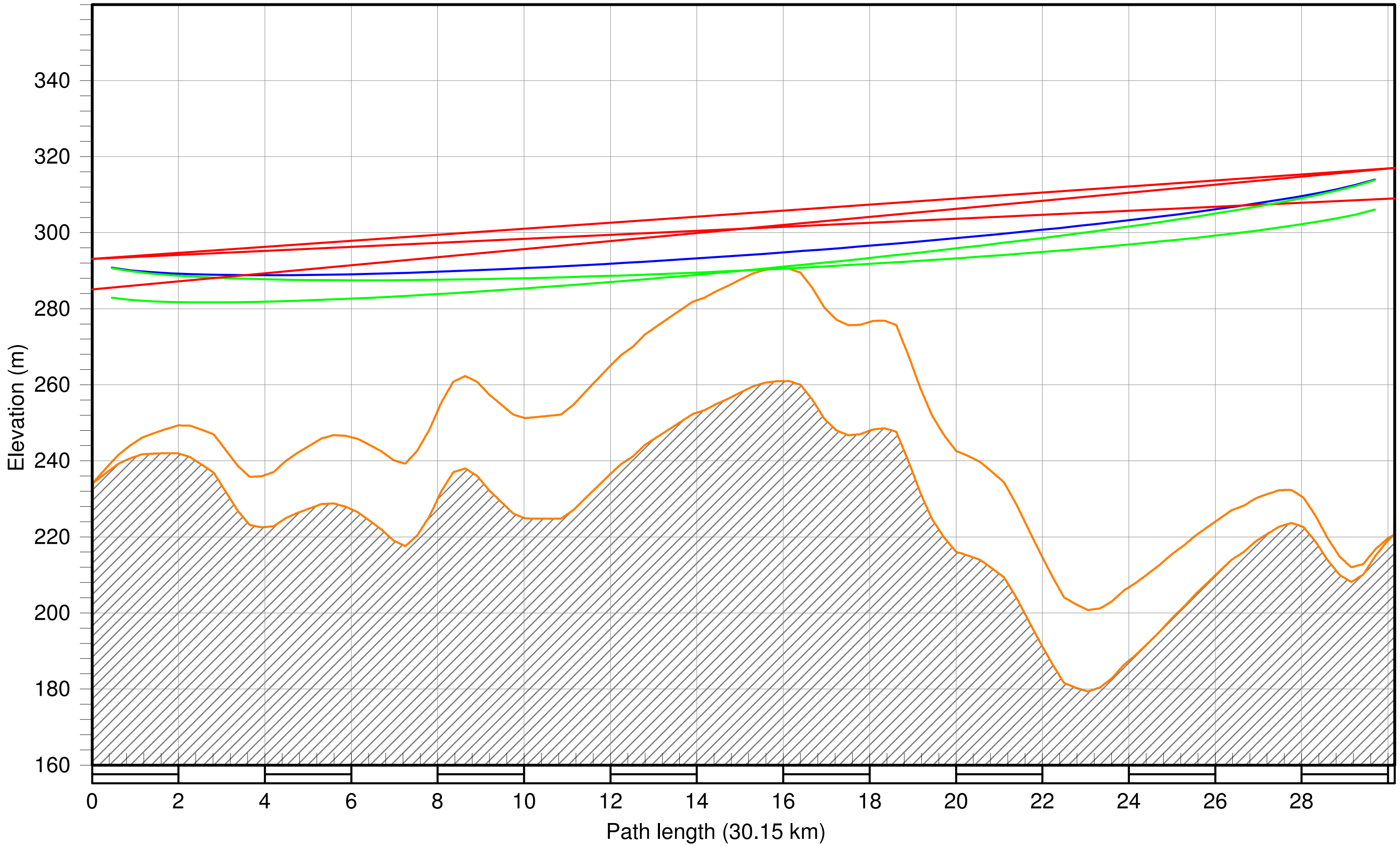


R28 Wandana	
Latitude	28 20 05.00 S
Longitude	115 07 11.00 E
Azimuth	177.62°
Elevation	287 m ASL
Antenna CL	128.5, 120.5 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R29 Eradu	
Latitude	28 37 06.00 S
Longitude	115 07 59.00 E
Azimuth	357.62°
Elevation	215 m ASL
Antenna CL	78.5, 70.5 m AGL

Gibson Quai - AAS 61758

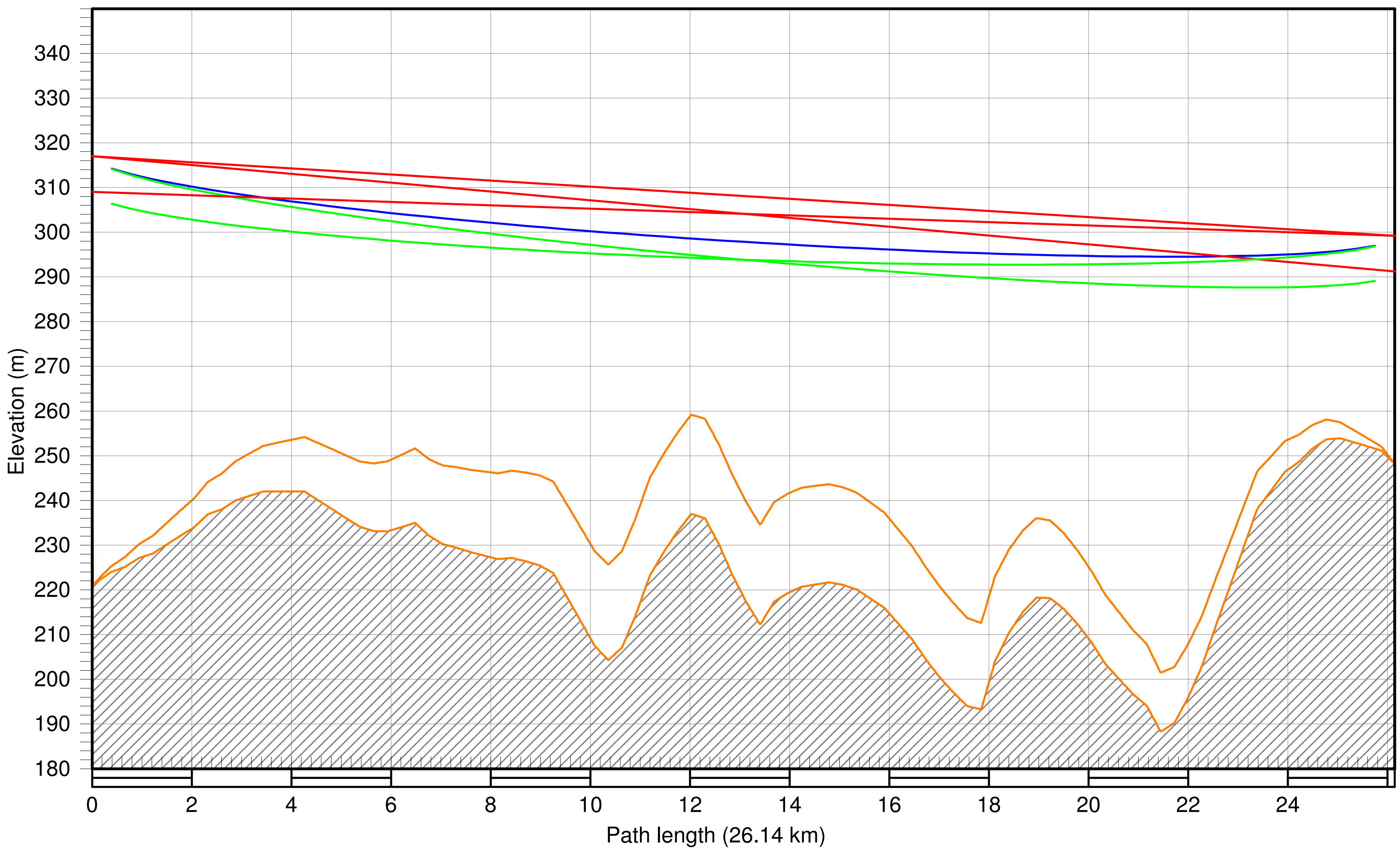


R29 Eradu	
Latitude	28 37 06.00 S
Longitude	115 07 59.00 E
Azimuth	178.40°
Elevation	215 m ASL
Antenna CL	78.5, 70.5 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R30 Nangetty Road	
Latitude	28 53 25.00 S
Longitude	115 08 30.00 E
Azimuth	358.40°
Elevation	238 m ASL
Antenna CL	78.5, 70.5 m AGL

Gibson Quai - AAS 61758

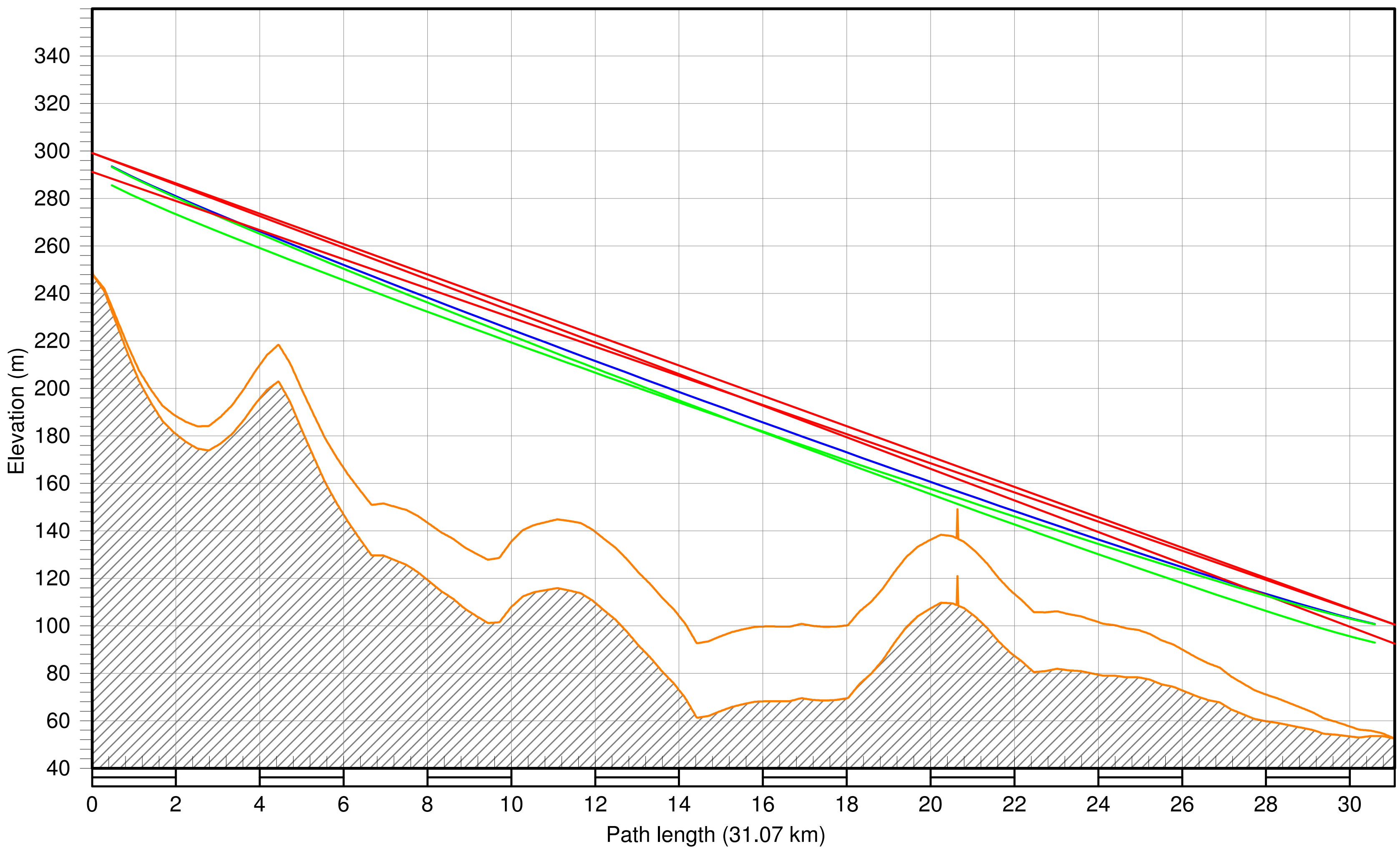


R30 Nangetty Road	
Latitude	28 53 25.00 S
Longitude	115 08 30.00 E
Azimuth	180.59°
Elevation	238 m ASL
Antenna CL	78.5, 70.5 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R31 Allandora Road	
Latitude	29 07 34.00 S
Longitude	115 08 20.00 E
Azimuth	0.59°
Elevation	251 m ASL
Antenna CL	48.5, 40.5 m AGL

Gibson Quai - AAS 61758

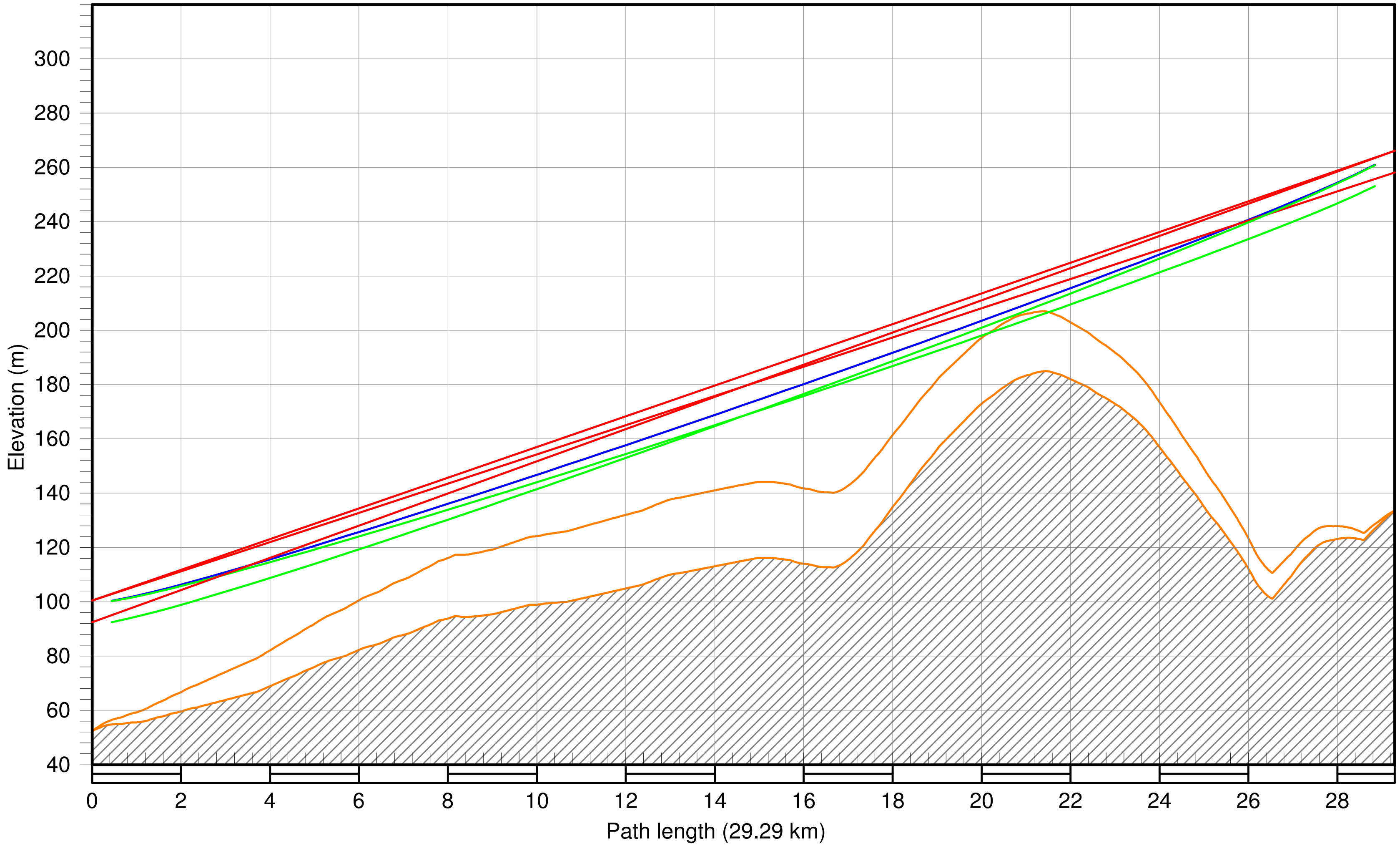


R31 Allandora Road	
Latitude	29 07 34.00 S
Longitude	115 08 20.00 E
Azimuth	179.85°
Elevation	251 m ASL
Antenna CL	48.5, 40.5 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R32 Adams Road	
Latitude	29 24 23.00 S
Longitude	115 08 23.00 E
Azimuth	359.85°
Elevation	52 m ASL
Antenna CL	48.5, 40.5 m AGL

Gibson Quai - AAS 61758



R32 Adams Road

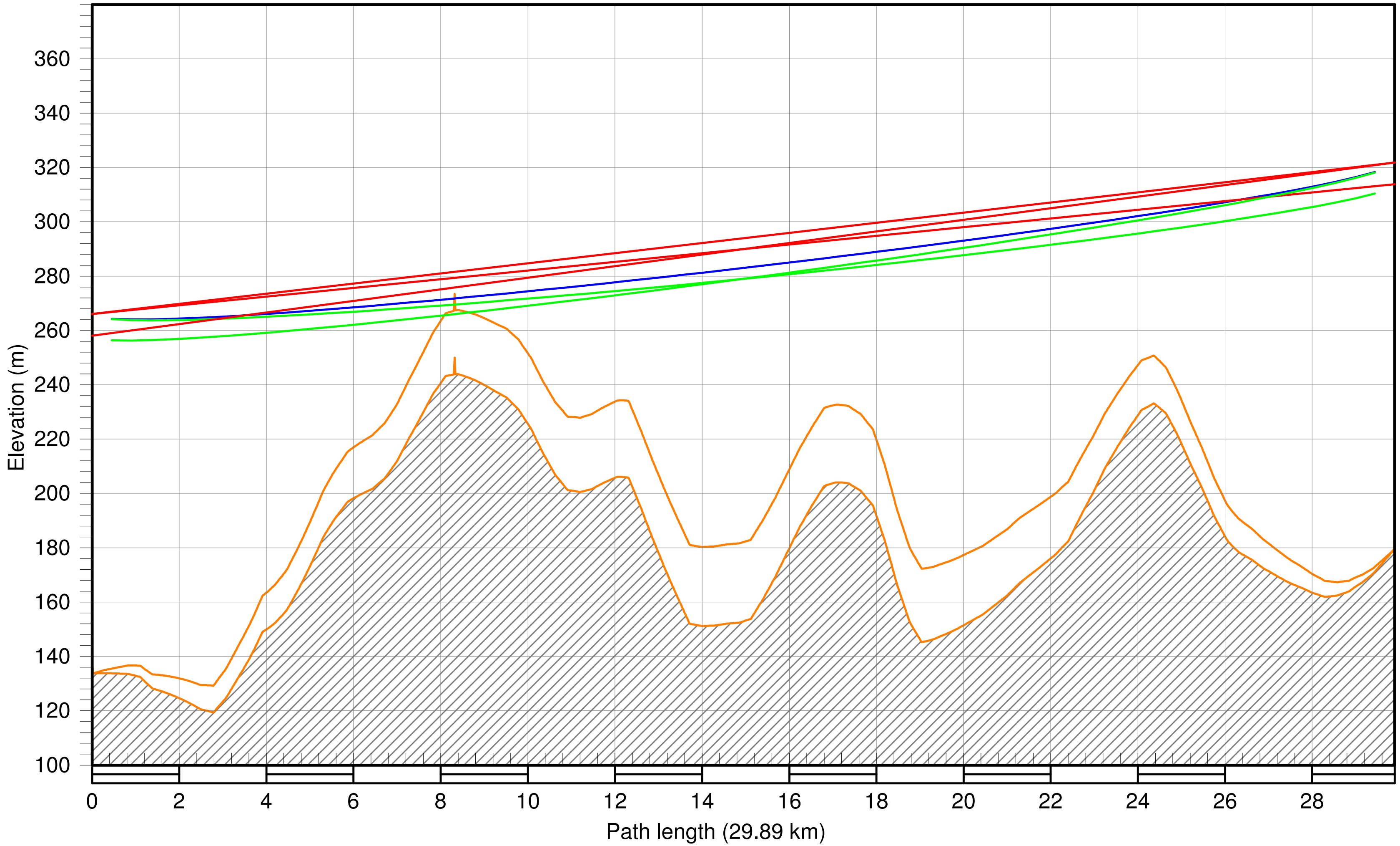
Latitude 29 24 23.00 S
Longitude 115 08 23.00 E
Azimuth 144.51°
Elevation 52 m ASL
Antenna CL 48.5, 40.5 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R33 Arrowsmith

Latitude 29 37 17.00 S
Longitude 115 18 55.00 E
Azimuth 324.42°
Elevation 137 m ASL
Antenna CL 129.0, 121.0 m AGL

Gibson Quai - AAS 61758

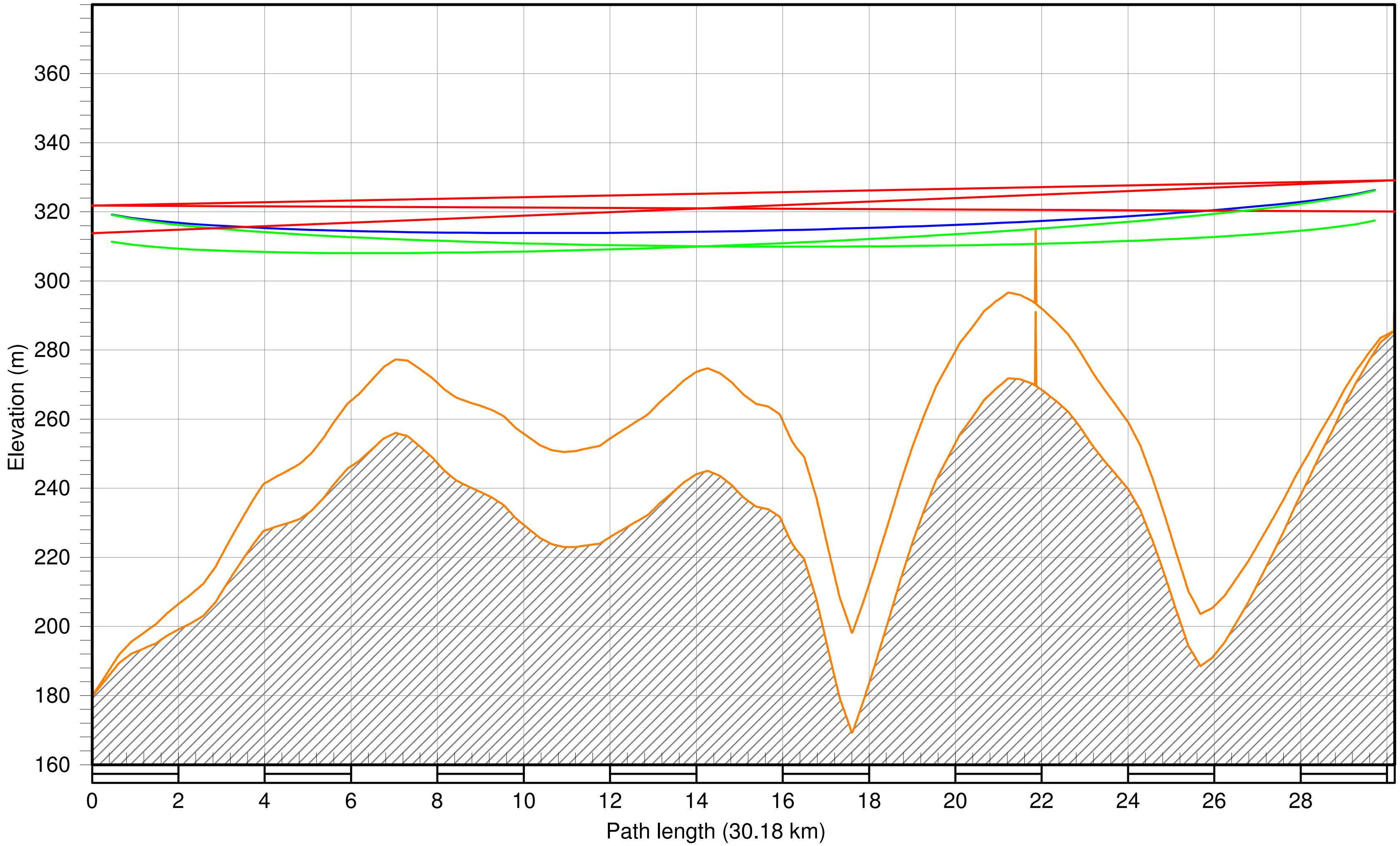


R33 Arrowsmith	
Latitude	29 37 17.00 S
Longitude	115 18 55.00 E
Azimuth	171.48°
Elevation	137 m ASL
Antenna CL	129.0, 121.0 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

Gibson Quai - AAS 61758

R34 Eneabba	
Latitude	29 53 17.00 S
Longitude	115 21 40.00 E
Azimuth	351.46°
Elevation	193 m ASL
Antenna CL	128.5, 120.5 m AGL

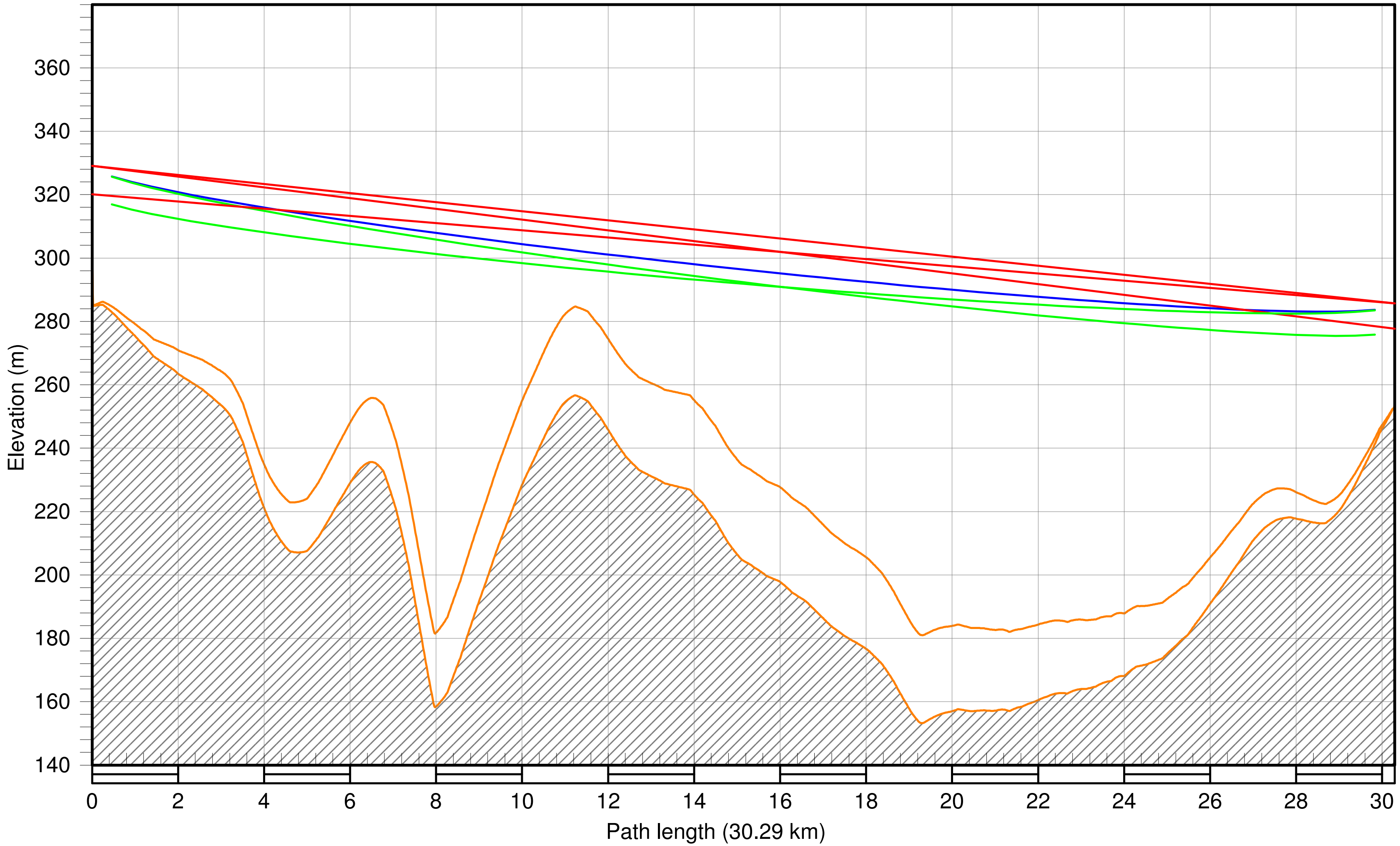


R34 Eneabba	
Latitude	29 53 17.00 S
Longitude	115 21 40.00 E
Azimuth	174.86°
Elevation	193 m ASL
Antenna CL	128.5, 120.5 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

Gibson Quai - AAS 61758

R35 Coomallo Hill	
Latitude	30 09 33.00 S
Longitude	115 23 21.00 E
Azimuth	354.85°
Elevation	299 m ASL
Antenna CL	29.9, 20.9 m AGL



R35 Coomallo Hill

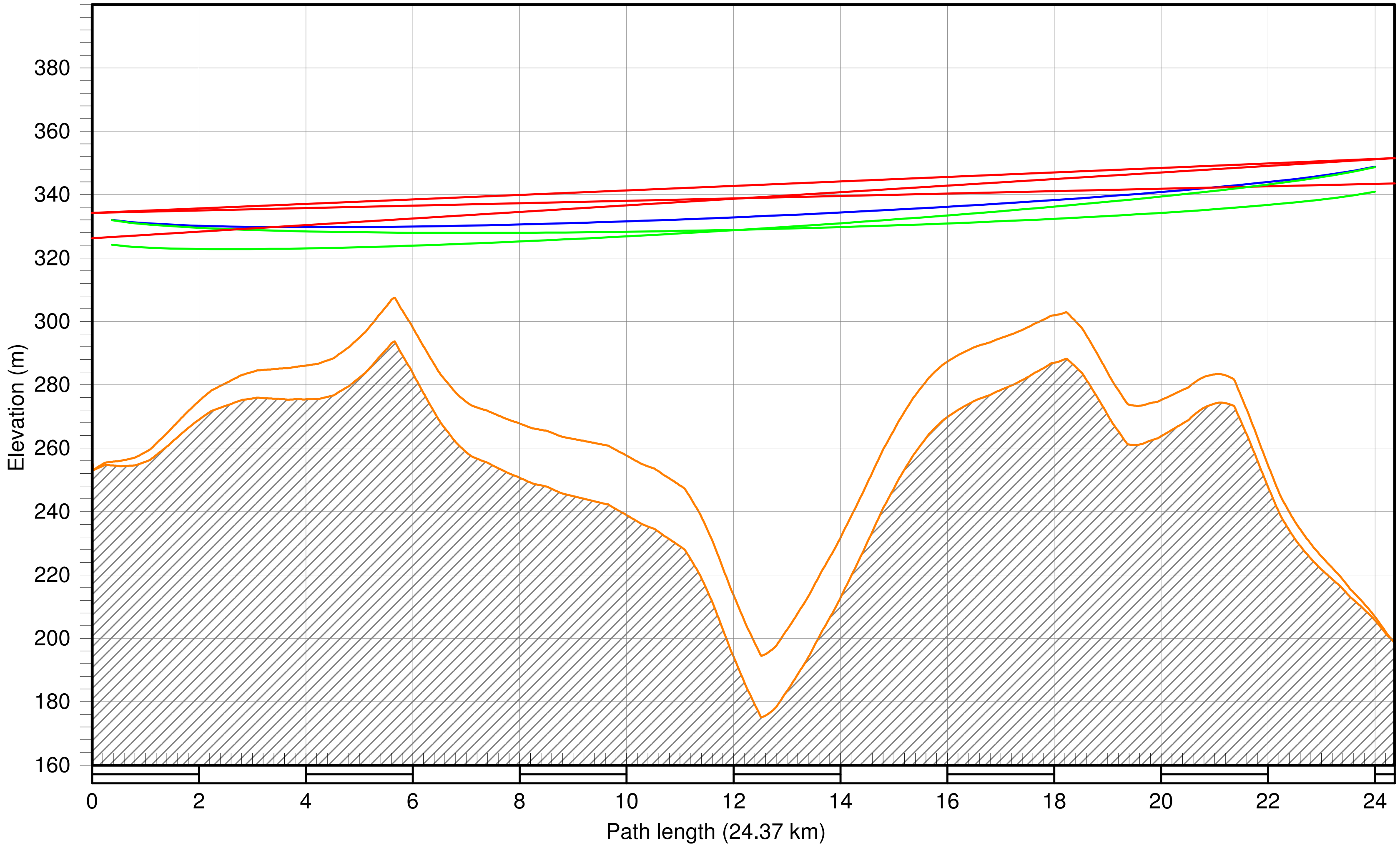
Latitude	30 09 33.00 S
Longitude	115 23 21.00 E
Azimuth	158.98°
Elevation	299 m ASL
Antenna CL	29.9, 20.9 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R36 Badgingarra

Latitude	30 24 51.00 S
Longitude	115 30 08.00 E
Azimuth	338.93°
Elevation	256 m ASL
Antenna CL	30.0, 22.0 m AGL

Gibson Quai - AAS 61758

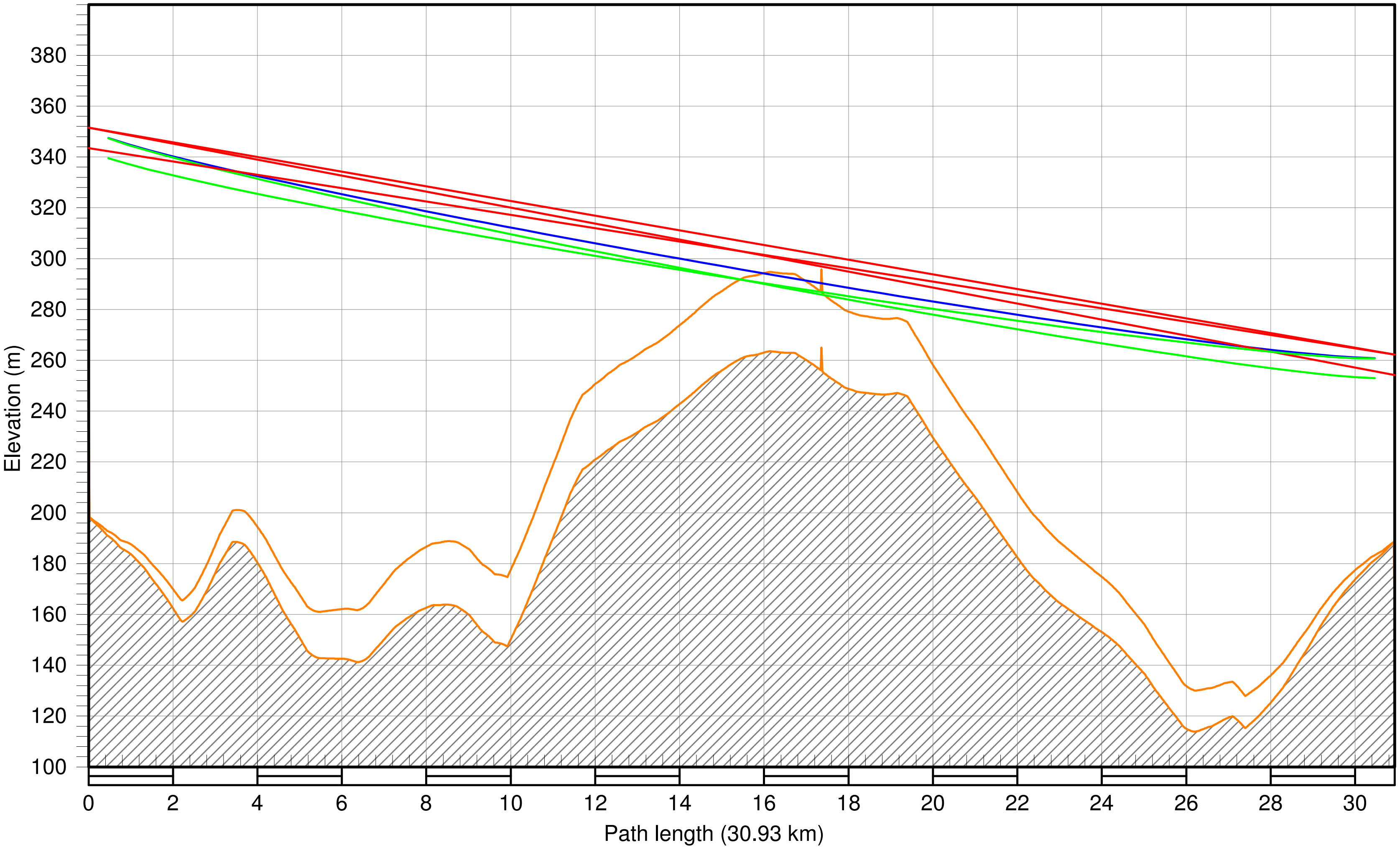


R36 Badgingarra	
Latitude	30 24 51.00 S
Longitude	115 30 08.00 E
Azimuth	166.09°
Elevation	256 m ASL
Antenna CL	78.5, 70.5 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R37 Mullering Road	
Latitude	30 37 39.00 S
Longitude	115 33 48.00 E
Azimuth	346.06°
Elevation	243 m ASL
Antenna CL	108.5, 100.5 m AGL

Gibson Quai - AAS 61758



R37 Mullering Road

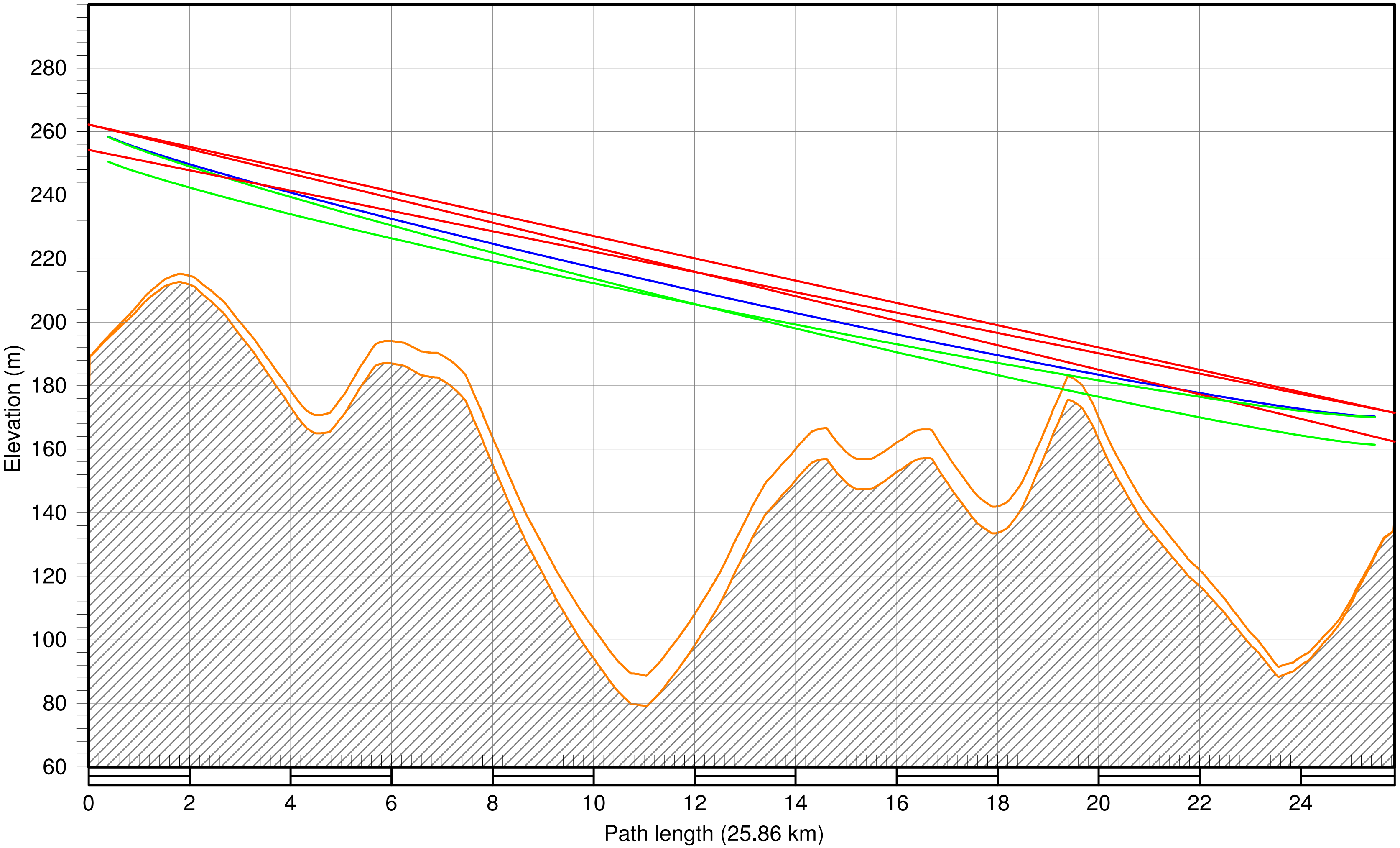
Latitude	30 37 39.00 S
Longitude	115 33 48.00 E
Azimuth	159.39°
Elevation	243 m ASL
Antenna CL	108.5, 100.5 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R38 Wayloo

Latitude	30 53 19.00 S
Longitude	115 40 38.00 E
Azimuth	339.33°
Elevation	154 m ASL
Antenna CL	108.5, 100.5 m AGL

Gibson Quai - AAS 61758

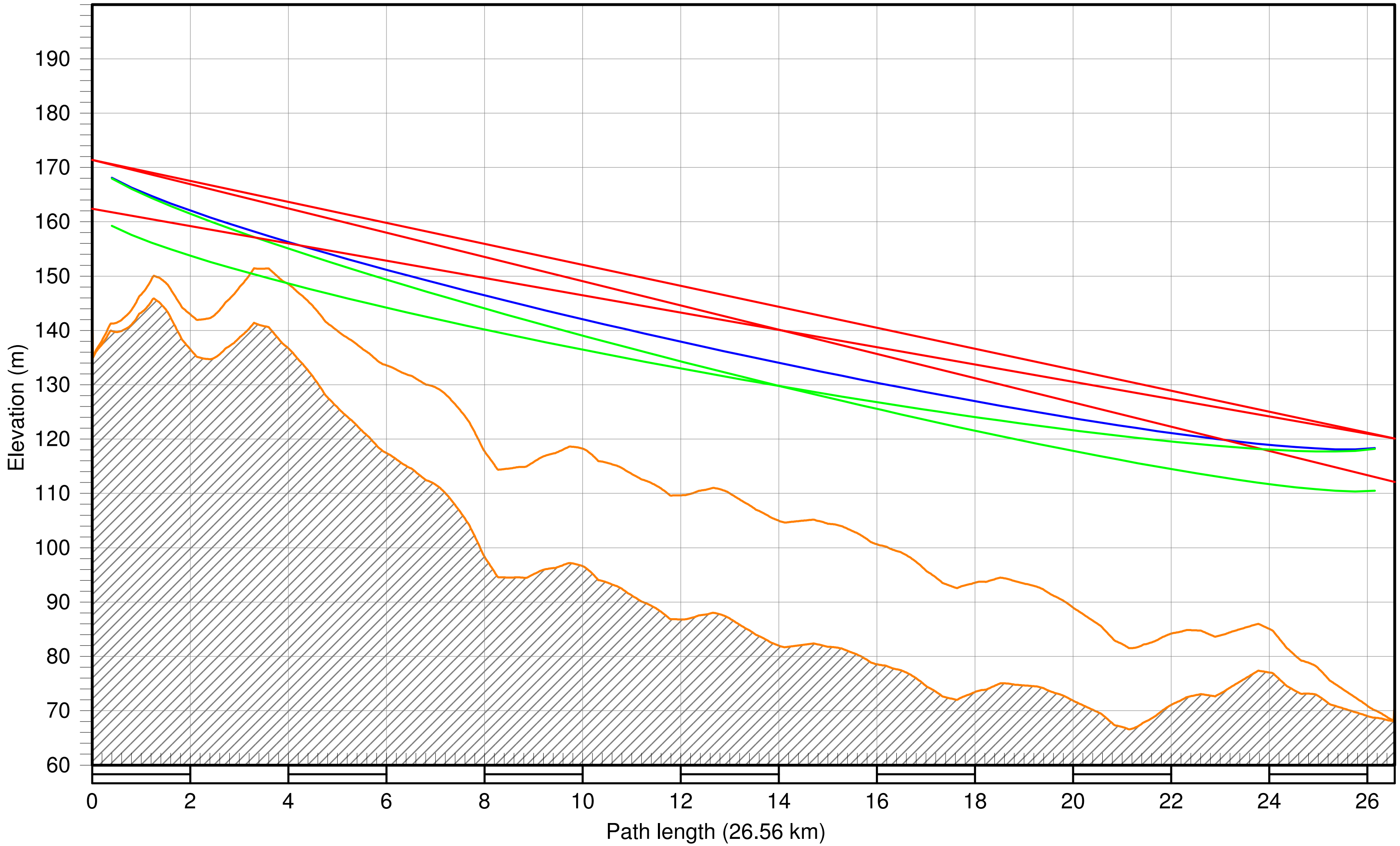


R38 Wayloo	
Latitude	30 53 19.00 S
Longitude	115 40 38.00 E
Azimuth	158.48°
Elevation	154 m ASL
Antenna CL	108.5, 100.5 m AGL

Frequency (MHz) = 6700.0
K = 1.33
%F1 = 60.00, 60.00

R39 Red Gully	
Latitude	31 06 20.00 S
Longitude	115 46 36.00 E
Azimuth	338.43°
Elevation	142 m ASL
Antenna CL	29.9, 20.9 m AGL

Gibson Quai - AAS 61758

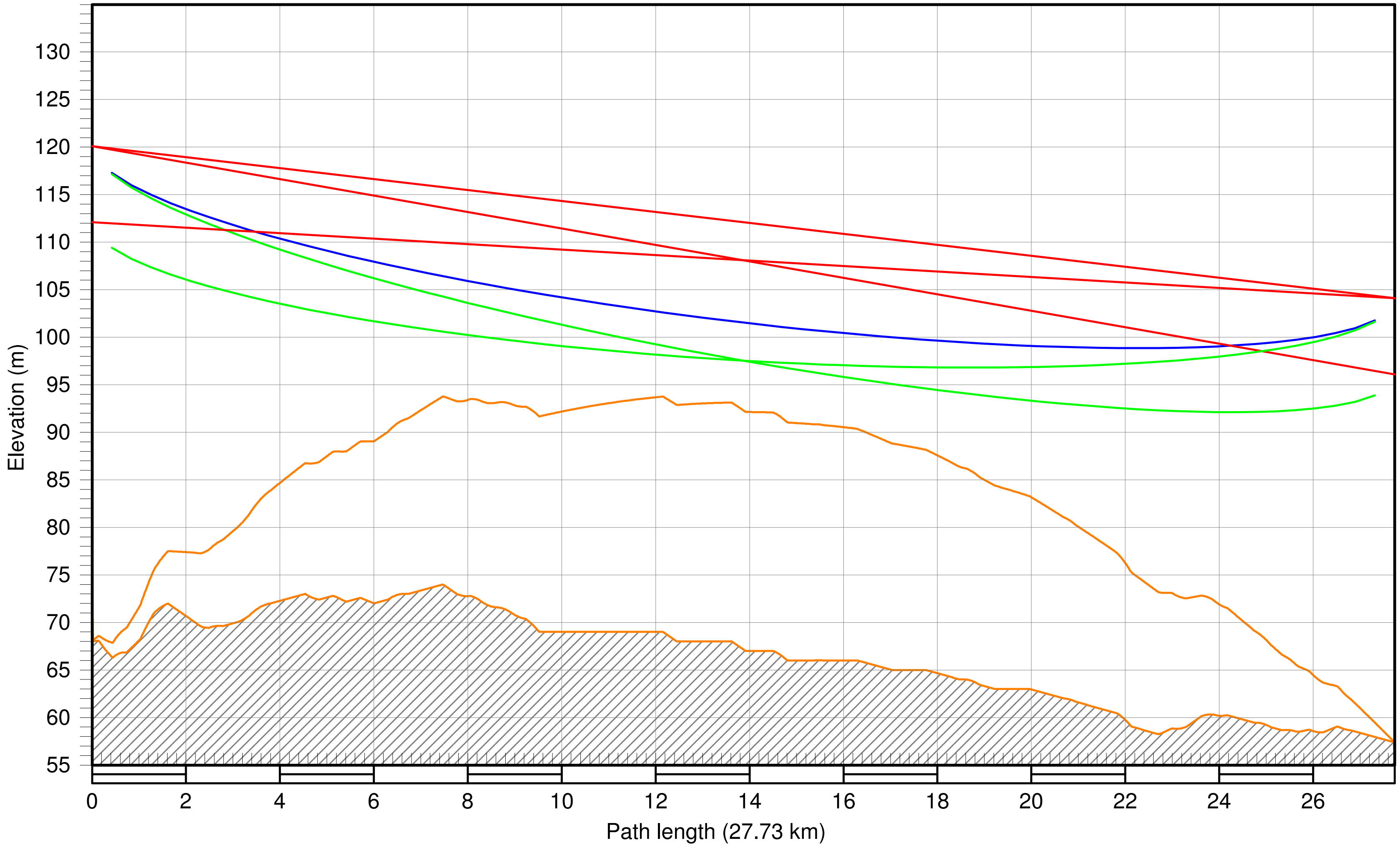


R39 Red Gully	
Latitude	31 06 20.00 S
Longitude	115 46 36.00 E
Azimuth	161.37°
Elevation	142 m ASL
Antenna CL	29.9, 20.9 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R40 Gingin	
Latitude	31 19 57.00 S
Longitude	115 51 57.00 E
Azimuth	341.32°
Elevation	72 m ASL
Antenna CL	48.5, 40.5 m AGL

Gibson Quai - AAS 61758



R40 Gingin

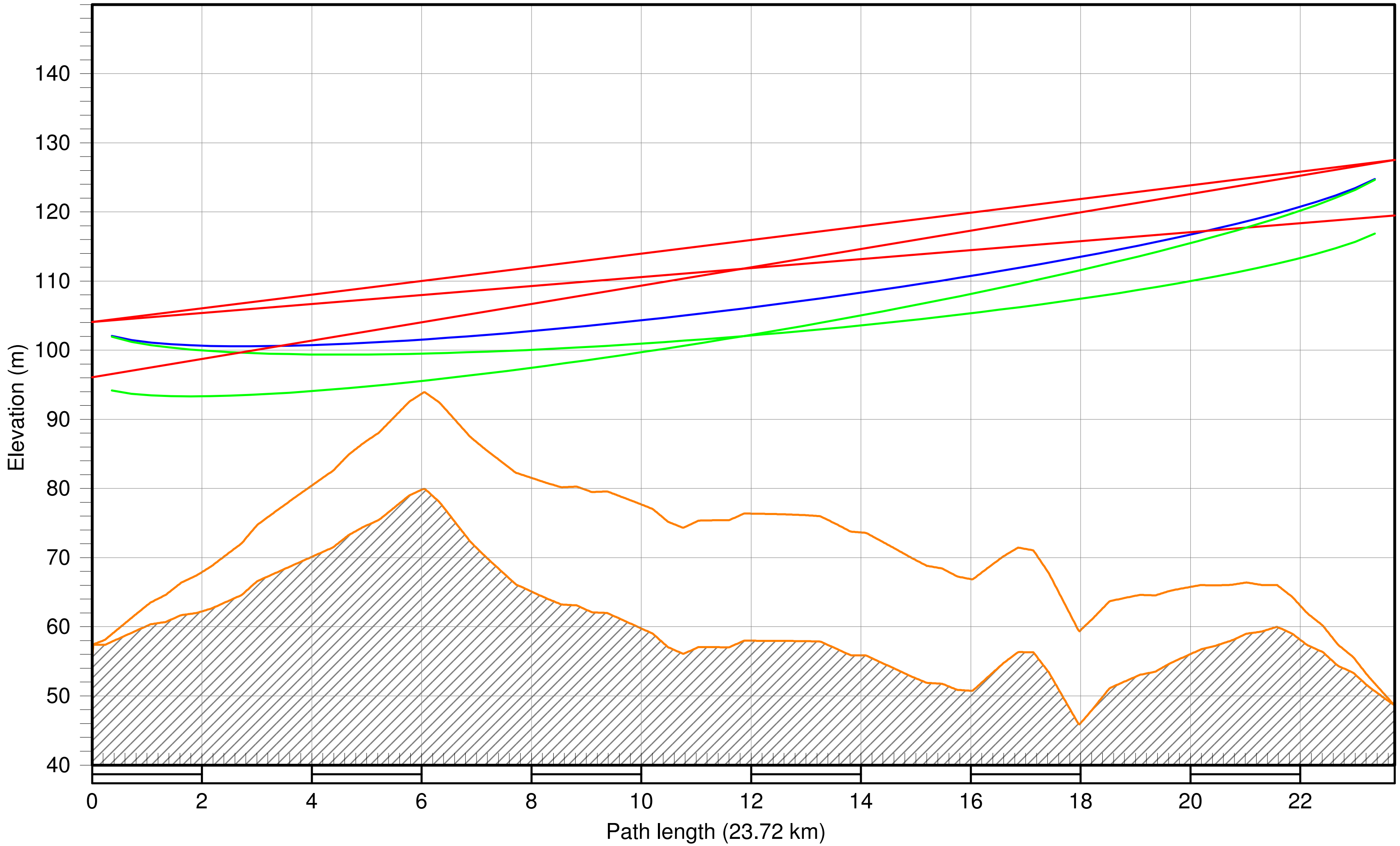
Latitude	31 19 57.00 S
Longitude	115 51 57.00 E
Azimuth	161.14°
Elevation	72 m ASL
Antenna CL	48.5, 40.5 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R41 Muchea

Latitude	31 34 09.00 S
Longitude	115 57 37.00 E
Azimuth	341.09°
Elevation	56 m ASL
Antenna CL	48.5, 40.5 m AGL

Gibson Quai - AAS 61758



R41 Muchea	
Latitude	31 34 09.00 S
Longitude	115 57 37.00 E
Azimuth	179.56°
Elevation	56 m ASL
Antenna CL	48.5, 40.5 m AGL

Frequency (MHz) = 6700.0
K = 0.60
%F1 = 60.00, 60.00

R42 Gnangara Road	
Latitude	31 46 59.00 S
Longitude	115 57 44.00 E
Azimuth	359.55°
Elevation	49 m ASL
Antenna CL	78.5, 70.5 m AGL

Gibson Quai - AAS 61758

E. AVAILABILITY ANALYSIS

AVAILABILITY ANALYSIS

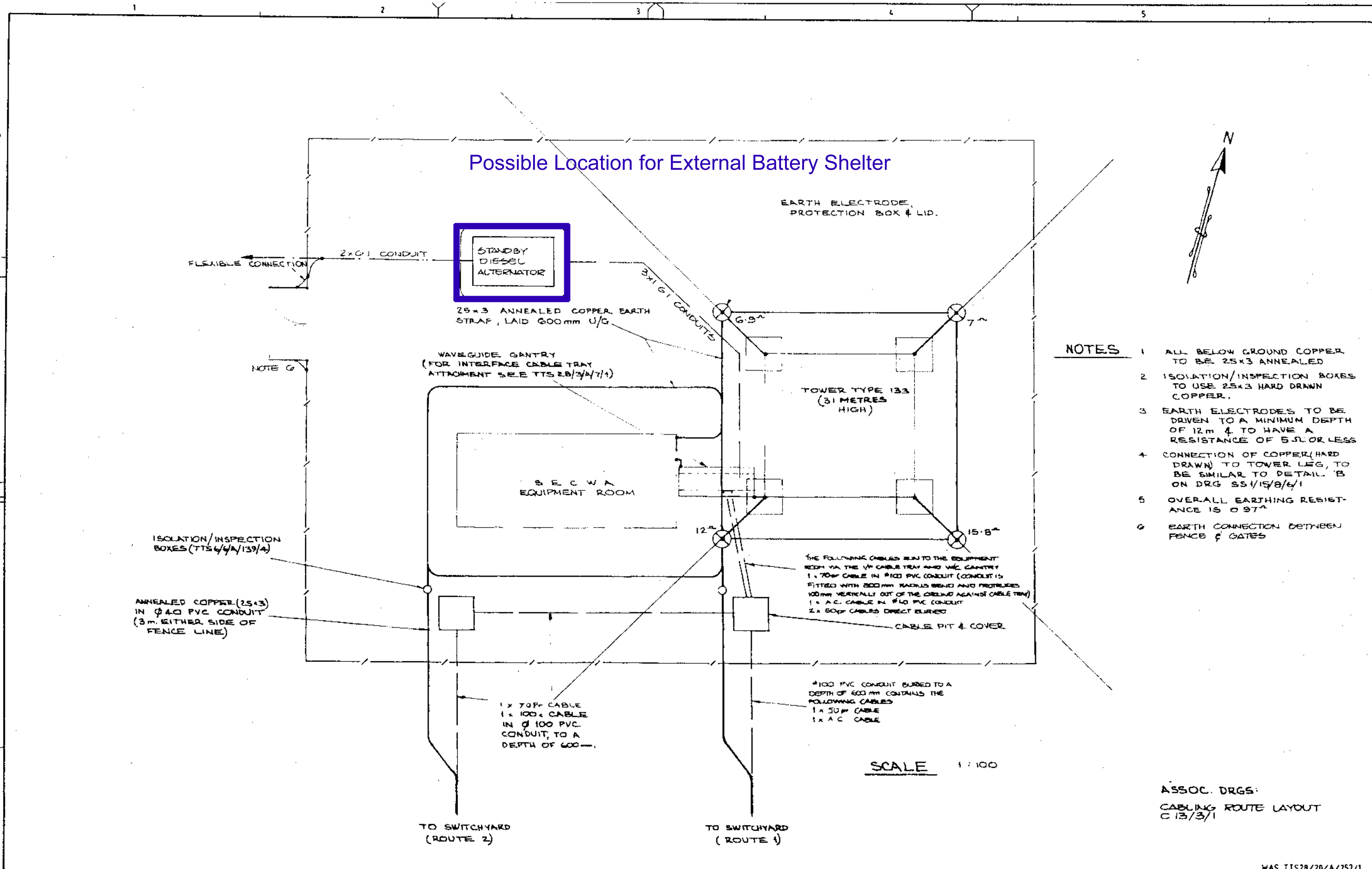
Link		SPLIT SYSTEM (IDU / ODU)				INDOOR ONLY SYSTEM (IDU)			
FROM	TO	Proportional Propagation Un-Availability	Total Availability	Total Unavailability	Total Unavailability Objective	Proportional Propagation Un-Availability	Total Availability	Total Unavailability	Total Objective
R0	R1	0.000000	99.999845	0.000155	0.000233	0.000000	99.999845	0.000155	0.000233
R1	R2	0.000010	99.999835	0.000165	0.000233	0.000023	99.999822	0.000178	0.000233
R2	R3	0.000007	99.999838	0.000162	0.000233	0.000040	99.999805	0.000195	0.000233
R3	R4	0.000010	99.999835	0.000165	0.000233	0.000287	99.999558	0.000442	0.000233
R4	R5	0.000010	99.999835	0.000165	0.000233	0.000070	99.999775	0.000225	0.000233
R5	R6	0.000003	99.999842	0.000158	0.000233	0.000010	99.999835	0.000165	0.000233
R6	R7	0.000017	99.999828	0.000172	0.000233	0.000087	99.999758	0.000242	0.000233
R7	R8	0.000013	99.999832	0.000168	0.000233	0.000240	99.999605	0.000395	0.000233
R8	R9	0.000043	99.999802	0.000198	0.000233	0.001667	99.998178	0.001822	0.000233
R9	R10	0.000020	99.999825	0.000175	0.000233	0.000243	99.999602	0.000398	0.000233
R10	R11	0.000013	99.999832	0.000168	0.000233	0.000033	99.999812	0.000188	0.000233
R11	R12	0.000010	99.999835	0.000165	0.000233	0.000040	99.999805	0.000195	0.000233
R12	R13	0.000027	99.999818	0.000182	0.000233	0.000253	99.999592	0.000408	0.000233
R13	R14	0.000013	99.999832	0.000168	0.000233	0.000163	99.999682	0.000318	0.000233
R14	R15	0.000013	99.999832	0.000168	0.000233	0.000060	99.999785	0.000215	0.000233
R15	R16	0.000013	99.999832	0.000168	0.000233	0.000173	99.999672	0.000328	0.000233
R16	R17	0.000013	99.999832	0.000168	0.000233	0.000207	99.999638	0.000362	0.000233
R17	R18	0.000013	99.999832	0.000168	0.000233	0.000080	99.999765	0.000235	0.000233
R18	R19	0.000010	99.999835	0.000165	0.000233	0.000057	99.999788	0.000212	0.000233
R19	R20	0.000037	99.999808	0.000192	0.000233	0.000640	99.999205	0.000795	0.000233
R20	R21	0.000017	99.999828	0.000172	0.000233	0.000543	99.999302	0.000698	0.000233
R21	R22	0.000033	99.999812	0.000188	0.000233	0.000490	99.999355	0.000645	0.000233
R22	R23	0.000017	99.999828	0.000172	0.000233	0.000143	99.999702	0.000298	0.000233
R23	R24	0.000013	99.999832	0.000168	0.000233	0.000053	99.999792	0.000208	0.000233
R24	R25	0.000017	99.999828	0.000172	0.000233	0.000110	99.999735	0.000265	0.000233
R25	R26	0.000013	99.999832	0.000168	0.000233	0.000047	99.999798	0.000202	0.000233
R26	R27	0.000017	99.999828	0.000172	0.000233	0.000217	99.999628	0.000372	0.000233
R27	R28	0.000040	99.999805	0.000195	0.000233	0.001470	99.998375	0.001625	0.000233
R28	R29	0.000017	99.999828	0.000172	0.000233	0.000407	99.999438	0.000562	0.000233
R29	R30	0.000013	99.999832	0.000168	0.000233	0.000103	99.999742	0.000258	0.000233
R30	R31	0.000007	99.999838	0.000162	0.000233	0.000020	99.999825	0.000175	0.000233
R31	R32	0.000017	99.999828	0.000172	0.000233	0.000040	99.999805	0.000195	0.000233
R32	R33	0.000007	99.999838	0.000162	0.000233	0.000037	99.999808	0.000192	0.000233
R33	R34	0.000007	99.999838	0.000162	0.000233	0.000197	99.999648	0.000352	0.000233
R34	R35	0.000013	99.999832	0.000168	0.000233	0.000097	99.999748	0.000252	0.000233
R35	R36	0.000013	99.999832	0.000168	0.000233	0.000017	99.999828	0.000172	0.000233
R36	R37	0.000003	99.999842	0.000158	0.000233	0.000037	99.999808	0.000192	0.000233
R37	R38	0.000003	99.999842	0.000158	0.000233	0.000033	99.999812	0.000188	0.000233
R38	R39	0.000003	99.999842	0.000158	0.000233	0.000020	99.999825	0.000175	0.000233
R39	R40	0.000007	99.999838	0.000162	0.000233	0.000010	99.999835	0.000165	0.000233
R40	R41	0.000007	99.999838	0.000162	0.000233	0.000017	99.999828	0.000172	0.000233
R41	R42	0.000003	99.999842	0.000158	0.000233	0.000010	99.999835	0.000165	0.000233
R42	R43	0.000003	99.999842	0.000158	0.000233	0.000003	99.999842	0.000158	0.000233
Totals		**0.000587**	**0.007252**	**0.007252**	**0.010019**	**0.008493**	**0.015158**	**0.015158**	**0.010019**

F. ERRORED SECONDS

BER ANALYSIS

Link		SPLIT SYSTEM (IDU / ODU)			INDOOR ONLY SYSTEM (IDU)	
		Severely Errored Seconds (SES) Worst Month (%) - Adjusted for Space Diversity			Severely Errored Seconds (SES) Worst Month (%) - Adjusted for Space Diversity	
FROM	TO	D'Alessi	Vigants - Barnett	SES Objective	Vigants - Barnett (North to South)	SES Objective
R0	R1	0.000010	0.000000	0.002	0.000000	0.002
R1	R2	0.000150	0.000080	0.006	0.000180	0.006
R2	R3	0.000133	0.000060	0.006	0.000320	0.006
R3	R4	0.000110	0.000080	0.006	0.002280	0.006
R4	R5	0.000110	0.000080	0.006	0.000560	0.006
R5	R6	0.000140	0.000040	0.006	0.000080	0.006
R6	R7	0.000200	0.000140	0.007	0.000700	0.007
R7	R8	0.000020	0.000110	0.007	0.001930	0.007
R8	R9	0.000350	0.000360	0.010	0.013620	0.010
R9	R10	0.000133	0.000160	0.007	0.002000	0.007
R10	R11	0.000500	0.000100	0.006	0.000280	0.006
R11	R12	0.000110	0.000100	0.007	0.000340	0.007
R12	R13	0.000350	0.000210	0.009	0.002070	0.009
R13	R14	0.000140	0.000120	0.007	0.001320	0.007
R14	R15	0.000250	0.000100	0.006	0.000500	0.006
R15	R16	0.000025	0.000100	0.006	0.001440	0.006
R16	R17	0.000120	0.000240	0.009	0.003480	0.009
R17	R18	0.000100	0.000130	0.007	0.000670	0.007
R18	R19	0.000120	0.000090	0.006	0.000470	0.006
R19	R20	0.000075	0.000300	0.010	0.005360	0.010
R20	R21	0.000050	0.000160	0.007	0.004560	0.007
R21	R22	0.000030	0.000280	0.010	0.004100	0.010
R22	R23	0.000133	0.000140	0.007	0.001240	0.007
R23	R24	0.000180	0.000110	0.007	0.000470	0.007
R24	R25	0.000180	0.000160	0.007	0.000940	0.007
R25	R26	0.000120	0.000120	0.007	0.000400	0.007
R26	R27	0.000120	0.000140	0.007	0.001860	0.007
R27	R28	0.000200	0.000340	0.010	0.012640	0.010
R28	R29	0.000025	0.000140	0.007	0.003500	0.007
R29	R30	0.000350	0.000120	0.007	0.000900	0.007
R30	R31	0.000035	0.000040	0.006	0.000180	0.006
R31	R32	0.000010	0.000140	0.007	0.000360	0.007
R32	R33	0.000180	0.000040	0.006	0.000320	0.006
R33	R34	0.000015	0.000330	0.006	0.001720	0.006
R34	R35	0.000050	0.000110	0.007	0.000860	0.007
R35	R36	0.000050	0.000110	0.007	0.000160	0.007
R36	R37	0.000030	0.000040	0.005	0.000340	0.005
R37	R38	0.000065	0.000040	0.007	0.000300	0.007
R38	R39	0.000075	0.000040	0.006	0.000190	0.006
R39	R40	0.000180	0.000050	0.006	0.000090	0.006
R40	R41	0.000190	0.000060	0.006	0.000160	0.006
R41	R42	0.000080	0.000110	0.005	0.000100	0.005
R42	R43	0.000040	0.000020	0.004	0.000040	0.004
Totals		**0.005524**	**0.005440**	**0.287638**	**0.073030**	**0.287638**

G. SITE SHELTER AND MAST LAYOUTS



WAS TTS28/20/A/257/1

REVISIONS	DRN	DATE	CHK'D
E	CRM	14.7.00	

RASTERED

ORG. No.	TITLE

DRAWING REFERENCES

KARRATHA (R0)
GENERAL
SITE LAYOUT

Western Power — TRANSMISSION DIVISION

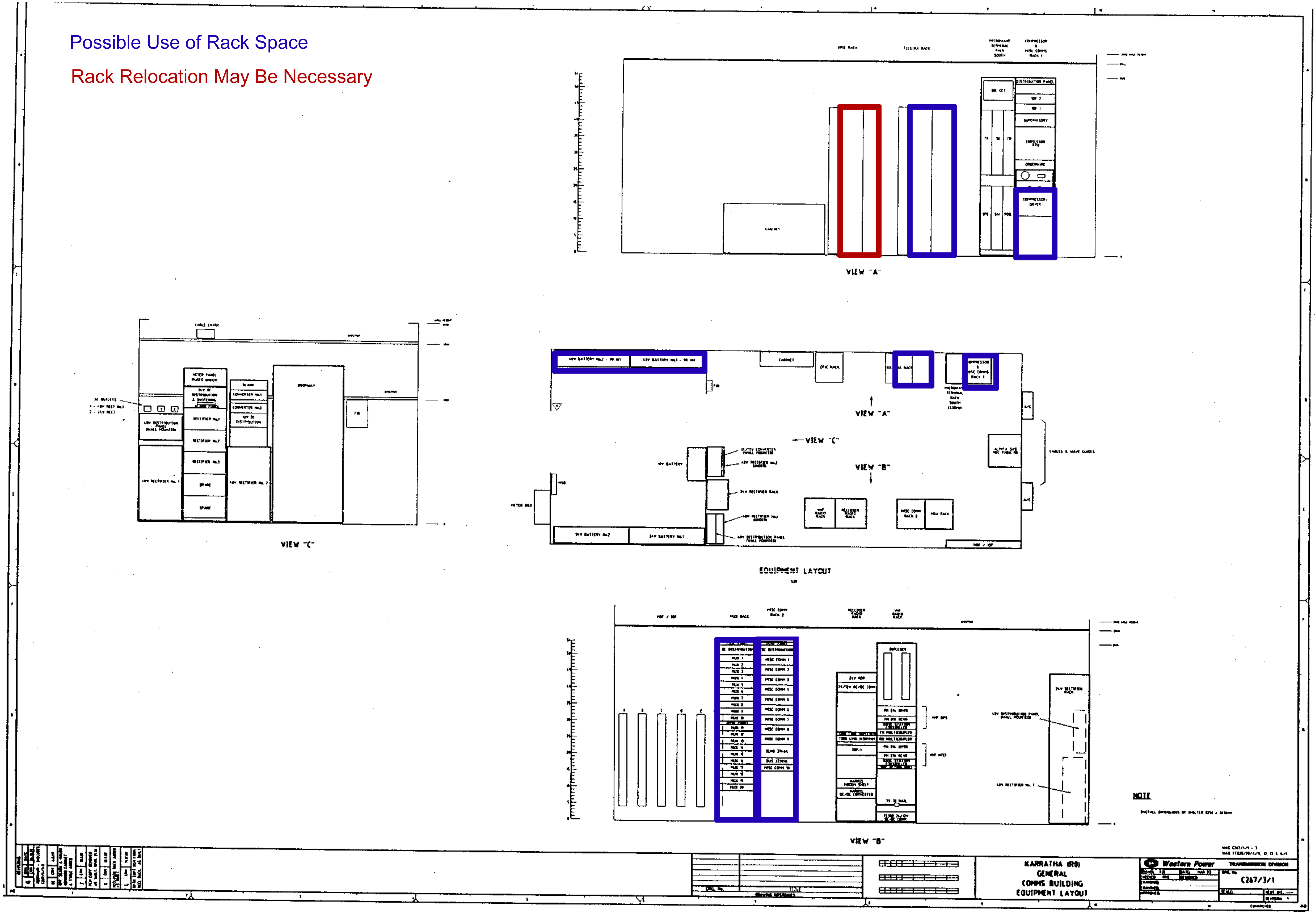
DRAWN: CRM	DATE: 31.12.82	ORG. No.	SCANNED DRAWING
CHECKED: JOH	DESIGNED:		C267/2/1
EXAMINED:			
EXAMINED:		SCALE:	NEXT SHT.
APPROVED:			REVISION: E

A2

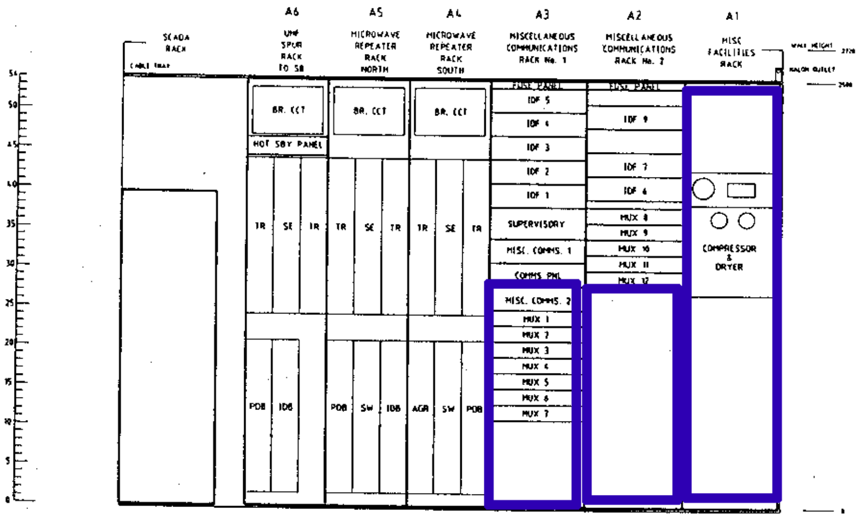
1.DGN
1.CIT

Possible Use of Rack Space

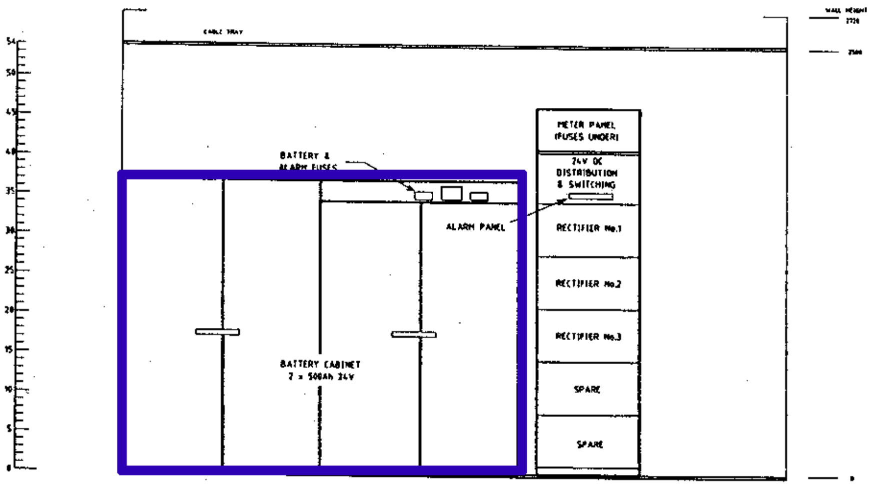
Rack Relocation May Be Necessary



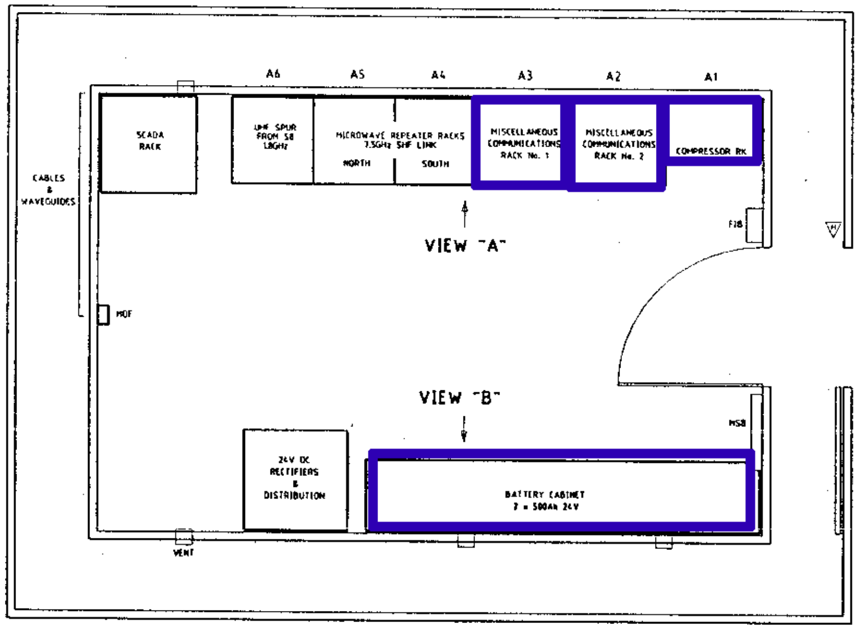
Possible Use of Rack Space



VIEW "A"



VIEW "B"



EQUIPMENT LAYOUT

NOTE

1. INTERNAL DIMENSIONS OF INTERNAL SHELTER 3780 x 2635mm

WAS TTS20/21/A/11, 12, 13/1

REVISIONS	DATE	DRN	CHK
C RETITLED & RENUMBERED	28.8.81		

DRG. No.	TITLE

DRAWING REFERENCES

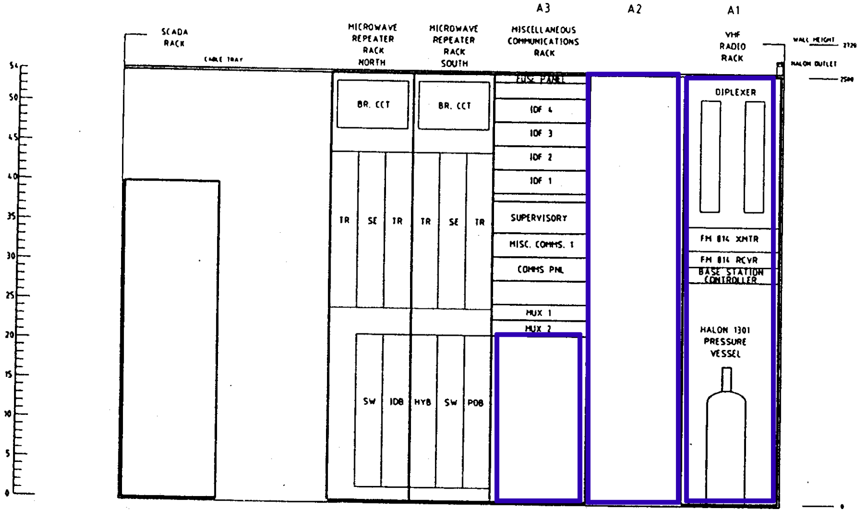
CAJUPUT WELL (R1)
GENERAL
COMMS BUILDING
EQUIPMENT LAYOUT

Western Power TRANSMISSION DIVISION

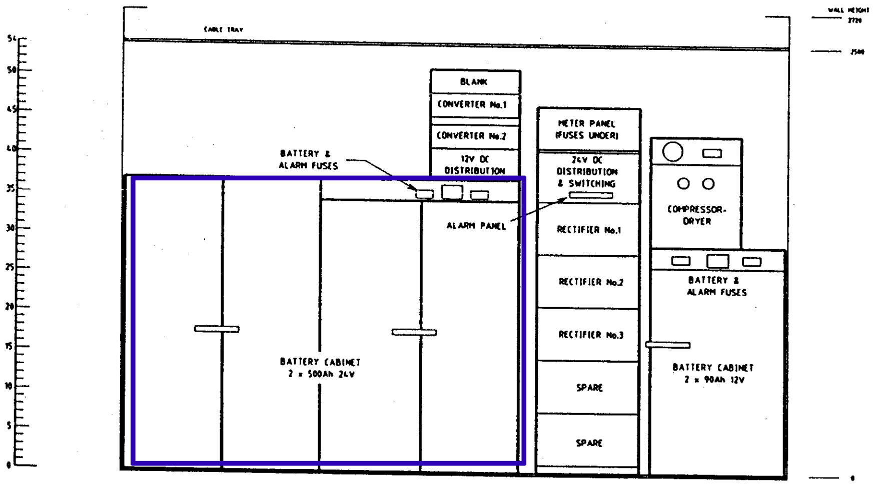
DRAWN: SGC	DATE: DEC 84	DRG. No.	C153/4/1
CHECKED: JH	DESIGNED:		
EXAMINED:		SCALE: 1:20	NEXT SHT. —
EXAMINED:			REVISION C
APPROVED:			

COMMARKED

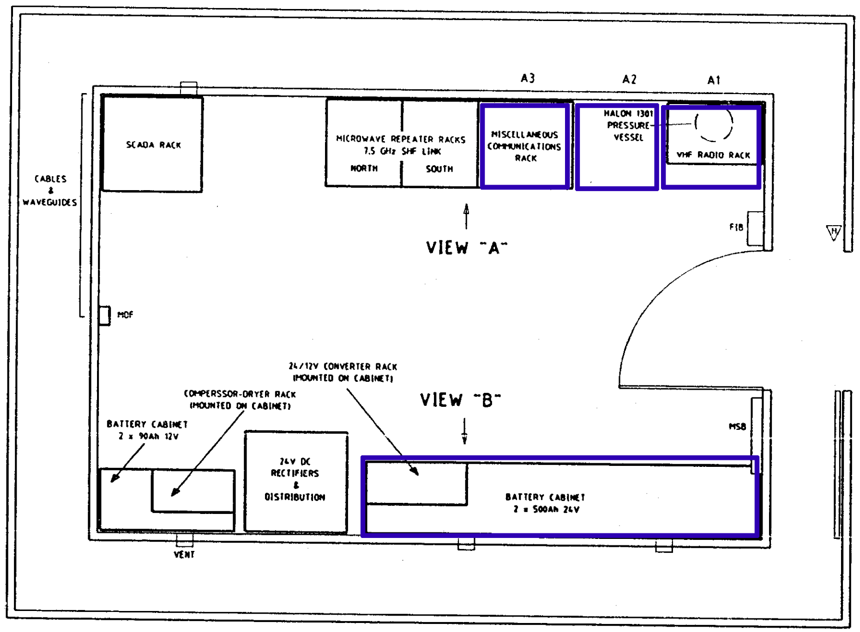
Possible Use of Rack Space



VIEW "A"



VIEW "B"



EQUIPMENT LAYOUT

NOTE
INTERNAL DIMENSIONS OF INTERNAL SHELTER 3780 x 2635mm

WAS C380/5/1 - 2
WAS TTS28/27/A/11, 12, 13/1

REVISIONS	DRG	DATE
C	CRH 18.9.95	REDRAWN - INCLUDES :380/5/1-2

DRG. No. | TITLE
DRAWING REFERENCES

PETER CREEK (RS)
GENERAL
COMMS BUILDING
EQUIPMENT LAYOUT

Western Power — TRANSMISSION DIVISION

DRAWN: RJB | DATE: DEC 87
CHECKED: ROS | DESIGNED:
EXAMINED:
EXAMINED:
APPROVED:

DRG. No. C380/4/1
SCALE: 1:20
NEXT SHT. —
REVISION: C
COMARCHED

H. PRELIMINARY FREQUENCY PLAN

PRELIMINARY FREQUENCY PLAN
DBP PIPELINE COMMUNICATIONS SYSTEM
MICROWAVE SYSTEM UPGRADE DESIGN DOCUMENT

I. LONGEST PATH RADIO PERFORMANCE WORKSHEETS

	R8 Claypan Well	R9 Ashburton
Elevation (m)	86.00	55.00
Latitude	22 06 26.00 S	22 28 23.00 S
Longitude	115 28 09.00 E	115 14 46.00 E
True azimuth (°)	209.53	29.61
Vertical angle (°)	-0.20	-0.12
Antenna model	Andrew	Andrew
Antenna height (m)	129.00	128.50
Antenna gain (dBi)	45.30	45.30
TX line type	Waveguide	Waveguide
TX line length (m)	1.00	1.00
TX line unit loss (dB /100 m)	5.10	5.10
TX line loss (dB)	0.05	0.05
Connector loss (dB)	0.50	0.50
Circ. branching loss (dB)	0.80	0.80
TX filter loss (dB)	1.50	1.50
RX filter loss (dB)	1.15	1.15
Antenna model	Andrew	Andrew
Antenna height (m)	121.00	120.50
Antenna gain (dBi)	45.30	45.30
TX line type	Waveguide	Waveguide
TX line length (m)	1.00	1.00
TX line unit loss (dB /100 m)	5.10	5.10
TX line loss (dB)	0.05	0.05
Connector loss (dB)	0.50	0.50
Div RX circulator loss (dB)	0.80	0.80
Other div RX loss (dB)	1.15	1.15
Frequency (MHz)	6700.00	
Polarization	Vertical	
Path length (km)	46.58	
Free space loss (dB)	142.35	
Atmospheric absorption loss (dB)	0.43	
Main net path loss (dB)	57.53	57.53
Diversity net path loss (dB)	57.53	57.53
Radio model	155Mb SDH	155Mb SDH
TX power (watts)	0.79	0.79
TX power (dBm)	29.00	29.00
EIRP (dBm)	71.45	71.45
RX threshold criteria	BER 10E-6	BER 10E-6
RX threshold level (dBm)	-68.00	-68.00
Maximum receive signal (dBm)	-20.00	-20.00
Main RX signal (dBm)	-28.53	-28.53
Diversity RX signal (dBm)	-28.53	-28.53
Thermal fade margin (dB)	39.47	39.47
Dispersive fade margin (dB)	40.00	40.00
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	36.72	36.72
C factor	2.00	
Fade occurrence factor (Po)	8.12E-01	
Average annual temperature (°C)	23.00	
SD improvement factor	128.11	128.11
Worst month - multipath (%)	99.99982	99.99982
(sec)	4.66	4.66
Annual - multipath (%)	99.99993	99.99993
(sec)	20.53	20.53
(% - sec)	99.99987 - 41.07	
Rain region	ITU Region F	
0.01% rain rate (mm/hr)	28.00	
Flat fade margin - rain (dB)	39.47	
Rain rate (mm/hr)	2167.57	
Rain attenuation (dB)	39.47	
Annual rain (%-sec)	100.00000 - 0.00	
Annual multipath + rain (%-sec)	99.99987 - 41.07	

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Claypan Well-Ashburton_O.pl4
Reliability Method - Vigants - Barnett
Space Diversity Method Nortel IF Combining
Rain - ITU-R P530-7

	R8 Claypan Well	R9 Ashburton
Elevation (m)	86.00	55.00
Latitude	22 06 26.00 S	22 28 23.00 S
Longitude	115 28 09.00 E	115 14 46.00 E
True azimuth (°)	209.53	29.61
Vertical angle (°)	-0.20	-0.12
Antenna model	Andrew	Andrew
Antenna height (m)	129.00	128.50
Antenna gain (dBi)	45.30	45.30
TX line type	Waveguide	Waveguide
TX line length (m)	143.00	143.00
TX line unit loss (dB /100 m)	5.10	5.10
TX line loss (dB)	7.29	7.29
Connector loss (dB)	0.50	0.50
Circ. branching loss (dB)	0.80	0.80
TX filter loss (dB)	1.50	1.50
RX filter loss (dB)	1.15	1.15
Antenna model	Andrew	Andrew
Antenna height (m)	121.00	120.50
Antenna gain (dBi)	45.30	45.30
TX line type	Waveguide	Waveguide
TX line length (m)	143.00	143.00
TX line unit loss (dB /100 m)	5.10	5.10
TX line loss (dB)	7.29	7.29
Connector loss (dB)	0.50	0.50
Div RX circulator loss (dB)	0.80	0.80
Other div RX loss (dB)	1.15	1.15
Frequency (MHz)	6700.00	
Polarization	Vertical	
Path length (km)	46.58	
Free space loss (dB)	142.35	
Atmospheric absorption loss (dB)	0.43	
Main net path loss (dB)	72.01	72.01
Diversity net path loss (dB)	72.01	72.01
Radio model	155Mb SDH	155Mb SDH
TX power (watts)	1.58	1.58
TX power (dBm)	32.00	32.00
EIRP (dBm)	67.21	67.21
RX threshold criteria	BER 10E-6	BER 10E-6
RX threshold level (dBm)	-68.00	-68.00
Maximum receive signal (dBm)	-20.00	-20.00
Main RX signal (dBm)	-40.01	-40.01
Diversity RX signal (dBm)	-40.01	-40.01
Thermal fade margin (dB)	27.99	27.99
Dispersive fade margin (dB)	40.00	40.00
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	27.72	27.72
C factor	2.00	
Fade occurrence factor (Po)	8.12E-01	
Average annual temperature (°C)	23.00	
SD improvement factor	34.95	34.95
Worst month - multipath (%)	99.99319	99.99319
(sec)	179.10	179.10
Annual - multipath (%)	99.99750	99.99750
(sec)	788.74	788.74
(% - sec)	99.99500 - 1577.48	
Rain region	ITU Region F	
0.01% rain rate (mm/hr)	28.00	
Flat fade margin - rain (dB)	27.99	
Rain rate (mm/hr)	1175.66	
Rain attenuation (dB)	27.99	
Annual rain (%-sec)	100.00000 - 0.00	
Annual multipath + rain (%-sec)	99.99500 - 1577.48	

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Claypan Well-Ashburton_I.pl4
Reliability Method - Vigants - Barnett
Space Diversity Method Nortel IF Combining
Rain - ITU-R P530-7

J. PROJECT PLAN

To meet the proposed target of replacement by an operational microwave radio system at December 2007, the following milestone periods are essential:

ACTIVITY	DURATION	PERIOD
Tender process to negotiation and award	2 months	December 2006 to January 2007
Detailed design by successful vendor	2 months	January to March 2007
Equipment delivery	4 months	March to June 2007
Integration and factory testing	1 to 2 months	July/August 2007
Installation and system performance testing	4 months	August to November 2007
Acceptance and commissioning	1 month	November /December 2007