LAL LAL WIND FARM- YENDON SECTION
RADIO LINK EXCLUSION ZONES

[final]

17 August 2010

L. J. Derrick B. E. (Elec.) ACMA Accreditation No 008
Lawrence Derrick & Associates
Engineering Consultants & RF Frequency Assigners

CONTENTS

1 EXECUTIVE SUMMARY

Westwind Energy is developing a wind farm near Lal Lal in Victoria. The wind farm will comprise two wind turbine groups, the Yendon section and the Elaine section. This report covers the requirements of Planning Permit No PL-SP/05/0461 issued on 30th April 2009 (Ref.3) for aspects in relation to potential interference to radio communication for a Development Plan for the Yendon section. This requirement is associated with avoidance of possible impacts of the wind farm operation on existing radio communications. Clearance distances between point to point radio link paths and the turbines are required to be confirmed to avoid any potential for degradation to the performance of the links. This analysis is based on the latest ACMA data for licensed radio-communication systems and updates previous reports from Garrad Hassan and Gibson Quai-AAS in 2007. This study shows that there are a few additional links licenced which cross the wind farm and 2 are no longer listed. The current wind turbine layout does not encroach on any of the required exclusions zones for the currently licenced links.

2 INTRODUCTION

A Garrad Hassan (GH) Report (Ref. 1) dated 13 July 2007, commissioned by WestWind Energy, discussed the issues relating to potential interference to radiocommunication systems and broadcasting reception by wind turbines. The report established certain clearances required for point to point radio system paths which crossed the wind farm boundaries. Issues relating to interference to domestic TV and Radio reception were also discussed. Another Report by Gibson Quai-AAS (GQ-AAS)(Ref. 2) dated 1st October 2007 reviewed the GH Report and while confirming the radio links identified by GH also identified additional links which had a potential to be affected by wind turbines. Links without adequate vertical clearance over the top of turbines had horizontal clearance requirements established which enabled WestWind Energy to produce a buffer zone map (Ref. LL_SM[Y]_0019) showing where turbines should not encroach into.

As some time has elapsed since the radio link data was sourced from the ACMA Radcom database for the above studies it was considered prudent to confirm or modify the buffer zone corridors developed to take account of any additional links having being established (or any links being decommissioned). This Report was commissioned by WestWind to validate or modify the previous clearance zone results using the latest ACMA data.

.

3 EMI EFFECTS OF WIND TURBINES

The following is an extract from Ref. 9:

"It is well known that any large structure, whether stationary or moving, in the vicinity of a receiver or transmitter of electromagnetic signals may interfere with those signals and degrade the performance of the transmitter/receiver system. Under certain conditions, the rotor blades of an operating wind turbine may passively reflect a transmitted signal, so that both the transmitted signal and a delayed interference signal (varying periodically at the blade passage frequency) may exist simultaneously in a zone near the turbine. The nature and amount of electromagnetic interference (EMI) in this zone depend on a number of parameters, including location of the wind turbine relative to the transmitter and receiver, type of wind turbine, physical and electrical characteristics of the rotor blades, signal frequency and modulation scheme, receiver antenna characteristics, and the radio wave propagation in the local atmosphere. Other wind turbine components which have been considered to be potential causes of EMI are towers and electrical systems. However, neither of these has been found to be a significant source of interference. Thus, moving blades are the components of most importance in determining EMI levels.

“Television Interference from wind turbines is characterised by video distortion that generally occurs in the form of a jittering of the picture that is synchronised with the blade passage frequency.

“Effects on FM broadcast reception have been observed only in laboratory simulations."

Point to point links in microwave and lower frequency bands will be affected only if the turbine tower or turbine clearance to the line of site path to the other end of the link is within the second Fresnel zone which is dependent on the operating frequency of the link, the distance of the tower/turbine from the link antenna and the total link distance. D. F. Bacon (Ref. 4) proposes 3 potential degradation mechanisms - near field effects, diffraction and reflection or scattering. The reflection or scattering treatment in the reference suggests greater clearance requirements at positions close to the link terminals than the usually applied Fresnel Zone clearance.

4 METHOD OF ANALYSIS

The grid references shown in Attachment 1 of the current WestWind Energy’s wind turbine layout for the Yendon Section have been superimposed on radio link maps which were generated from the latest ACMA Radcom database . These maps show all point to point radio link paths and radio sites within a site within radius of at least 50 km from the wind farm. The overview maps for 2 operating frequency

ranges of radio links include the total wind farm boundaries as a rectangle. The close up map views show the actual wind turbine locations

4.1 Objective of this Study

The objective of this study and Report is to confirm the clearance requirements for the radio services in the area to allow the wind farm layout to be confirmed so that there will be no detrimental effects on the performance of the existing services. The object also is to derive a minimum required buffer zone for the omnidirectional services including mobile radio base stations and any close TV/ FM Broadcasting transmitting station while ensuring an acceptable grade of protection.

4.2 Scope

The criteria for clearance of obstructions from point to point link ray lines has been well established in the literature including for the specific case of rotating wind turbines. For omnidirectional mobile and other services however any need for a buffer zone is usually dismissed on the basis of the accepted variability of coverage to/from the mobile or hand held terminals in the normal operational environment. The known exception to this is the SA DTEI guidelines (Ref. 5) prepared by Telstra where an exclusion zone for the SA – GRN 400 MHz mobile radio base stations has been derived. This Report considers the factors involved in the specific services in the area and proposes what are considered to be acceptable clearance zones.

The possible impact on Free-to Air TV and radio broadcasting services to residents near the wind farm is outside the scope of this Report.

4.3 Assumptions

The source of data for the existing services in the area is the ACMA data base for licensed radiocommunication services both from the latest issued CD and the ACMA public web site. The accuracy of the location of towers is that contained in the data base, shown in some cases to be within 10 metres and in the others within 100 metres. No check survey has been carried out.

It is also assumed that modern wind generators are well shielded to international standards and are not the source of any significant generated electromagnetic interference in the frequency bands used for radio services in the area. This report considers the reflection, scattering or obstruction of signals to the radio services, potentially caused by close spacing of the wind turbines to these services.

5 WIND TURBINE IMPACTS ON RADIO COMMUNICATIONS

The paper by D. F. Bacon in 2002, Ref. 4, appears to have become the most used reference by the industry for the calculation of clearance zones from turbines to the ray line and antennas for point to point links. The Paper identifies three principal mechanisms which are relevant to a wind turbine in proximity to a microwave link. These are:

5.1 Near-field Effects

A transmitting or receiving antenna has a near-field zone where local inductive fields are significant, and within which it is not simple to predict the effect of other objects. Bacon's paper provides the well known formulae for calculation of the near-field distance depending on the gain or physical aperture of antenna. The near field distance is a function of frequency and the physical dimensions or gain of the antenna

5.2 Diffraction

An object detrimentally modifies an advancing wavefront when it obstructs the wave's path of travel Here the formula applied is for the classical Fresnel zone distance where diffraction will be insignificant if obstructions are kept outside an ellipsoid volume of space around a ray line.

5.3 Reflection

The physical structure of the wind turbine, and in particular the rotating rotor blades, reflects interfering signals into the receiving antenna of a fixed link. A formula is given to derive a distance from the radio path where any reflected/scattered signal will be of an amplitude sufficiently smaller

than the direct signal arriving at the receiver. The acceptable Carrier/Interference (C/I) ratio will depend on the modulation and coding schemes of the link. Bacon's Paper provides formulas to calculate the distance from the link path where the C/I will be below a desirable level depending on the link parameters.

The calculation of the scattering level of RF signals from wind turbines is complex and varies with RF frequency, physical dimensions of the rotor blades and their twist, tilt and orientation. Radar Cross-section (RCS) values are used in the Bacon paper and elsewhere to account for the scattering characteristics of individual wind turbines. A wide spread of values appear in the literature for typical modern wind turbines which makes the estimation of the scattered signal levels uncertain. It is noted that the Bacon Paper uses an RCS value of 30 m² whereas the SA DTEI guidelines uses a value of 480 m² which is the total area of the 3 blades based on an assumed width of 4 metres each and lengths of 40 metres. In another British study (Ref. 6) the RCS of turbines were modelled and validated with actual field measurements. This study was focused on the aviation radar signatures of wind farms and measurements were carried out with radar in the 1 to 3 GHz range. Peak RCS values can significantly exceed the physical area of the wind turbine but they will occur over narrow arcs. The nacelle and the general shape of the tower itself can make significant contributions. A 100 metre tall tower with 45 metre blades was estimated to have a maximum peak RCS of 25,000 m². According to the Report this high peak was probably associated with a particular style of nacelle and tower. For the purposes of this study a peak of 1,000 m² associated with the blades is considered appropriate. The RCS will of course vary with wind direction, blade pitch and other design factors including rotor tilt and coning angle. Multiple wind turbine interference from a wind farm will also be additive on a power basis due to the uncoordinated sources from physically separated locations.

5.4 Omnidirectional Services

The Bacon paper was written for the point to point radio link situation and no omnidirectional system (eg mobile radio base station) was considered. The DTEI guidelines have been developed for omnidirectional mobile services from the Bacon paper by applying the formula for the point to point link reflection/scattering case to an omnidirectional service. It further derives another criteria for the case where the remote mobile/portable unit is located at points where a wind turbine is in line with the transmission path to the base station. A criteria of no more than 10% of the Fresnel zone width being blocked by a blade width of 4 metres appears to have been employed to derive an exclusion zone. This purports to limit signal variations as a result of the wind turbine to 0.5 dB. Buffer zones have also been derived for omnidirectional VHF and UHF base stations near wind turbines in NZ in Ref. 7 and Ref. 8.

6 EXISTING SITUATION/ENVIRONMENT

From the latest ACMA database maps have been prepared showing registered radio sites and point to point links in the area. Attachment 2 shows the situation for system with frequencies below 1000 MHz. (VHF and UHF systems). Attachment 3 shows the links and sites for systems operating on frequencies above 1000 MHz which are generally considered as microwave systems.

6.1 Point to Point Systems

A number of point to point links are registered for operation within 50 km of the wind farm site. As shown in map in Attachments 2 there are 7 UHF/VHF links which traverse or are near to the boundaries of the Yendon section of the wind farm. Attachment 3 indicates that there are 4 microwave links (> 1GHz) with are near to or cross the wind farm site. Each link was initially checked to determine if the line of sight path had clearance over the maximum turbine height of nominally 121 metres above the ground. The path profiles were generated using "Pathloss 4" software, coordinates, antenna heights from the ACMA database and use 3 sec space shuttle Digital Elevation Model (DEM) terrain data. The ACMA Database antenna height field is not always completed so estimates have been used in some cases The paper by Bacon applies to microwave systems (> 1000 MHz frequency of operation) and recommends an exclusion zone from the link paths of the 2nd Fresnel zone width. The paper does not specifically cover VHF/UHF (<1000 MHz) Links and there appears to be no definitive acceptance of a particular exclusion distance by experts who provide analysis reports of wind farm telecommunications impacts. It is noted that the Panel Report on the Planning Permit Application and the subsequent Planning Permit issued on 30th April 2009 adopted a clearance criteria of 0.6x1st Fresnel zone after considering expert submissions on this subject. This has been adopted in this report for the VHF/UHF Links.

As the radio sites associated with the point to point links crossing the wind farm site are set back by a considerable distance from wind turbines detailed consideration of the Near Field and Reflection issues mentioned above were not required for this project.

The total width of the exclusion zone required for point to point radio links for an 82 metre diameter rotor (41 metre blade length) is 82 + 2x0.6 x Fresnel zone width, centered on the link ray line

6.2 Microwave Links (> 1 GHz)

A close up view of the microwave link ray lines near the wind turbines is shown in Attachment 4. The calculated path profiles for these links are shown in Attachment 6. All 4 microwave link path profiles indicate that there is sufficient clearance over the tips of the turbine blades (greater than 1st Fresnel zone clearance). It is therefore not necessary to specify any horizontal buffer zones.

6.3 VHF/UHF Links (< 1 GHz)

A close up view of the VHF/UHF link ray lines near the wind turbines is shown in Attachment 5. Of the 7 Links identified one operated by the CFA (Site 41712 to Site 11716) has sufficient vertical clearance so it is not necessary to specify a horizontal buffer zone for this link. The ACMA Licence for the MCS link (Site 11740 to Site 11717) is now shown as surrendered in the ACMA data and can therefore be ignored. The remaining 5 links do not have sufficient vertical clearance so horizontal clearance distances have been calculated based on 0.6 of the 1st Fresnel zone width as specified in the Section 1 (j) of the Planning Permit. The Fresnel zone width has been calculated for a representative position of turbines where they exist along each link path. This zone width may not be the maximum for each path which only occurs at the path midpoint. Path profiles of the 6 remaining links are shown in Attachment 7. A summary of the horizontal clearances to be maintained for the 5 links without vertical clearance are shown in Attachment 8 with typical calculations of the Fresnel zone clearances.

6.4 Point to Multipoint (PMP) Systems

Microwave band PMP base stations at Mt Buninyong and Mt Warrenheip operated by Aussie Broadband, Telstra, Vertical Telecoms and Kidillia respectively are not able to be assessed for potential interference as the remote customer ends are not registered. It is recommended that these organisations be corresponded with to obtain their views of any potential turbine interference potential

6.5 Radio Site Buffer Zones

The radio sites and link maps indicate that there are no radio sites within the wind farm site boundaries. The nearest radio sites external to the wind farm site are listed below for consideration

Site/ Service	**Frequency Band MHz**	**Approx. Distance to NearestTurbine km**	**Buffer Zone**	**Operator**
301191/Mob Radio Base	160	2.6 (Yendon)	OK	CFA
305764/ Mob Radio Base	470	1.22(Elaine)	OK	Sovereign Hill Museums Assoc.
302982/ Mob Radio Base	160/450	2.5(Elaine)	OK	CFA

Due to the spacing of the listed base stations being in excess of 1km no consideration of buffer zones is warranted for these omnidirectional services.

7 CONCLUSIONS

This study shows that there are 4 point to point microwave links which cross or approach the Yendon Section Wind Farm boundaries. Path profiles of the link paths indicate that there is sufficient clearance over the wind turbines and therefore horizontal clearances are not necessary. There are 5 VHF/UHF links on 4 paths which have insufficient clearance over the turbines and therefore require horizontal clearances Attachment 8 provides the clearances required to be maintained based on a 0.6x1st Fresnel zone width clearance as required by the Planning Permit. Examination of the current wind turbine layout in relation to the link paths indicate that all achieve the required calculated clearance for 41

metre long blades. Turbine YSNT03 blade tip however is 48 metres from the rayline of link path 45962 – 46209 which is marginally further than the calculated required clearance of 47.4 metres. This turbine cannot be moved any closer to the ray line should any micrositing be contemplated
No radio sites within or close to the wind farm were identified which would require the need to specify any buffer zones. The following table summarises the updated horizontal exclusion zones required centered on the link paths and uses the link ID's of the GQ-AAS report

Path ID*	0.6x 1st Fresnel Zone Max Radius	*Width of Exclusion Zone for Tower Locations*
1	30 m	*Not required adequate vertical path clearance*
2		*Link licence cancelled*
3	11.5 m	*Not required adequate vertical path clearance*
4		*Link Licence cancelled*
5	25 m	*Not required adequate vertical path clearance*
6	26 m	*Not required adequate vertical path clearance*
7	25 m	*Not required adequate vertical path clearance*
8	40 m	*162 m*
9		*Crosses Elaine Section*
10		*Crosses Elaine Section*
11	33.5 m	*149 m*
12	37 m	*156 m*
13	47.4 m	*177 m*
14		*Link Licence cancelled*

*Note: Path ID's used are from GQ-AAS Peer Review Report

Table of Total Horizontal Exclusion Zone Widths Required

MapInfo files of the identified point to point links are available for importing into a GIS system for WestWind Energy to create exclusion zone maps for the links if required.

In relation to microwave Point to Multipoint systems with base stations licenced at nearby hill top sites it is recommended that the operators listed above be advised of the wind farm proposal as the customer ends of these systems are not listed in the ACMA database and therefore any impact to individual paths cannot be assessed.

8 REFERENCES

[1] J. Moon, Assessment of Electromagnetic Interference Issues for the Proposed Lal Lal Wind Farm, Garrad Hassan Doc 2635/PR/001 13 July 2007

[2] Tony Bower, Peer Review of Garrad Hassan Report – Lal Lal Wind Farm, Gibson Quai Letter Ref 61859 of 1 October 2007

[3] Moorabool Shire Council, Planning Permit No PL-SP/05/0461, issued 30 Apr 2009.

[4] Fixed-Link wind-turbine exclusion zone method, Version 1.1, 28 October 2002, D.F. Bacon, OFCOM UK

[5] Guidelines for Minimizing the Impact of Wind Farms on the SAGRN, Issue 1, 22 October 2003, Rohan Fernandez, Telstra SA, Document TR049-SA

[6] Wind Farms Impact on Radar Aviation Interests-Final Report, September 2003, FES W/14/00614/00/REP, Contractor QinetiQ Prepared by Gavin J Poupart.

[7] Mahinerangi Wind Farm, Compatibility with Radio Services, 3 April 2007, Anton Pereira & Richard Brown, Kordia NZ

[8] Project Hayes, Compatibility with Radio Services, 7 July 2006, Duncan Chisholm, BCL NZ

[9] Electromagnetic Interference from Wind Turbines, Sengupta & Senior, Chapter 9, Wind Turbine Technology Ed. David E. Spera ASME Press 1994

9 GLOSSARY OF TECHNICAL TERMS

ACMA ..... Australian Communications & Media Authority

Coning Angle ..... Angle of turbine blades from 90 degrees to shaft

FM ..... Frequency Modulation

Fresnel Zone ..... Clearance to obstructions from the ray line on a radio path which does not produce any additional loss above free space loss

GRN ..... Government Radio Network (SA)

Nacelle ..... Housing for wind generator on top of turbine tower

Omnidirectional ..... Transmission in 360 degrees of azimuth with equal radiated power

RCS ..... Radar Cross section

SA DTEI ..... South Australian Department of Transport, Energy & Infrastructure

SCADA ..... Supervisory Control & Data Acquisition

VHF ..... Very High Frequency

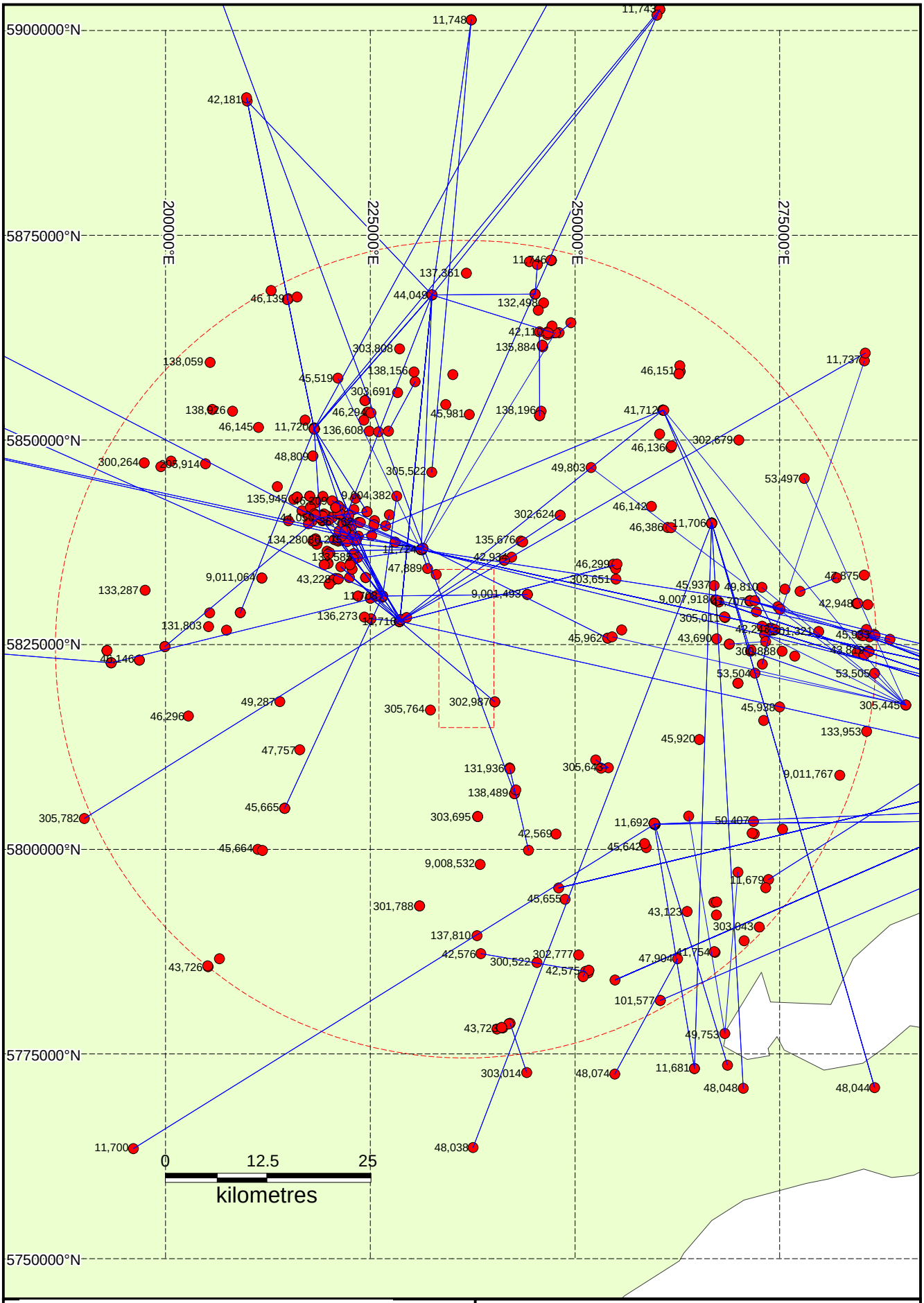
UHF ..... Ultra High Frequency

ATTACHMENT 1 WIND TURBINE CO ORDINATES YENDON SECTION

Identifier	Zone	Easting	Northing	Elevation	Map Grid Australia 1994
YSWT01	55H	235749	5834082	520	Australian Height Datum
YSWT02	55H	236288	5834090	531	
YSWT03	55H	237834	5834197	542.8	
YSWT04	55H	236751	5833682	527.9	
YSWT05	55H	237479	5833611	529.1	
YSWT06	55H	237872	5833859	529.1	
YSWT07	55H	236422	5833305	530	
YSWT08	55H	236950	5833099	533.1	
YSWT09	55H	237383	5833222	537.1	
YSWT10	55H	236427	5832689	511.1	
YSWT11	55H	236867	5832295	509	
YSWT12	55H	237362	5832449	511.1	
YSWT13	55H	237778	5832435	519.1	
YSWT14	55H	237721	5831776	516	
YSWT15	55H	237577	5831353	509	
YSWT16	55H	238492	5832517	517.9	
YSWT17	55H	238292	5832087	520	
YSWT18	55H	238663	5831719	509.9	
YSWT19	55H	238151	5831503	512.1	
YSWT20	55H	237011	5830822	498	
YSWT21	55H	236257	5830315	488.9	
YSWT22	55H	236743	5830314	477.9	
YSWT23	55H	236485	5829872	491.9	
YSWT24	55H	236209	5829599	484	
YSWT25	55H	237009	5829643	491	
YSWT26	55H	235996	5829179	474.9	
YSWT27	55H	236816	5829207	484.9	
YSWT28	55H	235859	5828710	474.9	
YSWT29	55H	236585	5828803	47.9	
YSWT30	55H	237553	5830953	505.1	
YSWT31	55H	237935	5831086	516	
YSWT32	55H	239265	5831110	516	
YSWT33	55H	237473	5830494	502	
YSWT34	55H	238063	5830698	505	
YSWT35	55H	238489	5830840	505	
YSWT36	55H	239624	5830764	508.1	
YSWT37	55H	238726	5830234	505.1	
YSWT38	55H	239378	5830392	498	
YSWT39	55H	240083	5830399	501.1	
YSWT40	55H	239743	5830040	491	

ATTACHMENT 2

MAP OF RADIO LINKS & SITES OPERATING BELOW 1000 MHz



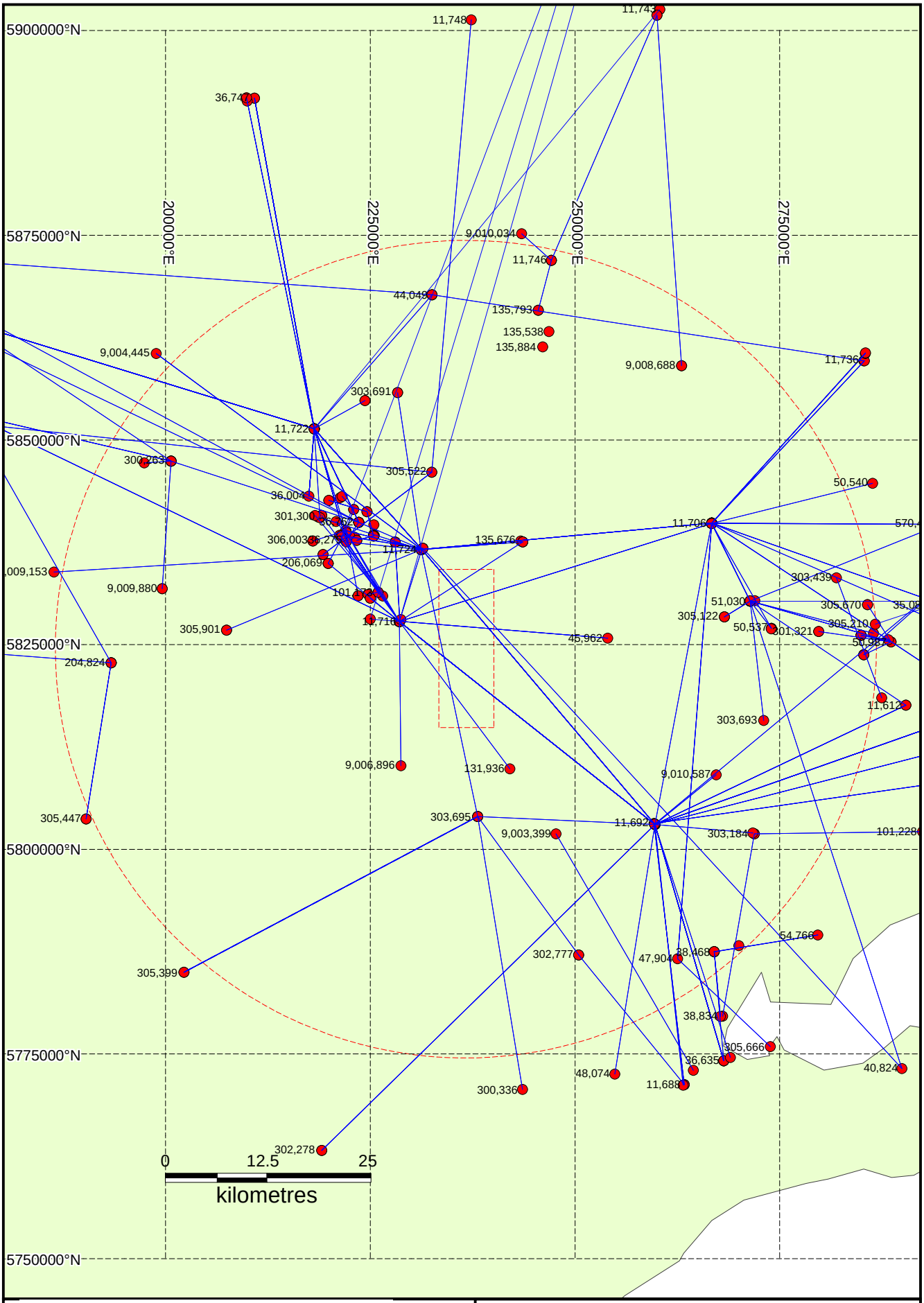
SPECTRUM ENGINEERING AUSTRALIA Pty Limited A.C.N. 008 642 028
Radiocommunications Planning and Design
Postal: P.O. Box 3213, BELCONNEN ACT 2617
Telephone: 02 6253 2555
Facsimile: 02 6253 2800

TITLE: **40-999 MHz Assignments As Extracted from RRL Database**

FILENAME:	40-999 MHz Lal Lal	DATE:	9/7/2010
PROJECT:	Lal Lal	SCALE:	N/A
DRWG NO:	1 of 2	BY:	SEA

ATTACHMENT 3

MAP OF RADIO LINKS & SITES OPERATING ABOVE 1000 MHz



SPECTRUM ENGINEERING AUSTRALIA *Pty Limited A.C.N. 008 642 028*

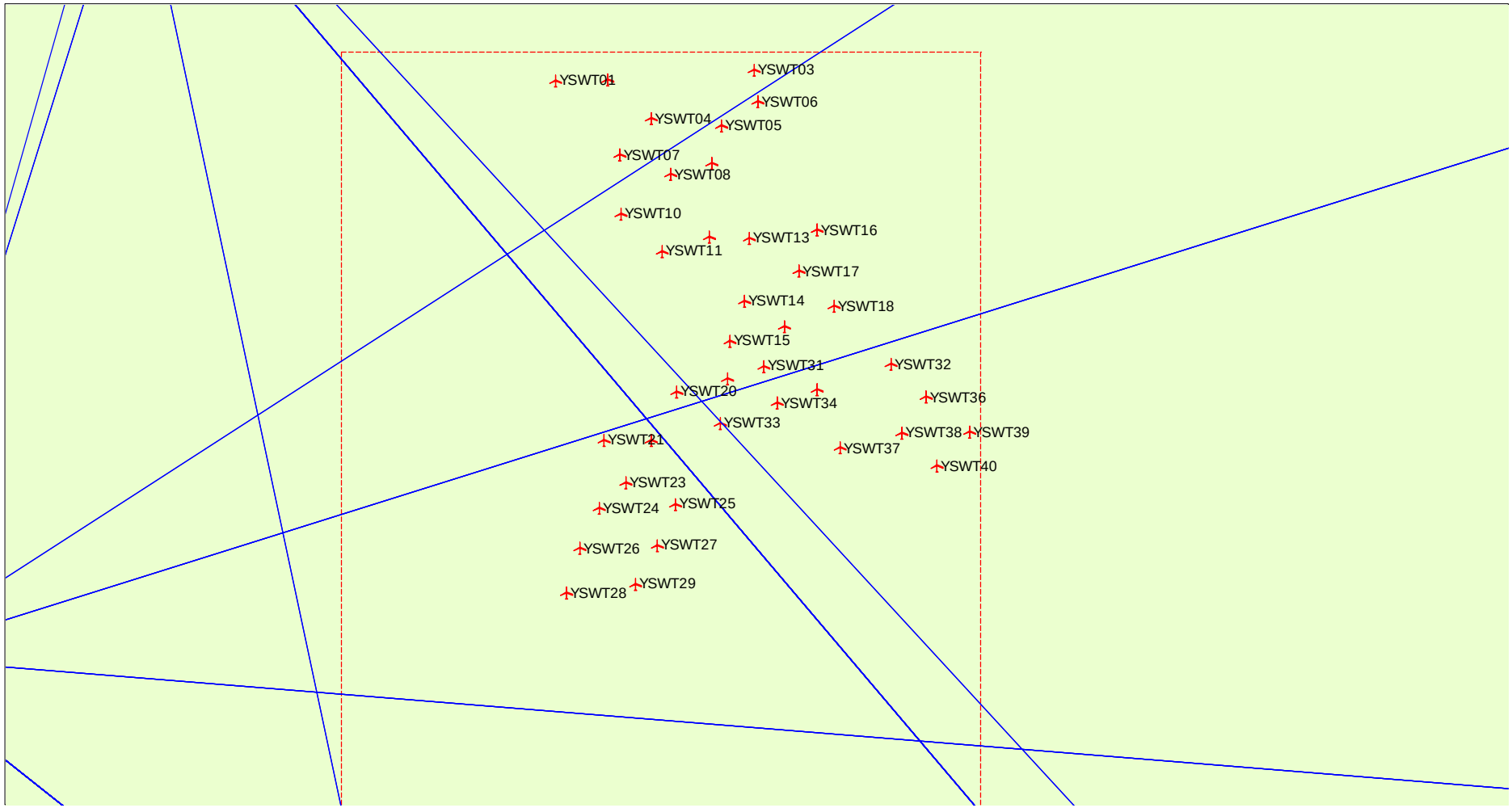
Radiocommunications Planning and Design

Postal: P.O. Box 3213, BELCONNEN ACT 2617
Telephone: 02 6253 2555
Facsimile: 02 6253 2800

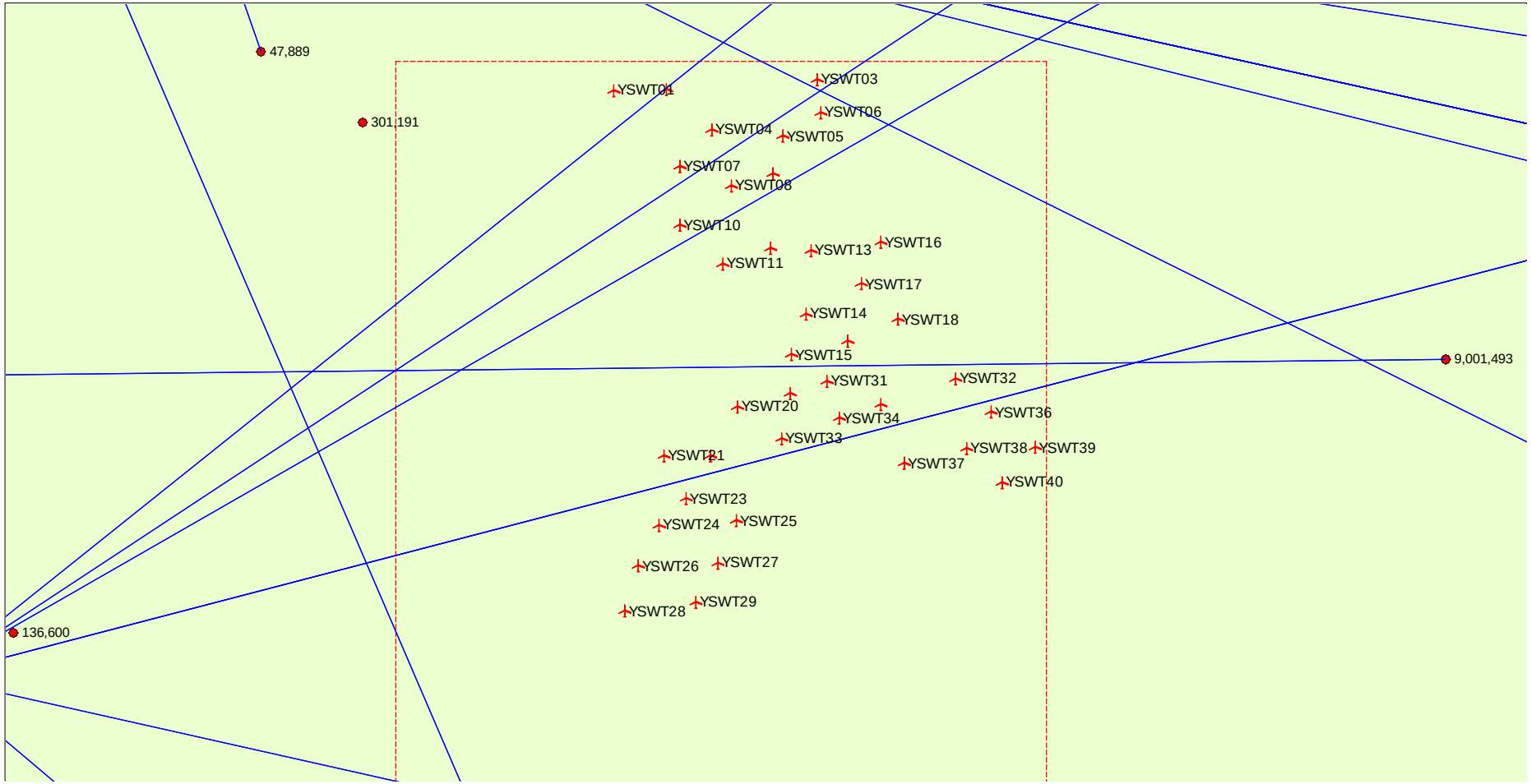
TITLE: **Above 1 GHz Assignments As Extracted from RRL Database**

FILENAME:	Above 1 GHz Lal Lal	DATE:	9/7/2010
PROJECT:	Lal Lal	SCALE:	N/A
DRWG NO:	2 of 2	BY:	SEA

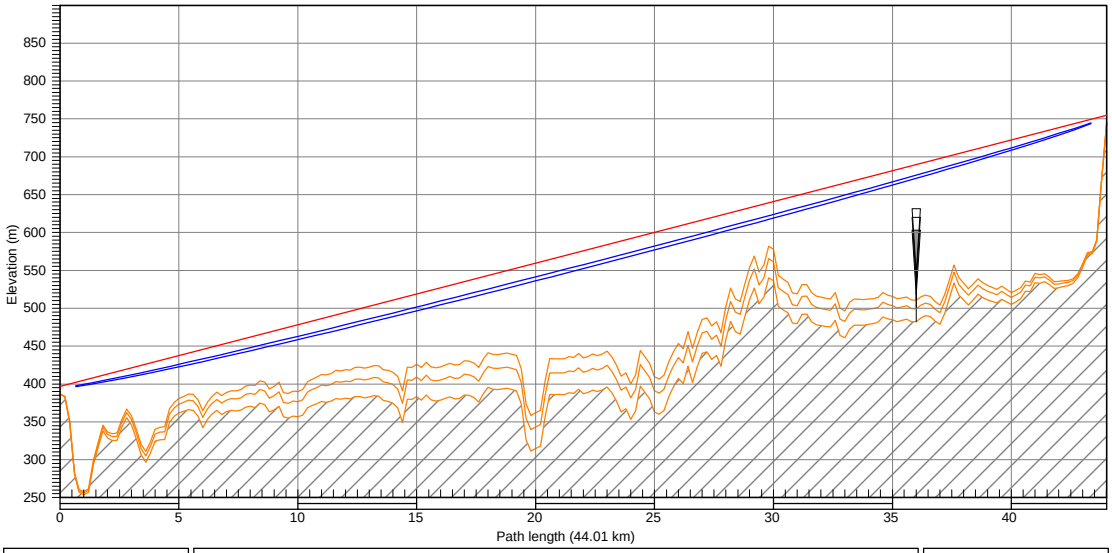
ATTACHMENT 4 MICROWAVE RADIO LINK PATHS NEAR WIND TURBINES



ATTACHMENT 5 VHF/UHF RADIO LINK PATHS NEAR WIND TURBINES

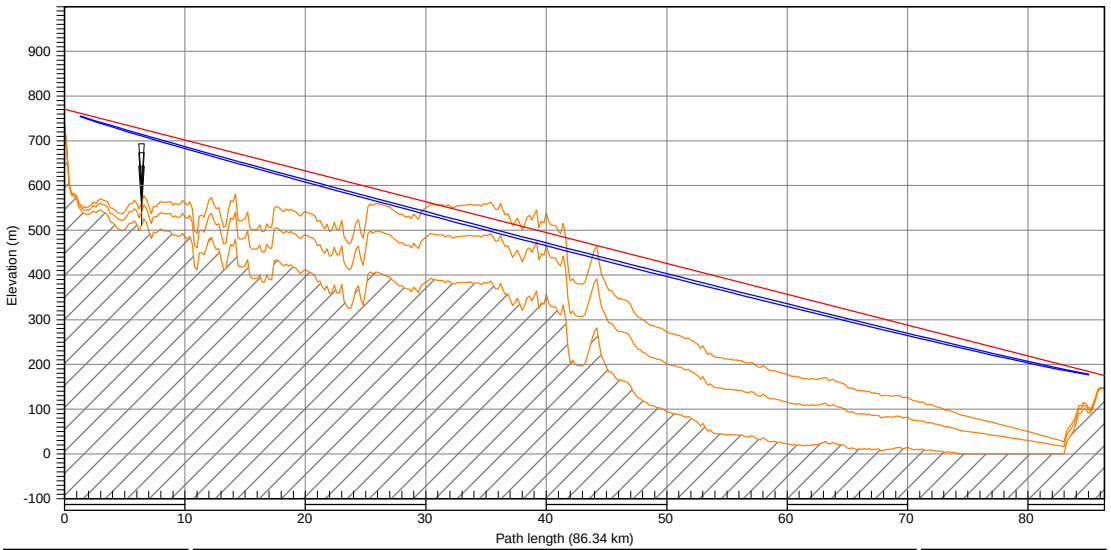


ATTACHMENT 6 PATH PROFILES FOR MICROWAVE LINKS



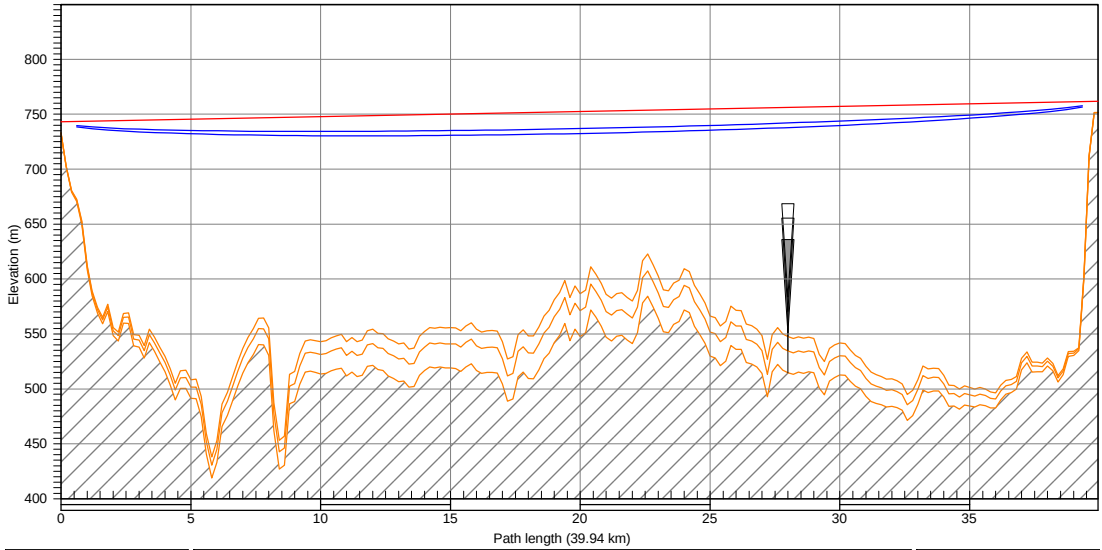
11693		Frequency (MHz) = 6000.0	11724	
Latitude	37 53 12.78 S	K = 0.80, 1.33	Latitude	37 34 36.03 S
Longitude	144 16 09.71 E	Fn = 0.60, 1.00	Longitude	143 57 30.05 E
Azimuth	321.37°		Azimuth	141.57°
Elevation	387 m ASL		Elevation	745 m ASL
Antenna CL	10.0 m AGL	Lawrence Derrick & Associates	Antenna CL	10.0 m AGL

	Aug 09 10	



150365		Frequency (MHz) = 7500.0	40824	
Latitude	37 34 31.32 S	K = 0.80, 1.33	Latitude	38 09 46.16 S
Longitude	143 57 36.59 E	Fn = 0.60, 1.00	Longitude	144 36 12.06 E
Azimuth	139.24°		Azimuth	318.85°
Elevation	738 m ASL		Elevation	145 m ASL
Antenna CL	32.5 m AGL	Lawrence Derrick & Associates	Antenna CL	30.0 m AGL

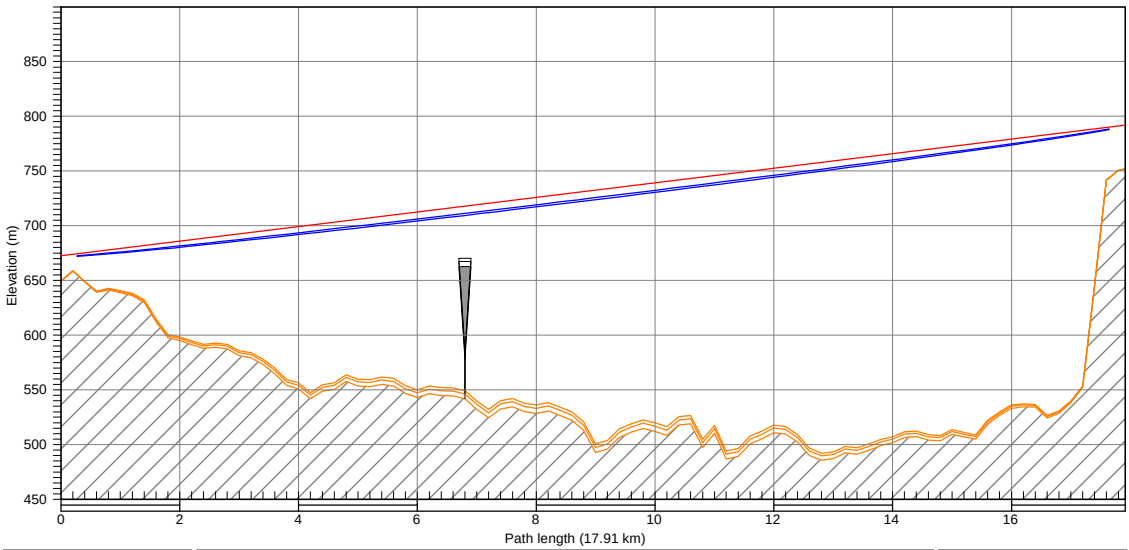
	Aug 09 10	



11707		Frequency (MHz) = 7500.0 K = 0.80, 1.33 Fn = 0.60, 1.00	11717	
Latitude	37 33 27.57 S		Latitude	37 39 17.74 S
Longitude	144 21 34.93 E		Longitude	143 55 27.00 E
Azimuth	254.19°		Azimuth	74.45°
Elevation	733 m ASL		Elevation	752 m ASL
Antenna CL	10.0 m AGL		Antenna CL	10.0 m AGL

Lawrence Derrick & Associates

	Aug 09 10	

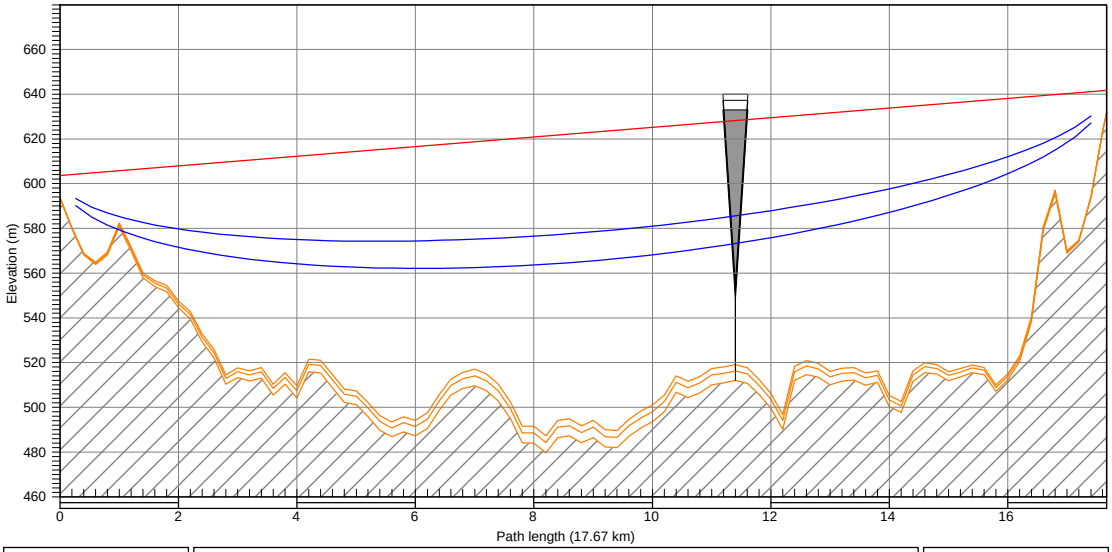


300281		Frequency (MHz) = 18000.0 K = 0.80, 1.33 Fn = 0.60, 1.00	11717	
Latitude	37 34 18.44 S		Latitude	37 39 17.74 S
Longitude	144 05 53.11 E		Longitude	143 55 27.00 E
Azimuth	238.94°		Azimuth	59.05°
Elevation	649 m ASL		Elevation	752 m ASL
Antenna CL	23.0 m AGL		Antenna CL	40.0 m AGL

Lawrence Derrick & Associates

	Aug 09 10	

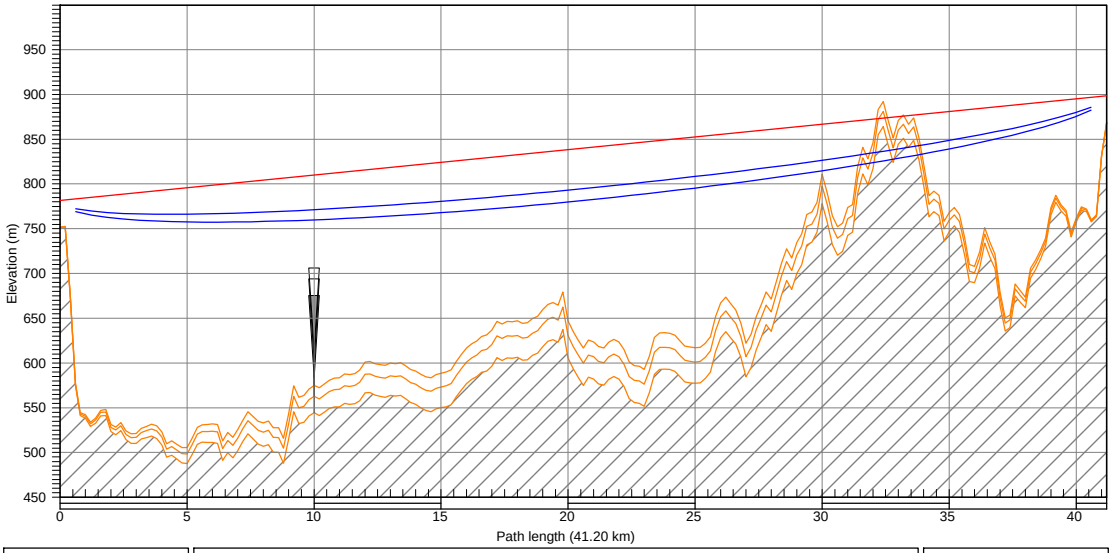
ATTACHMENT 7 PATH PROFILES VHF/UHF RADIO LINKS



301006		Frequency (MHz) = 400.0	9001493	
Latitude	37 37 35.08 S	K = 0.80, 1.33	Latitude	37 37 47.33 S
Longitude	143 54 08.13 E	Fn = 0.60, 1.00	Longitude	144 06 08.52 E
Azimuth	91.29°		Azimuth	271.16°
Elevation	594 m ASL		Elevation	632 m ASL
Antenna CL	10.0 m AGL		Antenna CL	10.0 m AGL

Lawrence Derrick & Associates

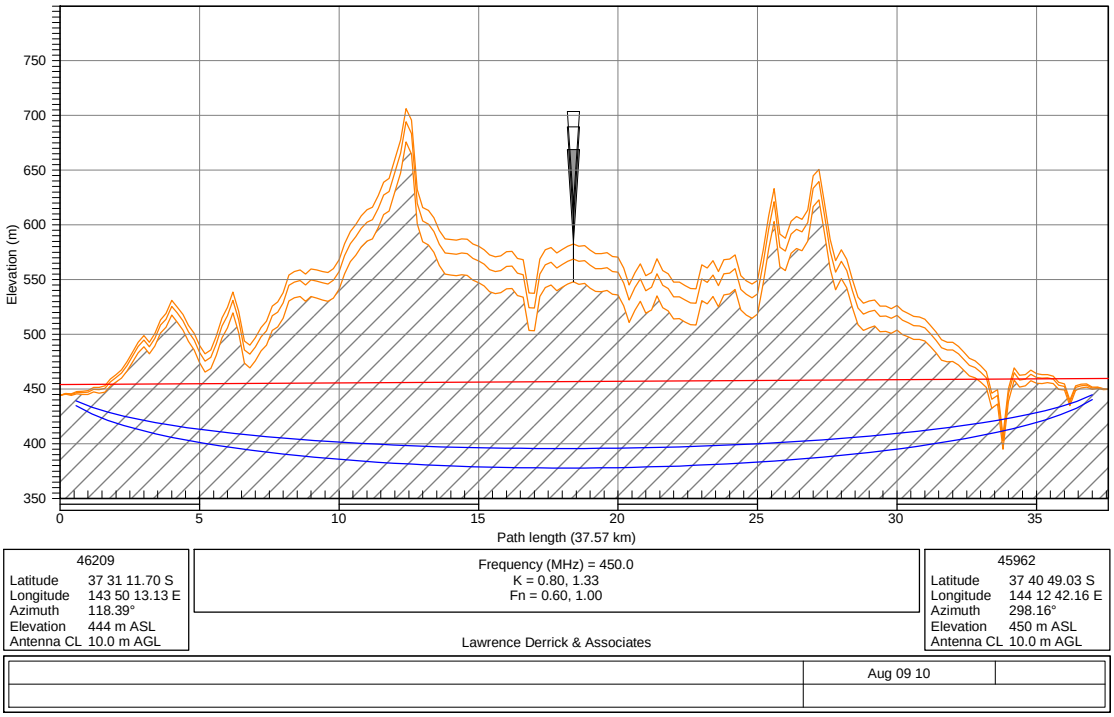
	Aug 09 10	



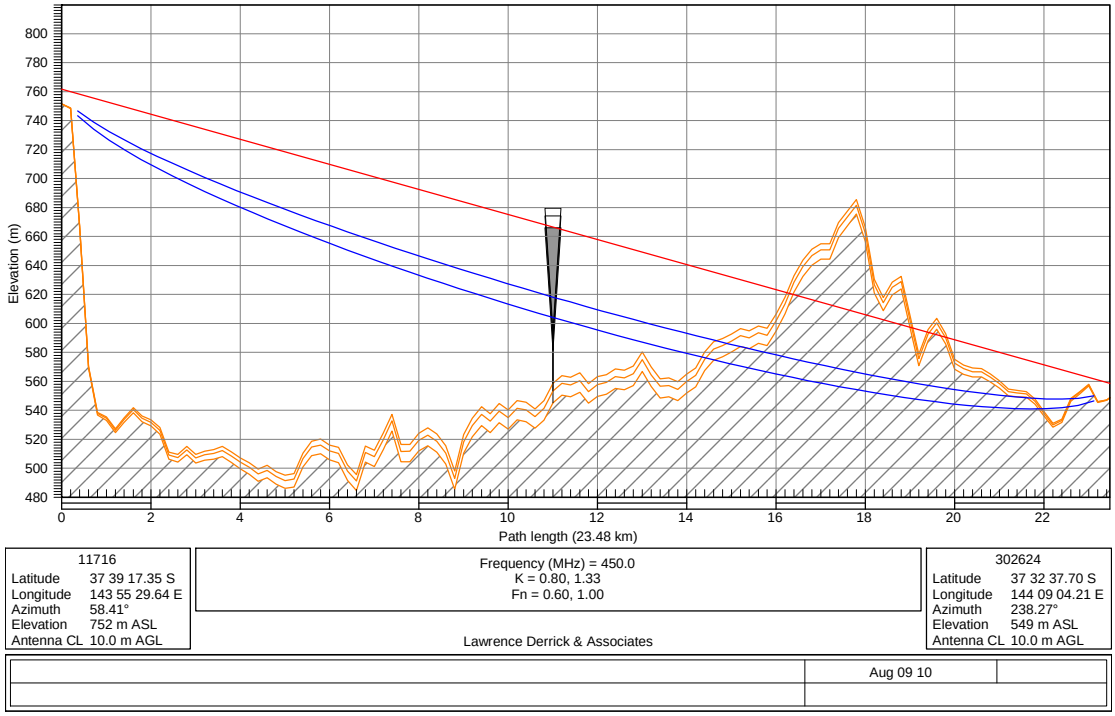
11716		Frequency (MHz) = 900.0	41712	
Latitude	37 39 17.35 S	K = 0.80, 1.33	Latitude	37 25 53.22 S
Longitude	143 55 29.64 E	Fn = 0.60, 1.00	Longitude	144 17 50.09 E
Azimuth	53.12°		Azimuth	232.89°
Elevation	752 m ASL		Elevation	869 m ASL
Antenna CL	30.0 m AGL		Antenna CL	30.0 m AGL

Lawrence Derrick & Associates

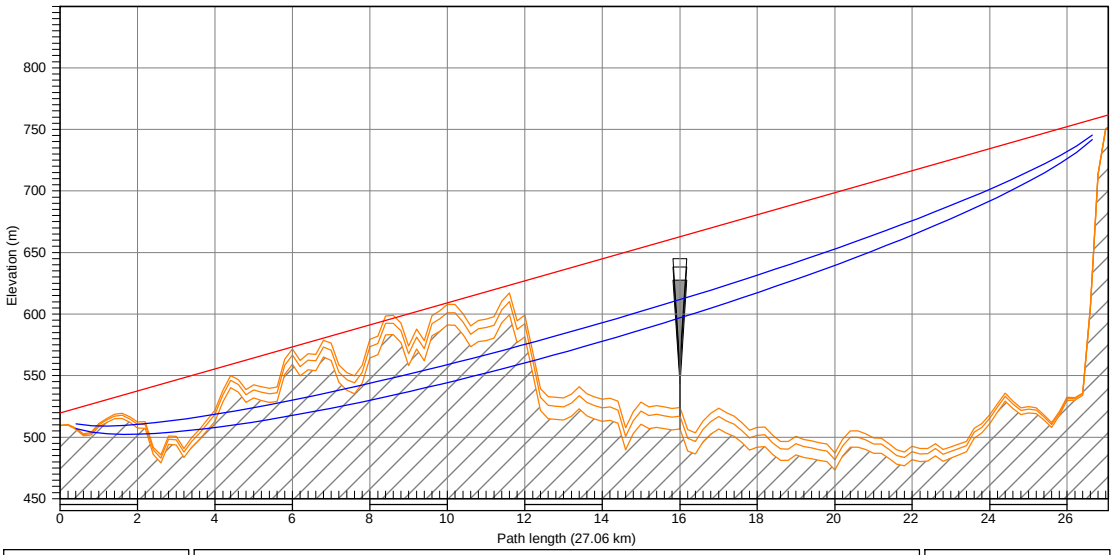
	Aug 09 10	



Note: Apparently an obstructed path using diffraction over mountain tops unless coords are in error



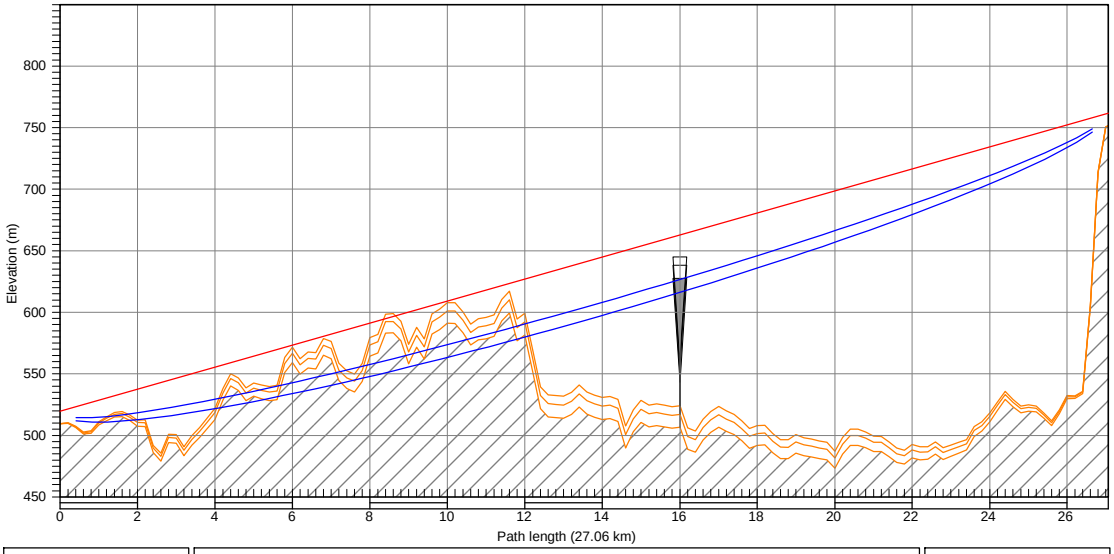
Note: Apparently an obstructed path using diffraction over obstruction



46299		Frequency (MHz) = 450.0	11716	
Latitude	37 36 01.81 S	K = 0.80, 1.33	Latitude	37 39 17.35 S
Longitude	144 13 25.52 E	Fn = 0.60, 1.00	Longitude	143 55 29.64 E
Azimuth	257.04°		Azimuth	77.22°
Elevation	510 m ASL		Elevation	752 m ASL
Antenna CL	10.0 m AGL		Antenna CL	10.0 m AGL

Lawrence Derrick & Associates

	Aug 09 10	



46299		Frequency (MHz) = 900.0	11716	
Latitude	37 36 01.81 S	K = 0.80, 1.33	Latitude	37 39 17.35 S
Longitude	144 13 25.52 E	Fn = 0.60, 1.00	Longitude	143 55 29.64 E
Azimuth	257.04°		Azimuth	77.22°
Elevation	510 m ASL		Elevation	752 m ASL
Antenna CL	10.0 m AGL		Antenna CL	10.0 m AGL

Lawrence Derrick & Associates

	Aug 09 10	

ATTACHMENT 8 – RADIO LINK CLEARANCE ZONES

VHF & UHF LINKS CLEARANCES

									Site 1 Grid Ref			Site 2 Grid Ref	
Site 1	Site 2	Operator	Freq MHz	Path m	dist m	2nd fresnel m	0.6 x Ist fresnel m	Z	GDA		Z	GDA	
9001493	301006	C Highlands Radio	400	17610	6720	78.95	33.50	55	244294	5831307	54	756126	5831672
41712	11716	CFA	900	41170	9680	70.26	29.81	55	260862	5853834	54	758026	5828457
45962	46209	CFA	450	37530	18200	111.80	47.43	55	254112	5825984	54	750721	5843677
302624	11716	CFA	450	23510	11200	88.43	37.52	55	248312	5840984	54	758026	5828457
11740	11717	MCS Lic cancelled	900	65590	11000	78.12	33.15	55	285582	5860804	54	757961	5828447
46299	11716	CFA	900	27000	11240	66.14	28.06	55	254912	5834884	54	758026	5828457
46299	11716	CFA	450	27000	11240	93.53	39.68	55	254912	5834884	54	758026	5828457

Note: The Licence for the MCS Link 11740 to 11717 has been surrendered so no exclusion zone is required
The CFA link 41712 to 11716 has sufficient vertical clearance over the wind turbines so no horizontal exclusion zone is required
As there are 2 CFA links operating on the 46299 to 11716 path the lower frequency of 450 MHz sets the buffer zone limits (wider)

MICROWAVE LINK CLEARANCES

Site 1	Site 2	Freq	D1	D2	2nd Fresnel	Operator	Zone	Site 1 Grid Ref		Zone	Site 2 Grid Ref	
ACMA ID	ACMA ID	Mhz	Metres	Metres	Metres			GDA 94			GDA 94	
11724	11693	6000	9000	44020	26.75804	DDA	54	761251	5837037	55	259867	5803220
150365	40824	7500	8800	86340	25.14451	Lake Imaging	54	761416	5837177	55	290032	5773405
11707	11717	7500	11100	39870	25.31356	Telstra	55	266782	5839985	54	757961	5828448
300281	11717	19000	11100	17900	11.53953	Telstra	55	243717	5837735	54	757961	5828448

Note: All the above microwave links appear to have sufficient vertical clearance over the wind turbines so the calculated horizontal clearances do not need to be applied