Energy3 Services Limited

As Built Documentation

For:

Windy Company Ltd.

Windy Site

Big Hill
AUSTRALIA

80m XHD NRG Mast

NRG Symphonie Plus Datalogger

1st January 20XX

As Built Wind Mast Documentation

Client Windy Company Ltd.

Date of Commissioning 1st January 20XX @ approx 1200h (local time)

Site Supervisor Thomas Cameron

Client Contract Number XX-YY-1234

Address	Windy Site, Big Hill, Australia
Map Reference	**UTM X** xxxxxx **UTM Y** yyyyyyy (Datum WGS84 / Zone 5XY) **Latitude** -XX.87361° **Longitude** YY.23966°
Altitude of Mast at Ground Level	XXXm
Mast Type	NRG XHD 80m Mast (Tubular Tilt-Up, Painted)
Land Owner / Manager	Client X
Contact Person	Foehn Windy
Phone Details	+61 XXX XXX XXX
Access	• Good off-road access from main road down well formed soil track. Track became quite rutted after several trips. Care to be taken and speed to be kept low.
Installation Issues	• Tractor with back hoe not allowed on site site due to slight hydraulic fluid leak • Wind direction behind mast on day of lift

Author _____
Matt Buchan

Reviewed _____
Thomas Cameron

1.0 Location Map – Viewed from 1.36 km AGL

2.0 Location Map – Viewed from 20.44 km AGL

3.0 Instrument Details

Unit Description	Specification	Serial Number	Comments/ Calibration
80m Instruments:			
Vector A100R/K Anemometer	MEASNET Calibrated	Body 12351 / Rotor EDD6	Slope 1.27195, Offset 0.176
NRG #40C Anemometer	MEASNET Calibrated	179500203588	Slope 0.763, Offset 0.31
NRG #200P Wind Vane	#200P	n/a	Slope 0.351, Offset 138
70m Instruments:			
NRG #40C Anemometer (1)	MEASNET Calibrated	179500203593	Slope 0.763, Offset 0.28
NRG #40C Anemometer (2)	MEASNET Calibrated	179500203594	Slope 0.771, Offset 0.28
NRG #200P Wind Vane	#200P	n/a	Slop 0.351, Offset 138.0
60m Instruments:			
NRG #40C Anemometer (1)	MEASNET Calibrated	179500203591	Slope 0.762, Offset 0.30
NRG #40C Anemometer (2)	MEASNET Calibrated	179500203592	Slope 0.768, Offset 0.27
NRG #200P Wind Vane	#200P	n/a	Slope 0.351, Offset 138.0
Other Instruments:			
Temperature Sensor & Shield	NRG #110S	n/a	Slope 0.136, Offset -86.38
Relative Humidity Sensor	NRG RH5X	4414	Slope 0.097, Offset 0.0
Aircraft Avoidance Light	Carmanah M650	1330111298	Solid-on red at night
Enclosure:			
Datalogger	NRG SymphoniePlus3	494102156	Hardware Rev. 034-034-057
Modem	NRG Satellite iPack	462000413	To be fitted
Enclosure	NRG Shelter Box	n/a	-

3.1 Anemometer Calibration & Boom Details

Instrument	Channel	Azimuth (°)	Serial Number	Exact Boom Height (m)*	Multiplier (m/s per Hz)	Offset (m/s)
Vector A100R/K	Flex 4	318	12351 / EDD6	80.10	1.27195	0.176
NRG #40C	C1	228	1795002030588	79.70	0.763	0.31
NRG #40C (1)	C2	318	1795002030593	70.47	0.763	0.28
NRG #40C (2)	C3	228	1795002030594	70.00	0.771	0.28
NRG #40C (1)	C13	318	1795002030591	60.75	0.762	0.30
NRG #40C (2)	C14	228	1795002030592	60.16	0.768	0.27

***Note** - Instrument height is from mast base to the centre of boom mast mount, please see Section 3.3 for up-stand heights.*

3.2 Wind Vane & Boom Details

Instrument	Channel	Azimuth (°)	Serial Number	Exact Boom Height (m)*	Multiplier	Offset (deg)
NRG #200P	A7	318	n/a	78.15	0.351	138
NRG #200P	A8	318	n/a	68.40	0.351	138
NRG #200P	A9	318	n/a	58.74	0.351	138

***Note** - Instrument height is from mast base to the centre of boom mast mount, please see Section3.3 for up-stand heights.*

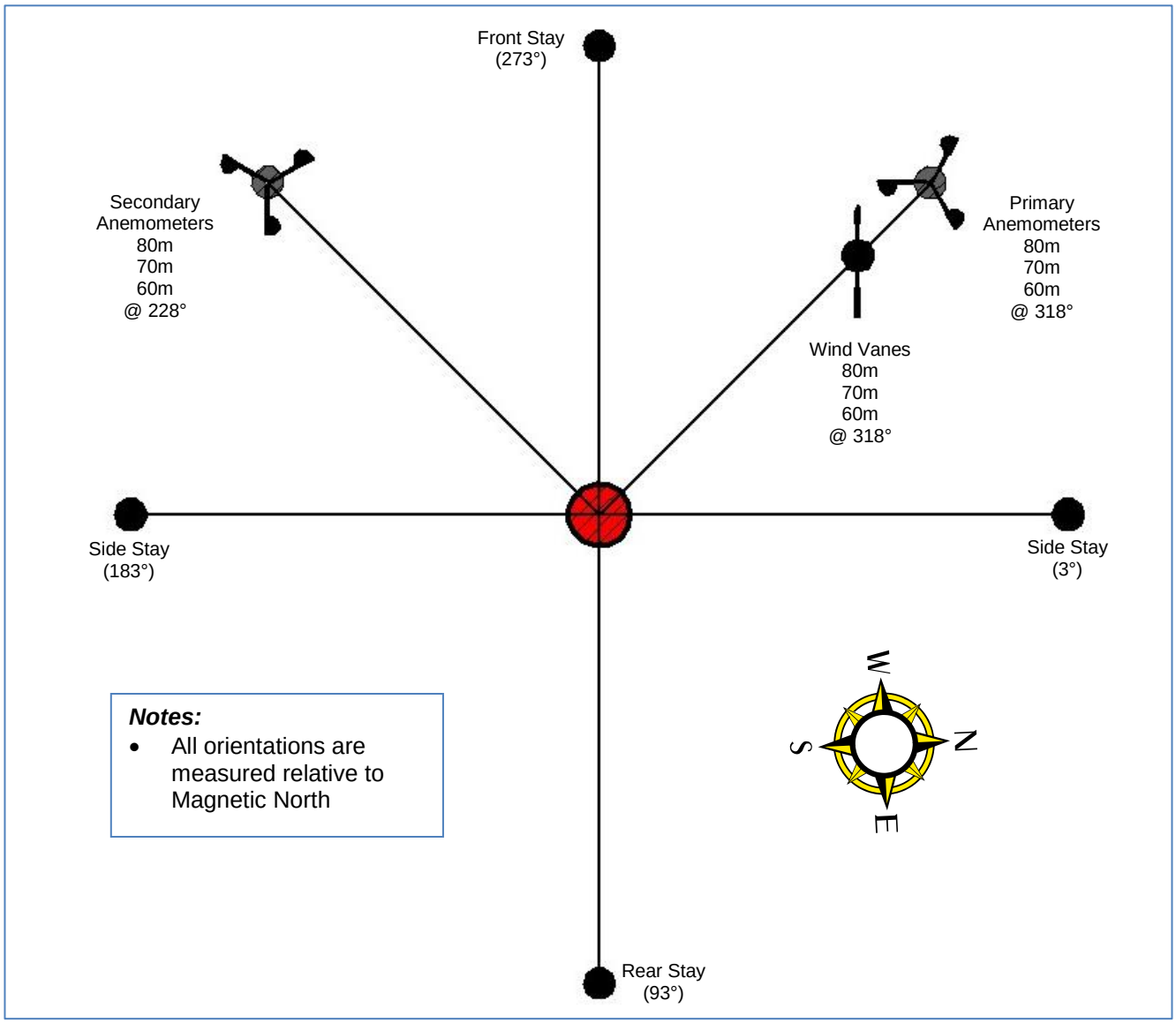
3.3 Boom Details

All instrument booms are NRG 2.4m Galvanised Steel booms (NRG Part # 4214). These booms meet or exceed industry IEC 61400-12-1 recommendations for tower and boom offset distances. Dimensions are given in the table below:

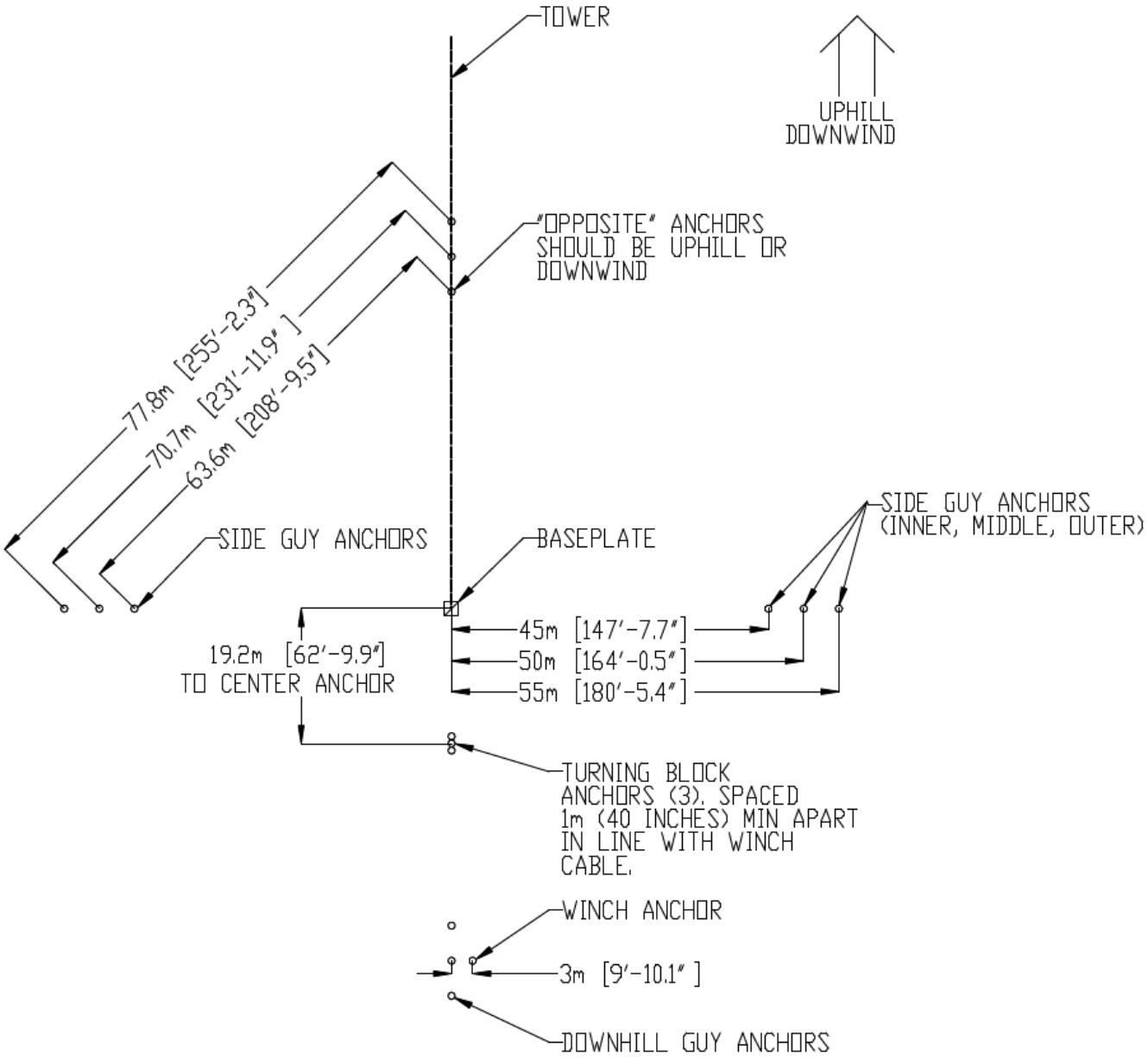
Boom Manufacturer	Cross Arm Length (mm) [1]	Up-stand Length (mm) [2]	Cross Arm Diameter (mm) [3]	Up-stand Diameter (mm) [4]
NRG	2400	381	15.8	13.0

[1] *- Overall boom length.*
[2] *- Distance measured from top of the mounting boom to the centerline of the swept area of anemometer. This distance corresponds to about 15 diameters of the horizontal boom.*
[3] *- Cross arm O.D.*
[4] *- At instrument mounting location.*

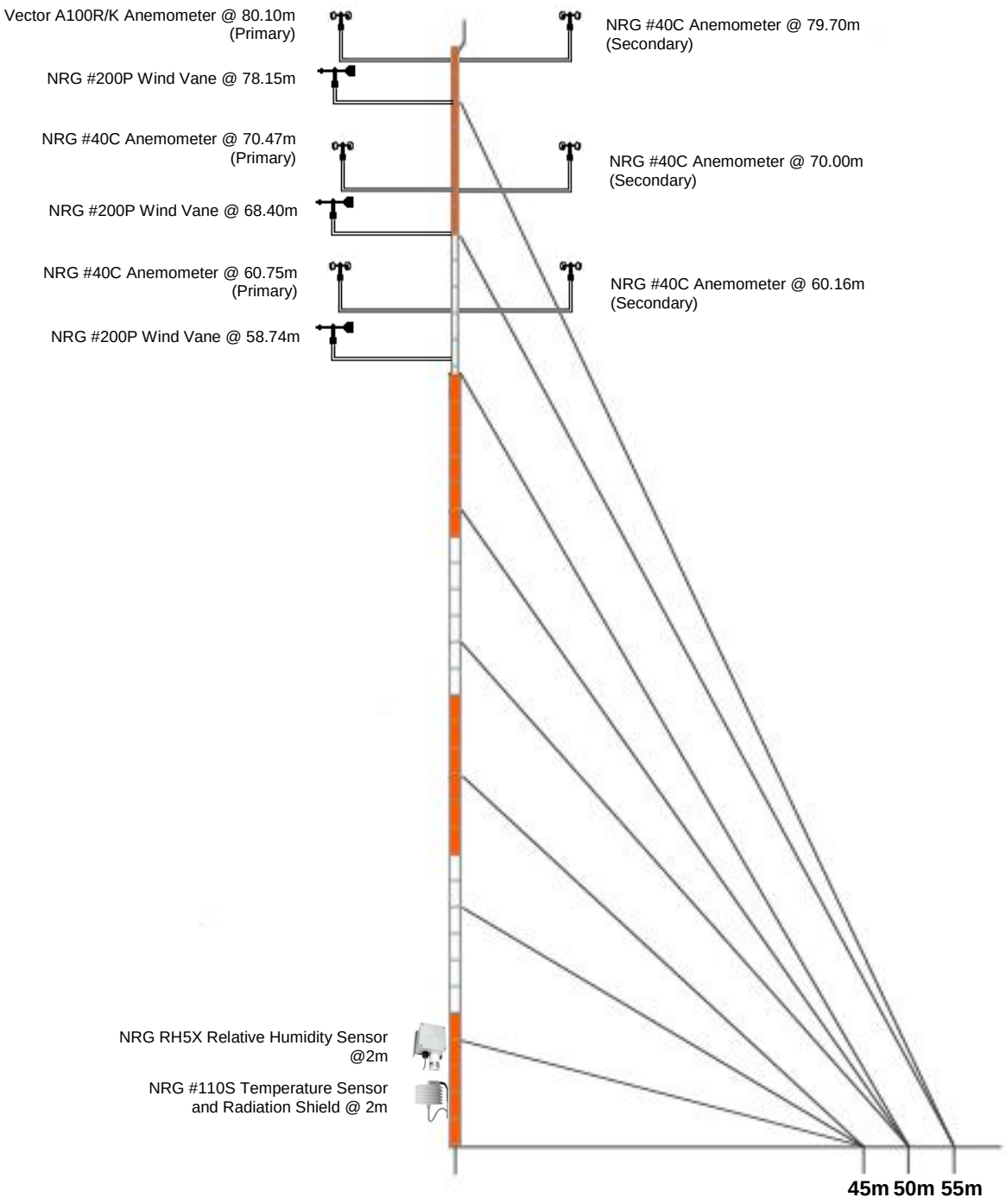
4.0 Boom Orientation Schematic



5.0 Site Layout Plan



6.0 Mast Instrument Schematic



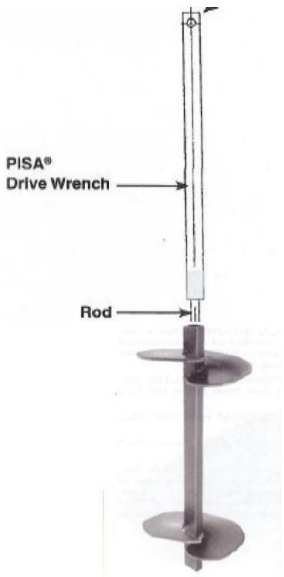
Note: Booms not drawn to scale (schematic only)

7.0 Anchors

NRG Double Helix Screw-In anchors were used, as the soil type at this site was found to be ideal for the use of this type of anchor. The anchors are 203 mm (8 in) in diameter and are constructed of galvanised steel. They have the following specifications:

Length Overall:	2.7 m (9 feet) (including 7 foot rod)
Helix Diameter:	203 mm (8.0 inches)
Materials:	TBD
Holding Power:	
Class 3 soils *	12700 kg (28000 pounds)
Class 4 soils *	10900 kg (24000 pounds)
Class 5 soils *	9090 kg (20000 pounds)
Class 6 soils *	6800 kg (15000 pounds)
Class 7 soils *	5450 kg (12000 pounds)

The anchors were installed utilizing a Bobcat excavator with a hydraulic auger drive. All anchors were installed to the maximum possible depth. One anchor from each group was pull tested using a hollow hydraulic ram and hand-pump. All anchors were pull tested to approximately 2200 psi which equates to 66.7kN as prescribed in the specifications from NRG.



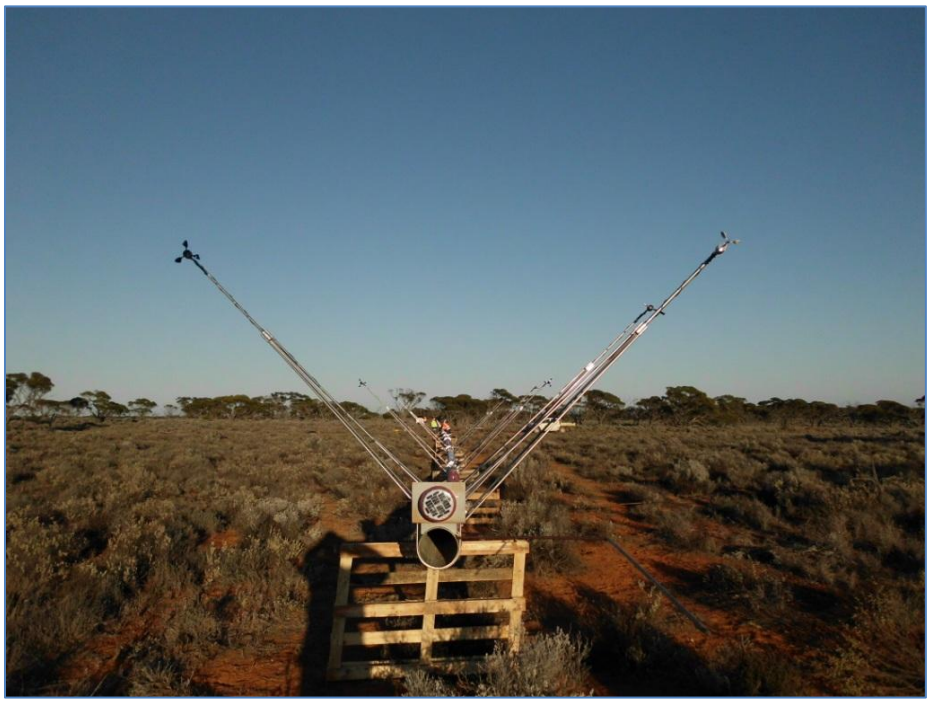
8.0 Photos

Excavator being used to Install Anchors

Anchors Prior to Installation

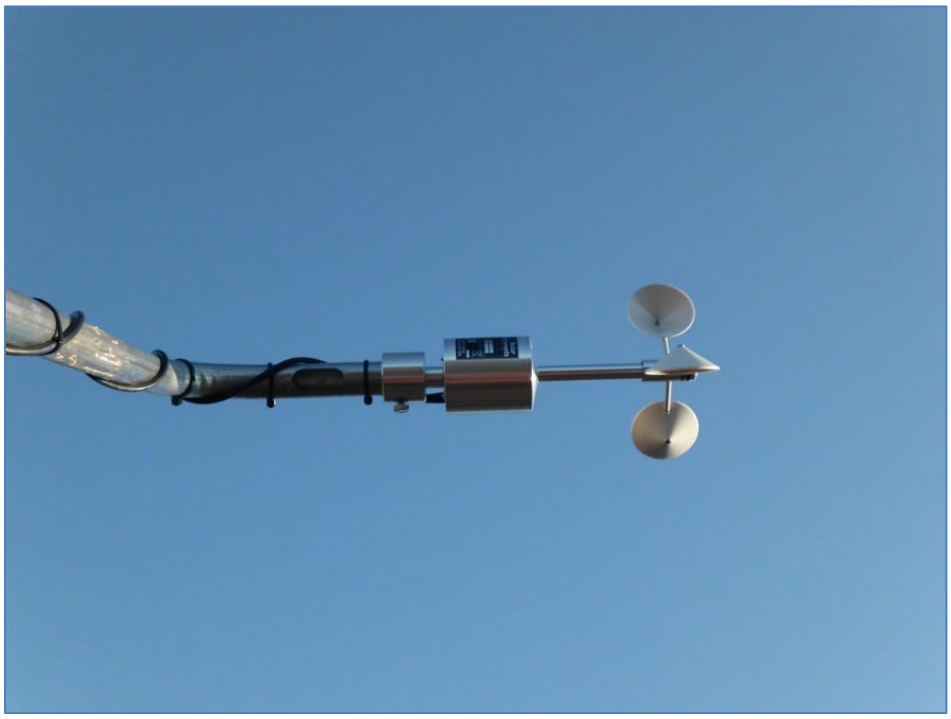
Pull Testing of the Anchors to 66.7Kn

Typical Pull Test Showing >2000 psi (>66.7kN)

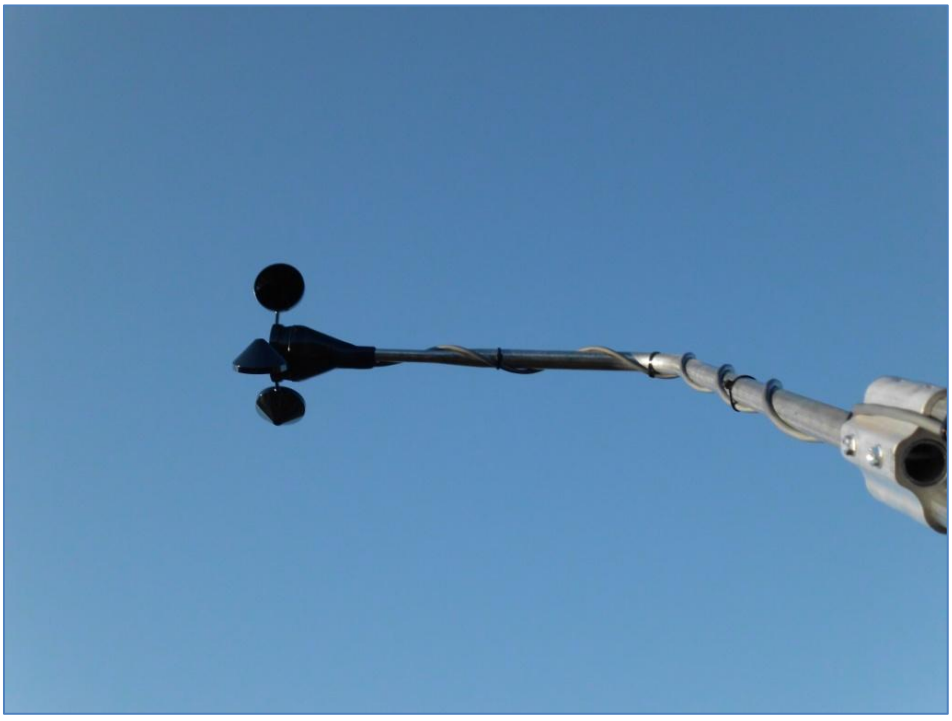


View of Mast from Top End Showing Aviation Light

Aviation Light and Lightning Rod as Mounted



Vector A100R/K Anemometer at 80m



NRG #40C Anemometer at 80m

NRG #200P Wind Vane at 80m

NRG #40C Primary Anemometer at 70m

NRG #40C Secondary Anemometer at 70m

NRG #200P Wind Vane at 70m

NRG #40C Primary Anemometer at 60m

NRG #40C Secondary Anemometer at 60m

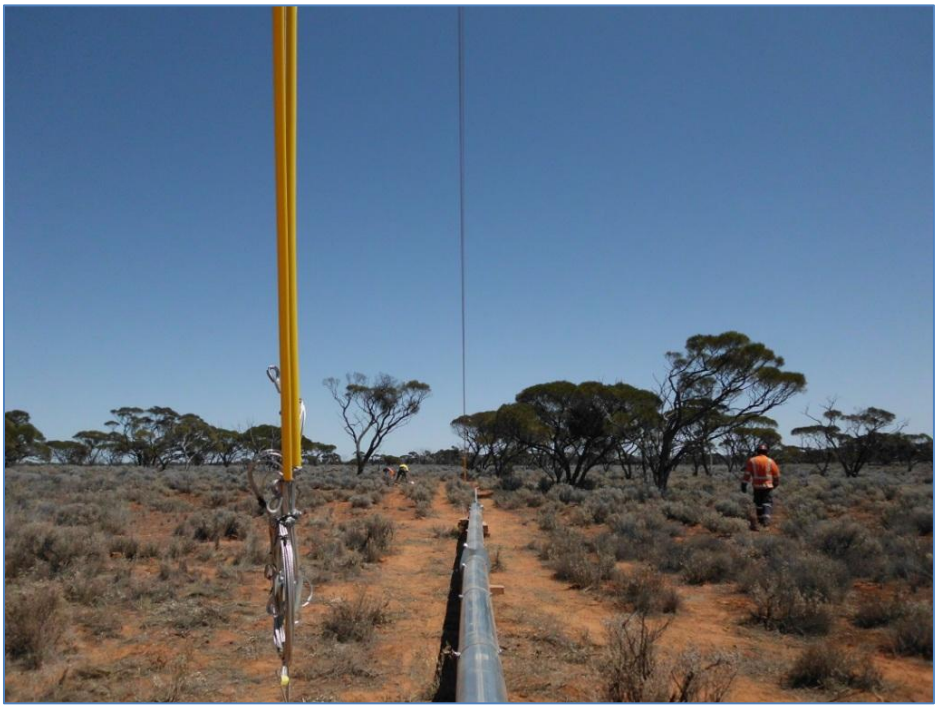
NRG #200P Wind Vane at 60m

Instrument Cables Neatly Spiraled Down Mast

Foam Added for Cable Protection at Guy Attachment Points

Photo Stitch of Complete Mast Prior to Lifting

Mast at Approximately 60 Degrees

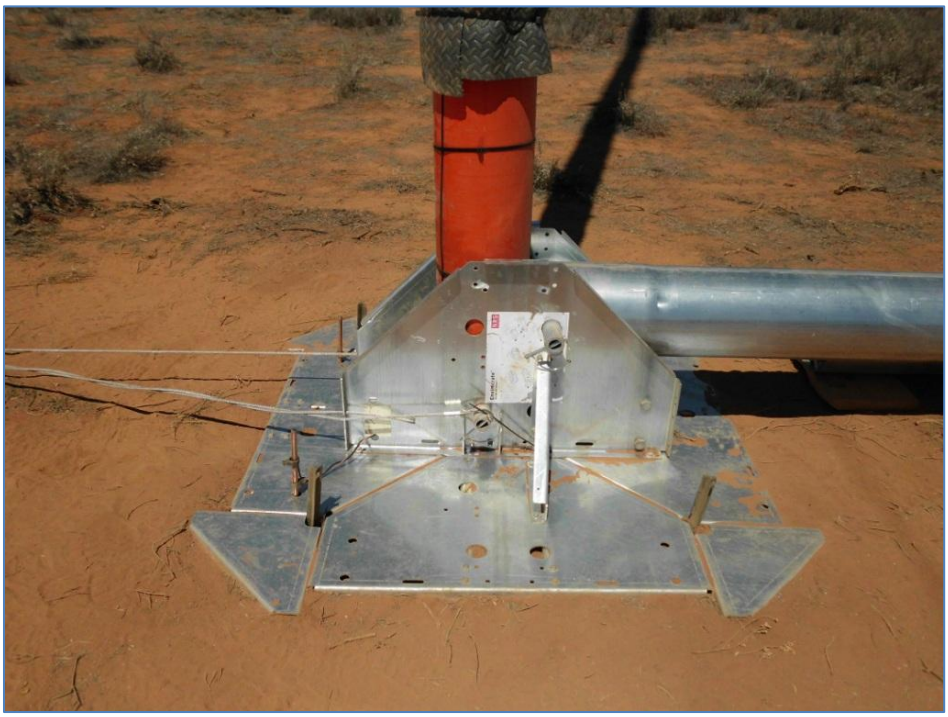


View to Front Stay (273° Mag)

View to Side Stay (3° Mag)

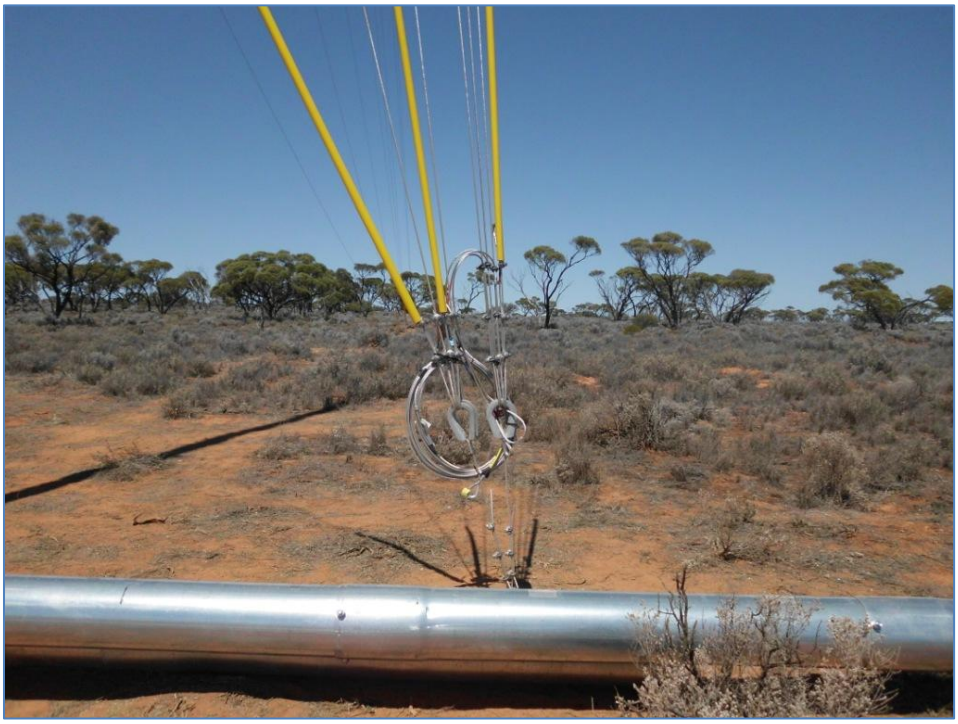
View to Rear Stay (93° Mag)

View to Side Stay (183° Mag)



Mast Base Plate and Earth Terminations

Temperature Sensor (NRG #110S) and Relative Humidity Sensor (NRG RH5X)



Lifter Wires Neatly Secured to Anchor

Enclosure as Fitted with Rubber for Cable Protection

View up Mast Showing Straightness

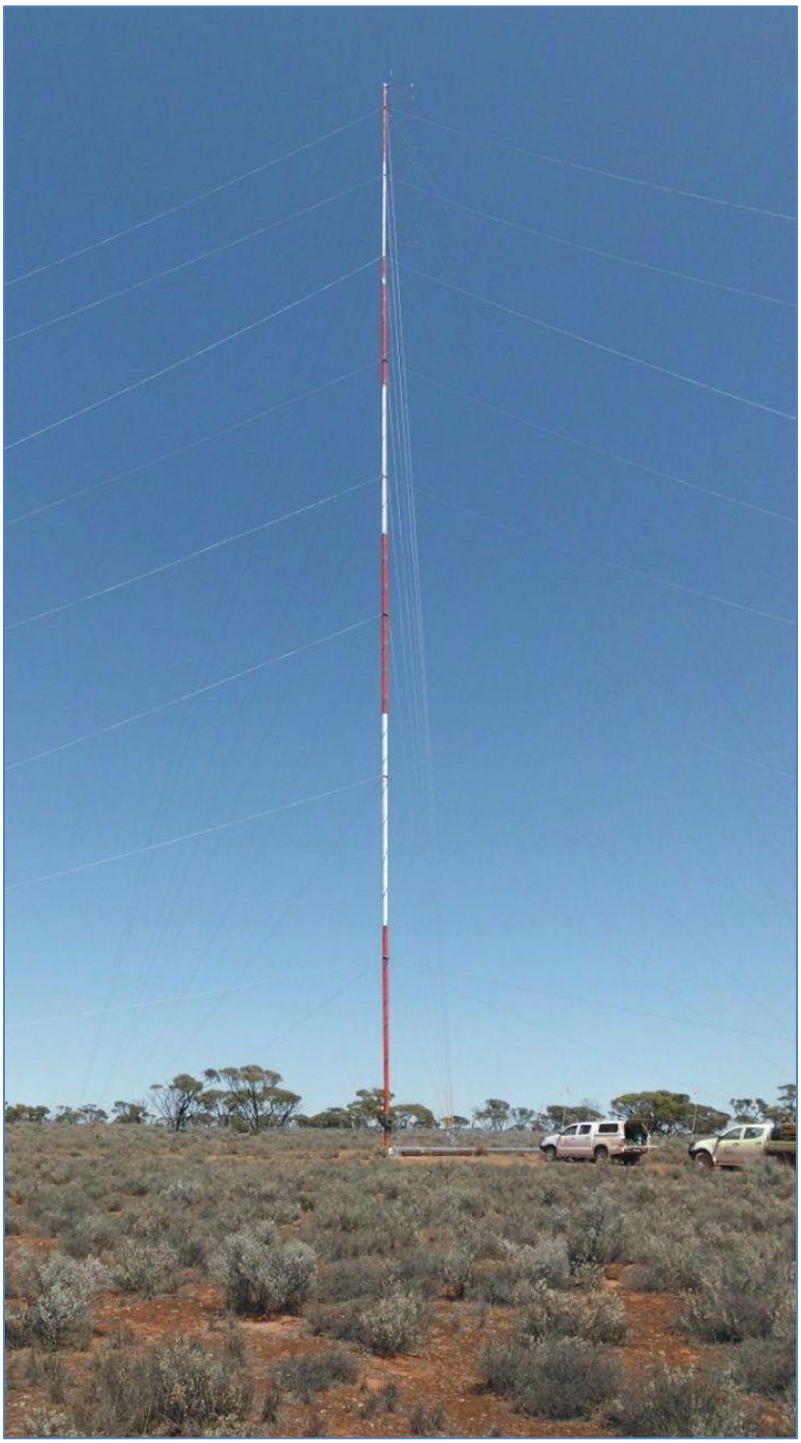
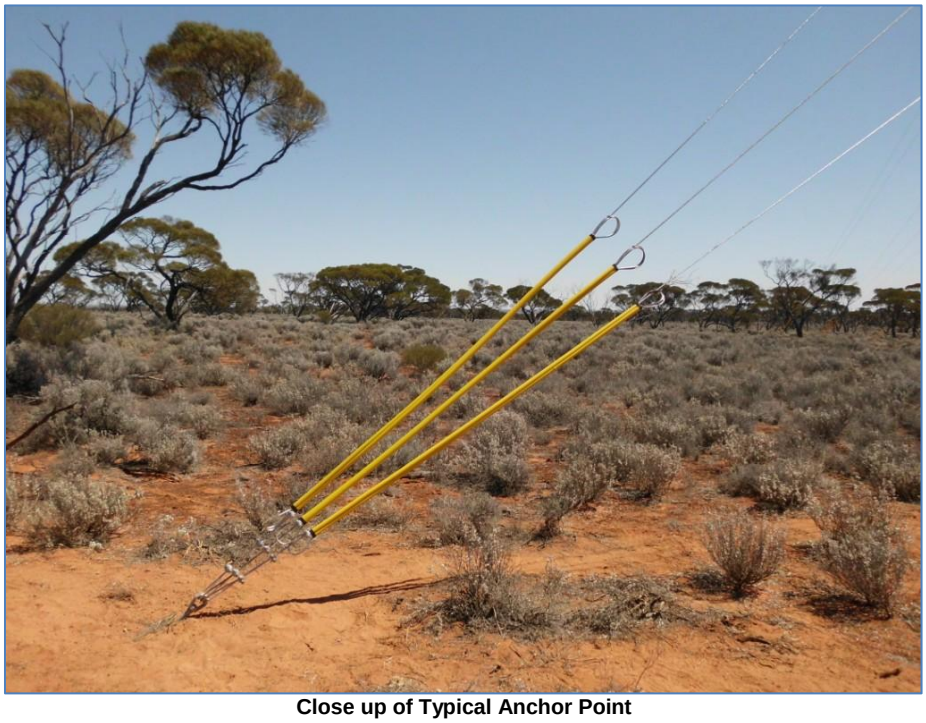


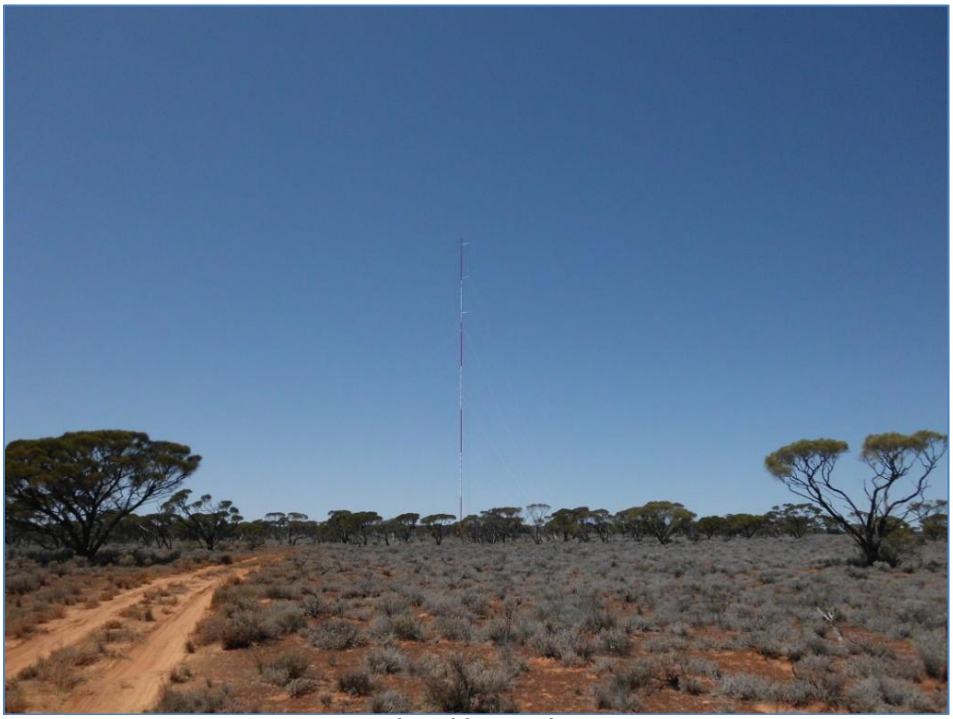
Photo Stitch of Complete Mast as Erected

Typical Anchor Point



Close up of Typical Anchor Point

Close up of Typical Anchor Point 2



Mast Viewed from a Distance

Equipment Packed for Storage on Pallets

Drive Rods and Anchor Installation Equipment in Storage

9.0 Summary

The mast was successfully raised on Monday 1st January and the instrument system commissioned on Tuesday 2nd January at approximately 1300h.

Double helix screw-in anchors were utilised as the soil conditions at the site proved to be ideal for their use. All anchors were installed to the maximum possible depth using a digger with a auger attachment. All anchors were pull-tested beyond the minimum specification using a hydraulic ram and pump.

The mast installation process proceeded in an orderly manner, with the only complication being short periods of wind behind the mast prior to beginning the lift. A tree was also in the path of the top side guy wires so these were maneuvered by hand when necessary to clear the tree without causing any damage.

All instruments were fully checked for correct function via connection to the datalogger before lifting the mast. The function of all instruments was also checked prior to leaving site.

The GSM iPack was fitted and tested to be working prior to leaving site. Signal strength was checked and maximized using the SDR software functions.

All health and safety protocols were adhered to with daily Pre-Start meeting being completed. Take 2 forms were filled out numerous times per day with a new form being completed for each differing task. Great care was taken to ensure the very minimum site disturbance occurred.

The site was left totally clean and clear of any rubbish. The gin pole was neatly stored in position on site as was the booster pole. Some pulleys and other equipment were left stored in the end(s) of the Gin Pole. Other equipment associated with the mast project was left neatly stored on pallets in the storage yard. This included the winch, HPU and other tools such as sledge hammer and rigging equipment.

Guy wires should be checked within approximately 6 weeks of installation to check tensions after a settling in period.