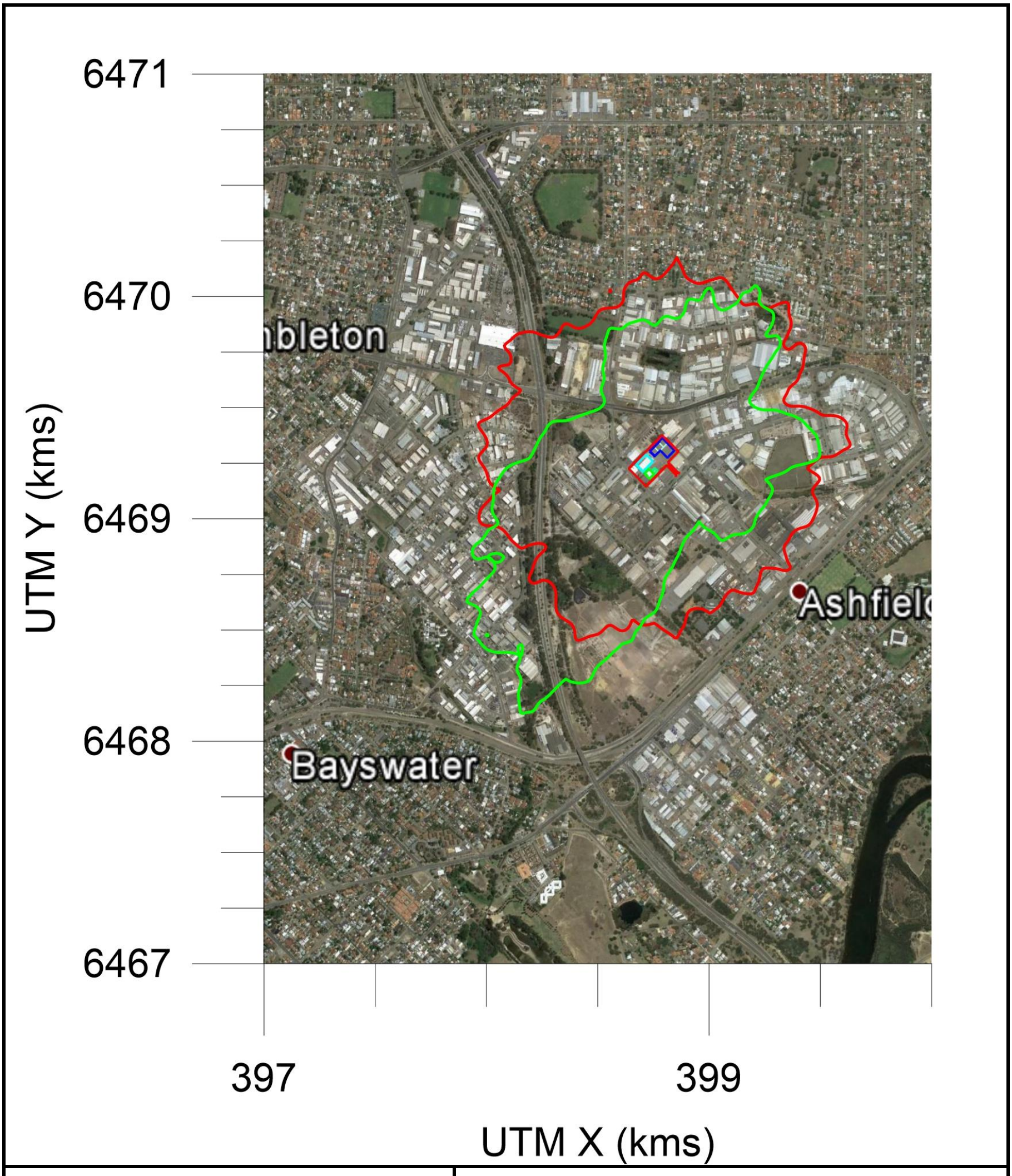

Odour Criterion:

- **2.5ou (green contour)**
- **8ou (red contour)**
- Criterion Averaging Time: 1-hr
- Criterion Assessment Percentile: 99.5th & 99.9th
- **Emissions Type: VOLUME SOURCE Constant OER's**

Meteorological Data:

- File: CALMETT PerthAP 2012 (Bassendean)
- Meteorological Hours: 8,784
- Modelling Hours Assessed: 44; 9
- Coordinates: UTM

Figure 5.2: CALPUFF Ground Level Odour Impact Projections for Proposed Bassendean WTRRF (Partitioned Building).

6 FINDINGS AND CONCLUSIONS

TOU has carried out an odour dispersion modelling assessment of Aurigen's proposed Waste Transfer Station at Bassendean, Western Australia. The objectives of the odour dispersion modelling were to provide three-dimensional CALPUFF odour modelling to determine if offsite odour would impact the nearest sensitive receptors outside of the industrial/commercial land use where the WTRRF is situated within.

The CALPUFF modelling system (ASG, 2011) was used to carry out the odour dispersion modelling. Geophysical data was sourced from national and international databases for terrain (Gallant, et al., 2011) and land use (USGS, 1997). Input into the CALMET meteorological model comprised of the processed geophysical data, observed surface meteorological data sourced from Perth Int'l Airport and numerical prognostic meteorological data for the Perth region using the derived representative year available (2012) with >98% raw data recovery. Odour emissions data was derived from other assessed Waste Transfer Stations throughout Australia and the average odour strength applied to this assessment.

The results of all modelling show compliance to the relevant DER odour concentration criteria with respect to the nearest sensitive receptors. Therefore it is concluded that no adverse odour impacts are expected as a result of the proposed operations of the Aurigen Bassendean WTRRF, and that modelling projection results for consent conditions have been shown to pass the relevant criterion.

REPORT SIGNATURE PAGE

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John Hurley
Senior Consultant & Modeller

Terry Schulz
Managing Director

Appendix A

Perth Int'l Airport Metadata

Australian Government
Bureau of Meteorology

Basic Climatological Station Metadata

Current status

Metadata compiled: 23 NOV 2015

Station: PERTH AIRPORT

Bureau of Meteorology station number: 009021
Bureau of Meteorology district name: Central Coast
State: WA

World Meteorological Organization number: 94610
Identification: YPPH

Network Classification: CLIMAT Stations, CLIMAT TEMP Stations, GCOS Upper Air Network, Regional Basic Synoptic Network
Station purpose: Synoptic, Upper Air, Aeronautical
Automatic Weather Station: Almos

Current Station Location				
Latitude	**Decimal**	-31.9275	**Hour Min Sec**	31°55'39"S
Longitude	**Decimal**	115.9764	**Hour Min Sec**	115°58'35"E
Station Height	15.4 m	**Barometer Height**	20 m	
Method of station geographic positioning			GPS	

Year opened: 1944
Status: Open

Station summary

No summary for this site has been written as yet.

Historical metadata for this site has not been quality controlled for accuracy and completeness. Data other than current station information, particularly earlier than 1998, should be considered accordingly. Information may not be complete, as backfilling of historical data is incomplete.

Prepared by the Bureau of Meteorology.
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Australian Government
Bureau of Meteorology

Basic Climatological Station Metadata

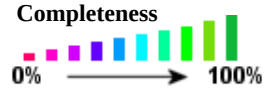
Current status

Station:	PERTH AIRPORT			**Location:**	PERTH AIRPORT			**State:**	WA
Bureau No.:	009021	**WMO No.:**	94610	**Aviation ID:**	YPPH	**Opened:**	01 Jan 1944	**Current Status:**	Still open
Latitude:	-31.9275	**Longitude:**	115.9764	**Elevation:**	15.4 m	**Barometer Elev:**	20 m	**Metadata compiled:**	23 NOV 2015

Observation summary

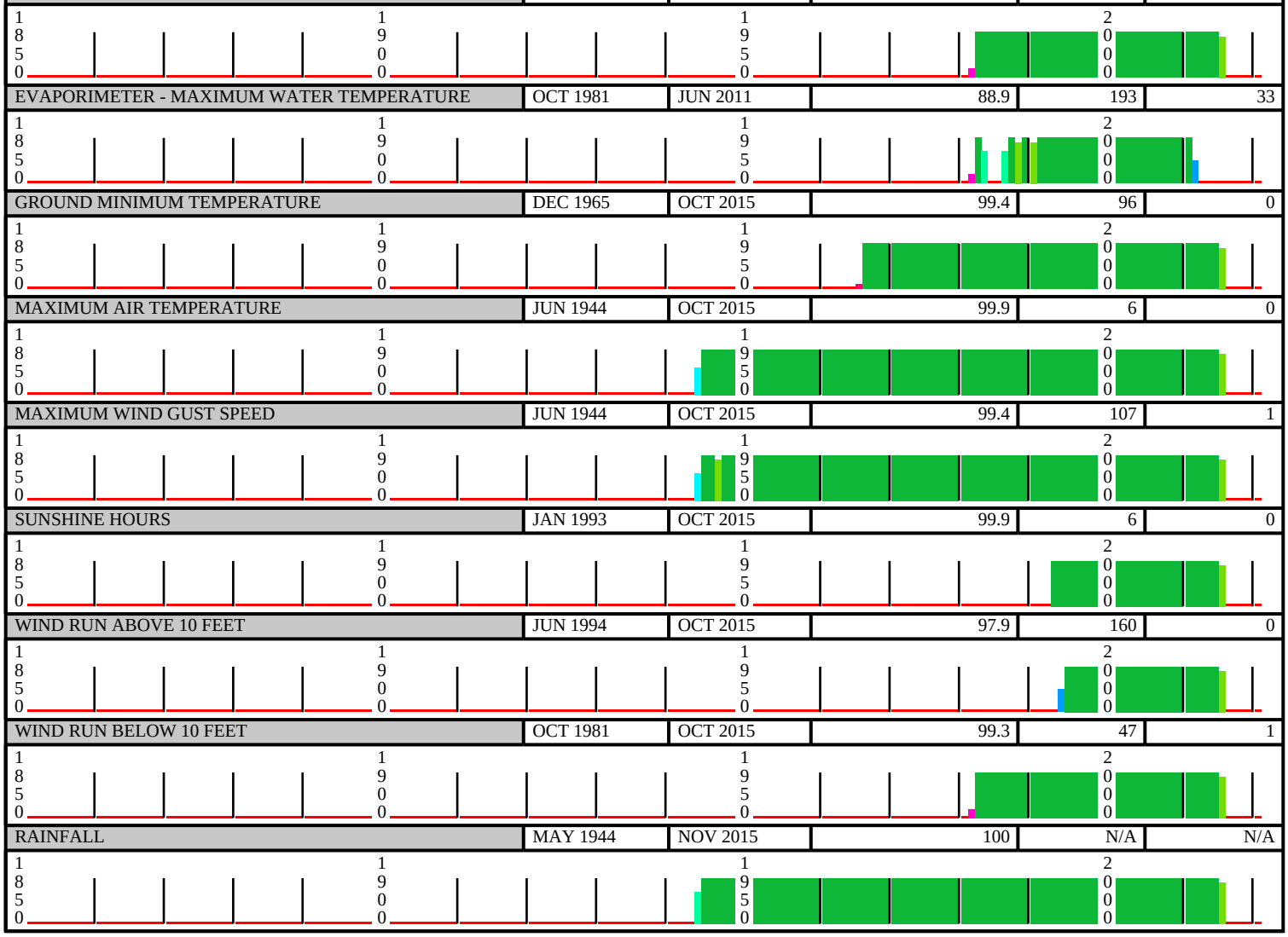
The table below indicates the approximate completeness of the record for individual element types within the Australian Data Archive for Meteorology. For elements not listed see the note below.

Completeness



DAILY DATA HOLDINGS

OBSERVATION TYPE	FIRST MONTH	LAST MONTH	COMPLETENESS (% estimate)	SINGLE DAYS MISSED	FULL MONTHS MISSED
EVAPORATION	OCT 1981	OCT 2015	99.7	34	0
EVAPORIMETER - MAXIMUM WATER TEMPERATURE	OCT 1981	JUN 2011	88.9	193	33
GROUND MINIMUM TEMPERATURE	DEC 1965	OCT 2015	99.4	96	0
MAXIMUM AIR TEMPERATURE	JUN 1944	OCT 2015	99.9	6	0
MAXIMUM WIND GUST SPEED	JUN 1944	OCT 2015	99.4	107	1
SUNSHINE HOURS	JAN 1993	OCT 2015	99.9	6	0
WIND RUN ABOVE 10 FEET	JUN 1994	OCT 2015	97.9	160	0
WIND RUN BELOW 10 FEET	OCT 1981	OCT 2015	99.3	47	1
RAINFALL	MAY 1944	NOV 2015	100	N/A	N/A



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Australian Government
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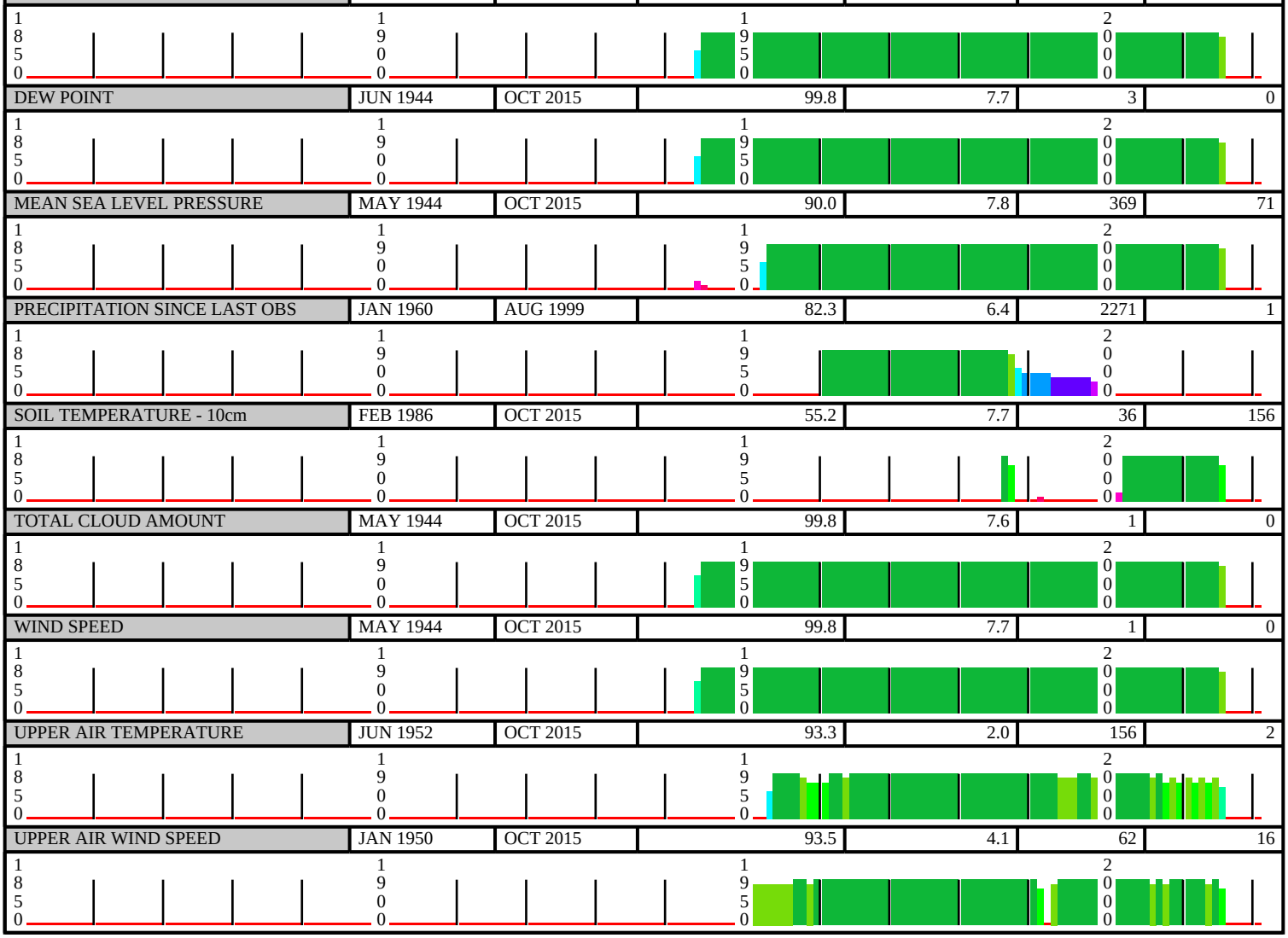
Basic Climatological Station Metadata

Current status

Station:	PERTH AIRPORT			**Location:**	PERTH AIRPORT			**State:**	WA
Bureau No.:	009021	**WMO No.:**	94610	**Aviation ID:**	YPPH	**Opened:**	01 Jan 1944	**Current Status:**	Still open
Latitude:	-31.9275	**Longitude:**	115.9764	**Elevation:**	15.4 m	**Barometer Elev:**	20 m	**Metadata compiled:**	23 NOV 2015

HOURLY DATA HOLDINGS - from 1 to 24 observations per day

OBSERVATION TYPE	FIRST MONTH	LAST MONTH	COMPLETENESS (% estimate)	FREQUENCY average daily	SINGLE DAYS MISSED	FULL MONTHS MISSED
AIR TEMPERATURE	MAY 1944	OCT 2015	99.7	7.7	28	0
DEW POINT	JUN 1944	OCT 2015	99.8	7.7	3	0
MEAN SEA LEVEL PRESSURE	MAY 1944	OCT 2015	90.0	7.8	369	71
PRECIPITATION SINCE LAST OBS	JAN 1960	AUG 1999	82.3	6.4	2271	1
SOIL TEMPERATURE - 10cm	FEB 1986	OCT 2015	55.2	7.7	36	156
TOTAL CLOUD AMOUNT	MAY 1944	OCT 2015	99.8	7.6	1	0
WIND SPEED	MAY 1944	OCT 2015	99.8	7.7	1	0
UPPER AIR TEMPERATURE	JUN 1952	OCT 2015	93.3	2.0	156	2
UPPER AIR WIND SPEED	JAN 1950	OCT 2015	93.5	4.1	62	16



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Australian Government
Bureau of Meteorology

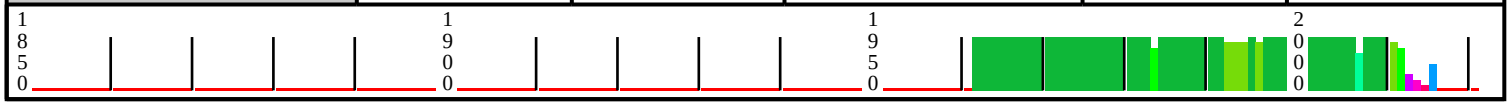
Basic Climatological Station Metadata

Current status

Station:	PERTH AIRPORT			**Location:**	PERTH AIRPORT			**State:**	WA
Bureau No.:	009021	**WMO No.:**	94610	**Aviation ID:**	YPPH	**Opened:**	01 Jan 1944	**Current Status:**	Still open
Latitude:	-31.9275	**Longitude:**	115.9764	**Elevation:**	15.4 m	**Barometer Elev:**	20 m	**Metadata compiled:**	23 NOV 2015

RAINFALL INTENSITY DATA HOLDINGS

OBSERVATION TYPE	FIRST MONTH	LAST MONTH	COMPLETENESS (% estimate)	SINGLE DAYS MISSED	FULL MONTHS MISSED
RAINFALL INTENSITY	JAN 1961	SEP 2015	88.7	1860	13



ONE-MINUTE DATA HOLDINGS

OBSERVATION TYPE	FIRST MONTH	LAST MONTH	COMPLETENESS (% estimate)	FREQUENCY average daily	SINGLE DAYS MISSED	FULL MONTHS MISSED
ALL ELEMENTS	APR 1997	NOV 2015	99.1	1427.0	N/A	0

HALF-HOURLY DATA HOLDINGS

OBSERVATION TYPE	FIRST MONTH	LAST MONTH	COMPLETENESS (% estimate)	FREQUENCY average daily	SINGLE DAYS MISSED	FULL MONTHS MISSED
ALL ELEMENTS	JAN 1985	NOV 2015	104.5	50.2	N/A	0

UPPER-AIR EDT DATA HOLDINGS

OBSERVATION TYPE	FIRST MONTH	LAST MONTH	COMPLETENESS (% estimate)	FREQUENCY average daily	SINGLE DAYS MISSED	FULL MONTHS MISSED
Wind only flights	May 2000	Nov 2015	N/A	2.0	104	1
Wind, temperature and pressure flights	Mar 1991	Nov 2015	N/A	2.0	63	0

Holdings calculated up to 01 Nov 2015

The % complete figure is the completeness of observations averaged over all months of record, for the given station and observation type, taking gaps into account. For hourly holdings, the completeness is relative to the maximum number of daily observations for the site each month, and is therefore an estimate. For daily holdings, the completeness figure shown is exact.

The single days missed figure is the total number of days for which no observation was received, not including full missed months. The full months missed figure is the total of full month gaps over the period of record. Where an element is not included assumptions can generally be made about availability, and the list to use has been suggested below.

Unlisted element	Listed element to use
Minimum air temperature	Maximum air temperature
Wet bulb temperature	Dew point
Soil temperature at 20, 50 & 100cm	10cm soil temperature
Relative humidity	Dew point
Minimum temp. of water in evaporimeter	Evaporimeter - max water temp
Visual observations eg. weather, visibility	Total cloud amount
Sea related observations	Sea state

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Extended Climatological Station Metadata
All History

Station:	PERTH AIRPORT			**Location:**	PERTH AIRPORT			**State:**	WA
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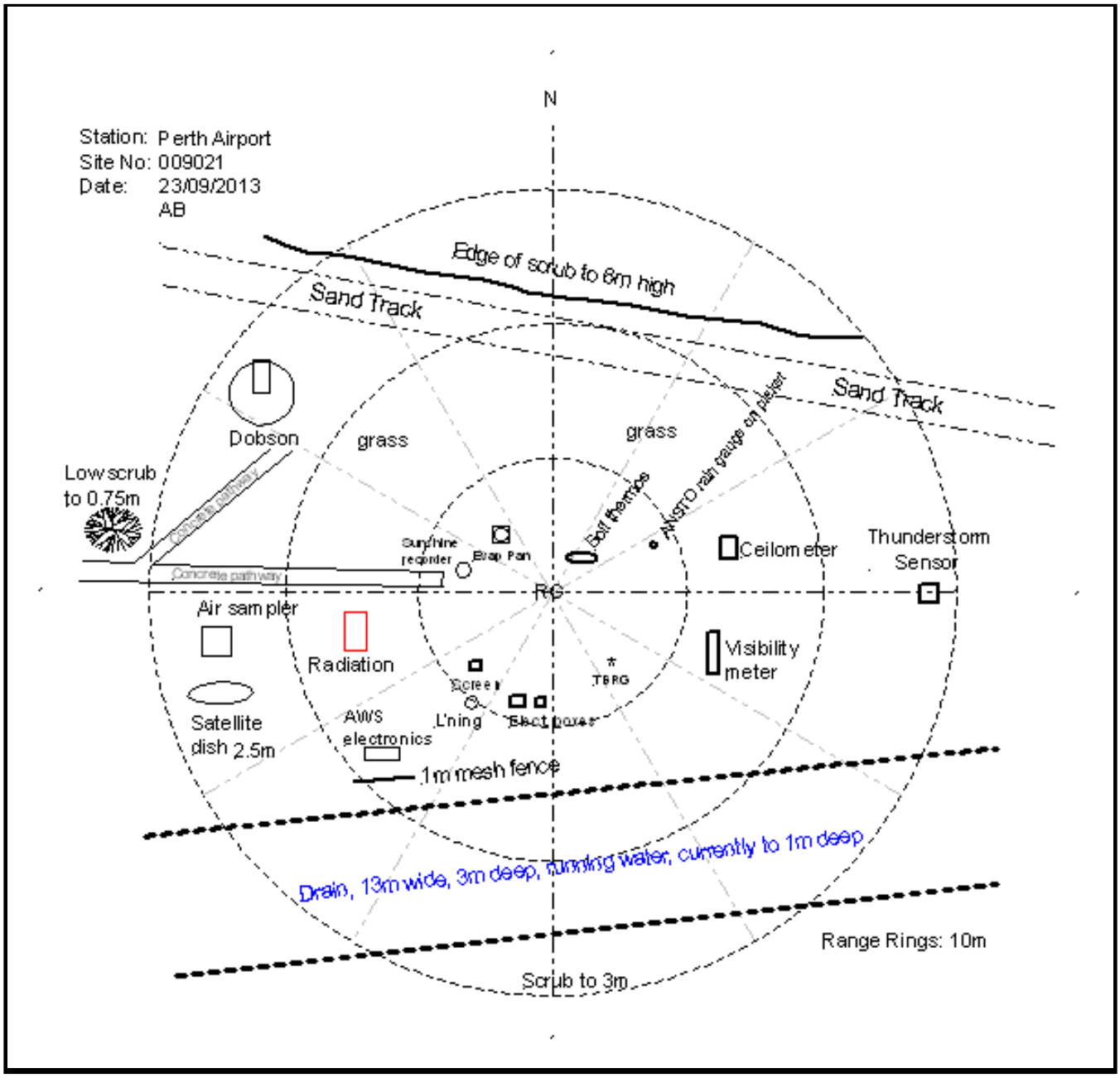
Instrument Location and Surrounding Features
23/09/2013(most recent)



Extended Climatological Station Metadata
All History

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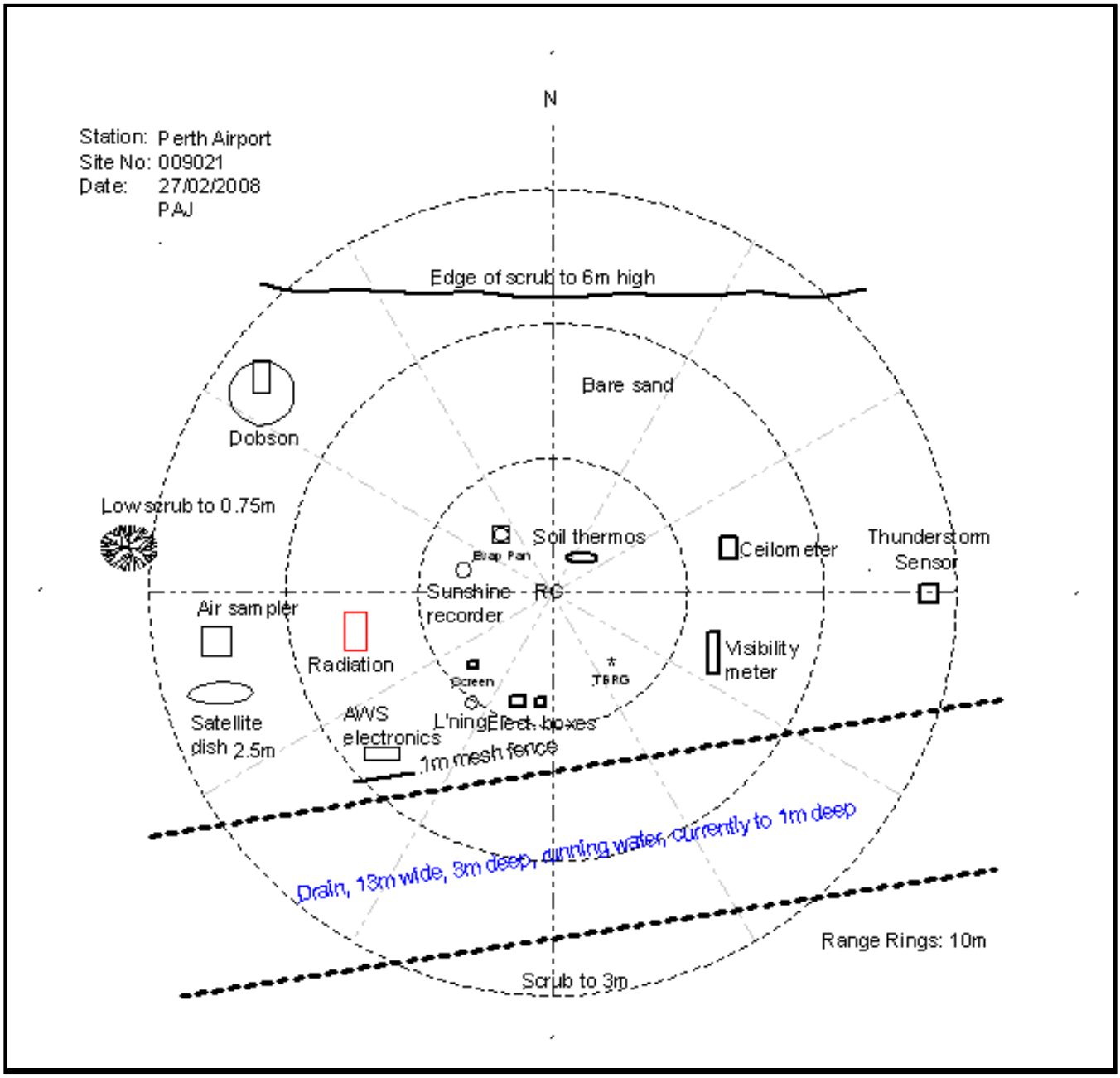
Instrument Location and Surrounding Features
27/02/2008



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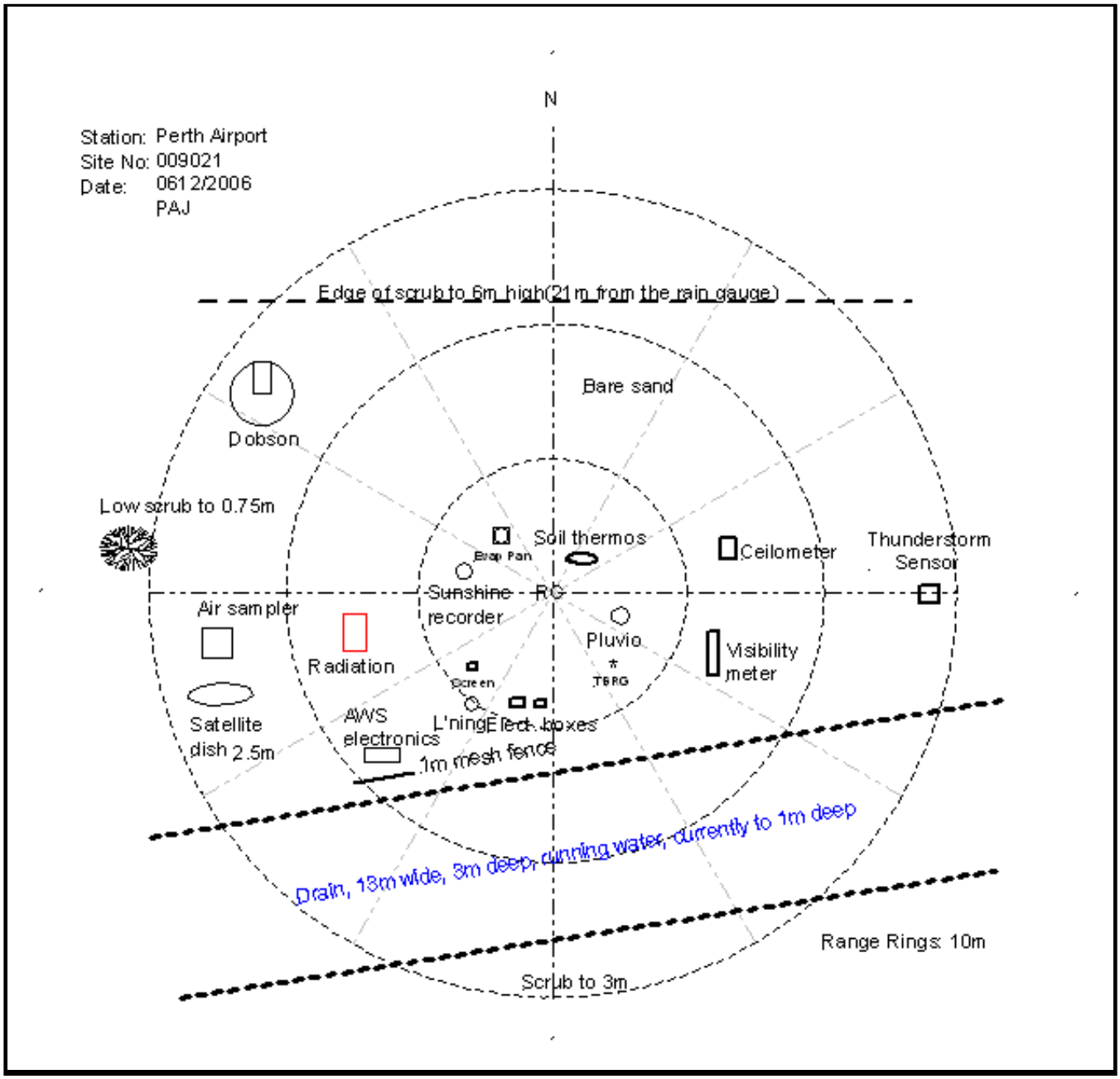
Instrument Location and Surrounding Features
06/12/2006



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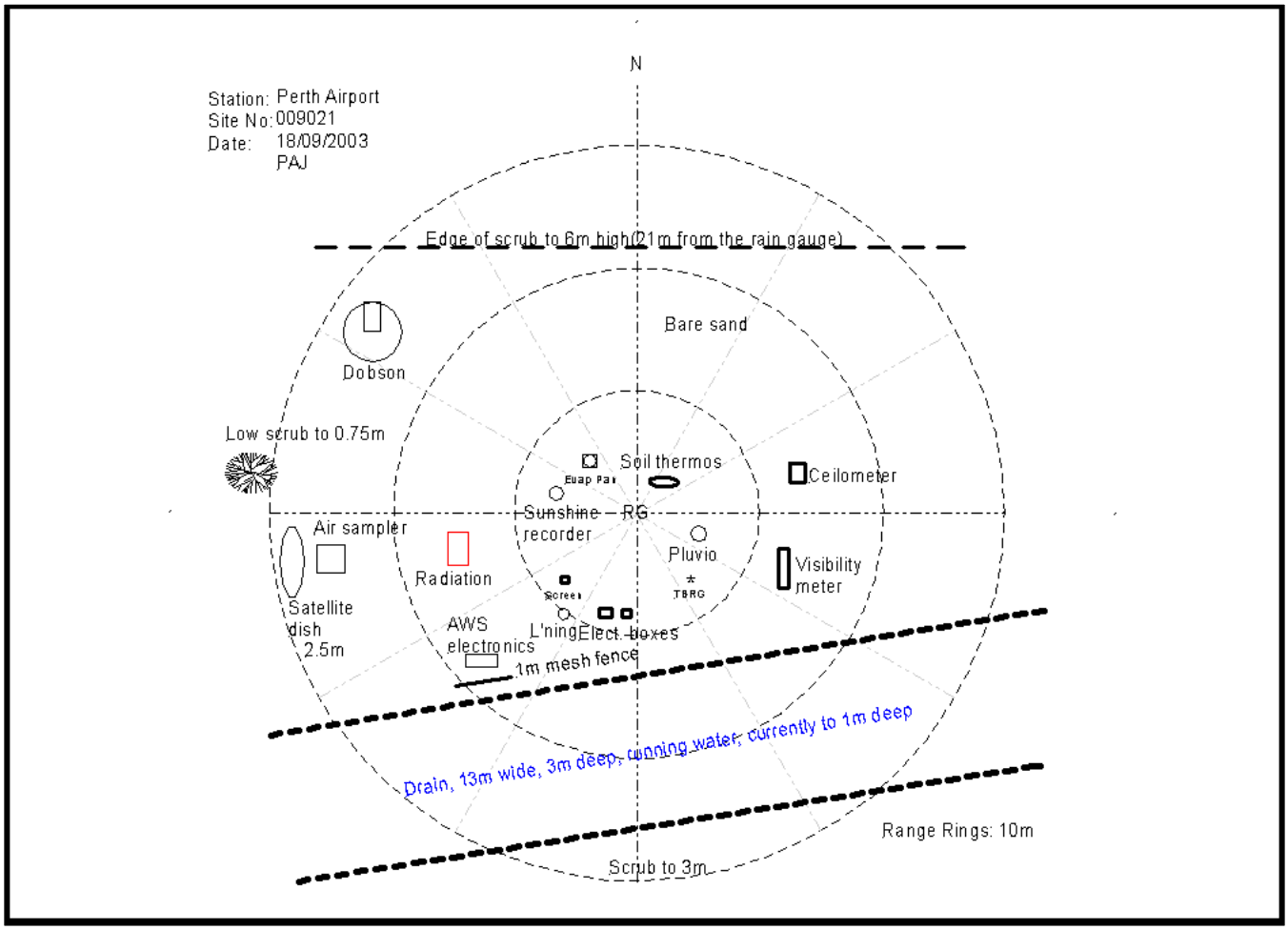
Instrument Location and Surrounding Features
11/09/2003



Extended Climatological Station Metadata
All History

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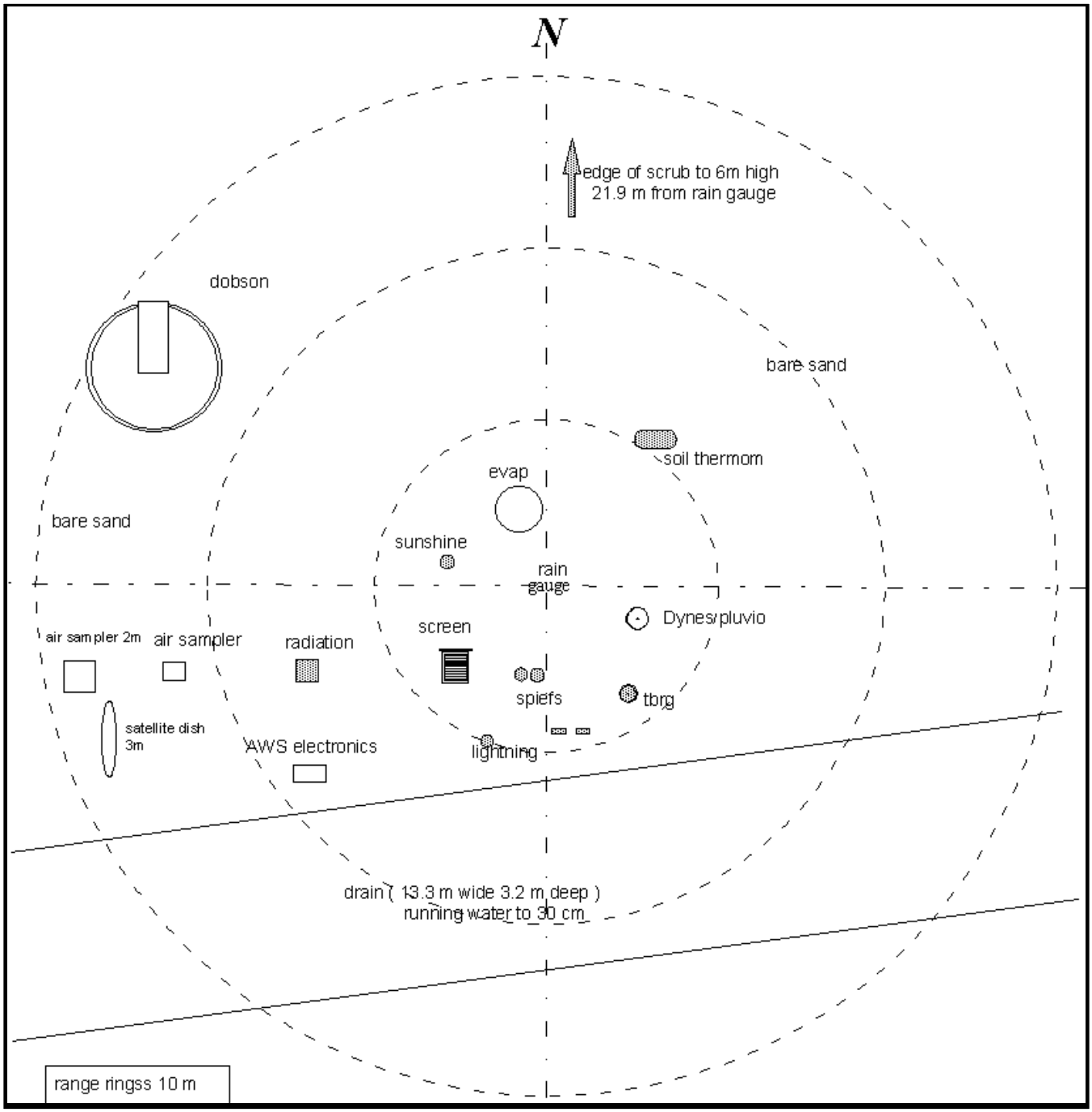
Instrument Location and Surrounding Features
02/11/2000



Extended Climatological Station Metadata
All History

Station:	PERTH AIRPORT			**Location:**	PERTH AIRPORT			**State:**	WA
Bureau No.:	009021	**WMO No.:**	94610	**Aviation ID:**	YPPH	**Opened:**	01 Jan 1944	**Current Status:**	Still open
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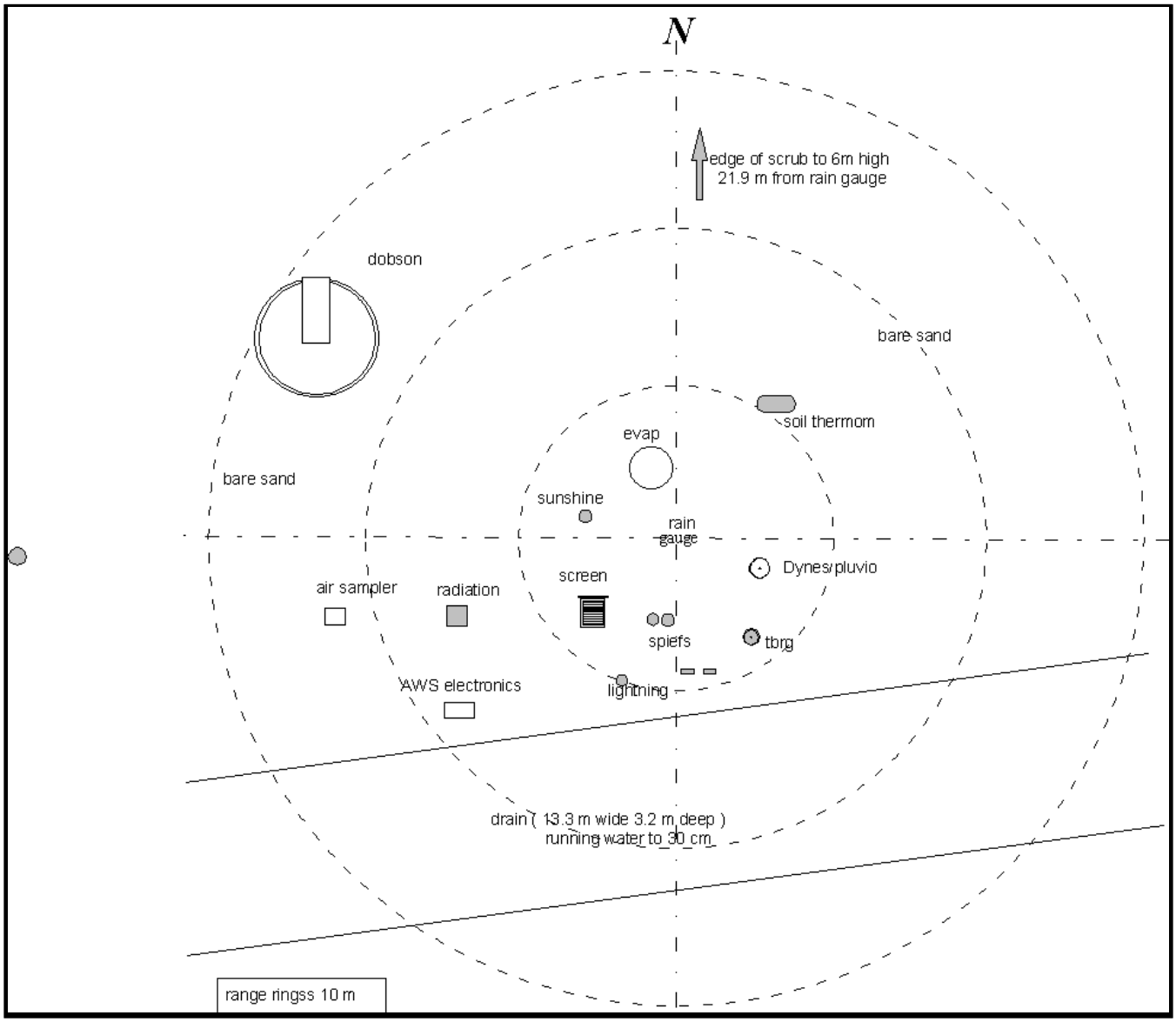
Instrument Location and Surrounding Features
27/10/1997



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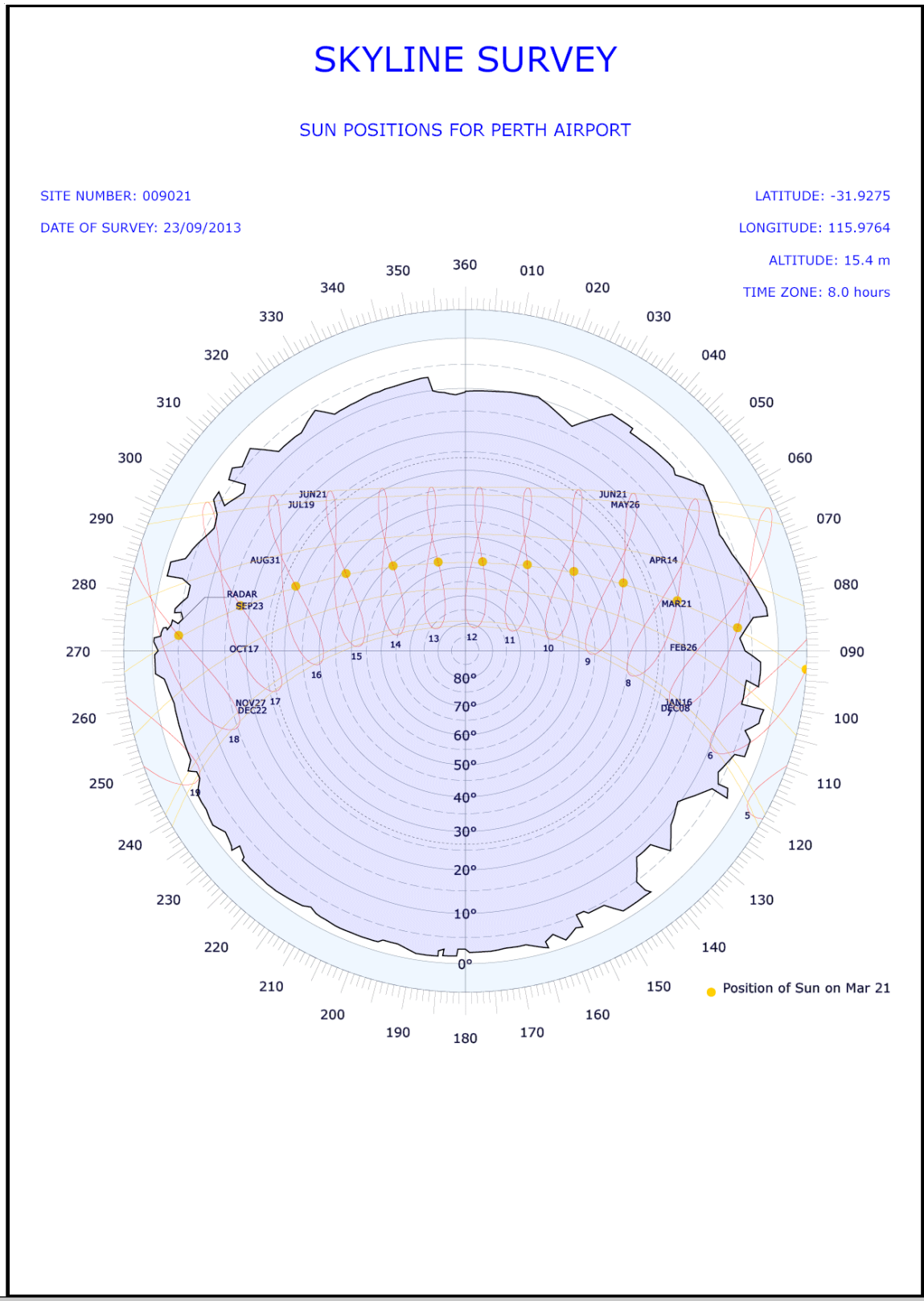
Skyline Diagram
23/09/2013(most recent)



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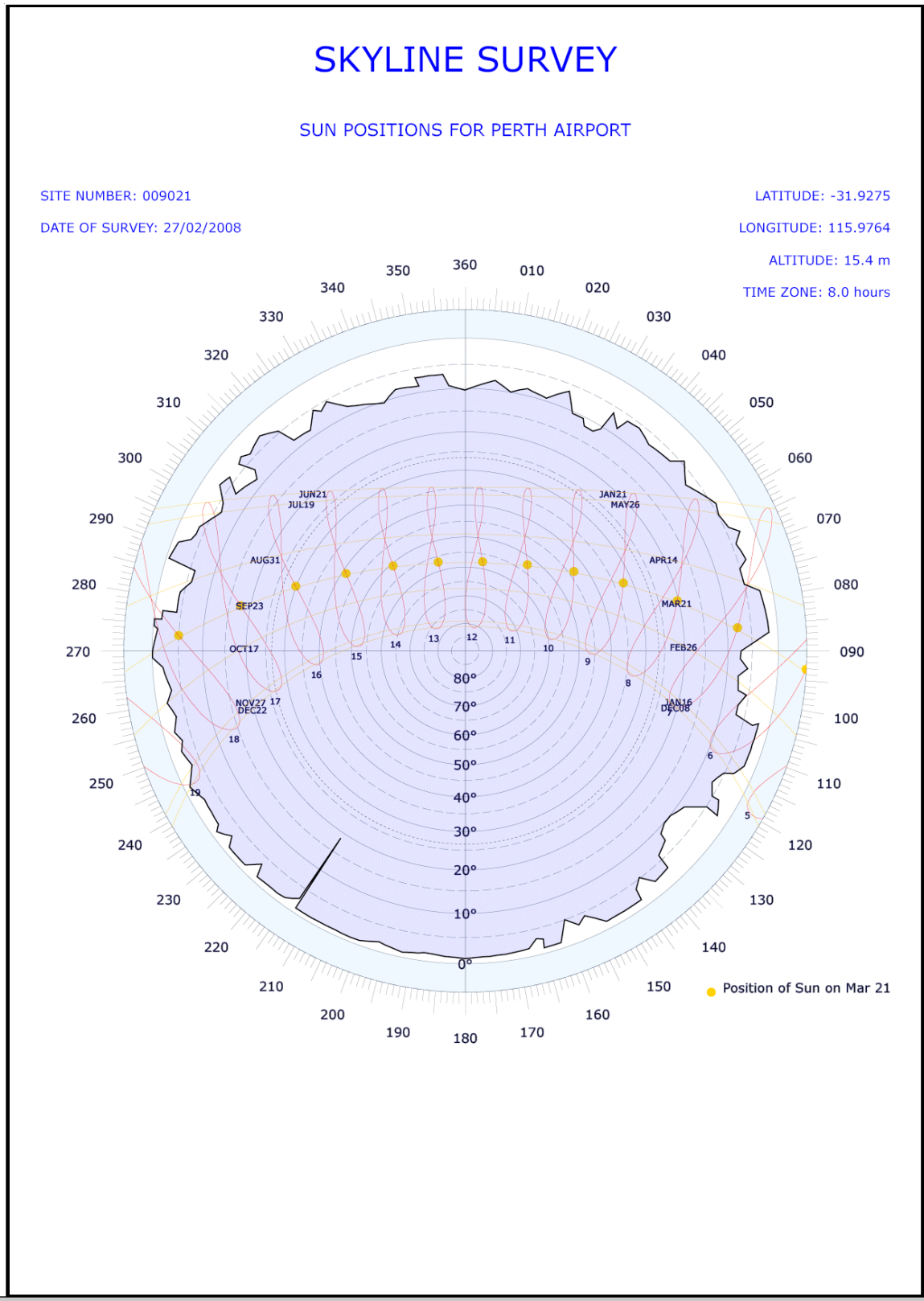
Skyline Diagram
27/02/2008



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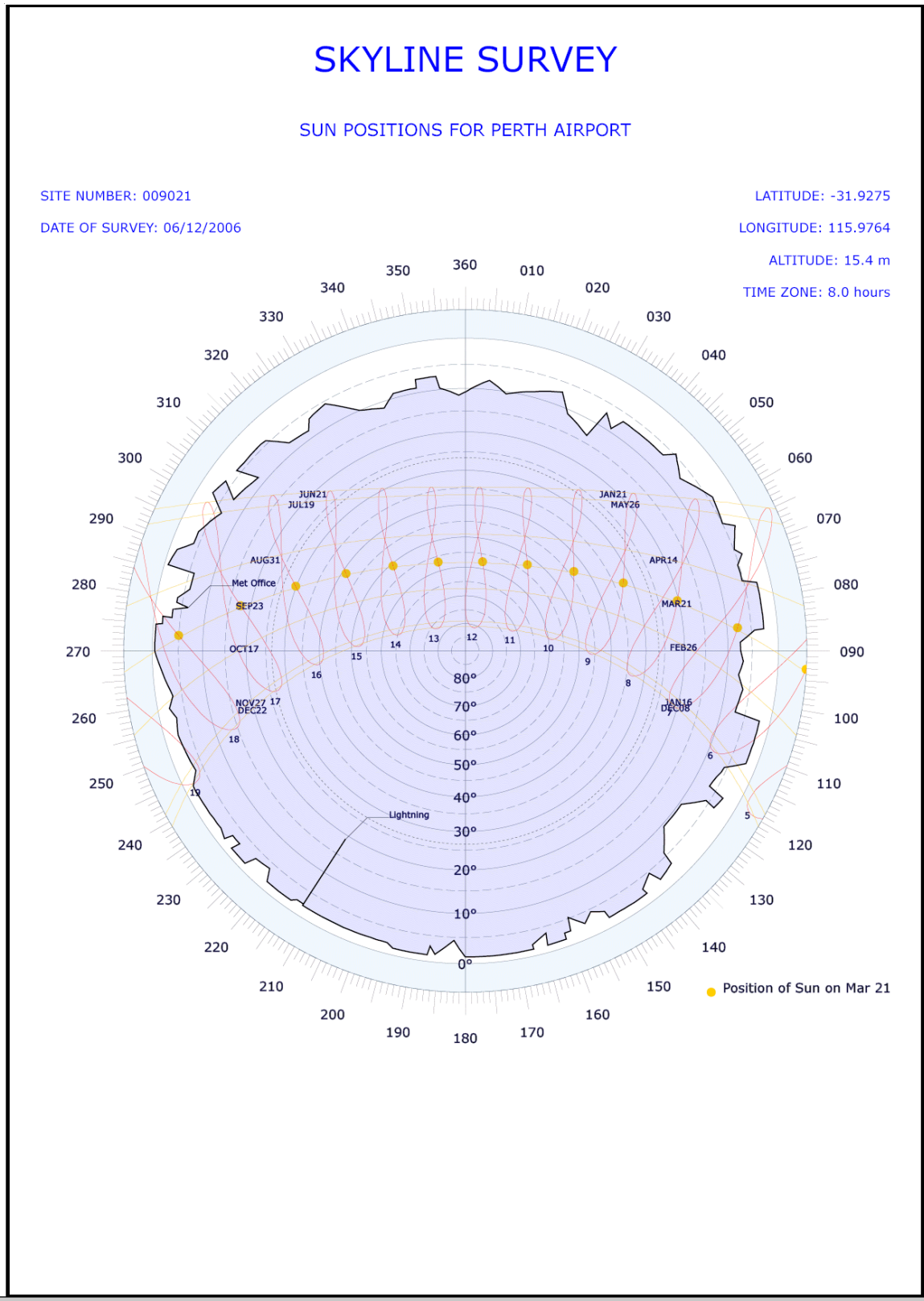
Skyline Diagram
06/12/2006



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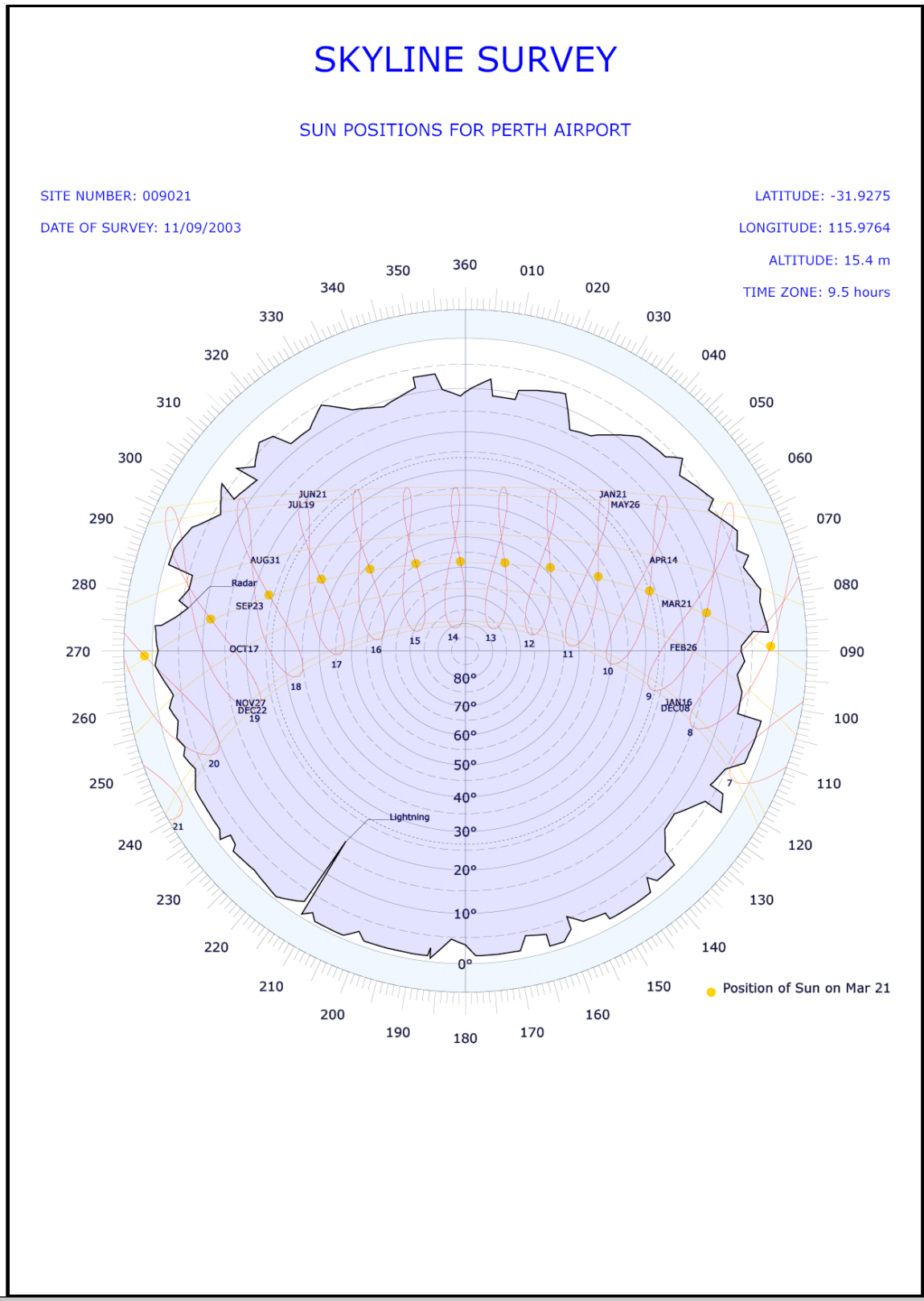
Skyline Diagram
11/09/2003



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Latitude:	-31.9275	**Longitude:**	115.9764	**Elevation:**	15.4 m	**Barometer Elev:**	20 m	**Metadata compiled:**	23 NOV 2015

Station Observation Program Summary (Surface Observations) from 01/06/1944 to 31/10/1997

Current Observation	Continuous	Half Hourly	Hourly
Surface Observations	Y	Y	Y

Current Observation	Program Type	12 AM	3 AM	6 AM	9 AM	12 PM	3 PM	6 AM	9 AM
Surface Observation	PERFORMED	Y	Y	Y	Y	Y	Y	Y	Y
Surface Observation	REPORTED	Y	Y	Y	Y	Y	Y	Y	Y
Surface Observation	SEASONAL	-	-	-	-	-	-	-	-

Station Observation Program Summary (Surface Observations) 23 NOV 2015 (most recent)

Current Observation	Continuous	Half Hourly	Hourly
Surface Observations	Y	Y	Y

Current Observation	Program Type	12 AM	3 AM	6 AM	9 AM	12 PM	3 PM	6 AM	9 AM
Surface Observation	PERFORMED	Y	Y	Y	Y	Y	Y	Y	Y
Surface Observation	REPORTED	Y	Y	Y	Y	Y	Y	Y	Y
Surface Observation	SEASONAL	-	-	-	-	-	-	-	-

Upper Air Routine 01/07/1999 (most recent)

Flight type	Time UTC	Mon	Tue	Wed	Thur	Fri	Sat	Sun
Wind & Temp.	00:00	Y	Y	Y	Y	Y	Y	Y
Wind & Temp.	06:00	-	-	-	-	-	-	-
Wind & Temp.	12:00	Y	Y	Y	Y	Y	Y	Y
Wind & Temp.	18:00	-	-	-	-	-	-	-
Wind	00:00	Y	Y	Y	Y	Y	Y	Y
Wind	06:00	Y	Y	Y	Y	Y	Y	Y
Wind	12:00	Y	Y	Y	Y	Y	Y	Y
Wind	18:00	Y	Y	Y	Y	Y	Y	Y

Extended Climatological Station Metadata
All History

Station:	PERTH AIRPORT			**Location:**	PERTH AIRPORT			**State:**	WA
Bureau No.:	009021	**WMO No.:**	94610	**Aviation ID:**	YPPH	**Opened:**	01 Jan 1944	**Current Status:**	Still open
Latitude:	-31.9275	**Longitude:**	115.9764	**Elevation:**	15.4 m	**Barometer Elev:**	20 m	**Metadata compiled:**	23 NOV 2015

Station Equipment History

Equipment Install/Remove

Cloud Height
04/APR/2000 INSTALL Ceilometer (Type Vaisala CT25K S/N - U01507) Surface Observations
02/JUL/2011 REPLACE Ceilometer (Now Vaisala CT25K S/N - W09405) Surface Observations
01/MAY/1944 INSTALL Cloud Base Searchlight (Type 63 Degree S/N - Unknown) Surface Observations
04/APR/2000 REMOVE Cloud Base Searchlight (Type 63 Degree S/N - Unknown) Surface Observations

River Height (No Electronic History)

Wind Run
22/OCT/1981 INSTALL Wind Run Anemometer (Type Unknown S/N - CBM391) Surface Observations

Spectral Radiation (No Electronic History)

Sea Surface Temperature (No Electronic History)

Sea Water Temperature (No Electronic History)

Evaporation
22/OCT/1981 INSTALL Evaporation Pan (Type Class A S/N - Unknown) Surface Observations
24/JUN/2008 REPLACE Evaporation Pan (Now Class A S/N - NONE) Surface Observations
10/AUG/2010 REPLACE Evaporation Pan (Now Class A S/N - NONE) Surface Observations
14/JUN/2005 REPLACE Evaporation Pan (Now Class A S/N - NONE) Surface Observations
03/FEB/2003 REPLACE Evaporation Pan (Now Class A S/N - Unknown) Surface Observations

Minimum Temperature
01/JUN/1944 INSTALL Thermometer, Alcohol, Min (Type Dobbie S/N - 17031) Surface Observations
20/JUN/2009 REPLACE Thermometer, Alcohol, Min (Now Dobbie S/N - 29052) Surface Observations
25/JUN/2012 REPLACE Thermometer, Alcohol, Min (Now WIKA S/N - 29048) Surface Observations

Soil Temperature 50cm
26/SEP/2003 INSTALL Temperature Probe - 50cm (Type Unknown S/N - 0067) Surface Observations
05/FEB/1986 INSTALL Thermometer, Soil, 50cm (Type Dobros S/N - M0976) Surface Observations
10/JUL/2010 REPLACE Thermometer, Soil, 50cm (Now Amarol S/N - 0137361) Surface Observations
03/OCT/2011 REPLACE Thermometer, Soil, 50cm (Now Dobros S/N - M5163) Surface Observations
04/JUL/2010 REPLACE Thermometer, Soil, 50cm (Now Dobros S/N - M5163) Surface Observations

Sub Surface Temperature (No Electronic History)

Electrical Conductivity (No Electronic History)

Maximum Temperature
01/JUN/1944 INSTALL Thermometer, Mercury, Max (Type Dobbie S/N - 15391) Surface Observations
04/OCT/2002 REPLACE Thermometer, Mercury, Max (Now Dobbie S/N - 17198) Surface Observations
25/JUN/2009 REPLACE Thermometer, Mercury, Max (Now WIKA S/N - 22072) Surface Observations
17/JUL/2015 REPLACE Thermometer, Mercury, Max (Now WIKA S/N - 32863) Surface Observations

Soil Temperature 20cm
26/SEP/2003 INSTALL Temperature Probe - 20cm (Type Unknown S/N - 0061) Surface Observations
05/FEB/1986 INSTALL Thermometer, Soil, 20cm (Type Dobros S/N - 9684859) Surface Observations
25/JUN/2012 REPLACE Thermometer, Soil, 20cm (Now Amarol S/N - 0967153) Surface Observations
06/DEC/2006 REPLACE Thermometer, Soil, 20cm (Now Dobros S/N - CBM597) Surface Observations
12/NOV/2004 REPLACE Thermometer, Soil, 20cm (Now Dobros S/N - M2305) Surface Observations

Solar Radiation (No Electronic History)

Soil Temperature 5cm
26/SEP/2003 INSTALL Temperature Probe - 5cm (Type Unknown S/N - 0071) Surface Observations

Extended Climatological Station Metadata
All History

Station:	PERTH AIRPORT			Location:	PERTH AIRPORT			State:	WA
Bureau No.:	009021	WMO No.:	94610	Aviation ID:	YPPH	Opened:	01 Jan 1944	Current Status:	Still open
Latitude:	-31.9275	Longitude:	115.9764	Elevation:	15.4 m	Barometer Elev:	20 m	Metadata compiled:	23 NOV 2015

Station Equipment History (continued)

Equipment Install/Remove(Continued)

Oxygen Content (No Electronic History)

Sea Water Level (No Electronic History)

Surface Inclination (No Electronic History)

Terrestial Minimum Temperature

26/SEP/2003 INSTALL Temperature Probe - Grass (Type Unknown S/N - NONE) Surface Observations
01/JAN/1965 INSTALL Thermometer, Terrestrial, Min (Type Dobbie S/N - M0059) Surface Observations
27/FEB/2008 REPLACE Thermometer, Terrestrial, Min (Now Dobbie S/N - 19625) Surface Observations
16/JAN/2007 REPLACE Thermometer, Terrestrial, Min (Now Dobbie S/N - 19625) Surface Observations
24/JUN/2002 REPLACE Thermometer, Terrestrial, Min (Now Dobbie S/N - 19638) Surface Observations
06/JUL/2001 REPLACE Thermometer, Terrestrial, Min (Now Dobbie S/N - 19654) Surface Observations
27/OCT/2011 REPLACE Thermometer, Terrestrial, Min (Now Dobbie S/N - 20766) Surface Observations
27/AUG/2001 REPLACE Thermometer, Terrestrial, Min (Now Dobbie S/N - 20766) Surface Observations
06/JUL/2007 REPLACE Thermometer, Terrestrial, Min (Now Dobbie S/N - 25974) Surface Observations
21/MAR/2006 REPLACE Thermometer, Terrestrial, Min (Now Dobbie S/N - CBM040) Surface Observations
31/OCT/2011 REPLACE Thermometer, Terrestrial, Min (Now Unknown S/N - 17031) Surface Observations
08/DEC/2012 REPLACE Thermometer, Terrestrial, Min (Now WIKA S/N - 32449) Surface Observations

Visibility

04/APR/2000 INSTALL Visibility Meter (Type Vaisala FD12 S/N - T49305) Surface Observations

Solar Radiation (Direct) (No Electronic History)

Magnetic Bearing (No Electronic History)

Wind Direction

01/JUN/1944 INSTALL Anemometer (Type Dines S/N - Unknown) Surface Observations
27/OCT/1997 INSTALL Anemometer (Type Synchrotac Vane - Type 706 S/N - 65493) Surface Observations
20/JUN/1994 INSTALL Anemometer (Type Synchrotac Vane - Type 706 S/N - Unknown) Surface Observations
20/JUN/1994 INSTALL Mast Anemometer (Type Pivot, Standard 10m S/N - NONE) Infrastructure
22/OCT/1981 INSTALL Wind Run Anemometer (Type Unknown S/N - CBM391) Surface Observations
20/JUN/1994 REMOVE Anemometer (Type Dines S/N - Unknown) Surface Observations
27/OCT/1997 REMOVE Anemometer (Type Synchrotac Vane - Type 706 S/N - Unknown) Surface Observations

Air Temperature

20/JUN/1994 INSTALL Temperature Probe - Dry Bulb (Type Rosemount S/N - 0265) Surface Observations
01/MAY/1944 INSTALL Thermograph (Type Fielden S/N - Unknown) Surface Observations
20/JUN/1994 REMOVE Thermograph (Type Fielden S/N - Unknown) Surface Observations
01/JUN/1944 INSTALL Thermometer, Mercury, Dry Bulb (Type Dobbie S/N - 14561) Surface Observations

Wet Bulb Temperature

20/JUN/1994 INSTALL Temperature Probe - Wet Bulb (Type Rosemount S/N - 0224) Surface Observations
08/MAY/2000 REPLACE Temperature Probe - Wet Bulb (Now Rosemount S/N - 304) Surface Observations
26/JUN/2003 INSTALL Thermometer, Mercury, Wet Bulb (Type Dobbie S/N - 14633) Surface Observations
02/NOV/2000 INSTALL Thermometer, Mercury, Wet Bulb (Type Dobbie S/N - 14645) Surface Observations
02/NOV/2000 INSTALL Thermometer, Mercury, Wet Bulb (Type Dobbie S/N - M1874) Surface Observations
25/JUN/2003 REMOVE Thermometer, Mercury, Wet Bulb (Type Dobbie S/N - 14633) Surface Observations
15/SEP/2009 REMOVE Thermometer, Mercury, Wet Bulb (Type Dobbie S/N - 20340) Surface Observations
12/APR/2004 REPLACE Thermometer, Mercury, Wet Bulb (Now Dobbie S/N - 14632) Surface Observations
06/SEP/2002 REPLACE Thermometer, Mercury, Wet Bulb (Now Dobbie S/N - 14633) Surface Observations

Extended Climatological Station Metadata
All History

Station:	PERTH AIRPORT			**Location:**	PERTH AIRPORT			**State:**	WA
Bureau No.:	009021	**WMO No.:**	94610	**Aviation ID:**	YPPH	**Opened:**	01 Jan 1944	**Current Status:**	Still open
Latitude:	-31.9275	**Longitude:**	115.9764	**Elevation:**	15.4 m	**Barometer Elev:**	20 m	**Metadata compiled:**	23 NOV 2015

Station Equipment History (continued)

Equipment Install/Remove(Continued)

12/SEP/2005 REPLACE Thermometer, Mercury, Wet Bulb (Now Dobbie S/N - 20340) Surface Observations
14/JUL/2008 REPLACE Thermometer, Mercury, Wet Bulb (Now Dobbie S/N - 20381) Surface Observations
29/APR/2004 REPLACE Thermometer, Mercury, Wet Bulb (Now Dobbie S/N - 24119) Surface Observations
23/AUG/2004 REPLACE Thermometer, Mercury, Wet Bulb (Now Dobbie S/N - M0695) Surface Observations
18/JUN/2002 REPLACE Thermometer, Mercury, Wet Bulb (Now Dobbie S/N - M1895) Surface Observations
21/OCT/2014 REPLACE Thermometer, Mercury, Wet Bulb (Now WIKA S/N - 20271) Surface Observations
01/MAR/2013 REPLACE Thermometer, Mercury, Wet Bulb (Now WIKA S/N - 24112) Surface Observations
27/JUN/2011 REPLACE Thermometer, Mercury, Wet Bulb (Now WIKA S/N - 27462) Surface Observations
23/SEP/2013 REPLACE Thermometer, Mercury, Wet Bulb (Now WIKA S/N - 27462) Surface Observations

Lightning

21/FEB/1981 INSTALL Lightning Flash Counter (Type CIGRE - Vertical Aerial S/N - Unknown) Surface Observations
03/AUG/2005 INSTALL Lightning Sensor (Type Vaisala TSS928 (Thunderstorm Sensor) S/N - Z5030005) Surface Observations
30/JUL/2013 REPLACE Lightning Sensor (Now Vaisala TSS928 (Thunderstorm Sensor) S/N - Z5150004) Surface Observations

Turbidity (No Electronic History)

Total Column Ozone Amount

19/OCT/1998 INSTALL Photo Spectrometer (Type Dobson S/N - Unknown) Radiation

Pressure

01/JUL/1951 INSTALL Barometer (Type Kew pattern mercury S/N - 1983) Surface Observations
20/JUN/1994 INSTALL Barometer (Type Vaisala PA11A S/N - R5110008) Surface Observations
20/JUN/1994 REMOVE Barometer (Type Vaisala PA11A S/N - 561174) Surface Observations
01/JAN/1990 REPLACE Barometer (Now Kew pattern mercury S/N - 1948) Surface Observations
13/JUN/2007 REPLACE Barometer (Now Vaisala PA11A S/N - 433545) Surface Observations
31/MAR/1993 REPLACE Barometer (Now Vaisala PA11A S/N - 561174) Surface Observations
10/FEB/2012 REPLACE Barometer (Now Vaisala PTB330B (General Use) S/N - G2970057) Surface Observations

Humidity

01/MAY/1944 INSTALL Hygrograph (Type Fielden S/N - Unknown) Surface Observations
20/JUN/1994 REMOVE Hygrograph (Type Fielden S/N - Unknown) Surface Observations

Sunshine Hours

01/JAN/1993 INSTALL Sunshine Recorder (Type Campbell-Stokes S/N - 190) Surface Observations

Pressure Trend

01/JAN/1966 INSTALL Barograph (Type Weekly S/N - CBM068) Surface Observations
15/FEB/2010 REMOVE Barograph (Type Weekly S/N - CBM068) Surface Observations

Snow Height (No Electronic History)

Wind Speed

01/JUN/1944 INSTALL Anemometer (Type Dines S/N - Unknown) Surface Observations
27/OCT/1997 INSTALL Anemometer (Type Synchrotac Vane - Type 706 S/N - 65493) Surface Observations
20/JUN/1994 INSTALL Anemometer (Type Synchrotac Vane - Type 706 S/N - Unknown) Surface Observations
20/JUN/1994 INSTALL Mast Anemometer (Type Pivot, Standard 10m S/N - NONE) Infrastructure
22/OCT/1981 INSTALL Wind Run Anemometer (Type Unknown S/N - CBM391) Surface Observations
20/JUN/1994 REMOVE Anemometer (Type Dines S/N - Unknown) Surface Observations
27/OCT/1997 REMOVE Anemometer (Type Synchrotac Vane - Type 706 S/N - Unknown) Surface Observations

Rainfall

01/JAN/1961 INSTALL Pluviograph (Type Unknown S/N - Unknown) Rainfall Intensity

Extended Climatological Station Metadata
All History

Station:	PERTH AIRPORT			**Location:**	PERTH AIRPORT			**State:**	WA
Bureau No.:	009021	**WMO No.:**	94610	**Aviation ID:**	YPPH	**Opened:**	01 Jan 1944	**Current Status:**	Still open
Latitude:	-31.9275	**Longitude:**	115.9764	**Elevation:**	15.4 m	**Barometer Elev:**	20 m	**Metadata compiled:**	23 NOV 2015

Station Equipment History (continued)

Equipment Install/Remove(Continued)

01/JAN/2008 REMOVE Pluviograph (Type Dines syphoning S/N - CBM251) Rainfall Intensity
19/APR/2005 REPLACE Pluviograph (Now Dines syphoning S/N - CBM251) Rainfall Intensity
26/JAN/1961 REPLACE Pluviograph (Now Dines syphoning S/N - Unknown) Rainfall Intensity
01/MAY/1944 INSTALL Raingauge (Type 203 mm (8in) - 200mm capacity S/N - Unknown) Surface Observations
30/OCT/2013 INSTALL Raingauge (Type HS TB3 S/N - 00004) Surface Observations
07/AUG/1996 INSTALL Raingauge (Type HS TB3A-0.2 S/N - 95-105) Rainfall Intensity
20/JUN/1994 INSTALL Raingauge (Type Rimco 7499 TBRG S/N - Unknown) Surface Observations
27/OCT/1997 REMOVE Raingauge (Type Rimco 7499 TBRG S/N - Unknown) Surface Observations
19/AUG/2005 REPLACE Raingauge (Now Rimco TBRG (type unspecified) S/N - 84595) Rainfall Intensity
19/AUG/2005 REPLACE Raingauge (Now Rimco TBRG (type unspecified) S/N - 84595) Surface Observations
24/MAY/2000 REPLACE Raingauge (Now Rimco TBRG (type unspecified) S/N - 890) Rainfall Intensity
24/MAY/2000 REPLACE Raingauge (Now Rimco TBRG (type unspecified) S/N - 890) Surface Observations
27/OCT/1997 SHARE Raingauge (Type HS TB3A-0.2 S/N - 95-105) Surface Observations
27/OCT/1997 SHARE Raingauge (Type Rimco TBRG (type unspecified) S/N - 890) Surface Observations

Soil Temperature 100cm

26/SEP/2003 INSTALL Temperature Probe - 100cm (Type Unknown S/N - 0041) Surface Observations
05/FEB/1986 INSTALL Thermometer, Soil, 100cm (Type Dobros S/N - 9725159) Surface Observations
13/OCT/2007 REPLACE Thermometer, Soil, 100cm (Now Amarol S/N - 0398354) Surface Observations
08/AUG/2012 REPLACE Thermometer, Soil, 100cm (Now Amarol S/N - 0398366) Surface Observations

Soil Temperature 10cm

26/SEP/2003 INSTALL Temperature Probe - 10cm (Type Unknown S/N - 0045) Surface Observations
05/FEB/1986 INSTALL Thermometer, Soil, 10cm (Type Dobros S/N - 9725416) Surface Observations

Solar Radiation (Long Wave) (No Electronic History)

RF Reflectivity

01/AUG/1955 INSTALL Radar (Type 277F S/N - Unknown) Upper Air
01/AUG/1955 INSTALL Radar (Type 277F S/N - Unknown) WeatherWatch
01/AUG/1972 INSTALL Radar (Type WF44 S/N - Unknown) Upper Air
01/AUG/1972 INSTALL Radar (Type WF44 S/N - Unknown) WeatherWatch
01/OCT/2009 INSTALL Radar Interface (Type EEC 502 (BoM) S/N - 05) Upper Air
01/OCT/2009 INSTALL Radar Safety System (RSS) (Type RSS (2502C/8502S) S/N - Unknown) Upper Air
01/OCT/2009 INSTALL Radar Safety System (RSS) (Type RSS (2502C/8502S) S/N - Unknown) WeatherWatch
01/AUG/1972 INSTALL Radar Tower (Type Lattice WF44 - 18 ft S/N - Unknown) Infrastructure
01/JUL/1972 REMOVE Radar (Type 277F S/N - Unknown) Upper Air
01/JUL/1972 REMOVE Radar (Type 277F S/N - Unknown) WeatherWatch
27/OCT/1997 REMOVE Radar Tower (Type Lattice WF44 - 18 ft S/N - Unknown) Infrastructure
01/OCT/2009 REPLACE Radar (Now DWSR 2502C S/N - 018) Upper Air
01/OCT/2009 REPLACE Radar (Now DWSR 2502C S/N - 018) WeatherWatch
28/JUN/2012 REPLACE Radar Safety System (RSS) (Now RSS (2502C/8502S) S/N - Unknown) Upper Air
28/JUN/2012 REPLACE Radar Safety System (RSS) (Now RSS (2502C/8502S) S/N - Unknown) WeatherWatch

Extended Climatological Station Metadata
All History

Station:	PERTH AIRPORT			**Location:**	PERTH AIRPORT			**State:**	WA
Bureau No.:	009021	**WMO No.:**	94610	**Aviation ID:**	YPPH	**Opened:**	01 Jan 1944	**Current Status:**	Still open
Latitude:	-31.9275	**Longitude:**	115.9764	**Elevation:**	15.4 m	**Barometer Elev:**	20 m	**Metadata compiled:**	23 NOV 2015

Station Equipment History (continued)

The following table summarises information on field performance checks available electronically over the period indicated. The number of instances an instrument was found to fail field performance checks should only be used as a guide. A system of data quality flags is implemented by the Bureau of Meteorology to indicate the data quality of an observation as determined by a mutli-stage quality control process.

Available Date Range	Element	Fail Field Performance Check
24/JUL/2003 - 30/SEP/2015	Cloud Height	1
02/NOV/2000 - 27/FEB/2008	Wind Run	0
02/NOV/2000 - 23/SEP/2013	Evaporation	0
02/NOV/2000 - 23/SEP/2013	Minimum Temperature	0
02/NOV/2000 - 27/FEB/2008	Soil Temperature 50cm	0
02/NOV/2000 - 23/SEP/2013	Maximum Temperature	0
02/NOV/2000 - 27/FEB/2008	Soil Temperature 20cm	0
02/NOV/2000 - 27/FEB/2008	Terrestial Minimum Temperature	0
21/AUG/2001 - 30/SEP/2015	Visibility	4
16/AUG/1998 - 06/AUG/2014	Wind Direction	3
18/MAR/1998 - 30/SEP/2015	Air Temperature	1
18/MAR/1998 - 30/SEP/2015	Wet Bulb Temperature	2
02/NOV/2000 - 21/MAY/2013	Lightning	1
18/MAR/1998 - 30/SEP/2015	Pressure	3
02/NOV/2000 - 06/DEC/2006	Pressure Trend	0
16/AUG/1998 - 06/AUG/2014	Wind Speed	3
18/MAR/1998 - 30/SEP/2015	Rainfall	9
02/NOV/2000 - 27/FEB/2008	Soil Temperature 100cm	0
02/NOV/2000 - 27/FEB/2008	Soil Temperature 10cm	0
21/MAR/2005 - 21/JUL/2015	RF Reflectivity	0

Station Detail Changes

01/JUL/2011 CLASSIFICATION Australian Climate Observations Reference Network - Surface Air Temperature (ACORN-SAT)
26/JUN/2002 CLASSIFICATION CLIMAT Stations (CLC)
26/JUN/2002 CLASSIFICATION CLIMAT TEMP Stations (CLT)
09/MAY/2006 CLASSIFICATION Category A (TAF A)
10/JAN/2011 CLASSIFICATION Critical (ASOSCRIT)
10/JUN/2014 CLASSIFICATION Critical Aviation or Defence (AVCRIT)
27/OCT/1997 CLASSIFICATION Fielden (FFD)
14/FEB/1997 CLASSIFICATION GCOS Upper Air Network (GUAN)
01/JUL/1998 CLASSIFICATION Information and Observations (MIO) ENDED 18-11-2002
18/NOV/2002 CLASSIFICATION Observations Only (MO)
01/JUL/1998 CLASSIFICATION Rawinsonde Stations (RS)
14/FEB/1997 CLASSIFICATION Regional Basic Synoptic Network (RBSN)
07/APR/2003 OBJECT Document/009021Upgrade
01/MAR/2011 OBJECT Document/AWS SITE AUDIT
01/JUL/2011 OBJECT Document/CEILOMETER STATUS
21/MAY/2013 OBJECT Document/CEILOMETER STATUS

Extended Climatological Station Metadata
All History

Station:	PERTH AIRPORT			**Location:**	PERTH AIRPORT			**State:**	WA
Bureau No.:	009021	**WMO No.:**	94610	**Aviation ID:**	YPPH	**Opened:**	01 Jan 1944	**Current Status:**	Still open
Latitude:	-31.9275	**Longitude:**	115.9764	**Elevation:**	15.4 m	**Barometer Elev:**	20 m	**Metadata compiled:**	23 NOV 2015

Station Equipment History (continued)

Station Detail Changes(Continued)

30/SEP/2015 OBJECT Document/CEILOMETER STATUS
06/AUG/2014 OBJECT Document/CEILOMETER STATUS
28/AUG/2015 OBJECT Document/HYDRO INSPECTION CHECKSHEET
05/OCT/2005 OBJECT Document/RAPIC TX CAL DATA
23/SEP/2013 OBJECT Document/SKYLINE DATA
06/DEC/2006 OBJECT Document/SKYLINE DATA
11/SEP/2003 OBJECT Document/SKYLINE DATA
27/FEB/2008 OBJECT Document/SKYLINE DATA
02/SEP/2011 OBJECT Document/VISIBILITY METER STATUS
11/OCT/2012 OBJECT Document/VISIBILITY METER STATUS
21/MAY/2013 OBJECT Document/VISIBILITY METER STATUS
30/SEP/2015 OBJECT Document/VISIBILITY METER STATUS
16/JUL/2014 OBJECT Document/VISIBILITY METER STATUS
21/MAY/2013 OBJECT Document/ypph_tss_20130521
01/JAN/1944 STATION - (nondb seeding) Opened
01/JAN/1944 STATION - (nondb seeding) aero_ht Changed to 20
01/JAN/1944 STATION - (nondb seeding) bar_ht Changed to 31
01/JAN/1944 STATION - (nondb seeding) bar_ht_deriv Changed to SURVEY
01/JAN/1944 STATION - (nondb seeding) latitude Changed to -31.9414
01/JAN/1944 STATION - (nondb seeding) longitude Changed to 115.9653
01/JAN/1944 STATION - (nondb seeding) name Changed to PERTH AIRPORT
01/JAN/1944 STATION - (nondb seeding) stn_ht Changed to 20
01/JAN/1944 STATION - (nondb seeding) stn_ht_deriv Changed to SURVEY
01/JAN/1944 STATION - (nondb seeding) wmo_num Changed to 94610
27/OCT/1997 STATION aero_ht Changed to 20.4
27/OCT/1997 STATION aero_ht_deriv Changed to SURVEY
27/OCT/1997 STATION aviation_id Changed to YPPH
08/OCT/2003 STATION bar_ht Changed to 20
27/OCT/1997 STATION bar_ht Changed to 20.3
08/OCT/2003 STATION bar_ht_deriv Changed to SURVEY
27/OCT/1997 STATION bar_ht_deriv Changed to SURVEY
11/SEP/2003 STATION latitude Changed to -31.9275Using WGS84
27/OCT/1997 STATION latitude Changed to -31.9286
27/OCT/1997 STATION latlon_deriv Changed to GPS
11/SEP/2003 STATION latlon_deriv Changed to GPS
27/OCT/1997 STATION latlon_error Changed to
27/OCT/1997 STATION longitude Changed to 115.975
11/SEP/2003 STATION longitude Changed to 115.9764Using WGS84
27/OCT/1997 STATION lu_0_100m Changed to Airport
27/OCT/1997 STATION lu_100m_1km Changed to Airport
27/OCT/1997 STATION lu_1km_10km Changed to City area, buildings < 10 metres (3 storey)
27/OCT/1997 STATION soil_type Changed to sand
27/OCT/1997 STATION stn_ht Changed to 15.4

Extended Climatological Station Metadata
All History

Station:	PERTH AIRPORT			**Location:**	PERTH AIRPORT			**State:**	WA
Bureau No.:	009021	**WMO No.:**	94610	**Aviation ID:**	YPPH	**Opened:**	01 Jan 1944	**Current Status:**	Still open
Latitude:	-31.9275	**Longitude:**	115.9764	**Elevation:**	15.4 m	**Barometer Elev:**	20 m	**Metadata compiled:**	23 NOV 2015

Station Equipment History (continued)

Station Detail Changes(Continued)

27/OCT/1997 STATION stn_ht_deriv Changed to SURVEY
12/OCT/2004 STATION surface_type Changed to mostly covered by grass
06/DEC/2006 STATION surface_type Changed to partly covered by grass
27/OCT/1997 STATION surface_type Changed to partly covered by grass

System Changes

01/JAN/1944 SYSTEM Infrastructure Commenced
19/OCT/1998 SYSTEM Radiation Commenced
01/JAN/1961 SYSTEM Rainfall Intensity Commenced
01/JAN/2011 SYSTEM Reference Standards Commenced
01/MAY/1944 SYSTEM Surface Observations Commenced
01/JAN/1944 SYSTEM Upper Air Commenced
01/AUG/1955 SYSTEM WeatherWatch Commenced

Notes on these metadata

The following notes have been compiled to assist with interpreting the metadata provided in this document. These notes are subject to change as the network evolves. Changes in station-specific metadata occur more frequently, both as recent changes are recorded and historical information is transferred from paper file to electronic database.

Reliability of the metadata

The Commonwealth Bureau of Meteorology maintains information on more than 20,000 stations which have operated since observations began in the mid 1800s. The amount of information available for each of these sites and its associated uncertainty are influenced by a number of factors including the type and purpose of the station and the time over which it operated.

Early information about stations was held only on paper file. In 1998 a corporate electronic database was established to help maintain information about the network and its components. The number of parameters recorded about a station is now much greater than before this database was established. The national database has also helped improve consistency in the metadata through the implementation of predefined fields. As a result, and through the refinement of operating procedures, station metadata recorded since 1998 are of a higher overall standard than previously, although occasional omissions and errors are still possible.

The Bureau is part way through a task of entering historical information held on paper file into the corporate database. **Until this process is completed there will remain large gaps in the information contained in these metadata documents and considerable caution should be used when deriving conclusions from the metadata.** As an example, two consecutive entries about a rain gauge dated 50 years apart may appear in the equipment metadata. This may either mean that nothing happened to that instrument over the 50 years, or that information for the intervening period has yet to be entered into the database. Similarly, if no information was available about instruments at a site when it was first established, fields which were required to have a value present may have used the earliest information available as a best-guess estimate. Sometimes this was the metadata current when the database was established in 1998. In some instances there may be gaps in metadata relevant to the post 1998 period.

For the above reasons it is recommended that all metadata prior to 1998 be considered as indicative only, and used with caution, unless it has been quality controlled. The Bureau of Meteorology should be contacted if further information or confirmation of the data is required. Depending on the nature of the inquiry there may be a fee associated with this request. Contact details are provided in the telephone book for each capital city or the Bureau's web site at:
http://www.bom.gov.au

The following pages contain explanatory notes for selected terms found in this document.

Station Number

The Bureau of Meteorology station number uniquely specifies a station and is not intended to change over time time, although on very rare occasions a station number may change or be deleted from the record (usually to correct an error). Generally a new station number is established if an existing station changes in a way that would affect the climate data record for that site (measured in terms of air temperature and precipitation). Significant station moves are an example of this.

Some stations also possess a World Meteorological Organization (WMO) station number. The WMO number is different to the Bureau of Meteorology number. It also uniquely specifies a station at any given time but can be reassigned to another station if the new station takes priority in the global reporting network. Only selected stations will have a WMO number. Significant stations may maintain their WMO number for many decades.

Notes on these metadata

Network Classification

SUPPORTING the BASIC CLIMATE SERVICE
Global Climate Observing System (GCOS)
GCOS Upper Air Network (GUAN)
GCOS Surface Network (GSN)
National Climate Network {not yet assigned}
Reference Climate Stations (RCS)
Regional Basic Climatological Network (RBCN)
CLIMAT Stations (CLC)
CLIMAT TEMP Stations (CLT)
SUPPORTING the NATIONAL WEATHER WATCH SYSTEM
WMO Global Observing System (GOS)
GOS Upper Air Network
GOS Satellite Network
Global Atmospheric Watch
Background Atmospheric Pollution Monitoring Network (BAPMON)
Basic Ozone Network
Basic Solar and Terrestrial Radiation Network
Regional Basic Synoptic Network (RBSN)
WMO Global Oceanic Observing System (GOOS)
SUPPORTING the BASIC WEATHER SERVICE (BWS)
BWS Land Network
Significant Land Locations
Capital City Mesonets
National Benchmark Network for Agrometeorology (NBNA)
BWS Marine Network
Significant Coastal Loactions
Open Ocean Network
BWS Upper Air Network
Major Significant Locations
BWS Remote Sensing Network
Weather Watch Radar Network
Fire Weather Wind Mesonets
High Resolution Satellite
SUPPORTING the BASIC HYDROLOGICAL SERVICE
Regional Flood Warning Network
Water Resources Assessment Network
Global Hydrological Network
Global Terrestrial Observing System (GTOS)
World Hydrological Cycle Observing System (WHYCOS)
National Hydrological Network

Networks of stations are defined for a variety of purposes (as defined in above table).

Notes on these metadata

Network Classification Continued....

Stations may be included in several different networks, which may change over time. The table on the previous page lists current network classifications related to the scientific purpose of the network. Some of these networks - the GCOS network for instance - are components of a global network. Entries in the database for some networks may not be complete, thus not properly representing the status of the network. The composition of the network will usually change over time. While several of the networks have international significance, other network classifications have been developed to aid operational management.

Station Purpose

The station purpose can be classified according to the observation program listed below. Parameters in brackets list some of the various different configurations which occur.

- Synoptic [Seasonal, River Height, Climatological, Telegraphic Rain, Aeronautical, Upper Air]
- Climatological [Seasonal, Telegraphic Rain]
- Aeronautical
- Rainfall [River Height]
- River Height
- Telegraphic Rain [Non-Telegraphic River Height, Telegraphic River Height]
- Non-Telegraphic Rain [Telegraphic River Height]
- Evaporation [Rainfall, River Height, Telegraphic River Height, Non-Telegraphic River Height, Telegraphic Rain, Non-Telegraphic Rain]
- Pluviograph [Rainfall, Telegraphic Rain, Non-Telegraphic Rain, River Height, Telegraphic River Height, Non-Telegraphic River Height]
- Radiation
- Lightning Flash Counter
- Public Information
- Local Conditions
- Radar Site
- Unclassified
- No Routine Observations

Note: Telegraphic observations are those which are sent by some electronic means be it a phone or telegram to the responsible Bureau office. It is a term which is historically linked to analogue non automatic data transmission.

Station Observation Program Summary

Surface Observations

The following terms are used to describe the frequency of surface observations at a site. Historical observation programs will typically be missing for many sites until the database is backfilled with information.

Set a)

- Continuous Program
  - More than half hourly observations sent (eg an automatic weather station {AWS} which continuously transmits 10 minute observations). This will automatically include half hourly and hourly observations programs.
- Half hourly observations
  - Half hourly observations sent. This will automatically include hourly observations.
- Hourly observations
  - Hourly observations sent only. Stations report on non-synoptic hours (ie. 0100, 0200, 0400, 0500, etc)

Notes on these metadata

Surface observations continued....

Set b)

- Performed
  - Observations performed, instruments read and observations recorded
- Reported
  - Observations performed, instruments read and reported real time
- Seasonal
  - The program may only be performed during a defined season (such as Fire Weather observations) or the routine program may increase in reporting frequency and/or parameters. The program dates are currently modified at the start and end of each season for stations performing seasonal observations. Historically this was not always the case.

Current Station Equipment Summary

Equipment listed in this metadata product is catalogued under one of systems listed below, appropriate to its application. The "Infrastructure" category has been included since it contains information about the mast height of an anemometer (if present).

- Flood Warning
- Infrastructure
- Radiation
- Rainfall Intensity
- Surface Observations
- Upper Air
- Weather Watch {RADAR}

Station Equipment History

Equipment Install/Remove

One of four types of actions can be performed on an instrument in this listing:

Install - A new instrument is installed at the site. This can be either a completely new addition (eg the first barometer at the site), or the replacement of an existing instrument with a different type (eg replacing mercury barometer with electronic barometer)

Remove - An instrument can be removed either when it is no longer necessary to measure a particular element, or when the element is to be measured by an instrument of a different type (see under "Install" above)

Replace - This occurs when one instrument is replaced with another of the same type (eg Kew pattern mercury barometer replacing another Kew pattern mercury barometer)

Share - The same instrument is used for observations under two (or more) systems (eg a rain gauge may be used within both Surface Observations and Rainfall Intensity systems)

Unshare - The instrument is no longer shared between systems

Notes on these metadata

Calibration

During a site inspection an instrument will be calibrated as either being within or not within the specified tolerance in accuracy.

Where a quantative calibration result can be achieved by comparison to a transfer standard (eg barometer comparisons and tipping bucket rain gauge calibrations), the instrument will be recorded as being within or outside the required tolerance. Instruments (such as 203mm rain gauges, screens and evaporation pans) where quantitative calibrations cannot be derived should be regarded as meeting specifications when the instrument is in 'good working order'.

This product provides a summary table of the number of times an instrument was found to be out of calibration

Station Detail Changes

This set of metadata indicates when some aspect of the general information about a station has changed.

- STATION

Metadata which are categorised as pertaining to STATION are items of (textual) information describing a specific attribute of the station. A reference to (nondB seeding) indicates initial information of this field has been sourced from a previous database.

Station position

- Latitude and longitude

Derivation of station latitude and longitude, defined by the location of the rain gauge when it is present, has changed over time. Current practice is to locate or verify open and operational station latitude and longitude based on Global Positioning System equipment. Methods used to locate a station as described in this product (latlon_deriv) are as follows: GPS, MAP 1:10000, MAP 1:12500, MAP 1:25000, MAP 1:50000, MAP 1:100000, MAP 1:250000, SURVEY, and Unknown (which is more commonly represented by a null value). The field latlon_error should be used with caution as the method of determining this value has been interpreted in different ways over time.

- Height

Determination of heights for observing sites is by survey where possible. Otherwise height may be determined using a Digital Aneroid Barometer and a known surveyed point, or derived from map contours. The source of height is provided in the corresponding parameter with a suffix of "_deriv".

Heights which may appear in these metadata are:

- aero_ht
  - The official elevation of the aerodrome which normally corresponds to the altitude of the highest threshold of the runways at that airport;
- bar_ht
  - this represents the height of the mercury barometer cistern or the digital aneroid barometer above mean sea level (MSL);
- stn_ht
  - this normally represents the height of the rain gauge above MSL

Notes on these metadata

- Land Use

To assist the long term understanding of climate change it is important to be able to determine the differences over time which are attributed to variations in the climate. Since land use has an effect on the micro climate around the site, and changes in land use will therefore affect the climate record, it is important that the characteristics of the site are monitored. Soil types are recorded as they affect the land use and also add to the knowledge of the site details.

Defined Land use Types.

- Non-vegetated (barren, desert)
- Coastal or Island
- Forest
- Open farmland, grassland or tundra
- Small town, less than 1000 population
- Town 1000 to 10,000 population
- City area with buildings less than 10 metres (3 stories)
- City area with buildings greater than 10 metres (3 stories)
- Airport

The land use code is entered on the station inspection form in the ranges 0 to 100 m, 100 to 1 km and 1km to 10 km; ie:

- lu_0_100m: Land Use 0 to 100 metres from the enclosure
- lu_100m_1km: Land Use 100 metres to 1 kilometre
- lu_1km_10km: Land Use 1 kilometre to 10 kilometres

Defined Soil Type (At Enclosure).

- unable to determine
- sand
- black soil
- clay
- rock
- red soil
- other

Surface Type (At Enclosure).

- unable to determine
- fully covered by grass
- mostly covered by grass
- partly covered by grass
- bare ground
- sand
- concrete
- asphalt
- rock
- other

talis
delivering solutions

Appendix E: **Environmental Noise Assessment**

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Environmental Noise Assessment

Waste Management Facility, 25 Jackson Street, Bassendean

Reference: 16013476-01.docx

Prepared for:
Aurigen

Member Firm of Association of Australian Acoustical Consultants

Report: 16013476-01.docx

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Position:	Project Director
Date:	23 June 2016

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1 INTRODUCTION

It is proposed to open a Waste Management Facility at 25 Jackson Street in Bassendean – refer *Figure 1.1*.

It is understood that the site is existing and currently operates a cardboard/paper baling and scrap metal baling facilities. The proposed operations will include a putrescibles waste transfer station (WTS) and a commercial and industrial (C&I) waste Materials Recovery Facility (MRF) and may include a metal shredder on the site to assist with commodity aggregation activities. The new site will include three main buildings as follows:

- WTS and MRF building which includes designated acceptance areas for the WTS and the MRF. The building will have up to 6 roller shutter doors (2 for MRF, 3 for WTS, 1 for maintenance) with 2 doors of the WTS operational at any one time;
- Bale Shed (finished products storage); and,
- Metal Recycling Facility and Baler / Shredder Shed building which will be extended to house the existing baler and new metal shredder. This building will be fully open to the north east side to allow for access to the shredder.

The WTS and MRF each have a capacity of 100,000 tonnes per annum (tpa) consisting of municipal solid waste (MSW) and C&I waste streams with waste moved to and from site by truck.

The proposed hours of operations for various areas on site are as follows:

- WTS, 0600 to 1830 seven days per week
- (C&I) MRF, 24 hrs per day
- Metal shredder, 0600 to 1800 seven days per week

It is noted the proposed site is located within an industrial area and surrounded by industrial premises. The nearest noise sensitive premises identified are located on Shalford Street, approximately 600 metres to the north.

This report assesses the noise emissions from the facility, including truck movements on the premises, at the surrounding industrial receivers and nearest residences against the requirements of the *Environmental Protection (Noise) Regulations 1997.*

Appendix A presents the proposed site plan of the facility on which this assessment is based.

Appendix C contains a description of some of the terminology used throughout this report.

Figure 1-1 Project Locality

2 CRITERIA

Environmental noise in Western Australia is governed by the *Environmental Protection Act 1986*, through the *Environmental Protection (Noise) Regulations 1997* (the Regulations).

Regulation 7 defines the prescribed standard for noise emissions as follows:

"7. (1) Noise emitted from any premises or public place when received at other premises –

(a) Must not cause or significantly contribute to, a level of noise which exceeds the assigned level in respect of noise received at premises of that kind; and

(b) Must be free of –

i. tonality;

ii. impulsiveness; and

iii. modulation,

when assessed under regulation 9"

A "…noise emission is taken to significantly contribute to a level of noise if the noise emission … exceeds a value which is 5 dB below the assigned level…"

Tonality, impulsiveness and modulation are defined in Regulation 9. Noise is to be taken to be free of these characteristics if:

(a) The characteristics cannot be reasonably and practicably removed by techniques other than attenuating the overall level of noise emission; and

(b) The noise emission complies with the standard prescribed under regulation 7 after the adjustments of *Table 2-1* are made to the noise emission as measured at the point of reception.

Table 2-1 Adjustments Where Characteristics Cannot Be Removed

Where Noise Emission is Not Music			Where Noise Emission is Music	
Tonality	Modulation	Impulsiveness	No Impulsiveness	Impulsiveness
+ 5 dB	+ 5 dB	+ 10 dB	+ 10 dB	+ 15 dB

Note: The above are cumulative to a maximum of 15dB.

The baseline assigned levels (prescribed standards) are specified in Regulation 8 and are shown in *Table 2-2*.

Table 2-2 Baseline Assigned Noise Levels

Premises Receiving Noise	Time Of Day	Assigned Level (dB)		
		L_{A10}	L_{A1}	L_{Amax}
Noise sensitive premises: highly sensitive area[1]	0700 to 1900 hours Monday to Saturday (Day)	45 + influencing factor	55 + influencing factor	65 + influencing factor
	0900 to 1900 hours Sunday and public holidays (Sunday)	40 + influencing factor	50 + influencing factor	65 + influencing factor
	1900 to 2200 hours all days (Evening)	40 + influencing factor	50 + influencing factor	55 + influencing factor
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	35 + influencing factor	45 + influencing factor	55 + influencing factor
Commercial	All hours	60	75	80
Industrial	All hours	65	80	90

1. ***highly sensitive area*** means that area (if any) of noise sensitive premises comprising —
   (a) a building, or a part of a building, on the premises that is used for a noise sensitive purpose; and
   (b) any other part of the premises within 15 metres of that building or that part of the building.

The influencing factor applicable at the nearest noise sensitive premises to the north has been calculated as 7 dB as shown in *Table 2-3* and based on the land use map in *Appendix B*. The transport factor has been calculated as **2 dB**, due to Tonkin Highway being considered a major road (> 15,000 vehicles per day from MRWA Metropolitan Traffic Digest, 2013/14) within 450 metres of the residence.

Table 2-3 Influencing Factor Calculation

Description	Within 100 metre Radius	Within 450 metre Radius	Total
Industrial Land	20 %	30 %	5 dB
Commercial Land	0 %	0 %	0 dB
Transport Factor			2 dB
Total			**7 dB**

Table 2-4 shows the assigned noise levels including the influencing factor and transport factor at the receiving locations.

Table 2-4 Assigned Noise Levels

Premises Receiving Noise	Time Of Day	Assigned Level (dB)		
		L_{A10}	L_{A1}	L_{Amax}
Noise sensitive premises: highly sensitive area[1]	0700 to 1900 hours Monday to Saturday (Day)	52	62	72
	0900 to 1900 hours Sunday and public holidays (Sunday)	47	57	72
	1900 to 2200 hours all days (Evening)	47	57	62
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	42	52	62
Industrial	All hours	65	80	90

1. ***highly sensitive area*** means that area (if any) of noise sensitive premises comprising —
   (a) a building, or a part of a building, on the premises that is used for a noise sensitive purpose; and
   (b) any other part of the premises within 15 metres of that building or that part of the building.

It is noted that given the relatively large separation distance to the nearest noise sensitive premises, it is likely compliance with the Regulations will be driven by the assigned noise levels applicable at the boundary of the adjacent industrial premises.

In addition, the assigned noise levels are statistical levels and therefore the period over which they are determined is important. The Regulations define the Representative Assessment Period (RAP) as *a period of time of not less than 15 minutes, and not exceeding 4 hours*, which is determined by an *inspector* or *authorised person* to be appropriate for the assessment of a noise emission, having regard to the type and nature of the noise emission. An *inspector* or *authorised person* is a person

appointed under Sections 87 & 88 of the *Environmental Protection Act 1986* and include Local Government Environmental Health Officers and Officers from the Department of Environment Regulation. Acoustic consultants or other environmental consultants are not appointed as an *inspector* or *authorised person*. Therefore, whilst this assessment is based on a 4 hour RAP, which is assumed to be appropriate given the nature of the operations, this is to be used for guidance only.

Under regulation 3, nothing in the Regulations applies to the following noise emissions –

(a) noise emissions from the propulsion and braking systems of motor vehicles operating on a road;

(b) noise emissions from a safety warning device, other than a reversing alarm, fitted to a motor vehicle operating on a road;

(c) noise emissions from trains or aircraft (other than model aircraft and trains operating on railways with a gauge of less than 70cm);

(d) noise emissions from a safety warning device fitted to a train or vessel;

(e) noise emissions from an emergency vehicle as defined in the Road Traffic Code 2000 regulation 3(1);

(f) noise emissions from the propulsion system or the movement through the water of a vessel operating in water other than water on private premises;

(g) noise emissions –

(i) from a device for warning pedestrians installed at a pedestrian crossing on a road; or

(ii) from a device for warning of the passage of a train installed at a level crossing; or

(iii) from a safety warning device fitted to a building as a requirement of the Building Code as defined in the *Building Regulations 2012* regulation 3; or

(iv) for the purpose of giving a warning required under the *Mines Safety and Inspection Regulations 1995* regulation 8.26,

if every reasonable and practicable measure has been taken to reduce the effect of the noise emission consistent with providing an audible warning to people;

(h) noise emissions from –

(i) a reversing alarm fitted to a motor vehicle, mobile plant, or mining or earthmoving equipment; or

(ii) a startup or movement alarm fitted to plant,

if

(iii) it is a requirement under another written law that such an alarm be fitted; and

(iv) it is not practicable to fit an alarm that complies with the written law under which it is required to be fitted and emits noise that complies with these Regulations;

It is considered that reversing alarms fitted to commercial vehicles and mobile plant e.g. HV trucks or loaders, are not exempt under the Regulations since they are not specifically required under another written law. The commonly used fixed noise output tonal reversing alarms also known as 'reversing beeper' emit, by their very nature, tonal and modulating noise at high levels. As such, this type of reversing alarm generally cannot comply with the Regulations even at distant receivers.

If deemed to be required, an alternative reversing alarm type should be sourced. Such alternative, which can more readily comply with the Regulations, include alarms emitting a broadband signal in-lieu of a tonal 'beep'.

3 METHODOLOGY

3.1 Site Measurements

Site visits were conducted on the 13 April and 15 June 2016 to determine the sound power levels of various equipment and ambient noise levels applicable to the nearby industrial receivers.

The equipment used was a Rion sound level meter type NA28 and the following is noted in regard to the sound level meter:

- The equipment holds current laboratory certificates of calibration that are available upon request. The equipment was also field calibrated before and after the Event and found to be within +/- 0.5 dB.
- The microphone was fitted with a standard wind screen.
- The microphone was approximately 1.4 metres above ground level and at least 3.0 metres from reflecting facades (other than the ground plane).

3.2 Noise Modelling

Computer modelling has been used to predict the noise emissions from the proposed operations. The advantage of modelling is that it is not affected by background noise sources and can provide the noise level for various weather conditions and operating scenarios if necessary.

The software used was *SoundPLAN 7.4* with the CONCAWE algorithms selected. These algorithms have been selected as they are one of the few that include the influence of wind and atmospheric stability. Input data required in the model are:

- Meteorological Information;
- Topographical data;
- Ground Absorption; and
- Source sound power levels.

3.2.1 Meteorological Information

Meteorological information utilised is provided in *Table 3-1* and is considered to represent worst-case conditions for noise propagation. At wind speeds greater than those shown, sound propagation may be further enhanced, however background noise from the wind itself and from local vegetation is likely to be elevated and dominate the ambient noise levels.

Table 3-1 Modelling Meteorological Conditions

Parameter	Night (1900-0700)	Day (0700-1900)
Temperature (^{o}C)	15	20
Humidity (%)	50	50
Wind Speed (m/s)	3	4
Wind Direction*	All	All
Pasquil Stability Factor	F	E

* Note that the modelling package used allows for all wind directions to be modelled simultaneously.

It is generally considered that compliance with the assigned noise levels needs to be demonstrated for 98% of the time, during the day and night periods, for the month of the year in which the worst-case weather conditions prevail. In most cases, the above conditions occur for more than 2% of the time and therefore must be satisfied.

3.2.2 Topographical Data and Buildings

Topographical data was based on that publicly available from *GoogleEarth* in the form of spot heights as well as project specific data.

In addition, buildings within and surrounding the proposed site were incorporated as these can provide noise barrier effects and also reflection paths. Buildings on adjacent industrial sites were modelled at 6 metres high.

The buildings are assumed to be built from corrugated steel sheets at least 1mm thick and internally lined with acoustic insulation at least 50mm thick to prevent reverberant noise build up. Vents are also provided on the ridge line of the MRF building roof to allow for natural ventilation with approximately 100m^2 in total open area.

3.2.3 Ground Absorption

Ground absorption varies from a value of 0 to 1, with 0 being for an acoustically reflective ground (e.g. water or bitumen) and 1 for acoustically absorbent ground (e.g. grass). In this instance, a value of 0 has been used as an average across the study area.

3.2.4 Source Sound Levels

The sound power levels used in the modelling are provided in *Table 3-2*.

Table 3-2 Source Sound Power Levels

Description	Octave Band Centre Frequency (Hz)								Overall dB(A)
	31.5	63	125	250	500	1k	2k	4k	
Within Metal Recycling Facility and Baler/Shredder Building									
Excavator loading scrap metal into shredder and stockpile management	100	113	111	107	109	109	108	105	**114**
Metal Shredder, split into two sources, L_w each	126	113	123	117	117	115	106	104	**119**
Within New C&I MRF Building									
Loader (TCM 870) in tipping area	117	125	117	104	102	104	101	94	**109**
MRF Conveyors, L_w per metre	100	87	97	91	91	89	80	78	**93**
Glass crusher	60	69	79	85	92	94	94	90	**99**
Twin Ram Baler	100	87	97	91	91	89	80	78	**93**
Paper Baler	95	82	92	86	86	83	74	73	**88**
Within Bale Shed (finished products storage)									
Forklift (gas) working	102	108	102	98	96	95	92	87	**100**
Truck Movements									
Truck driving on site	113	108	103	99	97	97	94	91	**101**

With regards to the above, please note the following:

- The sound power levels represent L_{10} source levels;
- The sound power levels for the excavator were derived from on-site measurements with the equipment operating under normal conditions and not a static 'idle' condition;
- The sound power levels for other equipment were derived from measurements of similar equipment either already on file or provided by the Client;
- All mobile equipment were modelled as a point source located 2 metres above local ground, with the exception of the forklift, modelled 1m above ground; and,
- The conveyors and balers within the MRF building were modelled as line sources located between 1 and 3 metres above local ground.

3.2.5 Truck movements

A total of 153 trucks per day are expected at the facility during the operating day (0600 to 1830). The trucks are evenly split between the WTS/MRF (76 trucks) and aggregated commodities (77 trucks) and will also use dedicated entrances.

In relation to the WTS/MRF, trucks will enter and exit via the Alice Street weighbridges. There will also be two peak-hour periods, each two hours long, during which 28 trucks are expected (14 trucks per hour).

For the aggregated commodities, the trucks will enter and exit site from Jackson Street.

Assuming only one peak-hour period occurs over the representative assessment period (the RAP) of 4 hours, the worst-case numbers of trucks were estimated at 34 for the MRF/WTS and 25 for the aggregated commodities over the RAP.

4 RESULTS

4.1 Site Measurements

During our site visit of the 13 April 2016, only the excavator managing the scrap metal stockpile was operating. A noise level of 78 dB L_{A10} was recording at 25 metres from the excavator operating and this level was used as an input in the noise modelling. *Figure 4-1* shows the excavator at work.

A second site visit was undertaken to record local ambient noise levels at a location close to the potentially most affected industrial receiver located at No 6 Alice Street. Noise levels were continuously recorded over a period of 30 minutes in the morning while normal operations on the existing site and nearby receivers were occurring. The following noise levels were recorded:

- 78 dB L_{Amax} from a haul truck on Alice Street;
- 68 dB L_{A1}; and,
- 57 dB L_{A10}.

From our observation on site the ambient noise was found to be dominated by heavy goods vehicle traffic on Alice Street, industrial noise from surrounding industry and sporadic aircraft fly over. It was also noted the excavator on the proposed site was working behind a stock pile 3 to 4 metres high and therefore its noise emission was not audible at the monitoring location (refer *Figure 4-2*).

Figure 4-1 Excavator in Scrap Metal Yard

Figure 4-2 Monitoring Location at Entry Ramp From Alice Street

4.2 Noise Modelling

The results of the noise modelling for the proposed operations are shown as noise level contour plots in *Figures 4-3* and *4-4* for the day (0600 to 1830) and night (1830-0600) operations respectively, and are also summarised below in *Table 4-1*.

The day operations (0600 to 1830) include the noise emissions from the WTS and MRF facility, Bale Shed, truck movements and metal shredder. The new buildings (WTS and MRF, Bale Shed, etc.) are assumed to be internally lined with acoustic insulation at least 50mm thick to prevent reverberant noise build up. It is also noted that roller shutter doors are located on the southern west wall of the WTS and MRF. For the purpose of this assessment, it was assumed two roller doors can be open for more than 10% of the representative assessment period and therefore noise breaking out through two open roller doors was included in the model.

In relation to truck movements on site, in particular to/from the MRF/WTS, it was considered the industrial receiver at 6 Alice Street will be most impacted as this receiver is not shielded by other buildings and is directly adjacent the Alice Street entry/exit weighbridge. An average route length of 280 metres from the site boundary on Alice Street to the MRF doors (and back out) was derived from the site plans. Assuming an average truck speed of 20 km/hr, this means truck noise would be present on site for approximately 28 minutes based on 34 trucks over 4 hours. As such, truck noise is to comply with the L_{A10} assigned noise level.

For the night operations (1830 to 0600), only the noise from the MRF and Bale Shed are considered as other activities will not be occurring at night-time. Noise emissions include the MRF noise breakout via the roof vents and the open roller door to the Bale Shed, and the forklift noise.

Table 4-1 Summary of Noise Modelling

Location	Operating Scenario	
	Day Operations, 0600 to 1830, dB L_{A10}	Night Operations, 1830 to 0600, dB L_{A10}
Shalford Street Residences	52	40
South	67	52
Mid-west	67	56
North East	64	61
Weighbridge	75	52

Table 4-2 provides the noise source ranking at the noise sensitive receiver and the most affected industrial receivers along the boundary for the day operations.

Table 4-2 Day Operations Noise Source Ranking

Receiver	Noise Source	Predicted Noise Level dB, L_{A10}
Shalford Street	Shredder Shed (open side)	52
	MRF top vents	39
	Trucks on site	32
South	Shredder Shed (open side)	65
	Trucks on site	61
	MRF Building	52
Weighbridge	Shredder Shed (open side)	75
	Trucks on site	67
	MRF Building	52
Mid-West	Shredder Shed (open side)	66
	Trucks on site	52
	MRF building (NW wall)	55
North East	Shredder Shed (open side)	60
	MRF Building	60
	Trucks on site	43

During the night operations, the main source of noise are the noise breaking out through the roof vents and the MRF buildings walls, with the noise contribution from the open roller door to the bale storage area being minimal.

Proposed Waste Transfer Station, 25 Jackson Street
Day Operations (0600-1830) L_{A10} Noise Level Contours

Figure 4-3

Noise Levels
L_{A10} dB

= 55
= 60
= 65
= 70
= 75

N

Signs and symbols

- Point source
- Receiver
- Industrial building

17 June 2016

Length Scale 1:2300
0 10 20 40 60 m

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Proposed Waste Transfer Station, 25 Jackson Street
Night Operations (1830-0600) L_{A10} Noise Level Contours

Figure 4-4

Noise Levels
L_{A10} dB

= 55
= 60
= 65
= 70
= 75

N

Signs and symbols

Point source
Receiver
Industrial building

17 June 2016

Length Scale 1:2300
0 10 20 40 60 m

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5 ASSESSMENT

5.1 Day Operations - 0600 to 1830

It is noted the shredder shed will be fully open to the north east, therefore allowing for noise to breakout in this specific direction. Given the relatively short distances to the industrial receiver to the north east, impulsiveness is likely to be present in the noise emissions when the metal shredder is operating. In addition, the noise emissions from the trucks would also be considered tonal however, since the noise from the shredder dominates at all receivers, only the +10 dB penalty for impulsiveness was added in accordance with *Table 2-1*.

At the nearest noise sensitive premises, annoying characteristics are not considered to be present given the separation distance of 600 metres and the number of transport corridors nearby.

Given the proposed hours of operations, the noise emissions from the site will spread across the various time periods defined in the Regulations e.g. night-time and Sundays and public holidays, noting that the night-time on Sundays and public holidays technically finishes at 0900.

Table 5-1 assesses the noise levels from the day operations on site at each location against the relevant assigned noise levels.

Table 5-1 Assessment of Day Operations Noise Levels

Location	Period[1]	Assigned Noise Level[2]	Predicted Noise Level[3]	Adjusted Noise Level[4]	Calculated Exceedance
Shalford Street	Day (Mon-Sat, 0700-1900)	52 dB L_{A10}	52 dB L_{A10}	52 dB L_{A10}	*Complies*
	Sunday and public holidays (0900 to 1900)	47 dB L_{A10}	52 dB L_{A10}	52 dB L_{A10}	5 dB
	Night (0600 to 0700/0900)	42 dB L_{A10}	52 dB L_{A10}	52 dB L_{A10}	10 dB
South	*Anytime*	65 dB L_{A10}	67 dB L_{A10}	77 dB L_{A10}	12 dB
Mid-west	*Anytime*	65 dB L_{A10}	67 dB L_{A10}	77 dB L_{A10}	12 dB
North East	*Anytime*	65 dB L_{A10}	64 dB L_{A10}	74 dB L_{A10}	9 dB
Weighbridge	*Anytime*	65 dB L_{A10}	75 dB L_{A10}	85 dB L_{A10}	20 dB

Notes:
1. Periods are as defined in *Table 2-4*.
2. The assigned noise level is as defined in *Table 2-4*.
3. From *Table 4-1*.
4. Noise adjusted by +10 dB at industrial receivers for impulsiveness from metal shredder operating.

5.1.1 Residential Receivers

It can be seen from the assessment above the noise emissions from the site would only comply with the Regulations during the daytime, Monday to Saturday 0700 to 1900 hours. To be able to operate

the shredder during the daytime on Sundays and public holidays, that is between 0900 and 1900 hours, would require a further 5 dB reduction in overall noise levels.

5.1.2 Industrial Premises

In relation to the nearby industrial premises, it can be seen the predicted exceedances are larger than at the residential receivers and therefore the L_{A10} assigned noise level at the boundary with other industrial premises drives the compliance requirements. An overall noise reduction of 20 dB would be required to achieve compliance. It is noted this level of reduction assumes that noise emissions from the shredder are impulsive when assessed at the boundary and therefore should impulsiveness be removed then only an overall reduction of 10 dB is required.

However, it is also noted that should the shredder noise be mitigated, noise from trucks on site can become a significant noise contributor, in particular at the industrial receiver on the east side of the entry/exit ramp off Alice Street (No. 6 Alice Street). At that location the predicted truck noise level is 67 dB L_{A10} (refer *Table 4-2*). As this noise emission would be considered tonal, a +5 dB penalty must be added, resulting in an assessable level of 71 dB L_{A10}. Therefore, the noise from the trucks alone would result in a 6 dB exceedance at the industrial receiver located at No. 6 Alice Street.

5.2 Night Operations - 1830 to 0600

At night-time, no equipment will be operating outdoors and the noise emissions from the Bale Shed and MRF buildings will be contained within each building. However, the roller door to the Bale Shed will be in use and, as such, tonality could be present at the closest industrial receiver which is 'Mid-West', but was not considered likely at all other receivers.

Outside the hours of 0600 to 1830, only the MRF and Bale Shed buildings will continue operating and given the proposed hours of operations, its noise emissions will spread across all various time periods defined in the Regulations.

Table 5-2 assesses the noise levels from both buildings at each location and against the relevant assigned noise levels.

It can be seen from the assessment the noise emissions from night operations can comply with the Regulations at all times and at all receivers and therefore no noise mitigation would be required.

Table 5-2 Assessment of Night Operations Noise Levels

Location	Period[1]	Assigned Noise Level[2]	Predicted Noise Level[3]	Adjusted Noise Level[4]	Calculated Exceedance
Shalford Street	Day (Mon-Sat, 0700-1900)	52 dB L_{A10}	40 dB L_{A10}	40 dB L_{A10}	*Complies*
	Evening (1900-2200)	47 dB L_{A10}	40 dB L_{A10}	40 dB L_{A10}	*Complies*
	Sunday and public holidays (0900 to 1900)	47 dB L_{A10}	40 dB L_{A10}	40 dB L_{A10}	*Complies*
	Night	42 dB L_{A10}	40 dB L_{A10}	40 dB L_{A10}	*Complies*
South	*Anytime*	65 dB L_{A10}	52 dB L_{A10}	52 dB L_{A10}	*Complies*
Mid-west	*Anytime*	65 dB L_{A10}	56 dB L_{A10}	61 dB L_{A10}	*Complies*
North East	*Anytime*	65 dB L_{A10}	62 dB L_{A10}	62 dB L_{A10}	*Complies*
Weighbridge	*Anytime*	65 dB L_{A10}	52 dB L_{A10}	52 dB L_{A10}	*Complies*

Notes:
1. Periods are as defined in *Table 2-4*.
2. The assigned noise level is as defined in *Table 2-4*.
3. From *Table 4-1*.
4. Adjustment for tonal penalty made at specific receiver.

6 RECOMMENDATIONS

6.1 Day Operations

6.1.1 Industrial Receivers

On the basis the assigned noise levels at the boundary with adjacent industrial premises drive the compliance requirements, an overall noise reduction of 20 dB is required.

It is noted the most significant noise source is the metal shredder and that it's sound power levels were derived from sound pressure measurements conducted by others. Therefore it is recommended to first confirm the selected metal shredder noise levels from manufacturer/supplier or arrange for measurements to be made of similar shredder on alternative site, with the aim to identify targeted noise controls to mitigate the shredder noise at the source. Alternatively, the following noise controls could be used to reduce the impact from the shredder shed noise:

- Incorporate localised noise barriers within the shed and around the shredder to provide at least 10 dB overall noise reduction to the combined metal shredder and excavator noise. Or,
- Close off the open side of the shredder shed when the shredder is in operation. This could be done using roller doors or large flexible noise curtains which can be open and closed on demand and relatively quickly.

It is considered that either noise controls above will remove the impulsiveness characteristic and result in compliance with the Regulations.

It is noted that truck noise would also need to be mitigated by at least 10 dB at the receiver on the east side of the entry ramp from Alice Street, which could be achieved by building a noise wall along the east side of the ramp and a section of the north east boundary. It is noted such noise barrier will also mitigate noise from the shredder shed at that receiver. Alternatively, reducing the number of trucks entering the site via the Alice Street ramp to 28 in any 4 hours would result in truck noise being present in that area of the site for approximately 23 minutes. Compliance with the L_{A1} assigned noise levels of 75 dB would then be achieved even with the tonal penalty included.

Furthermore, if deemed required for reversing alarms to be fitted, all trucks and mobile equipment are recommended to have broadband noise reversing alarms fitted to minimise the impact of vehicle reversing noise.

6.1.2 Residential Receivers

Compliance with the Regulations during the daytime, that is Monday to Saturday between 0700 and 1900 hours, can be achieved. However, to operate the shredder during the daytime on Sundays and public holidays, that is between 0900 and 1900 hours, would require a further 5 dB reduction in overall noise levels.

This level of reduction is expected to be readily achieved by noise controls implemented to achieve compliance at the neighbouring industrial receivers.

6.2 Night Operations

The night operations were predicted to comply with the Regulations and therefore no mitigation measures are required other than ensuring the inside of the buildings are lined with acoustic insulation at least 50mm thick to prevent reverberant noise build up.

Appendix A

Site Plan

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ASSET MANAGEMENT
CIVIL ENGINEERING
ENVIRONMENTAL SERVICES
SPATIAL INTELLIGENCE
WASTE MANAGEMENT

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PO Box 454, Leederville WA 6903

Client: AURIGEN

NOTES

1. This drawing is the property of Talis Consultants Pty Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. All levels refer to Australian Height Datum.
3. DO NOT SCALE, use figured dimensions only, if in doubt please contact Talis Consultants.

No.	Date	Drwn/Chk	Amendment / Issue	App.
D	20.06.16	PG/TM	RESIZE BAILER/SHREDDER	RC
C	07.06.16	PG/TM	AREA CHANGE (WTS, C&I)	RC
B	03.06.16	PG/TM	EXTRA DOORS, ADDED WEIGHBRIDGE, GLASS CRUSHER	RC
E	23.06.16	CDB/TM	LAYOUT AND NOTE FINALISATION	RC

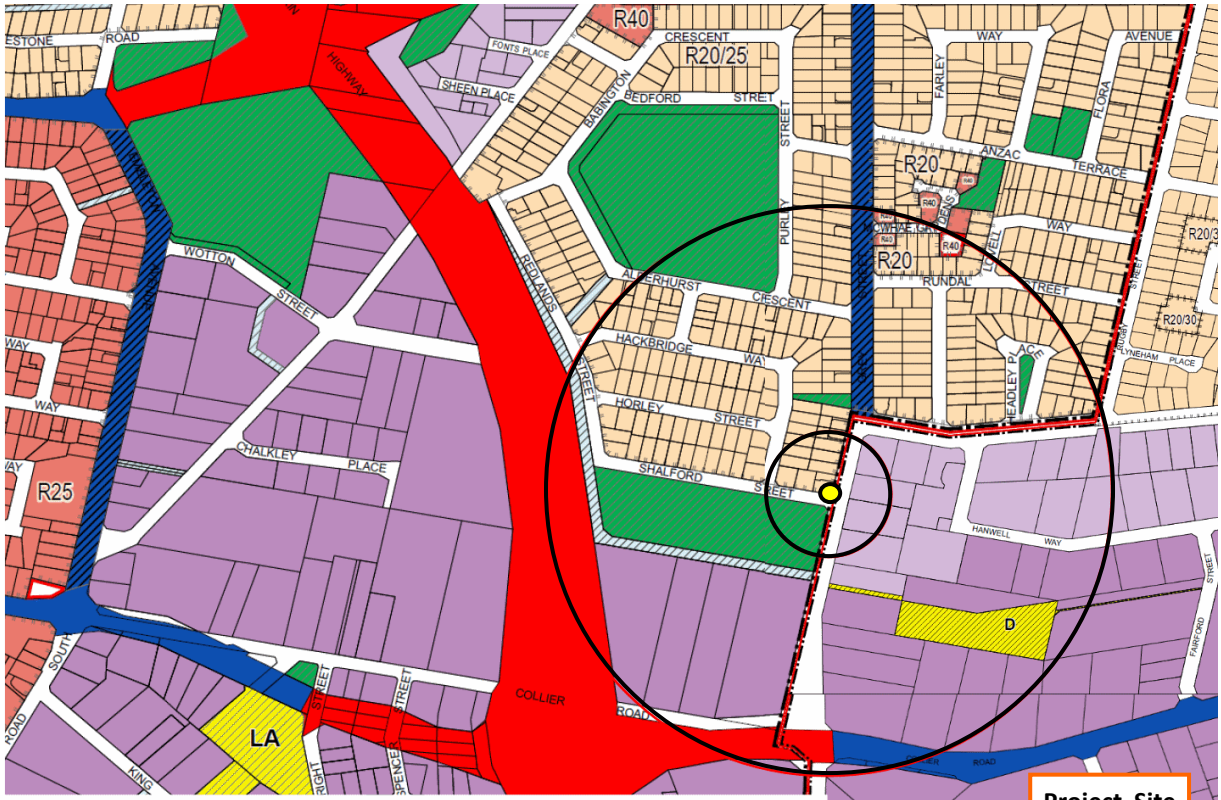
Project: JACKSON STREET WASTE TRANSFER AND RESOURCE RECOVERY FACILITY

Title: CONCEPTUAL SITE PLAN

Drawn by:	CDB	Job No:	TW15042
Checked by:	TM	File No:	TW15042-G-001
Approved by:	RC	Drg. No:	G-001
Scale:	1:1000	Rev:	E
Date:	23.06.2016		

Appendix B

Land Use Map



LEGEND

REGION SCHEME RESERVES (MRS)

- Civic and cultural
- Other regional roads
- Parks and recreation
- R Parks and recreation restricted
- Port installations
- Primary regional roads
- Railways
- State forests
- Waterways
- Water catchments

Public purposes
- CP Public purposes - car park
- CG Public purposes - Commonwealth Government
- HS Public purposes - high school
- H Public purposes - hospital
- P Public purposes - prison
- SU Public purposes - special uses
- SEC Public purposes - State Energy Commission
- TS Public purposes - technical school
- U Public purposes - university
- WSD Public purposes - Water Authority of WA

LOCAL SCHEME RESERVES

(see scheme text for additional information)

- Parks and recreation
- D Public purposes : Drainage
- H Public purposes : Hospital
- PS Public purposes : Primary school

LOCAL SCHEME ZONES

(see scheme text for additional information)

- General industry
- Light industry
- Local shopping
- Residential
- Town centre

N

0 250 500 750 1,000

metres

Appendix C

Terminology

The following is an explanation of the terminology used throughout this report.

Decibel (dB)
The decibel is the unit that describes the sound pressure and sound power levels of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

A-Weighting
An A-weighted noise level has been filtered in such a way as to represent the way in which the human ear perceives sound. This weighting reflects the fact that the human ear is not as sensitive to lower frequencies as it is to higher frequencies. An A-weighted sound level is described as L_A dB.

Sound Power Level (L_w)
Under normal conditions, a given sound source will radiate the same amount of energy, irrespective of its surroundings, being the sound power level. This is similar to a 1kW electric heater always radiating 1kW of heat. The sound power level of a noise source cannot be directly measured using a sound level meter but is calculated based on measured sound pressure levels at known distances. Noise modelling incorporates source sound power levels as part of the input data.

Sound Pressure Level (L_p)
The sound pressure level of a noise source is dependent upon its surroundings, being influenced by distance, ground absorption, topography, meteorological conditions etc and is what the human ear actually hears. Using the electric heater analogy above, the heat will vary depending upon where the heater is located, just as the sound pressure level will vary depending on the surroundings. Noise modelling predicts the sound pressure level from the sound power levels taking into account ground absorption, barrier effects, distance etc.

L_{ASlow}
This is the noise level in decibels, obtained using the A frequency weighting and the S time weighting as specified in AS1259.1-1990. Unless assessing modulation, all measurements use the slow time weighting characteristic.

L_{AFast}
This is the noise level in decibels, obtained using the A frequency weighting and the F time weighting as specified in AS1259.1-1990. This is used when assessing the presence of modulation only.

L_{APeak}
This is the maximum reading in decibels using the A frequency weighting and P time weighting AS1259.1-1990.

L_{Amax}
An L_{Amax} level is the maximum A-weighted noise level during a particular measurement.

L_{A1}
An L_{A1} level is the A-weighted noise level which is exceeded for one percent of the measurement period and is considered to represent the average of the maximum noise levels measured.

L_{A10}
An L_{A10} level is the A-weighted noise level which is exceeded for 10 percent of the measurement period and is considered to represent the "*intrusive*" noise level.

L_{Aeq}
The equivalent steady state A-weighted sound level ("equal energy") in decibels which, in a specified time period, contains the same acoustic energy as the time-varying level during the same period. It is considered to represent the "average" noise level.

L_{A90}
An L_{A90} level is the A-weighted noise level which is exceeded for 90 percent of the measurement period and is considered to represent the "*background*" noise level.

One-Third-Octave Band
Means a band of frequencies spanning one-third of an octave and having a centre frequency between 25 Hz and 20 000 Hz inclusive.

L_{Amax} assigned level
Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded at any time.

L_{A1} assigned level
Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded for more than 1% of the representative assessment period.

L_{A10} assigned level
Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded for more than 10% of the representative assessment period.

Tonal Noise
A tonal noise source can be described as a source that has a distinctive noise emission in one or more frequencies. An example would be whining or droning. The quantitative definition of tonality is:

the presence in the noise emission of tonal characteristics where the difference between -

(a) the A-weighted sound pressure level in any one-third octave band; and

(b) the arithmetic average of the A-weighted sound pressure levels in the 2 adjacent one-third octave bands,

is greater than 3 dB when the sound pressure levels are determined as $L_{Aeq,T}$ levels where the time period T is greater than 10% of the representative assessment period, or greater than 8 dB at any time when the sound pressure levels are determined as $L_{A\ Slow}$ levels.

This is relatively common in most noise sources.

Modulating Noise
A modulating source is regular, cyclic and audible and is present for at least 10% of the measurement period. The quantitative definition of modulation is:

a variation in the emission of noise that —

(a) is more than 3 dB $L_{A\ Fast}$ or is more than 3 dB $L_{A\ Fast}$ in any one-third octave band;

(b) is present for at least 10% of the representative.

Impulsive Noise
An impulsive noise source has a short-term banging, clunking or explosive sound. The quantitative definition of impulsiveness is:

a variation in the emission of a noise where the difference between $L_{A\ peak}$ and $L_{A\ Max\ slow}$ is more than 15 dB when determined for a single representative event;

Major Road
Is a road with an estimated average daily traffic count of more than 15,000 vehicles.

Secondary / Minor Road
Is a road with an estimated average daily traffic count of between 6,000 and 15,000 vehicles.

Influencing Factor (IF)

$$= \frac{1}{10}(\%\ \text{Type A}_{100} + \%\ \text{Type A}_{450}) + \frac{1}{20}(\%\ \text{Type B}_{100} + \%\ \text{Type B}_{450})$$

where :

$\%\ \text{Type A}_{100}$ = the percentage of industrial land within a100m radius of the premises receiving the noise

$\%\text{TypeA}_{450}$ = the percentage of industrial land within a 450m radius of the premises receiving the noise

$\%\ \text{Type B}_{100}$ = the percentage of commercial land within a100m radius of the premises receiving the noise

$\%\text{TypeB}_{450}$ = the percentage of commercial land within a 450m radius of the premises receiving the noise

+ Traffic Factor (maximum of 6 dB)

= 2 for each secondary road within 100m

= 2 for each major road within 450m

= 6 for each major road within 100m

Representative Assessment Period
Means a period of time not less than 15 minutes, and not exceeding four hours, determined by an inspector or authorised person to be appropriate for the assessment of a noise emission, having regard to the type and nature of the noise emission.

Background Noise
Background noise or residual noise is the noise level from sources other than the source of concern. When measuring environmental noise, residual sound is often a problem. One reason is that regulations often require that the noise from different types of sources be dealt with separately. This separation, e.g. of traffic noise from industrial noise, is often difficult to accomplish in practice. Another reason is that the measurements are normally carried out outdoors. Wind-induced noise, directly on the microphone and indirectly on trees, buildings, etc., may also affect the result. The character of these noise sources can make it difficult or even impossible to carry out any corrections.

Ambient Noise
Means the level of noise from all sources, including background noise from near and far and the source of interest.

Specific Noise
Relates to the component of the ambient noise that is of interest. This can be referred to as the noise of concern or the noise of interest.

Peak Component Particle Velocity (PCPV)

The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and in one of the three orthogonal directions (x, y or z) measured as a peak response. Peak velocity is normally used for the assessment of structural damage from vibration.

Peak Particle Velocity (PPV)

The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and is the vector sum of the PCPV for the x, y and z directions measured as a peak response. Peak velocity is normally used for the assessment of structural damage from vibration.

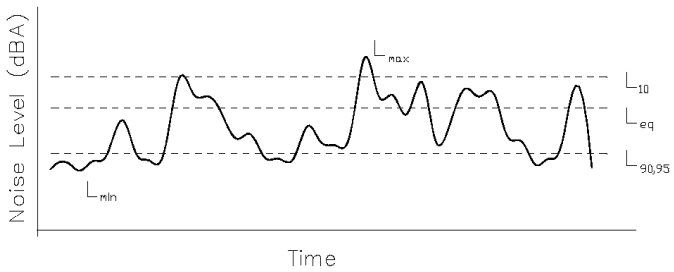
RMS Component Particle Velocity (PCPV)

The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and in one of the three orthogonal directions (x, y or z) measured as a root mean square (rms) response. RMS velocity is normally used for the assessment of human annoyance from vibration.

Peak Particle Velocity (PPV)

The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and is the vector sum of the PCPV for the x, y and z directions measured as a root mean square (rms) response. RMS velocity is normally used for the assessment of human annoyance from vibration.

Chart of Noise Level Descriptors



Typical Noise Levels