Completion of Permanent Survey Mark Plans

Specification

SIG/2013/427

Version 1.04

Last reviewed 19/6/2017

Version History

Version	Date	Description/Comments
1.00	11/7/2012	Replacing former NRW policy RPS/2004/1891
1.01	16/08/2013	Rebranding due to departmental name change and updated references
1.02	23/09/2014	Adding Appendix A about dealing with Uncertainty versus Class and Order and adding appropriate references to the new Appendix within the body of the document.
1.03	11/12/2015	Integrating former Appendix A into the body of the specification and adding a new appendix with examples of GNSS booking sheets.
1.04	19/06/2017	Change to AUSPOS lodgement whereby only 6 hour or more GNSS datasets will now be considered for inclusion in the Department's Datum adjustment and therefore are the only times Rinex data and field records need to be lodged.

Approval

Position	Name	Date
Director, Cadastral and Geodetic Services	Russell Priebbenow	21/6/2017

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1 Purpose

This specification provides for the preparing and lodging of permanent survey mark plans in the Department.

2 Scope

Placement of permanent survey marks

Section 15(2) of the *Survey and Mapping Infrastructure Regulation 2004* provides that a surveyor or a person supervised by a surveyor may place or reinstate a permanent survey mark.

Recording of permanent survey marks

Section 15 of the Act provides for a permanent survey mark plan to be prepared on the current approved form (Form 6) for each permanent survey mark placed in the course of conducting a survey, and for the plan to be submitted within 40 business days of the mark being placed. This specification sets out the requirements for completion of version 5 of the permanent survey mark plan.

The purpose of the permanent survey mark plan is to positively identify the permanent survey mark and facilitate its recovery in the field. The information from the permanent survey mark plan forms part of the State's survey and mapping infrastructure and is maintained by the department within the survey control register.

Section 45 of the Act requires registered persons to notify the chief executive of the disrepair, destruction or removal of a permanent mark, or apparent irregularities in information about the mark in the survey control register.

3 Specification

The information shown on a permanent survey mark plan is to be compiled in a clear style, which is suitable for imaging and reproduction.

Face of permanent survey mark plan

1. The following information is to be supplied on the face of the plan:
    - Registered number – as stamped on plaque or tag
    - Meridian used on the plan
    - Mark type
    - Suited to GNSS
    - Installed by (the registered person or public authority that placed the mark) and the installation date
    - Location sketch of the mark.
2. Where the permanent mark lies within a road, the location sketch must clearly depict identifiable features in their correct relationship to each other and show the following information:
    - Approved road name(s) and a distance to the closest named intersecting or joining road, feature (creek crossing etc) or town where appropriate. (See also Item 4 below for the use of a speedo traverse.)
    - Real property description of adjoining properties (with property address where available).

- Offsets to nearby fence lines and road edges or centreline.
- Suitable radiations to locate the mark – to any of the following identifiable features listed in order of priority:
    - buildings – where applicable
    - power poles or towers, electric light poles, telecom terminal posts, water valves, manholes, culverts etc, recording any identifying numbers appearing on such structures
    - street name signs, distinctive trees or rocks, and other ornamental or unusual features
    - fence posts, gate posts – note types of fences
    - cadastral marks – pegs, alignment spikes, screws, drill holes and existing subsurface marks (eg pins).
- Bearings and lengths of each radiation.
    - distances measured to identifiable features should be of sufficient accuracy to enable the mark to be found
    - bearings are to be either magnetic, on a defined meridian (eg MGA, CAM) or on the meridian of an existing survey with the location sketch noted accordingly. In NO circumstances should an assumed meridian be adopted.
- If the permanent survey mark forms part of a survey control network there may be radiations to recovery marks and/or witness post(s). The connections to these marks should be shown. The distances measured to recovery marks should be of sufficient accuracy to re-establish the permanent mark.
- A north point.
- Bearings along all fences, road centre lines, power lines etc. to establish local meridian.
- Alternate names for the mark (eg MR34.5) should be shown on the face of the plan.

3. Where the mark lies within freehold or state-owned land, the plan must clearly depict identifiable features in their correct relationship to each other and show the following information:
    - All of the information required in Item 2 above – where these requirements are applicable.
    - If that information does not clearly locate the mark, an additional location sketch should be provided on the face of the plan.
4. Where a clear, unambiguous description of the location of the mark is difficult, a speedometer traverse from the nearest clearly identified feature should be supplied and the details of the traverse shown on the plan.

Permanent Survey Mark Data Sheet (Sheet 2 of permanent survey mark plan)

5. This data sheet which forms the second page of the form must be completed as set out below.
    - Administrative Data
        - The fields marked with asterisks are to be completed (choosing options from the drop-down lists where provided).
        - Note: The other fields should be completed as appropriate.
    - Vertical Control Data
        - If the mark has a height, the fields marked with asterisks are to be completed (choosing options from the drop-down lists where provided).
        - In addition, if the “Fixed by” is GNSS, the following are also to be completed:
            - Geoid-Spheroid “N” value

        - Datum
        - Model
- Horizontal Control Data
    - If the mark has coordinates, the fields marked with asterisks are to be completed (choosing options from the drop-down lists where provided). If the coordinates are determined by connection to an existing datum mark, i.e. not Network RTK or AUSPOS, the fields marked with hashes are also to be completed (choosing options from the drop-down lists where provided).
    - Note: Coordinates must be supplied in the current accepted datum.
    - Note: If the mark is one of a series of marks in a survey control network, you may also supply the relevant vertical and horizontal control data in a digital file format with the appropriate adjustment name. See later sections regarding lodgement of GNSS observation data.
- Cadastral Connection Data
    - Show the plan number of the survey plan which contains the cadastral connection.

Updates/amendments to permanent survey mark plan

6. When the information on an existing permanent survey mark plan is to be updated the following action is recommended:
    - Where the information on the front (eg the location sketch) of the permanent survey mark plan is to be updated you may:
        - prepare a new permanent survey mark plan completing the front and marking it as “REDRAWN” in the top right hand corner of the location sketch area; or
        - annotate a copy of the current permanent survey mark plan, provided the new information can be shown with clarity.
    - Where the permanent survey mark data sheet information on the back of the permanent survey mark plan is to be updated you may:
        - prepare a new permanent survey mark data sheet for the mark, completing the relevant sections; or
        - except for the provision of new vertical or horizontal control data, annotate a copy of the current permanent survey mark data sheet, provided the new information can be shown with clarity.

Lodgement of permanent survey mark plan

7. Completed permanent survey mark plans or updates prepared as per Item 6 above, should be forwarded to the relevant office of the department for registration or amendment of the permanent mark information.

4 Definitions

the Act	the *Survey and Mapping Infrastructure Act 2003*
department	the department administering the Act
Form 6	permanent survey mark plan approved under the Act
CAM	County Arbitrary Meridian

GNSS	Global Navigation Satellite System
MGA	Map Grid of Australia
RTK	Real Time Kinematic
Survey control register	Register for recording information about survey marks maintained under the Act

Permanent Survey Mark Data Sheet Definitions

Administrative

Alternative Name	Alternative name for registered number. May be a control/geographical name, a horizontal control name, or a government department/local authority name. For example MANLY WT, QGS 1246, BCC203/14.
Installed by	Name of the department, consultant or authority that installed the mark.
Installed date	Date mark installation was completed.
Date last visited	Latest date of inspection of mark.
Mark Type	Description of the mark type.
Mark Condition	Physical condition of the mark.
Locality	Official name of locality the mark is within.
City or Town	Name of city or town the mark is within.
Local Government	Name of local government the mark is within.
Location Description	Brief description of the location of the mark to assist in future location and identification.

Vertical Control Data

Height	Height of the mark.
Datum	Datum of height. For example, AHD, AHD derived, Main Roads datum, local datum.
Vertical Accuracy – Order	Order of the height. For example, 1st order, 2nd order, 5th order. For a guide to the application of order and class, refer to later sections on interpretation of uncertainty as defined in ICSM Publication SP1 – Standards of Accuracy V 1.7.
Vertical Accuracy – Class	Class of the height. For example, Class A, Class B, Class E. For a guide to the application of order and class, refer to later sections on interpretation of uncertainty as defined in ICSM Publication SP1 – Standards of Accuracy V 1.7.
Vertical Origin – Regd No	Registered number of the origin mark used to determine height.
Vertical Origin – Height	Adopted height of the origin mark.
Vertical Origin – Datum	Datum of height for the origin mark.
Geo-Sphd – N	Geoid/Spheroid separation calculated at the mark.

Geo-Sphd – Datum	Datum that the spheroid is based on. For example, GRS80 when using AUSGEOID.
Geo-Sphd – Model	Model used to calculate geoid/spheroid separation. For example, AUSGEOID98, AUSGEOID09. Latest available national AUSGEOID model should be used.
Vertical – Fixed by	Method of heighting used for the mark.
Date	Date height was determined.

Horizontal Control Data

Latitude	Geographical latitude.
Longitude	Geographical longitude.
Datum	Datum of the geographical coordinates. For example, AGD84, GDA94.
Easting	Easting value on UTM projection of datum. For example, AMG84, MGA94.
Northing	Northing value on UTM projection of datum. For example, AMG84, MGA94.
Zone	UTM zone within which coordinates have been calculated.
Horiz Origin Regd No.	Registered number of the origin mark used to determine coordinate values.
Horiz Origin – Lat	Adopted geographical latitude of the origin mark.
Horiz Origin – Long	Adopted geographical longitude of the origin mark.
Horiz Origin - Datum	Datum of coordinates for the origin mark.
Date	Date horizontal position was determined.
Horizontal Positional Uncertainty	Horizontal Positional Uncertainty as defined in ICSM SP1 – Standard for Australian Survey Control Network.
Horizontal – Fixed By	Method by which the horizontal position was established.

Cadastral Connection Data

Connected on Cadastral Plan No	Plan number of plan(s) which show a survey connection to the mark.

5 References

Cadastral Survey Requirements
<www.dnrm.qld.gov.au/__data/assets/pdf_file/0013/105601/cadastral-survey-requirements.pdf>

Permanent Survey Mark Plan Form 6 v5
<www.dnrm.qld.gov.au/__data/assets/pdf_file/0018/105750/Form-6-v5-permanent-survey-mark.pdf>

Standard for the Australian Survey Control Network, ICSM Special Publication 1 (SP1)
http://www.icsm.gov.au/geodesy/sp1.html

(Note: Latest version of SP1 should typically apply except in the case of Vertical Class and Order, where SP1 Version 1.7 applies).

6 Legislation

Survey and Mapping Infrastructure Act 2003

Survey and Mapping Infrastructure Regulation 2014

7 Interpretation of Guidelines based on Uncertainty when Lodging Class and Order for the Survey Control Database

Introduction

Since ICSM released Version 2 of Special Publication 1 (SP1) on the *Standard for the Australian Survey Control Network*, Departmental procedures have transitioned from Class and Order to Uncertainty as the basis for evaluating and expressing quality. Future versions of the Department's Survey Requirements will use terminology based on uncertainties. However, the Survey Control Data Base (SCDB) is still based on Class and Order, so it cannot currently store or manage SP1-style Uncertainty values. This section explains how Surveyors should deal with Class, Order and Uncertainties until Department's survey control management systems are upgraded.

Relevant Changes to SP1

SP1 Version 2.0 defines Survey Uncertainty (SU) and Positional Uncertainty (PU) for survey control marks and Relative Uncertainty (RU) between marks. The uncertainties are stated at a 95% confidence level in line with the internationally accepted *Guide to the Expression of Uncertainty in Measurement*.

Another important aspect of SP1 Version 2.0 is that it introduces a distinction between *Datum Control Surveys* and *General Purpose Control Surveys*. Datum Control Surveys define, extend or improve the datum, while General Purpose Control Surveys simply connect to the datum.

Marks with Datum Values in Queensland

In Queensland, the Department manages the Datum Control survey by undertaking a state wide adjustment of geodetic observations and rigorously computing uncertainties. The Department has created a process to publish Positional Uncertainties for marks in the Datum Control Survey on the Queensland Globe and in the download file available through the Queensland Government Information Service, QSpatial. The lineage of those marks is shown as *Datum*. For SCDB and SmartMap reports, the Department has also assigned Class and Order to Datum Marks (as A and 1st or better; depending on SU and PU).

Marks with Derived Values in Queensland

For General Purpose Control Surveys, where the measurements are not included in the Department's adjustment, lineage will be shown as *Derived*. Horizontal coordinates should be lodged with estimates of Positional Uncertainties in accordance with the current version of SP1. AHD heights should still be lodged with estimates of Class and Order as set out below.

Estimating Class for AHD Heights

Where a survey technique has achieved a particular Class in the past, surveyors should continue to state that as the Class for any new surveys using that technique.

In the case of General Purpose Control Surveys using GNSS, AHD heights should be derived by applying AusGeoid values and the Class should be stated as D. Ellipsoidal heights cannot currently be stored in the SCDB so estimates of Class are not required for ellipsoidal heights.

In the case of General Purpose Control Surveys using levelling, SP1 has guidelines for achieving various **vertical** Survey Uncertainties and they are expressed in the traditional way as a value (in millimetres) multiplied by the square root of the levelled distance (in kilometres). SP1 Version 2 covers levelling techniques to achieve a vertical SU of 2mm*$\sqrt{\mathrm{K}}$, 6mm*$\sqrt{\mathrm{K}}$ and 12mm*$\sqrt{\mathrm{K}}$, which is in line with previous versions of SP1 and Class for those techniques should continue to be stated as A, B and C, respectively. Levelling with an SU of 18mm*$\sqrt{K}$ is no longer covered in SP1 but Class for such levelling should continue to be stated as D.

Estimating Order for AHD Heights

For General Purpose Control Surveys, an initial estimate of the Order assigned to a mark should follow the same convention as has always been applied, namely:

- Not higher than equivalent to the Class assigned to that survey, and;
- Not higher than the Order of existing marks to which the survey is connected.

However, to distinguish from the Datum Control Survey, values from a General Purpose Control survey ***should never be assigned better than 2nd Order***.

Examples

The following examples illustrate how to apply the above to General Purpose Control Surveys:

- If a levelling technique achieves a vertical SU of 12mm*$\sqrt{K}$, Class C can be assigned. If the survey connects to 4th Order AHD marks, the new AHD marks cannot be assigned better than 4th Order ~ so Class C, 4th Order;
- If the levelling technique achieves a vertical SU of 2mm*$\sqrt{K}$, Class A can be assigned. If the survey connects to 1st Order AHD marks, in the past 1st Order would be assigned but because the Department cannot adjust the observations, the new marks cannot be assigned better than 2rd Order ~ so Class A, 2rd Order;
- AHD heights from GNSS surveys should be stated as Class D. If the survey is connected to 1st, 2nd 3rd or 4th Order AHD marks, the new marks will be 4th Order ~ so Class D, 4th Order;
- If the GNSS survey is connected to 5th Order AHD marks, the new marks will be 5th Order ~ so Class D, 5th Order.

8 Submission of GNSS Survey Data

Where permanent survey marks are fixed by GNSS, the Department is interested in including suitable GNSS measurements in the geodetic adjustment of the State Control Survey. This will allow the GDA and AHD values to be rigorously maintained over time as we move to GDA2020 and/or upgrade AUSGEOID models. Inclusion in the geodetic adjustment also allows rigorous assessment of uncertainties and strong levels of legal traceability. Surveyors should use the following procedures for supplying GNSS observation information to the Department.

AUSPOS

The Department encourages surveyors to submit **all** GNSS surveys processed using Geoscience Australia's AUSPOS service. When using AUSPOS, surveyors should pay particular attention to entering the correct antenna type and height referred to the correct antenna reference point (see references below). Ideally, the AUSPOS results submitted should use the IGS Final orbits but results using Rapid Orbits will also be accepted.. The amount of information to be lodged for an AUSPOS occupation of a PSM will depend on the length of the GNSS observation time (see below).

GNSS Projects

The Department also encourages surveyors to submit other significant GNSS surveys processed using proprietary software. Such surveys might include cadastral surveys of 10 lots or more and control surveys for major construction, mining or aerial mapping activities. Relevant GNSS surveys might use Static, Quick Static, Network RTK or Single Base RTK techniques. The Department is able to accept GNSS surveys managed and/or post-processed using proprietary software from the following manufacturers:

- Javad
- Leica
- Topcon
- Trimble

Permanent Survey Mark Plan

The surveyor should prepare a permanent survey mark plan or maintenance form and use the following to describe the Horizontal Control Data:

- Horizontal Datum: GDA94

  (Note: In the case of AUSPOS, surveyors should take care to state the GDA94 values not the ITRF values that are also shown in the AUSPOS Report)
- Horizontal Positional Uncertainty: Value as stated on the AUSPOS Report or estimated from results of processing in proprietary software;
- Horizontal Fixed by: GNSS

Where the GNSS derived height is to be used (e.g. the mark does not have a better height from levelling), the surveyor should use the following to describe the Vertical Control Data:

- Vertical Datum: AHD Derived;
- Vertical accuracy: 5th Order/Class D;
- Vertical Fixed by: GNSS.

To ensure that the GNSS results are correctly reflected in the Department's registers, all relevant digital files should be lodged with the relevant Cadastral Survey or, in the case of other surveys,

emailed to the survey control business area of the department with “SCDB” contained within the Subject field. The following files should be lodged or attached to the email:

- Permanent survey mark plan or maintenance form as PDF;
- In the case of GNSS Project files, the entire project directory (including raw GNSS observation files and processing results) should be zipped into a single file for lodgement;
- Field Records for each PM occupied (see Appendix A for examples) including:
    - Antenna type, antenna height to relevant antenna reference point for that antenna type (see references below), ideally substantiated by a photo of the measured value, receiver model and serial number;
    - Photo/s of sites if available (e.g. showing mark number, obstructions, skyline).
- In the case of AUSPOS processing the processing report (as PDF) should always be included;
- Lodgement of RINEX data in addition to the AUSPOS processing report is only required if:
    - For a newly coordinated PSM there are two occupations each with at least 6 hours of GNSS data, or;
    - For a PSM previously “fixed by GNSS” there is a second occupation with at least 6 hours of GNSS data;
    - In those cases where RINEX data is lodged, field records as described above should also be lodged.

Depending on the value for the State Control Survey, the Department may reprocess the GNSS observation files and add the results into the statewide geodetic adjustment so that coordinates, heights and uncertainty values can be rigorously assessed. In such cases, the surveyor may also be contacted to obtain any additional information, such as to clarify any ambiguity about antenna heights etc.

References

Further general information about AUSPOS is available from Geoscience Australia’s web site <www.ga.gov.au/scientific-topics/positioning-navigation/geodesy/auspos>.

Background information on antenna types and antenna reference points is available from the AUSPOS FAQ,
<www.ga.gov.au/scientific-topics/positioning-navigation/geodesy/auspos/faq5>.

For specific information about particular models of antennas and their corresponding antenna reference points, see the US National Geodetic Survey’s Antenna Calibration Program, <www.ngs.noaa.gov/ANTCAL/>.

9 Appendix A

Example of GNSS booking forms:

GNSS Single Static Session Field Observation Record

Project	

Mark ID (PSM#)	Alternate Name	Station Description	GA 4 Character ID	
			QLD 4 Character ID	

Region/Location	Observer/s	Agency	UT Day of Year at Start	
		DNRM	Date Start	/ /

Receiver	Antenna	Set	Time Start	:
Type: Leica Viva		NGS Antenna ID:	Date Stop	/ /
S/N:			Time Stop	:

Electronic Data Filenames		Weather Information (circle appropriate)			Local Time ☐ OR UTC ☐	
	Raw	Temperature	Sky	Wind	UT -> Local	+ 10 hrs
	RINEX	Hot >30ºC	Fine/Clear	Calm	Elevation Mask	10 °
	Quality Control	Warm 15-30ºC	Shower/O'cast	Moderate	Epoch Rate (Seconds)	30 sec
	Booking Sheet	Cold <15ºC	Rain/Storms	Strong	GPS only ☐ GPS + GLONASS ☐	

Antenna Height Details

Measure height to top of adaptor before attaching antenna if sighting to bottom of antenna mount is difficult. Measure "slant height" to bottom of ground plane, centre of bumper (R8), or the centre of bottom ring (LEI1203/Viva) at 3 points. For geodetic antennas, measure to inside of notch and book notch number. **"Height Entered into**

	Height to Bottom Antenna Mount / Top of Adaptor	
	Height Entered into Receiver/Controller	
	Slant Height 1 <- Before **Notch #** After ->	
	Slant Height 2 <- Before **Notch #** After ->	
	Slant Height 3 <- Before **Notch #** After ->	
	MEAN SLANT HEIGHT <- Before After ->	

Station Setup Checks

	Before	After
Antenna Height Checks OK	☐	☐
Levelled & Centred	☐	☐
Antenna Oriented North	☐	☐
Logging Data	☐	☐
On-site tracking confirmed	☐	☐
External Power Connected	☐	☐
Power Still on at End	☐	
PSM number physically confirmed	☐	
Photos/Proof of Occupation	☐	

Antenna Height Checks:

BAM = Bottom of Antenna Mount
ARP = Antenna Reference Point

ARP = √ (Mean Slant Height² - Radius²) - Ground Plane Offset

Height Check Parameters: - 0.005 m < ARP - BAM < 0.005 m

ARP (Before) = √(² - ²) -
= √ -
ARP (Before) =

ARP - BAM = **0.** **m** **(+/- 0.005m to BAM)**

Height Check Before OK ? **Y** ☐ **N** ☐

ARP (After) = √(² - ²) -
= √ -
ARP (After) =

ARP - BAM = **0.** **m** **(+/- 0.005m to BAM)**

Height Check After OK ? **Y** ☐ **N** ☐

Problems Encountered

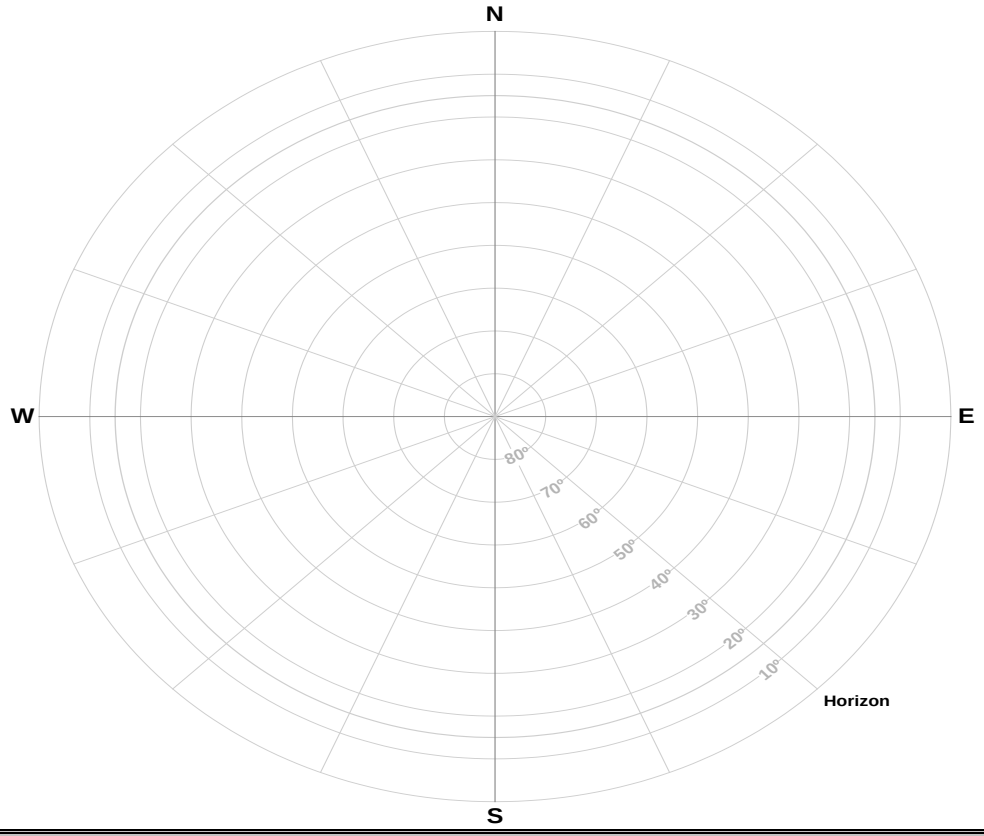
	Solved?
	Y ☐ N ☐
	Y ☐ N ☐
	Y ☐ N ☐

Comments:

Antenna Offsets	TRM R8 (M1, 2 & 3), 5800 & MC L1/L2	TRM Zephyr	TRM Zephyr Geodetic 1&2	TRM 4800	LEI AX1203 + GNSS	LEI GS15 (Viva)	JAV Triumph 1
Radius	0.091	0.0937	0.1698	0.1090	0.085	0.0980	0.0888
Ground Plane Offset	0.0552	0.0387	0.0444	0.1240		0.1610	0.0550

Queensland Government

Skyplot Sketch



Station Setup / Updated Form 6 Sketch

SESSION ID		OBSERVER		PROJECT	

Station Details			GNSS Observation Details						Checks							Office
ID (PSM#)	Location	Mark Type	Receiver S/N	Antenna Ht (Slope) [1]	Start Date	Start Time	Finish Date	Finish Time	Centred & Levelled	Antenna North	Tracking Satellites	Recording Data	Photos [2]	Site ID Confirmed	Power [3]	Antenna Ht in RINEX [4]

[1] = To bottom of Grey Bumper at Cnr [2] = Obstructions, Ht, Stn ID #, Inst S/N [3] = External power connected? Power still on at end? Battery ID & % power remaining [4] = Corrected Ht to Bottom Antenna Mount