

Department of Planning and Environment

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Establishing survey benchmarks guideline

Floodplain harvesting measurement

July 2022



Acknowledgement of Country

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Introduction

The NSW Government is implementing a framework to licence and measure floodplain harvesting to ensure this take occurs within legal sustainable limits.

An important part of this framework is that floodplain take is measured by accurate, auditable and tamper-proof metering equipment.

The NSW Government has developed a series of implementation guidelines to assist water users and duly qualified persons (DQPs) in understanding their compliance obligations under this framework.

What is in this guideline

This section outlines the purpose of the guideline and whom it is relevant to.

Benchmark installer qualifications

To perform this type of work, personnel and firms must be trained in surveying. Field work can be undertaken by an experienced person however the final benchmark installation (coordinates and levels) must be certified (signed off) by a person who has one of the following minimum qualifications:

- registered surveyor - NSW Board of Surveying and Spatial Information (BOSSI)
- person or class of persons approved by the Minister.

The Minister may, on application, or at their discretion, approve a person or class or persons with the necessary expertise performing this function.

If a survey benchmark was established prior to these rules coming into effect, the survey benchmark must be validated by a registered surveyor, or a person or class of persons approved by the Minister. This information must be entered into the DQP Portal

Survey firms must be capable of undertaking continuously operating reference system (CORSnet-NSW) GNSS observations. All survey equipment must be compatible with **GDA2020** datum and with **AUSGeoid2020**. Surveyors must have experience processing GNSS data.

The levelling between the storage meter and the benchmark must be done by a DQP with training and experience in surveying work.

Registration in the DQP Portal

Registered surveyors intending to undertake this type of work must register in the DQP Portal at <https://dqp.waternsw.com.au/> The contact details of the registered surveyor and the BOSSI registration number must be submitted to WaterNSW through the portal.

Practitioners wishing to access the DQP Portal to upload survey benchmarks must register with WaterNSW and complete a short DQP Portal training session (~1 hr). They will then be provided with a unique identification to access the survey benchmark section of the DQP Portal. The pathway is outlined in Figure 1.

Process summary






	Landowner engages DQP (CSV) to establish storage metering equipment.
	CSV engages registered surveyor. <ul style="list-style-type: none">• Alternatively, the landowner may engage the registered surveyor directly.
	Surveyor installs benchmarks and undertakes all other necessary survey work. <ul style="list-style-type: none">• A minimum of three survey benchmarks are required.
	Surveyor documents all survey work <ul style="list-style-type: none">• A separate field sheet/form must be completed for each storage.
	Surveyor enters all survey data into the DQP Portal.

Figure 1. The process of establishing and entering survey benchmarks into the DQP Portal.

1 Equipment method and summary

This section outlines the required equipment and method to install survey benchmarks for floodplain harvesting storage meters.

The (approximate) coordinates of the storage centroid will be the unique identifier for each survey and storage location. The Map Grid of Australia 2020 (MGA 2020) coordinates are essential to each data sheet to ensure the same correct data is applied to the correct storage. MGA 2020 coordinates can be obtained from maps.six.nsw.gov.au prior to the site visit.

Note: Map Grid of Australia 2020 (MGA2020) is a metric rectangular grid coordinate system. It is a two-dimensional coordinate system based on the Universal Transverse Mercator (UTM) projection system and the GDA2020 datum.

1.1 Surveying requirements

All surveyors who install survey benchmarks on a property for the purpose of floodplain harvesting are required to:

- install at least three benchmarks at the on-farm storage, including:
 - one (**primary**) benchmark at the storage near the storage measurement device
 - two (**secondary**) benchmarks to act as checks for the first benchmark in case of movement or damage.
- use the CORSnet-NSW post-processed method to transfer level and coordinates to the site (primary benchmark)
- use RTK or other conventional survey techniques to transfer level and coordinates between primary and secondary benchmarks

You can read the user's guide for CORSnet-NSW on the NSW Spatial Services at https://www.spatial.nsw.gov.au/surveying/corsnet-nsw/user_guides

1.1.1 CORSnet-NSW post-processed

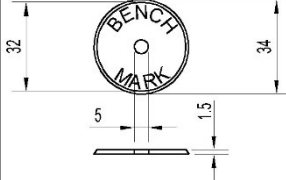


CORSnet-NSW is a network of global navigation satellite systems (GNSS) continuously operating reference stations (CORS) covering NSW and providing centimetre-level real-time positioning. The network allows nearby equipment and machinery to accurately determine coordinates for positioning and guidance solutions. The CORSnet-NSW network continuously observes and corrects satellite navigation signals to achieve international-standard, high-accuracy positioning data for NSW.


1.2 Benchmark type

Table 1 lists recommended survey benchmarks.

We recommend that you do not use Survey Control Information Management System (SCIMS) type marks for establishing benchmarks, as this has additional reporting requirements.

Table 1. Recommended survey mark types for floodplain harvesting benchmarks in NSW

Survey mark type	Description	SCIMS	Image of mark
<p>Type 17 – ‘Bench mark’ token:</p> <ul style="list-style-type: none"> defined by a non-corrodible token at least 32mm in diameter and 1.5mm thick with “Bench mark” permanently stamped, engraved or etched on the upper surface. secured using a non-corrodible nail, spike, rivet or screw. painted. 	Suitable for concrete structure.	Non-SCIMS	<p>Dimensions are in millimetres</p> 
<p>Type 18 – chiselled triangle:</p> <ul style="list-style-type: none"> defined by a triangle placed in concrete with sides at least 80mm long, 10mm wide and 10mm deep. hole punched in the centre. painted. 	Suitable for concrete structure.	Non-SCIMS	
<p>Type 19 – deep driven steel star picket fence post with marker post:</p> <ul style="list-style-type: none"> defined by a punch mark at the top. top straight and level. painted. 	Suitable for reactive soils.	Non-SCIMS	

Survey mark type	Description	SCIMS	Image of mark
<p>Type 20— deep driven steel fence post:</p> <ul style="list-style-type: none"> defined by a triangle cut in the steel (angle grinder). defined by the point of the triangle and the height must be the top of post at the point of the triangle. painted. 	Suitable for reactive soils.	Non-SCIMS	

2 Data and reporting

This section outlines the data and reporting that the surveyor must complete.

2.1 Observational codes and meanings

All surveyors must report in a similar manner to ensure a consistent reporting structure. The following observation codes have been developed to identify and record benchmarks and significant points uniformly. Surveyors must report the observational code, coordinates (eastings, northings) and level of benchmarks and other features using the observational codes listed in Table 2.

Figure 2 and Figure 3 also give an example of the codes and naming conventions.

Table 2. Observation codes for field work.

Point Description	Code
Benchmark	BM1, BM2, BM3
Temporary benchmark	TBM1
Ground surface for LiDAR comparison. Four sites external to dam/storage	LGS1, LGS2, LGS3, LGS4
Dam water level (current)	DWL1, DWL2
Dam wall top	DTOPGS
Dam (full supply) top water level	DTOPWL
Dam lowest point (near outlet)	DLP
Dam gauge meter (GNSS surveyed)	DMETERGNSS

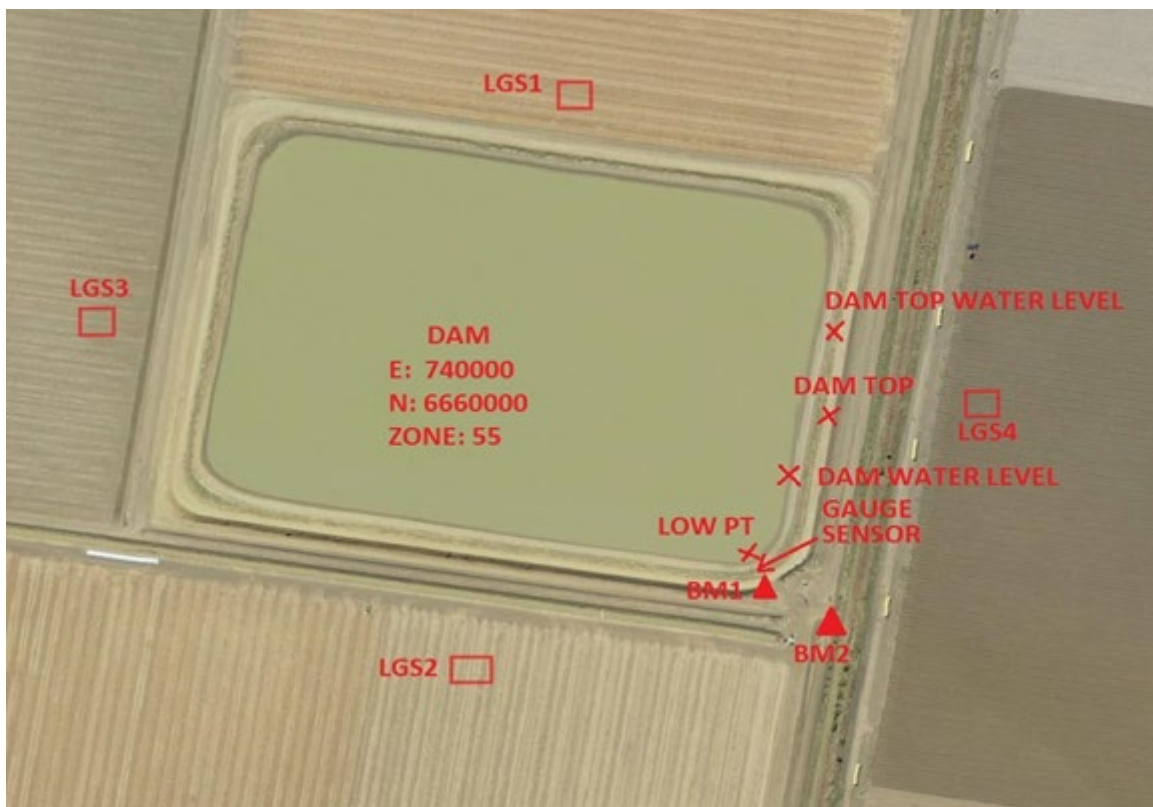


Figure 2. Aerial image of storage with survey information.



Figure 3. Close up aerial image of storage with survey information.

2.2 Field data format

Surveyors must meet the following requirements:

- each report file (PDF) must be unique to one storage
- the report file naming convention must include:
 - easting and northings (within 50m of the centroid coordinates of the storage), followed by the MGA Zone
 - **Note:** easting and northings must be whole numbers – ie. no decimals
 - values separated by an underscore (_), for example, '662920_6751679_55.PDF'
- the observation field sheets must also be submitted as a scanned PDF document containing a file name with the centroid coordinates of the storage.
- coordinate results for each site survey are to be delivered in CSV format, for example, '662920_6751679_55.CSV'
- the Excel CSV format separates values with a comma (.). Each line of the CSV file must have:
 - point number (numerical only – no alpha characters – preferably unique, not repeated)
 - MGA2020 easting
 - MGA2020 northing
 - mAHD level
 - observation code (Table 2 above)
 - MGA Zone (Zone 55 or Zone 56), for example, '4,662920,6751679,100.000, BM1,55'.

2.3 Survey reporting

To ensure information is recorded consistently, surveyors must use the *survey form for floodplain harvesting benchmarks* – see Table 4 – to record observations and findings. This information will be submitted when registering the benchmark in the DQP Portal at dqp.waternsw.com.au.

All field data sections of this form should be completed prior to leaving the site.

All aerial imagery should include observation codes, coordinates and zone data of the site. You can see an example of this in Figure 2 and Figure 3.

It is recommended that prior to attending a site, surveyors use *SIX Maps* and talk with the landholder to identify hazards on the property and confirm access requirements and any other important information which may assist the survey.

2.3.1 Submitting information

A qualified person, as defined above, must certify all survey work including level runs.

A qualified person, as defined above, must upload all the survey benchmark information in the DQP Portal at dqp.waternsw.com.au with the following supporting information.

1. **CSV** file containing all the features detailed in the *survey form for floodplain harvesting benchmarks* – see Table 4.
2. **PDF** of a plan of the all the features detailed in *the survey form for floodplain harvesting benchmarks* – see Table 4.

A copy of the supporting information to the landowner and CSV.

3 Survey method accuracy

3.1 Survey accuracies

All GNSS surveys must achieve an accuracy of:

- within 30 mm horizontal
- within 50 mm vertical (level).

3.2 Quality assurance

The recommended survey techniques should be self-checking if certain procedures are followed.

The CORSnet system is self-checking for these reasons:

- the CORSnet-NSW 1.5hr logged data set automatically contains repeat observations every 30 seconds
- the baseline and network adjustment software have in-built error warning flags to prevent the use of erroneous data – standard baseline processing procedures must be employed.

Multiple benchmarks and differential levelling between benchmarks will establish independent checks.

To ensure these checks are accurate, surveyors will need to verify the following three aspects before starting observations.

A CORSnet-NSW antennae height

The GNSS receiver height from the antennae reference point to the benchmark is critical and must be verified by 2 independent measurements.

The distance to the Antenna Reference Point (ARP) from the Ground Mark must be checked by measuring in metres and then independently in inches. The conversion of the inches to metres provides a check on the ARP height above the ground mark.

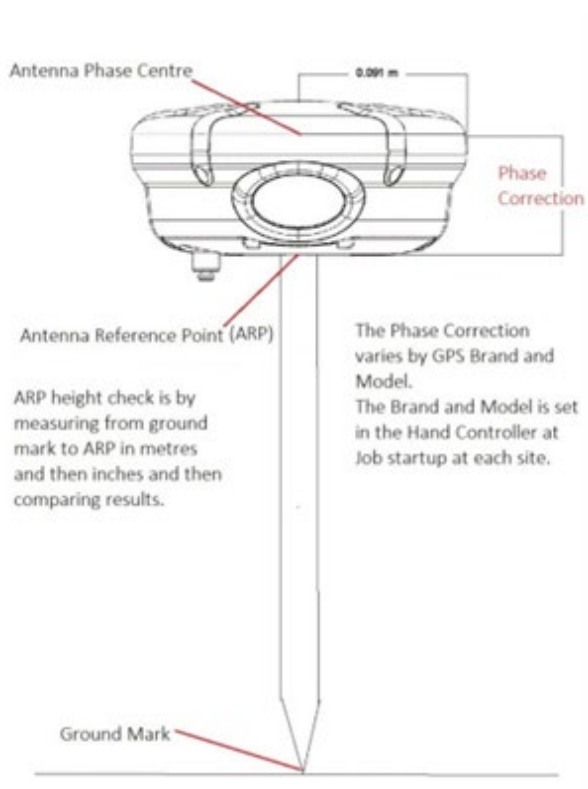


Figure4. CORSnet-NSW antenna device.



Figure 5. Example of survey hand controller.

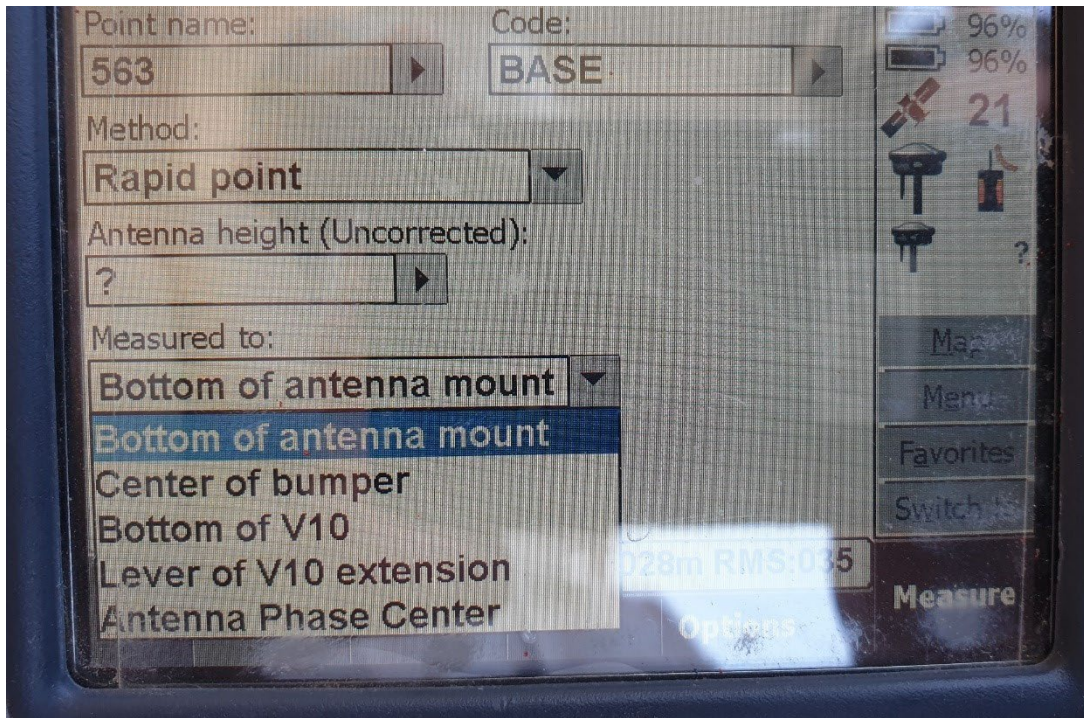


Figure 4. Example of hand controller menu options to enter antenna measurements.

B CORSnet-NSW phase correction

The phase correction is different for every GNSS brand and model. The manufacturer can supply the correction for each GNSS type, but the brand and model still need to be input into the GNSS hand controller. Independent checking of the antenna type and make selected in the controller must be part of the quality control.

The recommended method for determining the phase correction is to take 2 observations at the same location without moving:

- measurement 1 - to the bottom of the antenna mount
- measurement 2 - to the antenna phase centre.

There should be 20-second intervals between observations and the range pole is not to be changed in height between both observations.

The difference between the resultant heights will be the phase correction plus minor variations in the satellite observations. This procedure can be repeated several times to improve accuracy. This confirmation procedure must be recorded with the results.

C Levelling from the farm benchmark to the storage meter and between benchmarks

The levelling between the storage's meter must be undertaken with a closed loop level run back to the starting benchmark. Observation and calculation errors are detected by the closed loop level run.

Before a level survey is done and during the observations, the following is required:

1. the level's collimation error is checked and adjusted
2. the levelling staff is checked for errors

3. all observations have equal backsights and foresights to eliminate remaining collimation error.
4. the level bubble is checked and adjusted.
5. change points are a solid object, such as a dumpy peg, solid rock or screwdriver pushed into ground, using the handle as a change point
6. all reductions are shown, and levelling error is recorded
7. levelling accuracy is a minimum of **Third Order** levelling — the accuracy shall be: **misclosure (mm) = $12\sqrt{\text{distance (km)}}$** .

4 Survey form for floodplain harvesting benchmarks

Figure 5. Survey form for floodplain harvesting benchmarks

Survey data for benchmarks and storage meters			
Dam centroid approx. (MGA from SIX Maps):	Easting	Northing	Zone
Property name (if applicable):			
Water supply work approval holder's name			
Water supply (storage) work approval number			
Water access licence number			
Storage description or name (if applicable)			
Date of survey (dd/mm/yyyy):			
Surveyor's company name:			
Surveyor's name:			
Surveyor's registration number:			
GNSS ARP location			
BM1 (primary) mark type description			
BM2 (secondary) mark type description			
BM3 (secondary) mark type description			

Mark observation	Survey method and comments	Start time	Finish time	Observation time
Benchmark BM1 (primary)				
Benchmark BM2 (secondary)				
Benchmark BM3 (secondary)				
LiDAR ground surface (LGS) level (m AHD)	LGS1	LGS2	LGS3	LGS4
Storage meter – measurement point	Easting	Northing	m AHD (1)	
Storage meter – measurement point	Level survey (m AHD) (2)		Difference between (1) and level survey (2)	
Level check				
Storage water level – current (DW1) (m AHD)				
Storage (full supply) top water level (DTOPWL) (m AHD)				
Storage bank (wall top) (DTOPGS) (m AHD)				
Storage low point near outlet (DLP)	Level (m AHD)	Storage has water at time of survey? (Y/N)	Is low point of outlet accessible? (Y/N)	
Aerial image of storage Include aerial image that identifies the following: <ul style="list-style-type: none"> Storage (incl. eastings and northings) Dam low point 				

<ul style="list-style-type: none">• Meter• Benchmark 1 (primary)• Benchmark 2 (secondary)• Benchmark 3 (secondary)• LGS1, LGS2, LGS3, LGS4• Dam top water level	
Comments:	