

Department of Climate Change, Energy, the Environment and Water


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Survey benchmark guideline

Floodplain harvesting measurement

February 2024



Acknowledgement of Country

The Department Climate Change, Energy, the Environment and Water acknowledges that it stands on Aboriginal land. We acknowledge the Traditional Custodians of the land and we show our respect for Elders past, present and emerging through thoughtful and collaborative approaches to our work, seeking to demonstrate our ongoing commitment to providing places in which Aboriginal people are included socially, culturally and economically.

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1 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 and to ensure that the floodplain harvesting water take is consistent with the individual's licensed volumes and legal limits.

A DQP has the prescribed qualifications, skills and experience to carry out certain work in relation to metering equipment.

This guideline focuses on the surveying aspects of the process and provides guidance for persons carrying out survey work on licensed floodplain harvesting storages.

2 Qualifications, DQP Portal registration and process summary

The installation and validation of metering equipment requires DQPs with specialised technical expertise. A list describing the types of DQPs and their roles can be found on NSW Department of Climate Change, Energy, the Environment and Water's (the department) website at water.dpie.nsw.gov.au > Plans and Programs > Floodplain Management > Floodplain harvesting measurement > Who can install floodplain metering equipment.

A registered surveyor or a person or class of persons with the necessary surveying expertise and approved by the Minister are deemed DQPs under Clause 236 of the Water Management (General) Regulation 2018.

2.1 Survey qualification requirements

Field work may be completed by an experienced person under the supervision of a registered surveyor. All deliverables must be certified by a registered surveyor at the time of submission.

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

To be successful in your application, survey firms and personnel must be capable of, and competent in:

- placing Permanent Survey Marks (PSMs)
- undertaking continuously operating reference system (CORSnet-NSW) Global Navigation Satellite System (GNSS) or UASPOS observations (all survey equipment must be compatible with GDA2020 datum utilising AUSGeoid2020)
- processing GNSS data
- Class LC spirit levelling (preferably using digital levelling techniques)
- preparing quality results, presented professionally in a clear and concise manner.

2.2 Registration in the DQP Portal

To upload survey information to the DQP Portal, registered surveyors must email WaterNSW at dqp.enquiries@waterNSW.com.au with the subject line: 'Request floodplain harvesting survey benchmark upload'.






The email should include:

- their professional registration details (surveyor's name, company name (if applicable) and surveying registration number)
- evidence of landholder's consent (this could be an email from the landholder approving the work or a signed contract).

2.3 Process summary

Figure 1 outlines a summary of the process for engaging surveyors, and submitting survey work.

Figure 1. General process overview

	Landowner engages certified storage validator (CSV) to install the storage metering equipment.
	<p>A CSV or landholder engages a registered surveyor.</p> <p>A landholder can have the metering equipment installed first to limit visits by a registered surveyor.</p> <p>A registered surveyor can ensure that both the storage curve and survey points align to Australian Height Datum (AHD).</p>
	Registered surveyor installs PSMs and completes all other necessary survey work. A minimum of three benchmarks are required: one primary PSM and at least two secondary PSM benchmarks.
	Registered surveyor documents all survey work for Department of Customer Service (DCS) Spatial Services and submits via the DCS Spatial Services Customer Hub.
	Registered surveyor documents all survey work for the department before submitting it to WaterNSW for upload to the DQP Portal.

3 Field survey

This section outlines the survey methodology to establish MGA2020 coordinates, zone and AHD 71 (derived) heights on PSMs being established.

3.1 Field work preliminaries

DQPs establishing PSMs for floodplain harvesting must adhere to the following legislation and documentation (in force at the date of survey):

- [Surveying and Spatial Information Act 2002](#)
- [Surveying and Spatial Information Regulation 2017](#)
- [Surveyor-General's Direction No.1 – Approved Permanent Survey Marks \(SGD1\)](#)
- [Surveyor-General's Direction No.2 – Preparation of Locality Sketch Plans \(SGD2\)](#)
- [Surveyor-General's Direction No.12 - Control Surveys and SCIMS \(SGD12\)](#)
- [Surveyor-General's Direction No.12 –Control Surveys and SCIMS \(Technical Specifications for NSW Secondary Control Surveys\)](#)
- [Surveyor-General's Direction No.12 - Control Surveys and SCIMS \(Resource Pack\)](#)
- [ICSM's publication Standards and Practices for Control Surveys \(SP1\), Version 1.7.](#)

These will be referred to in further detail in this guideline.

The approximate MGA2020 coordinates (and zone) of the storage centroid will be the unique identifier for each survey and storage location and are essential metadata to ensure the information is applied to the correct storage.

MGA2020 coordinates, zone and AHD 71 heights can be obtained from SCIMS or [SIX Maps](#) before field work commences.

Before attending a site, surveyors must contact the landowner to gain consent to enter the land. This presents an opportunity to discuss potential hazards on the property, confirm access requirements and any other important information (such as soil type/reactivity) which may inform the survey.

3.2 PSM (type) selection

All PSMs placed must be in the form and style of a PSM as described in Clause 27(1) and Schedule 4 of the Surveying and Spatial Information Regulation 2017 and SGD1.

The DCS Spatial Services team recommends using the following types of PSMs, as these are known to be the most stable for this use:

- for stable soils:
 - Type 1 (State Survey Mark; not to be used as secondary marks)
 - Type 4 (Stainless Steel Pin in cover box)
 - Type 6 (Non-Urban Type; use of 1,800 mm star pickets driven fully or until refusal must be used and in cover box).
- for unstable soils (for example, highly reactive and /or ‘black’ soils):
 - Type 8 (“Type” C; diameter 20 mm non-ferrous rod – driven to a depth of 1,800 mm or until refusal – must be used and in cover box).

3.3 PSM installation

Three PSMs, for floodplain harvesting, should be installed as close as practical to the on-farm storage (considering ongoing stability, accessibility and longevity):

- One (primary) PSM: this will be given a ‘PM’ or ‘SS’ prefix (as appropriate) and subsequent number allocated by DCS Spatial Services). The primary PSM will be located closest to the storage measurement device. This is the most important PSM within the storage location and should therefore be placed in a safe location.
- Two secondary PSMs (types 1, 2, 15 and 16 are not to be used as secondary marks): which will be given a ‘MM’ prefix and subsequent number allocated by DCS Spatial Services. This will allow for the distinction between the primary PSM and two secondary PSMs and will act as checks for the primary PSM in case of tampering, ground movement or damage. It is recommended these are placed at least 50-100 m away from each other and removed somewhat from the primary PSM. They must also be placed in a safe location.
- A ‘witness’ star picket will be placed 1 m from each PSM, painted yellow to assist in protection, location and identification. A survey plaque will be attached to the witness picket (section 4 of SGD2).

It is strongly advisable that sites that have excellent visibility to the sky to get a better result. This location will minimise the potential for re-survey if the positional uncertainty specifications are not achieved.

Upon placement of each PSM, a Locality Sketch Plan (LSP) must be prepared in accordance with SGD2. Individual sketch plans are required for each PSM.

3.4 Field observations

3.4.1 General requirements

Mark prefixes must be PM, SS, GB, MM, or TS (SSM, PSM are not to be used).

All GNSS equipment and observation techniques adopted must be able to achieve positional uncertainties (at the 95% confidence level) of:

- ± 30 mm horizontal
- ± 50 mm vertical.

All surveyors establishing PSMs should familiarise themselves with the [Surveyor General's SGD12 Technical Specification](#) and the SGD12 Resource Pack, in particular with the following sections of the technical specification:

- Section 5 Differential Levelling Specifications: details how to carry out differential levelling observations to fulfil DCS Spatial Services requirements for entry into SCIMS
- Section 6.1 GNSS Static: details how to carry out GNSS static observations to fulfil Spatial Services requirements for entry into SCIMS
- Section 6.3 AUPOS: details how to carry out AUSPOS observations to fulfil DCS Spatial Services requirements for entry into SCIMS.

Exceptions to the above technical specification are made specifically for GNSS observations in this project (by default these are optional in the technical specification):

- bipods are not to be used
- antenna heights must be measured to the Antenna Reference Point and recorded in both metric (mm) and imperial (inches) as a check. Upon completing any GNSS observation, the antenna height must be re-measured and documented on the GNSS log sheet
- DCS Spatial Services log sheets must be provided for all GNSS survey techniques used in establishment of the PSM's (available in the SGD12 Resource Pack).

When conducting the PSM survey at each storage location, surveyors must not 'mix and match' different GNSS observation techniques. For example, if the surveyor is establishing the primary PSM at the storage location via AUSPOS, then only AUSPOS may be used for all three PSMs at that location. This is the same for CORSnet–NSW post-processed baselines. A PSM will be rejected if it uses a combination of observation techniques at the same storage site.

If an existing established PSM is being used as either a primary or secondary mark, its MGA2020 coordinates, zone and height must be validated as part of this survey. This information must be entered into the DQP Portal. If you need access to the Portal, please contact WaterNSW by emailing dqp.enquiries@waterNSW.com.au.

All spirit levelling equipment must be capable of achieving Class LC specification. A 'two peg test' must be carried out before levelling at each site (results must be supplied at submission stage).

RTK/NRTK observations are not to be used for the establishment of the three PSMs and will be rejected at the submission stage, requiring re-survey.

RTK (not NRTK) observations may be used elsewhere in the preparation of the department storage plan, provided that the base station for the survey is set locally on the primary PSM and its final SCIMS coordinates, zone and AHD level are adopted for the survey. (This will typically involve a 3-parameter transformation of the collected RTK data once SCIMS is updated with the primary PSM values). Check measurements must be made to both secondary PSMs if RTK methodology is used so that the validation of both the base station and rover setup can be made against SCIMS values.

3.4.2 Establishing the primary PSM

The primary PSM will be the 'point of truth' at each storage location, with its MGA2020 coordinates, zone and AHD (derived) height typically generated and adopted from either AUSPOS or static GNSS originating from CORSnet-NSW.

The following GNSS observation methods may be used to establish the primary PSM:

- Method 1 – AUPOS (preferred option)
 - Minimum occupation 4.1 hours (or longer if deemed necessary until the stated accuracies are achieved in the resultant processing report).
Consideration shall be given to overnight sessions being logged. By taking this approach, session times are extended, providing significantly improved results, and reducing waiting time on site. (This will generally result in a return to site to collect equipment.)
- Method 2 – CORSnet-NSW post-processed static baselines
 - Two or more CORSnet-NSW stations must be used to introduce redundancy into the survey.
 - Alternate AUSPOS methodology must be used if the closest CORSnet-NSW station is greater than 15 km from the storage location.
 - Processing and adjusting the baselines being measured through GNSS processing and least squares adjustment packages respectively is required.

- Be familiar with the user’s guide for CORSnet-NSW on DCS Spatial Services website at [spatial.nsw.gov.au > Surveying > CORSnet-NSW > User guides](https://spatial.nsw.gov.au/Surveying/CORSnet-NSW/User%20guides).

3.4.3 Establishing the secondary PSMs

MGA2020 easting, northing, zone and AHD (derived) heights shall be established on the secondary PSMs. The secondary PSMs must be established using the same methodology chosen to establish the primary PSM at each site. They are a redundancy for the primary PSM if the primary PSM is tampered with, damaged or there has been ground movement.

Where Method 1 (AUSPOS) is used, the AHD (derived) heights of the secondary PSMs and the storage gauge will ultimately be established from the primary PSM results. This is achieved using two-way differential levelling to a minimum standard of Class LC, forming a closed, two-way level survey between all three PSMs (as well as the gauge) and will form a check against the AHD height derived from AUSPOS observations. Results must satisfy the positional uncertainties specified in section 3.4.1. Submission of data is addressed later in section 4.

Where Method 2 (static) is used, GNSS baselines shall be observed from at least two CORSnet-NSW stations to each PSM. In addition, spirit levelling shall be carried out using two-way differential levelling to a minimum standard of Class LC. This will form a closed, two-way level survey between all three PSMs (as well as the gauge) and will allow the user to carry out a least squares adjustment. Submission of data is addressed later in section 4.

3.4.4 Aligning AHD survey benchmarks and storage curve

Storage metering equipment relies on the use of storage curves, which defines the depth, volume and surface area relationship for each storage. Storage curves are also known as a staged-storage table or rating curve.

It is important the storage curve survey is referenced to survey benchmarks at each site. This will ensure the volumetric survey is in the correct coordinate (MGA2020) and level datum (AHD). Primary and secondary measurement devices are also levelled-in to AHD.

If a storage curve survey has been undertaken prior to the installation of survey benchmarks, the storage curve survey must be checked by the surveyor for accuracy against the survey benchmarks. If they are not aligned, the storage curve survey will need to be updated or renewed by a suitably experienced person, like a registered surveyor. Refer to the [Storage Curve Guideline – Floodplain Harvesting Measurement](#) for more information.

It is important that the AHD levels of the storage curves are accurate and align with the benchmarks so that both the secondary and primary metering devices reconcile with the volumes provided by storage curves.

Note, it is the surveyor's responsibility to ensure secondary devices are levelled-in to AHD. A surveyor may also level-in primary devices if this has not been done by the installer (Certified Storage Validator). Storage curves can be accessed in the DQP Portal.

3.4.5 Department storage plan and field coding for survey observations

All surveyors must submit reports to the department using the survey form for floodplain harvesting permanent survey marks (below) to record observations and findings on site. This information will later be submitted to WaterNSW to upload to the DQP Portal. All field data sections of this form should be completed before leaving the site. Refer to Appendix A for the survey form.

To aid consistency, the following field coding has been developed to record PSMs and significant points digitally in the field as well as providing standard labelling for the department's storage plan (Figure 2).

Figure 2. Field coding for survey observations

Point description	Code
Permanent Survey Mark "xxxxx" = mark number from SCIMS	PMxxxxx, MMxxxxx, MMxxxxx
Temporary benchmark 'x' = next number available	TBMx
Ground surface for LiDAR comparison. Four flat 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 meter – Primary (survey by class C levelling)	DMETERLEV1
Dam meter – Secondary (survey by class C levelling)	DMETERLEV2

4 Deliverables

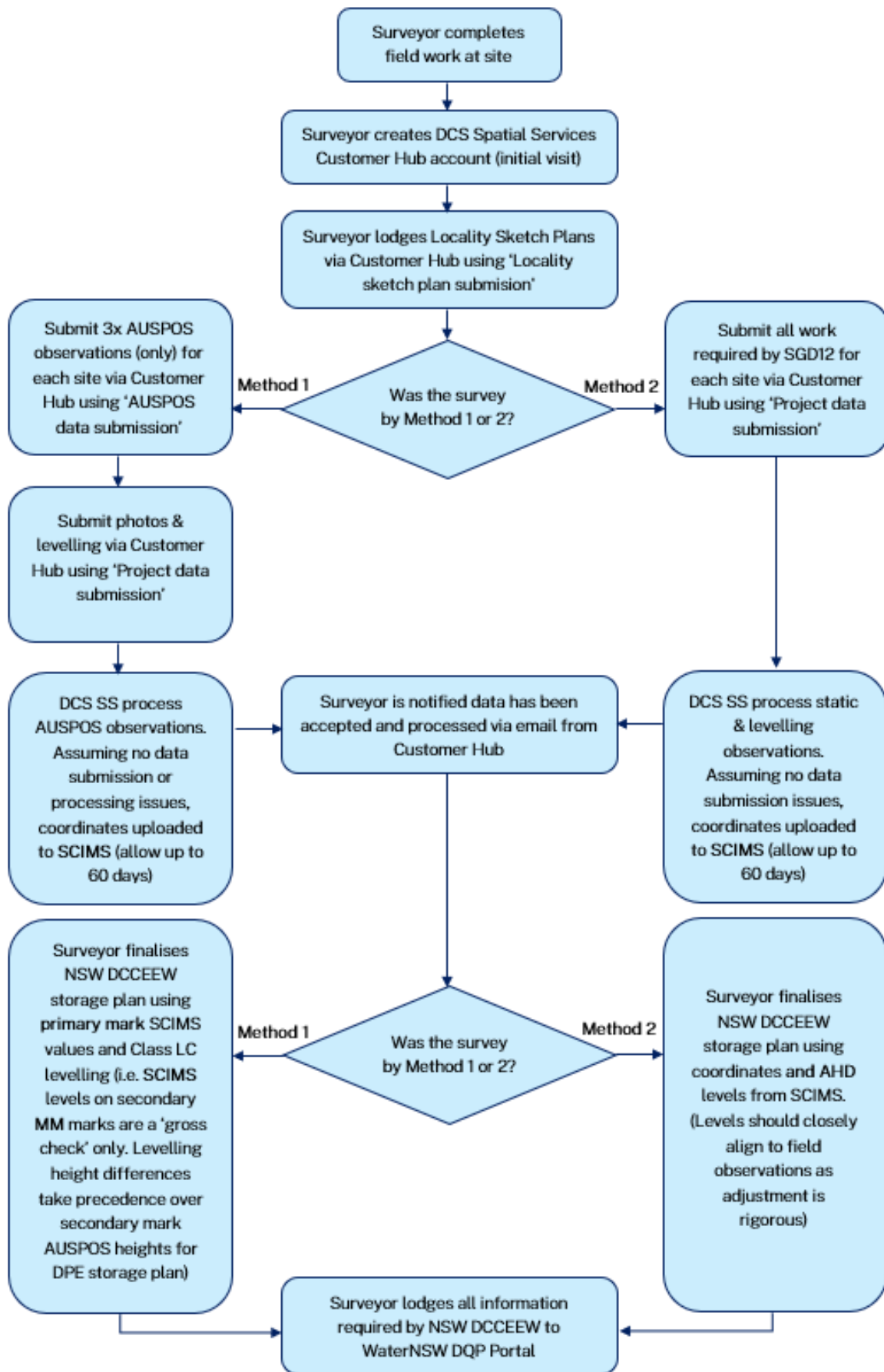
4.1 General information and process

DQPs must provide two separate submissions:

- Spatial Services (via DCS Spatial Services Customer Hub): required to comply with the legislation and documentation outlined in section 3.1 above. Once Spatial Services assesses and approves the submission, this will have the added benefit of establishing the PSMs surveyed in SCIMS.
- The department (via submission to WaterNSW - DQP Portal): required for the department to manage the records associated with each storage surveyed.

The process for submission of information is shown in Figure 3.

Figure 3. Flowchart for submission of deliverables to DCS Spatial Services



4.2 DCS Spatial Services submission

4.2.1 DCS Spatial Services' specific process and deliverables

In general terms:

- the process shown in Figure 3 must be followed
- all legislation outlined in section 3.1 must be followed in addition to further requirements necessitated by this guideline
- a registered surveyor must validate all survey work completed
- a LSP must be prepared showing all PSMs placed at each site, and an individual LSP must be prepared for each PSM
- data for this project must be submitted for each site separately through the Customer Hub utilising one of two methods outlined in Section 3
 - Method 1: AUSPOS (Preferred option): separate data submissions for each PSM will be required via the 'AUSPOS data submission' option
 - Method 2: CORSnet-NSW post-processed static baselines: the data shall be supplied as one combined submission for each site in accordance with SGD12 via the 'Project data submission' option

Sections 10 and 11 of SGD12 must be adequately addressed or the submission will be rejected.

Note: for Method 1 (AUSPOS), a least squares adjustment, report and checklist are not required.

For any assistance regarding export file formats for specific instruments, please contact DCS Spatial Services before submitting data for any help needed. If available, this will be of significant benefit to all parties in expediting the reduction /adjustment process.

The following photographs of each PSM placed must be provided:

- close up of each PSM with the mark number clearly visible
- 'all in view' photographs for context, clearly showing the storage facility and all PSMs with witness posts installed
- minimum of 6 photographs (more than 6 is acceptable) would be expected of each site
- photograph file names should follow this format:
 - PM123156 YYYYMMDD (1) Mark
 - PM123456 YYYYMMDD (2) North (this would be taken south of the mark looking north)
 - MM501589 YYYYMMDD (3) East.

4.3 Submission to the department

4.3.1 DQP Portal

To upload survey information to the DQP Portal, registered surveyors must email WaterNSW at dqp.enquiries@waternsw.com.au with the subject line: 'Request floodplain harvesting survey benchmark upload.'

The email should include:

- their professional registration details (surveyor's name, company name (if applicable) and surveying registration number)
- evidence of landholder's consent (this could be an email from the landholder approving the work or a signed contract).

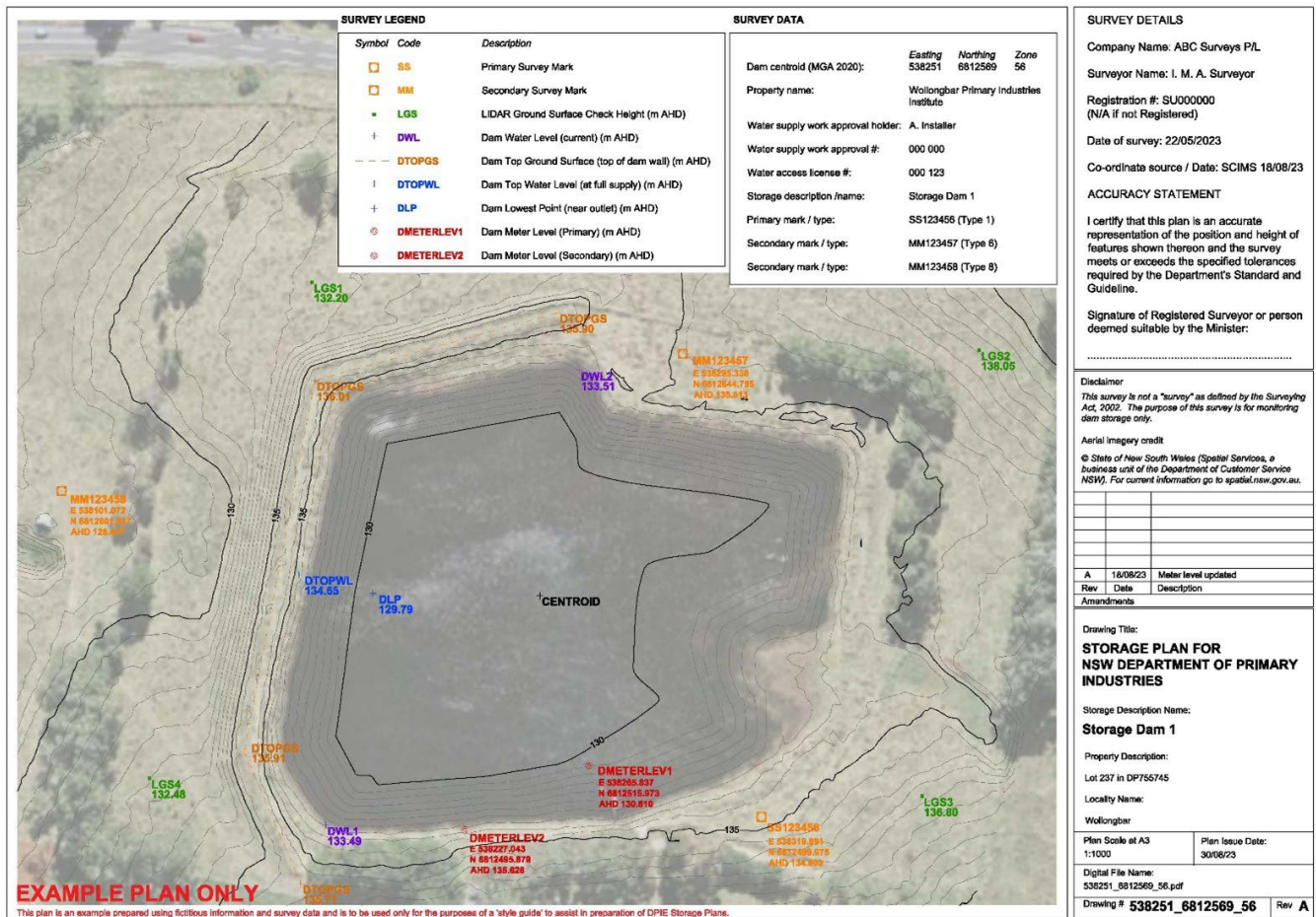
4.3.2 Department's deliverables

A DQP must submit all site information to WaterNSW via email to dqp.enquiries@waternsw.com.au for upload to the DQP Portal. The subject of the email should include the Registration Of Interest (ROI) number or Works Approval number and the following supporting information should be provided:

- a copy of all data supplied to DCS Spatial Services
- CSV file containing all features detailed in the survey form for floodplain harvesting permanent survey marks (Figure 2)
- a copy of any supporting information to the landowner and certified storage validator
- a concise and professionally CAD drawn plan, (known as the 'DCCEEW storage plan') shall be prepared for each site, showing the following:
 - certification by a NSW Registered Surveyor as to the plan being an accurate representation of the position and height of features shown thereon and that the survey meets or exceeds the specified positional uncertainties required by this guideline (section 3.4.1).
 - table of MGA2020 coordinates, zone and derived AHD heights for PSMs, obtained from SCIMS (post survey after DCS Spatial Services processes the information – refer to Figure 3)
 - the date SCIMS information was obtained
 - surveyor's company name
 - surveyor's name

- surveyor’s registration number BOSSI (if applicable)
- property name
- water supply work approval number
- water access licence number
- storage description name (for example, BR002_02_west storage)
- accuracy statement
- Primary Permanent Survey Mark
- Secondary Permanent Survey Marks
- dam centroid (MGA 2020)
- LIDAR ground surface check height (m AHD)
- dam water level (current) (m AHD)
- dam top ground surface (top of dam wall) (m AHD)
- dam top water level (at full supply) (m AHD)
- dam lowest point (near outlet) (m AHD)
- dam meter level (primary) (m AHD)
- dam meter level (secondary) (m AHD)
- Aerial photo underlay
- Storage plan format:
 - colour
 - A3 size
 - PDF (preferably georeferenced).

Figure 4. Image of department storage plan example



Appendix A

Survey data for permanent survey marker and storage meters

Please print multiple copies of this form to use in the field.

	Easting	Northing	Zone
Dam centroid approx. (MGA from SIX Maps)			
Property name			
Water supply work approval holders name			
Water supply work approval number			
Water access licence number			
Storage descriptor (e.g., BR003_2_west dam)			
Date of survey (dd/mm/yy)			
Surveyor's company name			
Surveyor's name			
Surveyor's registration number			
GNSS ARP location			
SS1 (Primary Survey Mark)/type description			
MM1 (Secondary PSM)/type description			
MM2 (Secondary PSM)/type description			

Mark observation	Survey method and comments	Start time	Finish time	Observation time
PSM1 (Primary Survey Mark)				
MM1 (Secondary PSM)				
MM2 (Secondary PSM)				
	LGS1	LGS2	LGS3	LGS4
LiDAR ground surface (LGS) level (mAHD)				
	Easting	Northing	mAHD (1)	
Primary storage meter – measurement point				
	Level survey (mAHD) (2)		Difference between (1) and level survey (2)	
Primary storage meter – measurement point Level check				
Storage water level – current (DW1) (mAHD)				
Storage (full supply) top water level (DTOPWL) (mAHD)				
Storage bank (wall top) (DTOPGS) (mAHD)				
	Level (mAHD)	Storage has water at the time of survey? (Y/N)	Is low point of outlet accessible? (Y/N)	
Storage low point near outlet sill (DLP)				

<p>Aerial image of storage</p> <p>Include aerial image that identifies the following:</p> <ul style="list-style-type: none">• Storage (incl. eastings and northings)• Dam low point• Primary meter• Secondary meter• Primary PSM• Secondary PSM 1• Secondary PSM 2• LGS1, LGS2, LGS3, LGS4• Dam top water level	
<p>Comments</p>	