

# Specifications for Geodetic Control of Hydrographic Surveys

Version 1.1  
National Geodetic Office

Date 09 April 2020

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## Terms and definitions

For the purposes of this specification, the following terms and definitions apply.

<b>Term/abbreviation</b>	<b>Definition</b>
CORS	Continuously Operating Reference Station, eg the PositionNZ Stations
CSD	Cadastral Survey Dataset
DMS	Degrees Minutes Seconds
GNSS	Global Navigation Satellite Systems (including GPS)
GPS	Global Positioning System
JPG	Joint Photographic Experts Group (graphics file)
LINZ	Land Information New Zealand
NZGD	New Zealand Geodetic Datum
PNG	Portable Network Graphics (graphics file)
RINEX	Receiver INdependent EXchange Format
SINEX	Solution INdependent EXchange Format
TIF	Tagged Image File Format (graphics file)

# 1 Introduction

This document specifies the requirements for the establishment and survey of Geodetic Marks for use in LINZ Hydrographic surveys by contracting organisations.

## 1.1 Variations from this Specification

- (a) Compliance with all aspects of this specification is expected.
- (b) It is recognised that on occasions a better outcome for the survey control system may be obtained through an alternative approach. If a Supplier believes this to be the case, a variation to these specifications must be sought.
- (c) Any application for a variation must be in writing and agreed to by LINZ prior to any work being carried out.
- (d) Where marks fail to achieve the status required because these specifications have not been followed the National Geodetic Office may identify where additional vectors should be observed, observations repeated or request that additional information is supplied.

## 1.2 Related Rules Standards and Specifications

This guideline is consistent with and has references to:

- Specifications for Geodetic Services v1.5
- The following standards, guidelines and Rules should be consulted when interpreting this guideline:
- Standard for tiers, classes and orders of LINZ data – LINZS25006 (18 September 2009)
- Standard for the New Zealand survey control system – LINZS25003 (18 September 2009)
- Guideline for the provision and maintenance of the New Zealand survey control system – LINZG25704 (18 September 2009)

### **INFORMATION - Related Documents**

The above documents can be obtained from the following web addresses:

**<http://www.linz.govt.nz/geodetic/standards-publications/geodetic-specifications>**

**<http://www.linz.govt.nz/data/geodetic-system/standards-specifications-publications/standards-guidelines>**

**<https://www.linz.govt.nz/regulatory/25704>**

## 1.3 Templates

The following templates are referred to in this document:

- **Mark Data.xlsx**
- **Simplified Geodetic Control Survey Report.docx**
- **Mark and Site Image Template.pptx**
- **GNSS Field Sheet V3.docx**
- **Mark Details.xlsx**

### INFORMATION - Templates

Some of the above templates can be obtained from:

**<http://www.linz.govt.nz/geodetic/standards-publications/geodetic-specifications>**

## 1.4 Contact Information

National Geodesist  
Positioning and Resilience  
Land Information New Zealand  
Radio New Zealand House  
155 The Terrace  
PO Box 5501  
Wellington 6145

Phone: 04 460 0110

Email: [CRM\\_geodetic@linz.govt.nz](mailto:CRM_geodetic@linz.govt.nz) (Keywords: **Specifications for Geodetic Control of Hydrographic Surveys**)

## 1.5 Version Control

<b>Version 1.0</b>	<b>Released September 2018</b>
	<p><b>This document supersedes the previous specification named: <i>Specifications for Order 5 Surveys for Hydrographic Control – V1.0</i> This was released in May 2016.</b></p> <p><b>Apart from the change in name the changes between the two specifications are as follows.</b></p> <p>All references to Order 5 have been removed</p> <p><b>2.2.2(b)(iv)</b> information regarding numbering of marks</p> <p><b>3(a)(i)</b> Independent GNSS session exceeding one hour added</p> <p><b>3(c)</b> Added information regarding definition of an independent setup</p> <p><b>3.2(c)</b> Changed naming and file type for field sheets</p> <p><b>3.4(a)(i)</b> Wording changed regarding the photo of mark</p> <p><b>3.4(c)(iii)(b)</b> Added wording regarding using an arrow to identify mark</p> <p><b>4</b> New section on levelling to be carried out between groups of marks at each location surveyed</p> <p><b>5</b> Section that was 4 is now 5</p> <p><b>5.2(I)</b> Requirement to check RINEX files before submission to LINZ</p> <p><b>5.4(e)</b> Information on levelling equipment used to be in the Survey Report</p> <p><b>5.4(h)</b> GNSS added to Equipment used</p> <p><b>5.4(i)</b> Addition of recording method for levelling to be in the Survey Report</p> <p><b>5.4(J)</b> Comparison of height distances between GNSS and Levelling results</p> <p><b>5.5</b> Format for final results of levelling including example and file name to be used</p> <p><b>6.2</b> Two additional required files for the levelling information to be supplied</p>
<b>Version 1.1</b>	<b>Released 09 April 2020</b>

	<p><b>Apart from corrections to spelling and punctuation, the changes between the version 1.0 and 1.1 are as follows.</b></p> <p><b>1.3</b> Added Mark Details to list of templates Updated information box on templates</p> <p><b>3 (f)</b> Geonet ftp site link is updated</p> <p><b>3.3 (a) and (b)</b> have been moved to 3.4 Mark Details File <b>(c)</b> has been deleted, this information will be in the Mark Details file <b>(d)</b> The word “details” has been changed to “data” in the text In the example the comments have been deleted as this information will be captured in the Mark Details file Comments can be left blank</p> <p><b>3.4</b> Mark Details File has been added to the specifications This file will hold the data to be loaded into the Geodetic Database about each mark in the survey <i>Note especially section (d)</i> <i>The insertion of this section has changed the numbering for the remainder of the document</i></p> <p><b>5.1 (b)</b> has been changed <b>(c), (d) and (e)</b> have been added This Section deals with the requirements for submitting deliverables to LINZ, Positioning</p> <p><b>5.2 (c)</b> has been changed to specify the allowable epoch rates in the deliverables for RINX files Link to antenna information from igs has been updated.</p> <p><b>6.2</b> Mark Details file added to table Zip file added to table</p>
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## 2 Geodetic Marks

Geodetic marks may be existing marks which appear in the Geodetic Database, be on a CSD or be specified in the contract documents. The marks to be surveyed both existing and new must meet the requirements outlined here.

### 2.1 Mark Attributes

A selected mark or new geodetic mark must:

- (a) be positioned to enable it to be easily located, safely occupied and observations efficiently collected,
- (b) be constructed and located such that it can reasonably be expected to survive and remain useable for at least 50 years,
- (c) be physically located:
  - (ii) flush with (or in the case of existing benchmarks, above) ground level so it is safe and will not pose a hazard, or
  - (iii) if a buried mark:
    - (a) up to 0.30m below ground level, if protected by a box and cover that is installed flush with the surrounding ground level, or
    - (b) up to 0.10m below ground level, if in an unsealed area, safe from stock or horticultural equipment and locatable with a metal detector, or
    - (c) between 0.20m and 0.50m below ground level, where additional depth is necessary to provide protection, for example, from stock or agricultural equipment. Such a mark in an unsealed area must be locatable with a metal detector and indicated by a Marker Post
- (d) have a defined reference point for both horizontal and vertical observations that enables plumbing and heighting with a repeatability of at least 2mm.
- (e) have at least 70% clear sky visibility above 15° from the horizon in all directions, now and for the foreseeable future,
- (f) be at least 5m clear of obstacles such as fences and buildings that may cause multipath, and
- (g) be at least 20m clear of sources of radio interference such as radio transmitters, cell-phone transmitters and high-tension power lines.

## 2.2 Names of Marks

### 2.2.1 Names for Existing Marks

- (a) For all non CORS stations with a geodetic code the existing mark name shall be retained except that:
  - (i) all letters of the name shall be shown in upper case, however,
  - (ii) where a Survey District forms part of the name, the Survey District name shall be enclosed in brackets, be in sentence case, and followed by "SD".
  - (iii) The format of CORS station names shall not be changed from that already in the Geodetic Database.
- (b) Where an existing non-boundary mark shown on an approved survey plan or approved Cadastral Survey Dataset (CSD) plan is upgraded:
  - (i) its existing identification along with its plan number shall be used,
  - (ii) the use of "OLD" (as in OIT I) to prefix a mark name shall not be used, and
  - (iii) the latest name shown on a CSD plan shall be continued.
- (c) A single space character shall be inserted between each element of a name.
- (d) Where a mark has an alternative name (e.g. a geographical location), that name shall be included in the ALTN column of the Mark Data File.

### 2.2.2 Names for New Marks

- (a) New marks shall be given a unique name.
- (b) Mark names shall consist of the following components in this order:
  - (i) an abbreviation that describes the physical mark type (e.g. BP for bronze plaques, PIN for stainless steel pins),
  - (ii) a unique numeric identifier, and
  - (iii) a name from the location, plus feature if available.
  - (iv) each Tide Gauge sites marks can be numbered starting at 1

#### **EXAMPLE - New Mark Names**

A new bronze plaque mark shall be named "BP 1 SUNNY BAY WHARF".

A new stainless-steel pin mark shall be named "PIN 2 KAHIKATEA POINT".

## 2.3 New Geodetic Marks

- (a) A geodetic mark shall consist of a bronze (mushroom) plaque that is stamped with the geodetic code or a stainless-steel pin accompanied by an Identification Plaque stamped with the code.
- (b) These marks to be set in concrete or grouted into solid rock. The amount of concrete to be used will depend on the ground in which it is placed and must establish a mark which is unlikely to be easily moved or destroyed.
- (c) Existing suitable marks may need the addition of concrete for stabilisation and to attach an identification plaque.
- (d) In sealed areas the bronze (mushroom) plaque may be installed flush in a solid structure, such as a concrete berm, kerb or wharf.
- (e) In non-sealed areas, extra stability may be given to the bronze (mushroom) plaque, by inserting part of the plaque's stem into an iron tube with a minimum length of 0.20m driven in the ground. Ensure that the plaque sits proud of the tube so that the tube is covered by concrete to prevent the tube from rusting.
- (f) To enable easier location a plastic marker post may be installed near the mark.
- (g) Codes for new marks or marks not currently in the Geodetic Database can be obtained by request from CRM\_Geodetic@linz.govt.nz
- (h) Survey consumables such as plaques, stainless steel pins, name plaques, covers etc can be obtained from: Survey Services Hawkes Bay Ltd, Phone (06) 8444354, email: mark@surveyhb.co.nz

### 3 Method of Survey

- (a) All control survey observations must be made using GNSS with a minimum of two receivers, ideally three. The methodology for connecting to the existing High Order network (Order 1 to 4) can be either:
  - (i) At one of the three marks at each Tide Gauge location, a session of at least 4 hours and an independent session exceeding one hour processed using PositionZ-PP (this processes against the closest three LINZ CORS stations); or
  - (ii) At one of the three marks at each Tide Gauge location, static observations to the two closest accessible High Order marks (Order 1 to 4) plus the closest LINZ or GeoNet CORS station. Two independent sessions of 30 minutes (one of which can be done as part of (b) below).
- (b) The other two marks at each tide gauge location must be connected to the initial mark surveyed by 30 minute GNSS observations to form a measured triangle; each of the three stations must have two independent sessions.
- (c) An independent session involves closing the file in the receiver, power down if necessary, changing the instrument height by a minimum of 0.10m and where possible rotating the optical plummet or tribrach by 180 degrees.
- (d) PositionZ-PP is available at: <http://www.linz.govt.nz/data/geodetic-services/positionz/positionz-post-processing-service>
- (e) A list and map of all government CORS stations is available at: <https://data.linz.govt.nz/layer/1029-nz-government-gnss-cors/webservices/>
- (f) RINEX data for CORS stations can be downloaded from the following ftp site: <ftp://ftp.geonet.org.nz/gnss>

#### **GUIDELINE – When three receivers are available**

If three receivers are available and the PositionZ-PP methodology is being used the quickest methodology is to place a receiver over each of the three marks, measure for 4 hours, change the heights of all receivers and measure for 30 minutes. Where this is done an independent session of one hour mentioned in 3(a)(i) above is not required.

### 3.1 Field Survey Requirements

All GNSS observations should comply with the following field procedures.

- (a) Prior to survey, equipment such as tribrach's and pole bubbles should be in adjustment and checked again at the completion of the survey. Rotating optical plummets, checked during each setup are ideal.
- (b) The antenna must be centred over the horizontal reference point and have its height measured relative to the vertical reference point (highest point of mark).
- (c) Each station to be occupied twice with a change in height between setups.

- (d) The survey procedure shall include sufficient checks and redundancy to identify and mitigate potential errors, such as multipath or plumbing, and to ensure that survey accuracy can be proven.

## 3.2 Field Sheet

- (a) A field sheet recording data for each GNSS setup must be filled for each occupation of a mark. The Example Field sheet located on the LINZ website is designed to accommodate two occupations on the one sheet.
- (b) A modified version of the field sheet on the web site, either paper or electronic based may be used but the information fields on the one on the LINZ website must be utilized.
- (c) Field Sheets must be scanned and supplied as part of the deliverables.

<b>INFORMATION – File Names</b>		
Mark field sheet files should use the following naming convention:		
CODEDDDYfsV.JPG		
<b>e.g. HNPC03118fs1.tif</b>		
Where:		
<b>Abbreviation</b>	<b>Description</b>	<b>Example</b>
CODE	Geodetic Code (or mark name if no Code)	HNPC
Julian Day	DDD	031
YY	Year of information (last two digits)	18
fs	Indicates field sheet file	fs
V	Sequential file number	1

### 3.3 Mark Data File

- (a) Approximate (to the nearest metre) latitudes and longitudes should be provided in decimal degrees (if DMS format is supplied instead this should be clearly stated).
- (b) Approximate (to the nearest metre) ellipsoidal heights should be supplied in metres.
- (c) A comment should be provided that would help locate or identify the mark.
- (d) The mark data should be submitted in the format of the template available from the LINZ website and called **Mark Data.xls** available from: <http://www.linz.govt.nz/data/geodetic-system/standards-specifications-and-publications/geodetic-specifications>

Example:

Code	Name	Latitude (dec deg)	Longitude (dec deg)	Ellipsoid Hgt (m)	Vertical Reference Point	Comments
XXXX	BP 1 Sandy Point	-41.8056208	171.256780	100.01	Highest Point on BP	
YYYY	PIN 2 Sandy Point	-41.8056104	171.256787	200.02	Highest point on SS Pin	
AAAA	Para	-41.8056202	171.256730	200.03	Highest Point on SS Pin	

### 3.4 Mark Details File

- (a) Details of the mark type and its location should be recorded while the field work is being undertaken.
- (b) Mark details are required for all marks visited during the survey.
- (a) A report shall be supplied that provides updated information about all geodetic marks visited, maintained and searched for by the Supplier.
- (b) CORS stations (including PositionNZ stations) are not required to be included in the Mark Details File.
- (c) Where a mark already exists in the Geodetic Database and its physical state will be changed to *Destroyed* or *Not Found*, the details of the mark should be retained in the mark details file.
- (d) A file which contains data on marks to be used in the survey that are currently in the GDB can be obtained by emailing a list of mark codes to [crm\\_geodetic@linz.govt.nz](mailto:crm_geodetic@linz.govt.nz), the file can be updated, and new marks added to it.
- (e) The Mark Details file should be named Mark Details\_file.xlsx
- (f) The following fields shall be provided for each geodetic mark:

Field Name	Contents	Format
CODE	Geodetic Code	Four-character geodetic code
NAME	Mark Name	See Section 2.2
EXMK	Existing Mark	<ul style="list-style-type: none"> <li>• <b>N</b> = Mark is not currently in the GDB</li> <li>• <b>Y</b> = Mark exists in the GDB</li> </ul>
MRKT	Mark Type	<ul style="list-style-type: none"> <li>• <b>IS</b> = Iron Spike Iron Rod or similar</li> <li>• <b>IT</b> = Iron Tube, Iron Pipe or similar</li> <li>• <b>LP</b> = Lead or Aluminium Plug</li> <li>• <b>NAIL</b> = Nail</li> <li>• <b>PIN</b> = Steel Pin, Stainless or other material such as bronze</li> <li>• <b>BP</b> = Bronze Plaque</li> <li>• <b>FCTR</b> = Forced Centring</li> <li>• <b>OTHR</b> = Any other type of mark (Includes RNZN BM)</li> <li>• <b>UNMK</b> = Unmarked</li> <li>• <b>UNKN</b> = Not Specified</li> </ul>
MPSC	Mark Physical State	<ul style="list-style-type: none"> <li>• <b>DEST</b> = Destroyed</li> <li>• <b>DMGD</b> = Damaged</li> <li>• <b>NFND</b> = Not Found</li> <li>• <b>RELB</b> = Reliable</li> <li>• <b>THRT</b> = Threatened</li> </ul>
PLRF	Plan references	<ul style="list-style-type: none"> <li>• For existing marks, the plan references from the geodetic database (including those listed on scanned mark diagrams)</li> </ul>
EDAT	Date mark originally established	YYYY.MM.DD
MRKR	Most prominent mark protection	<ul style="list-style-type: none"> <li>• <b>2MBE</b> – 2m Beacon</li> <li>• <b>4MBE</b> – 4m Beacon</li> <li>• <b>CICV</b> – Cast Iron Cover</li> <li>• <b>COVR</b> – Concrete or Non-Standard Cover</li> <li>• <b>MKPT</b> – Wooden or Non-Standard Marker Post</li> <li>• <b>PLPT</b> – Plastic Marker Post</li> <li>• <b>PLCV</b> – Plastic Cover</li> <li>• <b>PREN</b> – Post and Rail Enclosure</li> <li>• <b>NOPR</b> – No Protection</li> <li>• <b>NSTD</b> – Non-Standard Beacon</li> </ul>
MRKR2	Secondary mark protection	<ul style="list-style-type: none"> <li>• <b>2MBE</b> – 2m Beacon</li> <li>• <b>4MBE</b> – 4m Beacon</li> <li>• <b>CICV</b> – Cast Iron Cover</li> <li>• <b>COVR</b> – Concrete or Non-Standard Cover</li> <li>• <b>MKPT</b> – Wooden or Non-Standard Marker Post</li> <li>• <b>PLPT</b> – Plastic Marker Post</li> <li>• <b>PLCV</b> – Plastic Cover</li> <li>• <b>PREN</b> – Post and Rail Enclosure</li> <li>• <b>NOPR</b> – No Protection</li> <li>• <b>NSTD</b> – Non-Standard Beacon</li> </ul>
MRKE	Beacon type	<ul style="list-style-type: none"> <li>• <b>AA</b> - Cairn</li> <li>• <b>CN</b> - Chimney</li> <li>• <b>DB</b> – Deep Drilled Braced Monument</li> <li>• <b>LH</b> - Lighthouse</li> <li>• <b>MR</b> – Marine Beacon</li> <li>• <b>MS</b> - Mast</li> </ul>

		<ul style="list-style-type: none"> <li>• <b>NB</b> – Not Beaconed</li> <li>• <b>ND</b> - Unknown</li> <li>• <b>PL</b> – Pillar</li> <li>• <b>SB</b> – Shallow Drilled Braced Monument</li> <li>• <b>TO</b> – Tower</li> <li>• <b>TT</b> – Transmission tower</li> <li>• <b>2T</b> – 2m metal beacon (Clarke, Nelson, Gisborne)</li> <li>• <b>2W</b> – 2m Wooden Beacon (Ellison)</li> <li>• <b>4T</b> – 3m or 4m Metal Beacon (Pipe, Angle Iron)</li> <li>• <b>4W</b> 3m or 4m Wooden Beacon</li> <li>• <b>NS</b> – Non – Standard Beacon (Diagram of beacon required with heights)</li> </ul>
GLREL	Ground level relationship	Metres to two decimal places, Negative if mark above ground level, positive if below ground level. Where ground level is uneven measure an average height
BCNHGT	Height measurement for beacons and pillars, to two decimals	<p style="text-align: center;">Beacon Diagram</p>
BCNHGT2	Height measurement for beacons and pillars	See Beacon diagram above, blank if not required
BCNHGT3	Height measurement for beacons and pillars	See Beacon diagram above, blank if not required
BCNHGT4	Height measurement for beacons and pillars	See Beacon diagram above, blank if not required



BCNHGT5	Height measurement for beacons and pillars	See Beacon diagram above, blank if not required
BCNHGT6	Height measurement for beacons and pillars	See Beacon diagram above, blank if not required
BDAT	Date Beacon Erected	YYYY.MM.DD, blank if not known
BECC	Beacon Eccentricity	<ul style="list-style-type: none"> <li>• Central</li> <li>• Eccentric</li> <li>• Blank, if not beacons</li> </ul> (In the case that any eccentricity of a Four Metre or Non-Standard Beacon is greater than 0.01m the direction (degrees) and distance from the mark to the centre of the beacon shall be recorded in the survey report)
MRKD	Description of ground mark	A text description of the ground mark
MLOC	Description of site and location	A text description of the ground marks location
PLQEXIST	ID plaque existence	<ul style="list-style-type: none"> <li>• <b>E</b> = Rectangular Bronze ID Plaque already exists</li> <li>• <b>Y</b> = Rectangular Bronze ID Plaque installed</li> <li>• <b>N</b> = Rectangular Bronze ID Plaque non-existent</li> </ul>
PLTEXIST	ID plate existence	<ul style="list-style-type: none"> <li>• <b>E</b> = Aluminium ID Plate already exists</li> <li>• <b>Y</b> = Aluminium ID Plate installed</li> <li>• <b>N</b> = Aluminium ID Plate non-existent</li> </ul>
INFOEXIST	Information plate existence	<ul style="list-style-type: none"> <li>• <b>E</b> = Aluminium Information Plate already exists</li> <li>• <b>Y</b> = Aluminium Information Plate installed</li> <li>• <b>N</b> = Aluminium Information Plate non-existent</li> </ul>
MDAT	Date of most recent maintenance or site inspection	YYYY.MM.DD
MPSM	Description of mark maintenance completed	Text, state "None" if no work completed
MPSB	Description of beacon maintenance completed	Text, state "None" if no work completed
MPSP	Description of protection maintenance completed	Text, state "None" if no work completed
MDMK	Description of mark	Text, state "None" if no work required

	maintenance required	
MDBE	Description of beacon maintenance required	Text, state "None" if no work required
MDPR	Description of protection maintenance required	Text, state "None" if no work required
OWNR	Name of contact person to permit access to and occupation of mark	Text, state "Road Reserve" if in road reserve and "Not for Public Record – Contact LINZ" if the contact person does not wish their details to appear on the Public Record
PHNO	Phone number of OWNR	(0X) XXX XXXX, blank if OWNR is Road Reserve, Foreshore or DOC
PADD	Physical address of OWNR, where they can be contacted	Text, blank if OWNR is Road Reserve, Foreshore or DOC
ARES	Restrictions to accessing mark	Text, state if there are access restrictions to the mark location
GNSSU	GNSS Suitability	<ul style="list-style-type: none"> <li>• <b>GD</b> = Good</li> <li>• <b>PR</b> = Poor</li> <li>• <b>US</b> = Unsuitable</li> </ul>
CELL	Cell phone network coverage of at least one provider	Text in the following format: Spark: Good; Vodafone: No Coverage; 2Degrees: Not Tested Options are: <ul style="list-style-type: none"> <li>• <b>Good</b> = Strong signal</li> <li>• <b>Poor</b> = Weak but reliable signal</li> <li>• <b>No Coverage</b> = Weak signal or unreliable signal</li> <li>• <b>Not Tested</b> = Network signal not tested</li> </ul>
ADAT	Date that owner/occupier information and access data was verified	YYYY.MM.DD
COMM	Optional comments	Text, for information only. These comments will not be loaded into the Geodetic Database or Landonline

(g) The Mark Details File shall:

- (i) be supplied in a Microsoft Excel Spreadsheet (xlsx),
- (ii) contain the following header line:

CODE,NAME,EXMK,MRKT,MPSC,PLRF,EDAT,MRKR,MRKR2,MRKE,GLREL,  
BCNHGT,BCNHGT2,BCNHGT3,BCNHGT4,BCNHGT5,BCNHGT6,BDAT,BECC,

MRKD,LOC,PLQEXIST,PLTEXTIST,MDAT,MPSM,MPSB,MPSP,MDMK,MDBE,  
MDPR,OWNR,PHNO,PADD,ARES,GNSSU,CELL,ADAT,COMM

- (iii) contain information about one mark per line

#### **GUIDELINE – Mark Details File**

The Mark Details File contains mark information that a Supplier has collected or verified. It is used to update Landonline and the geodetic database with the latest information about geodetic marks.

It is important to ensure data formats are maintained in xlsx files, particularly the specified number of characters (eg Year.Month.Day: YYYY.MM.DD).

Information regarding PositioNZ or CORS sites not visited by the Supplier should not be included in the Mark Details File.

### 3.5 Photos

- (a) The following photographs must be provided for each mark in the survey, except those not visited (e.g. CORS):
- (i) Close mark vertical photograph that clearly shows the mark and any name plate, the mark type should be recognizable from the photo,
  - (ii) Site Photograph that clearly shows the mark in relation to its immediate surroundings, including any protection structures *in situ*, and
  - (iii) Extended Site Photograph that shows a wider view of the site, its surroundings, and other features which may help to locate the mark in the future.
- (b) Photographs must be taken after all maintenance has been completed at the site.
- (c) Photos must meet the following criteria:
- (i) not include members of the public, or anything else that could compromise an individual's privacy, bearing in mind that these photographs will be made available over the internet in a public database,
  - (ii) be vertically aligned for ease of viewing (i.e. ground at the bottom of the photograph, sky at the top), and
  - (iii) not be digitally altered, except to:
    - (a) overcome privacy issues, or
    - (b) identify the location of the mark if it is not obvious in the photo. A vertically placed arrow indicating the location should be used.
- (d) The mark and site images for each site shall be added to a template downloaded from the LINZ website: <http://www.linz.govt.nz/data/geodetic-system/standards-specifications-and-publications/geodetic-specifications>. The

PowerPoint template from this site can be used to create the site images but the results are to be provided as a JPG image. Click on the *insert picture from file* icon when the PowerPoint template is open to insert each picture.

**INFORMATION – File Names**

Mark and Site Image files should use the following naming convention:

CODEYYpV.JPG

**e.g. HNPC17p1.JPG**

Where:

Abbreviation	Description	Example
CODE	Geodetic Code	HNPC
YY	Year of information (last two digits)	17
p	Indicates photo file	p
V	Sequential file number	1

### 3.6 Access and Finder Diagrams

- (a) An access or finder diagram must be provided for every non-CORS mark found or installed.
- (b) The following types of diagram shall be provided:
  - (i) access diagrams shall be provided for all trigs and marks with complex access instructions, or
  - (ii) finder diagrams shall be provided in all other cases.
- (c) An existing mark diagram may be used as an access or finder diagram if:
  - (i) the content is still applicable and correct, and
  - (ii) it complies with the requirements of this section
- (d) Access diagrams shall provide enough information to ensure that anyone locating the mark will travel via the safest, most direct route or the route preferred by the landowner/occupier.
- (e) Finder diagrams shall include enough street pattern to indicate the shape of the formation and where the mark lies in the street, and

- (f) Street names and ties to at least three nearby physical objects (if they exist) to allow the mark to be located in a timely manner.
- (g) In areas where there is no man-made infrastructure for ties then they should be to natural features and to any other marks in the survey that are in the immediate area.
- (h) Finder diagrams shall show ties to features to at least decimetre accuracy (0.1m)
- (i) All diagrams must:
  - (i) be drawn at a scale appropriate to show features useful in accessing the mark (access and finder diagrams will be recorded as "Not to Scale" on the Mark and Site details form),
  - (ii) have a north arrow and be aligned so that the north arrow points up the page,
  - (iii) show all topographical features and names useful in accessing the mark, including the geodetic code of the mark,
  - (iv) show the measured relationship of physical features with respect to the ground mark, which would allow the mark to be located in a timely manner, and
  - (v) show the relationship of any Marker Post with respect to the ground mark.
- (j) Diagrams must be square in shape and contain detail that is clearly visible when the image is displayed at 8cm x 8cm.
- (k) Each diagram is to be supplied as a PNG file.

### **INFORMATION – File Names**

Access or finder diagram files should use the following naming convention:

CODEYYAD.PNG

**e.g. HNPC17ad.png**

Where:

<b>Abbreviation</b>	<b>Description</b>	<b>Example</b>
CODE	Geodetic Code	HNPC
YY	Year of information (last two digits)	17
ad	Indicates access/finder diagram	ad

## 4 Levelling

At each site levelling is to be carried out between each of the marks, this will include the three marks for the survey plus any other close existing geodetic mark.

Results of the levelling shall be supplied in the format shown in section **5.5**

### 4.1 Method of Survey

- (a) Each group of marks must be levelled both forwards and backwards (double-run levelling).
- (b) Levelling should be undertaken with equipment which will attain the accuracy for 1V surveys. This may include the use of bar code staves.
- (c) Equipment used should be in good condition and regularly calibrated.

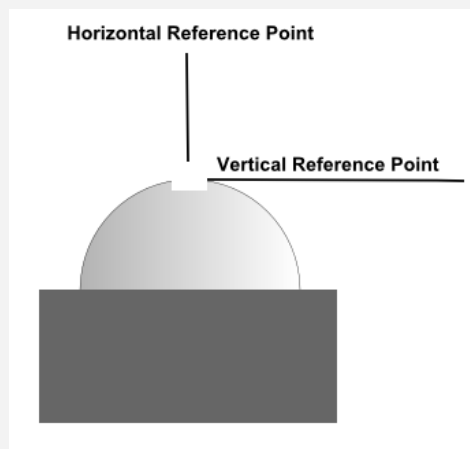
#### **GUIDELINE – Reporting Methodology**

The methodology used, circuit fore and back misclose and comparisons to allowable miscloses, shall be fully documented in the Survey Report.

Field Notes including full details of reductions applied shall also be provided, this being tif images of handwritten field notes or an electronic file where the data is captured in an instrument or data recorder in a text based format.

- (d) Unless otherwise indicated in the existing records or where NZ Navy Hydrographic marks are encountered the vertical reference point to which heights must be referenced is the highest point on the mark.

#### **GUIDELINE – Horizontal and Vertical Reference Points**



## 4.2 Levelling Accuracy

- (a) All surveyed control marks must achieve the Order 1V accuracy standard.
- (b) The allowable misclose in millimetres for height differences between fore and back levelling runs is defined by: Misclose =  $5\sqrt{k}$

### **GUIDELINE – Levelling Checks against GNSS Height Differences**

When GNSS observations between the marks are processed, either in-house where availability of software allows or by LINZ after supply of deliverables the differences in height between marks will be compared against those gained by levelling.

The differences in height between marks should be within 10mm and any difference over 20mm will be questioned.



## 5 Survey Deliverables

### 5.1 Delivery of Data

- (a) All data to be in electronic format using the file naming specified in this specification.
- (b) All required files pertaining to marks in a submitted survey shall be contained in one ZIP file with no directory structure apart from folders for the Rinex data as described in Section 5.2 (e)
- (c) The zip file should be named to signify the Hydrographic contract number and area of the sites such as:
  - (i) HYD58 – Doubtful Sound, or
  - (ii) 2019JLAS\_Area\_3 - Auckland
- (d) Data for all marks pertaining to one Hydrographic survey or area should be submitted as one data delivery.
- (e) Additional supporting files not required as part of the specifications can be supplied in a separate ZIP file named as above but appended with \_Supporting. These files may be the PowerPoint file of photos or the raw access diagrams. This allows for in house editing when required.
- (f) The Survey Report can cover several Tide Gauge sites.

### 5.2 RINEX Data

- (a) RINEX data is to be provided in the same RINEX version which is used for the PositionZ stations at the time of survey.
- (b) Separate RINEX observation files are required for each occupation of each mark.
- (c) RINEX can be recorded at 1 second epochs but must be submitted as either 15 second or 30 second epochs in the deliverables
- (d) Navigation files are not required.
- (e) All RINEX files (or the single zip file) for each Julian day shall be supplied in a sub-directory.
- (f) The format of the sub-directory name is to be: YYDDD
- (g) Where a RINEX file includes data from more than one Julian day, DDD refers to the Julian day at the start of the occupation.
- (h) Raw data shall be converted to RINEX using software proven to produce an accurate translation, (such as the translator recommended by the receiver's manufacturer). Alternatively the program TEQC can be used, available from: <https://www.unavco.org/software/data-processing/teqc/teqc.html>

- (i) The RINEX files shall show correct:
  - (i) control mark names in the "Marker Number" field, and
  - (ii) four-character geodetic codes in the "Marker Name" field

**INFORMATION – RINEX Marker Number and Marker Name**

Placing the geodetic code in the "Marker Name" field, rather than the "Marker Number" field ensures that the geodetic code gets treated as the primary identifier when the RINEX file is imported into GNSS processing software.

- (j) Antenna heights shall be reduced to the vertical and stated with respect to the antenna reference point – ARP, which is normally the bottom surface of the antenna.

**INFORMATION – Antenna Information**

The position of the antenna reference point shall follow the IGS standard available from:

<ftp://ftp.igs.org/pub/station/general/antenna.gra>

The NGS web site is a useful reference for antenna dimensions:

<https://www.ngs.noaa.gov/ANTCAL/>The RINEX data downloaded from CORS sites contain the antenna height (Sometimes called the "spacer" height) but does not contain the antenna offsets which need to be obtained from the NGS site mentioned above.

- (k) The following minimum fields shall be populated with information in the RINEX header:
  - (i) RINEX Version/Type
  - (ii) Observer/Agency
  - (iii) Marker Name (the geodetic **code** must be entered here)
  - (iv) Marker Number (the mark name must be entered here)
  - (v) Rec # / Type / Vers
  - (vi) Ant # /Type
  - (vii) Antenna: Delta H/E/N
  - (viii) # / Types of Observ
  - (ix) Interval
  - (x) Time of First Obs

### INFORMATION – File Names

RINEX files should use the following naming convention:

CODEDDDS.YYo

eg **HNPC0961.17o**

Where:

Abbreviation	Description	Example
CODE	Geodetic Code	HNPC
DDD	Julian day of year	096
S	Session Number	1
YY	Year of information (last two digits)	17
o	lower case letter o	o

- (l) Before submission of deliverables to LINZ all RINEX files should be Quality Controlled using the software TEQC mentioned in 5.2(h) above. The use of the GUI WinTEQC available from <http://teqc.silkwerks.com/> enables the checking of multiple files at once.

## 5.3 SINEX Data Files

- (a) All RINEX files for Long Occupations (4-hour) sites are to be submitted to the LINZ PositionZ-PP - GNSS Post-Processing Service and the resultant SINEX file submitted with the deliverables.
- (b) The only file required is identified by PositionZ-PP in its filelist.csv as "SINEX file of **minimum** constraints calculation for ..."
- (c) The SINEX filename is determined by the input RINEX file and can be retained.

### Information – SINEX files

SINEX is a Solution Independent Exchange format file which contains the original normal equation systems for precise GPS adjustments so they can be reconstructed.

The PositioNZ-PP - GNSS Post-Processing Service checks RINEX files for compatibility for such things as correct receiver and antennae model identifiers to ensure that the data will be correct for future re-processing.

## 5.4 Survey Report

A Survey Report should be submitted in the form of the template available on the LINZ website **Simplified Geodetic Control Survey Report.docx**. As a minimum the report must cover the following:

- (a) Introduction – Location details and a brief background to the survey.
- (b) Nominated Contact – Details of the person submitting the survey including: name, company, email address and phone number.
- (c) Personnel involved in the survey.
- (d) List of GNSS Equipment - receiver and antenna makes models and serial numbers.
- (e) List of levelling equipment used to include makes, models, serial number staff type and recording method.
- (f) Calibration – Brief details of before and after tribrach calibrations tests or bubble checks. Comment should be made that **no** "site calibrations" using the GNSS equipment were carried out.
- (g) Marks – A list of all the marks in the survey, along with their geodetic code.
- (h) GNSS Methodology – A brief description of the field methods adopted to meet the standards. For example: independent measurements of antenna heights, independent mark occupations, the length of sessions, etc.
- (i) Levelling recording method and close results.
- (j) Comparison of differences in height between the GNSS heights and the levelling heights if they have been computed.

## 5.5 Levelling Results:

The final results of the levelling will be in the following format in an excel spreadsheet:

	1	2	3	4	5	6	7	8	9
1	FCODE	TCODE	DATE	TIME	DHGT	LVDIST	METH	EFAC	COMM
2	EB4V	F2QA	2018.02.20	10.01	-11.6008	272	LVL1		
3	F2QA	EB4V	2018.02.20	10.31	11.5993	273	LVL1		
4	F2QA	F26R	2018.02.12	10.01	-0.0298	57	LVL1		
5	F26R	F2QA	2018.02.12	10.15	0.0301	57	LVL1		
6	F26R	EVVK	2018.02.12	10.31	0.7044	261	LVL1		
7	EVVK	F26R	2018.02.12	11.01	-0.7061	258	LVL1		
8	EVVK	F26U	2018.02.12	11.15	-0.1343	426	LVL1		
9	F26U	EVVK	2018.02.12	11.45	0.1333	425	LVL1		
10	F26U	F26T	2018.05.31	12.01	0.2334	71	LVL1		
11	F26T	F26U	2018.05.31	12.15	-0.2331	71	LVL1		
12	F26U	F26V	2018.05.31	12.31	-0.8437	49	LVL1		
13	F26V	F26U	2018.05.31	12.45	0.8442	49	LVL1		
14									

### Guideline – Levelling Spreadsheet

FCODE – From Code

TCODE – To Code

DATE – Date of observations in the format YYYY.MM.DD

DHGT – Difference in height

LVDIST – Level Distance (Where distance is not observed use 1)

METH – Always LVL1

EFAC – Leave Blank

COMM – Comments if any

**NB:** The levelling from all sites of a survey should be included in one file without gaps between sites.

### **INFORMATION – File Names**

The levelling file from **5.5** above should use the following naming convention:

HYNNNYYL.xlsx

**eg HY06118L.xlsx**

Where:

<b>Abbreviation</b>	<b>Description</b>	<b>Example</b>
HY	Indicates Hydrographic Survey	
NNN	Number of Hydrographic Survey with leading zero if required	061
YY	Year of information (last two digits)	18
L	Indicates a levelling file	L

## 6 Submission of Data

### 6.1 General

- (a) All information should be provided to the National Geodetic Office in digital form only.
- (b) The information should also be provided to the New Zealand Hydrographic Authority as part of the deliverables for the completed Hydrographic Survey.
- (c) Information can be provided:
  - (i) By email:  
CRM\_geodetic@linz.govt.nz
  - (ii) Via Dropbox or other file sharing service agreed to by both parties.

### 6.2 Required Files

The following table summarises the files that are to be supplied:

File	Format	Reference	Comment
Field Sheet files	tif	Section 3.2	
Mark Data File	xlsx	Section 3.3	Lists all marks in the survey
Mark Details File	xlsx	Section 3.6	Lists all marks in the survey
RINEX observation file, individual	RINEX	Section 5.2	Individual file for each occupation
SINEX files	SINEX	Section 5.3	Supply if PositionNZ-PP is used
Survey Report	docx (or pdf)	Section 5.4	Summary of the survey
Photographs	JPG	Section 3.4	Individual for each mark in survey
Access or Finder Diagrams	PNG	Section 3.5	Individual for each mark in survey
Levelling observations	Various	Section 4.1	Hand booked field note scanned to tif, Instrument/ data-logger file or xlsx file
Levelling Summary	xlsx	Section 5.5	Summary of all levelling
Submission of Data	ZIP	Section 5.1	Named as per 5.1 (c)

### 6.3 After Submission

LINZ will process the data submitted using SNAP and evaluate it against the *Specifications for Geodetic Control of Hydrographic Surveys v1.1* dated 09 April 2020.

Within 10 working days of submission of the data in Section 6.2, LINZ will contact the nominated contact to confirm the inclusion of the mark(s) submitted to the geodetic control system or to request additional information.

Once Landonline and the Geodetic Database have been updated with the new control marks, LINZ will notify the nominated contact of the update.