Toitu te whenua
Land Information New Zealand

Guideline for the provision and maintenance of the New Zealand survey control system

LINZG25704

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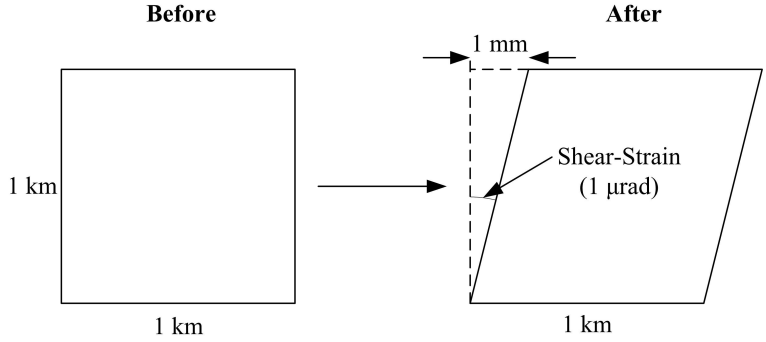
Table of contents

Tables

Terms and definitions

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

Term/abbreviation	Definition
BGN	basic geospatial network
CHN	cadastral horizontal control network
contiguous territorial sea	includes the connected waters within 12 nautical miles of the coast. Where an island is located within these waters, the contiguous territorial sea extends a further 12 nautical miles seaward around that and any other subsequently included islands
control mark	a mark that belongs to at least one control network and complies with all requirements for those control networks to which it belongs, as defined in *LINZS25003: Standard for the New Zealand survey control system*
CSD	cadastral survey dataset, as defined in the Cadastral Survey Act 2002 and submitted in terms of the rules for cadastral survey
CVN	cadastral vertical control network
datum	a particular type of reference system in which coordinates are defined in relation to a particular reference surface by means of distances or angles, or both
deformation	the change in shape, scale, or position of an area of land
DMN	deformation monitoring network
geodetic datum	a datum used to depict coordinates in relation to a model of the surface of the Earth. It is often implemented by the definition of a coordinate reference system and a reference ellipsoid.
GDRM	geodetic datum reference mark
GNSS	Global Navigation Satellite System
IERS	International Earth Rotation and Reference System
ITRF	International Terrestrial Reference Frame
IGS	International GNSS Service
Landonline order	a combined categorisation of a coordinate's local and network accuracy used to describe the accuracy of coordinates in the Landonline application. Landonline orders are specified in *LINZS25006: Standard for tiers, classes, and orders of LINZ data*, section 5.
LINZ	Land Information New Zealand

Term/abbreviation	Definition
national survey control system	a system used to determine the position of points, features, and boundaries in cadastral surveys, other surveys, and land information systems, as defined in s 4 of the Cadastral Survey Act 2002
NHN	national height network
NRF	national reference frame
official datum	a geodetic or vertical datum declared as official by the Surveyor-General
road controlling authority	as defined in s 5 of the Land Transport Management Act 2003
Ross Sea Region	that area bounded by longitudes 160° East and 150° West and south of latitude 60° South
rules for cadastral survey	rules made by the Surveyor-General under s 49 of the Cadastral Survey Act 2002, or any alternative requirements specified under s 47(5) of the Cadastral Survey Act 2002
shear–strain rate	the ratio of deformation perpendicular to the original length of a line, measured in micro-radians/year (µrad/year)
	
the standard	LINZS25003: Standard for the New Zealand survey control system
vertical datum	a curved or level surface taken as a surface of reference from which to determine elevations
VDRM	vertical datum reference mark
witness mark	a mark used to witness a boundary point in accordance with the rules for cadastral survey

Foreword

Introduction

(a) The Surveyor-General has a function and a duty under s 7(1)(b) of the Cadastral Survey Act 2002 to maintain a national survey control system. The control system is physically realised by survey control networks that include control marks and their positions.

(b) The function of providing and maintaining the survey control networks has been delegated by the Surveyor-General to Land Information New Zealand (LINZ) Customer Services. This guideline outlines how LINZ Customer Services will exercise this delegation.

Purpose of guideline

This guideline provides instruction from the Surveyor-General to LINZ Customer Services for use when exercising the delegated function of maintaining the national survey control system.

Brief history of guideline

This is a new guideline.

References

It is intended that this guideline be read in conjunction with:

- International GNSS Service 2007, *IGS Site Guidelines*, available at: http://igscb.jpl.nasa.gov/network/netindex.html
- LINZ 2009, *LINZS25003: Standard for the New Zealand survey control system*, Office of the Surveyor-General, LINZ, Wellington
- LINZ 2009, *LINZS65000: Rules for Cadastral Survey 2010, Office of the Surveyor-General*, LINZ, Wellington
- LINZ 2009, *LINZS25006: Standard for tiers, classes, and orders of LINZ data*, Office of the Surveyor-General, LINZ, Wellington

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Scope

(a) The Surveyor-General has issued a standard that specifies the requirements for the New Zealand survey control system (the standard). This guideline supports the standard by describing how LINZ Customer Services will maintain the national survey control system and provide information from it on behalf of the Surveyor-General.

(b) This guideline focuses on the following aspects of providing and maintaining the national survey control system:

(i) density of control marks within each survey control network,

(ii) connection of official datums to international reference frames,

(iii) deformation monitoring,

(iv) heights,

(v) characteristics of control marks,

(vi) accessibility to survey control networks, and

(vii) provision of control system information.

Intended use of guideline

This guideline will be used by LINZ Customer Services when exercising the delegated function to maintain the national survey control system and provide information from it.

1 Survey control network density

1.1 National reference frame

1.1.1 Geodetic datum reference marks

Reference to the standard

3.1(a)

This requirement enables the link between official geodetic datums and international reference systems to be reliably determined and temporal changes monitored.

Guideline

The national reference frame (NRF) should include at least one geodetic datum reference mark (GDRM) on the stable parts on each of the:

(a) Pacific tectonic plate within the New Zealand continental shelf,

(b) Australian tectonic plate within the New Zealand continental shelf, and

(c) Antarctic tectonic plate within the Ross Dependency.

1.1.2 Vertical datum reference marks

Reference to the standard

3.1(b)

This requirement enables the link between official vertical datums and international height systems to be reliably determined and temporal changes monitored.

Guideline

The NRF should include at least one vertical datum reference mark (VDRM) co-located at each GDRM.

Continued on next page

1.1 National reference frame, continued

1.1.3 Connecting to other observation systems

Reference to the standard 3.1(c)

Guideline Each NRF mark should be co-located with other geodetic sensors that can acquire observations suitable for inclusion in an International Earth Rotation and Reference System (IERS) determination of an International Terrestrial Reference Frame (ITRF).

1.1.4 Co-location of marks

Reference to the standard 3.1(c)

This requirement enables the link between official geodetic and vertical datums to be determined and monitored. These requirements are the same as those required at IGS GNSS sites co-located with other instrumentation, such as DORIS, SLR, gravity, and tide gauges (see subsection 2.2.18 of the *IGS Site Guidelines 25/07/2007*).

Guideline NRF marks can be considered to be co-located when:

(a) the geometric relationship between marks has been determined to an accuracy of better than 2 mm, at the 95 % confidence level,

(b) the relationship is published in terms of the ITRF in both geographic form ($\Delta\phi$, $\Delta\lambda$, Δh) and Cartesian form (ΔX, ΔY, ΔZ) with full variance-covariance information in an open and widely accepted format,

(c) the survey measurements, field notes, and reduced results are made available as soon as practical following a request, and

(d) the relationship is re-determined at least every two years, or sooner if the relationship is suspected to have changed, for example, as a result of a major deformation event in the vicinity.

1.2 Deformation monitoring network

1.2.1 Extent of deformation monitoring network

Guideline

For the purposes of 1.2.2, 1.2.3, and 1.2.4 of this guideline, the extent of New Zealand is limited to the North Island, South Island, Stewart Island/Rakiura, and all islands within their contiguous territorial sea.

This is to exclude offshore islands and the Ross Dependency from the requirement to determine and monitor deformation.

1.2.2 National-deformation marks

Reference to the standard

3.2(a)

This requirement specifies the minimum requirements for the density and configuration of the PositioNZ (national continuous GNSS) network to enable the determination and monitoring of national-scale deformation.

Guideline

For the purposes of determining and monitoring national-scale deformation, each national deformation monitoring network (DMN) control mark should be located so that every point in New Zealand is located within:

(a) 100 km of one national DMN mark, and

(b) 300 km of three national DMN marks.

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1.2 Deformation monitoring network, continued

1.2.3 Regional-deformation marks

Reference to the standard

3.2(b)

This requirement specifies the minimum requirements for the density and configuration of regional-scale deformation networks across New Zealand to maintain the accuracy of the official geodetic datum and to re-establish the cadastre following a major deformation event.

Guideline

(a) Each regional-deformation DMN control mark should be located so that the distance from any point in New Zealand does not exceed the maximum distances to marks set out in Table 1.

(b) It may be necessary to place additional marks where the magnitude of the expected or observed deformation cannot be accurately validated or measured using the minimum density or configuration in Table 1.

Table 1: Maximum distances to regional-deformation DMN marks

Rate of deformation (engineering sheer strain determined in accordance with paragraph 3.2)	**Maximum distance from any point to one regional-deformation DMN mark** (km)	**Maximum distance from any point to three regional-deformation DMN marks** (km)
>0.2 µrad/year	20	50
<0.2 µrad/year	35	70

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1.2 Deformation monitoring network, continued

1.2.4 Local-deformation marks

Reference to the standard

3.2(b)

This requirement specifies the minimum requirements for the density and configuration of local-deformation DMN marks in areas of high deformation where the regional-deformation DMN mark density is insufficient to retain the accuracy of the cadastral control network. These networks are not required in low deformation rural or wilderness areas.

Guideline

(a) Local-deformation DMN control marks should be positioned in areas where the predicted or observed rate of deformation is such that the accuracy of the cadastral horizontal network cannot be maintained by the regional-deformation DMN marks alone. This will usually be necessary where the local deformation rate exceeds 0.5 µrad/year.

(b) Local-deformation DMN control marks must be positioned in urban areas to enable the cadastre to be re-established following a major deformation event.

(c) Each local-deformation DMN control mark should be positioned so that the distance from any point in an area identified in (a) or (b) does not exceed the maximum distances to marks stated in Table 2.

(d) It may be necessary to place additional marks where the magnitude of the expected or observed deformation cannot be modelled using the minimum density or configuration in Table 2.

Table 2: Maximum distances to local DMN marks

Land use	**Rate of deformation** (engineering sheer strain determined in accordance with paragraph 3.2)	**Maximum distance from any point to one local-deformation DMN mark** (km)	**Maximum distance from any point to three local-deformation DMN marks** (km)
Urban	>0.5 µrad/year	3	6
Urban	<0.5 µrad/year	5	10
Rural	>0.5 µrad/year	10	20
Rural	<0.5 µrad/year	n/a	n/a

NOTE 1 'urban land use' means an area where the cadastre comprises primarily class A cadastral surveys, as specified in the Rules for Cadastral Survey 2010

NOTE 2 'rural land use' means an area where the cadastre comprises primarily class B or class C cadastral surveys, as specified in the Rules for Cadastral Survey 2010

1.3 Cadastral control networks

1.3.1 Cadastral horizontal control network

Reference to the standard 3.3

Background

(a) At 1 January 2009, 86 % of cadastral survey datasets (CSDs) met the requirements in 3.3 of the standard.

(b) The rules for cadastral survey require surveys to be connected to the official geodetic datum in most cases. This can be achieved through either CHN control marks or cadastral marks with a Landonline order of 6 or better, typically witness or permanent reference marks.

(c) Specifying the CHN density requirement as a percentage of CSDs with a Landonline order 6 mark provides Customer Services with discretion to place marks where there are currently no Landonline order 6 marks and where cadastral surveys are being carried out.

Guideline

LINZ Customer Services will be deemed to comply with 3.3 of the standard if the following percentages of submitted CSDs that include a witness mark have one or more witness or permanent reference marks that achieve Landonline order 6 or better by the specified dates.

Specified date	Percentage of CSDs that should meet the requirements of the standard
1 January 2010	89 %
1 January 2011	92 %
1 January 2012	95 %
1 January 2013	98 %

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1.3 Cadastral control networks, continued

1.3.2 Cadastral vertical control network

Reference to the standard 3.4

Background

(a) Most CSDs submitted to LINZ do not include heights. Of those CSDs that do include heighted boundaries, many will be defined as 'permanent structure boundaries' which do not require heighted permanent reference marks.

(b) 3.4 of the standard relates to those CSDs that define vertical boundaries in relation to a heighted permanent reference mark in accordance with the rules for cadastral survey.

Guideline

(a) It is likely that CVN marks will be required primarily in urban areas where multi-level developments are occurring or are likely to occur. The number of CVN marks provided in these areas should be sufficient to enable cadastral surveys to be connected to official vertical datums.

(b) To enable the transformation of CSD heights to official vertical datums, the relationships between major unofficial vertical datums and relevant official vertical datums should be determined.

1.4 Basic geospatial network

Reference to the standard 3.5

Background

(a) The purpose of the BGN is to ensure that users, other than cadastral surveyors, are able to efficiently connect to official geodetic and vertical datums. Major uses of this network are to support the registration of aerial- and space-based imagery and to enable consistent mapping of features and objects.

(b) In most parts of New Zealand these requirements will be achieved by the other control networks. Additional marks will probably be necessary only on New Zealand's offshore islands and in the Ross Sea Region.

Guideline

(a) Each basic geospatial network (BGN) mark should be located so that no land within New Zealand's jurisdiction, including its offshore islands and the Ross Sea Region, exceeds the maximum distances set out in Table 3 below.

(b) Customer Services will be deemed to comply with 3.5 of the standard for offshore islands if all existing survey observations are captured and adjusted into Landonline to enable the best currently held survey control system information to be made available by 30 June 2010.

(c) Despite (b), when LINZ carries out other work in the vicinity of an offshore island, BGN marks should be located on that island in compliance with (a) and reviewed in accordance with 10(d) of the standard.

Continued on next page

Guideline, continued

(d) For the purpose of (b) and (c) 'offshore islands' means all islands within New Zealand's jurisdiction and outside its contiguous territorial sea. These islands include:

(i) Kermadec Islands,

(ii) Auckland Islands,

(iii) Bounty Islands,

(iv) Antipodes Islands,

(v) Campbell Island group,

(vi) Snares Islands,

(vii) Solander Islands,

(viii) Mayor Island, and

(ix) White Island (Bay of Plenty).

Table 3: Basic geospatial network mark density

Geographic area	**Maximum distance from any point to one mark** (km)	**Maximum distance from any point to three marks** (km)
Mainland New Zealand including Stewart Island/Rakiura, Chatham Islands, and all islands within the contiguous territorial sea	50	100
Offshore islands within New Zealand's jurisdiction	50	100
Ross Sea Region where LINZ topographic mapping is provided at a scale of 1:100,000 or greater, and other areas as required to meet Government mandated outcomes	100	200

1.5 National height network

Reference to the standard

3.6

This requirement ensures that important precise levelling marks are retained and also to make sure that geometric heights are determined for new marks when they are established. These marks are only required on the North Island, South Island and Stewart Island/Rakiura of New Zealand.

Guideline

(a) The existing coverage of the major precise levelling networks should be maintained at a mark density that meets the requirements of 3.6 of the standard.

(b) Where possible, NHN marks should also be included as part of another survey control network so that heights in terms of the official geodetic and vertical datums can be compared.

2 Connection to international reference frames

2.1 Introduction

Survey observations

Survey observations need to be acquired and processed to determine and monitor the links between official datums and international reference systems.

2.2 Geodetic datum reference marks

Reference to the standard

3.1(a)

Guideline

(a) To determine the link between the official geodetic datum(s) and international reference systems the following activities should be carried out at each GDRM:

(i) observations collected that are of a type, quantity, and quality suitable for inclusion in an IERS determination of an ITRF,

(ii) new coordinates calculated from the observations in (i) at least once a calendar month. These coordinates should be compared to previous values to confirm the stability of the GDRM.

(b) All observations and coordinates acquired in (a) should be retained indefinitely.

2.3 Vertical datum reference marks

Reference to the standard 3.1(b)

Guideline

(a) To determine the link between the official vertical datums and international height systems the following activities should be carried out for each VDRM:

  (i) observations collected to determine the value of absolute gravity with a total uncertainty of less than 3 μGal (at the 95 % confidence level), and

  (ii) the determination of absolute gravity in (i) must be carried out in a way that takes into account the indirect effects of tidal loading present at the VDRM location.

(b) All observations and coordinates acquired in (a) should be retained indefinitely.

(c) The value of absolute gravity at each VDRM should be re-determined at least once every ten years.

3 Monitoring deformation

3.1 National deformation

Reference to the standard

3.2(a)

These requirements ensure that observations collected from national-deformation DMN control marks are processed and analysed to monitor both expected and unexpected changes in the network.

Guideline

(a) National-scale deformation should be determined and monitored using continuously operating reference stations. The following should be carried out for each national-deformation DMN control mark:

(i) observations collected that are of a type, quantity, and quality to comply with the latest version of the chapters of the *IGS Site Guidelines* relating to:

(A) guidelines for all IGS Sites,

(B) IGS Reference Frame Sites, and

(C) guidelines for IGS Sites with GPS/GLONASS Receivers.

(ii) new coordinates calculated from the observations in (i) at least once a calendar month. These coordinates should be compared to previous values to confirm the stability of the national DMN control mark.

(b) All observations and coordinates acquired in (a) should be retained indefinitely.

3.2 Regional and local deformation

Reference to the standard

3.2(b)

These requirements ensure that marks in the DMN are surveyed and that the observations from the surveys are used to update the estimated surface deformation rate for an area.

This also ensures that up-to-date positions of the DMN marks are available if the CHN, CVN, and BGN require re-establishing following a major deformation event.

Guideline

(a) Regional- and local-scale deformation should be determined and monitored using the following procedure.

(i) Determine an initial estimate of regional surface deformation across New Zealand from the best available national present-day deformation model.

(ii) Carry out a survey of marks placed for regional or local deformation monitoring, to enable verification of the deformation predicted in (i). This survey should meet the requirements in Tables 1 and 2 of the standard for regional- and local-deformation DMN control marks.

(iii) Re-calculate surface deformation rates within six months of the receipt of observations under (ii) with those observations collected under 3.1 of this guideline.

(iv) If the rate observed in (iii) is significantly different to the rate predicted in (ii) above then use the higher value of the two rates as the deformation rate for future re-surveys.

(v) Re-survey all regional and local-deformation DMN control marks at a frequency sufficient to monitor the predicted or observed surface deformation within the accuracy tolerances in both Table 1 and Table 2 of the standard, for DMN marks. Evaluate the re-survey period from an assessment of three survey determinations of a mark's position made at an interval sufficient to reliably determine the deformation rate.

(vi) Until the re-survey period can be determined from survey determinations under (v) above, it should not exceed seven years.

(b) Where localised deformation is shown to be too unpredictable to efficiently monitor using the steps in (a)(v), the accuracy should be consistent with the degree of unpredictability.

(c) All observations acquired under this section should be retained indefinitely.

4 Heights

4.1 Ellipsoidal heights

Reference to the standard

3.5

These requirements ensure that ellipsoidal heights are determined for control marks when observations are acquired that allow their calculation.

Guideline

When acquiring three-dimensional observations at a control mark, an ellipsoidal height in terms of the official geodetic datum should be determined for that mark.

4.2 Normal-orthometric heights

Reference to the standard

3.5 and 3.6

These requirements ensure that normal-orthometric heights are either observed from adjacent levelling marks or computed using an official geoid model.

The provision of heights in terms of both the local and official vertical datums is neither mandatory nor prohibited.

Guideline

(a) Normal-orthometric heights should be determined for control marks whenever they are surveyed by or for LINZ.

(b) Heights should be determined using direct height measurements from adjacent marks with existing normal-orthometric heights where the accuracy of the existing height is better than that which can be determined from (d).

(c) Heights determined in (b) should be reported in terms of the same vertical datum as the existing heights.

(d) If the height measurements in (b) are unavailable, the height can be determined using a transformation of the ellipsoidal height determined in 4.1 of this guideline.

(e) Heights determined in (d) should be reported in terms of the official vertical datum.

5 Control marks

5.1 Placement and physical access

Reference to the standard

6.2 and 8

These requirements ensure that marks are located so that they can be used safely and efficiently. Some existing control marks may be located in sub-optimal locations, such as in road formations. If these marks comply with the remainder of the standard then they are still acceptable.

The exemption in 5.1(e) of this guideline only applies to existing control marks. Any other existing mark or survey mark that is upgraded to a control mark should comply with all relevant aspects of this guideline when it is upgraded.

Guideline

(a) To ensure the security and on-going operation of NRF and national-deformation DMN control marks, physical access to the marks by users, including cadastral surveyors, may be restricted.

(b) Regional- and local-deformation DMN control marks should be positioned:

  (i) in locations that enable the detection of regional and local-scale surface deformation, and

  (ii) to ensure ongoing unimpeded and safe access.

(c) CHN and CVN marks should be positioned in locations where cadastral surveyors can easily and safely gain access to them.

(d) BGN and NHN marks should be positioned in locations where users and the general public can readily and safely gain access to them.

(e) Where CHN, CVN, and NHN marks already exist it may not be possible to comply with (c) and (d). Such marks should only be used if there are no compliant alternative marks nearby.

5.2 Mark locations

Reference to the standard

6.2 and 8

These requirements ensure that newly constructed marks are established in locations that enable their use with different technology. While it may not be possible to make GNSS observations from some existing control marks, eg precise levelling benchmarks, they will be acceptable if they comply with the remainder of the standard.

The construction and maintenance of permanent beacons on offshore islands and in Antarctica is not necessary due to their limited use, these marks can be temporarily beaconed by users for specific mapping projects.

The exemption in (b) below only applies to existing control marks. Any other existing mark or survey mark that is 'upgraded' to a control mark should comply with all relevant aspects of this guideline when it is upgraded.

Guideline

(a) Where practical, each control mark should be located to enable the efficient collection of GNSS survey observations from it.

(b) Existing CHN, CVN, and NHN control marks are exempt from (a).

(c) CHN control marks should be located to enable the collection of conventional survey observations both to and from adjacent CHN control marks.

(d) Each BGN control mark within the North Island, South Island, Stewart Island/Rakiura, and all islands within their contiguous territorial sea must be located to enable its use as a reference point for purposes such as aerial photography and remote sensing.

5.3 Mark stability

Reference to the standard 6.3 and 6.4

Guideline

A control mark can be considered stable if the mark cannot be moved in the course of normal surveying activities by more than:

(a) 2 mm, at the 95 % confidence level, for NRF marks,

(b) 3 mm, at the 95 % confidence level, for national- and regional-deformation DMN marks, and

(c) 5 mm, at the 95 % confidence level, for all control marks not included in (a) or (b).

5.4 Mark reference point

Reference to the standard 6.5

Guideline

The reference point of a control mark can be considered clearly defined if it is possible to plumb and measure a height with a repeatability not exceeding:

(a) 1 mm, at the 95 % confidence level, for NRF and national-deformation DMN marks,

(b) 3 mm, at the 95 % confidence level, for regional-deformation DMN marks, and

(c) 5 mm, at the 95 % confidence level, for all control marks not included in (a) or (b).

6 Network accessibility

6.1 Observation of marks

Reference to the standard 8(a)

Guideline

(a) If a control mark is below ground level it should be able to be located using a magnetic metal detector.

(b) Continuous GNSS observations, suitable for post-processing, observed at the following control marks, should be available for download from the LINZ website:

(i) NRF marks,

(ii) national-deformation DMN marks, and

(iii) regional-deformation DMN marks where continuous GNSS equipment is installed on the mark.

(c) Users should be able to physically occupy the following control marks for the purpose of making GNSS or conventional survey observations:

(i) regional-deformation DMN marks not included in (a),

(ii) local DMN marks,

(iii) CHN marks,

(iv) CVN marks, and

(v) NHN marks.

(d) Users should be able to observe the following control marks from afar:

(i) CHN marks with beacons for the purpose of making conventional survey observations, and

(ii) BGN marks within the North Island, South Island, Stewart Island/Rakiura, and all islands within their contiguous territorial sea for overhead imagery identification.

6.2 Beacons

Reference to the standard 8(c)

Guideline

A beacon should only be used for remote observation of a control mark when it:

(a) is easily identifiable as an official survey control structure; and

(b) provides a clearly defined reference point vertically above the control mark that enables:

(i) remote horizontal observations to be made and achieves the accuracy requirements of the networks to which the mark belongs, and

(ii) remote vertical observations to be made and achieve the accuracy requirements of the networks to which the mark belongs.

7 Survey control system information

7.1 Physical mark information

Reference to the standard 9(a)(i)

Guideline

(a) The physical mark information set out in Table 4 should be recorded for each control mark.

(b) The date of verification, calculation, or update, should be recorded for each record in (a).

Table 4: Physical mark information

Record	Definition
mark code	unique mark identifier
mark name	official name of mark
alternative mark name	alternative or historic name or names of the mark, where available
mark type	type of physical mark, eg stainless steel pin, brass plaque
ground level relationship	the height of the top of the mark in relation to ground level
mark details	description of the mark to aid in its identification and location

7.2 Coordinate information

Reference to the standard 9(a)(ii)

Guideline

(a) The coordinate information set out in Table 5 below should be recorded for each control mark, with the following exceptions:

(i) official height and order need only be provided where heights, ellipsoidal or normal-orthometric, have been determined at the mark,

(ii) local heights and order need only be provided where they have been previously published by LINZ or its predecessor departments, and

(iii) historic coordinates and heights need only be provided where they have been previously published on the LINZ website.

(b) The date of verification, calculation, or update, should be recorded for each record in (a).

(c) Where historic coordinates are provided for control marks the classification scheme to which their orders relate needs to be clearly identified.

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8.2 Coordinate information, continued

Table 5: Coordinate information

Record	Definition
mark network	the survey control network or networks to which the mark belongs
official coordinate	latitude, longitude, and ellipsoidal height of the mark in terms of the official geodetic datum
coordinate order	Landonline order of official coordinate
coordinate class	local accuracy, ie class, of official coordinate
coordinate tier	network accuracy, ie tier, of official coordinate
official height	normal-orthometric height of mark in terms of the official vertical datum
height order	Landonline order of official height
height class	local accuracy, ie class, of official height
height tier	network accuracy, ie tier, of official height
local height	normal-orthometric height in terms of a local vertical datum, where available
local vertical datum	vertical datum to which the local height refers
local height order	Landonline order of local height
local height class	local accuracy, ie class, of local height, where available
local height tier	network accuracy, ie tier, of local height, where available
historic coordinate	previous official coordinates in terms of the official geodetic datum, and previous official geodetic datums, where available
historic coordinate order	the Landonline order for each historic coordinate
historic height	previous normal-orthometric heights in terms of official vertical datum, local vertical datums, and previous official height systems, where available
historic height order	the Landonline order for each historic height

7.3 Location information

Reference to the standard 9(a)(iii)

Guideline

(a) The mark location information set out in Table 6 should be recorded for each control mark.

(b) The date of verification, calculation, or update, should be recorded for each record in (a).

Table 6: Location information

Record	Definition
owner or occupier	name of contact person to permit access to and occupation of the control mark. If the mark is located on a 'road reserve' it should be annotated as such, together with the name of the responsible territorial authority or road controlling authority.
telephone number	telephone number of owner or occupier
physical address	physical addresses of all land one must pass through to gain access to the control mark
mark access	description of the access to the mark to aid in its identification and location. The description must include the relationship of the mark to the surrounding topography and other features

7.4 Beacon information

Reference to the standard 9(a)(iv)

Guideline

(a) Where a beacon is present above a control mark, the information set out in Table 7 should be recorded for each control mark.

(b) The date of verification, calculation, or update, should be recorded for each record in (a).

Table 7: Beacon information

Record	Definition
beacon type	type of beacon, eg 2 m beacon, 4 m beacon, pillar
beacon dimension	dimensions of the structure to enable its identification and remote observation
beacon eccentricity	description of any eccentricity of the structure in relation to the mark. This description must quantify the distance and bearing of any eccentricity. It must be stated if the mark is not eccentric.

7.5 Protection structure information

Reference to the standard 9(a)(v)

Guideline

(a) Where a protection structure is present above a control mark, the information set out in Table 8 should be recorded for each control mark.

(b) The date of verification, calculation, or update, should be recorded for each record in (a).

Table 8: Protection structure information

Record	Definition
protection structure type	type of protection structure, eg cast iron cover, marker post
protection structure location	description of relationship of protection structure to the mark