Toitu te Land whenua Information New Zealand

Specifications for Geodetic Hydrographic Control Points

Version 1.1

Customer Services

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Contents

Foreword

These specifications are prepared for the provision of hydrographic control points.

Any comments or proposed amendments should be forwarded to Customer Services – Geodetic.

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SPECIFICATIONS FOR GEODETIC HYDROGRAPHIC PRIMARY CONTROL POINTS

1 Scope

Customer Services, Specialist Processing and Data Management of Land Information New Zealand is charged with the production of hydrographic charts. One component of this process is the provision of geodetic control for the establishment of:

- Electronic Positioning System base stations for positioning the survey vessel offshore;
- Electronic Positioning System monitoring stations;
- tidal reference stations; and
- secondary control points that are required to support the collection of data for hydrographic surveys.

This specification covers the provision of geodetic Order 2000 control to satisfy these hydrographic requirements. These form parts of a set of geodetic standards, specifications, and guidelines developed by Customer Services - Geodetic for geodetic control surveys in New Zealand.

1.1 *Document History*

Version No	Amendments
1.0	Original specification published 30 April 2001.
1.1	November 2006. References to Surveyor-General in the document changed to Customer Services.

2 Introduction

Geodetic control is required for hydrographic surveys for the spatial referencing of offshore hydrographic features in terms of The World Geodetic System 1984 (WGS84).). For practical hydrographic purposes New Zealand Geodetic Datum 2000 (NZGD2000) is regarded as being equivalent to WGS84.

2.1 *Primary Control*

Primary control is required for the establishment of the following Primary shore control points:

- Electronic Positioning System base stations for the positioning the survey vessel offshore;
- Electronic Positioning System monitoring stations to ensure integrity and monitoring of the base station; and
- tidal reference stations to relate tidal records for the determination of mean sea level to ground reference stations.

The following requirements are to be met:

- **Electronic Positioning System Base Station**

Horizontal Accuracy	+/- 5cm (Equivalent of NZGD2000 "5th Order")
Vertical (Spheroidal) Accuracy	+/- 15cm (Equivalent of NZGD2000 "5th Order")
Monumentation	Equivalent of NZGD2000 "3rd Order" (Note. In some circumstances a lower specification of monumentation may be accepted with Customer Services - Geodetic approval).
Documentation	As per standard Customer Services specifications (see following details)

- **Electronic Positioning System Monitoring Station**

Requirement	One monitoring station is required to constantly monitor the integrity of all base stations utilised during the duration of survey operations.
Horizontal Accuracy	+/- 5cm (Equivalent of NZGD2000 "5th Order")
Vertical (Spheroidal) Accuracy	+/- 15cm (Equivalent of NZGD2000 "5th Order")
Monumentation	Equivalent of NZGD2000 "3rd Order" (Note. In some circumstances a lower specification of monumentation may be accepted with Customer Services - Geodetic approval).
Documentation	As per standard Customer Services specifications (see following details)

- **Tidal Reference Stations**

Requirement	Three reference stations are required per tide gauge.
Horizontal Accuracy	+/- 5cm (Equivalent of NZGD2000 "5th Order")
Vertical (Spheroidal) Accuracy	+/- 15cm (Equivalent of NZGD2000 "5th Order")
Vertical levelling (orthometric)	3mm (Equivalent of NZGD2000 "C3 Class of observations")
Monumentation	Equivalent of NZGD2000 "3rd Order" (Note. a lower specification of monumentation a lower specification of monumentation
Documentation	As per standard Customer Services specifications (see following details)
GPS Height Dataset	A 6hr dual frequency, GPS RINEX dataset is required at one reference station to enable an accurate determination of the spheroid/geoid separation at that site. (Note that the data does not require processing by the contractor but must be supplied to Customer Services - Geodetic in RINEX version 2 format)

Where possible existing 5th or higher order Datum 2000 control points shall be used. Where they are used and they comply with these specifications no further work is required. Where new marks are required or existing marks do not comply with these specifications they must be upgraded to meet these specifications.

All primary control work is to be undertaken by a provider accredited by Customer Services - Geodetic for geodetic survey work.

[Note: The procedures documented in this report are the same as for the provision of geodetic control for Customer Services - Geodetic.]

2.2 *Secondary Control*

Secondary Control Points are control points that are not to be used for extending hydrographic control, but are required to support the collection of data for the survey. They may be marks used for local positioning, coastlining, positioning offshore rocks, and positioning navigation aids or marks for confidence checks on vessel positioning.

The following requirements are to be met:

Horizontal Accuracy	+/- 0.5m (Equivalent of NZGD2000 "8th Order")
Vertical (Spheroidal) Accuracy	+/- 1.0m (Equivalent of NZGD2000 "8th Order")
Vertical levelling (orthometric)	+/- 1.0m
Monumentation	Secondary control marks need not be permanently marked, but should be sufficiently marked so that they may be recoverable up to two years after the survey has been completed.
Documentation	As per standard Customer Services specifications (see following details)

Secondary control work may be undertaken by an accredited or non-accredited geodetic survey provider.

3 Secondary Control Marks

This section describes the requirements for secondary control marks that are far less rigorous than for Primary Control Marks.

Secondary Control Marks are control points, which will not be used for extending control, but are required to support the collection of data for the survey. They may be marks used for local positioning, coastlining, positioning offshore rocks and positioning navigation aids or marks for confidence checks on vessel positioning. All secondary control marks are to be named in a systematic fashion and fully described.

Secondary Control Points are to be determined relative to Primary Control Points or other Customer Services - Geodetic 5th or higher order 2000 marks. Stations fixed by GPS using a single static observation or by kinematic techniques are to be considered in this category.

3.1.1 *Station Marking for Secondary Control Points*

Secondary control marks need not be permanently marked, but should be sufficiently marked so that they may be recoverable up to two years after the survey has been completed. (Ground marks could consist of existing or new bolts, pins, and pegs).

Marks may be secured to the foundations of buildings, in holes cut in rock, cemented into concrete blocks or in the ground. In the interests of accuracy, stations shall be ground marked before being observed.

Marks shall be easily located and identified.

On request, a four-character geodetic code will be assigned to each mark by Customer Services - Geodetic.

3.2 *Reporting Requirements*

A ‘Report of Maintenance Work Completed or Required’ file, an Access Diagram and (if required) a Non-Standard Beacon Diagram shall be prepared and supplied for each mark (see section 8.6)

A separate section shall be included in the Geodetic Control Survey Contract Report (see section 9.9) that gives:

- a brief description of the survey carried out and the methodology used;
- a table listing the geodetic code; mark name; NZGD2000 latitude; NZGD2000 longitude; NZGD2000 spheroidal height (leave blank if unknown); and orthometric height (leave blank if unknown).

No other Contract Deliverables are required for Secondary Control Marks.

NOTE: The following sections relate to Primary Control Marks Only.

4 Ground Marks

4.1 *Existing Marks*

Marks must meet 3rd Order 2000 requirements (see section 4.2). In some circumstances a lower specification of monumentation may be accepted with Customer Services - Geodetic approval. Where existing Datum 2000 5th Order or higher marks are used and they do not meet this requirement, e.g. they may be iron tubes, they must be upgraded to meet the requirements in section 4.2.

4.2 *New Marks*

New 3rd Order 2000 marks shall be established and meet the following criteria:

1. Ground marks shall consist of a 10 or 25mm stainless steel pin grouted into solid rock where available else a 25mm stainless steel pin set in a stable concrete block. The concrete block shall measure at least 0.35×0.35×0.5m and be covered by a cast iron protective box and lid where appropriate to protect the mark (see Figures 2 and 3). The concrete block should not protrude above ground level.

2. No form of beacon or mark protection (other than that noted in 1 above), is required.

3. Marks shall be easily located and identified. Marks placed in footpaths or other pedestrian areas shall be placed below or flush with the ground where possible or clearly marked. Marks placed below the ground surface shall be suitably covered (i.e. with a cast iron protective box and lid) so as not to be a hazard and enable easy access.

4. Each new mark is to be assigned a unique Customer Services - Geodetic - defined four character geodetic code. Customer Services - Geodetic will supply codes on request to the Contractor for allocation to those marks requiring codes. Each geodetic code can only be assigned to a single mark within the national geodetic system. [Note. The code for existing geodetic marks shall remain unchanged from the existing code.]

5. The Customer Services - Geodetic geodetic (4 character) CODE assigned to the mark will be shown on an identification plaque attached to the mark, it's concrete surround, or the underside of the iron cover where a protective cover

is used. The identification bronze plaque shall be cast in the form shown in Figure 1 with outside base dimension of 112mm by 63mm. The wording shall be identical to that shown in Figure 1.

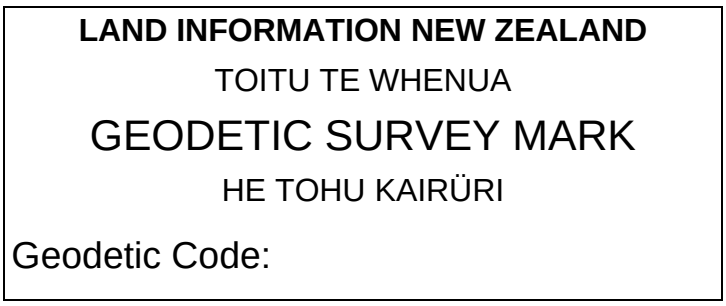

Figure 1: Identification Bronze Plaque

4.2.1 *Mark Naming*

Where an existing survey mark is selected, its existing identification should be used along with its plan number. Note that the use of "OLD" (eg as in OIT I) to prefix a mark is not applied to names in the LINZ Land*online* automation project. The following examples should be followed:

- for a mark called "IT XX DP 2468" that was replaced with a bronze pin due to being found disturbed the name would be "BP SO 1324 (IT XX DP 2468, disturbed)";
- for a mark off a plan referred to as "OIT IV DP 2532" (formally "IT DP 1432") the only name used is to be "IT DP 1432";
- for a mark (eg "IT III DP 2398") that has been renamed (eg "SS 23 SO 2865") the latter name, "SS 23 SO 2865", shall be used as the official name;
- for a mark that has an alternative name (eg geographical location) this name should be entered as the alternative name field.

Mark names must be formatted completely in Upper Case. There must be one and only one space between each of the key elements of the name (eg. IT XI DP 2345).

New marks shall be named by using the full name of the street in which they are located or are adjacent to. If two marks in the same project are located in the same street, the full street name followed by "East", "West", "North" or "South", as appropriate, shall be used to identify such marks. Where new marks are located away from a street an appropriate name should be devised and used. The Contractor shall ensure that such marks are named in this manner and the name of each mark is unique.

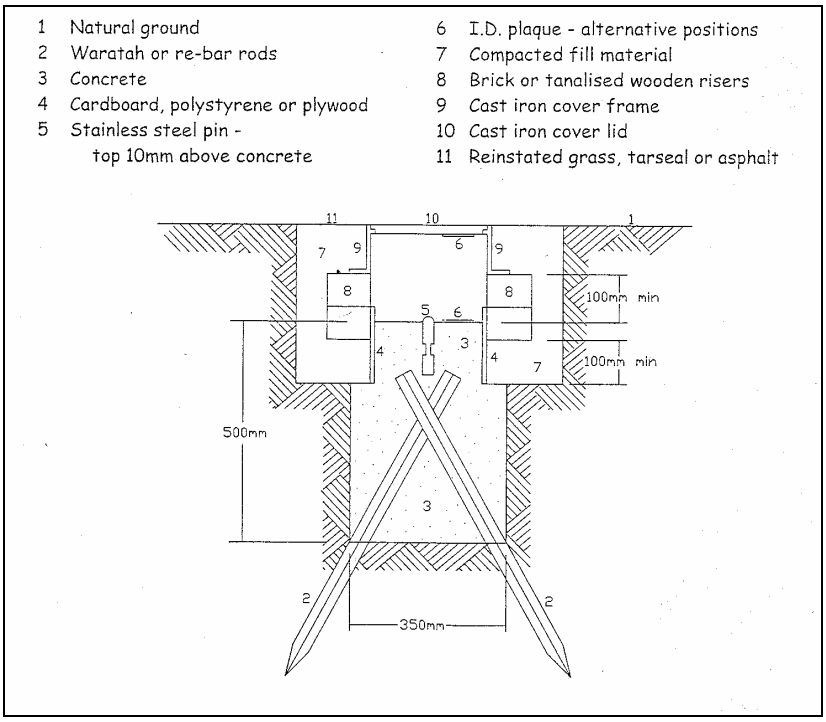

Figure 2. Diagram of a new 2000 Mark[1].

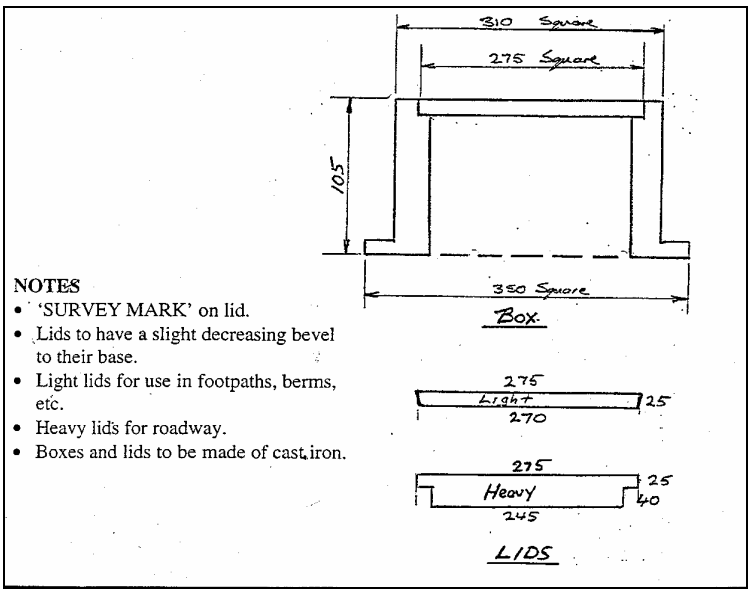

Figure 3. Cast Iron Box and Lid

[1] Note: All measurements are in millimetres
Depth of hole will depend on nature of foundation
ID plaque to be cast into concrete block. Face of ID plaque to be flush with top of block.
Pin to be 25mm stainless steel pin set in concrete.

5 Accuracy

5.1 *Electronic Base and Monitoring Stations*

The accuracy requirements for provision of electronic base and monitoring stations shall be to 5th Order 2000 control standards. These shall meet the following requirements for horizontal class and order:

- **Standards for Class 2000 Observations**

Order	Class	95% Confidence Limit Accuracy Standard	
		Constant - e (mm)	Line length error - p (ppm)
5	M30H	10	30

[1] Although p is a dimensionless quantity, when it is used in the formula below it has the effect of being a ppm accuracy standard, e.g. when p=1 this represents a distance dependent error of 1:1,000,000 or 1 part per million.

The Class of observations identifies the type of survey and the precision of measurements. The precision of the observations is defined by a constant term (**e**) and a distance proportional term (**p**). From these terms the accuracy for an observed vector can be determined by:

$$95\%\ \text{confidence limit} = \pm \sqrt{e^2 + (\text{distance (km)} \times p)^2} \quad \text{mm}$$

5.1.1 *Method of Position Fix*

The 5th order control shall be connected into the 4th or higher Order 2000 network. Position fixes of the control shall be by GPS where possible. Using the RTK method is considered appropriate provided the required accuracy standards are met. All observations must be checked from an independent base station.

Where necessary, conventional survey techniques may also be used.

5.2 *Tidal Reference Stations*

The accuracy requirements for provision of tidal reference stations shall meet the following requirements for horizontal and vertical class and order:

◆ **Standards for Class 2000 Observations**

Order	Class	95% Confidence Limit Accuracy Standard	
		Constant - e (mm)	Line length error - p[1] (ppm)
5	M30H	10	30
Vertical (orthometric)	C3	3	

[1] Although p is a dimensionless quantity, when it is used in the formula below it has the effect of being a ppm accuracy standard, e.g. when p=1 this represents a distance dependent error of 1:1,000,000 or 1 part per million.

The Class of observations identifies the type of survey and the precision of measurements. The precision of the observations is defined by a constant term (**e**) and a distance proportional term (**p**). From these terms the accuracy for an observed vector can be determined by:

$$95\%\ \text{confidence limit} = \pm \sqrt{e^2 + (\text{distance (km)} \times p)^2} \quad \text{mm}$$

5.2.1 *Method of Position Fix*

5.2.1.1 Horizontal Control

The 5th Order control shall be connected into the 4th or higher Order 2000 network. Position fixes of the control shall be by GPS where possible. Using the RTK method is considered appropriate provided the required accuracy standards are met. All observations must be checked from an independent base station.

Where necessary, conventional survey techniques may also be used.

5.2.1.2 Vertical (Orthometric) Control

Orthometric heights shall be fixed to C3 standards using levelling techniques capable of meeting this standard.

6 Assessing Data Accuracy

These tests apply to the horizontal and vertical (spheroidal) (i.e. GPS) data only. [Note: Levelling data should be tested by determining fore and back levelling and circuit misclosures.]

The adjustment software package SNAP (Version 2.14 or greater) shall be used for survey adjustments. Other adjustment packages may be used with prior approval from Customer Services - Geodetic. A copy of SNAP and its associated utilities may be downloaded from the LINZ Internet site.

Where GPS observations are used all baselines shall be processed. Carrying out an absolute accuracy test of the derived coordinates in terms of the higher order marks controlling the survey shall then test these data. This is checked by a constrained adjustment in which the higher order marks controlling the survey are held fixed. [Note: There are insufficient observations to perform a free network adjustment.]

6.1 *Absolute Coordinate Accuracy Test*

The "absolute" accuracy of the coordinates is defined by the *a priori* error ellipses in a constrained adjustment. The test is based upon *a priori* error ellipses in order to be unaffected by possible errors in the coordinates of the higher order constrained marks. The *a priori* errors of the observations in the constrained adjustment should be scaled to ensure the standard error of unit weight for the adjustment equals a value close to and not greater than unity.

The horizontal error ellipses and vertical errors are multiplied by the factors f and h (Table 1) to convert them to 95% confidence limits.

◆ **Table 1: Allowance for Degrees of Freedom**

n	R_{max}	f	h
10	2.80	2.86	2.23
20	3.02	2.64	2.09
50	3.28	2.52	2.01
100	3.47	2.48	1.98
200	3.66	2.47	1.97
500	3.88	2.46	1.96
1000	4.05	2.45	1.96

Note: Values calculated from the degrees of freedom in the free-net adjustment. For degrees of freedom not listed, either calculate using the formulae, or take the smaller of the nearest R_{max} values, and the larger of the nearest f and h values.

The absolute accuracy requirements are met if the horizontal and vertical 95% confidence limits of all marks are less than the value specified in Table 2 for the order of the survey.

◆ **Table 2: Test for the Accuracy of Coordinates** (Specifications for absolute and relative coordinate accuracy)

	Horizontal				Vertical		
	relative (mm)	**relative (ppm)**	**absolute (mm)**		**relative (mm)**	**relative (ppm)**	**absolute (mm)**
5th order	10	30	50		20	100	150

7 Field Procedures

7.1 *5th Order Horizontal Control*

Survey observations are to be undertaken in accordance with good survey practice. All observations shall be independent (eg. When repeating connections between marks, GPS receivers shall be reinitialised). Observation procedures shall be adopted to mitigate systematic errors (eg. plumbing errors and GPS multipath).

7.1.1 *Mark Connections by Observations*

The minimum number of independent connections between the proposed network and the existing network of higher Order 2000 control marks shall be 2. Proposed marks must be connected directly or indirectly by survey observations to existing marks of the same or a higher accuracy order.

The survey network shall be designed in such a way that ALL observations can be checked by a constrained network adjustment.

Each proposed 5th mark shall be connected to a minimum of two independent marks and observations should be separated by a minimum of 15 minutes (i.e. it is not sufficient to have two base stations observed at the same time from a single rover occupation).

7.1.2 *Instrument Centring*

Specific procedures must be adopted and documented so that instrument-centring errors do not go undetected. Tribrachs are to be calibrated at the beginning and end of each observation programme. The procedures and tribrach calibration results shall be documented in the "Field Observation Section" of the survey report (see section 9.9.1). For each Class of observation the accuracy requirements for instrument centring are summarised in Table 3.

◆ **Table 3: Field Observation Standards for Class 2000 Categories for Three Dimensional Observations**

Order	Class	95% Confidence Limit Accuracy Standard	
		Instrument Centring (mm)	Instrument Heighting (mm)
5	M30	5	10

7.1.3 *Instrument Heighting*

For GPS observations procedures must be adopted and documented so that heighting errors do not go undetected. Instrument heights must be recorded and checked by an independent means and recorded on the Field Notes. For each Class of observation the accuracy requirements for instrument heighting are summarised in Table 3.

7.1.4 *GPS Surveys*

Where practical methods should be adopted to reduce the effect of multipath. Such methods may include ensuring that vehicles are not parked within 20m (preferably 50m) of the mark. There is some evidence that very low setups (less than 0.25m above the ground) cause systematic errors due to multipath. To reduce such errors antennas should be set up higher than 0.3m. (Note: for RTK observations it is recognised that this requirement may be difficult to meet, however where possible methods to reduce multipath should be adopted).

Any obvious unavoidable potential multipath sources and sources of radio-electrical interference should be documented on the Field Notes.

Where GPS measurements other than RTK methods are being made the logging interval must be either 15 or 30 seconds to ensure compatibility with permanent tracking stations. If a lesser logging interval is required the interval must be a divisor of 15 seconds, i.e. 1, 3 or 5 seconds and additionally 10 or 15 seconds where 30 seconds is the required standard.

7.1.4.1 GPS Base Stations

Where GPS base stations are employed either as continuous tracking stations (eg Zero Order 2000 marks) or as survey specific, the receiver must be set up over a geodetic survey mark (new or existing). This mark may be used for convenience and may not necessarily form part of the original network design. In this instance, and where the ground mark established or set up over complies with a lower order (eg 5th order standard) than the class of observations would allow (eg for a 3rd order observations), the order of the mark must be shown in the deliverables as the least accurate (eg 5th order). For base stations occupying marks that do not have an assigned geodetic

code, a new Customer Services - Geodetic approved geodetic code is to be assigned. Site details of any such existing geodetic mark must be provided in accordance with Customer Services Specifications for Geodetic Physical Network.

7.1.5 *Conventional Surveys*

Where conventional surveys are used a full description of the methodology used should be documented in the "Field Observation Section" of the survey report (see section 9.9.1).

7.1.6 *Field Notes*

Field notes are not required to be supplied with the contract deliverables for 5th Order 2000 marks. However Customer Services - Geodetic may ask for the record of field notes to be produced for audit purposes. The field notes should include time of observations, heights of instruments, and any potential problems. The Contractor should retain the field notes for 2 years from the date of survey.

7.2 *Orthometric Height Control*

Survey observations are to be undertaken in accordance with good survey practice using levelling techniques suitable to meet the required standard. The three tidal reference stations and the tide pole shall be connected together in a manner to ensure that all observations are checked and comply with the accuracy requirements. Circuit or fore and back misclosures shall be documented in the survey report. The methodology used shall be fully documented in the survey report.

7.3 *GPS Height Dataset*

One of the three tidal reference stations per tide gauge shall be occupied by a dual frequency GPS receiver to obtain a dataset to be used by Customer Services - Geodetic to compute the spheroid/geoid separation at that site. A minimum of one 6-hour GPS dataset shall be recorded at 30-second epochs. This data does not require processing by the Contractor but should be provided to Customer Services - Geodetic in RINEX version 2 format. The methodology used shall be fully documented in the survey report. Special care shall be taken to ensure that no errors go undetected in the determination of the height of the antenna.

8 Contract Deliverables (Mark and Site Details)

Where existing marks are upgraded or new marks are installed the following deliverables are required. [**Note. A separate Index File should be prepared for the survey data deliverables from the mark and site deliverables**.]

Every page of data, every item of hard copy record, every page of every report must have the following information included:

- Hydrographic Project name;
- Hydrographic Contract number; and
- Hydrographic Project number (Note – this equates to the Geodetic Cell Number).

All information relating to the physical network shall be supplied to Customer Services - Geodetic in both **digital and hard copy** formats. The contract deliverables for the mark and site details are:

- Maintenance Summary Report
- Access Diagram
- Non-Standard Beacon Diagrams (if applicable)
- Report of Maintenance Work Completed or Required
- Maintenance Contract Report
- Index File
- Photographs of the Mark and Site
- Any accompanying documents

8.1 *Digital Data – File naming Conventions*

The following codes for naming conventions are to apply for digital files:

AD = Access diagram
BB = Unique 2 Character Contractor code as supplied by Customer Services Geodetic

BD = Beacon Diagram
CODE = Customer Services - Geodetic geodetic code
EXT = Digital file type eg tif, jpg, doc or xls
FFF = Sequential Index File number
MM = Numeric month (of maintenance work)

NNNN = The last 4 digits of the hydrographic project number ((Note – this equates to the Geodetic Cell Number)
V = Sequential number of visit, photo, or for staged deliverables (1,2 etc)
YY = Last 2 digits of the calendar year except where it is used in conjunction with the last 4 digits of the hydrographic project number (NNNN) when YY is the last two digits of the year in which the work was issued.
idx = 'IDX" indicates 'Index File'
m = 'M' indicates 'Maintenance'
p = 'P' indicates 'Photograph'

8.2 *Supply of Digital Data*

The digital data is to be supplied on a CD unless it is more practical to use another Customer Services - Geodetic approved medium where data quantities are relatively small.

Files required to be supplied in a zipped (compressed) format shall be compressed using Customer Services - Geodetic approved software, which currently include PKZIP, WINZIP and LHA.

8.3 *Format of Digital Image Files*

The digital image files are to be supplied in the following format:

Characteristic	Black & White Sheet	Colour Sheet
Scanning resolution	200 dpi	200 dpi
Colours	2	True Colour
Compression Algorithm	None	Quality Factor = 75%
Image type	PNG	JPEG
File extension (EXT)	png	jpg

Original documents to be scanned that can be clearly represented as a black and white image shall be supplied in PNG format. Original colour or grey scale documents that can not be shown clearly in PNG format shall be supplied in JPEG format.

8.4 *Index File*

The Index File contains a list of all the digital files relating to the contract (eg doc, xls, csv, tif, jpg). Information on all digital data files relating to the contract are to be supplied in the following comma delimited format with the header line as shown and followed by one data file per line:

DAFL,DATE,SCNO,CLID,DAFT,COMM

Fields required for each record of this inventory are –

Field Name	Contents	Notes
DAFL	Data File	The name of the data file for which this line of data is associated
DATE	Date	Approximate date relating to the information contained within the Data Dile (DAFL). To be show as Year.Month.Day in NZ Standard Time format yyyy.mm.dd (eg. 2000.06.02)
SCNO	Schedule Number	Schedule Number as issued by Customer Services - Geodetic
CLID	Cell Code	Cell Code as issued by Customer Services - Geodetic
DAFT	Data File Type	MSRX1 Maintenance summary report – xls, excel spreadsheet MSDT1 Mark and site details forms – tif format MWRC2 Report of maintenance work completed – csv, comma delimited file format PHOJ1 Photo – jpg format PHOT1 Photo – tif format ACDP1 Access diagram png format BCDP1 Beacon diagram png format MCRD1 Maintenance contract report – doc, word document MISv1 Miscellaneous data file where v = D for .doc file X for .xls file T for .tif file P for .png file J for .jpg file A for ascii file C for .csv file Z for zipped data (Note. Separate files contained within a zipped file should also be included as separate entries in the index file)
COMM	Comments	Optional comments about the data file

An example file is:

DAFL,DATE,SCNO,CLID,DAFT,COMM
990502M1.xls,1999.03.02,1999205,199920502,MSRX1,Maintenance summary
report
AU509903.tif,1999.03.02,1999205,199920502,MSDT1, Mark and site details
990502M1.csv,1999.03.02,1999205,199920502,MWRC1,Report of maintenance work completed or required
AQ2D99P1.jpg,1999.03.02,1999205,199920502,PHOJ1,Photograph of AQ2D
990502M1.doc,1999.03.02,1999205,199920502,MCRD1,Maintenance contract
report.

The filename format is to be:

BBidxFFF.csv

Eg TLIDX001.csv

8.5 *The Maintenance Summary Report*

A maintenance summary report is to be prepared for each mark upgraded for the survey or new mark installed.

Noting that Primary control marks must meet 3rd Order 2000 standards, the work that may be included in this report is limited to the items in the report template. The details of the work that needs to be completed to establish or upgrade a mark to 3rd Order 2000 standard shall be included as part of the Maintenance Summary Report.

The assessment and details of the work completed shall be recorded on a Maintenance Summary Report for each mark. The Maintenance Summary Report shall be in the form of the following template and supplied in digital and hard copy form. Additional information that will assist the subsequent maintenance works (such as a description of the damage or defect to be repaired) shall be supplied in the comments section. The report shall be supplied digitally in Microsoft Excel format, one worksheet per mark where the worksheet name shall be the geodetic code. The filename format is to be:

YYNNNNmV.xls

Eg 990305M1.xls

◆ **Maintenance Summary Report** (Use form as a template)

MAINTENANCE SUMMARY REPORT			
Mark Geodetic Code: **Mark Name:** **Date of Inspection:**		**Cell Code**: (or Works Order)	
	Work Required Y/N	Work Completed Y/N	Comments
1. Clear growth at the site			
a. Clear tall plants			
b. Clear vegetation			
2. Establish a new mark			
3. Supply and erect a new structure			
a. New post with ID plate			
b. New post & rail enclosure with ID plate			
c. New two metre beacon with ID plate			
4. Maintain an existing mark			
a. Replace an existing mark			
b. Upgrade an existing mark			
c. Stabilise an existing mark			
(i) Mark is loose in the ground			
(ii) Mark is loose in other material			
d. Offset existing survey mark			
e. Supply and fix new ID plaque			
f. Raise or lower cast iron protection cover			
g. Install/replace a cast iron protection cover			
h. Replace a cast iron or concrete lid			
i. Paint a cast iron or concrete lid			
5. Maintain existing structures			
a. Maintain a marker post			
b. Maintain a post and rail enclosure			
c. Paint a two metre metal beacon			
d. Paint a 3 or 4m wooden beacon			
e. Modify a 3 or 4m wooden beacon			
f. Repair a beacon			
g. Paint a benchmark			
h. Paint a pillar			
i. Supply and fix new ID plate			
j. Remove and dispose of unwanted material			
k. Supply and fit mast locking pin			
6. **Additional Information :**			

8.6 *Report of Maintenance Work Completed or Required*

A digital and hard copy report shall be provided of the maintenance work completed. The digital report is to be supplied in the following comma delimited format with the header line as shown and followed by one line per mark:

CODE,NAME,EXMK,MRKT,MRKS,MPSC,PLRF,EDAT,MRKR1,MRKR2, MRKE, GLREL, BCNHGT1, BCNHGT2, BCNHGT3, BCNHGT4,BCNHGT5, BCNHGT6,BDAT,BECC,MRKD,MLOC,PLQEXIST,PLTEXIST,MDAT, MPSM,MPSB,MPSP,MDMK,MDBE,MDPR,OWNR,PHNO,PADD,ARES, GPSU,ADAT,COMM

Fields required for each record of this inventory are -

Field Name	Data Required	Notes
CODE[1]	Geodetic Code	The four letter unique **mark** identifier
NAME[1]	Mark name	Where an existing mark, use its official name from the geodetic database. Where a proposed new mark, use proposed new name.
EXMK[1]	Existing mark	Show 'Y' for existing mark in geodetic database.
MRKT[1]	CRS mark type code	Refer codes in Table 4 below. Note: where a mark is upgraded use the new mark type, i.e. If a Stainless Steel Pin is placed in an iron tube the mark type is Stainless Steel Pin (PIN).
MRKS[1]	CRS mark status code	Refer codes in Table 5 below.
MPSC[1]	Mark physical state code	Refer codes in Table 6 below.
PLRF	Plan references	All survey plans relevant to the mark (maximum of 100 characters). This information should be transferred from existing Mark and Site Details forms (or N7 cards). It is not necessary to research all plans that may have used the mark.
EDAT	Date established	Year.Month.Day format - yyyy.mm.dd
MRKR[1]	Primary mark protection structure type code	Refer codes in Table 8 below Note: Where more than one type of Mark Protection exists for a particular mark, select the most prominent protection type.
MRKR2	Secondary mark protection structure type code	Refer codes in Table 8 below.

MRKE[1]	Mark beacon type code	Refer codes in Table 7 below.
GLREL[1]	Ground level relationship	The height (in decimals of metres) of the ground above (value positive) or below (value negative) the top of the mark.
BCNHGT[3]	Beacon/protection Structure height	See Table 9 for height description.
BCNHGT2[3]	Beacon/protection Structure height	See Table 9 for height description.
BCNHGT3[3]	Beacon/protection Structure height	See Table 9 for height description.
BCNHGT4[3]	Beacon/protection Structure height	See Table 9 for height description.
BCNHGT5[3]	Beacon/protection Structure height	See Table 9 for height description.
BCNHGT6[3]	Beacon/protection Structure height	See Table 9 for height description.
BDAT	Date Beacon Erected	Year.Month.Day format - yyyy.mm.dd
BECC[2]	Beacon Eccentricity	If beacon is found to be central: Add the comment “Central”. If beacon is found eccentric and subsequently made central: Dimension the offset (north/south/east/west (or direction) and distance) with respect to ground mark. Then add the comment “Now central”. If the beacon is found eccentric and not subsequently made central: Dimension offset (north/south/east/west (or direction) and distance) with respect to ground mark. Add the comment “Not central”. The reason for not centring the beacon is to be recorded in the contract report.

MRKD[1]	Mark details	Provide a full description of the ground mark as found, modified or proposed (maximum of 200 characters). Common abbreviations may be used, but spelling and grammar must be correct. There is no need to include information detailed elsewhere in this csv file (eg plaque and plate details), except that details of mark destruction should be included here if applicable. For existing marks: Use mark details from the geodetic database, edit/update details as required and re-supply full description ie add to but don't lose any existing information with the exception that any access information can be deleted and recorded in the MLOC field. Any spelling or grammar errors in existing information should be corrected. If the existing information is all in capital letters, it should be converted to "sentence case".
MLOC[1]	Mark location	A description of the location of the mark with respect to surrounding topography, including access details if off the road (maximum of 2000 characters). Common abbreviations may be used, but spelling and grammar must be correct. Any spelling or grammar errors in existing information should be corrected. If the existing information is all in capital letters, it should be converted to "sentence case".
PLQEXIST[1]	ID plaque exists/installed?	Show E if exists, Y if installed, N if non-existent. If N please explain under COMM.
PLTEXIST[1]	ID plate exists/installed?	Show E if exists, Y if installed, N if non-existent. If N please explain under COMM.
MDAT[1]	Date of maintenance	Date the most recent maintenance work was undertaken or site inspected (Year.Month.Day format - yyyy.mm.dd).

MPSM[1]	Description of mark maintenance completed	Brief description of the mark maintenance work completed. (Note: if no maintenance was required this should be stated).
MPSB[1]	Description of beacon maintenance completed	Brief description of the beacon maintenance work completed. (Note: if no maintenance was required this should be stated).
MPSP[1]	Description of protection maintenance completed	Brief description of the protection structure maintenance work (includes site maintenance) completed. (Note: if no maintenance was required this should be stated).
MDMK	Description of mark maintenance required	Brief description of the mark maintenance work still required.
MDBE	Description of beacon maintenance required	Brief description of the beacon maintenance work still required.
MDPR	Description of protection maintenance required	Brief description of the protection structure maintenance work still required.
OWNR[1]	Owner/occupier of the land	Name of contact person to permit access and occupation of the mark. If in road reserve state 'Road Reserve' (maximum of 100 characters).
PHNO	Phone number	Of owner/contact person.
PADD	Physical Address	Where owner/contact person can be located.
ARES	Access Restrictions	Examples include locked gates, lambing season.
GPSU[1]	GPS Suitability	Refer to suitability codes in Table 10 below.
CELL	Cell phone coverage	Confirm if available at or near site and state the cell phone network access code and provider (eg 027 Telecom, 021 Vodafone)
ADAT	Access Date	Date access notes, or owner/contactor details updated. In yyyy.mm.dd format.
COMM	Comments	Any additional comments including additional protection structures if more than two exist. Note: This field does not get stored in Customer Services – Geodetic databases. Any information which may be of interest to users of the geodetic network should be placed in one of the other descriptive fields.

Notes: [1] Leave blank if not applicableMandatory field for all marks..
[2] Mandatory if the mark is beaconed.
[3] Mandatory if the mark is beaconed EXCEPT where the beacon type is "Non-Standard".

If a field is not mandatory, it should be left blank if not applicable.

The filename format is to be :

YYNNNNmV.csv

Eg 990502M1.csv

◆ **Table 4: MRKT - CRS Mark Type Codes**

CRS Code	Mark Description
IS	Iron Spike, Bridge Spike, Iron Bar, Iron Bolt, Iron Rod, Iron Dog.
IT	Iron Tube, Iron Pipe
LP	Lead Plug
NAIL	Nail
PIN	Stainless Steel Pin (10/25 etc), Bronze Pin (formerly bronze or brass plaque), Steel Pin, Iron Pin
OTHR	Bayonet, Forced Centering, See Description Field
UNMK	Unmarked
UNKN	Not Specified

◆ **Table 5: MRKS - CRS Mark Status**

CRS Code	Mark Status Description
PEND	Pending – Proposed new mark.
COMM	Commissioned - Existing Order 2000 mark that will be connected to as part of the proposed scheme.

◆ **Table 6: MPSC - CRS Mark Physical State Condition**

CRS Code	Condition Description
DEST	Destroyed
DMGD	Damaged
NFND	Not Found
RELB	Reliable
THRT	Threatened
NSPE	Not Specified

◆ **Table 7: MRKE - CRS Mark Beacon Codes**

GDB Code	Description
AA	Cairn
AN	Chimney
LH	Lighthouse
MR	Marine Beacon
MS	Mast
NB	Not Beaconed
ND	Unknown
PL	Pillar
PS	Post
TO	Tower
TT	Transmission Tower
2M	2m Beacon
4M	3m or 4m Beacon

◆ **Table 8: MRKR - CRS Mark Protection Type Codes**

CRS Code	Protection Description
2MBE	2m Beacon
4MBE	3m or 4m Beacon
CICV	Cast Iron Cover
COVR	Cover and Box (eg wooden or concrete)
MKPT	Marker Post
PREN	Post & Rail Enclosure
NOPR	No Protection
NSPE	Not Specified
NSTD	Non Standard Beacon

Note: Where more than one type of mark Protection exists for a particular mark, only one is to be selected from Table 7 for the Report of Maintenance Work Completed or Required. References to other type(s) of Mark Protection are to be made under the field Comments of this same report.

Table 9: BCNHET – Height types

The height (in decimals of metres) of parts of the protection structurebeacon above (+ve) or below (-ve) the top of the ground mark (Fields are to be left empty if the mark is Not Beaconed (code NB) or Non Standard (NS)).

	Beacon	**Pillar**	**For all other Non-Standard Beacons**
Beacon Code	**2M or 4M**	**PL**	**NS**
BCNHGT	Top of mast	Top of Pillarpillar	*Leave all height fields blank*
BCNHGT2	Top of vane panels (target boards)	Top of black strip	
BCNHGT3	Bottom of vane panels (target boards)	Bottom of black strip	
BCNHGT4	Top of alloy head or apex (which ever is appropriate)		
BCNHGT5	Top of side panels (sight boards)		
BCNHGT6	Bottom of side panels (sight boards)		

Table 10: GPSU – Suitability for GPS

Suitability Code	**Suitability Description**
GD	Good: sky visibility (above 15 degrees), no obstructions or activities likely to cause interference (eg microwaves or reflective surfaces)
PR	Poor: Reduced sky visibility, structures that could cause multipath from satellites in some quadrants (ie at certain angles/altitudes)
US	Unsuitable: Major reduction of sky visibility, obstructions and activities likely to cause continuous interference.

8.6.1 *Access and Non-Standard Beacon Diagrams*

The diagrams are to be supplied as PNG images. These images must be square in shape, and the detail must be clearly visible when the image is reduced to 8cm x 8cm.

8.6.1.1 Access Diagrams

Every mark included in the Report of Maintenance Work Completed and Required (csv file) must have an Access Diagram, irrespective of whether it was maintained or

not. If the Access Diagram on the most recent Mark and Site Details form is still applicable, and the content and formatting requirements can be met, it is acceptable to supply this image as the Access Diagram.

The Access Diagrams must:

- Be drawn at a scale appropriate to show features useful in accessing the mark;
- Have a north arrow and be aligned so that the north arrow points up the page;
- Show all topographical features and names useful in accessing the mark, including the geodetic code of the mark;
- Show the relationship of any marker post with respect to the ground mark.

The diagrams must have a filename format of:

*CODE*YYAD.png

eg AU5099AD.png

8.6.1.2 Non-Standard Beacon Diagrams

Every mark included in the Report of Maintenance Work Completed and Required (csv file) which has a beacon type (MRKE) of "NS" must have a Non-Standard Beacon Diagram, irrespective of whether it was maintained or not. If the Non-Standard Beacon Diagram on the most recent Mark and Site Details form is still applicable, and the content and formatting requirements can be met, it is acceptable to supply this image as the Non-Standard Beacon Diagram.

The Non-Standard Beacon Diagrams must:

- Clearly depict the appearance of the beacon;
- Show prominent parts of the beacon, with the height (in decimal metres) of each part above (+ve) or below (-ve) the top of the mark.
- Show the height of the ground (in decimal metres) above (+ve) or below (-ve) the top of the mark.

The diagrams must have a filename format of:

*CODE*YYBD.png

eg AU5099BD.png

8.7 *Photographs of Mark and Site*

'Before' and 'after' colour images shall be supplied in digital form to provide evidence of the work carried out. Where clearly shown the mark and site may be included in one before and one after image. The images shall clearly show the geodetic code of the mark.

Where a site has to be revisited to complete the maintenance required, the 'after' photographs need only be supplied after the second visit when all the maintenance work has been completed.

If, however, no maintenance is required at a particular mark, only one photograph of the mark and of the site (ie two photographs unless one clearly shows the mark and site) need be supplied.

Digital images (see section 8.3 for format) can be generated from either scanning a photo or directly from a digital camera.

The photographs must be vertically aligned for ease of viewing (ie ground at the bottom of the photograph, sky at the top). The photographs must not be digitally altered, except that the geodetic code may be added as text if the code is not visible elsewhere in the image.

The filename format for those photographs taken before maintenance is carried out, the 'before' photographs, shall be combined into one digital image and is to be:

*CODE*YYpV.EXT

Eg AQ2D99P1.jpg

8.8 *Maintenance (Contract) Report*

A report on the contract shall be supplied in Microsoft Word format and must have a header with

- Hydrographic Project Name
- Hydrographic Contract Number
- Hydrographic Project Number

The format for the name of the Contract Report digital file is to be:

YYNNNNmV.doc

Eg 990305M1.doc

The report shall be verified as correct and certified by the Contractor.

The report shall have a short description of the work carried out and any problems or issues encountered.

9 Contract Deliverables (Survey Data)

All information relating to the geodetic control survey shall be provided to Customer Services - Geodetic in digital form. [**Note. A separate Index File should be prepared for the survey data deliverables from the mark and site deliverables**.]

Every page of data, every item of hard copy record, every page of every report must have the following information included:

- Hydrographic Project name;
- Hydrographic Contract number; and
- Hydrographic Project number. (Note – this equates to the Geodetic Cell Number)

Note that the data from GPS Height Dataset made at one of the Tidal Reference Stations should be forwarded separately to Customer Services - Geodetic **in RINEX version 2 format with copies of field sheets and a note explaining the naming convention used.**

9.1 *Digital Data - File Naming Conventions*

The following codes for naming conventions are to apply for directory and data files:

BB	=	Unique 2 character Contractor Identification code as supplied by Customer Services - Geodetic
CODE	=	Customer Services – Geodetic 4 character geodetic code.
EEEEEE	=	6 character alphanumeric code chosen by the Contractor to ensure unique digital filenames for all data supplied to Customer Services - Geodetic as part of the current or any previous contract
FFF	=	Sequential Index File number
NNNN	=	The last 4 digits of the Hydrographic Project number (Note – this equates to the Geodetic Cell Number)
O	=	Order of control. For 5th order 2000 = 5
P	=	Page/sheet number of the scheme plan.
R	=	Mark reliability check image.
V	=	Sequential number of visit, photo, sheet, or for staged deliverables (1,2 etc)
YY	=	Last 2 digits of the calendar year except where it is used in conjunction with the last 4 digits of the hydrographic project number (NNNN) when YY is the last two digits of the year in which the work was issued.
idx	=	'IDX' indicates 'Index File'
s	=	'S' indicates 'Survey'

9.2 *Supply of Digital Data*

The digital data is to be supplied on a CD unless it is more practical to use another Customer Services - Geodetic approved medium where data quantities are relatively small.

Files are required to be supplied in a zipped (compressed) format and shall be compressed using Customer Services - Geodetic approved software, which currently includes PKZIP, WINZIP and LHA.

9.3 *Format of Digital Image Files*

Any digital image files are to be supplied in the following format:

Characteristic	Black & White Sheet	Colour Sheet
Scanning resolution	200 dpi	200 dpi
Colours	2	True Colour
Compression algorithm	CCITT Group 4	Quality Factor = 75%
Image type	TIFF version 6	JPEG
Filename extension (EXT)	tif	jpg

Original documents to be scanned that can be clearly represented as a black and white image shall be supplied in TIFF format. Original colour (eg scheme plans) or grey scale documents that can not be shown clearly in TIFF format shall be supplied in JPEG format.

9.4 *GPS Data*

9.4.1 *Time and Date Conventions*

In all GPS data files, the following conventions are to apply for times and dates :

- All times are to be in terms of UTC.
- Julian day is to be regarded as the day of the year in terms of UTC.
- For any particular session, the Julian day is to be that corresponding to the beginning of the UTC observation period.

Data files commencing before 1200 hours NZST will be one Julian day before those representing observations commencing after 1200 hours NZST.

9.4.2 *Raw and RINEX Data*

No raw or RINEX data is required other than for the 2nd Order Spheroidal Height data which should be forwarded separately to Customer Services - Geodetic.

9.5 *Index File*

The Index File contains a list of all digital files relating to the contract (eg doc, xls, csv, tif, jpg). Information on all digital data files relating to the contract are to be supplied in the following comma delimited format with the header line as shown and followed by one data file per line:

DAFL,DATE,SCNO,CLID,DAFT,COMM

Fields required for each record of this inventory are –

Field Name	Contents	Notes
DAFL	Data File	The name of the data file for which this line of data is associated
DATE	Date	Approximate date relating to the information contained within the Data File (DAFL). To be shown as Year.Month.Day in NZ Standard Time format yyyy.mm.dd (eg. 2000.06.02).
SCNO	Schedule Number	Schedule Number as issued by Customer Services - Geodetic
CLID	Cell Code	Cell Code as issued by Customer Services - Geodetic
DAFT	Data File Type	Five or six-character codes for the data file type. For 5(b) Order 2000 Geodetic Control Survey these codes are: SCHJ1 Scheme plan – jpg format SCHT1 Scheme plan – tif format MDFC1 Mark data file - csv, comma delimited file format TRAC1 Observation data file, traverse data - csv, comma delimited file format HGTC1 Observation data file, height data - csv, comma delimited file format VECC1 Observation data file, vector data - csv, comma delimited file format SNPA1 Adjustment data (Note. provide files in SNAP format) GCRD1 Geodetic Control Survey Report – doc, word document MRCT1 Mark reliability checks – tif format MISv1 Miscellaneous data file where v = D for .doc file X for .xls file T for .tif file J for .jpg file

		A for ascii file C for .csv file Z for zipped data (Note. separate files contained within a zipped file should also be included as separate entries in the index file)
COMM	Comments	Compulsory for a zipped file to show the number of files included within the zip file.

An example file is:

DAFL,DATE,SCNO,CLID,DAFT,COMM
990203S.doc,1999.02.01,1999102,199910203,GCRD1,Control Survey Report
LI00013A.csv,1999.02.03,1999102,199910203,MDFC1, Mark Data File
LI00013B.csv, 1999.02.03,1999102,199910203,VECC1,

The filename format is to be :

BBidxFFF.csv

Eg TLIDX001.csv

9.6 *Mark Data File (Inventory of All Scheme Marks)*

The Mark (Coordinate) Data file contains the NZGD2000 coordinates of all marks (new and existing nodes) stored in the Observation files (section 9.7). The primary link between the Mark Data file and the Observation Data file is the Customer Services - Geodetic 4 character Geodetic Code (*CODE*).

The Contractor is to compile a comma delimited file listing all marks that formed part of the network being surveyed. Higher Order 2000 marks should be listed first followed by the 5(b) Order 2000 marks. Information on all marks is to be supplied with the header line as shown followed by one line per mark:

CODE,MRKS,MRKT,EXMK,DISTRICT,CROD,ORDV1,ORDV2,ORDV3,
NAME,ALTN,COMM

Fields required for each record of this inventory are -

Field Name	Contents	Notes
CODE	Geodetic Code	Customer Services - Geodetic 4 character code
MRKS	CRS Mark Status	A code from the CRS Mark Status table (see Table 9). Relates to the status of the ground mark.
MRKT	Mark Type	A code from the CRS Mark Type table (see Table 10). For proposed new marks use UNMK.
EXMK	Existing mark	Y- existing mark that is in the geodetic database N-to be created and/or is NOT in the geodetic database.
DISTRICT	Land District	A code from the Land District table (see Table 11)
CROD	Coordinate Order	If existing Order 2000 mark, show order of mark. If mark to be upgraded or new mark, show proposed new Order 2000 (see Table 12).
ORDV1	Ordinate Value 1	The NZGD2000 latitude in decimal degrees to 8 decimal places (+ve if north, -ve if south)
ORDV2	Ordinate Value 2	The NZGD2000 longitude in decimal degrees to 8 decimal places (+ve if east, -ve if west)
ORDV3	Ordinate Value 3	NZGD2000 ellipsoidal height shown in metres to 3 decimal places. If unknown leave field blank.
NAME	Mark Name	For existing marks use the original name. For proposed new marks use the proposed new name.
ALTN	Alternative Mark Name	Where there is an alternative mark name include in this field, otherwise leave blank.
COMM	Comments	Optional comments field

An example record is:

CODE,MRKS,MRKT,EXMK,DISTRICT,CROD,ORDV1,ORDV2,ORDV3,
NAME,ALTN,COMM
AP8Y,PEND,UNMK,N,AK,2k5,-37.9565977,177.0086700,209.716,
WHAKATANE,,existing trig station

The filename format is to be:

BBEEEEEE.csv

Eg LI00013A.csv

Coordinates shall be sufficiently accurate to indicate network geometry and are not necessarily final adjusted values.

◆ **Table 9: MRKS - CRS Mark Status**

CRS Code	Mark Status Description
PEND	Pending - Proposed new mark.
COMM	Commissioned - Existing Order 2000 mark that will be connected to as part of the proposed scheme.

◆ **Table 10: MRKT - CRS Mark Type**

CRS Code	Mark Type
IS	Iron Spike, Bridge Spike, Iron Bar, Iron Bolt, Iron Rod, Iron Dog.
IT	Iron Tube, Iron Pipe
LP	Lead Plug
NAIL	Nail
PIN	Stainless Steel Pin (10/25 etc), Bronze Pin (formerly bronze or brass plaque), Steel Pin, Iron Pin
OTHR	Bayonet, Forced Centering, See Description Field
UNMK	Unmarked
UNKN	Not Specified

◆ **Table 11: DISTRICT - GDB Land District Codes**

GDB Code	Land District Name
AA	Antarctica
CH	Canterbury
CI	Chatham Islands
GS	Gisborne
NA	Hawkes Bay
BM	Marlborough
NN	Nelson
AK	North Auckland
OI	Offshore Islands
DN	Otago
HN	South Auckland
IN	Southland
NP	Taranaki
WN	Wellington
HK	Westland

◆ **Table 12: CROD - Coordinate 2000 Order of Mark.**

CRS Code	Coordinate Order Description
2k0	Datum 2000 Zero Order permanent GPS station
2k1	Datum 2000 1st order
2k2	Datum 2000 2nd order
2k3	Datum 2000 3rd order
2k4	Datum 2000 4th order
2k5	Datum 2000 5th order

9.7 *Observation Data File*

There are currently two types of data that can be saved in an Observation Data File. One based on bearings and distances called Traverse data and the second for three-dimensional data such as GPS called Vector Data. The formats of both are described in the following sub-sections.

9.7.1 *Traverse Data*

This traverse data file format is to be used for data that can be represented by a projection bearing (or a direction) and sea-level distance.

The filename format for the Traverse Data file is to be :

BEEEEEEE.csv

Eg LI000005.csv

The traverse data is to be supplied in the following comma delimited format with the header line as shown and followed by one observation per line:

FCODE,TCODE,DATE,TIME,BGD,BGM,BGS,DIST,ROBG,COSY,COMM

Fields required for each record of this inventory are -

Field Name	Contents	Notes
FCODE	From Code	Geodetic code for instrument mark
TCODE	To Code	Geodetic code for target mark
DATE	Date	Year.Month.Day in NZ Standard Time (eg yyyy.mm.dd; 2001.02.26)
TIME	Time	Hour.Minute in NZ Standard Time expressed in terms of a 24 hour clock (eg hh.mm; 09.05)
BGD	Bearing Degrees	Degrees component of the Bearing
BGM	Bearing Minutes	Minute component of the Bearing
BGS	Bearing Seconds	Second component of the Bearing (show up to 2 decimal places)
DIST	Distance	Distances in metres (show up to 4 decimal places)
ROBG	Class	Class of survey observations (see Table 12)
COSY	Coordinate System	A code for the horizontal coordinate system. It is expected that for this contract 'NZGD2000' will be used.
COMM	Comments	Optional comments field

Note: Where the TIME of observations cannot be extracted from a survey plan or is not known then show the DATE which best represents the data on the plan and either put 0.00 in the TIME field or leave it blank.

An example file is:

FCODE,TCODE,DATE,TIME,BGD,BGM,BGS,DIST,ROBG,COSY,COMM
AP8Y, AP8Z, 1999.12.25, 23.59, 132, 46, 12.5, 420.78,M30,NZGD2000,

9.7.2 *Height Data*

The height data file format is to be used for data that can be represented by a reduced difference in elevation between two points.

The filename format for the Height Data file is to be :

BBEEEEEE.csv

Eg LI000003.csv

The height data is to be supplied in the following comma delimited format with the header line as shown and followed by one observation per line:

FCODE,TCODE,DATE,TIME,DHGT,LVDIST,ROBG,COMM

Fields required for each record of this inventory are -

Field Name	Contents	Notes
FCODE	From Code	Geodetic code for instrument mark
TCODE	To Code	Geodetic code for target mark
DATE	Date	Year.Month.Day in NZ Standard Time (eg yyyy.mm.dd; 2001.09.26)
TIME	Time	Hour.Minute in NZ Standard Time expressed in terms of a 24 hour clock (eg hh.mm; 09.05)
DHGT	Difference in Height	Orthometric height of "to" station minus the orthometric height of the "from" station expressed in metres to 4 decimal places.
LVDIST	Levelling distance run	Horizontal distance levelled expressed in metres to the nearest metre.
ROBG	Class	Class of survey observations (see Table 13)
COMM	Comments	Optional comments field

Note: Where the TIME of observations cannot be extracted from a survey plan then show the DATE which best represents the data on the plan and either put 0.00 in the TIME field or leave it blank.

An example file is:

FCODE,TCODE,DATE,TIME,DHGT,LVDIST,ROBG,COMM
AP8Y, AP8Z, 1999.12.25, 23.59, 465,-6.4534, C3,

9.7.3 *Vector Data*

This vector data file format is to be used for data that can be represented in terms of a three dimensional earth centred Cartesian coordinate system (such as NZGD2000 or WGS84). This vector format should be used for GPS data.

The filename format for the Vector Data file is to be :

BBEEEEEE.csv

Eg LI00013B.csv

The three dimensional vector data is to be supplied in the following comma delimited format with the header line as shown and followed by one observation per line:

FCODE,TCODE,DATE,TIME,dX,dY,dZ,ROBG,COMM

Fields required for each record of this inventory are -

Field Name	Contents	Notes
FCODE	From Code	Geodetic code for receiver 1
TCODE	To Code	Geodetic code for receiver 2
DATE	Date	Year and Julian day of year (eg yyyy.ddd; 2001.034)
TIME	Time	Hour.Minute in UTC expressed in terms of a 24 hour clock (eg hh.mm) at the start of the session
dX	Delta X	Delta x in metres (show up to 6 decimal places)
dY	Delta Y	Delta y in metres (show up to 6 decimal places)
dZ	Delta Z	Delta z in metres (show up to 6 decimal places)
ROBG	Class	Class of survey observations (see Table 13)
COMM	Comments	Optional comments field

An example record is:

FCODE,TCODE,DATE,TIME,dX,dY,dZ,ROBG,COMM
1163, A79B, 1999.359, 12.59, -12440.912, -7725.093, 12799.139,M30,

◆ **Table 13: ROBG - CRS Class of Survey Observations**

CRS Code	Class of Survey	Horizontal Order of Mark	Vertical Order of Mark
B10	B10	0	
B30	B30		0
B100	B100	1	
B300	B300		1
M1	M1	2	
M3	M3	3	2
M10	M10	4	3
M30	M30	5	4
M100	M100	6	5
M300	M300		6
C1	C1		
C3	C3		
C10	C10		

Note: For 5(b) Order 2000 control use M30.

9.8 *Adjustment Data.*

All the observation data files are to be supplied in a constrained adjustment of the entire network.

9.8.1 *SNAP Adjustment Software*

Unless Customer Services - Geodetic gives prior approval, SNAP Version 2.14 or greater shall be used to carry out adjustments. The following SNAP input and output adjustment files for a constrained adjustment are to be supplied with the specified filename conventions:

Constrained Adjustment:

BBCONNNN.cmd	SNAP Command file
BBCONNNN.crd	SNAP Coordinate file
BBCONNNN.lst	Listing file produced by SNAP
BBEEEEEE.dat	SNAP Data file (Note. Not the same format as the observation data file)

Where C is for Constrained.

The formats of the contents of these files are to meet the SNAP specifications.

A copy of SNAP and its associated utilities are available on the LINZ web site.

9.8.2 *Non-SNAP Adjustment Software*

Prior approval is required from Customer Services - Geodetic if an adjustment programme other than SNAP is to be used. This approval will also state the format the adjustment files needs to be provided in.

9.9 *Geodetic Control Survey (Contract) Report*

A brief report on the contract shall be supplied in Microsoft Word format and must have a header with

- Hydrographic Project name;
- Hydrographic Contract number; and
- Hydrographic Project number. (Note – this equates to the Geodetic Cell Number)

The format for the name of the Contract Report digital file is to be:

YYNNNNs.doc

Eg 990203S.doc

The report shall be verified as correct and certified by the Surveyor in Charge and should contain as a minimum the following sections.

9.9.1 *Field Observation Section*

This section shall include the following:

- a brief summary of the office planning and field campaign for the survey and any problems;
- a list of personnel involved in the survey and their function in the survey;
- a list of the equipment used on the survey including their system/configuration number, type of equipment, receiver specifications and characteristics, serial number of receivers, antennae, tribrachs and adapters;
- a description of the datum and coordinate system used for the survey;
- a list of the names and geodetic codes for the geodetic control marks involved in the survey;
- a diagram of the network observed that shows each mark involved, its name and the vectors that were observed (Note. where RTK observations have been made it is not necessary to show all vectors. Base stations occupied and a selection of vectors to indicate the general survey is sufficient);
- a description of the methods adopted to meet the specifications;
- a summary of calibrations carried out;
- a brief diary of field events and activities;
- where levelling forms have been used these should also be included in this section.

9.9.2 *Processing Section*

This section is to explain the processes used to reduce the observed baselines (ie. computing the vectors between GPS marks) and shall include (Note: that for RTK processing a brief description of methods used is sufficient):

- details of the software used and the parameters used for baseline processing;
- details of any data eliminated or corrected during processing with explanation;
- alterations to data (e.g. corrections to the geodetic code or mark name, non-use of certain satellites or epochs of data, etc).

9.9.3 *The Adjustment Section*

This section is to explain the processes used to adjust the baselines (vectors) and shall include:

- details of the software used;
- the parameters used for the adjustment and a list of the fixed marks;
- details of any data eliminated from the adjustment, with explanation;
- proof that the Order 2000 standards for coordinates have been met.

9.10 *Plan of Completed Scheme*

The Contractor shall supply two hard copies and one digital copy of a completed scheme plan.