Toitu te Land whenua Information New Zealand

Standards for Hydrographic Surveys (HYSPEC) v3

TH Standard 31

National Topographic/Hydrographic Authority

24 April 2001

Contents

Record of Changes

Version	Date	Amendment
Original	20th February 1998	
V2.0	10th January 2000	Re-Format of document in line with LINZ standards. Amendments to sections: Introduction; Scope; 1.3; 2.1; 2.2; 2.3; 2.4; 2.7; 2.8; 2.10; 2.11; 2.12; 2.13; 2.16; 2.17; 3.1; 3.2; 3.3; 1.1; 1.1; 4.2; 4.3; 4.4; 0; 0; 1.1.1; 5.8; 5.11; 5.11; 8.1; 8.4; 8.5; 9.1; 9.5; 10.3; 10.4 10.4.1.2.8; 10.4.5.1; 11; Annex A; References Minor amendments to other sections.
V 3.0	24th April 2001	Incorporation of superseded LINZ document "*Hydrographic MBES Survey Standards – TH 23 v2.2* 6th March 2000 LINZ" including separation of single-beam and multi-beam echosounder requirements into sections 6 & 7 respectively. Incorporation of superseded LINZ document "*Hydrographic Survey Digital Data Formats – TH 33* 6th March 2000 LINZ" Reorganising and updating of geodetic requirements to refer to the new LINZ Standard "*Specifications for Geodetic Hydrographic Control Points*. LINZ OSG" in place of the three LINZ OSG standards that used to apply. Major changes to section 10.4.5 "The Standard Sheet" Updating of sections 4.3 4.4 & 4.5 (Quality and Calibration of Positioning Sensors). Updating of sections 5.6 & 6.8 (Examinations and Disproving Searches). Updating of section 5.12 (Sound Velocity) to clearly state where and when SV should be measured and applied.

		Incorporation of new requirements for naming of underwater features in section 9.6. Correction of error in Transfer of Sounding Datum Form (Annex A) Requirement added for "Quality Assurance Data Pack" (Section 10.4.4) Requirement for 100% correlation between Standard Sheets and "Plotted Sounding" records in HTF files (Section 11.2.2) Minor amendments to many other sections.

Note: The following two documents have been cancelled and incorporated into this new version of HYSPEC:

Hydrographic MBES Survey Standards (TH Standard 23) – LINZ

Hydrographic Survey Digital Data Formats (TH Standard 33) - LINZ

1 PREAMBLE

1.1 *Introduction*

This *Standards Document* is issued to detail the requirements for hydrographic surveys undertaken on behalf of Land Information New Zealand.

This *Standards Document* is a generic document and is to be used in conjunction with the relevant project-specific *Contract Document* to give complete guidance for the undertaking of any particular project.

Hydrographic survey work undertaken for LINZ shall never be of a lower standard than that detailed in "*Standards for Hydrographic Surveys SP 44* IHO".

The contractor should be familiar with the publications listed in the Reference section at the end of this document together with any existing survey records for the area under consideration.

Any instructions or specifications which conflict with those issued in survey contracts, or any proposals for improvements to this document should be drawn to the attention of:

The Chief Hydrographer/Topographer
National Topographic Hydrographic Authority
Land Information New Zealand
Private Box 5501
WELLINGTON, NZ

Phone: 64-4-460-0136
Fax: 64-4-471-6894
Email: hydro-info@linz.govt.nz
URL: http://www.linz.govt.nz

Certified as National Topographic/Hydrographic Authority specification:

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Chief Topographer/Hydrographer

24th April 2001

STANDARDS FOR HYDROGRAPHIC SURVEYS (HYSPEC) V3

1.2 *Scope*

This *Standards Document* is the authoritative reference for the undertaking of hydrographic survey work for LINZ.

1.3 *Related Standards*

The following publications must be read in conjunction with this standard. The most recent versions of the following documents at the time of contract signing apply:

1. *Standards for Hydrographic Surveys SP 44* IHO
2. *Specifications for Geodetic Hydrographic Control Points.* LINZ OSG
3. *Views for Sailing Directions NP140*
4. *Hydrographic Transfer Format Version 2.02 Technical Specification* Royal Australian Navy Hydrographic Service
5. *Admiralty Manual of Hydrographic Surveying Chapter 2 (Tides and Tidal Streams) – NP 134 b (2).* Admiralty 1969
6. *Symbols, Terms and Abbreviations used on Charts NZ201* LINZ

Note: All LINZ publications detailed above are published at the LINZ web-site: http://www.linz.govt.nz/ or are available from LINZ, Wellington.

Note2: *Hydrographic Transfer Format Version 2.02 Technical Specification* is available on the AHO web-site: http://www.hydro.navy.gov.au/news/htf/htf.pdf

1.4 *Symbols & Abbreviated Terms*

Table 1

AMHS	Admiralty Manual of Hydrographic Surveying
BM	Benchmark
C-O	Correct minus Observed
CM	Central Meridian
CTD	Conductivity / Temperature / Depth
DGPS	Differential Global Positioning System
DOP	Dilution of Precision
EPF	Electronic Position Fixing
FPK	Field Population Key
GIHS	General Instructions for Hydrographic Surveyors
GPS	Global Positioning System
HTF	Hydrographic Transfer Format
HYSPEC	Standards for Hydrographic Surveys (TH Standard 31)
IHO	International Hydrographic Organisation
LAT	Lowest Astronomical Tide
LINZ	Land Information New Zealand
LOP	Line of Position
MBES	Multi-Beam Echosounder
MHWS	Mean High Water Springs
MILES	Nautical Miles
MSL	Mean Sea Level
NTHA	National Topographic/Hydrographic Authority (LINZ)
NZGB	New Zealand Geographic Board Ngä Pou Taunaha o Aotearoa

PA	Position Approximate
QC	Quality Control
RMSR	Root Mean Square Residual
ROS	Report of Survey
SBES	Single Beam Echosounder
SIC	Surveyor in Charge
SV	Sound Velocity
SVP	Sound Velocity Probe
TM	Transverse Mercator
TPE	Total Propagated Error
UTM	Universal Transverse Mercator
XBT	Expendable Bathythermograph

2 GENERAL PRINCIPLES

2.1 *Project Nomenclature*

1. Survey contracts or projects issued by LINZ will state the following three identifiers:

   Project Name: Danger Island Survey
   Contract Number: 97/98 - 5HS
   Project Number: 1007

2. Every page of data, every item of hard-copy record, every item of electronic media and every page of every report rendered for a hydrographic survey is to be labelled with the above three fields to aid in identification.

3. Similarly, the title page of every rendered document together with every item of electronic media and every rendered graphic (e.g. standard sheets) is also to be labelled with "Crown Copyright Reserved"

2.2 *Liaison With Local Authorities*

1. The Contractor is to contact and inform relevant national and local authorities well in advance of any intended survey work ashore and afloat. The Contractor is to confirm with LINZ the level of contact that has been made prior to awarding of the contract. The local harbour authority should be consulted at all stages of the planning and execution of any harbour surveys.

2. Where survey operations require the use of facilities or access or entry to Wildlife or Marine Reserves, the Contractor is to contact the relevant Department and obtain approvals for any landing and activities prior to commencing the work.

3. Any approvals, permits, proposals etc. given or obtained for the undertaking of the survey are to be copied to LINZ.

2.3 *Access to Private Land*

1. All Contractors are to obtain permission from the owners and/or relevant authorities before permanent or temporary surveying marks are erected, or any equipment is placed on private, populated, restricted or sensitive property. Arrangements are to be made to remove all equipment and temporary marks on completion of the work.

2. In planning hydrographic surveys, the seeking of approval to occupy private land is the responsibility of the Contractor. If the rightful owner of any property cannot be established within a reasonable time, and establishing the site without delay is essential for the conduct of the survey, then the local police should be given full particulars and requested to inform the owners of the land.

3. Prior approval is always to be obtained before erecting surveying marks of any sort on structures maintained by the various lighthouse and harbour authorities, who are also to be informed when the marks have been removed. Care is always to be exercised whenever it is necessary to visit lighthouses, navigational beacons, etc., that the functioning of such navigation aids (nav-aids), is in no way affected.

4. Any approvals, permits, proposals etc. given or obtained for the undertaking of the survey are to be copied to LINZ.

2.4 *Frequency Clearance*

1. It is the contractor's responsibility to ensure that all radio-transmitting devices utilised during the undertaking of the contract have been granted frequency clearance by the relevant authorities.

2.5 *Original Documents*

1. The term 'Original Documents' is used to describe the various Fair Sheets, maps, geodetic schemes, digital records, reports, etc that exist from previous surveys. In normal circumstances only copies are supplied to Contractors. The greatest care is to be taken of all 'Original Data' received on loan, and special attention is to be paid to their careful preservation. When a survey is completed, all 'Original Data ' pertaining to that survey is to be returned to the originating authority without delay.

2. No additions or amendments are to be made to any 'Original Data'. Under no circumstances are original digital records ever to be altered; if an amendment is necessary, a copy of the original is to be taken and the alteration made to this copy. The amended copy is to be clearly marked as such.

2.6 *Transmission of Survey Data*

1. Whenever Original Data, survey records, Standard Sheets, digital survey records, or material of a similar unique, sensitive or delicate nature are

transferred between two parties, proper measures are to be taken to ensure safe, secure and economic transfer.

2. Digital data such as computer disks and tapes must be wrapped in foil prior to packaging and the outer package must provide details of the enclosure. Under no circumstances, must digital data be allowed to pass through airport x-ray devices.

3. All hard-copy and digital data must be transported in crush-proof, water-resistant containers.

2.7 *Hydrographic Books and Forms*

1. It is the responsibility of the Contractor to provide appropriate hydrographic books and records for use throughout the survey to ensure an audit trail exists for all data collected. Where relevant data are collected, copies of the forms enclosed in Annex A of this document must be completed and rendered.

2.8 *Digital Surveying Systems (Hydrographic Software Packages)*

1. The operation of Digital Surveying Systems is to be in accordance with the Contractor's system operating manuals. As a minimum however, backups of raw data are to be made at the end of each working day and stored in a fire-proof safe. Regular backups of processed survey data are also to be made.

2.9 *Survey Planning*

1. The Contractor will provide details of survey planning including: methodology, processing and equipment in the tender response.

2.10 *Scale*

1. LINZ will specify in the contract document a scale at which the graphical data and Standard Sheets of the survey are to be rendered.

2. The scale to be used for shoal examinations and disproving searches will be at the discretion of the Surveyor-in-Charge (see sections 5.5; 5.6 and 6.8). The scale must be large enough to allow such close examination that the feature cannot escape detection and will be dictated by the type of bottom, the depth of water and the echosounder footprint. It must not be less than that of the

largest scale standard sheet or chart. The need to locate and show all significant bottom features must be the guiding principle. Such searches, whether or not the reported shoal has been located, must result in the forwarding of a tracing, at a suitable scale, showing the area covered by the search, the sounding density and the soundings obtained.

3. When utilising a multibeam echosounder for shoal investigation or disproving searches, the Surveyor In Charge must ensure that ping density is such that the chance of a danger escaping detection is remote. This may necessitate performing sounding at slower speeds and greater swath overlaps than for standard survey lines.

2.11 *Positional Control*

1. The method, or methods, to be used for positional control during a survey will be specified in the project contract document.

2.12 *Surveying Accuracies*

1. Positional and vertical accuracies will be specified in the contract document. The specifications in sections 4.1; 6.1 and 7.2 detail the minimum accuracy requirements which are to be used in the absence of any other guidance.

2.13 *Geodetic Control*

1. The contract will specify the horizontal datum, projection and grid to be used for a survey.

2. Geodetic control is to be in accordance with the LINZ specification, "*Specifications for Geodetic Hydrographic Control Points.* LINZ OSG" (refer to "Related Standards")

3. The survey contract will usually require that a number of Primary and Secondary Shore Control Points be established for the conduct of the survey. Definitions of these terms and details of requirements are outlined in section 3.2 and 3.3.

2.14 *Tidal Datums and Tidal Data*

1. The datum to which depths are to be reduced is fundamental to any bathymetric survey and the contract document will contain details of how this is to be established. Where the relationship between tidal levels and the land survey datum is known, precise details will generally be supplied, together with descriptions of suitable benchmarks. Elsewhere, it may be necessary to establish sounding datum by observation, and due allowance for this must be made when planning the survey. If observations are necessary, the datum must be related to the local land survey datum through existing or newly-established benchmarks.

2. Tidal observations, tidal stream and current measurement requirements will be specified in the contract.

2.15 *Verification of Charts and Publications*

1. During the execution of the contract every opportunity should be taken to verify the adequacy or inadequacy of existing published charts and documents of those areas in which surveys are being carried out.

2. When examining the detail on a published chart, attention should be paid to whether land features are visible from seaward (or even whether they still exist), to the prominence or otherwise of objects described as 'conspicuous' and to whether major changes have taken place in built-up areas.

2.16 *Time and Date*

1. All times rendered to LINZ in written or electronic format are to be UTC (Universal Time Co-ordinated).

2. All dates are to be quoted in terms of the Julian Calendar.

2.17 *Surveyor-In-Charge*

2.17.1 *Approval of SIC*

1. A Surveyor In Charge (SIC) of the project is to be approved by LINZ prior to commencement of the project. Such approval will involve a review of the individual's hydrographic surveying experience, qualifications and references.

2. As a minimum, the nominated SIC is to have passed an approved IHO Category A Hydrographic Survey Course with a specialism in Nautical Charting or equivalent and have at least five years field experience supported by evidence and references which imply that they are capable of meeting the requirements of a hydrographic survey for nautical charting. Equivalency to "Category A" is to be documented by a certificate issued by the IHO/FIG stating equivalency.

3. Additionally, if multi-beam sonar is to be utilised for the survey, the SIC is to have completed professional training in the principles and operation of MBES. Such training is to be at least equivalent to the courses run by the University of New Brunswick. The SIC must also provide evidence of at least two years' field experience that includes use of MBES.

2.17.2 *Responsibilities of Surveyor In Charge*

1. The SIC is responsible for, and must be involved in, all aspects of the work required for the survey including planning, preparation, conduct, rendering and approval.

2. The SIC may not be replaced or substituted without the prior written approval of LINZ

3. The SIC is to validate all data and document the quality control that has been undertaken

4. The SIC is to sign final data, reports and graphics before they are rendered or accepted by LINZ. This signature is an acceptance of liability and approves the use of the data for chart compilation.

2.17.3 *SIC Acknowledgement and Specimen Signature*

1. Prior to any work commencing the SIC is to provide to LINZ a written statement and specimen signature which includes the following details and text:

   Surname: Christian Names

   Signature: Date:

   Contact Details:

   Witnessed by: Name:

   Date:

   I …….. (named SIC)……. Acknowledge that in signing my signature above, I understand the requirements of the hydrographic survey project ……. (Project Name & Number) and that

use of my signature on any documents produced as part of the contract implies that ……..…….

(Company) accept responsibility for; the conduct of the survey, the accuracy and integrity of the data, the quality of the rendered documentation and graphics and any liability that may arise.

3 SURVEYING OPERATIONS ASHORE

3.1 *Geodetic Datums*

1. Shore-based geodetic hydrographic control surveys in New Zealand are to be carried out in terms of NZGD 2000 (see "*Specifications for Geodetic Hydrographic Control Points.* LINZ OSG"). Note that for practical purposes, WGS'84 and NZ Geodetic Datum 2000 can be regarded as the same at the decimetre level. All hydrographic survey work at sea is to utilise WGS'84 datum.

2. Vertical geodetic datum will normally be referred to chart datum, Lowest Astronomical Tide (LAT), or Mean Sea Level (MSL). However, depending on the type of geodetic observations undertaken and the particular use of the station, WGS84 spheroidal heights are often more appropriate. Care should be taken to ensure that geodetic heights used throughout the survey are related to the correct datum.

3. In New Zealand, many charts or maps are still based on the New Zealand Geodetic Datum (NZGD49) which uses the International (Hayford) Spheroid. This spheroid is defined by the following parameters:

Semi-major Axis (a)	6378388 metres
Semi-minor axis (b)	6356911.946 metres
Compression (f)	1/297
Geodetic Latitude	41^{o} 19' 08.9" South
Geodetic Longitude	175^{o} 02' 51.0" East

4. Prior to the use of GPS as a surveying tool, hydrographic surveys around New Zealand were undertaken on imperial North and South Island National Grids. In recent times these were metricated for use by the Royal New Zealand Navy (RNZN). These grids are based on Transverse Mercator Projections on the New Zealand Geodetic Datum (NZGD 49). The New Zealand Map Grid is not used for hydrographic surveying as there are significant scale distortions offshore.

5. Where existing data and new surveys overlap, conversion between datums will be required. The parameters of the North Island and South Island National Grids are as follows:

Table 3 – (Datum is NZGD 49, Projection is TM)

	NING	SING
True Origin	39^0 00’ 00” South 175^0 30’ 00” East	44^0 00’ 00” South 171^0 30’ 00” East
False Easting	274319.523 metres	457199.205 metres
False Northing	365759.364 metres	457199.205 metres
Central Meridian	175^0 30’00” East	171^0 30’00” East
Scale Factor on CM	1.0	1.0

6. LINZ Contracts require the use of the WGS 84 Datum for all survey work at sea. The WGS 84 reference spheroid parameters are as follows:

   Semi-major Axis (a) 6378137 metres

   Semi-minor Axis (b) 6356752.3142 metres

   Compression (f) 1/298.257223563

7. UTM Grid. The UTM grid is on a transverse Mercator projection covering the entire world in zones of six degrees of longitude. The parameters are as follows:

   True Origin 0^0 00’ 00” North

   Any odd multiple of 3^0 longitude

   False Origin 500000 m west of the true origin

   10000000 m south of true origin (if Sth of the equator)

   Central Meridian is the CM of the chosen zone

   Scale Factor on CM 0.9996

8. Contracts will specify the grid to be used. In some cases this will be a “Special UTM” Grid to ensure that the CM is close to the survey area.

9. Datum Transformation Parameters. Current parameters for a datum transformation (Helmert’s Method using 7 parameter shift) are as follows:

   NZGD49 to WGS84

Shift X:	+59.470m
Shift Y:	- 5.040m
Shift Z:	+187.440m
Rotation X:	-0.4700”
Rotation Y:	+0.1000”
Rotation Z:	-1.0200”
Scaling:	-4.6000ppm

10. For a WGS84 to NZGD49 transformation, the signs are reversed.

11. The contractor should note that certain software uses reverse sign notation for some of the above parameters. It is the contractor’s responsibility to test which sign convention applies. A worked example is available in the LINZ Technical Report *Recommended Transformation Parameters from WGS’84 to NZGD49* (See References) which is available at the LINZ Web Site.

3.2 *Primary Geodetic Control Points*

1. Primary Control Points are those marks established for each Electronic Position System Base Station, Reference Station, Integrity Monitoring Station, Tidal Station Bench Mark and any other marks used as a base from which control for the survey is extended. This includes existing LINZ trigs used to extend control or tie in observations.

2. Primary geodetic control points are to be in accordance with "*Specifications for Geodetic Hydrographic Control Points.* LINZ OSG" (See “Related Standards”)

3.3 *Secondary Geodetic Control Points*

1. Secondary Control Points 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 established in accordance with “*Specifications for Geodetic Hydrographic Control Points.* LINZ OSG” (See “Related Standards”)

3.4 *Levelling Procedures*

1. Levelling between tidal benchmarks and tide poles is to be in accordance with "*Specifications for Geodetic Hydrographic Control Points.* LINZ OSG" (see "Related Standards").

3.5 *Tidal Station Bench Marks*

1. Tidal Station Bench Marks are also Primary Control marks and their establishment and documentation should thus be in accordance with *Specifications for Geodetic Hydrographic Control Points.* LINZ OSG

2. A minimum of three Bench Marks (BM) are to be established close to each tide station.

3.6 *Conspicuous Objects and Landmarks*

1. The positions of all objects which may be of use to the mariner are to be fixed, shown on the Standard Sheet and documented in written reports.

2. Conspicuous objects are natural or artificial marks which stand out, are easily identifiable and plainly visible over a large area of sea (except in narrow approach channels), in varying light conditions.

3. When classifying objects within a survey area, the surveyor must ensure that his judgement is not over influenced by familiarity with the region. The objects must be obvious to those navigating in the area.

4. Photographs are to be taken to support reports and comments on conspicuous objects and landmarks. All photographs are to be clearly labelled.

3.7 *Coastlining*

1. The coastline is the line reached by Mean High Water Springs or Mean Higher High Water tides, and care is necessary in order to locate it accurately in places where the tidal range is great. The surveyor must always walk along the coastline observing and recording the details specified in AMHS Vol. 2, Binder 5, Coastlining and Topography. Land survey techniques must be used to fix or verify the coastline position.

2. Maps based on modern air photography are often available and will provide much assistance in plotting the coastline. LINZ contract's may call for spot checks along the coastline to verify the accuracy of the depicted coastline.

3. Where no suitable maps or photo plots are available, the contract document may direct that the coastline is to be surveyed by regular methods appropriate to the scale of the survey. Geodetic GPS used in kinematic mode should be used where possible.

4. Whenever a surveyor is examining the coastline, the nature of the foreshore and position of the drying line where this can be determined is to be recorded. The best way to fix the drying line is by reduced soundings, but it is important that the whole foreshore should be sighted at least once at low water in order to detect features and dangers which it may not be possible to distinguish whilst sounding close inshore. It is often better to delineate and height rocks along with other isolated dangers at low water than to rely on lines of soundings which may be a considerable distance apart.

3.8 *Delineation of the Drying Line*

1. The survey contractor must delineate the drying line. Surveyors are to take special care that the drying lines of the mainland, of islands and of all drying features, is adequately surveyed.

3.9 *Topography*

1. Where recent topographic maps, aerial photographs or plots from photographs are available, they should be thoroughly checked in the field and any discrepancies resolved. The topography shown on the largest scale chart should also be checked in the field, to update detail which is not normally shown on maps and which may not be visible on air photographs, paying particular attention to coastal detail such as beacons, flagstaffs, groynes, harbour development etc.

2. Charted objects which no longer exist should be recorded as deletions on a copy of the published chart, which should be forwarded with the survey results.

3.10 *Heights of Objects and Landmarks*

1. All newly co-ordinated stations, and all established stations for which heights are not known are to have their heights determined and recorded. The heights

of all prominent features within a survey area, whether natural or man-made, are to be observed and calculated. The heights are to be given as metres above Mean High water Springs, or if MHWS is not known, as heights above MSL.

2. The drying height of all offshore rocks and islets is to be determined, recorded and documented. The height of drying rocks is to be given as height above Chart Datum. Where there are many offshore rocks then the seaward most rocks are to be heighted as these will be the ones a mariner will use to determine distance off.

3. Any clearance height under bridges, wires or power cables is to be determined as height at MHWS.

3.11 *Coastal and Harbour Facilities*

1. Where ramps, slipways and beaches free from obstructions exist, and are suitable for beaching boats, brief details including dimensions, access and gradient should be included in the rendered documents.

2. During the course of a survey, the following information (as a minimum) is to be obtained for all jetties, wharves, marinas and ramps:

    a. dimensions;

    b. height (above chart datum, MHWS, or MHHW);

    c. orientation;

    d. depth alongside, and at 5, 10 and 20 metres off;

    e. type of construction;

    f. particular berthing or mooring arrangements (e.g. dolphins);

    g. boat landings; and

    h. cranes and other facilities. (e.g. water, fuel, toilets, phones and others depicted in NZ 201 for small craft facilities)

3. Where there is intensive recreational interest in an area, further details should be obtained from the Harbour Master, Marina Manager or other authority. Any local navigational or statutory regulations or recommendations should also be obtained.

4 POSITIONING

4.1 *Accuracies*

1. The contract document will state the required horizontal and vertical accuracies.

2. Tender responses are to include a detailed description of how the horizontal and vertical positioning accuracies are to be met.

3. Accuracy requirements are to include an assessment of the sum of the contributions of the errors from positioning and sounding systems and the likely use of the data. A statistical method to combine all error sources must be adopted and the position error at the 95% confidence level recorded along with the survey data.

4. Positions are to be referenced to the geodetic framework specified in the contract. This will generally be WGS 84. Where a local horizontal datum is used as a reference for position, ties between the local datum and WGS 84 Datum are to be made.

5. Horizontal control is to be in accordance with section 3 "SURVEYING OPERATIONS ASHORE"

6. Table 4 below details LINZ standard accuracy requirements for single-beam and multi-beam echosounder surveys in New Zealand waters and is based on (but refined in some aspects) the IHO guidelines from SP44.

Table 4 – Horizontal Accuracies

Order	**Special**	**1**	**2**	**3**
Horizontal Accuracy of Position of Soundings	2m	5m + 5%d	10m + 5%d	100m + 5%d
100% Bottom Search	Compulsory	SBES - Selected Areas MBES – Compulsory	SBES - As Specified MBES – Compulsory	SBES - Not Applicable MBES – Compulsory
Fixed Aids and Features Significant to Navigation	2m	2m	5m	5m

Drying Rocks	2m	5m	5m	10m
Natural Coastline	10m	10m	15m	20m
Mean Position of Floating Aids to Navigation	10m	10m	15m	20m
Topographical Features	10m	10m	15m	20m

Notes:
1. d = Depth
2. All accuracies are required at the 95% Confidence Level
3. The horizontal positional accuracy for MBES surveys is the accuracy of the position of the sounding on the seabed.
4 The horizontal positional accuracy for SBES surveys is the accuracy of the position of the echosounder transducer.

4.2 *Positioning Accuracy of Soundings*

1. All sources of horizontal error are to be monitored and the contractor is to undertake sounding operations so as to minimise their impact. An a priori assessment (i.e. "error budget") should be undertaken prior to the commencement of sounding to ensure that planned operations will meet the specified standards for horizontal control.

2. The survey contractor must provide evidence that positioning system quality factors are monitored on an ongoing basis (e.g. logs of DOP values, satellite configurations, RMSR values etc).

3. The accuracy of a position is the accuracy at the position of a feature (e.g.. sounding, nav-aid etc.) to be located within a geodetic reference frame and not simply the accuracy at the positioning system sensor.

4. If a single beam echo sounder (SBES), is being used to obtain bathymetry then the horizontal accuracy of the sounding is related to the position of the sounding system transducer.

5. If a multibeam echo sounder (MBES), is being used to obtain the bathymetry then the horizontal accuracy of the sounding is related to the position of the sounding on the seabed.

6. The position of soundings, dangers, navigation aids and all other important hydrographic features should be determined such that the horizontal accuracy is as specified in Table 4.

4.3 *Quality of Positioning*

1. Two independent positioning systems are required on all survey platforms to maintain redundancy. This requirement may be waived for small survey launches (<7m) on written request to LINZ.

2. Both the primary and the secondary positioning systems are to be referred to a common datum point (the primary echosounder transducer).

3. As part of the "Quality Assurance Data Pack", the survey contractor is to provide evidence of regular comparisons between primary and secondary positioning systems. Any instances where the difference between primary and secondary positioning systems exceeds the required survey accuracy are to be noted and rendered to LINZ.

4.3.1 *GPS Quality Control*

1. The following are the minimum criteria to be monitored for GPS positioning systems to ensure that the quality of horizontal positioning is within specifications. Any periods where real-time QC indicates that the required tolerances have been exceeded are to be rendered to LINZ as part of the "Quality Assurance Data Pack". This includes data obtained from any integrity monitoring station.

    a. The sigma values or semi-major axis of the positional error ellipse are not to exceed 3.5m at the 95% confidence level.

    b. The DGPS correction age is not to exceed 10 seconds

    c. PDOP is not to exceed 6 for recording and continued sounding. If PDOP is greater than 7 then surveying is to be halted until it improves.

    d. The minimum number of healthy satellites being tracked for continued sounding is to be 4.

    e. The minimum elevation for SV is to be 10^{o} angle from the horizontal.

2. A shore-based integrity monitoring system must be established on a known co-ordinated point to monitor the integrity of DGPS signals for the duration of survey operations. Any deviation outside the positioning specifications must be noted and rendered in the Report of Survey. A statistical analysis of the results of the integrity monitoring system is to be rendered to LINZ as part of the project "Quality Assurance Data Pack"

4.3.2 *Ranging EPF System Quality Control*

1. Where a ranging positioning system is used;

    a. There is to be a minimum of three LOP at all times with a minimum angle of cut of 30 degrees between any two LOPs.

    b. The misclosure between LOPs is to be less than 7m at all times.

4.4 *Calibration of Position Fixing Systems*

1. Whenever DGPS or electronic position-fixing (EPF) systems are used for control of positioning for a survey, they must be verified against a reference position which is more accurately known, or by comparison with a more accurate system before sounding commences.

2. Positioning confidence checks are required during the course of the survey at least once per week. A confidence check must also be performed after any major positioning component swap-out, any change of geodetic parameters or any change of vessel offsets. Records of all calibrations and checks must be provided to LINZ as part of the "Quality Assurance Data Pack".

3. All positioning equipment (including antennae) is to remain mounted onboard the vessel during positioning confidence checks in order that correct application of vessel offsets can also be verified.

4.5 *Calibration of Heading Sensors*

1. Heading sensors (e.g. gyrocompass or "GPS-gyro") must be calibrated during mobilisation. "Correct-Observed" values must be determined by comparing the observed value on the heading sensor with the lubber-line of the vessel as calculated using land-survey techniques. Observations must be undertaken on reciprocal vessel headings. The resultant C-O value must be applied to resultant on-line heading values to correct for any alignment error. Results of all calibration and checks must be provided to LINZ as part of the "Quality Assurance Data Pack".

5 BATHYMETRY

5.1 *Total Propagated Error*

1. The following error source must be considered when determining the accuracy of a sounding. (reference: RN Hydrographic Professional Paper No.25 - The Assessment of the Precision of Soundings).

2. Depth accuracy is the accuracy of the reduced depths. In determining the depth accuracy all sources of individual errors need to be quantified and incorporated into a statistical model to derive the Total Propagated Error (TPE).

3. To provide a measure of the accuracy of sounding achieved during a survey, and verify that the accuracy criteria at section 6.1 (Single-Beam Echosounder Accuracy Requirements) and section 7.2 (Multibeam Survey Accuracy Requirements) have been met, the Report of Survey is to contain a table listing the standard error assessments for each of the components listed below.

4. An example of the layout of a table of assessed standard errors in a sounding, for a survey in which the depth of water varied throughout the area from 50 to 200 metres is given in Table 7. The values given in the table are fictitious.

5. A list of those occasions where the criteria for sounding accuracy is not achieved, is also to be included in the survey report, with an explanation for each occasion.

6. Sources of Error to be Considered;

    a. Draught Setting: Draught setting is achieved by shallow bar check. It's accuracy depends on the accuracy of the bar check lines and the precision with which the trace can be read. For large vessels, the draught of the transducer is set by computations based on the ship's trim and the accuracy of the setting will depend on how accurately the trim is determined and the precision with which the trace can be read.

    b. Variation of Draught: The midship location of most transducers means that there should be little variation in transducer draught between draught setting determinations. The variation can be determined by shallow bar checks at the beginning and end of a period of sounding.

    c. Sound Velocity: The SV is usually determined by sound velocity profile using a SVP, CDT or expendable bathythermograph (XBT). The deep bar check is used for periodic confirmation of the SVP profile value. The accuracy of the determination of SV will depend on

the equipment calibration and the accuracy of the echosounder tachometer.

d. Spatial Variation in SV: Depending on the survey location and extent it is likely that mean SV will vary across a survey area, particularly in the vicinity of fresh water rivers or discharges. The initial matrix of SV observations should indicate the SV variations and provide a guide as to the need to divide the area into domains of similar SV rates.

e. Temporal Variation in SV: In temperate climates SV will change with the seasons and although the sign of change can be predicted with some certainty, the rate of change of the value may be uncertain. In shallow water, marked local variations may occur during severe weather.

f. Application of measured SV: On the continental shelf the assumed (measured) SV can only be set to the nearest 1 metre/sec on most echo sounders. This introduces a resolution error of up to +0.5 metres/second. It is unlikely that the measured SV will be an exact whole number of metres/second.

g. Depth Measurement (Instrumental Accuracy): A factor upon which the determination of depth by echo sounder depends is the internal precision of the machine. The stability of the internal oscillator to maintain the assumed SV while the pulse is in transit contributes to this precision.

h. Depth Measurement (Trace Resolution): Due to the solid state printing methods, modern echo sounders print depths in steps of 0.1 metres on the analogue trace, introducing a rounding error of +0.05 metres (2σ) independent of depth or other factors mentioned in preceding paragraphs.

i. Heave: Heave may be determined by inspection of the echosounder trace. The surveyor must assess what portion of the trace is due to heave and what error this has produced. The use of a heave compensator device will remove much of the error introduced by vessel movement. The error of a heave compensator is commonly assessed as ± 0.05 metres at the 2σ level.

j. Settlement and Squat: Settlement and squat can be quantified through the conduct of squat and settlement trials.

k. Roll, Pitch and Seabed Slope: The observed depth is plotted as the position of the observers echo sounder transducer, and this depth cannot be correct for that position if the echo returned from a point on the seabed is not immediately below the vessel. For practical purposes

such errors are overcome by the echo sounder beam width and the short duration of the vessels roll/pitch.

l. Tidal Readings: The accuracy of tide readings will depend on whether they are taken from a pole or gauge and the sea state at the time of reading. When reading a pole in calm weather an accuracy of + 0.03 m should be attainable, the standard error of the gauge reading can be determined during the gauge/pole calibration.

m. Co-tidal Correction: Assessing the accuracy of co-tidal corrections is difficult unless a seabed tide gauge is available. Even a well constructed co-tidal chart, based on a number of flat bottom sounding stations, is likely to be in error by 0.5m or more.

n. Tide Corrections: The accuracy of the tidal correction, assuming errors for reading and co-tidal correction are already accounted for, will depend on the accuracy of the tidal curve produced from half hourly readings and the precision with which the reduction can be plotted on the trace or in the case of automated systems, the method the system uses to apply tidal corrections. This can only be quantified by the Contractor.

o. Trace Reading: For manual procedures, the accuracy to which the trace can be read will depend on the range in use, the sea state, bottom topography and the alertness of the trace reader.

7. When the individual standard errors of the various elements determining the accuracy of a sounding have been assessed, they are to be combined into the standard error (z) of a sounding by the basic combination of errors formula. The co-variance between the elements is considered to be nil.

$$z^2 = x^2 + y^2 + ...$$

where: z is the total standard error,

x and y etc. are the standard errors of individual elements.

Table 7 - EXAMPLE OF A TABLE OF TOTAL PROPAGATED ERROR

SOURCE OF ERROR	AT 200m	AT 100m	AT 50m
Draught Setting	0.1	0.1	0.1
Variation of Draught	0.05	0.05	0.05
Velocity of Sound	0.27	0.13	0.07
Spatial Variation in SV	0.13	0.07	0.03
Temporal Variation in SV	0.13	0.07	0.03
Application of Measured SV	0.13	0.07	0.03
Depth Measurement (Inst. Acc)	0.1	0.1	0.1
Depth Measurement (Trace Resolution)	0.01	0.01	0.01
Heave	0.05	0.05	0.05
Settlement and Squat	0.1	0.1	0.1
Roll, Pitch and Seabed Slope	0	0	0
Tidal Readings	0.06	0.06	0.06
Co-tidal Corrections	0.79	0.79	0.79
Tide Corrections	0.01	0.01	0.01
Trace	0.5	0.25	0.1
Total Standard Error	1.39	1.08	.92

5.2 *Use of Side-Scan Sonar*

1. The requirement to conduct a side-scan sonar search will be advised in the contract document. Side-scan sonar searches are to be conducted along all leading lines and recommended tracks.

2. Side-scan sonar searches are to ensure total insonification of the survey area. Survey lines are to be spaced to ensure that the seabed directly under the transducer, and at least 50m beyond it, is insonified by the adjacent sweeps. Where practical, adjacent lines are to be run in opposite directions. Along leading lines and recommended tracks the search should extend to the width of the channel or to at least two cables on either side of the centre line.

3. Prior to commencing a side-scan sonar search and regularly during its execution, confidence checks are to be made using known features. These confidence checks must be documented in the "Quality Assurance Data Pack"

4. For single-beam side-scan systems, sonar searches must not be conducted at speeds in excess of six knots. At six knots, all targets of two metres and greater in cross-section should produce a 'return'.

5. The optimum height at which to keep the fish above the seabed is equivalent to 10% of the range scale in use, i.e. using the 150m range scale the fish should be flown 15m above the seabed.

6. If wire-sweeping is not employed, side-scan sonar is also required for heighting of all navigationally significant wrecks. Side-scan sonargrams of such wrecks must be rendered as "Accompanying Tracings" (see section 10.4.6.1). Where MBES has been specified for the survey, a large-scale accompanying tracing of the MBES image for each navigationally significant wreck located is also to be produced.

5.3 *Examination of Seabed Features*

1. Agreement between international hydrographic authorities has defined a significant bathymetric feature as a feature that has dimensions as follows:

Table 9 – "Significant Feature" Criteria

Depth	Is a Significant Feature if the variation in depth is Greater than
< 10 metres	> 0.1 x depth
10 to 40 metres	> 1.0 m
> 40 metres	> 10% variation in depth.

For example:

in 5m of water a change of 0.5m is significant
in 20m a change of 1m is significant
in 45m a change of 4.5m is significant

2. Whilst it is desirable to investigate every feature which meets the above criteria, for single-beam surveys in complex areas this will not be possible. Surveyors may need to use their own judgement as to which shoals warrant investigation, and in this matter he/she also needs to consider the likely use of the area (draught of vessels etc), and the likely significance of the shoal noting the general depths in the area.

3. At the end of each examination the Surveyor-in-Charge must give a firm opinion as to the status of each feature located, being the only person with all the facts at their disposal. Findings are to be included in the rendered data. Newly discovered features which may be dangerous to navigation, and charted features which are found to be significantly changed, are to be reported by Hydrographic Note.

4. See Section 6.8 for the requirements for obtaining the least depth over seabed features with single-beam echosounders.

5.4 *Variations*

1. It is very likely that significant bathymetric features (see section 5.3 for definition) which require an unknown level of additional work to fully delineate their least depth and extent will be detected during the course of a hydrographic survey.

5.4.1 *Limits of Variations Included*

1. Where significant bathymetric features are found to lie within the specified project area or up to a distance of 2 cables outside the area then examination, delimitation and delivery of such work is considered to be part of the work of this survey, and is not considered to be a variation (unless otherwise stated in the contract document)

2. Where an examination or investigation of either doubtful data or a shoal is specified and listed as part of the survey the work required to determine the extent and least depth is not considered to be a variation.

5.4.2 *Limits of Variations Excluded*

1. Where significant bathymetric features are detected more than 2 cables outside the survey project area and the least depth and extent of such dangers requires to be determined such work is deemed to be a variation and the work should be referred to LINZ before being undertaken.

5.5 *Shoal Soundings*

1. The examination of all indications of shoal soundings or of other dangers, whether new or already charted, is one of the most important aspects of any survey. No survey can be considered complete until all such shoals have been examined, and any charted shoals which have not been located have been disproved. The failure to find charted shoals should be reported in detail with recommendations concerning future charting.

2. Where the scale of the survey allows (see section 2.10), sufficient soundings are to be inserted on the Standard Sheet to indicate that a full examination has been made in the vicinity of each new or previously charted danger.. The least depth obtained is invariably to be shown. Where necessary, and especially where the depth may be critical to navigation in the vicinity, the feature is to be wire-swept, or examined in sufficient detail by multi-beam sonar, side-scan sonar or diver as to permit the Surveyor-in-Charge to make a firm statement as to whether the least depth has been found, and to document the reason for any differences.

3. On drying shoals the least depth is to be established by observation, such as level and tachstave or vertical angle reduced to tidal datum whenever practical.

4. It is solely the responsibility of the Surveyor-in-Charge to ensure that all dangers are fully examined, and that charted shoals are verified or disproved. In the absence of a careful search and a definitive report proving the non-existence of a previously reported danger or shoal sounding, charted detail is to be retained.

5. All shoals located during the course of any survey are to be examined with respect to position, extent and least depth. Shoals are to be proved or disproved with a definitive statement in the Report of Survey, whether they have been examined or not and the SIC recommendation for subsequent charting action.

6. Advantage should always be taken of the local knowledge of fishermen (and others) to ascertain the existence and position of rocks and other dangers which are frequently known to them due to their attraction to fish.

7. Details of the required scales with which to perform shoal examinations are described in section 2.10.

5.6 *Disproving Searches*

1. Best endeavours must be exercised in disproving charted wrecks, obstructions reported or other dangerous features, which have not been located and examined during previous surveys. They will not be removed from the chart without a positive statement from the Surveyor-in-Charge that this is justified.

2. In determining the effort required to disprove a reported danger whose position is not accurately known the guidance at GIHS article 0752, Searches for Reported Dangers or Shoals is to be used.

3. Objects whose positions have been previously established, but which cannot be found during the survey, need a very detailed investigation to disprove them. Such searches are to include a side-scan sonar sweep in two directions at right angles to each other, and a close echo sounding search over a radius of at least 0.5 mile from the charted position; consideration should be given to including a wire-sweep. Alternatively, high-definition multibeam sonar can be utilised as a disproving tool, where the resolution of the sonar system can be proved to be better than the size of the target.

4. When searching for an object whose position is only known approximately (usually a "PA") the sonar search (high-definition multibeam or side-scan) should also be undertaken in 2 directions at right angles and consideration should be given to extending the search over a radius of at least 2.5 miles

5. Searches for wrecks not within a regular survey area must be extended to a radius of at least 2.5 miles.

5.7 *Channels, Leading Lines and Recommended Tracks*

1. Whenever a survey includes a channel, recommended track or leading line in restricted waters, it must be very carefully sounded and examined, where possible searched with side scan sonar and, if necessary, wire-swept.

2. A distance of 200m either side of the leading line is to be to be examined unless otherwise specified in the contract. This is especially important when the terrain is rocky or the channel lies between reefs or rock ledges, or if the seabed is believed to be mobile and subject to sand-wave activity.

3. If a leading line or recommended track is found to be unsuitable, consideration should be given to recommending alternatives (consulting local authorities where possible), which must also be fully examined and shown on the Standard Sheet.

4. The true bearing of the leading lines is to be determined and annotated on the Standard Sheets and detailed in the Report of Survey.

5.8 *Shallow Water Sounding*

1. The contractor must demonstrate during the contract that every effort has been made to survey in shallow waters. Examples are as follows:

    a. posting bow and stern lookouts at all times when sounding in shallow waters;

    b. carrying out a shallow water reconnaissance at low water;

    c. sounding suspect areas in shallow-draught boats or inflatables fitted with portable echosounders prior to a ship entering the area or ahead of the ship; and

    d. carrying out a multibeam sonar or side-scan sonar sweep parallel to the shore, or a series of such sweeps successively further inshore, prior to commencing sounding.

2. Contractors should also consider the value of local knowledge. A positive effort is to be made to obtain advice and information by contacting potential sources prior to commencement of the survey. Such sources may include local harbour authorities, fishermen, yacht clubs or articles of local knowledge in the local press.

3. When surveying within harbours and boat havens, it should be remembered that drying heights and the location of foul ground, in areas where small craft anchor or take the ground, are very important to owners, and should be precisely surveyed whenever possible.

4. In undertaking surveying operations close inshore, particularly in close to poorly charted and/or coral features, all care must be taken to ensure the continued safety of the vessel.

5.9 *Reporting New Dangers*

1. It is of paramount importance that any new danger located is reported without delay and the Surveyor-In-Charge must take steps to ensure that all such dangers are brought to the attention of LINZ immediately.

2. The Surveyor-In-Charge is to draw attention in the Report of Survey to any errors, omissions or short comings of the survey. This is essential with the increasing risk that litigation may follow accidents which are thought to have resulted through short-comings from the survey information.

3. Changes to charted information not posing an immediate threat to the mariner may be promulgated via a Hydrographic Note using the form included at Annex A.

5.10 *Automated Systems – Logging Parameters & Sounding Selection*

1. In all cases, the fixing interval should be determined so that the sounding positioning criteria for the project are met when sounding speed and survey scale are taken into consideration.

2. Automatic sounding selection is an aid to processing logged sounding lines and to the production of final digital depth models and subsequent plotting of standard sheets. For single-beam echosounder surveys, the results are to be checked and verified against the analogue echo trace. Processing should be used to achieve a sounding density appropriate for the scale of the survey.

3. The Surveyor-in-Charge should ensure that any gaps in soundings are not the result of missing data, and that no significant soundings have been omitted. Care should be taken in selecting processing parameters so as to minimise the need for further editing.

4. Where automated sounding selection algorithms are used to thin digitally logged soundings the system is to use a shoal biased model.

5.11 *Reducing the Soundings*

1. In reducing soundings, the principle to be observed is that depths are never to be shown greater than they actually are, relative to sounding datum.

2. All soundings are to be corrected for vessel draught.

3. Squat, settlement, pitch, roll, yaw and heave are to be recorded where appropriate to the platform type and soundings reduced accordingly.

4. Soundings in depths of 200m and less are to be corrected for tidal height.

5. Soundings in depths greater than 200m are not to be corrected for tidal height unless the tide is a significant component of the Total Propagated Error.

6. Soundings must also be corrected for variation in sound velocity (SV) as described in section 5.12 “Observation of Sound Velocity”.

7. See section 8.8 for reduction of Soundings for Tide.

5.12 *Observation of Sound Velocity*

1. Sound velocity must be measured at a 6-hourly interval for MBES operations and 12-hourly interval for SBES operations. Sound velocity must also be re-observed after any substantial changes in vessel location. Sound velocity interval may be relaxed at the discretion of the LINZ "Quality Assurance Representative".

2. Determination of Sound Velocity must be by an independent method other than the echosounder. Velocity must be measured to better than 2 metres per second.

3. For soundings which are between 0m and 200m, the SV can be determined by SV probe or CTDS probe.

4. For single-beam soundings deeper than 200m, the SV correction can be determined by probe (e.g. XBT, CTDS, SV etc) or by deriving corrections from NP139 or other approved digital record. Whichever method is chosen, evidence must be produced to confirm that errors obtained in measuring SV will not cause the sounding error budget to be exceeded. SV is to be applied to single-beam soundings as a harmonic mean of the obtained profile.

5. For multi-beam soundings deeper than 200m, the SV correction must be determined by probe (e.g. XBT, CTDS, SV etc). For multibeam soundings, SV observations are to be made to a minimum of 95% of the anticipated water depth and used to generate velocity profiles for reduction of bathymetry.

6 SINGLE-BEAM ECHOSOUNDING OPERATIONS

6.1 *Single-Beam Echosounder Accuracy Requirements*

1. Table 10, below provides the LINZ depth accuracy and target detection specifications for each order of single-beam echosounder survey.

Table 10 - Depth Accuracy for Reduced Depths (95% Confidence Level)

ORDER	Special	1	2	3
A B	0.25m 0.0075m	0.5m 0.013m	1.0m 0.023m	1.0m 0.023m
Size of Cubic Objects to be Detected by the System	>1m	>2m in depths up to 40m. 10% of depth beyond 40m	>2m in depths up to 40m. 10% of depth beyond 40m	Not Applicable

1. The following formula is used to calculate the error limits:

$$\pm\sqrt{[a^2 + (b \times d)^2]}$$

Where a = constant depth error, i.e. the sum of all constant errors

b x d = depth dependent error, i.e. the sum of all depth dependant errors

b = factor of depth dependant error

d = depth

6.2 *Single-Beam Echosounding Equipment*

1. If two systems are used, the preferred system is to be nominated “Primary”.
2. The system must produce a digital record that is capable of being processed in an automated system,
3. The system is to operate on frequencies capable of determining the first bottom return in depths less than 40 metres.

4. The system is to continuously track the bottom in steeply shelving areas

5. Where the system has multiple frequencies then the highest frequency is to be operated and logged in depths less than 40 metres.

6. A hard copy record (echogram) of the seabed below the platform is to be produced. This is to be annotated with time and position at intervals of less than 2 minutes. Any changes in the range scale are also to be annotated.

7. The quality of the graphic record is to be such that depths can be digitised or manually read off the trace to fill gaps in the digital record and to allow QA and audit.

6.3 *Calibration of Single-Beam Echosounding Equipment*

1. Echo sounders are always to be set to read depth below the surface of the sea, and never to depth below the keel. Before use they must be calibrated precisely and adjusted for draught setting, index error and sound velocity. Allowance must be made for ship squat.

2. Index error and draught setting (TX) are to be determined from a shallow bar check and corrected for by adjusting the draught control on the echo sounder recorder. This method ensures that the echogram record can be directly related to the digital record when checking and validating data.

    a. Note that the spacing of the marks on the bar lowering lines should allow for the appropriate mark to be placed on the sea surface when bar-checking, and not at the deck-edge.

    b. The shallow bar check should be carried out on a daily basis at start and end of day, (SOD, EOD) for all inshore work. The echosounder bar check traces are to be retained and rendered with the other records.

    c. Between bar checks the echo sounder draught setting should be adjusted for known changes in the draught of the vessel.

    d. When a bar check is not possible due to sea state, etc., the transmission line should be set at the depth of the transducers below the waterline or determined by another method.

3. In depths of 0 to 30 metres, the SV as determined by probe (see section 5.12) is to be verified on a daily basis by deep bar check. This check should also be carried out at the start and finish of sounding (in any depth) or if changing area. If accurate bar checking is impossible, SV should be determined by probe alone (CTDS or SV).

4. By whatever method an echo sounder is calibrated, it should not be done until the equipment is thoroughly warmed up. The draught and SV settings should be checked regularly throughout the working day and recorded on the echo trace, and in the appropriate logs.

5. Where an echo sounder has multiple frequencies, each frequency is to be calibrated independently in order to allow for the different response times of the transducers. When such echo sounders are used, the depths logged in digital form are to be those arising from the highest frequency used, to ensure that the highest resolution is maintained.

6. Ship squat effects at speeds ranging from 5 knots to normal sounding speed (economical speed), and over a range of water depths, are to be determined from carefully controlled trials. Squat is to be applied to all measured depths where the effect exceeds 0.1 metre.

7. The lengths of bar-check lines may change significantly due to wear, stretch and the effects of corrosion due to the ingress of salt water. Except where the bar is the same length as the beam of the craft at the position of the echo sounder transducers, the bar check lines will not hang vertically in the water, and allowance for this must be made when they are constructed to ensure that the markings on the lines are such that the bar will be lowered to the correct depth below the sea surface.

8. The lengths and markings of bar-check lines must be verified at mobilisation and demobilisation.

6.4 *Speed Whilst Sounding*

1. When determining the speed at which to conduct sounding the surveyor must consider the depth of water being sounded and the pulse repetition rate of his echo sounder. High speed combined with a slow pulse repetition rate may lead to small but significant features being missed, particularly in shallow water. The surveyor is to adjust his speed so that for a single beam echo sounder a target of 0.3m cross-section receives five pulses of sound from the echo sounder, this should ensure the detection of all significant features.

2. A general formula for calculating the depth at which five pulses should insonify a target of given size at different speeds is:

$$D = \frac{(0.003426\ Sr) - t}{2 \tan (\phi/2)}$$

Where:

D = least depth in metres of detection

S = speed in knots

r = depth measured by one complete revolution of the stylus (in metres) at range scale in use.

t = cross section of target to be detected.

ϕ = echo sounder's beam width (fore and aft) in degrees.

3. When using an MBES, a suitable vessel speed must be chosen so as to ensure the specified target detection criteria is met.

4. As a normal rule, the echosounder should be operated in the shallowest range scale possible and at the highest frequency possible (and therefore the highest pulse repetition rate). In very shallow water, or on a steeply sloping seabed or coral atoll, it may still be necessary to reduce speed.

6.5 *Density of Soundings*

1. In detailed surveys on the continental shelf (using Single Beam Echo Sounders), the spacing of sounding lines will generally be determined by the scale of the survey. For SBES it will be usual for these to result in line spacing of 0.5 cm on paper at the rendering scale. This spacing is to be adopted for all detailed surveys unless discretion is given to open the lines of soundings in particular circumstances.

2. Additional soundings are to be obtained along recommended tracks, and in any indentations in the coast that may be used as anchorages, or off headlands where a mariner may pass closer to shore than normal.

3. Where irregularities are found to exist, or where the nature of the seabed or adjacent coastline features may indicate previously undetected dangers, the areas must be more carefully sounded using interlines and/or cross-lines.

4. In detecting shoals the Contractor must make the most of an efficiently spaced network of sounding lines which both maximise the possibility of detection and maximise the effort required to sound the area (see section 5.5).

5. For surveys using SBES unless otherwise specified in the contract, the spacing for sounding lines are;

Table 11 – Sounding Line Spacing

Depths	Line Spacing on Rendered Survey
0 - 200m	Standard line spacing of 0.5 cm on paper at rendering scale

200-1000m	Double spacing of 1.0cm on paper at rendering scale but not more than 800m on the ground
<1000m	Sounding lines at 1 kilometre intervals on the ground

This equates to:

Scale of Survey	Standard Line Spacing
1:5 000	25m
1:10 000	50m
1:25 000	125m
1:50 000	250m
1:100 000	500m

6.6 *Direction of Single-Beam Echosounder Sounding Lines*

1. When sounding is not being undertaken concurrently with a side-scan sonar sweep, the lines should generally be run approximately at right angles to the trend of depth contours if these have been established, or at right angles to the coast when working near the shore.

2. In the vicinity of jetties of wharves, lines are to be run parallel to the line of the berths to indicate where shoal depths may extend from them.

3. Additional lines of soundings are to be run along the line of recommended routes and leading lines identified on the survey ground.

4. In many cases, where an anchorage exists in a coastal survey, it may be desirable to differentiate it from the surrounding work by running additional lines of soundings. Any indentation of the coast which may afford an anchorage in times of stress, or any headland which will be passed close to hand by vessels on normal passage, must receive special attention.

5. When working in areas where the existence of sand-waves is known or suspected, sounding lines should be run at right angles to the line of the crests, to avoid the probability that the crest-lines would be missed if sounding parallel to, or along, the troughs.

6.7 *Single-Beam Echosounder Cross-Lines*

1. Cross-lines are to be run at angles of 60^{o} to 90^{o} to the main track-lines.

2. Cross lines are to be run no less frequently than 20 times the line interval of the basic sounding (i.e. at intervals of 10 cms on paper if the normal line interval is 0.5 cm on paper).

3. Cross-lines should also be run whenever the Surveyor-in-Charge is not satisfied that the normal sounding has revealed all significant features, as well as in sand-wave fields, near headlands, in bays and along channels and recommended routes.

4. A statistical comparison of raw data between the main survey track and the cross-line is to be undertaken to ensure that the accuracy requirements of the order of the survey are met. A summary of the statistics and definitive statement about the results are to be included in the Report of Survey.

5. Whenever cross-lines reveal a discrepancy in depth exceeding twice the sounding accuracy specified in the contract, the discrepancy is to be investigated, explained and detailed in the weekly report.

6.8 *Examinations with Single-Beam Echosounder*

1. Some shoals found during sounding or interlining will require detailed examination to determine the least depth. Unless specified in the contract for the elimination of doubtful data, the decision to conduct an examination lies with the Surveyor-in-Charge. Consideration must be given to the position and probable least depth of the shoal, the seabed topography and the draught of vessels operating in the area.

2. During examinations, the vessels speed must be sufficiently slow to ensure that all pinnacles are located. Conversely, the echosounder paper speed must be fast so that the maximum detail of the bottom is recorded.

3. Line spacing during examinations must be determined by considering the footprint of the sounder's beam and the probable extent of the shoal. At times it may be necessary to run lines as little as 5m apart.

4. The surveyor should have available a predicted tidal curve so that the least depth can be recognised when found. He should keep a tally of the least depth and its position on each line so that the approximate shape of the shoal can be established.

5. When the least depth has been found a hand lead is to be dropped on it to confirm the depth and obtain a bottom sample where possible. If a diver is available the lead can be held on the shoalest point, and a bottom sample and description of the shoal can be obtained. In many cases the only positive means of establishing the least depth over a rock pinnacle or wreck is by use of a wire drift sweep or by divers.

6. Where diving or wire-sweep is not possible, the least depth is to be obtained by saturation sounding. The required line spacing is to be calculated from a knowledge of the echosounder beam width and general depths in the area, allowing an overlap of at least 25% between lines of sounding.

7. Details of the required scales with which to perform shoal examinations are described in section 2.10.

7 MULTI-BEAM ECHOSOUNDING OPERATIONS

7.1 *Corrections to be Determined and Applied to Multibeam Soundings*

1. Platforms utilising MBES systems must be fitted with peripheral equipment which can provide corrections for the following;

   - Vessel Heading
   - Vessel Roll
   - Vessel Heave
   - Vessel Pitch
   - Vessel Speed
   - Vessel Squat and Settlement
   - Vessel Draught
   - Vessel Positioning
   - Vessel Offsets
   - Synchronised Timing
   - Velocity of Sound in Water
   - Tidal Time and Height

7.2 *Multibeam Survey Accuracy Requirements*

1. Four orders of survey (MB-Special to MB-3) are used by LINZ to identify the accuracy requirements whenever use of an MBES is specified.

2. The depth accuracy required for MBES surveys is stated as a function of multiples of 1.0, 1.5, 2.0, and 2.5 times the LINZ Single-Beam Special Order depth accuracy for reduced depths (see section 6.1 “Single-Beam Echosounder Accuracy Requirements”). The accuracies associated with each order are detailed in the following table (Table 12). Positional accuracies are detailed in Table 4 (section 4.1).

Table 12

LINZ Order	MB Special	MB-1	MB-2	MB-3
Depth Accuracy Across the Swath Width	1 x IHO SO	1.5 x IHO SO	2 x IHO SO	2.5 x IHO SO
Target Detection	Minimum Horizontal Size of Target required to be Detected			
Water depth < 40m	1m	2m	2m	8m
Water depth >40m	2.5% of depth	5 % of depth	10% of depth	20% of depth
Maximum distance for Three Strikes Along and Across Track	2.5% of depth	5 % of depth	10% of depth	20% of depth
Swath to Swath Area Coverage	200%	100%	100%	100%

Note 1: Accuracies are stated at the 95% confidence level.
Note 2: d = Water Depth

3. As stated above, system accuracy only has to be achieved in terms of the permissible error in reduced soundings at the 95% confidence level over the full width of the selected swath. Outer beams may well have to be "rejected" in order to achieve this accuracy. Rejected beams are only to be used for reconnaissance and are to be logged but not to be incorporated into the final processed data sets.

7.2.1 *Example of Multibeam Depth Accuracy*

1. The following table indicates the results of calculations of depth errors at 95% Confidence Levels for the multiples of LINZ Single-Beam SO and various depths

Table 13

DEPTH ACCURACY IN MULTIPLES OF LINZ SBES SPECIAL ORDER (SO)				
	DEPTH ACCURACY			
Depth (m)	1 X SO (m)	1.5 X SO (m)	2 X SO (m)	2.5 X SO (m)
5	0.2528	0.3792	0.5056	0.6320
10	0.2610	0.3915	0.5220	0.6525
15	0.2741	0.4112	0.5483	0.6854
20	0.2915	0.4373	0.5831	0.7289
25	0.3125	0.4688	0.6250	0.7813
30	0.3363	0.5045	0.6727	0.8409
50	0.4507	0.6760	0.9014	1.1267
100	0.7906	1.1859	1.5811	1.9764

200	1.5207	2.2810	3.0414	3.8017
300	2.2638	3.3958	4.5277	5.6596
500	3.7583	5.6375	7.5166	9.3958
1000	7.5042	11.2562	15.0083	18.7604
2000	15.0021	22.5031	30.0042	37.5052

Example 1: MB- Special Order Survey Depth Accuracy

Depth accuracy of 1 x LINZ Single-Beam SO is to be met across the entire swath.

Reduced depths at 50m are to be accurate to ±0.45m at 95% confidence level

Reduced depths at 100m are to be accurate to ±0.79m at 95% confidence level

Example 2: MB-Order 2 Survey Depth Accuracy

Depth accuracy of 2 x LINZ Single-Beam SO is to be met across the entire swath at 95% confidence level.

Reduced depths at 50m are to be accurate to ±0.90m at 95% confidence level

Reduced depths at 100m are to be accurate to ±1.58 m at 95% confidence level

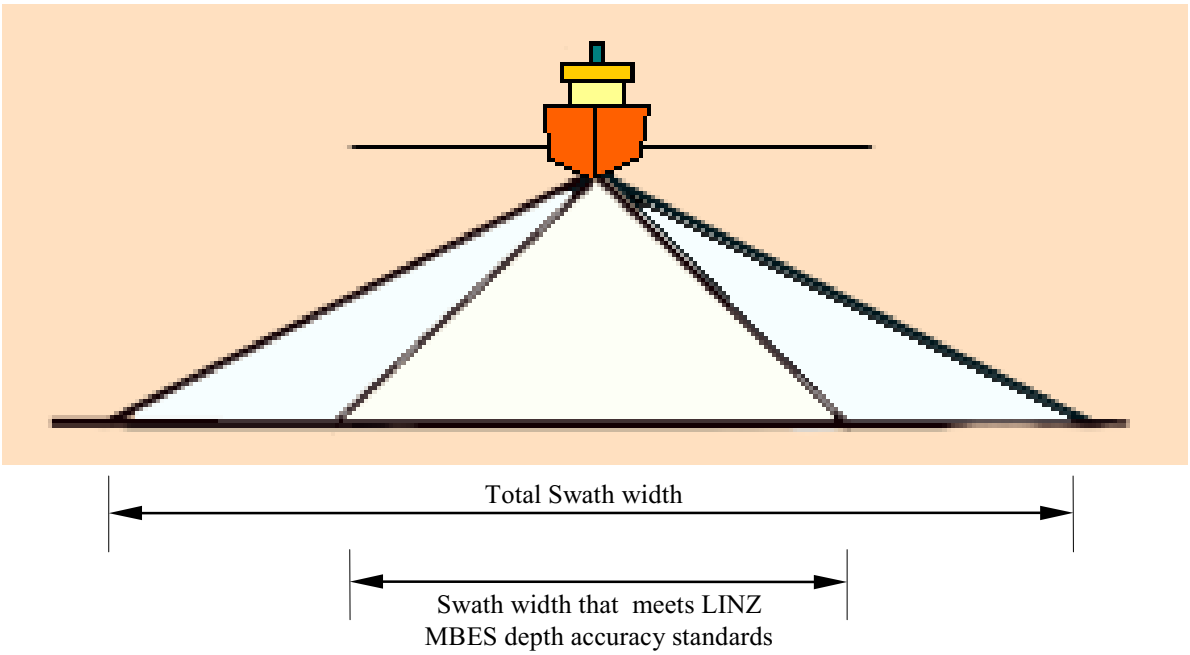
7.3 *Seabed Coverage and Target Resolution Standards*

1. The total coverage of the seabed and target resolution by a MBES is to be achieved by a combination of the following standards:

7.3.1 *Swath to Swath Overlap*

1. For these Standards the swath width used to define any coverage is to be that part of the swath which meets the accuracy standards (see Figure 1):

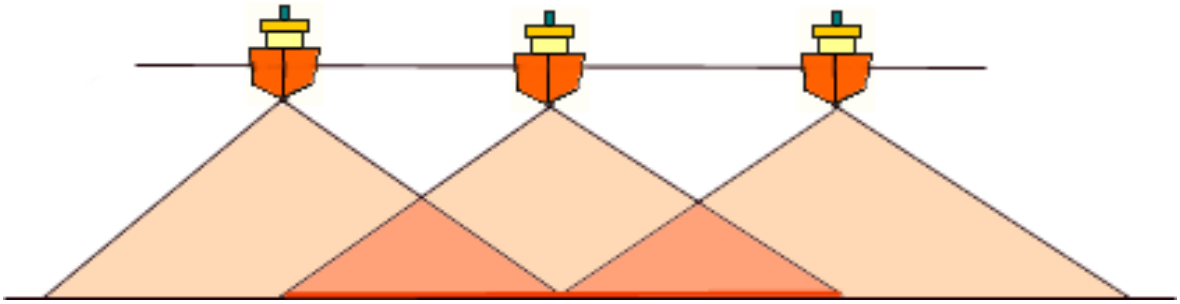
Figure 1



7.3.1.1 Overlap for MB-Special Order Surveys

1. For Special order surveys 200% swath to swath coverage is required (see Figure 2). This coverage is to be of that part of the swath which meets the accuracy standard of 1 x LINZ Single-beam SO.

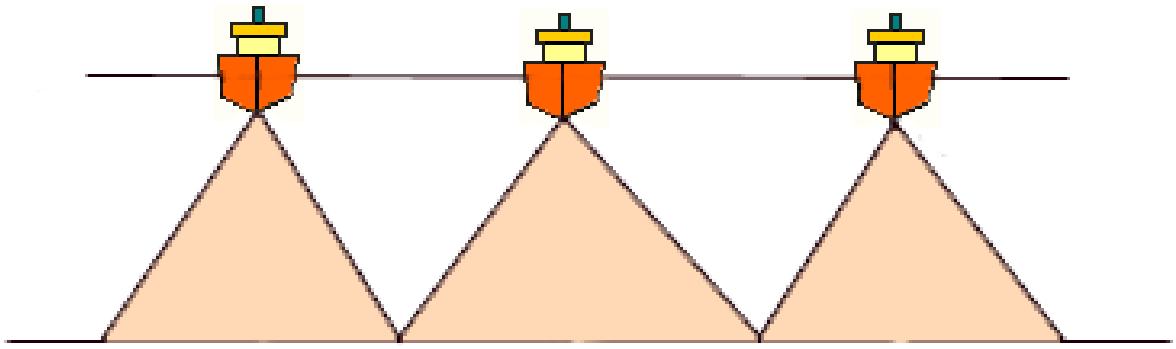
Figure 2



7.3.1.2 Overlap for Orders MB-1 to 3

1. The swath coverage for Orders MB-1, MB-2 MB-3 is to be 100% (see Figure 3).

Figure 3



7.3.2 *Target Resolution Based on Inter-Ping Gap*

1. To ensure insonification sufficient to delineate small wavelength features on the seabed, a minimum of three along track and three across track strikes on a target of specified size are required.

2. To achieve the above, the centre-to-centre distance of each ping (i.e. the bore-site spacings) should be no more than half the required target dimension apart.

7.3.3 *Logging Hiatuses*

1. MBES systems will experience gaps in recorded data for many reasons. The following table includes a column defining the maximum number of sequential pings that may be missed for each order of survey.

Table 14

Order of MBES Survey	No of Missing Sequential Pings Permitted
MB-Special	10
MB-1	10
MB-2	7
MB-3	3

7.4 *Multibeam Line Orientation and Spacing*

1. Sounding track-lines are to be parallel to adjacent track-lines and also the bathymetric contours wherever possible.

2. Track-lines are to be spaced such that the depth accuracy for the order of survey is met.

7.5 *Multibeam Survey Cross Lines*

1. Cross lines are to be run at angles of 60° to 90° to the main track-lines at intervals not exceeding 10cm on paper at the scale of the rendered sounding sheets.

2. A statistical comparison of raw data between the main survey swath and cross line swathes is to be undertaken to ensure that the accuracy requirements of the order of the survey are met. A summary of the statistics and definitive statements about the results are to be included in the Report of Survey.

3. Cross line comparisons will be used by LINZ to assess quality of the data. Raw and Processed Data sets of track-line crossings will be required to be delivered at intervals throughout the survey for ongoing LINZ validation.

7.6 *Acquired Data*

1. Data acquired during turns and when following sinuous track-lines is to be logged but not to be incorporated into the final processed data-sets. However, on providing evidence that accuracy requirements are acceptable during these manoeuvres, they may be incorporated into the final processed data-sets on the approval of the LINZ "Quality Assurance Representative".

2. The exception to this is data acquired during periods of calibration and testing. During these times all data is to be logged and processed.

3. Data acquired by the outer beams of the MBES which fall outside the required accuracy standard are to be used for reconnaissance and are to be logged but not incorporated into the final processed data sets.

7.7 *Multi-beam Back-scatter*

1. For all MBES surveys for LINZ the received back-scatter intensity is to be logged and supplied as a survey deliverable. All MBES acquire back-scatter data but the method by which the intensity is derived varies with the system used. Documentation describing the method by which the back-scatter intensity is derived is to be supplied as a deliverable.

7.7.1 *Multi-beam Back-scatter Parameters to be Logged*

1. The following parameters are to be logged at all times when an MBES is being operated for a LINZ survey. The raw logged parameters are to be rendered as a deliverable (See also section 11.2.2).

    - Back-scatter Intensity
    - Source level
    - Pulse Length
    - Transmit Beam Patterns
    - Receive Beam Patterns
    - Receiver Time Varying Gain Functions
    - Path Length Attenuation Characteristics, (Spherical spreading and absorption co-efficients)
    - Seabed Grazing Angle

7.8 *Multi-beam Echosounder Calibrations*

7.8.1 *Mobilisation Calibration*

1. Fully documented calibrations of the MBES and all peripherals are be undertaken prior to each survey project or after any significant component swap-out of the MBES system or associated sensors. As a minimum, such calibrations are to quantify the following error sources or to verify their correct measurement:

    - Sensor offsets
    - MBES time latency
    - Gyro alignment
    - Roll and pitch alignment
    - Heave sensor measurements
    - Sound Velocity Profile
    - Vessel draft, settlement and squat changes whilst underway
    - Cross-talk between pitch and roll measurements (due to misalignment of motion sensor).

2. In addition, the following procedures are to be undertaken prior to each survey project or after any significant component swap-out of the MBES system or associated sensors:

    - Target Detection Capability Verification, to validate the system ability to detect targets of the minimum size required by the order of the survey. Such tests should include use of side scan to verify all targets have been detected, particularly in water 40m or less.
    - Ground-truthing of the back-scatter signal against physical bottom samples
    - Determination of the settlement period of all motion sensors after typical end-of-line / start-of-line manoeuvres.
    - Acoustic noise interference test. This test must demonstrate that the level of vessel noise at all combinations of propeller revolutions and pitches expected during the survey does not interfere significantly with

the MBES system. The test must also demonstrate that acoustic noise from other vessel sensors expected to be in use during the survey does not interfere with the MBES system.

- A comprehensive cross-line analysis or "patch-test" to verify the system capabilities after all corrections have been applied.

7.8.2 *Periodic Calibration*

1. The following errors have to be quantified by calibration on a six-monthly basis or after any significant component swap-out of the MBES system or associated sensors. In addition, the following errors have to be quantified immediately prior to demobilising the survey vessel at the end of a project.

    - MBES time latency
    - Gyro alignment
    - Roll and pitch alignment

7.8.3 *Daily Verifications*

1. The following daily checks are to be undertaken during MBES operations:

    - Transducer draft measurement.
    - Comparison of the MBES centre-beam data with a single-beam survey echosounder.

7.8.4 *Calibration Documentation*

1. A comprehensive report documenting the MBES system, the methodology, raw results obtained and processed results of the calibrations is to be rendered and approved by LINZ prior to commencement of the survey work proper. This report is to contain evidence of compliance with this Standard to validate the MBES performance for the Order of Survey being undertaken. A copy of the report is also to be included in the "Quality Assurance Data Pack".

2. The calibration report is to be accompanied by the necessary digital files and plots.

7.9 *Additional MBES Survey Deliverables*

1. In addition to the digital deliverables detailed in section 11 "DIGITAL DATA" and other deliverables detailed in this document, the following specific deliverables are required for MBES surveys:

7.9.1 *Sun-Illuminated Images*

1. Using the Processed Data Set (see section 11.1.2 "Processed Data Set"), hard copies of two sun illuminated images from orthogonal directions are to be rendered. Chart scale and limits are to be the same as those specified for the Standard Sheets. A suitable vertical exaggeration is to be chosen. The images may be depth coded for colour or may be rendered simply in grey-scale.

2. In addition, the above images are to be rendered as TIFF files on CD-ROM.

7.9.2 *Gridded Depth Encoded Images*

1. Using the Processed Data Set (see section 11.1.2 "Processed Data Set"), hard copies of Gridded Depth Encoded Images are to be rendered. The grid image is to be of a mean surface selection rather than shoal biased selection, with grid spacing at the resolution of the smallest resolvable target size for the order of the survey. Chart scale and limits are to be the same as those specified for the "Standard Sheet". Depth is to be coded in colour with suitable vertical intervals.

2. In addition, the above images are to be rendered as geo-referenced GeoTIFF files on CD-ROM.

7.9.3 *Calibrated Multi-beam Back-scatter Strength*

1. A digital file containing the back-scatter strength for every ping averaged across 2° intervals of the whole of the MBES angular sector used for the survey is to be rendered. The file structure and format is to be fully documented. The reduction methods and parameters used to derive the back-scatter strength are to be clearly documented.

7.9.4 *Regional Map of Mean Back-scatter Strength*

1. A hard-copy mosaic image of back-scatter strength across track for every ping for all survey lines is to be produced. The plot is to use the highest possible

across-track resolution for the MBES angular sector used for which depth accuracy meets the order of the survey. Chart scale and limits are to be the same as those specified for the Standard Sheets. Digital files of the above images are also to be rendered. Digital files are to be in GeoTIFF format and are to be rendered on CD-ROM.

7.9.5 *MBES Calibration Deliverables*

1. All calibration reports, digital files and plots which have been used to validate the MBES system at any time during the survey are to be rendered as part of the Quality Assurance Data Pack.

8 TIDAL OBSERVATIONS

Primary Reference: Admiralty Tidal Handbook No.2

8.1 *Sounding Datum and Chart Datum*

1. Sounding Datum and Chart Datum are defined as follows:

   a. Sounding Datum is a low-water plane to which soundings are reduced and above which drying heights are given on the Standard Sheet and in other survey records.

   b. Chart Datum is the level to which soundings are reduced on the published chart and to which tidal heights are referred in the NZ Nautical Almanac (NZNA) and Admiralty Tide Tables (ATT). It should be a plane so low that the tide will seldom fall below it but some datums, fixed many years ago, do not conform. It may, or may not, be the same as Sounding Datum.

2. The datum to be used during the survey will normally be described in the survey contract, and may not always be that of the published chart. If it is not, care must be exercised when comparing surveyed depths with the chart. All references to the datum used during the survey should bear the wording "Sounding Datum".

3. Sounding Datum is to be determined by conducting a transfer in accordance with the methods specified in the Admiralty Tidal Handbook No 2. This involves simultaneously recording observations at both the tide station in survey area and the nearest Standard Port for a period of at least 4 low waters and 3 high waters at spring tides.

4. Sounding Datum derived from the transfer is to be further checked by plotting low water heights for the Primary tidal stations gauges against the Standard Port for 30 days and using linear regression to verify the intercept of the line through all points is consistent with the value for sounding datum .

5. Sounding Datum is also to be checked by inspecting the coastline and drying heights on a day when the tide falls close to datum to verify the precision. Comments on this check are to be made in the rendered reports.

8.2 *Establishing Datum*

1. In many cases, surveys will be conducted in areas where a datum value already exists. If the bench marks associated with the original datum can be

recovered, datum is to be re-established by levelling. If the bench marks have been destroyed an acceptable datum may be re-established by making observations for MSL.

2. If an incorrect datum is chosen, or is revised as a result of data collected during the survey, the rendered data is to be adjusted to conform to the amended datum prior to drawing the fairsheet. When the data is referred to a single tide station, a simple block shift can be applied to the data. In the case of reduction using multi-station models (tidal triangles), the adjustment is much more complicated as the datum relationship is a sloping plane rather than a simple vertical difference.

3. All interim sounding is to be reduced to either predicted or observed tides corrected for temporary datum and then reprocessed for the correct datums once it has been confirmed. Temporary datums are to be nominally established by semi-diurnal sounding datum transfer.

4. In all cases, the new datum must be connected by levelling to a minimum of three fixed benchmarks in the vicinity. When existing datums are provided relative to fixed marks, levelling between pole/gauge and all of the available marks is to be conducted when recovering datum. Full details of all transfers, observations, levelling comparisons are to be detailed in the survey report.

5. When an existing datum is re-established from benchmarks, the MSL value above the Chart Datum value provided by LINZ is to be checked by 25 hours of observation, typically incorporated in the pole/gauge comparison. Observed discrepancies are to be reported to LINZ Contract Manager who will provide further advice.

6. If, during the course of a survey, the datum is found to be unsuitable for any reason, LINZ should be informed without delay. Any adjustments made to the datum during a survey are to be fully documented in the survey report.

7. Datum in an Estuary or Narrow Bay. In an estuary, or narrow bay, where the range of the tide alters progressively, datum everywhere should be the low water level of a tide which falls to Chart Datum at the main port, or tidal station, as advised by LINZ. However, care is necessary in the transfer of datum from one part of the estuary to another, and it must be borne in mind that the actual tidal characteristics will vary from place to place. In addition, meteorological effects (e.g.. persistent winds causing the water to pile up) may often affect one shore more than another (see Admiralty Tidal Handbook No.2).

8. Datum in a River. Datum in a river cannot normally be established by transfer from a gauge outside the river. It must be remembered that as the tide progresses up the river the heights of MHWS and MLWS, or MHHW and MLLW, gradually approach each other until they become coincident. Still further up, Neap tides sometimes fall lower than Spring tides. The positions at

which these changes take place can only be established by observations at Springs and Neaps by suitably placed gauges.

9. The levels of many rivers vary markedly with the seasons, and for this reason datum in a river is usually established at the lowest level to which the river falls in the driest season of the year (see Admiralty Tidal Handbook No.2).

8.3 *Connections to Benchmarks*

1. Sounding datum must always be connected by spirit levelling to at least 3 permanent Bench Marks ashore, established close to each tidal station. See "*Specifications for Geodetic Hydrographic Control Points.* LINZ OSG" for details. Depending on the locality, these marks may either be part of, or connected to, a local land levelling system. These BM are to be used as witness marks to recover the sounding datum or for checks on movement of the gauge or pole.

2. When an established tide gauge (belonging to a local authority) is to be used, the gauge zero versus datum value must always be checked independently to ensure that it corresponds to the stated figure. Most Port gauges have the zero set to Chart Datum. This check is to be documented in the Tidal Data Pack.

3. When any tide gauge is used, other than an offshore bottom-mounted gauge, a tide pole is always to be erected nearby and levelled to benchmarks to establish/recover sounding datum. The pole is also to be used for checking and comparison with the gauge to calculate the datum relationship on the gauge (pole/gauge comparison). A tide pole is also required when a near-shore bottom-mounted tide gauge is deployed. It will be used to establish MSL by at least 25 hours observation, preferably 3 days (75 hours), at the beginning of gauge operation. This will allow a positive tie-in of the gauge datum with the benchmarks via a common MSL, determined from simultaneous observations. The method of relating datums to benchmarks is impracticable in offshore waters, and the datum there will be related to MSL only.

4. Levelling is to be conducted between the three BM, the tide pole and any existing BM in the vicinity. Levelling is to comprise a looped traverse recorded to the nearest mm except for readings made directly to the tide pole. The specifications for levelling are detailed in "*Specifications for Geodetic Hydrographic Control Points.* LINZ OSG".

5. If BM's are inconvenient, have been destroyed, or local intelligence suggests that they may be disturbed, new marks should be established and levelled to.

6. Site descriptions and diagrams are to contain bearings and taped distances to identifiable permanent features in the vicinity. A second or third benchmark

must therefore not be described solely in relation to the first. Panoramic photographs with each benchmark identified are to be taken and rendered in the Geodetic Data Pack.

8.4 *Establishing Tidal Stations*

1. Tidal stations will be referred to as Primary and Secondary Tidal Stations.

2. The following specifications are to be used when establishing tidal stations;

   a. Primary Tidal Station: Comprises a tide gauge capable of recording both tidal time and averaged tidal height at intervals of at least every 10 minutes, a tide pole, and a minimum of three benchmarks close to the gauge. The bench marks are used to link sounding datum to the tide pole though accurate spirit levelling, and also as witness marks, and to recover sounding datum or checking on pole or gauge movement. There is to be a 25 hour pole to gauge calibration conducted at each primary site at or near to spring tides to derive the tidal calibration curve.

   b. Secondary Tidal Station: Comprises a tide pole and a minimum of two benchmarks, linked by levelling. Records are made manually by tide-watchers for the duration of the periods of observation.

3. At all tidal stations the following recording parameters are to be used:

   a. Tidal time is to be recorded to within +/- 5 seconds.

   b. Tidal height is to be recorded to within +/- 0.01m. The recorded value is to be an average of height samples taken over a minimum of 30 seconds centred on the time of reading.

4. When selecting a tidal station site, the surveyor should be guided by the criteria contained in AMHS Vol. 2 Chap 2 Section 8.

8.5 *Calibration of Tide Gauges*

1. Modern digital tide gauges do not require instrument calibration in the field and should be returned for repair if found to be recording erroneous data. Standard procedures for pre-deployment checks are contained in relevant manufacturers' handbooks.

2. The calibration or connection of the gauge to the pole and thereby to the BM's is to be conducted by recording pole and gauge readings at 30 minute intervals for a period of at least 25 hours and preferably during spring tides. For the

period 30 minutes either side of high and low water, readings should be taken every 10 minutes. These readings are then to be plotted on graph paper, the pole along the Y axis and the gauge along the x axis to display the pole/gauge relationship.

3. A straight line will mean that a direct relationship exists between pole and gauge. This is the Tide Gauge Calibration Curve and is to be rendered with the ROS. The gradient, Intercept and RMS error must also all be rendered.

4. A table with the following three columns detailing all the raw pole and gauge readings is to be rendered in the ROS:

    - Time
    - Raw Pole Reading
    - Raw Gauge Reading

5. All rendered sheets detailing the calibration must state the tide-gauge make, model, serial number and location as well as the date and times that the calibration took place

6. Gauge readings are to be verified for reliability and accuracy by using the Calibration Curve before being converted to pole heights, then reduced to sounding datum heights before being used for reduction of soundings.

7. Once established, a daily check of the tide pole and gauge is to be conducted to ensure that the relationship remains valid. The frequency of this check may be relaxed on written approval of the LINZ "Quality Assurance Representative". If a gauge becomes defective and has to be re-established, then a new calibration must be conducted. All daily checks are to be rendered as part of the ROS.

8.6 *Use of Co-Tidal Charts*

1. If co-tidal reduction methods are specified or utilised, the contractor should construct a co-tidal chart for the survey area following the methods described in AMHS Vol. 2 Chap 2. Such charts take into account the tidal range ratios and HW and LW time differences over the survey area, based on values from a nearby standard port.

2. If co-tidal reduction methods are employed, the contractor must render a co-tidal chart as an A1-sized "Accompanying Tracing", suitably labelled showing co-tidal time curves as well as co-tidal range curves for the survey area. If one chart is utilised to show both sets of curves, each set of curves is to be depicted in its own distinct colour. See section 10.4.6.1 for details of "Accompanying Tracings"

8.7 *Tidal Observations*

1. The contractor must always obtain observations for each of the tidal regimes which may occur within the survey area to ensure that an accurate tidal model can be constructed.

2. Tidal observations are required for the reduction of soundings and for predicting tidal characteristics and updating Admiralty Tide Tables.

3. The interval between observations of the height of tide is governed by the range of the tide at the pole/gauge site; the normal interval for pole observations is 30 minutes, but if the range is small, hourly readings will suffice. However, in places where the range is great, intervals of 15 or even 10 minutes must be maintained in order that the tidal curve may accurately reproduce the tidal movement, and that errors in the reduction of soundings are minimal. In all cases, observations must be taken at 10 minute intervals near High and Low waters so as to accurately time and model these events, this therefore sets the logging interval for gauges. All tidal observations are to be made in Universal Time Co-ordinated (UTC).

4. Tide pole observations are to be recorded in a tabular form. Summaries of reduced tidal data displaying half hourly heights with tabulated high and low waters are to be rendered with the Report of Survey. Tidal heights should be recorded to ±0.01 metre; times are to be better than ±2 minutes.

5. Digital tide gauge data is to be rendered together with relevant deployment records and logging parameters. It is important that gauge data is correctly annotated to differentiate it from the pole readings. Digital tidal data is to be stored in ASCII files in terms of time and height to the nearest 0.001m.

8.8 *Reduction of Soundings for Tide*

1. In reducing soundings, the principle to be observed is that depths are never to be shown as greater than they actually are, relative to chart datum (sounding datum).

2. When using manual tidal reduction techniques, a true tidal curve obtained from tide pole or gauge readings (corrected to sounding datum), and adjusted if necessary by co-tidal factors, is to be reproduced on the echosounder trace. This line is to be used throughout as the zero for transferring soundings directly from the analogue trace.

3. In digital logging and processing systems, the tidal data for each station, whether predicted or observed, will be in a discrete file. The system will

utilise the data to interpolate the tidal heights as required, and reduce the raw depths to Sounding Datum.

4. In some circumstances, it may be sufficient to use predicted tides for the reduction of soundings. Such predictions are to be generated from approved computer prediction programs and must be approved by LINZ before acceptance of the rendered survey.

5. Tidal reductions applied to soundings within and external to any tidal model boundaries are to be periodically checked for validity.

6. In some circumstances, especially when using conventional survey methods in bathymetrically complex areas, consideration should be given to splitting the survey area into multiple sub-areas centred around localised secondary tidal stations.

7. LINZ may specify in the survey contract the preferred method of reduction of soundings and tidal model, and surveyors are to report any problems with implementation of these instructions.

8. In areas where the character of the tide is unknown, tide poles or gauges should be set up at regular intervals. A comparison of the curves from adjacent gauges should show whether any intervening area requires a separate tide station and, subsequently, whether a co-tidal model should be used.

9. It is often possible to refine a co-tidal model, or guard against gross errors, by mooring the ship or boat in a convenient part of the area where the bottom is flat. Depths are then taken at regular intervals for one or more tidal cycles. From these observations, which must be taken in calm weather, and preferably near Springs, approximate range ratios can be obtained, as well as the time differences for High and Low Water. The flat bottom sounding method described above should only be used as a last resort.

10. As a precaution when undertaking coastal surveys, the times at which detached drying rocks are awash should be noted and compared with the tide reduction values. If the reductions are always the same at the times that the rock is awash on successive rising and falling tides, and particularly if the rock is awash at half-tide (greatest rate of change), then there can be no doubt that the correct reductions are being used. If significant differences occur, the reductions are incorrect. Results of this check should be included in the Tidal Data Pack.

11. In certain areas where there is a large tidal range, and especially where high standard accuracy is required, it may be necessary to sound only within one hour of High or Low Water. This will reduce the effect of any differences between the time of the tide at the tidal station and in the area being sounded, as the rate of change of tide is at a minimum. If there is a suspicion that the

tide pole/gauge is impounded at Low Water, sounding will need to be further restricted to High Water periods only.

8.9 *Tidal Streams and Currents*

1. The direction and rate of tidal streams are to be observed wherever they are of navigational significance and where there is no evidence that observations have been made previously. Positions will normally be indicated in the survey contract, but Surveyors-in-Charge are to include additional stations if they consider this necessary. Entrances to harbours, channels, navigable straits, anchorages and in the vicinity of wharves are the most important.

2. When using a pole logship, it is only practicable to observe tidal streams over a limited period. The observations should be undertaken at Springs and are to last at least 26 hours in semi-diurnal waters, and no less than 49 hours in diurnal waters. Speed and direction for logships should be determined with an accuracy of at least ± 0.1 knot and ± 5° respectively.

3. When observations are made using a digital recording current meter, the current meter must record an average tidal stream between the sea-surface and 5 metres depth.

4. When observing tidal streams, simultaneous observations of tidal height must always be obtained at the nearest convenient location, preferably by deploying a digital tide gauge on a common mooring with the current meter. When using a pole logship, all reasonable care is to be taken to prevent inaccuracies which could result in faulty analysis and erroneous deductions regarding the character of water movement at the location. Observations should not be made under abnormal weather conditions.

5. Logship observations are to be recorded and rendered in an appropriate format. Tidal stream observations obtained from digital recording current meters are to be downloaded to disc and then processed. A copy of the raw downloaded data is to be rendered in addition to the processed data.

6. In addition to measuring the tidal stream using current meters or drifting logships, information of a less formal nature which may be of navigational significance is to be recorded and rendered, especially if it may effect low powered vessels or yachts. Data should include the estimated maximum rates at Springs and the directions of tidal streams assessed by the best available means. Local knowledge should be sought where possible.

7. This data is of particular importance in narrow channels, and may vary between the centre and the sides of the passage, and with the direction of flow. Data should be shown on the Standard Sheet or an accompanying tracing, and is to be described in Amendments to Sailing Directions and in the ROS.

8. Full instructions for observing and analysing tidal stream observations are contained in AMHS Vol. 2. Chapter 2. In processing tidal stream information, results are always to be related to the closest standard port and are to clearly state the recommended text and numerical values to insert in the resultant, charted, "tidal diamond" table.

8.10 *Eddies and Overfalls*

1. In areas of strong tidal stream, especially in the vicinity of banks, rock shelves, headlands and in narrow passages, eddies and overfalls may occur which can be of considerable significance especially to low-powered vessels or yachts.

2. The limits of these phenomena are to be fixed on both directions of the tidal stream, inserted on the Standard Sheet or an accompanying tracing, and remarked on in the ROS.

9 MISCELLANEOUS OBSERVATIONS

9.1 *Nature of the Seabed*

1. Determination of the composition of the seabed, the collection of samples and interpretation of the side-scan sonar trace or MBES back-scatter trace are required during surveys on the continental shelf (unless otherwise stated in the contract document). If seabed texture tracings are required, specific reference will also be made in the contract document.

2. In depths less than 200 metres, the nature of the seabed is to be obtained as follows:

    a. in all charted and likely anchorages;

    b. on all banks, shoals and seamounts, particularly where these are likely to be unstable, and in the channels between them;

    c. at regular intervals in a systematic pattern throughout the survey area. Unless otherwise stated in the contract document, the interval between samples is as follows: In depths under 100m at interval of 10 cms on paper at the rendering scale. In depths between 100m and 200m this interval is increased to 20 cms;

    d. as required to assist in the interpretation of side-scan sonar records or MBES back-scatter records, and

    e. at the discretion of the Contractor.

3. All samples taken are to be recorded and reported in the ROS. The position and nature of the seabed samples are to be recorded. Sample types are to be classified in accordance with the types shown on pages 36-38 of NZ 201. If sample retention is specified in the contract, the samples required by subparagraphs a and b, and 10% of c and d above are to be rendered.

4. Samples are to be obtained by diver, grab or dredge. It is especially important to obtain a substantial sample when attempting to relate it to the seabed texture as depicted on the side-scan sonar or MBES back-scatter trace. The Shipek grab should not be used for sampling soft or liquid mud, as the sample will wash out before the grab reaches the surface.

5. Some indication of bottom type can be deduced from good side-scan sonar or MBES records, and these are especially useful in deciding where one type of seabed merges into another; from this the surveyor may also be able to determine where additional sounding lines will be necessary, for instance in areas of rock or sand-waves. Areas of soft mud overlaying a hard bottom, indicated by a dual-frequency echosounder, are to be noted in the ROS.

9.2 *Freshwater Springs*

1. The positions of any fresh water springs are to be fixed during normal surveying operations. Indications of such a spring will usually be obtained from the echo sounder trace, and must be verified by water samples.

9.3 *Fixing of Floating Navigational Marks*

1. Lightships, light floats and buoys should be fixed in both their flood and ebb positions to determine the scope and, if plottably different, these should be shown on a tracing accompanying the Standard Sheet. The mean position should be shown on the Sheet, or an accompanying tracing, and used in correspondence.

2. If a floating navigational mark is used to check an EPF system, allowance must be made on every occasion for the way it is lying to its mooring.

3. When a mark is found to be sufficiently displaced as to be a navigational hazard, it is to be reported without delay using an Hydrographic Note (See Annex A).

9.4 *Characteristics of Lights and Buoys*

1. The characteristics of navigational lights, both on shore, and on beacons and floating marks, are to be carefully checked in the field and compared with the entries in the current amended Admiralty Light List, NZNA and on the relevant charts. Light sectors are also to be checked in the field. Such checking is to be done by ship-borne observation and logging the arcs and cut-off.

2. Where differences in the details are found, local authorities should be asked whether the changes are permanent. Discrepancies are to be forwarded in the reports or by Hydrographic Note (Annex A) if considered more urgent. Any lights found to be unlit or to have significantly modified characteristics are to be reported immediately to LINZ . To avoid ambiguity, the Light List Volume and the International Number of the light are always to be quoted when reference is made to a listed light.

3. The characteristics of all lights and lightbuoys checked in the field are to be shown on the Standard Sheet, or an accompanying tracing.

9.5 *Secchi Disk Observations*

1. Secchi Disk observations are to be performed when called for in the contract. Unless otherwise specified in the contract, observations are to be taken at 10km intervals in general depths of 20-30 metres.

2. The extinction depth on the down-cast, the up-cast and the mean are to be rendered in the ROS together with the position of the cast. The the apparent colour of the disc (e.g. Blue/green) is also to be stated.

9.6 *Nomenclature*

1. In general, names should be accepted from the latest maps (or charts) of an area, where these are published by an authoritative source. Names and spelling from maps (including topo and cadastral) are accepted for features above the level of MHWS/MHHW.

2. In areas where there are no modern maps or charts, every endeavour must be made to ascertain the correct names and spelling from local authorities. The source from which names have been obtained should be given in the Report of Survey.

9.6.1 *Proposals for New Feature Names*

1. The names of any newly located underwater features for which names cannot be ascertained may be proposed by the surveyor and used in the survey. The Report of Survey is to indicate which are the new names proposed and brief reasons for choosing them.

2. Where a name is in use locally, its origins should be ascertained and summarised in the Report of Survey. Proposed names (whether new or locally known) may appear on Standard Sheets and other documents accompanying the Report, but should be shown in brackets to indicate their provisional nature.

3. It is undesirable to have too many names. The need to name a feature depends primarily on its significance to the mariner and navigation. New names should not be proposed for minor or insignificant features.

4. The contractor is responsible for ensuring that any new name that is proposed during the undertaking of a hydrographic contract is forwarded together with all the required documentation to the Chief Topographer/Hydrographer for consideration.

5. The contractor is also responsible for ensuring that any officially undocumented but locally used name that comes to light during the undertaking of a hydrographic contract is forwarded together with all necessary documentation to the Chief Topographer/Hydrographer for consideration.

6. An information pack which gives precise instructions for submitting and documenting name proposals can be obtained on request from:

   The Chief Topographer/Hydrographer
   Land Information New Zealand
   Private Box 5501
   Wellington
   New Zealand

7. All proposals and documentation for undersea feature names should be in accordance with the IHO document "Standardization of Undersea Feature Names".

8. The following is a summary of the LINZ and IHO principles which should be followed when assigning names to features:

   a. A new name is not to be proposed where there is an existing name, even though this may not conform to the accepted guidelines. Check Sailing Directions, topographic maps, etc.

   b. Names should be short and simple.

   c. The principal purpose in naming should be to provide effective, convenient, and appropriate reference; commemoration of persons or ships is a secondary consideration.

   d. The first choice, where feasible, should be a name which is geographical in nature, e.g. South Canterbury Bight.

   e. Where a ship name is used, it should be that of the vessel discovering the feature.

   f. If names of living persons are proposed:

      - Surnames should be used.

      - Choice should be limited to those who have made an outstanding or fundamental contribution to the marine or hydrographic sciences. This does not preclude the honouring of a member of the ship's company or survey party for a particularly worthy performance.

- The person after whom the feature is named must first give their written permission.
- Note that features within the 12nm New Zealand Territorial Seas must not be named after living persons.

g. Groups of like features may be named collectively, e.g.. Star Reefs, where the individual features bear names of stars.

h. Names should not be duplicated within New Zealand's area of charting responsibility. Consideration of duplicated names may, however, be made on a case by case basis by the NZGB.

i. Descriptive names are acceptable when they refer to distinguishing characteristics, e.g.. Halfmoon Reef.

j. Obscure, personal or flippant names are not to be used. The following categories of names must not be used:

- Names in poor taste
- Names that are in any way of a derogatory nature
- Names that are inappropriate
- Names that are insulting

k. When using generic terms, the following definitions should be considered; however, generic terms should not be combined, as in "Shoal Bank". The following terms have been sourced from IHO SP 32 - "Hydrographic Dictionary":

- BANK - an elevation over which the depth of water is relatively shallow, but normally sufficient for safe surface navigation.
- REEF - A mass of rock or coral which either reaches close to the sea surface or is exposed at low tide, posing a hazard to navigation.
- SHOAL - an offshore hazard to surface navigation composed of unconsolidated material, except coral or rock.

(Other terms may be found in NP100, The Mariner's Handbook.)

9.7 *Sailing Directions*

1. During the course of any survey, the relevant Sailing Directions are to be carefully examined and suitable amendments are to be included in the ROS. Notes for these amendments must be kept throughout the survey, as the need for them is realised, and the revised text should be compiled immediately after the completion of work in the field, when every essential point is still fresh in the mind. It is not possible to write Sailing Directions solely from study of the Standard Sheet. Early thought to the matter of Sailing Directions will ensure that the need for additional details, such as accurate positions, is identified before the ship leaves the area.

2. Sailing Directions are written by the surveyor as information supplementary to the Standard Sheet, but should also be applicable, if possible, to the existing published chart. It should be borne in mind that the revisers of Sailing Directions do not normally see the Standard Sheet and will use the published chart when examining the surveyor's proposed text. Consequently reference objects should whenever possible be common both to the chart and Standard Sheet.

3. As a general rule the Sailing Directions applicable to a survey will be covered by only a few pages in the published volume, but care must be taken to check the general information in Chapter 1 as well as that in any of the appendices which may be relevant to the area being surveyed or to adjacent localities.

4. Sailing Directions should always be checked whilst on passage or when visiting a new port and all changes reported by letter or by Hydrographic Note (See Annex A).

9.8 *Amendments to Sailing Directions*

(Ref. NZ Pilot)

1. In 1983 the UK Hydrographic Office introduced a revised style for the Admiralty Pilots, to be introduced gradually as each volume was due for major revision. To date few Pilots have appeared in the new style but the UKHO has requested that amendments for all Pilots be submitted in the new style when large amendments, which involve complete rewriting, are involved.

2. The aim has been to change from the present, discursive style to a more succinct one that concentrates on the channels and waterways with details of the marks and directions required for safe navigation.

    a. Texts are now being divided into waterways which are described with:

- An introduction - topography, pilotage, natural conditions, navigation marks.
- directions for the passage.
- ports and anchorages.

b. Ports are given an introduction followed by limiting conditions, information required prior to entry, directions, berths and port services.

c. Only detail of importance to safe navigation is included.

d. No attempt is made to describe the chart.

e. Repetition within the volume and between the Sailing Directions and other publications is minimised.

f. Unimportant names are listed separately at the end of each "waterway" and no attempt is made to introduce them into the text.

g. A standard format is adopted where possible.

h. Cross-referencing and indexing are done by paragraph number.

3. The surveyor should always be prepared to be more expansive in the text than is likely to be necessary for the published book. The reviser will then be able to get a fuller picture of the area and will be able to condense or revise the proposed amendments with more authority.

4. Surveyors should write amendments to the Sailing Directions in their own words whilst adhering to the following principles:

a. Treat the area in strict geographical sequence following the general direction of the published book unless this is obviously very illogical or inconvenient. In general, deal with matter in the order in which it will be sighted or used by a mariner arriving from seaward, or taking passage along the coast.

b. Bear in mind that Sailing Directions are intended as a brief for the stranger arriving at a place for the first time. Set out in words a methodical description of the area step by step. The emphasis should be placed on describing waterways rather than coasts, eliminating from the text information which is not directly relevant and which can be obtained from the published chart. Remarks should start with a general description of the area, covering topography and landmarks, together with any other information of a general nature, such as tidal streams, affecting the entire area. Thereafter it should be broken down into sections of 10 to 30 miles, depending on the amount of information available, with the larger ports being treated as individual sections.

Particular attention should be paid to information which it is difficult or impossible to show on the Standard Sheet or in other records.

c. When rewriting or amending an existing text it is important to realise that the reviser needs to know the detail of the new information and that which has changed as well as that which is no longer correct and should be deleted. For instance when a pilotage station has moved the amendment should give its former position as well as the present one. The reviser will then know that a positive change has taken place.

d. Important navigational marks are to be fully described in the Sailing Directions. Leading lines, recommended tracks, and measured distances are also to be fully described, and should include appropriate pilotage advice.

e. Whenever possible, any structure specifically mentioned in Sailing Directions should be illustrated by photographs (see section 9.10) and general views (photographic or manuscript). These are especially valuable in the approaches to ports, and along recommended leading lines.

f. Directions for channels, approaches and entrances to harbours should always be given just as an embarked pilot would advise a mariner when approaching for the first time. Such directions should have been used navigationally, or obtained from local pilotage sources, and not merely written up from an inspection of the survey after leaving the area.

g. Ports and harbours must be fully described as an aide memoir. To avoid unnecessarily long descriptions of large ports it will often suffice if copies of the port brochures and regulations are obtained and forwarded with the Sailing Directions. Attention is also drawn to section 3.11 (Coastal and Harbour Facilities). The details required by this paragraph are also required in the Sailing Directions.

h. Where applicable, details of several shoals in a given locality may be indicated by a general statement referring the reader to the chart, e.g.. "Within 1.5 miles NNE of Cape Best a number of shoals exist, the positions of which can best be seen from the chart". It is most important that ambiguous and vague statements be avoided, e.g.. "Another shoal lies a little further to the west".

i. Tidal streams, overfalls, and currents in the area should be described. There is no need to produce tidal stream tables as would result from observations and as shown on some charts, but a semi-tabular layout is often possible and preferable to lengthy sentences in the text.

j. Metric units are to be used for depths, heights and distances on land, whilst distances at sea are to be given in nautical miles and decimals. Cables are not to be used.

9.9 *Amendments to Other Publications*

1. The following publications are also to be checked for any errors or omissions during the course of the survey. Proposed amendments are to be included in the Report of Survey:

    - New Zealand Nautical Almanac
    - Admiralty List of Radio Signals
    - Admiralty Light List

9.10 *Photographic Views*

1. The requirements for photographs to illustrate Sailing Directions are fully described in NP140 (Views for Sailing Directions) together with methods to be employed, helpful techniques and methods of annotating and rendering the data. This reference should be carefully studied before a programme of view photography is contemplated.

2. Whilst NP140 specifically describes the methods to be employed for illustrating Sailing Directions, the same techniques should equally be applied to the illustration of the ROS in order to assist the cartographer in interpretation of significant features in the survey area which are not appropriate to Sailing Directions. Thus panoramic views of a coastline to illustrate cliff lines and prominent features, or to illustrate that certain charted features are not visible to the mariner, should be obtained in a similar fashion and rendered with the ROS. Ships with helicopters should take every opportunity to obtain oblique photography.

3. It should be remembered that photographic views of low-lying coastlines may not be particularly effective; in these circumstances a hand-drawn view using an expanded vertical scale will often be preferable. It will often be useful, however, to obtain a photographic view from the same position as a hand-drawn sketch for comparison purposes.

10 PROCESSING AND RENDERING OF DATA

10.1 *General Principals*

1. The care and attention devoted to work in the field must be extended to all aspects of preparing the fair data, and to the careful and legible annotation of all original material. The underlying principle to be observed in compiling records of any survey is that they must be entirely intelligible to any person having a sound knowledge of the type of survey concerned, and who may be required to process either the final data, or the original field data. The preparation of all data in the established manner, neatly, concisely and accurately, is absolutely vital.

2. The Surveyor-in-Charge has a prime and very personal responsibility to ensure that the records being prepared by his personnel are compiled in accordance with established practices, that they are fully and independently checked by personnel who are entirely familiar with those practices, and that they are accurate and legible. The Surveyor-in-Charge is to sign all major items of written data rendered, and by so doing accepts that they are of a sufficiently high standard to be accepted by LINZ and subsequently published for use by mariners. Material which does not require a signature must nevertheless be prepared to the same standards, and the fact that it is being forwarded under cover of a Report of Survey or similar document carries the same implications and obligations.

3. Inadequate or erroneous data will be returned to the Contractor for correction at the Contractors cost.

10.2 *Custody and Security of Survey Data*

1. The Surveyor-in-Charge is to ensure that there are positive measures in force to ensure the safe custody of all original and survey data in whatever form, and that there is an organisation whereby the data will be taken to a place of safety should the compartments on board or in shore drawing offices be threatened by fire, flood or other damage.

10.3 *Collection, Collation and Checking of Data*

1. A rigorous and thoroughly documented QC and checking procedure must exist onboard the survey vessel.

2. The Surveyor-in-Charge must establish regular routines for checking that the logging system is recording the same figures that are being displayed on

peripherals such as nav-aids, echo sounder recorders, and other instruments. They must ensure that plotters and printers are recording the data correctly and they must be positive that the manual inputs (such as system configuration changes, navigation system data changes, C-O corrections, etc) are inserted accurately. Such changes must always be approved by the Surveyor-in-Charge and recorded appropriately.

3. As data is recorded, whether automatically or manually, the surveyor must constantly monitor whether it appears consistent with adjacent data already collected. Any apparent inconsistency must be investigated promptly. Whenever records are transposed into another form by calculation or transcription, it is essential that they be fully checked by an independent surveyor. The Surveyor-in-Charge must ensure that fail safe arrangements exist for such checking processes.

4. In particular, when the final fair records of the survey are being prepared, whether on digital media or as a graphic, report or form, it is vital not only that the physical transcription should be checked but that all related documents are examined for consistency and accuracy.

5. In preparing survey records the following general considerations should be borne in mind:

    a. Much of the final data will be unique, will form the basis for amending and maintaining charts and publications until the area is re-surveyed (probably very many years in the future) and will become part of the national archives as a public record.

    b. Graphics will generally be photocopied and will often be photo-reduced when being used for chart compilation. It is essential that all detail is neat, clear and sufficiently bold to be capable of photo reduction without loss of clarity. If, in particular, the soundings have to be severely reduced in size to depict an area satisfactorily, it may be better to enlarge the scale to provide a clearer picture.

    c. Where practicable, 'field' records should be rendered as 'final' records; this will only be possible if they have been neatly prepared and presented in the form required with all necessary additional information inserted. Deletions are not to be erased, but ruled through. Copying from one form to another for the sake of slightly improved neatness, or typing a form which in manuscript was sufficiently clear already, should not normally be necessary and introduces the possibility of transcription errors. Where it is deemed necessary to transcribe original field notes, originals are to be forwarded.

    d. The number of graphics should be kept to the minimum, and their sizes should not exceed the size of an A1 sheet.

e. Compilation of survey data should be progressed concurrently with field work in order that it can be rendered as expeditiously as possible.

f. All Reports of Survey (ROS) must be comprehensive, detailed, but concise. The ROS is the vehicle whereby the Surveyor-in-Charge can explain in full all aspects of the survey which would not otherwise be clear.

6. In a sound Quality Control (QC) environment, it will always be the case that any alterations or adjustments to data are documented and approved by a checker. In practical terms this means that:

   a. Checkers must be nominated and accountable.

   b. Any changes to data must be justified and recorded. Suitable annotation or notes on relevant traces and printouts or remarks in a Post Processing Log are required.

   c. Checkers must ensure that corrective actions taken as a result of the QC process have been satisfactorily carried out before the work is approved; this can be achieved by authenticating signatures incorporated on data sheets and in processing logs.

7. The formal checking of manuscript records against references and original data, the independent checking of computations and the signing of graphics and records that have traditionally taken place are all manifestations of proper quality control.

10.4 *Data to be Rendered on Completion of Surveys*

1. Unless otherwise stated in the survey contract, the following data is to be rendered on completion of the survey:

   a. Report of Survey (2 copies)

   b. Standard Sheet(s) (2 copies - 1 matt plastic/polyester and one paper)

   c. Accompanying Tracings (2 copies - 1 matt plastic/polyester and one paper)

   d. Tidal Data Pack (2 copies)

   e. Geodetic Data Pack (2 copies)

   f. Quality Assurance Data Pack (1 copy)

   g. Digital media

h. Field Records (calibration data, deck books, field tracings and plots, echo rolls, sonar traces and subsidiary hydrographic forms).

2. All documents should be clearly labelled on the front cover with the survey project title, project number, contract number, dates of survey and the contractors name. Field records are to be fully annotated to a level which will allow data to be tracked from date of collection to final sounding on sheets. Wherever relevant, the forms in Annex A are to be used for presenting data.

3. The title pages of all rendered documents must include the text "Crown Copyright Reserved".

4. Rendering of survey graphics, reports, supporting data and documentation are to be approved and signed by the SIC.

5. The Report of Survey, the Tidal Data Pack, the Geodetic Data Pack and the Quality Assurance Data Pack are to be accompanied by a digital copy in WORD 7.0 format.

10.4.1 *Report of Survey*

1. The ROS must give a clear and comprehensive account of how the survey was carried out, the results achieved, the difficulties encountered and the shortcomings if any.

2. The Title Page/Cover of Binder layout should be based along on the following example:

Project Number/Title of Survey
Contract Number
Surveyed by (Name of Company & Surveyor-in-Charge)
Surveyed for Land Information New Zealand
Inclusive Dates
Scale Rendered

REPORT OF SURVEY

Date of Report

3. The Title of the Report is to be consistent with that of the contract and other rendered data, including Standard Sheets. The Title section should also include an A4 size chartlet depicting the completed survey area. This chartlet should appear immediately after the Title Page/Cover of Binder. The chartlet is to include sufficient topographic, and geographic detail to be readily understandable without reference to any other source.

4. The ROS should be in two parts:

Part One (Descriptive)

Part Two (Technical Annexes)

5. Two copies of the report should be rendered to the LINZ Contract Manager. One is to be hard bound and will be treated as the original. The second should not be hardbound and will be used as a working copy.

6. The ROS is to be based along guidelines printed below:

10.4.1.1 Part 1 (Descriptive)

(The Surveyor-in-Charge is required to comment on all sections listed below)

10.4.1.1.1 Introduction

1. Give start and finish dates. Remark on the scope of the survey, any particular difficulties encountered plus any non-surveying activities which interrupted the progress of the survey.

2. Give a general statement on the weather, including the seasonal climate and variations experienced. Comments on weather are essential when surveying unstable, critical areas which require optimum hydrodynamic conditions to determine the absolute minimum depth over each feature. Comments are also required on how the weather affected the quality of data - e.g. ship motion on E/S trace, stability of nav-aid in storms, etc.

3. Comment on any extraneous activities (e.g.. commercial fishing) which affected the conduct of the survey. Mention whether the strength of the tidal stream caused any particular difficulties. Mention any logistic problems.

4. Give an overall opinion of the completeness of the survey. Identify any areas which require further investigation. Include opinion of thoroughness of survey with regard to line spacing.

10.4.1.1.2 Geodetic Control

1. State the horizontal datum, projection, spheroid and grid used.

2. State how much existing geodetic control was used and briefly describe how any new control was established; give a general statement on the degree of accuracy achieved.

3. Include a description of the GPS observations for geodetic control. The description is to cover parameters, problems, solutions of any observations, either static or kinematic. A full description of geodetic observations is to be included in the Geodetic Data Pack.

10.4.1.1.3 Digital Surveying System

1. State which systems were used, if appropriate. Include any desktop or offline systems.

2. Briefly describe any difficulties experienced and venture an opinion of the effectiveness of the systems used.

10.4.1.1.4 Position-Fixing Systems

1. Briefly describe the types and operating modes of the systems used.

2. Give an opinion of the quality and reliability of the equipment.

3. For DGPS, include a brief description of the system and the parameters used.

10.4.1.1.5 Bathymetry

1. State the type of echo-sounders used and the transmission frequencies, especially where dual frequency sets are used. State the results of squat and settlement trials conducted, and how corrections for ship squat were applied.

2. State the type of heave compensation used and give a brief summary of its performance.

3. State the sounding line direction, line spacing and average speed of advance. For shoal investigations, etc, quote the density of the sounding lines and the seabed footprint of the echo sounder beam. Give a general statement of how the bathymetry meets the standards of accuracy required by the contract and note the accuracy of soundings achieved. Detail those periods where accuracy was not achieved and explain why.

10.4.1.1.6 Sonar

1. State the types of sonar used and the transmission frequencies.

2. Mention the type and frequency of confidence checks carried out (cross reference to details described in the Quality Data Pack). Include an opinion of the quality and reliability of the sonar equipment.

3. State the choice of sonar line direction, line spacing, sonar range, and mean SOA.

4. State the sector sweep adopted for hull-mounted sonars and give an estimate of the effective ranges achieved.

5. State the allowance made for side-scan sonar layback at the end of lines and whether or not an extra line was run outside the required survey area limits to achieve a full search.

6. Give an opinion of the thoroughness of the sonar coverage and a definitive statement of the extent and category of side-scan search achieved.

10.4.1.1.7 Seabed Sampling

1. Briefly describe the method of sampling used and mention any problems with the equipment or the recovery of seabed samples. State the sampling interval and any particular samples obtained from interesting features. Quote the number of samples retained (if any).

10.4.1.1.8 Seabed Topography and Texture

1. Give a brief thumb-nail sketch description of the seabed topography of the surveyed area. Provide a statement in relation to all significant features, their nature and distribution throughout the survey area, including areas of liquid mud indicated by dual-frequency echo-sounders. Comment on any difficulties experienced in interpreting the side-scan sonar trace when preparing the 'texture' tracing, if required.

2. State the reason if unable to investigate a shoal as thoroughly as desired and estimate the reliability of the least depth obtained; identify the extra work needed to ascertain the absolute least depth.

3. Give an opinion of the comparison with previous surveys and any doubts on the detection of all existing (charted) shoal depths, or recommendations for retaining previously surveyed depths. Comment on any movement of sand-waves when compared with previous surveys.

10.4.1.1.9 Tides and Sounding Datum

1. State where the tidal station was sited and how sounding datum was established. Explain any transfer of datum involved and the use of co-tidal charts.

2. State the types of tide gauge and tide pole used and the periods of use.

3. Mention any tidegauge malfunctions and any difficulties in obtaining tide readings, such as impounding or surge.

4. Quote the standard port used for predicted tides, or explain the use of harmonic constants.

5. Provide an opinion as to the accuracy of the levelling used to establish sounding datum and the accuracy of tidal reductions. An assessment from scrutiny of cross-line intersections is useful.

10.4.1.1.10 Tidal Streams

1. State where and when tidal stream observations were carried out. Mention any problems with the equipment.

2. State what analysis has been carried out. Give an opinion as to the accuracy of the observations.

10.4.1.1.11 Wrecks and Obstructions

1. Briefly describe the method of investigating wrecks and obstructions.

2. Provide a general statement on details obtained from fishermen or others with local knowledge.

10.4.1.1.12 Lights and Buoys

1. State whether or not light sectors or buoys were checked in the survey area or on passage, referring (if necessary) to a more detailed description in Annex J.

2. Whenever possible, the authority responsible for establishing any new light or buoy should be quoted.

3. Describe how the position of each buoy was fixed on the flood and ebb and quote the spread of position about the final accepted mean.

4. Give an opinion on the accuracy of the observations to determine light sectors and positions of buoys.

10.4.1.1.13 Coastline, Topography and Conspicuous Objects

1. State whether fixed or checked in the field and if so by what method, or whether accepted from another source, which is to be specified.

2. State how heights were observed. Comment on any significant changes such as foreshore erosion or significant soft sediment build-up.

3. Comment on any new man-made facilities such as marinas or jetties (which are also to be included in amendments to Sailing Directions).

4. Remark on those objects considered to be conspicuous. Include these in amendments to Sailing Directions and in Annex L.

10.4.1.1.14 Sailing Directions and Nomenclature

1. Remark on how views were observed. Remark as to whether charted names have been checked giving details of how this was done. Remark on any new names proposed. Comment should also be made as to whether amendments are required. Detailed information is to be included at Annex L.

10.4.1.1.15 Radio Stations

1. Provide a general statement on the accuracy of ALRS. Specific detail is to included at Annex N.

10.4.1.1.16 Ancillary Observations

1. Briefly outline any ancillary observations that were undertaken. These may include:
   i. fresh water springs;
   ii. overfalls, eddies and tide rips (a marked up chart showing these, together with the validity of any previously reported observations is required);
   iii. leading lines;
   iv. measured distances;
   v. photography;
   vi. transparency/water colour;
   vii. any special scientific observations ordered (e.g. magnetic variation, bottom photography, ocean currents, water sampling); and
   viii. recommended tracks.

2. Give an opinion of the usefulness of iii, iv and viii and any recommendations for improving their direction and appearance.

10.4.1.1.17 Miscellaneous

1. Comment on any other facets of the execution and results of the survey which may be of value to LINZ or of historic interest when reviewed in future years.

2. [Signature Block of Surveyor -in-Charge]

10.4.1.2 List of Annexes: Part II (Technical)

1. Each Annex should commence on a separate sheet. Separate sheets indicating Nil Return are required and should be noted in the List of Annexes within Part I as 'NA'.

10.4.1.2.1 Annex A - Accompanying Documents

1. List all the documents accompanying the Report of Survey. Such items must include:
   a. Standard Sheet(s),
   b. Miscellaneous Tracings
   c. Geodetic Data Pack
   d. Tidal Data Pack
   e. Sounding data (E/S traces, logging system printouts, side scan sonar traces)
   f. Field Records, and
   g. Digital Data.

h. Predicted Environmental Assessment (from tender document)
i. Daily Narrative

2. The Environmental Assessment listed above should contain the predicted environmental parameters expected for the survey area. These include wind speed and direction, temperature, sea state, swell height, wave period, expected visibility etc. After completion of the survey, the actual experienced environmental parameters listed above should also be rendered.

3. The daily narrative listed above is to be kept by the SIC from the day of contract signing to the submission of the end deliverables. Items to be included are:

- Record of daily activity
- Record of the work achieved
- A record of difficulties encountered together with solution processes
- A record of the progress of the project against the time-line
- A record of the weather, wind direction, wind speed, sea-state, swell directions and heights and any adverse weather which precluded survey activities
- A record of al data collection, data reduction, data processing and final deliverable parameters used during the course of the project with any difficulties or changes.
- Any comments or observations that may be relevant to the project or compilation of the chart.
- Adequate documentation to support any decision to cease data collecting due to environmental or technical constraints.

10.4.1.2.2 Annex B - Digital Surveying System

1. Include a description of system hardware; software version number, software packages; main software functions; suggested improvements (if appropriate); diary of defects.

2. List the offsets applied in the software for the vessels ‘datum point’, normally the position of the echo transducer.

10.4.1.2.3 Annex C - Geodetic Records

1. List the co-ordinates, heights and accuracy of all electronic position-fixing system stations, visual marks, and other geodetic stations used to control the survey. A logging system printout giving this data is satisfactory. Give details of how they were fixed if this was done during the course of the survey. Include the source (i.e. authority) of all stations used. Mention any known geodetic stations which no longer exist.

10.4.1.2.4 Annex D - Position Fixing Systems/Nav-aid Calibration Results

1. State types of position fixing system, frequencies, assumed velocities of propagation, and operating modes. List the stations used (Geographical and grid positions should be given in Annex C). State the ranges and accuracies achieved. Any abnormally high EPF system error values should be explained. List all calibration results (C-O). Include any computer printouts (if available) for all calibrations carried out before, during and after the survey in the Quality Data Pack.

2. List the results of any confidence checks and baseline crossings.

10.4.1.2.5 Annex E - Sound Velocity and Bar-Check Observation Results

1. State the method of obtaining sound velocity (SV).

2. List the dates and results obtained for SV and bar-check observations. Supporting evidence (echo traces) may be included as an accompanying document.

3. When mean sound velocities have been calculated from XBT observations, the consecutive numbers of the XBT observations and the assumed salinity values used must be included.

10.4.1.2.6 Annex F - Levelling and Tidal Observations

1. Quote the levelling results in the form of a diagram, and state clearly the value of Sounding Datum established, referred to benchmarks and MSL.

2. List the tidal stations and briefly describe the application of tidal observations to reduce soundings.

3. Give an opinion of the accuracy of the tidal/tidal stream observations with particular reference to the effects of the weather on data quality.

4. A detailed list of levelling and tidal information should be covered within the Tidal Data Pack.

10.4.1.2.7 Annex G - Accuracy of Sounding and Horizontal Positions of Soundings

Tabulate error sources and likely error magnitudes. See section 5.1 (Total Propagated Error).

1. Give an estimation of the overall accuracy of soundings.

10.4.1.2.8 Annex H - Significant Bathymetric Features (Shoal Summary)

1. A list defining the depth, location, whether presently charted, whether examined, if least depth was obtained and the SIC recommendations for charting action for all shoals and examinations located during the survey. Each depth listed should be given an individual identifying number. This number should appear in the geographic location on any graphic rendered showing significant depths (see section 10.4.5.23 "Ancillary Sheets"). The location should be given in geographical co-ordinates (degrees, minutes and decimal minutes).

2. Generally list all features which differ from the surrounding depths by more than 10%. Explain briefly the reasons for the differences from charted depths.

3. In complex areas, such as rocky seabeds or sand-wave areas only the really significant differences in depth need be listed. In such cases the controlling depth in the local area must be clearly identified.

4. Where significant differences occur between the present and previous depths and/or positions, the Surveyor-in-Charge must forward a firm recommendation on the charting action to be taken. It may be convenient to use a marked-up copy of the published chart or a print of the Standard Sheet to key this section.

10.4.1.2.9 Annex I - Wrecks and Obstructions

1. Provide a detailed description of the methods used to investigate wrecks and obstructions, including the techniques used for diving or wire sweeping. Comment on any problems encountered with obtaining the least depths. Specify any disproving searches conducted in accordance with section 5.6 (Disproving Searches).

2. Provide details of the areas considered for each disproving search

10.4.1.2.10 Annex J - Light Sectors and Buoys/List of Light Amendments

1. Describe how light sectors were checked and were fixed. If any new light has been established it should be fully described using the format in the Light List, and the method of determining its position stated List all discrepancies found between the detail shown in the relevant Light List and published charts (including T and P notices) and those observed.

2. List all lights, buoys by name, number (where appropriate), characteristics and position (mean of flood and ebb fixes).

10.4.1.2.11 Annex K - Conspicuous Objects

1. List all objects currently charted as conspicuous by name and position, with comment on whether the description is still appropriate, together with objects considered conspicuous but not formerly charted as such.

10.4.1.2.12 Annex L - Sailing Directions Amendments and Nomenclature

1. Render in accordance with 9.8 (Amendments to Sailing Directions). Give recommendations for pilotage through the survey area (if appropriate). All charted names should be checked in so far as this is possible. List separately any new names proposed, with full explanation of the reasoning behind the need to name the feature and the selection of the proposed names.

10.4.1.2.13 Annex M - Views

1. Views, photographic or hand drawn, are to be listed and rendered in accordance with section 9.10 (Photographic Views).

10.4.1.2.14 Annex N - Radio Signals Amendments

1. List amendments for the appropriate ALRS Volume.

10.4.1.2.15 Annex O - Ancillary/Miscellaneous Observations

1. Provide details in as clear and concise a format as possible (preferably tabular).

10.4.1.2.16 Annex P - Reports of Dangers and Hydrographic Notes

1. List all signalled or telexed reports of dangers and enclose copies of any Hydrographic Notes raised.

10.4.1.2.17 Annex Q - Personnel

1. Provide a nominal list, with relevant dates, of all personnel involved with the survey.

10.4.1.2.18 Annex R - Diary of Notable Events

1. List all significant events (with their dates) which have influenced the conduct of the survey. These may include:
   a. Establishing control
   b. Pre-survey checks/calibrations
   c. Start of fieldwork
   d. Post-survey activities

10.4.2 *The Geodetic Data Pack*

1. Two copies of the Geodetic Data Pack are to be rendered for all surveys. The original should be bound and the copy may be loose leaf.

2. All sheets in the pack are to be numbered consecutively and initialled by a checker where appropriate.

3. The Geodetic Data Pack should include all hard-copy and electronic deliverables which are required by "*Specifications for Geodetic Hydrographic Control Points.* LINZ OSG" (see "Related Standards").

10.4.3 *The Tidal Data Pack*

1. Two copies of the Tidal Data Pack are to be rendered to the LINZ Contract Manager for all surveys in which observations of tidal height are made for the reduction of soundings. It should consist of the sections listed below.

2. All sheets are to be numbered consecutively and initiated by a checker where appropriate.

3. Digital tidal records are to be rendered as part of the TDP. Digital tidal stream observations are also to be rendered if they have been observed.

10.4.3.1 Section 1 Introduction

1. The introduction should include a full narrative of the procedures conducted for the establishment of tide stations, calibration of equipment determination of datum and recording of tides and tidal streams.

10.4.3.2 Section 2 Level Observations

10.4.3.3 Section 3 Transfer of Sounding Datum

10.4.3.4 Section 4 Pole/Gauge Calibrations

10.4.3.5 Section 5 Record of Tidal Observations

10.4.3.6 Section 6 Record of Tide Gauge Checks

10.4.3.7 Section 7 Tidal Stream Observations

10.4.3.8 Section 8 Tidal Stream Analysis (and plots)

1. Tidal stream analysis and plots may be compiled manually using methods in the Admiralty Tidal Handbook, or by an approved software program.

10.4.4 *Quality Assurance Data Pack*

1. The Quality Assurance Data Pack must provide a continuous audit trail of quality control from initial signing of the hydrographic contract to the delivery of the final survey products to LINZ. The Quality Assurance Data Pack must provide all necessary evidence that data gathered during the survey is of the required quality.

2. One bound paper copy of the Quality Assurance Data Pack must be rendered, together with an electronic copy in "Word 7" format.

3. The Quality Assurance Data Pack must be signed and approved by the SIC.

4. The cover of the Quality Assurance Data Pack must be of a similar format to the Report of Survey.

5. The Quality Assurance Data Pack must be divided into the following sections:

   - Introduction
   - List of survey personnel
   - Periodic Checks
   - Initialisation and Survey Set-up
   - Equipment Calibration
   - Pre-Mobilisation Bench-Tests
   - Mobilisation Checks

- Positioning System Checks
- Integrity Monitoring System Results
- Data Processing Checks
- Fair Documentation Checks
- Reports

10.4.5 *The Standard Sheet*

(Ref. NZ 201 - Symbols, Terms and Abbreviations used on Charts)

10.4.5.1 General

1. Hard-copies of Standard Sheets are to be accompanied by digital copies as per Section 11.1.4 “Digital Copies of the Signed Standard Sheets”.
2. Each standard sheet is to show a unique reference to the specific file that is the digital copy of the sheet.
3. All ancillary sheets are to be in a similar format to standard sheets.
4. Each sheet is to be signed by the SIC.
5. Standard Sheets should normally be in the form of 0.003” - 0.005” double matt plastic or polyester film. The size of the sheet is to be A1 size.
6. A second copy of all standard sheets and ancillary sheets is to be rendered on paper at A1 size.
7. All work on the Standard Sheet is to be completed in black waterproof ink (apart from contours which are to be in red waterproof ink). Care must be taken to ensure that all work is clearly legible and sufficiently dense to enable photographic reduction. To ensure legibility, the minimum figure size is to be not less than l mm.
8. Sheets are to be identified by survey index and serial numbers. The survey project number is to be adopted as the index number and a logical serial numbering of sheets determined by the surveyor.
9. Standard Sheets are to be stowed flat.
10. Standard sheets are to be orientated with the title block on the bottom edge, but may alternatively be used with the title block on the left or right hand side if this provides more economic coverage of the survey area.

10.4.5.2 Symbols to be Used on Standard Sheets

1. The symbols to be used on standard sheets should comply with the format within NZ 201 - Symbols, Terms and Abbreviations used on Charts. Further guidelines are listed in the following paragraphs to this section.

10.4.5.3 Title Block

1. All Standard Sheets are to contain a title panel along the lower border of the sheet, although the title block may be placed on the left or right hand side of the sheet if this is more practical to do so. The title panel must be fully completed for all standard sheets of a series.

2. The title block may be completed using an automatic plotting package or with stencils.

3. It is important that information portrayed in the title block is relevant for the sheet it is printed on and not a carry over from a previous sheet. Care should be taken not to use the same title block for all sheets as this may provide misleading or erroneous information on some sheets.

4. The title block should include the following headings and information as a minimum:

   Title:
   Client:
   Surveyed by:
   Date:
   Spheroid:
   Projection:
   Grid:
   Scale:
   Chart Limits (Grid):
   Chart Limits (Geographical):
   Depths in:
   Topography:
   Accompanying Tracings / Ancillary Sheets:
   Sounding Datum:
   Drawn by:
   Checked by:
   Approved By:
   Approved for Charting Action:
   Chart Number:
   HDR:
   Crown Copyright Reserved

5. The following notes are issued to aid compilation of the title panel:

- **Title Section:** Insert project number, contract number and name of survey.

- **Surveyed By:** Include the name of prime contracting company and primary vessel used. The logo of the prime contracting company or the vessel logo may also be included if desired.

- **Client:** Insert the adjacent logo (electronic copy available from LINZ):

- **Date:** Include the dates for the full period of the survey, from the first until the last survey activity at sea.

- **Spheroid, Projection and Grid (Zone):** are to be completed if applicable.

- **Scale:** Clearly state the scale of the standard sheet together with a scale bar in kilometres. If the chart is a Mercator projection, state the mid-latitude and ensure that the scale is correct for the mid-latitude.

- **Chart Limits (Grid):** Insert the extreme grid extents of the standard sheet (see example):

235000 N

175000 E 185000E

2300000 N

- **Chart Limits (Geographical):** Insert the extreme geographical extents of the standard sheet (see example):

35° 25’ S

178°10’ E 178° 30’ E

35° 35’ S

- **Depths in:** Insert units (i.e., metres and decimetres) and specify the cut-off value for showing decimetres (normally 30 or 31 metres).

- **Coastline/Topography:** Is to include a brief description of how the depiction of the coastline and other topographic detail on that sheet was derived. Leave blank if no coastline/topography shown

- **Accompanying Tracings / Ancillary Sheets:** A note is to be placed on the parent standard sheet directing reference to the ancillary sheet. e.g. See also sheet 147/3A - Accompanying Tracing

- **Sounding Datum:** Is to describe the relationship between Sounding Datum and the tide pole and bench marks, at the tidal site for which the soundings were reduced, e.g.: "Sounding Datum is 1.506m on the tide pole at Main Wharf, and 5.325m below BM 1/98, a hexagonal bolt set into the northern side of the Main Wharf, and 6.342m below BM 2/98, a steel plate set in concrete at the root of the Main Wharf." This description should be the same as that mentioned in the ROS.

- **Drawn by and Checked by:** Show printed name of the person responsible for compilation and checking.

- **Approved By:** Is for the signature by the Surveyor-in-Charge only.

- **Approved for Chart Action:** Left blank. This is for signature by LINZ, only when all the queries on the survey have been resolved.

- **Chart Number:** Chart number is to be divided into two distinct boxes. "Index Number" is to be the LINZ project number. "Serial number" is to be allocated in a logical fashion by the contractor. See example lay-out opposite (not to scale).

	Chart No.	HDR
Index	1006	
Serial	11	

- **HDR:** This box is for the use of LINZ and is to be inserted by the contractor but left blank. See above example.

- **Crown Copyright Reserved** This phrase is to be inserted close to the edge of the title block..

10.4.5.4 Index Sheet

1. Where more than two Standard Sheets are required to cover a survey area, an index sheet is to be drawn showing the coverage and layout of the Standard Sheets.

2. This index sheet is to be drawn on a standard sheet at a convenient scale, e.g. that of an existing chart and is to show the following information :
   a. Borders of the standard sheets.
   b. Serial number of each sheet.
   c. Limits of the Survey area.
   d. Approximate coastline (pecked line).

3. Grid ticks and geographical ticks

4. Grid border and geographical border (to the same specification as those on the standard sheets)

10.4.5.5 Geographical Intersections

1. Geographical intersections (ticks) should be shown as circles of 0.3 cm diameter with lines extending 0.3cm from the circumference in the cardinal directions.

2. Within the body of the sheet, the spacing of the intersections should not exceed 20 cms.

3. The geographical graticule must be evenly sub-divided. Except in extreme cases the number of minutes of longitude separating the meridians should equal the number of minutes of latitude separating the parallels.

10.4.5.6 Grid Intersections

1. Grid intersections (ticks) should be shown as 1cm crosses with lines oriented in the cardinal directions.

2. Within the body of the sheet, the spacing of the intersections should not exceed 20 cms.

3. The grid graticule must be evenly sub-divided. The number of metres of eastings separating the grid intersection ticks should equal the number of metres of northings separating the grid intersection ticks.

10.4.5.7 Geographical Border

1. A geographical border is to be inserted around the geographical extent of the chart. The border is to be of a similar presentation to the example below and must ensure that geographical co-ordinates can easily be scaled off the chart.

2. Each axis of the geographical border is to contain at least one label showing a value of degrees.

3. Each axis of the geographical border is to be divided into minutes and further subdivisions as appropriate.

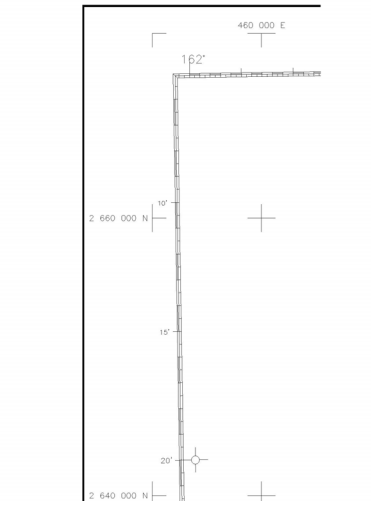


Figure 4 (not to scale)

10.4.5.8 Grid Border

1. A border depicting grid labels is to be inserted around the outside of the geographical border (see above example). The border must ensure that grid co-ordinates can easily be scaled off the chart.

2. Each axis of the grid border is to be labelled with grid values at least once every 20cms.

10.4.5.9 The Meridian

1. The direction of True North is to be shown on the sheet in a convenient place. An arrow should be used to indicate the direction with the letter 'N' drawn above its tip. All standard sheets are to be drawn north-up.

10.4.5.10 Geodetic Stations

1. Primary Stations should be shown on the sheet as circles 0.6 cm diameter enclosing an equilateral triangle.

2. Secondary stations should be shown as circles 0.4 cm diameter.

3. Sounding Marks should be shown as circles 0.2cm diameter.

4. The stations distinguishing letter or LINZ Special Code (as detailed in the Geodetic pack) should be written beside its symbol.

5. Circles and triangles are to be broken, as necessary, where they cross the HW line or any other detail.

10.4.5.11 Tidal Stream Information

1. The position of tidal stream observations is to be shown on the Standard Sheet as a tidal stream diamond drawn upright and containing a reference capital letter.

2. If the density of sounding precludes the insertion of the tidal stream diamond it may be shown on an accompanying tracing.

3. If full tidal stream observations have not been conducted but sufficient information has been gathered to warrant depiction on the Standard Sheet this should be in the form of tidal stream arrows.

10.4.5.12 Depths

1. Depths are to be drawn in Univers Sloping style “North up”. Where sounding lines run in a due east/west direction depths may be drawn west up.

2. Soundings are amongst the most important data shown on the sheet and other detail must not interfere with their legibility.

3. Drying soundings (including soundings of 0m) are to be indicated by a horizontal line under the metre figure of the sounding. Isolated drying features such as pinnacle rocks are to be depicted by the appropriate symbol with the drying height in brackets beside it.

10.4.5.13 Determining the Gravity Position (Node) of a sounding

15_8

A typical Sounding

Imaginary bounding box around the sounding

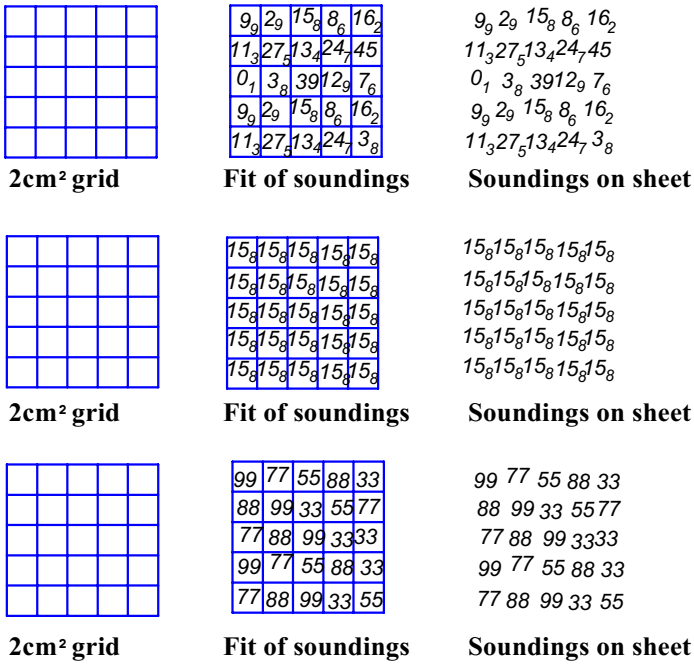
Determine centre of box

This is the centre of gravity or node of the sounding

10.4.5.14 Density of Soundings

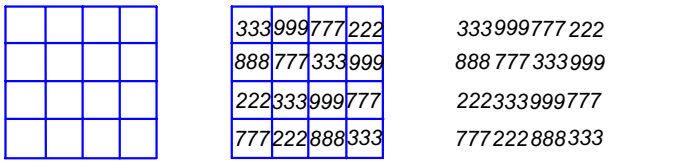
1. For depths less than 99 metres, not less than 25 soundings per 2cm x 2cm square grid are to be plotted on the standard sheet. This also includes decimetre figures. (see Figure 5). Density of soundings should be further increased for examinations.

   Figure 5



2. For depths greater than 100m, not less than 16 soundings per 2cm x 2cm square grid are to plotted on the standard sheet. Decimetre figures are not required (see Figure 7). Density of soundings should be further increased for examinations.

Figure 7



2cm² grid **Fit of soundings** **Soundings on sheet**

10.4.5.15 Contours

1. The depth contours should be traced on to the Standard Sheet from the sounding tracing if no suitable automatic contouring tool is available.

2. Contours are to be plotted on to the same paper sheet as soundings and should not be supplied separately.

3. Contours are drawn as smooth curves broken as necessary where they pass written soundings. Where a sounding has the exact value of the contour, the contour should aim to pass through the centre of gravity of that sounding. However 'spot' shoals with the exact value of the contour should be encircled with a contour. A 'spot' deep with the exact value of the contour should not be contoured.

4. In intricate areas some contours (not the shoalest) may be omitted in the interest of clarity.

5. The following contours (none of which are to be labelled) are to be inserted:

   2, 5, 10, 15, 20, 30, 50, 100, 200, 500, 1000m and then at 1000 metre intervals.

6. Where a contour is imperfectly defined it should be shown as a pecked line.

7. Contours are to be drawn in red ink.

10.4.5.16 The Drying Line

1. The drying line should be inserted as a continuous line where it is perfectly known and as a pecked line where it is not fully defined. Where it is formed by a particular feature, e.g. rocks, coral etc. the appropriate symbol from NZ 201 should be used.

10.4.5.17 Coastline

1. The coastline, which is the line of Mean High Water Springs, should always be drawn on the Standard Sheet. It is an important feature and should be inserted at an early stage of the drawing.

2. If the coastline has been surveyed in the field or taken from a checked air photo plot, it should be inserted as a continuous line. A pecked line should be used if the coastline source is unconfirmed or it is imperfectly known e.g. the edge of mangroves.

10.4.5.18 Topography

1. Only topographic detail that has been surveyed in the field, or checked for accuracy if from another source, is to be inserted on the Standard Sheet.

10.4.5.19 Conspicuous Objects

1. The position of conspicuous objects are to be marked using the symbol in New Zealand 201, i.e. a circle 0.2 cm diameter with a central dot. The name of the object (if any) and its description e.g. tower, chimney etc. are to be written beside the symbol.

2. Other features whose positions are known and are useful for fixing, but are not considered conspicuous are to be marked with a circle 0.2 cm in diameter with a central dot. The name and description of the feature should be written alongside the symbol.

10.4.5.20 Names and Legends

1. Names and legends on the Standard Sheet may be stencilled using the Univers style or written in stump. The following lettering styles should be used:

   Univers Upright Capitals - important names on land.
   Univers Upright - unimportant names on land.
   Univers Sloping Capitals - important names in the sea.
   Univers Sloping - unimportant names in the sea.
   Stump - for all legends and other descriptive and unimportant writing both on land and sea.

2. All sloping styles should be at an angle of about 15°.

3. Where names are written on a curve, the curvature should be moderate and regular, and should either follow the shape of the feature or should trend away from the object towards the horizontal.

4. Where names or legends are written in a straight line they should be horizontal, unless written along a channel whose axis is straight, e.g. in a narrow dredged area, or along a leading line, recommended track, railway or other straight line.

5. Soundings and important detail must never be obscured by names or legends, and it must be remembered that what may be marginally legible on a Standard Sheet will almost certainly be illegible on subsequent dyeline copies used by LINZ. When words have to be woven through soundings it is essential that the first and last letters are in the open and that the tops of all letters are complete.

6. If the density of sounding precludes the insertion of an important name on the standard sheet it may be inserted on an accompanying tracing.

7. The use of punctuation marks within the body of the Standard Sheet is to be avoided.

10.4.5.21 Measured Distances

1. The distance shown on the Standard Sheet between the terminals of "Measured Distances" should be the spherical distance between those terminals.

10.4.5.22 Area Surveyed on Another Scale

1. The limits of areas surveyed on a scale different to that of the Standard Sheet are to be indicated with pecked lines and the legend "Surveyed on ....." (scale) with year of survey underneath in brackets,

   e.g. Surveyed on 1:10,000 (1980)

10.4.5.23 Ancillary Sheets

1. Each standard sheet must be accompanied by an ancillary sheet. Ancillary sheets are to be at the same scale and similar presentation to the parent sheet. Ancillary sheets are to depict the following information:

   - Nature of the bottom, including seabed sample locations:

- Names and legends;
- Sound Velocity Dip locations
- Secchi Disk locations
- Significant Bathymetric Features
- Floating navigational marks, light characteristics and sectors:
- Spoil grounds, dredged areas and sand-wave areas;
- Limits of sounding datums used
- Limit of the specified survey area (shown as black line labelled "Survey Area Limit).
- Nav-aid calibration data;
- Area swept by sonar or wire.
- Track-lines for soundings (for single-beam echosounder operations)
- Depiction of track-lines showing swath extents (for multibeam echosounder operations)
- Match-lines between standard sheets (match-lines should be black solid lines and should be labelled with the name of the adjoining standard sheet).

2. Where necessary a legend is to be provided on ancillary sheets to interpret symbols used.

10.4.5.24 Checking Standard Sheets and Other Graphics

1. The contractor must produce documentation (e.g. check-lists) to demonstrate that a rigorous procedure has been followed in checking final standard sheets and other graphics. Completed checking documentation is to be included in the Quality Assurance Data Pack.

10.4.6 *Graphical and Other Data*

10.4.6.1 Accompanying Tracings

1. If data can not be depicted on the standard sheet or ancillary sheet (for example due to constraints of scale), then it may be presented as an "Accompanying Tracing". Information on such tracings may include:

   - Shoal Investigations
   - Disproving Searches
   - Areas swept by side-scan or wire
   - Nav-aid calibration data
   - Other information not able to be depicted on standard sheets or ancillary sheets

2. Where necessary a legend is to be provided on accompanying tracings to interpret symbols used.

3. The decision to render an accompanying tracing is at the discretion of the Surveyor-in-Charge. In certain circumstances he may exercise flexibility in determining the scale of such a tracing e.g. co-tidal factors and nav-aid calibration data may clearly be shown on a smaller scale than that of the parent survey.

4. A note is to be placed on the parent standard sheet directing reference to the tracing to accompany. e.g. See also sheet 1200/3A - Accompanying Tracing depicting shoal investigation of "Rag Rock".

5. Accompanying tracings must be presented on matt plastic or polyester film and be of a similar format to the standard sheet. They may, however, be rendered at A2 or A3 size as appropriate.

10.4.6.2 Photographs

1. Photographs may be used to illustrate many aspects of surveying data, e.g. trig stations, benchmarks, leading lines, views for Sailing Directions etc. All photographs should be rendered to LINZ in the following manner:

   a One print approx. 200mm x 150mm of each negative marked on the reverse with an identifying letter;
   b Film negatives in a protective envelope;

c Electronic image of each photograph in JPEG format at a minimum resolution of 800x600 pixels.
d Index list identifying photograph subjects, negative and photograph numbers and file-names.

2. In the case of photographic views for sailing directions, the following additional information is to be supplied with each photograph:

   a Date and time (with zone):
   b Position of the camera in latitude and longitude (±0.5 mile);
   c Bearing and distance of a prominent charted feature (to within $\pm 1^{o}$ and ±0.2 mile, if possible, especially if a leading line or similar view is being illustrated);
   d. Other features, charted or uncharted, identified as described below;
   e. Height of camera above sea level:
   f. Type of camera;
   g. Name of photographer and vessel.

3. The photographs, negatives and index list may be conveniently placed in a suitably labelled envelope and enclosed with the rendered data to which the are pertinent.

4. Where it is desired to draw attention to a particular feature on a photograph, e.g. a trig station on an aerial view, it may be accurately pricked through, circled in red ink and labelled on the reverse of the print.

5. Where two copies of a report are required by LINZ, photographic material need only be included in the original.

10.4.6.3 Field Records

1. All field records are to be rendered to the LINZ Contract Manager. Such records will include (but not limited to) the following:

   Plotting Sheets
   Lattice Sheets
   Track-plots
   Sounding collectors/tracings
   Echograms
   Sonargraphs
   Tidal Curves
   Notebooks/ Whitewash books
   Raw working graphics
   Calibration Records
   Negatives of Photographs

2. Documentation is to be maintained and field records annotated with sufficient detail to allow the reconstruction of the survey at a later date. The following records indicate some which will be required to be rendered. Logs for consecutively numbered and labelled echograms and side scan sonar records. Logs for processing of digital data by file name and correction applied.

11 DIGITAL DATA

1. All digital data obtained during the course of the survey is to be rendered. This includes, raw, corrected and processed data.

2. An index of rendered digital data is to be produced together with a description of any proprietary file formats, headers used etc.

11.1 *Types of Digital Data*

1. Four types of digital hydrographic data are required to be rendered for any hydrographic survey undertaken on behalf of LINZ as follows:

11.1.1 *Raw Data*

- Data: 100% of all data collected, no corrections applied but gross errors removed.
- Format: Proprietary
- Media: DLT Tape

11.1.2 *Processed Data Set*

- Data: The raw data (as described in section 11.1.1) with corrections for vessel motion, position, tide, draft, and sound velocity applied. All soundings are to be included in the data-set. Soundings plotted on the "Standard Sheet" are to have the "Plotted Sounding" flag set to 1. Soundings which have been rejected are to have the "Rejected Sounding" flag set to 1.
- Format: HTF (see section 11.2.2 for specific LINZ requirements for the HTF format).
- Media: DLT Tape
- File Size: The processed data set should be split into separate HTF files, each file not exceeding 2Gb in size.

11.1.3 *Multi-beam Deliverables*

1. Additional digital deliverables which are specific to multibeam data are detailed in Section 7.9 "Additional MBES Survey Deliverables" (for example, sun-illuminated, grid depth encoded, back-scatter etc).

11.1.4 *Digital Copies of the Signed Standard Sheets*

- Data: Digital copy of the signed authoritative standard sheets at the required density level.
- Format: AutoCAD 3D DXF
- Media: CD ROM

11.2 *Hydrographic Transfer Format (HTF)*

11.2.1 *HTF Overview*

1. The current standard for the HTF file format is version 2.02 as detailed in the RAN publication "*Hydrographic Transfer Format Version 2.02 Technical Specification* Royal Australian Navy Hydrographic Service". The specification is available at the RAN Hydrographic Office Web Site as detailed in section 1.3 of this standard "Related Standards". The essential definitions of the format are as follows.

2. The data structure of the HTF Sounding Data is defined by its function - data exchange and preservation. The HTF structure is robust, reliable, readable, stable, complete and self-documenting. The HTF format retains elements and attributes captured during survey acquisition and subsequent processing in a portable, non-proprietary form.

11.2.2 *Specific LINZ Requirements for HTF Files*

1. It should be noted that LINZ require an additional field representing "Back-scatter Amplitude" to be inserted over and above the basic RAN specification at location S3.21. This field is specific to MBES surveys and should be omitted if only single-beam echosounder is used. The field is allowed for under the provision for "Additional Fields" as detailed in the RAN

specifications. The field should also be described in the "Sounding Data Description" section of the file.

2. The contractor must ensure that the correlation between soundings plotted on rendered standard sheets and the field "S3.20 – Plotted Sounding" in the corresponding rendered HTF files is perfect. The HTF "Plotted Sounding" records are therefore to be clearly understood as "authoritative" in the same sense as Standard Sheets.

Annex A

Hydrographic Forms

Examples of the following forms are enclosed for use by Contractors. In all cases where relevant data are collected, these forms or close copies of them must be rendered as a deliverable:

Form Number	Description
LHS F3	Level Observations
LHS F6	Transfer of Sounding Datum
LHS F4	Hydrographic Note
LHS F5	Hydrographic Note for Port Information

TRANSFER OF SOUNDING DATUM

(where tide is 'mainly semi-diurnal')

Date and time of 1st LW observation. .....

	At Established Station:					At New Station:				
	Heights above Chart Datum			Contributions for		Heights above zero of pole			Contributions for	
	H.W.	L.W.	Factor	H.W.s	L.W.s	H.W.	L.W.	Factor	H.W.s	L.W.s
a	-		1	-		-		1.000	-	
b		-	1		-		-	1.000		-
c	-		3	-		-		3.000	-	
d		-	2		-		-	2.000		-
e	-		3	-		-		3.000	-	
f		-	1		-		-	1.000		-
g	-		1	-		-		1.000	-	
Sums of contribution										
Observed MHW and MLW										

(Observed MHW = sum of HW contributions / 4)
(Observed MHW = sum of HW contributions /8)

Observed Mean Range (R) = (r) =
Observed Mean Level (M') = (m') =

(Obs. Mean range = Obs MHW-Obs MLW)
(Obs Mean Level = 1/2(Obs MHW+Obs MLW)

CALCULATION OF SOUNDING DATUM (d) AT NEW GAUGE

(A) Where 'True Spring ML' at established station is known

From Tide Tables (ATT or NZTT)

MHWS ..... m
MLWS ..... m
Half sum m=M
(True Spring M.L.)

d = m'-(M'-M)-M(r/R)

d = metres above zero of pole

(B) Where 'True Spring ML' at established station is not known

d = m'-(M'r/R)

d = metres above zero of pole

Lat ..... Long ..... Lat ..... Long .....

CONNECTION BETWEEN FIXED MARKS
AND CHART DATUM AT ESTABLISHED STATION

.....
.....
.....
.....
.....
.....
.....

CONNECTION BETWEEN FIXED MARKS
AND SOUNDING DATUM AT NEW STATION

.....
.....
.....
.....
.....
.....

Remarks

.....

Date.

LEVEL OBSERVATION

LHS F3

Project:	Date.	Observer
Locality:	Time. Map No.	Recorder
BM'S:	Weather	Inst. No.
		Staff No.

Staff Station	Distance		Back Reading	Delta Height	Inter Reading	Forward Reading	Delta Height	Rise	Fall	Reduced Level	Remarks
		T M B									
		T M B									
		T M B									
		T M B									
		T M B									
		T M B									
		T M B									
		T M B									
		T M B									
Check Totals											**Traverse length (K)** ________ **km**
Reduced **Checked**					**Delta Height**						**Allow. M' close** ________ **mm** **Actual M'close** **mm**

HYDROGRAPHIC NOTE

Forwarding Information for Charts and Hydrographic Publications

INSTRUCTIONS:

1. Mariners are requested to notify the Chief Topographer/Hydrographer, Land Information New Zealand, P.O. Box 5501, Wellington, New Zealand, when new or suspected dangers to navigation are discovered, changes observed in aids to navigation, or corrections to publications seem to be necessary. The Mariners Handbook (NP 100), Chapter 3, gives general instructions.

2 This form and its instructions have been designed to help both the sender and the recipient. It should be used, or followed, closely, whenever appropriate. Copies of this form may be obtained gratis from, Chief Topographer/Hydrographer, Land Information New Zealand, P.O. Box 5501, Wellington, New Zealand

3. When a position is defined by sextant angles or bearings (true or magnetic being specified) more than two should be used in order to provide a check. Distances observed by radar should be quoted. When however there is a series of fixes along a ship's course, only the method of fixing and the objects used need to be indicated. Latitude and longitude should only be used specifically to position the details when they have been fixed by astronomical observations and a full description of the latter should then be given.

4. A cutting from the largest scale chart is the best medium for forwarding details, the alterations and additions being shown thereon in red. When requested, a new copy will be sent in replacement of a chart that has been used to forward information, or when extensive observations have involved defacement of the observer's chart. If it is preferred to show the amendments on a tracing of the largest scale chart (rather than the chart itself) these should be in red as above, but adequate detail from the chart must be traced in black ink to enable the amendments to be fitted correctly.

5. When soundings are obtained the Mariners Handbook (NP 100) should be consulted. The echo sounding trace should be marked with times, depths, etc, and forwarded with the report. It is important to state whether the echo sounder is set to register depths below the surface or below the keel; in the latter case the vessel's draught should be given. Time and date should be given in order that corrections for the height of the tide may be made where necessary. The make, name, and type of set should also be given.

6. Modern echo sounders frequently register greater depths than the advertised maximum for the set, e.g., with a set whose maximum is 500 metres a trace appearing at 50 metres may in fact be 550 metres or even 1,050 metres. Erroneous deep soundings caused by 2nd Transmission error can usually be recognised by the following:

   (a) The trace being weaker than normal for the depth registered,
   (b) The trace appearing to pass through the transmission line,
   (c) The "feathery" nature of the trace.

7. Reports which cannot be confirmed or are lacking in certain details should not be withheld. Shortcomings should be stressed and any firm expectation of being able to check the information on a succeeding voyage should be mentioned.

8. Reports of shoal soundings, uncharted dangers and navigational aids out of order should, at the mariner's discretion, also be made by radio to the nearest coast radio station. The draught of modern tankers is such that any uncharted depth under 30 metres or 15 fathoms may be of sufficient importance to justify a radio message.

   NOTE: An acknowledgement of receipt will be sent and the information then used to the best advantage which may mean immediate action or inclusion in a revision in due course. When a Notice to Mariners is issued the sender's ship or name is quoted as authority unless as sometimes happens the information is also received in a foreign Notice to Mariners. An explanation of the use made of contributions from all parts of the world would be too great a task and a further communication should only be expected when the information is of outstanding value or has unusual features.

HYDROGRAPHIC NOTE

(For instructions, see opposite)

National Topographic
Hydrographic Authority
P.O. Box 5501
Wellington
New Zealand

Fax : 064-4-471-6894
email:
hydro-info@linz.govt.nz

Toitu te whenua Land Information New Zealand

Date …….

Ref.No. ……

Name and address of ship or sender

……..

……..

……..

General locality ……

Subject …….

Approx. Position. Lat. …….. Long. ……

Charts affected …….

Latest Notice to Mariners held ……

Publications affected (Edition No. and date of latest supplement)

……..

Details:

A replacement copy of Chart No. ……. is required (see Instruction 4).

Signature of observer/reporter ……

HYDROGRAPHIC NOTE FOR PORT INFORMATION

Name of Ship or Sender:	
Address:	
Reference Number:	
Date:	
Signature of Observer / Reporter:	

1	**Name of Port**	
2	**General Remarks** Principal activities and trade Latest population figures & Date Number of ships & tonnage handled per year Maximum size of vessel handled. Copy of Port Handbook if available	
3	**Anchorages** Designation, depths, holding ground, shelter afforded	
4	**Pilotage** Authority for requests. Embarkation position Regulations	
5	**Directions** Entry and berthing information. Tidal Streams Navigational Aids	
6	**Tugs** Number available and max. h.p.	
7	**Wharves** Names. Numbers or positions Lengths Depths alongside Heights above chart datum Facilities available	
8	**Cargo Handling** Containers, lighters, Ro-Ro etc	
9	**Cranes** Brief details and max. capacity.	
10	**Repairs** Hull, machinery and underwater Ship and boat yards. Docking or slipping facilities. Give size of vessels handled or dimensions. Hards & Ramps. Divers.	
11	**Rescue and Distress** Salvage, lifeboat, Coastguard etc.	
12	**Supplies** Fuel with type and quantities available. Fresh water with rate of supply. Provisions.	
13	**Services** Medical, De-ratting.	

	Consuls, Ship Chandlery, Compass adjustment, Tank cleaning, Hull painting.	
14	**Communications** Road, rail and air services available Nearest airport or airfield. Port radio and information services with frequencies and hours of operation.	
15	**Port Authority** Designation, address and telephone number.	
16	**Small Craft Facilities** Information and facilities for small craft (e.g. yachts) visiting the port. Yacht Clubs, berths, etc.	
17	**Views** Photographs (where permitted) of the approaches, leading marks, the entrance to the harbour etc. Picture postcards may also be useful.	

References

Guidelines for the Preparation of Hydrographic Survey Specifications. Royal Institute of Chartered Surveyors, 1983

General Instructions for Hydrographic Surveyors 17th ed. (NP135). The Hydrographer of the Navy, 1996

Standards for Hydrographic Surveys 4th ed. (SP No44). The International Hydrographic Bureau, 1998

Admiralty Manual of Hydrographic Surveying Vol. 1. The Hydrographer of the Navy, 1965

Admiralty Manual of Hydrographic Surveying Vol.2, b1 to b6. The Hydrographer of the Navy, 1965 to 1982

Admiralty Tidal Handbook, Vol. 1 - NP 122(1). Admiralty, 1985

Admiralty Tidal Handbook, Vol. 2 - NP 122(2). Admiralty, 1975

Admiralty Tidal Handbook, Vol. 3 - NP 122(3). Admiralty, 1986

Echo Sounding Correction Tables 3rd Edition (NP139). 1980

Use of Side-Scan Sonar for Hydrographic Surveying & the Gathering of Bottom Texture Information (RN PP24) 1983 Parts 1& 2

The Assessment of the Precision of Soundings (RN PP25) 1990

Recommended Transformation Parameters from WGS'84 to NZGD49 Geodetic System Technical Report. Office of the Survey or General. Land Information New Zealand, 1997

New Zealand Pilot N.P. 51 Admiralty