Maritime & Coastguard Agency

UK Civil Hydrography Programme

Survey Specification

Civil Hydrography Services in European Waters

June 2016

Part
A

UK Civil Hydrography Programme

Survey Specification

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A1. The Maritime & Coastguard Agency

The Maritime & Coastguard Agency (MCA) is an Executive Agency of the Department for Transport. The MCA is responsible throughout the UK for developing and implementing the UK Government's maritime safety and environmental protection policy. That includes co-ordinating Search and Rescue (SAR) at sea through Her Majesty's Coastguard 24 hours a day, and checking that ships meet UK and international safety rules. The MCA work to prevent the loss of lives at the coast and at sea, to ensure that ships are safe, and to prevent coastal pollution: Safer Lives, Safer Ships, Cleaner Seas

In accordance with the Equality Act 2010, in our capacity as a public body we have a statutory duty to eliminate unlawful discrimination, promote equality of opportunity and promote good relations between people from different groups.

Contractors will be expected to ensure that the service they provide promotes Equality between the MCA and its customers and does not directly or indirectly discriminate on the grounds of Equality in accordance with both the Act and the Duty.

A2. Contents

A3. Record of Changes

Version	Date	Status	Approved	Signature
2013.01	08/03/2013	Working draft. Circulated for comments.	-	-
2013.02	05/04/2013	Final version for comments	AVC	
2013.1	09/04/2013	Final version for ITT	AVC	
2016.01	03/08/2015	Working draft. Circulated for comments	-	-
2016.02	18/12/2015	Final version for comments	RK	
2016.02(P)	08/06/2016	Version for public release	AVC	

A4. Symbols & Abbreviated Terms

Abbreviation	Term
ADCP	Acoustic Doppler Current Profiler
BM	Benchmark
CD	Chart Datum
CHP	Civil Hydrography Programme
DGPS	Differential Global Positioning System
ETRS98	European Terrestrial Reference System 1989
FIG	Féderération Internationale des Géometres
GPS	Global Positioning System
GNSS	Global Navigation Satellite System
HI	Hydrographic Instruction
HMOG	Hydrographic & Meteorological Operational Guidance
IHO	International Hydrographic Organization
MBES	Multibeam Echosounder
MCA	Maritime & Coastguard Agency
MSL	Mean Sea Level
OD	Ordnance Datum
OJEU	Official Journal of the European Union
RoS	Report of Survey
RTK	Real Time Kinematic
SBES	Single Beam Echosounder
UKHO	United Kingdom Hydrographic Office
UTC	Universal Time Co-ordinated
USB	Universal Serial Bus
UTM	Universal Transverse Mercator
VORF	Vertical Offshore Reference Frame
WCD	Water Column Data

A5. Acknowledgements

1. Hydrographic Survey Specifications – Shipping Lane 2 (v1.2) 17/10/00 *Land Information New Zealand*

2. Technical Specifications for HI 1059 Western Approaches to English Channel 20/08/03 *United Kingdom Hydrographic Office*

3. Charter of MV Confidante – Statement of Requirements. 27/01/04. *Director of Naval Survey, Oceanography & Meteorology*

4. Hydrographic Survey Specification: Routine Resurvey Contract. 05/01/06. *Maritime and Coastguard Agency*

5. Hydrographic Survey Services Specification: MV Anglian Sovereign. 25/02/10 *Maritime and Coastguard Agency*

6. UK Civil Hydrography Programme: Survey Specification v 1.3. 22/05/12. *Maritime and Coastguard Agency*

Part
B

UK Civil Hydrography Programme

Survey Specification

Civil Hydrography Services in European Waters

B1. Introduction

The UK Civil Hydrography Programme (CHP) is a multi-million pound Government initiative to prioritise and survey the waters surrounding the British Isles for the primary purpose of updating the UK's nautical charts and publications. Currently, around 30% of UK waters have been surveyed to modern standards.

Responsible for an area of seabed in excess of 720,000 km², the CHP makes extensive use of Geographic Information Systems (GIS) to prioritise survey areas using a contemporary risk analysis methodology capable of reflecting the changing pressures of the maritime environment.

Much of the hydrographic survey work commissioned for the CHP is undertaken by contractors offering turn-key solutions. These contractors gather and report seabed data using their own personnel, equipment and vessels.

CHP work packages are split by:

- Routine resurvey
- Shallow water: predominantly <40m water depth.
- Shallow to medium water: 0 to 200m water depth.

To ensure data is gathered to the highest possible quality for navigational charting, technical personnel from both the MCA and UKHO routinely visit CHP survey vessels during scheduled operations to verify data integrity. Prior to final survey data being accepted from contractors, it passes through a rigorous quality assurance appraisal process at the UKHO.

At the UKHO checks are made against items such as data density, inter-line consistency, geodetic parameters and tidal observations, for example. Once data has passed verification, it is archived to the UKHO's hydrographic database ready for inclusion in their range of Admiralty products.

B2. Scope

Part B of this document details the project-specific requirements for conducting hydrographic surveys as part of the CHP.

CHP surveys are characterised by a mix of sounding set deliverables (survey specification A) and statistical bathymetric surface deliverables (survey specification B). Specific requirements are detailed herein.

Under the Routine resurvey workscope, singlebeam echosounding has been reintroduced to inform knowledge of the highly mobile shallow and inter-tidal banks covered by the programme, and to permit their extents being adequately described on navigational products. It is not intended that these surveys will provide full coverage, but operations are envisaged to run in parallel with survey specification B.

B3. Related Standards

All requirements in the most recent versions of the following publications are to be adhered to in every respect in conjunction with this specification:

- Standards for Hydrographic Surveys. Special Publication No. 44. Edition 5. *International Hydrographic Organization*.

The most recent versions of the following publications should be referred to for additional information and guidance:

- The Mariner's Handbook (NP100). *United Kingdom Hydrographic Office*.
- Admiralty Tidal Handbook No.2. *United Kingdom Hydrographic Office.*
- Admiralty List of Lights and Fog Signals Volume A (NP74). *United Kingdom Hydrographic Office*.
- HM Operational Guidance (HMOGs) NP145. (Edn 1/11). *United Kingdom Hydrographic Office*.

B4. Technical Requirement A: Sounding Set Deliverables

B4.1 Personnel

B4.1.1	**Charge Surveyor**	A Charge Surveyor (Party Chief/Surveyor in Charge) shall be on site at all times during survey operations. The Charge Surveyor shall have completed an IHO/FIG Category A accredited hydrographic survey course (or equivalent) and have a minimum of 5 years offshore surveying experience including surveying for Nautical Charting purposes. The Charge Surveyor shall have the authority and experience to make and implement operational decisions and will be available for the UKHO/MCA to contact regularly to assess progress and modify the survey plan if necessary. The Charge Surveyor's other duties and responsibilities shall be arranged such that they do not interfere with the management of the contract.
B4.1.2	**Survey Team**	The Contractor shall list the number, qualifications and experience of the survey personnel and provide these to the MCA prior to survey operations commencing. Survey teams will include personnel with adequate experience both in charge of and in assisting with all aspects of surveys of complex offshore areas for nautical charting purposes, including office data compilation as well as fieldwork.

B4.2 Swathe Bathymetry		
B4.2.1	**Primary Depth Sensor**	Depth will be measured throughout the survey area using a swathe bathymetry system capable of meeting all of the requirements stated below. The Contractor shall provide empirical evidence of each system's ability to meet the stated requirement to the MCA as a tender deliverable.
B4.2.2	**Uncertainty**	Sounding uncertainty (in three dimensions) shall be in accordance with IHO Order 1A.
B4.2.3	**Uncertainty Model**	The Contractor shall provide a fully developed uncertainty model to the MCA prior to survey operations commencing. The model shall state all component uncertainties, as well as the combined total uncertainty.
B4.2.4	**Object Detection**	For all parts of the survey area, the minimum size of object detected shall be: • Cube with sides of 2m in depths < 40m • Cube with sides of 10% of depth in depths >40m Contractors proposing phase measuring bathymetric sonars must submit a proposal when tendering stating how individual samples will be aggregated into a *sounding* for a given part of the acoustic footprint. Single interferometric samples will not be considered as a *sounding* unless they can be proven to meet the uncertainty requirements without any form of aggregation. For example, samples could be aggregated into a fixed across track bin size or binned by number of samples.
B4.2.5	**Sounding Density**	Each object (see above) is to be detected by at least 3 valid data points in the along-track direction and 3 valid data points in the across-track direction, forming a minimum 3x3 grid of 9 data points. To monitor compliance with the Target Detection requirements for a given area, a minimum sounding density of 9 accepted soundings will be achieved in the following bin sizes: • Bin with sides of 2m in depths < 40m • Bin with sides of 10% of depth in depths >40m
B4.2.6	**Acoustic Coverage**	Full seafloor coverage shall be achieved to the defined depth contour as detailed in the HI. Where a survey block lies adjacent to the coastline, data coverage (meeting the above requirements) shall extend into the 2m CD depth contour unless specified differently in the HI.
B4.2.7	**Crosslines**	A minimum of 4 bathymetric crosslines shall be run for each Survey Block of the Hydrographic Instruction. Crosslines shall be at approximately equal spacing, and be approximately perpendicular to the typical mainline orientation in that block. Crosslines shall be rendered in folders separate from the mainline data structure, and the data should be cleaned as per 4.2.12 to allow for a statistical analysis. A statistical analysis between a cross-line and the main data set is not required in the RoS – the UKHO will undertake their own analysis against compliancy with IHO depth accuracies.
B4.2.8	**Wreck Investigations**	All suspected (or obvious) wrecks located during the course of the survey shall be reported (with respect to position, orientation, extent and least depth).

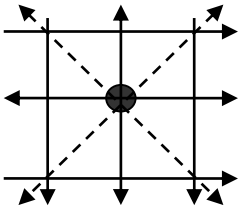
		All wrecks are to be investigated by running one survey line, centred over the centre of the wreck and orientated along the major axis, followed by two further parallel lines offset either side from the major axis. Sufficient lines run at right angles to the first so as to cover the entire length shall also be run. All investigation lines are to be run at as slow a speed as is possible, to maximise the sounding density. The contractor shall clearly indicate within the RoS whether the least depth for each wreck has been determined by the real time bottom detect, by analysis of swathe bathymetry water column data, or by other means if previously agreed by the MCA.
B4.2.9	**Swathe Bathymetry Water Column Data (WCD)**	Swathe bathymetry water column shall be logged for further analysis during all wreck investigation lines. This data shall be analysed in an appropriate software package to compare the data digitised in real time by the swathe bathymetry with other features present in the water column. The surveyor shall have the ability to re-pick fully geo-referenced depths from the water column data for inclusion in the final sounding data if a shoaler depth over a given feature has been found within the water column data. These depths will be imported into the final CARIS HIPS data structure, and be fully corrected for sound speed and tide. The Contractor will supply images with the RoS showing the water column replay for each wreck to support the designation of least depth. All WCD files are also to be rendered. The Contractor shall supply details of the procedure, software and file formats to be utilised for swathe bathymetry water column data interpretation prior to survey operations commencing. **Any Contractor proposing phase measuring bathymetric sonars must clearly indicate how they intend to meet this water column requirement as a tender deliverable.**
B4.2.10	**Depth Data Precision**	Depth data recorded shall be logged to at least two decimal places of a metre.
B4.2.11	**Data Cleaning**	All accepted soundings within the final bathymetric dataset shall fall within the IHO Order 1A uncertainty allowance. All systematic errors and obvious outliers shall be rejected from the bathymetric data. Data points falling within the Order 1A depth requirements but still numerically distant from the main dataset will still be regarded as outliers.

B4.3 Tides & Reduction of Soundings		
B4.3.1	**Reduction of Soundings**	Soundings are to be reduced to Chart Datum by using dual frequency carrier phase GNSS height observations (which comply with requirement B4.4.3) combined with the VORF model. Soundings are to be presented as depths below Chart Datum, as supplied by the UKHO and defined in VORF. The Contractor shall demonstrate that the method chosen for sounding reduction results in the overall depth uncertainty requirements being met.
B4.3.2	**Establishment of Shore-Based and Offshore (Seabed Mounted) Tide Gauges**	Coastal or offshore tidal stations may be required within the extents of an HI area. The HI for a particular area will confirm local requirements. Some HIs will require supplementary tidal stations, and some will require the use of locally available permanently installed gauges, e.g. local Harbour Master, National Tidal and Sea Level Facility (NTSLF) or Channel Coast Observatory (CCO) tide gauges. When requested in the HI, tidal heights will be measured throughout the survey period and for a minimum of 30 days using a temporary or permanent tide gauge capable of meeting all of the requirements stated below. Automatic tide gauges (both onshore and offshore) should be capable of resolving water level measurement to ±0.01m in height and ±2 min in time. Heights must be recorded to at least 2 decimal places of precision and at sample intervals no higher than 5 minute resolution. Offshore (on non-vented) tide gauges shall be corrected for atmospheric pressure. Atmospheric pressure shall be recorded within 100km of the gauge location at a temporal resolution no greater than 6 hours.
B4.3.3	**Pole-to-Gauge Calibration**	All temporarily-contractor-installed tide gauges must be calibrated by reference to independent readings using a tide pole or 'top down air gap' measurements (e.g. by weighted tape measure from an appropriate reference mark which can be subsequently tied into the vertical control). The H143 spreadsheet must be used for this purpose. Readings are to be taken half-hourly as a minimum, with 10-minute interval readings taken for the duration of one hour before to one hour after high and low water. If observing at a location with a tide range in excess of 7m (or where the range is perceived to be changing rapidly) the observations are to be taken every 10 minutes, and every 5 minutes for the duration of one hour before to one hour after high and low water. Automatic coastal tide gauges installed by the contractor only require a minimum 13-hour period of manual observations. When reading a pole in calm weather an accuracy of ± 0.03m should be attainable, with the time of each reading recorded to within ± 5 seconds of UTC; the same for a 'top down air gap' measurement technique. Reports on the Pole to Gauge comparison are also to be made on Form H516 (Summary of Checks on Automatic Tide gauge). The pole used shall be levelled to at least two permanently mounted and documented control points which meet the requirements stated in **Station Marking and Documentation.**

		When a permanent / previously established tide gauge is given in the HI, the gauge zero versus Chart Datum connection stated in the HI may be required to be checked independently by means of a pole to gauge calibration to ensure the gauge is correctly calibrated (unless documented evidence can be provided in the RoS that this check has recently (within the last 6 months) been undertaken by appropriate owning authority). The HI for a particular area will confirm local requirements.
B4.3.4	**Verification of VORF Model**	When requested in the HI, the Contractor shall perform a static validation of the VORF model at specified tide gauge locations (including both offshore and coastal gauges). This comparison shall be conducted by stationing each survey vessel within 1km of the tide gauge location for a minimum of 8 hours and logging corresponding water levels using the GNSS and VORF system, compared to the tide gauge data. This 8 hour period shall include successive high and low water events. The vessel shall be stationary during this period. The results should be presented in both tabular and graphical format in the RoS, and clearly demonstrate the relationship between the water line and the vessel reference frame. Comparisons between GNSS/VORF derived tidal heights for the vessel and the observed tidal heights (with co-tidal corrections) from the tide gauge(s) shall be made at regular intervals covering the entire survey period to confirm the VORF values and methodology.
B4.3.5	**Tidal Stream Observations**	Some HIs may require tidal stream observations. Tidal Stream observations will be conducted in the locations listed in each HI using a seabed mounted ADCP. These observations shall as a minimum obtain the Tidal Stream in the "surface" layer of the water column, which is to be representative over a depth of 5 - 10m below MSL. The ADCP should also record the stream movement throughout the water column at appropriate bin sizes in order to achieve, at the very minimum, a 'mid-column' and 'near seabed' stream rates and directions. Bin size to be set to 0.5m in water depths of ≤20m, and 1m in depths >20m If the ADCP is also capable of recording water level, this should also be enabled and supplied. The time interval of recorded tidal stream data (and height data if available) is to be every 10 minutes, preferably with each hour occurring 'on the hour'. ADCPs will be deployed for tidal stream observations to enable a minimum of 15 days continuous data to be collected, unless stated differently in the HI.

B4.4 Positioning, Survey Control and Calibration		
B4.4.1	**Survey Geodesy**	Unless otherwise stated, every survey shall be rendered using the following geodetic parameters Datum: ETRS89 Spheroid: GRS '80 Projection: UTM Grid Zone 29/30/31North (as specified in the HI) All rendered positions shall be quoted as geographical co-ordinates (i.e. in terms of Lat. / Long) as degrees and decimal minutes.
B4.4.2	**Horizontal Accuracy**	The Horizontal Accuracy of all depths and positions shall be in accordance with IHO S44 Order 1a.
B4.4.3	**Positioning**	Soundings are to be positioned by using dual frequency carrier phase GNSS combined with the Ordnance Survey Active Networks (i.e. Post Processed Kinematic GNSS). In some offshore locations the Contractor may need to switch to Precise Point Positioning techniques or utilise base stations from alternative networks. This will be permitted for an HI only by prior approval from the MCA. Post processed positions should ideally be integrated with the vessel attitude data to avoid bias associated with vessel motion. The Contractor shall demonstrate that the method chosen for sounding positioning results in the overall horizontal uncertainty requirements being met. Conventional Differential GNSS is acceptable for real time positioning (as these positions will later be discarded) – although more precise positioning may also be used if required by the Contractor. The contractor will state methodologies for post-processed and real time positioning as a tender deliverable.
B4.4.4	**Establishment of Survey Control**	Three dimensional position of any existing or newly established survey control shall be determined by dual frequency carrier phase GNSS techniques, tied in to the Ordnance Survey Active Network. A minimum of six hours observations are required per station. This six hour observation period should be divided into two three hour sessions. At the end of the first session the antenna should be physically moved away from the mark and then re-established over the mark before commencing the 2nd observation session. The height of the static GNSS antenna should be measured before each session and clearly recorded and reported. If the height measured is a slope distance from the edge of the antenna, this shall be appropriately corrected to obtain the true vertical offset. The static GNSS antenna shall be positioned directly over the control point using an optical plummet. The absolute uncertainty with respect to ETRS89 for any existing or newly established survey control shall not exceed 1cm in horizontal and 2 cm in vertical (at 2 sigma). The appropriate OD height and appropriate UTM coordinate for each station shall be computed. Where necessary, co-ordinate conversion shall be conducted using approved conversion programs and an estimated final uncertainty stated.

B4.4.5	**Optical Levelling**	To perform a redundant check on any control established and/or utilised, all control points shall be optically levelled from two pre-existing control points referred to the appropriate Ordnance Datum. Levelling is to be conducted between the 2 control points established, the tide pole and any existing BM's in the vicinity provided in the HI. Levelling is to comprise a looped traverse – no intersights shall be taken. Levels should be read and recorded to a precision of 0.001m. Levelling shall be recorded using the H532 Levelling Reduction Form. Any levelling field records should also be supplied. In some cases, this levelling requirement may be replaced by an entirely GNSS based redundant technique upon agreement with the MCA, should pre-existing control prove unsuitable or non-existent.
B4.4.6	**Station Marking and Documentation**	All geodetic stations established during survey operations shall be described, photographed and permanently marked to assist their future recovery. They shall be marked with a stainless steel, brass or bronze bolt drilled into concrete, in an area where they are unlikely to be disturbed. The bolt shall be punched to mark the precise horizontal measurement point. Stations shall not be established in tarmac. Stations deviating from the above requirements due to site conditions will only be permitted at the prior discretion of the MCA. A full station description shall be recorded using the H159 Description of Geodetic Control Station Form, including photographs and diagrams to aid recovery.
B4.4.7	**Vessel Dimensional Control**	An appropriate dimensional control survey of each vessel utilised shall have been conducted prior to commencement. Permanent and recoverable control points are to be established on each vessel utilised, coordinated to the vessel reference frame to within a tolerance ±0.01m relative (at the 95% confidence level) in X, Y and Z. All sensors shall be established within the vessel reference frame within a tolerance of ±0.02m relative (at the 95% confidence level) in X, Y and Z. Where appropriate, the rotations of each sensor around the X, Y and Z axis shall be initially determined by the dimensional control survey to within ±0.2 degrees (at the 95% confidence level). These values may be later adjusted during the sonar patch test if required. The centre of gravity (rotation) should also be estimated and it's location within the vessel reference frame and method of establishment clearly stated in the RoS. A copy of the dimensional control report for each vessel shall be supplied with the RoS for each HI.
B4.4.8	**Swathe Bathymetry Calibration**	A calibration of the swathe bathymetry system and associated sensors (i,e, "patch test") shall be performed at the start of each survey season or after changing out or significantly reconfiguring any survey sensor (methodology shall be detailed in tender). Final post calibration repeatability shall be proven by means of the repeatability test detailed below.
B4.4.9	**Static Positioning Check**	A static positioning check shall be performed at the start of each survey season or after changing out or significantly reconfiguring any survey sensor (methodology shall be detailed in tender). The check shall monitor the three dimensional position of either the primary GNSS antenna or another appropriate point within the vessel reference frame, for a period of no less than 30 minutes at a 1 minute resolution. The subsequent report should separately state the computed statistical reliability of both

		the horizontal position and the height measured. The positioning data to be compared will have been derived using the same procedures used to obtain all positions associated with the bathymetric data (i.e. post processed kinematic). Any local survey control utilised in this procedure shall be compliant with the requirements stated in section **Establishment of Survey Control**.
B4.4.10	**Swathe Bathymetry Repeatability Test**	A swathe bathymetry repeatability test shall be performed following calibration at the start of each survey season or after changing out or significantly reconfiguring any survey sensor (methodology shall be detailed in tender). This test should be conducted after the static position check stated above. The test shall monitor the three dimensional position of a clearly defined small but easily detectable feature on the seabed. The feature should be first surveyed near nadir from multiple directions – as a minimum from north, south, east and west. Secondly the feature should be boxed in, so that it appears in the outer beams on port for 2 lines, and the outer beams on starboard for 2 lines.  The subsequent report should separately state the computed statistical reliability of both the horizontal position and the depth measured for the feature.
B4.4.11	**Vertical Offset Check**	A vertical offset gross error check shall be performed at the start of each survey season or after changing out or significantly reconfiguring any survey sensor (methodology shall be detailed in tender). The check shall compare the physical measurements of the distance from the primary and secondary GNSS antennas on the vessel to the seabed. This shall be performed in one location using a method entirely independent of the vessel's survey systems (e.g. level staff or leadline in a berth). These measurements shall be compared to data logged simultaneously in the same location using the vessel's survey system and software. The results should be compared and detailed in the RoS.
B4.4.12	**Quality**	The Contractor shall provide an indication of the continuous quality of the post-processed 3D position.

B4.5 General Requirements		
B4.5.1	**Hydrographic Notes**	Reports of any newly discovered dangers to surface or sub-surface navigation shall be passed immediately to the MCA Hydrography and Receiver of Wreck teams and to the UKHO using the H102 Hydrographic Note form.
B4.5.2	**Eddies and Over-falls**	Observations of any eddies or over falls which may be significant to small craft are to be rendered in the Report of Survey, stating the approximate geographic extents of such features, and how they relate to tidal and weather conditions. All previously charted eddies and over-falls must be reported on, even if just to state that the current charted information is correct.
B4.5.3	**Sound Speed**	The Contractor shall observe sound speed profiles at an interval consistent with the proposed error budget.
B4.5.4	**Backscatter**	High resolution, geo-referenced multibeam backscatter data shall be collected to inform on seabed textural change, and rendered in the proprietary format of the swathe bathymetry system utilised. The Contractor shall endeavour to ensure that systemic variations to backscatter intensity are kept to a minimum and that gain, pulse length or any other system changes are minimised during data acquisition.
B4.5.5	**Seabed Sampling**	Where requested in the HI, seabed sampling is to be conducted on an approximate 5km grid with at least one sample being taken in each major textural area identified. Sampling will not be conducted until all bathymetry and backscatter for a given block or HI is complete, so as to inform the required positions for samples within the major textural areas. All seabed samples are to be retained and logged using the Folk Classification scheme. Samples are to be taken with the ship stopped in the water. All samples are to be forwarded to the British Geological Survey: [redacted] Plastic screw top containers are to be used to preserve the samples. The use of polythene bags for preserving retained samples is not acceptable
B4.5.6	**Amendments to Sailing Directions**	The relevant Admiralty Pilot shall be checked in the field and appropriate amendments rendered. Particular attention shall be paid to any recommended approach routes and anchorages within or adjacent to the survey area. If no changes to the relevant Admiralty Pilot are thought to be required by the Contractor, this should also be recorded in the RoS.
B4.5.7	**Views for Sailing Directions**	Details of photographs required to update existing views in the relevant Admiralty Pilot will be supplied in each HI. Views shall be supported by appropriate records in strict accordance with NP100 paragraph 4.83. New photography shall be in colour and

		prepared in accordance with NP100. Digital cameras shall be used and must be either Single Lens Reflex or described by their manufacturer as a "Bridge" or "Bridging" camera and shall have at least 6M pixel resolution.
B4.5.8	**Licences, Consents & Permissions**	The Contractor shall be responsible for arranging all licences, consents and permits, for access and frequency clearance for all survey operations whether ashore or afloat.
B4.5.9	**Fixed and Floating Aids to Navigation**	The positions and characteristics of all fixed and floating aids to navigation visible from the survey area do not need to be reported. However, if navigationally significant differences between physical features and their depiction on the current Admiralty nautical charts and publications are detected, then this should be immediately reported to the relevant Port Authority and General Lighthouse Authority using the H102 form. The MCA and UKHO should be copied on all correspondence of this type.
B4.5.10	**Leading Lines & Tracks**	The leading lines and recommended tracks along channels and into harbours and anchorages marked by lights or fixed daymarks must be very carefully examined. If navigationally significant differences between physical features and their depiction on the current Admiralty nautical charts and publications are detected, then this should be immediately reported to the relevant Port Authority and the General Lighthouse Authority using form H102. The MCA and UKHO should be copied on all correspondence of this type.
B4.5.11	**Magnetic Anomalies**	Charted or newly discovered magnetic anomalies are to be investigated. The ship should be steamed slowly in a wide octagon shape centred on the charted anomaly, both to port and starboard, made with the standard magnetic compass on 8 equidistant points during each turn. The ship should be steadied on each heading for at least a minute before the observation to allow the sub permanent magnetism resulting from the last course, to disappear. On each leg of the octagon, both magnetic and GNSS derived headings shall be logged and compared. Any anomaly found, or not found, shall be reported in the RoS, including the extent and magnitude of local variations.
B4.5.12	**Fishing Industry**	Liaison with, and compensation to, fishermen for loss/damage to fishing gear are matters which rest entirely with the Contractor. The Contractor is to liaise closely with local fisheries groups and the appropriate local District Fisheries Inspectors well in advance of the commencement of fieldwork.
B4.5.13	**Daily and Weekly Progress Report**	Progress reports detailing progress, planned activities, weather downtime and any problems encountered shall be completed and e-mailed to the MCA and UKHO representative on a daily basis. A short (e.g. 1-page) summary progress report shall be completed and e-mailed to the MCA and UKHO Representative on a weekly basis. This will include the predicted delivery dates for each active HI and associated vessel plans.
B4.5.14	**Quality Control**	Robust quality control procedures shall be provided and adhered to during processing of all data. These procedures shall be provided to the MCA prior to survey operations commencing.

B4.6 Safety		
B4.6.1	**Responsibility**	Equipment and survey personnel provided by the Contractor for work in connection with the contract shall be the Contractor's responsibility at all times. Any loss, injury or damage suffered or caused by them shall be at the Contractor's risk throughout, but must be reported to the MCA immediately and any other relevant authority, including the MAIB.
B4.6.2	**Safety Management Plan**	Details of the Contractor's safety policy and Safety Management Plan shall be supplied to the MCA prior to survey operations being undertaken for each HI.
B4.6.3	**Drugs and Alcohol Policy**	The Contractor shall have a drugs and alcohol policy, which forbids the presence of drugs or alcohol in vessels or offices used under this contract. The policy must include random drug and alcohol testing. MCA reserve the right to request evidence of the regime in place at any time throughout the life of the contract.
B4.6.4	**Daily Meetings**	The Surveyor-In-Charge shall hold daily "Toolbox Meetings" with members of the navigational watch. Meetings shall be minuted (briefly), posted in the mess and shall include the following headings as a minimum: ▪ Date, Time, List of attendees ▪ Activities - Last 24 Hours ▪ Planned Activities – Next 24 Hours ▪ Safety / Hazards
B4.6.5	**Work in Poorly Surveyed Waters**	The vessel master is responsible for the overall navigational safety of the vessel and crew. If the master considers that there is a conflict of interest in terms of the safety of the vessel and crew with regard to the proposed survey areas, he has the overriding authority to refuse to survey those areas. The contractor shall have an appropriate 'Shallow Water Working' procedure set out as part of their quality/safety management system.
B4.6.6	**Medical Certification**	All offshore survey personnel must have an in-date medical certificate of at least "ENG1" standard. Evidence of certification may be requested by the MCA or its representatives at any time.
B4.6.7	**Safety Training Certification**	All offshore survey personnel must have in-date certification to demonstrate completion of the STCW 78 as amended Basic Safety Training package including: ▪ Personal Survival Techniques (STCW A-VI / 1-1) ▪ Fire Fighting and Fire Prevention (STCW A-VI / 1-2) ▪ Elementary First Aid (STCW A-VI/ 1-3) ▪ Personal Safety and Social Responsibility(SCTW A- VI/1 – 4) (Note that survey personnel and supernumeraries may alternatively have in-date certification to demonstrate completion of an Offshore Petroleum Industry Training Organisation approved course adhering to the "Minimum Industry Safety Training Standards"). Evidence of certification may be requested by the MCA or its representatives at any time.

B4.6.8	**Familiarisation Training**	All offshore survey personnel must undertake familiarisation training prior to sailing which must ensure attendees are able to: ▪ Communicate with other persons on board on elementary safety matters and understand safety information symbols, signs and alarms; ▪ Know what to do if: a person falls overboard; fire or smoke is detected; the fire or abandon ship alarm is sounded; ▪ Identify assembly and embarkation stations and emergency escape routes; ▪ Locate and don lifejackets; ▪ Raise the alarm and have a basic knowledge of the use and types of portable fire extinguishers; ▪ Take immediate action upon encountering an accident or other medical emergency, before seeking further medical assistance on board; and close or open the fire, weathertight and watertight doors fitted in the particular ship, other than those for hull openings. Evidence of training may be requested by the MCA or its representatives at any time.
B4.6.9	**Vessel Inspections**	Each vessel tasked with survey under the CHP shall be subject to approval (via an MCA Marine Office inspection) prior to survey work commencing under the contract. The 'Approval Inspection' will be required for both UK and Foreign Flag vessels. Repeat annual inspections shall be undertaken throughout the duration of the contract. Vessels shall be inspected in the UK, however, where an overseas port is closer to the survey area for transit, crew change and onboard supplies, a vessel may be inspected overseas. The 'Approval Inspection', will be chargeable to the contractor. Where the MCA requests a repeat annual inspection, MCA will cover the cost and will be part of the MCA's normal activities and be recorded as a Port State Control inspection/inspection of a Foreign Flag vessel/Code Vessel inspection as appropriate. Any inspections overseas will be charged to the contractor, unless it is an annual inspection and the overseas port is the closest port to the particular survey area for transit, crew change and taking onboard supplies. In any case, the operator must cover travel costs.
B4.6.10	**Vessel Flag**	British Flag or EU registered vessels are preferred. The term "British Flag" includes not only those vessels flagged in the UK but also within the scope of the Red Ensign Category 1 and 2 Registers. Vessels registered with a Flag State on either the Black or Grey List will not be accepted for the purposes of the CHP.
B4.6.11	**Vessel Risk Profile**	Should a foreign flag vessel over 24 metres employed on CHP work receive a Ship Risk Profile of High Risk Ship (HRS), then the MCA reserves the right to remove this vessel from the contract until the Ship Risk Profile is deemed to be Standard Risk Ship (SRS) or a Low Risk Ship (LRS).
B4.6.12	**Vessel Commitment**	Once a vessel has been tasked to an HI, the contractor should seek the MCA's prior agreement to remove or replace the vessel with another.

		The MCA will only approve a vessel replacement if the oncoming vessel is an appropriate like-for-like exchange and continues to abide by the requirements of the specification and tender bid.
B4.6.13	**Vessel Visits**	All vessels employed on CHP contracts shall be visited by an MCA or UKHO representative at least once every 2 months. Visits are primarily intended to focus on the quality of hydrographic processes and deliverables but will also include an informal assessment of safety aspects onboard. If significant safety concerns are raised, then the contract overseer shall ensure that the local MCA marine office is made aware.

B4.7 Deliverables		
B4.7.1	**Data Delivery Deadline**	All data and associated documents are to be rendered to the UKHO within 70 working days of the completion of fieldwork milestone declared by the Contractor.
B4.7.2	**UKHO Appraisal Schedule**	If surveys are rendered to the UKHO between 65 and 70 working days following the completion of fieldwork milestone declared by the Contractor then the UKHO intend to fully validate the deliverables within 25 working days. If the data is delivered to the UKHO earlier than this then the UKHO will assign the survey to the next available slot in their programme. The validation timescales may increase but the UKHO intend to not exceed 25 working days past the Data Delivery Deadline. This assumes the deliverables are fully compliant with this specification.
B4.7.3	**Labelling of Records & Deliverables**	**Project Name:** UK Civil Hydrography Programme **Hydrographic Instruction Number:** *As detailed in each Hydrographic Instruction* **Hydrographic Instruction Name:** *As detailed in each Hydrographic Instruction* **Each rendered item of digital data shall bear a depiction of the MCA logo, together with the project name, HI number and HI name.** All data and accompanying documents and records, both working and fair, originating from the survey become the property of HM Government and must be handed over on demand. Where appropriate, they are to carry the following official markings: CROWN COPYRIGHT 2015* *year as appropriate.
B4.7.4	**Required Deliverables**	**UKHO deliverables:** ▪ Processed (cleaned) sounding data (CARIS HIPS Project), structured by vessel and including crosslines in separate folders. The CARIS HIPS software version shall be up-to-date at time of rendering. Projects delivered using CARIS HIPS v9 (and later) must not be indexed. The data must be converted to full HDCS format. ▪ Raw sounding data (proprietary format) containing full backscatter record ▪ Raw and processed Water Column Data from wreck investigations ▪ Backscatter mosaic in high resolution GeoTIFF format ▪ Seabed classification of backscatter data (digital seabed texture information) in ESRI shapefile format (see details at **Annex D3**) ▪ Sound-speed records in ASCII format and a minimum of four records per day in H635 digital format. ▪ ADCP data (when requested in HI). ▪ Digital Report of Survey (UKHO format including appropriate H forms): o Dimensional control / Calibration / validation data o Survey Control Geodetic data (including reference station RINEX)

		○ Wreck records (including Images showing the water column replay for each wreck investigated) ○ Tidal records ○ Amendments to any Admiralty Publications ○ Photographic views with supporting data ○ Seabed sampling records ○ Miscellaneous observations records **MCA deliverables (following successful data appraisal by UKHO and issue of H628B form):** ▪ Specific data and reports will be requested at times.
B4.7.5	**Backscatter Mosaic**	The backscatter mosaic should be a representation of the backscatter intensity across the respective HIs. Artefacts (nadir stripping, poor data, etc) and backscatter changes within homogenous areas shall be corrected for. If a survey area is too large to create one contiguous mosaic, then an individual mosaic for each block should be created. The resolution of the backscatter mosaic shall be the best achievable.
B4.7.6	**Seabed Classification**	A classification of seabed texture information shall be rendered as an ESRI shapefile. The Contractor shall interpret seabed textural changes across their respective HIs using a combination of the bathymetry, backscatter interpretation and ground-truthing from grab sampling. The Contractor shall provide details of the procedures and software to be employed as a tender deliverable. **Annex D3** provides further details.
B4.7.7	**"H Forms"**	"H Forms" have been designed by the UKHO to facilitate checking and validation of rendered data. The Contractor shall always use the appropriate "H Form" where one exists for a process which is undertaken.
B4.7.8	**Digital Data Media**	All Data shall be delivered on USB 3.0 hard drives (or equivalent). No rendered data file shall be larger than 2 Gigabytes in size. The Contractor shall provide all USB 3.0 media required for transferring data from ship to shore and for rendering completed surveys to the UKHO.
B4.7.9	**Report of Survey (RoS)**	A Report of Survey (RoS) shall be rendered in digital format in accordance with the latest UKHO requirements for digital RoS for each Hydrographic Instruction.
B4.7.10	**Bathymetric Data Attribution**	Processed bathymetric data shall contain the following attributes for each sounding as a minimum: position and depth; swath and beam number; backscatter intensity; 95% statistical uncertainty estimation for position; 95% statistical uncertainty estimate for depth. Files shall be full density (i.e. not "thinned") with rejected soundings flagged but not deleted from the data set.
B4.7.11	**Tidal Data**	Tide gauge records are to be rendered in a text file or Excel spreadsheet and containing the meta-data about the deployment, which as a minimum must be:- • Position of instrument • Depth of water at the deployment site

		• Start/ End of deployment time and date • Units in metres The tide gauge observations must be rendered in metres and not solely in pressure readings.

B4.7.12	**Tidal Stream Data**	An Excel spreadsheet containing the meta-data about the deployment:-
		• Position of instrument
		• Depth of water at the deployment site
		• Height of instrument above the seabed
		• Start/ End of deployment time and date
		• Local variable parameters
		  ○ Magnetic Variation
		  ○ Mean Water Density
		  ○ Barometric Pressure
		If the ADCP is also able to record tidal height data, then this must be configured in the deployment and supplied in Excel format, either accompanying the main tidal stream data or in a separate tab / spreadsheet.
		The stream data in the Excel spreadsheet must be displayed for each bin recorded in departures E and N, as well as Magnitude and Degrees (true). Units of the rates must be clearly stated.

B4.7.13	**Comparison with Published Charts**	The sounding detail shown on the largest scale published UKHO chart of the survey area is to be critically examined and any significant differences reported. In particular, a comment is required for any charted dangers that were not discovered during the survey, or where the least depth found over a danger during the survey is deeper than charted. Any other errors, ambiguities or other defects shall be reported.
B4.7.14	**Retention of Data**	All raw and processed digital records shall be retained and maintained by the Contractor for a period of 3 years from the date of the final contract payment. On completion of this 3 year period, the Contractor may seek permission from MCA to dispose of the data as they so wish.

B5. Technical Requirement B: Statistical Bathymetric Surface Deliverables

B5.1 Personnel

B5.1.1	**Charge Surveyor**	A Charge Surveyor (Party Chief/Surveyor in Charge) shall be on site at all times during survey operations. The Charge Surveyor shall have completed an IHO/FIG Category A accredited hydrographic survey course (or equivalent) and have a minimum of 5 years offshore surveying experience including surveying for Nautical Charting purposes. The Charge Surveyor shall have the authority and experience to make and implement operational decisions and will be available for the UKHO/MCA to contact regularly to assess progress and modify the survey plan if necessary. The Charge Surveyor's other duties and responsibilities shall be arranged such that they do not interfere with the management of the contract.
B5.1.2	**Survey Team**	The Contractor shall list the number, qualifications and experience of the survey personnel and provide these to the MCA prior to survey operations commencing. Survey teams will include personnel with adequate experience both in charge of and in assisting with all aspects of surveys of complex offshore areas for nautical charting purposes, including office data compilation as well as fieldwork.

B5.2 Swathe Bathymetry		
B5.2.1	**Primary Depth Sensor**	Depth will be measured throughout the survey area using a swathe bathymetry system capable of meeting all of the requirements stated below. The Contractor shall provide empirical evidence of each system's ability to meet the stated requirement to the MCA as a tender deliverable.
B5.2.2	**Uncertainty**	Sounding uncertainty (in three dimensions) shall be in accordance with IHO Order 1A.
B5.2.3	**Uncertainty Model**	The Contractor shall provide a fully developed uncertainty model to the MCA prior to survey operations commencing. The model shall state all component uncertainties, as well as the combined total uncertainty.
B5.2.4	**Object Detection**	For all parts of the survey area, the minimum size of object detected shall be: • Cube with sides of 2m in depths < 40m • Cube with sides of 10% of depth in depths >40m Contractors proposing phase measuring bathymetric sonars must submit a proposal when tendering stating how individual samples will be aggregated into a *sounding* for a given part of the acoustic footprint. Single interferometric samples will not be considered as a *sounding* unless they can be proven to meet the uncertainty requirements without any form of aggregation. For example, samples could be aggregated into a fixed across track bin size or binned by number of samples.
B5.2.5	**Sounding Density**	Shall comply with the data density requirements in section B5.9.
B5.2.6	**Acoustic Coverage**	Full seafloor coverage shall be achieved to the defined depth contour as detailed in the HI. Where a survey block lies adjacent to the coastline, data coverage (meeting the above requirements) shall extend into the 2m depth contour unless specified differently in the HI.
B5.2.7	**Crosslines**	A minimum of 4 bathymetric crosslines shall be run for each Survey Block of the Hydrographic Instruction. Crosslines shall be at approximately equal spacing, and be approximately perpendicular to the typical mainline orientation in that block. Crosslines shall be rendered in folders separate from the mainline data structure, and the data should be cleaned as per 4.2.12 to allow for a statistical analysis. A statistical analysis between a cross-line and the main data set is not required in the RoS – the UKHO will undertake their own analysis against compliancy with IHO depth accuracies.
B5.2.8	**Wreck Investigations**	Unless specifically excluded in the HI (see below), all suspected (or obvious) wrecks located during the course of the survey shall be investigated and reported (with respect to position, orientation, extent and least depth). All wrecks are to be investigated by running one survey line, centred over the centre of the wreck and orientated along the major axis, followed by two further parallel lines offset either side from the major axis. Sufficient lines run at right angles to the first so as to cover the entire length shall also be run. All investigation lines are to be run at as slow a speed as is possible, to maximise the sounding density. The contractor shall clearly indicate within the RoS whether the least depth for each wreck has been

		determined by the real time bottom detect, by analysis of swathe bathymetry water column data, or by other means if previously agreed by the MCA. For some Routine Resurvey areas only, wrecks that do not require investigation (because they have been fully investigated in previous years) will be shown in the HI Wrecks List as; / FOR INFORMATION. NO SPECIAL SEARCH NOW REQUIRED @ NO FURTHER INVESTIGATION REQUIRED However, if the mainline bathymetry indicates that these wrecks may now be shoaler than charted, a full investigation should be undertaken.
B5.2.9	**Swathe Bathymetry Water Column Data (WCD)**	Swathe bathymetry water column shall be logged for further analysis during all wreck investigation lines. This data shall be analysed in an appropriate software package to compare the data digitised in real time by the swathe bathymetry with other features present in the water column. The surveyor shall have the ability to re-pick fully georeferenced depths from the water column data for inclusion in the final sounding data if a shoaler depth over a given feature has been found within the water column data. These depths will be imported into the final CARIS HIPS data structure, and be fully corrected for sound speed and tide. The Contractor will supply images with the RoS showing the water column replay for each wreck to support the designation of least depth. All WCD files are also to be rendered. The Contractor shall supply details of the procedure and software to be utilised for swathe bathymetry water column data interpretation prior to survey operations commencing. **Any contractor proposing phase measuring bathymetric sonars must clearly indicate how they intend to meet this water column requirement as a tender deliverable.**
B5.2.10	**Depth Data Precision**	Depth data recorded shall be logged to at least two decimal places of a metre.

B5.3 Single Beam Bathymetry (Lot 3 – Routine Resurvey Programme only)		
B5.3.1	**Primary Depth Sensor**	Where open spaced SBES lines are specified, depth will be measured using a SBES capable of meeting all of the requirements stated below. If the contractor wishes to undertake any of the SBES lines using their CHP MBES system then they may do so. If this approach is taken, all MBES data must be fully cleaned and processed and meet all of the requirements stated below. The Contractor shall provide empirical evidence of each system's ability to meet the stated requirement to the MCA as a tender deliverable.
B5.3.2	**Uncertainty**	Depth and position (of sounding) uncertainty shall be in accordance with IHO Order 1A.
B5.3.3	**Uncertainty Model**	The Contractor shall provide a fully developed uncertainty model to the MCA prior to survey operations commencing. The model shall state all component uncertainties, as well as the combined total uncertainty.
B5.3.4	**SBES Frequency**	The acoustic frequency of the SBES shall be between 100 kHz and 300kHz. Only one frequency channel is required. The frequency of the transducer utilised shall be clearly stated in the RoS.
B5.3.5	**SBES Beamwidth**	The major axis of the beamwidth of the SBES transducer shall be between 3º and 8º. The beamwidth of the transducer utilised shall be clearly stated in the RoS.
B5.3.6	**Calibration**	The SBES utilised shall be corrected for draft offset (from the GNSS antenna or water line as appropriate) and sound speed to ensure the depth and position uncertainty requirements are met throughout. The Contractor shall supply details of the SBES calibration procedure as a tender deliverable.
B5.3.7	**Sounding Density**	The along track density of valid soundings shall not exceed 5m.
B5.3.8	**Survey Line Spacing**	As required by the HI.
B5.3.9	**Cross Lines**	As required by the HI. Cross lines shall be rendered in folders separate from the mainline data structure, and the data should be cleaned as per "Data Cleaning" to allow this data to be charted. A statistical analysis between a cross-line and the main data set is not required in the RoS – the UKHO will undertake their own analysis against compliancy with IHO depth accuracies.
B5.3.10	**Deviation from Planned Survey Lines**	The maximum deviation offline from the planned survey lines will be 20m, except in areas where an obstruction exists. Where an obstruction exists, the contractor shall follow the route around the obstruction which offers the least deviation from the planned survey line.
B5.3.11	**SBES Water Column Data**	SBES water column (also known as the "echogram") shall be logged for further analysis throughout to aid data cleaning. The Contractor shall supply details of the SBES water column data type and software to be utilised as a tender deliverable.

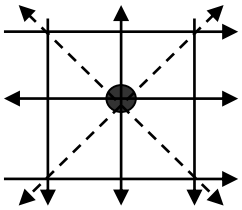
B5.3.12	**Reduction of Soundings**	Soundings are to be reduced by using dual frequency carrier phase GNSS height observations combined with the UKHO VORF model and the Ordnance Survey Active Networks. Soundings shall be reduced for tides in all depths. Soundings are to be presented as depths below / heights above Chart Datum, as supplied by the UKHO and defined in VORF. The Contractor shall demonstrate that the method chosen for sounding reduction results in the overall depth uncertainty requirements being met.
B5.3.13	**Heave Compensation**	The effect of heave shall be minimised in the depth data by use of either a heave compensator or by GNSS smoothing techniques. The Contractor shall supply details of the method to be used for countering the effect of heave as a tender deliverable.
B5.3.14	**Presentation of Depth Data**	Depth data recorded shall be logged to at least two decimal places of a metre.
B5.3.15	**Data Cleaning**	All accepted soundings within the final bathymetric dataset shall fall within the IHO Order 1A uncertainty allowance. All systematic errors and obvious outliers shall be rejected from the bathymetric data. Data points falling within the Order 1A depth requirements but still numerically distant from the main dataset will still be regarded as outliers.
B5.3.16	**SBES Data Deliverables**	Processed and cleaned SBES data shall be rendered as a part of the final CARIS HIPS project for each HI. The CARIS HIPS software version shall be up-to-date at the time of rendering. The SBES vessel and data shall be isolated from the MBES vessel and data using the conventional CARIS vessel hierarchy. Calibration data and crosslines shall be isolated from the main survey lines.

B5.4 Tides & Reduction of Soundings		
B5.4.1	**Reduction of Soundings**	Soundings are to be reduced to Chart Datum by using dual frequency carrier phase GNSS height observations (which comply with requirement B5.5.3) combined with the VORF model. Soundings are to be presented as depths below Chart Datum, as supplied by the UKHO and defined in VORF. The Contractor shall demonstrate that the method chosen for sounding reduction results in the overall depth uncertainty requirements being met.
B5.4.2	**Establishment of Shore-Based and Offshore (Seabed Mounted) Tide Gauges**	Coastal or offshore tidal stations may be required within the extents of an HI area. The HI for a particular area will confirm local requirements. Some HIs will require supplementary tidal stations, and some will require the use of locally available permanently installed gauges, e.g. local Harbour Master, National Tidal and Sea Level Facility (NTSLF) or Channel Coast Observatory (CCO) tide gauges. When requested in the HI, tidal heights will be measured throughout the survey period and for a minimum of 30 days using a temporary or permanent tide gauge capable of meeting all of the requirements stated below. Automatic tide gauges (both onshore and offshore) should be capable of resolving water level measurement to ±0.01m in height and ±2 min in time. Heights must be recorded to at least 2 decimal places of precision and at sample intervals no higher than 5 minute resolution. Offshore (on non-vented) tide gauges shall be corrected for atmospheric pressure. Atmospheric pressure shall be recorded within 100km of the gauge location at a temporal resolution no greater than 6 hours.
B5.4.3	**Pole-to-Gauge Calibration**	All temporarily-contractor-installed tide gauges must be calibrated by reference to independent readings using a tide pole or 'top down air gap' measurements (e.g. by weighted tape measure from an appropriate reference mark which can be subsequently tied into the vertical control). The H143 spreadsheet must be used for this purpose. Readings are to be taken half-hourly as a minimum, with 10-minute interval readings taken for the duration of one hour before to one hour after high and low water. If observing at a location with a tide range in excess of 7m (or where the range is perceived to be changing rapidly) the observations are to be taken every 10 minutes, and every 5 minutes for the duration of one hour before to one hour after high and low water. Automatic coastal tide gauges installed by the contractor only require a minimum 13-hour period of manual observations. When reading a pole in calm weather an accuracy of ± 0.03m should be attainable, with the time of each reading recorded to within ± 5 seconds of UTC; the same for a 'top down air gap' measurement technique. Reports on the Pole to Gauge comparison are also to be made on Form H516 (Summary of Checks on Automatic Tide gauge). The pole used shall be levelled to at least two permanently mounted and documented control points which meet the requirements stated in **Station Marking and Documentation.**

		When a permanent / previously established tide gauge is given in the HI, the gauge zero versus Chart Datum connection stated in the HI may be required to be checked independently by means of a pole to gauge calibration to ensure the gauge is correctly calibrated (unless documented evidence can be provided in the RoS that this check has recently (within the last 6 months) been undertaken by appropriate owning authority). The HI for a particular area will confirm local requirements.
B5.4.4	**Verification of VORF Model**	When requested in the HI, the Contractor shall perform a static validation of the VORF model at specified tide gauge locations (including both offshore and coastal gauges). This comparison shall be conducted by stationing each survey vessel within 1km of the tide gauge location for a minimum of 8 hours and logging corresponding water levels using the GNSS and VORF system, compared to the tide gauge data. This 8 hour period shall include successive high and low water events. The vessel shall be stationary during this period. The results should be presented in both tabular and graphical format in the RoS, and clearly demonstrate the relationship between the water line and the vessel reference frame. Comparisons between GNSS/VORF derived tidal heights for the vessel and the observed tidal heights (with co-tidal corrections) from the tide gauge(s) shall be made at regular intervals covering the entire survey period to confirm the VORF values and methodology.
B5.4.5	**Tidal Stream Observations**	Some HIs may require tidal stream observations. Tidal Stream observations will be conducted in the locations listed in each HI using a seabed mounted ADCP. These observations shall as a minimum obtain the Tidal Stream in the "surface" layer of the water column, which is to be representative over a depth of 5 - 10m below MSL. The ADCP should also record the stream movement throughout the water column at appropriate bin sizes in order to achieve, at the very minimum, a 'mid-column' and 'near seabed' stream rates and directions. Bin size to be set to 0.5m in water depths of ≤20m, and 1m in depths >20m. If the ADCP is also capable of recording water level, this should also be enabled and supplied. The time interval of recorded tidal stream data (and height data if available) is to be every 10 minutes, preferably with each hour occurring 'on the hour'. ADCPs will be deployed for tidal stream observations to enable a minimum of 15 days continuous data to be collected, unless stated differently in the HI.

B5.5 Positioning, Survey Control and Calibration		
B5.5.1	**Survey Geodesy**	Unless otherwise stated, every survey shall be rendered using the following geodetic parameters Datum: ETRS89 Spheroid: GRS '80 Projection: UTM Grid Zone 29/30/31North (as specified in the HI) All rendered positions shall be quoted as geographical co-ordinates (i.e. in terms of Lat. / Long) as degrees and decimal minutes.
B5.5.2	**Horizontal Accuracy**	The Horizontal Accuracy of all depths and positions shall be in accordance with IHO S44 Order 1a.
B5.5.3	**Positioning**	Soundings are to be positioned by using dual frequency carrier phase GNSS combined with the Ordnance Survey Active Networks (i.e. Post Processed Kinematic GNSS). In some offshore locations the Contractor may need to switch to Precise Point Positioning techniques or utilise base stations from alternative networks. This will be permitted for an HI only by prior approval from the MCA. Post processed positions should ideally be integrated with the vessel attitude data to avoid bias associated with vessel motion. The Contractor shall demonstrate that the method chosen for sounding positioning results in the overall horizontal uncertainty requirements being met. Conventional Differential GNSS is acceptable for real time positioning (as these positions will later be discarded) – although more precise positioning may also be used if required by the Contractor. The contractor will state methodologies for post-processed and real time positioning as a tender deliverable.
B5.5.4	**Establishment of Survey Control**	Three dimensional position of any existing or newly established survey control shall be determined by dual frequency carrier phase GNSS techniques, tied in to the Ordnance Survey Active Network. A minimum of six hours observations are required per station. This six hour observation period should be divided into two three hour sessions. At the end of the first session the antenna should be physically moved away from the mark and then re-established over the mark before commencing the 2nd observation session. The height of the static GNSS antenna should be measured before each session and clearly recorded and reported. If the height measured is a slope distance from the edge of the antenna, this shall be appropriately corrected to obtain the true vertical offset. The static GNSS antenna shall be positioned directly over the control point using an optical plummet. The absolute uncertainty with respect to ETRS89 for any existing or newly established survey control shall not exceed 1cm in horizontal and 2 cm in vertical (at 2 sigma). The appropriate OD height and appropriate UTM coordinate for each station shall be computed. Where necessary, co-ordinate conversion shall be conducted using approved conversion programs and an estimated final uncertainty stated.

B5.5.5	**Optical Levelling**	To perform a redundant check on any control established and/or utilised, all control points shall be optically levelled from two pre-existing control points referred to the appropriate Ordnance Datum. Levelling is to be conducted between the 2 control points established, the tide pole and any existing BM's in the vicinity provided in the HI. Levelling is to comprise a looped traverse – no intersights shall be taken. Levels should be read and recorded to a precision of 0.001m. Levelling shall be recorded using the H532 Levelling Reduction Form. Any levelling field records should also be supplied. In some cases, this levelling requirement may be replaced by an entirely GNSS based redundant technique upon agreement with the MCA, should pre-existing control prove unsuitable or non-existent.
B5.5.6	**Station Marking and Documentation**	All geodetic stations established during survey operations shall be described, photographed and permanently marked to assist their future recovery. They shall be marked with a stainless steel, brass or bronze bolt drilled into concrete, in an area where they are unlikely to be disturbed. The bolt shall be punched to mark the precise horizontal measurement point. Stations shall not be established in tarmac. Stations deviating from the above requirements due to site conditions will only be permitted at the prior discretion of the MCA. A full station description shall be recorded using the H159 Description of Geodetic Control Station Form, including photographs and diagrams to aid recovery.
B5.5.7	**Vessel Dimensional Control**	An appropriate dimensional control survey of each vessel utilised shall have been conducted prior to commencement. Permanent and recoverable control points are to be established on each vessel utilised, coordinated to the vessel reference frame to within a tolerance ±0.01m relative (at the 95% confidence level) in X, Y and Z. All sensors shall be established within the vessel reference frame within a tolerance of ±0.02m relative (at the 95% confidence level) in X, Y and Z. Where appropriate, the rotations of each sensor around the X, Y and Z axis shall be initially determined by the dimensional control survey to within ±0.2 degrees (at the 95% confidence level). These values may be later adjusted during the sonar patch test if required. The centre of gravity (rotation) should also be estimated and it's location within the vessel reference frame and method of establishment clearly stated in the RoS. A copy of the dimensional control report for each vessel shall be supplied with the RoS for each HI.
B5.5.8	**Swathe Bathymetry Calibration**	A calibration of the swathe bathymetry system and associated sensors (i,e, "patch test") shall be performed at the start of each survey season or after changing out or significantly reconfiguring any survey sensor (methodology shall be detailed in tender). Final post calibration repeatability shall be proven by means of the repeatability test detailed below.
B5.5.9	**Static Positioning Check**	A static positioning check shall be performed at the start of each survey season or after changing out or significantly reconfiguring any survey sensor (methodology shall be detailed in tender). The check shall monitor the three dimensional position of either the primary GNSS antenna or another appropriate point within the vessel reference frame, for a period of no less than 30 minutes at a 1 minute resolution. The subsequent report should separately state the computed statistical reliability of both

		the horizontal position and the height measured. The positioning data to be compared will have been derived using the same procedures used to obtain all positions associated with the bathymetric data (i.e. post processed kinematic). Any local survey control utilised in this procedure shall be compliant with the requirements stated in section **Establishment of Survey Control**.
B5.5.10	**Swathe Bathymetry Repeatability Test**	An swathe bathymetry repeatability test shall be performed following calibration at the start of each survey season or after changing out or significantly reconfiguring any survey sensor (methodology shall be detailed in tender). This test should be conducted after the static position check stated above. The test shall monitor the three dimensional position of a clearly defined small but easily detectable feature on the seabed. The feature should be first surveyed near nadir from multiple directions – as a minimum from north, south, east and west. Secondly the feature should be boxed in, so that it appears in the outer beams on port for 2 lines, and the outer beams on starboard for 2 lines.  The subsequent report should separately state the computed statistical reliability of both the horizontal position and the depth measured for the feature.
B5.5.11	**Vertical Offset Check**	A vertical offset gross error check shall be performed at the start of each survey season or after changing out or significantly reconfiguring any survey sensor (methodology shall be detailed in tender). The check shall compare the physical measurements of the distance from the primary and secondary GNSS antennas on the vessel to the seabed. This shall be performed in one location using a method entirely independent of the vessel's survey systems (e.g. level staff or leadline in a berth). These measurements shall be compared to data logged simultaneously in the same location using the vessel's survey system and software. The results should be compared and detailed in the RoS.
B5.5.12	**Quality**	The Contractor shall provide an indication of the continuous quality of the post-processed 3D position.

B5.6 General Requirements		
B5.6.1	**Hydrographic Notes**	Reports of any newly discovered dangers to surface or sub-surface navigation shall be passed immediately to the MCA Hydrography and Receiver of Wreck teams and to the UKHO using the H102 Hydrographic Note form.
B5.6.2	**Eddies and Over-falls**	Observations of any eddies or over falls which may be significant to small craft are to be rendered in the Report of Survey, stating the approximate geographic extents of such features, and how they relate to tidal and weather conditions. All previously charted eddies and over-falls must be reported on, even if just to state that the current charted information is correct.
B5.6.3	**Sound Speed**	The Contractor shall observe sound speed profiles at an interval consistent with the proposed error budget.
B5.6.4	**Backscatter**	High resolution, geo-referenced multibeam backscatter data shall be collected at all times and rendered in the proprietary format of the swathe bathymetry system utilised. The Contractor shall endeavour to ensure that systemic variations to backscatter intensity are kept to a minimum and that gain, pulse length or any other system changes are minimised during data acquisition.
B5.6.5	**Seabed Sampling**	Where requested in the HI, seabed sampling is to be conducted on an approximate 5km grid with at least one sample being taken in each major textural area identified. Sampling will not be conducted until all bathymetry and backscatter for a given block or HI is complete, so as to inform the required positions for samples within the major textural areas. All seabed samples are to be retained and logged using the Folk Classification scheme. Samples are to be taken with the ship stopped in the water. All samples are to be forwarded to the British Geological Survey: [redacted] Plastic screw top containers are to be used to preserve the samples. The use of polythene bags for preserving retained samples is not acceptable
B5.6.6	**Amendments to Sailing Directions**	The relevant Admiralty Pilot shall be checked in the field and appropriate amendments rendered. Particular attention shall be paid to any recommended approach routes and anchorages within or adjacent to the survey area. If no changes to the relevant Admiralty Pilot are thought to be required by the Contractor, this should also be recorded in the RoS.
B5.6.7	**Views for Sailing Directions**	Details of photographs required to update existing views in the relevant Admiralty Pilot will be supplied in each HI. Views shall be supported by appropriate records in accordance with NP100 paragraph 4.83. New photography shall be in colour and prepared in accordance with NP100. Digital cameras shall be used and must be either

		Single Lens Reflex or described by their manufacturer as a "Bridge" or "Bridging" camera and shall have at least 6M pixel resolution.
B5.6.8	**Licences, Consents & Permissions**	The Contractor shall be responsible for arranging all licences, consents and permits, for access and frequency clearance for all survey operations whether ashore or afloat.
B5.6.9	**Fixed and Floating Aids to Navigation**	The positions and characteristics of all fixed and floating aids to navigation visible from the survey area do not need to be reported. However, if navigationally significant differences between physical features and their depiction on the current Admiralty nautical charts and publications are detected, then this should be immediately reported to the relevant Port Authority and General Lighthouse Authority using the H102 form. The MCA and UKHO should be copied on all correspondence of this type.
B5.6.10	**Leading Lines & Tracks**	The leading lines and recommended tracks along channels and into harbours and anchorages marked by lights or fixed daymarks must be very carefully examined. If navigationally significant differences between physical features and their depiction on the current Admiralty nautical charts and publications are detected, then this should be immediately reported to the relevant Port Authority and the General Lighthouse Authority using form H102. The MCA and UKHO should be copied on all correspondence of this type.
B5.6.11	**Magnetic Anomalies**	Charted or newly discovered magnetic anomalies are to be investigated. The ship should be steamed slowly in a wide octagon shape centred on the charted anomaly, both to port and starboard, made with the standard magnetic compass on 8 equidistant points during each turn. The ship should be steadied on each heading for at least a minute before the observation to allow the sub permanent magnetism resulting from the last course, to disappear. On each leg of the octagon, both magnetic and GNSS derived headings shall be logged and compared. Any anomaly found, or not found, shall be reported in the RoS, including the extent and magnitude of local variations.
B5.6.12	**Fishing Industry**	Liaison with, and compensation to, fishermen for loss/damage to fishing gear are matters which rest entirely with the Contractor. The Contractor is to liaise closely with local fisheries groups and the appropriate local District Fisheries Inspectors well in advance of the commencement of fieldwork.
B5.6.13	**Daily and Weekly Progress Report**	Progress reports detailing progress, planned activities, weather downtime and any problems encountered shall be completed and e-mailed to the MCA and UKHO representative on a daily basis. A short (e.g. 1-page) summary progress report shall be completed and e-mailed to the MCA and UKHO Representative on a weekly basis. This will include the predicted delivery dates for each active HI and associated vessel plans.
B5.6.14	**Quality Control**	Robust quality control procedures shall be provided and adhered to during processing of all data. These procedures shall be provided to the MCA prior to survey operations commencing.

B5.7 Safety		
B5.7.1	**Responsibility**	Equipment and survey personnel provided by the Contractor for work in connection with the contract shall be the Contractor's responsibility at all times. Any loss, injury or damage suffered or caused by them shall be at the Contractor's risk throughout, but must be reported to the MCA immediately and any other relevant authority, including the MAIB.
B5.7.2	**Safety Management Plan**	Details of the Contractor's safety policy and Safety Management Plan shall be supplied to the MCA prior to survey operations being undertaken for each HI.
B5.7.3	**Drugs and Alcohol Policy**	The Contractor shall have a drugs and alcohol policy, which forbids the presence of drugs or alcohol in vessels or offices used under this contract. The policy must include random drug and alcohol testing. MCA reserve the right to request evidence of the regime in place at any time throughout the life of the contract.
B5.7.4	**Daily Meetings**	The Surveyor-In-Charge shall hold daily "Toolbox Meetings" with members of the navigational watch. Meetings shall be minuted (briefly), posted in the mess and shall include the following headings as a minimum: ▪ Date, Time, List of attendees ▪ Activities - Last 24 Hours ▪ Planned Activities – Next 24 Hours ▪ Safety / Hazards
B5.7.5	**Work in Poorly Surveyed Waters**	The vessel master is responsible for the overall navigational safety of the vessel and crew. If the master considers that there is a conflict of interest in terms of the safety of the vessel and crew with regard to the proposed survey areas, he has the overriding authority to refuse to survey those areas. The contractor shall have an appropriate 'Shallow Water Working' procedure set out as part of their quality/safety management system.
B5.7.6	**Medical Certification**	All offshore survey personnel must have an in-date medical certificate of at least "ENG1" standard. Evidence of certification may be requested by the MCA or its representatives at any time.
B5.7.7	**Safety Training Certification**	All offshore survey personnel must have in-date certification to demonstrate completion of the STCW 78 as amended Basic Safety Training package including: ▪ Personal Survival Techniques (STCW A-VI / 1-1) ▪ Fire Fighting and Fire Prevention (STCW A-VI / 1-2) ▪ Elementary First Aid (STCW A-VI/ 1-3) ▪ Personal Safety and Social Responsibility(SCTW A- VI/1 – 4) (Note that survey personnel and supernumeraries may alternatively have in-date certification to demonstrate completion of an Offshore Petroleum Industry Training Organisation approved course adhering to the "Minimum Industry Safety Training Standards"). Evidence of certification may be requested by the MCA or its representatives at any time.

B5.7.8	**Familiarisation Training**	All offshore survey personnel must undertake familiarisation training prior to sailing which must ensure attendees are able to: ▪ Communicate with other persons on board on elementary safety matters and understand safety information symbols, signs and alarms; ▪ Know what to do if: a person falls overboard; fire or smoke is detected; the fire or abandon ship alarm is sounded; ▪ Identify assembly and embarkation stations and emergency escape routes; ▪ Locate and don lifejackets; ▪ Raise the alarm and have a basic knowledge of the use and types of portable fire extinguishers; ▪ Take immediate action upon encountering an accident or other medical emergency, before seeking further medical assistance on board; and close or open the fire, weathertight and watertight doors fitted in the particular ship, other than those for hull openings. Evidence of training may be requested by the MCA or its representatives at any time.
B5.7.9	**Vessel Inspections**	Each vessel tasked with survey under the CHP shall be subject to approval (via an MCA Marine Office inspection) prior to survey work commencing under the contract. The 'Approval Inspection' will be required for both UK and Foreign Flag vessels. Repeat annual inspections shall be undertaken throughout the duration of the contract. Vessels shall be inspected in the UK, however, where an overseas port is closer to the survey area for transit, crew change and onboard supplies, a vessel may be inspected overseas. The 'Approval Inspection', will be chargeable to the contractor. Where the MCA requests a repeat annual inspection, MCA will cover the cost and will be part of the MCA's normal activities and be recorded as a Port State Control inspection/inspection of a Foreign Flag vessel/Code Vessel inspection as appropriate. Any inspections overseas will be charged to the contractor, unless it is an annual inspection and the overseas port is the closest port to the particular survey area for transit, crew change and taking onboard supplies. In any case, the operator must cover travel costs.
B5.7.10	**Vessel Flag**	British Flag or EU registered vessels are preferred. The term "British Flag" includes not only those vessels flagged in the UK but also within the scope of the Red Ensign Category 1 and 2 Registers. Vessels registered with a Flag State on either the Black or Grey List will not be accepted for the purposes of the CHP.
B5.7.11	**Vessel Risk Profile**	Should a foreign flag vessel over 24 metres employed on CHP work receive a Ship Risk Profile of High Risk Ship (HRS), then the MCA reserves the right to remove this vessel from the contract until the Ship Risk Profile is deemed to be Standard Risk Ship (SRS) or a Low Risk Ship (LRS).
B5.7.12	**Vessel Commitment**	Once a vessel has been tasked to an HI, the contractor should seek the MCA's prior agreement to remove or replace the vessel with another.

		The MCA will only approve a vessel replacement if the oncoming vessel is an appropriate like-for-like exchange and continues to abide by the requirements of the specification and tender bid.
B5.7.13	**Vessel Visits**	All vessels employed on CHP contracts shall be visited by an MCA or UKHO representative at least once every 2 months. Visits are primarily intended to focus on the quality of hydrographic processes and deliverables but will also include an informal assessment of safety aspects onboard. If significant safety concerns are raised, then the contract overseer shall ensure that the local MCA marine office is made aware.

B5.8 Deliverables - General		
B5.8.1	**Data Delivery Deadline**	All data and associated documents are to be rendered to the UKHO within 70 working days of the completion of fieldwork milestone declared by the Contractor.
B5.8.2	**UKHO Appraisal Schedule**	If surveys are rendered to the UKHO between 65 and 70 working days following the completion of fieldwork milestone declared by the Contractor then the UKHO intend to fully validate the deliverables within 25 working days. If the data is delivered to the UKHO earlier than this then the UKHO will assign the survey to the next available slot in their programme. The validation timescales may increase but the UKHO intend to not exceed 25 working days past the Data Delivery Deadline. This assumes the deliverables are fully compliant with this specification.
B5.8.3	**Labelling of Records & Deliverables**	**Project Name:** UK Civil Hydrography Programme **Hydrographic Instruction Number:** *As detailed in each Hydrographic Instruction* **Hydrographic Instruction Name:** *As detailed in each Hydrographic Instruction* **Each rendered item of digital data shall bear a depiction of the MCA logo, together with the project name, HI number and HI name.** All data and accompanying documents and records, both working and fair, originating from the survey become the property of HM Government and must be handed over on demand. Where appropriate, they are to carry the following official markings: CROWN COPYRIGHT 2015* *year as appropriate.
B5.8.4	**Required Deliverables**	**UKHO deliverables:** ▪ Partially processed sounding data (CARIS HIPS Project), structured by vessel and including crosslines in separate folders (outliers do not need to be cleaned out from the dataset, as long as they do not adversely affect the resultant statistical CUBE surface). The CARIS HIPS software version shall be up-to-date at time of rendering. Projects delivered using CARIS HIPS v9 (and later) must not be indexed. The data must be converted to full HDCS format. ▪ A finalised version of the CUBE surface, with all hydrographer selected shoal feature depths applied to the surface (detailed requirements stated in section B5.9). ▪ Raw sounding data (proprietary format) containing full backscatter record ▪ Raw and processed Water Column Data from wreck investigations ▪ Backscatter mosaic in high resolution GeoTIFF format (when requested in HI). ▪ Seabed classification of backscatter data (digital seabed texture information) in ESRI shapefile format (when requested in HI) . See details at **Annex D3** ▪ Sound-speed records in ASCII format and a minimum of four records per day in H635 digital format. ▪ ADCP data (when requested in HI).

		▪ Digital Report of Survey (UKHO format including appropriate H forms): o Dimensional control / Calibration / validation data o Survey Control Geodetic data (including reference station RINEX) o Wreck records (including Images showing the water column replay for each wreck investigated) o Tidal records o Amendments to any Admiralty Publications o Photographic views with supporting data o Seabed sampling records o Miscellaneous observations records **MCA deliverables (following successful data appraisal by UKHO and issue of H628B form):** ▪ Specific data and reports will be requested at times.
B5.8.5	**Backscatter Mosaic**	When a backscatter mosaic is requested in the HI, it should be a representation of the backscatter intensity across the respective HIs. Artefacts (nadir stripping, poor data, etc) and backscatter changes within homogenous areas shall be corrected for. If a survey area is too large to create one contiguous mosaic, then an individual mosaic for each block should be created. The resolution of the backscatter mosaic shall be the best achievable. **N.B. a backscatter mosaic is always required for HIs under Lots 1 and 2.**
B5.8.6	**Seabed Classification**	When requested in the HI, a classification of seabed texture information shall be rendered as an ESRI shapefile. The Contractor shall interpret seabed textural changes across their respective HIs using a combination of the bathymetry, backscatter interpretation and ground-truthing from grab sampling. The Contractor shall provide details of the procedures and software to be employed as a tender deliverable. **N.B. seabed classification is always required for HIs under Lots 1 and 2.** **Annex D3** provides further details.
B5.8.7	**"H Forms"**	"H Forms" have been designed by the UKHO to facilitate checking and validation of rendered data. The Contractor shall always use the appropriate "H Form" where one exists for a process which is undertaken.
B5.8.8	**Digital Data Media**	All Data shall be delivered on USB 3.0 hard drives (or equivalent). No rendered data file shall be larger than 2 Gigabytes in size. The Contractor shall provide all USB 3.0 media required for transferring data from ship to shore and for rendering completed surveys to the UKHO.
B5.8.9	**Report of Survey (RoS)**	A Report of Survey (RoS) shall be rendered in digital format in accordance with the latest UKHO requirements for digital RoS for each Hydrographic Instruction.
B5.8.10	**Bathymetric Data Attribution**	Processed bathymetric data shall contain the following attributes for each sounding as a minimum: position and depth; swath and beam number; backscatter intensity; 95% statistical uncertainty estimation for position; 95% statistical uncertainty estimate for depth. Files shall be full density (i.e. not "thinned") with rejected soundings flagged but not deleted from the data set.

B5.8.11	**Tidal Data**	Tide gauge records are to be rendered in a text file or Excel spreadsheet and containing the meta-data about the deployment, which as a minimum must be:- • Position of instrument • Depth of water at the deployment site • Start/ End of deployment time and date • Units in metres The tide gauge observations must be rendered in metres and not solely in pressure readings.

B5.8.12	**Tidal Stream Data**	An Excel spreadsheet containing the meta-data about the deployment:-
		• Position of instrument
		• Depth of water at the deployment site
		• Height of instrument above the seabed
		• Start/ End of deployment time and date
		• Local variable parameters
		  o Magnetic Variation
		  o Mean Water Density
		  o Barometric Pressure
		If the ADCP is also able to record tidal height data, then this must be configured in the deployment and supplied in Excel format, either accompanying the main tidal stream data or in a separate tab / spreadsheet.
		The stream data in the Excel spreadsheet must be displayed for each bin recorded in departures E and N, as well as Magnitude and Degrees (true). Units of the rates must be clearly stated.

B5.8.13	**Comparison with Published Charts**	The sounding detail shown on the largest scale published UKHO chart of the survey area is to be critically examined and any significant differences reported. In particular, a comment is required for any charted dangers that were not discovered during the survey, or where the least depth found over a danger during the survey is deeper than charted. Any other errors, ambiguities or other defects shall be reported.
B5.8.14	**Retention of Data**	All raw and processed digital records shall be retained and maintained by the Contractor for a period of 3 years from the date of the final contract payment. On completion of this 3 year period, the Contractor may seek permission from MCA to dispose of the data as they so wish.

B5.9 Swathe Bathymetry Data Deliverables		
B5.9.1	**Format of Bathymetric Data**	Processed bathymetric data shall be rendered as files in fully attributed CARIS HIPS/SIPS (Project) format. The data shall contain the following attributes for each sounding as a minimum: • Position • Depth • swathe and beam number • 95% statistical horizontal uncertainty estimate • 95% statistical vertical uncertainty estimate Files shall be full density (i.e. not "thinned") with rejected soundings flagged but not deleted from the data set. Corresponding raw (i.e. unprocessed) files shall also be supplied in proprietary format containing full backscatter. In addition, a CUBE surface shall be rendered (see B5.9.3/4). Outliers do not need to be cleaned out from the HIPS dataset, as long as they do not adversely affect the resultant statistical CUBE surface.
B5.9.2	**Total Propagated Uncertainty (TPU)**	THU (Horizontal TPU) and TVU (Depth TPU) values must be calculated for every depth and these values must reflect the full density data. If the TVU is smaller than the general spread of data on a flat seabed then it doesn't represent the data and should be adjusted. The magnitude of any tidal busts within the survey should be represented in the TVU values.
B5.9.3	**Bathymetric Surface Deliverable**	The required bathymetric deliverables are; 1. An up-to-date CUBE surface, preferably in CARIS BASE format, or alternatively in Fledermaus PFM format. 2. A finalised version of the CUBE surface, with all hydrographer selected shoal feature depths applied to the surface. 3. The full density soundings that were used to create the CUBE surface, correctly flagged as accepted, rejected or designated/feature where appropriate. Each depth should only have one of these flags. 4. If the CUBE surface deliverable is in Fledermaus PFM format, any cleaning/editing that has been conducted in the PFM should be unloaded back into the source CARIS HIPS project. The specifications for the CUBE surface are listed below.
B5.9.4	**CUBE Surface Layers**	The CUBE surface should contain at least the following layers: 1. Density (of accepted soundings on node used in CUBE surface) 2. CUBE depth 3. Hypothesis count

<table>
<tr><td></td><td></td><td>4. Hypothesis strength
5. Node standard deviation
6. Standard deviation
7. Uncertainty
8. User nominated (or custom hypotheses)</td></tr>
<tr><td>B5.9.5</td><td>CUBE Surface Resolution</td><td>Surfaces are to be created for the following depth bands using the parameters stated in the table:

<table>
<tr><th>Depth Range (m)</th><th>Surface Resolution (m)</th><th>Capture distance min</th><th>Capture distance scale %</th></tr>
<tr><td>Any drying depth - 40</td><td>1</td><td>0.707</td><td>0.1</td></tr>
<tr><td>40 – 100</td><td>2</td><td>1.414</td><td>3.535</td></tr>
<tr><td>100 – 200</td><td>5</td><td>3.535</td><td>3.535</td></tr>
<tr><td>200 – 300</td><td>10</td><td>7.07</td><td>3.535</td></tr>
</table>
= the controlling settings for each band and must be set. Other values are required if the software allows simultaneous use of fixed distance and percentage of depth.

For surveys with depths that span several depth ranges multiple surfaces should be used each with the correct resolution.

The values for the depth ranges and their related surface resolutions (bins) shown in the above table are the minimum requirements and relate to the object detection requirements.

The resolutions can be extended for deeper depths than the ranges stated in the above table if the survey system is capable of supporting this (consider beam footprint size etc.) and the data density is sufficiently high. Resolutions must not be used for shoaler depths than the ranges shown in the above table.

The surface resolutions must always be used in the order shown in the table, even if extending them to deeper depths. Not all resolutions need be used, but if a series of surfaces are made, resolutions within the series should not be missed out.

e.g. a 1m resolution surface can be used to a depth of 105m (if the system is capable of detecting 2m features at this depth). The next resolution used for data deeper than 105m must then be 2m (not 4m, the 2m resolution cannot be leapfrogged).</td></tr>
<tr><td>B5.9.6</td><td>Data Density</td><td>Each CUBE surface node must have at least 5 contributing soundings.

100% of all nodes must pass this specification. There must be no empty bins.</td></tr>
<tr><td>B5.9.7</td><td>Systematic Errors</td><td>Systematic errors (e.g. tidal, sound speed etc.) that cause problems with the CUBE surface should be corrected appropriately (e.g. manually cleaned/filtered or whole line rejected etc.). If these are not corrected they can create “tearing” of the CUBE surface.

All areas of CUBE surface “tearing” should be resolved. E.g. if the seabed has moved during the survey (sand waves) and 2 coincident survey lines that were correct at the time of gathering now disagree and cause “Tearing”, the CUBE should be fully resolved by forcing the correct (usually the shoalest) hypotheses to be used.</td></tr>
<tr><td>B5.9.8</td><td>Designated Soundings (a.k.a.</td><td>Critical soundings over important features (wrecks, contacts, complex natural seabed etc.) must be designated. The designated soundings must be the controlling depths</td></tr>
</table>

	Feature Soundings, Golden Soundings)	over the feature. More than 1 sounding should be designated over larger features (but the surveyor should still be selective and not over designate too many soundings). To find these features effectively, a conventional shoal biased surface should be used. The difference between the CUBE surface and the reliable shoaler sounding(s) must not deviate by more than ¾ of the IHO depth accuracy allowance. If they deviate by more than this soundings must be designated as appropriate or use the methods described in "CUBE Surface Editing". This applies to the entire CUBE surface not only over important features.
B5.9.9	**CUBE Surface Editing**	Where the CUBE surface is incorrect and either the wrong hypotheses has been chosen by the CUBE disambiguation or if there is not a suitable hypothesis at the required depth, the hydrographer must correct the CUBE surface using one of the following methods: 1. Reject soundings as necessary and re-CUBE the data in that location to force the CUBE disambiguation to select the hydrographer's preferred hypotheses depth. The 'user nominate' hypotheses function should not be used as any edits made this way will be undone if the data is re-CUBEd. 2. If rejecting soundings and re-CUBEing the data does not provide the hydrographer's preferred hypotheses depth, the required sounding(s) must be designated. This will ensure that the hydrographer's choice of depth is retained.
B5.9.10	**Outliers**	Where the CUBE surface is honouring the seafloor correctly outliers need not be removed from the full density data. Where outliers cause the CUBE surface to be shoaler or deeper than the likely true seafloor by an amount greater than ¾ of the IHO depth accuracy allowance, the methods described in "CUBE Surface Editing" must be used to ensure the correct depth is represented in the final CUBE surface. In areas of mobile seabed, the hydrographer should ensure that the final CUBE surface gives a safe depiction of the area and multiple surfaces due to changes in seabed level are adequately resolved. If 2 survey lines were correct at the time of gathering but disagree due to the seabed changing, the CUBE surface should not jump between the 2 results, it should be forced to go with the data the surveyor believes to be the safest (usually the shoalest). The potential for such issues should ideally be minimised by avoiding large time gaps between overlapping swathes in mobile areas.
B5.9.11	**CUBE Surface Uncertainty**	The standard deviation and the uncertainty for each node of the final CUBE surface must be less than the IHO depth accuracy allowance. The only exception will be on steep gradients.
B5.9.12	**Finalised CUBE Surface**	When all editing is complete, the CUBE surface must be "finalised" to ensure that all edits and designated/feature soundings are applied correctly.
B5.9.13	**Reporting of Bathymetric Processing**	The Report of Survey should include: • A detailed description of the CUBE parameters that were used to create the surface.

		• A section explaining the calculation of the THU / TVU and TPU values for all soundings and CUBE nodes. How these were computed (i.e. the tide and SV errors that were used, the vessel model file explained) and why the contractor thinks that the values accurately represent the data. • Any areas of unusually high uncertainty should be commented on and explained. • Lists of wrecks and contacts and significant features.

Part
D

UK Civil Hydrography Programme

Survey Specification

Civil Hydrography Services in European Waters

Annex D1

Not applicable in Survey Specification please refer to ITT April 2013.

Annex D2

Not applicable in Survey Specification please refer to ITT April 2013.

Annex D3: Bottom Texture Deliverables

Bottom Texture Information is required in ESRI format. Precise requirements are as follows:

D3.1 ESRI Format Definition

Bottom Texture Information can be supplied in one of two ways:

I. A collection of Shapefiles (Details of the ESRI Shapefile spatial data format can be found at: http://www.esri.com/library/whitepapers/pdfs/shapefile.pdf).

II. A single file geodatabase containing a collection of feature classes.

D3.2 MCA Format Requirements

From this point forth, the term 'Shapefile' refers to either a feature class or a Shapefile depending on the chosen method of supply of bottom texture information.

- Shapefiles may only hold features with the same geometry, which is defined as either point, line, or polygon.
- Polygon Shapefiles must be of polygon type (not polygon ZM or other type).
- Where Shapefiles contain adjacent polygons, these shall join together such that there are no overlaps or gaps.
- ESRI ISO 19115 Metadata shall be fully populated and must include geospatial information.
- Shapefiles must have the appropriate assigned coordinate system.
- Each Bottom Texture information Shapefile shall contain all instances of that feature type. For example:
    - All Seabed Samples are held together in a single point Shapefile.
    - All Sandwave Crests are held together in a single line Shapefile
    - All Texture Areas are held together in a single polygon Shapefile.

D3.3 Bottom Texture Requirements

The following requirements, listed in respect of their geometry, describe the typical types of features to be included for Bottom Texture deliverables. Each survey is unique and as such not all of the types of features may be found in an individual survey. The Report of Survey should detail the types of Bottom Texture information that has been found and delivered.

Each type of Bottom Texture feature has a number of attributes to be included**.** The attributes listed are based on information required by the UKHO and are not absolute - extra features and/or attributes may be added at the discretion of the surveyor.

Note that due to a 10-character limit on Field Names for Shapefiles, a Field Alias is included for all attributes to aid the end users' understanding. If a File Geodatabase is supplied then there is no such limitation and the Field Names may mirror the Field Alias'.

Where Bottom Texture deliverables require a Texture Description and Texture Code, these are to be completed using Table 1 below. The Table is based on the Folk Sediment classification that both UKHO and BGS adopt.

Texture Code	Texture Description
0	Rock/Sediment Absent
1	Mud
2	Sandy Mud
3	Muddy Sand
4	Sand
5	Gravelly Sand
6	Gravelly Muddy Sand
7	Gravelly Mud
8	Muddy Gravel
9	Muddy Sandy Gravel
10	Sandy Gravel
11	Gravel
12	Pelagic Ooze

- Table 1: Texture Descriptions and Codes (based on Folk classification)

D3.4 Types of Features Required for Bottom Texture Shapefiles

Polygon Shapefiles

Shapefile Name: **Texture_Area**

Attributes:

Field Name	Field Alias	Field Type	Example
Code	Texture Code	Short Integer	2
Descript	Texture Description	Text	Sandy Mud
Comments	Comments	Text	

Guidance:

This Shapefile shall encompass the entire survey area (as detailed in each Hydrographic Instruction) such that no gaps shall remain.

Shapefile Name: **Sandwave_Area**

Attributes:

Field Name	Field Alias	Field Type	Units	Accuracy	Example
Aspect	Aspect	Text	Asymmetric or Symmetric	N/A	Symmetric
Height	Height (m)	Double	Metres	1 decimal place	2.7
Orient	Orientation (degrees)	Short Integer	Degrees	Whole number	155
Wavelength	Wavelength (m)	Double	Metres	1 decimal place	25.0
Comments	Comments	Text			

Guidance:

Where many sandwaves occur in groups these shall be classed as a Sandwave Area. The values given for Aspect, Height, Orientation and Wavelength shall be chosen to give a general description of the sandwaves found in this area. Where one or more of these values changes a new polygon shall be created.

A sandwave is defined as having a height greater than 1 metre. Features smaller than this shall be classed as ripples.

Shapefile Name: **Ripple_Area**

Attributes:

Field Name	Field Alias	Field Type	Units	Accuracy	Example
Height	Height (m)	Double	Metres	1 decimal place	0.7
Orient	Orientation (degrees)	Short Integer	Degrees	Whole number	270
Wavelength	Wavelength (m)	Double	Metres	1 decimal place	57.6
Comments	Comments	Text			

Guidance:

Where many ripples occur in groups these shall be classed as a Ripple Area. The values given for Height, Orientation and Wavelength shall be chosen to give a general description of the ripples found in this area. Where one or more of these values changes a new polygon shall be created.

A ripple is defined as having a height less than 1 metre. Features greater than this shall be classed as sandwaves.

Shapefile Name: **Ribbon_Area**

Attributes:

Field Name	Field Alias	Field Type	Units	Accuracy	Example
Type	Type	Text	Sand or Gravel	N/A	Gravel
Orient	Orientation (degrees)	Short Integer	Degrees	Whole number	270
Comments	Comments	Text			

Shapefile Name: **Scour_Area**

Attributes:

Field Name	Field Alias	Field Type	Units	Example
Type	Type	Text	Ice or Trawl	Trawl
Comments	Comments	Text		

Shapefile Name: **Thermal_Vent_Area**

Attributes:

Field Name	Field Alias	Field Type	Example
Comments	Comments	Text	

Shapefile Name: **Vegetation_Area**

Attributes:

Field Name	Field Alias	Field Type	Units	Accuracy	Example
Type	Type	Text	Kelp or Weed	N/A	Kelp
Height	Height from Seabed (m)	Double	Metres	To nearest 0.5 metre	4.5
Comments	Comments	Text			

Line Shapefiles

Shapefile Name: **Bedrock_Scarp**

Attributes:

Field Name	Field Alias	Field Type	Example
Comments	Comments	Text	

Shapefile Name: **Cable**

Attributes:

Field Name	Field Alias	Field Type	Units	Example
Type	Type	Text	Power or Telecommunications	Power
Comments	Comments	Text		

Shapefile Name: **Pipeline**

Attributes:

Field Name	Field Alias	Field Type	Units	Example
Type	Type	Text	Oil or Gas	Gas
Comments	Comments	Text		

Shapefile Name: **Ridge**

Attributes:

Field Name	Field Alias	Field Type	Units	Accuracy	Example
Type	Type	Text	Sand, Gravel or Rock	N/A	Gravel
Height	Height (m)	Double	Metres	1 decimal place	2.1
Width	Width (m)	Double	Metres	1 decimal place	2.0
Orient	Orientation (degrees)	Double	Degrees	Whole number	015
Comments	Comments	Text			

Shapefile Name: **Sandwave_Crest**

Attributes:

Field Name	Field Alias	Field Type	Units	Accuracy	Example
Aspect	Aspect	Text	Asymmetric or Symmetric	N/A	Symmetric
Height	Height (m)	Double	Metres	1 decimal place	3.4
Direction	Direction (degrees)	Double	Degrees	Whole number	070
Comments	Comments	Text			

Guidance:

Where isolated sandwaves are found these shall be identified and delineated.

Individual sandwaves need not be included in this shapefile where a Sandwave Area polygon has been identified and created.

A sandwave is defined as having a height greater than 1 metre. Features smaller than this shall be classed as ripples and do not need to be identified in a line Shapefile.

The values given in the Direction field shall describe the direction of the steepest side of the sandwave crest.

Shapefile Name: **Scour_Line**

Attributes:

Field Name	Field Alias	Field Type	Units	Example
Type	Type	Text	Ice or Trawl	Ice
Comments	Comments	Text		

Point Shapefiles

Shapefile Name: **Pockmark**

Attributes:

Field Name	Field Alias	Field Type	Example
Comments	Comments	Text	

Shapefile Name: **Seabed_Sample**

Attributes:

To be an exact copy of the H575 spreadsheet.

Guidance:

The CHP_H575.xls file has been designed in such a way that it can be directly brought into ArcGIS and converted into a Shapefile.

Shapefile Name: **Wreck**

Attributes:

To be an exact copy of the H525 summary spreadsheet.

Guidance:

The CHP_H525_summary.xls file has been designed in such a way that it can be directly brought into ArcGIS and converted into a Shapefile.

Shapefile Name: **Seabed_Spring**

Attributes:

Field Name	Field Alias	Field Type	Example
Comments	Comments	Text	