BATHYMETRIC AND SIDESCAN SONAR SURVEY
OF
WRECK SITE
MV GENERAL ZALINSKI

GRENVILLE CHANNEL CANADA
2011

SURVEY REPORT

Project	:	Zalinski Wreck Site Survey
Client	:	Canadian Coastguard Fisheries and Oceans 4260 Inglis Drive Richmond, B.C. V7B 1L7 Canada
Project number	:	P2196
Document	:	P2196-WSS-01-R00
Survey period	:	February 2011

Contents

1 Introduction

1.1 Background

The U.S. Army Transportation Corps vessel Brigadier General M.G. Zalinski (Zalinski), a ship used in both the first and second world wars, ran aground and sank in 1946 in about 34 meters (110 feet) of water during a storm in Grenville Channel in British Columbia's Inside Passage. The wreck rests in 34m (110 ft) of water and is located in approximate position 53-31-21 N, 129-34-55 W.

The vessel sank with a cargo of lumber, army vehicles and munitions. The unexploded ordnance onboard is believed to include at least a dozen bombs weighing approximately 227 kilograms (500 lbs) each. It is estimated that a maximum of 700 tonnes of Bunker fuel oil may also remain onboard. The wreck of the Zalinski lies approximately 100 kilometers (54 M) south of Prince Rupert and 2.5 kilometers (1.3 M) southeast of James Point on Lowe Inlet in the Grenville Channel. This is a busy route for ferries, cruise ships, oil tankers and virtually all ocean travel to Alaska.

1.2 Objectives

The purpose of this work is to provide the Canadian Coast Guard (CCG) Environmental Response Group with a high resolution hydrographic survey to present a detailed representation of the current physical status of the Zalinski wreckage and any associated debris field. The survey shall be completed at best-possible resolution to identify the position, bearing, damage sustained during the sinking and placement of the Zalinski as well as any seafloor debris, cargo, or unexploded ordinance (UXO) that may be in the vicinity. The final report will be used to define future technical assessments as well as support the identification and management of risks posed by any fuel oil or UXO that may be present. The Contractor is hereby advised that an undetermined amount and type of oil and ammunitions are present in and around the wreck site. To reduce the potential for disturbance, the survey shall not include physical contact with the wreckage or surrounding debris. It is anticipated that the survey will be completed with best-available acoustic hydrographic technology.

1.3 Project key plan

The wreck site is located in Grenville channel, British Columbia, Canada near Lowe inlet about 55 nautical miles south of Prince Rupert. The wreck is positioned about 35 meters outwards of the southern side of the channel at a depth of 30 meters and is laying upside down. The exact co-ordinates derived from the bathymetric survey are as follows:

Geographical co-ordinates (WGS'84)		Grid co-ordinates (WGS84, UTM zone 9)	
Bow			
LAT 53° 31 '22.215"	N	461403.18	mE
LON 129° 34' 55.865"	W	5930592.12	mN
Stern			
LAT 53° 31' 20.373"	N	461455.45	mE
LON 129° 34' 53.001"	W	5930534.77	mN

Figure 1: Zalinski location in Grenville channel

1.4 References and definitions

Client	Canadian Coastguard Fisheries & Oceans
Project name	Zalinski Wreck Site Survey, Canada BC
Contractor	Mammoet Salvage Americas Inc.
Project number	P2196
Survey report	P2196-WSS-01-R00

1.5 Used abbreviations

CCG	Canadian Coast Guard
COG	Centre Of Gravity
DGPS	Differential GPS
GPS	Global Positioning System
KP	Kilometre Post (Stationing in km)
MB	Multibeam Echosounder
MP	Metre Post (Stationing in meters)
MRU	Motion Reference Unit
MSL	Mean Sea Level
PPE	Personal Protection Equipment
QC	Quality Control
RTK	Real Time Kinematic
SSS	Side Scan Sonar
SV	Sound Velocity
USBL	Ultra Short Base Line subsurface positioning
UTM	Universal Transverse Mercator
WGS	World Geodetic System

2 Scope of work

Mammoet Salvage Americas Inc. is advising the officials at the Canadian Coast Guard on future actions regarding the Zalinski wreck site. The following aspects needed to be investigated:

The general state of the Zalinski's wreck and the surrounding area using multibeam echo sounder and sidescan sonar.

The scope of work consists of:

- Mobilisation of vessel, personnel and equipment at Prince Rupert;
- Calibration of equipment;
- High resolution multibeam echosounder and sidescan sonar survey of the wreck and the surrounding area;
- Demobilisation of personnel and equipment;
- Preparation of report, data and charts.

The sidescan sonar survey has to be conducted with an as small as possible range to get the best possible resolution. The data coverage of the multibeam survey must be 100% in a 0.1x0.1m grid. Constant monitoring of the data density was required during the survey in the 3D processing software Qloud

Navigation/QC had to be carried out using suitable acquisition software interfaced with inputs from the positioning system, heading sensor and echosounder. All data had to be logged to hard disk and back upped for data processing in the Netherlands

2.1 List of personnel

The following personnel were involved in the execution of the project:

Klaas Visser	Lead Surveyor
Koen van het Hekke	Surveyor
Bas Coppes	Project Manager
Han Schiet	Naval Architect

2.2 List of equipment

Mammoet mobilized the survey equipment from warehouse in the Netherlands to the port of Prince Rubert, British Columbia. This survey equipment was installed on the fishing vessel Royal Pride in order to collect data to show a detailed physical status of the wreckage and possibly wreck debris and cargo. The equipment used consisted of:

Survey vessel

Vessel:	Royal Pride

Surface positioning

Primary positioning:	Novatel Flexpack RTK GPS with RTK Basestation
Position aiding	IXSEA Rovins Inertial Navigation System

Subsurface positioning

USBL:	Sonardyne Scout

Bathymetric equipment

Multibeam Echosounder:	R2Sonic 2024 with mini svp for sv value at MB head
Sound velocity probe:	Navitronics SVP-15 (deployed from vessel for profile)

Sidescan sonar equipment

Sidescan sonar fish:	Klein 3900 500/900 kHz
Sidescan sonar recorder:	Klein 3900 / QPS Qinsy V8.0

Auxiliary equipment

Compass:	IXSEA Rovins INS
Motion sensor:	IXSEA Rovins INS
Navigation/QC software:	QPS Qinsy V8.0

Processing

Multibeam processing:	QPS Qinsy v8.0 & Qloud v2.2
Charting software:	Terramodel v10.4

2.3 Accuracy

The measurements were made by the multibeam sonar were relative to true vertical and true north as measured by the installed IXSEA Octans motion & heading sensor. An additional calibration procedure, commonly referred to as a patch test, was performed to derive actual offset values, which were applied to the data, to bring the system in proper alignment. The procedure involved collecting data over certain types of terrain and processing it by means of a set of patch test tools, integrated in the survey software.

A Reson SVP-15 sound velocity probe was used to correct the sonar data for changes in speed of sound through the water column. For the positioning of the survey vessel, Mammoet installed a Novatel OEMV-3 Multi-Frequency GNSS Receiver. The receiver made use of VRS network position solutions received from the Can-Net GNSS positioning network. Can-Net is a Canada-wide GNSS network that allows a user the ability to achieve centimeter level results with only one receiver.

2.4 Side Scan Sonar Survey

Survey lines were sailed in such way that the sonar data had 120% coverage over the site. The system was towed at a depth of 5 to 10 % of the depth above the seabed (when safe), which is the optimum depth. The Klein 3000/3900 system with dual-channel, operated at 100 kHz and 500 kHz. The data was slant range corrected and recorded digitally. The position of the Side scan sonar was determined by layback measurement.

2.5 Limitations

2.5.1 Weather

Although the location of the Zalinsky in Grenville channel is a location with relatively much shelter, the area is known to host severe weather. Because the wreck is positioned only 35 meters from the nearest shore, strong winds in combination with the generally strong current can make it dangerous to navigate with a survey vessel.

2.5.2 Operational limitations

Because the wreck is positioned very close to shore on a steep slope the survey vessel was limited in how close to the shore it could operate. Because of the strong current (between 3 and 4 knots) during the survey a safe working distance of about 15 meters from shore had to be maintained. This made it difficult to record good sidescan images of the starboard side of the wreck.

3 The Survey Vessel

3.1 General Particulars

The "ROYAL PRIDE" is steel construction fishing vessel. The wheel-house is situated forward of amidships.

	"ROYAL PRIDE"
Official Number	811213
Port of Registry	Vancouver, B.C.
Flag	Canadian
Type	Stern trawler
Gross Tons<2>	88
Length	16.8 m
Draught	F: 3.65 m A: 3.65 m
Crew	3
Built	1988, Vancouver, B.C.
Propulsion	Diesel engine, capable of 313 kW (420 BHP), driving a single controllable-pitch propeller in a Kort nozzle

3.2 Picture m.v. "Royal Pride"

Below the picture of the survey vessel with the outfitted survey pole

4 The Survey Operation

4.1 Health, safety and environment

The Party Chief had an overall responsibility for the survey activities, procedures and contacts with the client. All undertaken activities during the survey operations were described in daily reports which were signed by or send to the client.

All Mammoet personnel is committed to the HSE policy of the company. Additionally the role of the party Chief was to inform the client's representative in case of any health, safety or environmental hazards as well as any near-miss. As such, during survey operations, special attention was given to the proper use of the PPE.

4.2 Survey control

4.2.1 Horizontal reference

Mammoet has used a horizontal positioning system, capable of providing the survey vessel with accurate, unambiguous positioning control.

All geographical co-ordinates in this report are based on UTM North Zone 9 (129W) Grid on WGS'84 using the following parameters:

Datum	:	WGS'84
Spheroid	:	WGS 1984
Semi-major axis	:	6378137.000 m
Semi-minor axis	:	6356752.314 m
Inverse flattening	:	298.257220143
First eccentricity (e2)	:	0.0066943800
Second eccentricity (e2)	:	0.0067394967

Projection	:	UTM (Universal Transverse Mercator), North
Zone	:	9
Latitude of Origin	:	00º N
Longitude of Origin	:	129º W
Scale factor at Origin	:	0.99960000
X- Offset	:	500000.000m
Y- Offset	:	000000.000m

4.2.2 Vertical reference

<u>Chart Datum</u>

Mean Sea Level (MSL) is the reference level for height and/or depth measurements used during this project. Reduction from WGS84 based ellipsoid heights to MSL referenced geoid heights was done by use of the mean sea level, EGM 96 (earth) (Earth Geodetic Model) within the survey software.

<u>Depth measurements of the seabed</u>

Depth measurements are reduced to MSL by geodetic calculations within the survey software from WGS84 position heights measured by the accurate GPS system.

4.2.3 Accuracy

For horizontal and vertical control of the bathymetric survey, RTK height data was used. Dynamic positioning accuracy in RTK mode is specified by the manufacturer to be better than 2cm in the horizontal plane and 3cm in the vertical plane.

4.3 Survey systems

All relevant log sheets regarding the performed calibrations mentioned in this chapter can be found in the appendices of this report.

4.3.1 Vessel

All specified survey equipment was installed on the fishing vessel 'Royal Pride' during mobilisation. The vessel has a draft of 3.5 meter and was equipped with a winch used to tow the sidescan sonar. A custom made over the side bracket was fabricated to mount all underwater sensors. The sidescan sonar and bathymetric surveys were executed in separate operations.

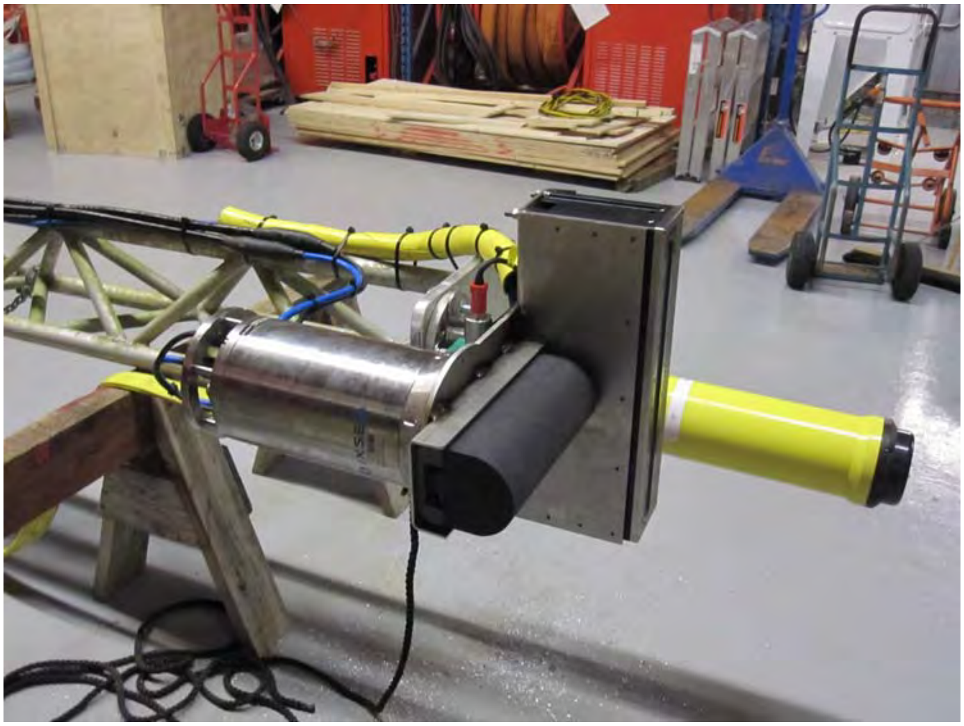


Figure 20: Custom fabricated sensor frame

All sensors were positioned relative to ship's zero point (COG) which corresponds with the acoustic centre of the multibeam transducer. The offset between this ships zero point and the GPS receiver is accurately known / measured.

The following offsets on-board of the survey vessel were measured and entered in the survey acquisition software:

	X Offset (m)	Y Offset (m)	Z Offset (m)
COG (Reference)	0.00	0.00	0.00
GPS Antenna	-0.22	0.24	7.46
MB Transducer	0.00	0.00	0.01
Motion sensor	0.00	-0.15	0.28
USBL Transceiver	-0.26	0.34	0.78

4.3.2 Positioning system

The primary surface positioning system consisted of a Novatel OEM-V GNSS receiver. This RTK GPS system used real-time RTK reference signals transmitted by a base station through a radio link to achieve centimetre accuracies.

This base station is normally set up at a known benchmark. Because a benchmark like this was not available at the very remote project location, the base station was set up and raw GPS co-ordinates were logged for a period of 15 minutes.
These base co-ordinates were used throughout the rest of the project. Using this method the accuracy was good enough (centimetre accuracy in the horizontal and vertical plane) to match all separate survey lines to create a 3D model. The overall position is only as good as the position derived from the raw GPS data. This will be within 0.5m accurate.

4.3.3 Heading sensor

Because the IXSEA Rovins heading sensor was mounted directly on the multibeam frame there was no need conduct a heading calibration on the vessel. The small mounting angles that may derive from this setup are compensated for with the result of the ‘patch test’ that will be discussed in the paragraph multibeam echosounder.

4.3.4 Motion sensor

During mobilization in Prince Rupert, the motion sensor misalignment values were gross-checked by measuring the heave, roll and pitch during a period of approximately 10 minutes, while the vessel was floating in calm water. A C-O value was entered in the survey software to compensate for this misalignment.

4.3.5 USBL system

For subsurface positioning, a Sonardyne Scout plus USBL was installed on board of the survey vessel.

For the roll and pitch mounting offsets, the internal MRU sensor of the transceiver head was used. To calibrate the mounting offset between the ships' heading reference and the USBL transceiver, a transponder was lowered on a quay point with known co-ordinates. The vessel moved around the beacon, continuously taking readings from the USBL calculated position of the transceiver. From the difference between the calculated and the known position, the residual heading offset was determined and entered in the survey software to be compensated for.

4.3.6 Sound velocity probe

The sound velocity in the water column is mainly influenced by temperature and salinity. To accurately measure distances under water and to compensate for refraction of sound waves when travelling through layers with different sound velocity values in the water column, a sound velocity profile is measured. This is done at the beginning and end of each survey period and when the sound velocity monitored at the MB sonar head had changed considerably. A sound velocity profile was recorded at one metre intervals to the maximum water depth. This profile was entered in the survey software to correct the multibeam depth measurements. The average sound velocity during the survey was 1472 m/s

4.3.7 Multibeam echosounder

The bathymetric survey was done using a R2Sonic 2024 multibeam echosounder. The survey area was 100% covered by the swath measurements.

To accurately measure the seabed, the measurements made by multibeam sonar must be relative to true vertical as reported by the motion sensor and the heading reported by the gyro compass. When the sensors are installed and calibrated on a vessel, it is not possible to get them in perfect alignment. An additional calibration procedure, commonly referred to as a patch test, must be performed to derive actual offset values, which can then be applied to the data, to bring the system in proper alignment. The procedure involves collecting data over certain types of terrain and processing it by means of a set of patch test tools, integrated in the survey software.

Latency

The latency offset is the time interval between a position measurement being valid and the time the message is output over the serial port to the data collection system. An incorrect latency results in a position error along track that is a function of the latency value and the speed of the vessel.

To determine the latency, a survey line was sailed perpendicular to a slope. For this line, two data sets were collected, with the vessel travelling in the same direction, but at two significantly different speeds. The first line was at the minimum speed at which the vessel can maintain good steering. The other line was at the maximum survey speed. The feature or slope on the seafloor will be found at different locations due to the latency offset.

In the patch test software, different latency values are applied to the two data sets until the data from the two lines match. Only the data near the centre of the swath (nadir) should be used for processing, to minimise the effect of yaw offsets.

Roll offset

The roll offset of the sonar head causes depth measurement errors which increase with both angle off nadir and water depth.

To determine the roll offset, two data sets were collected of a survey line over a flat seafloor, with the vessel travelling in opposite direction at the same speed. The data collected on this survey line will result in the same depths at nadir, but different depths away from nadir, caused by the roll offset. When a cross section containing both data sets is viewed, any roll offset will cause the data to appear as an ‘X’.

In the patch test software the roll correction was determined by applying varying roll offsets to the data sets until the data from the two lines matched.

Pitch offset

The pitch offset of the sonar head causes errors in position of the depth measurement. These errors are a function of the pitch offset error and the water depth.
To determine the pitch offset, two data sets were collected of a survey line perpendicular to a slope. These lines were at the same speed, but in opposite directions to the survey line. The slope will be found at different locations due to the pitch offset.

In the patch test software, different pitch values were applied to the two data sets until the data from the two lines matched. Again, only the data near the vessel track should be used, to minimise the effect of yaw offsets.

Yaw offset

Yaw offsets result from an angular difference in the horizontal plane, between the heading lubber line (along ship axis) of the compass and the rotation angle of the Z axis of the sonar projector. A yaw offset will result in position measurement errors which are larger in the outer beams. The magnitude of the position error will also increase with depth.

To determine the yaw offset, two parallel survey lines were sailed in the same direction over a well defined feature. The line spacing was set to allow the outer beams of one line to overlap the track for the other line. If there is a yaw offset in the data, the position of the feature will be off-set between the two data sets. Again, the patch test software helped us to figure out the yaw offset.

4.3.8 Sidescan sonar

A Klein 3900 system was mobilised to survey the wreck site. The system is capable of operating at two frequencies (500 kHz and 900 kHz) to generate a high-resolution side scan image of the seabed. For best resolution of the recorded seafloor features, the low frequency channel was used at a range of 30 meters.
The tow-fish had a 250 m long armoured umbilical. The position of the 'fish' was measured by the USBL sub-surface positioning system. As back-up positioning system the layback could be calculated by measuring the 'cable-out' length. Position fixes by the navigation computer were annotated on the recorder to position seafloor features from the records.

4.3.9 Software

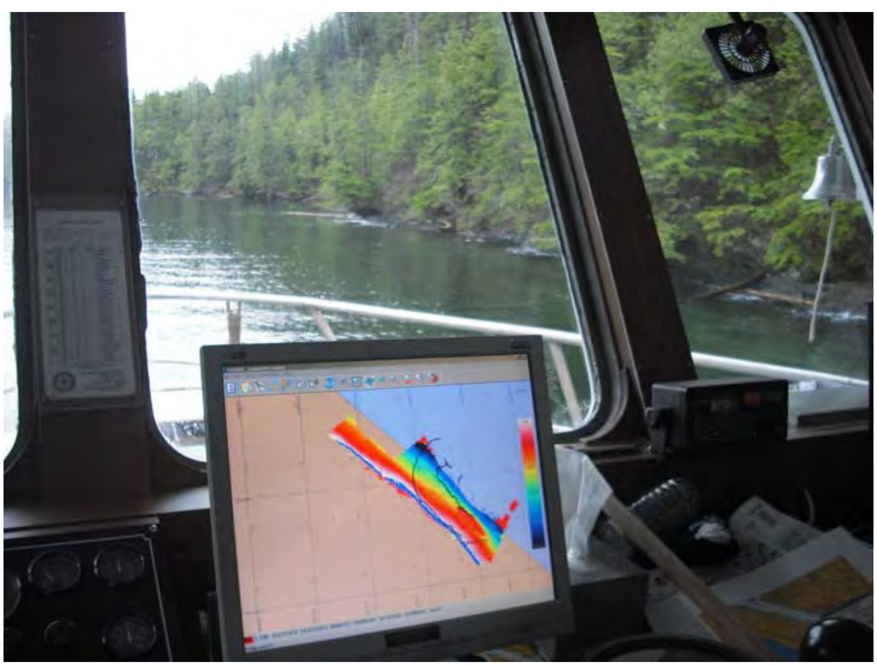
For this project an online computer was configured with QPS Qinsy survey software. The used software has sufficient modules to incorporate all used survey sensors and survey techniques. During the survey, positions of all sensors were computed and recorded continuously based on RTK GPS positions.
On board, the survey data was presented on the computer screen thus enabling the helmsman to steer straight lines, as predetermined in the software. Echosounder, side scan sonar and motion sensor data was continuously monitored and QC of positioning data and all other sensor data was performed on a continuous basis.

4.4 Operation

The survey operation was carried out exactly according to planning for dates and times we refer to the annex

4.5 Weather & sea state

The weather during the survey activities was optimal with flat seas and little winds. Of course it rained the majority of the time



5 USAT Brigadier General M.G. Zalinksi

With references to the annexes

Following the entry of the US into WW1 in 1917 the US Shipping board awarded contracts for 346 small steel hulled vessels for emergency salt water services. These vessels were classified as “Lakers” as they originated on the great lakes and most were given names using the first word “Lake”. Eventually 331 of these ships were built by Great Lake ship builders.

These “Lakers” had originally been constructed for the US Shipping Board during WW1, but the war was over by the time they were launched and they remain on the lakes until 1924

Given the name Lake Frohna, this small steel hulled freighter was built in 1919 as hull 759 by American Shipbuilding Co, Lorain Ohio for the US shipping board.

5.1 General Particulars

Name :	Lake Frohna
Type:	Laker
Year built:	1919
Hull number:	759
Builder:	American Shipbuilding Co, Lorain Ohio
USSB:	no 1637
Registry number us:	218268
Length Lpp:	251 ft
Length o.a.	261 ft
Breadth	43.6 ft
Depth	28.2 ft
Gross tonnage:	2616 tons
Net tonnage	1611 tons
Engine:	triple expansion, American Shipbuilding Co, Lorain Ohio
Former names:	1925 Ace,
	1941 Brigadier General M.G. Zalinski

5.2 Names & ownership

The US Shipping Board used the Lake Frohna as a package freighter until 1924 when she was sold to Minnesota Atlantic Transit Co, Duluth, Minnesota. The Lake Frohna was renamed Ace. (Ace Steamship Company from 1924 to1930 and from 1930 to 1941 she was owned by the Terminals & Transportation Corporation).

The Minnesota Atlantic Transit Co purchased five of these vessels and renamed them Ace, King, Queen, Jack and Ten affectionately known as the “poker fleet”. Since these ships were originally designed for ocean duty, they were small enough to transit the St. Laurence canals and they were equipped with surface condensers to reuse fresh water and “cargo ports” in the side for easy loading/unloading thus making them relatively simple to reconvert for saltwater use again. In 1940 the Queen and Ten were sold to Brazil while the other tree vessels, including the Ace followed their 2 sister, the following year to salt water when they were sold to the US Maritime Commission.

The US War Shipping Administration took over the operation for the WW II efforts in 1941, the Ace was renamed and became the Brigadier General M. G. Zalinski.

6 Bunkers tank arrangement

With references to the annexes

6.1 Coal to oil

These “Lakers” were originally designed to burn coal in there boilers. Vessels were equipped with two coal bunkers on either side of the engine room. Many of these “Lakers” were in an early stage converted to burn fuel oil instead of coal. When Lake Frohna was sold in 1924 and became Ace she apparently was still burning coal. When she returned to salt water trades in 1941 as Brigadier General M.G. Zalinski she was converted and burning fuel oil.

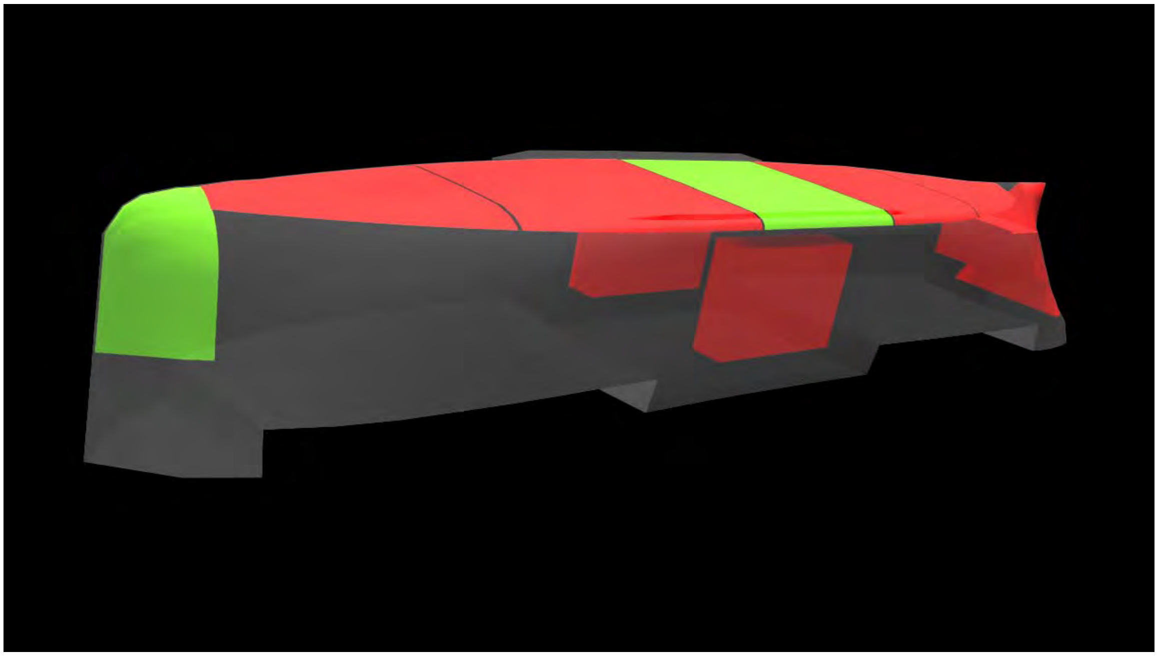
6.2 Bunker tanks

These so called “Lakers” were originally designed with 5 double bottom tanks. The double bottom tanks are numbered from forward to aft 1 to 5. Double bottom tanks 1 till 4 are divided into port and starboard compartments. When the double bottom tanks were converted to burn fuel oil 4 of these double bottom tanks were used to store fuel oil. As there are (sofar) no drawings available when the ace (or Brigadier General M.G. Zalinski) was converted to burn fuel oil it’s not completely clear which double bottom tanks are eventually used to store fuel oil. For the purpose of the survey we assume that the conversion of the Ace took place in the same line as the other so called “Lakers” were converted. This means that double bottom tank #3 port and starboard were used to store boiler water

6.3 Tank capacity

All together this leads to the following capacities

Name	Fuel (tons)	Water (tons)
Fore peak tank		78.0
Double bottom tank 1 Port	31.5	
Double bottom tank 1 Starboard	31.5	
Double bottom tank 2 Port	81.5	
Double bottom tank 2 Starboard	81.5	
Double bottom tank 3 Port		65.0
Double bottom tank 3 Starboard		65.0
Double bottom tank 4 Port	52.5	
Double bottom tank 4 Starboard	52.5	
Double bottom tank 5 centre	52.0	
Aft peak tank	101.0	
Coal bunker Port	116.0	
Coal bunker Starboard	116.0	
Coal chute	13.0	
	729.0	**208.0**



7 The Sinking

The following was found in the archives with regard to the sinking

"VANCOUVER SUN, SEPT. 30, 1946

Graphic details of how the 3,000-ton U.S. Army transport ship, General Zalinski sank in blinding rain in darkness south of Prince Rupert Saturday night, were related today by the ship's 48 survivors, who were rescued by a tug and passenger steamer.

No lives were lost and no one was injured in this first major marine disaster on the B.C. coast this fall. Union Steamship passenger ship SS Catala landed the 48 U.S. Army personnel survivors at Prince Rupert last midnight.

The Zalinski, en route from Seattle to Whittier, Alaska, with a cargo of army supplies crashed onto rocks of Pitt Island in Grenville Channel, 55 miles south of Prince Rupert. Her bottom was torn out and she sank within 20 minutes.

The 48 men, soaked to the skin, and shaken, were picked up from lifeboats and from the water by the passing tug, Sally N. "Driving rain made it so black we couldn't even see the bow when we struck," said winch-operator Bernard Boersema of Everett, Wash. "The force of the collision broke Nos. 1 and 2 hold clear open - a tear about 40 feet long." he said.

"As soon as we struck, the mate ordered me to 'sound' the bilge water in those two holds ."There was already about seven feet of water in No. 2 hold and more rushing in like fury. I knew then we were sinking. "The mate shouted to me to forget about No. 2 hold and abandoned ship. "I, and some of the others, jumped into No. 1 lifeboat, which had been lowered as soon as the vessel started to founder."

The tug Sally N, staggering in the heavy seas under the load of the 48 survivors plus her own crew, made her way to the nearby Canadian Fishing Co. cannery at Butedale. There is little chance of the Zalinski's being salvaged, since she lies in 80 fathoms of water."

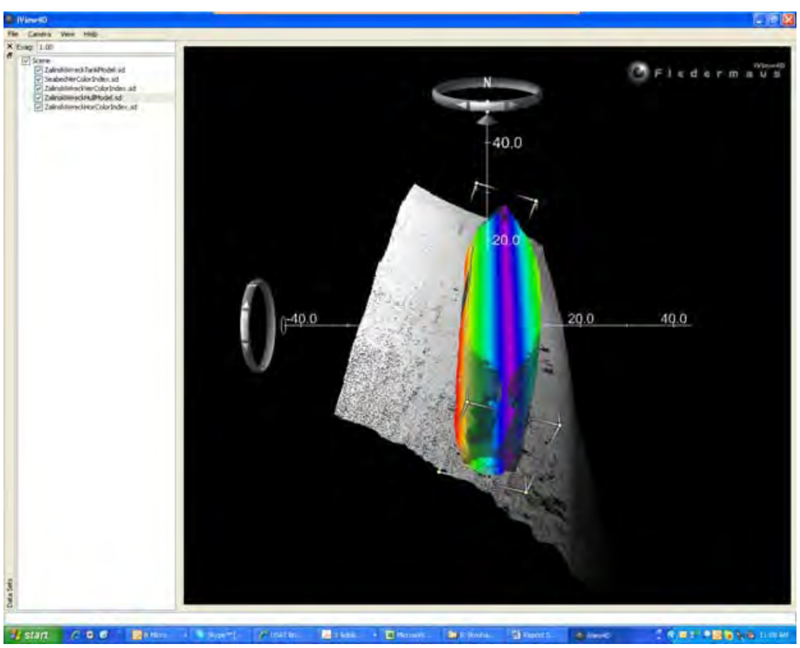
8 Results

8.1 Multi beam results

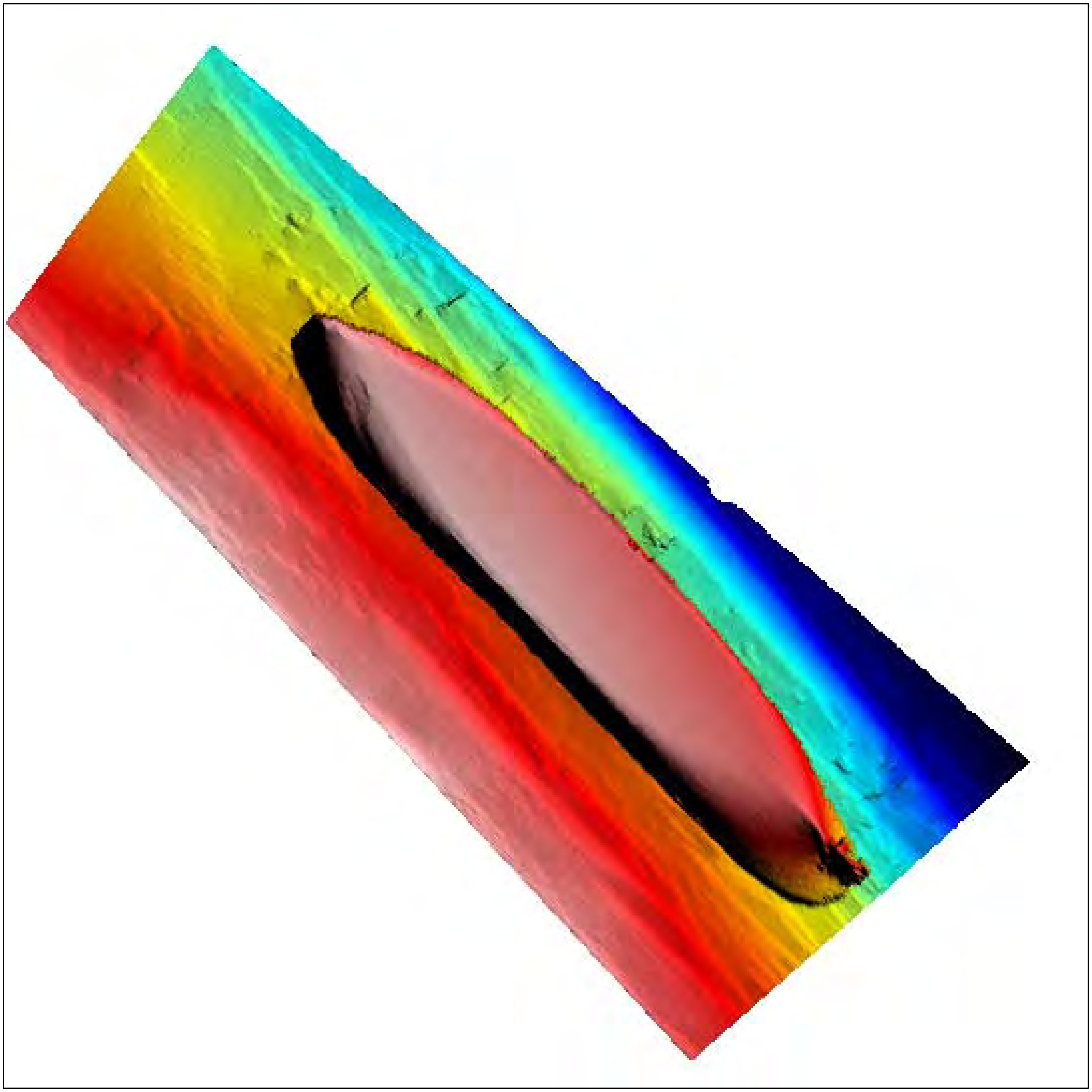
The following paragraph gives an overview of the results derived from the multibeam echosounder survey. All individual survey lines were edited, despiked, filtered for position errors and combined in a 3D points model. To get a good image of the state of the hull the 3D model of the multibeam survey was combined with a Theoretical 3D model of the Zalinski. This was build from general arrangement drawings provided by the CCG. The next figures give an overview of the general state of the wreck and the surrounding area.

8.2 Instructions for software viewer

To watch the 3D model of General Zalinksi on a computer install the viewer software. You do this by running the exe file on the memory stick named “win32_iview4d.exe”. Once installed, start up this program and go to the menu “FILE”, Select “OPEN” and open the file “Zalinskywreckseabedmodel.scene” also present on the memory stick. The wreck will now appear on your screen. Switch on the different layers in the left column and turn the wreck with you mouse

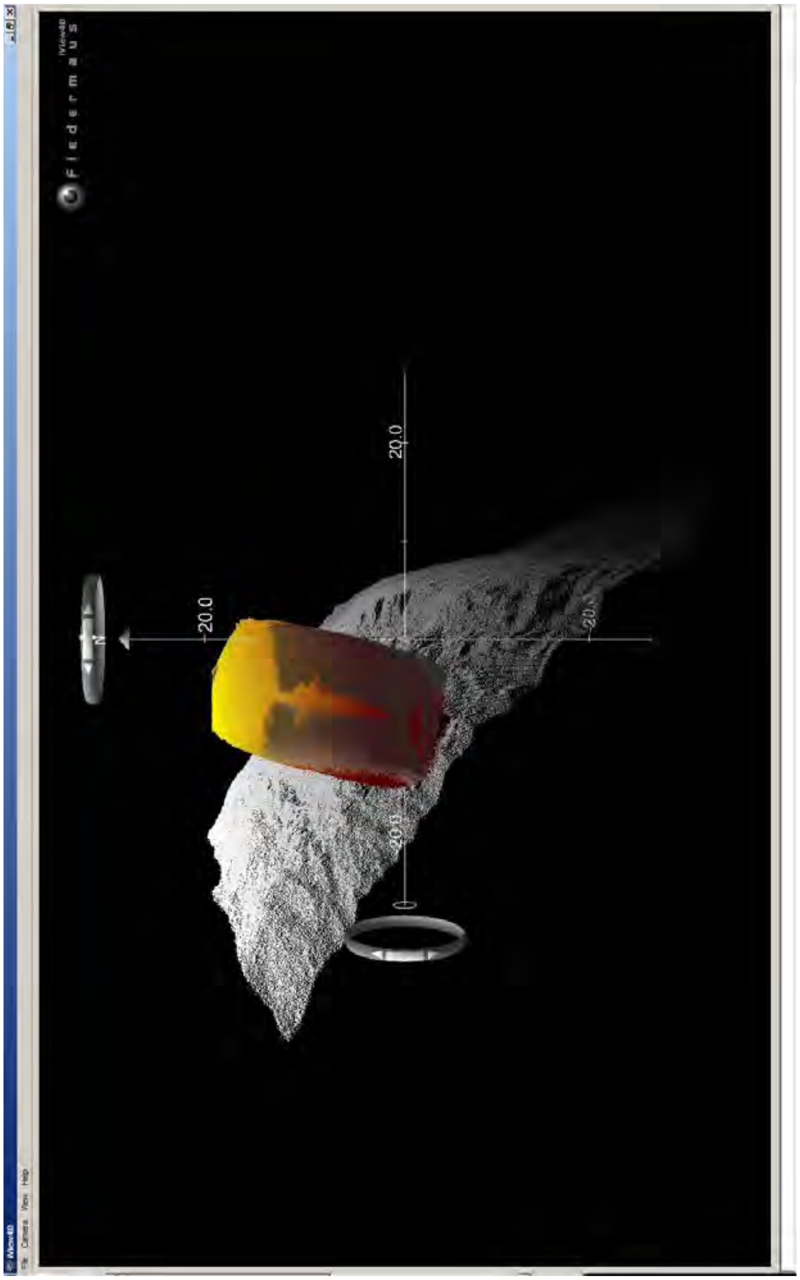


8.3 Overview wrecksite

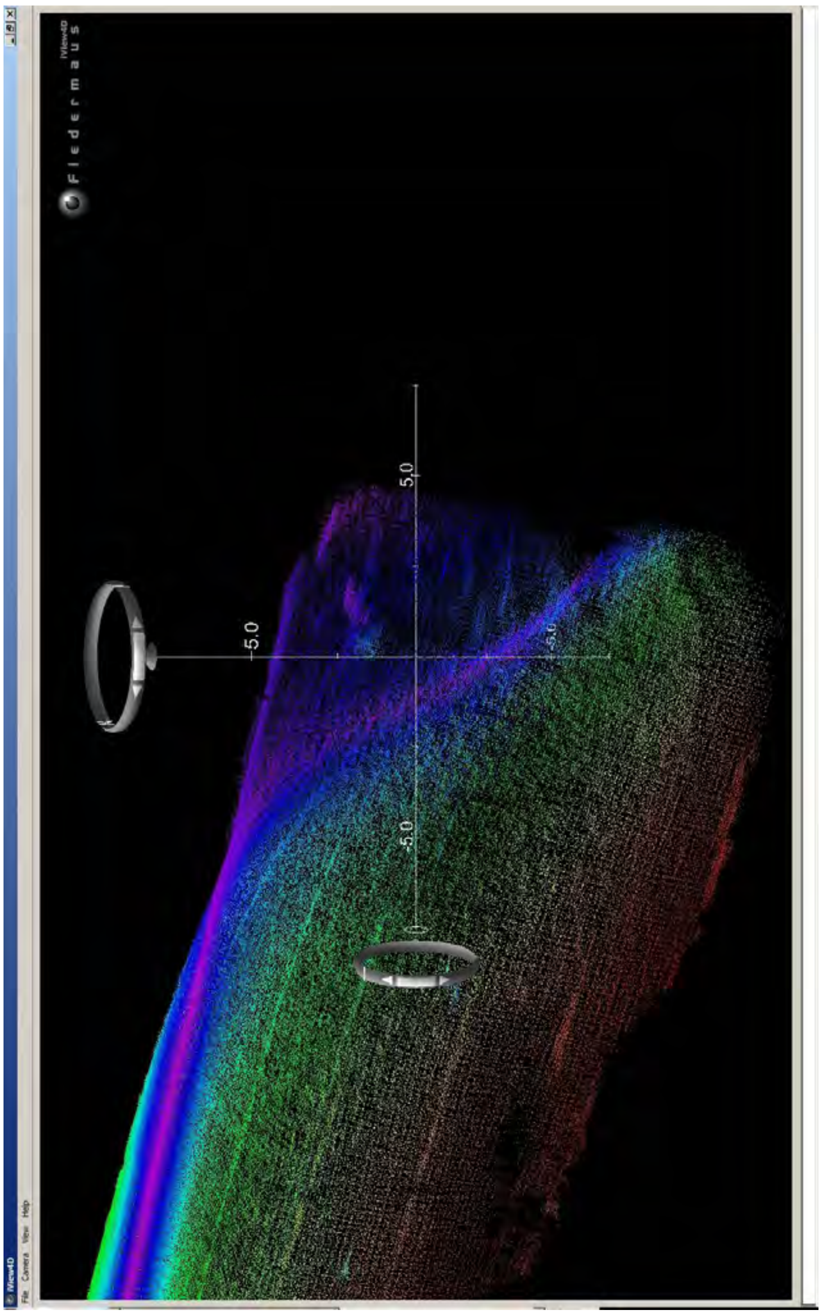


8.4 3D Overview of the wreck

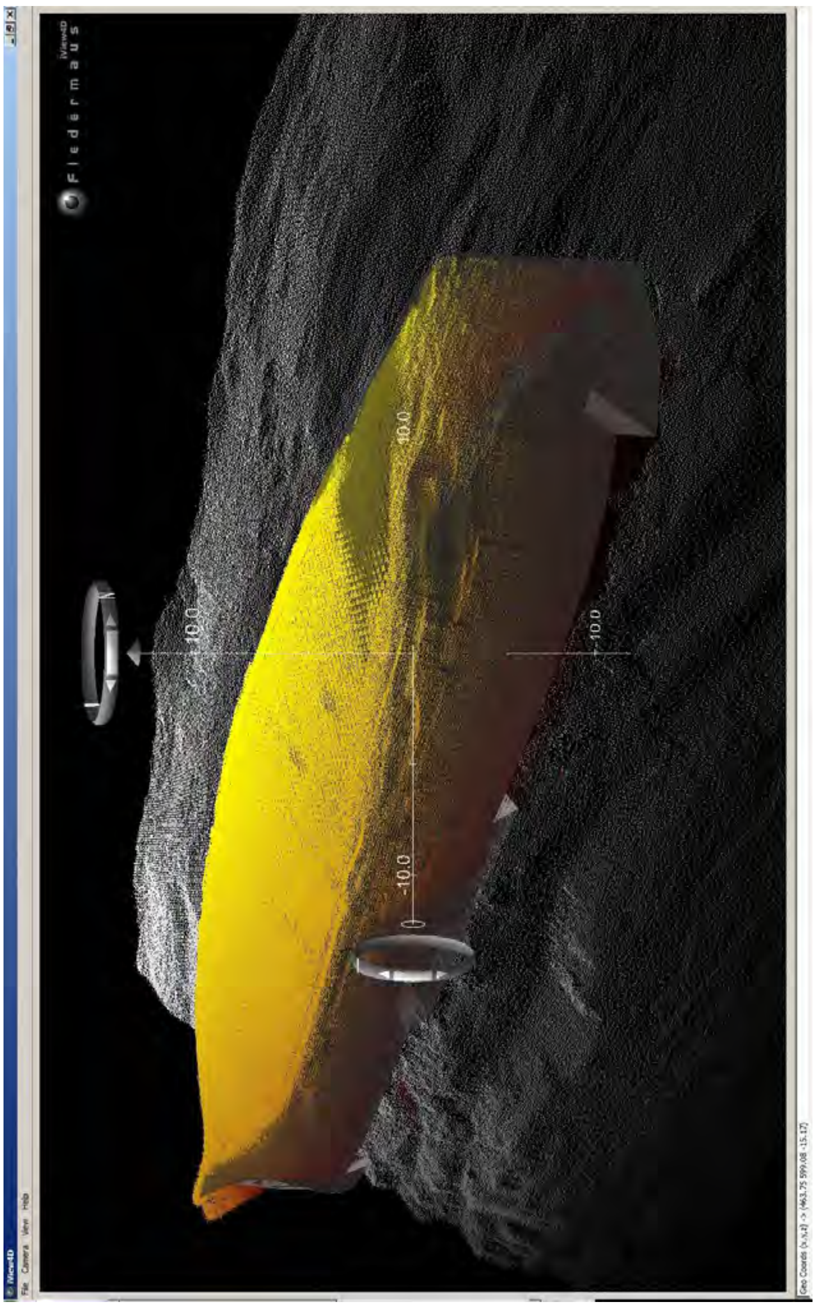
8.5 Wreck on very steep slope



8.6 Rudder and propeller

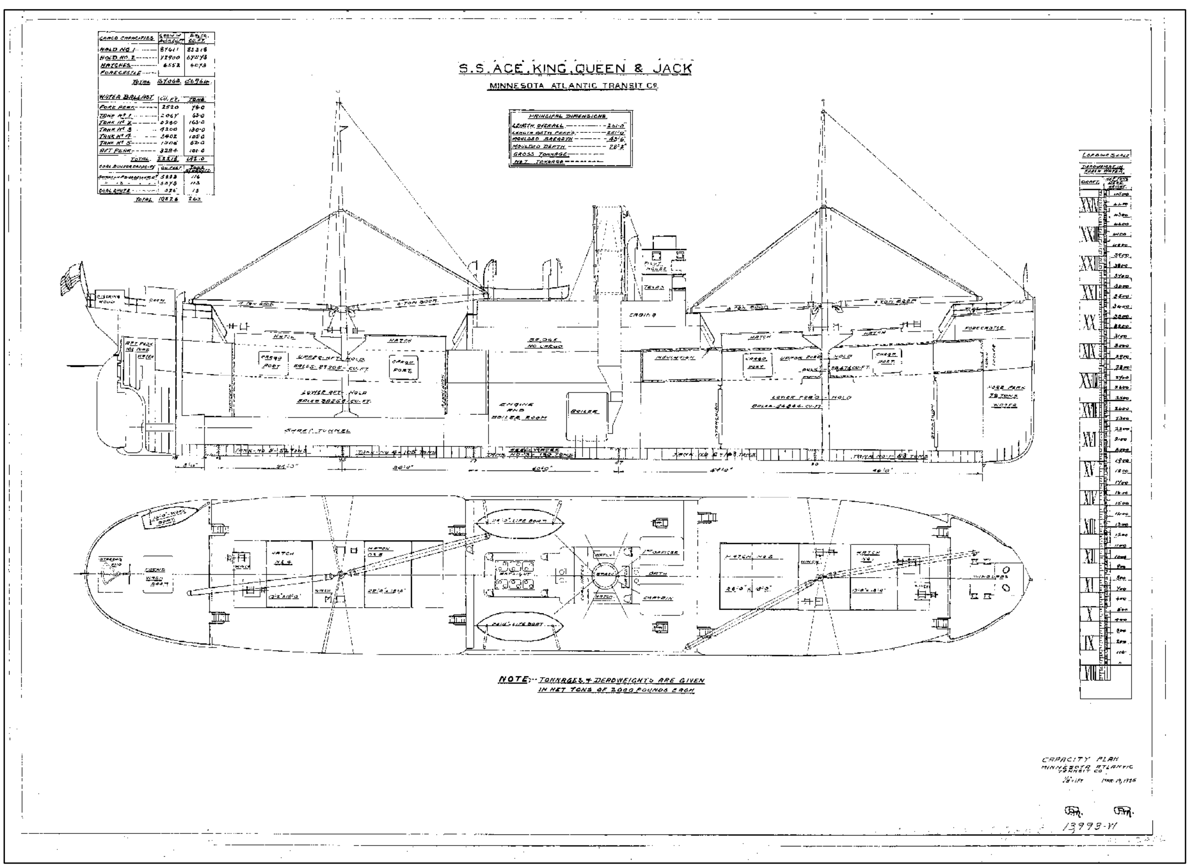


8.7 Damage on portside bow



9 Possible damages

During processing and comparing the data to the theoretical model some parts of the wreck were identified as possible damaged. The following figure shows the general arrangement of the vessel including tank plans which will be referred to in a later stage.

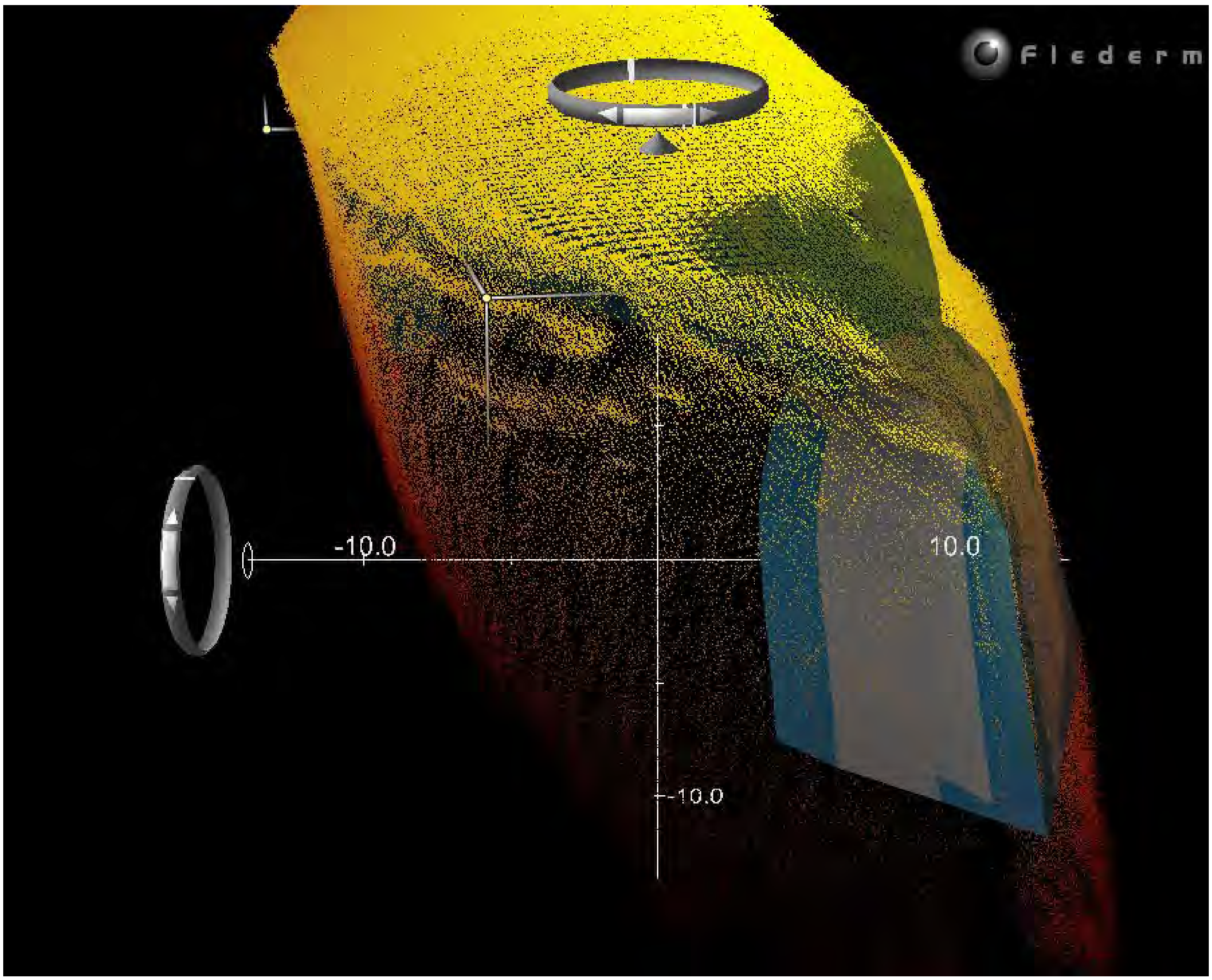


The main area's that appear damaged are the starboard bow and portside bow. The portside bow is ripped open from the bow until the bilge keel. This is probably caused by grounding of the vessel and would most likely be the damage that sank the vessel. Part of the starboard bow is damaged but it is not clear if this is caused by grounding or by the actual sinking of the vessel. Further damage can be found on the starboard side at deck level at the front of the vessel. During sinking the vessel most likely rolled upside down and landed on its starboard side causing this damage. A possible hole in the hull can be found on the vessel's starboard side located at the mid ship fuel tank. All possible damages combined might indicate that the following fuel tanks are damaged:

- SB Tank 1
- PS Tank 1
- PS Tank 2
- Forepeak tank
- SB mid tank

9.1 Forepeak tank

When you look at the multi beam results laid over the 3D tank model you can see that here is a severe damage in the fore peak tank. This damage extends to other tanks



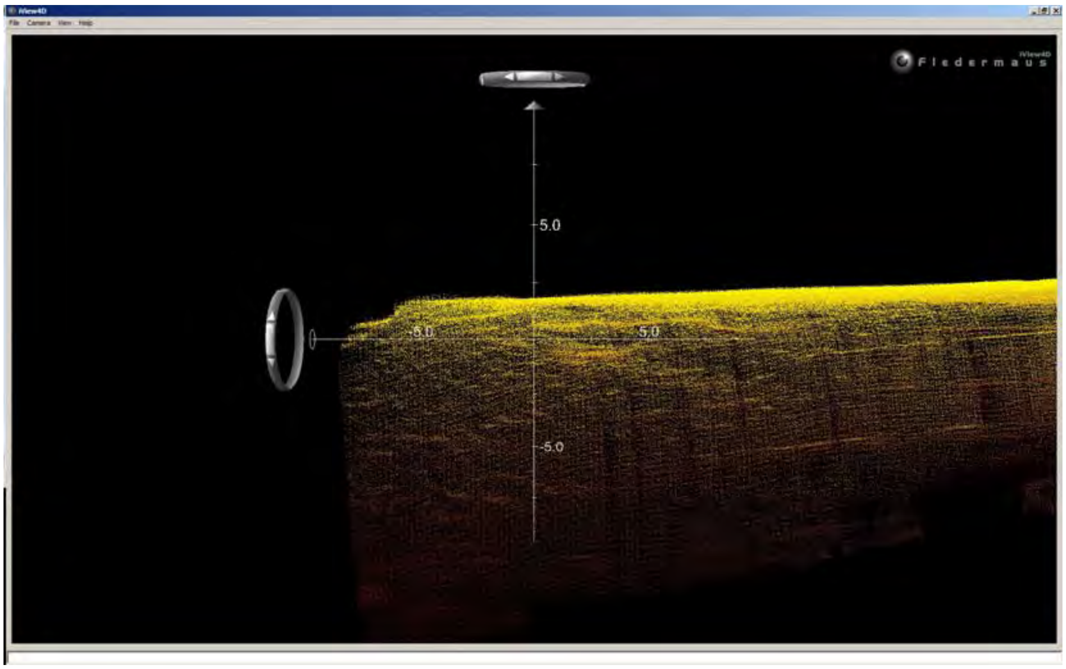


Figure 10: Damage Forepeak tank (data)

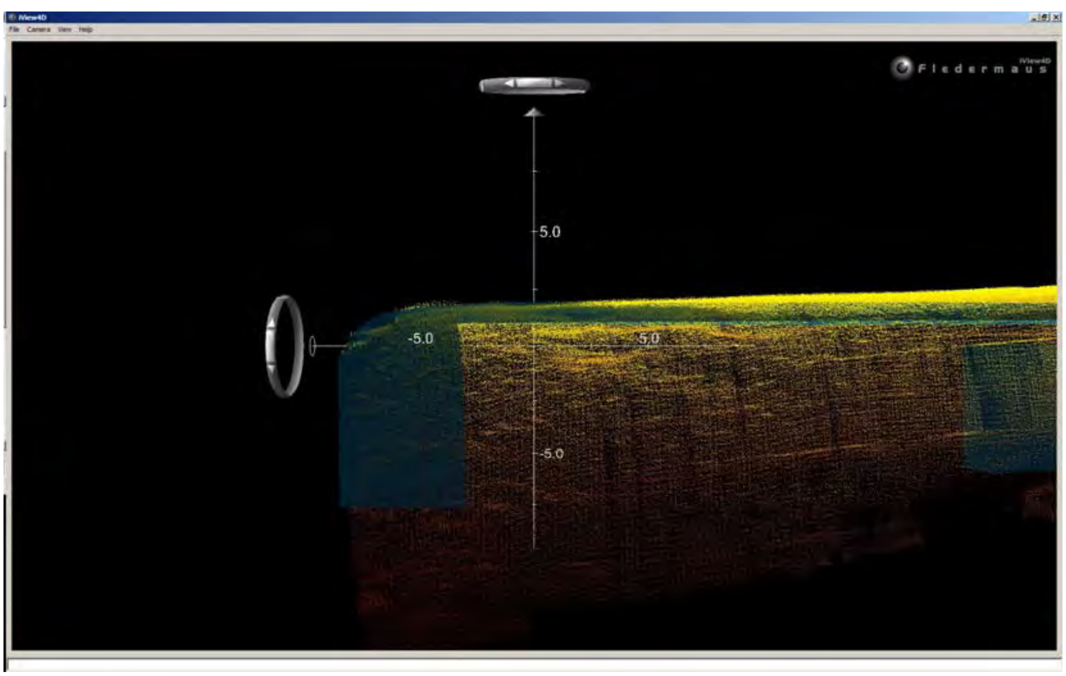
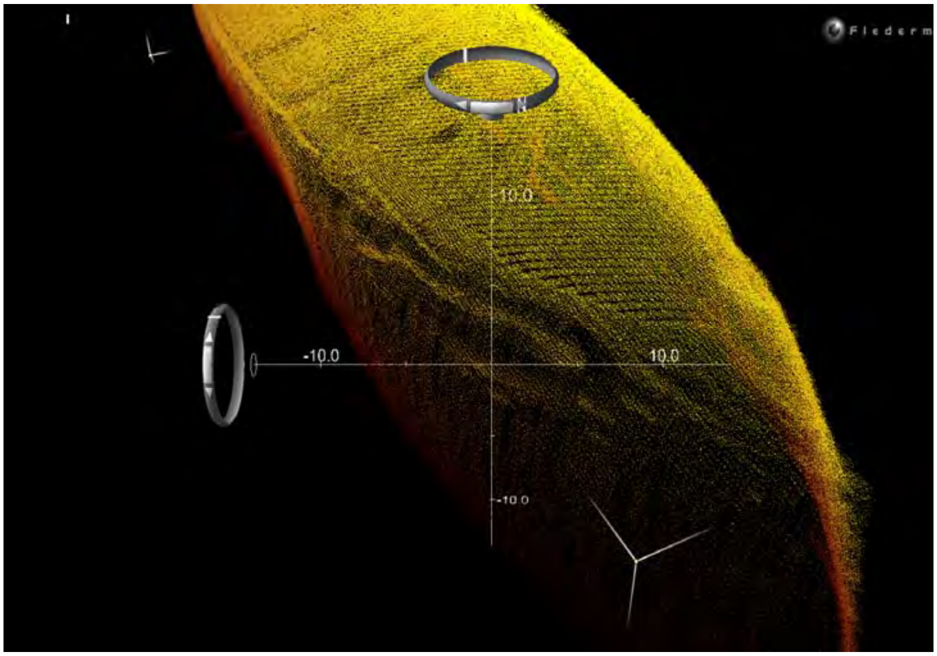
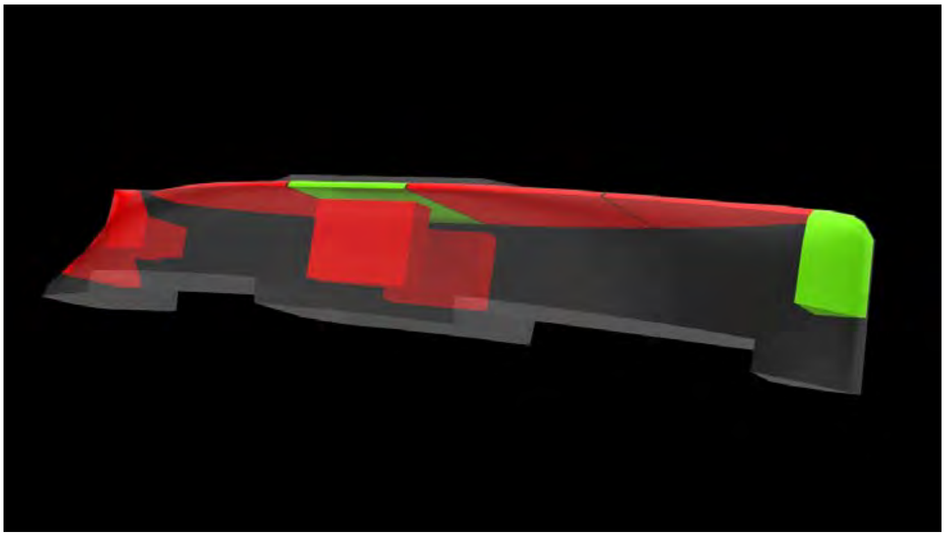


Figure 11: Damage Forepeak tank (model and data)

9.2 Double Bottom fuel tank #1 Portside

This tank shows clearly a large crack which starts in the forepeak tank all the way to the forward engine room bulkhead. This damage also extends into hold #1. This damage is most likely the cause of the sinking of the vessel.





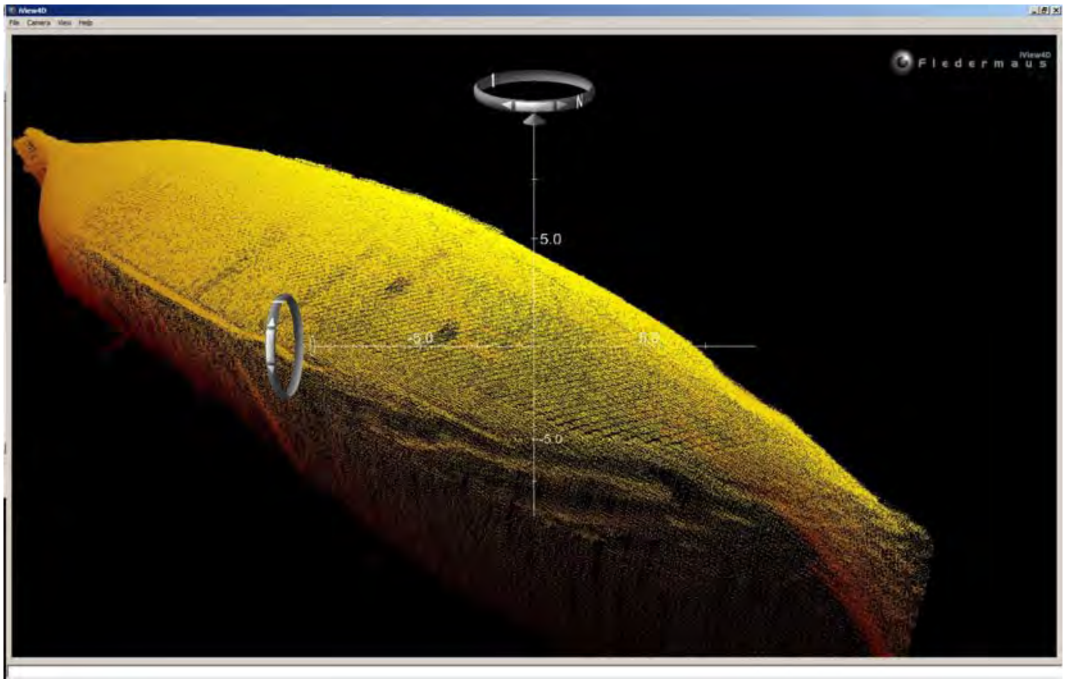


Figure 8: Damage PS tank 1 & 2 (data)

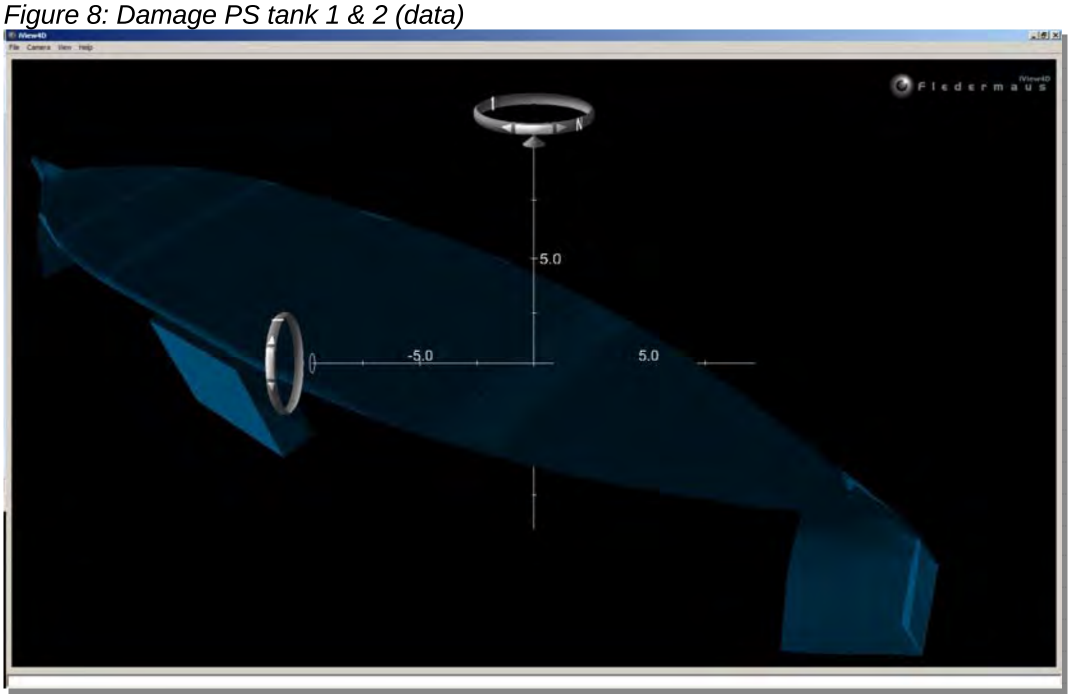
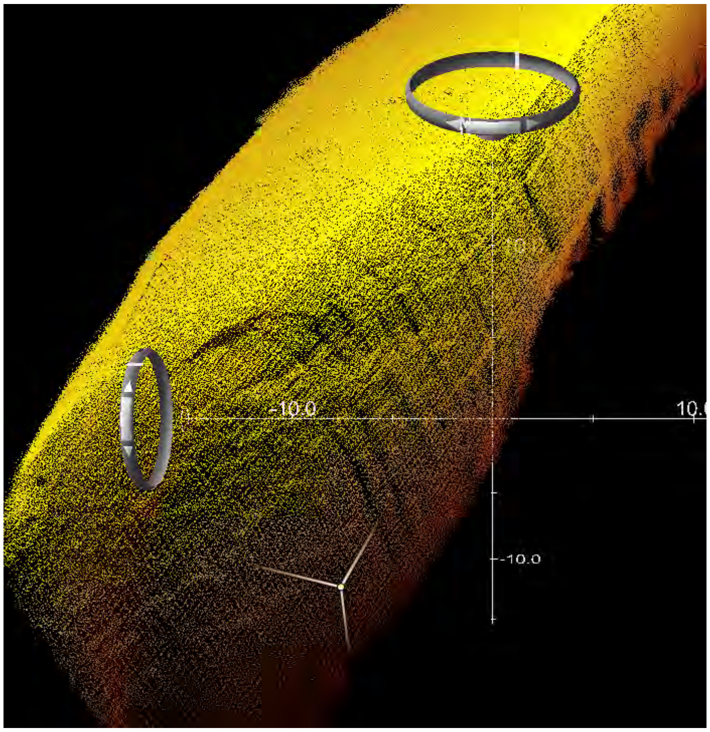
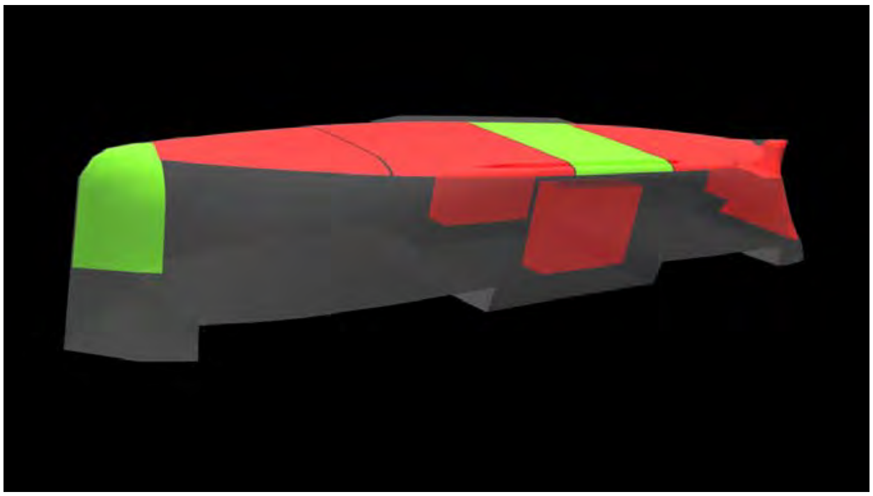


Figure 9: Damage PS tank 1 & 2 (model)

9.3 Double Bottom fuel tank #1 Starboard

This tank is also has a clear damage and can be considered breached. It is not clear if this damage caused the sinking or that this is the result of the sinking





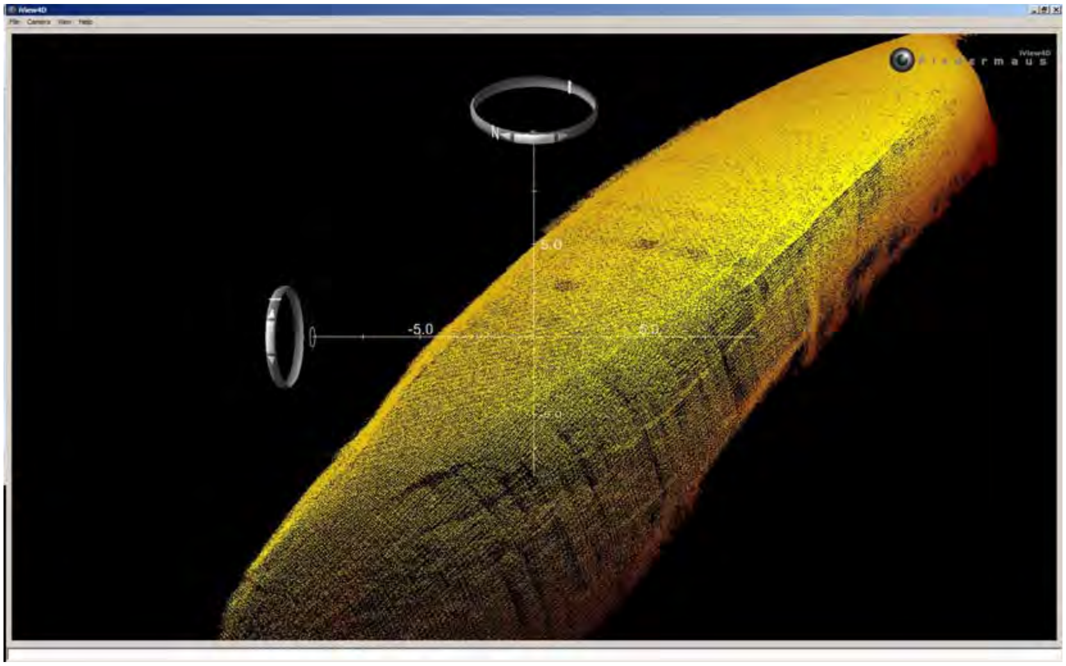


Figure 12: Damage SB tank 1 (data)

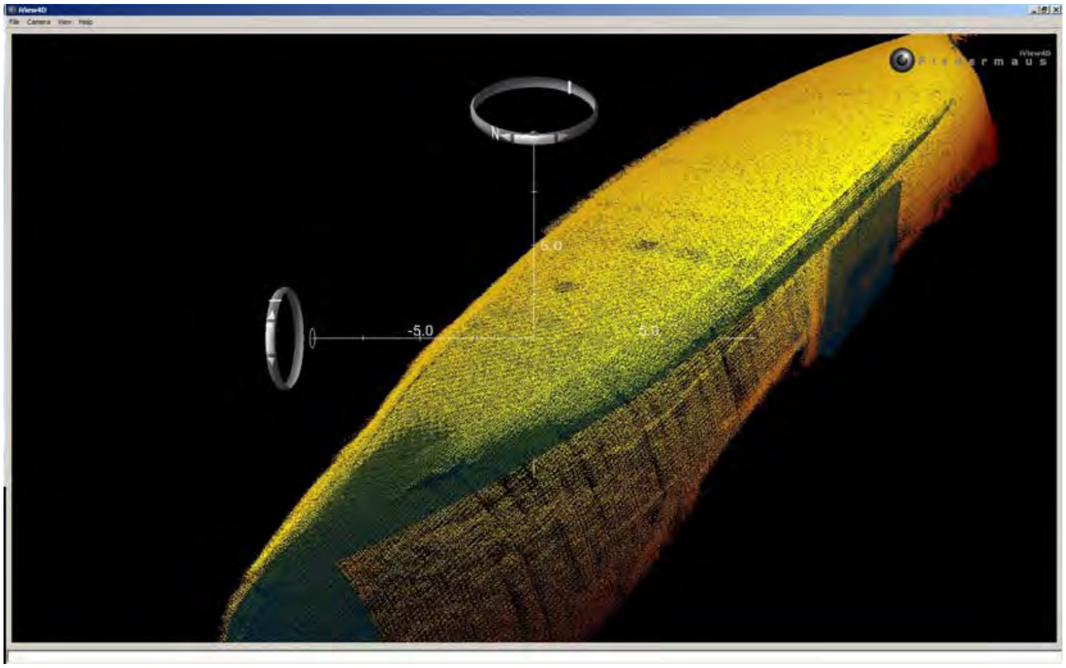
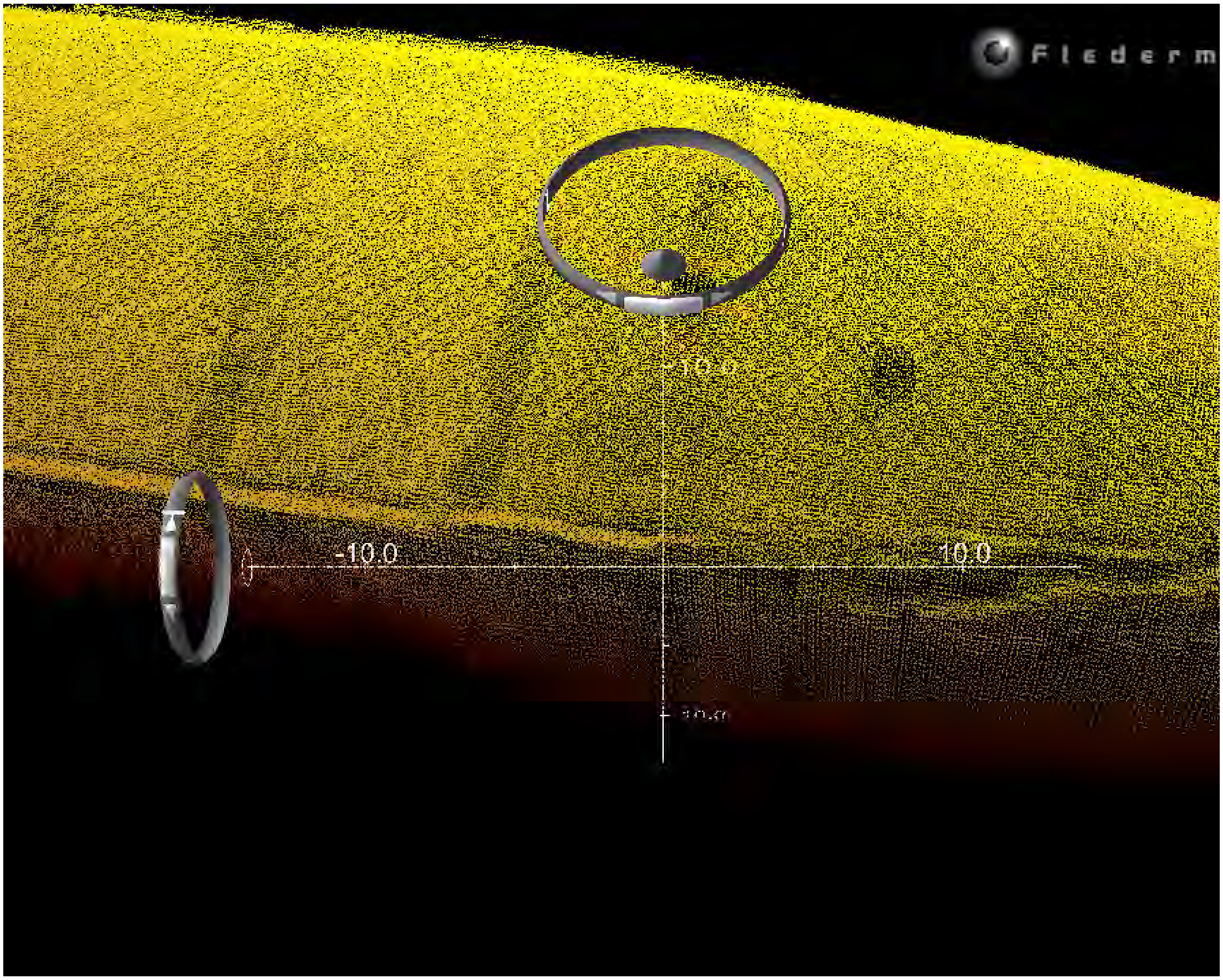


Figure 13: Damage SB tank 1 (model and data)

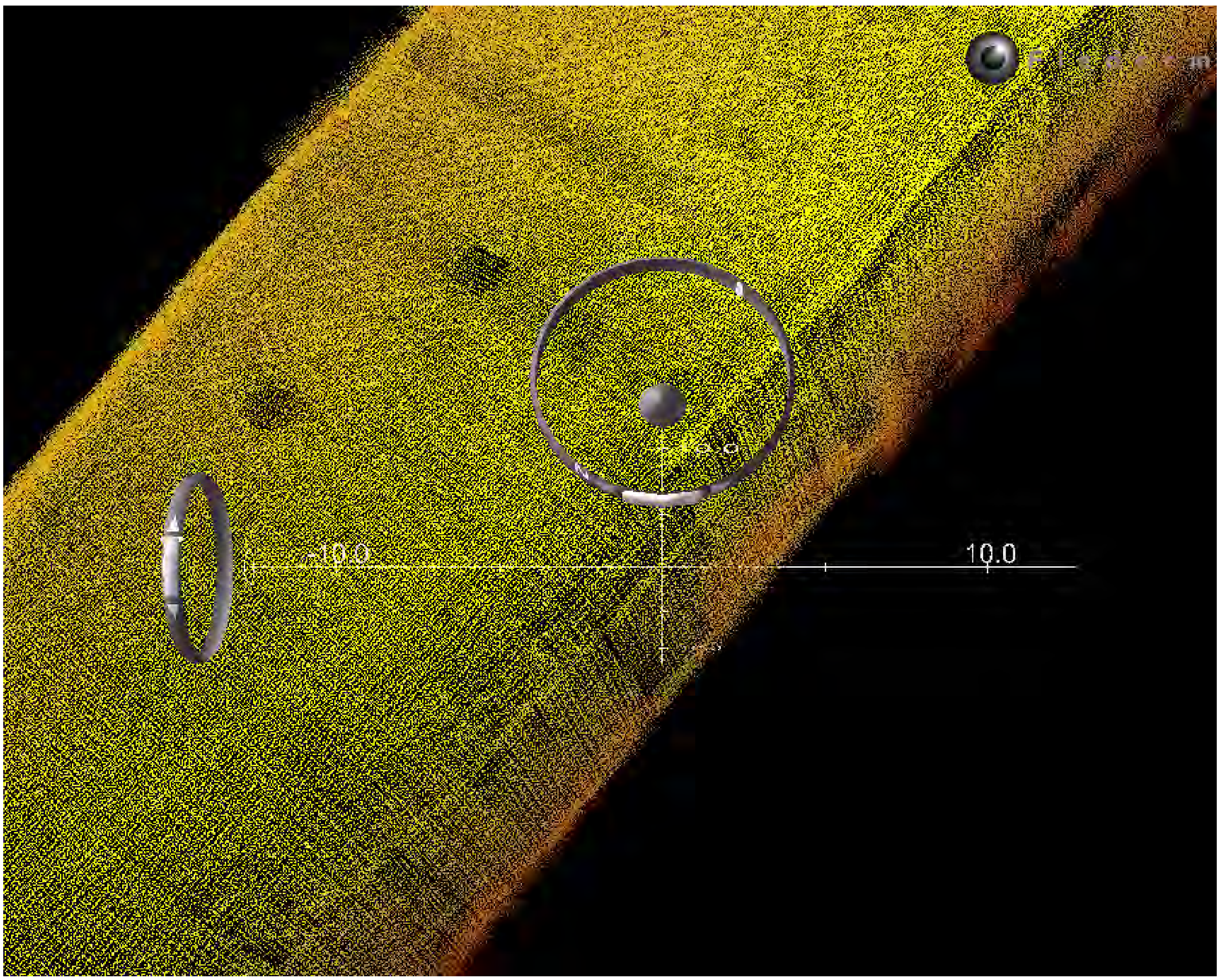
9.4 Double Bottom fuel tank #2 Port

This tank is also breached by the damage which started in the forepeak. Please note the deformed bilge keel which is a clear indication it hit something



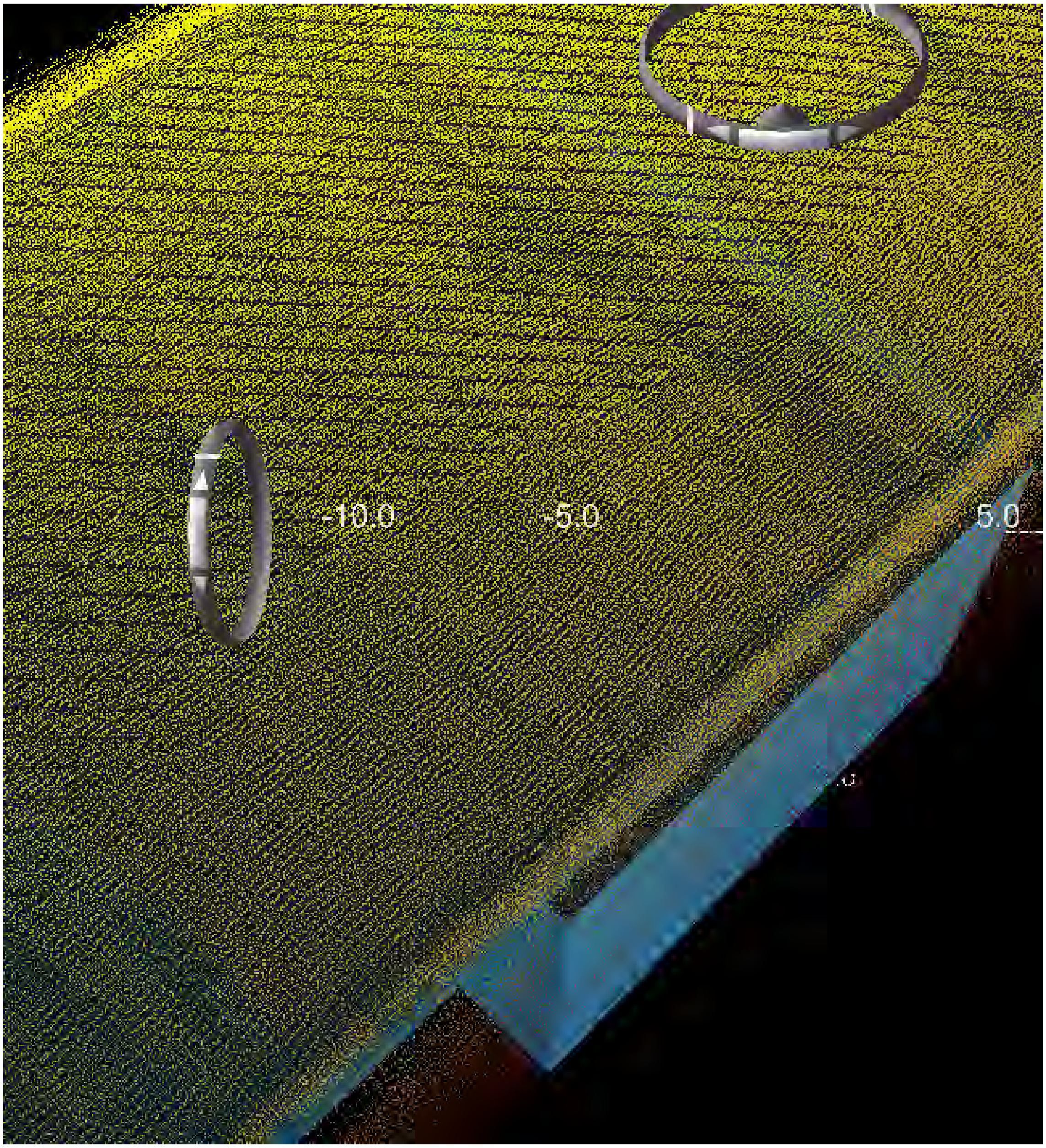
9.5 Double Bottom fuel tank #2 Starboard

There is no damage or deformation shown on the multi beam survey, note the strait bilge keel and the riveted edges of the strakes



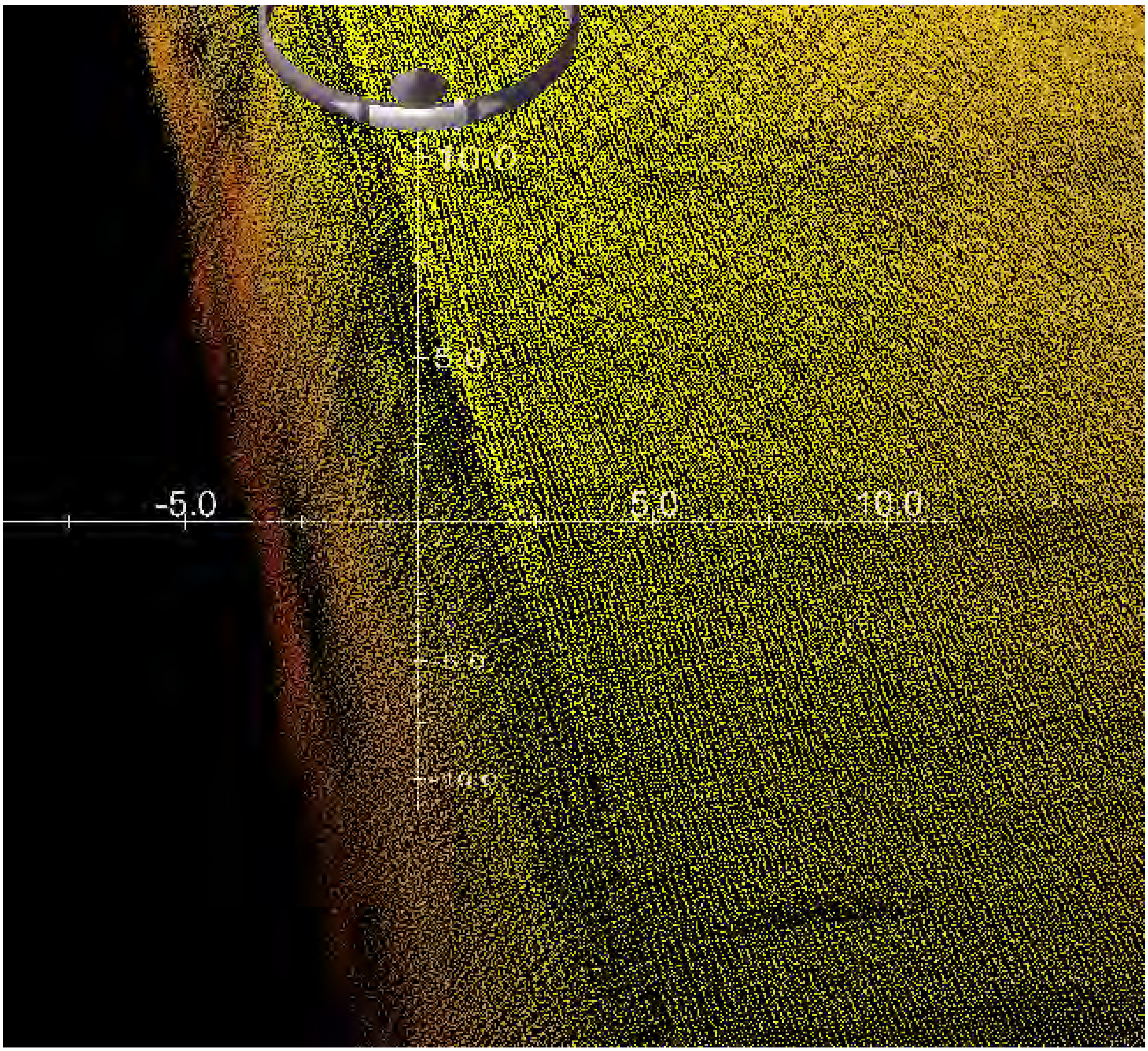
9.6 Double Bottom tank #3 Port

There is no damage or deformation shown on the multi beam survey



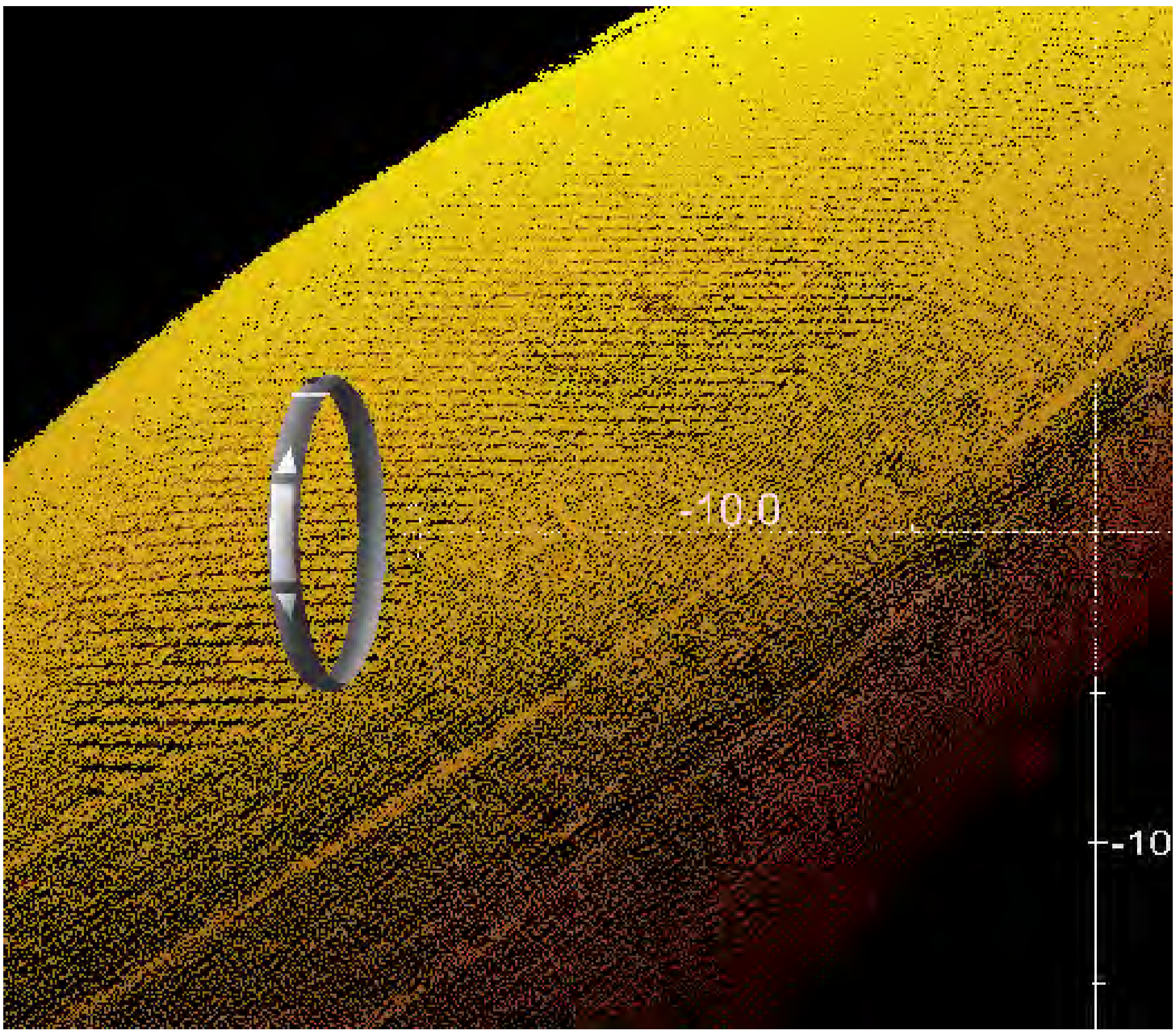
9.7 Double Bottom tank #3 Starboard

This tank has minor deformation in the bilge strake



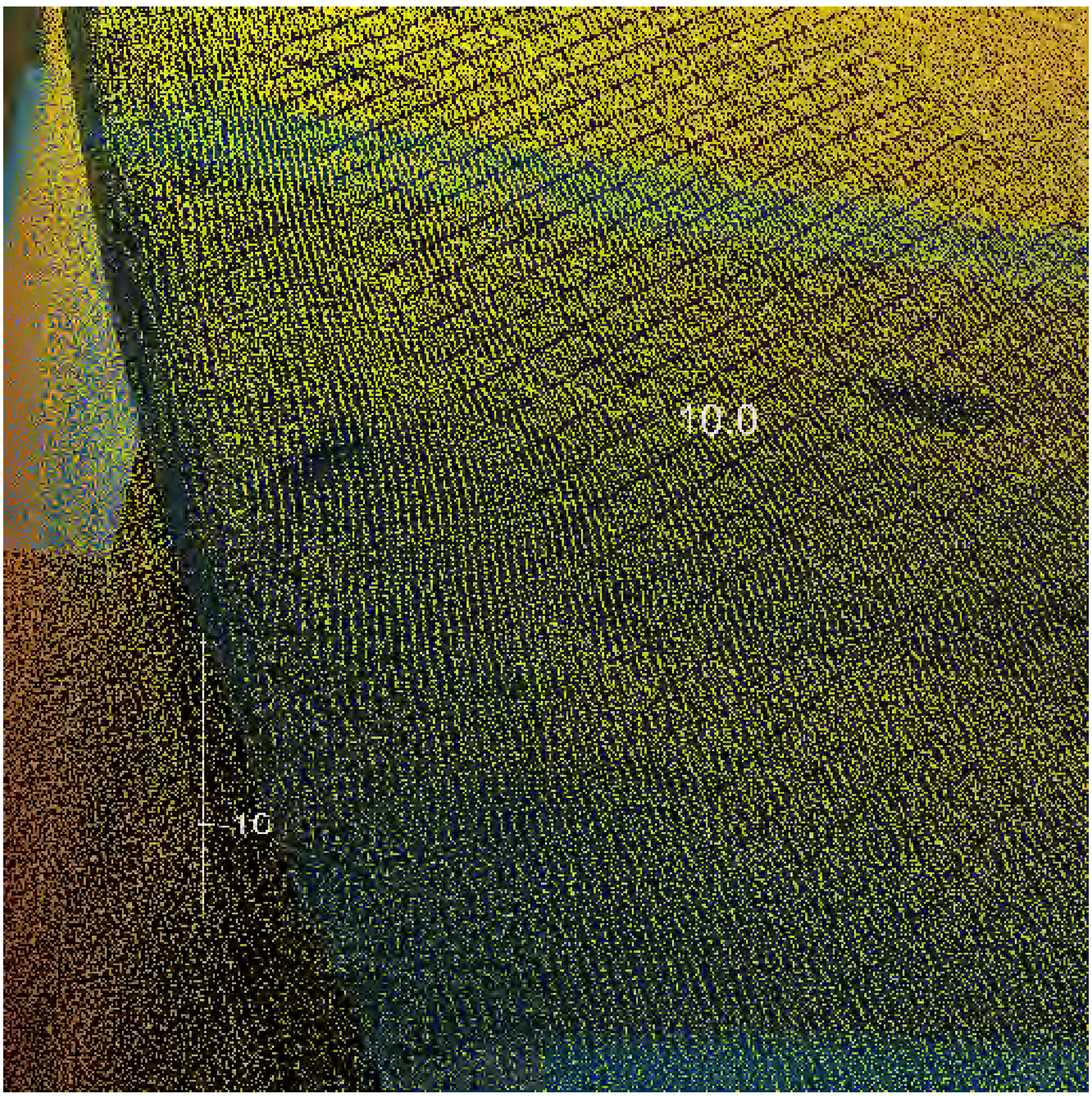
9.8 Double Bottom tank #4 Port

No visible damage, note the detail of the strakes



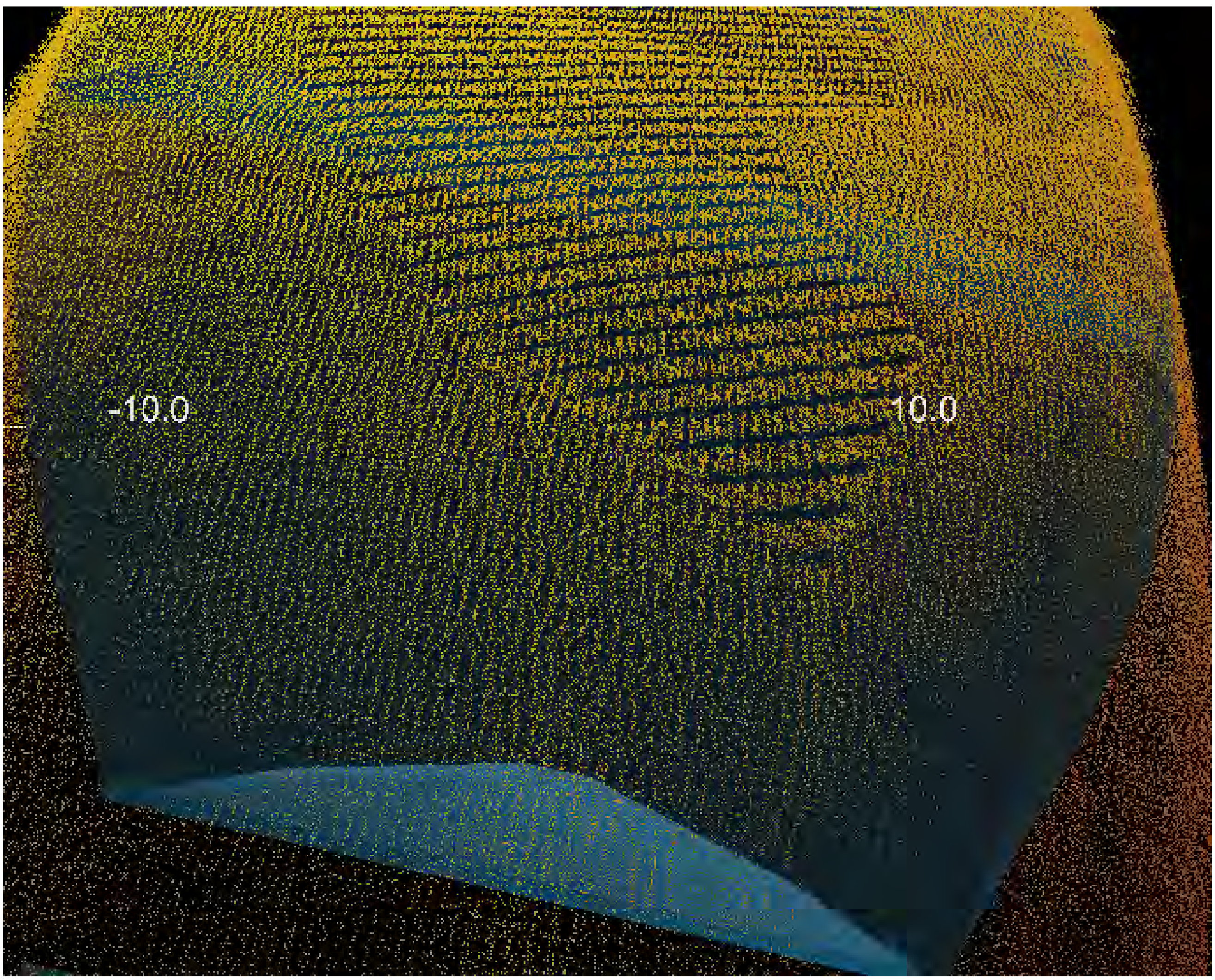
9.9 Double Bottom tank #4 Starboard

No visible damage



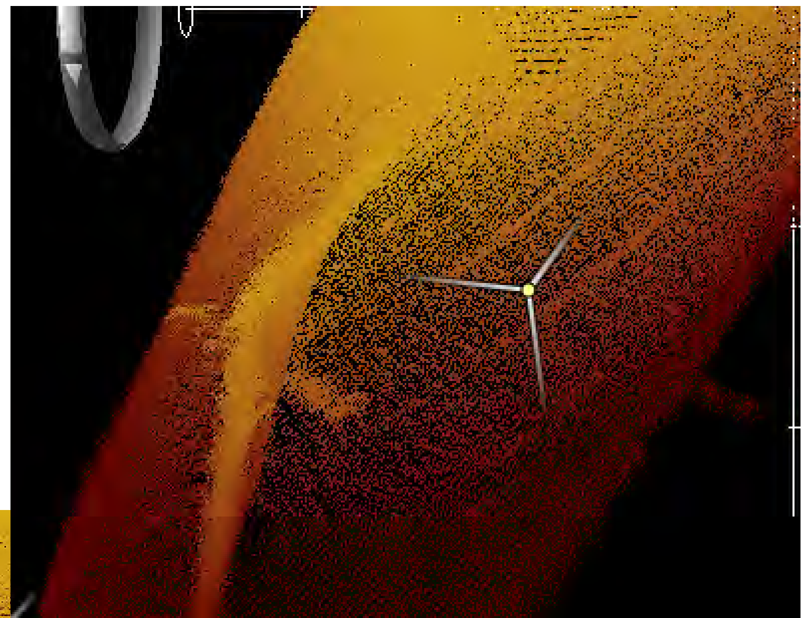
9.10 Double Bottom tank #5

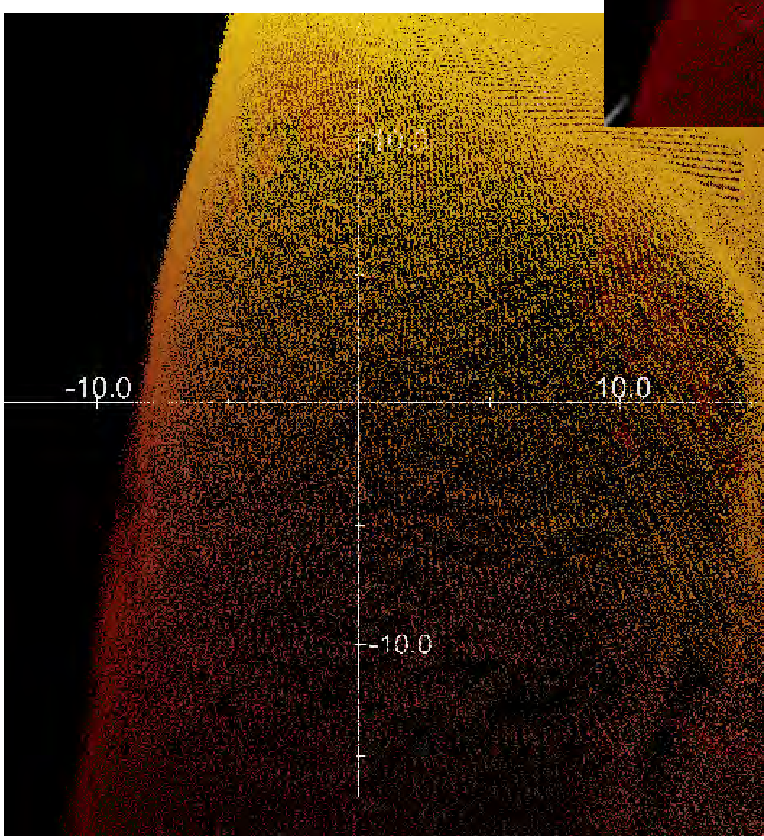
No visible damage



9.11 Aft peak tank

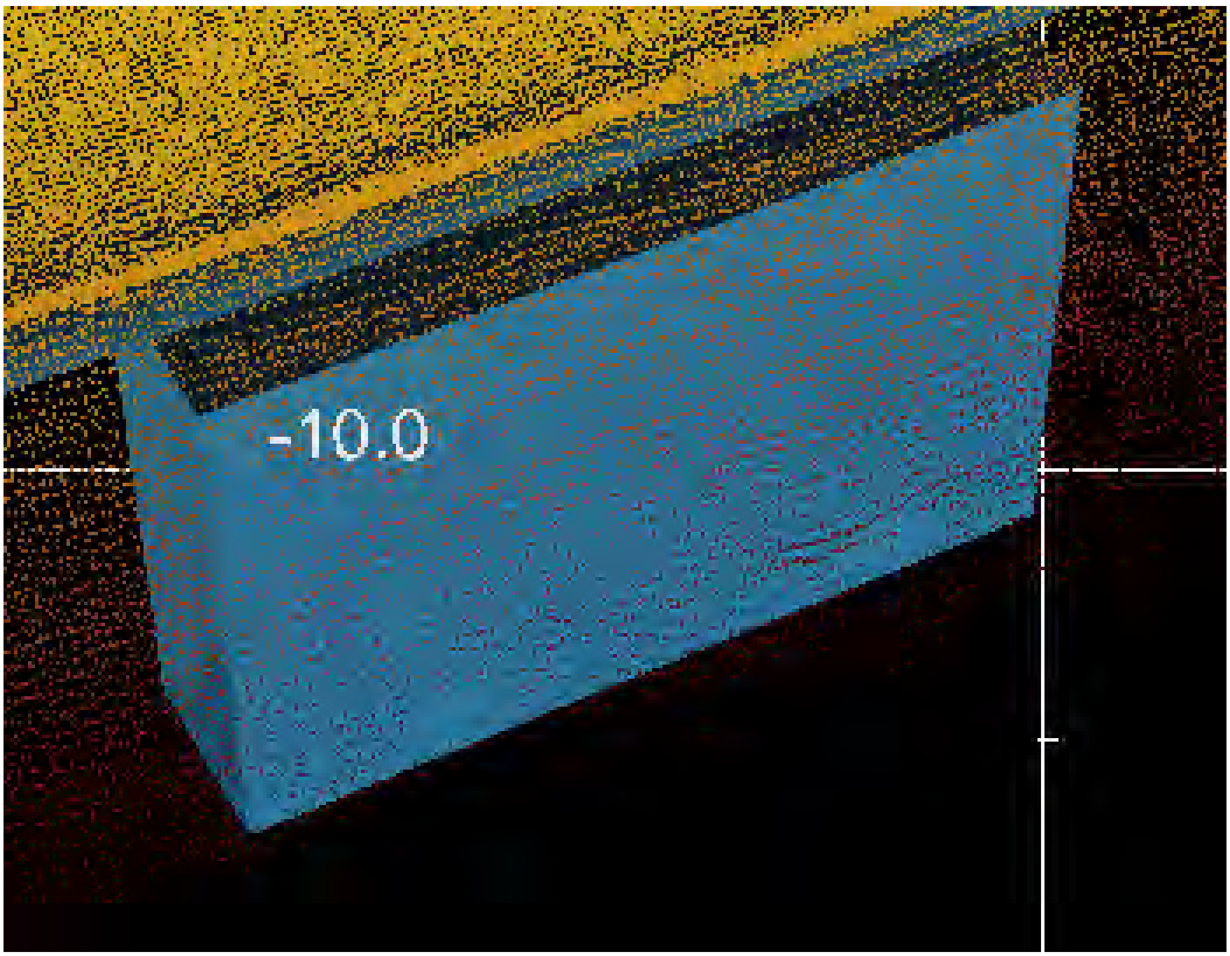
No visible damage





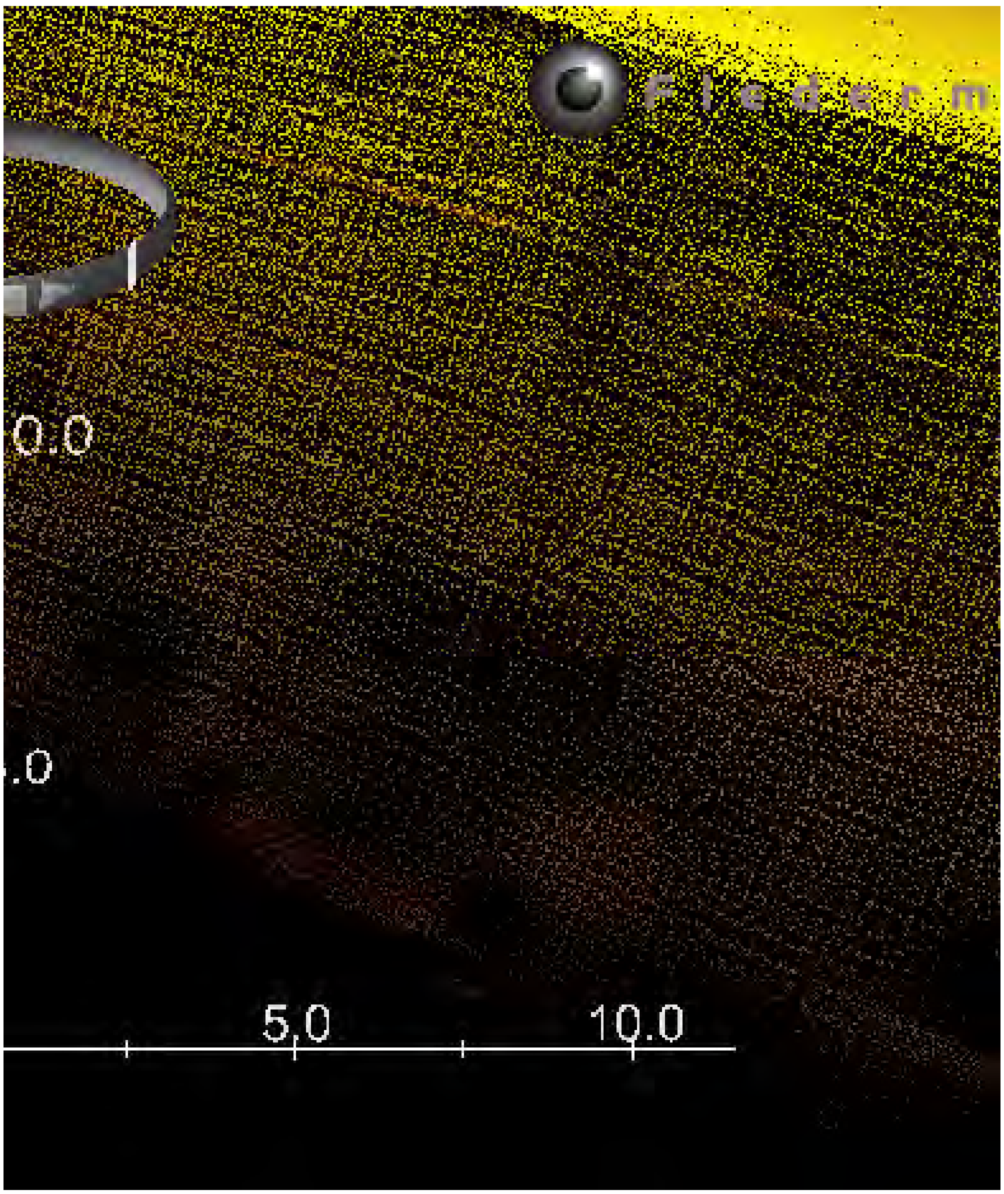
9.12 Coal bunker tank port

No visible damage



9.13 Coal bunker tank Starboard

This tank has damage on the upper side of the tank



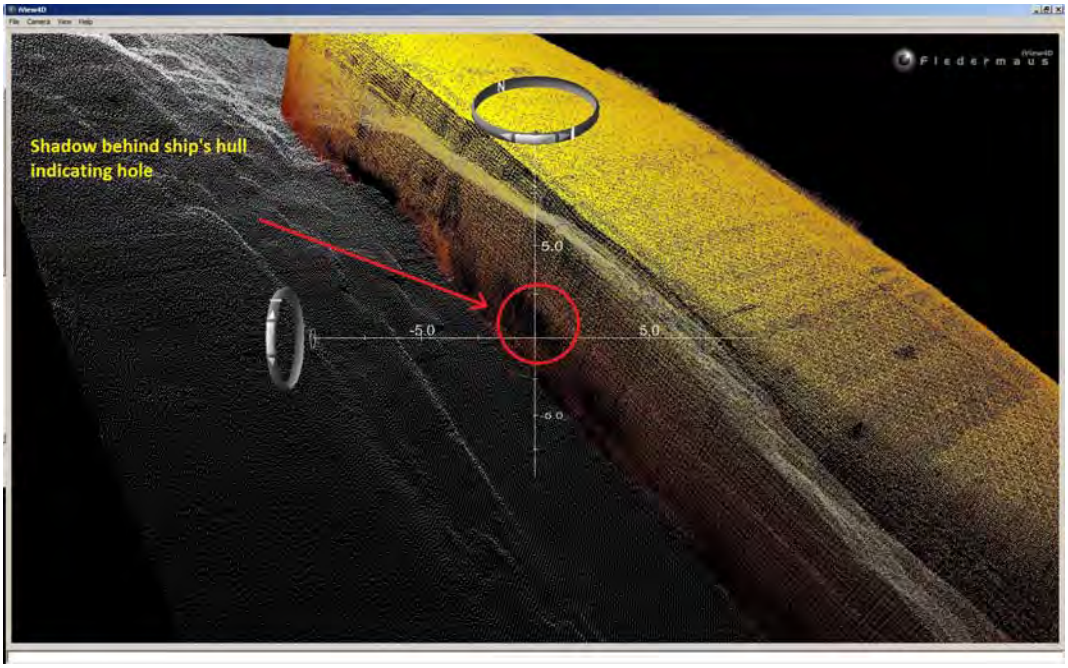


Figure 14: Damage SB mid tank (data)

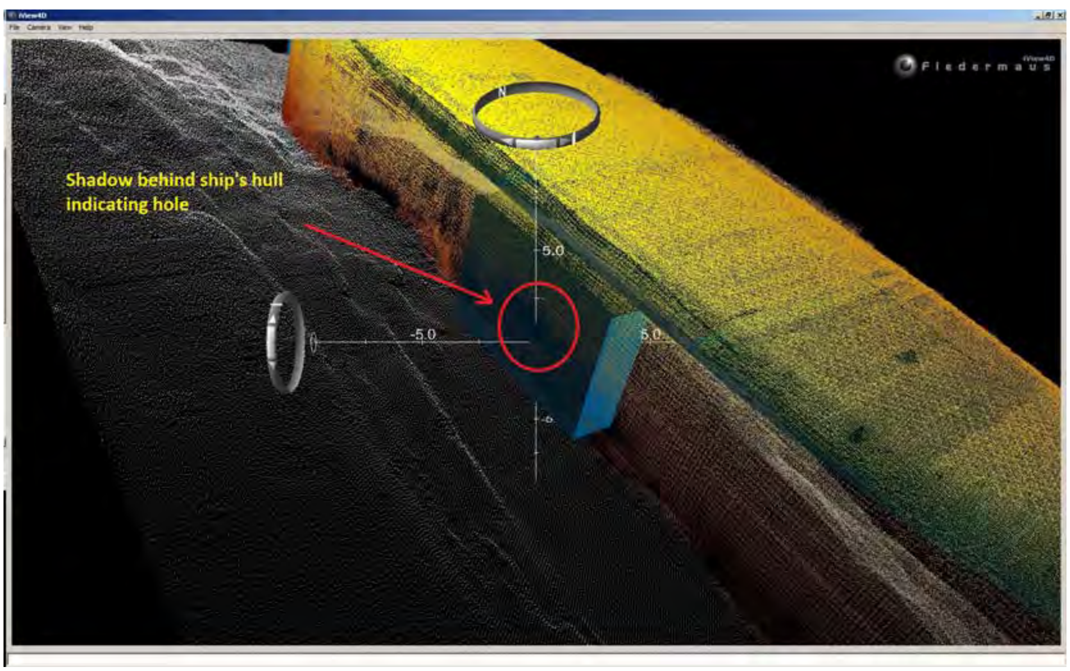


Figure 15: Damage SB mid tank (model and data)

10 Sidescan sonar results

After completion of the multibeam survey, a sidescan sonar survey was performed on the Zalinski wreck site. Special attention was given to the areas on the wreck that were identified as possibly damaged. Due to the position of the Zalinski on a very steep slope and the fact that it lays upside down on the seabed it proved very hard to produce useable sidescan images. The following figures show the different area's with possible damage.

Figure 16: Damage PS bow

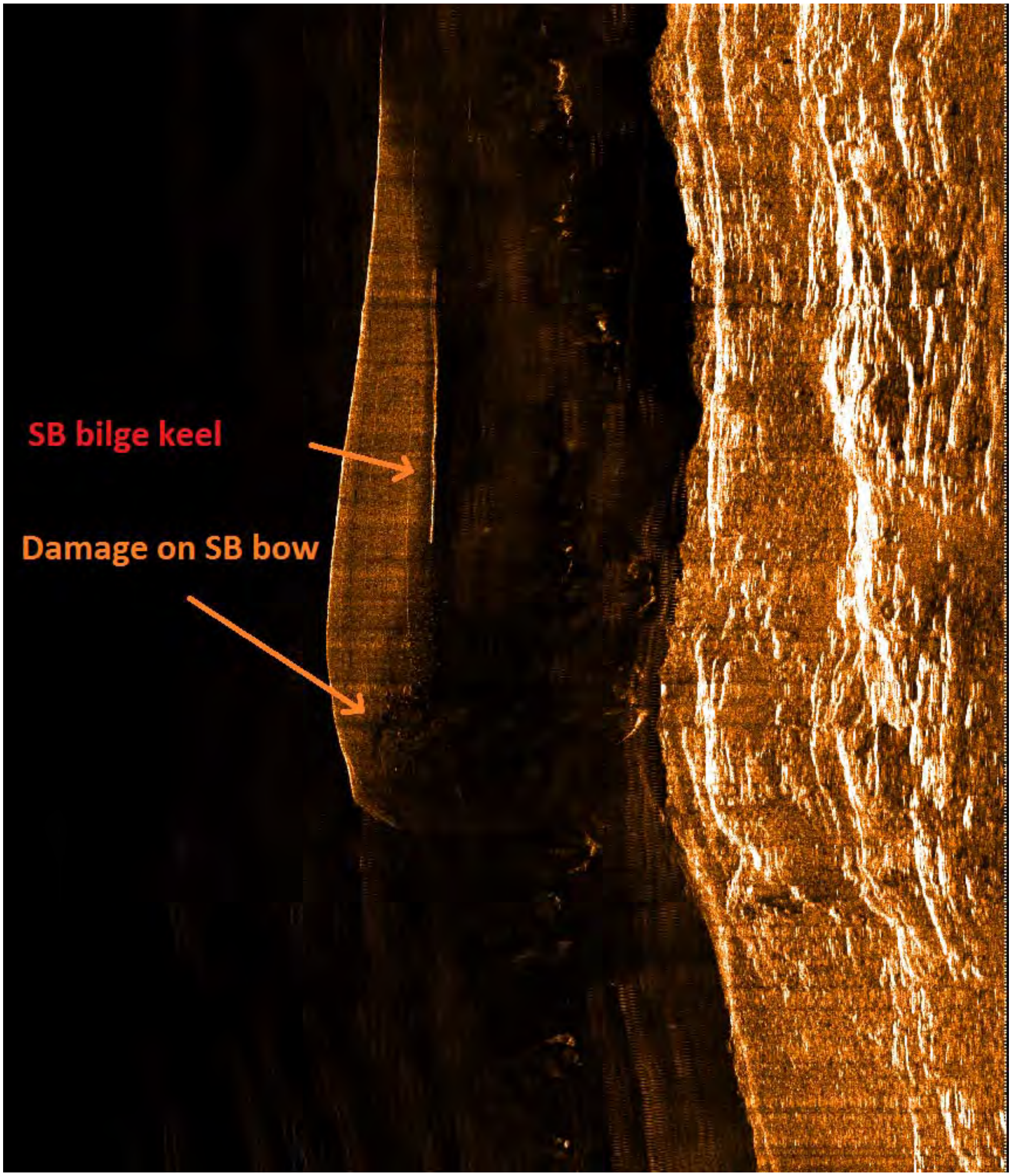


Figure 17: Damage SB bow

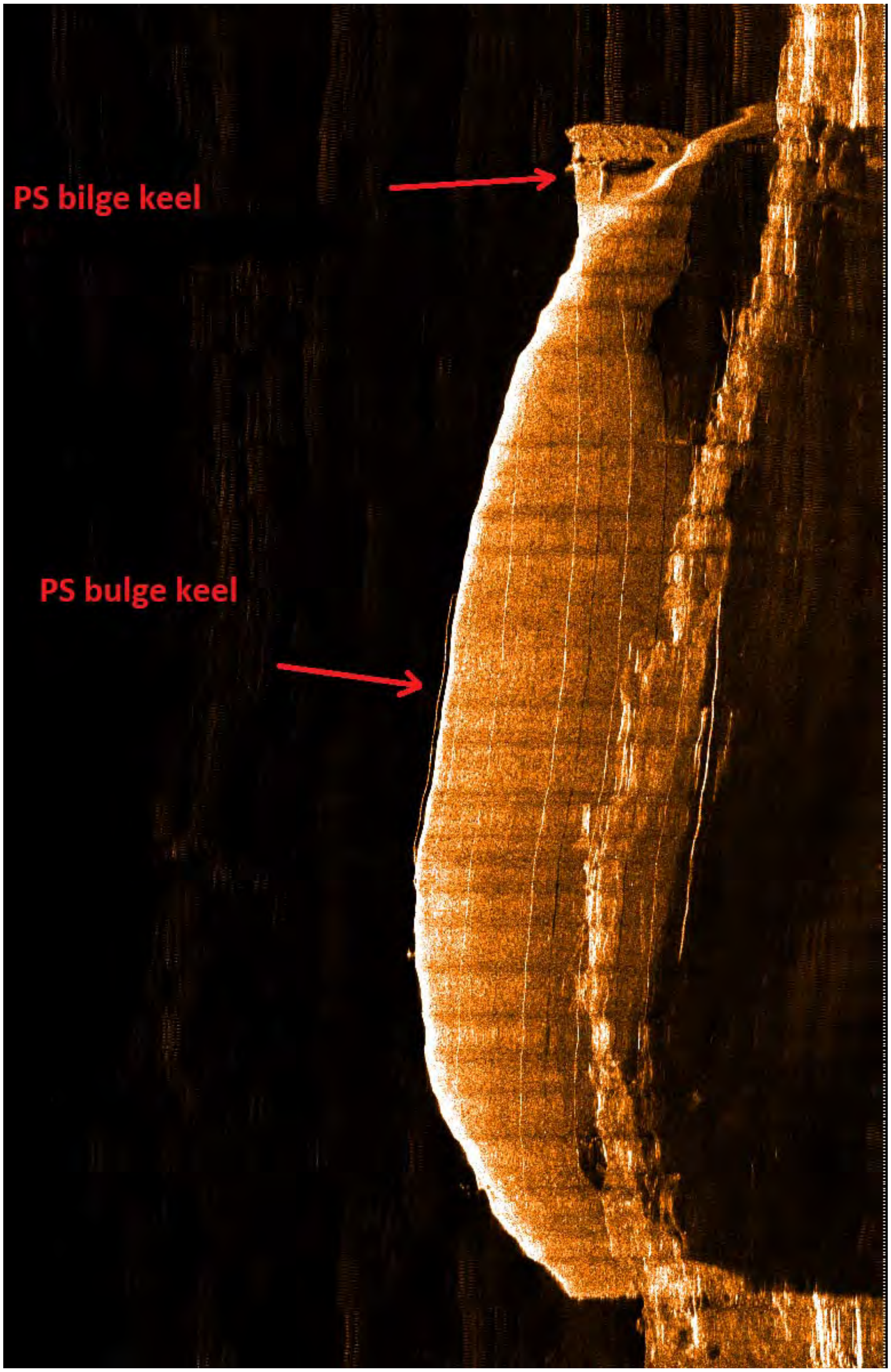
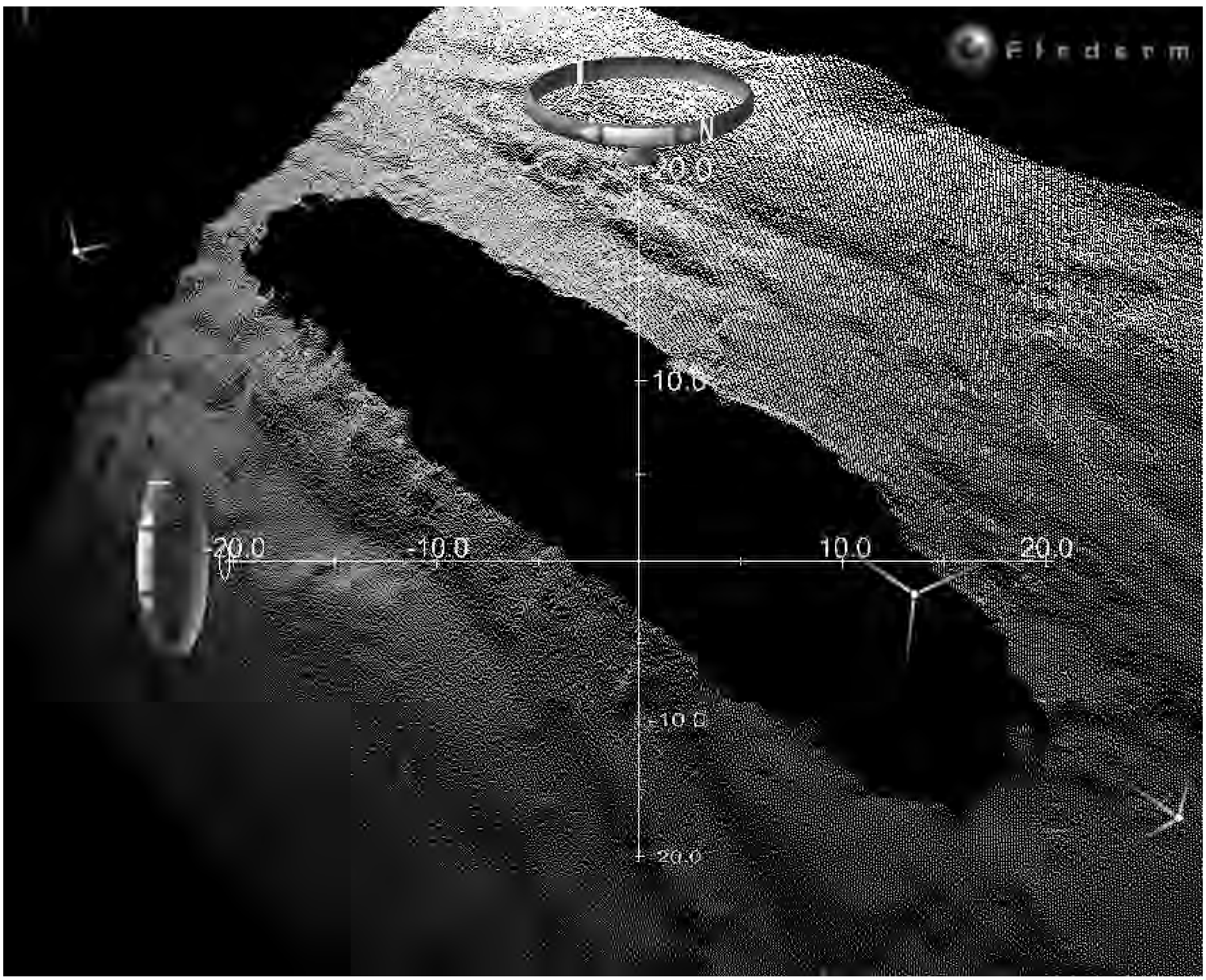


Figure 18: Rudder and propeller

11 Unexploded Ordnance

According to the dive video underneath the wreck, ammunition .30 and .50 caliber and 500 lbs aerial bombs were found. Neither one shows up on the survey on the areas around the vessel. It is possible that the ammunition has sunk into the mud. The aerial bombs are to big for this and would show.



12 Conclusions

12.1 Multibeam survey

The multibeam data recorded at the Zalinski wreck site was of very good quality. Although not much detail is to be seen on the wreck, the 3D images show very high resolution. The images show that wreck is reasonably intact. It is positioned with the bottom of the vessel facing upwards and is lying on a very steep rocky slope. Not much of the accommodation remains as the wreck is resting at its deck level. The crushed accommodation is probably the reason why the wreck is lying stable at such a steep slope.

The main damage which probably made the vessel sink can be found on the portside bow. The hull is ripped open from the bow up to the bilge keel. This is the location of the most forward cargo hold.

Combining the survey data with a theoretical model based on the general arrangement of the vessel proofed to be a difficult, time consuming but usefull process. Several areas on the wreck are identified as possibly damaged. Although dive inspections would have to be executed to make final conclusions, one can say that the following fuel tanks might be damaged:

- Starboard Tank 1
- Portside Tank 1
- Portside Tank 2
- Forepeak tank
- Starboard mid tank

The stern of the wreck shows no signs of damage or deformation. The rudder and the 4 blade propeller are intact. The starboard bilge keel seems to be intact while the portside bulge is damaged towards the bow. This might be caused by the grounding of the vessel.

12.2 Sidescan sonar survey

The sidescan images are of good quality. The position of the Zalinski on a very steep slope makes it difficult to produce a good overview of the wreck site. The sidescan sonar proofed to be a good tool to confirm specific details and damaged areas on the wreck. The damaged areas on the vessel that were confirmed with the sidescan sonar are the following:

- Starboard Tank 1
- Portside Tank 1
- Portside Tank 2

The possible damage at the forepeak tank and the starboard mid tank were not seen on the sidescan sonar. The damaged surfaces are vertical which makes them very difficult to survey.

13 ANNEX Times & Dates Survey log

Tuesday, 18 January 2011

	Departure Survey Equipment warehouse in The Netherlands

Monday, 31 January 2011

16:00	Meeting with Don Rodden & Jamie Toxopeus in Vancouver
17:30	Departure Survey Team from Amsterdam to Vancouver
18:25	Arrival Survey Team in Vancouver

Tuesday, 1 February 2011

8:10	Departure Survey team from Vancouver to Prince Rupert
10:07	Arrival Survey team Prince Rupert
13:00	Inspection Survey vessel m.v. Royal Pride in the Port of Prince Rupert
15:00	Survey Equipment custom cleared in Edmonton
16:00	Survey Equipment underway by road to Prince Rupert
	Inspection Survey pole in ware house Canadian Coast guard
	Discussions & meeting between Coastguard and Survey team

Wednesday, 2 February 2011

8:00	Arrival m.v. Royal Pride at warehouse Canadian Coast Guard Prince Rupert
10:00	Test fitting survey pole on
14:15	Arrival Survey Equipment in warehouse Coastguard Prince Rupert
	Outfitting survey pole with Multi Beam
	Outfitting survey vessel with winch & wiring
	Welding of survey winch to the deck
21:00	End of day

Thursday, 3 February 2011

08:00-15:10	Outfitting & tweeking Survey Equipment
15:10-17:10	Making calibration & test runs of mulitbeam in the port of Prince Rupert
17:10	Departure to Cove Inlet (near Zalinksy) with Royal Pride

Friday, 4 February 2011

3:15	Royal Pride at anchor Cove Inlet
7:00	Toolbox meeting Survey Team
8:15	Survey pole in the water
8:30	Coastguard alongside with RIB to pick up survey crew to set up reference station
9:15	Reference station setup on small island in Grenville channel
10:10	Coastguard RIB back alongside Royal Pride
10:30	Anchor up
10:30-11:30	Making calibration runs
11:30-16:10	Making multi runs over the Zalinksy
16:45	Anchor for the night
16:10-21:00	Processing & analyzing multibeam data

Saturday, 5 February 2011

7:00	Toolbox meeting Survey Team
7:45	Check up on reference station
8:05	Anchor up
8:36	Sidescan towfish in the water
10:50	Completer Sidescan Sonar survey
10:50-12:50	Making multi beam runs
12:50	Coastguard RIB alongside to collect crew to collect reference station
13:30	Underway to Prince Rupert
21:00	Arrival at Canadian Coastguard base Prince Rupert

Sunday, 6 February 2011

08:00-12:00	Unloading m.v. Royal Pride and packing survey equipment for pickup
17:00	Arrival survey team at pick up area to airport
	Informed all flights cancelled to Vancouver

Monday, 7 February 2011

10:00	Departure Survey Team Prince Rupert
11:21	Arrival Survey Team Vancouver
20:25	Earliest departure Survey team to Amsterdam
	Survey Equipment picked up

Tuesday, 8 February 2011

15:00	Earliest arrival Survey Team in Amsterdam

Wednesday, 9 February 2011

15:00	Survey Equipment arrived Vancouver airport
20:25	Survey airborn

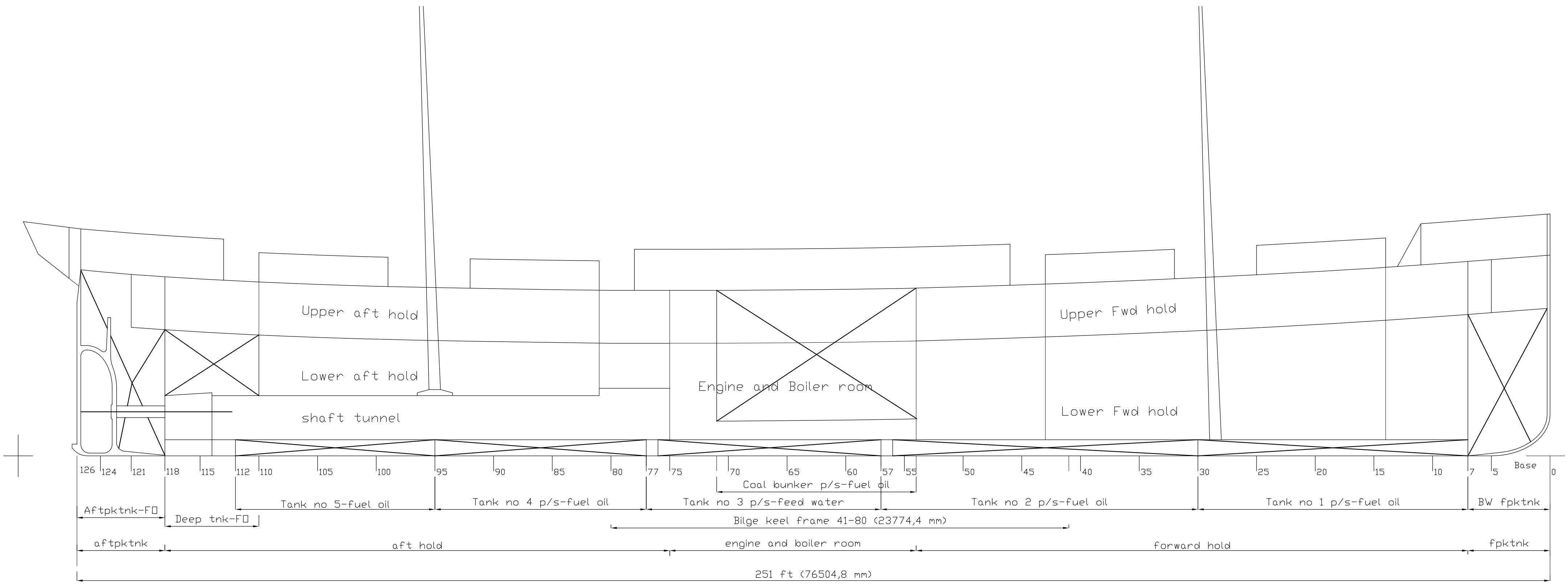
Thursday, 10 February 2011

15:00	Survey Equipment arrived Amsterdam Airport

Friday, 11 February 2011

14:00	Survey Equipment custom cleared and arrived in Warehouse

14 ANNEX General Arrangement



Upper aft hold
Lower aft hold
shaft tunnel
Engine and Boiler room
Upper Fwd hold
Lower Fwd hold
126 124 121 118 115 112 110 105 100 95 90 85 80 77 75 70 65 60 57 55 50 45 40 35 30 25 20 15 10 7 5 Base 0
Coal bunker p/s-fuel oil
Aftpktnk-F□
Tank no 5-fuel oil
Tank no 4 p/s-fuel oil
Tank no 3 p/s-feed water
Tank no 2 p/s-fuel oil
Tank no 1 p/s-fuel oil
BW fpktnk
Deep tnk-F□
Bilge keel frame 41-80 (23774,4 mm)
aftpktnk
aft hold
engine and boiler room
forward hold
fpktnk
251 ft (76504,8 mm)

15 ANNEX Tank Capacity Ace ships

CARGO CAPACITIES	GRAIN IN BULK CU.FT.	BALES. CU. FT.
HOLD NO 1	87611	83318
HOLD NO. 2	72900	67573
HATCHES	6552	6073
FORECASTLE		
TOTAL	167,063.	156,964.

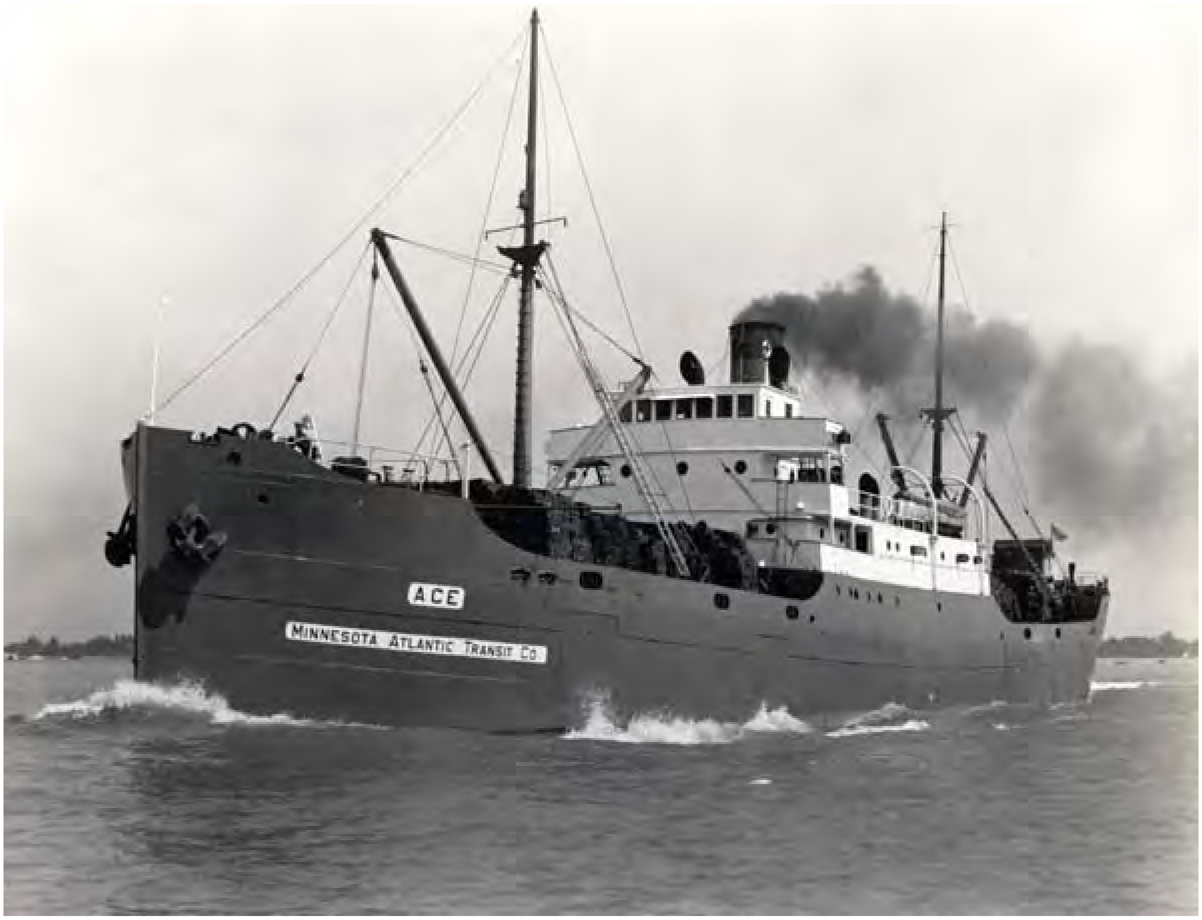
WATER BALLAST.	CU. FT.	TONS.
FORE PEAK	2520	78·0
TANK Nº 1	2057	63·0
TANK Nº 2	5250	163·0
TANK Nº 3	4200	130·0
TANK Nº 4.	3402	105·0
TANK Nº 5	1505	52·0
AFT PEAK	3284	101·0
TOTAL.	22218.	692.0

COAL BUNKER CAPACITY.	CU. FEET.	TONS AT 45 CU. FT.
BUNKER ON P. SIDE BELOW M.D.S	5223	116
" " S " " " "	5078	113
COAL CHUTE	525	13
TOTAL	10826.	242

16 ANNEX Historical pictures


Historical Collections of the Great Lakes
Bowling Green State University
ACE

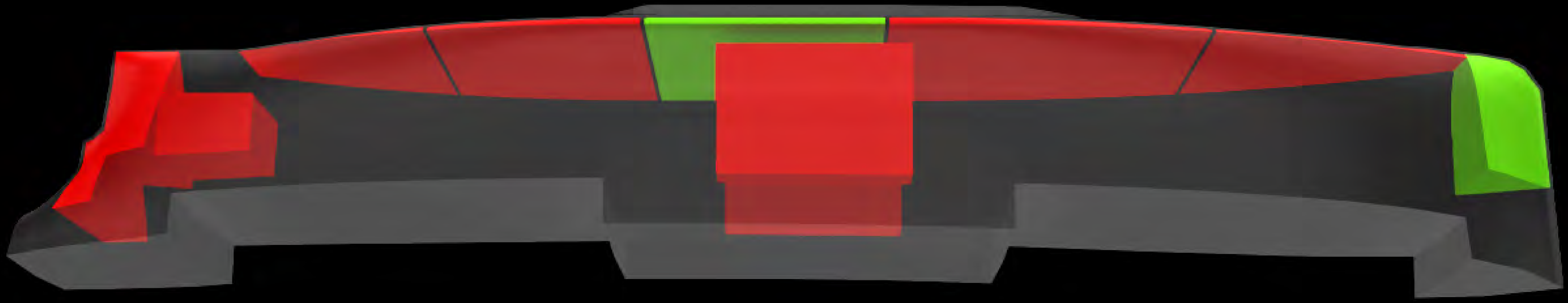

ACE

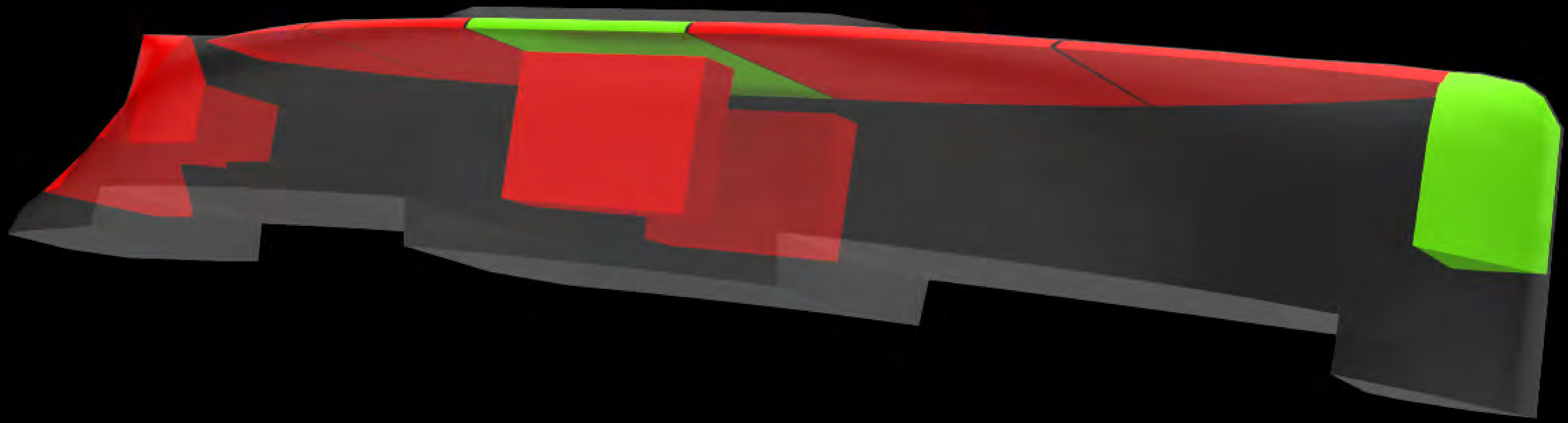

ACE
MINNESOTA ATLANTIC TRANSIT CO

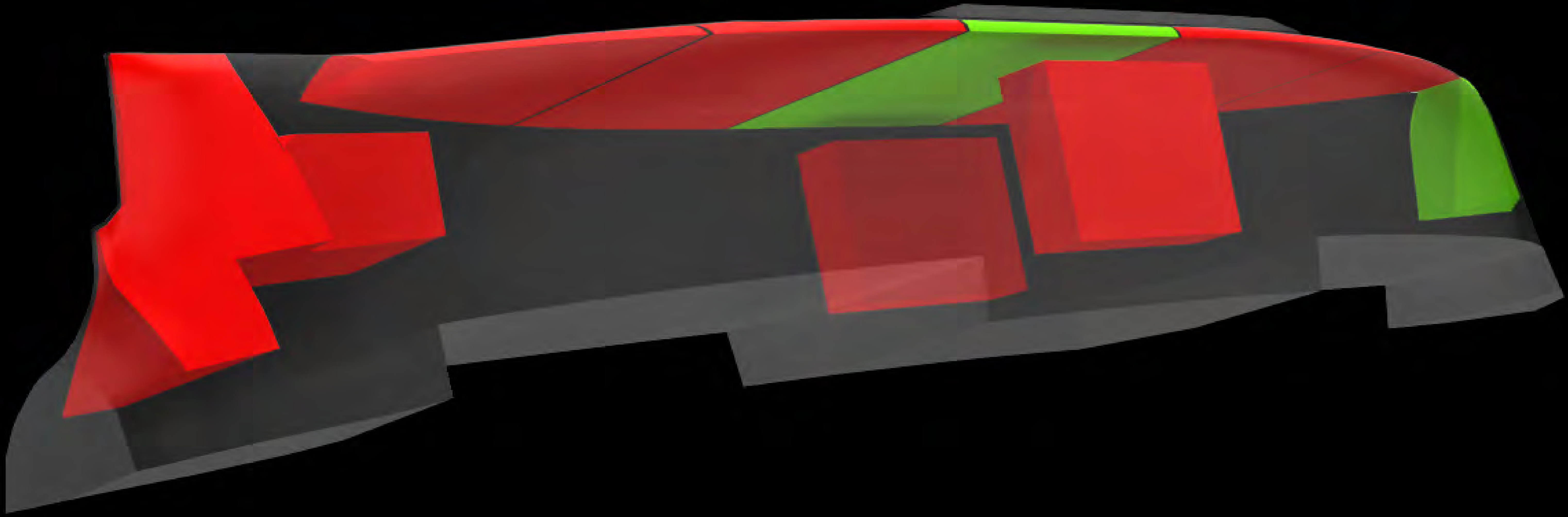

TRANSPORTATION CORPS U.S. ARMY
BRIG. GEN. M. G. ZALINSKI

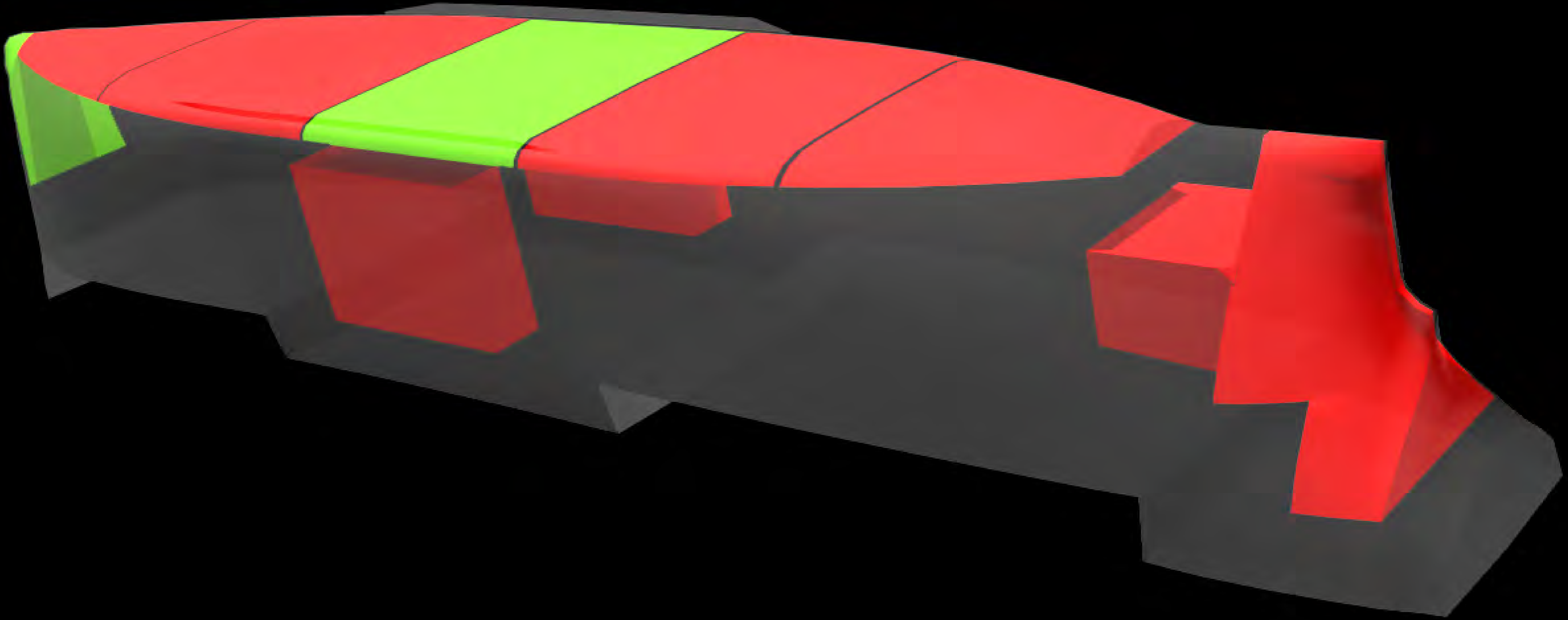
17 ANNEX 3D Digital terrain model & Image overlay (digital)

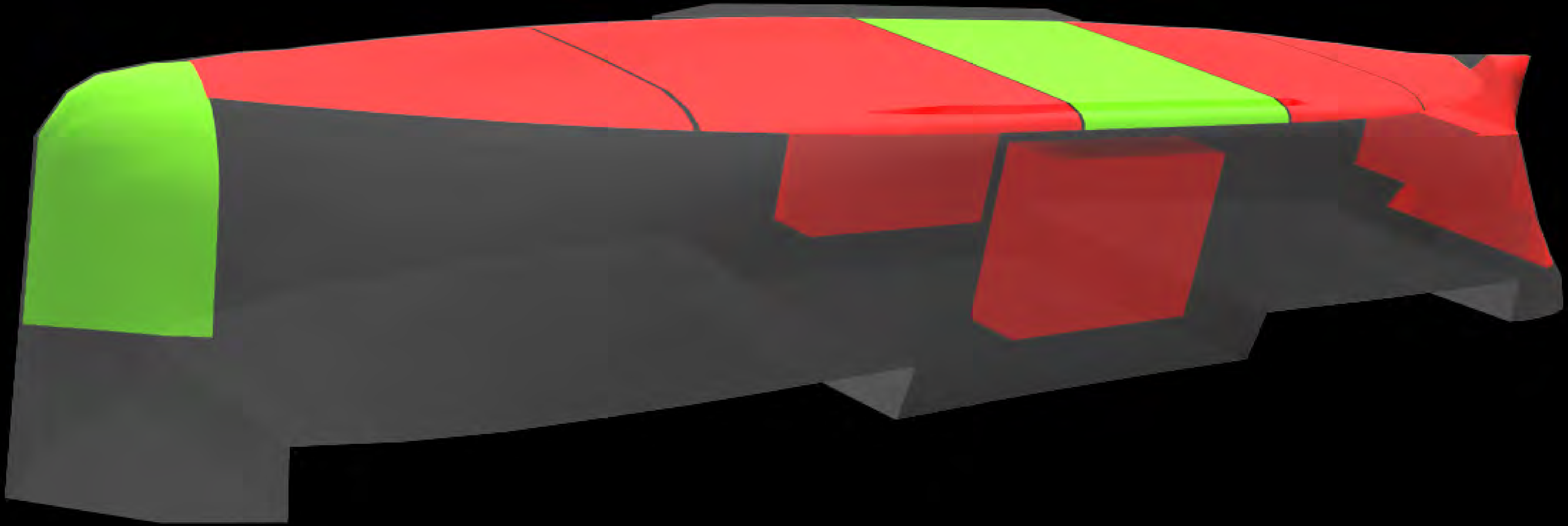
18 ANNEX 3D views of General Zalinksy models

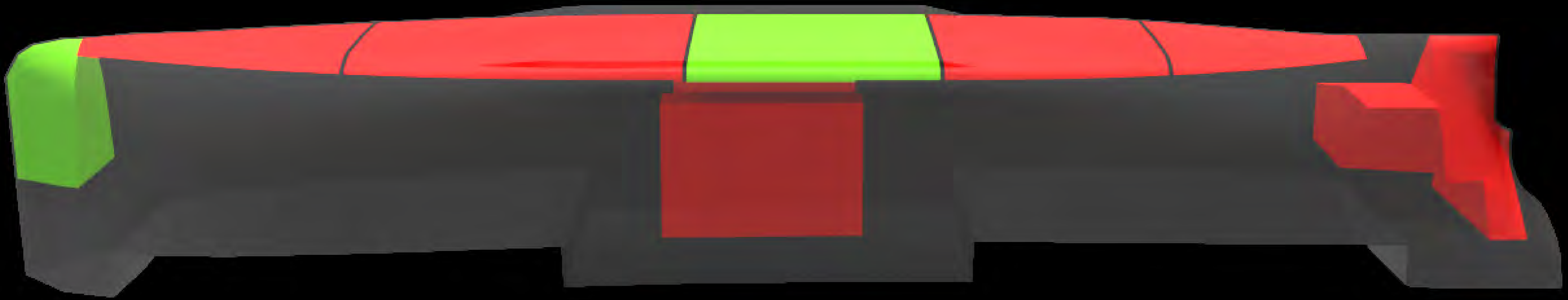






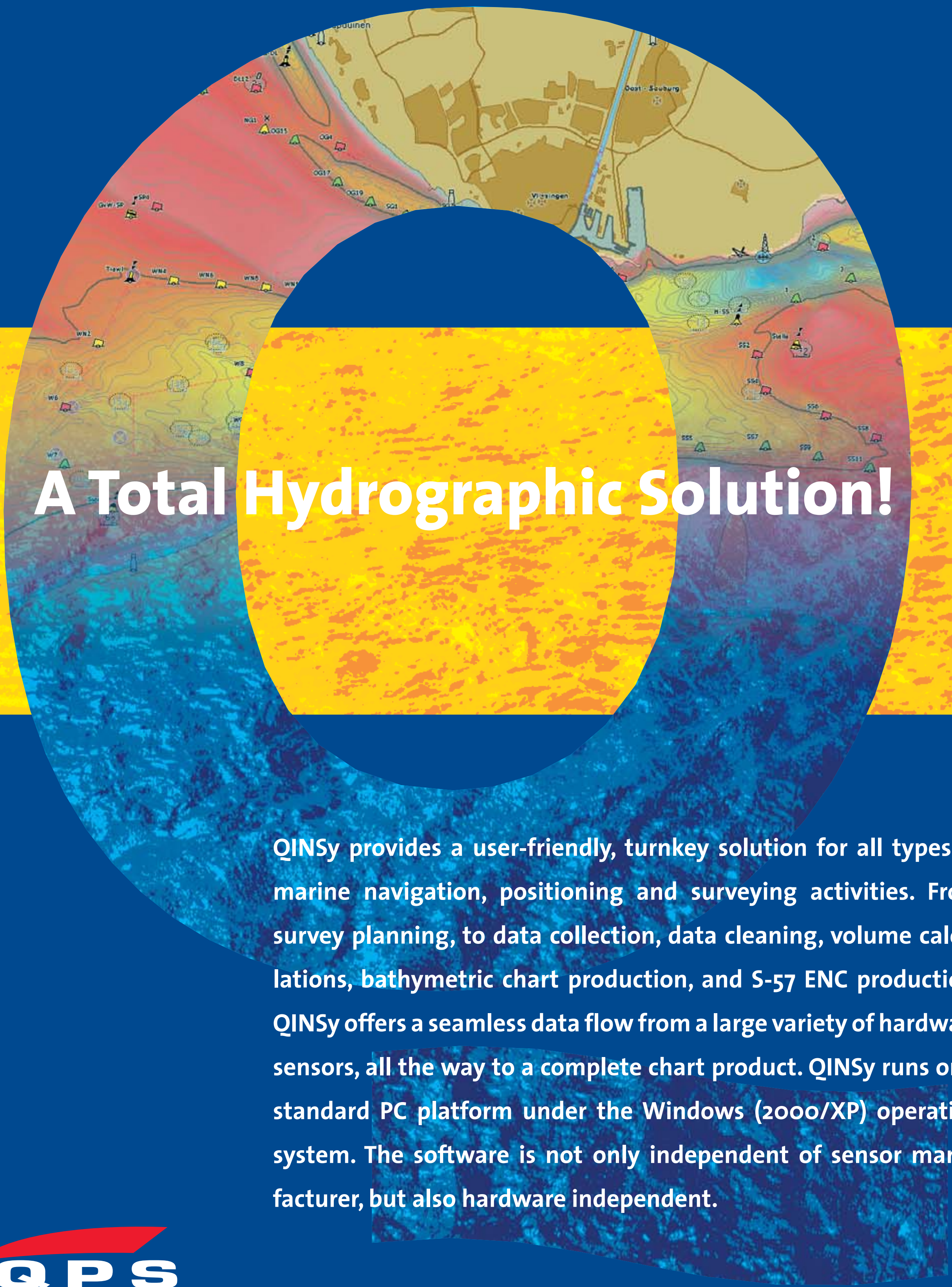






19 ANNEX Specifications survey equipment

QINSy



A Total Hydrographic Solution!

QINSy provides a user-friendly, turnkey solution for all types of marine navigation, positioning and surveying activities. From survey planning, to data collection, data cleaning, volume calculations, bathymetric chart production, and S-57 ENC production, QINSy offers a seamless data flow from a large variety of hardware sensors, all the way to a complete chart product. QINSy runs on a standard PC platform under the Windows (2000/XP) operating system. The software is not only independent of sensor manufacturer, but also hardware independent.

QPS

Extreme Versatility - Survey Applications

From scraping diamonds off the seabed to dumping rock on pipelines, from anchor handling to bathymetric or Side Scan Sonar surveys, its modular design and inherent flexibility makes QINSy perfect for a wide variety of applications. For example, it can be configured to perform:

- Hydrographic and Oceanographic Surveys
- Offshore Pipeline Inspection and Pipe-laying
- Marine Construction including Offshore Oil and Gas
- Dredge Monitoring and Support
- ROV and AUV Tracking and Data Collection
- Barge, Tug and Fleet Management
- Bathymetric Chart Production, Cross Section Creation, and Volume Calculation
- S-57 ENC Production

Since its launch in 1996, QINSy has become the standard in marine surveying, bathymetric chart production and ENC production.

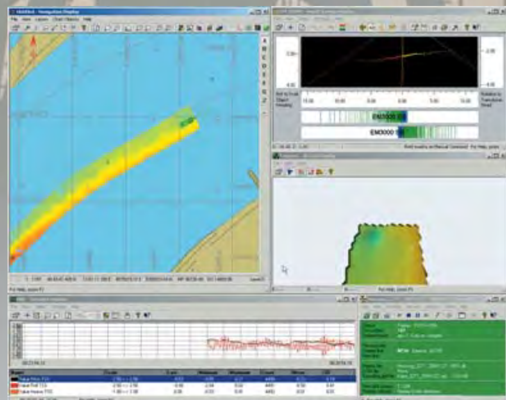
Extremely Large Sounding Grids

The key technology developed by QPS is based on the collection and presentation of large volumes of navigation and depth data, all in real-time to produce almost final results on-the-fly. A powerful Sounding Grid (SG) is used for on-line presentation and off-line processing.
The SG comprises multiple levels with a different resolution per level based on the quadtree technique. Only the highest resolution level need be defined; all others are produced automatically. The other resolutions (e.g.1m x 1m, 2m x 2m, 4m x 4m, 8m x 8m, etc.) are used for faster display purposes, and also to define the resolution of data exported from the Sounding Grid.
The SG has no boundaries and is therefore unlimited in size! In the Sounding Grid Utility (SGU) the user has only to define the base cell size (highest resolution). Online the first position recorded is used as origin.
Multiple layer support allows simultaneous storage of different data types to different layers. For example, multibeam data is stored in one layer, side scan sonar data to another, magnetometer data to a third layer and singlebeam data, pipe tracker data, dredger production value and/or any other system to additional layers in the same SG. During on-line navigation, displaying a combination of two layers is possible. This allows for draping side scan sonar data over multibeam bathymetric data, or dredge production volumes draped over bathymetric depth, or theoretical profile.

QINSy Survey

QINSy is based on a "no limits" design criterion, benefiting the user in supporting an unlimited numbers of vessels, sensors, computations and displays, and in making modifications and future developments easier and cheaper to achieve The key technologies behind the success of QINSy are based on precise navigation, data acquisition, presentation, storage and processing of large volumes of data all in real-time to produce almost final results on-the-fly.
QINSy Survey is the heart of the QINSy product portfolio. This package is used for Survey Planning, Data Acquisition, Processing and Data Cleaning. Add-on modules extend basic package functionality. Modules include:

- Multibeam support
- Side scan sonar and sub-bottom profiling support
- Dredging support
- DGPS QC functionality
- S-57 ENC update functionality
- Qloud

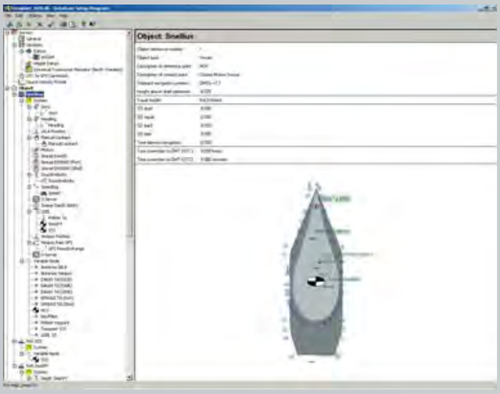


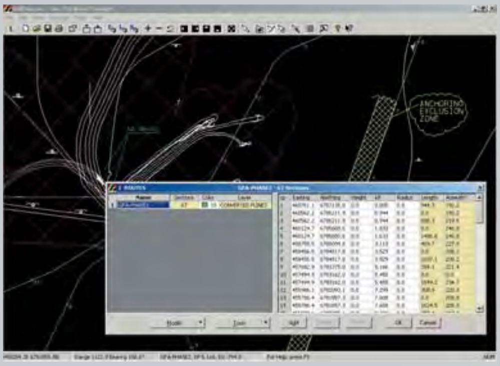
Great Flexibility -Sensor Support

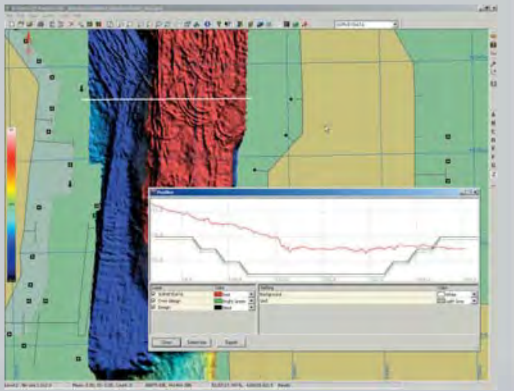
A very large number of sensor I/O drivers have already been developed over the past years. QINSy comes standard with over 600 field-tested I/O drivers, so, in most cases, it handles all your hydrographic related sensors right out of the box. If an existing driver does not meet your need, the ***I/O Driver Utility*** usually lets you write your own driver. Failing that, the modular design of QINSy allows QPS to write additional drivers quickly.
QINSy supports the following sensor types:

- Singlebeam, Multibeam Echosounders and Mechanical Profilers
- Motion Sensors, Gyros and Compasses
- GPS, DGPS, RTK and Total Stations
- Side Scan Sonar, Sub Bottom Profiler and Magnetometer
- Dredge Monitoring, Auto Pilot and DP Systems
- USBL and LBL systems
- ARPA and AIS functionality
- Generic Sensors (analog, weather, rpm, environmental)

The *Console* is your starting point in QINSy Survey. It makes navigation through the program suite very intuitive at each phase of the project. You are guided through the various program modules designed specifically for survey planning, data collection, data processing and chart production. The *Program Manager* provides a complete overview of project status at each phase.







The ***Line Database Manager*** is a comprehensive toolbox for survey planning, allowing the surveyor to manually define, automatically generate and/or import from ASCII and DXF files, the following line types:

- Targets and Symbols
- Single Lines
- Survey Grids
- Routes
- Wing Lines
- Cross Lines

Data can also be exported to:

- ASCII
- DXF

The Line Data Manager works interactively in real-time with the Online Navigation Display where points, lines and routes can be generated right in the Display during data acquisition.

Comprehensive Survey Planning

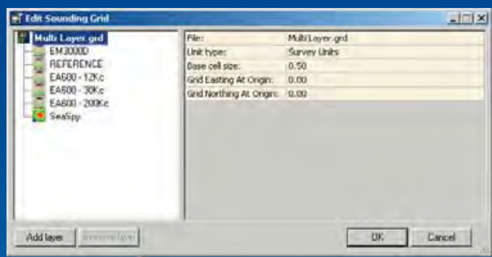
Created at the planning stage with the *Setup* program, a *Template Database* contains all survey configuration parameters pertinent to the project. QINSy supports most of the World's datums and projections (including predefined US State Plane System coordinate systems), multiple units and geoidal models used world-wide. The template contains vessel shapes, administrative information, as well as vessel offsets and I/O parameters. It is a complete reflection of your current survey set up and fully editable to kick-start your next project.

Background Display

Drawing files generated from CAD programs often contain more recent and more accurate information than electronic navigation charts. QINSy allows import of DXF, DWG and PRO files. To ensure speedy refresh rates of real-time displays, DXF and DWG files are converted with the *DXF Converter* at the planning phase. These binary files are displayed as an overlay to S-57 ENC charts in the Navigation Display. QINSy supports both S-57 and *CM93v3 Electronic Navigation Charts*.
The use of satellite images, aerial photo's or any other *geo-referenced bitmaps* in the Navigation Display gives another dimension to your area of interest.

Sounding Grid Utility

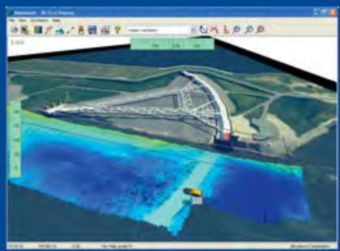
A Sounding Grid to be used during data acquisition is created in survey planning. Grid cell size, the statistics to be recorded per cell and the layers required to store the various data acquired online are all defined at this stage. No boundary definition is needed, and file size is no longer a software issue, the limits now being attributable to processing power, memory available and hard disk capacity.
The Sounding Grid Utility (SGU) is populated online with various data, all of which can be accessed offline in post processing. With support for ENCs, GeoTIFFs, and DXF background files, waypoint planning functionality in the utility is used during survey planning to design survey line layouts.



Real-time Final Results -Data Collection and Output

Raw Sensor Data
All raw sensor data is logged and permanently stored in fast relational databases (*.db) to each of which the entire survey configuration is copied from the template. Raw data can be analyzed and edited using the *Analyse* program, making it ready for the *Replay* program and generation of new results if that is necessary.

Accurate Timing and Ring Buffers
Accurate timing is imperative in many survey situations. QINSy uses a very sophisticated timing routine based on the PPS option (Pulse Per Second) available on almost all GPS receivers. All incoming and outgoing data is accurately time stamped with a UTC time label. Internally, QINSy uses so-called "observation ring buffers", so that data values may be interpolated for the exact moment of the event or ping.

Real-time DTM Production


All computations of position are performed in 3D. In combination with RTK or real-time tide gauges, this means that all depth observations are immediately available in absolute survey datum coordinates. This unique technique is called "on-the-fly DTM Production".
QPS was the first company introducing the "delta heave" method, which means that the quality of the final DTM is no longer affected by heave drift caused by vessel turns.
Gridded point data output to the Sounding Grid is paralleled by an output of ALL soundings to a second file (*.qpd,*.sds,*.fau,*.pts or other). Either reduced or full datasets are available for further DTM processing.

Data Storage
How raw and results data files are split up during acquisition is your choice. Data may be stored on a line-by-line basis, by file size, or by manual intervention. Whatever the method, data are normally stored in several separate databases for convenience in processing.

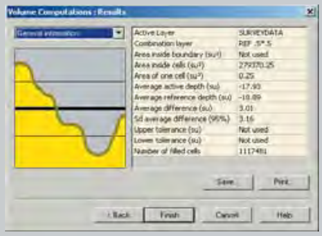
Enhanced Functionality - Getting the best out of your system

Side Scan Sonar

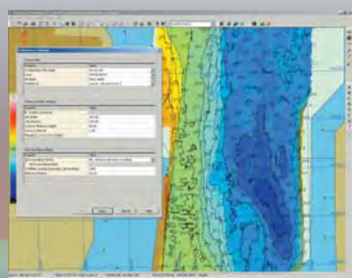

Backscatter from most modern multibeam systems (called 'snippets') and/or true Side Scan Sonar data, is mosaiced in real-time, geo-referencing being performed using a flat bottom assumption, or, better still, using a full 3D terrain model. In addition to the waterfall display, this geo-referenced backscatter data, and/or data from dedicated side scan sonar sensors, is presented in real-time as a mosaic in one layer of the multi-layered sounding grid, itself one of the layers in the multi-layered Navigation Display. QINSy offers advanced real-time SSS target detection, meaning that SSS processing time is cut down to almost zero. A dedicated SSS data viewer supports loading, viewing and performing target detection is just seconds.

Eventing
Used in many survey operations like pipe-laying, pipeline inspection, and buoy tendering for example, ***Eventing*** is a powerful feature in QINSy. Completely user-configurable, all events, and classes of events are defined in planning. Using the resultant Event Tablet online, events are easily generated with a single mouse click, with each event log stored in real-time.

Use of Multi Layer Sounding Grid
For multibeam surveys, "gridding" is the predominant data reduction method. However, achieved reductions usually mean a loss of resolution. In QINSy a regular multi-level gridding method is used. Based on the minimum cell size, 5 additional grids are generated on-the-fly. Grid file size is no longer an issue, since there is no limit to the number of grid cells. If the minimum cell size is selected to be 1x1 meter, then the following grid levels are automatically generated; 2 x 2, 4 x 4, 8 x 8, 16 x 16, 64 x 64 being the overview level.
The method used in QINSy ensures faster update of navigation and 3D displays (only show the resolution which fits to the viewing scale and screen resolution), smoother contours using larger cell size without loosing data and provide the user direct access to various resolution levels without the need of replaying the survey data.

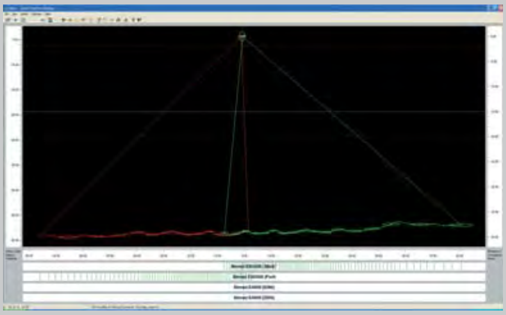


Beside the availability of multiple properties per cell such as mean value, minimum value, maximum value, value count, standard deviation etc, the user has access to create multiple layers into the same sounding grid. Data from multiple sensors can be recorded into the same sounding grid, at the same time, but on different layers. The user can toggle easily between the different layers and/or can set up multiple navigation displays showing different Sounding Grid layers. It is also possible to combine two layers, allowing the user to view, for example, Side Scan Sonar data draped over the multibeam echo sounder data in real time!
Sun illumination of the sounding grid layer opens the eyes of the user. Small items and difficult to find pipelines suddenly show up when using the colored sun illumination option on your data.

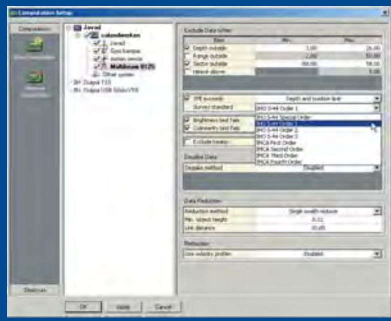


In post processing the recorded data can be viewed and edited using the special developed sounding grid utility, the user has the ability to perform;
- Improved Volume calculation between two layers with or without tolerance levels (Over dredge design);
- Quick cross profiles through Sounding Grid;
- GeoTIFF images can be exported for use by QINSy online, or by 3rd party software;
- Depth contours and spot soundings can be generated and exported to both S-57 ENC and DXF;
- Combining several layers (draping);
- Waypoint and single line planning;
- Overlay of DXF and PRO files;
- Sun Illumination and shade exaggeration to highlight seabed features;
- Full control over statistical information regarding data recorded in each layer;
- Manual editing of sounding grid entries

The Multilayer Sounding Grid can be used not only for bathymetry, but also for SSS Mosaicing, magnetometerdata, seabed classifications, dredging production etc.

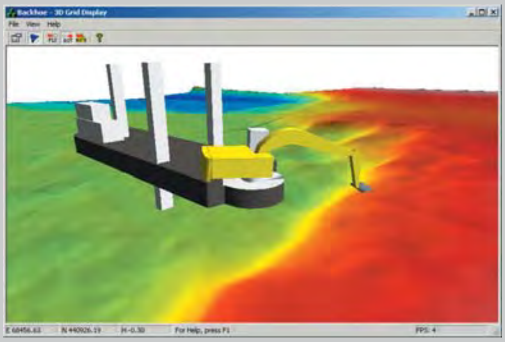


Total Propagated Error



So that our users could qualify their data in real-time according to IHO S-44 provisions, QPS implemented TPE (Total Propagated Error) functionality, sometimes referred to as 'error budget'. The TPE of a point is a measure of the accuracy to be expected for that point, when all relevant error sources are taken into account.

For example, the TPE of a computed DTM point on the seafloor, comprises the propagation of the individual errors of the echosounder system, motion reference system, sound velocity system, positioning system, heading system, ships offset system and other systems which contribute to the total propagated error.



Advanced Dredging Functionality

Advanced dredging functionality to control and monitor dredging operations in real-time is available as an add-on module to QINSy Survey. The available sensors on board the dredger are integrated in QINSy and used to calculate not only the exact location of the dredge tool, but also perform TDS and production calculations.

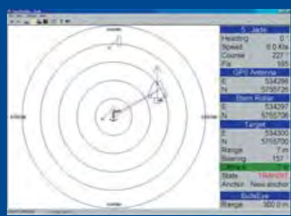
The Profile Display is used to visualize in real-time, the dredge tool relative to the various DTM layers containing, for example, current survey depth and theoretical profile. The dredge tool object shape (dredge head, bucket, etc.) is viewable from different angles. The Profile display shows the distance between the object and each of the DTM layers with an update rate of up to 10 times per second.

The entire dredge process can also be monitored using the powerful real-time 3D display, employing multiple perspectives from different camera views. Hopper dredgers, cutter dredgers, backhoes and other dredging tools are seen moving in a 3D environment at the same time that the dredged depths are updating the multi-layer sounding grid, all in real-time.

Anchor Handling &Barge Monitoring

Advanced functionality is used to monitor tugboats relative to a rig/barge and the local environment from one location. Data transmission between rig/barge and tugboats ensures anchor pattern exchange between the vessels. A special Tugboat Display program, requiring no surveyor, runs on each tugboat, providing continuous geographic context of position and target information for the required task.

For ease of use, anchor locations can all be positioned by click and drag of the mouse on the navigation display!



OBC-Seismic support

QINSy provides full support for the execution, monitoring and controlling of the OBC Seismic operation on both the recording, and the shooting, vessel.

On the shooting vessel, QINSy provides general navigation, positioning of the on-bottom streamer by means of a USBL system, and interpolation of hydrophone group positions.

On board of the airgun vessel, QINSy is used for general navigation, triggering of airguns at predefined positions (including user defined preload) and positioning of airguns.

QINSy can export and merge navigation records from the shooting and recording vessel using the UKOOA P1/90 format.

Quality Management System

A Quality Management System (QMS) provides both surveyor and processor with full insight into the calibrations performed, and the settings used, from start of survey (calibrations) to end (validation of data).

The following main features are recorded in the QMS:

- Start and end time of each survey line;
- Sound velocity profile;
- Alerts such as roll, pitch outside limits;
- Data cleaning tools and de-spiking used both on-line and off-line (Validator)
- Position check through Establishment Fix routine;
- Gyro and Height calibration;
- Tidal stations used in the Tide Processor;
- Comparison between a (single beam) reference line and another (single beam)survey line;
- Statistical information of data recorded in Sounding Grid

Speedy Processing - Data Validation, Editing, Calibration and Tide Reduction

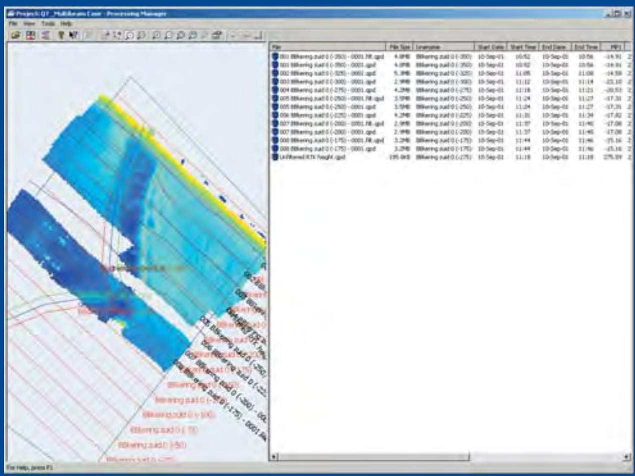
Data Cleaning

Employing various real-time data cleaning tools and correcting for motion, tide and refraction, QINSy is designed to output almost final results at the time of data acquisition. Moreover, the many quality assurance functions equip the surveyor with tools to qualify results data in real-time. Starting with a cleaner, and thinner, data set effectively reduces time spent in post processing.

The QINSy Processing Manager

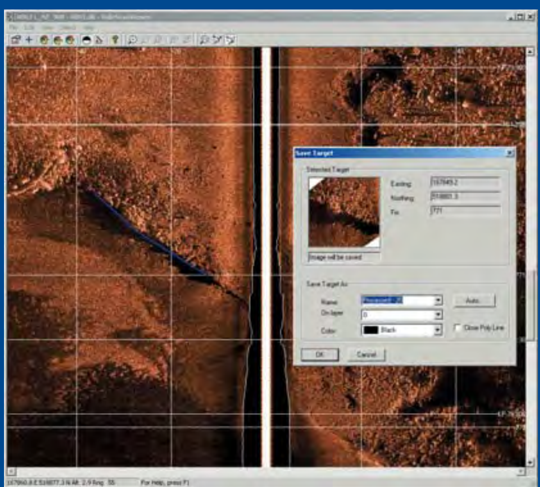
All XYZ files are listed in the QINSy Processing Manager, tabulated against a history of processes performed on each file. This provides a complete overview of the project processing status. Processing programs are launched from the Processing Manager:

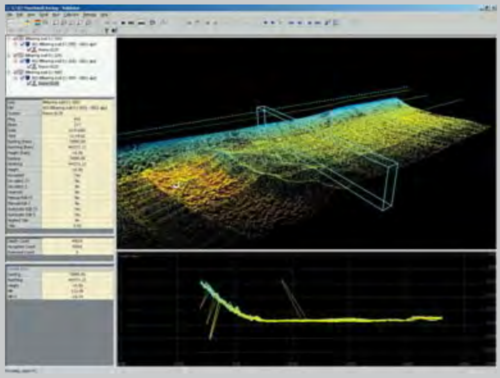
- The Tide Definition and Processing utility supports various methods for tidal reduction.
- The Validator supports both manual and automated data cleaning including advanced 3D splined surface cleaning.



Powerful Side Scan Sonar Functionality

Side Scan Sonar data is viewed and processed with the Side Scan Sonar Viewer Program . It offers the same look and feel as the waterfall SSS Display used during data acquisition. Powerful target detection tools allow you to export targets and geo-referenced bitmaps to the QINSy Mapping database to provide a complete targets overview.



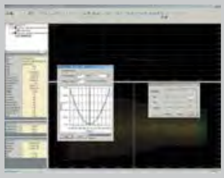


The QINSy Validator

Multibeam exploded the volume of point data and created data handling challenges both in the acquisition and processing phases. The QINSy Validator is probably the most powerful data-cleaning program on the market today. Inherently fast data access allows loading and viewing of millions of points in just seconds. The Validator has 4 different views, 3 of which can be opened simultaneously:

- Plan View
- Profile View
- Cross View
- 3D View

Multibeam Calibration



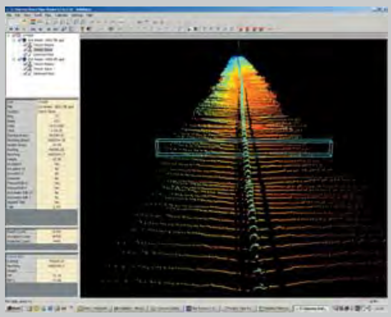
Multibeam calibration is interactive, and very easy, providing both manual and auto-calibration options. These tools calibrate for errors in:

- Roll
- Pith
- Yaw

Singlebeam and Multibeam Data Editing

Editing of singlebeam, or multibeam, has never been easier. A variety of automated cleaning algorithms are available:

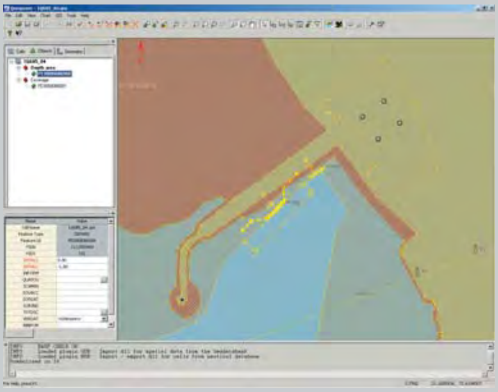
- Apply On-line Flags
- Adaptive Clipping
- Butterworth
- Multiply/Shift
- Clip Below /Clip Above
- Median and Mean
- 3D Spline Surface Despiker



The Validator adds fully automated pipeline detection features, such as:

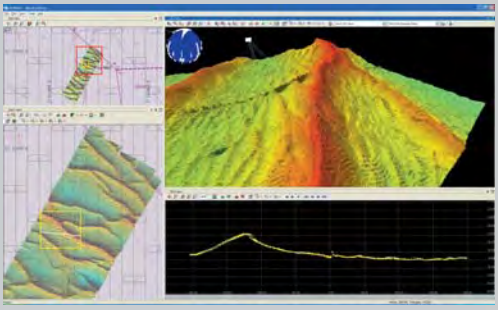
- Top of Pipe Detection
- Bottom of Trench
- Mean Seabed Detection

Eye-Catching Products
DTMs, Profiles, Volumes, Chart Production and ENC 's



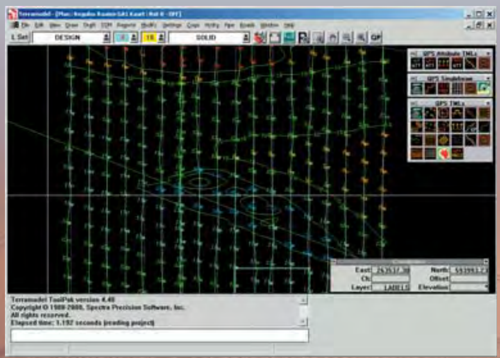
QINSy EPP-57

The QINSy ENC Production Platform 57 distinguishes itself from other approaches to electronic chart production platforms by its efficient way of data storage, and through the principle of semi-static base cells that are easily updated with highly dynamic bathymetric data. The bathymetric data is generated directly from the digital terrain model, itself updated constantly with new hydrographic survey data. This principle allows for a completely updated ENC cell ready for distribution within hours of survey completion. Since the system is built on open Oracle technology, it can be adapted and extended under the user's own supervision. The user makes use of the newly developed ENC Qomposer, an ENC editor for conversion of data to and from the EPP-57.



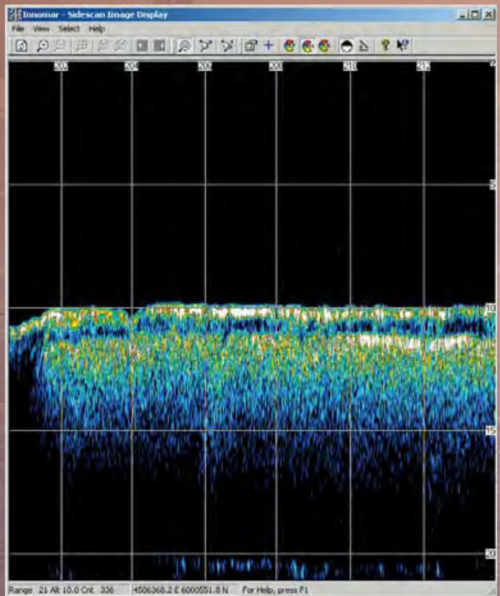
Qloud

Newer generations of multibeam echsounders dramatically increased the number of depth soundings, both in terms of number of beams, and in ping rate. Dual-head multibeam systems providing up to 20,000 depth measurements per second have become a reality.
Despite this increase in data volumes, the QPS philosophy of producing almost final soundings in real-time remains effective. However, as always, there is still a need to validate the online results using off-line tools. The difference is that these ever increasing data volumes require a new offline data analyze tool, ready for the future.
Our new 3D data cleaning tool, called Qloud, is specially developed to handle extremely large areas of multibeam data and to perform statistical data cleaning using parameters such as Total Propagated Error (TPE) in algorithms like CUBE (developed by the Ocean Mapping Group at the University of New Hampshire) and the surface spline filter.
Qloud allows very fast scrolling through the data and instantaneous focusing on the problem areas.



QINSy Mapping

QINSy Mapping is a powerful processing package for the marine surveying and construction industry. With its many task-specific macro utilities, the software performs all necessary calculations quickly and easily, produces plots, generates contours and spot soundings, and calculates precise volumes in just seconds. A dedicated add-on module is available to export depth contours and spot soundings directly into IHO S57 ENC vector chart format. The QINSy 3D Tool generates not only great looking images of the seafloor, but also realistic fly-through video clips ideal for client presentations.



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Web: www.qps.nl
E-mail: sales@qps.nl

Receivers

OEMV-3

Multi-Frequency GNSS Receiver Provides Expandable Functionality Without Compromising Performance

Benefits

Proven OEMV® technology

Integrated L-band supports OmniSTAR® and CDGPS correction services

Application Programming Interface (API) reduces hardware requirements and system complexity

Features

High random vibration performance for demanding applications

L1, L2, L2C and L5 signal tracking

Increased satellite availability with GLONASS tracking

RT-2™, RT-20®, ALIGN and GL1DE firmware options

If you require more information about our receivers, visit novatel.com/products/receivers.htm

Designed With Future in Mind

The OEMV-3 is designed to track the GPS L1, L2, L2C, and L5 signals, as well as GLONASS L1 and L2. With integrated L-band onboard and multi-frequency tracking loadable through firmware upgrades, the OEMV-3 receiver eliminates the need for future hardware changes.

Enhanced, Flexible Firmware Features

The OEMV-3 provides decimetre level pass-to-pass accuracy with NovAtel's GL1DE® technology. NovAtel's optional AdVance® RTK technology is available for centimetre-level real-time position accuracy. ALIGN® technology is available for heading and position outputs.

Superior Hardware Design

L-band capability is onboard the OEMV-3, eliminating the need for additional hardware. OEMV-3 hardware is designed to be flexible for a wide range of applications. It supports a higher input voltage range, and its high-vibe TCXO design allows for better shock and acceleration performance.

Customization With The API

The Application Programming Interface (API) functionality is available on the OEMV-3. Using a recommended compiler with the API library, an application can be developed in a standard C/C++ environment to run directly from the receiver platform; eliminating system hardware, reducing development time and resulting in faster time to market.

NovAtel

novatel.com

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1-800-NOVATEL (U.S. and Canada)
or 403-295-4900

Europe 44-1993-85-24-36

SE Asia and Australia 61-400-833-601

OEMV-3

Performance[1]

Channel Configuration
14 GPS L1, 14 GPS L2, 6 GPS L5
12 GLONASS L1, 12 GLONASS L2
2 SBAS
1 L-band

Horizontal Position Accuracy (RMS)

Single Point L1	1.5 m
Single Point L1/L2	1.2 m
SBAS[2]	0.6 m
CDGPS[2]	0.6 m
DGPS	0.4 m
OmniSTAR[2]	
VBS	0.6 m
XP	0.15 m
HP	0.1 m
RT-20[3]	0.2 m
RT-2	1 cm+1 ppm

Measurement Precision (RMS)

	GPS	GLO
L1 C/A Code	4 cm	15 cm
L1 Carrier Phase	0.5 mm	1.5 mm
L2 P(Y) Code	8 cm	8 cm
L2 Carrier Phase	1.0 mm	1.5 mm

Data Rate

Measurements	20 Hz
Position	20 Hz

Time to First Fix

Cold Start[4]	60 s
Hot Start[5]	35 s

Signal Reacquisition

L1	0.5 s (typical)
L2	1.0 s (typical)

Time Accuracy[6] **20 ns RMS**

Velocity Accuracy **0.03 m/s RMS**

Velocity[7] **515 m/s**

Physical and Electrical

Dimensions **85 x 125 x 13 mm**

Weight **75 g**

Power

Input Voltage	+4.5 to +18.0 VDC
Power Consumption	2.1 W (GPS only)
	2.8 W (GPS & GLONASS)

Antenna LNA Power Output

Output Voltage	5 V nominal
Maximum Current	100 mA

Communication Ports

- 1 RS-232 or RS-422 capable of 300 to 921,600 bps
- 1 RS-232 or LV-TTL capable of 300 to 921,600 bps
- 1 LVTTL capable of 300 to 230,400 bps
- 2 CAN Bus[8] serial ports capable of 1 Mbps
- 1 USB port capable of 5 Mbps

Input/Output Connectors

Main	40-pin dual row male header
Antenna Input	MMCX female
External Oscillator Input	MMCX female
CAN	14-pin dual row male header

Environmental

Temperature	
Operating	-40°C to +85°C
Storage	-45°C to +95°C
Humidity	95% non-condensing
Random Vibe	MIL-STD 810F (7.7 g RMS)[9]
	MIL-STD 810F tailored (19.4 g RMS)[10]
Sine Vibe	SAEJ1211 (4 g)
Bump/Shock	IEC 68-2-27 (30 g)

Options and Accessories

- ProPak-V3
- DL-V3
- 50 Hz output rate[11]
- GPS-700 series antennas
- ANT series antennas
- RF Cables–5, 10 and 30 m lengths
- 20g random vibe variant[10]

Additional Firmware Features

- RT-20
- ALIGN
- GL1DE
- RT-2
- OmniSTAR HP, XP, VBS, G2
- CDGPS
- L5 signal tracking
- Pseudo Range/Delta-Phase (PDP) Positioning

Additional Features

- Common, field-upgradeable software for all OEMV family receivers
- Auxiliary strobe signals, including a configurable PPS output for time synchronization and mark inputs
- Outputs to drive external LEDs
- External oscillator input

Version 4a -Specifications subject to change without notice

Printed in Canada. D09557

OEMV-3 February 2010

For the most recent details of this product:
novatel.com/Documents/Papers/OEMV-3.pdf

1 Typical values. Performance specifications subject to GPS system characteristics, US DOD operational degradation, ionospheric and tropospheric conditions, satellite geometry, baseline length, multipath effects and the presence of intentional or unintentional interference sources.
2 GPS only.
3 Expected accuracy after static convergence.
4 Typical value. No almanac or ephemerides and no approximate position or time.
5 Typical value. Almanac and recent ephemerides saved and approximate position and time entered.
6 Time accuracy does not include biases due to RF or antenna delay.
7 Export licensing restricts operation to a maximum of 515 metres per second.
8 User application software required.
9 Minimum integrity test.
10 Only available with high vibe hardware variant.
11 OmniSTAR and GLONASS not supported at 50 Hz.

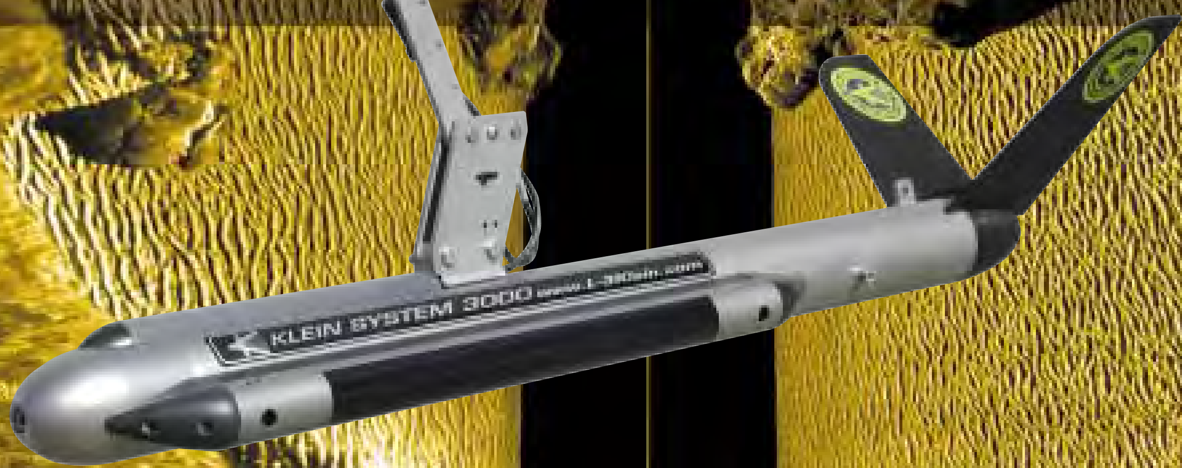
RoHS COMPLIANT

L3 communications
Klein Associates, Inc.

Klein System 3000 Digital Side Scan Sonar

"The difference is in the Image!"

The System 3000 System presents the latest technology in digital side scan sonar imaging. The simultaneous dual frequency operation is based on new transducer designs, as well as the high resolution circuitry recently developed for the Klein multi-beam focused sonar. The System 3000 performance and price is directed to the commercial, institutional and governmental markets.



- ADVANCED SIGNAL PROCESSING AND TRANSDUCERS PRODUCE SUPERIOR IMAGERY
- COST EFFECTIVE, AFFORDABLE
- PC BASED OPERATION WITH SONARPRO® SOFTWARE, DEDICATED TO KLEIN SONARS
- SMALL, LIGHTWEIGHT, AND SIMPLE DESIGNS - EASY TO RUN AND MAINTAIN
- EASILY ADAPTED TO ROVS, AND CUSTOM TOWFISH
- MEETS IHO & NOAA SURVEY SPECIFICATIONS @ 10 KNOTS

Side Scan Sonar Division

Navigation Division

Waterside Security and Surveillance Division

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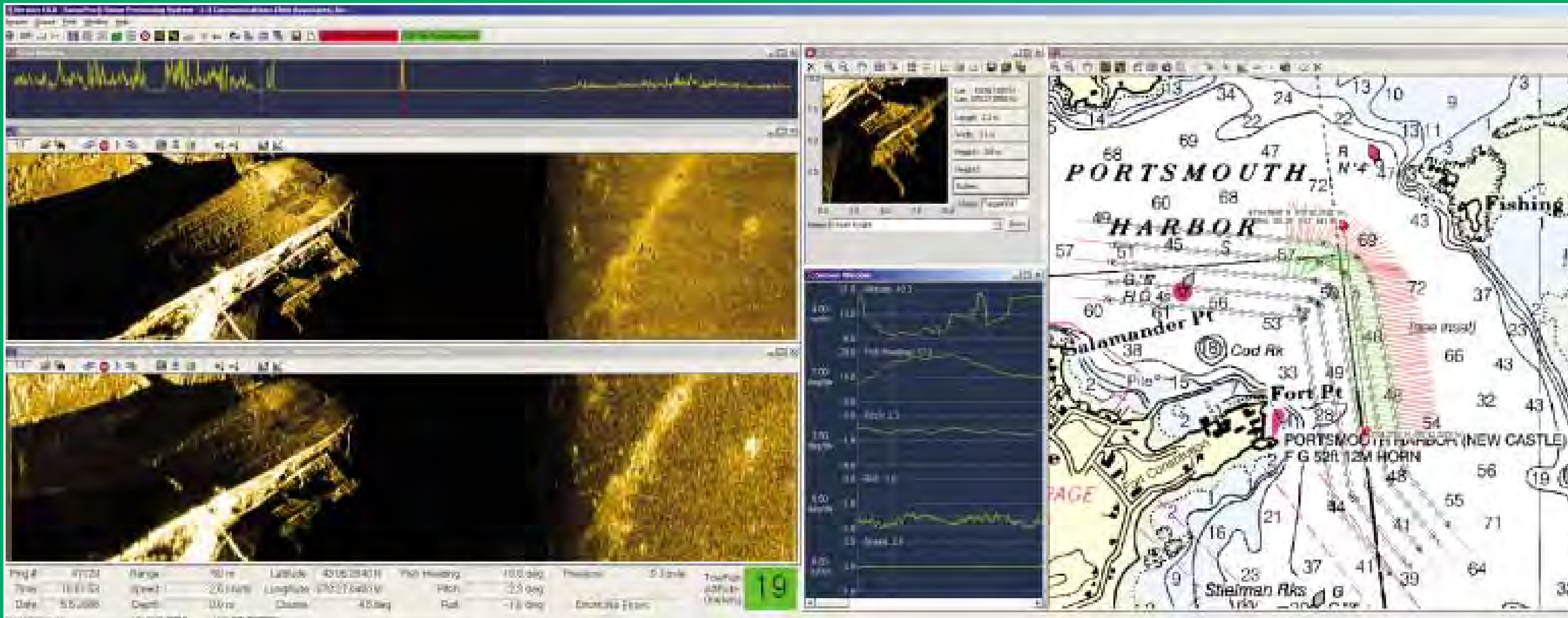


SPECIFICATIONS

Towfish

Frequencies	100 kHz (132 kHz +/- 1% act.), 500 kHz (445 kHz, +/- 1% act.)
Transmission Pulse	Tone Burst, operator selectable from 25 to 400 μsecs. **Independent pulse controls for each frequency**
Beams	Horizontal - 0.7 deg. @ 100 kHz, 0.21 deg. @ 500 kHz Vertical - 40 deg.
Beam Tilt	5, 10,15, 20, 25 degrees down, adjustable
Range Scales	15 settings - 25 to 1,000 meters
Maximum Range	600 meters @ 100 kHz; 150 meters @ 500 kHz
Depth Rating	1,500 meters standard, other options available
Construction	Stainless Steel
Size	122 cm long, 8.9 cm diameter
Weight	29 kg in air
Standard Sensors	Roll, pitch, heading
Options	Magnetometer, pressure, Acoustic Positioning

Transceiver Processor Unit (TPU)

Operating System	vxWorks® with custom application
Basic Hardware	19-inch rack or table mount, VME bus structure
Outputs	100 Base-Tx, Ethernet LAN
Navigation Input	NMEA 0183
Power	120 watts @ 120/240 VAC, 50/60 Hz (Includes Towfish)
Interfacing	Interfaces to all major Sonar Data Processors
Options	Splash proof packaging option available

Klein Sonar Workstation

Basic Operating System	Windows NT®, 2000®, or equivalent
Sonar Software	SonarPro®
Data Format	SDF or XTF or both selectable
Data Storage	Internal hard drive, CD/DVD-RW
Hardware	Industrial PC
Options	Optional waterproof laptops

Tow Cables

Klein offers a selection of coaxial, Kevlar® reinforced, lightweight cables, double armored steel cables, and interfaces to fiber optic cables. All cables come fully terminated at the towfish end.

L3 communications

Klein Associates, Inc.

11 Klein Drive, Salem, N.H. 03079-1249, U.S.A.

Phone: (603) 893-6131 Fax: (603) 893-8807

E-mail: sales@L-3com.com Web site: www.L-3Klein.com

SonarPro® Software

Custom developed software by users and for users of Klein side scan sonar systems operating on Windows NT®, 2000®. Field proven for many years. SonarPro® is a modular package combining ease of use with advanced sonar features.

Basic Modules	Main Program, Data Display, Information, Target Management, Navigation, Data Recording & Playing, and Sensor Display.
Multiple Display Windows	Permits multiple windows to view different features as well as targets in real time or in playback modes. Multi-Windows for sonar channels, navigation, sensors, status monitors, targets, etc.
Survey Design	Quick & easy survey set up with ability to change parameters, set tolerances, monitor actual coverage, and store settings.
Target Management	Independent windows permitting mensuration, logging, comparisons, filing, classification, positioning, time & survey target layers, and feature enhancements. Locates target in navigation window.
Sensor Window	Displays all sensors in several formats (includes some alarms) and responder set up to suit many frequencies and ping rates.
Networking	Permits multiple, real time processing workstations via a LAN including "master and slave" configurations.
"Wizards"	To help operator set up various manual and default parameters.
Data Comparisons Real Time	Target and route comparisons to historical data.

ROVINS

INERTIAL NAVIGATION SYSTEM FOR SUBSEA VEHICLES

ROVINS is a combined survey-grade full featured Inertial Navigation System (INS) for water depths up to 3,000m. Designed specifically for offshore survey and construction works, ROVINS improves the efficiency of all operations where accurate position, heading and attitude are key benefits.

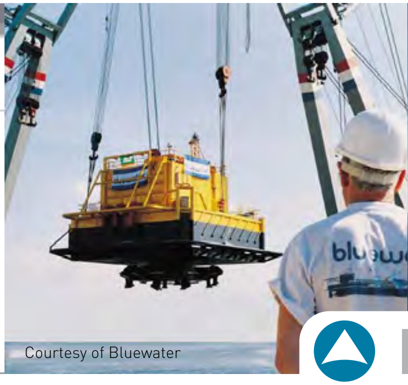
FEATURES

- All-in-one 3D positioning with heading, roll, pitch and heave
- Fiber Optic Gyroscope (FOG), unique strap-down technology
- Multiple aiding options (DVL, USBL, LBL, RAMSES, GPS, depth sensor)
- DVL Ready option available
- RAMSES Synthetic Baseline Positioning System option available
- OCTANS footprint compatible

BENEFITS

- Accurate georeferenced position and attitude for all subsea vehicles at high frequency
- No spinning element hence maintenance free
- Flexible and scalable configuration for all deployment scenarios
- Immediate availability and performance for all vehicles
- Ultimate sub-metric performance using sparse array transponders and on-the-fly calibration
- Immediately compatible

Courtesy of Ifremer


Courtesy of Bluewater

IXSEA

APPLICATIONS • ROV/AUV positioning • Multibeam sonar motion reference • Subsea construction

ROVINS
TECHNICAL SPECIFICATIONS

PERFORMANCE

Position accuracy (1)	
With USBL/LBL	Three times better than USBL/LBL accuracy
With DVL	0.2% of travelled distance
No aiding for 1 min/2 min	1.5 m/6 m
Heading accuracy(2)(3)	
With GPS/USBL/LBL/DVL	0.05 deg secant latitude
Roll and Pitch accuracy(2)	0.01 deg
Heave accuracy	5cm or 5% (Whichever is greater)

OPERATING RANGE / ENVIRONMENT

Operating / Storage Temperature	-20 to 55 °C / -40 to 80 °C
Rotation rate dynamic range	Up to 750 deg/s
Acceleration dynamic range	± 15 g
Heading / Roll / Pitch	0 to +360 deg / ±180 deg / ±90 deg
MTBF (computed/observed)	40,000 hours/80,000 hours
No warm-up effects	
Shock and Vibration proof	

PHYSICAL CHARACTERISTICS

Depth rating (m)	Material	Weight in air/water [kg]	Housing dimensions (Ø x H mm)	Connector	Mounting
3000	Titanium	15/6.2	213 x 374	3 x 12 pin 1 x 19 pin 1 x 26 pin SEACON MINI-CON	6 Ø 6.6 holes
3000 « DVL Ready »	Titanium	32.6/16.3 (WHN300K3,WHN600K3) 29.2/13.6 (WHN1200K3)	255 x 595	3 x 12 pin 1 x 19 pin 1 x 26 pin SEACON MINI-CON	6 Ø 11 holes

INTERFACES

Serial RS232/RS422 port	5 inputs / 5 outputs / 1 configuration port
Ethernet port (4)	UDP / TCP Client / TCP server
Pulse port (5)	3 inputs / 2 outputs
Sensors supported	GPS, USBL, RAMSES, LBL, DVL, DEPTH, CTD/SVP
Intput/Output formats	Industry standards: NMEA0183, ASCII, BINARY
Baud rates	600 bauds to 115.2 kbaud
Data output rate	0.1 Hz to 200 Hz
Power supply	24 VDC
Power consumption	15 W

(1) CEP: 50 % circular Error Probability. DVL aiding position accuracy is dependent on DVL performances.
(2) RMS values
(3) Secant latitude = 1 / cosine latitude
(4) All input /output serial ports are available and can be duplicated on Ethernet ports
(5) Input of GPS PPS pulse for accurate time synchronization of ROVINS

Specifications subject to change without notice

High Resolution Multibeam Systems for:

Hydrography

Offshore

Dredging

Defense

Research

R2Sonic LLC
1503-A Cook Pl.
Santa Barbara
California,
USA 93117

T: 805 967 9192
F: 805 967 8611

www.r2sonic.com

SONIC 2024

Multibeam Echo Sounder

Features:

- 60kHz Wideband Signal Processing
- Focused 0.5° Beam Width
- Selectable Frequencies 200-400kHz
- Selectable Swath Sector 10° to 160°
- System Range to 500m
- Embedded Processor/Controller
- Equiangular or Equidistant Beams
- Roll Stabilization
- Rotate Swath Sector

Applications:

- Hydrographic Survey
- Offshore Site Survey
- Pre & Post Dredge Survey
- Defense & Security
- Marine Research

System Description:

The Sonic 2024 is the world's first proven wideband high resolution shallow water multibeam echo sounder. With proven results and unmatched performance, the Sonic 2024 produces reliable and remarkably clean data with maximum user flexibility through all range settings to 500m.

The unprecedented 60 kHz signal bandwidth offers twice the resolution of any other commercial sonar in both data accuracy and image. With over 20 selectable operating frequencies to chose from 200 to 400 kHz, the user has unparalleled flexibility in trading off resolution and range and controlling interference from other active acoustic systems.

In addition to selectable operating frequencies, the Sonic 2024 provides variable swath coverage selections from 10° to 160° as well as ability to rotate the swath sector. Both the frequency and swath coverage may be selected 'on-the-fly', in real-time during survey operations.

The Sonar consists of the three major components: a compact and lightweight projector, a receiver and a small dry-side Sonar Interface Module (SIM). Third party auxiliary sensors are connected to the SIM. Sonar data is tagged with GPS time.

The sonar operation is controlled from a graphical user interface on a PC or laptop which is typically equipped with navigation, data collection and storage applications software.

The operator sets the sonar parameters in the sonar control window, while depth, imagery and other sensor data are captured and displayed by the applications software.

Commands are transmitted through an Ethernet interface to the Sonar Interface Module. The Sonar Interface Module supplies power to the sonar heads, synchronizes multiple heads, time tags sensor data, and relays data to the applications workstation and commands to the sonar head. The receiver head decodes the sonar commands, triggers the transmit pulse, receives, amplifies, beamforms, bottom detects, packages and transmits the data through the Sonar Interface Module via Ethernet to the control PC.

The compact size, low weight, low power consumption of 50W and elimination of separate topside processors make Sonic 2024 *very well suited* for small survey vessel or ROV/AUV operations.

Sonic 2024 Multi Beam Echo Sounder

Systems Specification:	
Frequency	200kHz-400kHz
Beamwidth, across track	0.5°
Beamwidth, along track	1.0°
Number of beams	256
Swath sector	Up to 160°
Max Range	500m
Pulse Length	10µs-500µs
Pulse Type	Shaped CW
Ping Rate	Up to 60 Hz
Depth rating	100m
Operating Temperature	0°C to 50°C
Storage Temperature	-30°C to 55°C

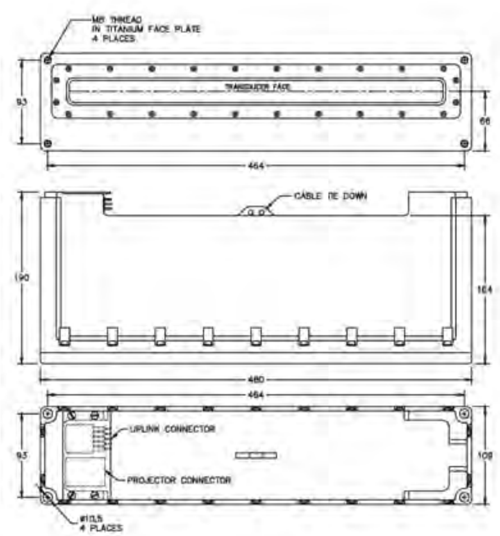
Electrical Interface	
Mains	90-260 VAC, 45-65Hz
Power consumption	<50W
Uplink/Downlink:	10/100/1000Base-T Ethernet
Data interface	10/100/1000Base-T Ethernet
Sync In, Sync out	TTL
GPS	1PPS, RS-232
Auxiliary Sensors	RS-232
Deck cable length	15m

Mechanical:	
Receiver Dim (LWD)	480 x 109 x 190 mm
Receiver Mass	12 kg
Projector Dim (LWD)	273 x 108 x 86 mm
Projector Mass	6 kg
Sonar Interface Module Dim (LWH)	280 x 170 x 60 mm
Sonar Interface Module Mass	2.4 kg

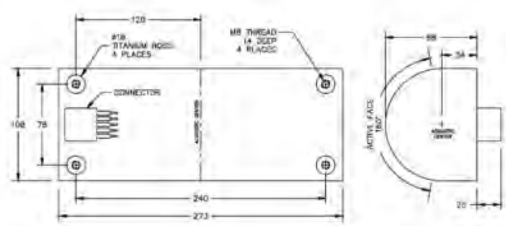
Sonar Options:

Snippets Imagery Output
Switchable Forward Looking Sonar Output
Mounting Frame & Hardware
Over-the-side Pole Mount
Sound Velocity Probe & Profiler
Extended Sonar Deck Cable, 25m or 50m
3000m Depth Immersion Depth

Sonar Interface Module



Sonic 2024 Receiver



Sonic 2022 Projector

High Resolution Multibeam Systems for:

Hydrography

Offshore

Dredging

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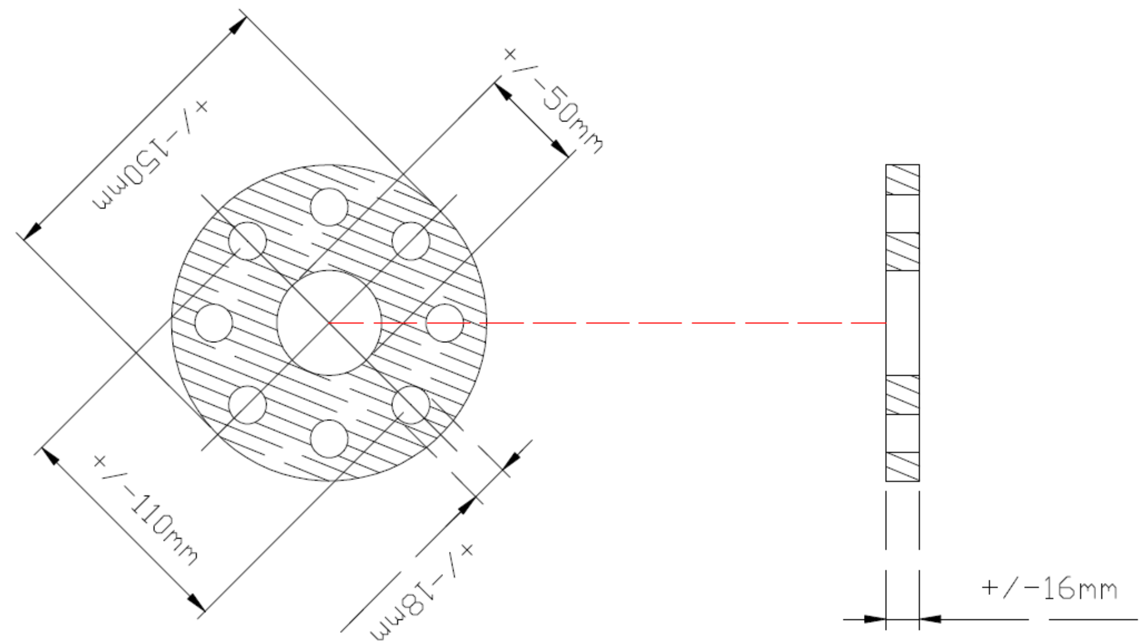

Multibeam flens

DIN 2576-ND10-NW40/48.3-C22.8-7983/Y0

III- MECHANICAL INTERFACE

The Octans 3000 TI is installed using six M6 screws on the base plate of the unit (see figure 2). Alignment is carried out by means of two centering pins located on the bottom plate of the system, enabling precise "point/line" positioning. These pins are located on the Octans 3000 TI centerline as shown by grooves on the base plate of the unit. The mechanical tolerance in the manufacture of Octans bottom plate allows to have 0,01° of accuracy on the centreline of the unit.

NOTE: Useable configuration

All our subsea units are designed as a standard for use on a vertical configuration.
For a subsea use in an horizontal configuration, please *consult IXSEA*.

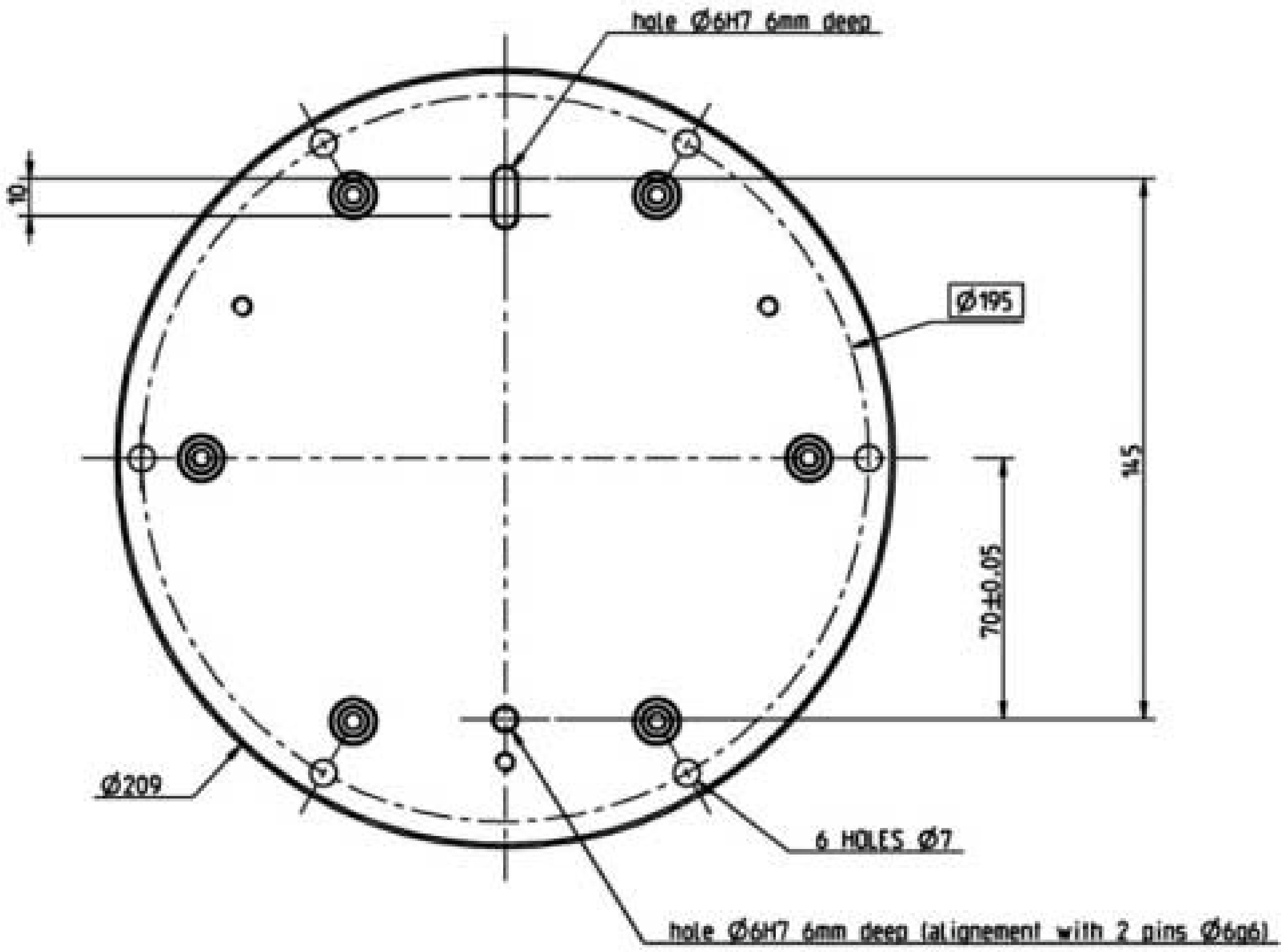

Figure 2 : Subsea Octans bottom plate mounting diagram

High Resolution
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SONIC 2024

Multibeam Echo Sounder

Features:

- 60kHz wideband signal processing
- Selectable frequencies 200-400kHz
- Selectable swath sector 10°to 160°
- Focused 0.5°x 1°beam widths
- 1-500m range
- Embedded processor/controller
- Low weight, volume and power
- Easy installation and operation

Applications:

- Hydrographic Survey
- Offshore Site Survey
- Pre & Post Dredge Survey
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- Marine Research

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The unprecedented 60 kHz signal bandwidth offers twice the resolution of any other commercial sonar in both data accuracy and image, over the entire frequency band.

With over 20x selectable operating frequencies to chose from 200 to 400 kHz, the user has unparalleled flexibility in trading off resolution and range and controlling interference from other active acoustic systems. In addition to selectable operating frequencies, the Sonic 2024 provides variable swath coverage selections from 10°to 160°. Both the frequency and swath coverage may be selected 'on the fly, in real-time during survey operations.

The Sonar consists of the outboard projector and receiver modules, and the inboard Sonar Interface Module (SIM). Third party auxiliary sensors are connected to the SIM. The sonar data is tagged with GPS time.

The sonar operation is controlled from a graphical user interface on a PC or laptop which is typically equipped with navigation, data collection and storage applications software.

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The compact size, low weight, low power consumption <50W and elimination of separate topside processors make Sonic 2024 *very well* suited for small survey vessel or ROV/AUV operations. For AUV integration, apart from the transmit and receive transducer, the only hardware to be housed on the AUV is an interface board the size of a PC/104, Ethernet ports, and the provision of isolated 48V DC power.

The standard data output format is compatible with SeaBat™ 81xx for ease of interface to existing systems. An expanded format will be released as part of a planned firmware update, to incorporate additional features.

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Pulse Type	Shaped CW
Depth rating	100m
Operating Temperature	0℃ to 50℃
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Mains	90-260 VAC, 45-65Hz
Power consumption	<50W
Uplink/Downlink:	10/100/1000Base-T Ethernet
Data interface	10/100/1000Base-T Ethernet
Sync In, Sync out	TTL
GPS	1PPS, RS-232
Auxiliary Sensors	RS-232
Deck cable length	15m

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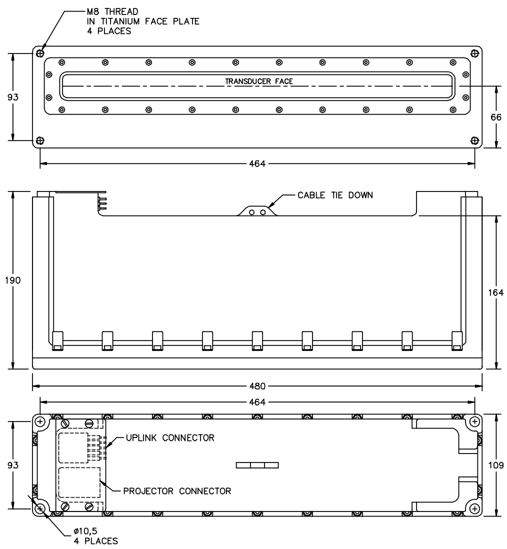
Receiver Mass	12.9 kg
Projector Dim (LWD)	273 x 108 x 86 mm
Projector Mass	3.3 kg
Sonar Interface Module Dim (LWH)	280 x 170 x 60 mm
Sonar Interface Module Mass	2.4 kg

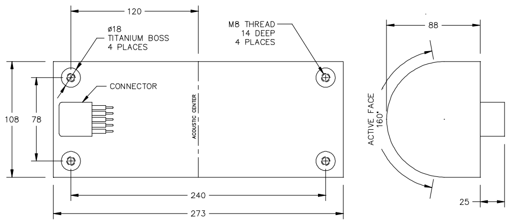
Sonar Options:

Snippets Imagery Output
Switchable Forward Looking Sonar Output
Steerable Transmit Projector w/Multi-ping
Mounting Frame & Hardware
Over-the-side Pole Mount
Sound Velocity Probe & Profiler
Extended Sonar Deck Cable, 25m or 50m
3000m Depth Immersion Depth

Sonar Interface Module



Sonic 2024 Receiver



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