Jan De Nul GROUP

Document title:

METHOD STATEMENT

Project:

PUERTO BOLIVAR MAINTENANCE DREDGING WORKS

Principal:

YILPORT HOLDING INC.

YILPORT TERMINAL OPERATIONS (YILPORTECUA S.A.)

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1 TERMS & DEFINITIONS

1.1 ABBREVIATIONS

Abbreviation	Written in Full
JDN	Jan de Nul Group
TSHD	Trailing Suction Hopper Dredger
CD	Chart Datum
DGPS	Differential Global Positioning System
QHSSE	Quality, Health, Safety, Security and Environment
PMT	Project Management Team
W&T	Wear&Tear

1.2 DEFINITIONS

Term	Meaning
Client	Yilport Terminal Operations (YILPORTECUA S.A.)
Contractor	Flanders Dredging Corporation NV
Project Management Team	All personnel of Flanders Dredging Corporation assigned to a management function in the project organization as defined in the “Organization Chart”
Project	A project is a temporary endeavour with a defined beginning and end (usually time constrained, and often constrained by funding or deliverables), [a] undertaken to meet unique goals and objectives, [b] typically to bring about beneficial change or added value. NOTE: The temporary nature of projects stands in contrast with business as usual (or operations), [c] which are repetitive, permanent, or semi-permanent functional activities to produce products or services.

2 SCOPE OF WORK

2.1 GENERAL

This Method Statement describes the dredging and disposal works related to maintenance dredging in Puerto Bolivar and is presenting the methodology and equipment to execute it. This document is based on the data, drawings or any information for the concerned project presented by YILPORT TERMINAL OPERATIONS (YILPORTECU) S.A.

Puerto Bolivar is the port of the municipality of Machala. Machala is a city in south-west Ecuador. It is the capital of the El Oro Province, and is located near the Gulf of Guayaquil on fertile lowlands. Machala is the eighth-biggest city in the country, and the second-most important port.

Puerto Bolívar is, with its annual production of three million tons bananas, one of the world's largest shipment points for bananas, mainly destined for North America. It has been referred to as the 'Banana Capital of the World'. Puerto Bolívar is also a hub for the shrimp industry.

Figure 1 Geographical location

Yildirim Group's subsidiary Yilport Holding secured the rights to Puerto Bolívar in Machala City, Ecuador in August 2016. In the 50-year concession, Yilport committed to invest USD 750 million in the port, to modernize and expand Puerto Bolivar's port terminal in 5 phases. Upon completion of the five investment phases, the annual container handling capacity will reach 2,5 million TEU.

At the moment, phase I and phase II have been executed successfully in the following periods:

- Phase I: 29th of March 2018 – 31st of May 2018 (stopped for whale season)
- Phase II: April 4th– May 31st 2019 (as year before, stopped due whale season.)

2.2 BRIEF PROJECT SUMMARY

The Work covers the maintenance dredging of the following areas as shown in Figure 2:

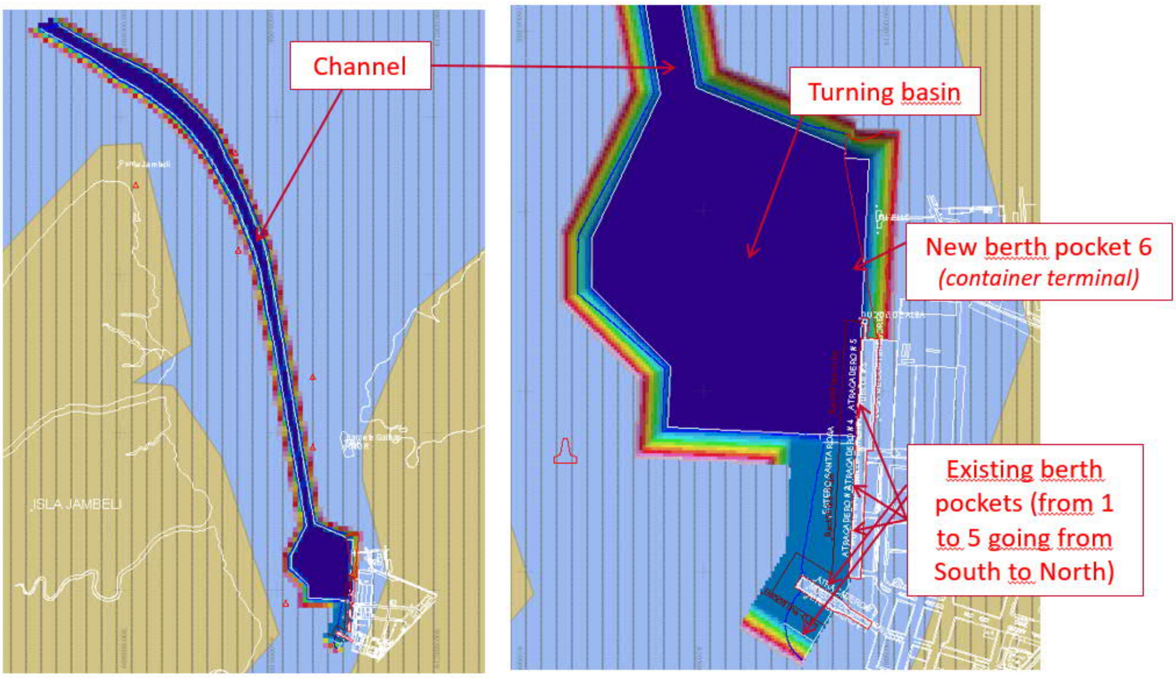

Figure 2 Scope of works

- Puerto Bolivar Access Channel: The design depth is -14.5 mCD (slopes 1:6) with an overdredge of 0.5 mCD.

- Puerto Bolivar Turning Basin: The design depth is -14.5 mCD (slopes 1:6) with an overdredge of 0.5 mCD.

- Puerto Bolivar Berth Pockets 1-4: The design depth is -12.5 mCD (slopes 1:6) with an overdredge of 0.5 mCD.

- Puerto Bolivar Berth Pocket 5: The design depth is -14.5 mCD (slopes 1:6) with an overdredge of 0.5 mCD.

During the different maintenance campaigns, the design to be dredged can vary depending on the requirements of the client at that moment.

Therefore, no volume will be provided in this method statement. Volumes need to be confirmed based on the in-survey, planned shortly before the start of the works, and on the requirements of the client.

According to the available soil investigation information, most of the dredge material will be loose silty clay and soft clay, with a possible presence of loose sand. Local pockets of gas can be expected in the dredging areas.

The work includes the disposal of all dredged material in the designated offshore disposal site (illustrated in Figure 3) located at average 13.6 nm one-way sailing distance from the entrance of the Access Channel.

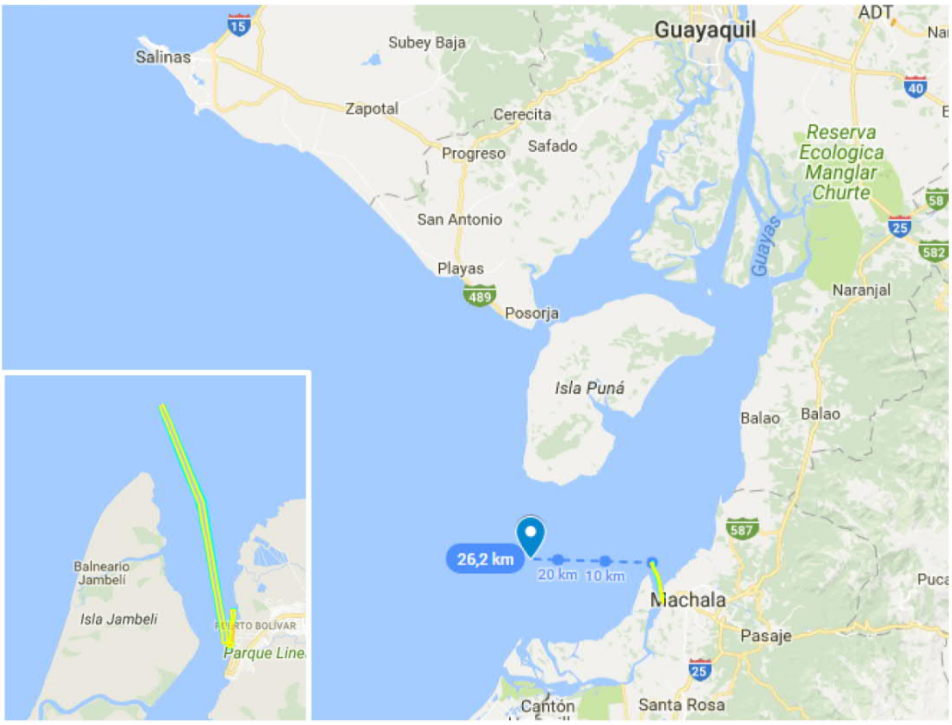

Figure 3 Offshore disposal area

3 PROJECT ORGANIZATION

Reference is made to Project Execution Plan.

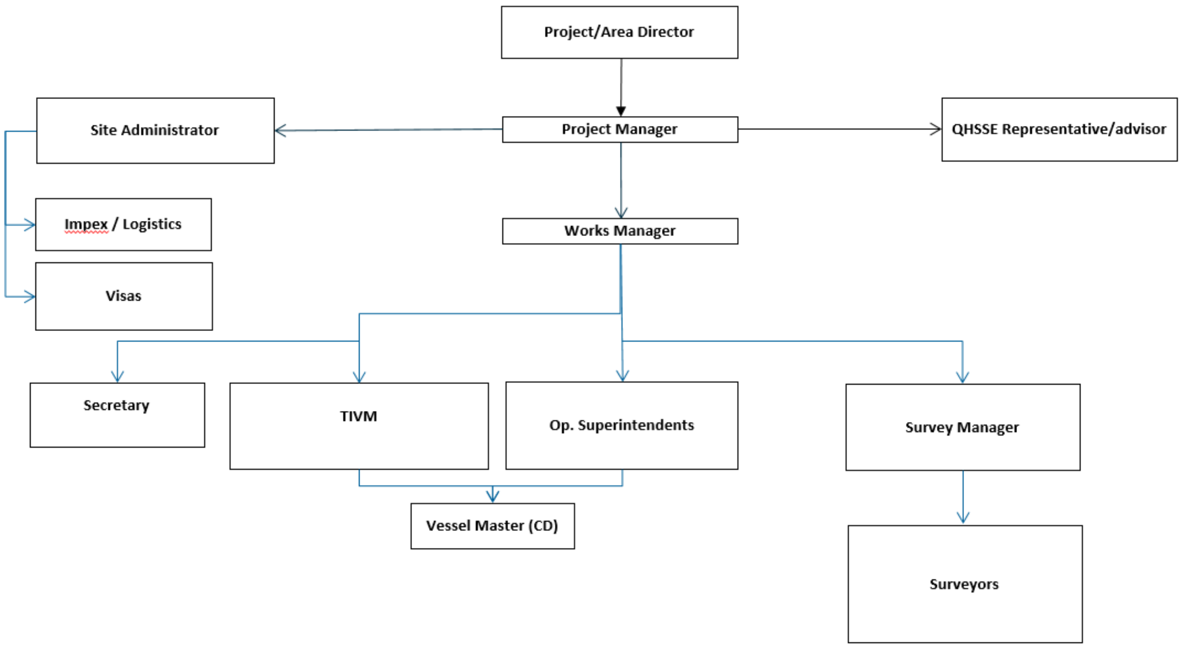

Figure 4 Project organization chart

4 RESOURCES

4.1 HUMAN RESOURCES

4.1.1 HOME OFFICE

The project will be completely controlled by the site Project Management Team (PMT) that reports to the dedicated Area Manager for the project at the Contractor's Home Office.

The Area Manager will support the PMT and follow up the site performance, administration, safety and quality.

Other support provided by the Home (and or Regional) Office includes:

- Logistical support to ensure that all required spare parts are dispatched in time to Ecuador.
- Technical support to ensure that vessels maintenance schedules are adhered to and supported.
- Production follow up to ensure that most efficient dredging set-up is applied.
- Survey support to ensure that survey department on site has all technical tools, software and spare parts to ensure continuous survey efforts to provide the vessels with the quality control loop they require for maximum dredging efficiency.
- Administrative support for legal work, insurances, bonds, certificates, licenses etc.
- Support regarding environmental matters.

4.1.2 SITE OFFICE

A coordination and project preparation group is set up within our Project office in Guayaquil, Ecuador. The dedicated project office will house the Project Management Team (PMT) and serves as the centre to monitor, control and coordinate all the project related activities.

All communication and correspondence between Employer, Subcontractors, Vendors and other third parties will be addressed to and originated from this office.

In addition, all Project related documents either from the Contractor's Home Office, onshore or offshore construction teams and vendors or subcontractors will be sent to this office for review and approval by the Project Manager prior to submitting to the Employer for approval or releasing for construction to onshore or offshore construction teams.

All staff being part of the Project Management Team will reside onshore for the duration of the project.

4.1.3 CREW

All primary dredging vessels proposed have sufficient accommodation for their marine crew.

All the accommodation on board of our vessels is under the supervision of the flag state control and local port control. The on board accommodation exceeds the standards given by the MLC requirements according to minimum sleeping facilities, free and available health and safety services, free food and beverage, on board entertainment,...

Since the crew of the TSHDs "Vitus Bering" and "Charles Darwin" have living quarters on board, there is no need for daily transfers of their crew members to and from the shore.

Our expatriate and local staff and marine crew, who are not accommodated on board of our vessels and cannot reasonably commute from their home to and from the work site, will reside onshore. The accommodation and living conditions provided will be in accordance with the majority of the worker's tradition and will live up to Employer's and Contractor's requirements.

During a scheduled crew change between 4 and 12 people will be brought to the shore. This transport will be ensured by one of the auxiliary crafts and is executed in line with Contractor's company guidelines.

During crew changes, additional onshore transfer/accommodation might be required. Based on the number of crew per unit and their leave schedule, an estimate can be made of the short stay accommodation demand profile. This demand is expected to be limited in numbers.

4.2 SUBCONTRACTORS AND CONSULTANTS

The only suppliers and/or subcontractors we foresee at present are:

- fuel + lubricants
- local tug and crew launch
- food and garbage disposal supply

4.3 EQUIPMENT

4.3.1 MAIN FLOATING EQUIPMENT

For the execution of the Maintenance Dredging Works under this Project, the Contractor proposes to deploy one Trailing Suction Hopper Dredger (TSHD). After taking into consideration the anticipated soil, sea state and weather conditions likely to be expected in the working area, together with the draught restrictions of the dredge at disposal site, and the milestones to be reached, the TSHD could be any TSHD with the characteristics between a TSHD of type “Vitus Bering” or “Charles Darwin”, like the THSD “Pedro Alvarez Cabral” or “Filippo Brunelleschi”.

- THSD Vitus Bering
    - Hopper capacity: 7.500 m³
    - Built in: 2012
- THSD Charles Darwin
    - Hopper capacity: 30.500 m³
    - Built in: 2011
- THSD Pedro Alvarez Cabral
    - Hopper capacity: 14.000 m³
    - Built in: 2012
- THSD Filippo Brunelleschi
    - Hopper capacity: 11.300 m³
    - Built in: 2003

Figure 5 TSHD’s “Vitus Bering” and “Charles Darwin”

A TSHD is mainly used for dredging loose and soft soils such as sand, gravel, silt or clay. One or two suction tubes, equipped with a drag head, are lowered on the seabed, and the drag head is trailed over the bottom. A pump system sucks up a mixture of sand or soil and water, and discharges it in the ‘hopper’ or hold of the vessel. Once fully loaded the vessel sails to the unloading site. The material can be deposited on the seabed through bottom doors, or reclaimed by using the ‘rainbowing’ technique. The material can also be discharged through a floating pipeline to shore, and used for reclaiming land.

For a detailed overview of the working principles of a TSHD, see Annex 3.

All vessels mobilised to the site will be under class registration and have all required certificates up to date.

The dredgers follow a regular maintenance program to keep them in good working order and ready for the task throughout the duration of the Contract. Sufficient spare parts, including the important W&T parts will be mobilised and regular maintenance periods will be scheduled (in case applicable).

The technical specifications of mentioned marine equipment can be found in the leaflets in the Annexes 2 and 3.

4.3.2 AUXILIARY FLOATING EQUIPMENT

For survey operations a third party vessel will be deployed, equipped with:

- Online survey PC + extra helmsman-monitor for skipper
- Survey positioning equipment
- Gyro compass
- Radio modem for receiving tidal data
- Heave-compensator or motion sensor
- MB: High resolution Kongsberg EM2040C Transducer & Processing Unit (or similar)
- Dual-frequency SBE with inbound mounted transducers
- Suitable bar for echo-sounder calibration

This vessel will be used as well for crew change and general logistics and will combine both the marine survey works with the environmental monitoring works.

Here below in Figure 6 the launch intended to be used, the Aquavit.

Figure 6 Aquavit launch

5 EXECUTION METHODOLOGY

5.1 PROJECT ENGINEERING/MOBILISATION

5.1.1 PROJECT AND SITE PREPARATION

The preparative works will be carried out mainly by specialised personnel from the Contractor's head office together with the Project Manager and the key personnel members of the Project Management Team stationed in Ecuador.
The initial tasks include:

- Licences and permits
- Insurances and bonds (if necessary)

- Bank accounts and accountancy
- Setup of Project Management System
- Development of Project Execution Plans
- Contractual and legal requirements

The preparation stage also includes practical arrangements such as: office installation (in case applicable), housing requirements and other general logistics.

Other important preparative works are the survey of the dredging areas, disposal areas and access routes. Prior to any dredging activity, a joint in-survey will be carried out.

Some of the tasks listed here above do not need to be repeated for future maintenance campaigns.

5.1.2 PROJECT ENGINEERING

The project engineering scope of works comprises:

- the setup of the project specific Quality, Quality Control, Health, Safety, Security and Environmental system;
- performance of construction engineering;
- Study of slope stability around the dredging area.

The construction engineering comprises the detailed evaluation of the proposed execution methods.

Prior to any dredging or excavation activity, a joint in-survey will be carried out. Upon completion of this survey a detailed dredge plan will be developed.

Prior to the start of the works, the Client will inform the Contractor if any pipelines, ship wrecks or other structures are present inside the dredging scope. In case any objects are present, it will be jointly decided if these need to be removed before the dredging can start.

The project team will have support from the departments within the corporate organisation of Contractor. These departments hold an in-house expertise in geology, geotechnics, hydrotechnics, etc. specific for their specialised stabilisation discipline. They will assist in engineering work, calculations and assessments for the abovementioned engineering requirements.

The engineering activities are facilitated by software, some specialised for dedicated applications, some more generic with specific developed calculation sheets. Supporting software includes Mathcad, MS Excel, SolidWorks, AutoCAD, SLOPE/W, etc.

The slope around the dredging area shall be designed in order to ensure stability of the dredged slope for static permanent loading but excluding external.

5.1.3 MOBILISATION

After award of contract, the preparation for mobilising the dredging plant will start, comprising the major items as listed under section 4.3.

All equipment will be mobilized in due time to respect the program.

5.2 DREDGING WORKS

Prior to the start of the dredging works, a joint in-survey from the dredge area will be carried out.

Taking into consideration the anticipated soil, initial seabed levels, sea and weather conditions likely to be expected in the working area, the Contractor proposes to deploy a TSHD.

The dredging operation of a Trailing Suction Hopper Dredger (TSHD) exists out of four steps:

1. Sailing empty when returning from the disposal area
2. Dredging
3. Sailing full when going to the disposal area
4. Dumping the dredged material in the disposal area

Independent of the location where the dredger is working, whether this is in the approach channel, the turning basin or in the berth pockets, these four steps will be repeated until the seabed has reached the design level. The main difference between the working areas is that the captain, officer and pipe operator have to determine how to position the ship to fill the hopper as efficiently as possible. For areas like the Berth Pockets, the main considerations are the shallow depth and the fixed structures. For the Channel, the limited width and thus limited manoeuvrability, together with pre-dredge seabed levels related to the TSHD's loaded draught are the limiting factors. In the turning basin on the other hand, a lot of space is available to execute all manoeuvres while dredging. The most important factor here is the shallow areas near the turning basin, which force the dredger to stay inside the design limits at all times.

As a TSHD is continuously moving while dredging, in contrast with other types of dredgers such as Cutter Suction Dredgers or Backhoe Dredgers, they are under the constant influence of external forces. Current, wind and waves push the dredger so that constant adjusting is necessary to keep the dredger on the desired course to remove the soil as planned.

We refer to our Document "General Layout and Working Principles of a TSHD" (Annex 03) for more details on the working procedure of the equipment proposed, the sections below explain these principles based on the Project conditions.

The execution methodology is based on the soil characteristics and the location of the materials to be dredged. In general, we have based ourselves on the following reasoning:

- According to the available soil investigation information, most of the dredge material will be silty clay and soft clay, with a possible presence of loose sand

5.2.1 OFF-SHORE DISPOSAL AREA

All the dredged material will be dumped in the dedicated area offshore. The coordinates of the dredged material disposal site are listed in Table 1here below.

Table 1 Coordinates of Marine Disposal Area

	Easting - X [m]	Northing - Y [m]
1	583544.00	9649248.00
2	583880.00	9651278.00
3	585837.00	9651184.00
4	585560.00	9649187.00

Figure 7 here below shows the location of the dredged material disposal site. The distance from the disposal site and the dredging area is approximately 13.6 nm, according to the Environmental Management Plan of the Project.

Figure 7 Location of the Dredged Material Disposal Site

5.3 SURVEY

5.3.1 IN-SURVEY

Prior to commencement of dredging operations, an initial survey will be performed of the area to be dredged and of the dumping area. A representative of the Client will be invited to witness the initial survey.

Data of the initial survey will be provided to the Contractor.

5.3.2 OUT-SURVEY

A final survey will be carried out at the end of the dredging works.

5.4 A REPRESENTATIVE OF THE CLIENT WILL BE INVITED TO WITNESS THE FINAL SURVEY.DEMOBILISATION

Towards the end of the dredging and disposal works, actions will be taken to start site dismantling, make the out-survey and demobilise all the equipment from the site.

6 SEQUENCE OF THE WORKS

The sequence of the Works will be adapted in function of the new in-survey and the Date of Notice to Proceed.

7 HEALTH, SAFETY AND ENVIRONMENT

7.1 HSE MANAGEMENT

The Health, Safety and Environment are managed by the respective key personnel assigned for these tasks. The Health and Safety of all personnel is the highest priority on site.
For the project a dedicated Project Execution Plan is prepared () and introduced based on experiences on other projects and based on the present documentation from Head Office. This manual was prepared in line with the Head Office policy, the Client's policy and the state regulation.

7.2 GENERAL SAFETY CONSIDERATIONS & SAFETY ISSUES

The items discussed below are addressed in far greater detail in respective sections of the Project Execution Plan but they are briefly summarized here because they are directly associated with the Project's execution:

7.2.1 TRAINING AND INSTRUCTIONS

As per company's HSSE policy, all our staff and crew will be properly trained as per corporate instructions and as per Project QHSSE Implementation Plan, project safety inductions and toolbox meetings.

7.2.2 MEDICAL EVALUATION PLAN

This very important aspect of the overall safety program will be thoroughly discussed and prepared.

7.2.3 PROJECT HAZARD IDENTIFICATION

Before commencement all operations that will be performed during the execution of the project will be screened for potential hazards and their mitigating measures.

7.2.4 EMERGENCY RESPONSE PLAN

Following company procedures are in place, and will be revised in light of local rules or regulations and Client's requirements to ensure compliance. Reference is made to our Project Execution Plan and the following procedures:

- Man Over Board Procedure
- Medical Evacuation
- Fire Fighting
- Black-out Procedure
- Damage Control
- Abandon Ship Procedure
- Collision Procedure
- Oil Spill Procedure

7.3 OPERATIONAL SAFETY CONSIDERATIONS & SAFETY ISSUES

The items discussed below are to be addressed in far greater detail in respective sections of the Project Execution Plan but they are briefly summarized here because they are directly associated with the project's execution:

7.3.1 OPERATING TIMES

The work will be executed 24 hours per day and 7 days a week till the end of the project, aside of course the scheduled stops for maintenance and bunkering and equipment breakdown.

7.3.2 INTERFACE MANAGEMENT AND COMMUNICATION

A proper communication schedule between Employer and Contractor will minimize the interference with other port or canal activities. Such communication procedure will allow us to plan our dredging activities sufficiently ahead of time so that any impact to other traffic is avoided and the impact to the dredging works is kept to a minimum.
Following rules apply:

- All communication with Company and Company's Representative goes via the PM.
- Normal day-to-day marine communication between vessels, marine authorities or other offshore facilities and vessel goes via the vessel's masters.
- All the floating plant will be equipped with bridge-to-bridge radiotelephone equipment.
- Communication between working vessels will be through VHF by the use of the channel set before the start-up of the works.

A comprehensive list with all important telephone numbers will be compiled. This list will be displayed on board in several key areas such as wheel house, mess rooms, engine room etc. and will be distributed to all the parties involved in the dredging works: Client Representative, Traffic Control, etc.

7.3.3 BUNKERING

Bunkering will be scheduled – as much as possible – in accordance with the scheduled down-time for maintenance. Bunkering will only be done by means of appropriate and fully licensed fuel delivery vessels.

7.3.4 WEATHER FORECASTING

Weather monitoring forms an essential part to increase the fleet's preparedness to deal with adverse weather conditions. It also allows the operational time to be maximized without increasing the risk to crew and fleet.
Daily the captain and the superintendent will acquire meteorological forecast from an independent and recognized meteorological institution.

7.3.5 SCHEDULED MAINTENANCE

During this period the following activities will be executed:

- necessary repairs
- regular scheduled preventive maintenance works in engine and pump room
- inspection and maintenance of main dredging components
- required oiling and greasing procedure
- general welding works
- bringing on board of stores and spare parts etc.

7.3.6 TRANSPORTS OF GOODS TO AND FROM THE VESSELS

Goods such as food supplies and spare parts for the vessel will most of the time be transported by a launch. All hoists will be performed by means of approved hoisting slings, nets and wires and in accordance with Contractor's company guidelines.

When approaching the vessel to make a delivery the launch master will call the wheelhouse of the other vessel over the VHF and ask permission to come alongside. The launch will only come alongside when such permission has been given together with the instruction which side he should come alongside against.

7.4 PERSONNEL PROTECTION EQUIPMENT

Standard Personal Protection Equipment (PPE) is issued to all personnel. Additional PPE has to be used in different working situations. Wearing a life jacket is compulsory for all water works and transfers from ship to ship or from ship to jetty. Wearing Safety glasses will be required whilst working in a dusty environment or whilst executing metal work. All shore workers shall wear a high visibility vest or jacket or shall have high visibility stripes attached to the working clothes.
For working on height, Safety Harnesses shall be used which needs to be connected to appropriate

fixed structure.

7.5 ENVIRONMENTAL CONSIDERATIONS & ENVIRONMENTAL ISSUES

Due to the nature of the works, the main direct environmental impact shall be caused by an increased TSS value in the direct neighbourhood of the dredging and disposal area.
It is our policy that the best practice dredging techniques will be adapted during the dredging works. Furthermore, as is standard for our company, a zero-dumping policy is applied resulting in the necessary procedures concerning waste disposal and preventive measures against oils spills that will be prepared before the start of the works.

8 QUALITY CONTROL AND MANAGEMENT

8.1 CALIBRATION

In accordance with Contractor's QA & QC Policy the following calibrations are critical for the proper execution of this dredging project:

- DGPS of all vessels
- DGPS reference station
- gyro compasses of all vessels
- angle reducers of dredging equipment
- echo sounder of survey vessel
- RTK receivers

For the calibration of survey equipment reference is made to FDC6808.MES.61.01.s.01

8.2 MONITORING

Two types of monitoring are identified to ensure the quality of the work, namely the intermediate surveys and the contractual reporting to the Client.

8.2.1 INTERMEDIAL SURVEY

Regular hydrographical surveys of sections of the Project serve three (3) essential purposes:

- It provides the update of the survey data (digital terrain model) stored in the survey computer that presents the dredge master with a view of how much material he can expect. It allows him to adjust some settings to improve the dredging process. The quality of the collected data and the speed at which it is processed and made available to the survey computer determines the effectiveness of this “quality control loop”.

- It also provides the superintendents with an update on the work’s progress and allows more accurate planning which in turn increases the dredging efficiency. Again, the speed at which the data is collected and made available to them determines the efficiency of the “monitoring & control loop”.

8.2.2 REPORTING

Daily reports will be issued to the Client.

9 ANNEXES

9.1 ANNEX 1 - LEAFLET TSHD VITUS BERING

Vitus Bering.

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Vitus Bering.

Trailing Suction Hopper Dredger

Hopper capacity	7,500 m³
Deadweight	11,800 t
Length o.a.	119.1 m
Breadth	23 m
Draught loaded	8.15 m
Maximum dredging depth	46.4 m
Suction pipe diameter	1,000 mm
Pump power (trailing)	2,000 kW
Pump power (discharging)	4,000 kW
Propulsion power	2 x 4,000 kW
Total installed diesel power	8,975 kW
Speed	14 kn
Accommodation	21
Built in	2012

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9.2 ANNEX 2 - LEAFLET TSHD FILIPPO BRUNELLESCHI

Filippo Brunelleschi.

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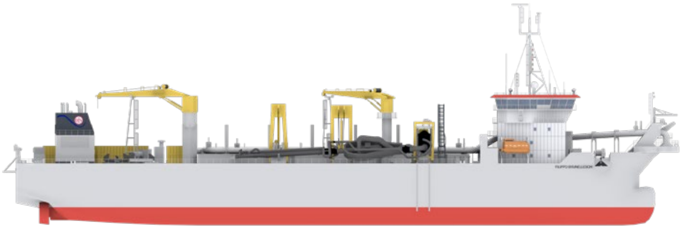
Filippo Brunelleschi.



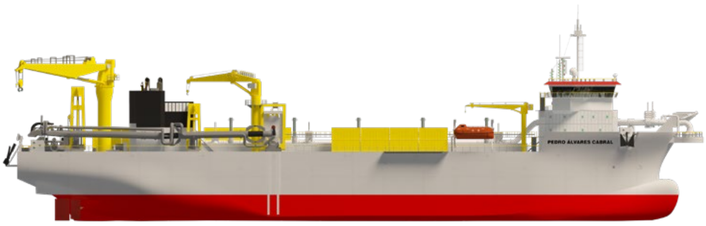
Trailing Suction Hopper Dredger

Hopper capacity	11,300 m³
Deadweight	18,620 t
Length o.a.	142.5 m
Breadth	27.5 m
Draught loaded	9.1 m
Maximum dredging depth	38 / 57.5 / 77 m
Suction pipe diameter	1,200 mm
Pump power (trailing)	3,400 kW
Pump power (discharging)	7,500 kW
Propulsion power	2 x 5,750 kW
Total installed diesel power	13,110 kW
Speed	15.3 kn
Accommodation	34
Built in	2003

9.3 ANNEX 3 - LEAFLET TSHD PEDRO ALVAREZ CABRAL

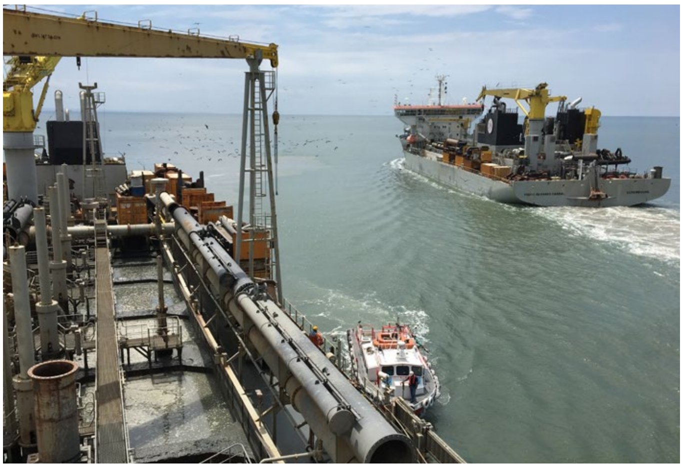
Pedro Álvares Cabral.

Pedro Álvares Cabral.



Trailing Suction Hopper Dredger

Hopper capacity	14,000 m³
Deadweight	26,530 t
Length o.a.	147.8 m
Breadth	30 m
Draught loaded	11.2 m
Maximum dredging depth	43.8 / 52 m
Suction pipe diameter	1,300 mm
Pump power (trailing)	4,000 kW
Pump power (discharging)	8,500 kW
Propulsion power	2 x 7,200 kW
Total installed diesel power	15,960 kW
Speed	15.7 kn
Accommodation	33
Built in	2012



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9.4 ANNEX 4 - LEAFLET TSHD CHARLES DARWIN

Charles Darwin.

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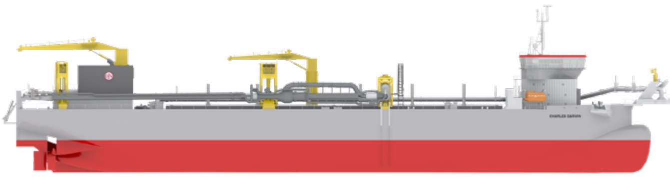
Charles Darwin.



Trailing Suction Hopper Dredger

Hopper capacity	30,500 m³
Deadweight	54,140 t
Length o.a.	183.2 m
Breadth	40 m
Draught loaded	13 m
Maximum dredging depth	93.5 m
Suction pipe diameter	2 x 1,200 mm
Pump power (trailing)	2 x 3,400 kW
Pump power (discharging)	15,000 kW
Propulsion power	2 x 10,800 kW
Total installed diesel power	23,600 kW
Speed	16 kn
Accommodation	42
Built in	2011

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9.5 ANNEX 5 - WORKING PRINCIPLE TSHD

9.5.1 GENERAL DESCRIPTION

The TSHD is a very common dredging vessel. It is a sea-going, self-propelled dredging vessel and its main working components and their respective function in the dredging process are briefly explained below. A TSHD is in general deployed for the mining and hauling of granular materials for reclamation purposes and the dredging of soft to firm clays.

For the general layout see Figure 9-1.

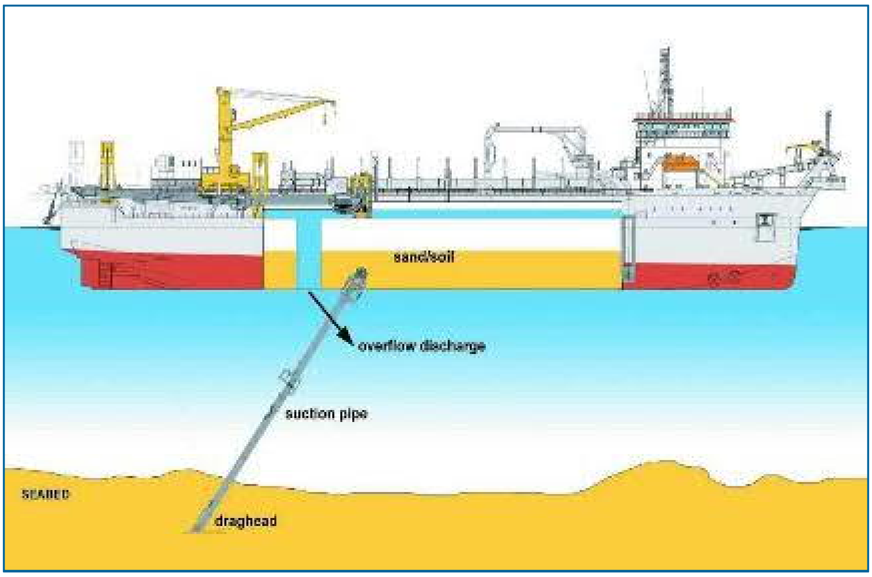

Figure 9-1: General Layout of TSHD

In principle the main parts of the dredge are:

- The draghead (Figure 9-2) is the T-shaped part mounted at the end of the suction pipe. It has several movable parts that ensure that the drag head makes good contact with the soil that needs excavating. It can also be fitted with a set of teeth that help loosen the soil. A set of jet nozzles through which water is jetted at high flow rates is also used to loosen cohesive soils. A grid installed can be installed inside the drag head(s) to prevent objects larger than a certain size to enter the pumps. Such grid also prevents ordnance entering the pumps.

Figure 9-2: Draghead

- The suction pipe (Figure 9-3) is the tube that transports the dredged materials to the hopper well. It is made up of two section that hinge at a flexible section but the movement is constrained by a metal frame (cardan) to prevent the pipe from being torn off. Some vessels have an underwater pump mounted on the suction pipe to boost the vessel's output.

Figure 9-3: Suction Pipe

- Suction is provided by the inboard pumps (Figure 9-4). These pumps are also used to empty the vessel when she is deployed for a reclamation project.

Figure 9-4: Inboard Pump

The hopper well (

- Figure 9-5) is the large compartment in which the dredged materials are pumped and stored for transport to the offshore disposal area or the reclamation area.

Figure 9-5: Hopper Well

- The bottom doors are a set of doors that are located at the bottom of the hull parallel to the ship's keel. They are activated to discharge the hopper load once the vessel has arrived at the dedicated dumping ground. Some TSHD are split hoppers and dump in the same way as SHBs.

  TSHD Vitus Bering possesses bottom doors and will be dumping as shown in Figure 9-6.

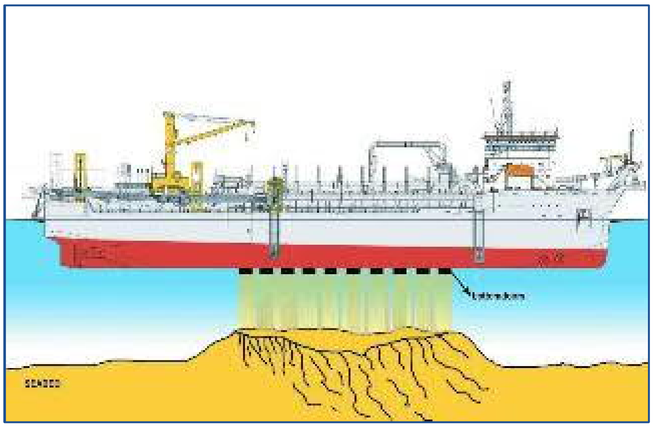

Figure 9-6: Dumping through Bottom Doors

In the case of TSHD Pinta, it is a split hopper and dumps in the same way as the SHBs, as shown in Error! Reference source not found..

- The overflow funnel(s) (Figure 9-7) are vertically mounted tubes inside the hopper well that are used to drain off (through the keel) excess water inside the hopper well allowing the hopper load to be maximized. The anti-turbidity valve or so-called "green valve" is a hydraulically controlled valve mounted inside the overflow funnel(s). This valve drastically reduces the turbidity generated by the overflow water drained through the overflow funnels

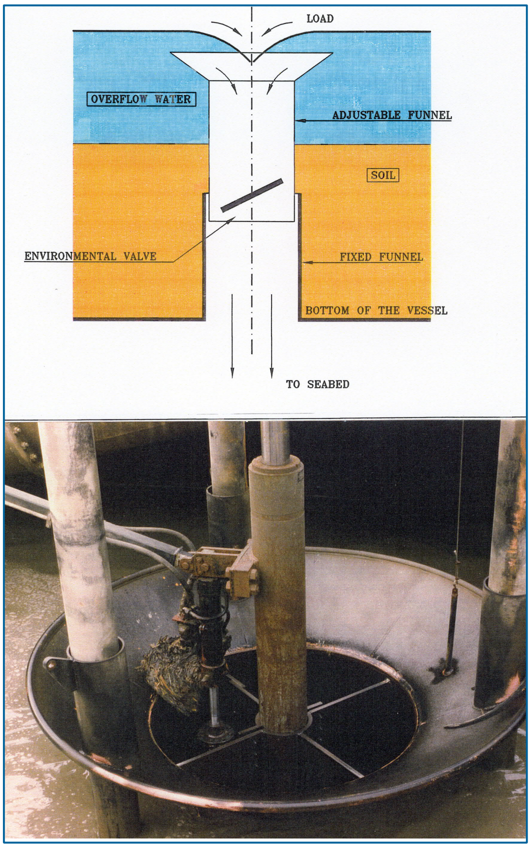

Figure 9-7: Overflow Funnel

9.5.2 DREDGING CYCLE

Conventional hopper dredging activities can be divided in following consecutive activities: sailing empty, loading (dredging), sailing loaded and discharging. A complete set of these four activities is called a dredging cycle.

Sailing Empty - The dredging cycle starts with the empty hopper dredge sailing to the dredging area guided by its in-house developed, highly accurate navigation systems. In this stage of the dredging cycle, the hopper dredge is regarded as a normal cargo vessel.

Dredging - The dredging systems of a hopper dredge consist of one or two suction tubes, each driven by a powerful centrifugal pump, called the sand pump. During the dredging, and in a process, which is quite similar to the domestic vacuum cleaning, the lower ends of the suction tubes are trailing along on the seabed, while the sand pumps provide the suction power to lift the materials from the seabed into the hopper.

Once the hopper dredger approaches the borrow area, the sailing speed is reduced and the suction tubes will be hoisted over board and lowered to the seabed.

At the lower end of the suction tube, a special draghead is attached which is designed for maximizing the dredging production during the loading phase. The suction power is provided by the sandpump, which is normally installed in the pumproom in the engine rooms of the dredge. Alternatively, the suction power can be provided by an underwater pump mounted on the suction tube itself. This underwater pump enables high dredging productions at greater water depths.

During the dredging, while the dragheads are on the seabed, the hopper dredge will maintain a low trailing speed. Such trailing speed is depending on the nature of the materials being dredged.

The materials thus lifted (dredged) from the seabed, will be pumped into the hopper as a soil/water mixture. Care will be taken to minimise the water content in the mixture.

Specialised operators control the highly computerised dredging process. The dredge master and the navigating officer will, each one responsible for his area of control, co-operate closely. The computerisation covers all possible parameters involved in the dredging: dredging productions, engine and pump loads, draghead positions, hopper levels, etc...

Sailing Loaded - As soon as the hopper dredge is fully loaded, the suction tubes will be hoisted back onboard and course will be set towards the area for unloading the hopper dredge. During this transit the hopper dredge is sailing as a regular cargo vessel.

Discharging/Dumping - The dredge material is discharged either through the bottom doors or by opening the split hopper.