RG141536 - Tugas Akhir

IDENTIFIKASI MORFOLOGI DAN POTENSI BAHAYA SEKITAR TITIK PENGEBORAN MENGGUNAKAN MULTIBEAM ECHOSOUNDER DAN MAGNETOMETER

(STUDI KASUS: SELAT MAKASSAR, KALIMANTAN TIMUR)

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JURUSAN TEKNIK GEOMATIKA
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IDENTIFICATION OF MORPHOLOGY AND HAZARD POTENTIALS AROUND THE DRILLING POINT USING MULTIBEAM ECHOSOUNDER AND MAGNETOMETER

(CASE STUDY: MAKASSAR STRAIT, EAST BORNEO)

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THESIS

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IDENTIFIKASI MORFOLOGI DAN POTENSI BAHAYA DI SEKITARAN TITIK PENGEBORAN MENGGUNAKAN MULTIBEM ECHOSUNDER DAN MAGNETOMETER

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Abstrak

Konstruksi lepas pantai adalah struktur dan fasilitas di lingkungan laut, digunakan untuk produksi dan mentransmisi listrik, minyak, gas dan sumber daya lainnya. Pembangunan lepas pantai melibatkan ekstraksi energi dalam bentuk minyak atau gas. Hal ini berhubungan dengan pembangunan Bangunan Lepas Pantai. Survei batimetri telah dimaksudkan untuk memperoleh data Kedadalam, topografi dasar laut, dan morfologi dasar laut termasuk lokasi berbahaya dan benda-benda lainnya.

Penelitian ini membahas tentang perencanaan pembangunan konstruksi lepas pantai dengan menggunakan beberapa instrumen seperti Multibeam Echo Sounder dan Magnetometer. Penelitian ini bertujuan untuk memberikan informasi tentang kondisi morfologi dan medan magnet atau benda-benda logam yang tertanam di dasar laut sekitar titik pengeboran yang dapat membahayakan proyek itu sendiri.

Multibeam Echo Sounder digunakan untuk mendapatkan gambaran dari fitur dan morfologi dasar laut pada sekitar titik pengeboran dan Magnetometer digunakan untuk mendapatkan gambaran jika ada pipa atau medan magnet di dasar laut sekitar titik pengeboran. Semua instrumen ini dapat saling mendukung dengan kelebihan dan kekurangan mereka dalam rangka untuk menunjukan peta potensi bahaya dari morfologi dan medan magnet untuk mendukung Kegiatan konstruksi lepas pantai.

Kata Kunci: Multibeam Echosounder, Magnetometer, Konstruksi Lepas Pantai, Potensi Bahaya, Morfologi, Dasar Laut, Medan Magnet

IDENTIFICATION OF MORPHOLOGY AND HAZARD POTENTIALS AROUND THE DRILLING POINT USING MULTIBEAM ECHOSOUNDER AND MAGNETOMETER

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Abstract

Offshore construction is the installation of the structures and facilities in the marine environment, usually for production and transmission of electricity, oil, gas and other resources. The Offshore construction involves the extraction of energy in the form of oil or gas. It is usually associated with the construction of The Offshore platforms. Bathymetry survey has been intended to obtain data of depth, seabed topography, and seabed morphology including the hazardous location and objects.

The research will be carried out about the offshore construction development planning by using several instruments such as Multibeam Echosounder and Magnetometer. This research is to provide information of the conditions of morphology and the magnetic field or metal objects that embedded at the seafloor around the drilling point that can endanger the project itself.

Multibeam Echosounder was used to obtain an overview of the seabed and the morphology feature at the drilling point and Magnetometer were used to obtain an overview if there was an existing pipeline or magnetic field at the seabed of the drilling point. All of these instruments Results can support each other with their advantages and disadvantages in order to make the map of the hazard potentials of morphology and magnetic field to support The Offshore construction activities.

Keywords: Multibeam Echosounder, Magnetometer, Offshore Construction, Hazard Potentials, Morphology, Seabed, Magnetic Field

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There are still shortcomings and some mistakes in the preparation of this thesis. Therefore, the researcher expects the suggestions and the constructive criticism as a learning purposes for researcher to be a better writer in the future, I do hope this thesis can be beneficial and useful.

May 21st , 2015

Moh Gema Perkasa Drakel

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CHAPTER I
PRELIMINERY

1.1 The Background

Indonesia is a maritime country that is of the area is water. The area of the seas 2/3 (two thirds) of the total area of Indonesia. The potential contains mineral resourches in the vast area of Indonesia’s sea that needs to be expanded. With larger sea area than land, construction in the sea area, especially offshore has a close relationship with the development of exploration and extraction of energy in the form of oil and gas (Nugraha 2014).

The Offshore construction is the installation of the structures and facilities in the marine environment, usually for production and transmission of electricity, oil, gas and other resources. The Offshore construction involves the extraction of energy in the form of oil or gas. It is usually associated with the construction of offshore platforms. The Offshore structure or building is built offshore to support the exploration or exploitation of minerals. Usually The Offshore drilling rig has a function to analyze the nature of the geological reservoir and to create holes that allow the retrieval reserves of petroleum or natural gas from the reservoir (Drakel and Mukti 2014).

One of the activities that can be conducted in Indonesia sea area is a Hydrographic Survey to support the exploration and exploitation of natural resources contained in the Indonesian seas. The Hydrographic surveying deals with the configuration of the bottom and adjacent land areas of oceans, lakes, rivers, harbors, and other water forms on Earth. Bathymetric survey is one of offshore activates that can show information about the depth of an area in the ocean and also the information about the seabed. The Bathymetry survey has been intended to obtain data of depth, seabed topography, and seabed morphology including the hazardous location and objects.

Echosounder is an instrument for measuring the depth of water by sending a wave of the echo from the surface to the bottom of the water and notes the time until the echo back from the bottom of the water. The Echosounder is an instrument used to determine the depth of the sea, a distance-measuring device using ultra sonic. Magnetometers measure magnetic fields, to determine the existing pipeline or metal field that is embedded in the seabed that could endanger the plan of the offshore construction.

In any offshore activities required some of supporting surveys before the process of exploration and exploitation done. To determine a drilling point it is necessarily need to see from different aspects such as mineral deposits, a potential hazard, and several sciences that probably could support all the process. In this research depend on the data obtained from the data provider, the drilling point has been determined before the survey of potential hazards was held in the area Area of drilling point.

East Borneo is the plan area for offshore construction building to support the exploitation of minerals. The research will be carried out about the offshore construction development planning by using several instruments such as Multibeam Echosounder and Magnetometer. This research is to provide the information of the conditions of the morphology and the magnetic field or metal objects that embedded at the seafloor around the drilling point that can endanger the project itself.

1.2 Problem Definition

Problem Definition from this research is:

a. How are the characteristics of the seabed features in the area of drilling point (East Borneo – Makassar Strait).
b. How are the profile overviews of the seafloor using the data from Multi-beam Echosounder and Magnetometer.

1.3 Problem Limitation

Problem Limitation from this research is:

a. The Research will be conducted on the scope of the Makassar Strait - East Borneo.
b. The Identifying features of the seabed around drilling point.
c. The Scope of the research is to identify of potential hazards caused by natural morphology and magnetic field on the seabed of the survey

area in the offshore construction development plan.

1.4 The Goal

The goals of holding this thesis are:

a. To Identify the data results acquisition from Multibeam Echosounder and Magnetometer for potential of morphology that can cause hazard at the sea floor around the drilling point.
b. To Identify the data results acquisition from Magnetometer for potential of magnetic field that can cause hazard at the sea floor around the drilling point.
c. To Make the map of the hazard potentials of morphology and magnetic field.

1.5 The Advantage

The research is expected to provide advantages such as:

a. Obtaining an overview of the seabed features at the drilling point.
b. Obtaining an overview of the seabed morphology at the drilling point.
c. Obtaining an overview if there's an existing pipeline or magnetic field at the seabed of the drilling point.
d. Obtaining an overview if there's potential hazard at the seabed of the drilling point.

CHAPTER II
LITERATURE

2.1 Hydrographic Surveying

2.1.1 Definition of Hydrographic Surveying

Firstly it is necessary to consider the IHO (International Hydrographic Organization) definition of Hydrography, which stands as follows: That branch of applied sciences which deals with the measurement and description of the features of the seas and coastal areas for the primary purpose of navigation and all other marine purposes and activities, including – inter alia - offshore activities, research, protection of the environment, and prediction services (IHO, 2008). Therefore, the development of a National Maritime Policy requires a well developed capability to conduct all these activities which will allow the obtaining of basic knowledge of the geographical, geological and geophysical features of the seabed and coast, as well the currents, tides and certain physical properties of the sea water. All of this data must then be properly processed so that the nature of the sea bottom, its geographical relationship with the land and the characteristics and dynamics of the ocean can be accurately depicted in all zones of national shipping. In brief, Hydrography as defined, is the key to progress on all maritime activities, normally of great national economic importance. Coastal and offshore sedimentary areas may contain mineral deposits, in particular hydrocarbons, which require adequate surveys in order to be identified. If the existence of these hydrocarbons is confirmed, this will lead to the coastal nation's undertaking the development of the hydrocarbon production which implies the interpretation of the sea floor morphology, navigation safety for the transportation of these hazardous cargoes, safety of the offshore platforms and related sea floor transmission systems and the placement of production wells and the laying of pipelines. Bathymetric, tidal and meteorological data provided by a Hydrographic Service is a fundamental element in the development of a hydrocarbon industry.

2.1.2 IHO Standard for Hydrographic Surveying

Based on the IHO S-44 5th edition, published in February 2008, The Determination of the right characteristics of the detected features and systems and procedures to detect such features is the responsibility and authority of each country. Some of the main points of the S-44 are:

a. Classification of Surveys

The Hydrographic survey is divided into four different orders, are:

i. Special Orders

This is the most rigorous of the orders and its use is intended only for those areas where under clearance is critical. Because under clearance is critical a full sea floor search is required and the size of the features to be detected by this search is deliberately kept small. Since under-keel clearance is critical it is considered unlikely that Special Order surveys will be conducted in waters deeper than 40 meters.

Examples of areas that may warrant Special Order surveys are: berthing areas, harbors and critical areas of shipping channels.

ii. Order 1a

This order is intended for those areas where the sea is sufficiently shallow to allow natural or man-made features on the seabed to be a concern to the type of surface shipping expected to transit the area but where the under-keel clearance is less critical than for Special Order above. Order 1a surveys may be limited to water shallower than 100 meters.

iii. Order 1b

This order is intended for areas shallower than 100 meters where a general depiction of the seabed is considered adequate for the type of surface shipping expected to transit the area. A full sea floor search is not required which means some features may be missed although the maximum permissible line spacing will limit the size of the features that is likely to remain undetected. An example would be an area where the seabed characteristics are such that the likelihood of there being a man-made or natural feature on the sea floor that will endanger the type of surface vessel expected to navigate the area is low.

iv. Order 2

This is the least stringent order and is intended for those areas where the depth of water is such that a general depiction of the seabed is considered adequate. A full sea floor search is not required. It is recommended that Order 2 surveys are limited to areas deeper than 100 meters as once the water depth exceeds 100 meters the existence of man-made or natural features that are large enough to impact on surface navigation and yet still remain undetected by an Order 2 survey is considered to be unlikely.

b. Positioning

Positions should be referenced to a geocentric reference frame based on the International Terrestrial Reference System (ITRS) e.g. WGS84. If, exceptionally, positions are referenced to the local horizontal datum, this datum should be tied to a geocentric reference frame based on ITRF.

c. Depth

The measured depths and drying heights shall be referenced to a vertical datum that is compatible with the products to be made or updated from the survey e.g. chart datum. Ideally this sounding datum should also be a well-defined vertical datum such as, LAT, MSL, and a geocentric reference frame based on ITRS or a geodetic reference level.

d. Other Measurements

The following observations may not always be necessary but if specified in the survey requirement should meet the following standard, such as: Seabed Sampling, Chart and Land Survey Vertical Datum's Connection, Tidal/Tides Prediction, and Tidal/Tides Stream and Current Observation.

2.2 Bathymetric Surveying

2.2.1 Definition of Bathymetric Surveying

Bathymetry is the measurement of the depths of water bodies from the water surface. It's the marine equivalent to topographic (IHO, 2008). Bathymetric surveys are generally conducted with a transducer, which both transmits a sound pulse from the water surface (usually attached to a boat) and records that same signal when it bounces from the bottom of the water body. An Echosounder attached to the transducer filters and records the travel time of the pulse. At the same time that the pulse occurs, a GPS unit

can record the location of the reading. After many of these readings are taken, corrections are made based on fluctuations in the water surface elevation that may have occurred during the survey (United States Environmental Protection Agency, 2012).

2.2.2 Depth Determination

Sounding is a method of determining the depth of the principles reflected acoustic wave (Yuwono, 2005). The instrument used for this activity is the Echosounder. The basic principle is the instrument works using the properties of acoustic waves emitted vertically from the sea surface to the seabed. These tools record the travel time of waves emitted and received by the transducer so that the depth it can be measured.

$$D = \frac{1}{2}(v.\Delta t)$$

Equation above is to determain the Depth using Pulse. Which are (V) is Pulse Velocity In Water ($^{m}/_{s}$), (Δt) Pulse Travel time (s) and (D) is the results of Depth measurement (m).

2.3 Multibeam Echosounder

2.3.1 Principle

Multibeam Echosounders are used to measure multiple depths from one transducer array. The depths are measured along a swath out from the transducer array. Multibeam Echosounders are characterized by the following parameters:

a. Frequency, typically ranging from 12 to 500 KHz.
b. Swath sector / swath width, typically ranging from 90 to 180° (2 to 12 × water depth). Accuracy generally degrades with higher swath widths. For accurates measurements, swath width are normally limited to 4 times the water depth (120°)
c. Beam width, typically ranging from 0.5 to 3°
d. Range resolution, depending on depth, best resolution 1 – 15 cm.

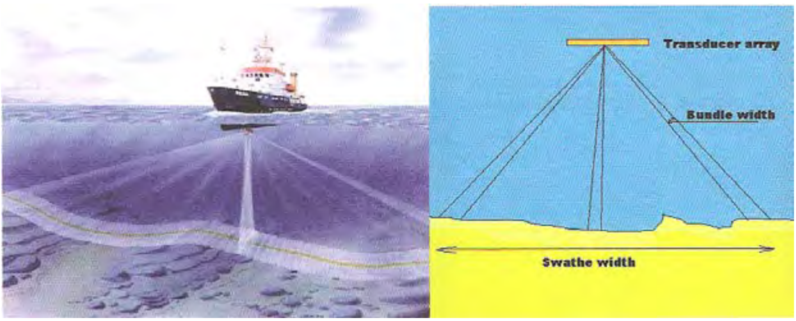

Figure 2.1 Multibeam Principle (Lekkerkerk, 2006)

2.3.2 Applications

Multibeam Echosounders are used in almost every branch of hydrographic surveying, with each branch using the Multibeam Echosounder for different purpose:

a. *Dredging:* used for controlling construction projects and projects where a high resolution combined with a 100% coverage is needed.
b. *Offshore:* used for inspection of pipelines, fall pipe projects, inspection of structures with ROVs. If used for fall pipe projects, two Multibeam Echosounders are needed, one in front of the fall pipe to determine the condition of the pipeline and its location, and one on the back of the fall pipe to check the work done.
c. *Pre-design surveys associated with pipeline and cable routes:* Typically a feasible route is defined based on surface Multibeam. However, in deeper water, surface Multibeam has a reduced resolution and the surface survey is generally followed up by either an AUV or ROV based low fly swath survey, in those areas where detailed bathymetry is essential to complete the design.
d. *Charting:* used in areas where a 100% coverage of the bottom is needed. This is required by the IHO (Special Publication 44) for harbors, shipping channels and shallow areas with a high traffic density. A large number of government charting organizations perform offshore charting projects using Multibeam technology.

Examples are the NOAA (USA), USACE (USA), NPD (Norway) and the Rijkswaterstaat (the Netherlands).

e. *Government:* inspection of dams, dikes and harbors. If used for inspection works, the Multibeam is often used in surface – looking mode, which means that the outermost angle of one side of the Multibeam is directed at the water level, creating at least a 90° coverage of the object inspected (Lekkerkerk, et al., Handbook of Offshore Surveying Volume Two: Acquisition & Processing, 2006).

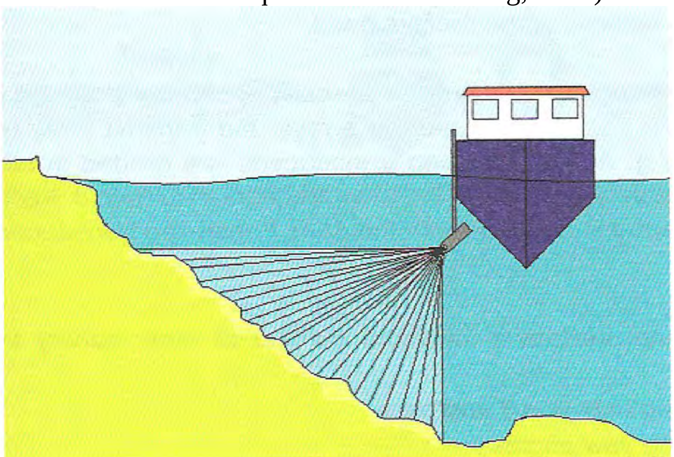

Figure 2.2 Multibeam turned at an angle (45°) for inspection work (Lekkerkerk, 2006)

2.3.3 <u>System</u>

With the above environmental criteria considered in design phase, a Multibeam system is manufactured consisting of the following parts:

a. Acoustic data processor

The acoustic data processor is the heart of the Multibeam system. Depending on the type of Multibeam this processor can be housed in a standard 19” rack unit (Seabat series) or is a 19” rack by it self (Simrad EM950, Atlas fansweep). The processor has to process huge amounts of data, to give an example, the Seabat 8125 has a maximum ping rate of 40 swaths / second and each swath contains 240 beams. The processing power housed within the Seabat data processor is based on so – called Digital Signal Processing (DSP) chips, which have the equivalent power of approximately 50 Pentium processors running at 500 MHz

b. Control display

The control display is used to change the setting of the Multibeam. On this display the readings from the Multibeam will be displayed as well as the status of the Multibeam.

c. Transducers

Multibeam transducer arrays can be subdiveded using a number of the parameters such as frequency, number of beams, beam angle and maximum depth rating. All these parameters influence the size of the transducer. Apart from size, the Multibeam transducer can be divided into flat arrays and round arrays.

The main advantage of the round array is that there is a direct relationship between the position of the receive element of the transducer and the beam number. When using flat arrays, phase detection is used to electronically detect the beam number based on the returned signal. This process is also called focusing on the array. Because the wavelength of the signal depends on the frequency and speed of sound, a sound velocity probe is used to correct for differences in sound velocity at the receive head.

Depending on the type of the Multibeam, the transmit and receive array can either be separated or combined. The Reason using separate transmit and receive arrays, the transmit array is called the projector. Some Transducers, e.g. Atlas Fansweep transducers, are divided in separate port and starboard transducer, each working on its own frequency to avoid interference. A separate transmit and receive array is not used with the Atlas Fansweep Transducers.

d. Peripheral system

In order to operate a Multibeam system, a minimum number of the survey system is required as listed below:

i. Motion sensor for measuring heave, roll and pitch

ii. Gyro compass for measuring yaw angles
iii. Positioning system
iv. Acquisition software
v. Sound velocity probe for measuring the speed of sound at different depths (sound velocity profile).

2.3.4 Coverage of Seabed

Apart from these sensor specific parameters, a number of external parameters will also influence the bottom coverage achieved:

a. Changes in bottom topography
b. Line keeping of the survey vessel
c. Alignment of the Multibeam
d. Motion of the vessel

The effect of these parameters is shown on the pictures hereunder.

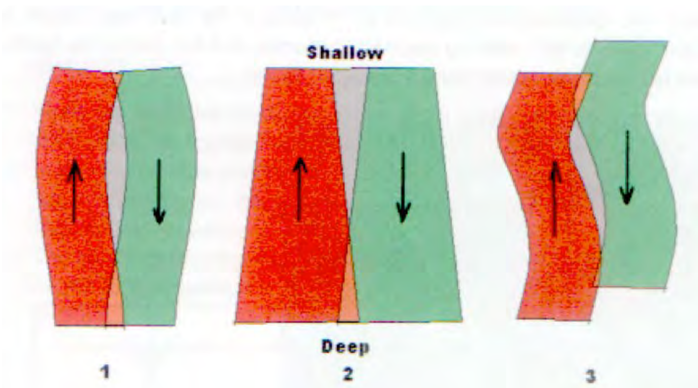

Figure 2.3 Coverage of Multibeam: 1 line keeping,
2 changes in bottom topography,
And 3 roll motion of the vessel (Lekkerkerk, 2006)

When performing normal Multibeam surveys a line pattern will be established as a guideline to the skipper of the survey vessel. Although defining survey lines is not necessary when performing Multibeam surveys, it has been found that achieving 100% coverage without sailing pre-defined lines is very hard, even for experienced survey skippers.

As a rule of the thumb, lines are sailed at an overlap between 20 and 200% to keep the coverage of the bottom at the required level. For a reasonably flat bottom, with a good skipper and little waves an overlap 20% may be sufficient. When surveying a bottom with rough bottom topography, overlaps of 100 to 200% may be required. Lines next to each other are generally sailed in opposite direction to check data integrity in the area of overlap.

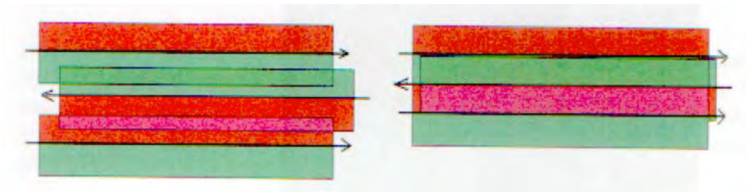

Figure 2.4 Survey lines at 100% overlap and 200% overlap, opposite direction
(Lekkerkerk, 2006)

2.3.5 Sensor Filtering

Sensor filtering is done for the purpose so that the results of acquisition data of Multibeam echosounder can be corrected noise during the data acquisition process. noise is the result of the interference reflection of acoustic waves received by Multibeam echosounder, can be caused by marine biota such as fish which pass through the pulse wave of Multibeam echosounder.

2.3.6 DTM Data Making

Digital Terrain Model (DTM) or Digital Elevation Model (DEM) known as a digital model or 3D representation of a terrain surface - commonly for a planet (including Earth), moon, or asteroid - created from terrain elevation data. DTM main purpose is to show the 3D shape of the seabed.

2.3.7 Depth Correction

Depth correction is done with supporting data such as tides and sound velocity profile of the data included as the correction of sounding data.

2.4 Magnetometer

Magnetometers have been employed to search application for many years. They have been used in air bone, marine and ground systems in the search for submarines, sunken vessels, archeological artifacts, unexploded ferrous ordnance and mines, pipelines, cables and much more (Lekkerkerk, et al., Handbook of Offshore Surveying Volume One: Preparation & Positioning, 2006). Their successful use depends upon several unrelated factors, including the nature of the target, the general environment in the target area and the amount of local magnetic disturbance around the target.

2.4.1 General

Magnetometers have evolved over the years, from the early Proton types (Proton Free Precession type), Over Hauser type, through to the Cesium Optically Pumped Magnetometer currently available.

Marine Magnetometers generally consist of the following components:

a. Sensor 'Fish'. A non-metallic body (often fiberglass) with stabilizing fins containing the magnetic sensor. Often a depth sensor is installed, sometimes an altimeter and leak detector as well.
b. Tow cable
c. Power supply system
d. Recording system. Recording normally takes place on a normal PC or laptop, using software supplied with the equipment.

Fluxgate Magnetometer developed in the 1940s, the fluxgate Magnetometer found early application in the detection of submarines. The fluxgate Magnetometer is a continuous reading instrument with a potential accuracy of $\pm$1nT. The fluxgate Magnetometer however requires an accurate orientation, which makes it more suitable for ground surveys than marine or airbone surveys.

Proton Magnetometer is the most commonly used Magnetometer for marine survey work is currently the nuclear precession or proton Magnetometer. The proton precession Magnetometers utilize the precession of protons in a hydrocarbon fluid for the measurement of total intensity. The fluid, typically kerosene contained within a coil of wire in the sensor, is momentarily magnetized by direct current in the wire. This current is then removed and the protons (hydrogen nuclei) will now process like a spinning top, about the direction of the earth's magnetic field at a frequency directly proportional to the total magnetic intensity and independent of the direction of the coil of wire (sensor).

2.4.2 Applications

One application of the magnetic surveys is the exploration of ores. Such surveys area often airbone surveys, with the benefit that vast areas can be surveyed rapidly. During marine site surveys, Magnetometers are often used for the detection of ferromagnetic objects, such as pipelines, cables and debris (wrecks). Often, magnetic data is acquired to crosscheck it with side scan sonar data. Fully integrated systems are available on the market (e.g. Klein).

Passive Magnetometers are often used in site surveys to detect debris, pipelines and cables. Pulse induction is typically used for pipe detection (pipe tracker) during for example rock dumping surveys. Active AC/DC methods are generally used for cube detection. Handheld divers' Magnetometers are used a lot in archeological survey, wreck survey and site surveys for which a very high accuracy is required.

One of the benefits of the Magnetometers, compared with the side scan sonar, is that it will detect buried, possibly hazardous, metallic objects.

2.4.3 Pipeline and Cable Detection

Pipeline search procedures are in many cases different to those that would be followed for the search for isolated objects. The Information is often desire regarding a pipeline that is not interest in order types of searches. Among kinds of information desired for pipelines can be obtained from a towed Magnetometer, it is possible to detect the pipeline, map the pipeline, and with some difficulty detect the pipeline sections or joints. It is important to be aware of the capabilities and limitations of Magnetometers for various aspects of pipeline mapping. Pipelines and most submarine communication cables contain or are made of steel and are effectively infinitely long objects, properties which allow a Magnetometer to be used for various location and mapping projects for sub marine pipelines and cables.

2.4.4 Target Detection

For a search of individual or discrete objects, however, there are many more choices in the procedures and parameters of the searches. The first consideration in conducting a search is to determine as much as possible what is magnetic, if anything, in the objects or related to the object. Frequently, similar objects can be obtained and measured in the presence of Magnetometers at varying distance and orientations. It is only the mass of ferromagnetic material and not the mass of the entire object that is important in magnetic searches. Once the magnetic mass is estimated, it is possible to determine the maximum probable anomaly at various distances. Estimation of this maximum anomaly is important to determine whether the object can partially be detected, how close the grid must be spaced, how close the sensor must be at the bottom and, lastly, whether or not the entire search problem is feasibly considering economics, time, etc.

2.4.5 Magnetometer Data Processing

On the phase of Magnetometer data processing It is the product of a collaborative effort between magnetic field modellers and the institutes involved in collecting and disseminating magnetic field data from satellites and from observatories and surveys around the world.

2.5 Tides

2.5.1 Tides Definition

Ocean tides are the result of gravitational attraction and the centrifugal effect. Centrifugal effect is a boost to the outside of the center of rotation. Although the size of the moon is smaller than the sun, gravitational attraction of the moon is two times greater than the tensile strength of the sun in generating the ocean tides because the moon's distance closer than the sun's distance to the earth.

2.5.2 Equilibrium Model

Let us consider the earth that is covered with water and without landmasses. The water depth is equal around the earth and is deep enough to minimize resistance with the bottom. This condition, with the water mass in rest is called the theory of equilibrium.

The moon and the earth rotate each other along an ellipsoidal path. The center of rotation is at point Z (see figure below), which is located within the earth due to the mass difference between the earth and the moon.

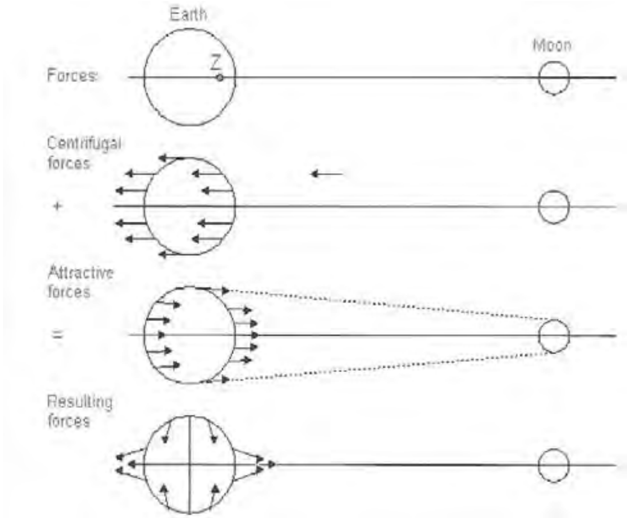

Figure 2.5 Tidal Movement caused by The Moon (Lekkerkerk, 2006)

Due to the motion of the moon and earth a centrifugal force will be exerted on all water particles. These particles will move away from the moon. At the same time there is a mutual gravitaional force between the earth and the moon, which will move the water particles towards the moon.

2.5.3 Spring Tide and Neap Tide

When the sun and the moon are aligned with the earth (picture below), then the forces are combined. This situation is called a spring tide.

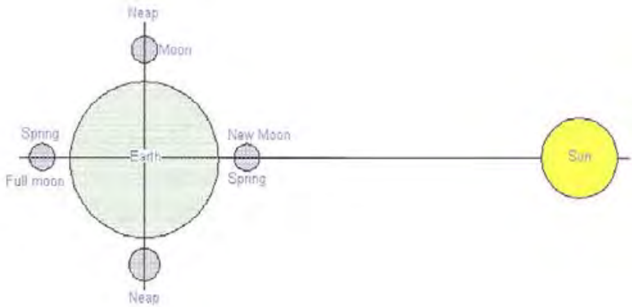

Figure 2.6 Sprring and Neap tide
(Lekkerkerk, 2006)

In this situation, high tides will be higher and low tides will be lower than usual. When the moon and the sun are perpendicular to each other their forces will conteract each other, resulting in neap tide. The result is that the water rises less than average.

Spring and neap tide occur twice per lunar month. Based upon the equlibrium theory one would expect spring tide to happen at full and new moon. Due to other effects, which will be detailed later, there is a time lag of two days between the full / new moon and spring tide in the North Sea.

The alignment as shown in the figure happens seldome, and represents a lunar or solar eclipse. Normally the moon will be at some angle to the sun. As consequence, spring and neap tides will generally not be the same. Due to the difference in tidal period between the solar and the lunar tide (12 hours vs. 12:25 hours), the two tides will reinforce and weaken each other periodically. Between spring and neap tide the sollar tides will reinforce the lunar tide, between neap and spring tide it will weaken the lunar tide.

2.5.4 Type of Tides

The following main types of tides can be distinguished:

a. Semi-diurnal tide Two high / low waters per day
b. Diurnal tide One high / low water per day
c. Mixed Combination of semi-diurnal and diurnal

2.6 **Positioning**

Global Positioning System (GPS) is a satellite navigation system and positioning are owned and managed by the United States (US). The things must be noted that GPS is the only navigation system or positioning system over many centuries that has such a powerful ability. The accuracy of GPS can achieve position accuracy of a few mm to cm / s and few nanoseconds for time accuracy. Position accuracy obtained will depend on several factors: the positioning and GPS observation method, satellite geometry, level of accuracy of data, and data processing methods.

2.6.1 Global Positioning System

GPS is designed to provide position, velocity, and time. Basically GPS consists of three major segments, such as:

a. Space segment

Consist of 24 satellites that are divided into 6 orbits with an inclination of 55 ° with a height of 20,200 km and orbital period of 11 hours 58 minutes.

b. Control system segment
Have to monitor the use of GPS satellites, so satellite can continuously operate the function. Example, for time synchronization, orbit prediction, and monitoring of "active" satellites.

c. User segment
User segment is the "user", whether on land, sea, or air, which uses GPS receiver to acquire GPS signals so that it can calculate the position, velocity, time, and other parameters.

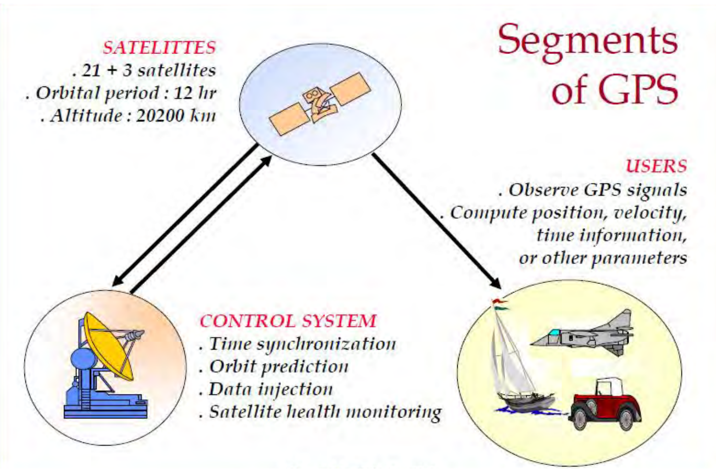

Figure 2.7 GPS Segments (Abidin, 2007)

2.6.2 Positioning Methods using GPS

The principle of GPS positioning is using resection, in which the distance measurements conducted simultaneously to several satellites that have known coordinates. The position given by the GPS is a 3D (three-dimensional) position (x, y, z or φ, λ, h) which are used for datum WGS (World Geodetic System) in 1984, while the height is the height of the ellipsoid.

2.7 Offshore Construction

Offshore construction is the installation of structures and facilities in the marine environment, usually for the production and transmission of electricity, oil, gas and other resources. Offshore construction involves the extraction of energy in the form of oil or gas is usually associated with the construction of offshore platforms. Offshore structure or building is built offshore to support the exploration or exploitation of minerals. Usually offshore drilling rig that has a function to analyze the nature of the geological reservoir and to create holes that allow the retrieval reserves of petroleum or natural gas from the reservoir.

2.7.1 Definition of Offshore Construction

Most of the platform located offshore of the continental shelf, though with advances in technology and increasing crude oil prices, drilling and production in deeper waters has become better, feasible and economical. A typical rig may have about thirty drill bits, directional drilling allows the wellbore can be accessed at two different depths and also at remote positions up to 5 miles (8 kilometers) from the platform. Remote subsea wells may also be connected to the bridge with the flow line and umbilical connection. Subsea solutions may consist of single well or with the central manifold (pipe with the hole that much) for use on some drilling.

The offshore structures can also be distinguished based on usage time:

a. Permanent construction or construction that is built to be operated in a long period of time at a work location (usually 20 to 30 years) and is not meant to be moved to another job site.
b. Mobile Unit is construction that is built to be operated for only some time (a few weeks or a few months), then it is moved to a place to be operated at the other work sites.

The offshore structures can also be distinguished based on functions:

a. Drilling rig: The rig is used to drill oil / gas, early drill is used to see the structure and content of capacity or as a requirement for continued drilling production / exploitation.
b. Production Platforms: Platform that is used as a place to separate the oil, gas and water.
c. Accommodation Platform: Platform is used as personal residence or a personnel transit.

d. Installation Platform: The platform is used to assist the installation of the other platforms crane facilities.
e. Pipe Platform: The construction platform has evolved from the simple to the semi submersible that comes with supporting facilities and modern welding.

2.8 Seafloor Features

There are three requirements for seafloor classification such as nautical charting, commerce / environment and military. Commerce / Environment for more detailed classification, usually obtained by using commercially processing software and used for by:

a. offshore engineering e.g. siting oil platforms, beacons and seawalls;
b. mineral exploration;
c. fishing etc.

2.8.1 Nature of The Seafloor

The seafloor is formed of rock of various types overlaid in most places by unconsolidated sediments from two main sources:

a. Materials washed from adjacent land masses or from erosion of the seafloor itself.
b. Biologically produced sediments which are formed from decaying animal and vegetable products within the ocean basins.

The size of grain can be determined by eye or by comparison with standard samples illustrated in a “comparator disk”, if held. The finer sediments are the hardest to classify. If size cannot be classified with the naked eye or by comparison, the sample may be placed between the teeth. If it feels gritty then it is silt; if it feels smooth and buttery in texture then it is clay. It is extremely difficult to estimate the relative percentages when samples contain sand, silt and clay.

Rock, A sample should only be classified as 'rock' if positive evidence is available. If the only evidence held by the collector is a score or dented or damaged sampler, the abbreviation "h" (hard) should be used.

Where additional qualities can be identified or the seafloor type can be positively classified as comprising another distinct material, the various references should be consulted for guidance.

2.8.2 Detection of Hazardous Features

Detection of the hazards of the seafloor at the survey area is one of the most important things in conducting hydrographic surveys. Potential hazards can also be determined by using several instruments such as Multibeam Echosounder and Magnetometer. This research focuses on Multibeam Echosounder and Magnetometer in case to identify the seafloor features that exist and can cause hazardous conditions. Therefore with this research, Multibeam Echosounder used to identify potential hazards of natural morphology at the bottom of the seafloor and Magnetometer used to identify hazards caused by magnetic field that embedded in the seabed.

The surveyor must remain cognisant of the fact that many features which are potentially hazardous to navigation do not fit the S-44 “cubic feature” criteria; for example the masts of wrecks and wellheads. However, ZOC (Zone of Confidence) criteria take such features into account if they rise above depicted depths by the prescribed amount (Sadeghi, 2007). The ability to detect such features is a critical issue when considering the type of system to be used to undertake feature detection. For instance, these types of features will normally be detected by SSS but may not be detected by MBES, lidar and other such systems due, for example, to the beam footprint or “filtering” algorithms.

As far as the surveyor is concerned the purpose of a sonar sweep is to ensonify the area between adjacent lines of soundings in order to detect any feature of significance to the mariner. Although no hard and fast definition of the minimum length of a wreck can be given, features less than three metres in length are unlikely to be sufficiently proud of the seafloor to cause concern. There will of course be occasions when this is not so (e.g in coral areas or when searching for masts) and the Surveyor must examine all sources of data available to him before deciding on the minimum length feature he wishes to detect.

Note that in all calculations that follow, involving speeds over the ground that must not be exceeded, the feature length is used and no account is taken of feature height. What is used for calculations is the maximum length of feature that just fails to receive five ‘pings’, this being considered the minimum to achieve feature detection. How much of the energy in the five rings on the feature that returns to the transducer is dependent upon:

a. Feature shape, extent, composition and aspect,
b. Sonar conditions
c. Nature of the seafloor and other factors.

2.8.3 The hazard Parameters depend on natural shape of the seafloor.

The possibility of hazardous conditions caused by the natural of the physical of the seafloor that need special attention to be investigated and to provide the informations. Therefore some types of The natural sea floors that could endangered offshore activities are:

a. Oceanic Trench.

   Ocean Trenches are the deepest parts of the ocean. They are also called submarine valleys. An ocean trench is a long, deep depression in the ocean floor, similar to deep chasms on the Earth's surface land. To Build offshore facilities adjacent to the Oceanic Trench is completely harmful, if occurrence of an earthquake on the seabed it could give a hazardous conditions to the offshore facilities.

b. Submarine Volcano.

   Submarine volcanoes are common features on certain zones of the ocean floor and some are still active at the present time. It is completely clear that the offshore activities should have a safety range zone from a Submarine Volcano in the form to avoid the activities from the Submarine Volcano it self.

c. Pockmark.

Pockmarks are craters in the seafloor environment usually caused by fluids (gas and or liquids) erupting and streaming through the sediments. Pockmarks need to be defined first, whether the pockmarks are could caused hazards potential or the pockmarks it could be the mineral resources.

2.9 Previous Researches

Previous researchers used the instruments such as Multibeam Echosounder, Side Scan Sonar and Sub - Bottom Profiler by Nugraha (2014). All the instruments used to detect or determine the Free-Span of the subsea pipeline. This condition occurs when there is a distance (gap) between the pipes as a result there is no contacts between the seabed and pipes. To detect the free span, it is necessary to know the information about the condition of the seafloor. To determine the seafloor, survey utilize a several of instruments Hydroacoustic such as Multibeam echosounder (MBES), Side Scan Sonar (SSS), and

Sub-bottom Profiler (SBP). These three instruments use the acoustic wave pulse , but have different working principles. The result from this research is to know the Bathymetric maps and the depth of the seabed morphology along the pipeline route.

There is also a study research of seafloor mapping using Multibeam echo-sounder by Hasanuddin (2009). In this study, the research explained about working principle of MBES, data recording velocity of sound, offset transducer calibration, recording MBES, for the basic concepts of data processing. Briefly, the research also described the advantages of using MBES compared with Single Beam echo-sounder (SBES).

CHAPTER III
RESEARCH METHODOLOGY

3.1 Research Locations

Location for this research is around Makassar Strait – East Borneo, Indonesia:

Figure 3.1 Research Location East Borneo – Makassar Strait (Google.com/maps)

3.2 Equipment and Materials

3.2.1 Equipment

The equipment used in this research are:

a. Hardware
   i. Computer
   ii. Laptop Processor
   iii. Hardisk 500Gb
   iv. Printer
   v. Plotter

b. Software
   i. Microsoft Office 2007
   ii. QINSy Console 8.0 (license owned by the company)
      - Raw Data Manager

- Processing Manager
- Sounding Grid Utility
- Qloud

iii. AutoCAD Land Desktop 2009 (license owned by the company)

iv. Terra Processor (license owned by the company)

Note that, there were several data were not be able to be shown in this research, because it was classified or not allowed by the Data Providers according to the company‘s requirement.

3.2.2 Materials

The Materials used in this research are:

a. Patch test Data
b. Multibeam Echosounder survey Data
c. Tidal Observation Data
d. Sound velocity profile
e. Magnetometer Data

3.3 Research Methodology

3.3.1 Implementation Phase

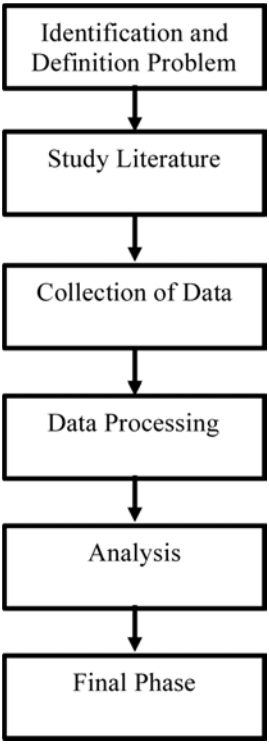

Figure 3.2 Flow Chart of implementation Phases

Explanation of the flow chart in Figure 3.2 is as below:

a. Identification and Definition Problem

This phase consists of a problem definition, is to determine what problems that exist and it should be solved through this research, limitation of the research, determination of the research purpose and the benefits derived from the research.

b. Study Literature

This phase is to learn about the concept of hydrographic surveying and magnetic surveying. Especially the application of the instruments such as Multibeam Echosounder and magnetometer for identification of seafloor morphology and the existence of potential hazards in the project area.

c. Collection of Data

All the data below will be obtained with the permit from PT. MAHAKARYA GEO SURVEY as the company, which has conducted a survey on the site that used for this research. Such as:

i. Patch test Data
ii. Multibeam Echosounder survey Data
iii. Tidal Observation Data
iv. Sound velocity profile
v. Magnetometer Data
vi. Side scan sonar data (for validation interpretation magnetic anomaly)

d. Data Processing

Data processing aims to produce spatial information in the form of a map of the seafloor morphology and hazardous potential for the purposes of installation of offshore construction.

e. Analysis

Data that have been processed and then analyzed to obtain the results and the conclusion that will be used to prepare a final report.

f. Final Phase

At this phase the preparation and writing of the final report are accompanied with the map of the seafloor morphology and hazardous potential for the purposes of installation of offshore construction.

3.3.2 Data Processing Phase

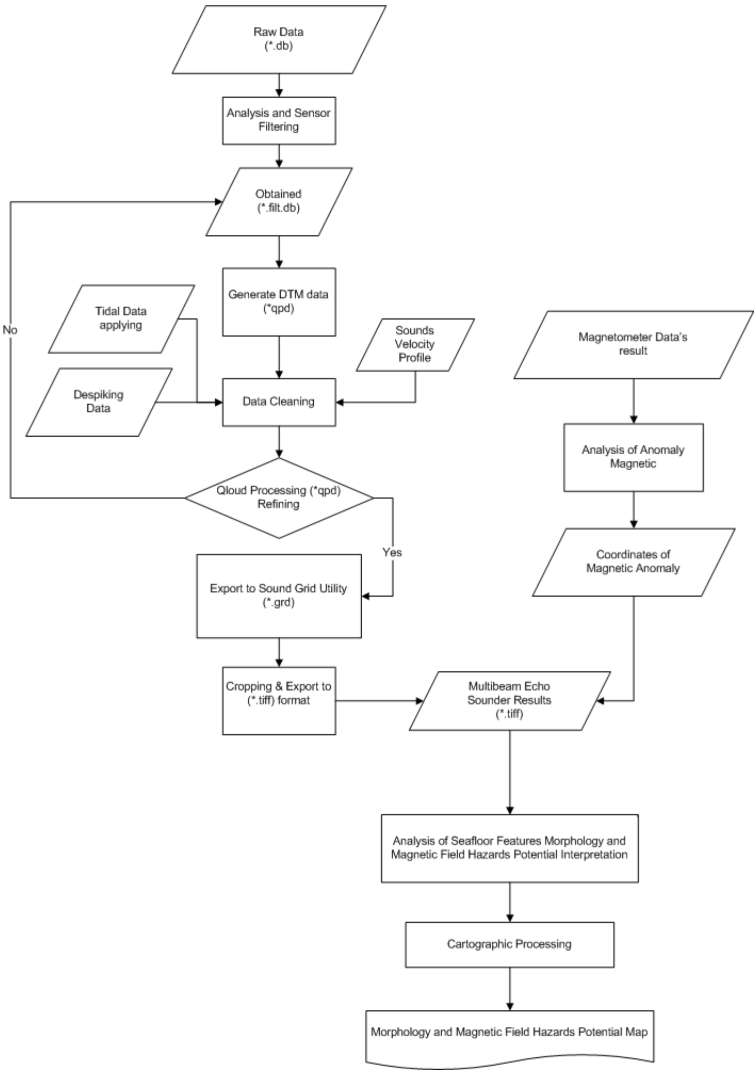

Figure 3.3 Data Processing Flow Chart

Explanation of the flowchart above is divided into three phases as follows:

a. Multibeam Echosounder data Processing
b. Magnetometer data Processing
c. Analysis

Explanation of Multibeam Echosounder data processing as follows :

a. Analysis and Sensor Filtering
   The initial analysis of the MBES data processed in (Raw Observation Inspect tool) contains in the Raw Data Manager. This is to clean up the noise in the raw data and to obtain the data which the format is (*filt.db)
b. Generate DTM Data (*qpd)
   After filtering process, make data DTM which the format is (*.qpd) through (*replay – controller)* containing in the Raw Data Manager.
c. Data Cleaning
   In This phase, MBES data were cleaned more details of the spike and the other points considered deviant and reduced the quality of the data and also to clean up the MBES data from the spike caused by marine life and other disorders caused by various factors that affect sound waves emitted and received by the transducer which consequently generated noise in the data acquisition. This process was done in the Validator and also applied tidal data.
d. Qloud Processing (*qpd)

This phase was done to refine the MBES data results from previous phase.

e. Export into Grid Format (*.grd)
After cleaning the data, then the data is exported to the grid format that can be processed and converted by using Sounding Grid Utility.
f. Cropping and Export into (*.tiff) format
This phase was done to obtain the area used to determine the problem in this research and to export it into (*.tiff) format.
g. Multi beam Echosounder Contour (*.tiff)
Obtaining the results of the Multibeam Echosounder from Exported data from previous phase.

Explanation of Magnetometer data processing as follows :

a. Magnetometer Data Result
This data is the result of data acquisition in the field that displays the magnetic field value along the corridor and the position (X,Y) has differentially been corrected by using a GPS device.
b. Analysis of Magnetic Anomaly
This, was to analyze the raw data in the form of a numeric list of the magnetic field (nT) and to obtain the coordinates of the location of the magnetic anomaly for the next validation purposes.
c. Coordinates of Magnetic Anomaly
To Obtain The coordinates, from the highest point of Magnetic Anomaly from analysis phase.

Analysis

a. Input
   Multibeam Echosounder data processing results and Input the Magnetometer data Processing results.
b. Analysis
   Analyzing the seafloor feature Morphology and Magnetic Field Hazards potential that can endanger the offshore construction.
c. Cartographic Processing
   Interpreting, determine the maps scale, and the information on the analysis model results.
d. Morphology and Magnetic Field Hazards potential map
   After Cartographic Processing, it produces distribution maps of potential hazards.

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CHAPTER IV
RESULTS AND ANALYSIS

4.1 The Research Results And Data

4.1.1 Multi Beam Echosounder (MBES) Data

The Multibeam Echosounder data acquisition was obtained by using instrument R2SONIC 2024 which was mounted at the survey vessel MV MGS GEOSURVEY. The acquisition process is to collect all the data from preparation, data record, until we obtained the raw data that were ready to be processed, and all the acquisition process was done by using QINSY Software. The Positioning system used the differential method with DGPS C-Nav 2050 and WGS84 as the datum reference.

After conducting the acquisition process, data was obtained in the form of raw data with the format (*db), then the filtering process was done to generate the data with the format (*filt.db) (Figure 4.1).

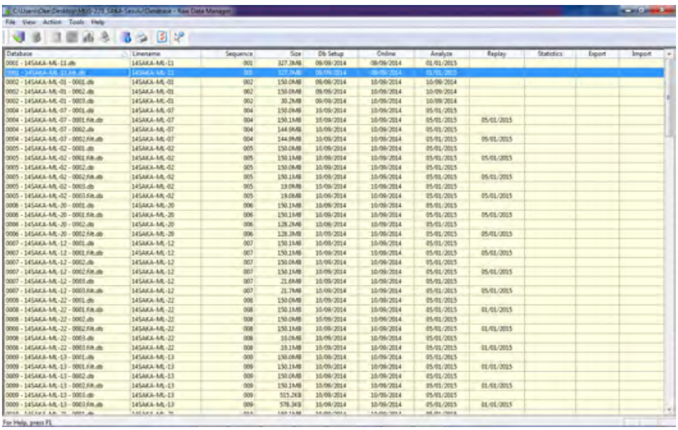


Figure 4.1 The List of Raw Data (*db and *filt.db)

The application of tidal observation is done based on time and location (position). The location is important if we need to transfer or interpolate the tidal values. The time is important for applying the correct tidal correction at the correct moment of the survey. It is important that the tidal observation and the survey area placed in the same time system. It is common for tidal observations to be made in a local time system if fixed gauges are used. Most survey packages will use UTC (Coordinated Universal Time) however as a time base, or worse computer time. If this is the case then we need to adjust all tidal observation (or the survey) to the same time frame or zone before applying them.

Gridding process in qinsy software is different with any other survey software, In addition to gridded data, QINSy produces various other DTM files as well. Most well-known is the point cloud QPD file, opened directly in the QINSy Processing Manager to clean and validate the multibeam data.

After filtering and exporting the data into a format (*qpd) and inputting the tides data and done despiking process, after that the data was exported to the sounding grid utility and if it was needed, the data also could be done by the shifting process in Qloud processor to refine the tides data, and the last phase to export the data into a format (*tiff) before we have done the next phase in cartographic process. The complete phases have already been mentioned and explained by the researcher in the chapter III in the flowchart explanations.

The results of data processing in the form of bathymetric and morphology maps were presented with a horizontal scale of 1: 5000 on A1 paper size. The actual Depth and actual Coordinates on the map were not be able to be shown in this research, because it was classified or not allowed by the Data Providers according to the company's requirement.

4.1.2 Magnetometer Data

Data collection was performed by using a marine device that has Magnetometer and readings accuracy up to 0.2 nanotesla. The results of Magnetometer data acquisition were using the instrument called Sea SPY recorded several information related to survey operation, two values needed the most are magnetic field value (nT) and the coordinates (not only these two data). In magnetic surveys in the area of Makassar Strait (Borneo), the total magnetic field intensity data was obtained in the form of graphics and numerical of 6 main lines, total of the raw data was obtained after Magnetometer acquisition process had been done, there were 6 data but the researcher only used 2 data, the 1st and the 3rd of the Magnetometer raw data acquisition result.

When the survey was in progress, The instrument (towfish Magnetometer) was towed from the stern of vessels with the layback distance of $\pm$ 200 meters, meaning that in addition to make closer the distance between towfish and the seabed, it was also intended to avoid the magnetic field effect of the vessel itself. To keep in mind that the ship was used for magnetic surveys also had its own magnetic field.

Magnetic field detection results were obtained from the data acquisition in the field to require data processing phase, in this case the researcher had done the process at the company as well as on campus. Data processing phases were expected to know the existence of metal objects and magnetic field that embedded on the seabed, especially on the Area around the drilling point that could cause hazardous conditions to the survey project, by presenting data from the Magnetometer into a map of hazard potentials.

The Researcher was only analyzing the amount of the magnetic field nanotesla (nT) contained in the data acquisition results of Magnetometer, to determine the position of the magnetic anomaly and after that it would be combined with the results of Multibeam Echosounder.

4.2 Analysis

There were several important aspects that should be discussed and analyzed according to the results obtained from the research. All the results would be analyzed in terms of hydrographic.

4.2.1 Analyzed The Data of MBES for Seabed Morphology Around The Drilling Point

The interpretation of the Multibeam Echosounder data is shown on a picture of the seabed morphology around the survey project area (Figure 4.2) and was also obtained from the data acquisition, total of the survey area was 3642291.2817 m^2. It depended on Bathymetric maps of observations (attached on an attachment), the overall depth of the seabed in the research area was generally between 45 to 54 meters.

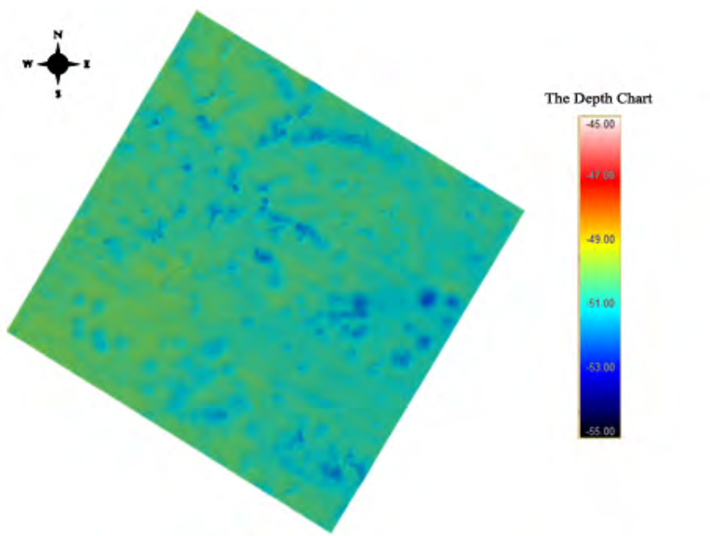


Figure 4.2 Seabed Morphology of The Survey area

From the overview of Multibeam Echosounder data results above, the researcher also analyzed that there were no seabed features or shape of seabed morphology that could endanger for offshore construction activities. But it could be seen there was an expanse of undefined object in the middle of the survey area adjacent to the drilling point (Figure 4.3) which would be analyzed by using Magnetometer data acquisition.

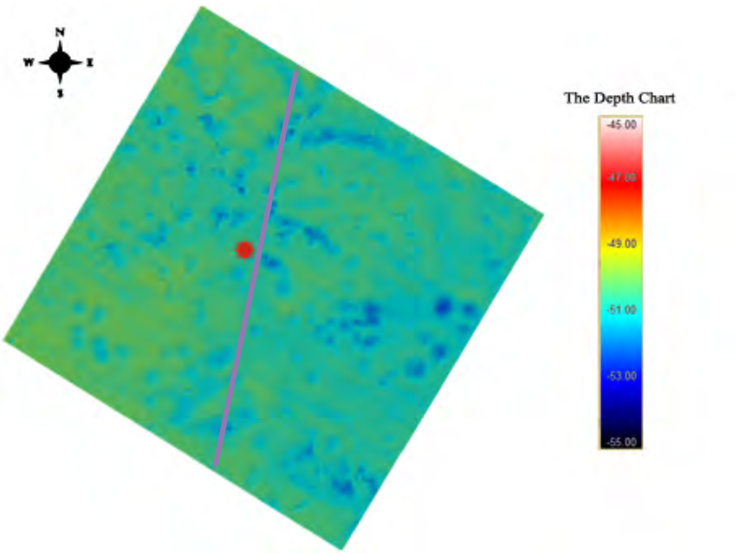


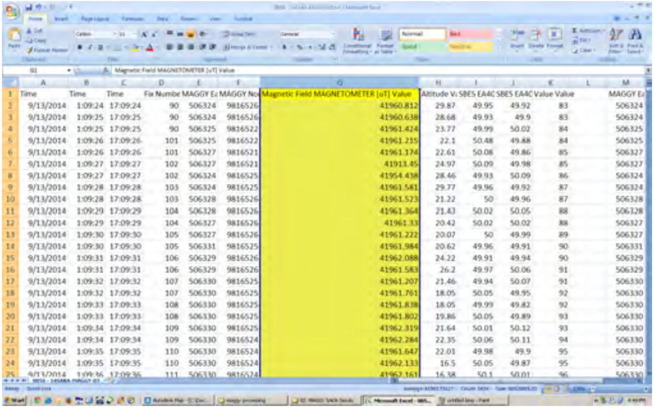
Figure 4.3 The Appearance of Undefined Object.

Information of Figure 4.3 :

- The red dot is the point of drilling point.
- – The purple line is an undefined object.
- For more information the complete map attached on an attachment.

4.2.2 Analyzed The Data of Magnetometer for Hazard Potentials Caused By Magnetic Field

The Limitation of data processing results of the Magnetometer was to analyze the raw data in the form of a numeric list of the magnetic field (nT) and to obtain the coordinates of the location of the magnetic anomaly for the next validation purposes. Please noted that Nanotesla (nT) is represent the value contained either on the surface of the earth or on objects that have a value of the magnetic field.



	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Time	Time	Time	Fix Numbe	MAGGY E:	MAGGY No	Magnetic Field MAGNETOMETER [uT] Value	Altitude V:	SBES EA4C	SBES EA4C	Value	Value	MAGGY E:
2	9/13/2014	1:09:24	17:09:24	90	506324	9816526	41960.812	29.87	49.95	49.92	83		506324
3	9/13/2014	1:09:25	17:09:25	90	506324	9816526	41960.638	28.68	49.93	49.9	83		506324
4	9/13/2014	1:09:25	17:09:25	90	506325	9816522	41961.424	23.77	49.99	50.02	84		506325
5	9/13/2014	1:09:26	17:09:26	101	506325	9816522	41961.215	22.1	50.48	49.88	84		506325
6	9/13/2014	1:09:26	17:09:26	101	506327	9816521	41961.174	22.61	50.08	49.86	85		506327
7	9/13/2014	1:09:27	17:09:27	102	506327	9816521	41913.45	24.97	50.09	49.98	85		506327
8	9/13/2014	1:09:27	17:09:27	102	506324	9816525	41954.438	28.46	49.93	50.09	86		506324
9	9/13/2014	1:09:28	17:09:28	103	506324	9816525	41961.581	29.77	49.96	49.92	87		506324
10	9/13/2014	1:09:28	17:09:28	103	506328	9816526	41961.523	21.22	50	49.96	87		506328
11	9/13/2014	1:09:29	17:09:29	104	506328	9816526	41961.364	21.43	50.02	50.05	88		506328
12	9/13/2014	1:09:29	17:09:29	104	506327	9816526	41961.33	20.42	50.02	50.02	88		506327
13	9/13/2014	1:09:30	17:09:30	105	506327	9816526	41961.222	20.07	50	49.99	89		506327
14	9/13/2014	1:09:30	17:09:30	105	506331	9816525	41961.984	20.62	49.96	49.91	90		506331
15	9/13/2014	1:09:31	17:09:31	106	506329	9816526	41962.088	24.22	49.91	49.94	90		506329
16	9/13/2014	1:09:31	17:09:31	106	506329	9816526	41961.583	26.2	49.97	50.06	91		506329
17	9/13/2014	1:09:32	17:09:32	107	506330	9816525	41961.207	21.46	49.94	50.07	91		506330
18	9/13/2014	1:09:32	17:09:32	107	506330	9816525	41961.761	18.05	50.05	49.95	92		506330
19	9/13/2014	1:09:33	17:09:33	108	506330	9816525	41961.838	18.05	49.99	49.82	92		506330
20	9/13/2014	1:09:33	17:09:33	108	506330	9816525	41961.802	19.86	50.05	49.89	93		506330
21	9/13/2014	1:09:34	17:09:34	109	506330	9816525	41962.319	21.64	50.01	50.12	93		506330
22	9/13/2014	1:09:34	17:09:34	109	506330	9816524	41962.284	22.35	50.06	50.11	94		506330
23	9/13/2014	1:09:35	17:09:35	110	506330	9816524	41961.647	22.01	49.98	49.9	95		506330
24	9/13/2014	1:09:35	17:09:35	110	506330	9816524	41962.133	16.5	50.05	49.87	95		506330
25	9/13/2014	1:09:36	17:09:36	111	506330	9816524	41962.161	16.38	50.1	50.01	96		506330

Figure 4.4 The Coordinates List and Numeric List of the Magnetic Filed (nT)

The meaning of Magnetic Anomalies in nanotesla (nT) if there is a change of the average of the numeric value in a region then at that point the magnetic anomalies occur.

Even with the changes for only 10 nanotesla (nT) could show the significant magnetic anomaly. On The chart of magnetic field below (Figure 4.5) shows that there were objects that have singular magnetic anomaly of the overall of the area (was estimated as object made of metal)

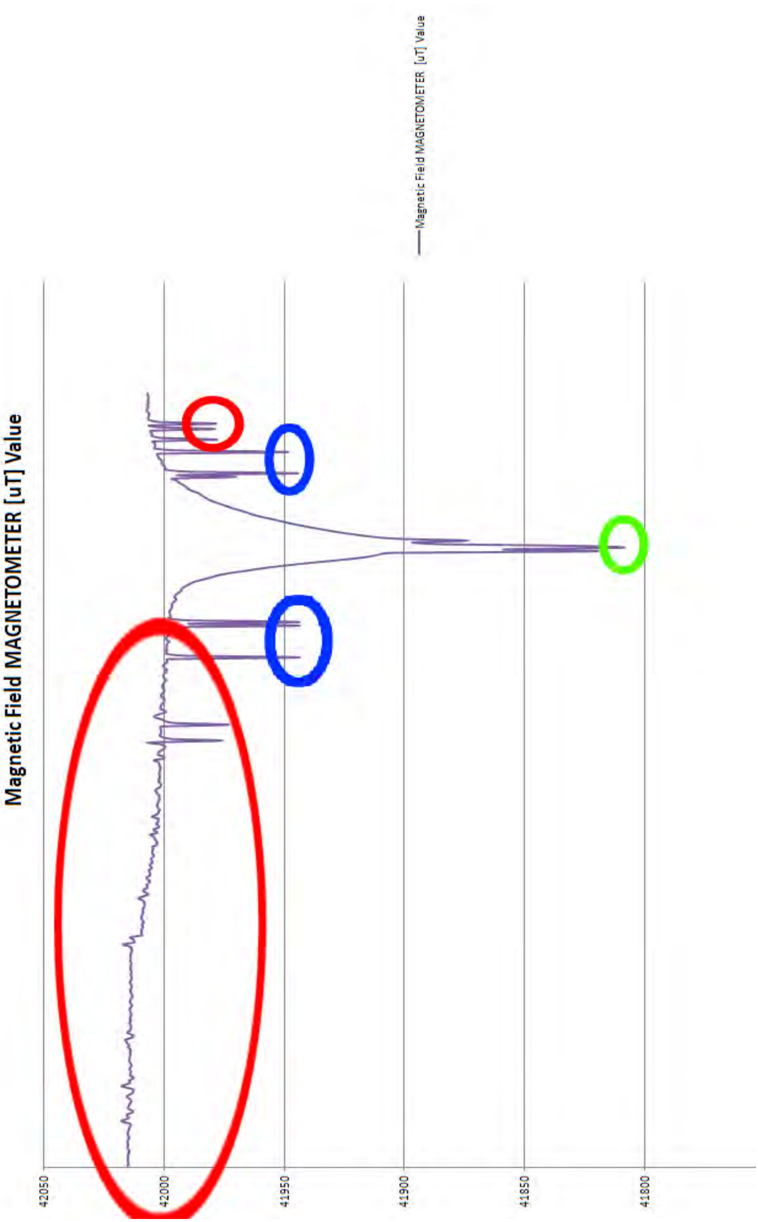


Figure 4.5 The Chart of Magnetic Filed (nT)

Information of Figure 4.5 :

- The Red circle shows that overall of the area has the same magnetic field characteristic.
- The Blue circle shows that there were differences, but the numeric amount of magnetic field was not deviate from the overall of the magnetic field characteristic. (It might be caused by magnetic debris did not appear or could not be seen on the results of Multibeam Echosounder acquisition).
- The Green circle shows the most different amount numeric of magnetic field from other points. So this is called The Magnetic Anomaly and from this point of magnetic anomaly we could obtain the information about time, coordinates (easting and northing) and the numeric amount of magnetic filed itself.

The Researcher continued to analyze 2 raw data acquisition results from the Magnetometer, as shown on the (Figure 4.6) below there are two main lines of acquisitions and on the (Tabel 4.1) and (Tabel 4.2) are the explanation list of the results from the 1st Main Line and 3rd Main Line .

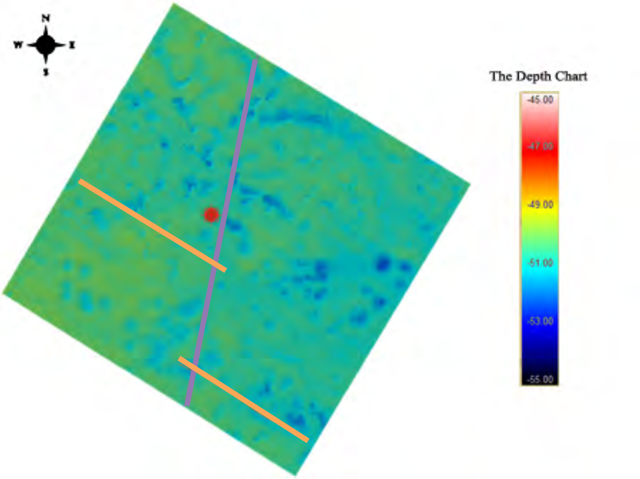


Figure 4.6 The Main Line of Magnetometer Surveys Acquisitions.

Information of Figure 4.6 :

- ● The Red dot is the point of drilling point.
- – The Purple line is an undefined object.
- – The Orange lines on the figure are the Main Line of Magnetometer Surveys Acquisitions.
- For more information the complete map attached on an attachment.

Tabel 4.1 The 1st Main Line

Time (Date)	Time (UTC)	Easting (m)	Northing (m)	Magnetic Field MAGNETOMETER [nT] Value
9/13/14	3:41:33	507157.23	9815354.51	41970.675
9/13/14	3:41:34	507157.23	9815354.51	41965.689
9/13/14	3:41:34	507155.3	9815355.08	41960.555
9/13/14	3:41:35	507155.3	9815355.08	41955.359
9/13/14	3:41:35	507153.7	9815356.12	41948.893

Time (Date)	Time (UTC)	Easting (m)	Northing (m)	Magnetic Field MAGNETOMETER [nT] Value
9/13/14	3:41:36	507153.7	9815356.12	41942.068
9/13/14	3:41:36	507152.28	9815356.55	41934.6
9/13/14	3:41:37	507152.28	9815356.55	41926.9
9/13/14	3:41:37	507150.91	9815357.32	41919.7
9/13/14	3:41:38	507150.91	9815357.32	41914.316
9/13/14	3:41:38	507149.51	9815358.12	41910.92
9/13/14	3:41:39	507149.51	9815358.12	41906.639
9/13/14	3:41:39	507148.11	9815358.95	41820.21
9/13/14	3:41:40	507148.11	9815358.95	41858.782
9/13/14	3:41:40	507146.55	9815359.7	41808.94
9/13/14	3:41:41	507146.55	9815359.7	41827.612
9/13/14	3:41:41	507145	9815360.59	41886.135
9/13/14	3:41:42	507145	9815360.59	41896.587
9/13/14	3:41:42	507142.95	9815361.35	41873.476
9/13/14	3:41:43	507142.95	9815361.35	41902.145
9/13/14	3:41:43	507141.09	9815362.32	41912.337
9/13/14	3:41:44	507141.09	9815362.32	41918.506
9/13/14	3:41:44	507139.59	9815362.94	41923.914
9/13/14	3:41:45	507139.59	9815362.94	41928.884
9/13/14	3:41:45	507138.16	9815363.67	41933.143
9/13/14	3:41:46	507138.16	9815363.67	41937.346
9/13/14	3:41:46	507136.22	9815364.56	41941.288

Note : All the numerical listed above are not an actual date,neither time, nor coordinates and Magnetic Fields.

Information of Table 4.1 :

- The complete lists of the data results are attached on an attachment.

- Right before The HighLight numbers on the table, the average number of the magnetic fields were around 41900 (nT) and then there were significant changes amount of the magnetic field numbers to 41800 (nT) and the changes of these numbers are called Magnetic Anomaly.
- The highest of Magnetic field obtained from this anomaly was 41858.782 (nT)

Tabel 4.2 The 3rd Main Line

Time (Date)	Time (UTC)	Easting (m)	Northing (m)	Magnetic Field MAGNETOMETER [nT] Value
9/13/14	1:22:12	507267.98	9815954.97	41907.795
9/13/14	1:22:13	507269.23	9815954.19	41902.319
9/13/14	1:22:13	507269.23	9815954.19	41899.182
9/13/14	1:22:14	507270.43	9815953.42	41899.991
9/13/14	1:22:14	507270.43	9815953.42	41903.454
9/13/14	1:22:15	507271.63	9815952.64	41908.25
9/13/14	1:22:15	507271.63	9815952.64	41914.547
9/13/14	1:22:16	507272.83	9815951.86	41922.676
9/13/14	1:22:16	507272.83	9815951.86	41932.135
9/13/14	1:22:17	507274.05	9815951.3	41942.527
9/13/14	1:22:17	507274.05	9815951.3	41951.688
9/13/14	1:22:18	507275.2	9815950.59	41958.541
9/13/14	1:22:18	507275.2	9815950.59	41963.079
9/13/14	1:22:19	507276.33	9815949.94	41966.565
9/13/14	1:22:19	507276.33	9815949.94	41969.613
9/13/14	1:22:20	507277.44	9815949.24	41972.275
9/13/14	1:22:20	507277.44	9815949.24	41974.091
9/13/14	1:22:21	507278.83	9815948.67	41975.264
9/13/14	1:22:21	507278.83	9815948.67	41975.749

Time (Date)	Time (UTC)	Easting (m)	Northing (m)	Magnetic Field MAGNETOMETER [nT] Value
9/13/14	1:22:22	507278.83	9815948.67	41975.614
9/13/14	1:22:22	507280.12	9815947.95	41975.867
9/13/14	1:22:23	507281.17	9815947.27	41976.099
9/13/14	1:22:23	507281.17	9815947.27	41976.66
9/13/14	1:22:24	507282.26	9815946.59	41976.559
9/13/14	1:22:24	507282.26	9815946.59	41975.788
9/13/14	1:22:25	507283.64	9815945.8	41974.831
9/13/14	1:22:25	507283.64	9815945.8	41974.73
9/13/14	1:22:26	507284.95	9815944.97	41974.992

Note : All the numerical listed above are not an actual date,neither time, nor coordinates and Magnetic Fields.

Information of Table 4.2 :

- The complete lists of the data results are attached on an attachment.
- Right before The HighLight numbers on the table, the average number of the magnetic fields were around 41900 (nT) and then there were significant changes amount of the magnetic field numbers to 41800 (nT) and the changes of these numbers are called Magnetic Anomaly.
- The highest of Magnetic field obtained from this anomaly was 41899.991 (nT)

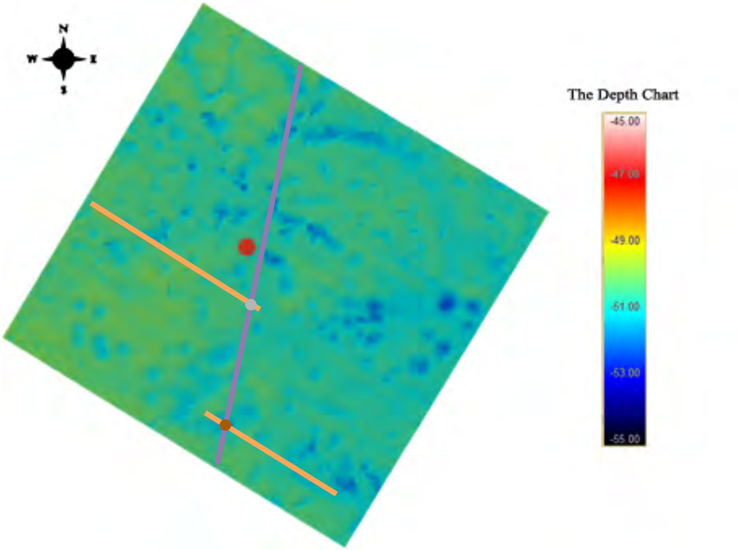


Figure 4.7 Two points of Magnetic Anomaly.

Information of Figure 4.7 :

- The Red dot is the point of drilling point.
- – The Purple line is an undefined object.
- – The Orange lines on the figure are the Main Line of Magnetometer Surveys Acquisitions.
- The Grey dot is the first Magnetic Anomaly
- The Brown dot is the second Magnetic Anomaly
- For more information the complete map attached on an attachment.

From The various analysis phases above that the undefined object was an object that has a magnetic anomaly. The shape of the object was known as a pipeline embedded at the seabed around the drilling point. Due to the position of the drilling point was adjacent with the existing pipeline, and this condition could cause hazard potential to the offshore construction.

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CHAPTER V
CONCLUSIONS AND SUGGESTIONS

5.1 Conclusions

From two main data used in this research such as Multibeam Echosounder and Magnetometer data acquisitions results were used to determine The Hazard Potential that could cause Hazardous Conditions Around The Drilling Point. Therefore several of the conclusion aspects obtained from The Analyzed Process in this research as follows :

a. Total Of The Survey Area Was 364.2291 ha and The overall average depth was generally between 45 to 54 meters. From the analysis and Identification process proven were not found such as Boulders, Pockmark, Slope or any Morphologies of the seabed around The Drilling Point which can cause Hazard. For the seabed morphology around the project area was tend to be safe for the Offshore Construction Activities.
b. There was an expanse of undefined object in the middle of the survey area adjacent to the drilling point. From The Magnetometers analysis and Identification process were proven that The shape of the object was known as a pipeline embedded at the seabed around the drilling point. Due to the position of the drilling point was adjacent with the existing pipeline, this condition could cause Hazard Potential from Magnetic Field for the Offshore Construction Activities.
c. Based on the analysis, the thesis came up with some results. There were 2 maps obtained from this research, The first one was Morphology and Hazard Potentials Map and The second one was

Bathymetric Map. (all the maps were attached on attachment).

5.2 Suggestions

In this research, the researcher studied about The Hazard potentials that might contain on The Seafloor, whether The Hazard potential caused by the morphology of the seabed it self or caused by the Magnetic Field embedded on the seabed. Therefore the writer suggested to the next researchers in conducting the research that relate to this topic in order to give the further improvements, These are several aspects that should probably be continued by the next researcher such as :

a. In this study case, the researcher could not explain the detail about Magnetic Anomaly because of the limitation of the researcher as a Geodet. Therefore for the next researcher suggested to Geophysicists in order to gather and to explain more about Magnetic Anomaly.
b. There were also Hazard Potentials like the content or the type of the seabed morphology that could not determined by MBES, for example is the sedimentations. That can be obtained and determined by using instrument called SBP (Sub Bottom Profiler), for the next researcher the writer recommended to use SBP (Sub Bottom Profiler) as the main Instrument.
c. Previous research could not obtain a clear imagery of the seafloor around the survey area with only use MBES. In order to obtain a clear imagery of a seafloor need another instrument as supporting instruments. The SSS (Side Scan Sonar) data results can be used to validate the results of Multibeam Echosounder. for the next researcher the writer recommend to use SSS (Side Scan Sonar) as the supporting Instrument.

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Tabel 4.1 The 1st Main Line

Time (Date)	Time (UTC)	Easting (m)	Northing (m)	Magnetic Field MAGNETOMETER [nT] Value
9/13/14	3:41:33	507157.23	9815354.51	41970.675
9/13/14	3:41:34	507157.23	9815354.51	41965.689
9/13/14	3:41:34	507155.3	9815355.08	41960.555
9/13/14	3:41:35	507155.3	9815355.08	41955.359
9/13/14	3:41:35	507153.7	9815356.12	41948.893
9/13/14	3:41:36	507153.7	9815356.12	41942.068
9/13/14	3:41:36	507152.28	9815356.55	41934.6
9/13/14	3:41:37	507152.28	9815356.55	41926.9
9/13/14	3:41:37	507150.91	9815357.32	41919.7
9/13/14	3:41:38	507150.91	9815357.32	41914.316
9/13/14	3:41:38	507149.51	9815358.12	41910.92
9/13/14	3:41:39	507149.51	9815358.12	41906.639
9/13/14	3:41:39	507148.11	9815358.95	41820.21
9/13/14	3:41:40	507148.11	9815358.95	41858.782
9/13/14	3:41:40	507146.55	9815359.7	41808.94
9/13/14	3:41:41	507146.55	9815359.7	41827.612
9/13/14	3:41:41	507145	9815360.59	41886.135
9/13/14	3:41:42	507145	9815360.59	41896.587
9/13/14	3:41:42	507142.95	9815361.35	41873.476
9/13/14	3:41:43	507142.95	9815361.35	41902.145
9/13/14	3:41:43	507141.09	9815362.32	41912.337
9/13/14	3:41:44	507141.09	9815362.32	41918.506
9/13/14	3:41:44	507139.59	9815362.94	41923.914
9/13/14	3:41:45	507139.59	9815362.94	41928.884
9/13/14	3:41:45	507138.16	9815363.67	41933.143
9/13/14	3:41:46	507138.16	9815363.67	41937.346
9/13/14	3:41:46	507136.22	9815364.56	41941.288

Time (Date)	Time (UTC)	Easting (m)	Northing (m)	Magnetic Field MAGNETOMETER [nT] Value
9/13/14	3:41:47	507136.22	9815364.56	41945.073
9/13/14	3:41:47	507134.43	9815365.54	41948.53
9/13/14	3:41:48	507134.43	9815365.54	41951.684
9/13/14	3:41:48	507132.63	9815366.2	41954.851
9/13/14	3:41:49	507132.63	9815366.2	41958.173
9/13/14	3:41:49	507130.99	9815367.07	41961.49
9/13/14	3:41:50	507130.99	9815367.07	41963.988
9/13/14	3:41:50	507129.41	9815367.6	41965.851
9/13/14	3:41:51	507129.41	9815367.6	41968.446
9/13/14	3:41:51	507127.93	9815368.36	41971.183
9/13/14	3:41:52	507127.93	9815368.36	41973.095
9/13/14	3:41:52	507126.42	9815369.16	41975.259
9/13/14	3:41:53	507126.42	9815369.16	41977.278
9/13/14	3:41:53	507124.92	9815370.03	41979.33
9/13/14	3:41:54	507124.92	9815370.03	41981.362
9/13/14	3:41:54	507123.26	9815370.56	41982.541
9/13/14	3:41:55	507123.26	9815370.56	41983.781
9/13/14	3:41:55	507121.74	9815371.38	41984.825
9/13/14	3:41:56	507121.74	9815371.38	41986.128
9/13/14	3:41:56	507120.21	9815372.2	41988.353
9/13/14	3:41:57	507120.21	9815372.2	41989.863
9/13/14	3:41:57	507118.68	9815373.09	41990.692
9/13/14	3:41:58	507118.68	9815373.09	41991.577
9/13/14	3:41:58	507116.67	9815373.77	41992.953
9/13/14	3:41:59	507116.67	9815373.77	41994.101
9/13/14	3:41:59	507114.89	9815374.76	41994.929
9/13/14	3:42:00	507114.89	9815374.76	41996.636
9/13/14	3:42:00	507113.35	9815375.33	41970.287

Time (Date)	Time (UTC)	Easting (m)	Northing (m)	Magnetic Field MAGNETOMETER [nT] Value
9/13/14	3:42:01	507113.35	9815375.33	41994.201
9/13/14	3:42:01	507111.93	9815376.09	41944.186
9/13/14	3:42:02	507111.93	9815376.09	41991.107
9/13/14	3:42:02	507110.2	9815376.8	41999.457
9/13/14	3:42:03	507110.2	9815376.8	41999.53
9/13/14	3:42:03	507108.56	9815377.65	41999.948
9/13/14	3:42:04	507108.56	9815377.65	42000.657
9/13/14	3:42:04	507106.86	9815378.52	42001.089
9/13/14	3:42:05	507106.86	9815378.52	42000.928
9/13/14	3:42:05	507105.25	9815379.54	42001.686
9/13/14	3:42:06	507105.25	9815379.54	42002.432
9/13/14	3:42:06	507103.71	9815380.6	42002.681
9/13/14	3:42:07	507103.71	9815380.6	42002.761
9/13/14	3:42:07	507102.26	9815381.64	41948.414
9/13/14	3:42:08	507102.26	9815381.64	41995.46
9/13/14	3:42:08	507100.84	9815382.64	42004.042
9/13/14	3:42:09	507100.84	9815382.64	42003.71
9/13/14	3:42:09	507099.41	9815383.62	42003.733
9/13/14	3:42:10	507099.41	9815383.62	42003.983
9/13/14	3:42:10	507097.96	9815384.67	42004.755
9/13/14	3:42:11	507097.96	9815384.67	41977.902
9/13/14	3:42:11	507096.53	9815385.8	42001.215
9/13/14	3:42:12	507096.53	9815385.8	42005.078
9/13/14	3:42:12	507095.13	9815387	42004.991
9/13/14	3:42:13	507095.13	9815387	42005.498
9/13/14	3:42:13	507093.14	9815386.72	42005.704
9/13/14	3:42:14	507093.14	9815386.72	41978.784
9/13/14	3:42:14	507091.63	9815387.28	42001.827

Time (Date)	Time (UTC)	Easting (m)	Northing (m)	Magnetic Field MAGNETOMETER [nT] Value
9/13/14	3:42:15	507091.63	9815387.28	42006.035
9/13/14	3:42:15	507089.99	9815387.83	41978.456
9/13/14	3:42:16	507089.99	9815387.83	42002.335
9/13/14	3:42:16	507088.29	9815388.54	42006.112
9/13/14	3:42:17	507088.29	9815388.54	42006.689
9/13/14	3:42:17	507086.64	9815389.32	42006.555
9/13/14	3:42:18	507086.64	9815389.32	42006.27
9/13/14	3:42:18	507084.89	9815390.14	42006.379
9/13/14	3:42:19	507084.89	9815390.14	42007.158
9/13/14	3:42:19	507083.27	9815391.12	42007.198
9/13/14	3:42:20	507083.27	9815391.12	42006.673
9/13/14	3:42:20	507081.54	9815391.71	42006.838
9/13/14	3:42:21	507081.54	9815391.71	42006.807
9/13/14	3:42:21	507079.89	9815392.48	42006.52
9/13/14	3:42:22	507079.89	9815392.48	42006.79
9/13/14	3:42:22	507078.48	9815393.01	42006.673
9/13/14	3:42:23	507078.48	9815393.01	42006.547
9/13/14	3:42:23	507076.99	9815393.82	42006.923
9/13/14	3:42:24	507076.99	9815393.82	42006.85

Note that this is not the full table, Check the disc for the complete table.

Tabel 4.2 The 3rd Main Line

Time (Date)	Time (UTC)	Easting (m)	Northing (m)	Magnetic Field MAGNETOMETER [nT] Value
9/13/14	1:09:24	506323.64	9816526.47	41960.812
9/13/14	1:09:25	506323.64	9816526.47	41960.638
9/13/14	1:09:25	506325.38	9816522.11	41961.424
9/13/14	1:09:26	506325.38	9816522.11	41961.215
9/13/14	1:09:26	506326.92	9816521.29	41961.174
9/13/14	1:09:27	506326.92	9816521.29	41913.45
9/13/14	1:09:27	506324.12	9816525.37	41954.438
9/13/14	1:09:28	506324.12	9816525.37	41961.581
9/13/14	1:09:28	506327.65	9816525.96	41961.523
9/13/14	1:09:29	506327.65	9816525.96	41961.364
9/13/14	1:09:29	506326.79	9816526.2	41961.33
9/13/14	1:09:30	506326.79	9816526.2	41961.222
9/13/14	1:09:30	506330.8	9816525.42	41961.984
9/13/14	1:09:31	506329.35	9816525.82	41962.088
9/13/14	1:09:31	506329.35	9816525.82	41961.583
9/13/14	1:09:32	506330.2	9816525.13	41961.207
9/13/14	1:09:32	506330.2	9816525.13	41961.761
9/13/14	1:09:33	506330.2	9816525.13	41961.838
9/13/14	1:09:33	506329.58	9816524.54	41961.802
9/13/14	1:09:34	506329.58	9816524.54	41962.319
9/13/14	1:09:34	506330.33	9816523.64	41962.284
9/13/14	1:09:35	506330.33	9816523.64	41961.647
9/13/14	1:09:35	506329.5	9816523.67	41962.133
9/13/14	1:09:36	506329.5	9816523.67	41962.161
9/13/14	1:09:36	506330.09	9816523.12	41962.527
9/13/14	1:09:37	506330.09	9816523.12	41962.234
9/13/14	1:09:37	506330.03	9816522.37	41962.153

Time (Date)	Time (UTC)	Easting (m)	Northing (m)	Magnetic Field MAGNETOMETER [nT] Value
9/13/14	1:09:38	506330.41	9816522.08	41962.214
9/13/14	1:09:38	506330.41	9816522.08	41961.948
9/13/14	1:09:39	506330.41	9816522.08	41961.97
9/13/14	1:09:39	506330.99	9816521.63	41962.734
9/13/14	1:09:40	506330.99	9816521.63	41963.15
9/13/14	1:09:40	506332.08	9816520.96	41962.25
9/13/14	1:09:41	506332.08	9816520.96	41962.306
9/13/14	1:09:41	506332.38	9816520.71	41962.235
9/13/14	1:09:42	506332.38	9816520.71	41962.531
9/13/14	1:09:42	506333.22	9816520.18	41962.808
9/13/14	1:09:43	506333.22	9816520.18	41962.754
9/13/14	1:09:43	506334.38	9816519.51	41962.031
9/13/14	1:09:44	506335.14	9816519	41962.42
9/13/14	1:09:44	506335.14	9816519	41962.744
9/13/14	1:09:45	506335.14	9816519	41963.109
9/13/14	1:09:45	506335.95	9816518.59	41963.174
9/13/14	1:09:46	506335.95	9816518.59	41963.478
9/13/14	1:09:46	506336.76	9816518.17	41963.306
9/13/14	1:09:47	506336.76	9816518.17	41962.456
9/13/14	1:09:47	506335.78	9816518.87	41962.663
9/13/14	1:09:48	506335.78	9816518.87	41963.684
9/13/14	1:09:48	506339.85	9816513.86	41963.439
9/13/14	1:09:49	506339.85	9816513.86	41962.618
9/13/14	1:09:49	506341.29	9816513.12	41963.274
9/13/14	1:09:50	506338.77	9816517	41963.607
9/13/14	1:09:50	506338.77	9816517	41963.2
9/13/14	1:09:51	506338.77	9816517	41962.408
9/13/14	1:09:51	506341.13	9816517.16	41963.071

Time (Date)	Time (UTC)	Easting (m)	Northing (m)	Magnetic Field MAGNETOMETER [nT] Value
9/13/14	1:09:52	506341.13	9816517.16	41964.169
9/13/14	1:09:52	506340.15	9816517.42	41963.86
9/13/14	1:09:53	506343.64	9816517.57	41963.348
9/13/14	1:09:53	506343.64	9816517.57	41963.076
9/13/14	1:09:54	506343.64	9816517.57	41963.488
9/13/14	1:09:54	506342.9	9816517.79	41963.926
9/13/14	1:09:55	506342.9	9816517.79	41963.974
9/13/14	1:09:55	506343.84	9816517.01	41964.23
9/13/14	1:09:56	506343.84	9816517.01	41964.622
9/13/14	1:09:56	506343.81	9816516.52	41964.23
9/13/14	1:09:57	506344.5	9816515.59	41963.813
9/13/14	1:09:57	506344.5	9816515.59	41963.973
9/13/14	1:09:58	506344.5	9816515.59	41964.024
9/13/14	1:09:58	506345.3	9816514.47	41964.158
9/13/14	1:09:59	506346.57	9816513.41	41964.282
9/13/14	1:09:59	506346.57	9816513.41	41964.567
9/13/14	1:10:00	506348.01	9816512.82	41964.695
9/13/14	1:10:00	506348.01	9816512.82	41964.469
9/13/14	1:10:01	506348.01	9816512.82	41964.123
9/13/14	1:10:01	506348.83	9816511.8	41964.114
9/13/14	1:10:02	506348.83	9816511.8	41964.29
9/13/14	1:10:02	506350.09	9816511.26	41964.516
9/13/14	1:10:03	506351.43	9816510.56	41964.876
9/13/14	1:10:03	506351.43	9816510.56	41965.064
9/13/14	1:10:04	506351.43	9816510.56	41964.499
9/13/14	1:10:04	506352.74	9816510.01	41964.29
9/13/14	1:10:05	506354.09	9816509.34	41964.517
9/13/14	1:10:05	506354.09	9816509.34	41964.682

Time (Date)	Time (UTC)	Easting (m)	Northing (m)	Magnetic Field MAGNETOMETER [nT] Value
9/13/14	1:10:06	506354.09	9816509.34	41964.546
9/13/14	1:10:06	506356.1	9816508.09	41964.224
9/13/14	1:10:07	506358.01	9816507	41964.323
9/13/14	1:10:07	506358.01	9816507	41964.223
9/13/14	1:10:08	506358.01	9816507	41965.016
9/13/14	1:10:08	506359.64	9816506.11	41965.236
9/13/14	1:10:09	506361.24	9816505.2	41964.712
9/13/14	1:10:09	506361.24	9816505.2	41964.146
9/13/14	1:10:10	506363.07	9816503.91	41963.996
9/13/14	1:10:10	506363.07	9816503.91	41964.275
9/13/14	1:10:11	506363.07	9816503.91	41964.332
9/13/14	1:10:11	506364.74	9816503.04	41964.98
9/13/14	1:10:12	506364.74	9816503.04	41964.113
9/13/14	1:10:12	506366.39	9816502.04	41963.684
9/13/14	1:10:13	506366.39	9816502.04	41964.474
9/13/14	1:10:13	506368.04	9816501.06	41965.903
9/13/14	1:10:14	506367.18	9816500.75	41963.795
9/13/14	1:10:14	506367.18	9816500.75	41963.743
9/13/14	1:10:15	506367.9	9816500.28	41963.849
9/13/14	1:10:15	506367.9	9816500.28	41964.271
9/13/14	1:10:16	506368.93	9816499.61	41964.394
9/13/14	1:10:16	506368.93	9816499.61	41964.551
9/13/14	1:10:17	506369.93	9816498.89	41964.43
9/13/14	1:10:17	506369.93	9816498.89	41963.509
9/13/14	1:10:18	506370.93	9816498.17	41963.445
9/13/14	1:21:30	507217.86	9815985.6	41965.428
9/13/14	1:21:31	507217.86	9815985.6	41966.004
9/13/14	1:21:31	507219.25	9815984.91	41966.125

Time (Date)	Time (UTC)	Easting (m)	Northing (m)	Magnetic Field MAGNETOMETER [nT] Value
9/13/14	1:21:32	507220.62	9815984.19	41966.145
9/13/14	1:21:32	507220.62	9815984.19	41965.352
9/13/14	1:21:33	507221.79	9815983.31	41964.817
9/13/14	1:21:33	507221.79	9815983.31	41964.585
9/13/14	1:21:34	507221.79	9815983.31	41964.781
9/13/14	1:21:34	507222.97	9815982.56	41965.542
9/13/14	1:21:35	507224.02	9815981.94	41965.419
9/13/14	1:21:35	507224.02	9815981.94	41965.208
9/13/14	1:21:36	507225.08	9815981.29	41964.642
9/13/14	1:21:36	507225.08	9815981.29	41964.126
9/13/14	1:21:37	507225.08	9815981.29	41964.455
9/13/14	1:21:37	507226.41	9815980.54	41964.753
9/13/14	1:21:38	507226.41	9815980.54	41964.849
9/13/14	1:21:38	507227.77	9815979.8	41964.22
9/13/14	1:21:39	507228.81	9815978.99	41963.373
9/13/14	1:21:39	507228.81	9815978.99	41963.219
9/13/14	1:21:40	507229.87	9815978.29	41963.564
9/13/14	1:21:40	507229.87	9815978.29	41963.835
9/13/14	1:21:41	507231.25	9815977.54	41963.524
9/13/14	1:21:41	507231.25	9815977.54	41962.985
9/13/14	1:21:42	507232.57	9815976.73	41962.898
9/13/14	1:21:42	507232.57	9815976.73	41962.116
9/13/14	1:21:43	507233.7	9815976.02	41961.771
9/13/14	1:21:43	507233.7	9815976.02	41961.846
9/13/14	1:21:44	507234.87	9815975.37	41961.653
9/13/14	1:21:44	507234.87	9815975.37	41961.311
9/13/14	1:21:45	507236.34	9815974.46	41960.718
9/13/14	1:21:45	507236.34	9815974.46	41960.149

Time (Date)	Time (UTC)	Easting (m)	Northing (m)	Magnetic Field MAGNETOMETER [nT] Value
9/13/14	1:21:46	507237.69	9815973.6	41960.233
9/13/14	1:21:46	507237.69	9815973.6	41959.905
9/13/14	1:21:47	507238.78	9815972.84	41959.661
9/13/14	1:21:47	507238.78	9815972.84	41959.651
9/13/14	1:21:48	507239.91	9815972.1	41958.93
9/13/14	1:21:48	507239.91	9815972.1	41958.172
9/13/14	1:21:49	507241.03	9815971.44	41957.596
9/13/14	1:21:49	507241.03	9815971.44	41957.014
9/13/14	1:21:50	507242.12	9815970.77	41956.495
9/13/14	1:21:50	507242.12	9815970.77	41956.106
9/13/14	1:21:51	507243.23	9815970.09	41955.677
9/13/14	1:21:51	507243.23	9815970.09	41954.732
9/13/14	1:21:52	507244.34	9815969.37	41953.68
9/13/14	1:21:52	507244.34	9815969.37	41953.078
9/13/14	1:21:53	507245.55	9815968.54	41952.554
9/13/14	1:21:53	507245.55	9815968.54	41952.036
9/13/14	1:21:54	507246.77	9815967.73	41951.744
9/13/14	1:21:54	507246.77	9815967.73	41950.661
9/13/14	1:21:55	507248.05	9815966.99	41949.4
9/13/14	1:21:55	507248.05	9815966.99	41948.47
9/13/14	1:21:56	507249.26	9815966.25	41947.538
9/13/14	1:21:56	507249.26	9815966.25	41946.621
9/13/14	1:21:57	507249.26	9815966.25	41945.51
9/13/14	1:21:57	507250.5	9815965.69	41944.128
9/13/14	1:21:58	507251.65	9815964.99	41942.777
9/13/14	1:21:58	507251.65	9815964.99	41941.43
9/13/14	1:21:59	507252.78	9815964.2	41940.556
9/13/14	1:21:59	507252.78	9815964.2	41939.714

Time (Date)	Time (UTC)	Easting (m)	Northing (m)	Magnetic Field MAGNETOMETER [nT] Value
9/13/14	1:22:00	507253.96	9815963.45	41938.36
9/13/14	1:22:00	507253.96	9815963.45	41936.587
9/13/14	1:22:01	507255.12	9815962.72	41935.046
9/13/14	1:22:01	507255.12	9815962.72	41933.365
9/13/14	1:22:02	507256.24	9815961.97	41932.316
9/13/14	1:22:02	507256.24	9815961.97	41930.949
9/13/14	1:22:03	507257.58	9815961.29	41928.911
9/13/14	1:22:03	507257.58	9815961.29	41927.17
9/13/14	1:22:04	507258.85	9815960.51	41925.212
9/13/14	1:22:04	507258.85	9815960.51	41923.61
9/13/14	1:22:05	507259.98	9815959.81	41922.238
9/13/14	1:22:05	507259.98	9815959.81	41921.151
9/13/14	1:22:06	507261.1	9815959.1	41919.557
9/13/14	1:22:06	507261.1	9815959.1	41917.73
9/13/14	1:22:07	507262.15	9815958.39	41916.49
9/13/14	1:22:07	507262.15	9815958.39	41915.928
9/13/14	1:22:08	507263.22	9815957.67	41915.85
9/13/14	1:22:08	507263.22	9815957.67	41916.102
9/13/14	1:22:09	507264.26	9815957.12	41915.831
9/13/14	1:22:09	507264.26	9815957.12	41915.339
9/13/14	1:22:10	507265.3	9815956.44	41914.849
9/13/14	1:22:10	507265.3	9815956.44	41914.865
9/13/14	1:22:11	507266.68	9815955.75	41915.397
9/13/14	1:22:11	507266.68	9815955.75	41915.344
9/13/14	1:22:12	507267.98	9815954.97	41912.82
9/13/14	1:22:12	507267.98	9815954.97	41907.795
9/13/14	1:22:13	507269.23	9815954.19	41902.319
9/13/14	1:22:13	507269.23	9815954.19	41899.182

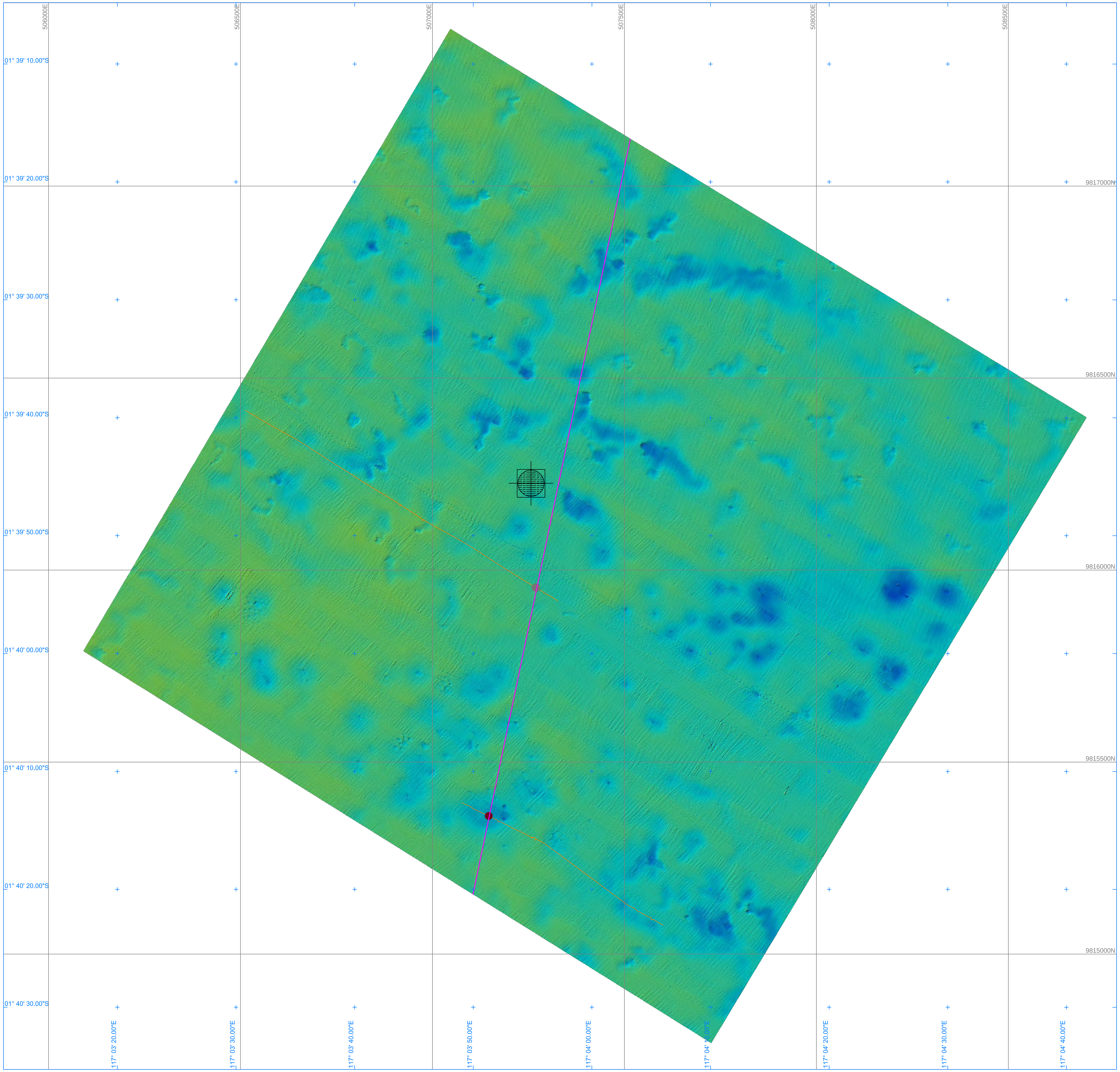
Time (Date)	Time (UTC)	Easting (m)	Northing (m)	Magnetic Field MAGNETOMETER [nT] Value
9/13/14	1:22:14	507270.43	9815953.42	41899.991
9/13/14	1:22:14	507270.43	9815953.42	41903.454
9/13/14	1:22:15	507271.63	9815952.64	41908.25
9/13/14	1:22:15	507271.63	9815952.64	41914.547
9/13/14	1:22:16	507272.83	9815951.86	41922.676
9/13/14	1:22:16	507272.83	9815951.86	41932.135
9/13/14	1:22:17	507274.05	9815951.3	41942.527
9/13/14	1:22:17	507274.05	9815951.3	41951.688
9/13/14	1:22:18	507275.2	9815950.59	41958.541
9/13/14	1:22:18	507275.2	9815950.59	41963.079
9/13/14	1:22:19	507276.33	9815949.94	41966.565
9/13/14	1:22:19	507276.33	9815949.94	41969.613
9/13/14	1:22:20	507277.44	9815949.24	41972.275
9/13/14	1:22:20	507277.44	9815949.24	41974.091
9/13/14	1:22:21	507278.83	9815948.67	41975.264
9/13/14	1:22:21	507278.83	9815948.67	41975.749
9/13/14	1:22:22	507278.83	9815948.67	41975.614
9/13/14	1:22:22	507280.12	9815947.95	41975.867
9/13/14	1:22:23	507281.17	9815947.27	41976.099
9/13/14	1:22:23	507281.17	9815947.27	41976.66
9/13/14	1:22:24	507282.26	9815946.59	41976.559
9/13/14	1:22:24	507282.26	9815946.59	41975.788
9/13/14	1:22:25	507283.64	9815945.8	41974.831
9/13/14	1:22:25	507283.64	9815945.8	41974.73
9/13/14	1:22:26	507284.95	9815944.97	41974.992
9/13/14	1:22:26	507284.95	9815944.97	41975.305
9/13/14	1:22:27	507286.21	9815944.16	41975.253
9/13/14	1:22:27	507286.21	9815944.16	41973.845

Time (Date)	Time (UTC)	Easting (m)	Northing (m)	Magnetic Field MAGNETOMETER [nT] Value
9/13/14	1:22:28	507287.47	9815943.37	41972.912
9/13/14	1:22:28	507287.47	9815943.37	41972.639
9/13/14	1:22:29	507288.69	9815942.56	41973.088
9/13/14	1:22:29	507288.69	9815942.56	41973.273
9/13/14	1:22:30	507289.9	9815941.72	41973.617
9/13/14	1:22:30	507289.9	9815941.72	41972.925
9/13/14	1:22:31	507291.08	9815940.88	41971.87
9/13/14	1:22:31	507291.08	9815940.88	41971.574
9/13/14	1:22:32	507292.22	9815940.08	41971.546
9/13/14	1:22:32	507292.22	9815940.08	41971.841
9/13/14	1:22:33	507293.35	9815939.29	41972.131
9/13/14	1:22:33	507293.35	9815939.29	41971.837
9/13/14	1:22:34	507294.52	9815938.5	41971.021
9/13/14	1:22:34	507294.52	9815938.5	41970.348
9/13/14	1:22:35	507295.92	9815937.9	41970.222
9/13/14	1:22:35	507295.92	9815937.9	41970.559
9/13/14	1:22:36	507296.99	9815937.31	41971.063
9/13/14	1:22:36	507296.99	9815937.31	41971.24
9/13/14	1:22:37	507298.06	9815936.67	41970.394
9/13/14	1:22:37	507298.06	9815936.67	41969.459
9/13/14	1:22:38	507298.06	9815936.67	41969.601
9/13/14	1:22:38	507299.23	9815936.02	41970.118
9/13/14	1:22:39	507300.41	9815935.34	41970.395
9/13/14	1:22:39	507300.41	9815935.34	41969.983
9/13/14	1:22:40	507301.92	9815934.65	41969.255
9/13/14	1:22:40	507301.92	9815934.65	41968.765
9/13/14	1:22:41	507303.34	9815933.82	41968.417
9/13/14	1:22:41	507303.34	9815933.82	41968.974

Time (Date)	Time (UTC)	Easting (m)	Northing (m)	Magnetic Field MAGNETOMETER [nT] Value
9/13/14	1:22:42	507303.34	9815933.82	41969.466
9/13/14	1:22:42	507304.73	9815933.02	41969.775
9/13/14	1:22:43	507306.04	9815932.26	41969.483
9/13/14	1:22:43	507306.04	9815932.26	41968.73
9/13/14	1:22:44	507307.13	9815931.85	41968.403
9/13/14	1:22:44	507307.13	9815931.85	41968.21
9/13/14	1:22:45	507308.21	9815931.26	41968.655
9/13/14	1:22:45	507308.21	9815931.26	41968.999
9/13/14	1:22:46	507308.21	9815931.26	41969.19
9/13/14	1:22:46	507309.7	9815930.41	41968.31
9/13/14	1:22:47	507310.64	9815929.68	41967.851
9/13/14	1:22:47	507310.64	9815929.68	41967.972
9/13/14	1:22:48	507310.64	9815929.68	41968.058
9/13/14	1:22:48	507311.65	9815929.01	41968.405
9/13/14	1:22:49	507311.65	9815929.01	41968.4
9/13/14	1:22:49	507312.99	9815928.38	41968.461
9/13/14	1:22:50	507312.99	9815928.38	41968.202
9/13/14	1:22:50	507314.28	9815927.62	41967.956
9/13/14	1:22:51	507314.28	9815927.62	41967.346
9/13/14	1:22:51	507315.36	9815926.82	41967.167
9/13/14	1:22:52	507315.36	9815926.82	41967.243
9/13/14	1:22:52	507316.55	9815926.07	41967.886
9/13/14	1:22:53	507316.55	9815926.07	41968.288
9/13/14	1:22:53	507317.72	9815925.55	41968.244
9/13/14	1:22:54	507317.72	9815925.55	41967.342
9/13/14	1:22:54	507318.82	9815924.91	41967.03
9/13/14	1:22:55	507319.98	9815924.24	41967.008
9/13/14	1:22:55	507319.98	9815924.24	41967.599

Time (Date)	Time (UTC)	Easting (m)	Northing (m)	Magnetic Field MAGNETOMETER [nT] Value
9/13/14	1:22:56	507321.38	9815923.29	41968.29
9/13/14	1:22:56	507321.38	9815923.29	41968.546
9/13/14	1:22:57	507321.38	9815923.29	41967.693
9/13/14	1:22:57	507322.54	9815922.51	41966.685
9/13/14	1:22:58	507322.54	9815922.51	41967.049
9/13/14	1:22:58	507323.71	9815921.77	41967.69
9/13/14	1:22:59	507323.71	9815921.77	41967.803
9/13/14	1:22:59	507324.95	9815920.89	41968.122
9/13/14	1:23:00	507324.95	9815920.89	41967.803
9/13/14	1:23:00	507326.19	9815920.06	41966.859

Note that this is not the full table, Check the disc for the complete table.



MORPHOLOGY AND HAZARD POTENTIALS MAP

LOCATION MAP

SCALE

0 50 100 150 200 250 300 350 400 450 500 Metres

SCALE 1 : 5,000

N W E S

GEODETIC PARAMETERS

DATA ACQUISITION

Survey vessel : MV *MGS Geo Survey*
Magnetometer : Sea SPY
Primary positioning system : StarFix 9200 G2

Acoustic positioning system : Sonardyne Ranger 2
Multibeam Echosounder : R2SONIC 2024

GEODETIC PARAMETER

Spheroid / Ellipsoid : WGS84
Semi Major Axis : 6 378 137.000 m
Semi Minor Axis : 6 356 752.314 m
Inverse Flattening (1/f) : 298.257 223 563
Primary Positioning System : StarFix

Projection : Universal Transverse Mercator
False Easting : 500 000 m
False Northing : 10 000 000 m
Unit On : m (meters)

LEGEND

Graticule

The Drilling Point

Magnetic Anomaly 1

Magnetic Anomaly 2

Acquisition Line of Magnetometer

An Existing Pipeline That Can Cause Hazard Potentials Around The Drilling Point

(Meter)
-45.00
-47.00
-49.00
-51.00
-53.00
-55.00

Note: The depth Chart and coordinates are not an actual. The real depth chart and coordinates are classified by the company.

DATA PROVIDER :

PT. MAHAKARYA GEO SURVEY
Jl. Tebet Raya No. 91 A
Jakarta Selatan 12820 Indonesia
Tel : +62 218378 3792 Fax : +62 218378 7136

PROCESSED AND DRAFTED BY :

Moh Gema Perkasa Drakel

3511 100 053

ADVISER 1 :

Ir. Yuwono, MT

ADVISER 2 :

Udiana Wahyu Deviantari ST, MT

ADVISER FROM DATA PROVIDER :

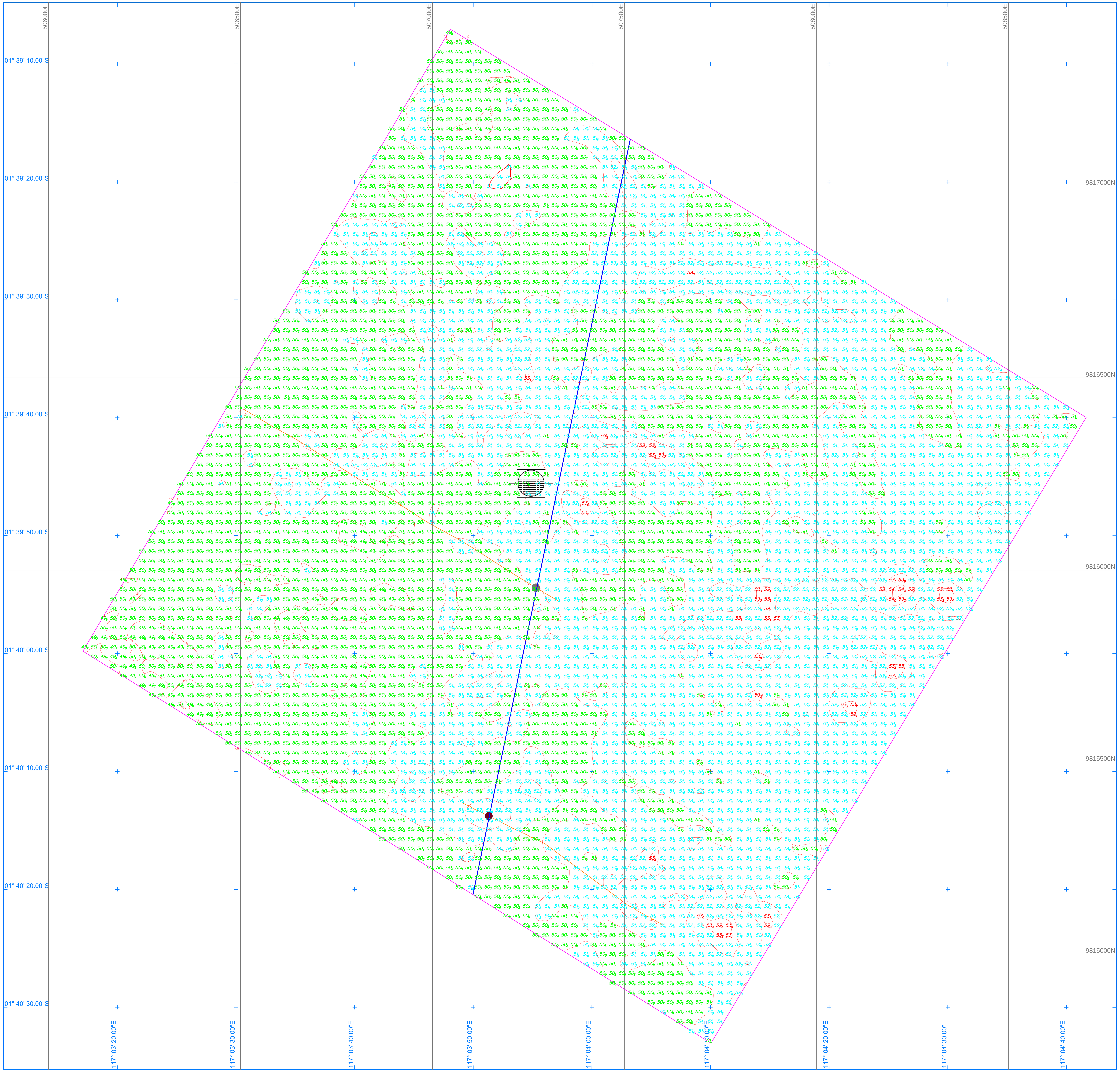
Muhammad Aga R. A

MANUFACTURED ON :

MARCH 27th 2015

GEOMATICS ENGINEERING DEPARTMENT
CIVIL ENGINEERING AND PLANNING FACULTY
SEPULUH NOPEMBER INSTITUTE OF TECHNOLOGY
SURABAYA
2015

Original Size A1



MORPHOLOGY AND HAZARD POTENTIALS MAP (BATHYMETRY)

LOCATION MAP

SCALE

0 50 100 150 200 250 300 350 400 450 500 Metres

SCALE 1 : 5,000

N
W E
S

GEODETIC PARAMETERS

DATA ACQUISITION

Survey vessel : MV *MGS Geo Survey*
Magnetometer : Sea SPY
Primary positioning system : StarFix 9200 G2
Acoustic positioning system : Sonardyne Ranger 2
Multibeam Echosounder : R2SONIC 2024

GEODETIC PARAMETER

Spheroid / Ellipsoid	: WGS84	Projection	: Universal Transverse Mercator
Semi Major Axis	: 6 378 137.000 m	False Easting	: 500 000 m
Semi Minor Axis	: 6 356 752.314 m	False Northing	: 10 000 000 m
Inverse Flattening (1/f)	: 298.257 223 563	Unit On	: m (meters)
Primary Positioning System	: StarFix		

LEGEND

Graticule

The Drilling Point

Magnetic Anomaly 1

Magnetic Anomaly 2

Acquisition Line of Magnetometer

An Existing Pipeline That Can Cause Hazard Potentials Around The Drilling Point

Contour Line

Depth Point

1 Meter — Contour Interval

Note: The depth Chart and coordinates are not an actual. The real depth chart and coordinates are classified by the company.

DATA PROVIDER :

PT. MAHAKARYA GEO SURVEY
Jl. Tebet Raya No. 91 A
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SURABAYA
2015

Original Size A1

BIOGRAPHY

Moh Gema Perkasa Drakel. Was born in Palu 1st October 1993, Grew up in Palu as well as in and Makassar. He is a middle son of three sisters. Several formal educations had been passed by the writer started from Raudhatul Athfal KinderGarden Palu, Lolu 6 Elementary School Palu, Al - Azhar Islamic Junior High School, Athirah Islamic Senior High School Makassar and then continued his study at Sepuluh Nopember Institute of Technology, Civil Engineering and Planning Faculty, in Geomatics Engineering Department Bachelor's Degree (S1). He passed the test through PKM in 2011 and registered with the NRP 3511 100 053. During his time in college life he was involved in several organisations, as a staff on Department KWU 2011-2012 for The Association of The Geodetic Student of Sepuluh Nopember Institute of Technology (HIMAGE-ITS) and also In 2013 he became The General Secretary of Association of Indonesian geodetic student (IMGI) For Period 2013-2014. Although he was busy with his college, he always had time to explore The Beauty of Indonesia and wrote it as well on www.gemadrakel.com without leaving his responsibility as an engineer student. The Writer also had an experience working in Hydrographic Surveying along with PT. Mahakarya Geo Survey on his Internship Programs in 2014. The Hydrographic Expertise was choosen by the writer as a reference for his thesis to finish his study.