IALA GUIDELINE

1104

THE APPLICATION OF MARITIME SURFACE PICTURE FOR ANALYSIS IN RISK ASSESSMENT AND THE PROVISION OF AIDS TO NAVIGATION

Edition 1.0

December 2013

10, rue des Gaudines - 78100 Saint Germain en Laye, France
Tél. +33 (0)1 34 51 70 01- Fax +33 (0)1 34 51 82 05 - contact@iala-aism.org
www.iala-aism.org

International Association of Marine Aids to Navigation and Lighthouse Authorities
Association Internationale de Signalisation Maritime

DOCUMENT REVISION

Revisions to this IALA Document are to be noted in the table prior to the issue of a revised document.

Date	Page / Section Revised	Requirement for Revision

CONTENTS

List of Figures

1. INTRODUCTION

The use of Geographic Information Systems (GIS) to enhance the overall maritime surface picture allows for a more thorough assessment of the risk presented to the mariner. As a consequence, decision making processes by Aids to Navigation (AtoN) authorities will be assisted and will provide a documented record of an appropriate assessment of the volume of traffic and the degree of risk.

2. SCOPE

This document provides guidance on the use of GIS to assess the requirement and impact of AtoN in the area of interest. It covers incorporation of charting overlays with new dangers and amplification of existing dangers. Automatic Identification System (AIS) data will be used to determine traffic profile and volume.

An appropriate level of competence in marine navigation and familiarity in the area being assessed will be required to make full use of this tool.

This document is a general guide only and is not intended to be a defined prescriptive document on the provision of AtoN using GIS. For more technical advice, Guideline 1057 on use of Geographic Information Systems by Aids to Navigation Authorities should be consulted.

The guidance introduces various potential applications for GIS data analysis to assist the AtoN authority to make a well informed decision based on all the quantitative and qualitative data available as well as using traditional methods of navigational analysis. The options discussed are not an exhaustive list and the AtoN authority should always look to use any additional information available to them.

3. OVERVIEW OF GIS METHODOLOGY

Initial use of GIS to assist in the determination of AtoN requirements will normally begin with data being transposed on to a nautical chart layer of an appropriate scale to inform further analysis.

Once the area of assessment is identified on the chart a series of layers can be used including:

- Vessel traffic patterns using AIS data;
- Leisure vessel data;
- Fishing vessel data;
- Existing and proposed offshore structures developments;
- Up to date and historical hydrographic survey information;
- Position, nominal range and sectors of visibility of lighthouses and beacons;
- Position and type of AtoN.

The GIS will then be used to systematically show and remove layers, allowing for in depth study of all factors both in isolation and in combination with the other elements.

4. APPLICATIONS

4.1. INTRODUCTION

There are a number of applications relevant to this analysis tool including

- Wreck marking;
- Obstructions such as new offshore structures;

- New dangers such as newly discovered shallow soundings;
- New routing measures or traffic separation scheme.

4.2. ASSESSMENT OF WRECKS AND OBSTRUCTIONS

When a new wreck or obstruction has been announced a formal assessment must be made on whether;

- a vessel and personnel need to be deployed to accurately survey or guard the wreck or obstruction
- an appropriate AtoN needs to be deployed

Before traffic data was available this decision relied almost entirely on the expertise of the assessor with no supporting evidence to underpin the decision. Information is and has been available for many years regarding vessel trading routes which helped to inform the process but this information was not able to provide quantitative data on specific traffic movements or indeed an assessment of the dimension of vessels actually passing over a particular location.

Considering each situation, those assessing the risk must make a rapid but informed decision based on the worst possible scenario. An assessment of the clearance between the wreck and the sea surface at chart datum or Lowest Astronomical Tide (LAT) must be made.

Using an appropriate analysis tool, and compiling AIS traffic data over a significant period, the assessor will be able to extract the volume and type of vessels over a specific draft that pass in the vicinity of the wreck.

As an example, referring to Figure 1:

If it is considered that an obstruction has been reported with a maximum height above the sea bed of 15 metres, which is located in an area with surrounding depths of 22 metres, then the available depth over the obstruction is 7 metres and therefore vessels with a draught over 5 metres maybe considered to be in danger.

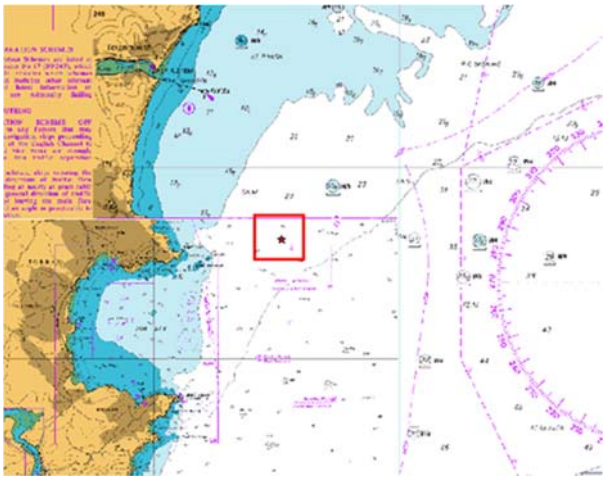

Figure 1 Initial position of the wreck plotted

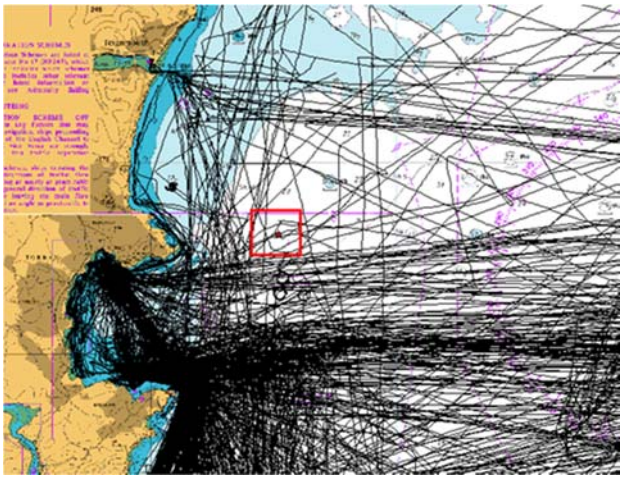

Figure 2 Wreck together with 28 days AIS data traffic

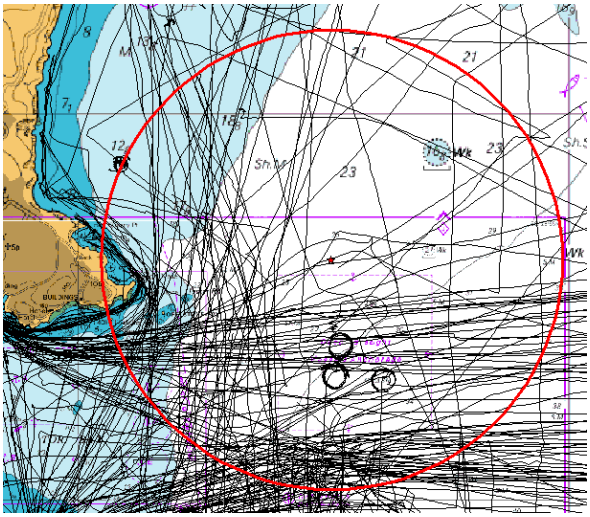

Figure 3 Vessels passing within 3nm of the wreck

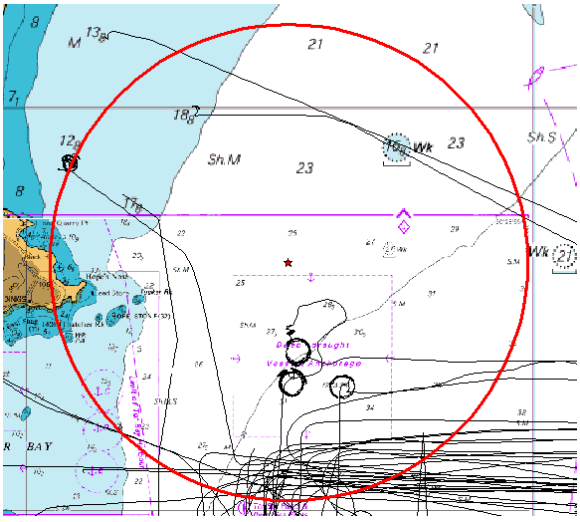

Figure 4 Vessels over 5 metres draught

Filtering of the AIS data layer to show only vessels with a draught in excess of 5 metres can then inform the risk assessment to determine whether further action is required which may include the deployment of AtoN to mitigate the risk.

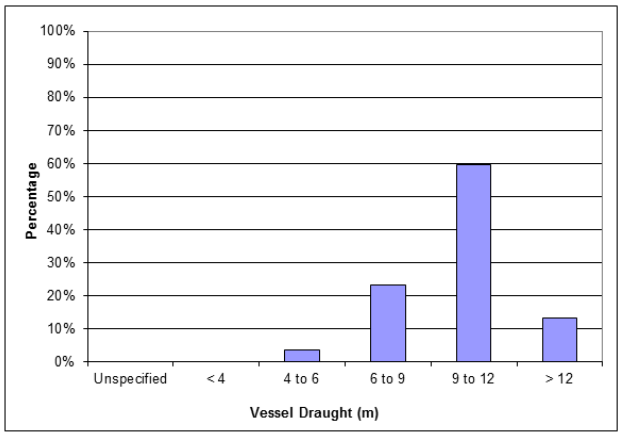

Figure 5 Traffic analysis by draught(1)

Draught (m)	No. of Vessels	%
Unspecified	0	0 %
< 4	0	0 %
4 to 6	3	4 %
6 to 9	19	23 %
9 to 12	49	60 %
> 12	11	13 %
Total	82	100 %

Figure 6 Traffic analysis by draught(2)

Further filtering of vessels types including the consideration of AIS class A and B will also provide for a more in depth assessment of the risk and mitigation measures required.

4.3. ASSESSMENT OF MARKING REQUIREMENTS FOR NEW OR EXISTING SHOALS AND SHALLOW AREAS SUBSEQUENT TO HYDROGRAPHIC SURVEY

When new survey information is received it is necessary to make an assessment as to whether both charting and AtoN requirements needs to be amended. This may have relevance to the AtoN already deployed. A decision shall be made on whether new or amended AtoN are required and the time frame within which they must be deployed.

When new survey information is received the GIS can be used to overlay survey and contour information from both the recent survey and historical data available. The rate of change and consideration of AtoN in the area can then be clearly examined to make an informed assessment of any changes that may be required. For example, the number, type, and draught of vessels, will have an impact on the decision for amending the current location of the AtoN or deployment of new AtoN.

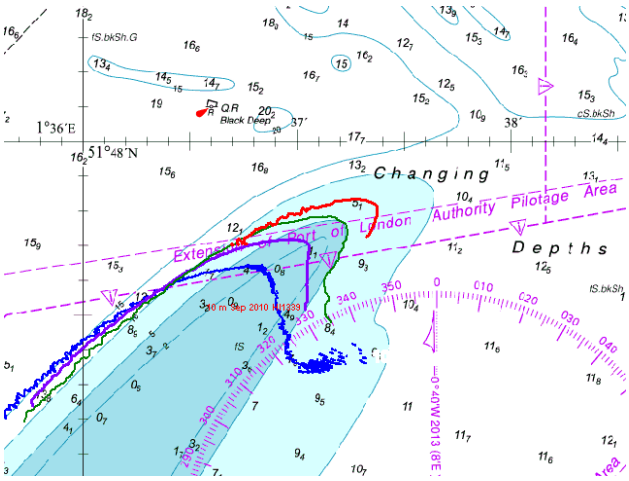

Figure 7 5 metres contours over a 4 year period

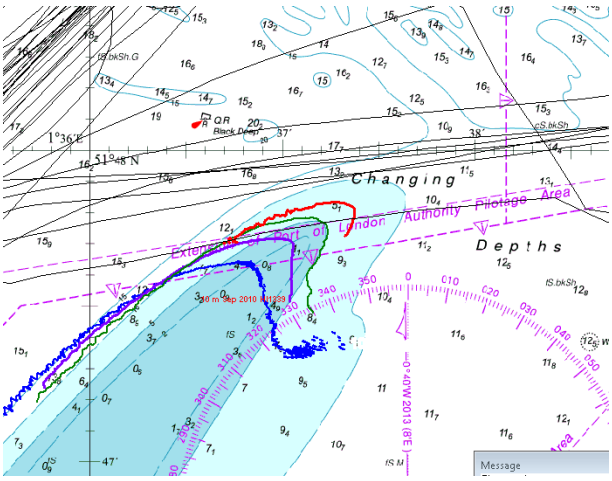

Figure 8 Original traffic patterns with contours

4.4. DETERMINING AND REVIEWING THE APPROPRIATE OVERALL REQUIREMENTS, NUMBER AND MIX OF AIDS TO NAVIGATION IN EXISTING AND NEW APPLICATIONS

By considering the actual coverage of current AtoN provided, including accurate assessment of nominal ranges of both charted and uncharted sectors of fixed lights, together with floating AtoN, then, combining this data with up to date traffic patterns an informed decision on the on-going requirements for existing AtoN and the requirement for additional or different AtoN can be made.

An on-going assessment will always be required to ensure that any changes, including bathymetry and new offshore dangers are addressed to ensure the continued safety of the mariner.

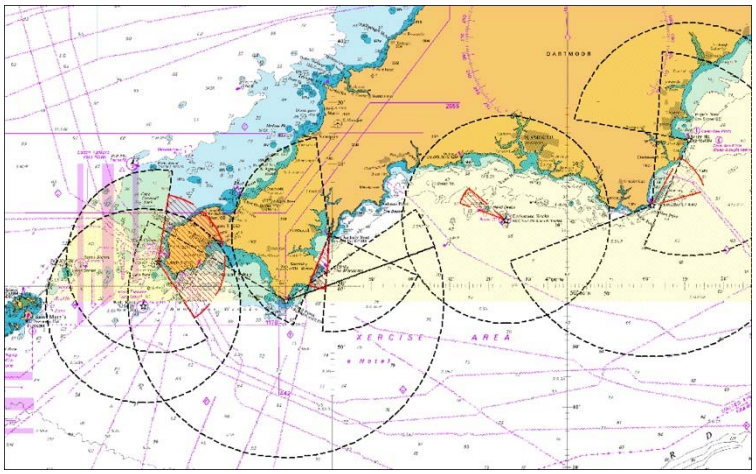

Figure 9 An example of adjacent lighthouses showing range and sector details

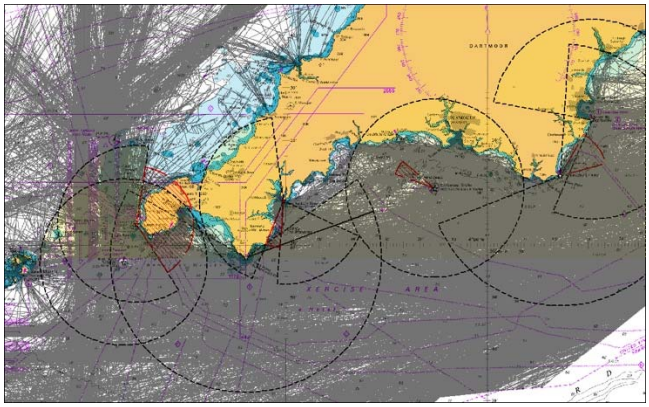

Figure 10 Lighthouse data with 28 days of traffic shown

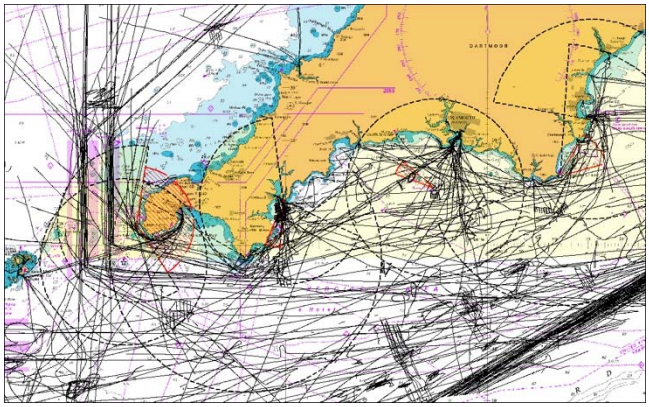

Figure 11 Vessel traffic filtered to show 1 day

From Figure 10 and Figure 11 it can be seen that initial overlays of extensive traffic data require careful filtering for example on period, type of vessel and draughts to make a more informed assessment of requirements.

4.5. DETERMINING THE NEED FOR NEW ROUTING MEASURES OR TRAFFIC SEPARATION SCHEMES

AIS data and other traffic information can assist in determining whether a new routing measure or separation scheme is required. The responsible authority, by analysing the AIS data for a specific area of interest, can determine the routes used by different types of vessels.

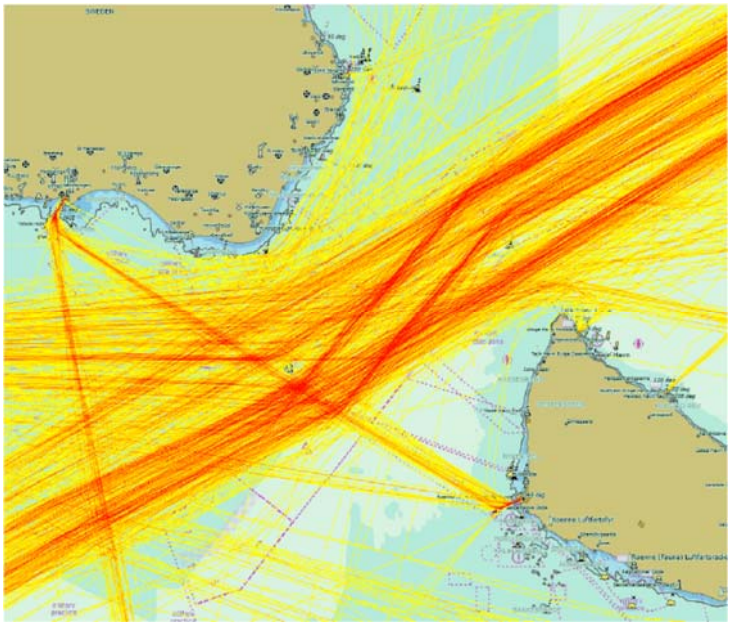

Figure 12 AIS density plot before the implementation of Traffic Separation Scheme (TSS) Bornholmsgat between Denmark and Sweden

4.6. POST IMPLEMENTATION ANALYSIS

Once changes to the shipping routes or the AtoN have been implemented, AIS overlays provide a useful tool to measure the effectiveness of the new measure(s) introduced.

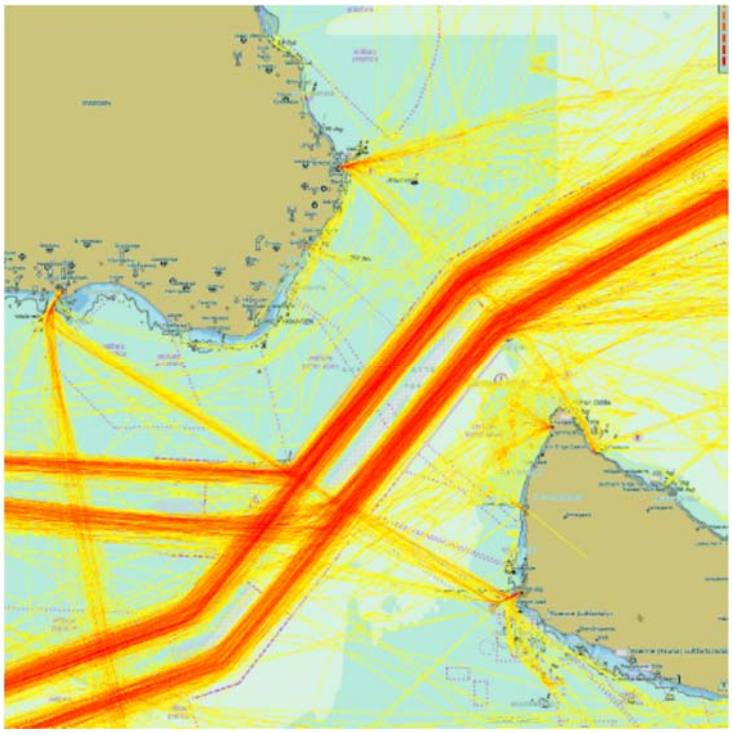

Figure 13 AIS density plot after the implementation of TSS Bornholmsgat between Denmark and Sweden

5. OTHER CONSIDERATIONS

5.1. POSSIBLE LIMITATIONS TO BE CONSIDERED WITH AIS DATA

The data and information that is gained through AIS traffic analysis must be treated with a certain amount of caution.

- The data received from the vessel, other than position information, is dependent on the accuracy of the input from the vessel;

  There are many instances where ship dynamic AIS data such as draught and destination are incorrect or suspect;

- Many users of AtoN are not required to carry AIS transceivers;

  Although many leisure craft now carry AIS class B, this is not mandatory and as such this sector of the user community must be further considered using other data inputs. For example, a yachting routing atlas, as a GIS overlay;

- AIS data is generally received from a network of base stations;

  The data will become less reliable the further the area being considered is offshore. There is not a firm line between good and poor data with differing atmospheric conditions affecting reception at different times. Data received from further offshore, including AIS satellite data, must be treated with caution;

- The volume and type of marine traffic may be subject to variations on an hourly, daily, weekly or seasonal basis e.g. fishing and tourist / leisure activities during the summer or traffic movements by local ferries at certain times of the day.

6. CONCLUSION

The assessment process for the provision of AtoN must rely mainly on the qualitative assessment of experts. The diversity of the various aspects that have to be considered will include the vast assortment and variety of vessels, the experience of the mariners involved and the very different parameters that exist at the different locations.

This qualitative assessment can now be informed by the quantitative, statistical elements provided by AIS traffic analysis data and GIS overlays; subject to the possible inaccuracies in overall AIS data.

It is essential that every opportunity is taken to provide the correct control measures to mitigate risk. These include the most appropriate mix of AtoN and consideration of navigation aids available on board the vessels in question.

It is also essential that resources are used appropriately without any negative effect on the safety of the mariner. In depth AIS traffic analysis can inform decisions to ensure that maximum efficiencies are achieved.

7. ACRONYMS AND DEFINITIONS

7.1. ACRONYMS

AIS	Automatic Identification System
AtoN	Aid to Navigation
GIS	Geographic Information System
LAT	Lowest Astronomical Tide
TSS	Traffic Separation Scheme

7.2. DEFINITIONS

Nominal range	The luminous range when the meteorological visibility is 10 nm. Nominal range assumes that the light is observed against a dark background, free of background lighting.