

# Underwater Noise

## 1.1 Introduction

The EU Marine Strategy Framework Directive (hereinafter referred to as ‘MSFD’) calls for the assessment of underwater noise as a pressure on the environmental status of marine waters (Table 2, Annex III of the Directive). Underwater noise constitutes the most widely introduced type of energy in the marine environment<sup>1</sup> and should be addressed with a view to achieve Good Environmental Status (hereinafter referred to as ‘GES’) in terms of MSFD Descriptor 11: *‘Introduction of energy, including underwater noise is at levels that do not adversely affect the marine environment’*.

For the purposes of the MSFD, noise is defined as *‘anthropogenic sound that has the potential to cause negative impacts on the marine environment, including component biota but not necessarily the whole environment’*<sup>2</sup>. Effects of increased levels of underwater noise are known for a variety of marine fauna, mainly cetaceans, turtles, fish<sup>3</sup> and some invertebrates (such as decapod crustaceans) which rely on sound for various biological functions such as communication, navigation, orientation and detection of predators and prey<sup>4</sup>. Such effects can range from exposures causing no adverse impacts, to behavioural disturbances, to loss of hearing, and to the worst case, mortality.

Negative impacts of anthropogenic underwater noise are documented on a global scale for at least 55 marine species, with impacts on marine mammals receiving particular attention mainly due to the use of active sonar or seismic surveys coinciding with cetacean mass stranding events<sup>5</sup>. Nevertheless, there are high levels of uncertainty on noise effects on marine taxa and research is required to better understand the impacts of anthropogenic sound on marine biodiversity. At the level of the European Union, data gaps also exist in relation to the current ambient noise levels in marine regions, trends in levels of underwater noise and the distribution of marine biota that is sensitive to sound<sup>6</sup>.

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<sup>1</sup> Tasker, M.L.; Amundin, M.; Andre, M.; Hawkins, A.; Lang, W., Merck, T., Scholik-Schlomer, A., Teilmann, J., Thomsen, F., Werner, S. & Zakharia, M. 2010 Marine Strategy Framework Directive: Task Group 11 Underwater noise and other forms of energy. Joint Research Centre EUR 24341

<sup>2</sup> Tasker, M.L.; Amundin, M.; Andre, M.; Hawkins, A.; Lang, W., Merck, T., Scholik-Schlomer, A., Teilmann, J., Thomsen, F., Werner, S. & Zakharia, M. 2010 Marine Strategy Framework Directive: Task Group 11 Underwater noise and other forms of energy. Joint Research Centre EUR 24341

<sup>3</sup> Sonars may have a negative impact on commercial fishing and the already depleted fish stocks throughout the world's oceans, as also evidenced by a study commissioned by the UK Defence Research Agency (FRR1 27/94): <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2005:174E:0186:0188:EN:PDF>

<sup>4</sup> UNEP/CBD/SBT/16/INF/12 downloaded from <http://www.cbd.int/doc/meetings/sbstta/sbstta-16/information/sbstta-16-inf-12-en.pdf>

<sup>5</sup> UNEP/CBD/SBT/16/INF/12 downloaded from <http://www.cbd.int/doc/meetings/sbstta/sbstta-16/information/sbstta-16-inf-12-en.pdf>

<sup>6</sup> Tasker, M.L.; Amundin, M.; Andre, M.; Hawkins, A.; Lang, W., Merck, T., Scholik-Schlomer, A., Teilmann, J., Thomsen, F., Werner, S. & Zakharia, M. 2010 Marine Strategy Framework Directive: Task Group 11 Underwater noise and other forms of energy. Joint Research Centre EUR 24341

The MSFD Commission Decision on criteria and methodological standards on good environmental status (2010/477/EU) acknowledges the need for additional scientific and technical progress in relation to the impacts of introduction of energy on marine life and to relevant noise and frequency levels, in order to support the further development of criteria related to MSFD Descriptor 11. At this stage, measurement of underwater noise for assessment and monitoring purposes is given priority.

At a local scale, underwater noise constitutes a relatively new environmental field, for which data is particularly limited, thus limiting assessment of status as required by the Directive. Within this context, the scope of this report is limited to a brief description of the location of activities (where known) which can generate underwater noise.

## **1.2 Existing legislation**

A number of regional and/or international multilateral environment agreements (MEAs) aimed at the conservation of biodiversity address underwater noise as a pressure on marine biota. In particular underwater noise is given due importance in specialised agreements targeted at the conservation of marine mammals.

The following provides a brief description of the decisions and resolutions issued under the conventions or agreements, deemed to be of relevance to this report. It should be noted that this section does not constitute an exhaustive list of legislative tools through which underwater noise can be addressed. In particular, this section is not including legislation targeted at the protection of marine species which legislation is included in MSFD Initial Assessment reports on species groups.

### **1.2.1 Convention on Biological Diversity**

The Convention on Biological Diversity (CBD) is a major UNEP-driven multilateral environment agreement targeted at the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising from the utilisation of genetic resources.

Decision X/29 (2010) adopted during the tenth meeting of the Conference of the Parties to the Convention on Biological Diversity, requested the Executive Secretary, in collaboration with Parties, other Governments, and relevant organizations, to compile and synthesize available scientific information on anthropogenic underwater noise and its impacts on marine and coastal biodiversity and habitats. The scientific synthesis of available knowledge about noise impacts on marine wildlife has been completed and presented at the sixteenth meeting of the

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Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA), held in Montreal in 2012<sup>7</sup>.

### **1.2.2 Convention on Conservation of Migratory Species of Wild Animals (Bonn Convention)**

The Convention on the Conservation of Migratory Species of Wild Animals aims at the conservation of migratory species and their habitats.

Species listed in Appendix I of this Convention are migratory species deemed to be in danger of extinction throughout all or a significant proportion of their range. Parties to the Convention shall seek the strict protection of these animals, conserving or restoring the habitats in which they live, mitigating obstacles to migration and controlling other factors that might endanger them.

Appendix II of the Convention lists migratory species that have an unfavourable conservation status or would benefit significantly from international co-operation. The Convention encourages the contracting parties to conclude global or regional agreements for the conservation and management of individual species or, more often, of a group of species listed on Appendix II.

The Conference of the Parties of the Bonn Convention, at its Ninth Meeting in 2008 adopted Resolution 9.19 on the adverse anthropogenic marine/ocean noise impacts on cetaceans and other biota<sup>8</sup>. This resolution calls on Parties to:

- endeavour to control the impact of introduction of anthropogenic noise pollution in habitats of vulnerable species and in areas where marine mammals or other endangered species may be concentrated,
- undertake, where appropriate, relevant environmental assessments on the introduction of systems which may lead to noise associated risks for marine mammals.
- adopt mitigation measures on the use of high intensity naval sonars until an assessment of their impact on marine mammals, fish and other marine life has been completed, and as far as possible aim to prevent impacts from the use of such sonars, especially in areas known or suspected to be important habitat to species particularly sensitive to active sonars (e.g. beaked whales) and in particular where risks to marine mammals cannot be excluded, taking account of existing national measures and related research in this field.
- develop provisions for the effective management of anthropogenic noise in CMS daughter agreements and other relevant bodies and Conventions.

At their tenth meeting, the Conference of Parties also adopted resolution 10.24<sup>9</sup> which reaffirms the need for ongoing and further internationally coordinated research on the impact of underwater noise on cetaceans and other migratory

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<sup>7</sup> <http://www.cbd.int/doc/meetings/sbstta/sbstta-16/information/sbstta-16-inf-12-en.pdf>

<sup>8</sup> [http://www.ascobans.org/pdf/ac16/AC16\\_46\\_CMSRes9-19\\_OceanNoise.pdf](http://www.ascobans.org/pdf/ac16/AC16_46_CMSRes9-19_OceanNoise.pdf)

<sup>9</sup> [http://www.cms.int/bodies/COP/cop10/resolutions\\_adopted/10\\_24\\_underwater\\_noise\\_e.pdf](http://www.cms.int/bodies/COP/cop10/resolutions_adopted/10_24_underwater_noise_e.pdf)

species and their migratory routes. This resolution calls on the prevention of adverse effects on cetaceans through the development of appropriate regulatory frameworks or implementation of relevant measures to ensure mitigation of anthropogenic underwater noise. It proposes that environmental impact assessments take full account of the effects of activities on cetaceans, and to integrate the issue of anthropogenic noise in the management plans of marine protected areas, where appropriate.

### **1.2.3 Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS)**

ACCOBAMS is a cooperative tool for the conservation of cetaceans (dolphins, whales and porpoises) in the Mediterranean, Black Seas and contiguous Atlantic zones. This agreement is mainly aimed at reducing threats to cetaceans in these areas and improving knowledge of these animals. ACCOBAMS is the first Agreement binding the countries in these subregions and enabling them to work together on a matter of general interest.

The Conservation Plan of ACCOBAMS, which is a full part of the Agreement, requires the Parties, amongst others to carry out impact assessments to provide a basis for regulating activities that might affect cetaceans or their habitats in the Agreement area and to establish the conditions under which such activities may be conducted; and

Three resolutions issued under the ACCOBAMS agreement are considered to be particularly relevant to addressing underwater noise in the marine environment. Collectively, these resolutions [Resolution 2.16 (2004), Resolution 3.10 (2007) and Resolution 4.17 (2010)] call for the following:

- Consideration of underwater noise as a potentially significant threat to marine mammals and other marine wildlife and to address the issue of anthropogenic noise in the marine environment, including cumulative effects, in the light of the best scientific information available;
- To avoid or minimize noise in marine protected areas, as well as in particular in areas containing critical habitat of cetaceans likely to be affected by man-made sound;
- To map the range of underwater noise to which animals are exposed and to define the exposure levels that might affect marine mammals.
- To consider effects of underwater noise in Environmental Impact Assessments and to integrate the issue of anthropogenic noise in management of Marine Protected Areas.

In addition, Resolution 4.17 from the Meeting of the Parties to the ACCOBAMS Agreement (2010) establishes guidelines to address the impact of anthropogenic noise on cetaceans in the ACCOBAMS area. A Working Group was also established by the Secretariat as per Resolution 3.10 to address anthropogenic noise. This Working Group was also tasked with the further development of the guidelines in Resolution

4.17 with the aim of testing the application of the guidelines in particular areas to make them implementable by the Parties and operators.

#### **1.2.4 Other initiatives**

##### *The European Parliament resolution - P6\_TA(2004)0047*

The European Parliament resolution on the environmental effects of high-intensity active naval sonars [P6\_TA(2004)0047] recommends the adoption of moratoriums aiming to restrict the use of high-intensity active naval sonars until a global assessment of their cumulative environmental impact on marine mammals, fish and other marine life has been completed. It also calls on EU Member States to monitor and investigate in a transparent manner mass strandings and deaths of marine mammals in EU waters which are associated with the use of intense anthropogenic noise.

##### *The International Maritime Organization (IMO)*

The Marine Environmental Protection Committee (MEPC) established under the International Maritime Organization (IMO) has also addressed the impact of ship-generated noise. MEPC 58 approved the inclusion of a new item in the work programme of the Committee on 'Noise from commercial shipping and its adverse impact on marine life' and a Correspondence Group was established to identify and address ways to minimize the incidental introduction of noise from commercial shipping operations into the marine environment to reduce potential adverse impacts on marine life. A document on this matter was presented at MEPC 61 putting forward recommendations for future work from this Correspondence Group<sup>10</sup>.

##### *Guidance Document on Wind Energy Developments and Natura 2000*

The European Commission Guidance Document on Wind Energy Developments and Natura 2000 refers to potential impacts of wind farms on marine animals due to marine noise pollution. The guidelines lists the effects of wind farms of potential relevance for marine mammals which include (i) Intense noise during piling-driving, drilling and dredging operations; (ii) continual operational noise and vibrations emanating from the wind turbines; and (iii) effects on prey, such as changes to fish behaviour.

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<sup>10</sup> [http://www.imarest.org/Portals/0/IMarEST/Community/IMO/MEPC%206119\\_NoiseCGReport.pdf](http://www.imarest.org/Portals/0/IMarEST/Community/IMO/MEPC%206119_NoiseCGReport.pdf)

### *The NATO approach*

The NATO Undersea Research Center (NURC), located in Italy, runs an international research project SOLMAR (Sound Oceanography and Living Marine Resources), that resulted in the development of the NATO Policy (NATO Staff Instruction 77-04). Initially conceived for sonar research and development, the Policy is being considered a reference for NATO Navies.

The SOLMAR Project addresses the issue of underwater noise and its effects on the marine environment and seeks to improve the understanding of anthropogenic noise characteristics which are potentially harmful to animals. The project includes the development of a set of comprehensive databases of oceanography, ecosystem dynamics and living marine resources in the Mediterranean Sea to support the development of models for predicting the presence of marine mammals based on seasonal and environmental parameters.

### **1.3 Sources of underwater noise**

Tasker *et al.* (2010)<sup>11</sup> identify various anthropogenic activities which can result in the introduction of underwater noise in the marine environment, including (i) Shipping; (ii) Construction works; (iii) Windfarms; (iv) Sonars for bottom imaging and (v) Seismic sources (such as airguns). The type of anthropogenic sounds generated by these activities can be classified into 'impulsive sound' and 'non-impulsive sound'.

Impulsive sounds are typically brief, characterised by a large change in amplitude over a short time and containing a wide frequency range (commonly referred to as 'broadband')<sup>12</sup>. Such sounds are generated by explosions, airguns and pile-driving.

Non-impulsive sounds can be broadband or more tonal, continuous or intermittent, with typically only small fluctuations in amplitude<sup>13</sup>. Sources of non-impulsive sounds include shipping, construction (e.g. drilling and dredging) or wind farm operation.

This section provides a brief overview of the activities in Malta which may give rise to impulsive and non-impulsive underwater sound. Such overview is only intended to provide a preliminary indication of potential sources of underwater noise in Malta. Further information on the location, type of and trends in activities carried out would be required to fulfil the requirements of the MSFD.

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<sup>11</sup> Tasker, M.L.; Amundin, M.; Andre, M.; Hawkins, A.; Lang, W., Merck, T., Scholik-Schlomer, A., Teilmann, J., Thomsen, F., Werner, S. & Zakharia, M. 2010 Marine Strategy Framework Directive: Task Group 11 Underwater noise and other forms of energy. Joint Research Centre EUR 24341

<sup>12</sup> Tasker, M.L.; Amundin, M.; Andre, M.; Hawkins, A.; Lang, W., Merck, T., Scholik-Schlomer, A., Teilmann, J., Thomsen, F., Werner, S. & Zakharia, M. 2010 Marine Strategy Framework Directive: Task Group 11 Underwater noise and other forms of energy. Joint Research Centre EUR 24341

<sup>13</sup> Tasker, M.L.; Amundin, M.; Andre, M.; Hawkins, A.; Lang, W., Merck, T., Scholik-Schlomer, A., Teilmann, J., Thomsen, F., Werner, S. & Zakharia, M. 2010 Marine Strategy Framework Directive: Task Group 11 Underwater noise and other forms of energy. Joint Research Centre EUR 24341

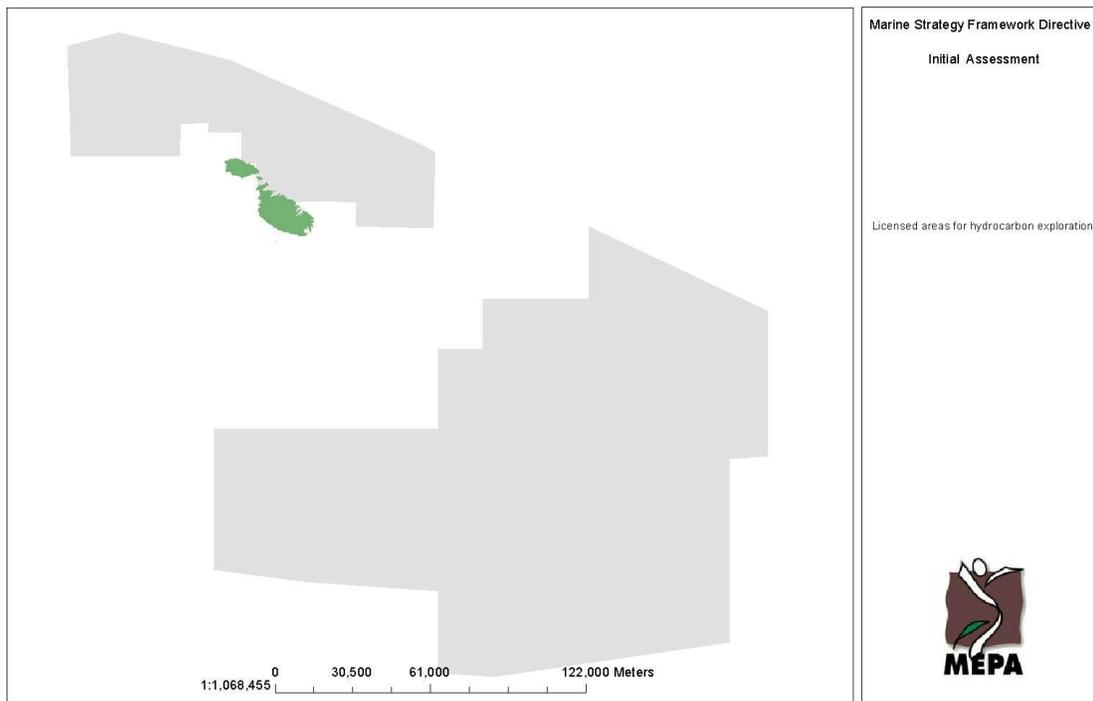
### 1.3.1 Seismic or sonar surveys

Seismic reflection surveying in Malta is mainly carried out in connection with hydrocarbon exploration. Hydrocarbon exploration activities offshore Malta commenced in the early 1970's and have to date been mostly limited to drilling of exploratory wells and carrying out of seismic surveys. At present three areas within Malta's continental shelf are licensed for oil exploration (

**Figure 1).** Malta's Continental Shelf Department indicated that since 2007, three seismic surveys were acquired covering nearly 2,500 km of 2D data and 1,000 square km of 3D data. Another survey is expected to be acquired later on this year to the north of Malta.

While marine research surveys unrelated to hydrocarbon exploration are generally subject to permitting procedures, there is no central data repository which would provide a holistic picture of the frequency and/or location of the use of sonar as part of research surveys in Malta. On the other hand, the Continental Shelf Department licensed approximately 10 research surveys during the past year including sub-bottom profiling surveys and surveys using multibeam echosounders and side scan sonars.

Figure 1: Areas licensed for oil exploration<sup>14</sup>



<sup>14</sup> <https://mticms.gov.mt/en/Pages/Continental%20Shelf/Continental-Shelf.aspx>

### **1.3.2 Construction at sea**

Construction at sea in Malta is mostly associated with port operations or development of marinas. Therefore the majority of the construction works are restricted to harbour or port areas. Development other than that related to port operations or marinas, as implied by an assessment of development permit applications submitted in the period 2000-2010, mainly pertains to small construction works such as construction of new slipways, ramps and quays.

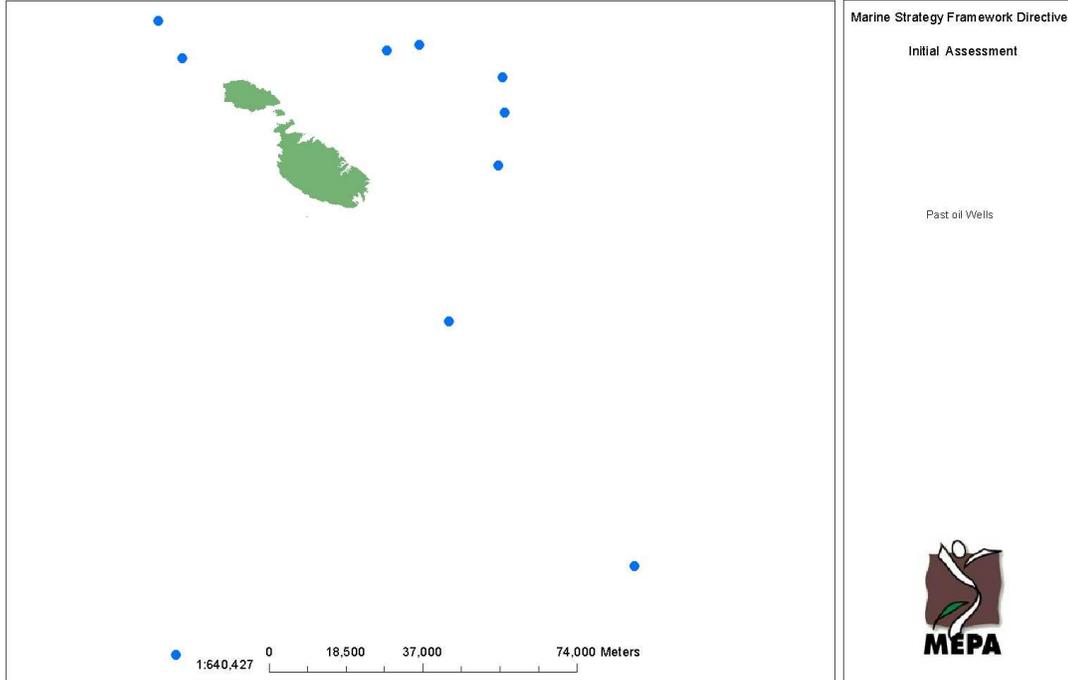
To date, no construction works have been carried out in offshore waters. However the possibility of development related to renewable energy installations cannot be excluded at this stage. At the time of writing this report, a development permit application for the development of a wind farm located on the North-East coast of Malta is pending environmental assessment. This type of development may involve pile driving and could thus be a potential source of impulsive underwater noise during construction.

### **1.3.3 Drilling**

Presently, there are no hydrocarbon production installations offshore Malta. Therefore drilling operations are limited to drilling of exploratory wells (refer to section on seismic surveys).

Since the 1970s, ten exploratory wells have been drilled offshore with the most recent drilling taking place in 2002 (Figure 2). Future projections of activities within the hydrocarbon exploration and exploitation sector are difficult to predict and an increase in the frequency of drilling in the future cannot be excluded at this stage. At the time of writing this report, there are plans for the spudding of the next well by the first quarter of 2014.

Figure 2: Location of past offshore oil wells



### 1.3.4 Dredging

Dredging in Malta is generally undertaken for maintenance of fairways for navigation or development of port facilities. However, dredging may also be carried out in relation to coastal engineering projects, such as the building of platforms, quays and development of new marinas.

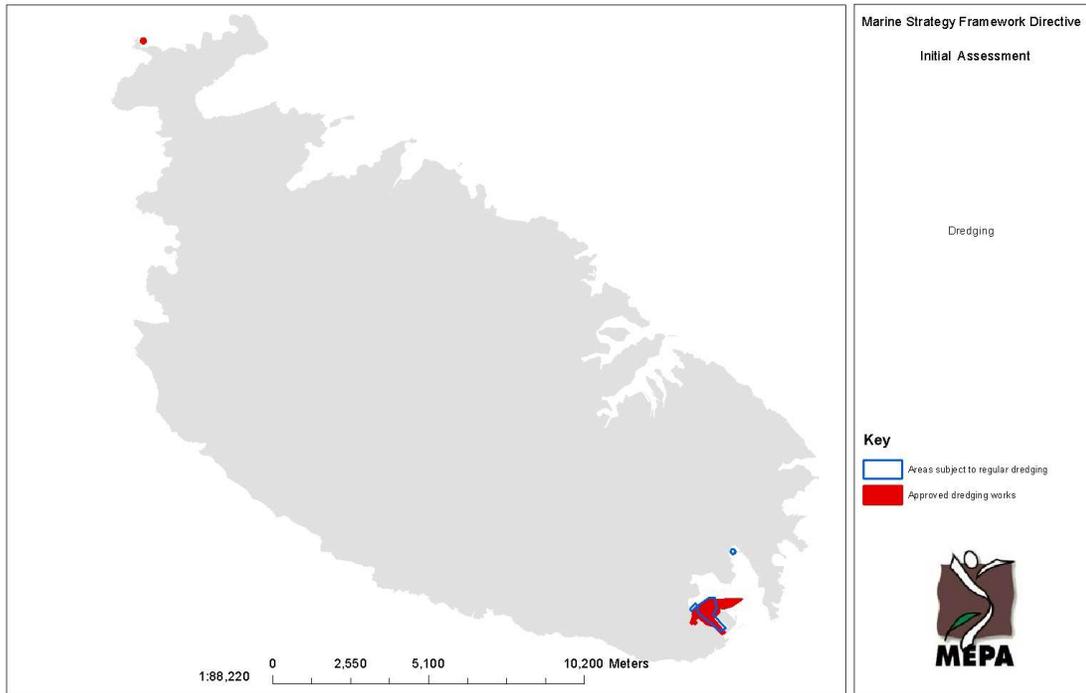
There are no areas designated for regular dredging, although some parts of Marsaxlokk harbour area are dredged every year (Transport Malta – Maritime – personal communication) (Figure 3). A review of 'Notices to Mariners' issued for the purposes of navigational safety between 2007-2012 implies that in addition to dredging at Marsaxlokk harbour, some dredging works also take place within the Grand Harbour and Marsamxett harbour. Mariners were informed of dredging works within these harbour areas twice in 2009 and once in 2011<sup>15</sup>. A preliminary assessment of development proposals submitted in the period 2000-2010, confirm that dredging activities are mainly restricted to harbour areas (Marsaxlokk harbour and Ċirkewwa).

Therefore the generation of continuous underwater noise from dredging activities in Malta is deemed to be localised and in close proximity to the shoreline. While any potential impacts still need to be assessed, it is highly likely for such impacts to be of

<sup>15</sup> Notice to Mariners No. 14 of 2009; No. 21 of 2009 and No. 27 of 2011

low significance, also due to the already modified nature of harbour areas, hence the low sensitivity of such areas in terms of marine biota.

Figure 3: Areas subject to regular dredging and approved dredging works



### 1.3.5 Shipping

As a result of its strategic location in the centre of the Mediterranean region, Malta constitutes an important hub for the shipping industry. Malta also provides a comprehensive range of maritime services and facilities including one of the busiest freeport areas in the Mediterranean, oil bunkering facilities and a cruise passenger terminal.

In 2012, the number of vessels arriving in Malta was 10,491 vessels with a total gross tonnage of 208,145,077<sup>16</sup>. Therefore shipping in Malta may constitute an important source of continuous sound in the marine environment.

An Incident Risk Assessment study was carried out in 2008 with the aim to improve Malta's state of preparedness to respond against a potential future pollution incident<sup>17</sup>. This study estimated the total number of vessels within 20 nautical miles from Malta to be 65,668 vessels. 45% of the total traffic volume are visiting the Grand Harbour, 35% are visiting Marsaxlokk (Freeport area), with international routes using the Strait of Gibraltar and the Suez Canal contributing to about 25% of the total number of vessels.

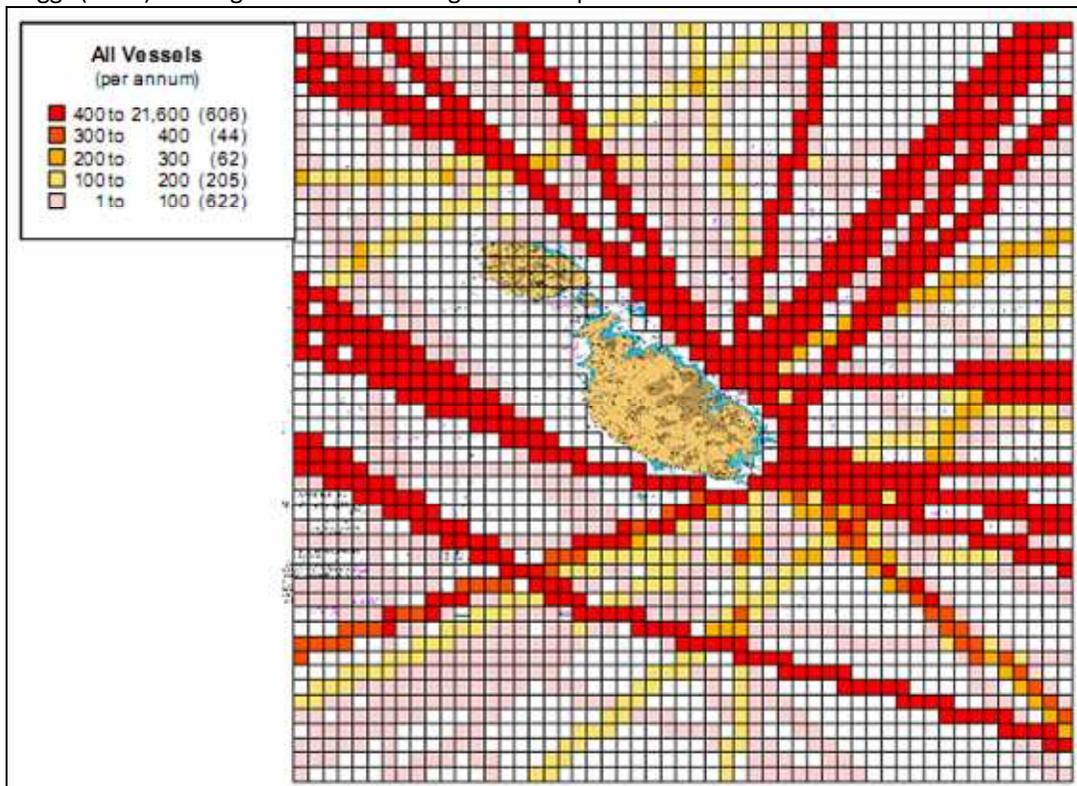
<sup>16</sup> Transport Malta – Annual Report (2012)

<sup>17</sup> Alpha Briggs. 2008. Incident Risk Assessment for the National Marine Pollution Contingency Plan for the Maltese Islands

Through this study, shipping traffic data - including number of vessels per year, vessel type distribution, port of departure/destination and route positions – was used to determine the number of movements on each route (port to port) and the movements by the defined vessel type categories and vessel size categories<sup>18</sup>. The position of each shipping route was determined by plotting a straight line on a detailed electronic chart between the departure and destination ports. Waypoints along this route were determined on the basis of navigational characteristics of the area travelled (e.g. traffic separation schemes, straits, shallow waters, navigation buoys, restrictions etc) and navigational features which would be avoided (such as bunkering areas, fish farms, navigation restrictions, shallow water, islands and offshore installations).

Figure 4, extracted from Alpha Briggs (2008), provides an indication of the shipping routes within 20 nm of the Maltese Coast and the number of vessels using such routes per annum.

Figure 4: Shipping routes within 20 nautical miles of the Maltese coast as extracted from Alpha Briggs (2008)<sup>19</sup>. The grid shown in this figure is composed of 1nm x 1nm cells.



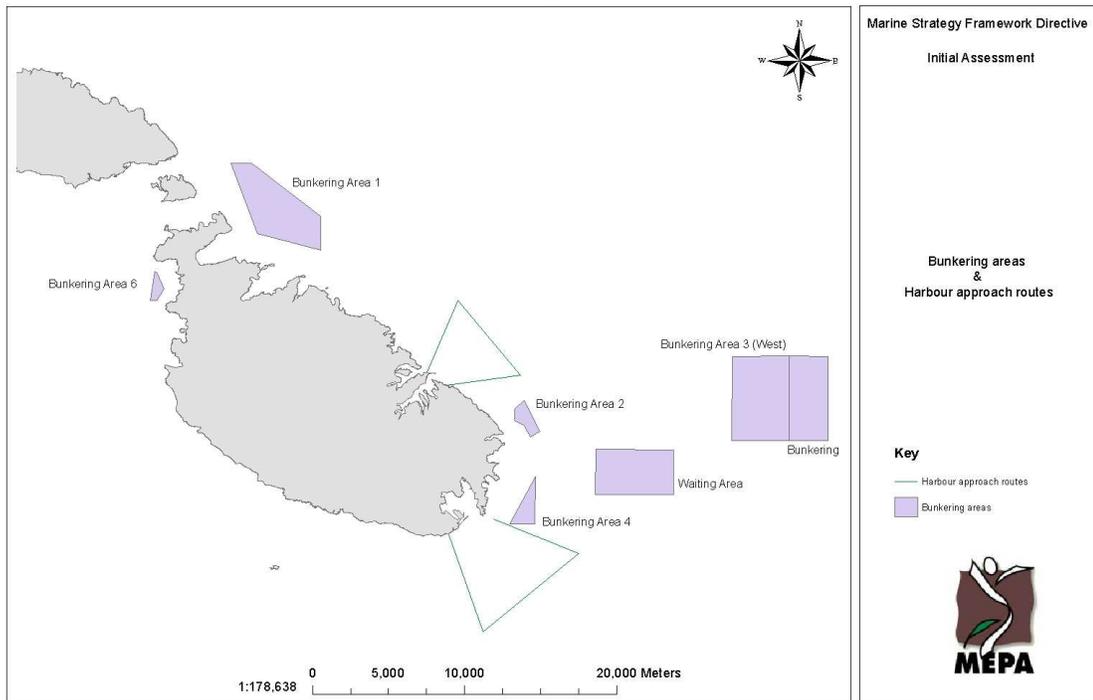
<sup>18</sup> The data analysed by Alpha Briggs (2008) covered the months of March, June, September and December of 2004.

<sup>19</sup> Alpha Briggs. 2008. Incident Risk Assessment for the National Marine Pollution Contingency Plan for the Maltese Islands

In addition to the indicative shipping lanes provided by Alpha Briggs (2008), Figure 5 shows the location of bunkering areas and indicates the main harbour approach routes, which areas are also expected to be subject to substantial shipping activity, hence to increased levels of underwater noise.

In terms of trends, Transport Malta’s annual report (2012) indicates that the number of vessels arriving in Malta in 2012 was slightly less than that reported for 2011. Nevertheless, there was a general increase in number of vessels during the period 2003-2011. Alpha Briggs (2008) make reference to a general global increase in shipping traffic. Such increase could potentially result in increased levels of continuous underwater noise in the future.

Figure 5: Harbour Approach Routes and Bunkering Areas



#### 1.4 Assessment of status

The MSFD Commission Decision on criteria and methodological standards on good environmental status of marine waters (2010/477/EU) acknowledges the need for additional scientific and technical progress to support the further development of the criteria for assessment of the achievement of Good Environmental Status in terms of Descriptor 11 on underwater noise. At this stage, the criteria and indicators are geared towards the measurements of underwater noise as a first priority in relation to assessment and monitoring. The stipulated criteria and indicators are listed hereunder

**Criterion 11.1: Distribution in time and place of loud, low and mid frequency impulsive sounds**

- Proportion of days and their distribution within a calendar year over areas of a determined surface, as well as their distribution, in which anthropogenic sound sources exceed levels that are likely to entail significant impact on marine animals measures as Sound Exposure Level (in dB re  $1\mu\text{Pa}^2\cdot\text{s}$ ) or as a peak sound pressure level (in dB re  $1\mu\text{Pa}_{\text{peak}}$ ) at one metre, measured over the frequency band 10Hz to 10kHz (11.1.1)

**Criterion 11.2: Continuous low frequency sound**

- Trends in ambient noise level with the 1/3 octave bands 63 and 125 Hz (centre frequency) (re  $1\mu\text{Pa}$  RMS; average noise level in these octave bands over a year) measured by observation stations and/or with the use of models if appropriate (11.2.1)

As indicated throughout the report, the currently available information does not allow an assessment of the status in terms of the MSFD criteria and indicators. The current information on activities taking place in the marine waters implies that the main sources of impulsive underwater noise are associated with the use of seismic surveys for hydrocarbon exploration, while shipping is considered to be the main sources of continuous underwater noise. However actual measurements of the levels of underwater noise generated through such activities are not available.

## **1.5 Data gaps**

As indicated throughout this report, there is no currently available information with respect to any potential increased levels of underwater noise in the marine environment. Malta will be addressing this shortcoming through the establishment of the MSFD monitoring programme.