

# **Microbial Pathogens**

## **1.1 Introduction**

Microbial pathogens are identified amongst the pressures and impacts related to biological disturbance under the Marine Strategy Framework Directive (Directive 2008/56/EC – Table 2 on Pressures and Impacts under Annex III on Indicative lists of characteristics, pressures and impacts)<sup>1</sup>. There is no descriptor that addresses specifically the issue of microbial pathogens, nor are there any criteria and indicators to specifically address this issue in the Commission Decision 2010/477/EU on criteria and methodological standards on good environmental status of marine waters.

This Report provides a review of biological disturbance through the introduction of microbial pathogens in the marine environment by focusing on the 87 coastal bathing waters (categorised into Zones A, B, C and D) that are monitored in Malta against the limit values set in the old and the new Bathing Waters Directive<sup>2</sup>. The following sections address the data requirements on microbial pathogens under the MSFD vis-à-vis characteristics (see section 1.3) and status and impacts (section 1.4).

## **1.2 Description of relevant legislation and management measures**

This Section provides a brief overview of the EU and national legislation that in some way deal with the issue of microbial pathogens either vis-à-vis monitoring of water quality and hence detecting the presence and quantity of microbial pathogens, and/or in terms of regulating/controlling sources/activities that result in the discharge of microbial pathogens into the marine environment.

### *1.2.1 Bathing Water Quality*

Within the context of pathogens, the Bathing Waters Directive requires Member States, including Malta, to every year:

- identify the bathing waters in their territory and define the length of the bathing season monitor;
- monitor at the location most used by bathers or where the risk of pollution<sup>3</sup> is greatest, and assess water quality on the basis of data defined according to the parameters as per Annex I of the Directive;
- classify, according to the criteria set out in Annex II of the Directive, the bathing water quality of the areas concerned;
- take adequate measures to prevent, reduce or eliminate the causes of pollution;

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<sup>1</sup> <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:164:0019:0040:EN:PDF>

<sup>2</sup> Directive 2006/7/EC of the European Parliament and of the Council of 15 February 2006 concerning the management of bathing water quality and repealing Directive 76/160/EEC

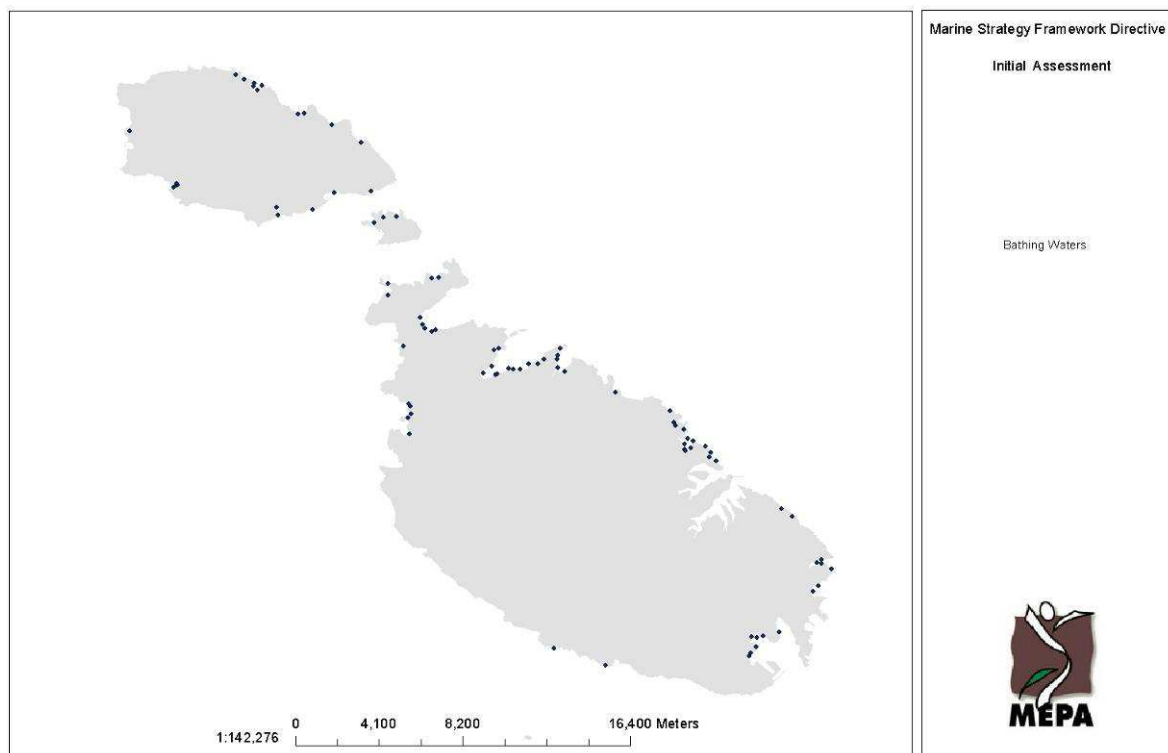
<sup>3</sup> Defined as “the presence of microbiological contamination or other organisms or waste affecting bathing water quality and presenting a risk to bathers’ health”

- keep the public informed, and
- communicate the results of monitoring to the Commission with a description of the water quality management measures.

By the end of the 2015 bathing season, Member States must ensure for the purpose of the Bathing Waters Directive that all bathing waters are at least of sufficient quality, and must have taken appropriate measures to increase the number of waters classified as good or excellent.

The Bathing Waters Directive is transposed into national law via the “Management of Bathing Water Quality Regulations, 2008” (Legal Notice 125 of 2008, as amended by Legal Notice 237 of 2011)<sup>4</sup>. Similar to the Directive, the purpose of these regulations is to preserve, protect and improve the quality of the environment and to protect human health. These regulations, correspondingly with the Directive, lay down provisions for: (a) the monitoring and classification of bathing water quality; (b) the management of bathing water quality; and (c) the provision of information to the public on bathing water quality. 87 coastal bathing waters are monitored in Malta as shown in Figure 1.

**Figure 1 - Sampling points at official bathing waters in Malta designated under the Bathing Water Directive**



<sup>4</sup> <http://www.justiceservices.gov.mt/DownloadDocument.aspx?app=lom&itemid=11866&l=1>

The status in 2012 was largely of excellent quality with 2 bathing waters of good water quality. The EEA Report N° 4/2013 on European bathing water quality in 2012 (EEA, 2013)<sup>5</sup> mentions Malta amongst the 10 countries that reached compliance levels with excellent quality (or complying with the guide values) that were above the EU average (78.3 %); in Malta's case this was 96.6% of bathing waters.

Annex I to this Chapter lists all 87 bathing waters and, provides a graphical representation of status for each one in Malta, Gozo and Comino for the period 2005 to 2012. Malta has no inland bathing waters. The 87 bathing areas are given a site code according to the zone where they are found as follows:

#### MALTA

- Coastal Zone A comprises Xgħajra (A01, A02), Marsascula (A03-A06), St Thomas Bay (A07-A08), Marsaxlokk (A09), Birżebbuġia (A10-A15), Wied iż-Żurrieq (A16) and Għar Lapsi (A17);
- Coastal Zone B comprises Baħar iċ-Ċagħaq (B01), Pembroke (B02), St George's Bay to St Julian's (B03-B04), St Julian's (B05), Spinola Bay (B06-B07), Balluta Bay (B08-B09), Sliema (B10-B15);
- Coastal Zone C comprises Ġnejna (C01), Għajn Tuffieħa (C02-C03), Golden Bay (C04-C05), Anchor Bay (C06), Ċirkewwa (C07-C08), Armier (C09), Little Armier (C10), Mellieħa Bay (C11-C15), Mistra Bay (C16-C17), St Paul's Bay (C18-C24), Buġibba (C25-C27), Qawra (C28-C32);

#### GOZO and COMINO

- Coastal Zone D comprises Southern Gozo (D01-D03), Xlendi (D04-D07), Dwejra (D08), Marsalforn (D09-D14), Nadur Area (D15-D18), South East Gozo (D19-D20) and Comino (D21-D23)

The national bathing season starts from the third week of May and ends in the third week of October. The Public Health Laboratory Services (PHLS) within the Environmental Health Directorate carry out all tests for microbiological parameters. As part of the implementation of Legal Notice 125 of 2008, as amended by Legal Notice 237 of 2011:

- the general public are informed of any temporarily closed sites by press releases, which are issued to the media by the Department of Information, sent to all Local Councils by e-mail and also placed on the Environmental Health Directorate<sup>6</sup> webpage; information signs are placed at such sites by environmental health officers informing the public that these sites are temporarily closed and bathing is not recommended;
- environmental health officers carry out routine inspections on site to check for any possible sources of pollution and also investigate any complaints made by the public; in cases of doubt additional samples are collected and sent for analysis at the public

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<sup>5</sup> EEA (2013). *European bathing water quality in 2012*. Report Number 4/2013. Luxembourg: Publications Office of the European Union, 2013

<sup>6</sup> [https://ehealth.gov.mt/HealthPortal/public\\_health/environmental-health/health\\_inspectorate/env\\_hlt\\_risk\\_management/bathing\\_water\\_press\\_releases.aspx](https://ehealth.gov.mt/HealthPortal/public_health/environmental-health/health_inspectorate/env_hlt_risk_management/bathing_water_press_releases.aspx)

health laboratory, whereas in the case that visual evidence of pollution is noted, the effected site will be temporarily closed for bathing;

- during the bathing season, the Environmental Health Directorate issues a weekly report with the classification for each bathing area; a weekly report with the logos as per Commission Implementation Decision 2011/321/EU for the classification of sites is also issued; copies of these reports are sent by e-mail to all those who requested to be placed on the Directorate mailing list and to all local councils; annual reports on bathing water monitoring and status in Malta are available online<sup>7</sup>.
- raw data is posted by the Environmental Health Directorate on its webpage on a weekly basis<sup>8</sup>;
- all bathing areas monitored as part of the bathing water monitoring programme are clearly identified by fixed information signs indicating the site code and stating that the area is monitored by the Environmental Health Directorate on a regular basis; these information signs are in five languages; if there will be the need to temporarily close any of these areas, a temporarily closure sign is attached at the same site and again the information is provided in five languages, namely Maltese, English, French, German, and Italian; these information signs will be replaced with new information board so as to include further information on the classification of sites and beach profiles;
- officials from the Environmental Health Directorate participate on television and radio programmes to discuss and provide information to the general public on bathing water quality.

Malta also monitors its bathing water quality against the standards set by the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (Barcelona Convention), through the MED POL Programme<sup>9</sup>. The Barcelona Convention requires that at least 90 percent of the total samples do not exceed 1000 Faecal Coliform (FC) counts per 100 ml, and also that in at least 50 percent of the samples FC counts do not exceed 100 per 100 ml. In Malta, since 1996 the following classification scheme has been adopted:

- First Class: less than 100FC/100ml in 95% of samples
- Second Class: Compliance with Interim Criteria (1985) on a seasonal basis (though not necessarily on a monthly basis).
- Third Class: Fail to conform to Interim Criteria (1985)

Results on water quality on the basis of FC counts for the period 1996 to 2004 are graphically presented in Figure 2.

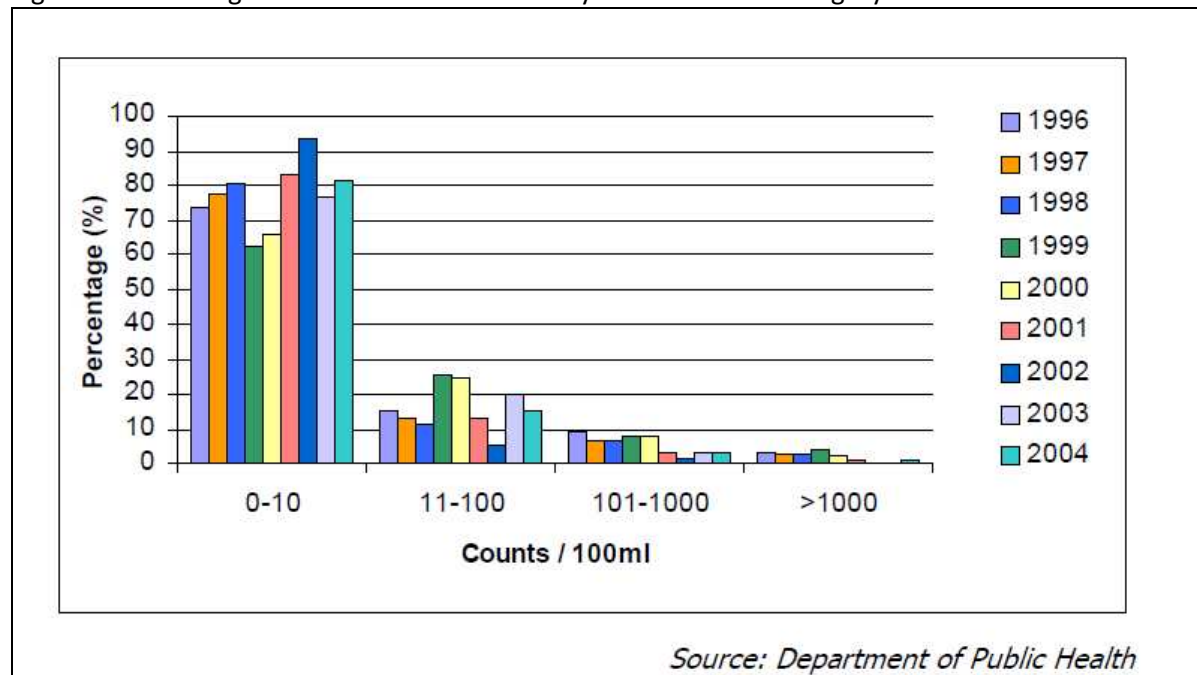
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<sup>7</sup> [https://ehealth.gov.mt/HealthPortal/public\\_health/environmental-health/health\\_inspectorate/env\\_hlt\\_risk\\_management/envhlt\\_eubw\\_reports.aspx](https://ehealth.gov.mt/HealthPortal/public_health/environmental-health/health_inspectorate/env_hlt_risk_management/envhlt_eubw_reports.aspx)

<sup>8</sup> [https://ehealth.gov.mt/HealthPortal/public\\_health/environmental-health/health\\_inspectorate/env\\_hlt\\_risk\\_management/envhealth\\_bathingwater09.aspx](https://ehealth.gov.mt/HealthPortal/public_health/environmental-health/health_inspectorate/env_hlt_risk_management/envhealth_bathingwater09.aspx)

<sup>9</sup> The MED POL programme is the marine pollution assessment and control component of the Mediterranean Action Plan and is responsible for the follow up work related to the implementation of the Protocol for the Protection of the Mediterranean Sea against Pollution from Land-Based Sources and Activities (1980, as amended in 1996)

Figure 2: Percentage of faecal coliform counts by contamination category



### 1.2.2 Other Directives

Council Directive 2006/113/EC on the quality required for shellfish waters does not apply to Malta.

The discharge of urban waste water can influence the quality of bathing waters in relation to microbiological contamination. Council Directive 91/271/EEC concerning urban waste water treatment<sup>10</sup> addresses the collection, treatment and discharge of urban waste water and the treatment and discharge of waste water from certain industrial sectors. This Directive has been transposed into Maltese law via the “Urban Waste Water Treatment Regulations, 2004, as amended” (Legal Notice 340 of 2001, as amended by Legal Notices 192 of 2004, 120 of 2005 and 426 of 2007)<sup>11, 12</sup>. Eight sensitive areas around the coast of the Maltese islands have been identified in line with Article 5 of the Directive with the reason for designation being possible eutrophication due to nitrates. A revision of these areas is being planned in order to ensure that the areas previously designated are actually areas which are subject to eutrophication<sup>13</sup>. The sites in question are depicted in Figure 3. The emission standards for discharges to these designated Nutrient Sensitive Protected Areas must be achieved with seven years of the designation of that area.

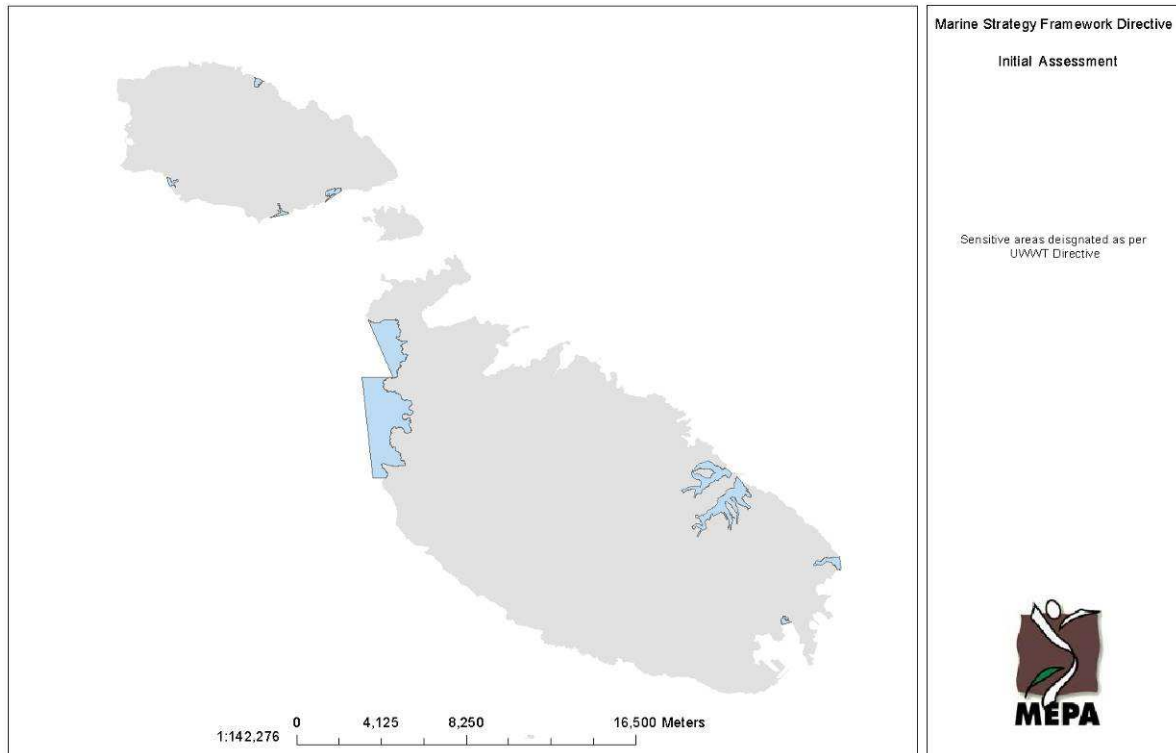
<sup>10</sup> <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:1991:135:0040:0052:EN:PDF>

<sup>11</sup> <http://www.justiceservices.gov.mt/DownloadDocument.aspx?app=lom&itemid=11517&l=1>

<sup>12</sup> More information on the implementation of this legislation is available from: <http://www.mepa.org.mt/marine-discharges-uwvtd>.

<sup>13</sup> <http://www.mepa.org.mt/file.aspx?f=9213>

Figure 3: Sensitive Areas designated for Malta under the Urban Waste Water Treatment Directive (1) Malta South Agglomeration - Marsaxlokk Bay; (2) Malta South Agglomeration - Marsaskala Bay/ Wied il-Għajn Bay; (3) Malta South Agglomeration - Marsamxetto and the Grand Harbour; (4) Malta North Agglomeration - Qammieħ Point till Ras ir-Raheb; (5) Gozo Agglomeration - Mġarr Harbour; (6) Gozo Agglomeration - Mġarr ix-Xini; (7) Gozo Agglomeration - Xlendi Bay (8) Gozo Agglomeration - Marsalforn Bay

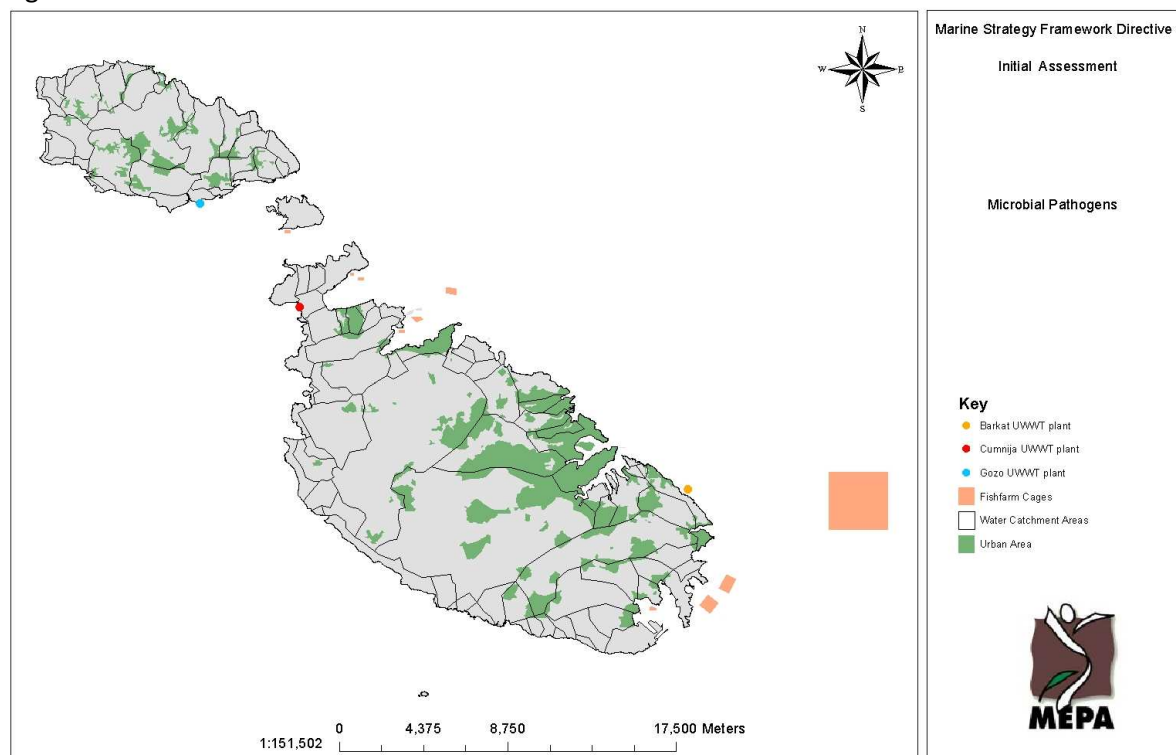


All effluents discharged to the marine environment require an environmental permit, which contains emission limit values for substances discharged into the water and all other environmental requirements, thus ensuring an integrated approach. Amongst the activities that have been identified as requiring an environmental permit due to discharges to the marine environment, are sewage treatment plants, land-based fish farming and aquaculture activities and any other direct discharges into the marine environment.

Malta's First Water Catchment Management Plan draws attention to the overall positive health impacts of treating all municipal wastewaters prior to discharge into the sea. Such benefits include the reduction of the risk of harmful microbial contamination in seawater. Before 2008, only a small percentage of sewage was treated prior to discharge to sea, and the bulk of sewage generated in the Maltese islands was discharged as raw sewage from a number of outfalls, such as San Blas and Wied il-Mielah in Gozo, and iċ-Ċumnija and Wied Għammieq in Malta. Taking the latter location as a case example, the sewage was released into the sea via a submarine pipe that ran perpendicular to the coast. When the submarine outfall was not operating, sewage was discharged directly at the shore. The release of untreated wastewaters resulted in microbiological and nutrient pollution in the coastal waters of Xgħajra. While there is no evidence of extensive nutrient enrichment in the area, very likely because of the nature of the exposed coastline, there were indications of

pollution<sup>14</sup>. To prevent the further discharging of raw sewage into the sea, the Water Services Corporation commissioned three new wastewater treatment plants: the two urban wastewater treatment plants at Ras il-Hobż (Gozo) and Iċ-Ċumnija (Malta) came into operation in November 2007 and October 2008, respectively, whereas the Malta South plant at Ta' Barkat started operating in June 2011 (Figure 4). The latter plant treats 80% of sewage produced in Malta. This means that the country is now fully compliant with the European Union's Urban Wastewater Treatment Directive, stipulating that all wastewater must be treated prior to disposal at sea. Bathing waters (Site code A01) in the Xgħajra area (which area was until 2011 subject to discharge of untreated sewage) have shown improved bathing water quality classifying as 'excellent' quality in terms of *Escherichia coli* concentrations during the 2012 bathing season<sup>15</sup>, compared to the 'good' quality in 2011<sup>16</sup>.

Figure 4: Location of Urban Waste Water Treatment Plants and Fish Farms



Council Directive 2006/88/EC on animal health requirements for aquaculture animals and products thereof, and on the prevention and control of certain diseases in aquatic animals<sup>17</sup>, establishes a harmonised framework aiming at preventing the spread of aquatic animal diseases. It contains several provisions on surveillance/monitoring aimed at the early detection of both listed pathogens and possible emerging diseases (Annex IV of Directive – Part II on Listed Diseases). This Directive is transposed into Maltese law via the “Animal

<sup>14</sup> The bathing waters in Xgħajra are A01 and A02. Indeed prior to the commissioning of the Ta' Barkat plant, these bathing waters were on occasion not compliant with either mandatory values under the old Bathing Waters Directive or samples were tested as of poor quality under the new Bathing Waters Directive (more information is found in Section 1.3 of this report).

<sup>15</sup> <https://ehealth.gov.mt/download.aspx?id=7721>

<sup>16</sup> <https://ehealth.gov.mt/download.aspx?id=5581>

<sup>17</sup> <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:328:0014:0056:en:PDF>



health requirements for aquaculture animals and products thereof, and on the prevention and control of certain diseases in aquatic animal rules”<sup>18</sup> (Legal Notice 24 of 2009, as amended by Legal Notices 125 and 129 of 2013). Further within the context of the aquaculture sector, the draft Aquaculture strategy for Malta<sup>19</sup> acknowledges the need for tuna penning operations to be established in offshore waters, mainly due to the general requirements of bluefin tuna for deeper offshore waters, but also in view of the fact that the use of large quantities of frozen fish as feed and the associated risk of pollution of nearby bathing areas. As part of this draft strategy, alternative sites are currently being considered with a view to minimise any possible harmful impacts on bathing areas, amongst other criteria. The current location of fish farms is depicted in Figure 4.

### 1.3 Characteristics/Analysis of Microbial pathogens

This section provides information on the current state and trends for output levels of microbial pathogens within bathing waters on the basis of monitoring under the Bathing Waters Directive. Information by coastal bathing water is also provided in Annex I to this chapter.

Water quality assessment under the Bathing Waters Directive consists in identifying which values are found for individual bathing waters and establishing their level of quality classified on the basis of higher and lower limit values for microbiological parameters falling in certain classes. These classes of level of quality differ between the old and new Bathing Waters Directive.

Under the old Bathing Waters Directive (Directive 76/160/EEC), water samples from bathing waters are checked against a set of microbiological and physico-chemical parameters (total coliforms, faecal coliforms, mineral oils, surface-active substances and phenols). On the basis of results of the sampling for five parameters, bathing waters are then classified into those that comply with the mandatory values (higher limit values); those that comply with the more stringent guide values (lower limit values), those that do not comply with the mandatory values; and those that are banned or closed (temporarily or throughout the bathing season). The microbial pathogens that are tested and their set limit values are shown in (Table 1).

**Table 1:** Microbiological Parameters and Set Values for the different classes of water quality under Directive 76/160/EEC

| Microbiological Parameter   | Classes           |                    |
|-----------------------------|-------------------|--------------------|
|                             | Guide             | Mandatory          |
|                             | Lower Limit Value | Higher Limit Value |
| Total coliforms/100ml       | 500               | 10,000             |
| Faecal coliforms/100ml      | 100               | 2,000              |
| Faecal streptococci/100ml   | 100               | -                  |
| Salmonella/1 litre          | -                 | 0                  |
| Enteroviruses PFU/10 litres | -                 | 0                  |

<sup>18</sup> <http://justiceservices.gov.mt/DownloadDocument.aspx?app=lom&itemid=11031&l=1>

<sup>19</sup> <http://www.mrra.gov.mt/loadfile.ashx?id=1bb77c1f-f3a5-43fd-974d-23b46d44f605>



In contrast, the New Bathing Waters Directive (Directive 2006/7/EC, which is to repeal Directive 76/160/EEC) reduces the number of key microbiological parameters to two: intestinal enterococci and *Escherichia coli* for which different values are considered as shown in Table 2. The bathing waters quality classes are 'excellent quality', 'good quality', 'sufficient quality' and 'poor quality', while those bathing waters that cannot be classified according to their quality are instead classified as those that are “closed temporarily or throughout the bathing season”; those that are “new” (not yet classification possible); those where “changes” occur that affect the classification of a bathing water (meaning that classification is not yet possible after the changes).

**Table 2:** Microbiological Parameters and Set Values for the different classes of water quality under Directive 2006/7/EC

| Parameter   | Excellent Quality | Good Quality | Sufficient Quality | Reference methods of analysis |
|---|-------------------|--------------|--------------------|-------------------------------|
| Intestinal enterococci (cfu/100 ml)   | 100 (*)           | 200 (*)      | 185 (**)           | ISO 7899-1 or ISO 7899-2      |
| <i>Escherichia coli</i> (cfu/100 ml)  | 250 (*)           | 500 (*)      | 500 (**)           | ISO 9308-3 or ISO 9308-1      |
| (*) based upon a 95-percentile evaluation<br>(**) based upon a 90-percentile evaluation |                   |              |                    |                               |

There is a transition period for bathing waters assessment when the necessary data set for assessing bathing water quality under the New Bathing Waters Directive has not yet been compiled. During the transition period, samples of intestinal enterococci and *Escherichia coli* are reported under the New Bathing Waters Directive but assessment is done according to the assessment rules of the old Bathing Waters Directive. The parameters 'intestinal enterococci' and '*Escherichia coli*' are evaluated according to the mandatory values defined in the Annex to the old Bathing Waters Directive for the parameter 'faecal coliforms' and the guide values defined in the Annex for the parameters 'faecal streptococci' and 'faecal coliforms' (Table 3). When a set of samples of intestinal enterococci and *Escherichia coli* for four years and three years respectively is available, the assessment is done according to the assessment rules of the New Bathing Waters Directive.

**Table 3:** Parameters used to assess bathing water quality during the transition period

| Parameter in Directive 2006/7/EC       | Corresponding parameter in Directive 76/160/EEC | Guide Values | Mandatory Values    |
|--|---|--------------|---------------------|
| 1. Intestinal enterococci (cfu/100ml)  | 3. Faecal streptococci/100ml                    | 100          | - (*) <sup>20</sup> |
| 2. <i>Escherichia coli</i> (cfu/100ml) | 2. Faecal coliforms/100ml                       | 100          | 2000                |

It should be noted that under the new Directive the classification of bathing water quality is determined on the basis of a three- or four-year trend instead of a single year's result, as was the case for the old Bathing Waters Directive, thereby increasing the reliability of

<sup>20</sup> (\*) There is no mandatory standard for the parameter 'faecal streptococci' under Directive 76/160/EEC. This means that only the parameter 'faecal coliforms' is taken to account for evaluating the compliance of bathing water with mandatory values. Evaluation of compliance with guide standards is based on both parameters.

results which would also be more realistic. The classification under the New Bathing Waters Directive is also less susceptible to bad weather or one-off incidents.

A total of 87 bathing areas were monitored in the Maltese Islands between 2005 and 2012 without adding or delisting any of the bathing areas. For the years 2005 to 2008, Malta assessed bathing water quality under the old Directive, and started applying the revised classification under the new Directive from 2009 to date. The status of quality of coastal bathing waters is summarised in Table 4 and Table 5, while Figure 5 shows a graphical representation of the figures provided in these two tables.

Detailed graphical representations of the bathing water quality of the individual bathing waters are included in Annex I to this document. Counts of faecal coliforms and total coliforms on the basis of raw data for the period 2006-2008, and of intestinal enterococci and *Escherichia coli* for the period 2009-2011 are graphically represented in Annex II. Raw data for the year 2012 was not available during the time of the compilation of this report.

Table 4 provides the results for the period 2005 to 2008. While non-compliance with water quality was observed for some bathing waters, there is an increasing trend in compliance rates with the requirements of the Bathing Waters Directive. The Environmental Health Directorate confirmed that non-compliance during this period was mainly attributed to the physico-chemical parameters (mineral oils, surface-active substances and phenols) rather than to microbiological contamination (Mr. Charles Bonnici, personal communication).

**Table 4:** Results of bathing water quality in coastal bathing waters in Malta from 2005 to 2008 – Assessment under Directive 76/160/EEC<sup>21,22</sup>

| Total number of bathing waters |    | Compliance with guide values |      | Compliance with mandatory values |      | Not Compliant      |     | Banned/closed temporarily or throughout the season |     |
|--------------------------------|----|------------------------------|------|----------------------------------|------|--------------------|-----|--|-----|
|                                |    | Number                       | %    | Number                           | %    | Number             | %   | Number   | %   |
| 2005                           | 87 | 29                           | 33.3 | 35                               | 40.2 | 6                  | 6.9 | 0  | 0.0 |
| 2006                           | 87 | 73                           | 83.9 | 84                               | 96.6 | 3                  | 3.4 | 0  | 0.0 |
| 2007                           | 87 | 78                           | 89.7 | 83                               | 95.4 | 4                  | 4.6 | 0  | 0.0 |
| 2008                           | 87 | 82                           | 94.3 | 86                               | 98.9 | 1(*) <sup>23</sup> | 1.1 | 0  | 0.0 |

Table 5 provides the results for the period 2009 to 2012. Under this period, monitoring is done under the new Bathing Waters Directive and hence is on the basis of a three- or four-year trend instead of a single year's result. For instance, for the assessment of bathing water quality for 2009, Malta made use of monitoring data collected during the bathing seasons 2006, 2007 and 2008.

<sup>21</sup> Bathing waters which were insufficiently sampled or not sampled according to the Bathing Water Directive were not included in this table. Therefore, in some cases, the sum of the different categories will not be equal to the total number of bathing waters. Bathing waters which were compliant with the guide values were also compliant with the mandatory values.

<sup>22</sup> Here compliance/non-compliance is shown for both microbiological and physicochemical parameters.

<sup>23</sup> (\*) non-compliant with the mandatory values due to the parameter Surface-active substances

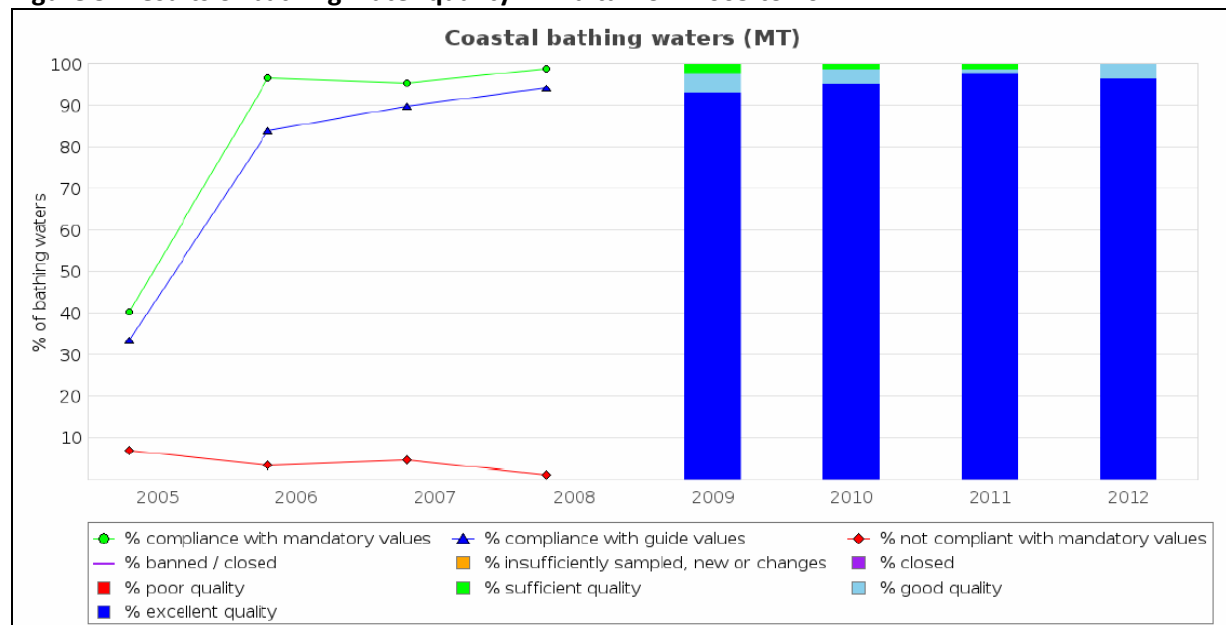
**Table 5: Results of bathing water quality in coastal bathing waters in Malta from 2009 to 2012 – Assessment under Directive 2006/7/EC**

| Total number of bathing waters | Excellent Quality |    | Good Quality |   | Sufficient Quality |   | Poor Quality |   | Closed |   | Insufficiently Sampled |   | New |   | Changes |   |     |
|--------------------------------|-------------------|----|--------------|---|--------------------|---|--------------|---|--------|---|------------------------|---|-----|---|---------|---|-----|
|                                | #                 | %  | #            | % | #                  | % | #            | % | #      | % | #                      | % | #   | % | #       | % |     |
| 2009                           | 87                | 81 | 93/1         | 4 | 4.6                | 2 | 2.3          | 0 | 0.0    | 0 | 0.0                    | 0 | 0.0 | 0 | 0.0     | 0 | 0.0 |
| 2010                           | 87                | 83 | 95.4         | 3 | 3.4                | 1 | 1.1          | 0 | 0.0    | 0 | 0.0                    | 0 | 0.0 | 0 | 0.0     | 0 | 0.0 |
| 2011                           | 87                | 85 | 97.7         | 1 | 1.1                | 1 | 1.1          | 0 | 0.0    | 0 | 0.0                    | 0 | 0.0 | 0 | 0.0     | 0 | 0.0 |
| 2012                           | 87                | 84 | 96.6         | 3 | 3.4                | 0 | 0.0          | 0 | 0.0    | 0 | 0.0                    | 0 | 0.0 | 0 | 0.0     | 0 | 0.0 |

When considering the period 2009 to 2012 (monitoring under new Bathing Waters Directive), Malta has an increasing trend in coastal waters with excellent quality from 2009 to 2011 with one less in 2012 when compared to 2011.

Figure 5 shows a more-or-less increasing trend in the overall improvement of water quality in Maltese coastal bathing waters with the majority having an excellent quality. When article 13.3 of Directive 2006/7/EC<sup>24</sup> is applied to harmonise microbiological quality classes between the old and new Directives, and when then considering the period 2005 to 2012, one may say that there are increasing trends in both excellent and good or sufficient status in Maltese coastal bathing waters as shown in Figure 6.

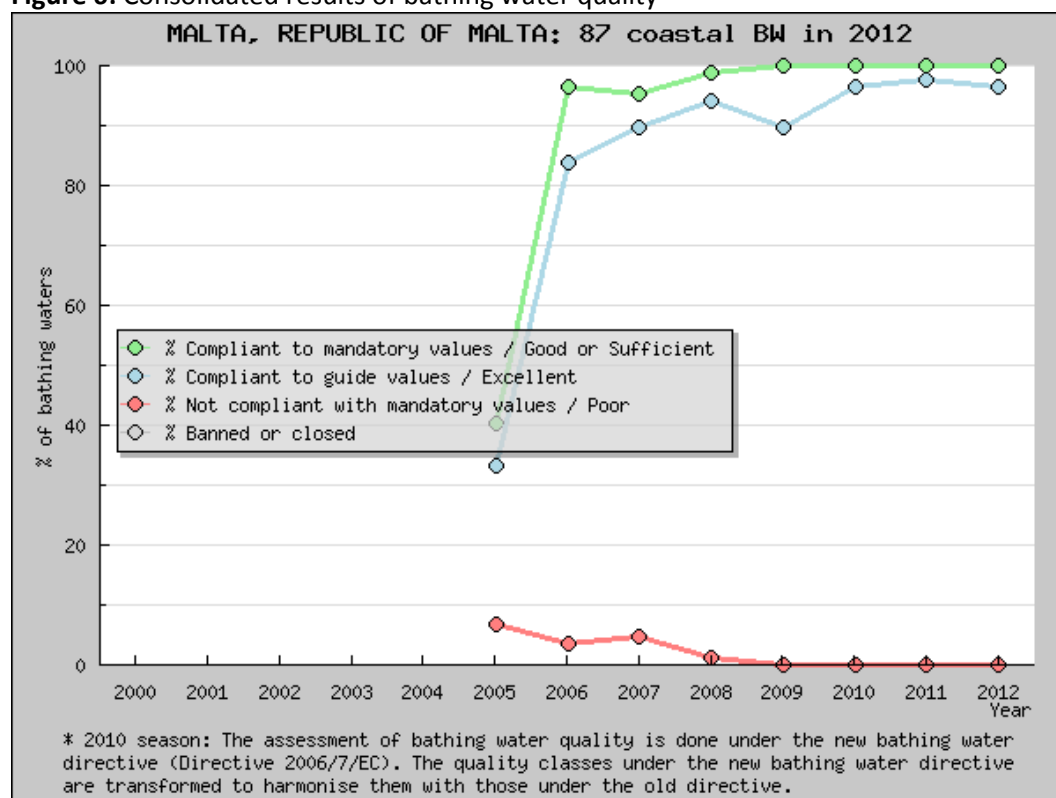
**Figure 5: Results of bathing water quality in Malta from 2005 to 2012<sup>25</sup>**



<sup>24</sup> Foresees that the parameter Escherichia coli reported under Directive 2006/7/EC is assumed to be equivalent to the parameter Faecal coliforms of Directive 76/160/EEC and that the parameter Intestinal enterococci reported under Directive 2006/7/EC is assumed to be equivalent to parameter Faecal streptococci under Directive 76/160/EEC.

<sup>25</sup> Source: EEA (2012) – Bathing Water Results 2012 – Malta

**Figure 6: Consolidated results of bathing water quality**



More information on the microbial results for the 87 coastal bathing areas for the period 2005 to 2012 is available online<sup>26</sup>.

<sup>26</sup> [https://ehealth.gov.mt/HealthPortal/public\\_health/environmental-health/health\\_inspectorate/env\\_hlt\\_risk\\_management/envhealth\\_bathingwater09.aspx](https://ehealth.gov.mt/HealthPortal/public_health/environmental-health/health_inspectorate/env_hlt_risk_management/envhealth_bathingwater09.aspx)

#### **1.4 Assessment/Pressure Status of Microbial pathogens and their impacts**

This section provides information on the main activities that are contributing to, or causing, microbial pathogens in the assessment area (i.e. in the relevant coastal bathing waters).

Pressures that may affect the bathing water quality of the Maltese Islands boil down to land-based discharges at sea, aquaculture and polluted rainwater run-off. Heavy rain or similar exceptional situations may also cause pollution problems for a few days. Various measures are now in place to regulate/minimise such pressures. More information is available in Section 1.2 of this Chapter. Of note, is the progress made by Malta to commission the sewage treatment plants in Malta and Gozo. As a result, the country now treats all of its sewage before discharging it into the sea.

When considering the period 2005 to 2012, temporary closure warnings were issued as shown in Table 6. It is clear that the main existing pressure is the contamination of bathing waters that occurs as a result of overflows from the sewerage network due to storm water, blockages, pumping station malfunctions and/or insufficient capacity. Nevertheless, such overflows are rigorously controlled by Malta's Water Services Corporation and the influx of raw sewage into the marine environment from sewage overflows is deemed to be localised and of short duration.

Table 6: Temporary Closure Health Warnings issued between 2005 and 2012

| Year | Bathing Areas for which temporarily closure health warnings were issued by the Department of Public Health   | Reason   |
|------|--|--|
| 2005 | A01 and A02 – Xgħajra Bay<br>A11 and A12 – St George’s Bay at Birzebbugia<br>B03 and B04 –St. George’s Bay in St Julians<br>B09 – Balluta Bay in Sliema<br>B12 – Fond Għadir in Sliema<br>C23 – St Francis Street in St Paul’s Bay<br>C24 – Siren’s Area in St Paul’s Bay<br>D01 – Ix-Xatt l-Aħmar in Gozo | localised sewage overflows                         |
| 2006 | A01 and A02 – Xgħajra Bay<br>B12 – Fond Għadir in Sliema<br>C11 – Mellieħa Bay<br>C24 – Siren’s Area in St Paul’s Bay<br>C26 – Bay Square at Buġibba<br>C27 – Perched Beach at Buġibba<br>C31 – Ċens tal-Ġebel at Qawra  | localised sewage overflows                         |
| 2007 | A12 – St George’s Bay at Birzebbugia<br>B09 – Balluta Bay in Sliema<br>B12 – Fond Għadir in Sliema<br>C15 – Mellieħa Bay   | localised sewage overflows                         |
| 2008 | A06 – Marsascala<br>A11 – Qajjenza in Buġibba<br>B06 and B07 – St Julian’s Bay<br>B12 – Fond Għadir in Sliema<br>C26 – Bay Square at Buġibba   | localised sewage overflows                         |
| 2009 | C18 – St Paul’s Bay, Wharf in front of Fekruna pumping station   | localised sewage overflow                          |
| 2010 | C26 – Bay Square in Buġibba<br>D04, D05, D06 and D07 – Xlendi Bay in Gozo<br>C28, C29, C30, C31 and C32 - Qawra Bay in Qawra   | localised sewage overflow                          |
| 2011 | No health warnings issued  | N/A  |
| 2012 | B03 and B04 –St. George’s Bay in St Julians<br>C18 –St Paul’s Bay, Wharf in front of Fekruna Pumping Station<br>D04, D05, D06 and D07 – Xlendi Bay in Gozo   | localised sewage overflow following heavy rainfall |

Sites that may have been prone to register health warnings due to occasional overflows from nearby sewage/waste water pumping stations were in Xgħajra, St. Julians, Sliema and St Paul’s Bay, and recently even Xlendi Bay in Gozo. However such incidences have been reduced drastically during the last years following a comprehensive maintenance programme on all pumping stations carried out by the waste water unit within the Water Services Corporation. There are 122 pumping stations in Malta and Gozo including one on Comino. These are used in areas where sewage must be pumped uphill and the ground topology does not allow use of a gravity system. Each station is equipped with at least two pumps, one as a spare in case of any failure. Several key stations are also equipped with stand-by generators in the event of a power cut.

The impact of sewage outfalls has been the subject matter under investigation by various studies including dissertations undertaken in part of the completion of BSc, MSc or PhD

studies within the University of Malta (Mallia, 1991<sup>27</sup>; Chircop, 1992<sup>28</sup>; Rizzo, 1996<sup>29</sup>; Ferro, 2001<sup>30</sup>; Cachia, 2004<sup>31</sup>; Ghio', 2004<sup>32</sup>; Grima Connell, 2006<sup>33</sup>; Guillaumier, 2006<sup>34</sup>; Saliba, 2006<sup>35</sup>; Zammit, 2009<sup>36</sup>; Ellul, 2010<sup>37</sup>; and Mifsud, 2012<sup>38</sup>). Documented environmental impacts of the discharge of untreated sewage include the degradation of exposed inshore waters and habitats, especially in the vicinity of the main sewage outfalls and pollution of marine sediments by heavy metals (lead, zinc, cadmium and copper). Some investigations have looked at the zonation patterns on exposed and sheltered rocky shores under the influence of sewage outfalls, while others have also employed satellite imagery to assess the extent of impact of sewage outfall (Axiak, Pavlakis, Sieber & Tarchi, 2000)<sup>39</sup> and to assess the impact of levels of suspended solids in coastal waters on the environmental quality and marine life (Ellul, 2010). Azzurro *et al.* (2007)<sup>40</sup> assessed the effects of two sewage outfalls on the rocky-reef fish community along the NW coast of Malta and highlighted significant alterations to the marine environment caused by the sewage outfalls.

While the impacts associated with sewage outfalls on habitats and species groups have been assessed through the above-mentioned studies, these impacts do not necessarily reflect those associated with microbiological contamination. Assessment of microbiological contamination has to date been geared towards ensuring human safety through the implementation of Bathing Water Quality legislation, and the effects of such contamination on habitats and species groups has never been assessed.

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- <sup>27</sup> Mallia, A. (1991). *Zonation patterns on a rocky shore under the influence of a sewage outfall*. Unpublished BSc Dissertation, University of Malta
- <sup>28</sup> Chircop, P. (1992). *An investigation on the sewage outfall at Wied Ghammieg*. Unpublished BSc Dissertation, University of Malta
- <sup>29</sup> Rizzo, Y. (1996). *Wastewater discharge through coastal outfalls - a case study*. Unpublished MSc Dissertation, University of Malta
- <sup>30</sup> Ferro, H. (2001). *Zonation patterns on exposed and sheltered shores at Sliema (Malta) and the effect of sewage on the sheltered bay*. Unpublished BSc Dissertation, University of Malta
- <sup>31</sup> Cachia, A. (2004). *Assessing the biological impact of Cumnija sewage outfall using metallothionein induction*. Unpublished BSc Dissertation, University of Malta
- <sup>32</sup> Ghio', S. (2004). *Assessing impact of sewage outfalls at Cumnija and Anchor Bay: A preliminary investigation*. Unpublished BSc Dissertation, University of Malta
- <sup>33</sup> Grima Connell, M. (2006). *The Ic-Cumnija Sewage Outfall*. Unpublished BSc Dissertation, University of Malta
- <sup>34</sup> Guillaumier, R. (2006). *Local Marine Wastewater Discharges: Characterisation and Impacts*. Unpublished MSc Dissertation, University of Malta
- <sup>35</sup> Saliba, E. (2006). *Beach Management and Bathing Water Quality at Xgħajra*. Unpublished BSc Dissertation, University of Malta
- <sup>36</sup> Zammit, A. (2009). *Assessing the Impacts of Discharges Of Sewage From The Main Outfall In Gozo*. Unpublished BSc Dissertation, University of Malta
- <sup>37</sup> Ellul, M. (2010). *The Use Of Remote Sensing And GIS - Models In Assessing The Impact Of Levels Of Suspended Solids In Coastal Waters On Environmental Quality And Marine Life*. Unpublished PhD Dissertation, University of Malta
- <sup>38</sup> Mifsud, D. (2012). *Influence of the Wied Ghammieg sewage outfall on shallow water rocky habitat*. Unpublished BSc Dissertation, University of Malta
- <sup>39</sup> Axiak, V., Pavlakis, P., Sieber, A.J., & Tarchi, D. (2000). Re-assessing the Extent of Impact of Malta's (Central Mediterranean) Major Sewage Outfall Using ERS SAR. *Marine Pollution Bulletin*, Volume 40, Issue 9, Pages 734–738.
- <sup>40</sup> Azzurro, E., Matiddi, M., Fanelli, E., Camilleri, J., Giodano, P., Scarpato, A. & Axiak, V. (2007). Effects of Sewage Discharges on Coastal Fish Assemblages in Malta, Strait of Sicily, Mediterranean Sea. *Rapp. Comm. int. Mer Médit.*, 38, p. 424.



## **1.5 Data gaps**

There are no data gaps in relation to the microbial pathogens which need to be monitored as part of the EU Bathing Water Quality Directive. However other microbial pathogens not covered by this Directive have not been assessed to date and the potential effects of microbiological contamination on habitats and species are not known.

