UNITED NATIONS

EP

UNEP(DEPI)/MED WG.402/3

UNITED NATIONS ENVIRONMENT PROGRAMME MEDITERRANEAN ACTION PLAN

20 October 2014
Original: English

Regional Training Workshop for Environmental Inspectorates

Athens, Greece, 25-27 November 2014

Agenda item 2 (a): Correlation tool on ELV and EQs

Recommendations and conclusions on the testing of a modeling system to assess the variations of EQSs with ELVs for nitrogen and mercury in Gulf de Lion and Izmir Bay

UNEP/MAP
Athens, 2014

Introductory note by the Secretariat

During 2012-2013, the Secretariat supported the development of a correlation tool between the Emission Limit Values and Environmental Quality Standards (ELV-EQS) in the framework of the MedPartnership project. This ELV-EQS tool had the objective to provide a bridge between the ecosystem approach and the UNEP/MAP Barcelona Convention Protocol on Land Based Sources following a combined ecosystem and precautionary approach.

The relation between the EQS and the ELV depends on the characteristics of the discharge, on the characteristics of the substance of concern and on the characteristics of the receiving water body. Mathematical water quality modeling is an accepted and often applied way of quantifying the relation between the EQS and the ELV, taking into account all of these factors.

The present document (UNEP (DEPI)/MED WG.402/3) contains only the main recommendations of the study on the ELV-EQS tool presented as an information document UNEP(DEPI)/MED WG.402.Inf 3"Testing of a modeling system to assess the variations of EQSs with ELVs for nitrogen and mercury in Gulf de Lion and Izmir Bay".

The purpose of presenting the conclusions and recommendation of the whole report (UNEP(DEPI)/MED WG.402.Inf.3) is to provide participants with the reasons based on which the ELV/EQS correlation tool has been developed including information on the mixing zone. These recommendations have been widely taken into account while developing the web-based tool ELV/EQS which is presented in detail in document UNEP (DEPI)/MED WG.402/4.

6 Conclusions and recommendations

6.1 Conclusions

This report discussed a methodology to provide a bridge between the ecosystem approach and the MEDPOL Land Based Sources Protocol. As such, it establishes a relation between environmental quality standards (EQS) and emission limit values (ELV) following a combined, precautionary approach. In this study, we used the concept of a mixing zone as defined in the related EC Guidance Document (EC, 2010). A mixing zone is an area around a discharge point where the concentration of a substance may locally exceed the EQS. This implicitly determines the highest acceptable emission or the ELV: if the EQS is given, the ELV follows from the requirement that the EQS is satisfied at the edge of the designated mixing zone.

The quantitative assessment of the relation between the EQS and the ELV depends on the characteristics of the discharge, on the characteristics of the substance of concern and on the characteristics of the receiving water body. Mathematical water quality modelling is an accepted and often applied way of quantifying the relation between the EQS and the ELV, taking into account all these factors.

Within the Water Framework Directive community, a simple web-based tool (the “Tier 2 Discharge Test”) has been developed that evaluates the acceptability of a certain discharge, given the EQS and a defined mixing zone. This tool implicitly establishes the relation between the EQS and the ELV, but it discards the substance characteristics and most of the (variability of the) characteristics of the receiving water body.

In this study we used two 3D modelling approaches. The “detailed 3D modelling” approach takes into account in detail the characteristics of the receiving water body and the substance characteristics. This approach however, requires a high level of skill from its user, is very site specific and requires detailed input data. The effort required for the detailed 3D modelling approach is so large that the application to all hot spots would be very costly, and would not lead to coherent and harmonised results.
This report also discusses a “generalised Tier 3” method, which is based on the “Screening Model for Coastal Pollution Control in the Mediterranean”, developed in 1989 for the Ministry of the Environment of Greece. This method takes into account in detail the substance characteristics, but uses a simplified representation of the characteristics of the receiving water body. This obviously leads to a loss of accuracy, but it allows for easy application and offers a generic, coherent and harmonized approach. The method includes sufficient site-specific information to allow application to the variety of coastal environments encountered in the Mediterranean.
The objective of using both approaches simultaneously is to explore the possibilities to have credible and site-specific results from the generalised Tier 3 method, which can much easier be applied to a large amount of sites than the detailed 3D modelling approach.

In water quality modelling, experts distinguish the “near field” where the fate of a pollutant discharge depends primarily on the properties of the discharge, and the “far field” where the fate of the pollutants depends primarily on the properties of the receiving water body and the substance properties. A water quality model that deals with both the near field and the far field in a detailed and fully integrated way is not yet available for routine application. The Tier

2 Discharge Test mentioned above focuses on the near field, whereas the 3D models used in this study focus on the far field.

In view of the commonly applied range of mixing zones (500-1000 m) for the assessment of EQSs for the annually averaged concentration (AA-EQS), the spatial scale of the analysis of an individual discharge is in the order of 5 km. At this spatial scale and close to the shore where we typically find coastal discharges, the fate of a pollution discharge under Mediterranean conditions needs to be analysed taking into account the far field. Transport patterns are typically dominated by wind induced horizontal and vertical circulation patterns. The detailed 3D model can definitely simulate such patterns, but it will need input from field data to establish that the simulated current patterns are indeed correct. The generalized Tier 3 model lacks this ability: it simply uses field data directly as input.

The spatial scale of the mixing zone for an evaluation of EQSs for the maximum allowable concentration (MAC-EQS) may be much smaller. In some countries, mixing zones of 10-25 m are used to evaluate the MAC-EQS. At these small spatial scales, the evaluation results are dominated by the near field stage, and both the detailed 3D modelling and generalised Tier 3 modelling methods loose their relevance. At such occasions, a dedicated near-field model is more appropriate. In this report we provided two alternative approaches: (a) for larger MAC-EQS mixing zones, we applied the detailed 3D modelling and generalised Tier 3 modelling methods, and (b) for small MAC-EQS mixing zones, we demonstrate the near field based approach.

Our case studies demonstrate that the far field is essential at the spatial scale that we are interested in for the evaluation of AA-EQS. The near field is typically much smaller (10-50 m). This suggests that more detail about the characteristics of the receiving water body is required than included in the Tier 2 Discharge Test.

The results from our ELV assessments for nitrogen and mercury for discharges in Izmir Bay and the Gulf of Lions (near Marseille) are compiled in Table 5.2 and Table 5.4.

Our results indicate that while using the same EQSs, the ELVs for the study site in the Gulf of Lions (near Marseille) are about 5 times higher than those for the study site in the Inner Izmir Bay. This can be attributed to the differences between those water bodies: the Izmir Bay is shallower and more enclosed than the bay near Marseille.

Our case studies for nitrogen and mercury also demonstrate that it is vital to include the substance characteristics in the assessment. This is particularly relevant for mercury, because the WFD-EQS applies to the dissolved concentration only. In our case studies, this concentration was about 10% of the total concentration.

Our case studies demonstrated that the generalized Tier 3 model provides results that are in the same range as the detailed 3D model, though not equal. An approach with certain simplifications, such as the generalised Tier 3 model presented here, should produce conservative results, to ascertain that the adopted simplifications will not lead to overestimation of the ELV. The results presented in this report demonstrate that the generalised Tier 3 model does not always provide conservative results: in some cases it provides a higher ELV than the detailed 3D model. For this reason, we recommend the use of a safety factor. Our initial proposal for such a safety factor is 2.0 (based on the currently available applications to Izmir Bay and the Gulf of Lions).

Our case studies for nitrogen indicate that the Tier 2 Discharge Test produces significantly more conservative results than the generalized Tier 3 model and the detailed 3D model. For mercury, this tool could not be applied.

Our case studies indicate that the size of the mixing zone for the evaluation of the MAC-EQS is decisive for the ELVs for mercury. If the mixing zone is the same as for the AA-EQS, the ELVs found are an order of magnitude higher than if the mixing zone is in the order of 10-50 m.

Table 6.1 provides an overview of the strengths and weaknesses of the tools and methods applied in this report. This table demonstrates how an increasing effort, an increasing level of required skill and increasing data needs result in more advanced assessments with a higher accuracy, a lower uncertainty and higher ELVs.

Table 6.1 Overview of strengths and weaknesses of methods discussed in this report

	Tier 2 Discharge Test	**Generalized Tier 3 model**	**Detailed 3D model**
High level of skill required	No	A little more than the Tier 2 Discharge Test	Yes
Large amount of data needed	No, about 20 numbers to characterise the load and the environment	A little more than the Tier 2 Discharge Test, see Table 4.1 and Table 4.2	Yes
Large effort needed	No	No	Yes
Representation of discharge characteristics / near field	Good	Medium	Medium
Representation of substance characteristics	No	Yes	Yes
Representation of receiving water body / far field	Poor	Medium	Good
Accuracy in Case Studies carried out	Conservative (ELVs 6-7 times lower than detailed 3D model)	Conservative due to use of a safety factor (ELVs ≈ 2 times lower than detailed 3D model	Presumably the best

6.2 Recommendations

In view of the large amount of hot spots around the Mediterranean and the diversity of these sites, in terms of their natural environment and the socio-economic conditions, we recommend that an easily applicable method will be made available to water managers and policy makers. This method should offer a clear framework, and allow for a generic, coherent and harmonized approach, which ensures a “level playing field” for the permitting policy around the Mediterranean. The successful implementation of such a method probably requires a Guidance Document and a supporting software tool. Examples of similar methods are available or under development for the permitting of anti-fouling paints and ballast water treatment systems (OECD, 2005; van Hattum et al, 2006; Zipperle et al., 2011).

We recommend a method which combines the strong points of the Tier 2 Discharge Test and the generalized Tier 3 model discussed in this report (see Table 6.1). In particular, the generalised Tier 3 model requires some improvements with respect to the representation of discharge characteristics and the near field modelling, for example like it has been implemented in the Tier 2 Discharge Test. The input required for this recommended method would comprise about 30 items as indicated in Table 6.2.

Table 6.2 List of input required for the recommended model

Substance / Discharge	**Receiving Environment**
EQS of substance (optionally MAC- and AA-EQS)	Type of environment (Case I or II, Figure 3.9)
Position of discharge	Orientation of study area relative to North
Discharge flow rate and concentration	Depth of thermocline and/or halocline
Discharge density	Salinity above and below halocline
Discharge pipe opening diameter	Temperature above and below thermocline
Substance partition coefficient	Water depth near-shore
Substance decay rate	Bottom slope
Mixing zone for evaluation AA-EQS	Wind speed and direction (optionally several typical conditions with associated probability)
Mixing zone for evaluation MAC-EQS	Current speed (optionally several typical conditions with associated probability)
	Suspended solids concentration
	Settling velocity of particles

The recommended method is not yet available in a way that allows easy application at the regional level and at the national level. The effort to make it available via the internet is fairly limited based on the results of the present study and on the existing web-based Tier 2 Discharge Test. If this effort will be made, the use of the model will require very limited training for the future user. The available experience with the existing web-based Tier 2 Discharge Test indicates that a 1-day training workshop is more than sufficient.

We quantified the reduced accuracy of the generalized Tier 3 model discussed in this report, as compared to a detailed 3D modelling study, for two study sites and two substances. This leads to the recommendation to apply a safety factor of 2 to the results obtained. It is recommended that UNEP discusses with the stakeholders whether or not the present study provides a sufficient picture of the uncertainties connected to this method. If not, then additional substances and/or additional sites should be studied in a similar way as it has been done in this report.

A final recommendation is that UNEP-MAP discusses the size of the mixing zone to be used for the evaluation of MAC-EQSs. Should this mixing zone be in the same order as the mixing zone for the evaluation of AA-EQSs? Or should it be much smaller, as it is in some European countries?