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# Application of the Danish EPA's Marine Model Complex and Development of a Method Applicable for the River Basin Management Plans 2021-2027

## Water Framework Directive Scenario 1c – Ignoring System Contribution

Miljø- og Fødevareministeriet
Miljøstyrelsen

Technical Note
October 2021

The expert in **WATER ENVIRONMENTS**

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## Water Framework Directive Scenario 1c – Ignoring System Contribution

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| Prepared for | Danish EPA (Miljøstyrelsen, Fyn) |
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*Eelgrass in Kertinge Nor*
*Photo: Peter Bondo Christensen*


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| Project number | 11822953 |
| Approval date | 29-10-2021 |
| Classification | Open |



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# Preface

This report is commissioned and funded by the Danish Environmental Protection Agency (EPA). The data, methods and results included in the report are intended to be an integrated part of the material behind the Danish River Basin Management Plans (RBMP) 2021-2027.

The work reported was managed and performed by DHI and AU/DCE. During the project, a steering committee followed the development, and was involved through dialogue and follow-up on progress, etc. The steering committee consisted of members from the Danish Ministry of Environment and Food (MFVM), the Danish EPA (MST), DHI and AU.

In addition, a follow-up group consisting of members from The Danish Agriculture & Food Council, SEGES, Sustainable Agriculture (BL), the Danish Society for Nature Conservation, the Danish Sports Fishing Association, Danish Fishermen PO (DFPO), the Danish Ports, and KL/municipalities was affiliated with the project. The follow-up group has been continuously informed about the progress of the project at meetings convened by the MFVM.

Choice of methods, data processing, description and presentation of results have been solely AU's and DHI's decision and responsibility. A draft version of this report has been reviewed by MST and the follow-up group.

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# 1 Introduction

When preparing the Danish River Basin Management Plans 2015-2021 (RMBP 2015-2021), DHI and Aarhus University (AU) developed a number of mechanistic (DHI) and statistical (AU) models that were used for calculating chlorophyll-a target values defining the threshold (GM) between 'Good Ecological Status' (GES) and 'Moderate Ecological Status'. The models were also used for calculating Maximum Allowable Inputs (MAIs) of total nitrogen (N) from Danish catchments based on the GM threshold value and a proxy for eelgrass depth limit. Hence, the development aimed at both the model development and the development of a method for calculating the MAIs.

As part of the political, regulatory package 'The Food and Agriculture Agreement from 2015' an international evaluation of the procedures used in the RBMP 2015-2021 was conducted. The evaluation was finalised autumn 2017 with a report (Herman *et al.* 2017) including a number of recommendations for improving the scientific background behind the RBMP 2021-2027.

To follow up on the international evaluation, the Danish EPA facilitated a range of research and development projects (R&D) projects with the overall aim of developing methods to calculate robust, transparent and differentiated chlorophyll-a reference values (and corresponding GM values) and MAIs in as many water bodies as possible for implementation into the RBMP 2021-2027.

Two central R&D projects relate to the continued model development in the assessment of reference chlorophyll-a values (and corresponding target values) and final MAI calculations. Other projects support different aspects of the final MAI calculations, but here we focus on the following two central R&D projects:

- 'Recommendations for the continued development of models and methods for use in the River Basin Management Plan 2021-2027. Follow-up on the international evaluation of marine models behind the River Basin Management Plan 2015-2021' (Erichsen & Timmermann 2018)
- 'Application of the Danish EPA's Marine Model Complex and Development of a Method Applicable for the River Basin Management Plans 2021-2027'.

The outcome of the above research projects is a set of MAIs based on a range of scenarios reflecting different assumptions regarding future developments in nutrient loading from neighbouring countries and the atmosphere as described in Erichsen *et al.* 2020. These management scenarios are based on assumptions defined by the Danish EPA and they are related to either 1) assumptions regarding international adopted treaties related to nutrient management 2) assumptions regarding future development in land-based loadings from other countries 3) assumptions regarding future development in atmospheric deposition and 4). different levels of compliance with the Water Framework Directive (WFD). In the present technical note, the assumptions behind the Water Framework Directive (WFD) scenario 1c and corresponding results are presented. In the documentation of the general method behind the calculations of the Danish land-based N-MAIs (see Erichsen *et al.* 2020) a system contribution is described. Generally, the system contribution is taken into consideration when calculating Danish N-MAIs but in the WFD scenario 1c we calculate the Danish MAIs without considering this system contribution.

# 2 Preconditions for MAI Calculations

The Danish MAIs will, among other things, also depend on future loadings from neighbouring countries and atmospheric N-depositions as described in more detail in Erichsen *et al.* 2020. In addition, some water bodies may also respond to Danish land-based P loadings why one set of Danish land-based N-MAIs corresponds to a set of Danish land-based P-MAIs.

To be able to calculate a set of Danish land-based N-MAIs, we need to make assumptions on future loadings and management strategies from neighbouring countries (management scenarios) as well as assumptions regarding Danish land-based P loadings.

With respect to reductions in neighbouring countries, the Danish EPA has defined a set of prerequisites to be used for constructing management scenarios defining potential developments in future non-Danish land-based loadings and atmospheric deposition. For each scenario, Danish land-based N-MAIs are calculated based on either 0%, 10%, 20%, 30% or 50% Danish land-based P reductions.

In this technical note, we have not assessed whether or not the scenarios defined by the Danish EPA are realistic, or even possible, but solely provided N-MAIs that will ensure target reaching given that the corresponding conditions related to nutrient loading from other countries, atmospheric N deposition and P loading from Danish catchments are fulfilled.

## 2.1 WFD-Scenario Definitions

As mentioned above, the Danish EPA has defined a set of assumptions regarding nutrient inputs from other countries and the atmosphere to be used as a precondition for the Danish land-based N-MAI calculations. The assumptions are grouped into three management scenarios and one scenario related to the interpretation of the Water Framework Directive (WFD-scenario). The different assumptions are described in general terms in Erichsen *et al.* 2020, whereas the present technical note describes WFD Scenario 1c in more details (also see 'bold' description below).

### 2.1.1 WFD-Scenarios

The method for estimating land-based MAIs applicable for RBMP2021-2027 (Erichsen *et al.* 2020) include averaging between indicators and model-results (statistical and mechanistic model results, respectively) The method aims at estimating a MAI for each indicator that would bring the indicator from the present status to the boundary between “good” and “moderate” status and it include the system contribution in the calculation of Danish land-based N-MAIs. The system contribution covers delays or lag-time in response, feedback mechanisms, climate changes and uncertainties (see Erichsen *et al.* 2020 for details).

In the WFD-scenarios the implications of the different aspect of the method for calculating MAI are addressed by making scenarios based on:

a) Increasing the likelihood of achieving GES by changing the indicator target values from the good-moderate boundary to a target value between good and high status.

b) One-out-all-out principles. This approach will use average model results per indicator but include the lowest MAI between the two indicators.

**c) MAI calculations are performed without taking the system contribution into account.**

The present technical note describe scenario 1c where we assess the impact of taking the system contribution into account when calculating Danish MAIs. The system contribution is an

essential part of the overall method described in Erichsen *et al.* 2020, but here we estimate the impact of not considering the system contribution.

For the above three sub-scenarios, the land-based nutrient loadings and atmospheric N depositions will be kept as described in management scenario 1.

### 2.1.2 Scenario Loadings

The full overview of the scenario reductions applied for WFD-scenario 1c in other countries than Denmark and atmospheric depositions are summarised in Table 2-1, and explained briefly in the following sections. The data on present-day Danish loadings can be found in *Erichsen & Birkeland 2020a.*

#### Baltic Sea Action Plan (BSAP)

In Management scenario 1, the land-based nutrient loadings to the Baltic Sea are based on the BSAP. All countries around the Baltic Sea have adopted the BSAP as the regional treaty that governs nutrient reductions to the Baltic Sea. Germany has, however, adopted stricter reductions as part of the German RBMP 2015-2021, and these will be described in the following section.

The BSAP consists of national MAIs including both land-based nutrient loadings of N and P and atmospheric depositions (or Country Allocated Reduction Targets – CART). It is necessary to distinguish between land and atmospheric nutrient loading from other countries than Denmark. In order to split the total nutrient loading from the CART, we used data on land-based nutrient loading on a country-by-country level from 1997-2003. This period is consistent with the BSAP baseline period, and allows us to calculate how much of the baseline nutrient loading for each country derives from land-based sources, and how much is atmospheric deposition. We have then assumed that this relationship is constant under the BSAP future conditions, and calculated the country-specific MAIs by subtracting the atmospheric part from the CART, providing us with information on atmosphere and land-based nutrient loading under the BSAP. This calculation has been done for both total nitrogen and phosphorous.

The present-day average loading (average of 2014-2018 loadings) is then compared to the land-based MAIs within the two basins Baltic Proper (BAP) and Danish Straights (DS) and converted into a need for reduction (in %). This estimation is done excluding Danish land-based loadings, as they are the target of the present exercise.

#### RBMP 2015-2021

As mentioned above, Germany is the only country (besides Denmark), that has adopted N reductions that are stricter than the CART defined in the BSAP.

According to the German RBMP 2015-2021, nutrient targets for TN are defined as average TN concentrations of 2.6 mg N/l in rivers discharging to the Baltic Sea and 2.8 mg N/l in rivers discharging to the North Sea (COWI 2018). For TP, no new targets have been defined in the RBMP 2015-2021 why German TP concentrations in rivers discharging to the North Sea are similar to present-day TP concentrations, and TP concentrations in rivers discharging to the Baltic Sea follow the reductions determined by BSAP.

Based on Gadegast & Venohr (2015), the average concentration in the rivers discharging to the North Sea was 4.04 mg N/l in 2005 why a change in concentrations to 2.8 mg N/l corresponds to an average reduction of 31% of German land-based N-loads. For comparison, COWI (2018) estimated a reduction need from German rivers of 30-48% based on 2001-2005 loadings. Here we use the 31%, as the data reported in Gadegast & Venohr (2015) also relates to the reductions used for defining reference loadings from German and Dutch rivers discharging into the German Bight.

The 31% reduction is applied to all German rivers discharging to the North Sea as well as other North Sea rivers (due to lack of knowledge) in the simulations. Applying the same reduction on

all North Sea rivers is an assumption; however, as the German rivers are the governing source of nutrients impacting Danish waters, it is considered to be a good assumption.

Concerning concentrations in rivers discharging to the Baltic Sea, COWI (2018) reports a target of 2.6 mg N/l, and according to COWI (2018), this corresponds to a reduction of 44%. For management scenario 1, we adopt this reduction from German rivers discharging to the Baltic Sea.

### Allocation of Reductions

To estimate the dose-response, ie. how much the GES indicators respond to a change in nutrient load, we used model simulations based on a 30% nutrient reduction (N or P on land-based, respectively, and atmosphere N load), with the exception of Danish land-based nutrient loadings. These simulations provided us with information on the dose-response for each of the GES indicators for the 30% reduction. Using these results, we can estimate the dose-response to a given reduction in local nutrient loading to the Baltic Proper (BAP) and Danish Straits (DS) depending on the source of the nutrient load and the location of the responding GES indicator.

According to HELCOM (2020), we can allocate reductions from BAP to DS and estimate the resulting dose-response from the above scenarios. However, we will have to assume that the impact from reductions differs between the Danish water bodies, as, eg. German reductions will have a profound impact on Flensburg Fjord, whereas the impact on the Sound is regarded as less profound. Hence, we operate with different reductions depending on the individual water bodies.

Assuming no difference in impact from reductions in BAP and DS, the combination of BSAP and German RBMP 2015-2021 equals a reduction of 4% for TN loadings and 27% for TP loadings.

Assuming difference in impacts as described in HELCOM (2020)[1] the corresponding TN reductions equal a 35% reduction whereas a full impact from German RBMP 2015-2021 equals a reduction of 44%.

As HELCOM (2020) defines a reduced impact from reductions as we move from one water body to another (e.g. from BAP to DS), we need to distribute the above reductions from Germany and other countries. This distribution is done according toFigure 2-1 and Table 2-1.

[1] Here we assume that the difference in %-reductions can be translated into a %-reduction according to HELCOM (2020). In HELCOM (2020) the effects, however, relate to tons of N and P why this is not entirely correct. As we operate in %-reductions this assumption will likely overestimate the effects of the German reductions.

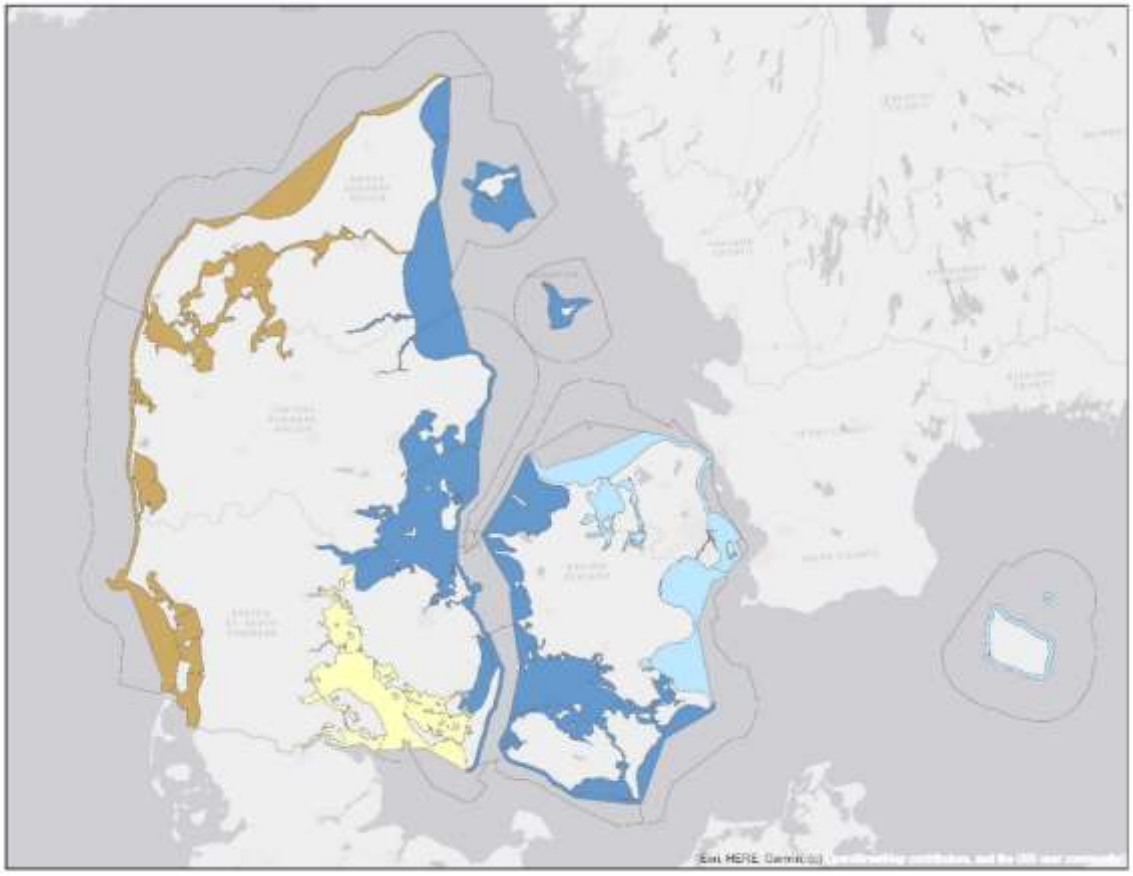

Figure 2-1 Distribution of reductions applied in scenario 1. Nutrient reductions resulting from the German implementation of the RBMP (2015-2021) to the North Sea and Baltic Sea are applied in water bodies marked with brown and yellow, respectively. Nutrient reductions resulting from implementation of the BSAP to the BAP and DS are applied to water bodies marked in light blue. In dark blue areas BSAP reductions to BAP and DS are applied after taking into account effect of transport processes accounted for by the HELCOM (2020) allocation scheme.

## NEC-directive

According to Blicher-Mathiesen & Sørensen (2020), the reductions in atmospheric N deposition after full implementation of the NEC-directive altogether amount to 16% or a 10% reduction in 2027, if the different countries' predictions are implemented. The full reduction of 16% is used for management scenarios 1 and 2, whereas the prediction of 10% reduction is used for management scenario 3a (see Erichsen *et al.* 2020 for details).

Data are delivered by AU, and the reductions are resolved on an overall water body scale and implemented in the Danish land-based N-MAIs calculations (see Figure 2-2 for data).

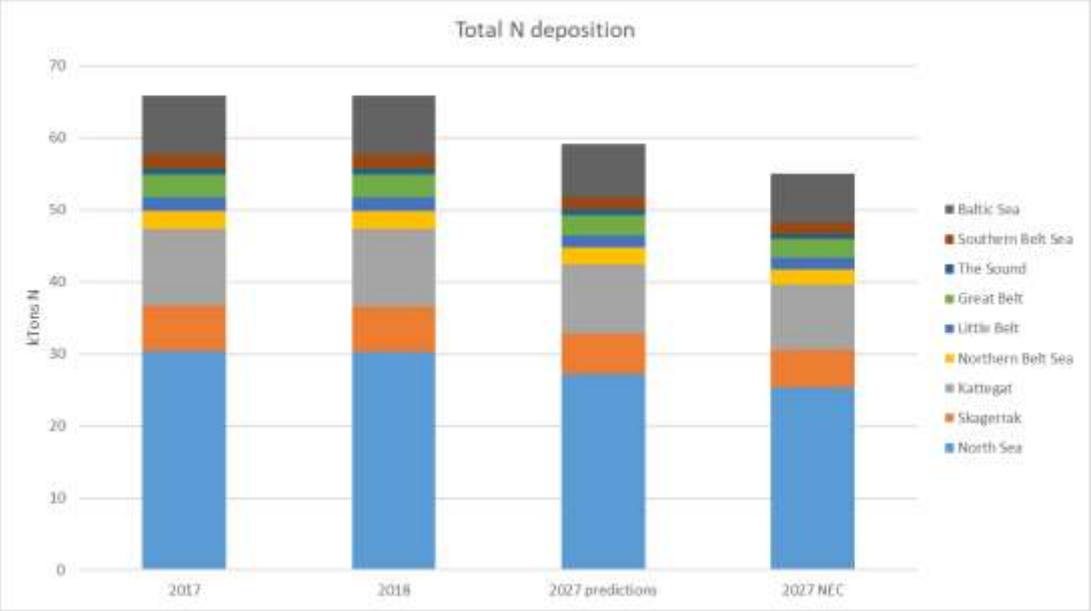


Figure 2-2 Atmospheric N depositions summarised at overall water body level. '2017' and '2018' represent present-day atmospheric N-depositions whereas '2027 NEC' represents agreement behind the directive, and '2027 predictions' represent the different country prognosis.

Table 2-1 Overview of input data used to construct WFD scenario 1a.

| Danish water areas affected | N load reduction in WFD scenario 1a. Reductions are in % of current (2014-2018) load | P load reduction applied in WFD scenario 1a. Reductions are in % of current (2014-2018) load | Adopted treaties |
|---|---|---|---|
| Western Baltic Sea (Light blue area, Figure 2-1) | 4% | 27% | Effect of BSAP to DS and BAP |
| Great belt and Kattegat (dark blue area, Figure 2-1) | 35% | 27% | Effect of BSAP and German RBMP, using Helcom allocation scheme |
| Southern Little Belt (yellow area, Figure 2-1) | 44% | 27% | Effect of German RBMP |
| North Sea water bodies and Limfjorden (brown area, Figure 2-1) | 31% | 0% | Effect of German RBMP |
| Atmospheric deposition, all Danish water bodies | 16% | 0% | NEC directive |

## 2.2 Method for Calculating Danish N-MAI

Based on the assumed future load reductions from neighbouring countries and atmospheric deposition as described above, N-MAIs from Danish catchments to each of the 109 water bodies is calculated. This is based on the status value of the indicators in each water body, as well as a defined target value (*Erichsen & Birkeland 2020b*). The status values for the two indicators are based on measurements. Target values are defined as a “slight deviation from

reference conditions", where reference conditions refer to a state with minimal human influence. Based on the method described in Erichsen *et al*. (2020), each target value will have a MAI which will support the system to achieve GES.

Since all Danish water bodies are connected to a higher or lesser degree, the reduction needed for a single water body cannot be assessed in isolation. In addition, it is necessary to consider the load reduction requirement estimated for nearby water bodies. To account for connected water bodies, the following scheme was applied:

1) Catchments are assigned to each water body. Local catchments are assigned to the inner part (sub-catchments) of estuaries (upstream water bodies), whereas two or more local catchments (main-catchments) are assigned for downstream water bodies (e.g. the outer part of estuaries) and more open water bodies.

2) Load reductions (in %) for each individual water body are calculated as described in Erichsen *et al.* (2020) and transformed into a N-reduction requirement in tons using the load of the assigned catchment.

3) For up-stream water bodies (with local catchments) the calculated reduction is a minimum requirement that should be obtained independently of downstream waterbody requirements.

4) Reduction requirements for downstream water bodies are corrected, considering any minimum reduction handled by up-stream water bodies.

5) Reduction requirements are transformed into MAIs by subtracting the required load reduction from the average annual load and aggregated to the corresponding local and/or regional catchment.

## 2.3 Results

Based on the above-described assumption (implementation of BSAP, German nutrient reductions according to RBMP 2015-2021 and reductions in atmospheric N deposition according to the NEC directive), the different reduction requirements and corresponding MAIs are calculated.

The different reduction requirements (%-wise and in actual tons) based on the different indicators and different models are included in Appendices A-E, whereas the aggregated MAIs are reported in Table 2-2.

Table 2-2 Maximum Allowable Nitrogen Inputs (N-MAIs) for Danish water bodies given the implementation of the BSAP, German nutrient reductions according to RBMP 2015-2021 and reductions in atmospheric N deposition according to the NEC directive and aiming at indicator values in the middle between high and good ecological status.
The table shows N-MAIs in tons N per year, where 'main' denotes main-catchment and 'sub' denotes sub-catchments being part of a main-catchment. The table shows average annual loads as well as N-MAIs calculated for 5 different phosphorus reduction scenarios designated P0, P10, P20, P30 and P50, where phosphorus loadings from Danish catchments are reduced by 0%, 10%, 20%, 30% and 50%, respectively. The column 'aggregated' denotes sub-catchments included in specific MAIs.

| No. | Name | Aggregation | Average annual (main) | Average annual (sub) | P0 (main) | P0 (sub) | P10 (main) | P10 (sub) | P20 (main) | P20 (sub) | P30 (main) | P30 (sub) | P50 (main) | P50 (sub) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Roskilde Fjord,ydre | 1,2 | | 764 | | 464a | | 464a | | 464a | | 464a | | 464a |
| 2 | Roskilde Fjord, indre | 2 | | 388 | | 380 | | 381 | | 382 | | 382 | | 384 |
| 6 | Nordlige Øresund | 6 | 1,098 | | 856 | | 862 | | 867 | | 872 | | 883 | |
| 16 | Korsør Nor | 16 | | 40 | | 24a | | 24a | | 24a | | 24a | | 24a |
| 17 | Basnæs Nor | 17 | | 69 | | 40a | | 40a | | 40a | | 40a | | 40a |
| 18 | Holsteinborg Nor [c)] | 18 | | 22 | | 22 | | 22 | | 22 | | 22 | | 22 |
| 24 | Isefjord, ydre | 24,165 | | 899 | | 339a | | 344a | | 350a | | 355a | | 366a |
| 25 | Skælskør Fjord og Nor | 25 | | 44 | | 37 | | 37 | | 38 | | 39 | | 41 |
| 28 | Sejerø Bugt | 28 | 164 | | 108a | | 108a | | 108a | | 108a | | 108a | |
| 29 | Kalundborg Fjord | 29 | 69 | | 22b | | 24b | | 25b | | 27b | | 29b | |
| 34 | Smålandsfarvandet, syd [c)] | 34 | 523 | | 523 | | 523 | | 523 | | 523 | | 523 | |
| 35 | Karrebæk Fjord | 35 | | 1,272 | | 956 | | 987 | | 1,017 | | 1,046 | | 1,100 |
| 36 | Dybsø Fjord | 36 | | 61 | | 61 | | 61 | | 61 | | 61 | | 61 |
| 37 | Avnø Fjord | 37 | | 238 | | 139a | | 139a | | 139a | | 139a | | 139a |
| 38 | Guldborgsund [c)] | 38 | 419 | | 419 | | 419 | | 419 | | 419 | | 419 | |

| No. | Name | Aggregation | Average annual (main) | Average annual (sub) | P0 (main) | P0 (sub) | P10 (main) | P10 (sub) | P20 (main) | P20 (sub) | P30 (main) | P30 (sub) | P50 (main) | P50 (sub) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 44 | Hjelm Bugt | 44 | 91 | | 20b | | 20b | | 20b | | 20b | | 20b | |
| 45 | Grønsund | 45 | 278 | | 161a | | 161a | | 161a | | 161a | | 161a | |
| 46 | Fakse Bugt | 46,47 | 509 | | 345 | | 345 | | 346 | | 347 | | 348 | |
| 47 | Præstø Fjord | 47 | | 208 | | 105 | | 108 | | 112 | | 116 | | 123 |
| 48 | Stege Bugt [c)] | 48,49 | 259 | | 246 | | 246 | | 247 | | 247 | | 247 | |
| 49 | Stege Nor | 49 | | 24 | | 11a | | 11a | | 11a | | 11a | | 11a |
| 56 | Østersøen, Bornholm | 56 | 860 | | 184b | | 184b | | 184b | | 184b | | 184b | |
| 57 | Østersøen, Christiansø | 57 | 3 | | 2a | | 2a | | 2a | | 2a | | 2a | |
| 59 | Nærå Strand | 59 | | 98 | | 22b | | 22b | | 24a | | 26a | | 34a |
| 62 | Lillestrand | 62 | | 11 | | 5a | | 5a | | 5a | | 5a | | 5a |
| 68 | Lindelse Nor | 68 | | 50 | | 30a | | 30a | | 30a | | 30a | | 30a |
| 72 | Kløven | 72 | | 43 | | 27a | | 27a | | 27a | | 27a | | 27a |
| 74 | Bredningen | 74 | | 128 | | 42b | | 42b | | 42b | | 42b | | 42b |
| 80 | Gamborg Fjord | 80 | | 80 | | 73 | | 73 | | 73 | | 73 | | 73 |
| 82 | Aborg Minde Nor | 82 | | 152 | | 34b | | 34b | | 34b | | 34b | | 43a |
| 83 | Holckenhavn Fjord | 83 | | 290 | | 81b | | 81b | | 81b | | 81b | | 81b |
| 84 | Kerteminde Fjord | 84,85 | | 50 | | 40 | | 40 | | 40 | | 40 | | 40 |
| 85 | Kertinge Nor | 85 | | 24 | | 19a | | 19a | | 19a | | 19a | | 19a |
| 86 | Nyborg Fjord | 83,86 | | 308 | | 99b | | 99b | | 99b | | 99b | | 99b |

| No. | Name | Aggregation | Average annual (main) | Average annual (sub) | P0 (main) | P0 (sub) | P10 (main) | P10 (sub) | P20 (main) | P20 (sub) | P30 (main) | P30 (sub) | P50 (main) | P50 (sub) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 87 | Helnæs Bugt | 87 | | 216 | | 110a | | 110a | | 110a | | 110a | | 110a |
| 89 | Lunkebugten | 89 | | 16 | | 6a | | 6a | | 6a | | 6a | | 6a |
| 90 | Langelandssund | 83,86,89,90 | 768 | | 523 | | 523 | | 523 | | 523 | | 523 | |
| 92 | Odense Fjord, ydre | 92,93 | | 1,358 | | 685a | | 685 | | 685aa | | 685a | | 685a |
| 93 | Odense Fjord, Seden Strand | 93 | | 1,288 | | 615a | | 615a | | 615a | | 615a | | 615a |
| 95 | Storebælt SV | 95 | 188 | | 115a | | 115a | | 115a | | 115a | | 115a | |
| 96 | Storebælt NV | 96, 84, 85 | 227 | | 132a | | 132a | | 132a | | 132a | | 132a | |
| 101 | Genner Bugt | 101 | | 35 | | 13b | | 13b | | 13b | | 13b | | 13b |
| 102 | Åbenrå Fjord | 102 | | 130 | | 59b | | 59b | | 59b | | 59b | | 59b |
| 103 | Als Fjord | 103,104,105 | | 269 | | 78b | | 78b | | 78b | | 78b | | 78b |
| 104 | Als Sund | 104 | | 68 | | 68 | | 68 | | 68 | | 68 | | 68 |
| 105 | Augustenborg Fjord | 105 | | 62 | | 62 | | 62 | | 62 | | 62 | | 62 |
| 106 | Haderslev Fjord | 106 | | 239 | | 104b | | 104b | | 104b | | 104b | | 104b |
| 107 | Juvre Dyb | 107 | | 349 | | 119a | | 119a | | 119a | | 119a | | 119a |
| 108 | Avnø Vig | 108 | | 60 | | 26a | | 27a | | 28a | | 29a | | 32a |
| 109 | Hejlsminde Nor | 109 | | 138 | | 92a | | 98a | | 98a | | 98a | | 98a |
| 110 | Nybøl Nor | 110 | | 66 | | 37a | | 37a | | 38a | | 39a | | 40a |
| 111 | Lister Dyb | 111 | | 2,155 | | 947 | | 1,017 | | 1,089 | | 1,163 | | 1,318 |
| 113 | Flensborg Fjord, indre | 113 | | 51 | | 19b | | 19b | | 19b | | 19b | | 19b |

| No. | Name | Aggregation | Average annual (main) | Average annual (sub) | P0 (main) | P0 (sub) | P10 (main) | P10 (sub) | P20 (main) | P20 (sub) | P30 (main) | P30 (sub) | P50 (main) | P50 (sub) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 114 | Flensborg Fjord, ydre | 110,113,114 | | 219 | | 157a | | 158a | | 158a | | 159a | | 160a |
| 119 | Vesterhavet, syd | 119, 107, 111, 121, 120 | 8,538 | | 2,952a | | 3,022a | | 3,095a | | 3,257a | | 3,934a | |
| 120 | Knudedyb | 120 | | 2,910 | | 841a | | 841a | | 841a | | 841a | | 1,433a |
| 121 | Grådyb | 121 | | 2,920 | | 842a | | 842a | | 842a | | 930 | | 1,576 |
| 122 | Vejle Fjord, ydre | 122,123 | | 968 | | 424a | | 428a | | 431a | | 435a | | 443a |
| 123 | Vejle Fjord, indre | 123 | | 561 | | 409a | | 413a | | 417a | | 417a | | 418a |
| 124 | Kolding Fjord, indre | 124 | | 493 | | 202b | | 209a | | 222a | | 236a | | 272a |
| 125 | Kolding Fjord, ydre | 124,125 | | 528 | | 238b | | 245b | | 257b | | 271b | | 278b |
| 127 | Horsens Fjord, ydre | 127,128 | | 833 | | 306a | | 310a | | 315a | | 320a | | 329a |
| 128 | Horsens Fjord, indre | 128 | | 782 | | 315a | | 316a | | 317a | | 318a | | 320a |
| 129 | Nissum Fjord, ydre | 129,131,130 | | 2,412 | | 1,028a | | 1,075a | | 1,137a | | 1,224a | | 1,563a |
| 130 | Nissum Fjord, mellem | 130,131 | | 2,083 | | 698a | | 746a | | 822a | | 964a | | 1,291a |
| 131 | Nissum Fjord, Felsted Kog | 131 | | 1,938 | | 1,300b | | 1,300b | | 1,300b | | 1,361a | | 1,300a |
| 132 | Ringkøbing Fjord | 132 | | 4,748 | | 2,446a | | 2,446a | | 2,446a | | 2,446a | | 2,446a |
| 133 | Vesterhavet, nord | 133,129,130 ,131, 132 | 7,237 | | 3,552 | | 3,599 | | 3,661 | | 3,748 | | 4,086 | |
| 136 | Randers Fjord, indre | 136 | | 2,925 | | 2,201a | | 2,201a | | 2,201a | | 2,201a | | 2,201a |
| 137 | Randers Fjord, ydre | 136,137 | | 3,078 | | 1,917a | | 1,917a | | 1,917a | | 1,917a | | 1,917a |

| No. | Name | Aggregation | Average annual (main) | Average annual (sub) | P0 (main) | P0 (sub) | P10 (main) | P10 (sub) | P20 (main) | P20 (sub) | P30 (main) | P30 (sub) | P50 (main) | P50 (sub) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 138 | Hevring Bugt | 138, 137, 136 | 3,235 | | 2,074 | | 2,074 | | 2,074 | | 2,074 | | 2,074 | |
| 139 | Anholt [c)] | 139 | 9 | | 9 | | 9 | | 9 | | 9 | | 9 | |
| 140 | Djursland Øst | 140 | 856 | | 538a | | 538a | | 538a | | 538a | | 538a | |
| 141 | Ebeltoft Vig [c)] | 141 | 14 | | 14 | | 14 | | 14 | | 14 | | 14 | |
| 142 | Stavns Fjord | 142 | | 5 | | 3a | | 3a | | 3a | | 3a | | 3a |
| 144 | Knebel Vig | 144 | | 18 | | 9 | | 9 | | 9 | | 9 | | 9 |
| 145 | Kalø Vig | 144,145 | | 190 | | 180 | | 180 | | 180 | | 180 | | 180 |
| 146 | Norsminde Fjord | 146 | | 140 | | 93a | | 93a | | 93a | | 93a | | 93a |
| 147 | Århus Bugt og Begtrup Vig | 144,145,147 | 656 | | 645 | | 647 | | 647 | | 647 | | 647 | |
| 154 | Kattegat Læsø [c)] | 154 | 78 | | 78 | | 78 | | 78 | | 78 | | 78 | |
| 157 | Bjørnholms Bugt, Riisgårde Bredning, Skive Fjord og Lovns Bredning | 157,158 | | 3,632 | | 992b | | 992b | | 992b | | 1,111a | | 1,340a |
| 158 | Hjarbæk Fjord | 158 | | 1,795 | | 411b | | 411b | | 411b | | 411b | | 411b |
| 159 | Mariager Fjord, indre | 159 | | 516 | | 79b | | 79b | | 79b | | 81a | | 86a |
| 160 | Mariager Fjord, ydre | 159,160 | | 963 | | 526 | | 526 | | 526 | | 528 | | 533 |
| 165 | Isefjord, indre | 165 | | 812 | | 422 | | 422 | | 422 | | 422 | | 422 |
| 200 | Kattegat Nordsjælland | 1,2,24,165,200 | 1,857 | | 997a | | 1,002a | | 1,008a | | 1,013a | | 1,024a | |
| 201 | Køge Bugt | 201 | 1,109 | | 431b | | 439b | | 447b | | 455b | | 471bb | |

| No. | Name | Aggregation | Average annual (main) | Average annual (sub) | P0 (main) | P0 (sub) | P10 (main) | P10 (sub) | P20 (main) | P20 (sub) | P30 (main) | P30 (sub) | P50 (main) | P50 (sub) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 204 | Jammerland Bugt og Musholm Bugt | 204 | 1,327 | | 818a | | 818a | | 818a | | 818a | | 818a | |
| 206 | Smålandsfarvandet, åbne del | 16,17,18,25,35,36,37,206 | 2,014 | | 1,133a | | 1,133a | | 1,133a | | 1,133a | | 1,133a | |
| 207 | Nakskov Fjord | 207 | | 454 | | 247a | | 248a | | 249a | | 249a | | 249a |
| 208 | Femerbælt | 207,208,209 | 1,530 | | 978 | | 978 | | 978 | | 979 | | 979 | |
| 209 | Rødsand og Bredningen | 209 | | 521 | | 232 | | 232 | | 232 | | 232 | | 232 |
| 212 | Fåborg Fjord | 212 | | 30 | | 10b | | 10b | | 10b | | 10b | | 10b |
| 214 | Det sydfynske Øhav | 68,72,212,214 | 633 | | 176b | | 176b | | 176b | | 176b | | 176b | |
| 216 | Lillebælt, syd | 87,101,102,103,104,105,110,113,114,216 | 1,309 | | 847a | | 848a | | 848a | | 849a | | 850a | |
| 217 | Lillebælt Bredningen | 74,82,106,108,109,217 | 956 | | 327b | | 327b | | 327b | | 327b | | 327b | |
| 219 | Århus Bugt, syd, Samsø og Nordlige Bælthav | 59,62,92,93,127,128,142,146,219 | 2,810 | | 626b | | 626b | | 626b | | 626b | | 626b | |
| 221 | Skagerrak | 221 | 1,423 | | 1,423 | | 1,423 | | 1,423 | | 1,423 | | 1,423 | |
| 222 | Kattegat Ålborg Bugt [c)] | 222,159,160 | 2,026 | | 1,589 | | 1,589 | | 1,589 | | 1,591 | | 1,596 | |
| 224 | Nordlige Lillebælt | 122,123,224 | 1,588 | | 988a | | 988a | | 988a | | 988a | | 988a | |

| No. | Name | Aggregation | Average annual (main) | Average annual (sub) | P0 (main) | P0 (sub) | P10 (main) | P10 (sub) | P20 (main) | P20 (sub) | P30 (main) | P30 (sub) | P50 (main) | P50 (sub) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 225 | Nordlige Kattegat Ålbæk Bugt | 225 | 706 | | 646 | | 646 | | 646 | | 646 | | 646 | |
| 231 | Lillebælt Snævringen | 231,124,125,80 | 789 | | 259b | | 259b | | 259b | | 259b | | 259b | |
| 232 | Nissum Bredning | 232 | 880 | | 297b | | 297b | | 297b | | 297b | | 308b | |
| 233 | Kaas Bredning og Venø Bugt | 232,233 | | 1,955 | | 1,034a | | 1,065a | | 1,097a | | 1,130a | | 1,201a |
| 234 | Løgstør Bredning | 157,158,234, 233, 236 | | 4,336 | | 1,979b | | 1,979b | | 1,979b | | 1,979b | | 1,979b |
| 235 | Nibe Bredning og Langerak | 157, 158, 233, 234, 235, 236, 238 | 11,064 | | 6,036a | | 6,036a | | 6,036 | | 6,036 | | 6,036 | |
| 236 | Thisted Bredning | 236 | | 1,091 | | 269b | | 269b | | 269b | | 269b | | 269b |
| 238 | Halkær Bredning | 238 | | 620 | | 114b | | 114b | | 114b | | 114b | | 114b |
| | ***Danish N-load (National MAI)*** | | 58,100 | | 31,090 | | 31,231 | | 31,387 | | 31,660 | | 32,734 | |

[a] Truncated at land-based reference N-load for one indicator

[b] Truncated at land-based reference N-load for two indicators

[c] Chlorophyll-a and light GM target obtained based on measurement (and independent of reductions from neighbouring countries or atmospheric depositions

## 2.4 Closing remarks

The estimated Maximum Allowable Nitrogen Input (N-MAI) to Danish water bodies presented in this report is based on the preconditions that the BSAP, the RBMP 2015-2021, and the NEC directive will be fully implemented. These treaties have been adopted but not yet fully implemented. These assumptions, which have not been assessed as part of this study, are accepted as preconditions.

If the preconditions are fulfilled, and the MAI for Danish water bodies is reached by the end of 2027, all Danish water bodies will most likely not have reached Good Ecological Status (GES) as defined in the WFD. This is because:

- The MAI estimation is based on the depth of light as a proxy for the indicator eelgrass depth limit. Hence, even if light has reached the target value, recovery of eelgrass after light improvements may take years to decades. In addition, other factors, such as sediment suitability, lack of seedlings, etc., may delay or prevent eelgrass recovery.

- With the given preconditions in management scenario 1, one or both of the indicators (chlorophyll-a and light) may not reach the target value despite reductions from Danish catchments. In these situations, the reduction requirement for that indicator is cut off/truncated at the reference loading. A cut-off at reference loading indicates that due to the scenario and associated preconditions, a specific MAI for that water body that ensures GES cannot be obtained, and administrative choices have to be made, like applying an average reduction from neighbouring water bodies, reductions to down-stream water bodies or a general MAI (kg/ha) for those water bodies. However, the implication is that GES for both indicators cannot be expected in these water bodies, even if MAI is obtained.

- The method is not based on the one-out-all-out principle as required in the WFD, but on an average of two indicators. Hence, it is expected that both indicators will be as close to the target value as possible, but one will theoretically be above and one below the target value.

- In this management scenario, we are using the boundary between good and moderate status as the target value for each of the indicators. Due to uncertainties, there is a 50% chance that the indicator value will end in good status and a 50% chance that the indicator value will end in moderate status, if MAI for that indicator is reached, assuming the measured indicator follows a symmetrical distribution.

- As some ecosystems respond with significant time-lags to changes in loadings, it will take years before the full environmental effects of nutrient reductions can be observed. Hence, reaching MAI will provide the conditions for obtaining GES but the achievement of GES will likely be delayed.

# 3 References


/1/ Blicher-Mathiesen G & Sørensen P (red) (2020). Baseline 2027 for udvalgte elementer. Aarhus Universitet, DCE – Nationalt Center for Miljø og Energi, 120 s. - Teknisk rapport nr. 184 http://dce2.au.dk/pub/TR184.pdf

/2/ COWI (2018). Nabotjek af EU-landes fremgangsmåder ved planlægning for marine vandområder i henhold til Vandrammedirektivet. Komparativ rapport. COWI rapport.

/3/ Erichsen AC (Ed.), Timmermann K (Ed.), Christensen JPA, Kaas H, Markager S, Møhlenberg F (2017). Development of models and methods to support the Danish River Basin Management Plans. Scientific documentation. Aarhus University, Department of Bioscience and DHI, 191 pp.

/4/ Erichsen AC (Ed.), Timmermann K (Ed.), Birkeland M, Christensen JPA, Markager S, Møhlenberg F. (2018) Recommendations for continued development of models and methods for use in the River Basin Management Plan 2021-2027. Follow-up on the international evaluation of marine models behind the River Basin Management Plan 2015-2021. Technical report. DHI.

/5/ Erichsen AC, Birkeland M, Timmermann K, Christensen J & Markager S (2020). Application of the Danish EPA's Marine Model Complex and Development of a Method Applicable for the River Basin Management Plans 2021-2027. Conceptual Method for Estimating Maximum Allowable Inputs. Technical report. DHI.

/6/ Erichsen AC, Birkeland M (2020a). Development of Mechanistic Models – Short Technical Description of Biogeochemical Model Input Data. Technical report. DHI.

/7/ Erichsen AC, Birkeland M (2020b). Methods for establishing Chlorophyll-a references and target values applicable for the River Basin Managements Plan 2021-2027. Technical report. DHI.

/8/ Gadegast M & Venohr M (2015). Modellierung Historischer Nährstoffeinträge und -Frachten zur Ableitung von Nährstoffreferenz – und Orientierungswerten für Mitteleuropäische Flussgebiete. Technical Report

/9/ Herman P, Newton A, Schernewski G, Gustafsson B, Malve O (2017) International Evaluation of the Danish Marine Models, Danish EPA.

/10/ HELCOM (2020). Accounting for extra reductions. https://helcom.fi/baltic-sea-action-plan/nutrient-reduction-scheme/progress-towards-country-wise-allocated-reduction-targets/follow-up-concept/accounting-for-extra-reductions/

/11/ Timmermann K, Christensen JPA & Erichsen A (2020) Referenceværdier og grænseværdier for ålegræsdybdegrænser til brug for vandområdeplanerne. (In prep.)

# Appendix A – Maximum Allowable Nitrogen Inputs (N-MAIs) based on WFD scenario 1a and assuming 0% reduction in Danish land-based P-loads

Table A- 1 Water body-specific MAIs based on the two individual indicators chlorophyll-a (Chl-a) and light penetration depth (light) estimated from statistical models (STAT) and mechanistic models (MEK), respectively.
The table shows both the individual calculations and the averaged water-specific MAIs (without any aggregation) and the corresponding need for reduction in %. The data in this table are based on WFD scenario 1a and Danish land-based P-reductions set at 0%.

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Roskilde Fjord,ydre | 1,2 | 764 | | | 651 | 276 | | 464 | 464 | 39 |
| 2 | Roskilde Fjord, indre | 2 | 388 | 388 | | 388 | 354 | 388 | 371 | 380 | 2 |
| 6 | Nordlige Øresund | 6 | 1,098 | | | 1,098 | 614 | | 856 | 856 | 22 |
| 16 | Korsør Nor | 16 | 40 | | | 40 | 9 | | 24 | 24 | 39 |
| 17 | Basnæs Nor | 17 | 69 | | | 69 | 10 | | 40 | 40 | 42 |
| 18 | Holsteinborg Nor | 18 | 22 | | | 22 | 22 | | 22 | 22 | 0 |
| 24 | Isefjord, ydre | 24,165 | 899 | 469 | 206 | 476 | 206 | 337 | 341 | 339 | 62 |
| 25 | Skælskør Fjord og Nor | 25 | 44 | | | 36 | 37 | | 37 | 37 | 17 |
| 28 | Sejerø Bugt | 28 | 164 | | | 164 | 53 | | 108 | 108 | 34 |
| 29 | Kalundborg Fjord | 29 | 69 | 13 | 35 | 27 | 13 | 24 | 20 | 22 | 68 |
| 34 | Smålandsfarvandet, syd | 34 | 523 | | | 523 | 523 | | 523 | 523 | 0 |
| 35 | Karrebæk Fjord | 35 | 1,272 | | | 1,272 | 640 | | 956 | 956 | 25 |
| 36 | Dybsø Fjord | 36 | 61 | | | 61 | 61 | | 61 | 61 | 0 |
| 37 | Avnø Fjord | 37 | 238 | | | 238 | 40 | | 139 | 139 | 42 |
| 38 | Guldborgsund | 38 | 419 | | | 419 | 419 | | 419 | 419 | 0 |
| 44 | Hjelm Bugt | 44 | 91 | | | 20 | 20 | | 20 | 20 | 78 |
| 45 | Grønsund | 45 | 278 | | | 278 | 44 | | 161 | 161 | 42 |

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 46 | Fakse Bugt | 46,47 | 510 | | | 180 | 509 | | 345 | 345 | 32 |
| 47 | Præstø Fjord | 47 | 208 | | | 144 | 65 | | 105 | 105 | 50 |
| 48 | Stege Bugt | 48,49 | 259 | | | 259 | 259 | | 259 | 259 | 0 |
| 49 | Stege Nor | 49 | 24 | | | 18 | 4 | | 11 | 11 | 53 |
| 56 | Østersøen, Bornholm | 56 | 860 | | | 184 | 184 | | 184 | 184 | 79 |
| 57 | Østersøen, Christiansø | 57 | 3 | | | 0 | 3 | | 2 | 2 | 48 |
| 59 | Nærå Strand | 59 | 98 | | | 22 | 22 | | 22 | 22 | 77 |
| 62 | Lillestrand | 62 | 11 | | | 8 | 3 | | 5 | 5 | 52 |
| 68 | Lindelse Nor | 68 | 50 | | | 50 | 11 | | 30 | 30 | 39 |
| 72 | Kløven | 72 | 43 | | | 43 | 11 | | 27 | 27 | 38 |
| 74 | Bredningen | 74 | 128 | | | 42 | 42 | | 42 | 42 | 67 |
| 80 | Gamborg Fjord | 80 | 80 | | | 66 | 80 | | 73 | 73 | 9 |
| 82 | Aborg Minde Nor | 82 | 152 | | | 34 | 34 | | 34 | 34 | 78 |
| 83 | Holckenhavn Fjord | 83 | 290 | | | 81 | 81 | | 81 | 81 | 72 |
| 84 | Kerteminde Fjord | 84,85 | 50 | | | 31 | 50 | | 40 | 40 | 19 |
| 85 | Kertinge Nor | 85 | 24 | 23 | | 23 | 5 | 23 | 14 | 19 | 22 |
| 86 | Nyborg Fjord | 83,86 | 308 | | | 130 | 130 | | 130 | 130 | 58 |
| 87 | Helnæs Bugt | 87 | 216 | | | 67 | 152 | | 110 | 110 | 49 |
| 89 | Lunkebugten | 89 | 16 | | | 5 | 7 | | 6 | 6 | 62 |

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 90 | Langelandssund | 83,86,89,90 | 768 | | | 424 | 623 | | 523 | 523 | 32 |
| 92 | Odense Fjord, ydre | 92,93 | 1,358 | 352 | 692 | 986 | 896 | 522 | 941 | 731 | 46 |
| 93 | Odense Fjord, Seden Strand | 93 | 1,288 | | 390 | 1,288 | 390 | 390 | 839 | 615 | 52 |
| 95 | Storebælt SV | 95 | 188 | | | 41 | 188 | | 115 | 115 | 39 |
| 96 | Storebælt NV | 96, 84, 85 | 227 | | | 38 | 227 | | 132 | 132 | 42 |
| 101 | Genner Bugt | 101 | 35 | | | 13 | 13 | | 13 | 13 | 62 |
| 102 | Åbenrå Fjord | 102 | 130 | 59 | | 59 | 59 | 59 | 59 | 59 | 55 |
| 103 | Als Fjord | 103,104,105 | 269 | | | 67 | 67 | | 67 | 67 | 75 |
| 104 | Als Sund | 104 | 68 | | | 68 | 68 | | 68 | 68 | 0 |
| 105 | Augustenborg Fjord | 105 | 62 | 62 | | 62 | 62 | 62 | 62 | 62 | 0 |
| 106 | Haderslev Fjord | 106 | 239 | | | 104 | 104 | | 104 | 104 | 56 |
| 107 | Juvre Dyb | 107 | 349 | | | 119 | | | 119 | 119 | 66 |
| 108 | Avnø Vig | 108 | 60 | | | 32 | 20 | | 26 | 26 | 56 |
| 109 | Hejlsminde Nor | 109 | 138 | | | 127 | 58 | | 92 | 92 | 33 |
| 110 | Nybøl Nor | 110 | 66 | | | 44 | 29 | | 37 | 37 | 44 |
| 111 | Lister Dyb | 111 | 2,155 | | | 947 | | | 947 | 947 | 56 |
| 113 | Flensborg Fjord, indre | 113 | 51 | 19 | | 19 | 19 | 19 | 19 | 19 | 63 |
| 114 | Flensborg Fjord, ydre | 110,113,114 | 219 | 219 | | 219 | 66 | 219 | 142 | 180 | 17 |

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 119 | Vesterhavet, syd | 119, 107, 111, 121, 120 | 8,538 | | | 3,934 | | | 3,934 | 3,934 | 54 |
| 120 | Knudedyb | 120 | 2,910 | 841 | | 841 | | 841 | 841 | 841 | 71 |
| 121 | Grådyb | 121 | 2,920 | | | 842 | | | 842 | 842 | 71 |
| 122 | Vejle Fjord, ydre | 122,123 | 968 | | | 445 | 403 | | 424 | 424 | 56 |
| 123 | Vejle Fjord, indre | 123 | 561 | 532 | 288 | 530 | 288 | 410 | 409 | 409 | 27 |
| 124 | Kolding Fjord, indre | 124 | 493 | 188 | | 246 | 188 | 188 | 217 | 202 | 59 |
| 125 | Kolding Fjord, ydre | 124,125 | 528 | | | 278 | 278 | | 278 | 278 | 47 |
| 127 | Horsens Fjord, ydre | 127,128 | 833 | | | 508 | 104 | | 306 | 306 | 63 |
| 128 | Horsens Fjord, indre | 128 | 782 | | | 405 | 225 | | 315 | 315 | 60 |
| 129 | Nissum Fjord, ydre | 129,131,130 | 2,412 | | | 1,357 | 713 | | 1,035 | 1,035 | 57 |
| 130 | Nissum Fjord, mellem | 130,131 | 2,083 | | | 898 | 498 | | 698 | 698 | 66 |
| 131 | Nissum Fjord, Felsted Kog | 131 | 1,938 | 1,938 | | 662 | 662 | 1,938 | 662 | 1,300 | 33 |
| 132 | Ringkøbing Fjord | 132 | 4,747 | | 1,679 | 4,748 | 1,679 | 1,679 | 3,213 | 2,446 | 48 |
| 133 | Vesterhavet, nord | 133,129,130 ,131, 132 | 7,237 | | | 7,237 | | | 7,237 | 7,237 | 0 |
| 136 | Randers Fjord, indre | 136 | 2,925 | 2,925 | 1,477 | 2,925 | 1,477 | 2,201 | 2,201 | 2,201 | 25 |
| 137 | Randers Fjord, ydre | 136,137 | 3,078 | 3,078 | 755 | 3,078 | 755 | 1,917 | 1,917 | 1,917 | 38 |
| 138 | Hevring Bugt | 138, 137, 136 | 3,175 | | 3,235 | 2,996 | 3,235 | | 3,116 | 3,116 | 2 |

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 139 | Anholt | 139 | 9 | | | 9 | 9 | | 9 | 9 | 0 |
| 140 | Djursland Øst | 140 | 856 | | | 219 | 856 | | 538 | 538 | 37 |
| 141 | Ebeltoft Vig | 141 | 14 | | | 14 | 14 | | 14 | 14 | 0 |
| 142 | Stavns Fjord | 142 | 5 | | | 5 | 1 | | 3 | 3 | 37 |
| 144 | Knebel Vig | 144 | 18 | | | 11 | 7 | | 9 | 9 | 49 |
| 145 | Kalø Vig | 144,145 | 190 | 190 | 190 | 190 | 190 | 190 | 190 | 190 | 0 |
| 146 | Norsminde Fjord | 146 | 140 | | | 140 | 47 | | 93 | 93 | 33 |
| 147 | Århus Bugt og Begtrup Vig | 144,145,147 | 656 | 631 | 656 | 636 | 656 | 644 | 646 | 645 | 2 |
| 154 | Kattegat Læsø | 154 | 78 | | | 78 | 78 | | 78 | 78 | 0 |
| 157 | Bjørnholms Bugt, Riisgårde Bredning, Skive Fjord og Lovns Bredning | 157,158 | 3,633 | | | 992 | 992 | | 992 | 992 | 73 |
| 158 | Hjarbæk Fjord | 158 | 1,795 | | | 411 | 411 | | 411 | 411 | 77 |
| 159 | Mariager Fjord, indre | 159 | 516 | | | 79 | 79 | | 79 | 79 | 85 |
| 160 | Mariager Fjord, ydre | 159,160 | 963 | | | 784 | 516 | | 650 | 650 | 32 |
| 165 | Isefjord, indre | 165 | 812 | 266 | | 344 | 812 | 266 | 578 | 422 | 48 |
| 200 | Kattegat Nordsjælland | 1,2,24,165,200 | 1,857 | | | 1,857 | 629 | | 1,243 | 1,243 | 33 |
| 201 | Køge Bugt | 201 | 1,109 | 612 | | 249 | 249 | 612 | 249 | 431 | 61 |
| 204 | Jammerland Bugt og Musholm Bugt | 204 | 1,327 | | | 1,327 | 308 | | 818 | 818 | 38 |

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 206 | Smålandsfarvandet, åbne del | 16,17,18,25,35,36,37,206 | 2,014 | | | 2,014 | 252 | | 1,133 | 1,133 | 44 |
| 207 | Nakskov Fjord | 207 | 454 | | | 450 | 43 | | 247 | 247 | 46 |
| 208 | Femerbælt | 207,208,209 | 1,530 | | | 426 | 1,530 | | 978 | 978 | 36 |
| 209 | Rødsand og Bredningen | 209 | 521 | | | 284 | 180 | | 232 | 232 | 55 |
| 212 | Fåborg Fjord | 212 | 30 | | | 10 | 10 | | 10 | 10 | 67 |
| 214 | Det sydfynske Øhav | 68,72,212,214 | 633 | 176 | 176 | 176 | 176 | 176 | 176 | 176 | 72 |
| 216 | Lillebælt, syd | 87,101,102,103,104,105,110,113,114,216 | 1,309 | | | 462 | 1,309 | | 885 | 885 | 32 |
| 217 | Lillebælt Bredningen | 74,82,106,108,109,217 | 956 | 276 | | 276 | 276 | 276 | 276 | 276 | 71 |
| 219 | Århus Bugt, syd, Samsø og Nordlige Bælthav | 59,62,92,93,127,128,142,146,219 | 2,810 | | | 626 | 626 | | 626 | 626 | 78 |
| 221 | Skagerrak | 221 | 1,423 | | | 1,423 | | | 1,423 | 1,423 | 0 |
| 222 | Kattegat Ålborg Bugt | 222,159,160 | 2,026 | | | 2,026 | 2,026 | | 2,026 | 2,026 | 0 |
| 224 | Nordlige Lillebælt | 122,123,224 | 1,588 | | | 389 | 1,588 | | 988 | 988 | 38 |
| 225 | Nordlige Kattegat Ålbæk Bugt | 225 | 706 | | | 587 | 706 | | 646 | 646 | 8 |
| 231 | Lillebælt Snævringen | 231,124,125,80 | 789 | | 134 | 134 | 134 | 134 | 134 | 134 | 83 |

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 232 | Nissum Bredning | 232 | 880 | 297 | 297 | 297 | 297 | 297 | 297 | 297 | 66 |
| 233 | Kaas Bredning og Venø Bugt | 232,233 | 1,955 | | | 1,457 | 611 | | 1,034 | 1,034 | 47 |
| 234 | Løgstør Bredning | 157,158,234, 233, 236 | 6,503 | | | 1,980 | 1,980 | | 1,980 | 1,980 | 70 |
| 235 | Nibe Bredning og Langerak | 157, 158, 233, 234, 235, 236, 238 | 11,065 | | 8,882 | 2,442 | 6,473 | 8,882 | 4,457 | 6,670 | 40 |
| 236 | Thisted Bredning | 236 | 1,091 | | | 269 | 269 | | 269 | 269 | 75 |
| 238 | Halkær Bredning | 238 | 620 | | | 114 | 114 | | 114 | 114 | 82 |

# Appendix B – Maximum Allowable Nitrogen Inputs (N-MAIs) based on WFD scenario 1a and assuming 10% reduction in Danish land-based P-loads

Table B- 1 Water body-specific MAIs based on the two individual indicators chlorophyll-a (Chl-a) and light penetration depth (light) estimated from statistical models (STAT) and mechanistic models (MEK), respectively.
The table shows both the individual calculations as well as the averaged water-specific MAIs (without any aggregation) and the corresponding need for reduction in %. The data in this table are based on WFD scenario 1a and Danish land-based P-reductions set at 10%.

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Roskilde Fjord,ydre | 1,2 | 764 | | | 651 | 276 | | 464 | 464 | 39 |
| 2 | Roskilde Fjord, indre | 2 | 388 | 388 | | 388 | 358 | 388 | 373 | 381 | 2 |
| 6 | Nordlige Øresund | 6 | 1,098 | | | 1,098 | 625 | | 862 | 862 | 22 |
| 16 | Korsør Nor | 16 | 40 | | | 40 | 9 | | 24 | 24 | 39 |
| 17 | Basnæs Nor | 17 | 69 | | | 69 | 10 | | 40 | 40 | 42 |
| 18 | Holsteinborg Nor | 18 | 22 | | | 22 | 22 | | 22 | 22 | 0 |
| 24 | Isefjord, ydre | 24,165 | 899 | 490 | 206 | 476 | 206 | 348 | 341 | 344 | 62 |
| 25 | Skælskør Fjord og Nor | 25 | 44 | | | 37 | 38 | | 37 | 37 | 15 |
| 28 | Sejerø Bugt | 28 | 164 | | | 164 | 53 | | 108 | 108 | 34 |
| 29 | Kalundborg Fjord | 29 | 69 | 13 | 41 | 27 | 13 | 27 | 20 | 24 | 66 |
| 34 | Smålandsfarvandet, syd | 34 | 523 | | | 523 | 523 | | 523 | 523 | 0 |
| 35 | Karrebæk Fjord | 35 | 1,272 | | | 1,272 | 703 | | 987 | 987 | 22 |
| 36 | Dybsø Fjord | 36 | 61 | | | 61 | 61 | | 61 | 61 | 0 |
| 37 | Avnø Fjord | 37 | 238 | | | 238 | 40 | | 139 | 139 | 42 |
| 38 | Guldborgsund | 38 | 419 | | | 419 | 419 | | 419 | 419 | 0 |
| 44 | Hjelm Bugt | 44 | 91 | | | 20 | 20 | | 20 | 20 | 78 |

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 45 | Grønsund | 45 | 278 | | | 278 | 44 | | 161 | 161 | 42 |
| 46 | Fakse Bugt | 46,47 | 510 | | | 181 | 509 | | 345 | 345 | 32 |
| 47 | Præstø Fjord | 47 | 208 | | | 146 | 70 | | 108 | 108 | 48 |
| 48 | Stege Bugt | 48,49 | 259 | | | 259 | 259 | | 259 | 259 | 0 |
| 49 | Stege Nor | 49 | 24 | | | 18 | 4 | | 11 | 11 | 53 |
| 56 | Østersøen, Bornholm | 56 | 860 | | | 184 | 184 | | 184 | 184 | 79 |
| 57 | Østersøen, Christiansø | 57 | 3 | | | 0 | 3 | | 2 | 2 | 48 |
| 59 | Nærå Strand | 59 | 98 | | | 22 | 22 | | 22 | 22 | 77 |
| 62 | Lillestrand | 62 | 11 | | | 8 | 3 | | 5 | 5 | 52 |
| 68 | Lindelse Nor | 68 | 50 | | | 50 | 11 | | 30 | 30 | 39 |
| 72 | Kløven | 72 | 43 | | | 43 | 11 | | 27 | 27 | 38 |
| 74 | Bredningen | 74 | 128 | | | 42 | 42 | | 42 | 42 | 67 |
| 80 | Gamborg Fjord | 80 | 80 | | | 66 | 80 | | 73 | 73 | 9 |
| 82 | Aborg Minde Nor | 82 | 152 | | | 34 | 34 | | 34 | 34 | 78 |
| 83 | Holckenhavn Fjord | 83 | 290 | | | 81 | 81 | | 81 | 81 | 72 |
| 84 | Kerteminde Fjord | 84,85 | 50 | | | 31 | 50 | | 40 | 40 | 19 |
| 85 | Kertinge Nor | 85 | 24 | 24 | | 23 | 5 | 24 | 14 | 19 | 20 |
| 86 | Nyborg Fjord | 83,86 | 308 | | | 130 | 130 | | 130 | 130 | 58 |
| 87 | Helnæs Bugt | 87 | 216 | | | 67 | 152 | | 110 | 110 | 49 |

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 89 | Lunkebugten | 89 | 16 | | | 5 | 7 | | 6 | 6 | 62 |
| 90 | Langelandssund | 83,86,89,90 | 768 | | | 424 | 623 | | 523 | 523 | 32 |
| 92 | Odense Fjord, ydre | 92,93 | 1,358 | 352 | 692 | 996 | 932 | 522 | 964 | 743 | 45 |
| 93 | Odense Fjord, Seden Strand | 93 | 1,288 | | 390 | 1,288 | 390 | 390 | 839 | 615 | 52 |
| 95 | Storebælt SV | 95 | 188 | | | 41 | 188 | | 115 | 115 | 39 |
| 96 | Storebælt NV | 96, 84, 85 | 227 | | | 38 | 227 | | 132 | 132 | 42 |
| 101 | Genner Bugt | 101 | 35 | | | 13 | 13 | | 13 | 13 | 62 |
| 102 | Åbenrå Fjord | 102 | 130 | 59 | | 59 | 59 | 59 | 59 | 59 | 55 |
| 103 | Als Fjord | 103,104,105 | 269 | | | 67 | 67 | | 67 | 67 | 75 |
| 104 | Als Sund | 104 | 68 | | | 68 | 68 | | 68 | 68 | 0 |
| 105 | Augustenborg Fjord | 105 | 62 | 62 | | 62 | 62 | 62 | 62 | 62 | 0 |
| 106 | Haderslev Fjord | 106 | 239 | | | 104 | 104 | | 104 | 104 | 56 |
| 107 | Juvre Dyb | 107 | 349 | | | 119 | | | 119 | 119 | 66 |
| 108 | Avnø Vig | 108 | 60 | | | 34 | 20 | | 27 | 27 | 54 |
| 109 | Hejlsminde Nor | 109 | 138 | | | 138 | 58 | | 98 | 98 | 29 |
| 110 | Nybøl Nor | 110 | 66 | | | 45 | 29 | | 37 | 37 | 43 |
| 111 | Lister Dyb | 111 | 2,155 | | | 1,017 | | | 1,017 | 1,017 | 53 |
| 113 | Flensborg Fjord, indre | 113 | 51 | 19 | | 19 | 19 | 19 | 19 | 19 | 63 |
| 114 | Flensborg Fjord, ydre | 110,113,114 | 219 | 219 | | 219 | 66 | 219 | 142 | 180 | 17 |

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 119 | Vesterhavet, syd | 119, 107, 111, 121, 120 | 8,538 | | | 3,934 | | | 3,934 | 3,934 | 54 |
| 120 | Knudedyb | 120 | 2,910 | 841 | | 841 | | 841 | 841 | 841 | 71 |
| 121 | Grådyb | 121 | 2,920 | | | 842 | | | 842 | 842 | 71 |
| 122 | Vejle Fjord, ydre | 122,123 | 968 | | | 452 | 403 | | 428 | 428 | 56 |
| 123 | Vejle Fjord, indre | 123 | 561 | 546 | 288 | 531 | 288 | 417 | 409 | 413 | 26 |
| 124 | Kolding Fjord, indre | 124 | 493 | 200 | | 251 | 188 | 200 | 219 | 210 | 58 |
| 125 | Kolding Fjord, ydre | 124,125 | 528 | | | 278 | 278 | | 278 | 278 | 47 |
| 127 | Horsens Fjord, ydre | 127,128 | 833 | | | 516 | 104 | | 310 | 310 | 63 |
| 128 | Horsens Fjord, indre | 128 | 782 | | | 407 | 225 | | 316 | 316 | 60 |
| 129 | Nissum Fjord, ydre | 129,131,130 | 2,413 | | | 1,444 | 713 | | 1,078 | 1,078 | 55 |
| 130 | Nissum Fjord, mellem | 130,131 | 2,083 | | | 993 | 498 | | 746 | 746 | 64 |
| 131 | Nissum Fjord, Felsted Kog | 131 | 1,938 | 1,938 | | 662 | 662 | 1,938 | 662 | 1,300 | 33 |
| 132 | Ringkøbing Fjord | 132 | 4,747 | | 1,679 | 4,748 | 1,679 | 1,679 | 3,213 | 2,446 | 48 |
| 133 | Vesterhavet, nord | 133,129,130 ,131, 132 | 7,237 | | | 7,237 | | | 7,237 | 7,237 | 0 |
| 136 | Randers Fjord, indre | 136 | 2,925 | 2,925 | 1,477 | 2,925 | 1,477 | 2,201 | 2,201 | 2,201 | 25 |
| 137 | Randers Fjord, ydre | 136,137 | 3,078 | 3,078 | 755 | 3,078 | 755 | 1,917 | 1,917 | 1,917 | 38 |
| 138 | Hevring Bugt | 138, 137, 136 | 3,175 | | 3,235 | 2,998 | 3,235 | | 3,117 | 3,117 | 2 |

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 139 | Anholt | 139 | 9 | | | 9 | 9 | | 9 | 9 | 0 |
| 140 | Djursland Øst | 140 | 856 | | | 219 | 856 | | 538 | 538 | 37 |
| 141 | Ebeltoft Vig | 141 | 14 | | | 14 | 14 | | 14 | 14 | 0 |
| 142 | Stavns Fjord | 142 | 5 | | | 5 | 1 | | 3 | 3 | 37 |
| 144 | Knebel Vig | 144 | 18 | | | 11 | 7 | | 9 | 9 | 49 |
| 145 | Kalø Vig | 144,145 | 190 | 190 | 190 | 190 | 190 | 190 | 190 | 190 | 0 |
| 146 | Norsminde Fjord | 146 | 140 | | | 140 | 47 | | 93 | 93 | 33 |
| 147 | Århus Bugt og Begtrup Vig | 144,145,147 | 656 | 656 | 656 | 636 | 656 | 656 | 646 | 651 | 1 |
| 154 | Kattegat Læsø | 154 | 78 | | | 78 | 78 | | 78 | 78 | 0 |
| 157 | Bjørnholms Bugt, Riisgårde Bredning, Skive Fjord og Lovns Bredning | 157,158 | 3,633 | | | 992 | 992 | | 992 | 992 | 73 |
| 158 | Hjarbæk Fjord | 158 | 1,795 | | | 411 | 411 | | 411 | 411 | 77 |
| 159 | Mariager Fjord, indre | 159 | 516 | | | 79 | 79 | | 79 | 79 | 85 |
| 160 | Mariager Fjord, ydre | 159,160 | 963 | | | 823 | 597 | | 710 | 710 | 26 |
| 165 | Isefjord, indre | 165 | 812 | 266 | | 344 | 812 | 266 | 578 | 422 | 48 |
| 200 | Kattegat Nordsjælland | 1,2,24,165,200 | 1,857 | | | 1,857 | 629 | | 1,243 | 1,243 | 33 |
| 201 | Køge Bugt | 201 | 1,109 | 628 | | 249 | 249 | 628 | 249 | 439 | 60 |
| 204 | Jammerland Bugt og Musholm Bugt | 204 | 1,327 | | | 1,327 | 308 | | 818 | 818 | 38 |

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 206 | Smålandsfarvandet, åbne del | 16,17,18,25,35,36,37,206 | 2,014 | | | 2,014 | 252 | | 1,133 | 1,133 | 44 |
| 207 | Nakskov Fjord | 207 | 454 | | | 452 | 43 | | 248 | 248 | 45 |
| 208 | Femerbælt | 207,208,209 | 1,530 | | | 427 | 1,530 | | 978 | 978 | 36 |
| 209 | Rødsand og Bredningen | 209 | 521 | | | 284 | 180 | | 232 | 232 | 55 |
| 212 | Fåborg Fjord | 212 | 30 | | | 10 | 10 | | 10 | 10 | 67 |
| 214 | Det sydfynske Øhav | 68,72,212,214 | 633 | 176 | 176 | 176 | 176 | 176 | 176 | 176 | 72 |
| 216 | Lillebælt, syd | 87,101,102,103,104,105,110,113,114,216 | 1,309 | | | 462 | 1,309 | | 885 | 885 | 32 |
| 217 | Lillebælt Bredningen | 74,82,106,108,109,217 | 956 | 276 | | 276 | 276 | 276 | 276 | 276 | 71 |
| 219 | Århus Bugt, syd, Samsø og Nordlige Bælthav | 59,62,92,93,127,128,142,146,219 | 2,810 | | | 626 | 626 | | 626 | 626 | 78 |
| 221 | Skagerrak | 221 | 1,423 | | | 1,423 | | | 1,423 | 1,423 | 0 |
| 222 | Kattegat Ålborg Bugt | 222,159,160 | 2,026 | | | 2,026 | 2,026 | | 2,026 | 2,026 | 0 |
| 224 | Nordlige Lillebælt | 122,123,224 | 1,588 | | | 389 | 1,588 | | 988 | 988 | 38 |
| 225 | Nordlige Kattegat Ålbæk Bugt | 225 | 706 | | | 587 | 706 | | 646 | 646 | 8 |
| 231 | Lillebælt Snævringen | 231,124,125,80 | 789 | | 134 | 134 | 134 | 134 | 134 | 134 | 83 |

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 232 | Nissum Bredning | 232 | 880 | 297 | 297 | 297 | 297 | 297 | 297 | 297 | 66 |
| 233 | Kaas Bredning og Venø Bugt | 232,233 | 1,955 | | | 1,519 | 611 | | 1,065 | 1,065 | 46 |
| 234 | Løgstør Bredning | 157,158,234, 233, 236 | 6,503 | | | 1,980 | 1,980 | | 1,980 | 1,980 | 70 |
| 235 | Nibe Bredning og Langerak | 157, 158, 233, 234, 235, 236, 238 | 11,065 | | 9,103 | 2,442 | 7,169 | 9,103 | 4,806 | 6,954 | 37 |
| 236 | Thisted Bredning | 236 | 1,091 | | | 269 | 269 | | 269 | 269 | 75 |
| 238 | Halkær Bredning | 238 | 620 | | | 114 | 114 | | 114 | 114 | 82 |

# Appendix C – Maximum Allowable Nitrogen Inputs (N-MAIs) based on WFD scenario 1a and assuming 20% reduction in Danish land-based P-loads

Table C- 1 Water body-specific MAIs based on the two individual indicators chlorophyll-a (Chl-a) and light penetration depth (light) estimated from statistical models (STAT) and mechanistic models (MEK), respectively.
The table shows both the individual calculations and the averaged water-specific MAIs (without any aggregation) and the corresponding need for reduction in %. The data in this table are based on WFD scenario 1a and Danish land-based P-reductions set at 20%.

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Roskilde Fjord,ydre | 1,2 | 764 | | | 651 | 276 | | 464 | 464 | 39 |
| 2 | Roskilde Fjord, indre | 2 | 388 | 388 | | 388 | 361 | 388 | 375 | 381 | 2 |
| 6 | Nordlige Øresund | 6 | 1,098 | | | 1,098 | 635 | | 867 | 867 | 21 |
| 16 | Korsør Nor | 16 | 40 | | | 40 | 9 | | 24 | 24 | 39 |
| 17 | Basnæs Nor | 17 | 69 | | | 69 | 10 | | 40 | 40 | 42 |
| 18 | Holsteinborg Nor | 18 | 22 | | | 22 | 22 | | 22 | 22 | 0 |
| 24 | Isefjord, ydre | 24,165 | 899 | 511 | 206 | 476 | 206 | 358 | 341 | 350 | 61 |
| 25 | Skælskør Fjord og Nor | 25 | 44 | | | 37 | 40 | | 38 | 38 | 13 |
| 28 | Sejerø Bugt | 28 | 164 | | | 164 | 53 | | 108 | 108 | 34 |
| 29 | Kalundborg Fjord | 29 | 69 | 13 | 47 | 27 | 13 | 30 | 20 | 25 | 64 |
| 34 | Smålandsfarvandet, syd | 34 | 523 | | | 523 | 523 | | 523 | 523 | 0 |
| 35 | Karrebæk Fjord | 35 | 1,272 | | | 1,272 | 763 | | 1,017 | 1,017 | 20 |
| 36 | Dybsø Fjord | 36 | 61 | | | 61 | 61 | | 61 | 61 | 0 |
| 37 | Avnø Fjord | 37 | 238 | | | 238 | 40 | | 139 | 139 | 42 |
| 38 | Guldborgsund | 38 | 419 | | | 419 | 419 | | 419 | 419 | 0 |
| 44 | Hjelm Bugt | 44 | 91 | | | 20 | 20 | | 20 | 20 | 78 |
| 45 | Grønsund | 45 | 278 | | | 278 | 44 | | 161 | 161 | 42 |

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 46 | Fakse Bugt | 46,47 | 510 | | | 183 | 509 | | 346 | 346 | 32 |
| 47 | Præstø Fjord | 47 | 208 | | | 149 | 75 | | 112 | 112 | 46 |
| 48 | Stege Bugt | 48,49 | 259 | | | 259 | 259 | | 259 | 259 | 0 |
| 49 | Stege Nor | 49 | 24 | | | 18 | 4 | | 11 | 11 | 53 |
| 56 | Østersøen, Bornholm | 56 | 860 | | | 184 | 184 | | 184 | 184 | 79 |
| 57 | Østersøen, Christiansø | 57 | 3 | | | 0 | 3 | | 2 | 2 | 48 |
| 59 | Nærå Strand | 59 | 98 | | | 25 | 22 | | 24 | 24 | 76 |
| 62 | Lillestrand | 62 | 11 | | | 8 | 3 | | 5 | 5 | 52 |
| 68 | Lindelse Nor | 68 | 50 | | | 50 | 11 | | 30 | 30 | 39 |
| 72 | Kløven | 72 | 43 | | | 43 | 11 | | 27 | 27 | 38 |
| 74 | Bredningen | 74 | 128 | | | 42 | 42 | | 42 | 42 | 67 |
| 80 | Gamborg Fjord | 80 | 80 | | | 66 | 80 | | 73 | 73 | 9 |
| 82 | Aborg Minde Nor | 82 | 152 | | | 34 | 34 | | 34 | 34 | 78 |
| 83 | Holckenhavn Fjord | 83 | 290 | | | 81 | 81 | | 81 | 81 | 72 |
| 84 | Kerteminde Fjord | 84,85 | 50 | | | 31 | 50 | | 40 | 40 | 19 |
| 85 | Kertinge Nor | 85 | 24 | 24 | | 23 | 5 | 24 | 14 | 19 | 20 |
| 86 | Nyborg Fjord | 83,86 | 308 | | | 130 | 130 | | 130 | 130 | 58 |
| 87 | Helnæs Bugt | 87 | 216 | | | 67 | 152 | | 110 | 110 | 49 |
| 89 | Lunkebugten | 89 | 16 | | | 5 | 7 | | 6 | 6 | 62 |

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 90 | Langelandssund | 83,86,89,90 | 768 | | | 424 | 623 | | 523 | 523 | 32 |
| 92 | Odense Fjord, ydre | 92,93 | 1,359 | 352 | 692 | 1,006 | 969 | 522 | 987 | 754 | 44 |
| 93 | Odense Fjord, Seden Strand | 93 | 1,288 | | 390 | 1,288 | 390 | 390 | 839 | 615 | 52 |
| 95 | Storebælt SV | 95 | 188 | | | 41 | 188 | | 115 | 115 | 39 |
| 96 | Storebælt NV | 96, 84, 85 | 227 | | | 38 | 227 | | 132 | 132 | 42 |
| 101 | Genner Bugt | 101 | 35 | | | 13 | 13 | | 13 | 13 | 62 |
| 102 | Åbenrå Fjord | 102 | 130 | 59 | | 59 | 59 | 59 | 59 | 59 | 55 |
| 103 | Als Fjord | 103,104,105 | 269 | | | 67 | 67 | | 67 | 67 | 75 |
| 104 | Als Sund | 104 | 68 | | | 68 | 68 | | 68 | 68 | 0 |
| 105 | Augustenborg Fjord | 105 | 62 | 62 | | 62 | 62 | 62 | 62 | 62 | 0 |
| 106 | Haderslev Fjord | 106 | 239 | | | 104 | 104 | | 104 | 104 | 56 |
| 107 | Juvre Dyb | 107 | 349 | | | 119 | | | 119 | 119 | 66 |
| 108 | Avnø Vig | 108 | 60 | | | 36 | 20 | | 28 | 28 | 53 |
| 109 | Hejlsminde Nor | 109 | 138 | | | 138 | 58 | | 98 | 98 | 29 |
| 110 | Nybøl Nor | 110 | 66 | | | 46 | 29 | | 38 | 38 | 43 |
| 111 | Lister Dyb | 111 | 2,155 | | | 1,089 | | | 1,089 | 1,089 | 49 |
| 113 | Flensborg Fjord, indre | 113 | 51 | 19 | | 19 | 19 | 19 | 19 | 19 | 63 |
| 114 | Flensborg Fjord, ydre | 110,113,114 | 219 | 219 | | 219 | 66 | 219 | 142 | 180 | 17 |

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 119 | Vesterhavet, syd | 119, 107, 111, 121, 120 | 8,538 | | | 3,934 | | | 3,934 | 3,934 | 54 |
| 120 | Knudedyb | 120 | 2,910 | 841 | | 841 | | 841 | 841 | 841 | 71 |
| 121 | Grådyb | 121 | 2,920 | | | 842 | | | 842 | 842 | 71 |
| 122 | Vejle Fjord, ydre | 122,123 | 968 | | | 459 | 403 | | 431 | 431 | 55 |
| 123 | Vejle Fjord, indre | 123 | 561 | 561 | 288 | 532 | 288 | 425 | 410 | 417 | 26 |
| 124 | Kolding Fjord, indre | 124 | 493 | 222 | | 256 | 188 | 222 | 222 | 222 | 55 |
| 125 | Kolding Fjord, ydre | 124,125 | 528 | | | 278 | 278 | | 278 | 278 | 47 |
| 127 | Horsens Fjord, ydre | 127,128 | 833 | | | 525 | 104 | | 315 | 315 | 62 |
| 128 | Horsens Fjord, indre | 128 | 782 | | | 409 | 225 | | 317 | 317 | 59 |
| 129 | Nissum Fjord, ydre | 129,131,130 | 2,413 | | | 1,562 | 713 | | 1,138 | 1,138 | 53 |
| 130 | Nissum Fjord, mellem | 130,131 | 2,083 | | | 1,146 | 498 | | 822 | 822 | 61 |
| 131 | Nissum Fjord, Felsted Kog | 131 | 1,938 | 1,938 | | 662 | 662 | 1,938 | 662 | 1,300 | 33 |
| 132 | Ringkøbing Fjord | 132 | 4,747 | | 1,679 | 4,748 | 1,679 | 1,679 | 3,213 | 2,446 | 48 |
| 133 | Vesterhavet, nord | 133,129,130 ,131, 132 | 7,237 | | | 7,237 | | | 7,237 | 7,237 | 0 |
| 136 | Randers Fjord, indre | 136 | 2,925 | 2,925 | 1,477 | 2,925 | 1,477 | 2,201 | 2,201 | 2,201 | 25 |
| 137 | Randers Fjord, ydre | 136,137 | 3,078 | 3,078 | 755 | 3,078 | 755 | 1,917 | 1,917 | 1,917 | 38 |
| 138 | Hevring Bugt | 138, 137, 136 | 3,175 | | 3,235 | 2,998 | 3,235 | | 3,117 | 3,117 | 2 |

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 139 | Anholt | 139 | 9 | | | 9 | 9 | | 9 | 9 | 0 |
| 140 | Djursland Øst | 140 | 856 | | | 219 | 856 | | 538 | 538 | 37 |
| 141 | Ebeltoft Vig | 141 | 14 | | | 14 | 14 | | 14 | 14 | 0 |
| 142 | Stavns Fjord | 142 | 5 | | | 5 | 1 | | 3 | 3 | 37 |
| 144 | Knebel Vig | 144 | 18 | | | 11 | 7 | | 9 | 9 | 49 |
| 145 | Kalø Vig | 144,145 | 190 | 190 | 190 | 190 | 190 | 190 | 190 | 190 | 0 |
| 146 | Norsminde Fjord | 146 | 140 | | | 140 | 47 | | 93 | 93 | 33 |
| 147 | Århus Bugt og Begtrup Vig | 144,145,147 | 656 | 656 | 656 | 636 | 656 | 656 | 646 | 651 | 1 |
| 154 | Kattegat Læsø | 154 | 78 | | | 78 | 78 | | 78 | 78 | 0 |
| 157 | Bjørnholms Bugt, Riisgårde Bredning, Skive Fjord og Lovns Bredning | 157,158 | 3,633 | | | 992 | 992 | | 992 | 992 | 73 |
| 158 | Hjarbæk Fjord | 158 | 1,795 | | | 411 | 411 | | 411 | 411 | 77 |
| 159 | Mariager Fjord, indre | 159 | 516 | | | 79 | 79 | | 79 | 79 | 85 |
| 160 | Mariager Fjord, ydre | 159,160 | 963 | | | 870 | 672 | | 771 | 771 | 20 |
| 165 | Isefjord, indre | 165 | 812 | 266 | | 344 | 812 | 266 | 578 | 422 | 48 |
| 200 | Kattegat Nordsjælland | 1,2,24,165,200 | 1,857 | | | 1,857 | 629 | | 1,243 | 1,243 | 33 |
| 201 | Køge Bugt | 201 | 1,109 | 644 | | 249 | 249 | 644 | 249 | 447 | 60 |
| 204 | Jammerland Bugt og Musholm Bugt | 204 | 1,327 | | | 1,327 | 308 | | 818 | 818 | 38 |

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 206 | Smålandsfarvandet, åbne del | 16,17,18,25,35,36,37,206 | 2,014 | | | 2,014 | 252 | | 1,133 | 1,133 | 44 |
| 207 | Nakskov Fjord | 207 | 454 | | | 454 | 43 | | 249 | 249 | 45 |
| 208 | Femerbælt | 207,208,209 | 1,530 | | | 427 | 1,530 | | 978 | 978 | 36 |
| 209 | Rødsand og Bredningen | 209 | 521 | | | 284 | 180 | | 232 | 232 | 55 |
| 212 | Fåborg Fjord | 212 | 30 | | | 10 | 10 | | 10 | 10 | 67 |
| 214 | Det sydfynske Øhav | 68,72,212,214 | 633 | 176 | 176 | 176 | 176 | 176 | 176 | 176 | 72 |
| 216 | Lillebælt, syd | 87,101,102,103,104,105,110,113,114,216 | 1,309 | | | 462 | 1,309 | | 885 | 885 | 32 |
| 217 | Lillebælt Bredningen | 74,82,106,108,109,217 | 956 | 276 | | 276 | 276 | 276 | 276 | 276 | 71 |
| 219 | Århus Bugt, syd, Samsø og Nordlige Bælthav | 59,62,92,93,127,128,142,146,219 | 2,810 | | | 626 | 626 | | 626 | 626 | 78 |
| 221 | Skagerrak | 221 | 1,423 | | | 1,423 | | | 1,423 | 1,423 | 0 |
| 222 | Kattegat Ålborg Bugt | 222,159,160 | 2,026 | | | 2,026 | 2,026 | | 2,026 | 2,026 | 0 |
| 224 | Nordlige Lillebælt | 122,123,224 | 1,588 | | | 389 | 1,588 | | 988 | 988 | 38 |
| 225 | Nordlige Kattegat Ålbæk Bugt | 225 | 706 | | | 587 | 706 | | 646 | 646 | 8 |
| 231 | Lillebælt Snævringen | 231,124,125,80 | 789 | | 134 | 134 | 134 | 134 | 134 | 134 | 83 |

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 232 | Nissum Bredning | 232 | 880 | 297 | 297 | 297 | 297 | 297 | 297 | 297 | 66 |
| 233 | Kaas Bredning og Venø Bugt | 232,233 | 1,955 | | | 1,583 | 611 | | 1,097 | 1,097 | 44 |
| 234 | Løgstør Bredning | 157,158,234, 233, 236 | 6,503 | | | 1,980 | 1,980 | | 1,980 | 1,980 | 70 |
| 235 | Nibe Bredning og Langerak | 157, 158, 233, 234, 235, 236, 238 | 11,064 | | 9,321 | 2,702 | 7,855 | 9,321 | 5,279 | 7,300 | 34 |
| 236 | Thisted Bredning | 236 | 1,091 | | | 269 | 269 | | 269 | 269 | 75 |
| 238 | Halkær Bredning | 238 | 620 | | | 114 | 114 | | 114 | 114 | 82 |

# Appendix D – Maximum Allowable Nitrogen Inputs (N-MAIs) based on WFD scenario 1a and assuming 30% reduction in Danish land-based P-loads

Table D- 1 Water body-specific MAIs based on the two individual indicators chlorophyll-a (Chl-a) and light penetration depth (light) estimated from statistical models (STAT) and mechanistic models (MEK) respectively.
The table shows both the individual calculations and the averaged water-specific MAIs (without any aggregation) and the corresponding need for reduction in %. The data in this table are based on WFD scenario 1a and Danish land-based P-reductions set at 30%.

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Roskilde Fjord,ydre | 1,2 | 764 | | | 651 | 276 | | 464 | 464 | 39 |
| 2 | Roskilde Fjord, indre | 2 | 388 | 388 | | 388 | 365 | 388 | 377 | 382 | 1 |
| 6 | Nordlige Øresund | 6 | 1,098 | | | 1,098 | 646 | | 872 | 872 | 21 |
| 16 | Korsør Nor | 16 | 40 | | | 40 | 9 | | 24 | 24 | 39 |
| 17 | Basnæs Nor | 17 | 69 | | | 69 | 10 | | 40 | 40 | 42 |
| 18 | Holsteinborg Nor | 18 | 22 | | | 22 | 22 | | 22 | 22 | 0 |
| 24 | Isefjord, ydre | 24,165 | 899 | 533 | 206 | 476 | 206 | 369 | 341 | 355 | 60 |
| 25 | Skælskør Fjord og Nor | 25 | 44 | | | 37 | 41 | | 39 | 39 | 11 |
| 28 | Sejerø Bugt | 28 | 164 | | | 164 | 53 | | 108 | 108 | 34 |
| 29 | Kalundborg Fjord | 29 | 69 | 13 | 53 | 27 | 13 | 33 | 20 | 27 | 62 |
| 34 | Smålandsfarvandet, syd | 34 | 523 | | | 523 | 523 | | 523 | 523 | 0 |
| 35 | Karrebæk Fjord | 35 | 1,272 | | | 1,272 | 820 | | 1,046 | 1,046 | 18 |
| 36 | Dybsø Fjord | 36 | 61 | | | 61 | 61 | | 61 | 61 | 0 |
| 37 | Avnø Fjord | 37 | 238 | | | 238 | 40 | | 139 | 139 | 42 |
| 38 | Guldborgsund | 38 | 419 | | | 419 | 419 | | 419 | 419 | 0 |
| 44 | Hjelm Bugt | 44 | 91 | | | 20 | 20 | | 20 | 20 | 78 |

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 45 | Grønsund | 45 | 278 | | | 278 | 44 | | 161 | 161 | 42 |
| 46 | Fakse Bugt | 46,47 | 509 | | | 184 | 509 | | 347 | 347 | 32 |
| 47 | Præstø Fjord | 47 | 208 | | | 151 | 80 | | 116 | 116 | 44 |
| 48 | Stege Bugt | 48,49 | 259 | | | 259 | 259 | | 259 | 259 | 0 |
| 49 | Stege Nor | 49 | 24 | | | 19 | 4 | | 11 | 11 | 52 |
| 56 | Østersøen, Bornholm | 56 | 860 | | | 184 | 184 | | 184 | 184 | 79 |
| 57 | Østersøen, Christiansø | 57 | 3 | | | 0 | 3 | | 2 | 2 | 48 |
| 59 | Nærå Strand | 59 | 98 | | | 31 | 22 | | 26 | 26 | 73 |
| 62 | Lillestrand | 62 | 11 | | | 8 | 3 | | 5 | 5 | 52 |
| 68 | Lindelse Nor | 68 | 50 | | | 50 | 11 | | 30 | 30 | 39 |
| 72 | Kløven | 72 | 43 | | | 43 | 11 | | 27 | 27 | 38 |
| 74 | Bredningen | 74 | 128 | | | 42 | 42 | | 42 | 42 | 67 |
| 80 | Gamborg Fjord | 80 | 80 | | | 66 | 80 | | 73 | 73 | 9 |
| 82 | Aborg Minde Nor | 82 | 152 | | | 34 | 34 | | 34 | 34 | 78 |
| 83 | Holckenhavn Fjord | 83 | 290 | | | 81 | 81 | | 81 | 81 | 72 |
| 84 | Kerteminde Fjord | 84,85 | 50 | | | 31 | 50 | | 40 | 40 | 19 |
| 85 | Kertinge Nor | 85 | 24 | 24 | | 23 | 5 | 24 | 14 | 19 | 20 |
| 86 | Nyborg Fjord | 83,86 | 308 | | | 130 | 130 | | 130 | 130 | 58 |
| 87 | Helnæs Bugt | 87 | 216 | | | 67 | 152 | | 110 | 110 | 49 |

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 89 | Lunkebugten | 89 | 16 | | | 5 | 7 | | 6 | 6 | 62 |
| 90 | Langelandssund | 83,86,89,90 | 768 | | | 424 | 623 | | 523 | 523 | 32 |
| 92 | Odense Fjord, ydre | 92,93 | 1,359 | 352 | 692 | 1,015 | 1,006 | 522 | 1,010 | 766 | 44 |
| 93 | Odense Fjord, Seden Strand | 93 | 1,288 | | 390 | 1,288 | 390 | 390 | 839 | 615 | 52 |
| 95 | Storebælt SV | 95 | 188 | | | 41 | 188 | | 115 | 115 | 39 |
| 96 | Storebælt NV | 96, 84, 85 | 227 | | | 38 | 227 | | 132 | 132 | 42 |
| 101 | Genner Bugt | 101 | 35 | | | 13 | 13 | | 13 | 13 | 62 |
| 102 | Åbenrå Fjord | 102 | 130 | 59 | | 59 | 59 | 59 | 59 | 59 | 55 |
| 103 | Als Fjord | 103,104,105 | 269 | | | 67 | 67 | | 67 | 67 | 75 |
| 104 | Als Sund | 104 | 68 | | | 68 | 68 | | 68 | 68 | 0 |
| 105 | Augustenborg Fjord | 105 | 62 | 62 | | 62 | 62 | 62 | 62 | 62 | 0 |
| 106 | Haderslev Fjord | 106 | 239 | | | 104 | 104 | | 104 | 104 | 56 |
| 107 | Juvre Dyb | 107 | 349 | | | 119 | | | 119 | 119 | 66 |
| 108 | Avnø Vig | 108 | 60 | | | 39 | 20 | | 29 | 29 | 51 |
| 109 | Hejlsminde Nor | 109 | 138 | | | 138 | 58 | | 98 | 98 | 29 |
| 110 | Nybøl Nor | 110 | 66 | | | 48 | 29 | | 39 | 39 | 42 |
| 111 | Lister Dyb | 111 | 2,155 | | | 1,163 | | | 1,163 | 1,163 | 46 |
| 113 | Flensborg Fjord, indre | 113 | 51 | 19 | | 19 | 19 | 19 | 19 | 19 | 63 |
| 114 | Flensborg Fjord, ydre | 110,113,114 | 219 | 219 | | 219 | 66 | 219 | 142 | 180 | 17 |

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 119 | Vesterhavet, syd | 119, 107, 111, 121, 120 | 8,538 | | | 3,934 | | | 3,934 | 3,934 | 54 |
| 120 | Knudedyb | 120 | 2,910 | 841 | | 841 | | 841 | 841 | 841 | 71 |
| 121 | Grådyb | 121 | 2,920 | | | 930 | | | 930 | 930 | 68 |
| 122 | Vejle Fjord, ydre | 122,123 | 968 | | | 467 | 403 | | 435 | 435 | 55 |
| 123 | Vejle Fjord, indre | 123 | 561 | 561 | 288 | 533 | 288 | 425 | 410 | 417 | 26 |
| 124 | Kolding Fjord, indre | 124 | 493 | 248 | | 261 | 188 | 248 | 224 | 236 | 52 |
| 125 | Kolding Fjord, ydre | 124,125 | 528 | | | 278 | 278 | | 278 | 278 | 47 |
| 127 | Horsens Fjord, ydre | 127,128 | 833 | | | 535 | 104 | | 320 | 320 | 62 |
| 128 | Horsens Fjord, indre | 128 | 782 | | | 411 | 225 | | 318 | 318 | 59 |
| 129 | Nissum Fjord, ydre | 129,131,130 | 2,412 | | | 1,736 | 713 | | 1,224 | 1,224 | 49 |
| 130 | Nissum Fjord, mellem | 130,131 | 2,083 | | | 1,430 | 498 | | 964 | 964 | 54 |
| 131 | Nissum Fjord, Felsted Kog | 131 | 1,938 | 1,938 | | 906 | 662 | 1,938 | 784 | 1,361 | 30 |
| 132 | Ringkøbing Fjord | 132 | 4,747 | | 1,679 | 4,748 | 1,679 | 1,679 | 3,213 | 2,446 | 48 |
| 133 | Vesterhavet, nord | 133,129,130 ,131, 132 | 7,237 | | | 7,237 | | | 7,237 | 7,237 | 0 |
| 136 | Randers Fjord, indre | 136 | 2,925 | 2,925 | 1,477 | 2,925 | 1,477 | 2,201 | 2,201 | 2,201 | 25 |
| 137 | Randers Fjord, ydre | 136,137 | 3,078 | 3,078 | 755 | 3,078 | 755 | 1,917 | 1,917 | 1,917 | 38 |
| 138 | Hevring Bugt | 138, 137, 136 | 3,176 | | 3,235 | 3,001 | 3,235 | | 3,118 | 3,118 | 2 |

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 139 | Anholt | 139 | 9 | | | 9 | 9 | | 9 | 9 | 0 |
| 140 | Djursland Øst | 140 | 856 | | | 219 | 856 | | 538 | 538 | 37 |
| 141 | Ebeltoft Vig | 141 | 14 | | | 14 | 14 | | 14 | 14 | 0 |
| 142 | Stavns Fjord | 142 | 5 | | | 5 | 1 | | 3 | 3 | 37 |
| 144 | Knebel Vig | 144 | 18 | | | 11 | 7 | | 9 | 9 | 49 |
| 145 | Kalø Vig | 144,145 | 190 | 190 | 190 | 190 | 190 | 190 | 190 | 190 | 0 |
| 146 | Norsminde Fjord | 146 | 140 | | | 140 | 47 | | 93 | 93 | 33 |
| 147 | Århus Bugt og Begtrup Vig | 144,145,147 | 656 | 656 | 656 | 636 | 656 | 656 | 646 | 651 | 1 |
| 154 | Kattegat Læsø | 154 | 78 | | | 78 | 78 | | 78 | 78 | 0 |
| 157 | Bjørnholms Bugt, Riisgårde Bredning, Skive Fjord og Lovns Bredning | 157,158 | 3,632 | | | 992 | 1,230 | | 1,111 | 1,111 | 69 |
| 158 | Hjarbæk Fjord | 158 | 1,795 | | | 411 | 411 | | 411 | 411 | 77 |
| 159 | Mariager Fjord, indre | 159 | 516 | | | 83 | 79 | | 81 | 81 | 84 |
| 160 | Mariager Fjord, ydre | 159,160 | 963 | | | 926 | 741 | | 834 | 834 | 13 |
| 165 | Isefjord, indre | 165 | 812 | 266 | | 344 | 812 | 266 | 578 | 422 | 48 |
| 200 | Kattegat Nordsjælland | 1,2,24,165,200 | 1,857 | | | 1,857 | 629 | | 1,243 | 1,243 | 33 |
| 201 | Køge Bugt | 201 | 1,109 | 660 | | 249 | 249 | 660 | 249 | 455 | 59 |
| 204 | Jammerland Bugt og Musholm Bugt | 204 | 1,327 | | | 1,327 | 308 | | 818 | 818 | 38 |

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 206 | Smålandsfarvandet, åbne del | 16,17,18,25,35,36,37,206 | 2,014 | | | 2,014 | 252 | | 1,133 | 1,133 | 44 |
| 207 | Nakskov Fjord | 207 | 454 | | | 454 | 43 | | 249 | 249 | 45 |
| 208 | Femerbælt | 207,208,209 | 1,530 | | | 427 | 1,530 | | 979 | 979 | 36 |
| 209 | Rødsand og Bredningen | 209 | 521 | | | 284 | 180 | | 232 | 232 | 55 |
| 212 | Fåborg Fjord | 212 | 30 | | | 10 | 10 | | 10 | 10 | 67 |
| 214 | Det sydfynske Øhav | 68,72,212,214 | 633 | 176 | 176 | 176 | 176 | 176 | 176 | 176 | 72 |
| 216 | Lillebælt, syd | 87,101,102,103,104,105,110,113,114,216 | 1,309 | | | 462 | 1,309 | | 885 | 885 | 32 |
| 217 | Lillebælt Bredningen | 74,82,106,108,109,217 | 956 | 276 | | 276 | 276 | 276 | 276 | 276 | 71 |
| 219 | Århus Bugt, syd, Samsø og Nordlige Bælthav | 59,62,92,93,127,128,142,146,219 | 2,810 | | | 626 | 626 | | 626 | 626 | 78 |
| 221 | Skagerrak | 221 | 1,423 | | | 1,423 | | | 1,423 | 1,423 | 0 |
| 222 | Kattegat Ålborg Bugt | 222,159,160 | 2,026 | | | 2,026 | 2,026 | | 2,026 | 2,026 | 0 |
| 224 | Nordlige Lillebælt | 122,123,224 | 1,588 | | | 389 | 1,588 | | 988 | 988 | 38 |
| 225 | Nordlige Kattegat Ålbæk Bugt | 225 | 706 | | | 587 | 706 | | 646 | 646 | 8 |
| 231 | Lillebælt Snævringen | 231,124,125,80 | 789 | | 134 | 134 | 134 | 134 | 134 | 134 | 83 |

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 232 | Nissum Bredning | 232 | 880 | 297 | 297 | 297 | 297 | 297 | 297 | 297 | 66 |
| 233 | Kaas Bredning og Venø Bugt | 232,233 | 1,955 | | | 1,650 | 611 | | 1,130 | 1,130 | 42 |
| 234 | Løgstør Bredning | 157,158,234, 233, 236 | 6,503 | | | 1,980 | 1,980 | | 1,980 | 1,980 | 70 |
| 235 | Nibe Bredning og Langerak | 157, 158, 233, 234, 235, 236, 238 | 11,064 | | 9,537 | 3,288 | 8,530 | 9,537 | 5,909 | 7,723 | 30 |
| 236 | Thisted Bredning | 236 | 1,091 | | | 269 | 269 | | 269 | 269 | 75 |
| 238 | Halkær Bredning | 238 | 620 | | | 114 | 114 | | 114 | 114 | 82 |

# Appendix E – Maximum Allowable Nitrogen Inputs (N-MAIs) based on WFD scenario 1a and assuming 50% reduction in Danish land-based P-loads

Table E- 1 Water body-specific MAIs based on the two individual indicators chlorophyll-a (Chl-a) and light penetration depth (light) estimated from statistical models (STAT) and mechanistic models (MEK), respectively.
The table shows both the individual calculations and the averaged water-specific MAIs (without any aggregation) and corresponding need for reduction in %. The data in this table are based on WFD scenario 1a and Danish land-based P-reductions set at 50%.

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Roskilde Fjord,ydre | 1,2 | 764 | | | 651 | 276 | | 464 | 464 | 39 |
| 2 | Roskilde Fjord, indre | 2 | 388 | 388 | | 388 | 373 | 388 | 380 | 384 | 1 |
| 6 | Nordlige Øresund | 6 | 1,098 | | | 1,098 | 667 | | 883 | 883 | 20 |
| 16 | Korsør Nor | 16 | 40 | | | 40 | 9 | | 24 | 24 | 39 |
| 17 | Basnæs Nor | 17 | 69 | | | 69 | 10 | | 40 | 40 | 42 |
| 18 | Holsteinborg Nor | 18 | 22 | | | 22 | 22 | | 22 | 22 | 0 |
| 24 | Isefjord, ydre | 24,165 | 899 | 577 | 206 | 476 | 206 | 392 | 341 | 366 | 59 |
| 25 | Skælskør Fjord og Nor | 25 | 44 | | | 38 | 43 | | 41 | 41 | 7 |
| 28 | Sejerø Bugt | 28 | 164 | | | 164 | 53 | | 108 | 108 | 34 |
| 29 | Kalundborg Fjord | 29 | 69 | 13 | 63 | 27 | 13 | 38 | 20 | 29 | 58 |
| 34 | Smålandsfarvandet, syd | 34 | 523 | | | 523 | 523 | | 523 | 523 | 0 |
| 35 | Karrebæk Fjord | 35 | 1,272 | | | 1,272 | 928 | | 1,100 | 1,100 | 14 |
| 36 | Dybsø Fjord | 36 | 61 | | | 61 | 61 | | 61 | 61 | 0 |
| 37 | Avnø Fjord | 37 | 238 | | | 238 | 40 | | 139 | 139 | 42 |
| 38 | Guldborgsund | 38 | 419 | | | 419 | 419 | | 419 | 419 | 0 |
| 44 | Hjelm Bugt | 44 | 91 | | | 20 | 20 | | 20 | 20 | 78 |

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 45 | Grønsund | 45 | 278 | | | 278 | 44 | | 161 | 161 | 42 |
| 46 | Fakse Bugt | 46,47 | 510 | | | 187 | 509 | | 348 | 348 | 32 |
| 47 | Præstø Fjord | 47 | 208 | | | 157 | 89 | | 123 | 123 | 41 |
| 48 | Stege Bugt | 48,49 | 259 | | | 259 | 259 | | 259 | 259 | 0 |
| 49 | Stege Nor | 49 | 24 | | | 19 | 4 | | 11 | 11 | 52 |
| 56 | Østersøen, Bornholm | 56 | 860 | | | 184 | 184 | | 184 | 184 | 79 |
| 57 | Østersøen, Christiansø | 57 | 3 | | | 0 | 3 | | 2 | 2 | 48 |
| 59 | Nærå Strand | 59 | 98 | | | 45 | 22 | | 34 | 34 | 65 |
| 62 | Lillestrand | 62 | 11 | | | 8 | 3 | | 5 | 5 | 51 |
| 68 | Lindelse Nor | 68 | 50 | | | 50 | 11 | | 30 | 30 | 39 |
| 72 | Kløven | 72 | 43 | | | 43 | 11 | | 27 | 27 | 38 |
| 74 | Bredningen | 74 | 128 | | | 42 | 42 | | 42 | 42 | 67 |
| 80 | Gamborg Fjord | 80 | 80 | | | 66 | 80 | | 73 | 73 | 9 |
| 82 | Aborg Minde Nor | 82 | 152 | | | 51 | 34 | | 43 | 43 | 72 |
| 83 | Holckenhavn Fjord | 83 | 290 | | | 81 | 81 | | 81 | 81 | 72 |
| 84 | Kerteminde Fjord | 84,85 | 50 | | | 31 | 50 | | 40 | 40 | 19 |
| 85 | Kertinge Nor | 85 | 24 | 24 | | 23 | 5 | 24 | 14 | 19 | 20 |
| 86 | Nyborg Fjord | 83,86 | 308 | | | 130 | 130 | | 130 | 130 | 58 |
| 87 | Helnæs Bugt | 87 | 216 | | | 67 | 152 | | 110 | 110 | 49 |

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 89 | Lunkebugten | 89 | 16 | | | 5 | 7 | | 6 | 6 | 62 |
| 90 | Langelandssund | 83,86,89,90 | 768 | | | 424 | 623 | | 523 | 523 | 32 |
| 92 | Odense Fjord, ydre | 92,93 | 1,358 | 352 | 692 | 1,036 | 1,077 | 522 | 1,057 | 789 | 42 |
| 93 | Odense Fjord, Seden Strand | 93 | 1,288 | | 390 | 1,288 | 390 | 390 | 839 | 615 | 52 |
| 95 | Storebælt SV | 95 | 188 | | | 41 | 188 | | 115 | 115 | 39 |
| 96 | Storebælt NV | 96, 84, 85 | 227 | | | 38 | 227 | | 132 | 132 | 42 |
| 101 | Genner Bugt | 101 | 35 | | | 13 | 13 | | 13 | 13 | 62 |
| 102 | Åbenrå Fjord | 102 | 130 | 59 | | 59 | 59 | 59 | 59 | 59 | 55 |
| 103 | Als Fjord | 103,104,105 | 269 | | | 67 | 67 | | 67 | 67 | 75 |
| 104 | Als Sund | 104 | 68 | | | 68 | 68 | | 68 | 68 | 0 |
| 105 | Augustenborg Fjord | 105 | 62 | 62 | | 62 | 62 | 62 | 62 | 62 | 0 |
| 106 | Haderslev Fjord | 106 | 239 | | | 104 | 104 | | 104 | 104 | 56 |
| 107 | Juvre Dyb | 107 | 349 | | | 119 | | | 119 | 119 | 66 |
| 108 | Avnø Vig | 108 | 60 | | | 45 | 20 | | 32 | 32 | 46 |
| 109 | Hejlsminde Nor | 109 | 138 | | | 138 | 58 | | 98 | 98 | 29 |
| 110 | Nybøl Nor | 110 | 66 | | | 51 | 29 | | 40 | 40 | 39 |
| 111 | Lister Dyb | 111 | 2,155 | | | 1,318 | | | 1,318 | 1,318 | 39 |
| 113 | Flensborg Fjord, indre | 113 | 51 | 19 | | 19 | 19 | 19 | 19 | 19 | 63 |
| 114 | Flensborg Fjord, ydre | 110,113,114 | 219 | 219 | | 219 | 66 | 219 | 142 | 180 | 17 |

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 119 | Vesterhavet, syd | 119, 107, 111, 121, 120 | 8,538 | | | 3,934 | | | 3,934 | 3,934 | 54 |
| 120 | Knudedyb | 120 | 2,910 | 2,026 | | 841 | | 2,026 | 841 | 1,433 | 51 |
| 121 | Grådyb | 121 | 2,920 | | | 1,576 | | | 1,576 | 1,576 | 46 |
| 122 | Vejle Fjord, ydre | 122,123 | 968 | | | 482 | 403 | | 443 | 443 | 54 |
| 123 | Vejle Fjord, indre | 123 | 561 | 561 | 288 | 535 | 288 | 425 | 411 | 418 | 26 |
| 124 | Kolding Fjord, indre | 124 | 493 | 314 | | 271 | 188 | 314 | 230 | 272 | 45 |
| 125 | Kolding Fjord, ydre | 124,125 | 528 | | | 278 | 278 | | 278 | 278 | 47 |
| 127 | Horsens Fjord, ydre | 127,128 | 833 | | | 553 | 104 | | 329 | 329 | 61 |
| 128 | Horsens Fjord, indre | 128 | 782 | | | 414 | 225 | | 320 | 320 | 59 |
| 129 | Nissum Fjord, ydre | 129,131,130 | 2,413 | | | 2,412 | 713 | | 1,563 | 1,563 | 35 |
| 130 | Nissum Fjord, mellem | 130,131 | 2,083 | | | 2,083 | 498 | | 1,291 | 1,291 | 38 |
| 131 | Nissum Fjord, Felsted Kog | 131 | 1,938 | 1,938 | | | 662 | 1,938 | 662 | 1,300 | 33 |
| 132 | Ringkøbing Fjord | 132 | 4,747 | | 1,679 | 4,748 | 1,679 | 1,679 | 3,213 | 2,446 | 48 |
| 133 | Vesterhavet, nord | 133,129,130 ,131, 132 | 7,237 | | | 7,237 | | | 7,237 | 7,237 | 0 |
| 136 | Randers Fjord, indre | 136 | 2,925 | 2,925 | 1,477 | 2,925 | 1,477 | 2,201 | 2,201 | 2,201 | 25 |
| 137 | Randers Fjord, ydre | 136,137 | 3,078 | 3,078 | 755 | 3,078 | 755 | 1,917 | 1,917 | 1,917 | 38 |
| 138 | Hevring Bugt | 138, 137, 136 | 3,176 | | 3,235 | 3,003 | 3,235 | | 3,119 | 3,119 | 2 |

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 139 | Anholt | 139 | 9 | | | 9 | 9 | | 9 | 9 | 0 |
| 140 | Djursland Øst | 140 | 856 | | | 219 | 856 | | 538 | 538 | 37 |
| 141 | Ebeltoft Vig | 141 | 14 | | | 14 | 14 | | 14 | 14 | 0 |
| 142 | Stavns Fjord | 142 | 5 | | | 5 | 1 | | 3 | 3 | 37 |
| 144 | Knebel Vig | 144 | 18 | | | 11 | 7 | | 9 | 9 | 49 |
| 145 | Kalø Vig | 144,145 | 190 | 190 | 190 | 190 | 190 | 190 | 190 | 190 | 0 |
| 146 | Norsminde Fjord | 146 | 140 | | | 140 | 47 | | 93 | 93 | 33 |
| 147 | Århus Bugt og Begtrup Vig | 144,145,147 | 656 | 656 | 656 | 636 | 656 | 656 | 646 | 651 | 1 |
| 154 | Kattegat Læsø | 154 | 78 | | | 78 | 78 | | 78 | 78 | 0 |
| 157 | Bjørnholms Bugt, Riisgårde Bredning, Skive Fjord og Lovns Bredning | 157,158 | 3,632 | | | 992 | 1,689 | | 1,340 | 1,340 | 63 |
| 158 | Hjarbæk Fjord | 158 | 1,795 | | | 411 | 411 | | 411 | 411 | 77 |
| 159 | Mariager Fjord, indre | 159 | 516 | | | 93 | 79 | | 86 | 86 | 83 |
| 160 | Mariager Fjord, ydre | 159,160 | 963 | | | 963 | 866 | | 914 | 914 | 5 |
| 165 | Isefjord, indre | 165 | 812 | 266 | | 344 | 812 | 266 | 578 | 422 | 48 |
| 200 | Kattegat Nordsjælland | 1,2,24,165,200 | 1,857 | | | 1,857 | 629 | | 1,243 | 1,243 | 33 |
| 201 | Køge Bugt | 201 | 1,109 | 693 | | 249 | 249 | 693 | 249 | 471 | 58 |
| 204 | Jammerland Bugt og Musholm Bugt | 204 | 1,327 | | | 1,327 | 308 | | 818 | 818 | 38 |

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 206 | Smålandsfarvandet, åbne del | 16,17,18,25,35,36,37,206 | 2,014 | | | 2,014 | 252 | | 1,133 | 1,133 | 44 |
| 207 | Nakskov Fjord | 207 | 454 | | | 454 | 43 | | 249 | 249 | 45 |
| 208 | Femerbælt | 207,208,209 | 1,530 | | | 427 | 1,530 | | 979 | 979 | 36 |
| 209 | Rødsand og Bredningen | 209 | 521 | | | 284 | 180 | | 232 | 232 | 55 |
| 212 | Fåborg Fjord | 212 | 30 | | | 10 | 10 | | 10 | 10 | 67 |
| 214 | Det sydfynske Øhav | 68,72,212,214 | 633 | 176 | 176 | 176 | 176 | 176 | 176 | 176 | 72 |
| 216 | Lillebælt, syd | 87,101,102,103,104,105,110,113,114,216 | 1,309 | | | 462 | 1,309 | | 885 | 885 | 32 |
| 217 | Lillebælt Bredningen | 74,82,106,108,109,217 | 956 | 276 | | 276 | 276 | 276 | 276 | 276 | 71 |
| 219 | Århus Bugt, syd, Samsø og Nordlige Bælthav | 59,62,92,93,127,128,142,146,219 | 2,810 | | | 626 | 626 | | 626 | 626 | 78 |
| 221 | Skagerrak | 221 | 1,423 | | | 1,423 | | | 1,423 | 1,423 | 0 |
| 222 | Kattegat Ålborg Bugt | 222,159,160 | 2,026 | | | 2,026 | 2,026 | | 2,026 | 2,026 | 0 |
| 224 | Nordlige Lillebælt | 122,123,224 | 1,588 | | | 389 | 1,588 | | 988 | 988 | 38 |
| 225 | Nordlige Kattegat Ålbæk Bugt | 225 | 706 | | | 587 | 706 | | 646 | 646 | 8 |
| 231 | Lillebælt Snævringen | 231,124,125,80 | 789 | | 134 | 134 | 134 | 134 | 134 | 134 | 83 |

| No. | Name | Aggregation | Average annual N-load | Chl-a (STAT) | Light (STAT) | Chl-a (MEK) | Light (MEK) | N-MAI (STAT) | N-MAI (MEK) | Avg. MAI | Avg. reduction [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 232 | Nissum Bredning | 232 | 880 | 338 | 297 | 297 | 297 | 318 | 297 | 308 | 65 |
| 233 | Kaas Bredning og Venø Bugt | 232,233 | 1,955 | | | 1,791 | 611 | | 1,201 | 1,201 | 39 |
| 234 | Løgstør Bredning | 157,158,234, 233, 236 | 6,503 | | | 1,980 | 1,980 | | 1,980 | 1,980 | 70 |
| 235 | Nibe Bredning og Langerak | 157, 158, 233, 234, 235, 236, 238 | 11,064 | | 9,962 | 4,600 | 9,849 | 9,962 | 7,225 | 8,593 | 22 |
| 236 | Thisted Bredning | 236 | 1,091 | | | 269 | 269 | | 269 | 269 | 75 |
| 238 | Halkær Bredning | 238 | 620 | | | 114 | 114 | | 114 | 114 | 82 |