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# Riverine inputs and direct discharges to Norwegian coastal waters – 2016

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Riverine Inputs and Direct Discharges to Norwegian Coastal Waters - 2016

**Summary – sammendrag**

Riverine inputs and direct discharges to Norwegian coastal waters in 2016 have been estimated in accordance with the OSPAR Commission's principles. Nutrients, metals and organic pollutants have been monitored in rivers; discharges from point sources have been estimated from industry, sewage treatment plants and fish farming; and nutrient inputs from diffuse sources have been modelled. Trends in riverine inputs have been analysed, and threshold concentration levels investigated. Rapporten presenterer resultater fra Elvetilførselsprogrammet i 2016. Næringsstoffer, metaller og organiske miljøgifter er overvåket i norske elver, mens punktutslipp er beregnet fra industri, renseanlegg og akvakultur. Tilførsler av næringsstoff fra diffuse kilder er beregnet ved hjelp av TEOTIL-modellen. Trender i tilførsler fra utvalgte elver er beskrevet. Konsentrasjoner over gitte grenseverdier er funnet for både metaller og organiske miljøgifter i enkelte elver.

**4 emneord**

Elvetilførsler, direkte tilførsler, norske kystområder, overvåking

**4 subject words**

Riverine inputs, direct discharges, Norwegian coastal waters, monitoring

**Front page photo**

River Storelva (Vegårvassdraget) during autumn flooding. Photo: Tormod Haraldstad, NIVA

# Content

# Summary

This report presents the results from the 2016 RID Programme (Riverine Inputs and Direct discharges to Norwegian coastal waters). The RID Programme is part of a joint monitoring programme under the "OSPAR Commission for the Protection of the Marine Environment of the North-East Atlantic", where the purpose is to estimate the total loads of selected pollutants to Convention waters on an annual basis. The programme also gives information on pollutant concentration levels in Norwegian rivers, and can be further used to explain pollution levels along the coast. In 2016, 47 rivers were monitored, of which 11 were sampled monthly and the remaining 36 were sampled four times. In addition, direct discharges to the sea from point sources (industry, sewage, and aquaculture) have been recorded, and inputs from unmonitored areas have been estimated or modelled.

The weather in 2016 can be characterised as warm with normal precipitation rates for the country as a whole. The total nutrient inputs to Norwegian coastal waters in 2016 were estimated to 13 271 tonnes of phosphorus, 162 647 tonnes of nitrogen, 436 698 tonnes of silicate, 505 590 tonnes of total organic carbon, and 759 011 tonnes of suspended particulate matter. Inputs of metals to the Norwegian coastal areas were estimated to 128 kg of mercury, 2 tonnes of cadmium, 23 tonnes of arsenic, 39 tonnes of lead, 35 tonnes of chromium, 238 tonnes of nickel, 576 tonnes of zinc and 1251 tonnes of copper. Annual average concentrations exceeding the national threshold values (Miljødirektoratet 2017) were found for zinc (three rivers), lead (two rivers) and nickel (one river). Some single water samples had concentrations above threshold values for zinc, copper, nickel and chromium.

In 2016 the total water discharge to the Norwegian marine areas was close to the average for the period 1990-2015, and the loads of contaminants were, in general, close to the average level. Statistical trend analyses of data for nine rivers for the period 1990-2016 showed that four of the five Skagerrak rivers had a statistically significant increase in water discharge. This increase in water discharge is probably part of the explanation for the increase in nitrogen and phosphorus loads from some of these rivers. Metal loads from Norwegian rivers have mainly been reduced between 1990 and 2016. However, when examining the last 10 year-period a significant upward trend was found for concentrations of nickel in River Vefsna and zinc in River Glomma. In River Drammenselva there was a significant upward trend of lead loads for the last ten years. However, trend analyses of only ten years are rather uncertain. The geographical distribution of metals differ significantly; as an example, nickel loads in River Pasvikelva constituted about 60 % of the total Norwegian nickel loads to the sea in 2016.

Calculated direct discharges of nutrients and copper from fish farming have increased steadily during the last ten years. As a result, the total Norwegian inputs to the sea of these substances have increased. This is in marked difference from the other OSPAR countries draining to the Greater North Sea, where total inputs of nutrients have been reduced. For Norway as a whole the nutrient loadings from fish farming contributed to 74 % of the Tot-P inputs and about 35 % of the Tot-N inputs in 2016.

Organic contaminants have been monitored in three rivers (Glomma, Alna and Drammenselva) using a combination of passive samplers (documenting dissolved phases) and continuous flow centrifugation (documenting particle bound phases). The dissolved and particulate phases were

combined to 'whole water' concentrations, and compared with legislative thresholds of Water Framework Directive (WFD) priority pollutants. Estimates of "whole water" concentrations for fluoranthene, benzo[a]pyrene and PFOS were close to or above WFD AA-EQS (annual average environmental quality standards) for most rivers in 2016. The estimate of "whole water" concentrations for PFOS in River Alna was clearly above EQS. Concentrations of PFOS in rivers Drammenselva and Glomma also approached the WFD AA-EQS value of 0.65 ng/l in 2016.

The estimation of riverine loads of contaminants to the sea in 2016 showed that for most organic chemicals studied, the load from River Alna was highest when given per $km^2$ of drainage area. This is in agreement with estimates from the period 2013-2015. Area specific loads for Rivers Drammenselva and Glomma were generally similar to each other.

Four years of sensor testing (turbidity, conductivity, pH) have shown that sensor data in general correlated well with grab samples data, and the sensors can serve as 'proxies' for other substances with high environmental impact. The unique possibility of close to continuous monitoring of parameters provides improved insights into transport processes of water, particles and contaminants in rivers. The sets of continuous data are also useful for estimating the uncertainty connected to grab sampling. They also provide the possibility to detect shorter periods of high/low concentrations/values that can be harmful for the biota, which are not discovered through normal grab sampling. High-frequency monitoring can also better document effects of weather events, such as extreme episodes that would not otherwise have been monitored. Hence, despite the fact that sensors need calibration and require frequent maintenance and cleansing, the data from sensors are regarded as highly useful.

# Sammendrag

Elvetilførselsprogrammet er en del av Norges oppfølging av OSPAR-konvensjonen (www.ospar.org), og har pågått siden 1990. I 2016 ble 47 elver overvåket, hvorav 11 med månedlig prøvetaking og 36 kvartalsvis. Utslipp fra punktkilder som industri, renseanlegg og akvakultur inngår også i beregningene. Næringsstoffer som tilføres fra diffuse kilder i umålte felt modelleres. I Norge beregnes utslipp til de fire havområdene Skagerrak, Nordsjøen, Norskehavet og Lofoten/Barentshavet.

Nedbøren i 2016 var nær normalen, mens temperaturen lå høyere enn normalt. Totale tilførsler av næringsstoffer og partikler fra Norge til kystområdene i 2016 omfattet 13 271 tonn fosfor, 162 647 tonn nitrogen, 436 698 tonn silikat, 505 590 tonn totalt organisk karbon, og 759 011 tonn suspendert partikulært stoff. Metalltilførslene til kystområdene utgjorde 128 kg kvikksølv, 2 tonn kadmium, 23 tonn arsen, 39 tonn bly, 35 tonn krom, 238 tonn nikkel, 576 tonn sink og 1251 tonn kobber. Metallkonsentrasjoner ble vurdert mot grenseverdier, og dette året ble det funnet forhøyede gjennomsnittlige konsentrasjoner av sink i Orkla, Figgjo og Sauda, bly i Drammenselva og Figgjo, og nikkel i Pasvikelva. Det ble også funnet for høye grenseverdier i enkeltprøver: Sink i Glomma, Alna, Drammenselva, Orreelva, Tista, Figgjo og Sauda; kobber i Skienselva, samt kobber, sink og krom i Orkla.

Langtidsserien fra 1990 viser at tilførsler av næringsstoff har økt i enkelte elver som drenerer til Skagerrak. Dette gjelder Glomma (nitrogen), samt Drammenselva og Numedalslågen (nitrogen og fosfor). Noe av denne økningen kan forklares med økt vannføring, og dette kan bety at klimaendringer med mer nedbør og avrenning kan gi en økning i næringsstoff i elvene, noe som forsterker behovet for avbøtende tiltak. Samtidig har det blitt mindre nitrogen- og fosfortilførsler til kystområdene fra Vefsna. Ammoniumtilførslene har gått ned i mange vassdrag, trolig som følge av avløpstiltak. Tilførsler av tungmetaller har stort sett gått ned i hele landet, men de siste ti årene har det vært en økning i konsentrasjoner av nikkel i Vefsna og sink i Glomma; og tilførsler av bly fra Drammenselva. Trendanalyser fra kun ti år er imidlertid noe usikre. Det er stor geografisk variasjon i tilførslene, for eksempel utgjorde nikkeltilførslene i Pasvikelva omlag 60% av totale tilførsler fra Norge i 2016.

Det har vært en jevn stigning i beregnede tilførsler av næringsstoffer og kobber fra fiskeoppdrett det siste tiåret, og dette har medført at totale norske utslipp av disse stoffene har økt. Dette er i sterk kontrast til andre OSPAR-land som har tilførsler til Nord-Atlanteren, hvor særlig fosfortilførslene har gått ned. Akvakultur stod for 74% av totalfosfor og 35 % av total nitrogen tilført til norske kystområder i 2016.

Nye målemetoder for organiske miljøgifter (passive prøvetakere for løst fraksjon og sentrifuger for partikkelbundet fraksjon) er blitt testet ut i Glomma, Alna og Drammenselva siden 2013. Løst og partikulær fase er blitt kombinert til total konsentrasjon, og sammenlignet med Vanndirektivets grenseverdier for prioriterte stoffer. I 2016 var konsentrasjoner av fluoranthen, benzo[a]pyrene og PFOS nær eller over Vanndirektivets AA-EQS-grenser (årlige gjennomsnitt for miljøkvalitetsstandarder) i de fleste elvene. Totalestimatet (løst og partikulært) for PFOS i Alna var klart over miljøstandarden. Konsentrasjoner av PFOS i Drammenselva og Glomma var også nær miljøstandarden på 0,65 ng/l i 2016. Arealspesifikke tilførsler av miljøgifter er høyest i Alna. I Glomma og Drammenselva er de arealspesifikke tilførslene relativt like. Det er ingen vesentlige endringer i dette mønsteret, sammenlignet med foregående år (2013-2015).

Uttesting av metodikken har vist at den er i stand til å oppdage adskillig lavere konsentrasjoner av miljøgifter enn konvensjonelle metoder med stikkprøver.

Siden 2013 er det målt turbiditet, ledningsevne, pH og temperatur med sensor i Alna, Glomma og Drammenselva. Erfaringsoppsummeringen av dette viser at sensordata stort sett korrelerer bra med stikkprøvedata. Sensordata kan også brukes som erstatning for andre parametre, og de nesten kontinuerlige målingene gir en unik mulighet for å øke kunnskapen om transportprosesser (vannløselig og partikkelbundet forurensning) i elver. Ved å bruke sensordata kan man oppdage kortvarige episoder av spesielt høye eller lave konsentrasjoner av miljøfarlige stoffer, som stikkprøver neppe ville ha dekket. Data med høy tidsoppløsning kan også bidra til bedre å forstå virkninger av klimaendringer, ved at respons av forurensingskonsentrasjoner og/eller -transport på episoder med f.eks. høy/lav vannføring blir dokumentert. Selv om sensorer trenger kalibrering med stikkprøver og hyppig vedlikehold/rens, er derfor fordelene mange.

Det er utarbeidet et norsk faktaark om programmets resultater i 2016.

# 1. Introduction

## 1.1 The OSPAR RID Programme

The Riverine Inputs and Direct Discharges to Norwegian coastal waters (RID) is carried out as part of the Norwegian obligations under the OSPAR Convention. This Convention is the current legal instrument guiding international cooperation on the protection of the marine environment of the North-East Atlantic, and has some overlap with the Marine Strategy Framework Directive.

Work under the Convention is managed by the OSPAR Commission, made up of representatives of the Governments of 15 Contracting Parties and the European Commission, representing the European Union. The general principles of the RID Programme are posted at http://www.ospar.org/documents?d=33689, the main objectives are listed in Appendix I.

The programme has been on-going since 1990 and reports loads to the sea of nutrients, metals and organic contaminants. Contracting parties comprise all European countries bordering the North Atlantic Sea, as well as the EU. The RID Programme, together with the programmes for monitoring of air (Comprehensive Atmospheric Monitoring Programme – CAMP) and marine environments (Co-ordinated Environmental Monitoring Programme – CEMP) are all parts of OSPAR's Joint Assessment and Monitoring Programme (JAMP).

The Norwegian mainland drains to four marine OSPAR regions (Figure 1):

| | |
|---|---|
| I. Skagerrak: | From the Swedish border westwards to Lindesnes (the southernmost point of Norway), at about 57°44'N |
| II. North Sea: | From Lindesnes northwards to Stadt (62° N) |
| III. Norwegian Sea: | From Stadt northwards to Lofoten and Vesterålen (68°15'N) |
| IV. Barents Sea: | From 68°15'N (including Lofoten and Vesterålen) to the Russian Border in the north-east. |

Note that the definition of the border between the Norwegian Sea and the Barents Sea was changed in 2014 to correspond with the national reporting for marine areas. In former years the border was drawn at 70°30'N, which is the county border between Troms and Finnmark.

## 1.2 The Norwegian RID Programme in 2016

In Norway, the RID programme is carried out through a combination of monitoring and modelling. The Norwegian Environment Agency (NEA) has commissioned the Norwegian Institute for Water Research (NIVA), the Norwegian Institute for Bioeconomy Research (NIBIO), and the Norwegian Water Resources and Energy Directorate (NVE) to carry out the work. Information on personnel and sub-contractors is given in Appendix II.

A subset of Norwegian rivers has been selected for monitoring to fulfil the RID requirements (Table 1). In 2016, 11 rivers were monitored monthly or more often; and 36 rivers were monitored quarterly. The locations of the sampling sites are shown in Figure 2. More information on the catchments of the monitored rivers is given in Appendix III. In the period 1990-2003, 109 rivers were monitored once a year. One of these, River Alna, has been monitored monthly since 2013. The total drainage area of the 11+36 monitored rivers is about 180 000 km2, which constitutes about 50% of the total Norwegian land area draining into the convention seas.

***Table 1. The Norwegian RID monitoring programme.***

| Type of river | Number of rivers |
|---|---|
| Rivers monitored at least monthly in 2016 | 11 |
| Rivers monitored quarterly since 2004, and once a year in 1990-2003 | 36 |
| Rivers monitored once a year in 1990-2003; estimated from 2004 onwards | 108 |

The total load of constituents to the sea has been calculated by combining the monitored data with estimated and modelled results. In addition, direct discharges reported from sewage treatment plants, industry and fish farming are registered and included in the calculations. The total inputs are divided into inputs from rivers, unmonitored areas and direct discharges. For the data interpretation it is important to understand the difference between these terms. For example, the term “direct discharges” to the sea also covers effluents from point sources upstream in the unmonitored areas. Table 2 and Figure 3 have been provided to clarify some important terms within the RID Programme.

To fulfil the requirements of OSPAR, the following parameters were monitored in 2016:

- six fractions of nutrients (total phosphorus, orthophosphate, total nitrogen, ammonium, nitrate and silicate);
- nine heavy metals (copper, zinc, cadmium, lead, chromium, nickel, mercury, silver, and arsenic);
- five other parameters (suspended particulate matter, turbidity, pH, conductivity, and total organic carbon).

In addition, Norway monitored the following parameters in 2016 (not used to calculate total loads to the sea):

- Organic contaminants in rivers Glomma, Alna and Drammenselva, in both dissolved and particulate phases.
- Turbidity, conductivity, pH and temperature using automatic sensors in rivers Glomma, Alna and Drammenselva.
- Water temperature in all rivers, using several methods.

Details on changes in the RID monitoring programme throughout the years since 1990 are given in Appendix IV.

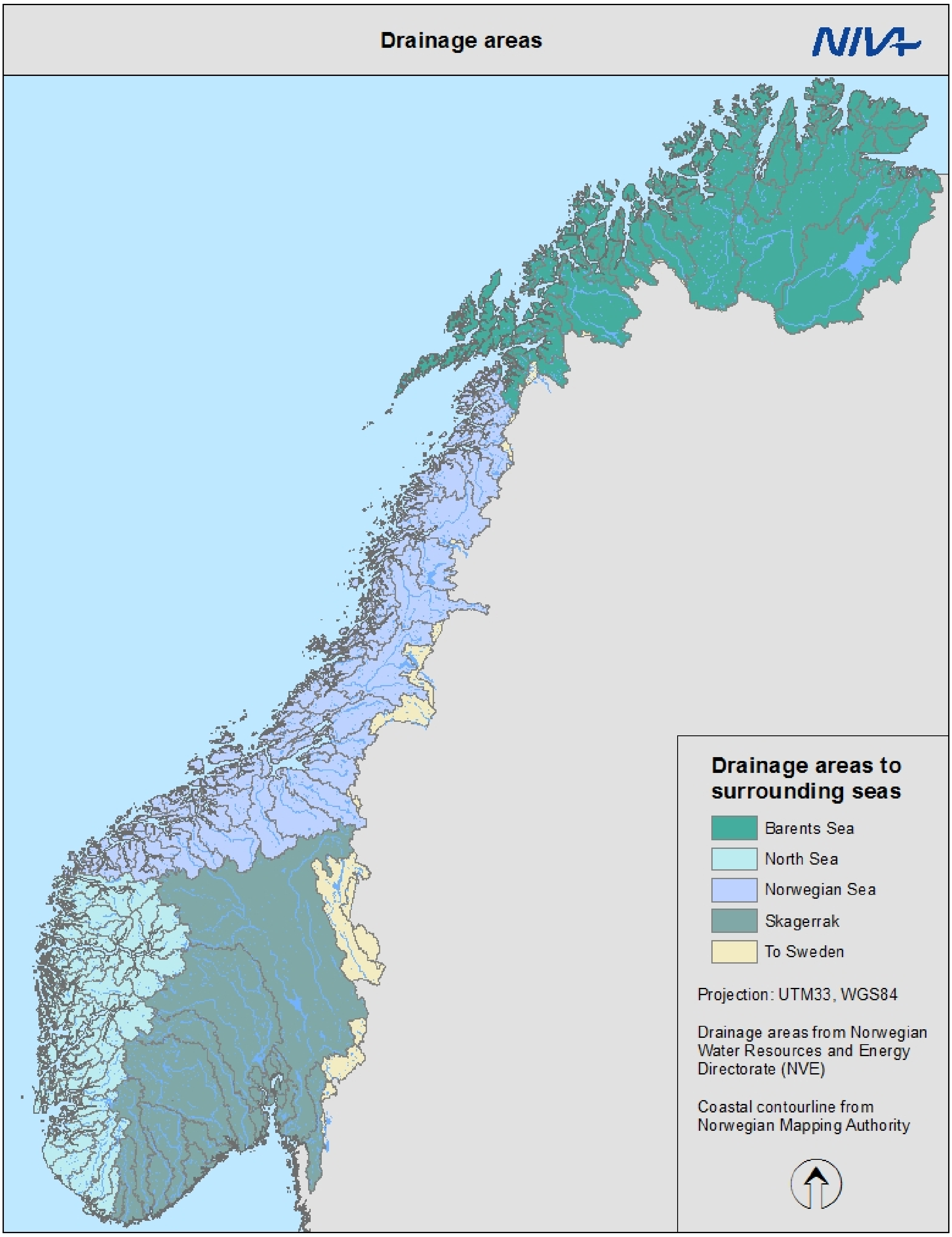


*Figure 1. Norway is divided into four drainage areas, which drain into the Skagerrak, the North Sea, the Norwegian Sea and the Barents Sea. Minor parts of Norway drain to Sweden.*

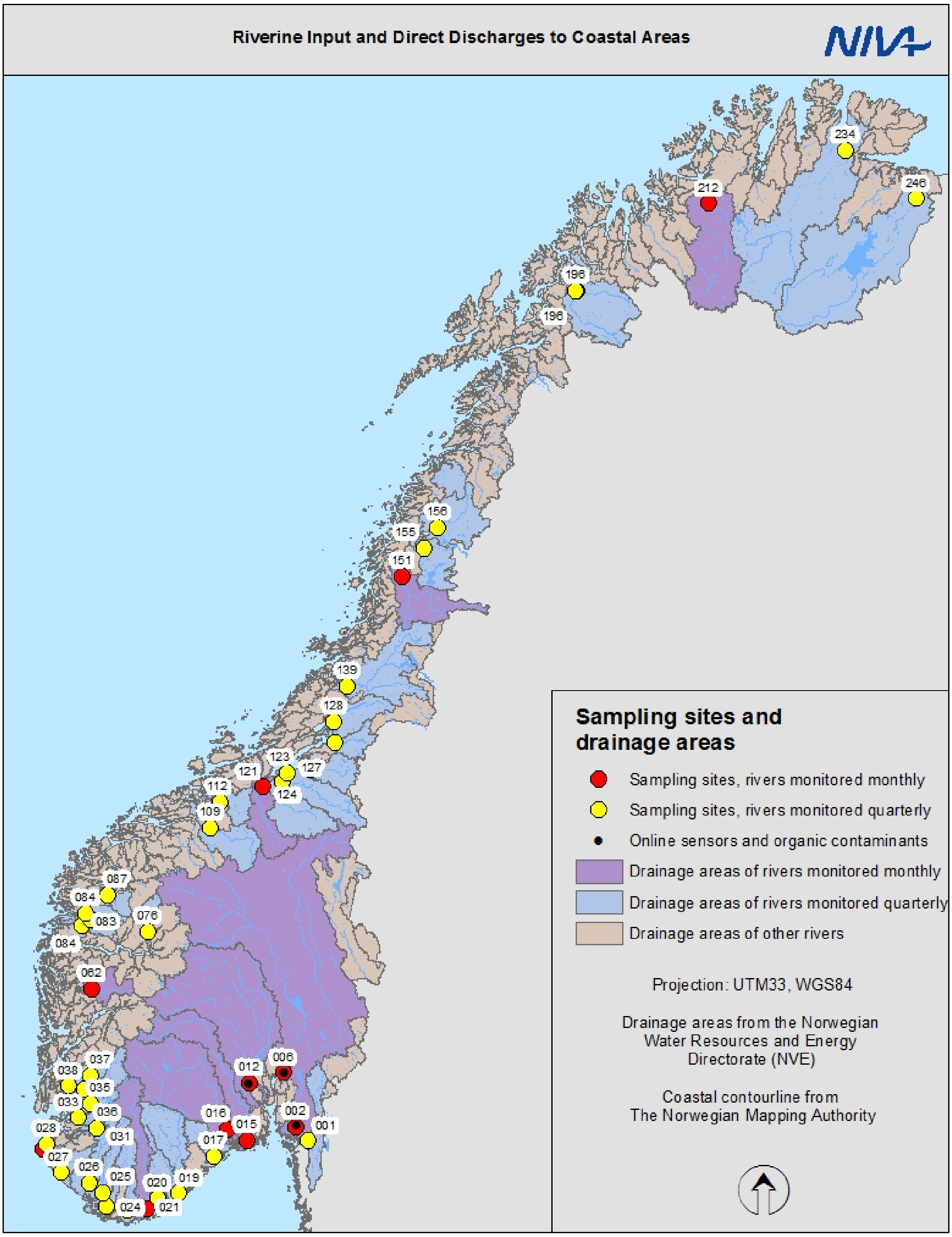


*Figure 2. River sampling sites in the Norwegian RID programme. The numbers refer to the national river basin register (REGINE; www.nve.no). The river basin register system classifies the Norwegian river basins into 262 main catchment areas, of which 247 drain to coastal areas.*

**Table 2. Definitions of the main constituent 'sources' and the main methodology associated.**

| Name | Definition | Comments |
|---|---|---|
| Monitored area | Area upstream the sampling points of the 11+36+108 rivers (cf. Table 1). | Grab sampling is presently done each year in 11 + 36 rivers. For the 108 rivers monitored once a year before 2004, an average concentration based on former years' data is used, and combined with the current year's water discharge, to calculate loads. |
| Unmonitored area | Covers the entire area that is not monitored, i.e. unmonitored river catchments, coastal areas and areas downstream of the sampling points in the 11+36+108 rivers. | In unmonitored areas, nutrient loads from diffuse runoff are estimated with the TEOTIL model. No estimates are made of loads of the other constituents. |
| Direct discharges | Reported emissions from point sources in the unmonitored areas.<br>This also includes *upstream* point sources in the unmonitored area. | For point emissions of nutrients, the TEOTIL model is used to account for retention from the source to the sea.<br>For metals it is assumed that no retention occurs. |
| Total loads | Loads calculated based on monitored areas + unmonitored areas + direct discharges. | |

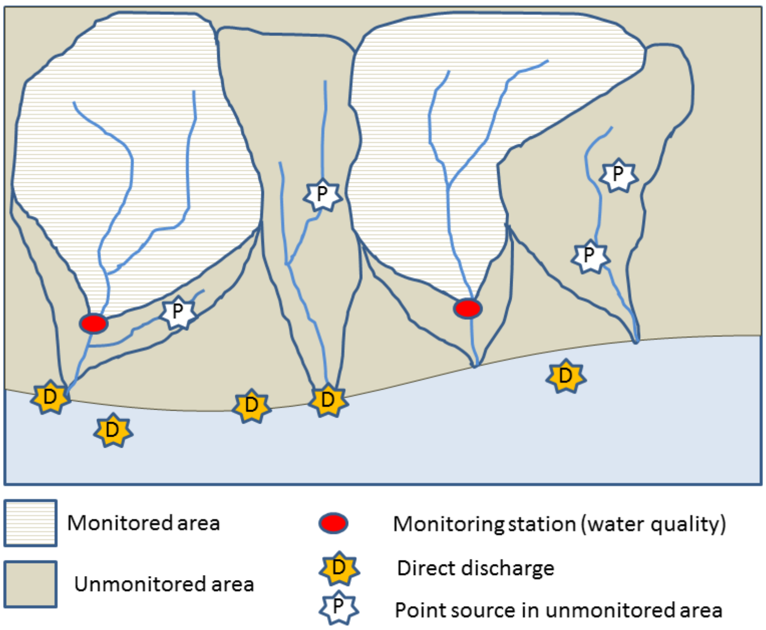


*Figure 3. Illustration of RID areas, point sources and direct discharges (source: OSPAR RID Agreement 2014.04; www.ospar.org). See also Figure 8 for the Norwegian adjustments to these principles.*

# 2. Materials and methods

## 2.1 Water discharge and hydrological modelling

For the rivers monitored monthly, daily water discharge measurements have been used for the calculation of loads. Except for River Alna, where discharge data has been provided by Oslo Water and Sewerage Works, discharge data have been provided by NVE. Since the hydrological stations are not located at the same site as the water quality stations, the water discharge at the water quality sampling sites have been calculated by up- or downscaling, proportional to the respective drainage areas.

For the remaining area, water discharge has been simulated with a spatially distributed version of the HBV-model (Beldring *et al.*, 2003). The use of this model was introduced in 2004. Appendix IV gives more information on the methodology. There have been no amendments or changes in this method since last year's reporting (Skarbøvik *et al.,* 2016).

## 2.2 River grab samples: Sampling and calculation

### 2.2.1 Sampling methodology

Sampling has been carried out in the same manner as the previous year of RID monitoring (Skarbøvik *et al.*, 2016). Monthly sampling is done in 11 rivers, although in two of the rivers (Glomma and Drammenselva), additional sampling is done during the spring to cover events of spring flooding. The quarterly sampling in 36 rivers is designed to cover four main meteorological and hydrological conditions in the Norwegian climate. These include the winter season with low temperatures, snowmelt during spring, summer low flow season, and autumn floods/high discharges. Sampling dates are shown in the Addendum's Table 1a.

### 2.2.2 Chemical parameters – detection limits and analytical methods

The parameters monitored in 2016 are listed in section 1.2. Information on methodology and levels of detection (LOD) for all parameters included in the grab sampling programme is given in Appendix IV.

When the results recorded were less than the limits of quantification (LOQ) the following estimate of the concentration has been used:

**Estimated concentration = ((100%-A) • LOQ)/100**

Where A = percentage of samples below LOQ.

This procedure is in accordance with OSPAR Agreement 2014-04 (the updated RID Principles).

According to the RID Principles (http://www.ospar.org/documents?d=33689), the analytical method should give at least 70% positive findings (i.e. no more than 30% of the samples below the detection limit). In 2016, orthophosphate, ammonium, mercury and silver did not reach this requirement (Table 3). Since the analytical methods have acceptably low detection limits, this reflects that the concentrations of these compounds are low in Norwegian river waters.

### 2.2.3 Quality assurance and direct on-line access to data

Data from the chemical analyses were transferred to a database and quality checked against historical data by researchers with long experience in assessing water quality data. If any anomalies were found, the samples were re-analysed. The data are available on-line at www.aquamonitor.no/rid, where users can view values and graphs of each of the 47 monitored rivers.

### 2.2.4 Calculating riverine loads

Estimates of annual riverine loads are done according to the formula below, which follows the recommendations in the RID Principles (OSPAR Agreement 2014:04; § 6.13 b). The method handles irregular sampling frequency and allows flood samples to be included in the annual load calculations.

$$Load = Q_r \frac{\sum_{1}^{n} Q_i \bullet C_i \bullet t_i}{\sum_{1}^{n} Q_i \bullet t_i}$$

where $Q_i$ represents the water discharge at the day of sampling (day i);
$C_i$ the concentration at day i;
$t_i$ the time period from the midpoint between day i-1 and day i to the midpoint between day i and day i+1, i.e., half the number of days between the previous and next sampling; and
$Q_r$ is the annual water volume.

For the 108[1] rivers monitored once a year in the period 1990-2003, but not from 2004 onwards, the calculation of loads was conducted as follows:

- For nutrients, suspended particulate matter, silica and total organic carbon, the modelled annual water volume in 2016 was multiplied with average concentration for the period 1990-2003.
- For metals, the modelled annual water volume in 2016 was multiplied with average concentration for the period 2000-2003 (data from earlier years were not used due to high LODs).

[1] River Alna was monitored once a year in the period 1990-2004, but is presently monitored monthly.

*Table 3. The proportion of analyses below the detection limit for all parameters included in the sampling programme in 2016. The detection limits are shown in Appendix IV.*

| Parameter | Unit | % below detection limit | Total no of samples | No of samples below detection limit |
|---|---|---|---|---|
| pH | | 0.0 | 282 | 0 |
| Conductivity | mS/m | 0.7 | 283 | 2 |
| SPM | mg/l | 8.1 | 283 | 23 |
| TOC | mg C/l | 0.0 | 283 | 0 |
| TOT-P | µg P/l | 0.0 | 283 | 0 |
| $PO_4$-P | µg P/l | 35.3 | 283 | 100 |
| TOT-N | µg N/l | 0.0 | 282 | 0 |
| $NO_3$-N | µg N/l | 1.1 | 282 | 3 |
| $NH_4$-N | µg N/l | 32.2 | 283 | 91 |
| SiO2 | mg/l | 0.0 | 283 | 0 |
| Pb | µg/l | 0.7 | 283 | 2 |
| Cd | µg/l | 17.3 | 283 | 49 |
| Cu | µg/l | 0.0 | 282 | 0 |
| Zn | µg/l | 2.5 | 283 | 7 |
| As | µg/l | 2.5 | 282 | 7 |
| Hg | ng/l | 72.8 | 283 | 206 |
| Cr | µg/l | 2.5 | 283 | 7 |
| Ni | µg/l | 0.0 | 283 | 0 |
| Ag | µg/l | 76.6 | 282 | 216 |

### 2.2.5 Statistical methodology for trends in riverine inputs

Only rivers monitored monthly are included in the statistical trend analyses, due to the lower sampling frequency for the remaining monitored rivers. The results presented this year focus on the actual riverine loads, without correction for water discharge.

Both the seasonal Mann-Kendall-test (Hirsch and Slack, 1984) and the partial Mann-Kendall test (Libiseller and Grimvall, 2002) have been used to test for long-term monotonic trends (including linear trends) in annual riverine inputs and monthly concentrations measured in nine of the ten main rivers. The latter method has its methodological basis in the seasonal Mann-Kendall-test with the difference that explanatory variables can be included. In this report, the seasonal Mann-Kendall trends are presented, but partial Mann-Kendall tests have also been done using water discharge as explanatory variable, in order to assess the reasons for the trends. This test also includes a correction for serial correlation up to a user-defined time span; in our case a span of one year. The method also offers convenient handling of missing values.

For the sake of visualisation we also applied a trend-smoother (and corresponding 95% confidence limits) on a selected number of river and substances with statistical significant trends. This method uses cross-validation to obtain the optimal statistical compromise between good fit and a smooth function. Confidence intervals for the fitted values are computed using residual resampling (bootstrap). New datasets (bootstrap samples) are generated by adding error terms drawn by sampling with replacement from the observed model residuals. The method is described in detail in Grimvall et al (2008).

The trends were regarded as statistically significant at the 5%-level (double-sided test), and trend slopes were computed according to Sen (1968).

In addition to the formal statistical test, a visual inspection of all the time series was performed (cf. graphs in Appendix V).

Apart from the long-term trends, we also report on trends observed in the data for the last ten years (2007-2016), where those differ substantially from the long-term trends. The statistical power of the applied analysis decreases when applied on shorter time-series, but the analysis may give information on recent changes.

Chemical variables analysed for trends include ammonium nitrogen ($NH_4$-N), nitrate nitrogen ($NO_3$-N), total nitrogen (TN), orthophosphate ($PO_4$-P), total phosphorus (TP), suspended particulate matter (SPM), cadmium (Cd), copper (Cu), lead (Pb), zinc (Zn), and nickel (Ni). Analyses were also performed for mercury (Hg), but the analysis of Hg is affected by great analytical uncertainty, with a different analytical method used from 1999 to 2003 (Weideborg *et al.*, 2004). The same holds true for arsenic (As).

Some methodological challenges when assessing the trends include:

- River Alta was sampled less than 12 times a year during the period 1990-1998.
- Some rivers have had more frequent sampling during floods in some years (e.g., rivers Glomma and Drammenselva in 1995)
- All samples from 1990 to 1998, and from 2004 to date, were analysed by the same laboratory, but samples in the period 1999-2003 were analysed by a different laboratory. These changes in laboratory involved changes in methods and detection/quantification limits for some substances.
- Some data were excluded from the dataset prior to the trend analyses; a detailed overview of excluded data is given in Skarbøvik *et al.* (2010). Examples are total phosphorus and mercury data 1999-2003, based on the change in laboratory mentioned above (see also Stålnacke *et al.,* 2009).
- Many concentrations were below LOQ-values, especially for metals. This is partly a result of relatively low contamination levels in Norwegian rivers, and partly because of analytical techniques in the early years of the RID-Programme with high LOQs. Many below-LOQ values were reported in the period 1990-2003, with a general increase in frequency of below-LOQ values for some metals, SPM and total phosphorus during the period 1999-2003 (change in laboratory and therefore higher LOQs). However, this problem was reduced after 2003, due to improvements in analytical techniques.

# 2.3 Unmonitored areas

For the unmonitored areas, nutrient and metal loads are treated as follows:

For nutrients, only loads originating from diffuse sources are reported from unmonitored areas. The nutrient loads from point sources in the unmonitored areas are reported as part of the direct discharges (see Chapter 2.4). Nutrient loads are calculated by means of the TEOTIL model (e.g. Tjomsland and Bratli, 1996; Bakken *et al.,* 2006; Hindar and Tjomsland, 2007). The model has been utilised for pollution load compilations of nitrogen and phosphorus in catchments or groups of catchments. The model estimates annual loads of phosphorus and nitrogen from point and diffuse sources. The point source estimates are based on national statistical information on sewage, industrial effluents, and aquaculture (see Chapter 2.4). Nutrient loads from diffuse sources (agricultural land and natural runoff from forest and mountain areas) are modelled by a coefficient approach (Selvik *et al.*, 2007). Area specific export coefficients for nutrients have been estimated for agricultural land in different geographical regions. The coefficients are based on empirical data from agricultural monitoring fields in Norway and are adjusted annually by NIBIO based on reported changes in agricultural practice (national statistics). For forest and mountain areas, concentration coefficients for different area types and geographical regions have been estimated based on monitoring data from reference sites. The annual loads from natural runoff vary from year to year depending on precipitation and discharge. The model adjusts for retention in lakes between the source and the sea. The inorganic fractions of phosphorus and nitrogen are estimated using different factors for the different sources.

For metals, no relevant model is available to estimate loads from diffuse sources. This means that the contribution of metals from diffuse sources in unmonitored areas has been set to zero in the RID estimates. However, point source discharges of these substances in the unmonitored areas are included in the estimates of the direct discharges to the sea (see Chapter 2.4).

Organic contaminant loads are not estimated from unmonitored areas. Such loads are currently only estimated based on novel monitoring techniques from the three rivers Glomma, Alna and Drammenselva.

# 2.4 Direct discharges

The direct discharges calculated in this programme comprise effluents from point sources in the unmonitored areas and effluents directly to the sea. Thus, the Norwegian RID Programme includes inland point sources under the RID term "direct discharges to the sea". This practice has been followed for all years of the RID Programme and is kept as before, in order to avoid major changes in the data series.

The discharges of nutrients from point sources in unmonitored areas are each year estimated using the TEOTIL model, as explained in Chapter 2.3. It should be noted that for metal releases that are not a direct discharge to the sea, retention is not accounted for. Organic contaminants are not included in the estimates, as the number of point sources and compounds reported is low, and thus not representative for calculating regional and national discharges. Sediment discharges may be under-reported from several types of direct sources.

The estimates are based on national statistical information, including:

- Sewage: Municipal wastewater and scattered dwellings (Statistics Norway - SSB / the KOSTRA Database);
- Industry: the database "Forurensning" from NEA;
- Aquaculture: Nutrients (from the Directorate of Fisheries / the ALTINN-database (altinn.no)) and copper (based on sales statistics of antifouling products made available by NEA).

The details on how these data were extracted are given in Appendix IV. The location of the reporting units of point source pollution is shown in Figures 4 (industry), 5 (sewage treatment plants), and 6 (fish farming).

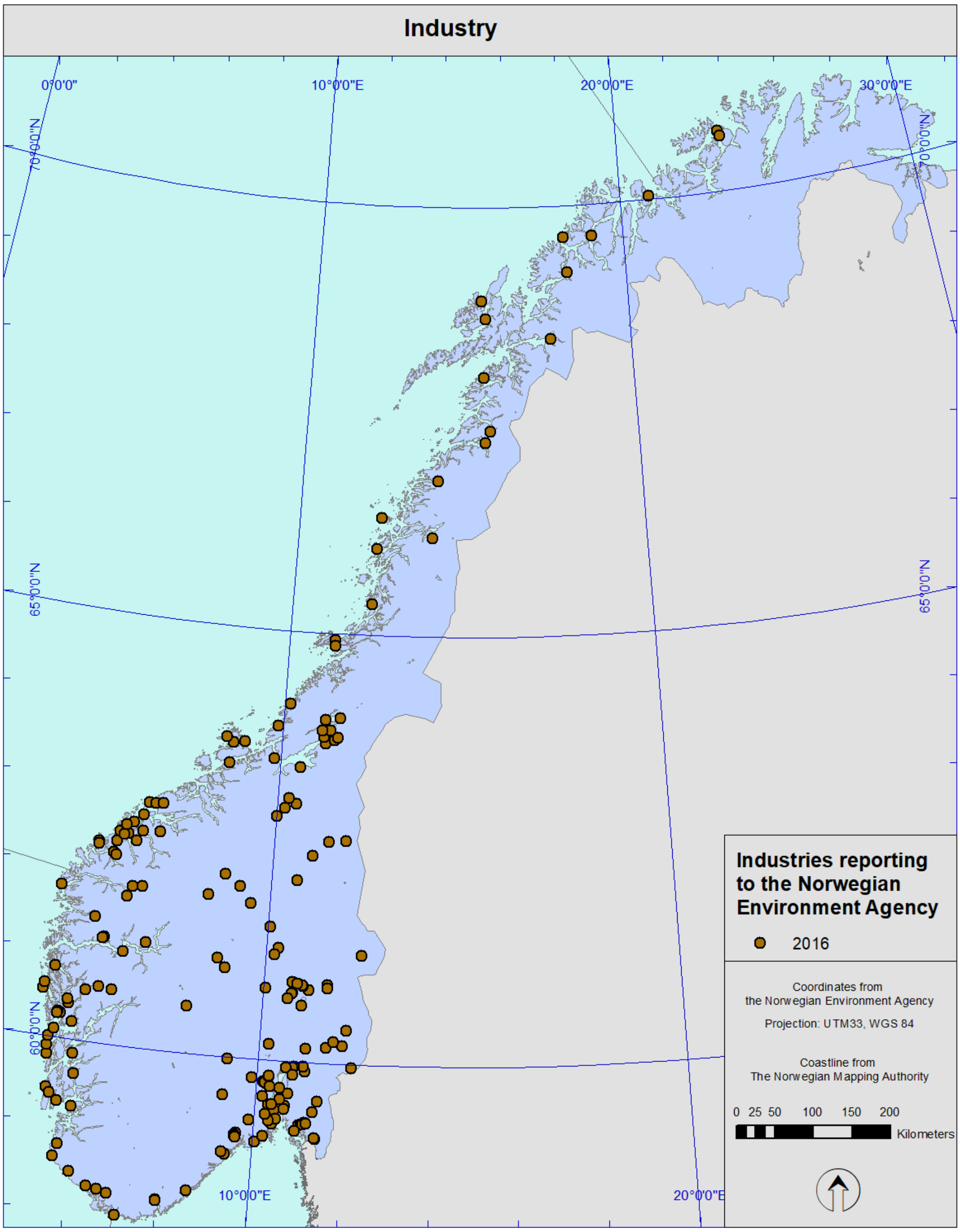


*Figure 4. Industrial units reporting discharges of nitrogen and phosphorus in 2016. Data from the database 'Forurensning' (Norwegian Environment Agency).*

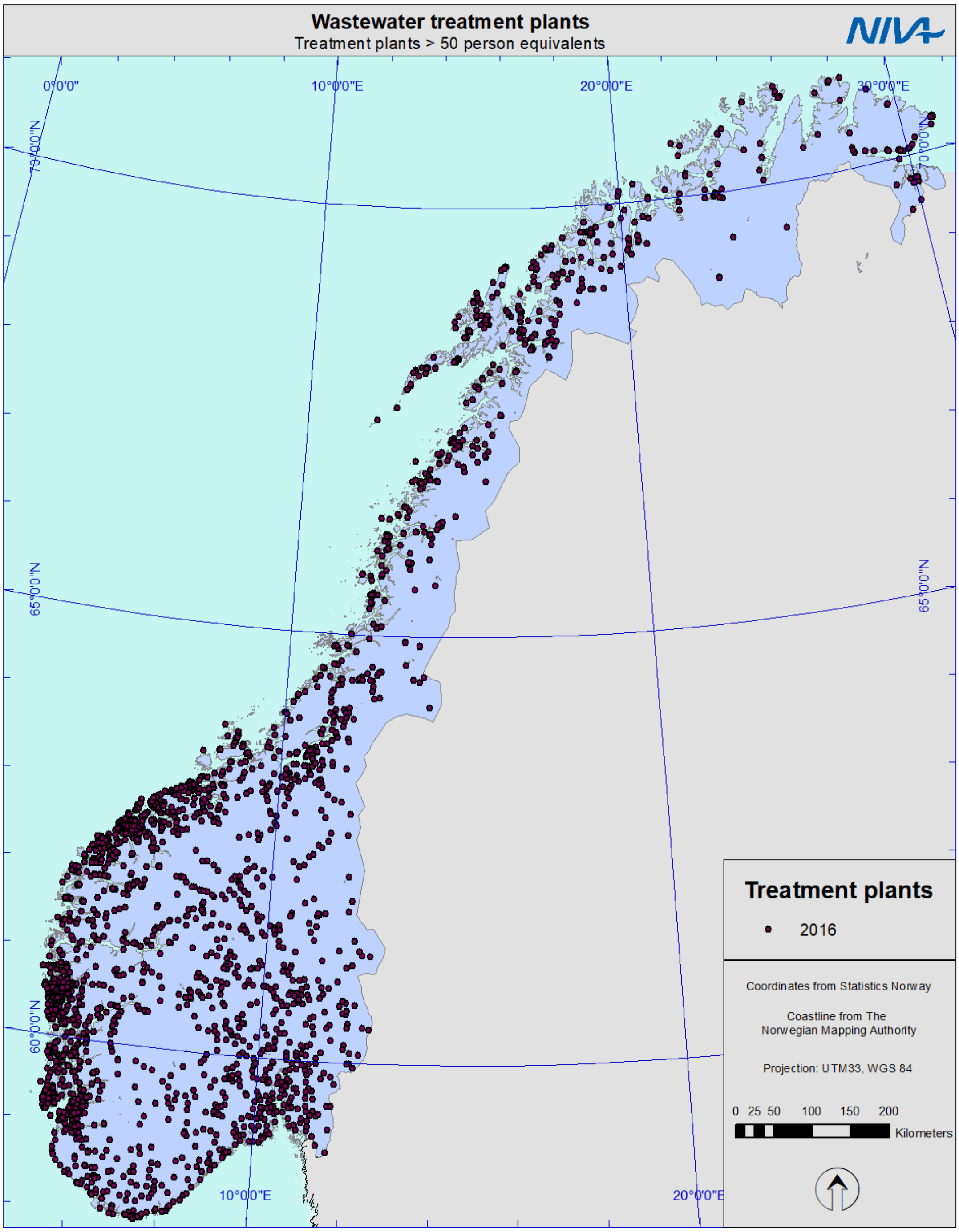


*Figure 5. Sewage treatment plants > 50 p.e. in Norway in 2016. Data from SSB (Statistics Norway).*

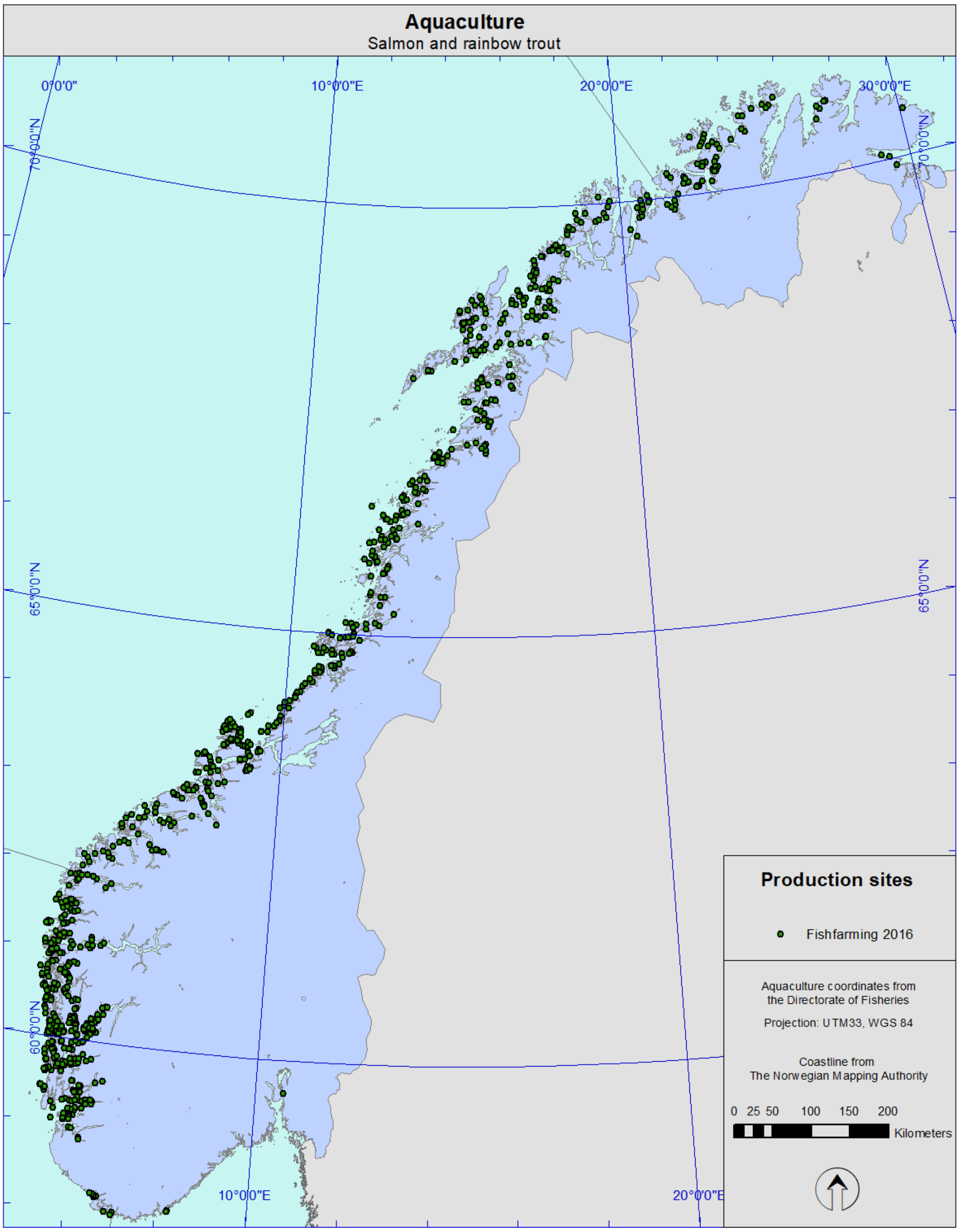


*Figure 6. Fish farms for salmon and trout in Norway in 2016. Based on data from the Directorate of Fisheries.*

Estimation of nutrient inputs from fish farming followed the same procedure as in recent years. The loads from fish farming were first included in the grand total values in 2000, i.e. originally these loads were not included in the input figures for the period 1990-1999. However, in the recalculation project in 2007, a time series for nitrogen, phosphorus and copper from aquaculture was established, and covered the entire period from 1990 to 2007 (Stålnacke *et al.*, 2009). In 2011, another adjustment was made, since the nutrient content in fish fodder has been reduced over the years. In 2011, a table showing changes in nutrient content over the period 2000-2010 was established, in cooperation with NEA (see Skarbøvik *et al.*, 2011). As a result, nutrient loads were adjusted from the year 2000 onwards.

The sales statistics from SSB with regard to trout and salmon show that there has been a steady increase from 1995 to 2012 (Figure 7). The amount of sold salmon and rainbow trout in 2016 was 4% lower than 2015 and similar to 2014 amounts.

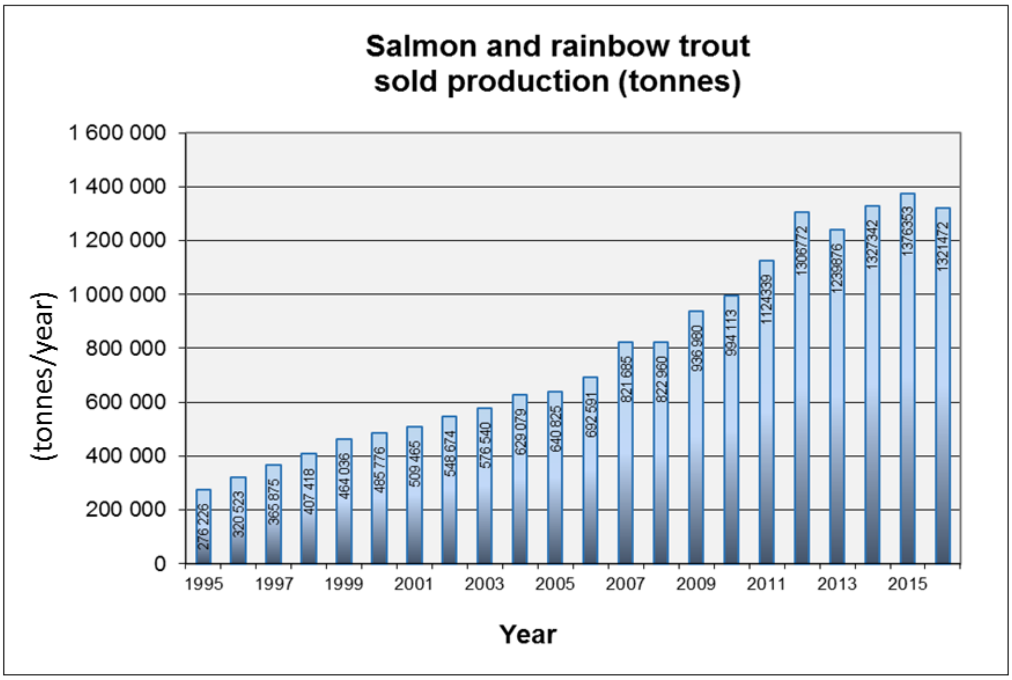


*Figure 7. Quantities of sold trout and salmon for the period 1995-2016 (tonnes/year). Based on data from SSB (Statistics Norway).*

In terms of copper loads from fish farming, the quantification of discharges is based on sales statistics for a number of antifouling products in regular use. NEA assumes that 85% of the copper is lost to the environment. The quantity used per fish farm is not included in official statistics, but for the RID Programme, a theoretical distribution proportional to the fish production has been used.

## 2.5 Calculating total loads to the sea

The information in the above sections (2.1-2.4) has been used to calculate the total loads to the four marine OSPAR areas, i.e., the Skagerrak, the North Sea, the Norwegian Sea and the Barents Sea. Table 2 in the introduction describes this, and Figure 8 shows an overview of how the total loads are calculated.

The deviations from the recommended procedures in the RID Programme (cf. Figure 3) are that point sources in unmonitored areas are included in the direct discharges, and not as inputs from unmonitored areas. As noted above, this deviation has always been a part of the Norwegian RID

Programme and it is not recommended to change this now, as it would mean an unfortunate shift in the datasets.

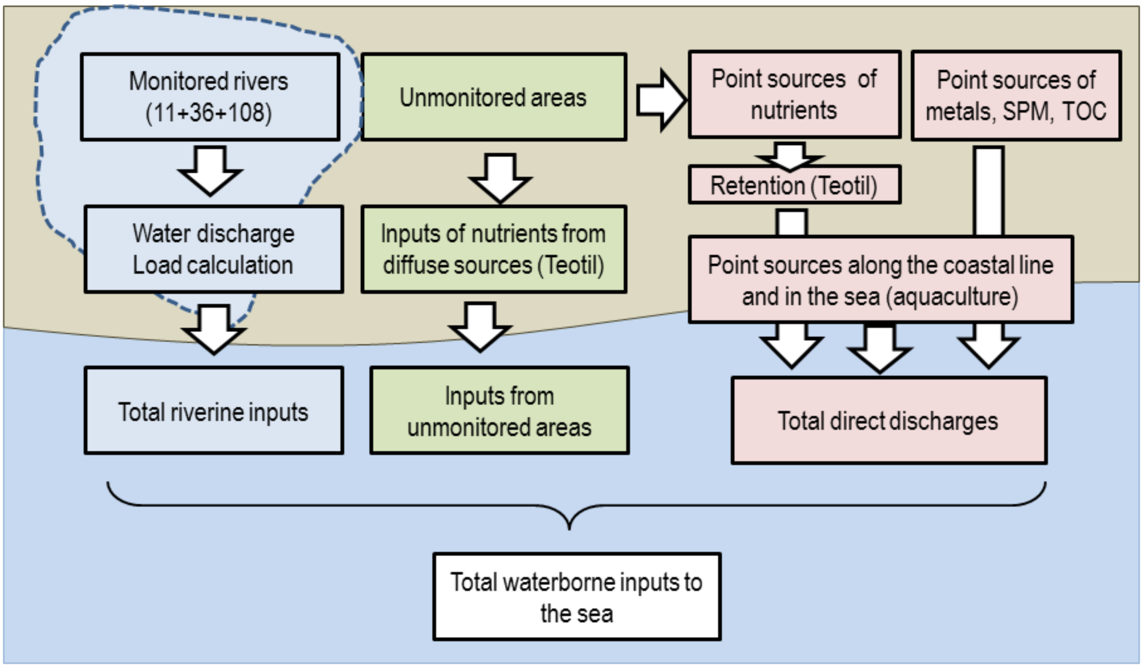


*Figure 8. Overview of how total waterborne inputs to the Norwegian marine areas are calculated. See also Figure 3.*

# 2.6 Organic contaminants: Sampling and calculation

Organic contaminants were monitored in Rivers Alna, Glomma and Drammenselva. The monitored contaminants in 2016 included polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), hexabromocyclododecane (HBCDD), per- and polyfluorinated alkylated substances (PFAS), bisphenol A (BPA), tetrabromobisphenol A (TBBPA) and short/medium chain chlorinated paraffins (S/MCCPs). In 2016, BDE209 was measured only in suspended particulate matter (SPM).

## 2.6.1 Sampling methodology

Hydrophobic organic contaminants present in river water are typically distributed between the freely dissolved phase, the particulate organic matter (POM) phase and the dissolved organic matter (DOM) phase (Warren et al., 2003). The relative proportion of contaminants associated with the POM and DOM, respectively, depends on the type and amount of POM and DOM. In this programme, organic contaminants are monitored using two different techniques:

i. *passive sampling*, for sampling of freely dissolved contaminants, and
ii. *continuous flow centrifugation* (CFC), for sampling of SPM-associated contaminants.
iii. Grab water samples for PFAS (including PFOS)

**Passive samplers**

Freely dissolved concentrations of hydrophobic and non-ionised contaminants were estimated from AlteSil™ silicone rubber *passive samplers* deployed *in situ* for periods of weeks to months (details in Table 4). Passive sampling devices accumulate contaminants from the medium they are exposed to by diffusion. The concentration of contaminants in the medium being sampled can be estimated from the masses of chemicals found in the samplers after exposure if sampler-water exchange kinetics are known. The dissipation of performance reference compounds (PRCs, labelled analogues of substances of interest, e.g. deuterated PAHs) spiked in the samplers before exposure allows the estimation of deployment-specific sampling rates ($R_s$, equivalent volume of water cleared by the sampler per unit of time, i.e. expressed in L/d).

A single batch of AlteSil™ silicone rubber (1000 $cm^2$ nominal sampling surface) passive samplers was prepared for 2016. The silicone was initially cleaned with a Soxhlet extractor to remove oligomers from the silicone. Further cleaning was done by soaking in methanol. PRCs were loaded into the samplers using a methanol:water solution (Booij et al., 2002). Samplers were then kept frozen until use. For each sampling period, two samplers were deployed at each site. Rivers Alna, Drammenselva and Glomma were all continuously monitored with passive samplers in 2016 (Table 4).

***Table 4. Exposure periods for silicone rubber passive samplers in 2016.***

| | Alna | Drammenselva | Glomma |
|---|---|---|---|
| Sampling period 9 | 83 d (05.02.16-28.04.16) | 69 d (12.02.16-21.04.16) | 62 d (26.02.16-28.04.16) |
| Sampling period 10 | 42 d (28.04.16-09.06.16) | 50d (21.04.16-10.06.16) | 42 d (28.04.16-09.06.16) |
| Sampling period 11 | Lost (09.06.16-12.10.16) | 118 d (10.06.16-06.10.16) | 119 d (09.06.16-05.10.16) |
| Sampling period 12 | 61 d (12.10.16-12.12.16) | 71 d (06.10.16-16.12.16) | 68 d (05.10.16-12.12.16) |

**Continuous flow centrifugation**

SPM-associated contaminants were sampled using a *continuous flow centrifugation* (CFC. Deployment of the CFC at secures sites (with electrical power supply) near the rivers allowed the continuous collection of SPM for periods of 4-10 days (Table 5). The SPM samples collected (5-50 g dry weight on average) were then extracted and analysed for the contaminants of interest (and particulate organic carbon content). More details of sampling with CFC can be found in earlier reports (Allan et al., 2011; Allan et al., 2009; Allan et al., 2010). The need for a secure site with electrical power supply for the CFC sampling means that the sampling sites in Rivers Glomma and Drammenselva were not identical to the ones for the grab samples, but slightly upstream. The same sampling sites as for the CFC sampling were used for the passive samplers (and for the sensor monitoring, cf. section 2.8).

*Table 5. Deployment periods for 2016 for the continuous flow centrifuge*

| | Alna | Drammenselva | Glomma |
|---|---|---|---|
| Sampling event 1 | 4 d (05.02.16-09.02.16) | 10 d (12.02.16-22.02.16) | 8 d (21.01.16-28.01.16) |
| Sampling event 2 | 6 d (22.04.16-28.04.16) | 7 d (21.04.16-28.04.16) | 6 d (22.04.16-28.04.16) |
| Sampling event 3 | 7 d (02.06.16-09.06.16) | 7 d (03.06.16-10.06.16) | 4 d (06.06.16-09.06.16) |
| Sampling event 4 | 7 d (05.10.16-12.10.16) | 7 d (06.10.16-13.10.16) | 8 d (28.09.16-05.10.16) |

**Grab water samples**

Four spot water samples were collected in 2016 for the analysis of perfluoro chemicals. For River Alna, samples were collected on the 10.02.2016, 28.04.2016, 09.06.2016, and 05.10.2016. For River Drammen, samples were collected on the 12.02.2016, 21.04.2016, 10.06.2016 and 06.10.2016. For River Glomma, samples were collected on the 28.01.2016, 28.04.2016, 09.06.2016 and 05.10.2016.

### 2.6.2 Chemical parameters and analytical methods

Silicone rubber passive samplers (field exposed samplers, control samplers and spiked samplers) were extracted and analysed at NIVA for performance reference compounds (deuterated PAHs and fluorinated PCBs), for PAHs, PCBs, PBDEs and HBCDD. BPA and S/MCCPs concentrations cannot be estimated from passive sampling because sampler-water partition coefficients are not available and sampling rate estimations for these substances would be uncertain. At the moment, passive sampling technology cannot be used reliably for the measurement of compounds such as TBBPA and PFASs.

Silicone rubber samplers were extracted using analytical-grade *n*-pentane. The volume of the sample was reduced to 1 ml and split into different fractions for further sample clean-up prior to analyses. Size-exclusion chromatography was used to clean-up extracts before PAH and PCB analysis by gas chromatography-mass spectrometry (GC-MS). Extracts for PBDE analysis were cleaned up with concentrated sulphuric acid and acetonitrile partitioning before GC-MS analysis in negative chemical ionization mode. Analysis for HBCDD isomers was by liquid chromatography Mass spectrometry (LC-MS).

SPM samples were analysed for PAHs, PCBs, PBDEs, and HBCDD at NIVA. Freeze-dried SPM samples were extracted (for PAHs, PCBs, PBDEs and HBCDD) using an ASE 200 accelerated solvent extractor using a mixture of dichloromethane and cyclohexane (50:50). Samples were extracted three times at 100 °C and 2000 PSI. For PFCs, samples were extracted twice with 90% acetonitrile. Combined extracts were diluted with LC mobile phase and analysed by LC-MS. The last sampling event for PFCs was based on bottle sampling rather than using SPM.

A subsample of SPM was sent to the Norwegian Institute for Air Research (NILU) for analysis for BPA, TBBPA and S/MCCPs. BPA and TBBPA were extracted from oven-dried and homogenized SPM samples with methanol by shaking. Further sample clean-up was undertaken prior to analysis with UPLC-HR-TOF-MS. For S/MCCPs, the samples were Soxhlet-extracted using 10% ethyl ether/hexane. Following clean-up, SCCPs and MCCPs were analysed using GC-HRMS.

### 2.6.3 Quality assurance

Spiked samplers (loaded with known/measured amounts of PAHs, PCBs, PBDEs and HBCDD) were used to evaluate the inter-batch variability in extraction and recovery of these substances during sample preparation and analysis. A spiked silicone rubber sampler was extracted together with every batch of passive sampling devices.

Six spiked samplers were analysed following the production of the batch of spiked samplers to obtain a reference average value for the amounts of contaminants in the spiked samplers. The absolute deviations between the contaminant amounts measured in two spiked samplers analysed during RID sampler batch analyses and the reference values were on average 11.3 % (absolute deviations in the range of 0.1 to 106 %) for PAHs, 8.9 % (absolute deviations in the range of 0.1 to 67 %) for PCBs, 18 % (absolute deviations in the range of 2.8 to 38 %) for PBDEs, and 11 % (absolute deviation in the range of 3.4 to 20 %) for HBCDD.

The deployment of duplicate passive sampling devices is important as it provides critical information for quality assurance purpose. There was excellent agreement of the information on water-polymer exchange kinetics (from PRCs, and masses of contaminants accumulated) from duplicate samplers. This indicates that our results are not influenced significantly by the use of multiple silicone rubber polymer batches (very little is known of inter-batch variability in partition properties of polymer batches). Relative percent deviation (%RPD) between estimated freely dissolved concentrations by duplicate passive sampling devices for PAHs and PCBs and most PBDEs are well below 40 % (Addendum, Table 1b).

The sampling rates, $R_s$ of passive samplers exposed in River Alna were consistently higher than those observed for the two other rivers. In addition, sampling rates in Alna did not show the strong decrease with exposure temperature seen for the two other rivers. We conducted a preliminary evaluation of the effects of the fouling of samplers deployed in River Alna. This fouling is mostly SPM sorbing to the surface of the sampler. In 2015, we conducted a passive sampler exposure alongside the standard sampler exposure but cleaned the surface of these additional samplers free of particles on a weekly basis (exposure from 15.10.2015 to 05.02.2016). The aim of this preliminary test was to assess whether minimising the amount of SPM deposited on the samplers affected: (i) sampling rates, (ii) masses accumulated for chemicals of interest, and (iii) estimated freely dissolved concentrations in water. Confounding factors arise from the analysis of these samplers undertaken in a different batch of analysis from those that did not undergo any cleaning. Sampling rates for samplers that were not cleaned were on average 26.5 l/d while those for samplers cleaned on a regular basis were 66.5 l/d. This is a difference of slightly more than a factor of two. The cleaning consistently increased masses of PAHs and PCBs accumulated in these samplers. The median of ratio of masses of PAHs and PCBs accumulated in the sampler under cleaning over those that were not cleaned is 1.44 (range of ratios from 0.78 to 23). Highest increases were seen for some of the lesser hydrophobic PAHs, while differences were minimal for the most hydrophobic PAHs and PCBs. The calculation of concentrations in water resulted in an increase in this ratio to a median value of 2.09 for PAHs and PCBs. While these data are not entirely conclusive (analysis in different batches, constancy of freely dissolved concentrations over time, especially for the least hydrophobic compounds), they tend to show that the important deposition of SPM onto the samplers in the Alna may affect the data obtained. One possible mechanisms to explain these results would be that particles depositing on the sampler enhance the dissipation of PRCs. In these conditions, uptake and release may not be entirely an isotropic process, as particles settled onto the samplers may not be able to "feed" chemicals to the sampler in the same way as they are capable of "attracting" the PRCs. Refractory organic carbon such as black carbon phases may play a role.

### 2.6.4 Calculating riverine loads and whole water concentrations of organic constituents

Sampling rates for AlteSil™ silicone rubber passive samplers were estimated using PRC data (performance reference compounds). PRC dissipation rates were estimated from the amount of PRCs remaining in the samplers after exposure (Booij et al., 1998; Huckins et al., 2002). Since the exchange of chemicals between the water and silicone is an isotropic phenomenon, the release of PRCs (analogues of chemicals of interest) provides us with information on the uptake kinetics for substances of interest. The non-linear least square method by Booij and Smedes (2010) was used to estimate sampling rates for each sampler for each deployment individually using all available PRC data. A boundary layer-controlled uptake rate model by Rusina et al. (Rusina et al., 2010) was used to estimate sampling rates for compounds for all substances of interest. The PRC data and the non-linear least square method were used to obtain estimates of an exposure-specific parameter $\beta_{sil}$ for each sampler and exposure period:

$$R_s = \beta_{sil} K_{sw}^{-0.08}$$

Silicone-water partition coefficients, $K_{sw}$ for PRCs (except for fluoroPCBs), PAHs and PCBs were from Smedes et al. (Smedes et al., 2009). These data were not corrected for temperature, and published literature values obtained at 20 °C were applied to all exposure periods. For substances for which $K_{sw}$ values are not available (i.e. PBDEs and HBCDD), a $\log K_{sw}$-$\log K_{ow}$ ($K_{ow}$ is the octanol-water partition coefficient) regression with a slope of 0.82 and intercept of 0.976 was used to estimate $K_{sw}$ values from their $K_{ow}$. Since the model by Rusina et al. (Rusina et al., 2010) predicts only a minor drop in sampling rate with increasing $\log K_{sw}$, it is not expected that the uncertainty in $K_{sw}$ results in substantial uncertainty (or bias) in the result.

For 2016, values of $\beta_{sil}$ (see equation above) ranged from 2.1 to 200 depending on the river and the period of deployment. Lower values were obtained for deployments with lowest temperatures. Differences in $\beta_{sil}$ values for duplicate samplers were in most cases very low. Sampling rates for substances with $\log K_{ow}$ = 5 were in the range 1 to 51 l/d depending on the river and exposure period.

Freely dissolved concentrations ($C_{w,free}$) were calculated using the following equation:

$$C_{w,free} = \frac{n_{acc}}{K_{sw} m_{sil} \left(1 - e^{-\frac{R_s t}{K_{sw} m_{sil}}}\right)}$$

where $n_{acc}$ is the amount of chemical absorbed into the sampler during deployment (ng), $m_{sil}$ is the mass of the silicone rubber sampler (g) and t the deployment time (d).

Analytical limits of detection where transformed into field limits of detection using the equation above.

Riverine fluxes or loads of contaminants in the freely dissolved phase or associated to suspended particulate matter were estimated separately from the passive sampling data and from the CFC sampling, respectively.

The riverine load of contaminants in the freely dissolved form was estimated using the following equation:

$$F_{Freely\ diss} = Q_{average} \times t_{PS} \times C_{Free\ diss}$$

where $F_{Freely\ diss}$ is the freely dissolved contaminant load (g) per passive sampler exposure period, $t_{PS}$ (d), $Q_{average}$ is the average riverine water discharge ($m^3/s$) for the passive sampler exposure (calculated from daily recording), and $C_{Freely\ diss}$ is the contaminant concentration measured with passive sampling (ng/l). $F_{Freely\ diss}$ values were estimated for each passive sampler exposure for each river and were added to estimate the yearly load (g/yr). For River Alna, passive samplers deployed for the third deployment period of 2016 were lost. Data for the period 09.06.2016 to 12.10.2016 are therefore not available. Loads calculated for the period 01.01 to 12.12.2016 were corrected by upscaling to the entire year based of discharge data, including the period for which samplers were lost.

The riverine load of contaminants associated with SPM was estimated using the following equation:

$$F_{SPM} = Q_{average} \times t_{SPM} \times [SPM] \times C_{SPM}$$

where $F_{SPM}$ is the particulate matter-associated contaminant load (g), [SPM] is the SPM content of the water (flow-weighted mean, mg/l) estimated from bottle sampling for the period of time the CFC sampling is representative of, $t_{SPM}$ (d), $Q_{average}$ is mean riverine discharge ($m^3/s$) for the $t_{SPM}$ period, and $C_{SPM}$ is the contaminant concentration in the SPM sample (ng/g dry weight (dw)). The period of time that CFC sampling is assumed to represent is from the mid-point between the sampling event and the previous sampling event to the mid-point between the sampling event and the following sampling event.

Annual average “whole water” concentrations were calculated by adding the yearly estimate of freely dissolved load of contaminants and that associated with the SPM phase and dividing that value by the total yearly discharge of the river. This was done for each single chemical.

When freely dissolved and particulate matter data is given as a range of concentrations, this is the result of certain concentrations being below limits of detection. When datasets presented some concentrations below limits of detection, these concentrations were assumed to be either zero or at the limits of detection level for the calculation of yearly averages and of sums of concentrations of chemicals. This procedure yielded ranges of concentrations with a lower limit representative minimum expected concentrations and an upper limit representative of an expected maximum concentration.

## 2.7 Water temperature

Water temperature data were acquired from four different sources: Sensor monitoring (hourly), TinyTag temperature loggers (hourly), manual temperature measurements (single measurements) and NVE temperature logging (daily averages from bi-hourly measurements).

Temperature sensors were applied in the three rivers with sensor monitoring also for other parameters (cf. section 2.8). In the remaining rivers monitored monthly, except River Orkla, temperature was monitored with TinyTag temperature loggers (TG-4100 or TKC-0002 from Intab). These loggers were secured to land and deployed in the river at the grab sampling locations. The loggers are replaced each autumn, to ensure sufficient battery capacity. In River Orkla, there are two outlets from hydropower plants just upstream of the sampling point, so the temperature at the grab sampling point was not considered representative. There were also difficulties with deployment at the sampling site. Hence, NVE data from further upstream were used instead. There are no major tributary rivers between the temperature logger location and the grab sampling point.

In the rivers monitored quarterly, temperature was measured directly in the water using a thermometer at the time of sampling, as a general rule. In some rivers NVE data were used instead. In 2016 NVE-data were used for 11 of these 36 rivers.

## 2.8 Sensor monitoring

Sensor monitoring was applied in rivers Alna, Drammenselva and Glomma. YSI 600 XL V2-O multiparameter sondes were installed in April 2013, measuring turbidity (optical sensor number 6136), pH (probe number 6561), conductivity, and temperature.

In River Alna the sonde was installed vertically in a tube attached to a walkway alongside/above the river, about 0.5 m from the river bank at 0.5-1 m depth. In rivers Drammenselva and Glomma the sondes could not be installed at the grab sampling locations, due to the lack of power supply. Instead they were installed at the same location as the sampling for organic contaminants.

The sensor data closest in time with grab samples were used for correlation analysis. E.g., if a grab sample was collected at 11:15, and sensor recordings existed at 11:00 and 12:00 hrs, the sensor recording used was the one at 11:00. In this case the longest deviation in time would be half an hour.

Prior to analysis, the data were examined and possible errors were identified. Also, all dates were adjusted to Norwegian winter time.

# 3. Results and discussion

## 3.1 Climate, water discharge and temperature

### 3.1.1 The weather conditions in 2016

The weather in 2016 can be characterised as warm with normal precipitation rates for the country as a whole, but with local variations (Figure 9). The average temperature was 1.5 °C above normal for the entire country, and the year was the 10th warmest since the measurements started in 1900. Note that the normal is based on the period 1961-1990.

The temperature during winter (December 2015 – February 2016) was 1.8 °C above normal. The highest relative change was in Eastern Norway, where the temperature in some stations was 3-4 degrees higher than normal. Precipitation in winter was 130 % higher than normal for the country as a whole, and 200-300% higher than normal in the very north and south.

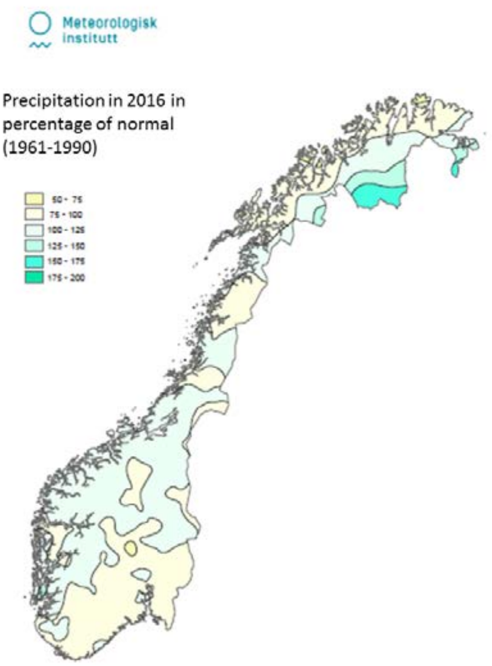


*Figure 9. Precipitation in Norway in 2016 as percentage of normal values (1961-1990)* (derived from Heiberg et al. 2016)

In the spring (March-May), the temperature was 2.2 °C higher than normal for the country as a whole, whereas the precipitation was slightly lower than normal.

In summer (June-August), the temperature was only 0.6 °C above normal, and the precipitation was 115 % above normal. In some regions, however, the precipitation was significantly higher, with rainfall 150-200 % above normal in the very north and in the western parts of the country.

It was a relatively warm and dry autumn, with temperatures 1.3 °C above normal (average for the whole country), and as much as 2.5 degrees higher in the north. This was the 20th driest autumn since the monitoring started in 1900.

### 3.1.2 Water discharge

Variations in water discharge can explain variations in both contaminant loads and concentrations. Hydrological stations in nine of the eleven rivers monitored monthly have historical data that can be used to assess long-term changes. The monthly mean water discharges in 2016 at these stations have been compared to the mean water discharges of the 30-year normal (1971-2000) (Table 6). Table 6 also shows the results of statistical analyses of annual water discharge in the period 1990-2016. See also Table 8 and 12 for data on changes in water discharge per sea area.

***Table 6. Average annual water discharges ($Q_{Hy}$) for nine hydrological stations in the 30-year period 1971-2000 and in 2016; and results of statistical analyses of annual water discharge scaled to the RID monitoring stations ($Q_{Chem}$) for the period 1990-2016. NA: Not available.***

| River | 30-year normal of $Q_{Hy}$ (1971-2000)* | $Q_{Hy}$ in 2016* | Difference $Q_{Hy}$ (2016 vs. 1971-2000) | Trends in $Q_{Chem}$** | Marine area |
|---|---|---|---|---|---|
| | $m^3/s$ | $m^3/s$ | % | p-value | |
| River Glomma | 678 | 643 | -5 | 0.0059 | Skagerrak |
| River Drammenselva | 281 | 282 | 0 | 0.0022 | |
| River Numedalslågen | 105 | 105 | 0 | 0.0206 | |
| River Skienselva | 260 | 278 | 6 | 0.0127 | |
| River Otra | 146 | 148 | 1 | 0.4670 | |
| River Orreelva | NA | 7 | NA | 0.0498 | |
| River Vosso | 73 | 74 | 1 | - | North Sea |
| River Orkla | 49 | 30 | -63 | 0.7409 | Norwegian Sea |
| River Vefsna | 150 | 123 | -22 | 0.8084 | |
| River Alta | 75 | 100 | 25 | 0.5816 | Barents Sea |

Legend:

| | |
|---|---|
| (red) | Significant upward (P-values < 0.05 ) based on statistical analyses. |
| (pink) | More than 5% increase in 2016 as compared to 1971-2000. |
| (cyan) | More than 5% decrease in 2016 as compared to 1971-2000. |

* $Q_{Hy}$ is water discharge directly at the hydrological stations: Solbergfoss in Glomma; Døvikfoss in Drammenselva; Holmsfoss in Numedalslågen; Norsjø in Skienselva; Heisel in Otra; Bulken in Vosso; Syrstad in Orkla; Laksfors in Vefsna; and Kista in Alta.

** $Q_{Chem}$ is water discharge scaled to the upstream area of the RID sampling stations, available for the period 1990-2016.

The trend analysis for the period 1990-2016 revealed that there are statistically significant upward trends of water discharge in rivers Glomma, Drammenselva, Numedalslågen, Skienselva and Orreelva, with subsequent risk of increased loads of pollutants. However, 2016 was a relatively normal year in terms of precipitation as compared to the period 1971-2000, and the water discharge in most of the rivers did not alter much from this 'normal'. Exceptions are rivers Orkla and Vefsna with considerably lower discharges, and River Alta with higher discharges than normal.

### 3.1.3 Water temperature

Table 7 shows the water temperature in the 11 rivers monitored monthly. Temperatures are in general recorded every hour, and the monthly averages are shown in the table. Water temperatures typically vary from the north to the south and also according to whether or not the river's headwaters are located in mountains (e.g., River Vosso) or lowland forested areas (e.g., River Alna). Temperatures have only been monitored for three years and there are presently no Norwegian analyses of long-term data series of riverine water temperature[2]. Hence, no discussion on trends is possible.

***Table 7. Water temperature as monthly means (ºC) from hourly observations in 11 rivers in 2016.***

| River | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Glomma | 0.2 | 0.3 | 1.8 | 4.3 | 9.0 | 14.4 | 16.8 | 16.5 | 15.0 | 9.0 | 4.0 | 1.3 |
| Alna | 1.0 | 2.1 | 3.6 | 5.8 | 10.1 | 13.5 | 14.9 | 13.1 | 13.0 | 7.5 | 3.8 | 2.9 |
| Drammenselva | 0.7 | 0.8 | 1.7 | 3.8 | 7.9 | 14.9 | 17.8 | 16.7 | 15.0 | 8.2 | 2.8 | 0.9 |
| Numedalslågen | 0.3 | 0.2 | 0.9 | 4.9 | 9.9 | 16.4 | 17.5 | 16.6 | 15.5 | 7.7 | 2.1 | 0.3 |
| Skienselva | 3.5 | 2.5 | 2.5 | 3.6 | 5.5 | 11.8 | 15.9 | 16.5 | 15.7 | 11.6 | 6.6 | 4.4 |
| Otra | 1.3 | 1.1 | 1.8 | 4.4 | 8.6 | 14.8 | 17.3 | 16.6 | 15.7 | 9.4 | 4.2 | 2.8 |
| Orre | 1.1 | 2.7 | 4.5 | 8.3 | 13.0 | 16.8 | 17.6 | 16.3 | 16.4 | 8.9 | 4.5 | 4.7 |
| Vosso | 0.9 | 0.4 | 0.5 | 2.2 | 5.0 | 9.4 | 11.2 | 12.5 | 12.8 | 8.9 | 5.2 | 3.3 |
| Orkla* | 0.0 | 0.3 | 1.2 | 2.4 | 4.8 | 10.6 | 13.3 | 11.8 | 10.3 | 4.6 | 0.3 | 0.1 |
| Vefsna | 0.1 | 0.1 | 0.1 | 2.1 | 5.1 | 9.2 | 13.7 | 13.0 | 10.3 | 3.4 | -0.9 | 0.2 |
| Alta | 0.0 | 0.0 | 0.2 | 0.8 | 3.7 | 6.1 | 7.8 | 7.7 | 6.6 | 4.9 | 2.6 | 1.8 |

* Data from NVE's sensor, based on daily average values.

## 3.2 Nutrients, particles, silicate and TOC

### 3.2.1 Total inputs in 2016

The total nutrient inputs to Norwegian coastal waters in 2016 were estimated to 13 271 tonnes of phosphorus and 162 647 tonnes of nitrogen (Figure 10). Overall, nitrogen inputs were highest to the North Sea and lowest to the Barents Sea; whereas phosphorus inputs were highest to the Norwegian Sea and lowest to the Skagerrak.

[2] Pers. comm. Ånund Kvambekk, NVE.

Total silicate inputs were estimated to 436 698 tonnes and total organic carbon (TOC) to about 505 590 tonnes. The input of SPM amounted to about 759 011 tonnes (see also Addendum's Table 3). Loads may be higher, since not all sources are monitored or modelled. This is true for loads of silicate and SPM from unmonitored areas, particulate matter from fish farming, silicate from some types of industry, and TOC from diffuse sources in unmonitored areas. Until approporiate methods are developed, these inputs remain unreported in this programme.

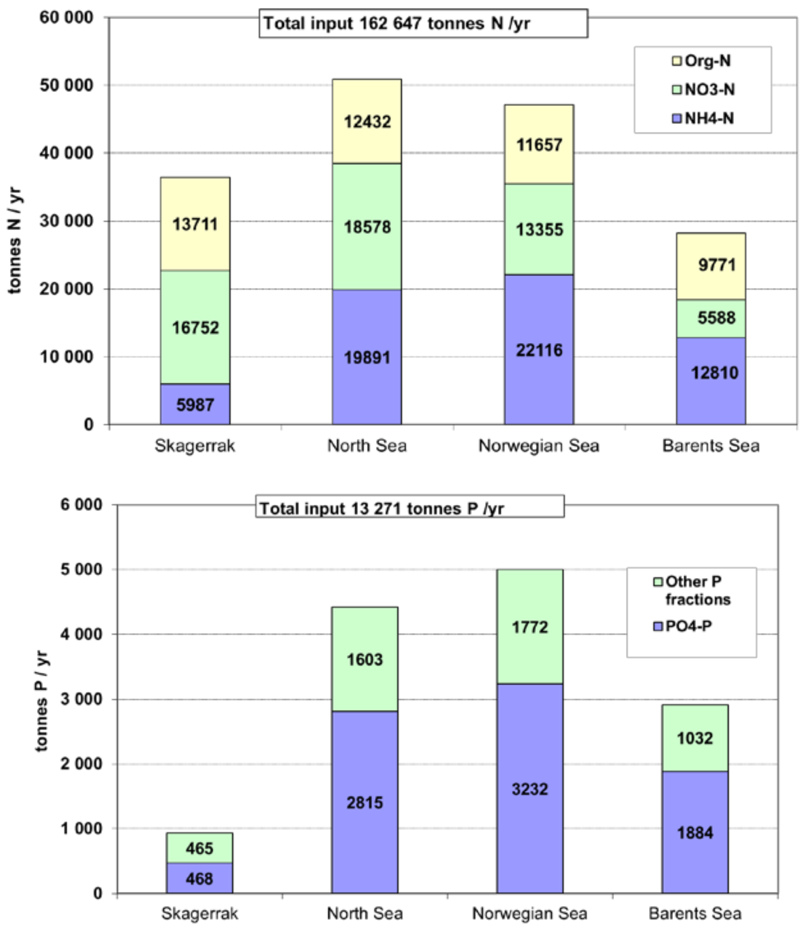


*Figure 10. Total inputs to the four Norwegian marine areas of total nitrogen (upper panel) and total phosphorus (lower panel), divided into different fractions.*

## 3.2.2 Trends in riverine nutrient loads and concentrations

All calculated annual loads of SPM and nutrients for rivers monitored monthly from 1990 onwards are presented in charts in Appendix V; for historical data on concentrations at each station we refer to http://vannmiljo.miljodirektoratet.no.

Table 8 shows the riverine loads of nutrients and SPM in 2016, as well as water discharges, compared to the averages for the period 1990-2015. The Norwegian Sea had about 14 % less water discharge in 2016 than the long-term average. Accordingly, loads of Tot-P, Tot-N and SPM were relatively low in 2016 in this region. The three other sea areas had minor changes in water discharge (less than 10 %). Nevertheless, more than 10 % reductions of Tot-P load can be seen in all four marine areas, and in the total for Norway.

In the Barents Sea/Lofoten area, a 40 % increase in Tot-N should be noted. The water discharges in this region increased with only 5 %, while the Tot-P loads decreased. The reason for the high Tot-N loads is one single sample in River Tana on 8 May 2016, with high water discharges and concurring high nitrogen concentrations. The load in this river alone was, based on four samples, calculated to 3537 tonnes, which comprises about 60 % of the total loads for tributary rivers in this region (5871 tonnes). Hence, it is likely that this apparent increase is due more to infrequent sampling than to an actual increase.

***Table 8. Total riverine loads (155 rivers) of total nitrogen (TN), total phosphorus (TP), suspended particulate matter (SPM), and water discharge as an average for 1990-2015 and in 2016. More than +/-10% change is marked with colour (orange: higher; green: lower)*.***

| Marine area | Water discharge ($m^3/s$) | | Nitrogen (tonnes) | | Phosphorus (tonnes) | | SPM (1000 tonnes) | |
|---|---|---|---|---|---|---|---|---|
| | Mean 1990-2015 | 2016 | Mean 1990-2015 | 2016 | Mean 1990-2015 | 2016 | Mean 1990-2015 | 2016 |
| Skagerrak | 2085 | 1904 | 30872 | 26788 | 793 | 680 | 381 | 409 |
| North Sea | 1804 | 1700 | 14100 | 12709 | 321 | 279 | 106 | 97 |
| Norwegian Sea | 1623 | 1415 | 9167 | 7970 | 306 | 251 | 185 | 146 |
| Lofoten/Barents | 934 | 990 | 4530 | 7739 | 216 | 196 | 87 | 90 |
| Total Norway | 6446 | 6008 | 58669 | 55206 | 1635 | 1405 | 759 | 741 |

* Note that these observations of changes are not the results of statistical trend analyses.

In addition to the above, statistical trend analyses of nutrients and suspended particles loads and concentrations have been carried out. Both trends for the last 10 years (2007-2016, labelled 10-years trends) and for the entire monitoring period (1990-2016; labelled long-term trends) have been analysed. As for last year, the trend analyses have been performed on total loads, without taking account of differenes in water discharge. Long-term trends are shown in Tables 9 (loads) and 10 (concentrations). The 10-year trends are shown in Appendix V.

***Table 9. Trends, shown as p-values, in annual water discharge (Q; estimated from daily measurements), nutrient and particle loads in nine Norwegian rivers (1990-2016). The colours indicate the degree of statistical significance (see legend).***

**LOADS 1990-2016**

| River | Q | $NH_4$-N | $NO_3$-N | Tot-N | $PO_4$-P | Tot-P | SPM |
|---|---|---|---|---|---|---|---|
| Glomma | 0.0231 | 0.0000 | 0.2516 | 0.0207 | 0.0231 | 0.3070 | 0.2516 |
| Drammenselva | 0.0081 | 0.0131 | 0.0764 | 0.0056 | 0.0009 | 0.0005 | 0.0014 |
| Numedalslågen | 0.0477 | 0.2035 | 0.5455 | 0.0056 | 0.0318 | 0.0390 | 0.0836 |
| Skienselva | 0.0231 | 0.0165 | 0.0003 | 0.6920 | 0.4656 | 0.1754 | 0.6022 |
| Otra | 0.4405 | 0.2187 | 0.0000 | 0.7545 | 0.1503 | 0.3700 | 0.1891 |
| Orreelva | 0.0996 | 0.6615 | 0.6316 | 0.4405 | 0.2035 | 0.1503 | 0.2347 |
| Orkla | 0.4162 | 0.0004 | 0.4162 | 0.7864 | 0.6920 | 0.1084 | 0.3927 |
| Vefsna | 0.5455 | 0.0000 | 0.0000 | 0.0033 | 0.0056 | 0.0006 | 0.0231 |
| Altaelva | 0.3272 | 0.2877 | 0.2187 | 0.8840 | 0.2692 | 0.2187 | 0.8512 |

Statistically significant downward ($p<0.05$)

Downward but not statistically significant ($0.05<p<0.1$)

Statistically significant upward ($p<0.05$)

Upward but not statistically significant ($0.05<p<0.1$)

***Table 10. Trends shown as p-values, in nutrient and particle concentrations in nine Norwegian rivers (1990- 2016). The colours indicate the degree of statistical significance (see legend).***

**CONCENTRATIONS 1990-2016**

| River | $NH_4$-N | $NO_3$-N | Tot-N | $PO_4$-P | Tot-P | SPM |
|---|---|---|---|---|---|---|
| Glomma | 0.0001 | 0.2894 | 0.2096 | 0.0054 | 0.4201 | 0.1174 |
| Drammenselva | 0.0032 | 0.2228 | 0.1148 | 0.1848 | 0.1429 | 0.8934 |
| Numedalslågen | 0.2667 | 0.9605 | 0.0278 | 0.1196 | 0.0838 | 0.2595 |
| Skienselva | 0.0019 | 0.0000 | 0.0000 | 0.3987 | 0.7482 | 0.2539 |
| Otra | 0.0317 | 0.0000 | 0.0439 | 0.0761 | 0.0017 | 0.0003 |
| Orreelva | 0.5128 | 0.0147 | 0.1196 | 0.0509 | 0.4517 | 0.3871 |
| Orkla | 0.0005 | 0.6182 | 0.0148 | 0.4715 | 0.2622 | 0.0268 |
| Vefsna | 0.0000 | 0.0000 | 0.0041 | 0.0027 | 0.0091 | 0.0029 |
| Altaelva | 0.0628 | 0.2894 | 0.1073 | 0.1054 | 0.5131 | 0.3304 |

Statistically significant downward ($p<0.05$)

Downward but not statistically significant ($0.05<p<0.1$)

Statistically significant upward ($p<0.05$)

Upward but not statistically significant ($0.05<p<0.1$)

**Nitrogen trends**

- **Tot-N loads** have **increased** significantly in the period 1990-2016 in rivers Glomma, Drammenselva and Numedalslågen. Increased water discharge explains the increased nitrogen loads in rivers Glomma and Drammenselva but not in River Numedalslågen. In River Numedalslågen, also the nitrogen concentration has increased significantly.
- In River Vefsna both loads and concentrations of Tot-N have **decreased** significantly from 1990 to 2016.
- In River Skienselva total loads of $NH_4$-N and $NO_3$-N have **decreased** from 1990-2016 despite a significant increase in water discharge. When water discharge is accounted for, the Tot-N load has also decreased significantly.
- In River Otra, the Tot-N, $NH_4$-N and $NO_3$-N concentrations have **decreased** significantly from 1990-2016. Loads of $NO_3$-N have also decreased in this period.
- In River Orkla, the Tot-N concentration has **increased** significantly from 1990-2016, but not the total load.
- When examining the last 10 year-period only, there is a significant upward trend in Tot-N and $NO_3$-N in River Altaelva.

Below, trends in rivers Glomma, Numedalslågen and Skienselva are discussed in more detail:

***Example: Nitrogen in River Glomma***

In River Glomma the Tot-N load has significantly increased in the monitoring period (Figure 11), while the Tot-N concentrations have been more stable (Table 10). The Tot-N loads correlate well with the water discharge ($R^2$=0.8). Due to the increased water discharge in the river the average nitrogen load the last ten years (2007-2016) is almost 14 % higher than the average nitrogen load the first ten years (1990-1999). However, concentrations and total loads of $NH_4$-N has significantly decreased.

When examining the last 10 year-period only, there are no significant trends in nitrogen loads or concentrations in this river.

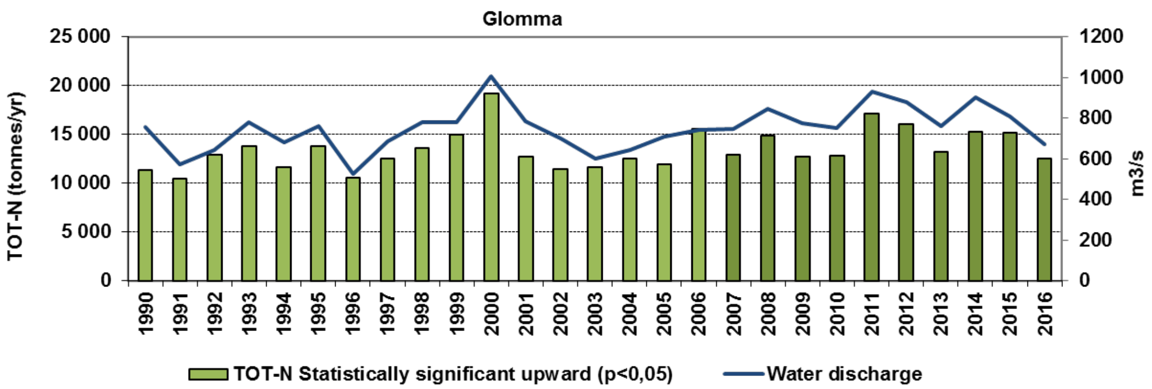


*Figure 11. Annual riverine loads of total nitrogen and water discharge in River Glomma in 1990-2016. For the last ten years (coloured a deeper shade of green) no trend was detected.*

***Example: Nitrogen in River Numedalslågen***

In River Numedalslågen both the Tot-N loads (Table 9, Figure 12) and concentrations (Table 10) have significantly increased during the monitoring period. The increase in nitrogen load is greater than what can be explained solely by the increase in water discharge. The average nitrogen load during the last ten years (2007-2016) is 25 % higher than the average nitrogen load during the period 1990-2000.

The last 10 year period had no significant trends in nitrogen loads or concentrations.

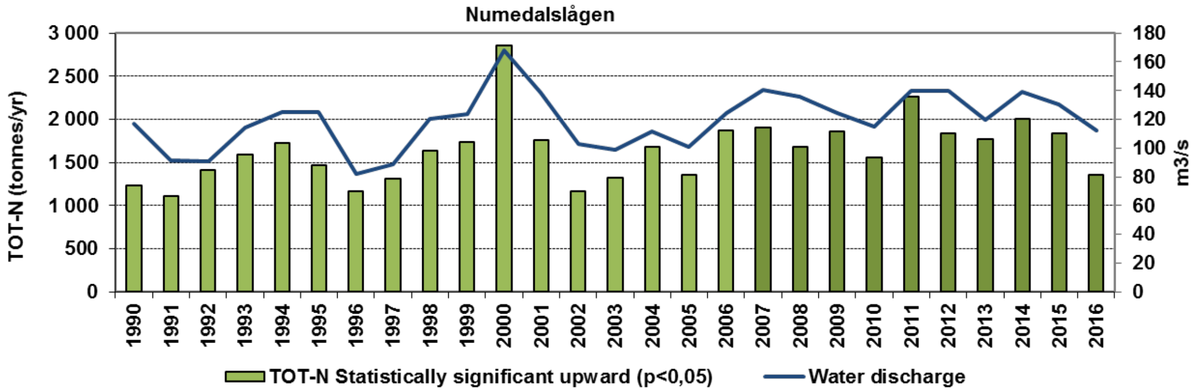


*Figure 12. Annual riverine loads of total nitrogen and water discharge in River Numedalslågen in 1990-2016. For the last ten years (coloured a darker shade of green) no trend was detected.*

***Example: Nitrogen in River Skienselva***

In River Skienselva water discharge has increased significantly while total loads of both $NH_4$-N and $NO_3$-N have decreased significantly (Figure 13). When water discharge is taken into account the Tot-N loads have also decreased significantly (Figure 14). The average nitrogen load in the last ten years (2007-2016) is 2 % lower than the average nitrogen loads the first ten years (1990-1999) of the monitoring series.

When only considering the last ten years, the decreasing trend in nitrate is also significant in River Skienselva.

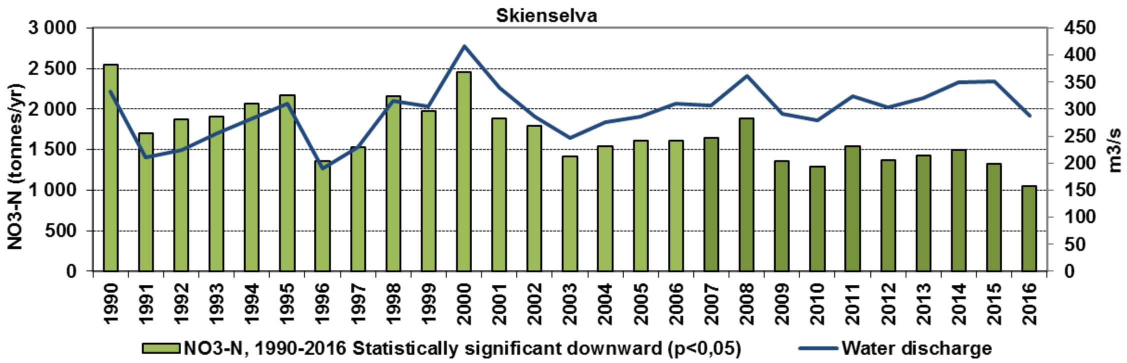


*Figure 13. Annual riverine loads of nitrate and water discharge in River Skienselva in 1990-2016. Also for just the last ten years (coloured a deeper shade of green) a statistically downward trend was found.*

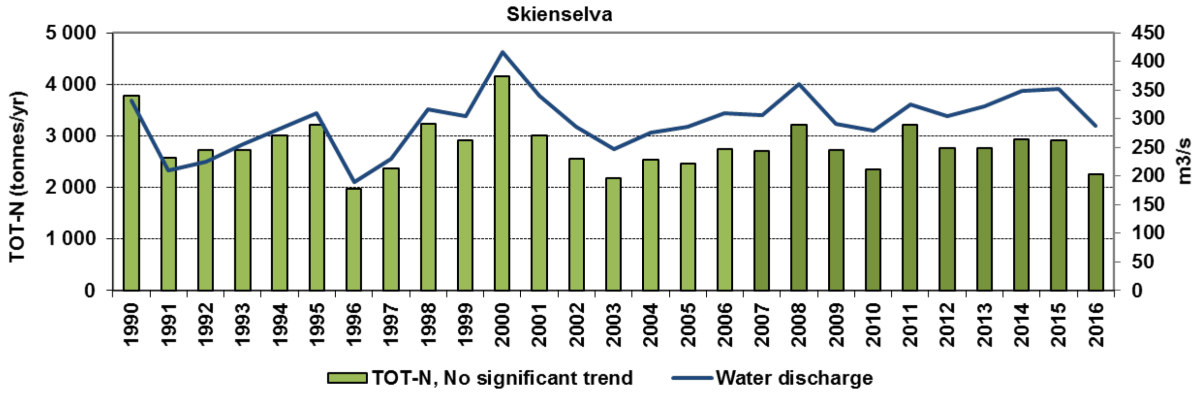


*Figure 14. Annual riverine loads of total nitrogen and water discharge in River Skienselva in 1990-2016. No trend was found for either the long-term period or the last ten years (coloured a deeper shade of green).*

**Phosphorus and suspended sediments**

- Tot-P loads have **increased** significantly in rivers Drammenselva and Numedalslågen from 1990 to 2016. Increased water discharge explains the increased phosphorus loads in River Numedalslågen but not in River Drammenselva. In River Drammenselva the loads of suspended particles have also increased significantly since 1990.

- Tot-P loads and concentrations have **decreased** significantly in River Vefsna from 1990 to 2016. The loads of suspended particles have also decreased significantly in this period.

- In River Otra the concentration of Tot-P and suspended particles has **decreased** significantly since 1990.

- Phosphate ($PO_4$-P) loads have **increased** significantly in rivers Glomma, Drammenselva and Numedalslågen and **decreased** significantly in River Vefsna since 1990.

- When examining the last 10 year-period only, there is a significant upward trend in Tot-P and $PO_4$–P in River Altaelva.

Below, trends in rivers Drammenselva and Otra are discussed in more detail:

***Example: Phosphorus in River Drammenselva***

In River Drammenselva the total loads of phosphorus (Figure 15), phosphate and suspended particles have increased significantly from 1990-2016. Phosphorus loads increased significantly even when the increase in water discharge was taken into account. It is not unlikely that the increase in water discharge has resulted in increased erosion of phosphorus-rich soils in the catchment.

In River Drammenselva the year 2012 had especially high loads of phosphorus, the reason was one sample in August with high concentrations of both SPM, TOT-P, $PO_4$, TOT-N, $NO_3$-N, Pb, Cr and Zn. However, even when omitting the year 2012 from the calculations, the average phosphorus loads during the last ten years (2007-2016) are almost 90 % higher than the average phosphorus loads the first ten years (1990-1999).

There are no significant trends in phosphorus loads or concentrations during **the last ten years** in River Drammenselva.

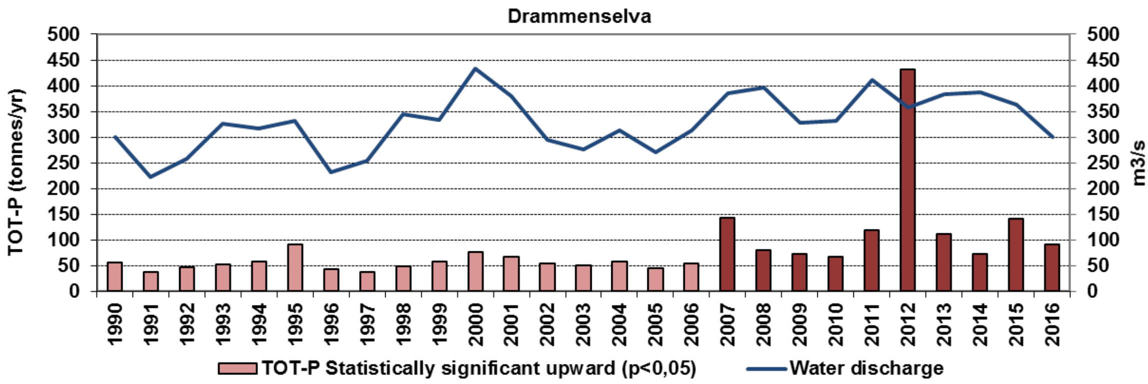


*Figure 15. Annual riverine loads of total phosphorus and water discharge in River Drammenselva in 1990-2016. For the last ten years (coloured a deeper shade of red) no trends were found.*

***Example: Phosphorus in River Otra***

While the concentrations of Tot-P and particles have decreased significantly since 1990 in this river, the loads have not. The trends in concentrations are linked to high concentrations the first years (1990-1996) of monitoring. In 1994-95 an industrial pipeline (going from Vennesla to Kristiansand) was installed on the river bed, and this may be part of the explanation for the high concentrations in this period. The water discharge has not changed significantly in the period, but high peaks in Tot-P load correlate well with peaks in water discharge in this river (Figure 16).

There are no trend in phosphorus load or concentration **in the last ten years** in River Otra.

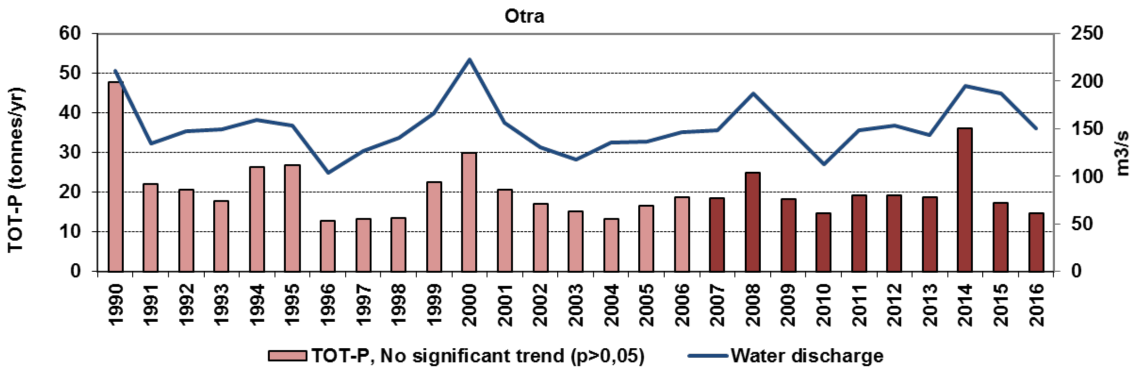


*Figure 16. Annual riverine loads of total phosphorus and water discharge in River Otra in 1990-2016, last ten years are coloured a deeper shade of red. No trend was found for either the long-term period or the last ten years (coloured a deeper shade of red).*

### 3.2.3 Direct discharges of nutrients and particles

In 2016, the total inputs of Tot-N from direct discharges amounted to about 73 000 tonnes, inputs of Tot-P to about 11 000 tonnes and inputs of SPM to about 17 000 tonnes. As is also shown in the next section, the nutrient loadings from fish farming contributed to 35 % of the total inputs of Tot-N and about 74 % of the Tot-P inputs.

There were few changes in nutrient inputs from direct discharges since last year, and the majority of the nutrients derive from fish farming along the coastline. In 2015, the total input of SPM was substantially higher than previous years, due to one, single effluent from a company refining fish waste into new products. In 2016 the SPM discharges were back to more normal values (ref. e.g. in 2014 when they amounted to about 15 000 tonnes; Skarbøvik et al, 2015).

### 3.2.4 Source apportionment of nutrients

Source apportionment is presently not a part of the RID programme, but in Norway, the TEOTIL model is run for the entire country (i.e. not using river monitoring data), and source apportionment based on this modelling is therefore shown for nitrogen (Figure 17) and phosphorus (Figure 18).

Especially for the three northern coastal areas, fish farming contributed to a significant part of the nutrient inputs. For Norway as a whole the nutrient loadings from fish farming contributed to 74 % of the Tot-P inputs and about 35 % of the Tot-N inputs in 2016, cf. Table 11. The proportion has increased slightly since 2015 (cf. Skarbøvik et al. 2016).

***Table 11. Proportion of discharges of different nutrient fractions from fish farming in 2016.***

| | $NH_4$-N | $NO_3$-N | $PO_4$-P | TN | TP |
|---|---|---|---|---|---|
| **% of total inputs** | 75 | 11 | 80 | 35 | 74 |
| **% of direct discharges** | 79 | 89 | 89 | 78 | 88 |

### 3.2.5 Comparison with nutrient trends in the Greater North Sea

OSPAR's intermediate assessment in 2017[3] reveals that nutrient inputs to the Greater North Sea have decreased significantly since 1990. These inputs include both riverine loads and direct discharges.

Total nitrogen inputs are more variable than total phosphorus inputs, but inputs of both of these nutrients have reduced significantly. Nitrogen reductions seem to be partly linked to reduced emissions of nitrogen to air. Reductions in phosphorus inputs to the Greater North Sea are significant, and since 2000 phosphorus inputs have roughly halved to about 40 kt/y. The greatest changes occurred between about 2000 and 2005, although further significant input reductions have occurred since 2006. Also in the Bay of Biscay and the Iberian Coast inputs of

[3] https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017

phosphorus have declined. These trends are not in concurrence with the Norwegian trends, where the total inputs of nutrients have increased due to fish farming.

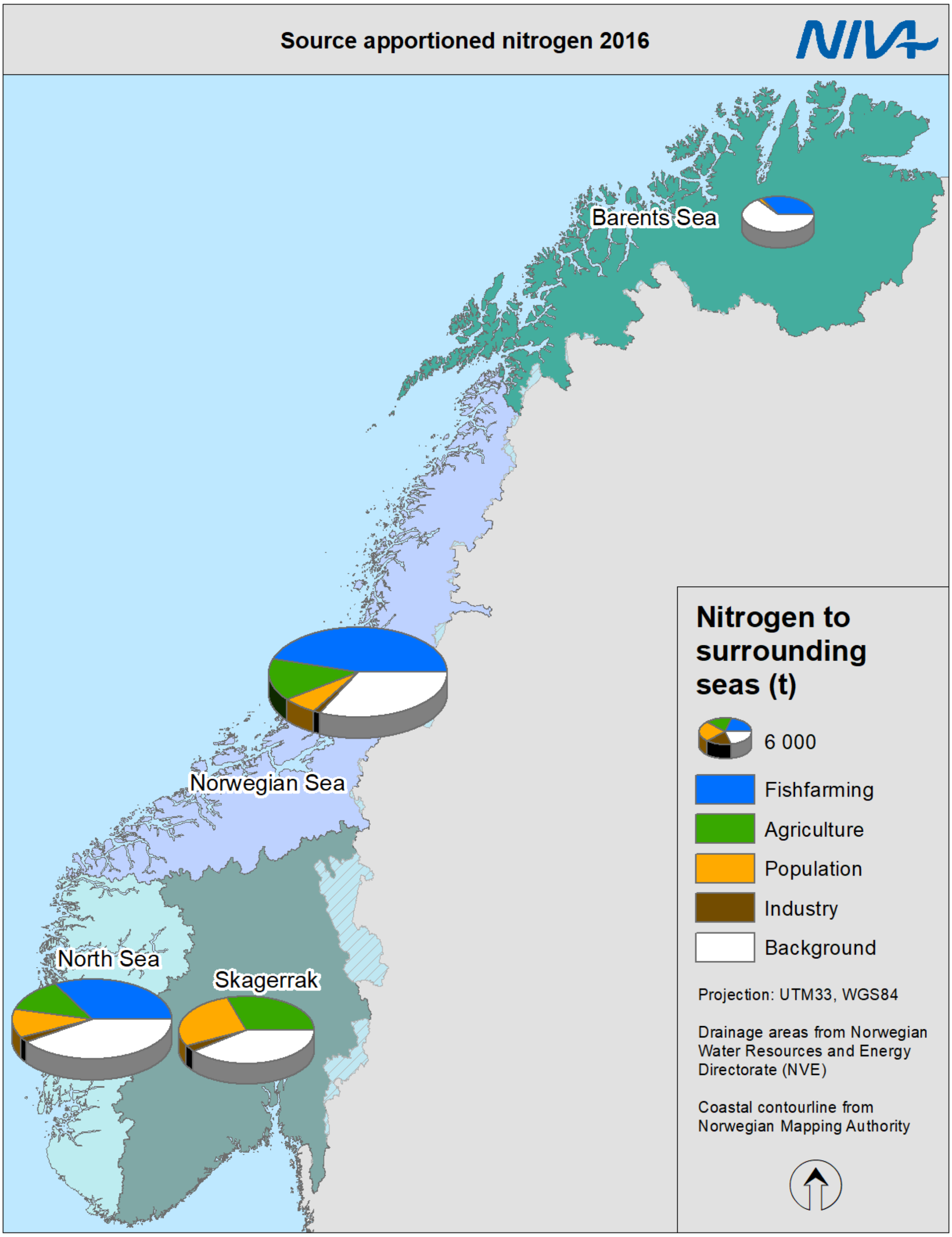


*Figure 17. Source apportionment of nitrogen in 2016. Based on the TEOTIL model.*

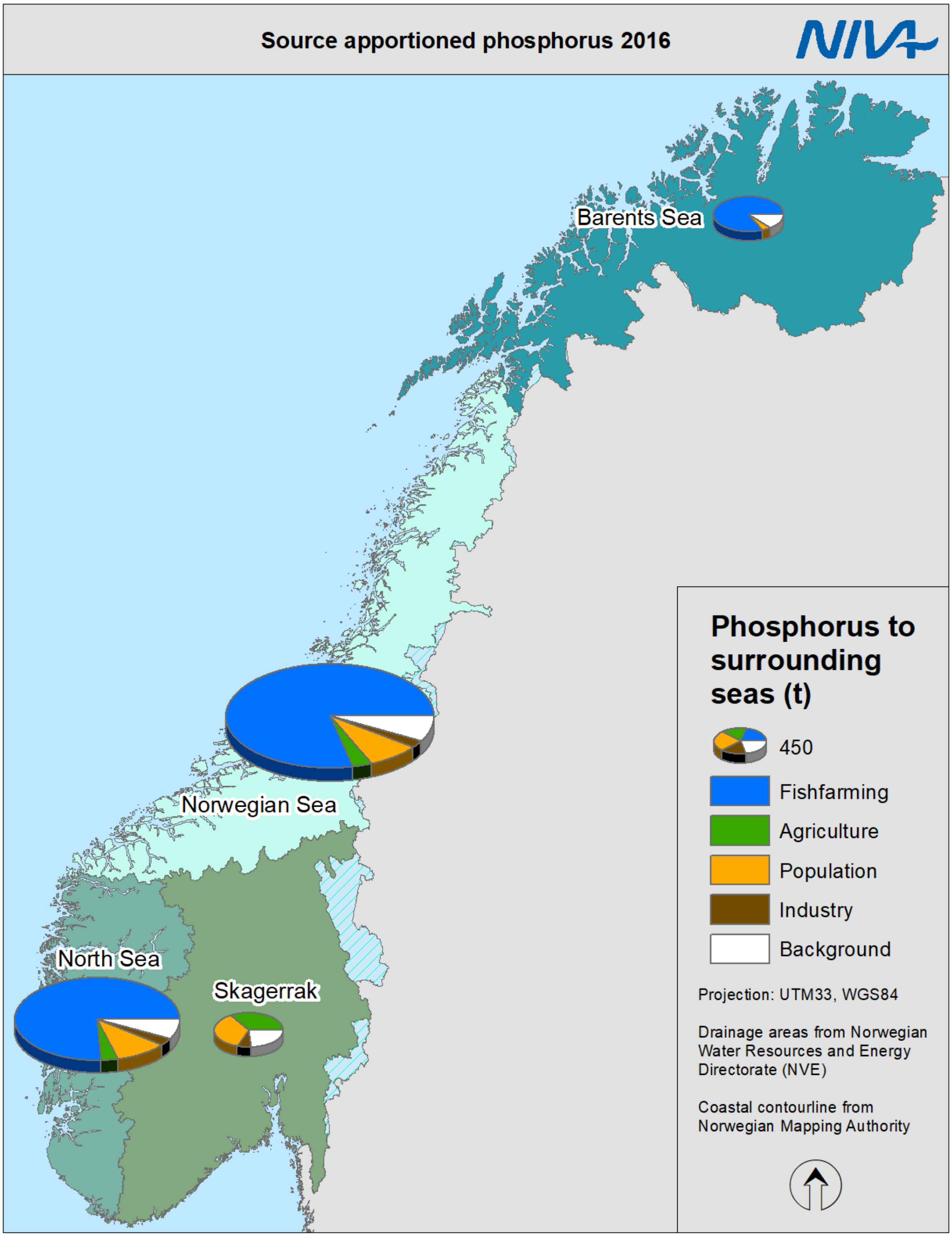


*Figure 18. Source apportionment of phosphorus in 2016. Based on the TEOTIL model.*

# 3.3 Metals

## 3.3.1 Total inputs of metals in 2016

In 2016, the inputs of metals to the Norwegian coastal areas were estimated to 128 kg of mercury, 2 tonnes of cadmium, 23 tonnes of arsenic, 39 tonnes of lead, 35 tonnes of chromium, 238 tonnes of nickel, 576 tonnes of zinc and 1251 tonnes of copper.

For all metals except copper, the riverine loads account for at least 90 % of the total inputs to Norwegian coastal waters. The high proportion of copper in the direct discharges is explained by fish farming. The fish cages are protected from algal growth with copper containing chemicals. Discharges of other metals from fish farming, including any residues from the fish fodder, are not estimated. The metal inputs per sub-region and other details are given in the Addendum's Table 3. It should be noted that no source estimates have been made for the riverine inputs, which may contain metal discharges from several different point sources.

As noted in the methods' chapter (Chpt. 2.4), the quantification of discharges of copper from fish farming is based on sales statistics for a number of antifouling products in regular use. The chart in Figure 19 shows the total discharges. A considerably higher quantity is registered from 2013 onwards, compared to previous years. The number of new product declarations in the official register increased from 2012 to 2013. The figure for 2016 is a preliminary estimate from September 2017.

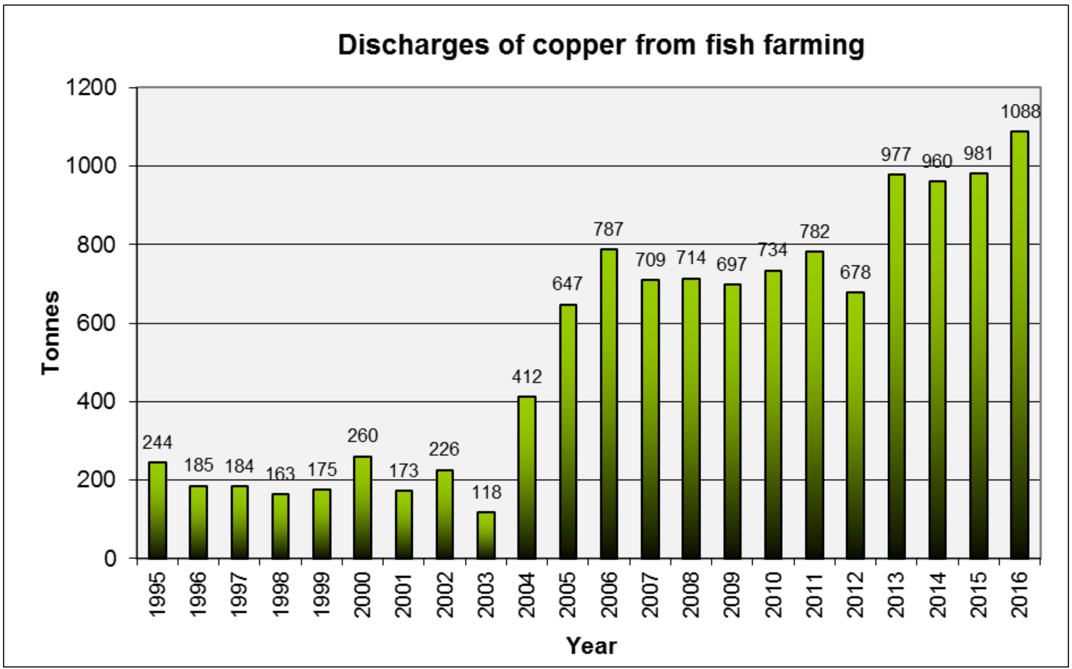


*Figure 19. Discharge of copper from fish farming, deriving from antifouling impregnation of net cages, in the period 1995-2016. The data are based on total losses, including cages above the RID rivers' sampling locations (minor contribution). It should be noted that the basis for these data is uncertain.*

### 3.3.2 Trends in metal loads and concentrations

Charts of long-term (1990-2016) metal loads are given in Appendix V. For historical records of concentrations we refer to http://vannmiljo.miljodirektoratet.no. Table 12 shows the difference in riverine inputs of metals in 2016 as compared to an average for the period 1990-2015.

In general, the loads of metals in 2016 were considerably lower than the long-term average. Two exceptions exist; these are copper and nickel to the Barents Sea. This is due to high concentrations in River Pasvikelva, a river affected by mining and metal industries. In fact, the nickel loads in River Pasvikelva constituted about 60 % of the total Norwegian nickel loads to the sea in 2016.

In 2016, new threshold levels for metals in freshwater were issued by NEA (Miljødirektoratet 2016). The threshold levels are given in Table 17a and b (Section 3.3.3) for average annual concentrations (corresponding to the Water Framework Directive's AA-EQS), and for single grab water samples (corresponding to WFD's MAC-EQS), respectively.

***Table 12. Total riverine loads (155 rivers) of eight metals as an average for 1990-2015 and in 2016. In kg for Hg, in tonnes for the rest. Changes at or higher than +/-10 % marked with bold font and colour (orange: higher; green: lower than the average)*.***

| Metal | Skagerrak | | North Sea | | Norwegian Sea | | Barents Sea | | Total Norway | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | 2016 | Mean | 2016 | Mean | 2016 | Mean | 2016 | Mean | 2016 |
| Arsenic | 12 | 10 | 4 | 4 | 6 | 4 | 4 | 3 | 27 | 21 |
| Lead | 28 | 25 | 12 | 9 | 9 | 3 | 4 | 1 | 53 | 38 |
| Cadmium | 2 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 4 | 2 |
| Copper | 93 | 58 | 33 | 23 | 73 | 33 | 36 | 41 | 235 | 154 |
| Zinc | 391 | 346 | 164 | 121 | 189 | 61 | 50 | 23 | 795 | 551 |
| Nickel | 43 | 33 | 15 | 13 | 33 | 24 | 55 | 161 | 146 | 230 |
| Chromium | 23 | 13 | 12 | 4 | 36 | 10 | 26 | 6 | 98 | 33 |
| Mercury (kg) | 183 | 48 | 34 | 33 | 42 | 26 | 20 | 8 | 278 | 115 |

* Note that these observations of changes are not the result of statistical trend analyses.

For more in-depth analyses of these changes, statistical trend tests (for which the methodology is described in Chapter 2.2.5) were performed for the following metals: Copper (Cu); lead (Pb); zinc (Zn); cadmium (Cd); and nickel (Ni).

The trend analyses in this report have been performed on total loads, without water discharge as a covariate. Both trends for the last 10 years (2007-2016, labelled 10-years trends) and for the entire monitoring period (1990-2016; labelled long-term trends) have been analysed. Long-term trends are shown in Tables 13 (loads) and 14 (concentrations). The 10-year trends are shown in Appendix V.

It should be emphasised that no firm conclusions can be drawn for the long-term changes for nickel, cadmium, and to some extent also lead. This is due to changed detection or quantification limits over time and/or large numbers of samples reported at or below the detection limit (see Skarbøvik *et al*., 2007 and Stålnacke *et al*., 2009, for details). Therefore, apparent trends in the data do not necessarily mean that there have been 'real' changes.

***Table 13. Trends, shown as p-values, for water discharge (Q) and metal loads in nine Norwegian rivers in the monitoring period (1990-2016). The colours indicate the degree of statistical significance (see legend).***

**LOADS metals. 1990-2016**

| River | Q | Cd | Cu | Ni | Pb | Zn |
|---|---|---|---|---|---|---|
| Glomma | 0.0231 | 0.0257 | 0.6022 | 0.4915 | 0.0477 | 0.4162 |
| Drammenselva | 0.0081 | 0.0049 | 0.0635 | 0.2516 | 0.0913 | 0.1754 |
| Numedalslågen | 0.0477 | 0.0147 | 0.0165 | 0.7230 | 0.0635 | 0.0432 |
| Skienselva | 0.0231 | 0.0001 | 0.0117 | 0.0081 | 0.7864 | 0.5455 |
| Otra | 0.4405 | 0.0352 | 0.3272 | 0.0009 | 0.2877 | 0.0257 |
| Orreelva | 0.0996 | 0.4405 | 0.3272 | 0.0432 | 0.2516 | 0.5181 |
| Orkla | 0.4162 | 0.0011 | 0.0025 | 0.0432 | 0.0231 | 0.0000 |
| Vefsna | 0.5455 | 0.0005 | 0.0001 | 0.0002 | 0.0000 | 0.0000 |
| Altaelva | 0.3272 | 0.0016 | 0.0014 | 0.0318 | 0.4042 | 0.0996 |

| | |
|---|---|
| (dark green) | Significant downward (p<0.05) |
| (light green) | Downward but not significant (0.05<p<0.1) |
| (red) | Significant upward (p<0.05) |
| (orange) | Upward but not significant (0.05<p<0.1) |

***Table 14. Trends, shown as p-values, for metal concentrations in nine Norwegian rivers in the monitoring period (1990-2016). The colours indicate the degree of statistical significance (see legend).***

**CONCENTRATIONS metals. 1990-2016**

| River | Cd | Cu | Ni | Pb | Zn |
|---|---|---|---|---|---|
| Glomma | 0.0740 | 0.0016 | 0.0022 | 0.0056 | 0.1867 |
| Drammenselva | 0.0002 | 0.0073 | 0.0066 | 0.3732 | 0.0030 |
| Numedalslågen | 0.0017 | 0.0007 | 0.0312 | 0.0080 | 0.0006 |
| Skienselva | 0.0000 | 0.0002 | 0.0020 | 0.0140 | 0.0000 |
| Otra | 0.1402 | 0.6661 | 0.0003 | 0.0210 | 0.0000 |
| Orreelva | 0.6908 | 0.0601 | 0.0006 | 0.0204 | 0.2385 |
| Orkla | 0.0020 | 0.0001 | 0.0038 | 0.0001 | 0.0000 |
| Vefsna | 0.0024 | 0.0000 | 0.0024 | 0.0000 | 0.0000 |
| Altaelva | 0.1011 | 0.0001 | 0.1013 | 0.0305 | 0.0003 |

| | |
|---|---|
| (dark green) | Significant downward (p<0.05) |
| (light green) | Downward but not significant (0.05<p<0.1) |
| (red) | Significant upward (p<0.05) |
| (orange) | Upward but not significant (0.05<p<0.1) |

## Copper (Cu)

The LOQ for copper has not changed much over the monitoring period 1990-2016, and there are few samples below LOQ.

Main results:

- **Concentrations** of copper have decreased significantly in all rivers except rivers Otra and Orreelva. In River Orreelva there is an increase in copper concentration that is almost significant.

- **Riverine loads** of copper have decreased significantly in rivers Numedalslågen, Skienselva, Orkla, Vefsna, and Altaelva.

- There is an **increase** in copper loads in River Drammenselva, albeit not significant. This increase is mainly due to increased water discharge.

### Example: Copper in River Vefsna.

In River Vefsna there was a sharp decline in many substances from 1999 onwards, including copper (Figure 20). The annual loads of copper in River Vefsna during the years 1990-1998 amounted to around 12-17 tonnes, while in the following period (1999-2016) the loads dropped to 2-5 tonnes per year. Despite contacts with local managers, it has not been possible to explain this sudden decrease.

For the last ten years, no trends can be detected for copper loads or concentrations in River Vefsna.

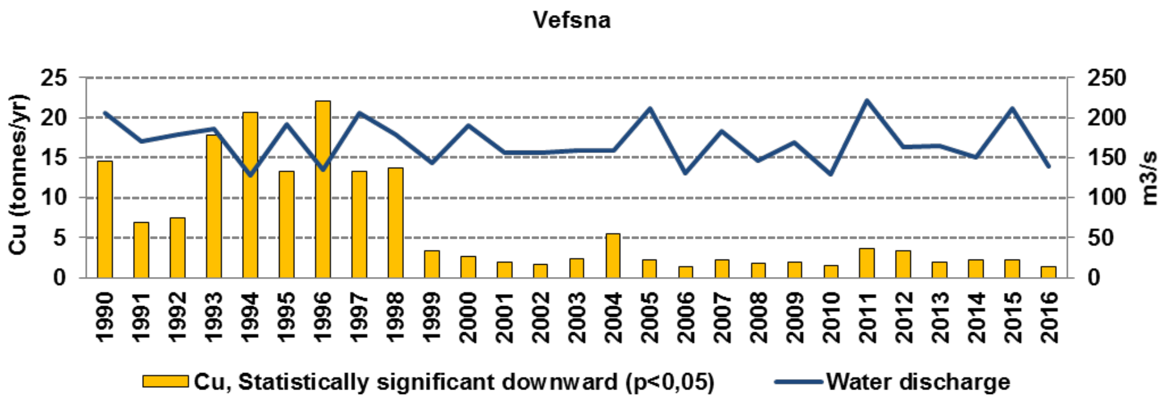


*Figure 20. Annual riverine loads of copper and water discharge in River Vefsna, 1990-2016.*

## Lead (Pb)

Table 15 shows that the LOQ for lead has changed by a factor of 100 during the monitoring period (1990-2016). This means that the interpretation of especially downward trends in lead loads should be carried out with great caution. These LOQ concerns does however not apply to the trends the last 10 years, since the LOQ has not changed in this period.

***Table 15. Changes in detection limits (LOQ) for lead (µg/l).***

| **Year** | 1990 | 1991 | 1992 - 1998 | 1999 | 2000 | 2001 | 2002-2003 | **2004-2016** |
|---|---|---|---|---|---|---|---|---|
| **LOQ** | **0.5** | **0.1** | **0.02** | **0.01 (0.1)[1]** | **0.01** | **0.01-0.02 (0.1)[1]** | **0.02-0.05 (0.2)[1]** | **0.005** |

1) The values in parenthesis are probably due to errors, as the quantification limit may have been given in the wrong unit.

Main results:

- **Concentrations** of lead have decreased significantly in all rivers except River Drammenselva.
- **Riverine loads** of lead have **decreased** significantly in rivers Glomma, Orkla and Vefsna.
- **Riverine loads** of lead have **increased** almost significantly in River Drammenselva, some of the increase can be explained by increased water discharge.
- **In the last ten years,** there is a significant **downward** trend in riverine loads and concentrations of lead in River Numedalslågen, and a significant **upward** trend in lead concentrations in River Drammenselva.

**Example: Lead in River Drammenselva**

Riverine loads of lead have increased almost significantly in River Drammenselva (Figure 21). Two out of the last three years (2014 and 2016) has had especially high lead concentrations (Figure 22) and in the last ten years, riverine concentrations of lead have increased significantly (Figure 22). In Section 3.3.3 this is discussed further.

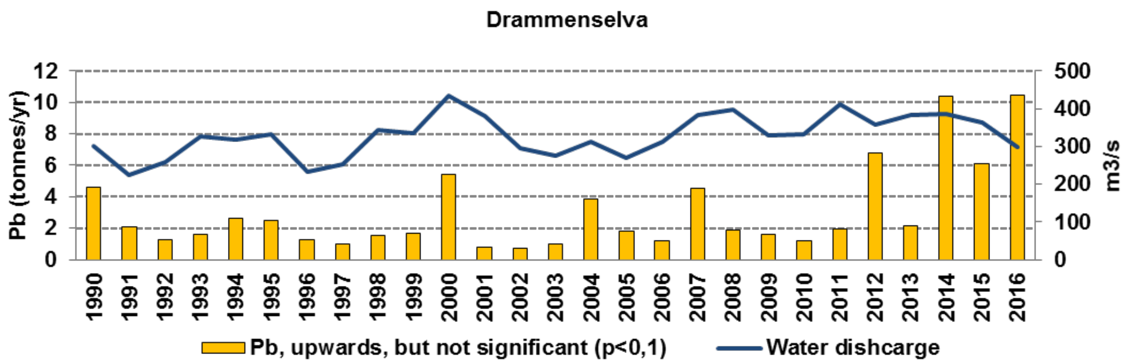


*Figure 21. Annual riverine loads of lead and water discharge in River Drammenselva 1990-2016.*

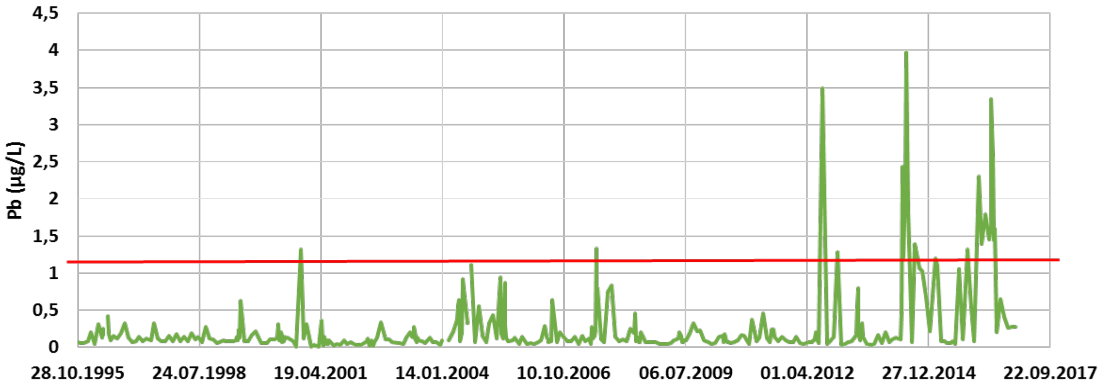


*Figure 22. Monthly concentrations of lead (Pb; µg/L) in River Drammenselva 1990-2016. Red line represents the AA-EQS for lead (1.2 µg/l; Miljødirektoratet 2016; see also Table 17).*

**Zinc (Zn)**

The LOQ for zinc has not changed much over the monitoring period 1990-2016.

Main results:

- **Concentrations** of zinc have **decreased** significantly in all rivers except rivers Glomma and Orreelva.
- **Riverine loads** of zinc have **decreased** significantly in rivers Numedalslågen, Otra, Orkla and Vefsna.
- In the **last ten years,** the concentrations of zinc have **increased** significantly in River Glomma.

For many of the examined rivers, the zinc loads show relatively low inter-annual variabilitycompared with many of the other metals. High loads in single years were almost solely explained by high single concentration values (e.g. 1993 in River Numedalslågen, 1990 in River Skienselva, 2005 in River Orreelva, and 2008 in River Altaelva).

**Example: Zinc in River Orkla**

Both concentrations and loads of zinc have decreased significantly in River Orkla during the monitoring period. For the loads there is also a significant decreasing trend the last ten years. The average load of zinc has decreased by more than 50 % from the first ten years (1990-1999) to the last ten years (2007-2016) of the monitoring programme.

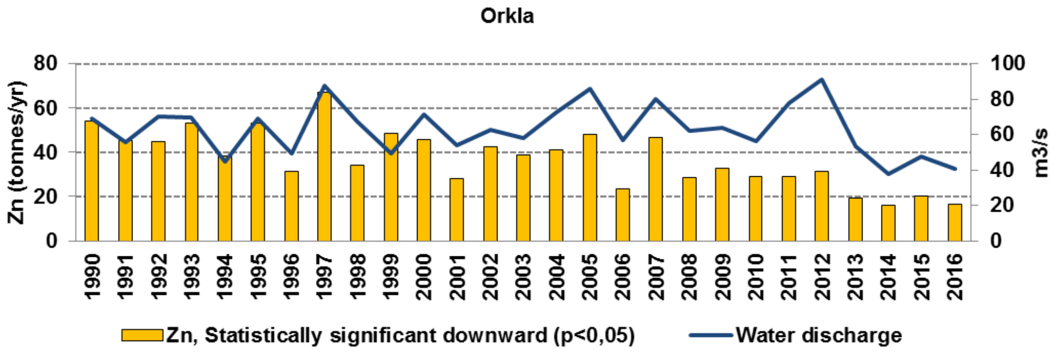


*Figure 23. Annual riverine loads of zinc and water discharge in River Orkla 1990-2016.*

**Example: Zinc in River Glomma**

In the latter years, loads and concentrations of zinc have **increased** significantly in River Glomma (Figure 24 and 25). The highest load peak was in 2012, and loads have decreased since then.

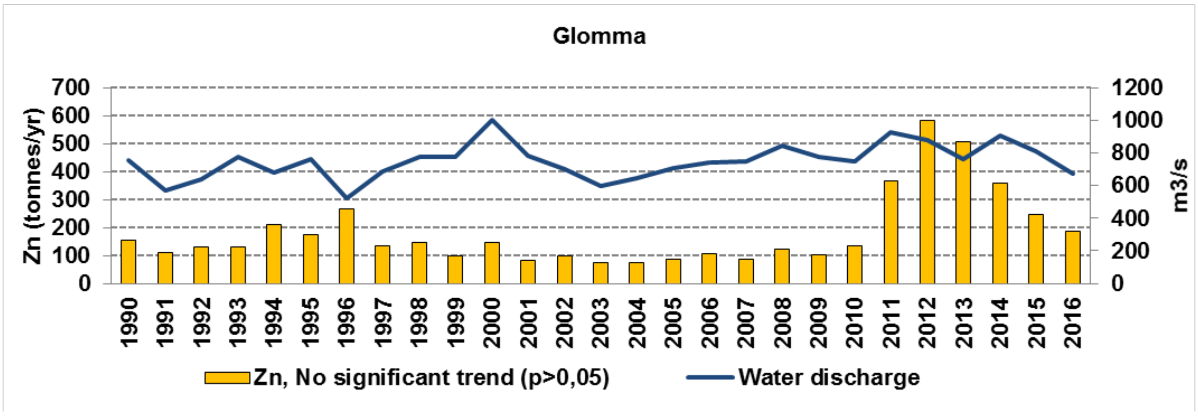


*Figure 24. Annual riverine loads of zinc and water discharge in Rivers Glomma 1990-2016.*

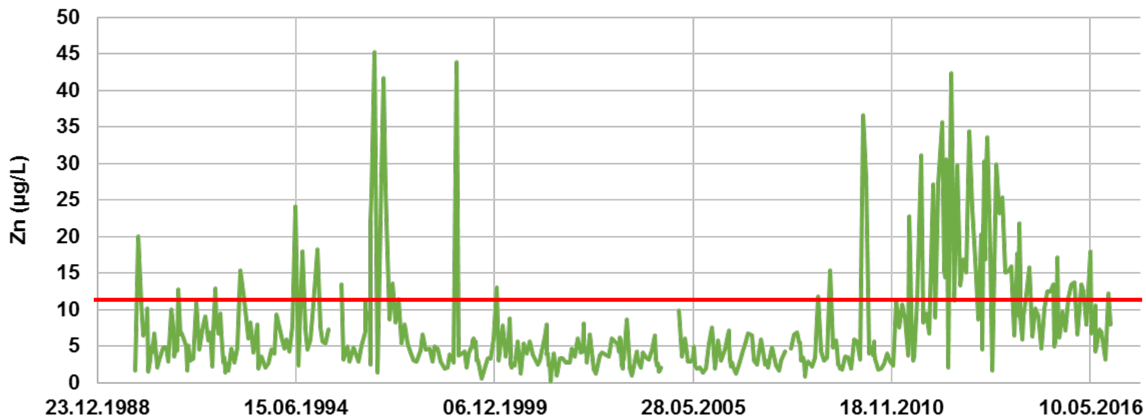


*Figure 25. Monthly concentrations of Zinc (Zn (µg/L) in River Glomma 1990-2016. Red line represents the MAC-EQS and AA-EQS (equal) for zinc (Miljødirektoratet 2016; Table 17).*

**Cadmium (Cd)**

Table 16 shows that the LOQs have changed substantially over the course of the monitoring period; e.g., from 100 ng/l in 1990 and down to 5 ng/l in 2004-2016. This means that the interpretation of especially downward trends in cadmium loads should be done with great caution. These LOQ-related concerns do not affect the 10 year-trends as the LOQ has not changed since 2004.

***Table 16. Changes in detection limits (LOQ) for Cadmium (ng/l).***

| **Year** | 1990 | 1991 | **2004-2016** |
|---|---|---|---|
| **LOQ** | **100** | **10** | **5** |

Main results

- Concentrations of cadmium have **decreased** significantly in all rivers except River Orreelva.
- Riverine loads of cadmium have **decreased** significantly in all rivers except River Otra and River Orreleva.
- About 25% of the cadmium observations in the nine investigated rivers were below LOQ, hence weakening the length of the available time series and the associated statistical power. The last ten years this is not an issue.
- The last ten years, concentrations of cadmium have **decreased** significantly in River Skienselva and almost significant in rivers Numedalslågen and Orkla. However, the slope change is very small for all these trends.
- The last ten years, loads of cadmium have **decreased** significantly in River Orkla. However, this trend disappears when water discharge is used as a covariate.

**Nickel (Ni)**
Similarly to lead and cadmium, the nickel LOQ has changed over the monitoring period and no firm conclusions can be drawn from the time-trends. The concerns related to LOQ do not affect the 10 year-trends as the LOQ has not changed since 2004 (see Appendix V).

Main results

- Concentrations of nickel have **decreased** significantly in all rivers except River Altaelva.

- The last 10 years, concentrations of nickel have **decreased** significantly in River Skienselva. However, the slope change is very small.

- The last 10 years, concentrations of nickel have **increased** significantly in River Vefsna. However, concentrations are still low and has not exceeded the threshold level (Table 17).

**Mercury (Hg)**
There is a high analytical uncertainty related to mercury data in the programme, following the changes of both laboratories and analytical methods between 1990 and 2015. Particularly, a different method used between 1999 and 2003 complicates the data interpretations. Therefore, the loads from 1999-2003 are based on estimated concentrations. The LOQs have not changed much over the course of the monitoring period, but a high proportion of the observations in the nine rivers have been below LOQ. Thus, no meaningful trend assessment of the annual loads was possible.

### 3.3.3 Metal concentrations and threshold levels

In 2016, new threshold levels for metals in freshwater were issued by NEA (Miljødirektoratet 2016). The threshold levels are given in Table 17a and b, for average annual concentrations (corresponding to the Water Framework Directive's AA-EQS), and for single grab water samples (corresponding to WFD's MAC-EQS), respectively. The first is the threshold value for chronic effects of long-term exposure, whereas the second is the the level when acute toxic effects may be expected.

***Table 17a. Exceeded threshold levels of annual means (the values in the cells are the average annual concentrations). n: number of samples per year***

| | **Metal** | Pb | Cu | Zn | Ni | Cr | Hg | Cd | As |
|---|---|---|---|---|---|---|---|---|---|
| River type | **Threshold level (µg/l)** | 1.2 | 7.8 | 11 | 4 | 3.4 | 0.047 | 0.08 | 0.5 |
| n= 12-16 | **Drammenselva** | 1.23 | | | | | | | |
| | **Orkla** | | | 12.79 | | | | | |
| n=4 | **Figgjo** | 1.35 | | 13.82 | | | | | |
| | **Sauda** | | | 21.30 | | | | | |
| | **Pasvik** | | | | 13.97 | | | | |

***Table 17b. Number of exceeded threshold levels for single water samples in each river (see Addendum 1 for the actual concentration values). n: number of samples per year.***

| | **Metal** | Pb | Cu | Zn | Ni | Cr | Hg | Cd | As |
|---|---|---|---|---|---|---|---|---|---|
| River type | **Threshold level (µg/l)** | 14 | 7.8 | 11 | 34 | 3.4 | 0.07 | 0.45 | 8.5 |
| n= 12-16 | Glomma | | | 4 | | | | | |
| | Alna | | | 4 | | | | | |
| | Drammenselva | | | 1 | | | | | |
| | Skienselva | | 1 | | | | | | |
| | Orreelva | | | 1 | | | | | |
| | Orkla | | 1 | 7 | | 1 | | | |
| n=4 | Tista | | | 2 | | | | | |
| | Figgjo | | | 1 | | | | | |
| | Sauda | | | 4 | | | | | |
| | Pasvik | | | | 1 | | | | |

The metal which most often exceeded its threshold value both in single water samples and as average over the year, was zinc. Three rivers had annual average values exceeding the threshold for zinc, and of these, two rivers were only sampled four times. In River Sauda, all four water samples collected in 2016 had zinc concentrations above the threshold for single samples (11 µg/l).

In single water samples, copper concentrations only exceeded the MAC-EQS in two rivers (Skienselva and Orkla). No river had average annual concentrations above the MAC-EQS. In 2015, copper concentrations were exceeded in eight rivers; this apparent reduction is due to a rather large increase in the guidance threshold level, from 1.5 µg/l to 7.8 µg/l.

Rivers Drammenselva and Figgjo had average concentrations of lead just above the AA-EQS threshold level; but no rivers had lead values exceeding the threshold for single samples (MAC-EQS).

River Pasvikelva has high concentrations of nickel, and in 2016, as in 2015, one single sample exceeded the threshold level for chromium in River Orkla.

### 3.3.4 Comparisons with metal trends in inputs to the Greater North Sea

As stated in OSPAR IA 2017[4], inputs to the Greater North Sea of mercury, cadmium and lead have been reduced since 1990. This is in accordance with the trend analyses of the Norwegian data. However, as for the Norwegian data, parts of the decline must be attributed to advances in analytical methods resulting in improved (lowered) detection limits. Some countries have also changed their analytical methods, for example from total metals to dissolved metals, due to the introduction of the EU WFD in 2000. This may have resulted in an apparent input reduction that is not real. Norway has maintained analyses of the 'whole water' sample and is therefore not included in this source of error.

Mercury and lead inputs to the Greater North Sea have approximately halved since 1990, whereas cadmium inputs have reduced by two-thirds. Mercury reductions are seen in all OSPAR countries between 1990–1995 and 2010–2014. The greatest reductions of lead inputs are seen in the Netherlands and Germany, accounting for half the total reduction of lead to the Greater North Sea. It is noted in the assessment that there is moderate confidence in the methods and low confidence in the data used.

## 3.4 Organic contaminants

Organic contaminants were determined in rivers Alna, Drammenselva and Glomma. Here follows a presentation of the concentrations and loads found.

**Polycyclic aromatic hydrocarbons (PAHs)**

Most PAHs were found above LODs both in the freely dissolved form and associated with SPM in 2016 (Addendum Table 1b). In River Alna, concentrations in 2016 were lowest for dibenzo[ah]anthracene (5 pg/l) and highest for pyrene with a concentration of 4.8 ng/l. This is a similar range of concentrations as those measured in the two previous years (Skarbøvik et al. 2015 and 2016). Across the entire range of PAHs, freely dissolved concentrations in the period 2013-2016 vary by a factor of 4-40 depending on the exposure and the chemical of interest. One has to bear in mind that the equilibrium sampling was obtained for some of the lighter PAHs (data is representative of the last few days of exposure/weeks for naphthalene for example) while sampling was integrative throughout the exposure period for the more hydrophobic PAHs (e.g. for benzo[ghi]perylene).

For 2016, PAH concentrations in River Drammenselva were below the limit of detection (LOD) (< 10-100 pg/l) for dibenzo[ah]anthracene and up to 13 ng/l for naphthalene. Freely dissolved concentrations for 2016 varied by up to one order of magnitude. Much of the data for benz[a]pyrene, perylene, indeno[1,2,3-cd]pyrene, dibenzo[ah]anthracene and benzo[ghi]perylene was below limits of detection with LODs in the range 10-100 pg/l. The last

[4] https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/

three PAHs were also consistently below limits of detection in River Glomma. PAH concentrations in River Glomma were slightly lower than those estimated for River Drammenselva in 2016. Concentrations ranged from below LOD for dibenzo[ah]anthracene (< 5-20 pg/l) to 11 ng/l for fluoranthene. Figure 26 presents examples of temporal variations in freely dissolved concentrations of fluoranthene, benzo[a]pyrene and benzo[ghi]perylene in River Alna for the period 2013-2016.

Freely dissolved concentrations measured in 2013-2016 in Rivers Alna (Figure 26), Drammenselva and Glomma are in line with those measured in previous studies from 2008-2012 (Allan et al., 2011; Allan et al., 2009; Allan et al., 2010; Allan et al., 2013; Allan and Ranneklev, 2011).

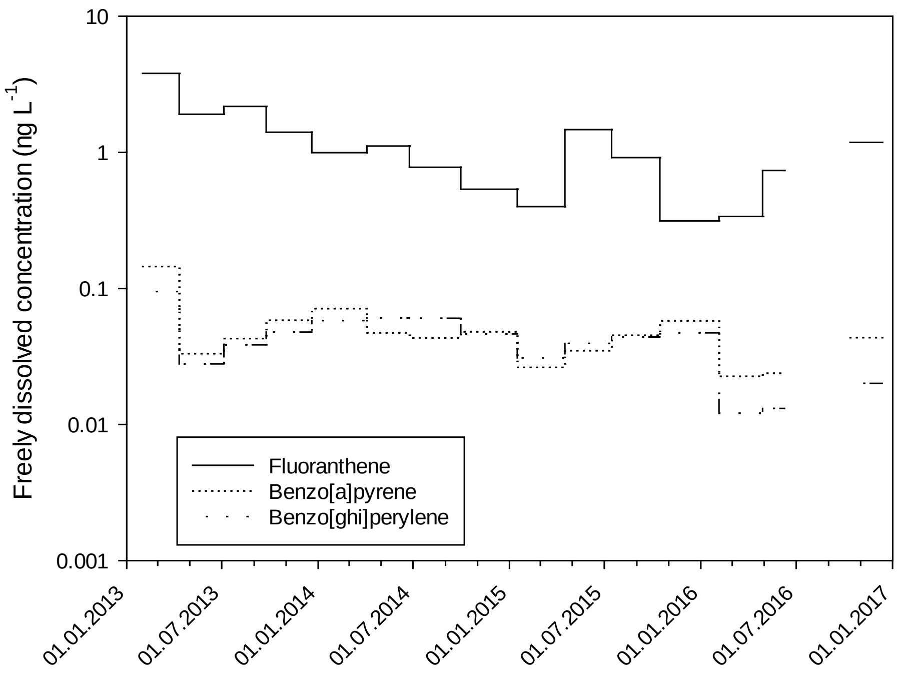


*Figure 26. Freely dissolved concentrations of selected PAHs (fluoranthene, benzo[a]pyrene and benzo[ghi]perylene) in River Alna for the period from January 2013 to December 2016. Note the log scale of the y-axis.*

SPM concentrations of PAHs in River Alna were lowest for acenaphthene (17-57 ng/g dw) and highest for pyrene and fluoranthene (560-1900 ng/g dw) (Addendum Table 1b). SPM concentrations of PAHs in River Drammenselva were as low as 3.1 ng/g for acenaphthene (< 2 ng/l for dibenzothiophene) and highest for fluoranthene (670 ng/g dw). PAHs concentrations in SPM from River Glomma were clearly lower than for the other two rivers, as in the two previous years. Naphthalene, acenaphthalene or dibenzothiophene were sparsely detected in the four SPM samples collected in 2016. In total, about ten PAHs were found at least once below LODs with LODs in the range 2-20 ng/g dw.

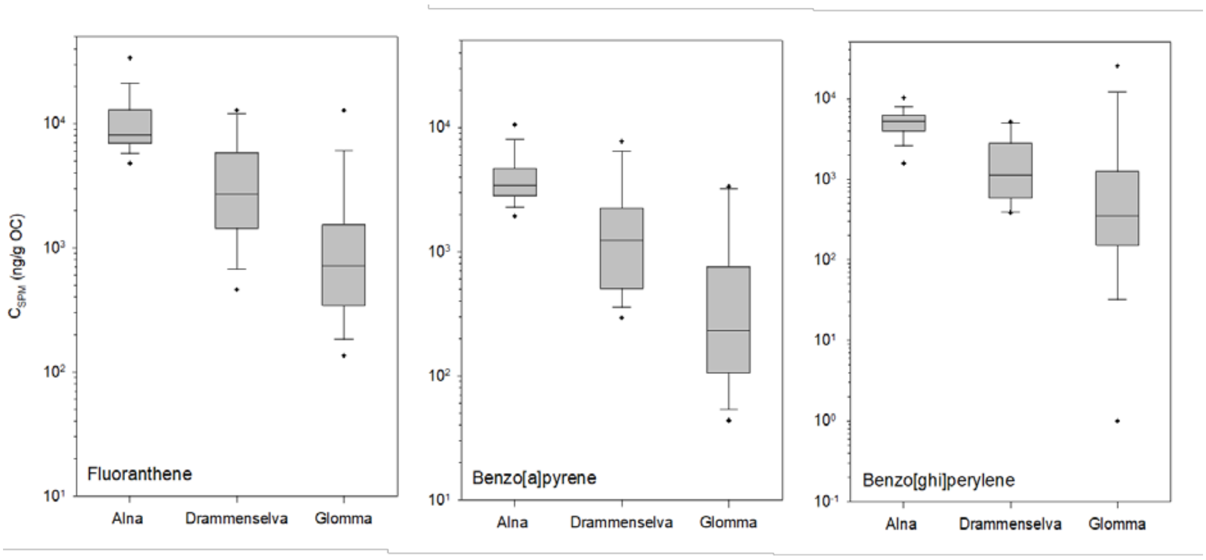


*Figure 27. Boxplot of mean organic carbon-normalised suspended particulate matter concentrations of selected PAHs (fluoranthene, benzo[a]pyrene and benzo[ghi]perylene) in Rivers Alna, Drammenselva and Glomma for the period from January 2013 to October 2016 (n = 16 for River Alna and n = 15 for Rivers Drammenselva and Glomma). Note: the log scale of the y-axis.*

Boxplots of organic carbon-normalised SPM concentrations of fluoranthene, benzo[a]pyrene and benzo[ghi]perylene for the period 2013-2016 (n=15-16) are presented in Figure 27. For comparisons of concentrations of hydrophobic organic compounds in SPM, at the very least, concentrations should be given on a OC-normalised basis since OC is the main component of SPM responsible for the sorption of these compounds to SPM (in a similar way to lipid-normalisation for biota tissues). On an organic carbon content basis, concentrations remained clearly higher for River Alna than for rivers Drammenselva and Glomma. In addition, the variability in SPM concentrations for these three compounds was clearly lower for River Alna than for the two other rivers. For Rivers Drammenselva and Glomma, there was more spread of the data including sampling events/samples that clearly deviated from the rest of the data (identified as outliers in the box plots). The highest SPM concentrations in rivers Drammenselva and Glomma were at the same level as those found for River Alna (Figure 27). It is likely that the variability in PAH concentrations is connected to the type of organic carbon present in the SPM samples. When SPM is composed of significant amounts of material from road run-off for example (associated with black carbon phases), PAH concentrations will likely be higher than if most of the organic carbon is of a natural origin.

**Polychlorinated biphenyls (PCBs)**

PCBs in the freely dissolved phase were consistently detected in River Alna in 2016 but found more sparsely above LODs in the two other rivers. This is consistent with the first three years of monitoring using passive sampling. LODs for PCBs ranged from 10 to 20 pg/l. As for previous years, PCB congeners with lower chlorination (less hydrophobic) were present in higher concentrations in the dissolved phase (?) than the ones with a higher degree of chlorination. In River Alna, concentrations of individual PCB congeners ranged from 0.5 pg/l for CB180 to 23 pg/l for CB28. The variation in concentrations between sampling periods in 2016 was under a factor of two for most congeners (see Figure 28).

An example of variation in PCB congener concentration in River Alna is given in Figure 28 for the period 2013-2016. PCB concentrations in River Drammenselva were often below LODs with LODs close to 10 pg/l. Concentrations reached a maximum of 50 pg/l for CB28 in 2016 and were lowest for CB138 with 2 pg/l. Congeners 101, 118, 138, 153 and 180 were below LOD for three passive sampler exposures out of four. As for previous years, PCB concentrations in River Glomma were slightly lower than those found in River Alna and Drammenselva. For congeners 28 and 52 that were consistently detected, concentrations varied by a factor of 4 and 10 over the year. CB congeners 101, 118, 138, and 180 were often below LOD (< 5-18 pg/l). Freely dissolved PCB concentrations obtained for River Alna in the period 2013-2016 were very similar to those from 2012 (Allan et al., 2013).

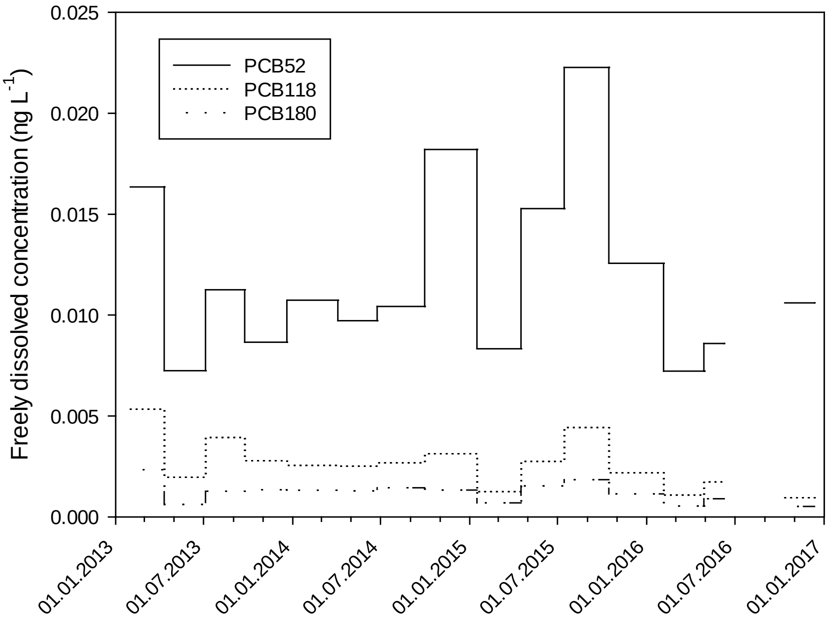


*Figure 28. Freely dissolved concentrations of selected PCB congeners (52, 118 and 180) in River Alna for the period from January 2013 to December 2016.*

As in 2013-2015, PCB congeners in the particulate matter phase were only detected in samples from River Alna. Only PCB153 was found above LOD in SPM from Rivers Drammenselva and Glomma. Concentrations were in the range 0.5-8.1 ng/g dw in 2016 in River Alna. Concentrations of most PCB congeners were below LOD in SPM from Rivers Drammenselva and Glomma (< 0.3-2.5 ng/g dw) in the four sets of samples analysed for each of the rivers.

**Polybrominated diphenyl ethers (PBDEs)**

PBDE concentrations in the three rivers ranged from below limits of detection below pg/l level up to 15 pg/l for BDE47 in River Drammenselva. The congeners that were mostly detected and quantified were BDE47, 99, 100, 153 and 154. Concentrations of BDE100, 153, 154, 126, 183 and 196 were mostly below LOD in all three rivers. For River Alna, concentrations were close to or below the pg/l level. Concentrations of PBDEs above LOD in River Alna were lowest for BDE100 (0.08-0.3 pg/l) and higher for BDE47 with concentrations of 0.6-1.5 pg/l. PBDE concentrations were slightly higher in freely dissolved fractions of Rivers Drammenselva and Glomma than in River Alna. Concentrations of BDE47 in Rivers Drammenselva and Glomma were in the range 1.5-15 pg/l. Concentrations for BDE congener 99 were in the range <1.5-5.5 pg/l and mostly below LOD for congener 100/153/154. BDE100 was measured above LOD in a few cases with estimated concentrations of 0.13 and 0.48 pg/l. As an example, variations in freely dissolved BDE47 concentrations in all three rivers over the period January 2013 to January 2016 can be found in Figure 29. PBDE concentrations in the dissolved phase in River Alna in 2016 were in a similar range to data published in 2013 (Allan et al., 2013). The concentration of freely dissolved BDE47 in River Drammenselva was in agreement with data from silicone rubber samplers from 2008 (Allan et al., 2009).

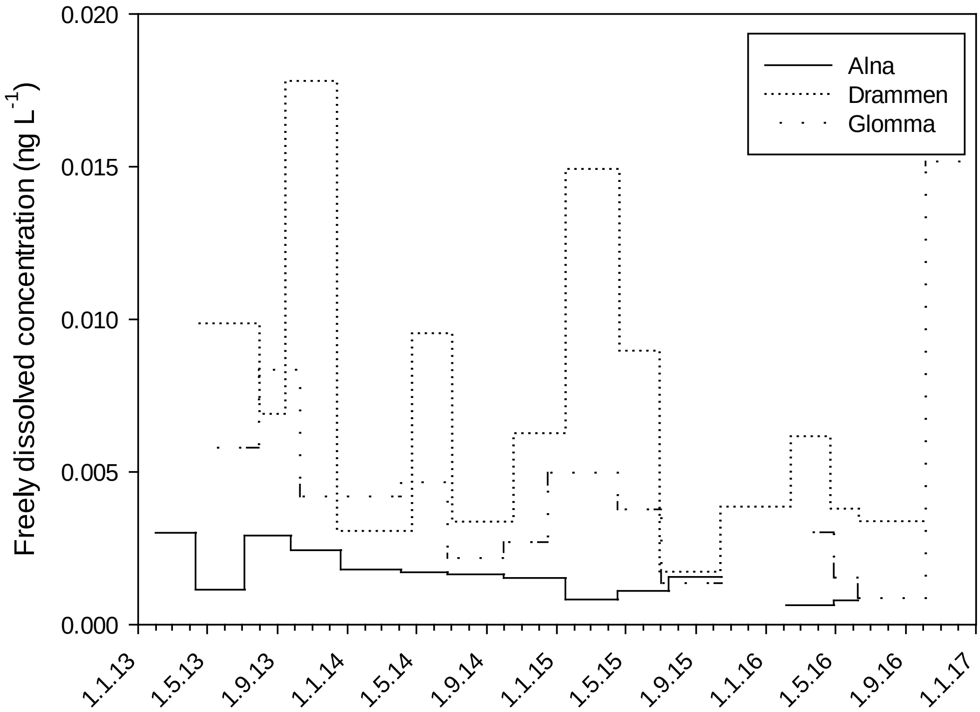


*Figure 29. Freely dissolved concentrations of PBDE 47 in Rivers Alna, Drammenselva and Glomma for the period from January 2013 to December 2016.*

BDE congeners 47, 99, 100, 153, 154, 183 and196 were measured in the concentration range 0.23-1.57 ng/g dw in SPM from River Alna. In River Drammenselva, BDE congeners 47 and 99 were found above LOD on one occasion with concentrations of 0.17 and 0.31 ng/g dw, respectively. In River Glomma, PBDEs were consistently below LOD with LODs between 0.1 and 0.3 ng/g dw.

BDE209 was not measured in passive sampler extracts for samplers deployed in 2016. However, BDE209 was frequently detected in SPM samples from all three rivers. SPM concentrations of BDE209 in River Alna in 2016 were generally similar to those measured previous years and in the range 32 to 49 ng/g dw. This range was similar to bed sediment concentrations measured in 2008 along the River Alna bed sediments (Ranneklev et al., 2009), and was generally higher than SPM concentrations in Rivers Drammenselva (2.3-7.0 ng/g dw) and Glomma (1.7-1.9 ng/g dw). On an organic carbon basis, BDE209 concentrations were also clearly higher for River Alna (Figure 30). The boxplot in Figure 30 also shows that organic carbon-normalised concentrations for BDE209 in River Alna SPM were surprisingly consistent.

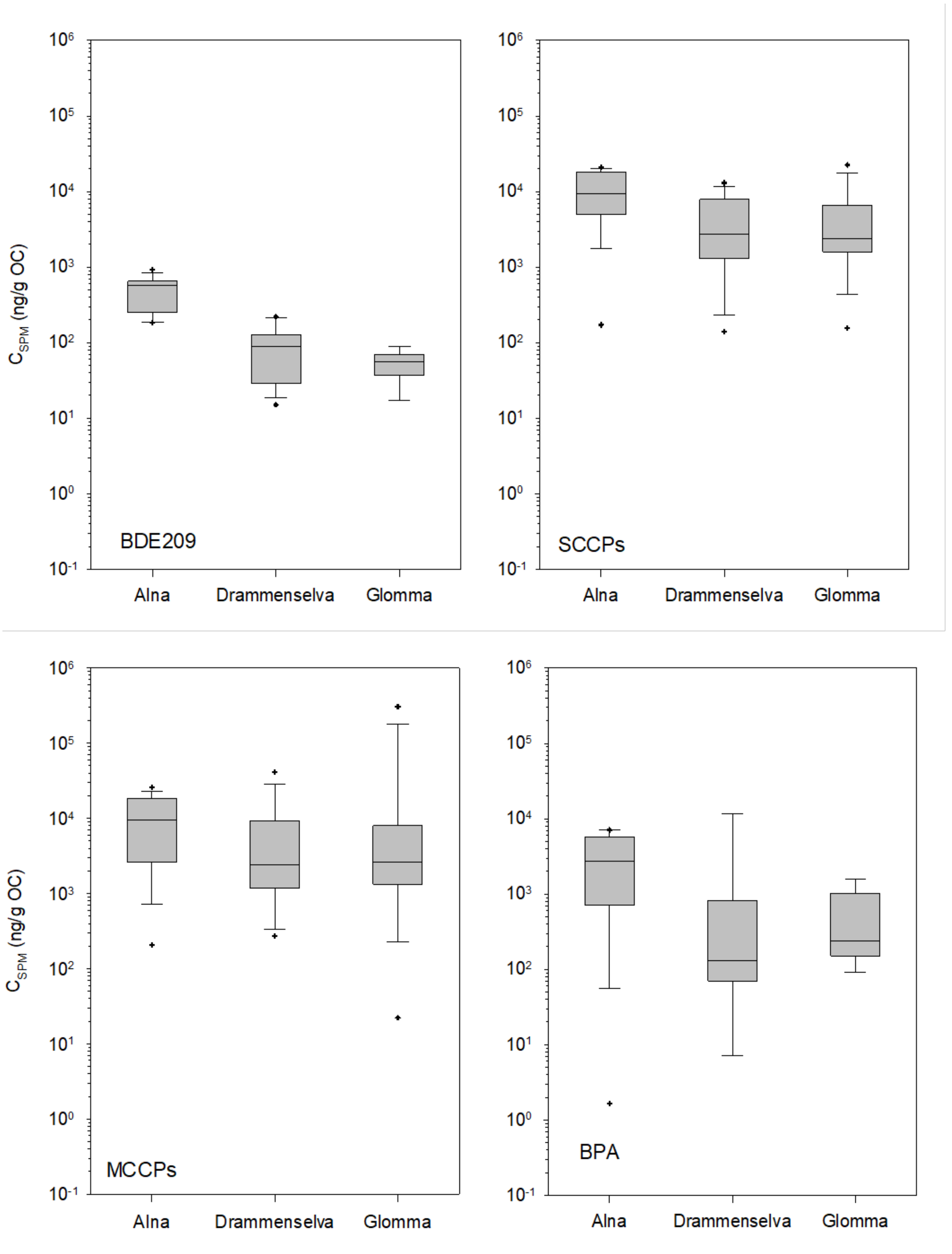


*Figure 30. Organic carbon (OC) normalised suspended particulate matter concentrations of selected BDE209, PFOS, S/MCCPs and BPA in Rivers Alna, Drammenselva and Glomma for the period from January 2013 to December 2016. Note the log scale of the y-axis.*

**Hexabromocyclododecane (HBCDD)**

In 2016, HBCDD isomers were most often detected in passive samplers exposed in River Alna with concentration estimates in the range 0.3-5 pg/l, which is a similar range to previous years. In 2016, the alpha isomer of HBCDD was found above LOD in River Drammenselva at concentrations in the range 4.5-46 ng/l. The beta an gamma isomers were consistently below LODs of 4-30 pg/l. The alpha isomer of HBCDD was measured above LOD in River Glomma on two occasions with concentrations 2.0 and 7.0 pg/l. All other data were below LODs (with LODs in the range 1.6-30 pg/l).

The alpha isomer of HBCDD was detected in SPM samples from River Alna at concentrations of 5.2 to 7.5 ng/g dw. The beta and gamma isomers were sporadically found at concentrations in the range 1.0-5.3 ng/g dw. The concentration of all three isomers were below LOD in the last SPM sample from River Alna. All three isomers were mostly below LODs in SPM samples of the two remaining rivers with LOD between 0.5 and 2 ng/g dw. Beta and gamma HBCDD were measured above LOD on two occasions in River Glomma at concentrations of 0.8 and 10 and 2.4 and 1.3 ng/g dw SPM respectively. The beta isomer was found above LOD in one sample from River Drammenselva (18 ng/g dw).

**Short and medium chain chlorinated paraffins (S/MCCPs)**

SPM concentrations for SCCPs measured in 2016 were higher in River Alna than in the other two rivers. Boxplots of organic carbon-normalised SPM concentrations shown in Figure 30 also show that S/MCCP concentrations over the period 2013-2016 were higher for River Alna than for Rivers Drammenselva and Glomma. However, these boxplots also show that concentrations were relatively variable with the presence of "outliers". In 2016, concentrations of S/MCCPs measured in the four SPM samples from each river varied by one to two orders of magnitude (<50-6059 ng/g dw). For River Alna, the concentration range was similar to the range found for S/MCCPs in bed sediments sampled in 2008 (Ranneklev et al., 2009).

**Bisphenol A (BPA)**

SPM concentrations of BPA were highest in River Alna and these were between 84 and 334 ng/g dw which is a similar range as that obtained in previous years. In 2016, BPA concentrations in River Drammenselva SPM were two orders of magnitude lower than those measured in River Alna. BPA in Drammenselva was above LOD in two samples only with concentrations of 2.4 and 4.8 ng/g dw. In River Glomma, SPM concentrations were mostly below LOD with LODs in the range of 1.2-1.7 ng/g dw. The final SPM sample from River Glomma had a BPA concentration of 22.6 ng/g dw. For comparison, previous measurements in River Alna bed sediments were between 0.4 and 47 ng/g dw (Ranneklev et al., 2009). In Figure 30, boxplots of organic carbon-normalised SPM concentrations of BPA (above LOD) for data from the 2013-2016 period show that these are very variable and can span two orders of magnitude. Concentrations in the hundreds of ng/g dw may indicate a source of BPA along River Alna. It is difficult to know from these data only what the source(s) of BPA to River Alna is(are). SPM concentrations are higher than those measured in bottom sediments upstream in River Alna (Ranneklev et al., 2009) and this tends to indicate that contaminated sediments along the river may not be the source of BPA. Possible sources may be run-off waters from paved surfaces and roads or industrial or landfill effluents.

**Tetrabromobisphenol A (TBBPA)**

TBBPA was only measured above LODs in some SPM samples from River Alna in 2016. Concentrations are close to limits of detection. Concentrations were in the range 0.7-1.3 ng/g dw in River Alna. TBBPA concentrations in Rivers Drammenselva and Glomma were consistently below LODs with these ranging from 0.25-1 ng/g dw.

**Perfluorinaded alkylated substances (PFAS)**

For PFAS, a total of five whole water samples were collected from each of the three rivers in 2016. Perfluorooctanesulfonic acid (PFOS) was the only perfluoro chemical consistently detected and measured in all three rivers. As for the water samples collected in 2015, the 2016 water samples from River Alna included quantifiable amounts of PFHxA, PFHpA, PFNA, PFOA, PFDA, PFBS, PFHxS, and 6:2 FTS at concentrations between 0.3 and 3.0 ng/l. PFOS and PFOSA were the most consistently detected PFCs in Rivers Drammenselva and Glomma. PFHxA, PFHpA and PFOA were also detected on multiple occasions in these two rivers. Mean annual average PFOS concentrations were 3.16, 0.25 and 0.18 ng/l in Rivers Alna, Drammenselva and Glomma, respectively.

The calculation of $logK_{poc}$ values from PFOS concentrations in water measured in 2016 and those measured in SPM in 2015 can help guauge how realistic measured concentrations in either phases were. $LogK_{poc}$ values were 3.69, 3.42 and 3.59 for Rivers Alna, Drammenselva and Glomma, respectively. These values are within a factor of 2 of the value of 3.7 measured for PFOS by Arhens et al. (2011). While PFOS is relatively water soluble, these value of $logK_{poc}$ demonstrate a moderate affinity for SPM.

### 3.4.1 Suspended particulate matter-water distribution of contaminants

As for the three previous years, it was possible to calculate particulate organic carbon-water distribution coefficients ($logK_{poc}$) for data from 2016. Mean values of $logK_{poc}$ for PAHs and PCBs in all three rivers for the period 2013-2016 are plotted in Figure 31 as a function of $logK_{ow}$. For River Alna, $logK_{poc}$ values for 2016 were very similar to data from previous years (Skarbøvik et al. 2015 and 2016). More variability in calculated $logK_{poc}$ was observed for the lighter, less hydrophobic PAHs (with low $logK_{ow}$ values) in 2016. For example the mean $logK_{poc}$ for naphthalene for 2013-2016 was 5.33 with a standard deviation of 0.46 (n= 15), while a lower variability in $logK_{poc}$ was seen for the higher molecular weight PAHs, e.g. the mean $logK_{poc}$ for benzo[ghi]perylene or dibenzo[ah]anthracene were 8.12 and 8.02 with standard deviations of 0.30 and 0.20 (n=15), respectively.

For PAHs in River Alna, standard deviations of mean $logK_{poc}$ (n= 12 for most compounds except for benzo[e]pyrene and perylene) ranged from 0.20 to 0.53 with a median value of 0.30. In general, the data from 2016 contributed to increasing the spread in the $logK_{poc}$ data for River Alna. The situation was slightly different for Rivers Drammenselva and Glomma. Mean $logK_{poc}$ values were on average lower than those found for River Alna, and the calculated $logK_{poc}$ values were more variable. The median of standard deviations of $logK_{poc}$ values was 0.56 and 0.55 for Rivers Drammenselva and Glomma, respectively. Data from 2016 also contributed to increased spread of the logKpoc data for Rivers Drammenselva and Glomma.

$LogK_{poc}$ for PAHs in River Alna for the period 2013-2016 were consistently above the 1:1 relationship with $logK_{ow}$, showing relatively high SPM sorption coefficients for PAHs. The slope and intercept of the linear regression with $logK_{ow}$ were 0.94 and 1.97, indicating that $logK_{poc}$ values were consistently almost two log units higher than $logK_{ow}$. Such a partitioning behaviour is not unexpected for PAHs, since a stronger sorption of PAHs to carbonaceous material (e.g. black carbon compared with sorption to amorphous carbon has been shown (Cornelissen et al., 2005). However, it has not often been measured in surface waters. Little is known of the temporal variability in concentrations of PAHs associated with suspended particulate matter in rivers or of the connection between particulate matter concentrations and those measured freely dissolved. However, it was shown that a significant proportion of PAHs associated with particulate matter from road run-off or in suspension in River Alna are not readily available for partitioning into the water phase (Allan et all., 2016). The low PAH accessibility measured in such particulate matter samples contributes to explain $\log K_{poc}$ values well above 1:1 relationship with $\log K_{ow}$. Interestingly, $\log K_{poc}$ values for Rivers Drammenselva and Glomma are closer to the 1:1 relationship with $\log K_{ow}$, indicating that suspended particulate matter in these rivers may comprise a smaller proportion of black carbon-like organic matter.

A different behaviour of the PCBs in River Alna can be seen for the same 2013-2016 period. $\text{Log}K_{poc}$ values for PCBs in River Alna are close to the 1:1 relationship with $\log K_{ow}$. The spread of $\log K_{poc}$ data for individual PCB congeners is low (median of all standard deviations for $\log K_{poc}$ for individual PCB congeners is 0.25). In general, these data support the correctness of the freely dissolved phase measurements made with the passive samplers.

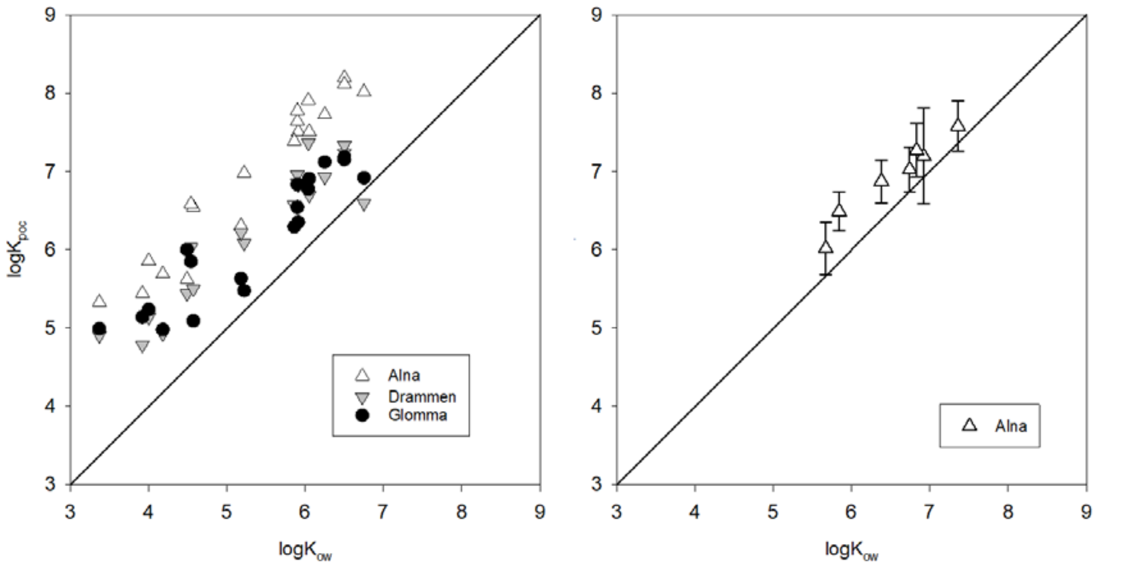


*Figure 31. Mean particulate organic carbon-water distribution coefficients as a function of $K_{ow}$ for PAHs (left) and PCBs (right) in Rivers Alna, Drammenselva and Glomma for different periods of sampling in 2013-2016. For PAHs, error bars are not shown, since it would make the graph difficult to read.*

$\text{Log}K_{poc}$ were also calculated for PBDE data from the three rivers for 2016, and the mean values from all data from 2013-2016 are plotted in Figure 32. Distribution coefficients for BDE47, 99, 100, 153 and 154 in River Alna were close to the 1:1 relationship of $\log K_{poc}$-$\log K_{ow}$ with more variable data for the more hydrophobic congeners. The data for the two other rivers were generally below the 1:1 relationship. For 2016, particulate organic carbon-water distribution coefficients for BDE209 were not calculated since BDE209 was only measured in SPM. Data plotted in Figure 32 are for the period 2013-2016. $\text{Log}K_{poc}$ values for BDE209 were consistently below the 1:1 relationship (in some cases by a few orders of magnitude). It may be that the SPM data for BDE209 was extremely variable and our continuous flow centrifuge data is not very representative of ambient BDE209 concentrations in SPM. It may also be that the passive sampling data overestimates BDE209 concentrations in the freely dissolved phase.

In Figure 32, $\log K_{poc}$ values for BDE47 for all three rivers are plotted. Consistently higher $\log K_{poc}$ values can be observed for BDE47 in River Alna (at $\log K_{ow}$ of 6.6) compared with Rivers

Drammenselva and Glomma. While whole water concentrations of PBDEs were generally higher in River Alna, it can be seen in Figure 29 that freely dissolved concentrations of BDE47 were lowest in River Alna and a larger proportion of this compound in water was bound to SPM. It is likely that differences in the type of organic matter (amorphous carbon or black carbon for example) in these rivers influence the distribution of PBDEs between SPM and water.

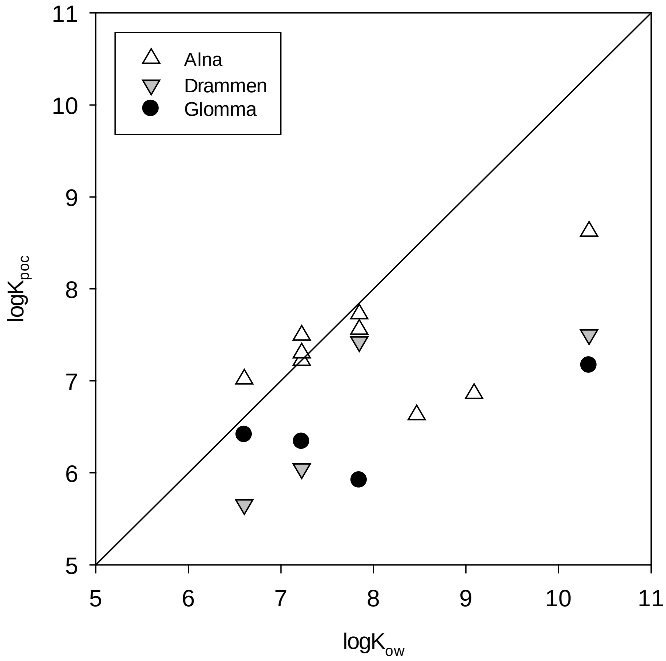


*Figure 32. Mean particulate organic carbon-water distribution coefficients as a function of $K_{ow}$ for PBDEs in Rivers Alna, Drammenselva and Glomma for the different periods of sampling during 2013-2016.*

### 3.4.2 Comparison with WFD environmental quality standards

Environmental Quality Standards (EQS) have been set at European level through the Water Framework Directive (WFD) for a number of substances that have been monitored during this study. The latest EQS values were published in 2013 and are given in Table 18.

Table 18 presents a comparison of annual average estimates of “whole water” concentrations for 2015 and 2016 for Rivers Alna, Drammenselva and Glomma with annual average environmental quality standards (AA-EQS) of the WFD. Such a comparison however needs to be treated carefully since our data is based on adding the concentrations estimates given for the freely dissolved phase and that measured associated with SPM, and this may or may not be an optimum way to obtain an estimate of (annual average) whole water concentrations. One has to bear in mind that the present monitoring programme was not established specifically for compliance monitoring (i.e. to compare against WFD AA-EQS values).

Estimates presented below clearly indicate that concentrations of naphthalene, anthracene, PBDEs (without BDE28), HBCDD (for Rivers Drammenselva and Glomma) were well below WFD EQS values in all rivers for monitoring data for both 2015 and 2016. For SCCPs, concentration estimates for all rivers were well below EQS values in 2013. As in 2014 and 2015, the “whole water” concentration range estimated for SCCPs in River Alna in 2016 was higher than in 2015 and extending to values closer to or slightly above EQS level (note that these estimates suffer significant uncertainty since measurements were only in the SPM phase). The range of estimated "whole water" concentrations for Rivers Drammenselva and Glomma is lower in 2016 than for 2015. As for the period 2013-2015, the concentration of fluoranthene in 2016 appeared to be close to or above EQS level in all three rivers. For benzo[a]pyrene, concentration estimates are above EQS for Rivers Alna and Drammenselva and close to EQS for River Glomma. For all three rivers, annual average concentration estimates for 2016 are within a factor of two of values obtained for 2015. The variability in PFOS concentrations in the five different whole water samples from each river was surprisingly low. Whole water sampling in 2016 confirms that the PFOS concentration in River Alna is well above EQS (by a factor of 5). Concentrations in Rivers Drammenselva and Glomma appear generally close to EQS and estimates are within a factor of 2-3 of the EQS value of 0.65 ng/l. For the very hydrophobic TBBPA, the 2016 estimates of average water concentrations for SPM-bound TBBPA (i.e. neglecting the freely dissolved concentration) are orders of magnitude below AA-EQS for all three rivers. For BPA, estimates of whole water concentrations concentrations are far from AA-EQS for Rivers Drammen and Glomma. However for River Alna, estimates are close to or above AA-EQS values. For PCB7, the sum of concentrations of the seven indicator PCB congeners estimated for 2016 is at 1-2 orders of magnitude lower than the AA-EQS value of 2.4 ng/L for Rivers Drammenselva and Glomma, respectively. For River Alna, the estimated annual average concentration is much closer to the AA-EQS. While the current monitoring programme was not specifically aimed at compliance checking with WFD AA-EQS values, "whole water" concentration estimates close to or above AA-EQS for fluoranthene, benzo[a]pyrene and PFOS in all three rivers, and BPA and PCB7 in River Alna certainly warrant further investigation.

The overall uncertainty in estimates of annual average concentrations will be dependent on the uncertainty of (i) freely dissolved concentrations, (ii) SPM-associated concentrations and (iii) the size of the fraction of contaminants not measured by the two techniques used in the present study. There is also a potential significant uncertainty arising from the extrapolation of a monthly average SPM level in water from a single SPM measurement. Overall, a sensitivity analysis should be conducted to identify the parameters that affect the quality of estimates of annual average concentrations. This would help in determining where to focus our monitoring effort to obtain best possible data for acceptable costs.

For fluoranthene, the fraction of the chemical present in the freely dissolved form in 2016 represented 6.5, 76 and 86 % of the estimated "whole water" concentration in Rivers Alna, Drammenselva and Glomma, respectively. For benzo[a]pyrene, these values were 0.7, 16 and 6.4 %, respectively. Differences in the distribution of fluoranthene and benzo[a]pyrene between the particulate and dissolved phase in the different rivers will affect the overall uncertainty of the "whole water" estimates. The standard error in the estimates of sampling rate provided by the non-linear least square method (Booij and Smedes, 2010) were in most cases between 10 and 20 %. For fluoranthene, however, in many cases, the uncertainty was not related to the sampling rate estimation but to the uncertainty in $K_{sw}$ values, since measurements with silicone samplers are made close to equilibrium with the dissolved phase. An uncertainty of 0.2 log unit can be expected for $\log K_{sw}$ values. This also means that the passive sampling of fluoranthene was not truly time-averaged over the entire period of deployment. The uncertainty resulting from this will depend on the temporal variability of the dissolved fluoranthene concentration in water. Since benzo[a]pyrene is more hydrophobic, time to equilibrium is longer than for fluoranthene and most passive sampling measurements remained time-averaged. Bias in passive sampling data can result from the temperature-dependency of $K_{sw}$ values. Higher $K_{sw}$ values at lower temperatures (as a result of decreasing solubility of hydrophobic chemicals in water with decreasing temperature) can be expected for deployments where the average temperature is significantly lower than that at which $K_{sw}$ values have been measured (20 °C). Applying a temperature correction to $K_{sw}$ values will result in the estimation of higher $R_s$ and lower concentrations in water. Since a significant proportion of fluoranthene is found in the particulate fraction in River Alna, uncertainties in the estimation of average SPM-associated fluoranthene and benzo[a]pyrene concentrations will play a major role in the overall uncertainty of estimated "whole water" concentrations. This is also the case for benzo[a]pyrene in Rivers Alna and Drammenselva. Knowledge of temporal variability of SPM-associated concentration and factors contributing to this variability is needed.

Clearly, these monitoring data are very useful for comparisons with WFD EQS. WFD EQS are set for the "whole water" for these substances and certain EQS have also been derived for biota for some of the hydrophobic and persistent compounds such as hexachlorobenzene. One challenge however is to reconcile the measurement of these substances in one or more matrix (particular or dissolved) and the comparison with "whole water"-based EQS. Different options are possible (Miége et al., 2015; Booij et al., 2016):

- As undertaken here for some of the substances of interest, measurements can be done separately on the SPM-associated fraction and in the freely dissolved form. Additional empirical modelling may be undertaken to estimate the concentration of chemicals associated with DOC, not sampled with the techniques used here. Whole water concentrations are then calculated from concentration estimates from each matrix.
- Measurements can be done on one matrix only, i.e. freely dissolved form or for SPM associated concentrations and empirical modelling can be conducted by using $K_{poc}$ values to infer concentrations in the phases not monitored. Values of $K_{poc}$ derived for PAHs and PCBs for the three rivers monitored in this programme may be used relatively reliably to estimate a whole water concentration. Reliable values of $K_{poc}$ were also obtained for PFOS.
- EQS values based on freely dissolved concentrations could be derived in the same way as sediment or biota based EQS are derived. This would help with the implementation of passive samplers for surveillance monitoring under the WFD.
- Finally, for substances where EQS have been derived for biota, passive sampling-measured concentrations can be expressed as a concentration of the chemical in lipid that would be at thermodynamic equilibrium with the water to facilitate comparisons with these EQS values. To enable such calculations, polymer-water and polymer-lipid partition coefficients are needed. Such calculations have been successfully undertaken for substances such as PCBs, however reliable polymer-water and polymer-lipid partition coefficients may be required for some the WFD priority substances.

Overall, a sensitivity analysis will be needed to determine the main parameters influencing the reliability of calculation of annual-average concentrations for comparison with EQS. For example, for PAHs in River Alna, it is possible that refining annual average concentrations can be achieved by more frequent sampling of SPM and assessment of SPM levels over time with a higher frequency. For some priority substances, maximum acceptable concentration EQS have been established. For such comparisons it is unlikely that a monitoring programme can allow the measurement of such concentration and some form of modelling will be required.

**Table 18. Comparison of calculated annual average contaminant concentrations for Rivers Alna, Drammenselva and Glomma for 2015 and 2016 with Water Framework Directive annual average environmental quality standards (AA-EQS). Blue, orange and red shading are for when "whole water" concentration estimates are well below EQS, close to EQS (i.e. within a factor of 2-4 below EQS) and above EQS, respectively.**

| Substance | Annual average "whole water" concentration (ng/l) for 2015 and 2016 | | | | | | WFD AA-EQS |
|---|---|---|---|---|---|---|---|
| | Alna | | Drammenselva | | Glomma | | |
| | 2015 | 2016 | 2015 | 2016 | 2015 | 2016 | |
| Naphthalene(1) | 3.0 | 2.5 | 4.7 | 7.7 | 2.8 | 6.8 | 2000 |
| Anthracene(1) | 2.2 | 1.3 | 0.16 | 0.24 | 0.14 | 0.28 | 100 |
| Fluoranthene(1) | 16.1 | 8.7 | 3.1 | 4.2 | 2.5 | 4.4 | 6.3 |
| Benzo[a]pyrene(1) | 6.8 | 3.6 | 0.37 | 0.49 | 0.03-0.13 | 0.03-0.52 | 0.17 |
| PFOS(2) | 1.2-12 | 3.2 | 0.05-0.5 | 0.25 | 0.1-2 | 0.18 | 0.65 |
| PBDEs (- BDE28)(3) | 0.20-0.24 | 0.02-0.024 | 0.01-0.03 | 0.01-0.024 | 0.019-0.029 | 0.002-0.03 | 140 |
| HBCDD | 0.53 | 0.09-0.1 | 0.024 | 0.05-0.08 | 0.001-0.022 | 0.07-0.09 | 1.6 |
| SCCPs(4) | 18-97 | 6-668 | 6-132 | 1-40 | 3-88 | 4-44 | 400 |
| TBBPA | | 0.004-0.007 | | < 0.003 | | < 0.01 | 250 |
| BPA | | 604-6035 | | 0.8-14 | | 2.8-36 | 1500 |
| PCB7 | | 0.55 | | 0.04-0.12 | | 0.03-0.06 | 2.4 |

(1) Whole water refers here to the sum of the freely dissolved concentration and that of the suspended particulate matter-associated contaminant concentration.
(2) PFOS annual average concentration for 2016 are based on the measured concentrations in the 4 whole water samples in. These were based on SPM concentrations in 2015
(3) The sum of PBDE congeners according to the WFD includes congener 28.
(4) SCCP annual average concentration are based on the measured concentrations in the SPM phase and predicted freely dissolved concentration based on measured SPM concentrations and a log$K_{poc}$ range of 5 to 8. The upper level estimates may suffer considerable uncertainty.
(5) Based on SPM concentrations only
(6) BPA annual average concentration are based on the measured concentrations in the SPM phase and predicted freely dissolved concentration based on measured SPM concentrations and a logKpoc range of 3.5 to 4.5.
Note: Contaminant sorption to dissolved organic matter is not taken into account here.

### 3.4.3 Estimation of riverine loads of contaminants for 2016

Annual riverine contaminant loads are given in Table 19. Riverine loads of S/MCCPs, BPA, TBBPA and PFOS are for the SPM fraction of contaminants. Generally, the loads were higher in River Glomma compared with River Drammenselva, and loads from both rivers were substantially higher than in River Alna. This reflects the large difference in annual discharge and differences in size of the river catchments. When comparing contaminant loads between years, it has to be noted that in 2016, the total estimated annual water discharge were 68, 82 and 83 % of those estimated for 2015 for Rivers Alna, Drammenselva and Glomma, respectively. For the SPM, annual discharges estimated were 23, 66 and 122 % of those estimated for 2015.

Yearly loads of individual PCB congeners for River Alna for 2016 were higher than in 2015 with loads below 2 g/yr. Yearly loads of PCB congeners for Rivers Drammenselva and Glomma range from < 7-136 g/yr for CB138 in River Drammenselva to 152-858 g/yr for CB28 in River Glomma. As mentioned before (Skarbøvik et al., 2015), these data represent a significant improvement to the use of bottle sampling for the estimation of loads of PCBs from Norwegian rivers. Estimates of loads for seven indicator PCB congeners were 8-10, 706-1183 and 2098-2925 g/yr for Rivers Alna, Drammenselva and Glomma, respectively. As for the three previous years, estimates for 2016 are more uncertain for Rivers Drammenselva and Glomma since concentrations in the SPM phase were mostly below LOD.

The 2016 loads of individual PBDE congeners were below 1 g/yr for River Alna, while the loads were in the range 1-62 g/yr for River Drammenselva and 1-153 g/yr for River Glomma. Riverine loads for HBCDD isomers were in the range 3-3.5, 651-772 and 677-1838 g/yr for Rivers Alna, Drammenselva and Glomma, respectively.

Yearly loads of individual PAHs for 2016 were below 0.5 kg/yr for River Alna and up to 135 kg/yr for phenanthrene and 144 kg/yr for naphthalene in River Glomma. Riverine loads for PAHs were far higher than those estimated for all the other contaminants. The total load of PAHs from River Alna in 2016 was lower than that estimated for 2015. However, loads for Rivers Drammenselva and Glomma were slightly lower for 2015.

The riverine discharge of S/MCCPs in River Glomma, however, was approaching the same level as PAHs in 2016. The overall load of PFOS for 2016 were 118, 2400 and 3850 g/yr for Rivers Alna, Drammenselva and Glomma, respectively. For PFOS, we originally calculated loads of freely dissolved PFOS assuming a $\log K_{poc}$ value of 4 (Ahrens *et al.*, 2011) of 72, 575 and 3110-4846 g/yr for Rivers Alna, Drammenselva and Glomma, respectively. These values are very close to estimated loads for 2016 based on whole water samples.

***Table 19. Estimated riverine contaminant loads in Rivers Alna, Drammenselva and Glomma, 2016***

| Compound | Unit | Annual contaminant load | | |
|---|---|---|---|---|
| | | Alna | Drammenselva | Glomma |
| $\Sigma PAH_{16}$ | kg/yr | 2.1 | 269-271 | 676-682 |
| $\Sigma PCB_7$ | g/yr | 8-10 | 706-1183 | 2100-2925 |
| ΣPBDE (excl. BDE28) | g/yr | 3-3.6 | 99-222 | 127-581 |
| BDE209[a] | g/yr | 8.5 | 139 | 428-497 |
| ΣHBCDD (α, β, γ) | g/yr | 3-3.6 | 651-772 | 677-1837 |
| SCCPs[a] | kg/yr | 0.21 | 9.7 | 71 |
| MCCPs[a] | kg/yr | 0.26 | 19 | 430 |
| BPA[a] | g/yr | 61 | 64-111 | 1521-2000 |
| TBBPA[a] | g/yr | 0.16-0.24 | < 24 | < 210 |
| PFOS[b] | g/yr | 118 | 2400 | 3850 |

[a]Estimated loads for these substances are only for the particulate matter-associated fraction; [b]For PFOS, total loads are based on whole water sampling.

Expressing contaminant loads relative to the size of the drainage basins of the rivers shows a very different picture. In general, data from 2016 tend to support data obtained for previous years. For all sets of chemicals, annual loads per $km^2$ of drainage basin were highest for River Alna both in 2016 and in previous years (Figure 33). This reflects that the majority (68%) of the River Alna catchment is urban area. Loads per $km^2$ of drainage basin for Rivers Drammenselva and Glomma were generally lower. Estimated area specific loads for Rivers Drammenselva and Glomma were similar for many classes of chemicals. A decrease in loads for most contaminants can be seen for River Alna from 2015 to 2016. This decrease is partly due to the decreases in water discharge and SPM load in that period. However, when data are from SPM monitoring only conducted four times a year they have to be assessed carefully, particularly when contaminant concentrations have been shown to span two orders of magnitude. Overall, estimates of area specific loads for Rivers Drammenselva and Glomma for PAHs, PCBs or PBDEs do not vary appreciably over the four years of monitoring. Area specific loads for TBBPA were much lower in 2016 compared with those estimated for previous years. For PFOS, load estimates from whole water sampling in 2016 are clearly and unsurprisingly higher than those for SPM-associated PFOS. As mentioned previously, there was an excellent agreement between PFOS concentrations in water (2016) and those associated with SPM (2015). For the situation when data was below LOD, loads were calculated using concentrations set to either 0 or to the LOD and these are shown in Figure 33. The impact of this procedure can be seen for loads for the sum of 7 indicator PCBs, the sum of HBCDD isomers or for TBBPA for example.

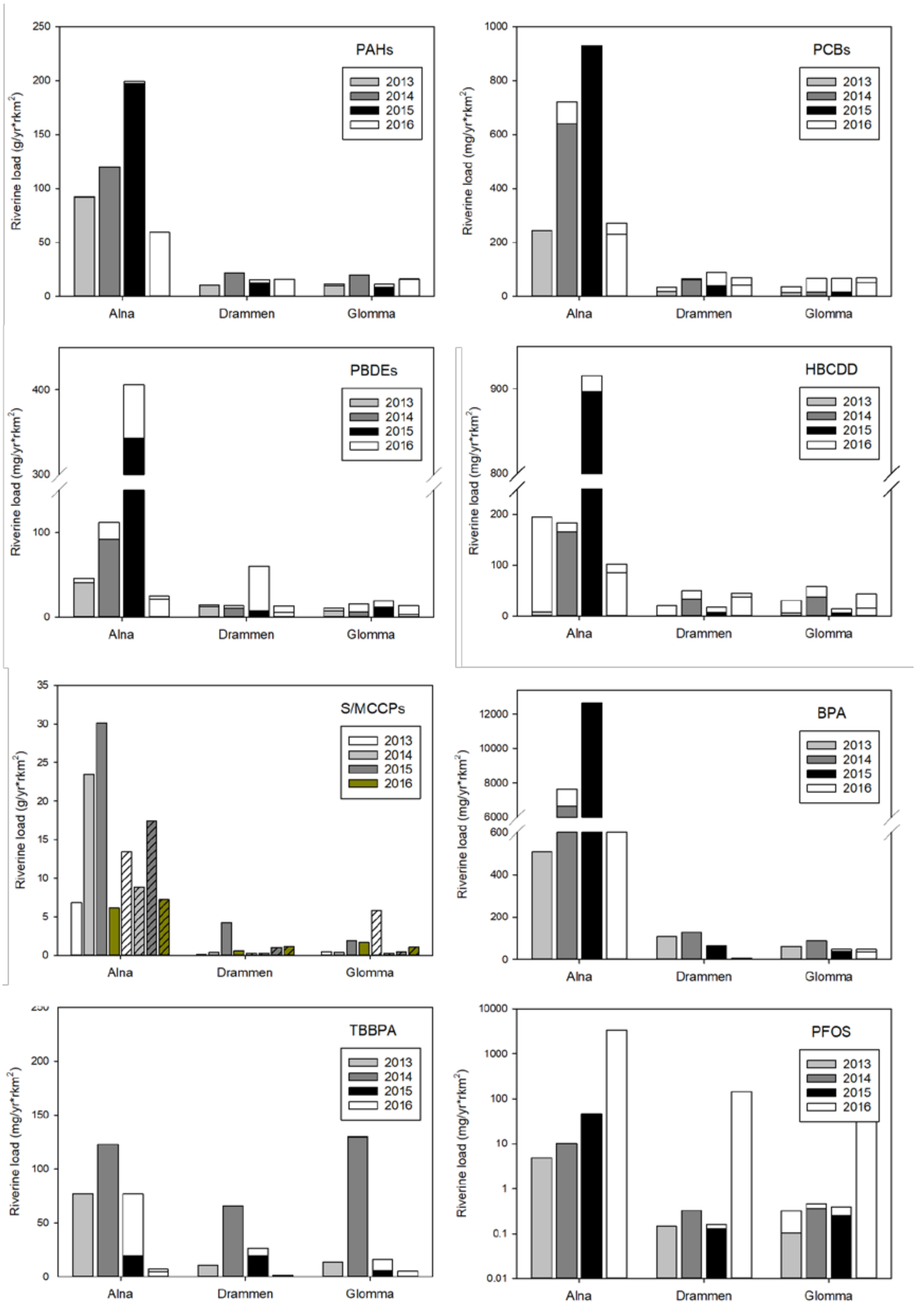


*Figure 33. Estimates of river basin surface area-normalised riverine loads of contaminants in Rivers Alna, Drammenselva and Glomma for 2013-2016. SCCPs and MCCPs are represented by bars without and with shading, respectively. Filled bars indicate riverine loads estimated based on data above limits of detection only. When datasets included data below limits of detection, estimated loads using LOD as concentration are shown as white stacked bars. For PFOS, data for 2013, 2014 and 2015 is based on SPM-associated loads while for 2016, these are for the whole water.*

# 3.5 Sensor data

Sensor data for turbidity, temperature, pH, and conductivity have been recorded in rivers Glomma, Alna and Drammenselva in the period May 2013 – December 2016.

## 3.5.1 Operation and maintenance

The sensors needed repeated maintenance during the year. In particular, the pH sensors had issues, and in River Alna the values exceeded 14 at two occations. In May, new pH sensors were installed in rivers Alna and Glomma. In River Drammenselva the tube with the sonde needed to be anchored more securely.

Appendix IV gives a detailed maintenance log for 2016. For maintenance logs before 2016, see Skarbøvik et al. (2016).

Despite these repeated maintenance efforts, a manual inspection of the data was necessary to 'flag' suspicious (unlikely) values. The maintenance log was consulted during this work. The suspicious data were removed before the below analyses were done.

## 3.5.2 Turbidity from sensors and in grab samples

A turbidity sensor measures the amount of light that is scattered by particles in water. It is therefore often used as a measure on suspended solids, as well as particle associated substances.

Figure 34 shows turbidity data from both sensors and grab samples in the three rivers monitored in 2016. As also noted in 2015, there are issues with the turbidity data from rivers Alna and Drammenselva, with data occationally varying rapidly over a short period of time. This is not unusual with this type of sensor and may be an effect from material clinging to the sensor. However, it can also reflect actual variations in visibility of the river waters. In River Glomma the turbidity data were very consistent, except for a few spikes; these were removed during the quality assurance. A grab sample collected in River Glomma in February had relatively high turbidity levels, and hence confirmed the peak in sensor turbidity at the same time. As noted below, grab water samples should be collected during different water flow and turbidity conditions for better assessment of the performance of the sensors.

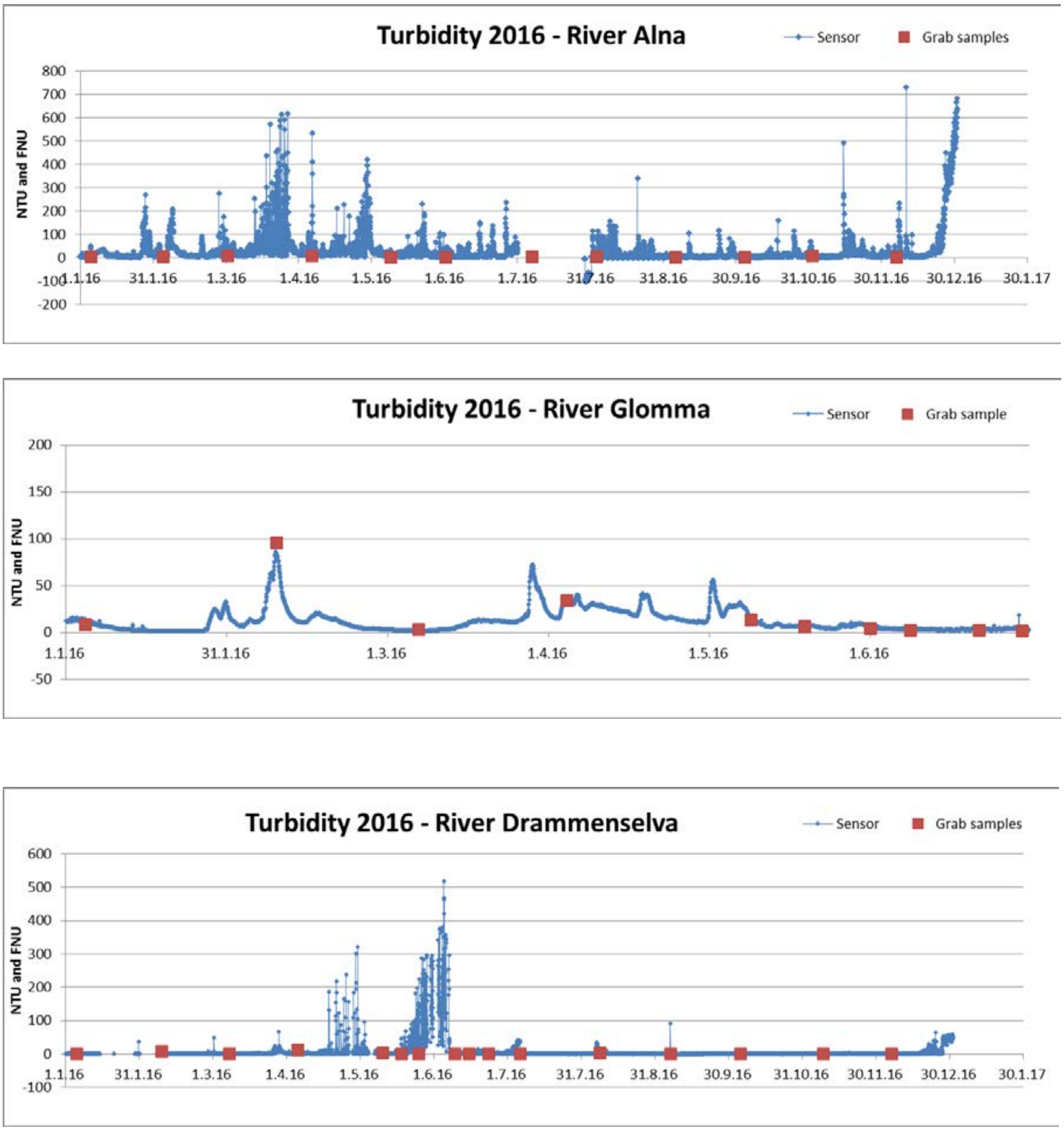


*Figure 34. Variations in turbidity in 2016 in the three rivers with sensor data.*

The graphs showing the correlation between turbidity measured in grab samples and data obtained from sensors, first shown in Skarbøvik et al. (2016), have been updated with data from the 2nd half of 2016 (Figure 35). The correlation between turbidity values in grab samples and from sensor data was good for rivers Glomma and Drammenselva. In River Alna, the correlation was good thanks to one sample with high values in both grab and sensor data. When this sample was removed from the dataset, the correlation became considerably poorer. Although experiences from other rivers have shown that it is not unusual that the correlation is poor at low turbidity values (e.g., Skarbøvik and Roseth 2014), it is likely that monitoring with sensors is more difficult at some locations and in some rivers than others. Examples of factors complicating measurements are floating debris and organic material that may cling to the sensor and disturb the recordings.

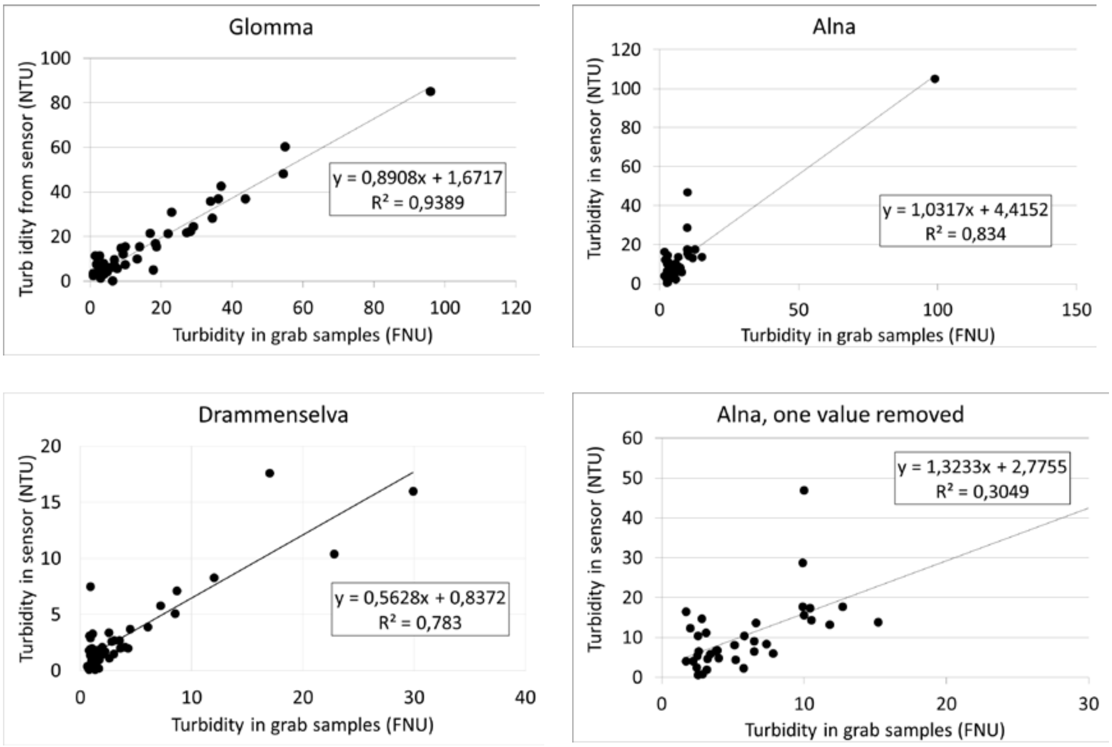


*Figure 35. Turbidity from sensor recordings and grab samples, compared for the three rivers with sensor recordings (2013-2016). For Alna two diagrammes are shown; one with and one without the single high value.*

### 3.5.3 Conductivity from sensors and in grab samples

Electrical conductivity is used to monitor the amount of dissolved substances in the water. It is measured by sending a constant voltage between two electrodes, resulting in an electric current through the water. The more dissolved substances in the water, the more conductive will the water be, and hence the higher conductivity.

Figure 36 shows conductivity data from both sensors and grab samples in the three rivers in 2016. Similar to last year, River Alna had the highest conductivity levels, with a maximum level of about 250 mS/m. This is considerably higher than the highest values found in grab samples (66 mS/m) in this river. As in 2015, the high values mainly occured during winter, and a hypothesis is that this can be linked to runoff of road salt (see e.g., Skarbøvik and Roseth 2014).

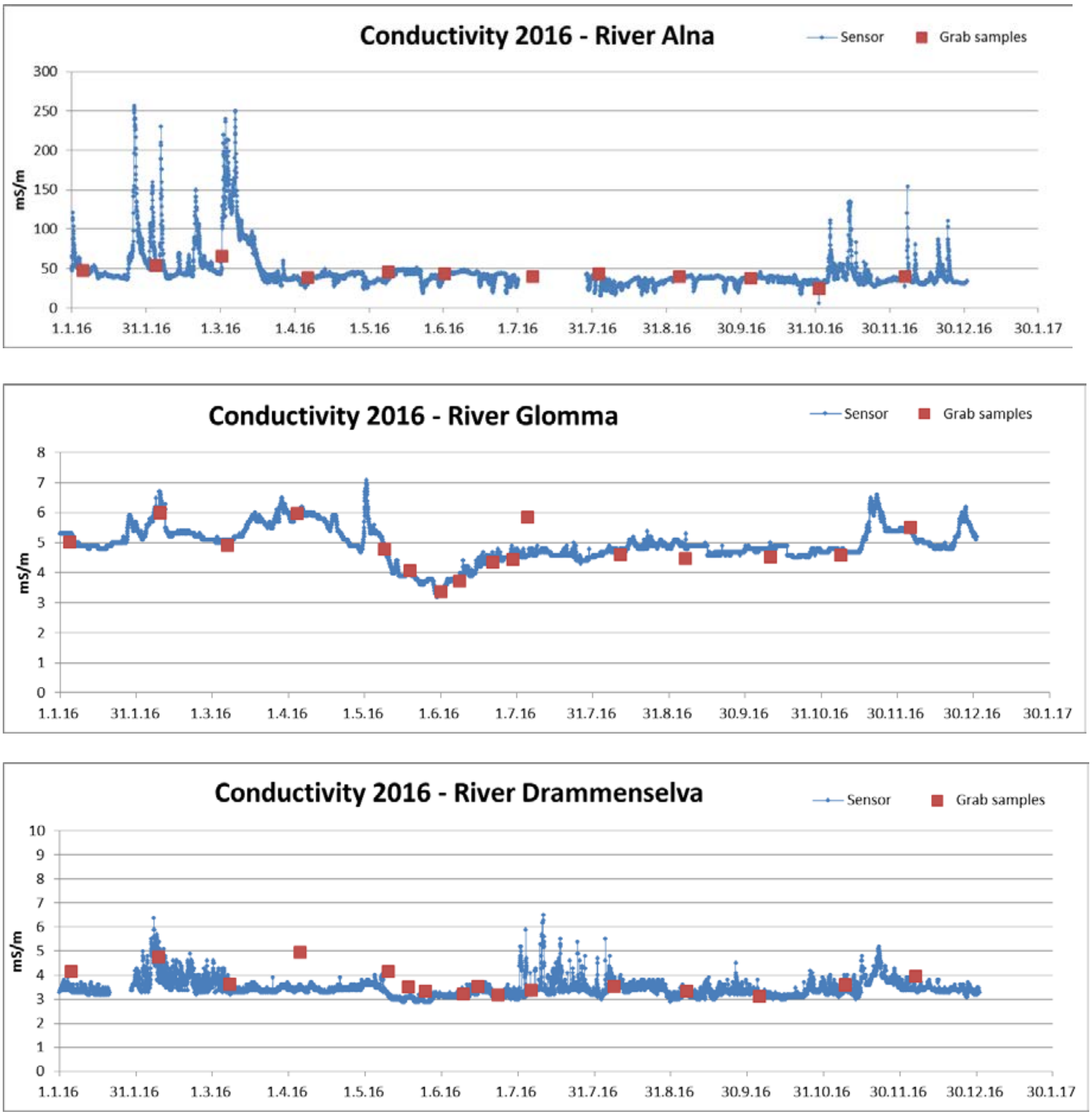


*Figure 36. Variations in conductivity in 2016 in the three rivers with sensor data.*

The updated correlation graphs (Figure 37) between conductivity in grab samples and in sensor recordings show the same as last year: While rivers Glomma and, to a somewhat less degree, Alna, show good correlation between sensor and grab samples, River Drammenselva does not. The reason for this is still not known. The range in conductivity in River Drammenselva is very low, but this is also the case for River Glomma, so the low range cannot be the only explanation.

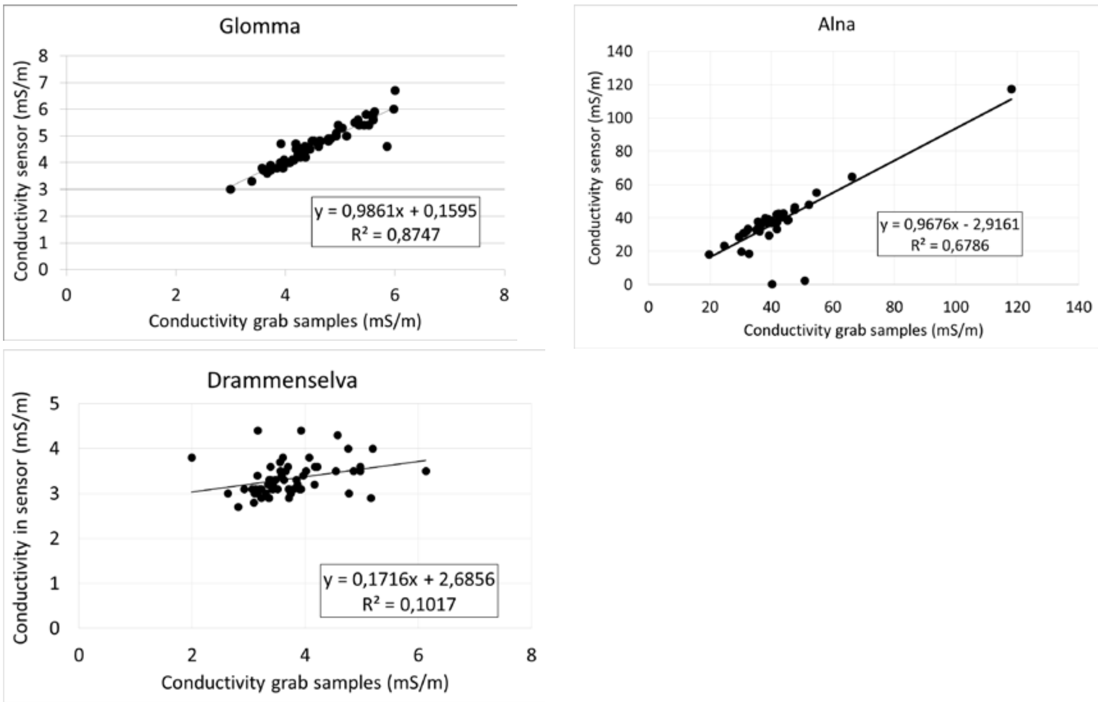


*Figure 37. Conductivity from sensor recordings and grab samples in the three rivers with sensor recordings (2013-2016).*

### 3.5.4 pH from sensors and in grab samples

pH is a measure of the acidity of the water, based on its hydrogen ion concentration. It is defined as the negative logarithm of the hydrogen ion concentration. The pH ranges on a logarithmic scale from 1-14, where pH 1-6 are defined as acidic, pH 7 is neutral, and pH 8-14 are defined as basic.

Similarly as in 2015 (Skarbøvik et al. 2016), individual pH values in grab samples and from sensor data did not vary much (Figure 38). However, the pH in grab samples and from sensor data did not correlate well (Figure 39). This lack of correlation can be expected, since the range in pH values was quite limited (cf. Figure 38). In addition, changes in pH may occur during transport and storage of the water bottles, including changes in temperature and loss of $CO_2$ from the water sample (Hindar et al. 2015).

As noted in section 3.5.1, the pH sensors had several issues in 2016, and many sensordata have been omitted from the series.

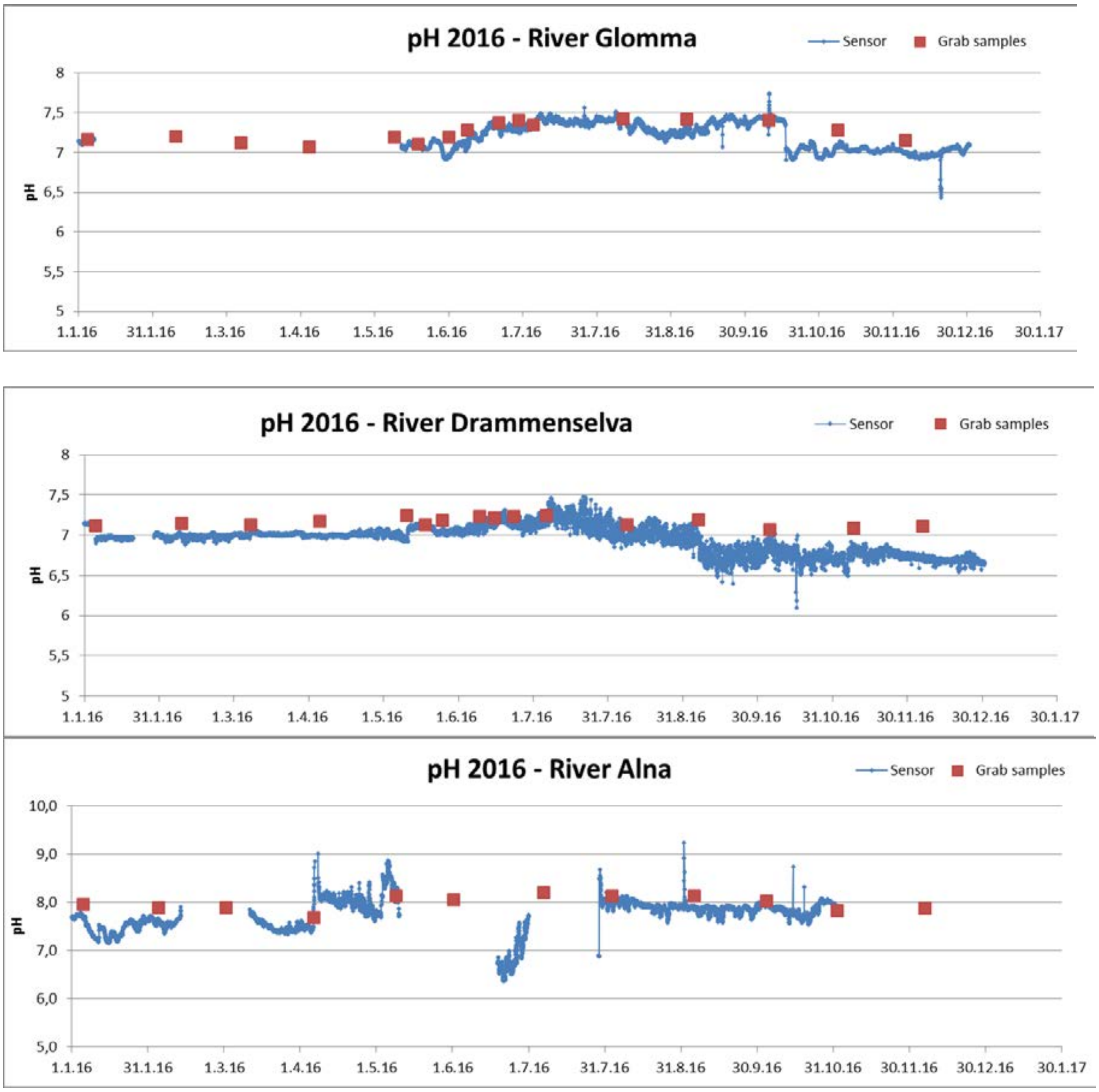


*Figure 38. pH in grab samples and sensor data (2013-2016).*

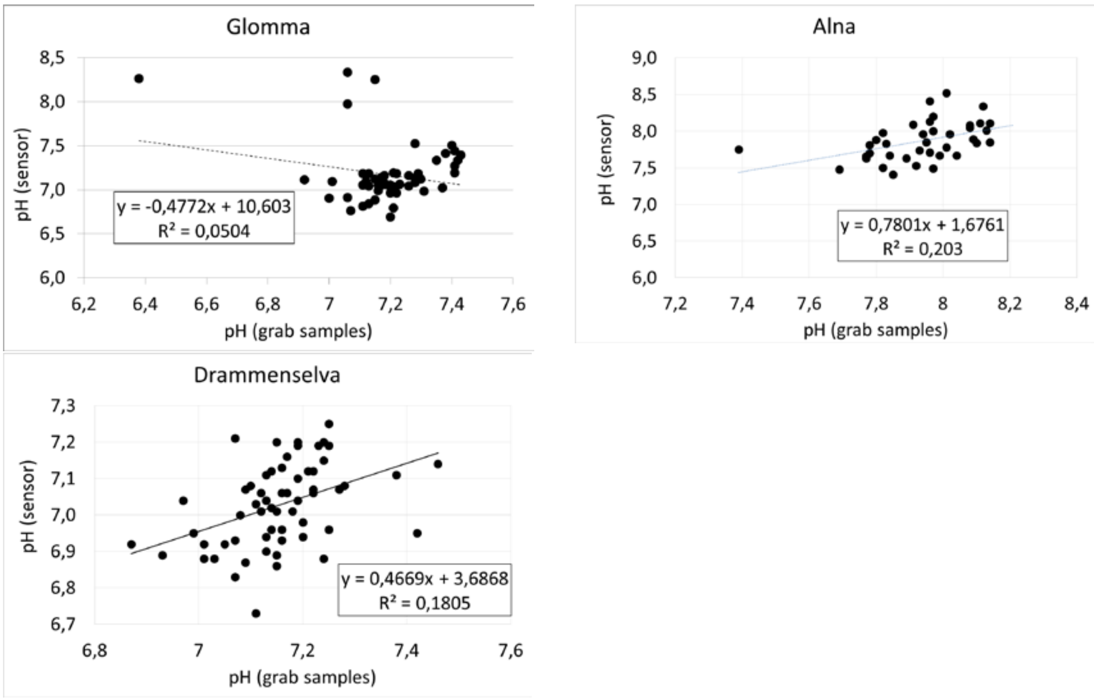


*Figure 39. Correlations between pH in grab samples and sensor data (2013-2016).*

## 3.5.5 Lessons learned from four years' use of sensors

The Norwegian RID Programme has tested different sensors in three rivers in the period May 2013-December 2016. Below the main lessons learned are summarized:

- Sensors give a unique possibility to monitor almost continuously. This gives improved insight into transport processes of water, particles and contaminants in rivers.
- Sensor data correlated, on the whole, well with grab samples. Some exceptions occur for all three parameters, but especially for pH where the variation of data values were relatively small.
- Sensor-based monitoring of basic parameters can serve as 'proxies' for other elements with high environmental impact. As an example, turbidity can reflect levels of and changes in SPM, Tot-P and particle associated metals such as nickel and lead (Skarbøvik and Roseth 2014).
- Sensors can be useful for estimating uncertainty of monthly or quarterly grab sampling. For example, Skarbøvik et al. (2015) demonstrated that SPM and ortho-P could be underestimated by about 30% and Tot-P by about 20%;
- Sensors give in-situ data and eliminates the risk of contamination during transport of water samples.
- Sensor data provide a possibility to detect shorter periods of high/low values of certain parameters (e.g., pH) that can be harmful for the biota in the river.
- High-frequency monitoring is important to document effects of climatic events (which can be difficult to capture with monthly grab samples).
- It would be an advantage if the monitoring programme for grab sampling could be extended when testing out sensors, for example by collecting additional grab water samples during floods (turbidity data) or snowmelt events (conductivity data). This

would have made it easier to calibrate the sensors with grab water samples, and hence assess the performance of the sensors.

- Sensors require frequent maintenance and cleaning, hence it is an advantage to have locally based assistants.
- There may be drift in the instruments, and if these occur gradually it might take time to discover and correct the sensors.
- The use of sensors results in a huge amount of data that can be time-consuming to quality assure.
- Quality assurance would have been easier if water level had also been monitored at the same site.
- Sensors can be costly, and are vulnerable for theft and damage by ice.

# 4. Conclusions

**Climate and water discharge**

The weather in 2016 can be characterised as warm with normal precipitation rates for the country as a whole, but with local variations. The average temperature was 1.5 °C above normal for the entire country, and the year was the 10th warmest since the measurements started in 1900.

**Total inputs of nutrients and metals in 2016**

The total nutrient inputs to Norwegian coastal waters in 2016 were estimated to 13 271 tonnes of phosphorus, 162 647 tonnes of nitrogen, 436 698 tonnes of silicate, 505 590 tonnes of TOC, and 759 011 tonnes of SPM.

Inputs of metals to the Norwegian coastal areas were estimated to 128 kg of mercury, 2 tonnes of cadmium, 23 tonnes of arsenic, 39 tonnes of lead, 35 tonnes of chromium, 238 tonnes of nickel, 576 tonnes of zinc and 1251 tonnes of copper.

Metal concentrations were compared with guidance threshold levels (Miljødirektoratet, 2016).The metal which most often exceeded its threshold value both in single water samples and as average over the year, was zinc. Three rivers had annual average concentration levels exceeding the limit. The threshold for copper had changed in the national guidance, and only two rivers had single water samples exceeding the copper threshold levels. Two rivers had an annual average concentration of lead exceeding the threshold level; but no rivers had lead values exceeding the threshold for single samples. Similarly to previous years, River Pasvikelva has concentrations of nickel exceeding the threshold value. River Orkla had one single sample exceeding the threshold level for chromium.

There were no significant changes in the distribution of sources for neither nutrients nor metals as compared to recent years. Fish farming continues to be a major direct source of nutrients and copper to the sea.

**Trends in river nutrient and metal inputs**

In 2016 the total water discharge to the Norwegian marine areas was close to the average for the period 1990-2015. However, there were local variations, an example being the Norwegian Sea where the water discharge was reduced by 14 % in 2016. Accordingly, loads of Tot-P, Tot-N and SPM were relatively low in 2016 in this region. More than 10 % reductions of Tot-P loads from rivers could be seen in all four marine areas, and subsequently also in the total riverine loads for Norway. In the Barents Sea/Lofoten area, there was a 40 % increase in Tot-N compared to the average for 1990-2015. This was, however, due to a single sample with high concentrations during high flows.

A more detailed statistical trend analyses of data for nine rivers monitored monthly or more often, for the period 1990-2016, showed that:

- Four out of the five Skagerrak rivers had a statistically significant **increase** in water discharge.

- Tot-N loads have **increased** significantly in rivers Glomma, Drammenselva and Numedalslågen. In Glomma and Drammenselva increased water discharges can be a reason, but water discharge cannot alone explain the increase in Numedalslågen. In River Vefsna Tot-N loads and concentrations have **decreased** significantly. Loads of ammonium nitrogen have **decreased** significantly in five rivers (rivers Glomma, Drammenselva, Skienselva, Orkla and Vefsna). A possible reason for this might be improved waste water treatment.

- Tot-P loads have **increased** significantly in rivers Drammenselva and Numedalslågen. Tot-P loads and concentrations have **decreased** significantly in River Vefsna.

- None of the nine rivers had significant upward trends during 1990-2016 in metal loads or concentrations.

- There was a **significant** downward trend in concentrations of all examined metals (cadmium, copper, nickel, lead and zinc) in four rivers (Numedalslågen, Skienselva, Orkla and Vefsna). In the remaining five rivers there were significant downward trends in concentrations of some of the metals, but not all.

- Although trends for the last ten years only may give uncertain results, they have nevertheless been included since they may point to important needs to reduce recent pollution discharges. When examining the last 10 year-period of sampling, there were significant upward trends in concentrations of nickel in River Vefsna and zinc in River Glomma. In River Drammenselva there was a significant upward trend of lead loads.

Whereas total nutrient inputs to the Greater North Sea has been reduced from OSPAR Convention Parties, nutrient inputs from Norway have increased due to fish farming.

**Organic contaminants**

As for previous years, an assessment of organic contaminant levels against legislative thresholds was undertaken by comparing calculated “whole water” concentrations (sum of freely dissolved and that sorbed to SPM) of WFD priority pollutants with WFD annual average environmental quality standards (-AA-EQS published in 2013. Estimates of “whole water” concentrations for fluoranthene, benzo[a]pyrene and PFOS were close to or above WFD AA-EQS for most rivers in 2016. The estimate of “whole water” concentrations for PFOS in River Alna was clearly above EQS and data from whole water sampling in 2016 was in agreement with SPM sampling conducted in 2015. Concentrations of PFOS in Rivers Drammenselva and Glomma also approached the WFD AA-EQS value of 0.65 ng/l in 2016. In general, the last four years of monitoring were able to identify out of the chemicals of interest in this monitoring programme those whose concentrations are consistently close or above EQS.

The estimation of riverine loads of organic contaminants to the sea in 2016 showed that for most chemicals studied, the load from River Alna was highest when given per $km^2$ of drainage area. This is in agreement with estimates from the period 2013-2015. Loads for Rivers Drammenselva and Glomma were generally similar. One major unknown factor in the estimation of fluxes is the concentration of contaminants sorbed to DOM (not quantified here). The variability in SPM-associated contaminants concentrations also adds significant uncertainty to the flux estimates. Over the three years of monitoring, some contaminants exhibit SPM concentration that can span over two orders of magnitude. Correlating the continuous turbidity measurements with SPM concentrations could, to some extent, help reduce this uncertainty.

**Sensor data analyses**

Four years of sensors testing have given hourly data of turbidity, pH and conductivity. The data from the sensors generally correlated well with grab samples, and, as shown in earlier years, turbidity correlated well also with other substances, such as SPM and Tot-P. This shows that sensor data can serve as ‘proxies’ for other elements with high environmental impact.

The unique possibility to monitor almost continuously can give improved insight into transport processes of water, particles and contaminants in rivers. The continuous datasets are also useful for estimating the uncertainty of less frequent grab sampling, as demonstrated in Skarbøvik et al. (2016). Sensors give in-situ data, hence eliminating the risk of contamination during transport of water samples. They also provide a possibility to detect shorter periods of high/low concentrations/values that can be harmful for the biota. High-frequency monitoring can better documents effects of climatic events.

Sensors need calibration, and it would be an advantage if the monitoring programme for grab sampling could be extended when sensors are tested, so that situations with high river water concentrations are covered. Sensors require frequent maintenance and cleansing, hence it is cost-effective to have locally based assistants. The use of sensors gives a huge amount of data that can be time-consuming both to quality assure and to assess. However, the data material has many potential uses, and some of these have probably not yet been properly explored.

# 5. References


Ahrens, L., Yeung, L.W., Taniyasu, S., Lam, P.K., Yamashita, N., 2011. Partitioning of perfluorooctanoate (PFOA), perfluorooctane sulfonate (PFOS) and perfluorooctane sulfonamide (PFOSA) between water and sediment. Chemosphere 85, 731–737.

Allan, I., Bæk, K., Kringstad, A., Bratsberg, E., Høgfeldt, A., Ranneklev, S., Harman, C., Garmo, Ø., 2011. RiverPOP 2010. Measurement of trace contaminants in the Glomma River and some recommendations from RiverPOP projects (2008-2011). NIVA Report 6126/2010.

Allan, I., Fjeld, E., Garmo, Ø., Langford, K., Kringstad, A., Bratsberg, E., Kaste, Ø., 2009. RiverPOP: Measuring concentrations of persistent organic pollutants and trace metals in Norwegian rivers RiverPOP: Måle konsentrasjoner av persistente organiske forurensende stoffer og metaller i norske elver. NIVA Report 5815/2009.

Allan, I., Garmo, Ø., Harman, C., Kringstad, A., Bratsberg, E., 2010. RiverPOP 2009: Measuring concentrations of persistent organic pollutants and trace metals in Norwegian rivers. NIVA-Report 5989/2010.

Allan, I.J., Harman, C., Ranneklev, S.B., Thomas, K.V., Grung, M., 2013. Passive sampling for target and nontarget analyses of moderately polar and nonpolar substances in water. Environmental Toxicology and Chemistry 32, 1718-1726.

Allan, I.J., O'Connell, S.G., Meland, S., Bæk, K., Grung, M., Anderson, K.A., Ranneklev, S.B., 2016. PAH Accessibility in Particulate Matter from Road-Impacted Environments. Environmental Science & Technology 50, 7964-7972.

Allan, I.J., Ranneklev, S.B., 2011. Occurrence of PAHs and PCBs in the Alna River, Oslo (Norway). Journal of Environmental Monitoring 13, 2420-2426.

Bakken, T. H., Lázár, A., Szomolányi, M., Németh Á., Tjomsland, T., Selvik, J., Borgvang, S., Fehér J. 2006. AQUAPOL-project: Model applications and comparison in the Kapos catchment, Hungary. NIVA-report 5189. 164 pp.

Beldring, S., Engeland, K., Roald, L.A., Sælthun, N.R. and Voksø, A. 2003. Estimation of parameters in a distributed precipitation-runoff model for Norway. Hydrology and Earth System Sciences, 7, 304-316.

Booij, K., Robinson, C.D., Burgess, R.M., Mayer, P., Roberts, C.A., Ahrens, L., Allan, I.J., Brant, J., Jones, L., Kraus, U.R. and Larsen, M.M., 2016. Passive sampling in regulatory chemical monitoring of nonpolar organic compounds in the aquatic environment. Environmental science & technology *50*,3-17.

Booij, K., Sleiderink, H.M., Smedes, F., 1998. Calibrating the uptake kinetics of semipermeable membrane devices using exposure standards. Environmental Toxicology and Chemistry 17, 1236-1245.

Booij, K., Smedes, F., 2010. An Improved Method for Estimating in Situ Sampling Rates of Nonpolar Passive Samplers. Environmental Science & Technology 44, 6789-6794.

Booij, K., Smedes, F., van Weerlee, E.M., 2002. Spiking of performance reference compounds in low density polyethylene and silicone passive water samplers. Chemosphere 46, 1157-1161.

Cornelissen, G., Gustafsson, Ö., Bucheli, T.D., Jonker, M.T., Koelmans, A.A., van Noort, P.C., 2005. Extensive sorption of organic compounds to black carbon, coal, and kerogen in sediments and soils: mechanisms and consequences for distribution, bioaccumulation, and biodegradation. Environmental Science & Technology 39, 6881-6895.

Heiberg, H., Kristiansen, S., Mamen, J., Skaland, R.G., Szewczyk-Bartnicka, H., Tilley Tajet, H.H. 2016. Været i Norge. Klimatologisk oversikt. Året 2016. Met.no-info; no.13/2016 ISSN 1894-759X; 23 pp.

Grimvall A., Wahlin K., Hussian M. and von Brömssen C. 2008. Semiparametric smoothers for trend assessment of multiple time series of environmental quality data. Environmetrics.

Hindar, A. and Tjomsland, T. 2007. Beregning av tilførsler og konsentrasjon av N og P i NVEs REGINEfelter i Otra ved hjelp av TEOTIL-metoden. NIVA-rapport – 5490. 55pp.

Hindar A, Garmo Ø, Teien H-C. 2015. Sammenhengen mellom labilt aluminium og pH i kalkede laksevassdrag. NIVA-rapport 6872, 31 s.

Hirsch, R.M. and Slack, J.R. 1984. A nonparametric trend test for seasonal data with serial dependence: Water Resources Research v. 20, p. 727–732.

Huckins, J.N., Petty, J.D., Lebo, J.A., Almeida, F.V., Booij, K., Alvarez, D.A., Clark, R.C., Mogensen, B.B., 2002. Development of the permeability/performance reference compound approach for in situ calibration of semipermeable membrane devices. Environmental Science & Technology 36, 85-91.

Miège, C., Mazzella, N., Allan, I.J., Dulio, V., Smedes, F., Tixier, C., Vermeirssen, E., Brant, J., O'Toole, S., Budzinski, H., Ghestem, JP., Staub, P.F., Lardy-Fontan, S., Gonzalez, JL., Coquery, M., Vrana, B., 2015. Position paper on passive sampling techniques for the monitoring of contaminants in the aquatic environment – Achievements to date and perspectives. Trends in Environmental Analytical Chemistry 8, 20-26.

Miljødirektoratet 2016. Grenseverdier for klassifisering av vann, sediment og biota. Veileder. M-608/2016. 24 pp.

Libiseller, C. and Grimvall A. 2002. Performance of Partial Mann Kendall Tests for Trend Detection in the Presence of Covariates, Environmetrics 13, 71-84.

Ranneklev, S., Allan, I., Enge, E., 2009. Kartlegging av miljøgifter i Alna og Akerselva. NIVA-Report 5776/2009;TA 2495-2009.

Rusina, T.P., Smedes, F., Koblizkova, M., Klanova, J., 2010. Calibration of Silicone Rubber Passive Samplers: Experimental and Modeled Relations between Sampling Rate and Compound Properties. Environmental Science & Technology 44, 362-367.

Selvik, J.R., Tjomsland, T. and Eggestad, H.O. 2007. Tilførsler av næringssalter til Norges kystområder i 2006. beregnet med tilførselsmodellen TEOTIL. Norwegian State Pollution Monitoring Programme. NIVA Rapport 5512-2007.

Sen, P.K. 1968. Estimates of the regression coefficient based on Kendall's tau. *Journal of the American Statistical Association*, 63, 1379-1389.

Skarbøvik, E. Stålnacke, P.G., Kaste, Ø., Selvik, J.R., Borgvang, S.A., Tjomsland, T., Høgåsen, T. and Beldring, S. 2007. Riverine inputs and direct discharges to Norwegian coastal waters – 2006. OSPAR Commission. Norwegian Pollution Control Authority (SFT). TA-2327/2007; NIVA Report 5511/2007. 142 pp.

Skarbøvik, E., Stålnacke, P.G., Kaste, Ø., Selvik, J.R., Tjomsland, T., Høgåsen, T., Aakerøy, P.A., and Beldring, S. 2010. Riverine inputs and direct discharges to Norwegian coastal waters – 2009. Climate and Pollution Agency TA-2726/2010; 75 pp.

Skarbøvik, E., Stålnacke, P., Selvik, J.R., Aakerøy, P.A., Høgåsen, T., and Kaste, Ø. 2011. Elvetilførselsprogrammet (RID) – 20 års overvåking av tilførsler til norske kystområder (1990-2009). NIVA-rapport 6235-2011. Klima- og forurensningsdirektoratet TA-2857/2011; 55 s.

Skarbøvik, E. & Roseth, R. 2014. Use of sensor data for turbidity, pH and conductivity as an alternative to conventional water quality monitoring in four Norwegian case studies. Acta Agric. Scand. Sect. B Soil and Plant Sci. Vol 65 (1), p. 63-73.

Skarbøvik, E., Allan, I., Stålnacke, P., Hagen, A.G., Greipsland, I., Høgåsen, T., Selvik, J.R., Beldring, S. 2015. Riverine inputs and direct discharges to Norwegian coastal waters – 2014. Miljødirektoratet Rapport M-439|2015, 83 pp.

Skarbøvik, E. Allan, I., Stålnacke, P., Høgåsen, T., Greipsland, I., Selvik, J.R., Schanke, L.B., Beldring, S. 2016. Riverine Inputs and Direct Discharges to Norwegian Coastal Waters – 2015. Miljødirektoratet Rapportserie M634-2016; 86 s.

Smedes, F., Geertsma, R.W., van der Zande, T., Booij, K., 2009. Polymer-Water Partition Coefficients of Hydrophobic Compounds for Passive Sampling: Application of Cosolvent Models for Validation. Environmental Science & Technology 43, 7047-7054.

Stålnacke, P., Haaland, S., Skarbøvik, E., Turtumøygard, S., Nytrø, T.E., Selvik, J.R., Høgåsen, T., Tjomsland, T., Kaste, Ø. and Enerstvedt, K.E. 2009. Revision and assessment of Norwegian RID data 1990-2007. Bioforsk Report Vol. 4 No. 138. SFT report TA-2559/2009. 20p.

Tjomsland, T. and Bratli, J.L. 1996. Brukerveiledning for TEOTIL. Modell for teoretisk beregning av fosfor- og nitrogentilførsler i Norge. (User guideline for TEOTIL. Model for calculation of phosphorus and nitrogen inputs in Norway). NIVA rapport - 3426. 84 s.

Warren, N., Allan, I.J., Carter, J.E., House, W.A., Parker, A., 2003. Pesticides and other micro-organic contaminants in freshwater sedimentary environments - a review. Applied Geochemistry 18, 159-194.

Weideborg, M., Arctander Vik, E. and Lyngstad, E. 2004. Riverine inputs and direct discharges to Norwegian coastal waters 2003. Norwegian State Pollution Monitoring Programme. Report number 04-043A. TA 2069/2004.

# Appendices

# Appendix I The RID objectives

The main objectives of RID (Agreement 2014-04; www.ospar.org) are listed as follows:

To assess, as accurately as possible, all river-borne and direct inputs of selected pollutants to Convention waters on an annual basis.

To contribute to the implementation of the Joint Assessment and Monitoring Programme (JAMP) by providing data on inputs to Convention waters on a sub-regional and a regional level.

To report these data annually to the OSPAR Commission and:

a. to review these data periodically with a view to determining temporal trends;

b. to review on a regular basis, to be determined by the Hazardous Substances and Eutrophication Committee (HASEC), whether RID requires revision.

Each Contracting Party bordering the marine area should:

a. aim to monitor on a regular basis at least 90% of the inputs of each selected pollutant. If this is not achievable due to a high number of rivers draining to the sea, modelling/extrapolation can be used to ensure sufficient coverage;

b. provide, for a selection of their rivers, information on the annual mean/median concentration of pollutants resulting from the monitoring according to paragraph 2.4a;

c. as far as possible, estimate inputs from unmonitored areas complementing the percentage monitored (see paragraph 2.4a) towards 100 %;

d. take opportunities to adapt their RID monitoring programmes to progress (cf. Section 12) and keep the monitoring effort proportionate, taking into account changes in risk.

The entire guidelines and principles of the RID Programme can be found at www.ospar.org, under Agreement 2014-04.

# Appendix II Personnel

In 2016, Øyvind Kaste (NIVA) has co-ordinated the RID programme. Other co-workers at NIVA include John Rune Selvik (direct discharges), James Edward Sample (databases, calculation of riverine loads, TEOTIL), Ian Allan and Marthe Torunn Solhaug Jenssen (organic contaminants), Liv Bente Skancke (quality assurance of sampling and chemical analyses; data preparation and calculations of sensor records), Odd Arne Segtnan Skogan (sensor monitoring) and Marit Villø, Tomas A. Blakseth and Kine Bæk (contact persons at the NIVA laboratory).

At NIBIO, Eva Skarbøvik has carried out data analyses and been the main responsible for editing the 2016 report. Inga Greipsland has carried out and reported the statistical trend analyses, and Per Stålnacke has performed quality assurance of this work.

At NVE, Trine Fjeldstad has been responsible for the local sampling programmes, Stein Beldring has carried out the hydrological modelling, and Morten N. Due has been the administrative contact.

Overall quality assurance of the annual report has been carried out by Hans Fredrik Veiteberg Braaten, NIVA.

The sampling has been performed by several fieldworkers; their names are given below.

| Personnel for water sampling in the rivers monitored monthly or more often: | Personnel for water sampling in the 36 rivers with quarterly sampling: |
|---|---|
| Nils Haakensen (Glomma)<br>Jarle Molvær og Jan Magnusson (Alna)<br>Vibeke Svenne (Drammenselva)<br>Sigmund Lekven (Numedalslågen)<br>Jon Klonteig (Skienselva)<br>Ellen Grethe Ruud Åtland (Otra)<br>Bjarne Horpestad og Einar Helland (Orre)<br>Geir Ove Henden og Ove Kambestad (Vosso)<br>Joar Skauge (Orkla)<br>Vebjørn Opdahl (Vefsna)<br>Anders Bjordal (Altaelva) | Nils Haakensen<br>Olav Smestad<br>Ellen Grethe Ruud Åtland<br>Sigbjørn Birkeland<br>Jan Stokkeland<br>Bjarne Horpestad og Einar Helland<br>Svein Gitle Tangen<br>Odd Birger Nilsen og Rolf Inge Valheim<br>Rune Roalkvam<br>Kjell Arne Granberg og Stein Erik Gulbrandsen<br>Leif Magnus Dale<br>Inger Moe<br>Ronny Løland<br>Bjarne Stangvik<br>Gudmund Kårvatn<br>Harald Viken<br>Eivind Leksås<br>Vebjørn Opdahl<br>Frøydis Forsmo<br>Øystein Iselvmo<br>Einar Pettersen |

Sub-contractors and data sources include the Norwegian Meteorological Institute (met.no) for precipitation and temperature data; Statistics Norway (SSB) for effluents from wastewater treatment plants with a connection of > 50 p.e. (person equivalents); the Norwegian Environment Agency for data on effluents from industrial plants; the Directorate of Fisheries (Fdir) for data on fish farming.

# Appendix III: Catchment information for 47 monitored rivers

**Maps of land cover**

The main types of land cover in Norway are forest, agriculture and other surfaces impacted by human activities, mountains and mountain plateaus, and lakes and wetlands (Figure A-III-1). Mountains and forests are the most important land cover categories, and this is reflected in the land cover distribution of the 11 rivers monitored monthly (Figure A-III-2).

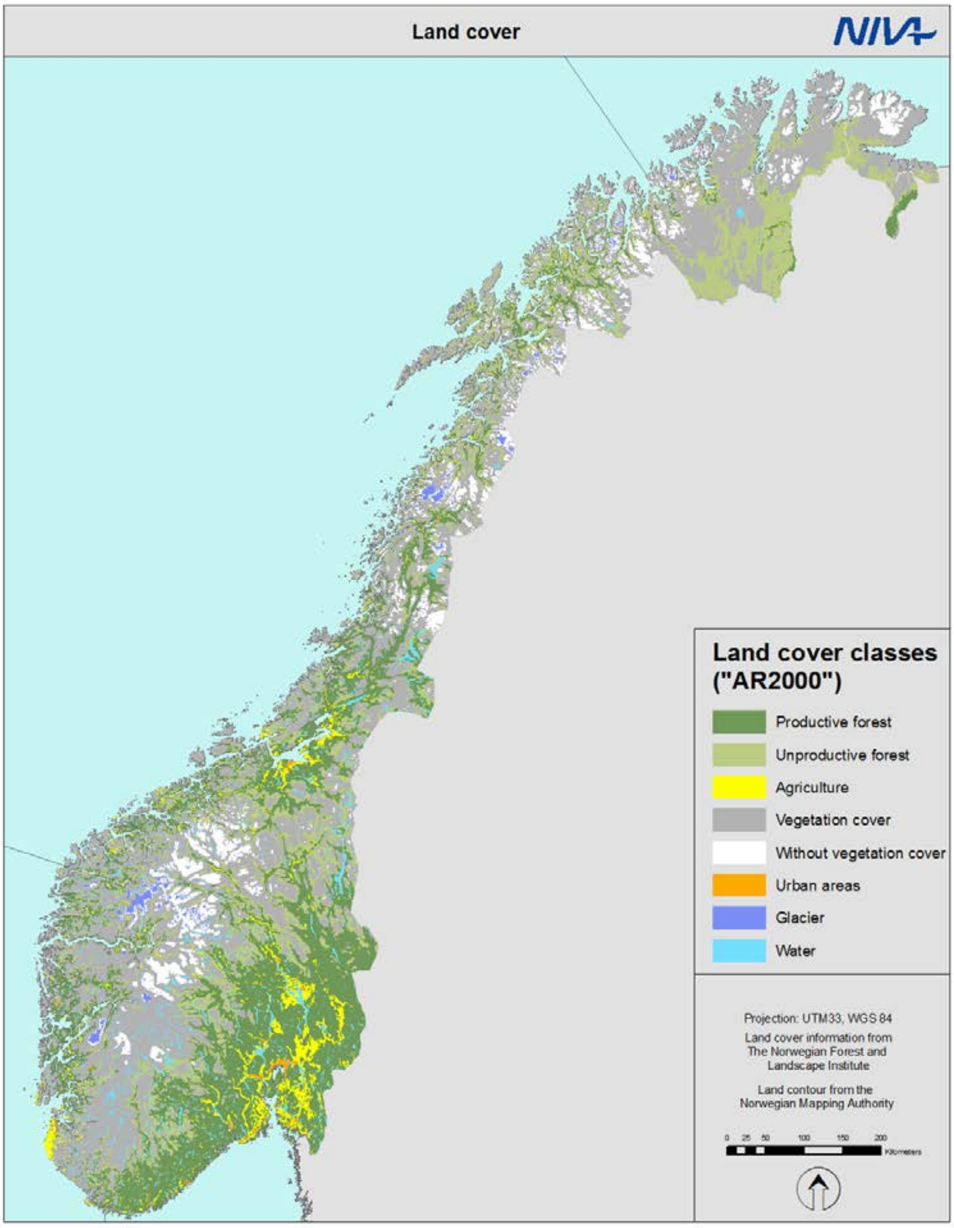


*Figure A-III-1. Land cover map of Norway. See also Figure A-III-2 in which the land use in the catchments of the 11 rivers monitored monthly is shown.*

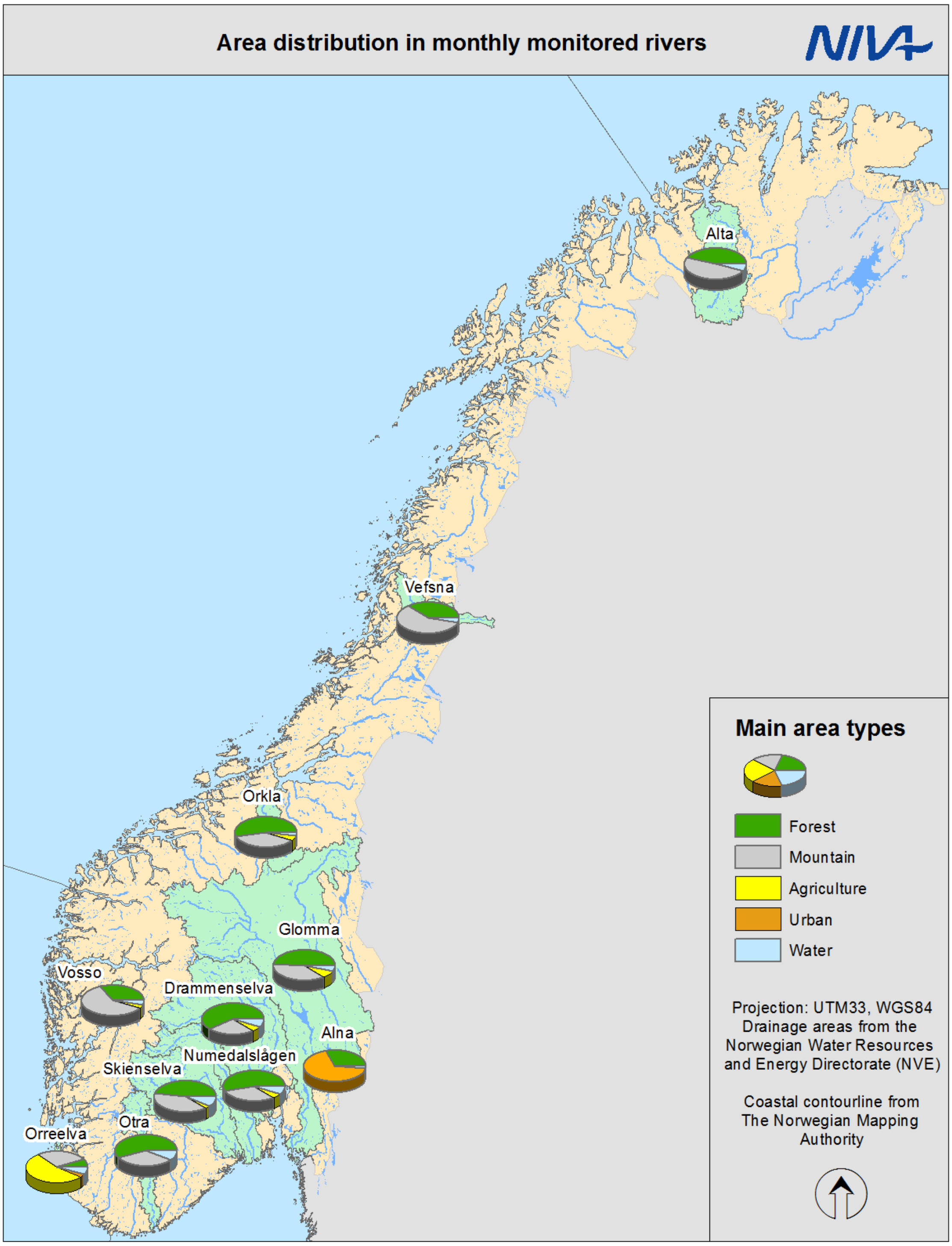


*Figure A.III-2. Land use in the catchment areas of the 11 rivers monitored monthly. 'Water' refers to lakes in the catchment; 'Mountain' includes moors and mountain plateaus not covered by forest. Based on data from NIBIO.*

**Catchment information for rivers monitored monthly**

The rivers are listed in Table A-III-1. Rivers Glomma, Alna, Drammenselva, Numedalslågen, Skienselva, and Otra drain into the Skagerrak, the part of the North Sea which is considered to be most susceptible to pollution. Apart from River Alna, that was added to the programme in 2013, these rivers also represent the major load bearing rivers in Norway. Of these, River

Glomma is the largest river in Norway, with a catchment area of about 41 200 $km^2$, or about 13 % of the total land area in Norway. River Drammenselva has the third largest catchment area of Norwegian rivers with its 17 034 $km^2$.

Rivers Orreelva and Vosso drain into the coastal area of the North Sea (Coastal area II). River Orreelva is a relatively small river with a catchment area of only 105 $km^2$, and an average flow of about 4 $m^3/s$, but it is included in the RID Programme since it drains one of the most intensive agricultural areas in Norway. More than 30% of its drainage area is covered by agricultural land, and discharges from manure stores and silos together with runoff from heavily manured fields cause eutrophication and problems with toxic algal blooms.

River Vosso has been in the RID Programme since its start in 1990. Until 2004 it was sampled once a year, and in the period 2004-2007 four times a year. From 2008 it was exchanged with River Suldalslågen (see below) as a main river with monthly samplings. River Vosso was chosen due to the low levels of pressures in the catchment. It has a low population density of 1.1 persons/$km^2$, and only 3 % of the catchment area is covered by agricultural land. The rest of the catchment is mainly mountains and forested areas.

River Suldalslågen was sampled as a main river up until 2007, but from 2008 this river has been sampled only four times a year. The reason for this is that the river is heavily modified by hydropower developments, and water from large parts of the catchment has been diverted to an adjacent catchment. The decision to change the sampling here was taken based on a weighing of advantages of long time series and disadvantages of continuing to sample a river which is very uncharacteristic. Since it was one of the main rivers from 1990-2007, its catchment characteristics are nevertheless given here: It has a drainage area of 1457 $km^2$ and a population density of only 2.4 persons/$km^2$. There are no industrial units reporting discharges of nitrogen or phosphorus from the catchment. The pressures are, thus, mainly linked to the aforementioned hydropower.

River Alna was sampled monthly for the first time in 2013. This is a relatively small river with only 69 $km^2$ catchment area, but it drains urban areas and is therefore of interest, not least in terms of metals and organic pollutants. The majority of the catchment area (68%) is urban, the rest is covered by forest. Changes in the rivers monitored monthly have implications for the comparisons of this group of rivers with former years, and for the long-term database. However, most year-to-year comparisons are done on all rivers or all inputs, and will therefore not be much affected by this change.

Rivers Orkla and Vefsna drain into the Norwegian Sea (Coastal area III). Agricultural land occupies 4 and 8 % of their catchment areas, respectively. Farming in this part of the country is less intensive as compared to the Orre area. More important are abandoned mines in the upper part of the River Orkla watercourse. Several other rivers in this area may also receive pollution from abandoned mines (heavy metals). These two rivers have, however, no reported industrial activity discharging nitrogen or phosphorus.

The last of the main rivers, River Alta is with its population density of only 0.3 persons per $km^2$ and no industrial plants reporting discharges, selected as the second of the two unpolluted river systems, although it is, as River Suldalslågen, affected by hydropower development. The river drains into the Barents Sea.

The ten watercourses represent river systems typical for different parts of the country. As such they are very useful when estimating loads of comparable rivers with less data than the main rivers. All rivers except River Orreelva are to varying degrees modified for hydropower production.

***Table A-III-1. The 11 main rivers, their coastal area, catchment size and long-term average flow.***

| Discharge area | Name of river | Catchment area ($km^2$) | Long-term average flow (1000 $m^3$/day)* |
|---|---|---|---|
| I. Skagerrak | Glomma | 41918 | 61347 |
| | Alna | 69 | 43** |
| | Drammenselva | 17034 | 26752 |
| | Numedalslågen | 5577 | 10173 |
| | Skienselva | 10772 | 23540 |
| | Otra | 3738 | 12863 |
| II. North Sea | Orreelva | 105 | 430 |
| | Vosso (from 2008) | 1492 | 2738 |
| III. Norwegian Sea | Orkla | 3053 | 3873 |
| | Vefsna | 4122 | 14255 |
| IV. Barents Sea | Alta | 7373 | 7573 |

** For the 30-year normal 1961-1990; at the water quality sampling points.*

** 30-year normal is not available, the figure for Alna is therefore based on an annual mean reported by NVE (The Norwegian Water Resources and Energy Directorate).

**Catchment information for rivers monitored quarterly – Tributary Rivers**

A list of the tributary rivers is given in Table A-III-2.

The average size of the catchment area of the rivers monitored four times a year is 2380 $km^2$, but the size varies from River Vikedalselva with its 118 $km^2$, to the second largest drainage basin in Norway, River Pasvikelva with a drainage basin of 18404 $km^2$.

Land use varies considerably, as shown in Figure A-III-3. As an example, Rivers Figgjo and Tista have the highest coverage of agricultural land (31 and 12%, respectively), whereas some of the rivers have no or insignificant agricultural activities in their drainage basins (e.g. Rivers Ulla, Røssåga, Målselv, Tana and Pasvikelva). Some catchments, such as Rivers Lyseelva, Årdalselva and Ulla in the west; and River Pasvikelva in the north, are more or less entirely dominated by mountains, moors, and mountain plateaus.

There is also considerable variation in population density, from rivers in the west and north with less than one inhabitant per $km^2$, to rivers with larger towns and villages with up to 100 or more inhabitants per $km^2$. Population density decreases in general from south to north in

Norway. The average population density of the 36 river catchments amounts to about 14 inhabitants per km$^2$, whereas the average density in the main river catchments is about 20 inhabitants per km$^2$.

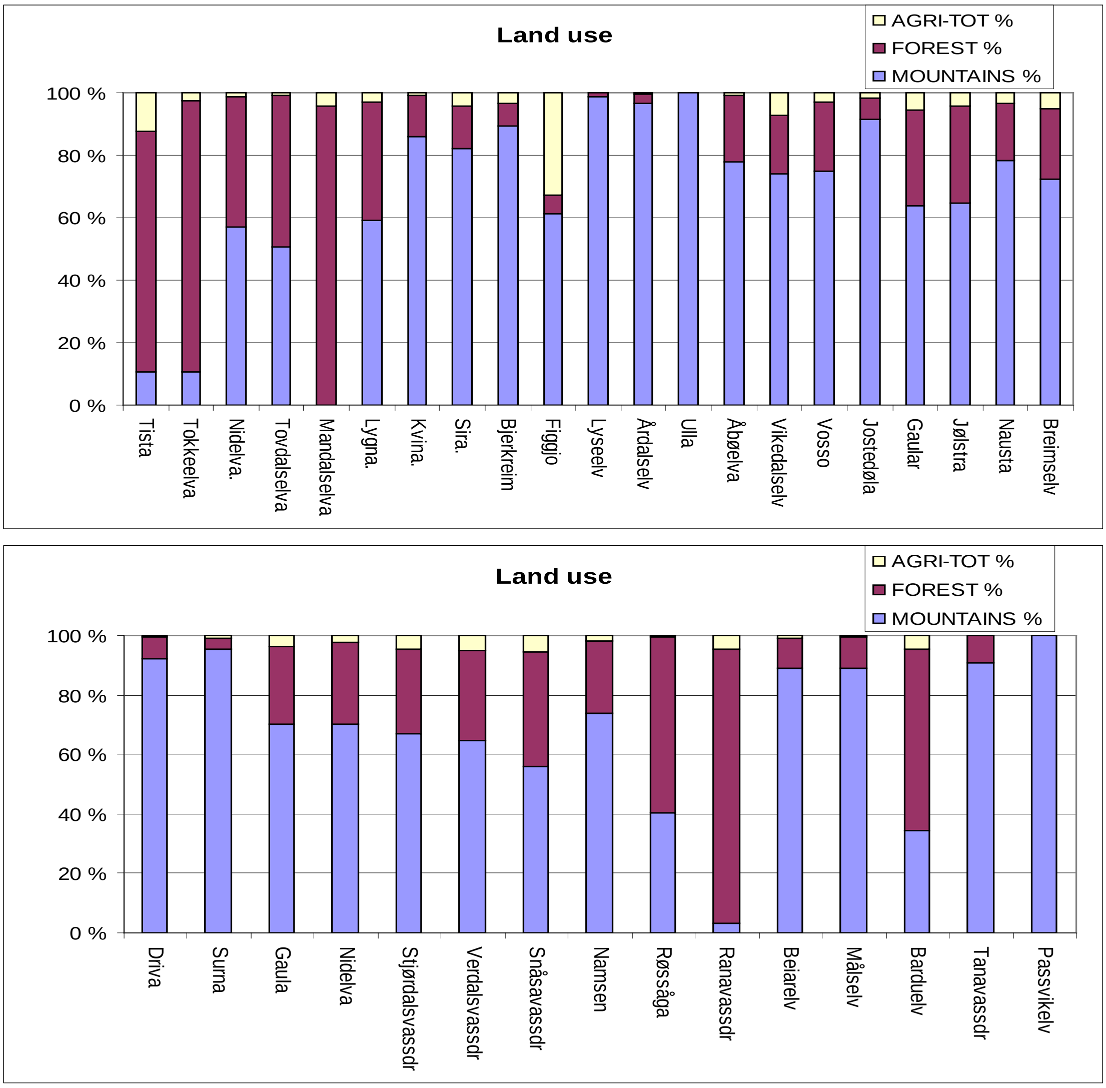


*Figure A-III-3. Land use distribution in the catchment areas of the 36 rivers monitored quarterly. "Agri-tot" means total agricultural land. "Mountains" include moors and mountain plateaus not covered by forest.*

**Table A-III-2. River basin characteristics for the 36 rivers monitored quarterly. Discharge Q is based on the 1961-1990 mean (from NVE).**

| Official Norwegian river code (NVE) | River | Basin area ($km^2$) | Area upstream samplings site ($km^2$) | Normal Q ($10^6$ $m^3$/yr) |
|---|---|---|---|---|
| 001 | Tista | 1588 | 1582 | 721 |
| 017 | Tokkeelva | 1238 | 1200 | 1042 |
| 019 | Nidelva | 4025 | 4020 | 3783 |
| 020 | Tovdalselva | 1856 | 1854 | 1984 |
| 022 | Mandalselva | 1809 | 1800 | 2624 |
| 024 | Lygna | 664 | 660 | 1005 |
| 025 | Kvina | 1445 | 1140 | 2625 |
| 026 | Sira | 1916 | 1872 | 3589 |
| 027 | Bjerkreimselva | 705 | 704 | 1727 |
| 028 | Figgjo | 229 | 218 | 361 |
| 031 | Lyseelva | 182 | 182 | 425 |
| 033 | Årdalselva | 519 | 516 | 1332 |
| 035 | Ulla | 393 | 393 | 1034 |
| 035 | Saudaelva | 353 | 353 | 946 |
| 036 | Suldalslågen | 1457 | 1457 | 6690 |
| 038 | Vikedalselva | 118 | 117 | 298 |
| 062 | Vosso | 1492 | 1465 | 2738 |
| 076 | Jostedøla | 865 | 864 | 1855 |
| 083 | Gaular | 627 | 625 | 1568 |
| 084 | Jølstra | 714 | 709 | 1673 |
| 084 | Nausta | 277 | 273 | 714 |
| 087 | Breimselva | 636 | 634 | 1364 |
| 109 | Driva | 2487 | 2435 | 2188 |
| 112 | Surna | 1200 | 1200 | 1816 |
| 122 | Gaula | 3659 | 3650 | 3046 |
| 123 | Nidelva | 3110 | 3100 | 3482 |
| 124 | Stjørdalsvassdraget | 2117 | 2117 | 2570 |
| 127 | Verdalsvassdraget | 1472 | 1472 | 1857 |
| 128 | Snåsavassdraget | 1095 | 1088 | 1376 |
| 139 | Namsen | 1124 | 1118 | 1376 |
| 155 | Røssåga | 2092 | 2087 | 2995 |
| 156 | Ranavassdraget | 3847 | 3846 | 5447 |
| 161 | Beiaren | 1064 | 875 | 1513 |
| 196 | Målselv | 3239 | 3200 | 2932 |
| 196 | Barduelva | 2906 | 2906 | 2594 |
| 234 | Tanavassdraget | 16389 | 15713 | 5944 |
| 244 | Pasvikelva | 18404 | 18400 | 5398 |

# Appendix IV Methodology, supplementary information

**Marine areas**

In 2014, the Norwegian Environment Agency decided to change the borders between the two northernmost seas, to coincide with Norwegian management regions. Hence, from the 2014 data reporting onwards, the border between the Norwegian sea and the Barents Sea was moved from the county border between Troms and Finnmark to south of Lofoten and Vesterålen (68°15'N). However, the data reported to OSPAR follow the same borders as earlier.

**Selection of rivers and sampling frequency**

For practical and economic reasons it is not possible to monitor all rivers that drain into the coastal waters of Norway. Hence, the Norwegian RID programme operates with three main groups of monitored rivers:

- Rivers monitored monthly or more often;
- Rivers monitored quarterly (since 2004);
- Rivers monitored once a year in the period of 1990-2003.

Ten rivers have been monitored monthly or more often in the entire monitoring period (1990-2013). These include the assumedly eight most load-bearing rivers in the country, which are Rivers Glomma, Drammenselva, Numedalslågen, Skienselva, Otra, Orreelva, Orkla and Vefsna. In addition, two relatively "unpolluted" rivers have been included for comparison purposes. Presently these are Rivers Vosso and Alta. Of these, River Vosso was only included in the 'group' of monthly monitored rivers in 2008/2009, when it replaced River Suldalslågen. In 2013 an additional river, River Alna, was included in this group, as an example of a river draining mainly urban areas. Consequently, 11 rivers were monitored monthly in 2013.

The number of rivers monitored four times a year since 2004 is 36. These rivers have not changed in the period of 2004-2013. The number of rivers monitored once a year in the period of 1990-2003 varies between 126 and 145. One of these rivers was River Alna, which has been monitored monthly since 2013. Since it has been of special importance to estimate the major loads to the Skagerrak marine area, a proportionally higher number of rivers have been chosen for this part of the country.

**Sampling methodology and sampling sites**

The sites are located in regions of unidirectional flow (no back eddies). In order to ensure as uniform water quality as possible, monitoring is carried out at sites where the water is well mixed, e.g. at or immediately downstream a weir, in waterfalls, rapids or in channels in connection with hydroelectric power stations. Sampling sites are located as close to the freshwater limit as possible, without being influenced by seawater.

Table A-IV-1 gives the coordinates of the sampling stations. For quality assurance reasons, the sampling sites have been documented by use of photographs. This, together with the coordinates, will ensure continuity in the event that sampling personnel changes.

***Table A-IV-1. Coordinates of the 47 sampling points.***

| Regine No | RID-ID | Station name | Latitude | Longitude | RID-Region |
|---|---|---|---|---|---|
| 002.A51 | 2 | Glomma at Sarpsfoss* | 59.27800 | 11.13400 | Skagerrak |
| 006.2Z | 8 | Alna | 59.90461 | 10.79164 | |
| 012.A3 | 15 | Drammenselva* | 59.75399 | 10.00903 | |
| 015.A1 | 18 | Numedalslågen | 59.08627 | 10.06962 | |
| 016.A221 | 20 | Skienselva | 59.19900 | 9.61100 | |
| 021.A11 | 26 | Otra | 58.18742 | 7.95411 | |
| 028.4A | 37 | Orreelva | 58.73143 | 5.52936 | North Sea |
| 062.B0 | 64 | Vosso (Bolstadelvi) | 60.64800 | 6.00000 | |
| 121.A41 | 100 | Orkla | 63.20100 | 9.77300 | Norwegian Sea |
| 151.A4 | 115 | Vefsna | 65.74900 | 13.23900 | |
| 212.A0 | 140 | Altaelva | 69.90100 | 23.28700 | Barents Sea |
| 001.A6 | 1 | Tista | 59,12783 | 11.44436 | Skagerrak |
| 017.A1 | 21 | Tokkeelva | 58.87600 | 9.35400 | |
| 019.A230 | 24 | Nidelv (Rykene) | 58.40100 | 8.64200 | |
| 020.A12 | 25 | Tovdalselva | 58.21559 | 8.11668 | |
| 022.A5 | 28 | Mandalselva | 58.14300 | 7.54604 | |
| 024.B120 | 30 | Lyngdalselva | 58.16300 | 7.08798 | North Sea |
| 025.AA | 31 | Kvina | 58.32020 | 6.97023 | |
| 026.C | 32 | Sira | 58.41367 | 6.65669 | |
| 027.A1 | 35 | Bjerkreimselva | 58.47894 | 5.99530 | |
| 028.A3 | 38 | Figgjoelva | 58.79168 | 5.59780 | |
| 031.AA0 | 44 | Lyseelva | 59.05696 | 6.65835 | |
| 032.4B1 | 45 | Årdalselva | 59.08100 | 6.12500 | |
| 035.A21 | 47 | Ulladalsåna (Ulla) | 59.33000 | 6.45000 | |
| 035.721 | 49 | Saudaelva | 59.38900 | 6.21800 | |
| 036.A21 | 48 | Suldalslågen | 59.48200 | 6.26000 | |
| 038.A0 | 51 | Vikedalselva | 59.49958 | 5.91030 | |
| 076.A0 | 75 | Jostedøla | 61.41333 | 7.28025 | |
| 083.A0 | 78 | Gaular | 61.37000 | 5.68800 | |
| 084.A2 | 79 | Jølstra | 61.45170 | 5.85766 | |
| 084.7A0 | 80 | Nausta | 61.51681 | 5.72318 | |
| 087.A221 | 84 | Gloppenelva (Breimselva) | 61.76500 | 6.21300 | |
| 109.A0 | 95 | Driva | 62.66900 | 8.57100 | Norwegian Sea |
| 112.A0 | 98 | Surna | 62.97550 | 8.74262 | |
| 122.A24 | 103 | Gaula | 63.28600 | 10.27000 | |
| 123.A2 | 104 | Nidelva(Tr.heim) | 63.43300 | 10.40700 | |
| 124.A21 | 106 | Stjørdalselva | 63.44900 | 10.99300 | |
| 127.A0 | 108 | Verdalselva | 63.79200 | 11.47800 | |
| 128.A1 | 110 | Snåsavassdraget | 64.01900 | 11.50700 | |
| 139.A50 | 112 | Namsen | 64.44100 | 11.81900 | |
| 155.A0 | 119 | Røssåga | 66.10900 | 13.80700 | |
| 156.A0 | 122 | Ranaelva | 66.32300 | 14.17700 | |
| 161.B4 | 124 | Beiarelva | 66.99100 | 14.75000 | |
| 196.B2 | 132 | Målselv | 69.03600 | 18.66600 | Barents Sea** |
| 196.AA3 | 133 | Barduelva | 69.04300 | 18.59500 | |
| 234.B41 | 150 | Tanaelva | 70.23000 | 28.17400 | Barents Sea *** |
| 246.A5 | 153 | Pasvikelva | 69.50100 | 30.11600 | |

* Stations for sensors and organic contaminants (only CFC in Drammenselva) have the following co-ordinates: River Drammenselva: 59.75570; 9.99438; River Glomma at Baterød: 59.30725; 11.13475
** Border from 2014 onwards; *** Former border (as found in the 1990-2013-reporting)

### Analytical methods and detection limits

Table A-IV-2 gives the analytical methods and detection limits used in grab water samples.

***Table A-IV-2. Analytical methods and limits of quantification for parameters included in the sampling programme in 2016.***

| Parameter | Limit of quantification | Analytical Methods (NS: Norwegian Standard) |
|---|---|---|
| pH | | NS-EN ISO 10523 |
| Conductivity (mS/m) | 1 | NS-ISO 7888 |
| Turbidity (FNU) | 0.2/0.3 | NS-EN ISO 7027 |
| Suspended particulate matter (SPM) (mg/L) | 0,1 mg/l when 1 liter is filtered | NS 4733 modified |
| Total Organic Carbon (TOC) (mg C/L) | 0.1 | NS-ISO 8245 modified |
| Total phosphorus (µg P/L) | 1 | NS 4725 – Peroxodisulphate oxidation method modified (automated) |
| Orthophosphate (PO4-P) (µg P/L) | 1 | NS 4724 – Automated molybdate method modified (automated) |
| Total nitrogen (µg N/L) | 10 | NS 4743 – Peroxodisulphate oxidation method |
| Nitrate ($NO_3$-N) (µg N/L) | 2 | NS-EN ISO 10304-1 |
| Ammonium ($NH_4$-N) (µg N/L) | 2 | NS-EN ISO 14911 |
| Silicone (Si) (Si/ICP; mg Si/L) | 0.005 | NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified |
| Silver (Ag) (µg Ag/L) | 0.0020 | NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified |
| Arsenic (As) (µg As/L) | 0.025 | NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified |
| Cadmium (Cd) (µg Cd/L) | 0.0030 | NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified |
| Chromium (Cr) (µg Cr/L) | 0.025 | NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified |
| Copper (Cu) (µg Cu/L) | 0.040 | NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified |
| Mercury (Hg) (µg Hg/L) | 0.001 | NS-EN ISO 12846 modified |
| Nickel (Ni) (µg Ni/L) | 0.040 | NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified |
| Lead (Pb) (µg Pb/L) | 0.005 | NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified |
| Zinc (Zn) (µg Zn/L) | 0.15 | NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified |

### Water discharge and hydrological modelling

For the 11 main rivers, daily water discharge measurements were, as in previous years, used for the calculation of loads. Since the discharge monitoring stations are not located at the same site as the water sampling is conducted (except in River Alna), the water discharge at the water quality sampling sites were calculated by up- or downscaling, proportional to the drainage areas.

For the 36 rivers monitored quarterly, as well as the remaining 108 rivers from the former RID studies, water discharge was simulated with a spatially distributed version of the HBV-model (Beldring *et al.*, 2003). The use of this model was introduced in 2004. Earlier, the water discharge in the then 145 rivers was calculated based on the 30-year average, and adjusted with precipitation data for the actual year. The results from the spatially-distributed HBV are transferred to TEOTIL for use in the load estimates. Smaller response units ('regine-units') have been introduced in TEOTIL in order to improve load estimates for smaller basins (tributaries).

The gridded HBV-model performs water balance calculations for square grid-cell landscape elements characterised by their altitude and land use. Each grid cell may be divided into two land-use zones with different vegetation cover, a lake area and a glacier area. The model is run with daily time steps, using precipitation and air temperature data as inputs. It has components for accumulation, sub-grid scale distribution and ablation of snow, interception storage, sub-grid scale distribution of soil moisture storage, evapotranspiration, groundwater storage and runoff response, lake evaporation and glacier mass balance. Potential evapotranspiration is a function of air temperature; however, the effects of seasonally varying vegetation characteristics are considered. The algorithms of the model were described by Bergström (1995) and Sælthun (1996). The model is spatially distributed in that every model element has unique characteristics which determine its parameters, input data are distributed, water balance computations are performed separately for each model element, and finally, only those parts of the model structure which are necessary are used for each element. When watershed boundaries are defined, runoff from the individual model grid cells is sent to the respective basin outlets.

The parameter values assigned to the computational elements of the precipitation-runoff model should reflect the fact that hydrological processes are sensitive to spatial variations in topography, soil properties and vegetation. As the Norwegian landscape is dominated by shallow surface deposits overlying rather impermeable bedrock, the capacity for subsurface storage of water is small (Beldring, 2002). Areas with low capacity for soil water storage will be depleted faster and reduced evapotranspiration caused by moisture stress shows up earlier than in areas with high capacity for soil water storage (Zhu and Mackay, 2001). Vegetation characteristics such as stand height and leaf area index influence the water balance at different time scales through their control on evapotranspiration, snow accumulation and snow melt (Matheussen *et al.*, 2000). The following land-use classes were used for describing the properties of the 1-km$^2$ landscape elements of the model: (i) areas above the tree line with extremely sparse vegetation, mostly lichens, mosses and grasses; (ii) areas above the tree line with grass, heather, shrubs or dwarf trees; (iii) areas below the tree line with sub-alpine forests; (iv) lowland areas with coniferous or deciduous forests; and (v) non-forested areas below the tree line. The model was run with specific parameters for each land use class controlling snow processes, interception storage, evapotranspiration and subsurface moisture storage and runoff generation. Lake evaporation and glacier mass balance were controlled by parameters with global values.

A regionally applicable set of parameters was determined by calibrating the model with the restriction that the same parameter values are used for all computational elements of the model that fall into the same class for land surface properties. This calibration procedure rests on the hypothesis that model elements with identical landscape characteristics have similar hydrological behaviour, and should consequently be assigned the same parameter values. The grid cells should represent the significant and systematic variations in the properties of the land surface, and representative (typical) parameter values must be applied for different classes of soil and vegetation types, lakes and glaciers (Gottschalk *et al.*, 2001). The model was calibrated using available information about climate and hydrological processes from all gauged basins in Norway with reliable observations, and parameter values were transferred to other basins based on the classification of landscape characteristics. Several automatic calibration procedures, which use an optimisation algorithm to find those values of model parameters that minimise or maximise, as appropriate, an objective function or statistic of the residuals between model simulated outputs and observed watershed output, have been developed. The nonlinear parameter estimation method PEST (Doherty *et al*., 1998) was used. PEST adjusts the parameters of a model between specified lower and upper bounds until the sum of squares of residuals between selected model outputs and a complementary set of observed data are reduced to a minimum. A multi-criteria calibration strategy was applied, where the residuals between model simulated and observed monthly runoff from several basins located in areas with different runoff regimes and landscape characteristics were considered simultaneously.

Precipitation and temperature values for the model grid cells were determined by inverse distance interpolation of observations from the closest precipitation stations and temperature stations. Differences in precipitation and temperature caused by elevation were corrected by precipitation-altitude gradients and temperature lapse rates determined by the Norwegian Meteorological Institute. There is considerable uncertainty with regard to the variations of precipitation with altitude in the mountainous terrain of Norway, and this is probably the major source of uncertainty in the stream flow simulations. The precipitation-altitude gradients were reduced above the altitude of the coastal mountain ranges in western and northern Norway, as drying out of ascending air occurs in high mountain areas due to orographically induced precipitation (Daly *et al.,* 1994). These mountain ranges release most of the precipitation associated with the eastward-migrating extra tropical storm tracks that dominate the weather in Norway. Figure A-IV-1 shows the spatial distribution of mean annual runoff (mm/year) for Norway for the period 1961-1990. The Norwegian Water Resources and Energy Directorate (NVE) performs this modelling.

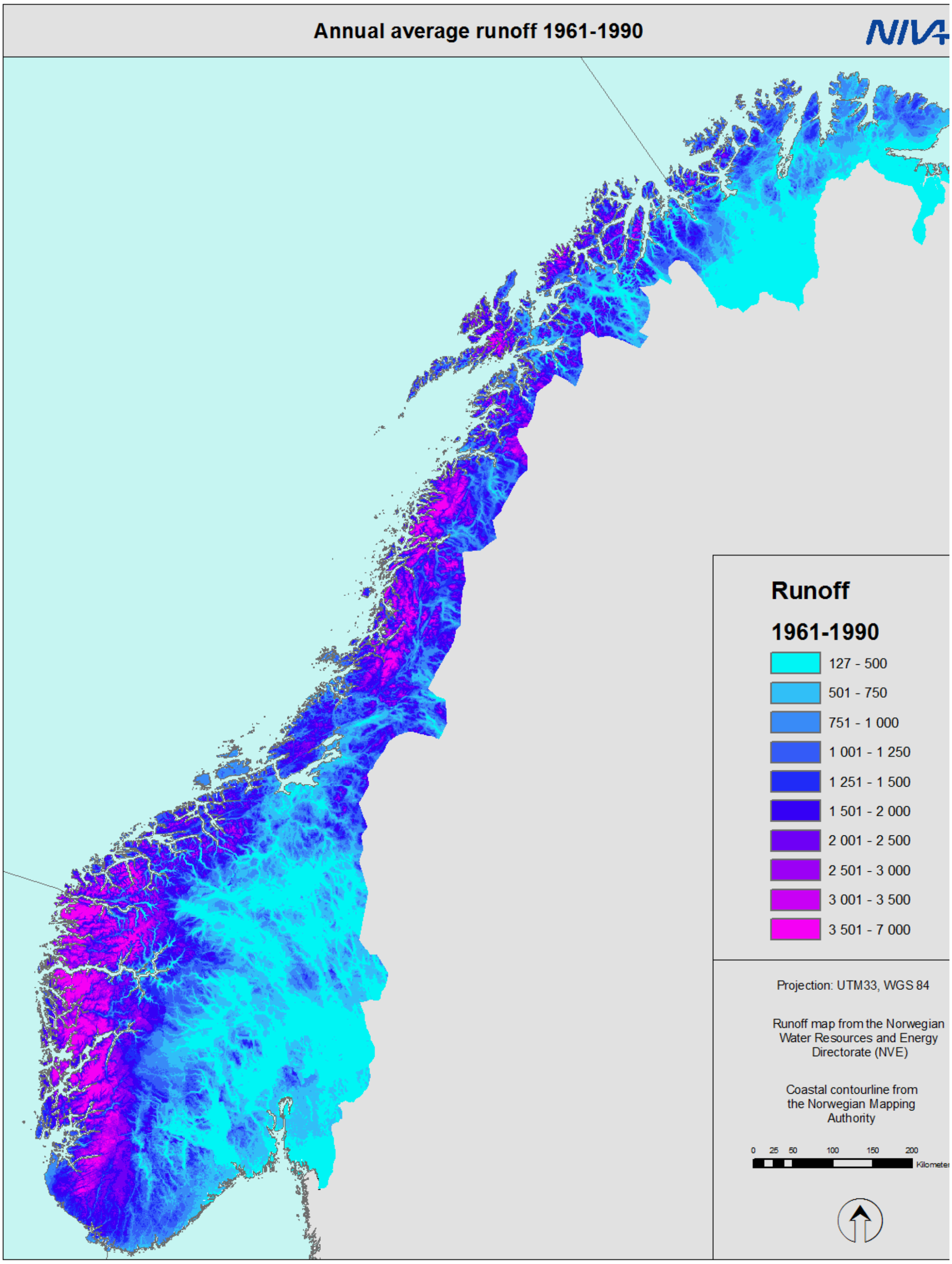


*Figure A-IV-1. Average annual runoff (mm/year) for Norway for the period 1961-1990.*

**Direct discharges to the sea**

The direct discharges comprise point source discharges in unmonitored areas. The estimates are based on national statistical information, including:

- Sewage: Municipal wastewater and scattered dwellings (Statistics Norway - SSB / the KOSTRA Database);
- Industry: the database “Forurensning” from the Norwegian Environment Agency.
- Aquaculture: Nutrients (from the Directorate of Fisheries / the ALTINN-database (altinn.no)) and copper (based on sales statistics of antifouling products made available by the Norwegian Environment Agency)

**Sewage effluents**

Statistics Norway (SSB) is responsible for the annual registration of data from wastewater treatment plants in the country. Approximately 50% of the Norwegian population is connected to advanced treatment plants with high efficiency of phosphorus or both phosphorus and nitrogen treatment. The rest of the population is connected to treatment plants with simpler primary treatment (42%) or no treatment (8%) (SSB, 2002). Most of the treatment plants with only primary treatment serve smaller settlements, while the majority of advanced treatment plants (plants with chemical and/or biological treatment) are found near the larger cities. Of the total hydraulic capacity of 5.74 million p.e. (person equivalent), chemical plants account for 37%, chemical/biological treatment for 27%, primary treatment for 24%, direct discharges for 8%, biological treatment for 2% and others for 2% (2002 data). In the region draining to the North Sea, most of the wastewater (from 83% of the population in the area) is treated in chemical or combined biological-chemical treatment plants, whereas the most common treatment methods along the coast from Hordaland county (North Sea) and northwards are primary treatment or no treatment. The fifty percent reduction target for anthropogenic phosphorus has been met for the Skagerrak coast as a result of increased removal of phosphorus in treatment plants.

Statistics Norway (SSB) and the Norwegian Environment Agency jointly conduct annual registration of data on nutrients from all wastewater treatment plants in the country with a capacity of more than 50 person equivalents (p.e.). The data are reported each year by the municipalities. The electronic reporting system KOSTRA is used for reporting of effluent data from the municipalities directly to SSB. For the plants with no reporting requirements (<50 p.e.), the discharge is estimated by multiplying the number of people with standard Norwegian per capita load figures and then adjusting the estimate according to the removal efficiency of the treatment plants. The “Principles of the Comprehensive Study of Riverine Inputs and Direct Discharges” (PARCOM, 1988) recommends the derived per capita loads listed in the table below. The Norwegian per capita loads are based on studies of Norwegian sewerage districts (Farestveit *et al.*, 1995), and are listed in the same table. The latter are used in the Norwegian reporting.

***Table A-IV-3. Per capita loads used for estimation of untreated sewage discharges.***

| Parameter | OSPAR | Norway |
|---|---|---|
| BOD (kg O/person/day) | 0.063 | 0.046 |
| COD (kg O/person/day) | | 0.094 |
| TOC (kg TOC /person/day) | | 0.023 |
| SPM (kg SPM./person/day) | 0.063 | 0.042 |
| Tot-N (kg N/person/day) | 0.009 | 0.012 |
| Tot-P (kg P/person/day) | 0.0027 | 0.0016 |

The metal loads from wastewater treatment plants reflect the sum of the *reported* load from wastewater treatment plants in unmonitored areas and along the coast. Reporting of metals is required only for the largest treatment plants (>20.000 p.e.). No assumptions on loads from other plants than those reporting have been considered.

**Industrial effluents**
Estimates of discharges from industry are based on data reported to the database "Forurensning" (Norwegian Environment Agency) and the share of municipal wastewater considered to derive from industry (see above). Sampling frequency for industrial effluents varies from weekly composite samples to random grab samples. Sampling is performed at least twice a year. Nutrient loads from industry in unmonitored areas are estimated using the TEOTIL model, based on the reported data. Metal loads, where reported, are summed.

**Fish farming effluents**
Fish farmers report monthly data for fish fodder, biomass, slaughtered fish and slaughter offal down to net cage level. These are reported by The Directorate of Fisheries. Raw data are available at altinn.no.

Statistics Norway has sales statistics for farmed trout and salmon. These show an increase in fish farming activities since 1995, which have led to increases in discharges from fish farming despite improvements in treatment yield and production procedures.

The waste from aquaculture facilities is predominantly from feed (De Pauw and Joyce, 1991: Pillay, 1992; Handy and Poxton, 1993), and includes uneaten feed (feed waste), undigested feed residues and faecal/excretion products (Cripps, 1993). The main pollutants from aquaculture are organic matter, nitrogen and phosphorus (Cho and Bureau, 1997).

NIVA estimates nitrogen and phosphorus discharges from fish farming according to the HARP Guidelines (Guideline 2/method 1, see Borgvang and Selvik, 2000). The estimates are based on mass balance equations, i.e. feed used (based on P or N content in feed), and fish production (based on P or N content in produced fish).

For more information about details in data reporting and availability see Selvik *et al.* (2007) and Skarbøvik *et al.* (2011). The total nutrient loads from fish farming are estimated using the TEOTIL model, based on the input data described above.

**Organic contaminants, information on uncertainties**
The method for estimating loads and concentrations of organic contaminants is described in detail in the main report, chapter 2.6.

Estimates of riverine loads of contaminants are the subject of some uncertainty. The issues listed below are all expected to contribute to the overall uncertainty of the estimates in contaminant loads.

- Water discharge data may suffer from some uncertainty and/or bias
- Measurements of the SPM content of the water are based on monthly spot/bottle sampling. In these circumstances, it is expected that values measured at the time of sampling are representative of a much longer period of time. The SPM content of the water can vary substantially and much higher concentrations can sometimes be expected/observed during periods of high flow, i.e. after heavy rainfall events. The

type and amount of particulate organic carbon may also vary substantially with time and river flow and this may induce further uncertainty. The type of particulate organic carbon can affect the sorption of organic contaminant to particulate organic matter in surface waters and impact the freely dissolved concentration. Organic carbon normalisation would tend to reduce the variability in contaminant concentrations in SPM.

- Depending on contaminant exchange kinetics between the sampler and water, the concentration of mildly hydrophobic substances in silicone samplers may reach equilibrium with that in water. This means that sampling for these substances is not time-integrative anymore and concentrations measured are not necessarily representative of the entire passive sampler exposure time
- Sampling rates of passive samplers may not be constant throughout the exposure period. Biofouling layer build-up and changes in water hydrodynamics around the samplers may result in sampling rates that vary over the course of the deployment.
- Passive sampling data is not corrected to account for differences in temperature between exposure periods. Deployment temperatures vary between 0 and 20 °C over the course of a year. Higher polymer-water partition coefficients can be expected at lower temperatures.
- The SPM accumulation/pre-concentration step performed by the continuous flow centrifuge may result in SPM samples with a particle size distribution that deviates from that of the water being sampled. It may be that the smallest particles are not retained as efficiently as larger particles by the CFC. This would induce a slight bias in SPM-associated contaminant concentrations and percentage OC measured in the SPM.
- Particle retention in the CFC may not be constant throughout time
- Uncertainty in the extraction and analysis of SPM and silicone rubber samples
- Uncertainty in the estimation of silicone rubber sampling rates

**Sensors and loggers in Rivers Glomma, Drammenselva and Alna**

Data are logged using an Observator OMC-045-III data logger and transferred directly to NIVA's server via GPRS. The data are then immediately available online at www.aquamonitor.no/rid. A QA routine was set up, flagging data which were obviously wrong, due to e.g. interrupted power supply, maintenance and in the case of River Glomma, interruptions of the flow through the flow cell. Flagged data are not visible online and are not included when downloading data, but are kept in the database. Maintenance record for the sensors in rivers Glomma, Drammenselva, and Alna before summer 2016 were given in Skarbøvik et al. 2016. Maintenance records in 2016 are given below:

- <u>River Alna:</u> March 2016: pH sensor had very high values (above 14). The pH sensor was exchanged in May 2016 and the sonde was manually cleaned. Observations from 13 June showed that the pH values had not been improved, and new service was needed. July-August: Issues with turbidity sensor, and later with temperature, which again had impacts on pH and conductivity.
- <u>River Drammenselva</u>: 5.January 2016: pH-sensor calibrated. 8 March: Ice damage at the site. 11. May 2016: pH sensor exchanged. The sonde was cleansed, and the tube with the sonde was moved a bit upwards in the water. In September there was maintenance of the pH sensor. Also, the tube where the sensor is placed was anchored more securely. Later in autumn it seemed that a result of the maintenance was that the sensor now was positioned higher up, and periods with dry conditions had probably occurred.

- River Glomma: 7. January 2016: pH calibrated. The sonde was cleaned. Firmware logger upgraded. 5. May 2016: pH-sensor exchanged, sonde cleaned. Autumn 2016: clearly need for more cleansing of sensors, hence agreements were made with employees at Baterød to help in cleaning the sensor.

## Changes in the Norwegian RID programme over the years

Since the Norwegian RID Programme started in 1990, several changes have been introduced. For this reason, in 2009 the entire Norwegian database was upgraded in order to better reflect the same methodology (Stålnacke *et al.*, 2009). However, not all methodological changes could be adjusted (such as the changes in LOD values over time). Below is an overview of the main changes in the RID methodology.

**Changes in the selection and monitoring frequency of the rivers monitored monthly**
Earlier, the term 'main river' was used for rivers monitored monthly or more often.

Up until 2013, 10 rivers were samples mainly monthly. In 2008, River Suldalslågen was removed from this selection of rivers, and instead River Vosso was introduced as a new river for monthly monitoring. The main reason was that River Suldalslågen is heavily modified by hydropower developments, and the load in this river does therefore not represent an unmodified watershed in this region. River Vosso, on the other hand, fitted well into the category of 'relatively unpolluted river' with a population density of 1.1 persons/km$^2$, and only 3% of the catchment area used for agriculture. The river is situated in the same marine region as River Suldalslågen.

In 2008, data from another sampling programme were included in the database for River Glomma, and the number of samples in this river is therefore increased in some, few years. This parallel dataset contains only data for some nutrients and TOC.

In 2013, River Alna in Southern Norway, draining to the Skagerrak Area (Oslo Fjord) was introduced as the 11$^{th}$ river monitored monthly. This river was previously part of the RID programme under the name River Loelva, monitored once a year from 1990 to 2003.

**Changes in the selection and monitoring frequency of the rivers monitored four times a year**
Earlier, the term 'tributary river' was used for these rivers. The term was only used to signify that these rivers were sampled less frequently than the rivers monitored monthly, as they all drain directly into the sea.

In the period 1990-2003, 145 rivers were sampled once a year only. In 2004, the number of 'tributary rivers' was reduced from 145 (sampled once a year) to 36 rivers, which were sampled four times a year. The remaining 109 rivers, formerly monitored once a year since 1990, were no longer sampled. One of these, River Alna, was included again in 2013 as a river monitored monthly.

**Changes in load calculation methods**
Several changes have been made in the calculation of loads; these are thoroughly described in Stålnacke *et al.* (2009). The present database is now based on a common method that is now the standard method in the Norwegian RID Programme.

The former method multiplied a flow-weighted annual concentration with the total annual discharge (i.e., total annual water volume) in accordance with the OSPAR JAMP Guidelines. For various reasons, the sampling is not always conducted at regular time intervals and in some cases also monthly data are missing. Thus, it was decided that it would be better to weight each sample not only by water discharge but also to the time period the sample represented. These time periods were defined by the midpoints between the samples. Note that the formula is used only within one year, i.e., the time period for a sample is never extended into another year. The modified load calculation formula is shown below.

$$Load = Q_r \frac{\sum_{1}^{n} Q_i \bullet C_i \bullet t_i}{\sum_{1}^{n} Q_i \bullet t_i}$$

where $Q_i$ represents the water discharge at the day of sampling (day i);
$C_i$ the concentration at day i;
$t_i$ the time period from the midpoint between day i-1 and day i to the midpoint between day i and day i+1, i.e., half the number of days between the previous and next sampling;
$Q_r$ is the annual water volume.

**Changes in laboratories, parameters, methods and detection limits**
During 1990-1998 the chemical analyses for the RID Programme were conducted at the NIVA-lab. In the period 1999-2003 the analyses were carried out by Analycen (now: EuroFins). In 2004 NIVA-lab resumed analysing the samples.

Changes in detection limits and laboratory analysis methods have been reported in each annual report and are not included here. However, changes in detection limits have been duly taken into account in the trend analyses.

In 2013, silver (Ag) was introduced as a new parameter in the programme. The same year, lindane and PCB (which had been monitored in the rivers sampled monthly) were omitted from regular the programme.

From 2013, also, Rivers Alna, Glomma and Drammenselva were monitored for organic contaminants, as well as high-frequency turbidity, conductivity, temperature and pH recordings through sensor data. Temperature monitoring was also started in the remaining 44 rivers, using different types of methodology.

**Changes in methods concerning direct discharges**
In 2008 a new method to calculate the direct discharges was introduced, and used on all years since 1990, as described in Stålnacke *et al.* (2009). Basically, the new method calculates the

discharges from a plant whenever data are lacking and there is no information that the plant has been shut down. This calculation is based on a trend line that is made from data on the former years' discharges. The missing value in the last year will be set equal to the value of the trend line in the former year (or the year with the most recent data).

Several industrial point sources that had huge discharges of sediments were excluded from the reporting in 2008. The reason was that these did not represent particle pollution to the coastal areas since the sediments were disposed in very restricted dumping tips. This significantly reduced sediment inputs to the Norwegian marine areas as compared to former years.

The loads from fish farming were first included in the grand total values in 2000, i.e. originally these loads were not included in the input figures for the period 1990-1999. However, in the recalculation project in 2007 a time series for nitrogen, phosphorus and copper from aquaculture, was established, covering the entire period from 1990 to 2007 (see Stålnacke *et al.*, 2009). Then, in 2011 another adjustment was made: Over the years the nutrient content in fish fodder has been reduced. In 2011 a table showing changes in nutrient content over the period 2000-2010 was established (see Skarbøvik *et al.*, 2011). As a result, nutrient loads were adjusted from the year 2000 onwards.

From 2013 onwards, direct discharges of organic contaminants are no longer reported. Previously such estimates were reported for sewage effluents of PCB7, but these estimates were considered highly uncertain, as only the largest treatment plants (>50.000 p.e.) are required to report this.

## References for this Appendix

Beldring, S. 2002. Runoff generating processes in boreal forest environments with glacial tills. Nordic Hydrology, 33, 347-372.

Beldring, S., Engeland, K., Roald, L.A., Sælthun, N.R. and Voksø, A. 2003. Estimation of parameters in a distributed precipitation-runoff model for Norway. Hydrology and Earth System Sciences, 7, 304-316.

Bergström, S. 1995. The HBV model. In: Singh, V.P. (Ed.), Computer Models of Watershed Hydrology. Water Resources Publications, Highlands Ranch, 443-476.

Borgvang, S.A. and Selvik, J.R. 2000. Development of HARP Guidelines; Harmonised Quantification and Reporting Procedures for Nutrients. SFT Report 1759-2000. ISBN 82-7655-401-6. 179 pp.

Cho, C.Y. and Bureau, D.P. 1997. Reduction of waste output from salmonid aquaculture through feeds and feeding. The Progressive Fish Culturist, 59, 155-160.

Cripps, S.J. 1993. The application of suspended particle characterisation techniques to aquaculture systems In: Techniques for Modern Aquaculture (Ed. J-W wang), pp 26-34. Proceedings of an Aquacultural Engineering Conference, 21-23 June, Spokane, Washington, USA.

Daly, C., Neilson. R.P. and Phillips, D.L. 1994. A statistical-topographic model for mapping precipitation over mountainous terrain. Journal of Applied Meteorology, 33, 140-158.

De Pauw, N. and Joyce, J. 1991. Aquaculture and the Environment, AAS Spec. Publication No. 16, Gent, Belgium 53 pp.

Doherty, J., Brebber, L. and Whyte, P. 1998. PEST. Model independent parameter estimation. Watermark Computing, 185 pp.

Farestveit, T., Bratli, J.L., Hoel, T. and Tjomsland, T. 1995. Vurdering av tilførselstall for fosfor og nitrogen til Nordsjøen fra kommunalt avløp beregnet med TEOTIL. Grøner/NIVA-Report no. 171441.

Gottschalk, L., Beldring, S., Engeland, K., Tallaksen, L., Sælthun, N.R., Kolberg, S. and Motovilov, Y. 2001. Regional/macroscale hydrological modelling: a Scandinavian experience. Hydrological Sciences Journal, 46, 963-982.

Handy, R.D. and Poxton, M.G. 1993. Nitrogen pollution in mariculture: toxicity and excretion of nitrogenous compounds by marine fish Reviews in Fish Biology and Fisheries, 3, 205-41.

Matheussen, B., Kirschbaum, R.L., Goodman, I.A., O'Donnel, G.M., Lettenmaier, D.P. 2000. Effects of land cover change on streamflow in the interior Columbia River Basin (USA and Canada). Hydrological Processes, 14, 867-885.

PARCOM 1988. Tenth Meeting of the Paris Commission- PARCOM 10/3/2. Lisbon 15-17 June 1988.

Pillay, T.V.R. 1992. Aquaculture and the Environment Fishing News Book, Oxford.

Selvik, J.R., Tjomsland, T. and Eggestad, H.O. 2007. Tilførsler av næringssalter til Norges kystområder i 2006. beregnet med tilførselsmodellen TEOTIL. Norwegian State Pollution Monitoring Programme. NIVA Rapport 5512-2007.

Skarbøvik, E., Stålnacke, P., Selvik, J.R., Aakerøy, P.A., Høgåsen, T., and Kaste, Ø. 2011. Elvetilførselsprogrammet (RID) – 20 års overvåking av tilførsler til norske kystområder (1990-2009). NIVA-rapport 6235-2011. Klima- og forurensningsdirektoratet TA-2857/2011; 55 s.

Stålnacke, P., Haaland, S., Skarbøvik, E., Turtumøygard, S., Nytrø, T.E., Selvik, J.R., Høgåsen, T., Tjomsland, T., Kaste, Ø. and Enerstvedt, K.E. 2009. Revision and assessment of Norwegian RID data 1990-2007. Bioforsk Report Vol. 4 No. 138. SFT report TA-2559/2009. 20p.

Sælthun, N.R. 1996. The Nordic HBV model. Norwegian Water Resources and Energy Administration Publication 7, Oslo, 26 pp.

# Appendix V Trends in riverine loads and concentrations.

## Pollutant Concentrations – 10 year trends

Analyses done for concentrations in the water samples, not volume-weighted.

Legend:

| | |
|---|---|
| Dark green | Significant downward (p<0.05) |
| Light green | Downward but not significant (0.05<p<0.1) |
| Red | Significant upward (p<0.05) |
| Orange | Upward but not significant (0.05<p<0.1) |

***Table A-V-0a. Trends in nutrient and particle concentrations in nine Norwegian main rivers in the last 10 years (2007- 2016). The table shows the p-values. The colours indicate the degree of statistical significance (see legend).***

| CONCENTRATIONS. 2007-2016 | | | | | | |
|---|---|---|---|---|---|---|
| River | $NH_4$-N | $NO_3$-N | Tot-N | $PO_4$-P | Tot-P | SPM |
| Glomma | 0.3378 | 0.2868 | 0.5605 | 0.2705 | 0.9103 | 0.7144 |
| Drammenselva | 0.8954 | 0.0161 | 0.3414 | 0.4755 | 0.6713 | 0.5399 |
| Numedalslågen | 0.1831 | 0.2341 | 0.6821 | 0.6628 | 0.3697 | 0.4705 |
| Skienselva | 0.2309 | 0.0022 | 0.0824 | 0.7295 | 0.2192 | 0.0893 |
| Otra | 0.1672 | 0.2409 | 0.5999 | 0.7085 | 0.1933 | 0.1757 |
| Orreelva | 0.1163 | 0.3414 | 0.0864 | 0.6548 | 0.1445 | 0.3751 |
| Orkla | 0.4460 | 0.6088 | 0.0234 | 0.3391 | 0.5678 | 0.3953 |
| Vefsna | 0.8371 | 0.4268 | 0.5757 | 0.1889 | 0.7178 | 0.5214 |
| Altaelva | 0.4113 | 0.0284 | 0.0050 | 0.0234 | 0.0087 | 0.5226 |

***Table A-V-0b. Trends for metal concentrations in nine Norwegian main rivers in the last 10 years (2007-2016). The table shows the p-values. The colours indicate the degree of statistical significance (see legend).***

| CONCENTRATIONS metals. 2007-2016 | | | | | |
|---|---|---|---|---|---|
| River | Cd | Cu | Ni | Pb | Zn |
| Glomma | 0.9358 | 0.0380 | 0.2959 | 0.6626 | 0.0495 |
| Drammenselva | 0.4383 | 0.0285 | 0.3329 | 0.2268 | 0.0631 |
| Numedalslågen | 0.0724 | 0.0155 | 0.2080 | 0.0211 | 0.0369 |
| Skienselva | 0.0312 | 0.1008 | 0.0200 | 0.9699 | 0.0785 |
| Otra | 0.7900 | 0.0068 | 0.4014 | 1.0000 | 0.1535 |
| Orreelva | 0.7577 | 0.6859 | 0.0518 | 0.2672 | 0.0961 |
| Orkla | 0.0794 | 0.0058 | 0.0572 | 0.1549 | 0.0641 |
| Vefsna | 0.1845 | 0.3761 | 0.0301 | 0.1389 | 0.0318 |
| Altaelva | 0.7494 | 0.1732 | 0.0600 | 0.7333 | 0.1258 |

## Trend Analyses - Pollutant Loads, 10 year trends

Not water discharge weighted.
Legend:

| | |
|---|---|
| Dark green | Significant downward ($p<0.05$) |
| Light green | Downward but not significant ($0.05<p<0.1$) |
| Red | Significant upward ($p<0.05$) |
| Orange | Upward but not significant ($0.05<p<0.1$) |

***Table A-V-0c. Trends in annual water discharge (Q; estimated from daily measurements). nutrient and particle loads in nine Norwegian main rivers in the last 10 years (2007- 2016). The table shows the p-values. The colours indicate the degree of statistical significance (see legend).***

**LOADS. 2007-2016**

| River | Q | $NH_4$-N | $NO_3$-N | Tot-N | $PO_4$-P | Tot-P | SPM |
|---|---|---|---|---|---|---|---|
| Glomma | 0.9287 | 0.4208 | 0.7884 | 0.9287 | 0.4208 | 0.5312 | 0.1797 |
| Drammenselva | 0.5312 | 0.4208 | 0.2449 | 0.3252 | 0.4208 | 0.9287 | 0.6547 |
| Numedalslågen | 0.1797 | 0.0892 | 0.2449 | 0.4208 | 0.6547 | 0.4208 | 0.3252 |
| Skienselva | 0.7884 | 0.1797 | 0.0892 | 0.9287 | 0.3252 | 0.1797 | 0.1797 |
| Otra | 0.5312 | 0.1797 | 0.9287 | 0.7884 | 0.5312 | 0.4208 | 0.5312 |
| Orreelva | 0.7884 | 0.4208 | 0.3252 | 0.4208 | 0.5312 | 0.1797 | 0.3252 |
| Orkla | 0.0397 | 0.1797 | 0.0056 | 0.0603 | 0.2449 | 0.0892 | 0.4208 |
| Vefsna | 0.6547 | 0.4208 | 0.1797 | 0.6547 | 0.5312 | 0.9287 | 0.5312 |
| Altaelva | 0.7884 | 0.3252 | 0.1284 | 0.0603 | 0.0157 | 0.0603 | 0.1797 |

***Table A-V-0d. Trends for metal loads in nine Norwegian main rivers in the last 10 years (2007-2016). The table shows the p-values. The colours indicate the degree of statistical significance (see legend).***

**LOADS metals. 2007-2016**

| River | Q | Cd | Cu | Ni | Pb | Zn |
|---|---|---|---|---|---|---|
| Glomma | 0.9287 | 0.4208 | 0.1284 | 0.9287 | 0.3252 | 0.1284 |
| Drammenselva | 0.5312 | 0.6547 | 0.1284 | 0.9287 | 0.0397 | 0.7884 |
| Numedalslågen | 0.1797 | 0.0892 | 0.0253 | 0.3252 | 0.0603 | 0.0892 |
| Skienselva | 0.7884 | 0.9287 | 0.5312 | 0.3252 | 0.2449 | 0.2449 |
| Otra | 0.5312 | 0.7884 | 0.0095 | 0.5312 | 0.7884 | 0.2449 |
| Orreelva | 0.7884 | 0.7884 | 0.6547 | 0.7884 | 0.9287 | 0.5312 |
| Orkla | 0.0397 | 0.0253 | 0.0157 | 0.5312 | 0.7884 | 0.0253 |
| Vefsna | 0.6547 | 0.4208 | 0.6547 | 0.5312 | 0.1797 | 0.0397 |
| Altaelva | 0.7884 | 0.9287 | 0.9287 | 0.1797 | 0.7884 | 0.2449 |

## Pollutant Loads - complimentary charts

Loads are not flow-normalised.

Extra- or interpolated values are indicated with different colours. The substances where such extra- or interpolation has been performed include total-P, ammonium-N ($NH_4$-N), mercury (Hg), arsenic (As) and PCB7.

For data on concentrations in each river since 1990, it is referred to http://vannmiljo.miljodirektoratet.no/.

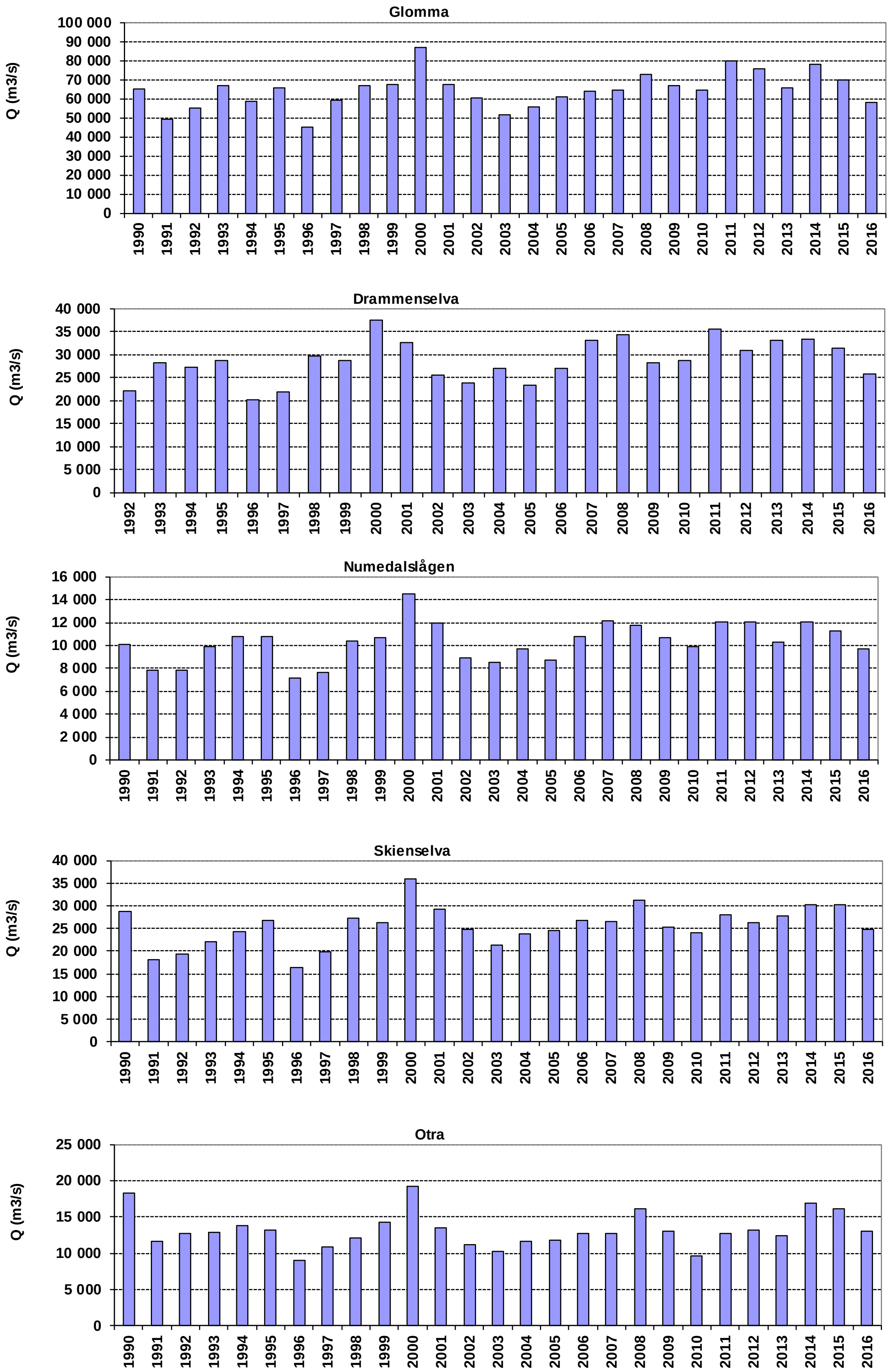


*Figure A-V-1a. Annual water discharge (Q) in the five main rivers draining to Skagerrak, Norway, 1990-2016.*

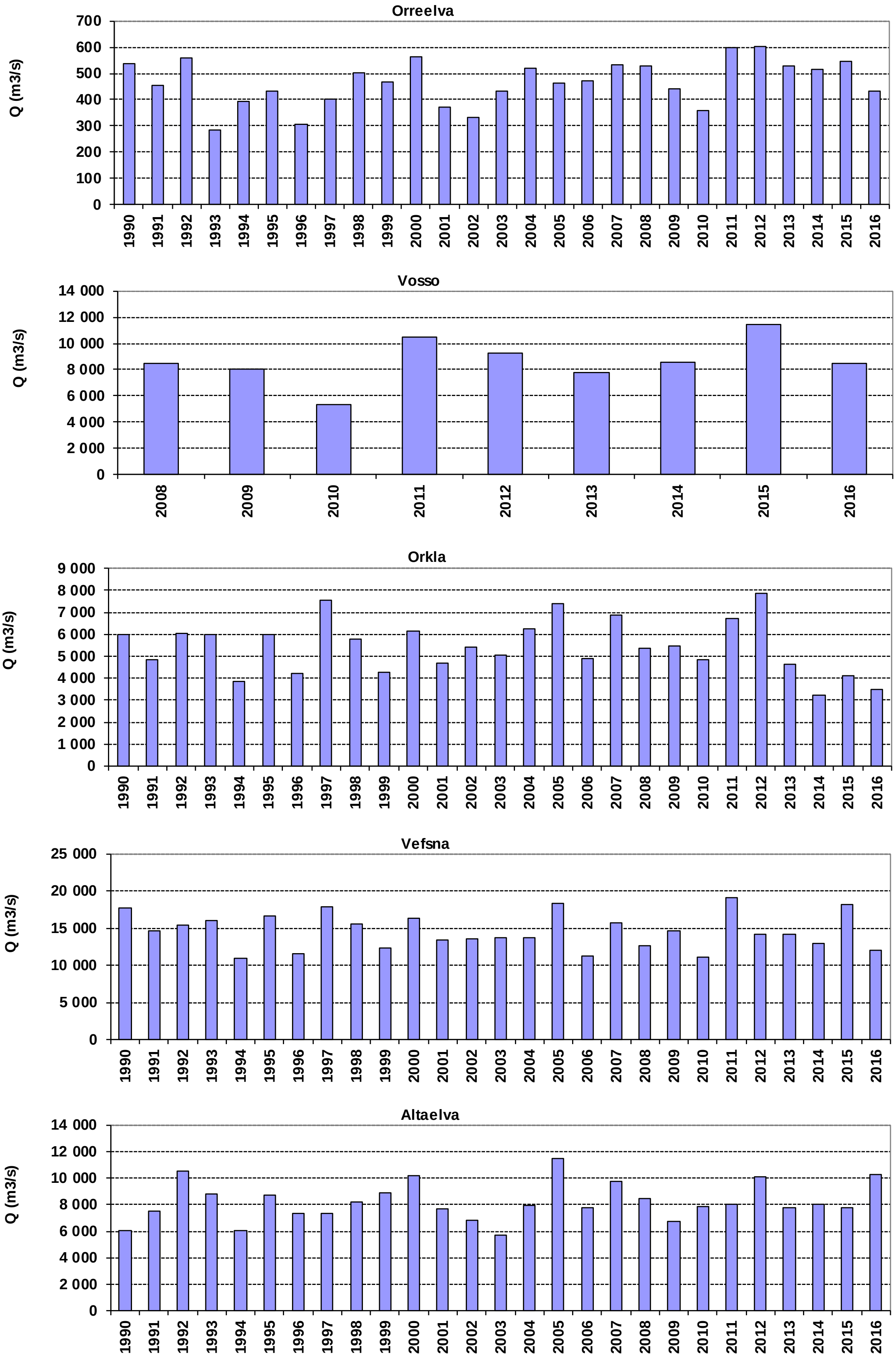


*Figure A-V-1b. Annual water discharge (Q) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2016 (2008-2016 for River Vosso).*

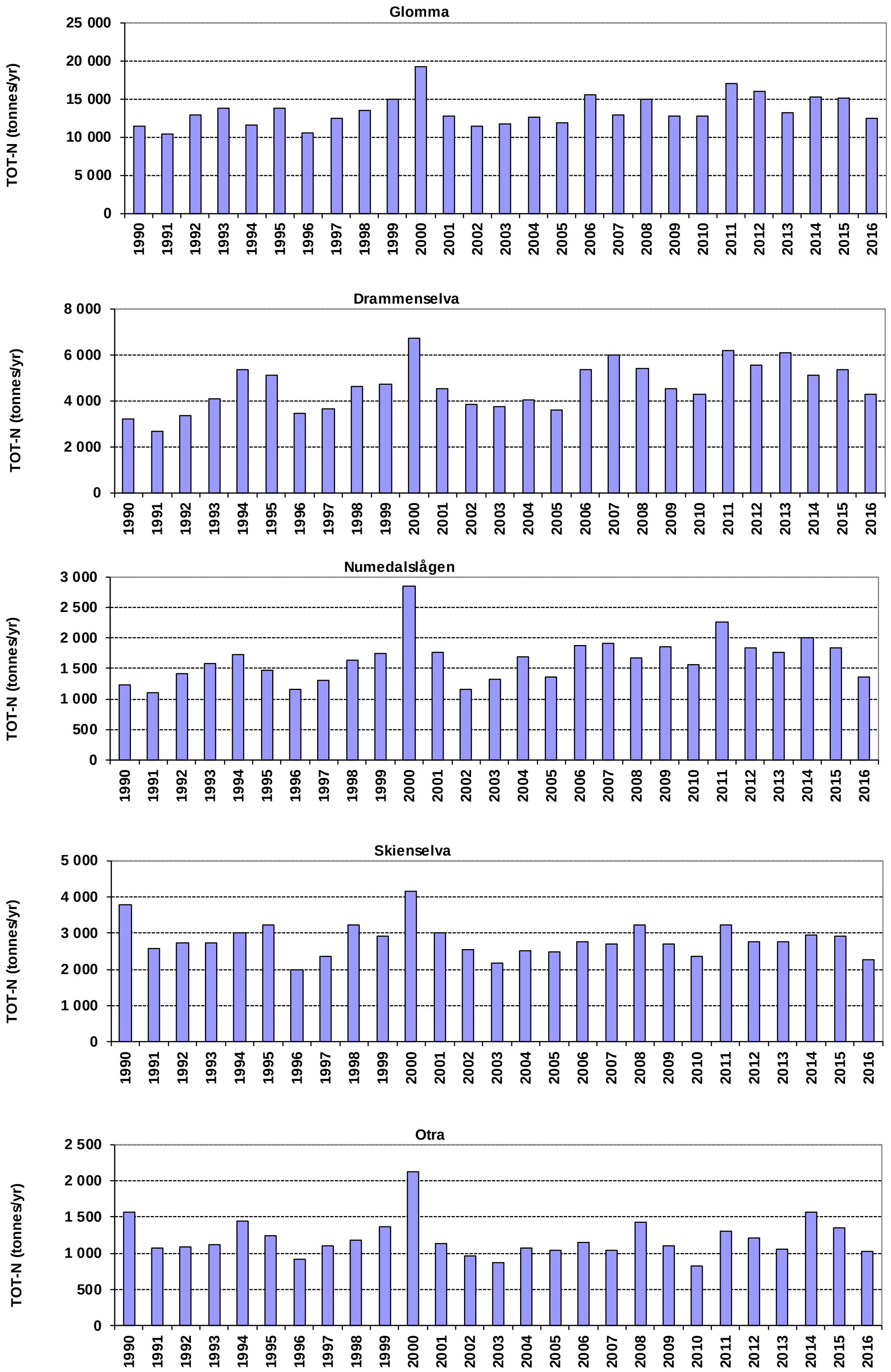


*Figure A-V-2a. Annual riverine loads of total nitrogen (Tot-N) in the five main rivers draining to Skagerrak, Norway, 1990-2016.*

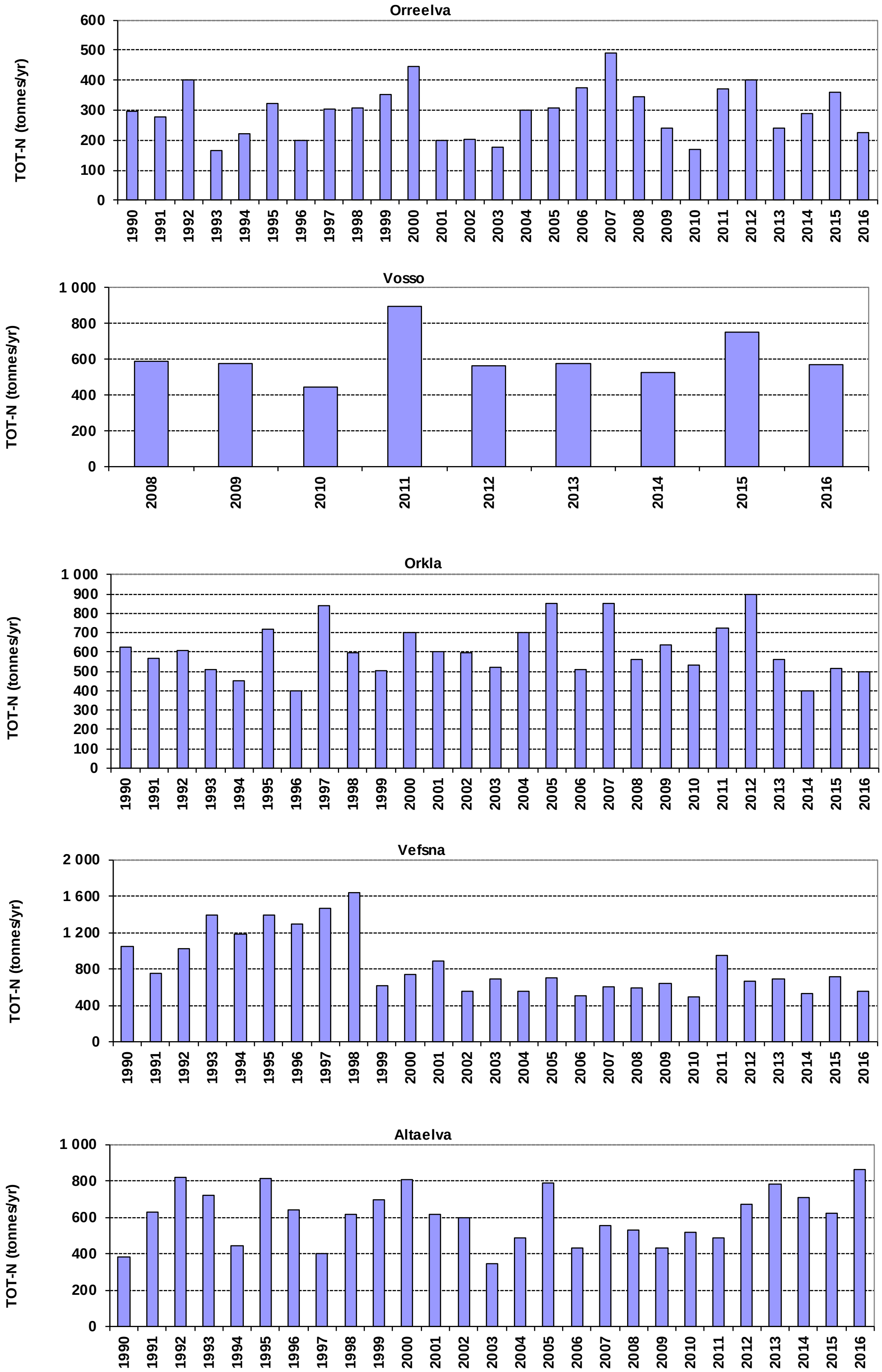


*Figure A-V-2b. Annual riverine loads of total nitrogen (Tot-N) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2016 (2008-2016 for River Vosso).*

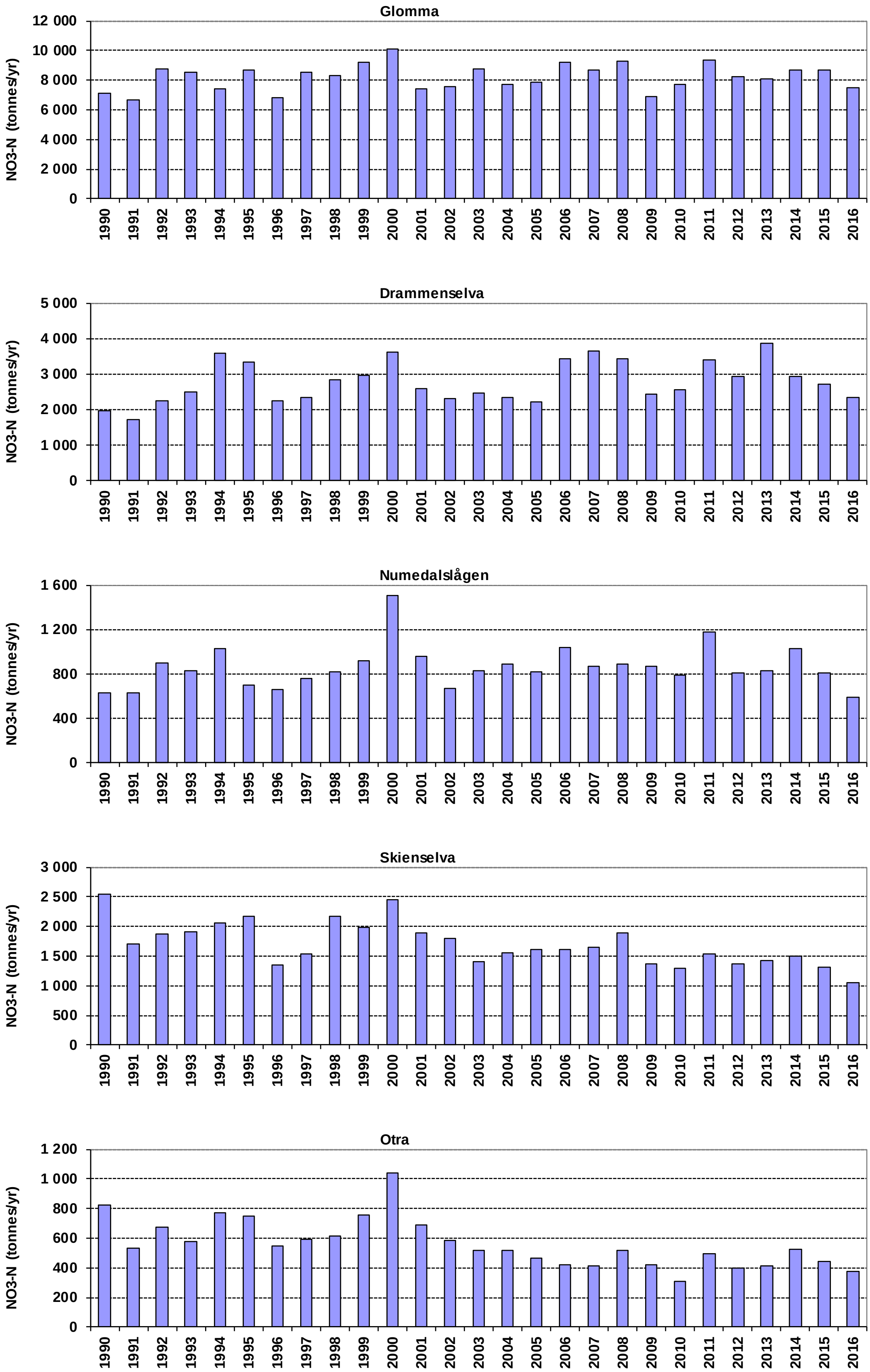


*Figure A-V-3a. Annual riverine loads of nitrate-nitrogen ($NO_3$-N) in the five main rivers draining to Skagerrak, Norway, 1990-2016.*

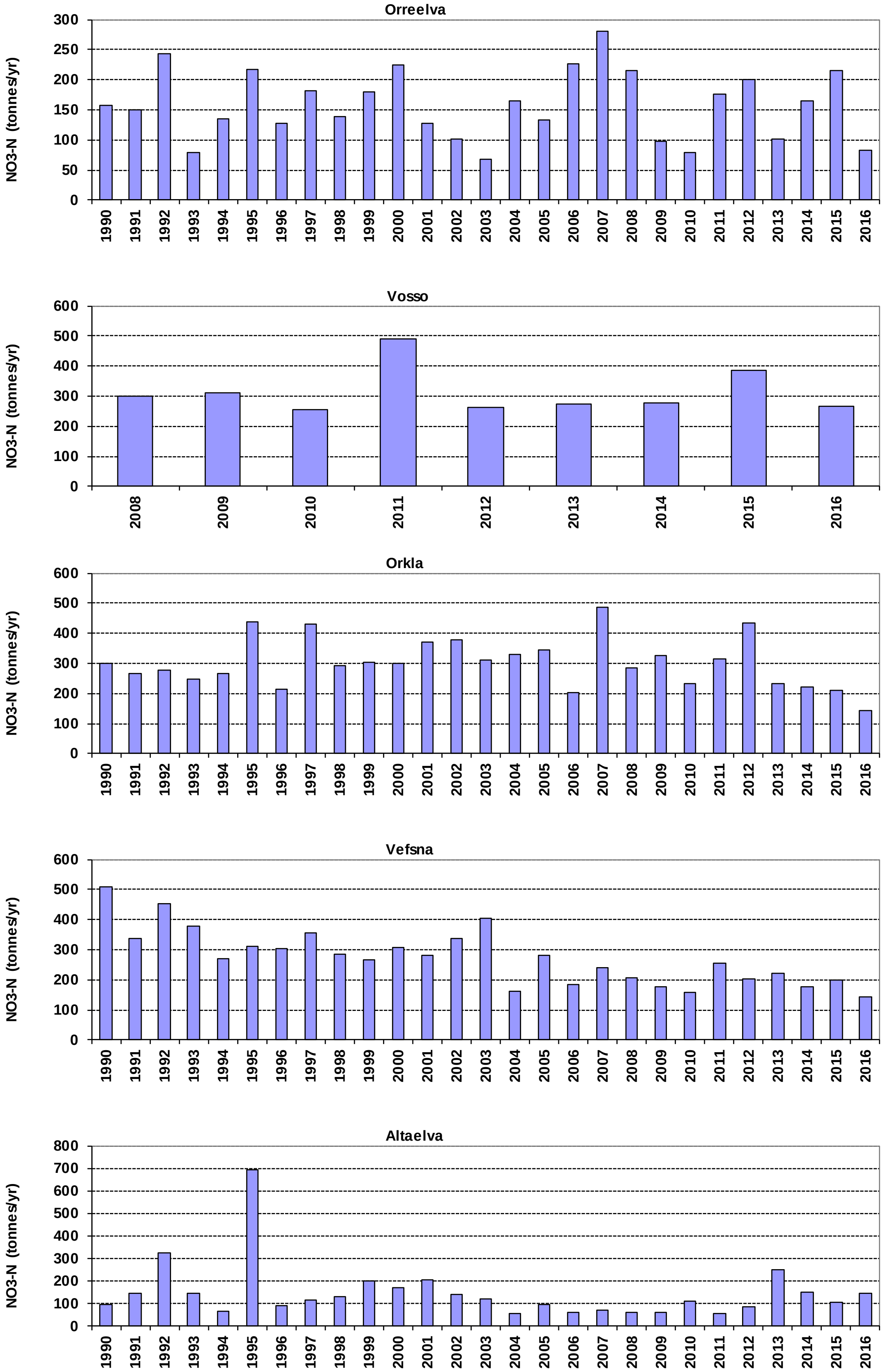


*Figure A-V-3b. Annual riverine loads of nitrate-nitrogen ($NO_3$-N) from five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2016 (2008-2016 for River Vosso).*

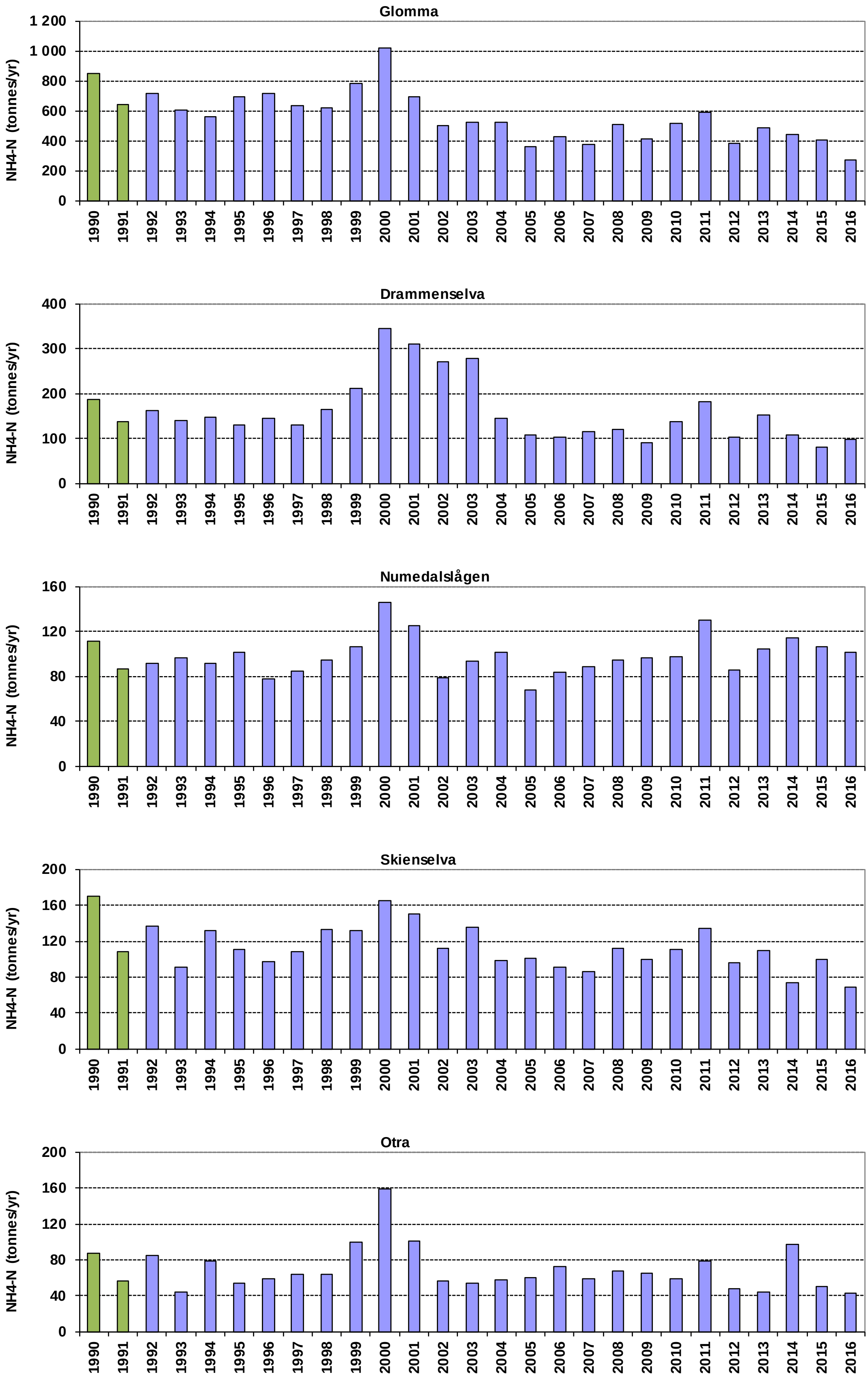


*Figure A-V-4a. Annual riverine loads of ammonium-nitrogen ($NH_4$-N) in the five main rivers draining to Skagerrak, Norway, 1990-2016. Years with extra- or interpolated values are given in green.*

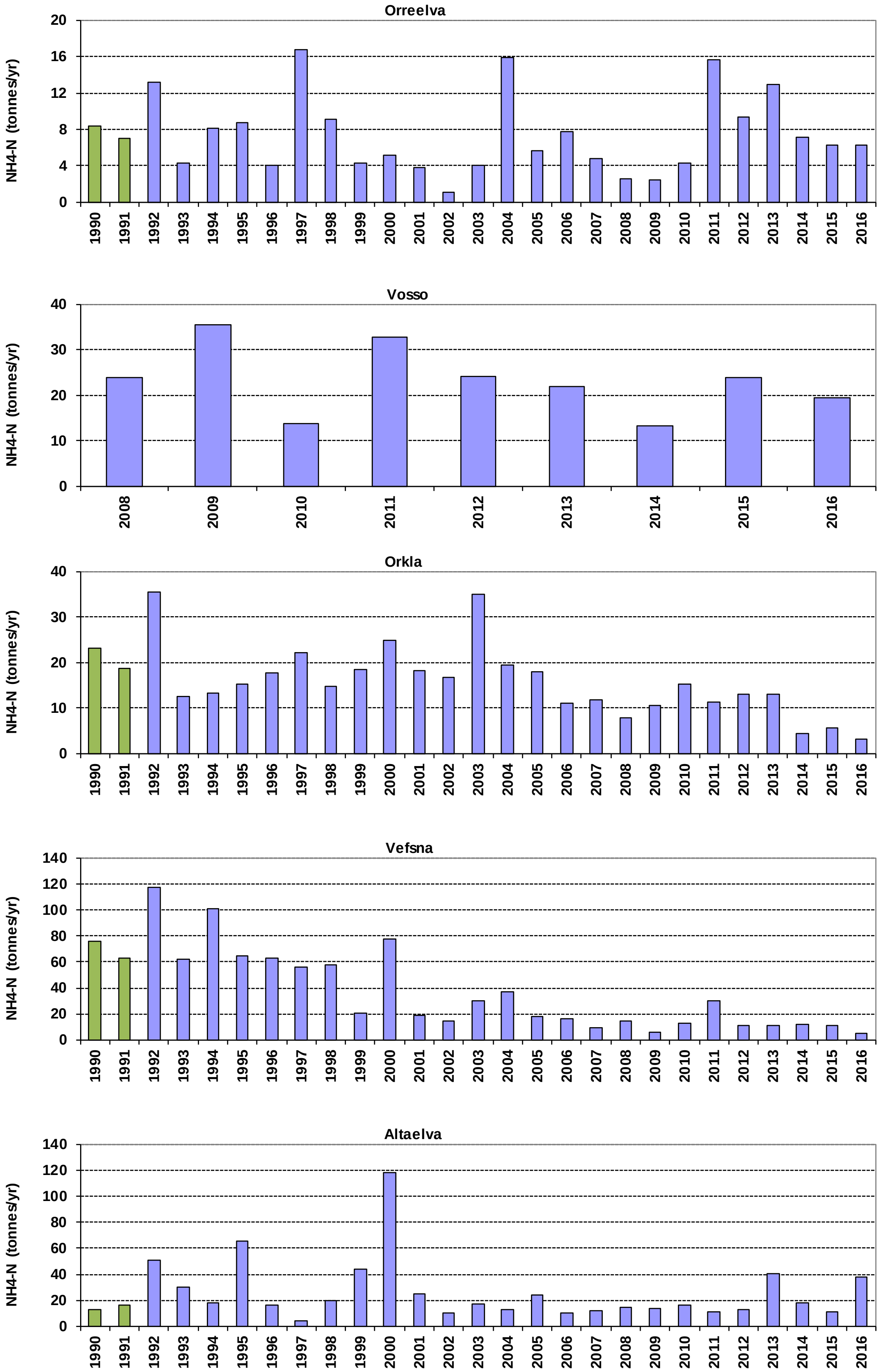


*Figure A-V-4b. Annual riverine loads of ammonium-nitrogen ($NH_4$-N) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2016 (2008-2016 for River Vosso). Years with extra- or interpolated values are given in green.*

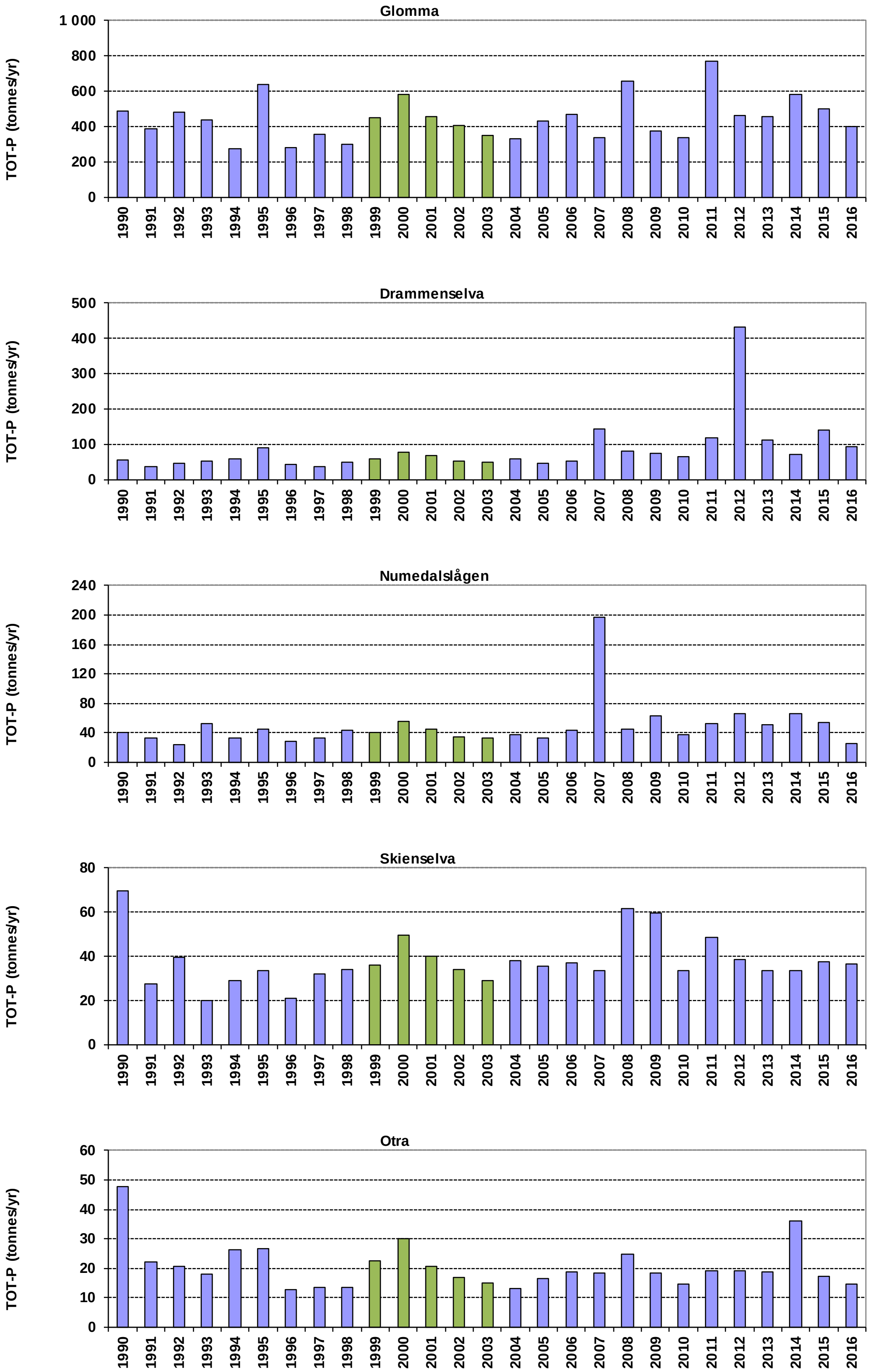


*Figure A-V-5a. Annual riverine loads of total phosphorus (Tot-P) in the five main rivers draining to Skagerrak, Norway, 1990-2016. Years with extra- or interpolated values are given in green.*

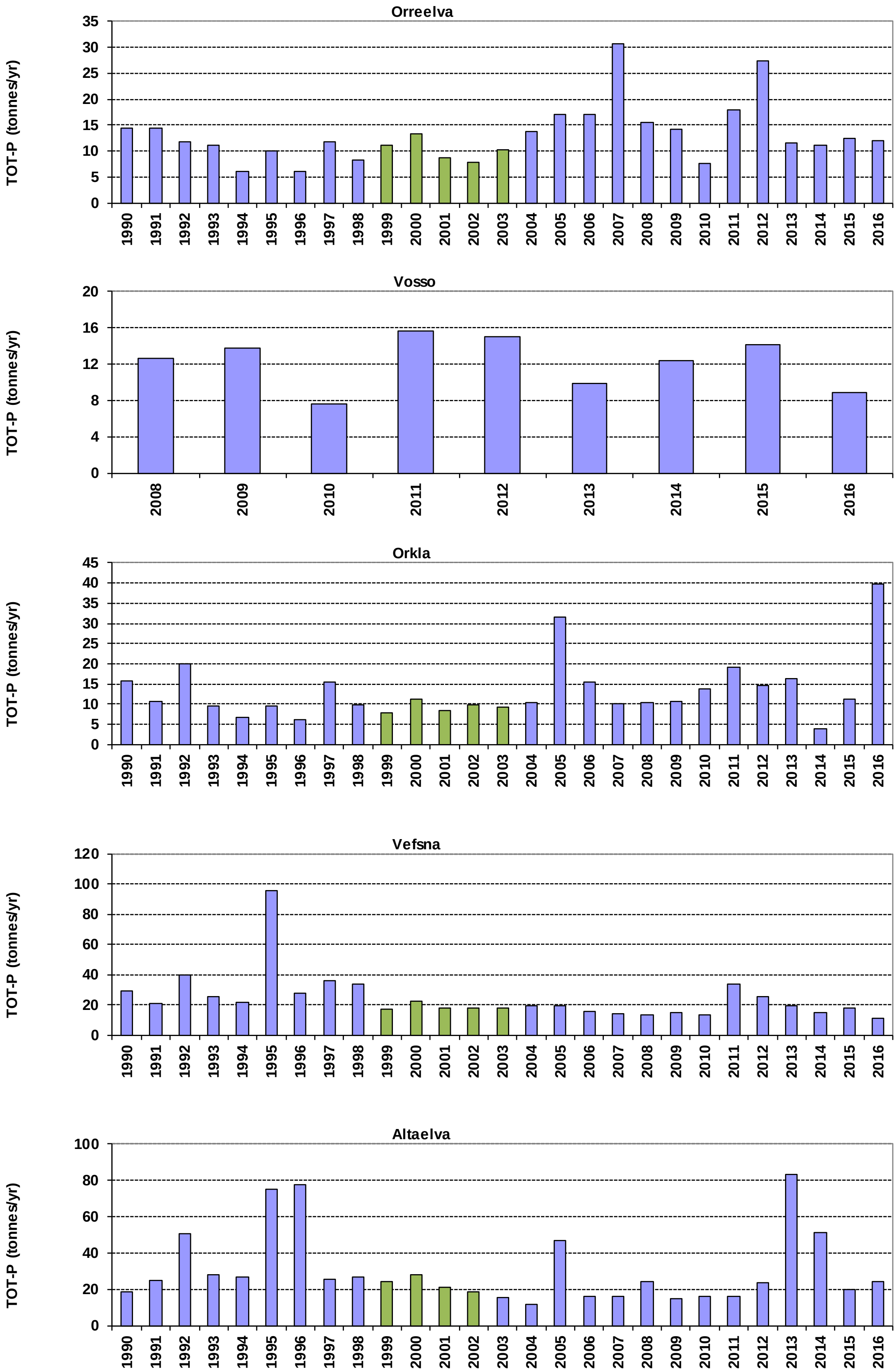


*Figure A-V- 5b. Annual riverine loads of total phosphorus (Tot-P) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2016 (2008-2016 for River Vosso). Years with extra- or interpolated values are given in green.*

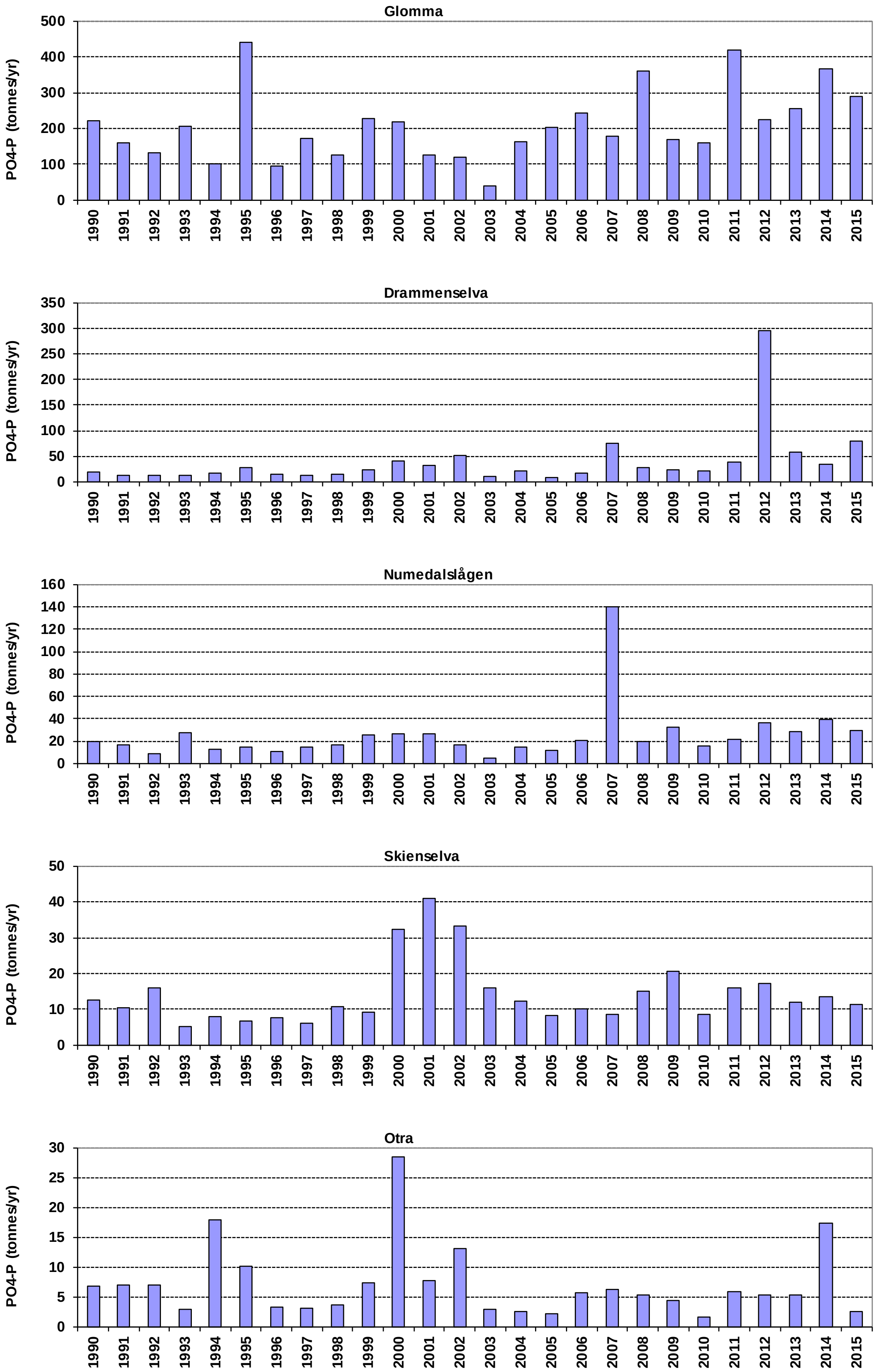


*Figure A-V-6a. Annual riverine loads of orthophosphate-phosphorus ($PO_4$-P) in the five main rivers draining to Skagerrak, Norway, 1990-2016.*

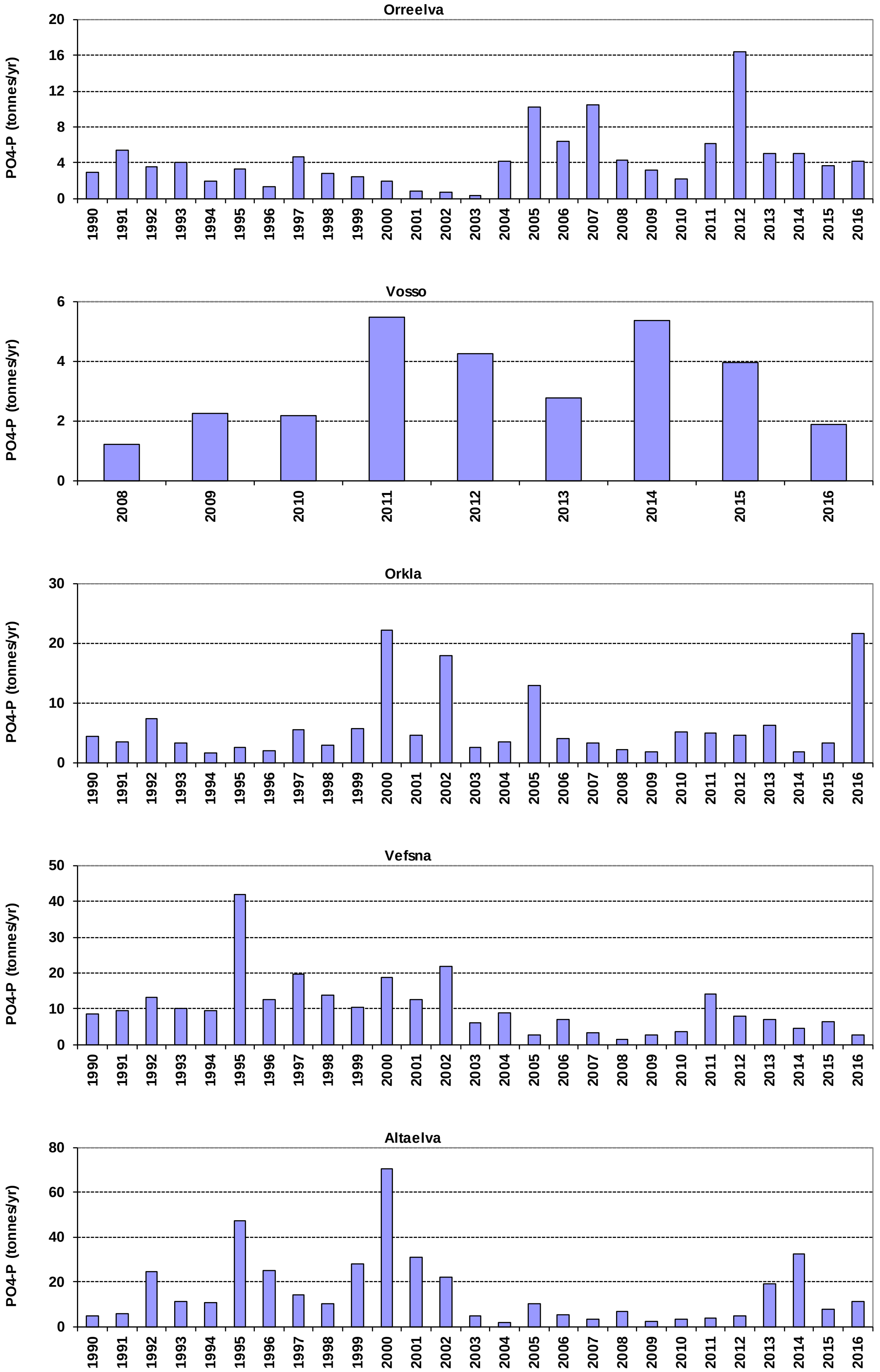


*Figure A-V-6b. Annual riverine loads of orthophosphate-phosphorus ($PO_4$-P) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2016 (2008-2016 for River Vosso).*

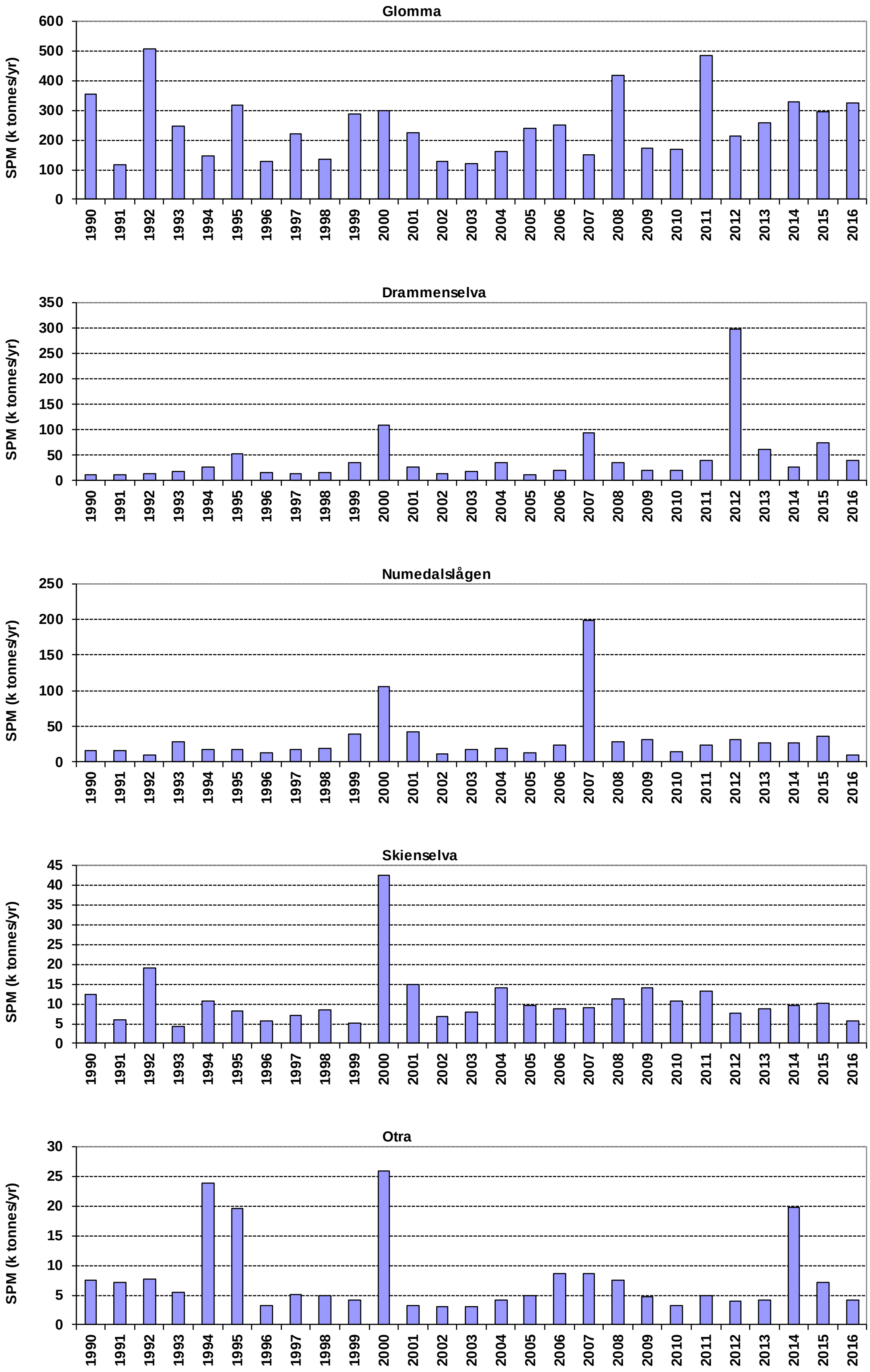


*Figure A-V-7a. Annual riverine loads of suspended particulate matter (SPM) in the five main rivers draining to Skagerrak, Norway, 1990-2016.*

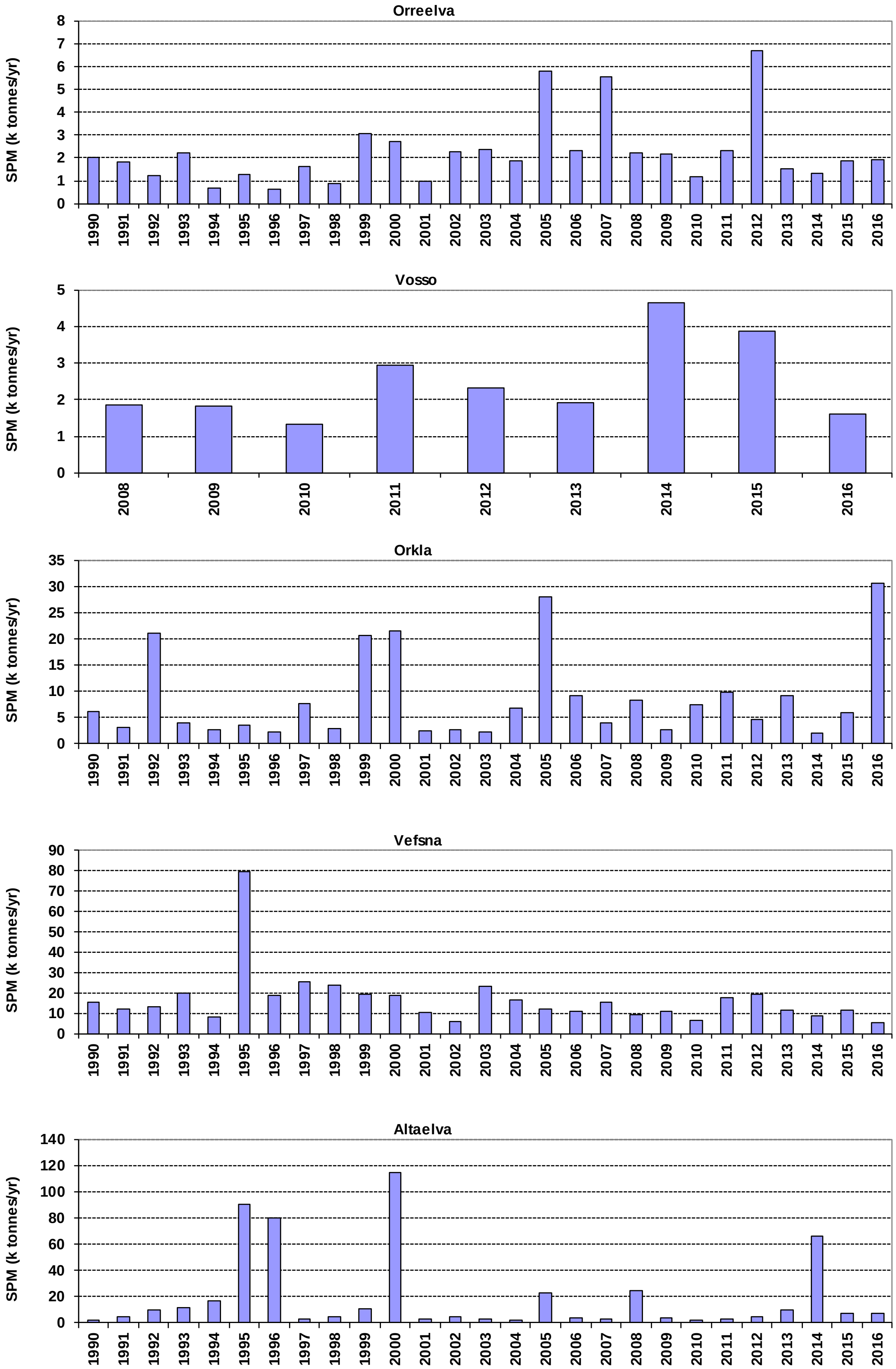


*Figure A-V-7b. Annual riverine loads of suspended particulate matter (SPM) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2016 (2008-2016 for River Vosso).*

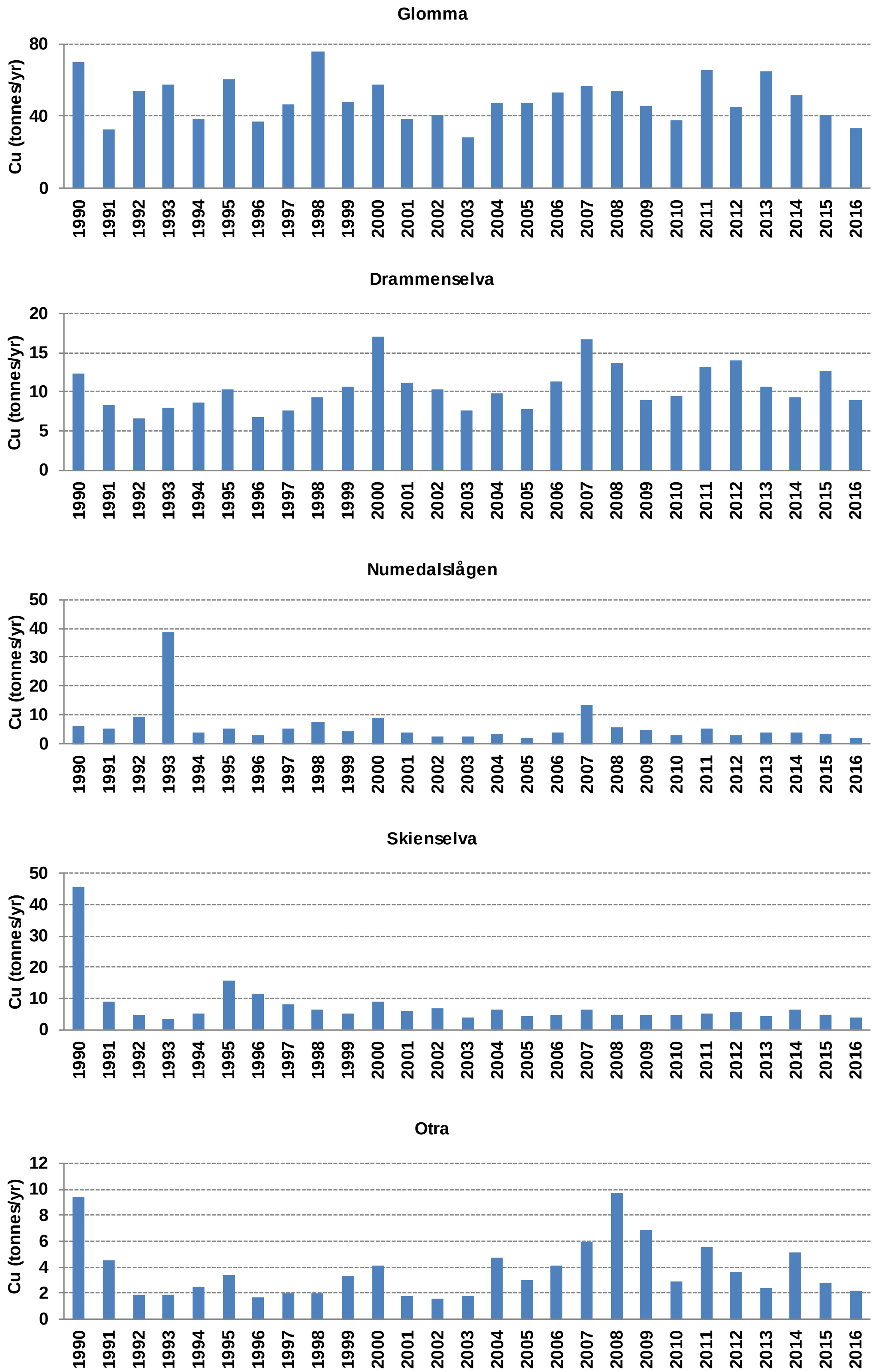


*Figure A-V-8a. Annual riverine loads of copper (Cu) in the five main rivers draining to Skagerrak, Norway, 1990-2016.*

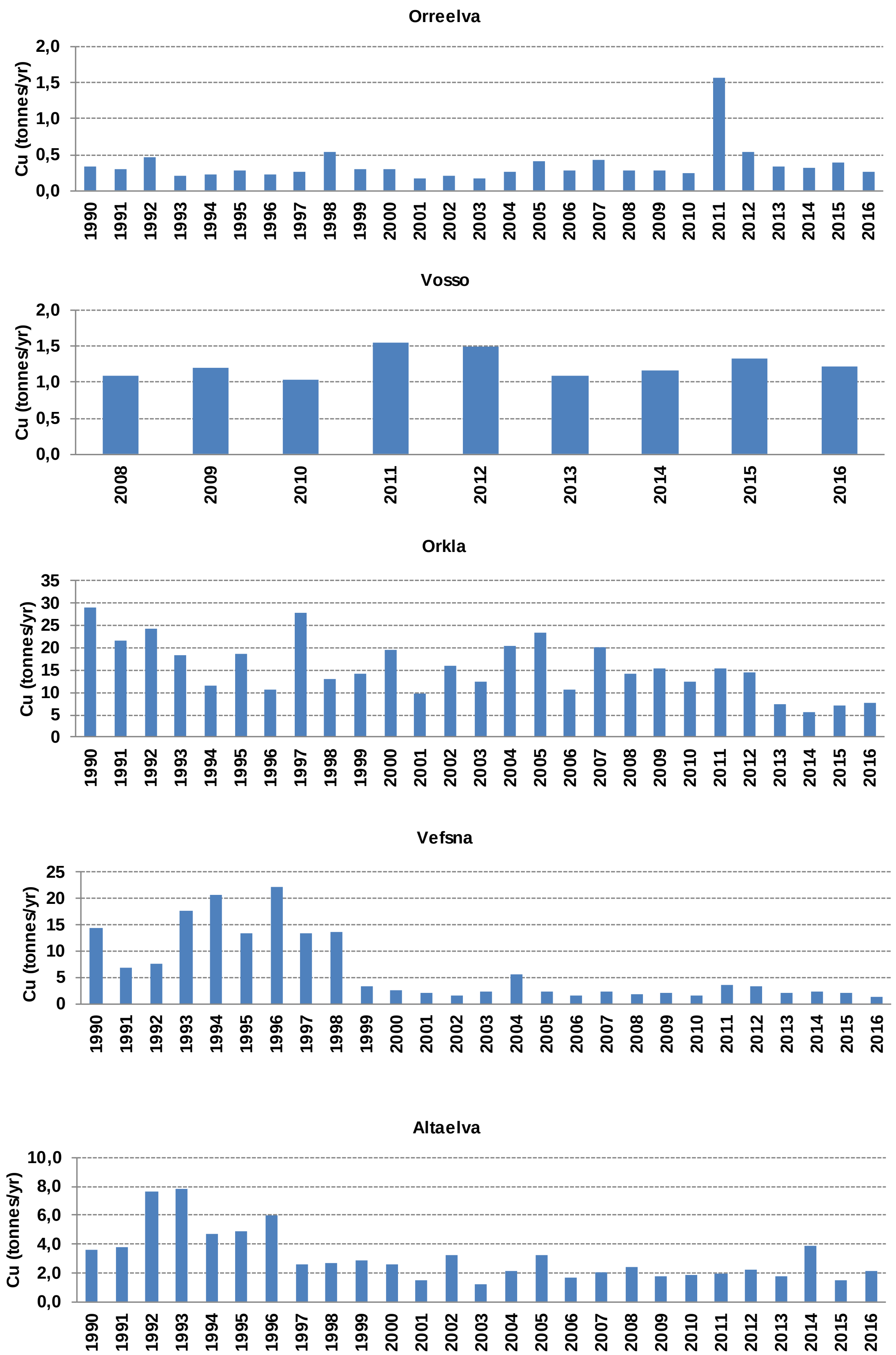


*Figure A-V-8b. Annual riverine loads of copper (Cu) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2016 (2008-2016 for River Vosso).*

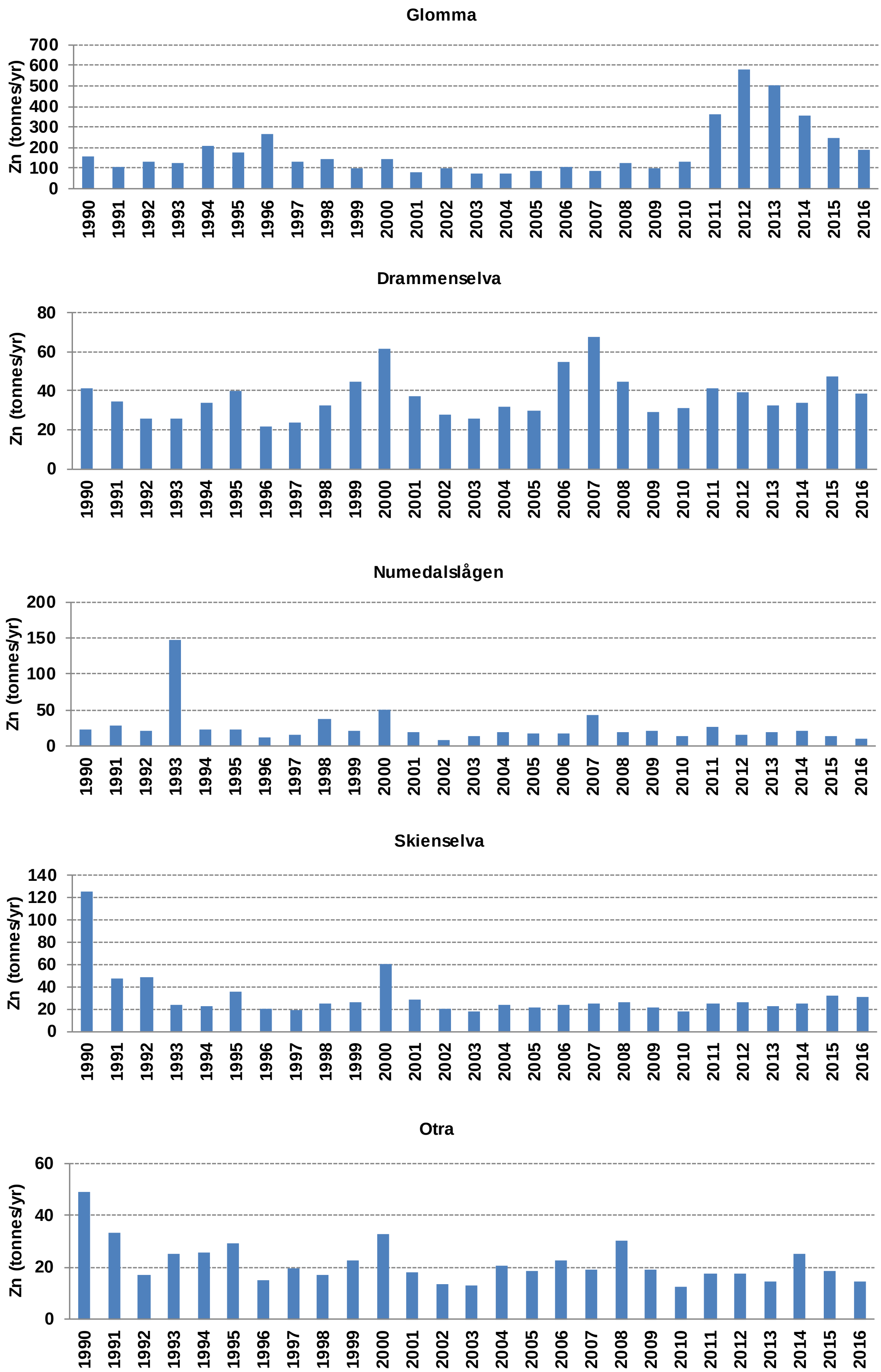


*Figure A-V-9a. Annual riverine loads of zinc (Zn) in the five main rivers draining to Skagerrak, Norway, 1990-2016.*

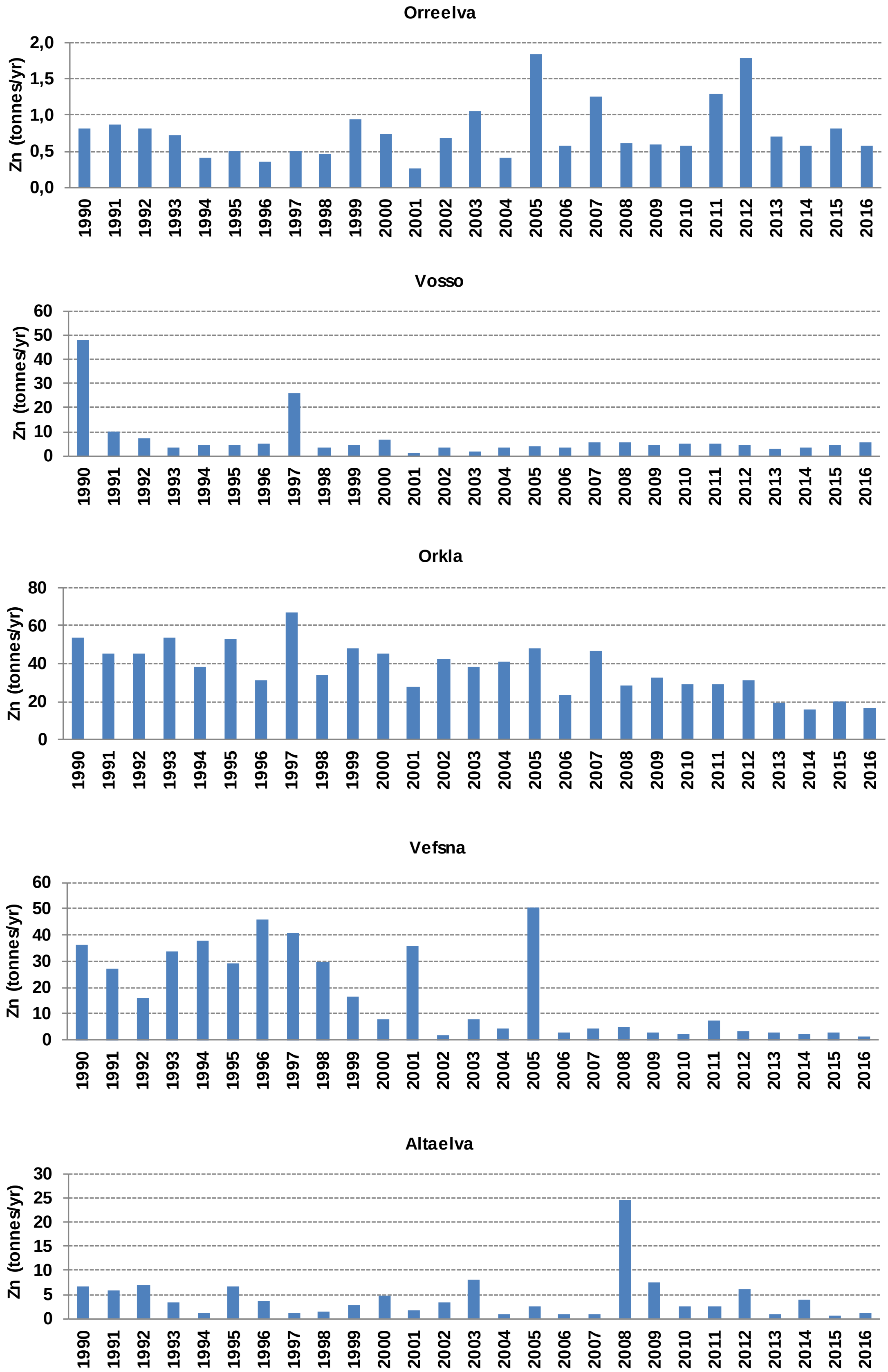


*Figure A-V-9b. Annual riverine loads of zinc (Zn) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2016 (2008-2016 for River Vosso).*

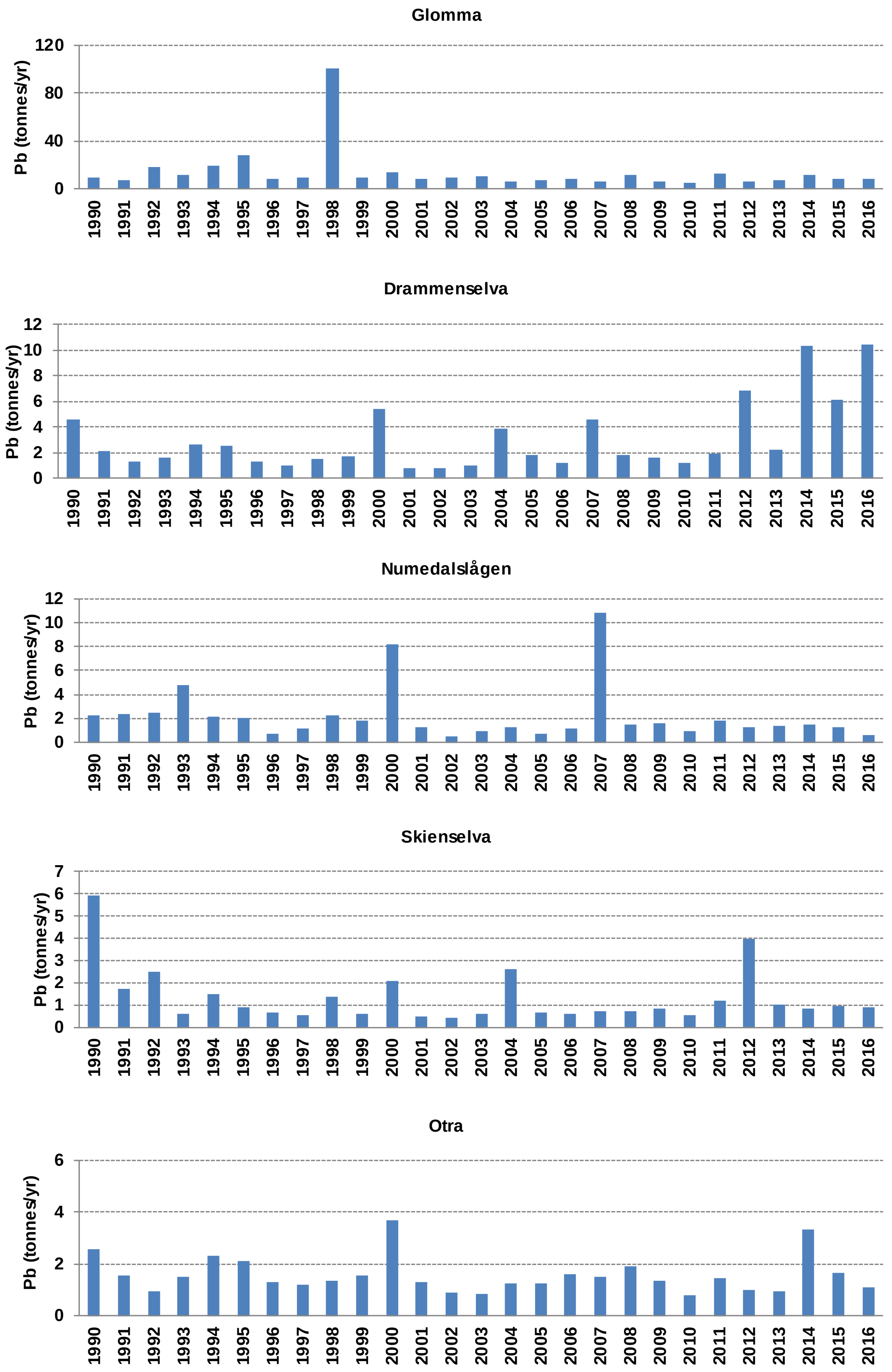


*Figure A-V-10a. Annual riverine loads of lead (Pb) in the five main rivers draining to Skagerrak, Norway, 1990-2016.*

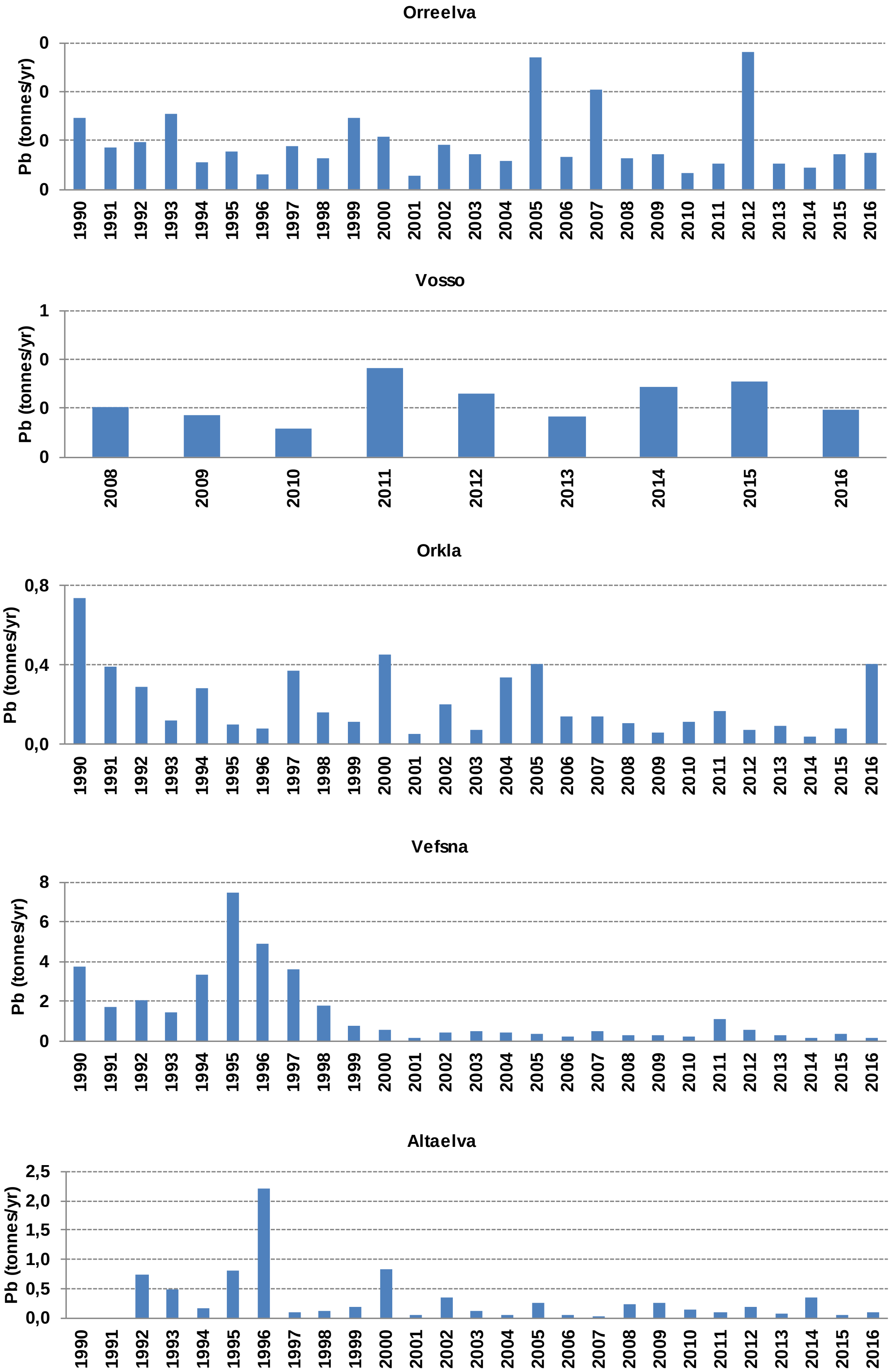


*Figure A-V-10b. Annual riverine loads of lead (Pb) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2016 (2008-2016 for River Vosso).*

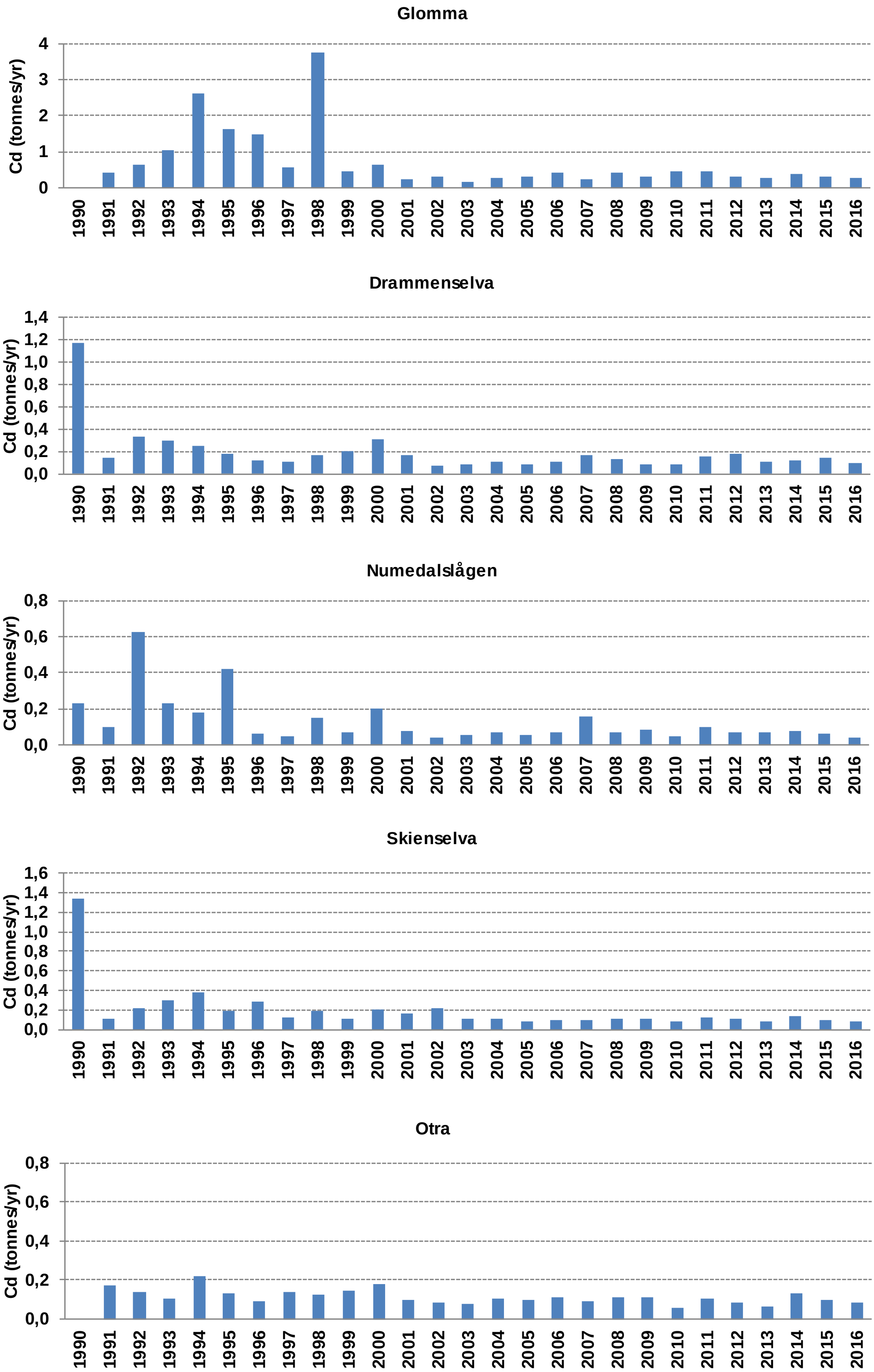


*Figure A-V-11a. Annual riverine loads of cadmium (Cd) in the five main rivers draining to Skagerrak, Norway, 1990-2016.*

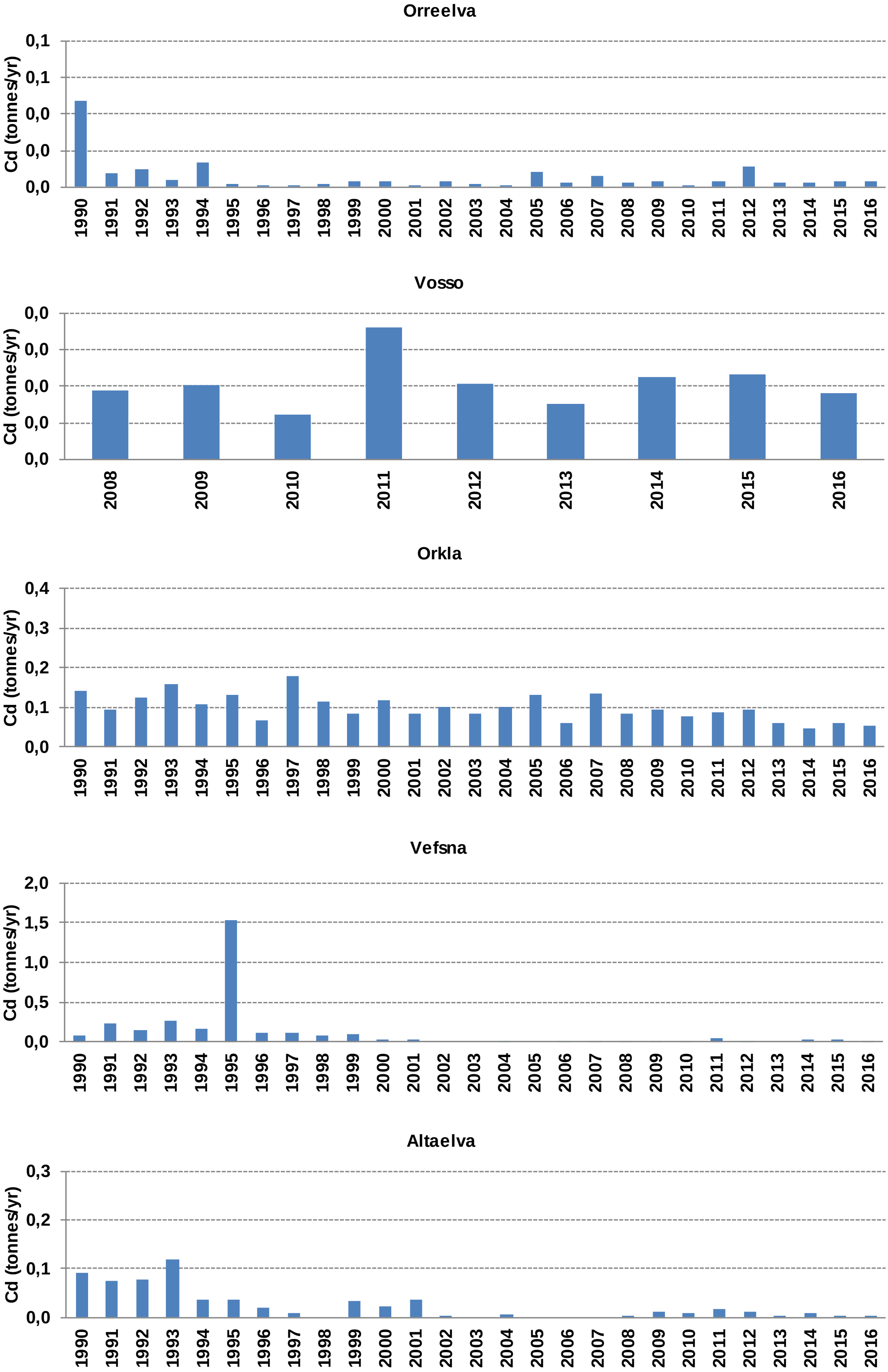


*Figure A-V-11b. Annual riverine loads of cadmium (Cd) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2016 (2008-2016 for River Vosso).*

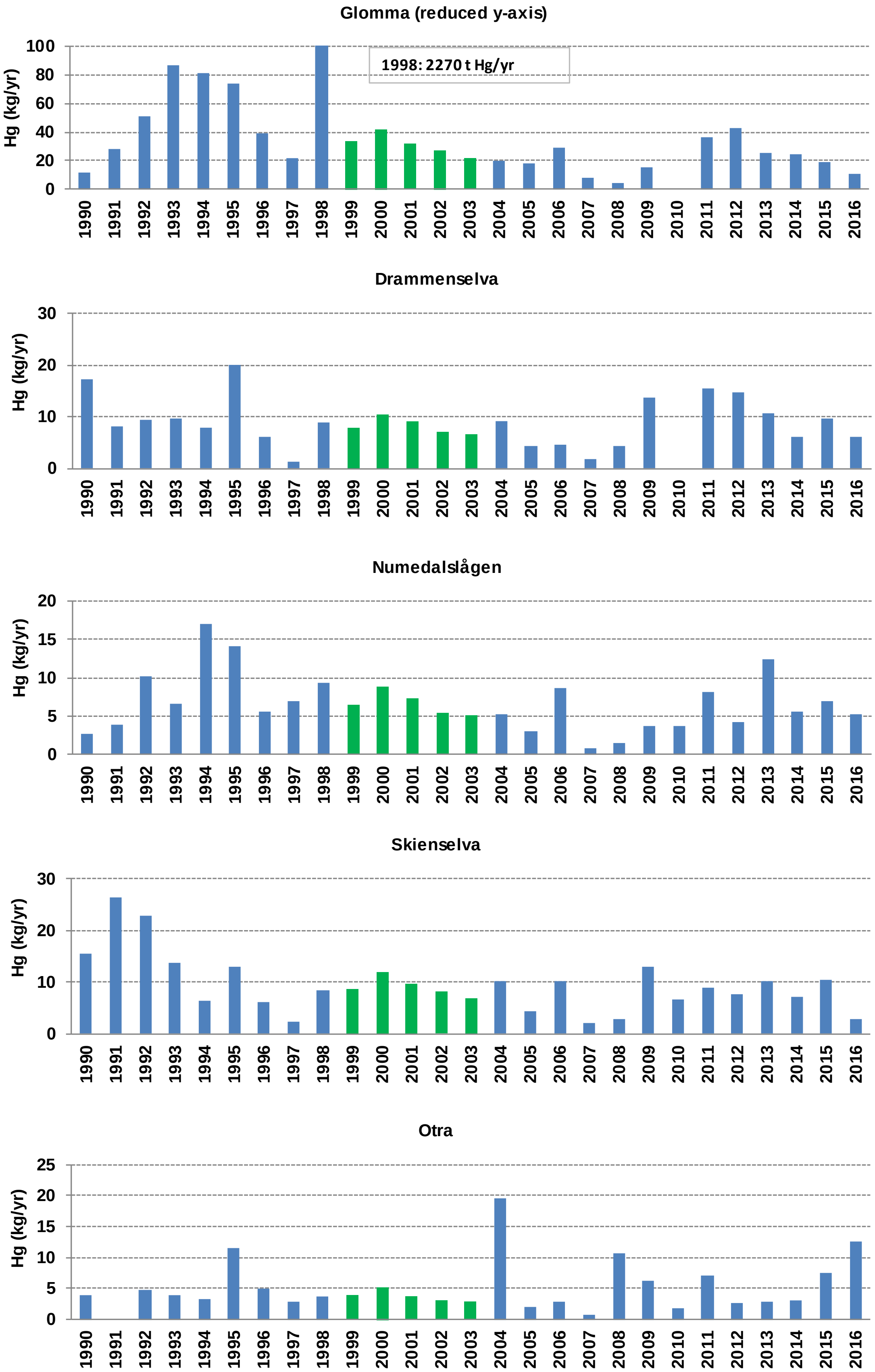


*Figure A-V-12a. Annual riverine loads of mercury (Hg) in the five main rivers draining to Skagerrak, Norway, 1990-2016. Years with interpolated loads are given in green. Note Glomma with reduced y-axis.*

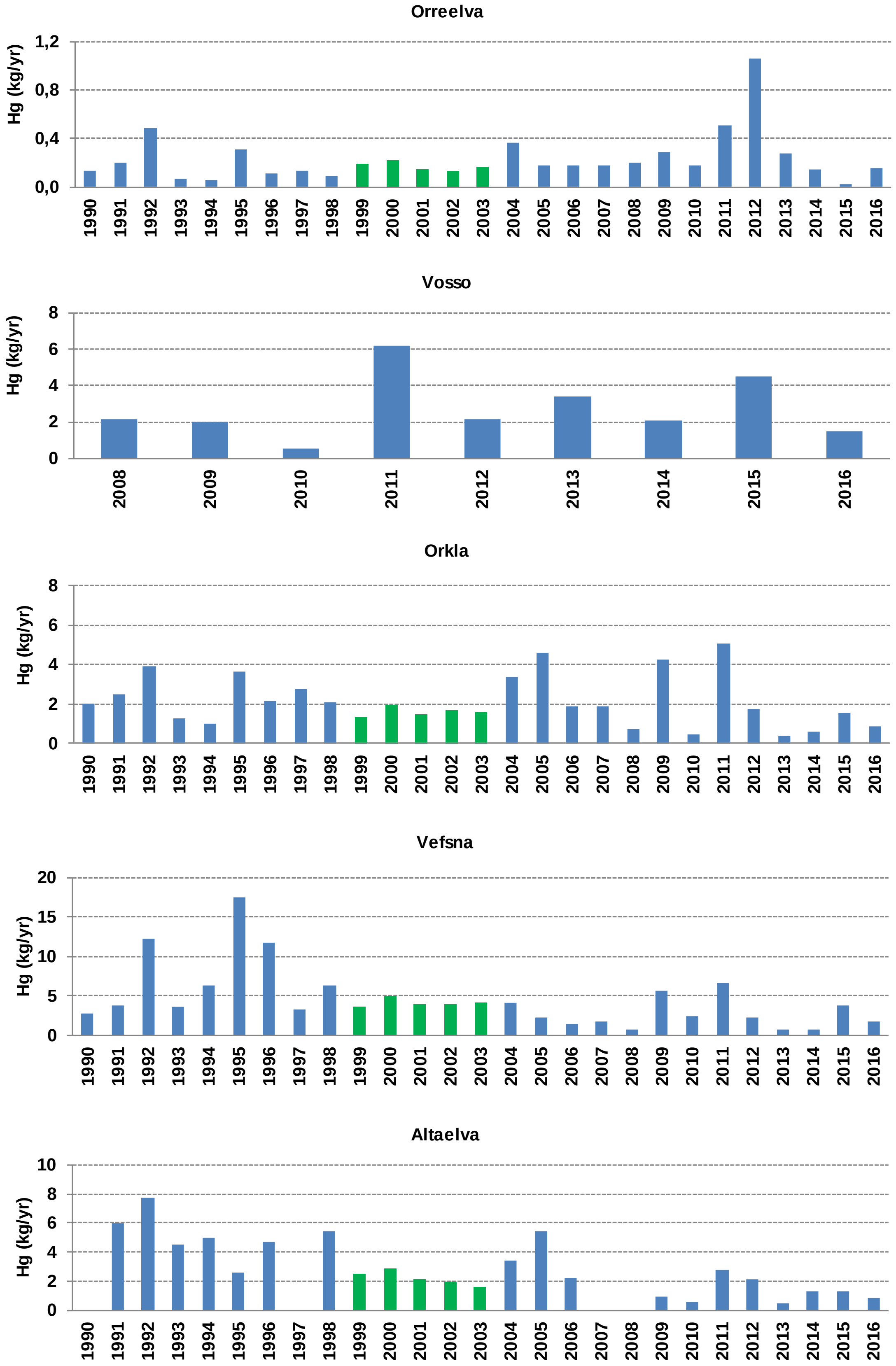


*Figure A-V-12b. Annual riverine loads of mercury (Hg) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2016 (2008-2016 for River Vosso). Years with interpolated loads are given in green.*

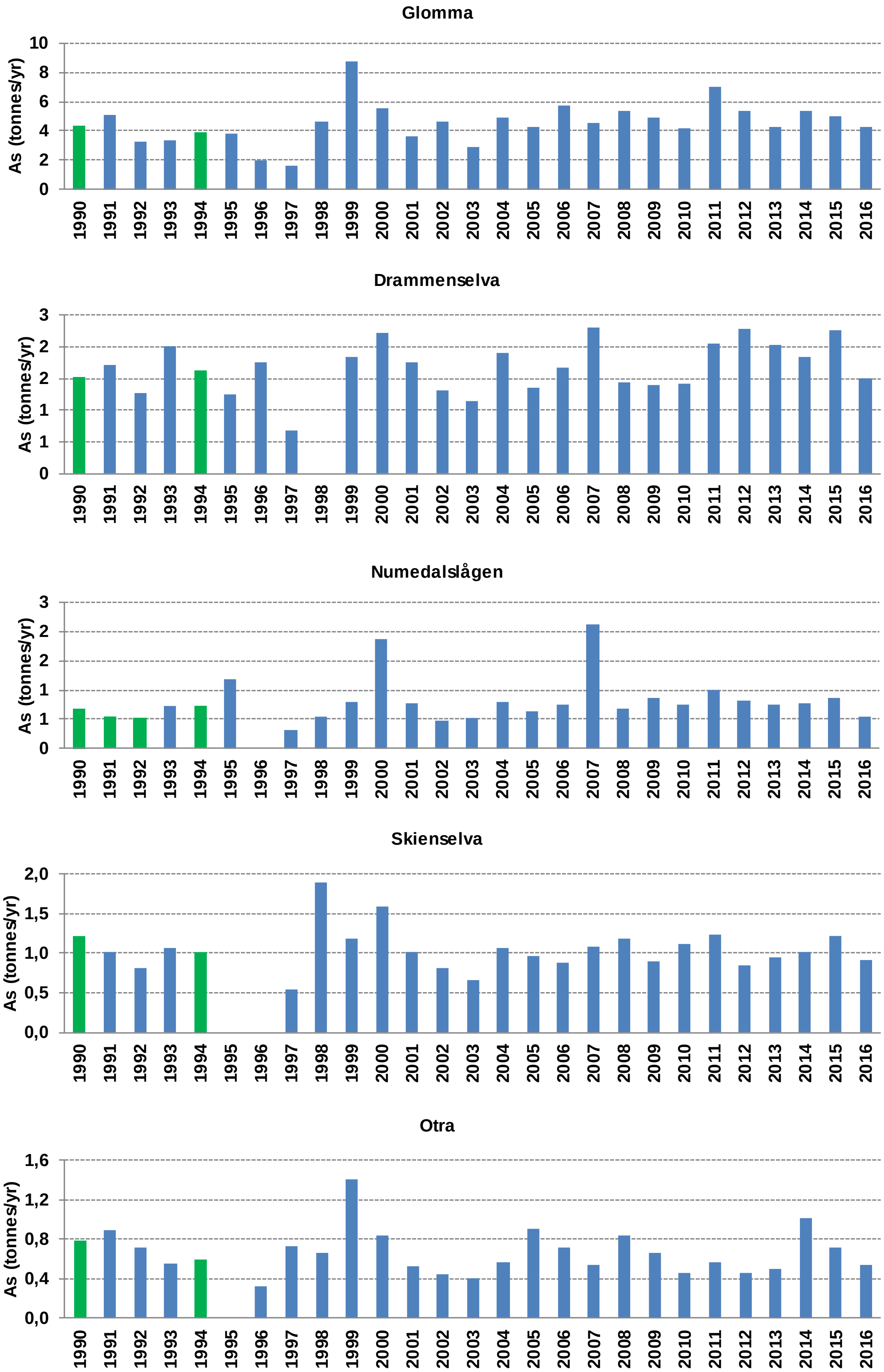


*Figure A-V-13a. Annual riverine loads of arsenic (As) in the five main rivers draining to Skagerrak, Norway, 1990-2016. Years with extra- or interpolated loads are given in green.*

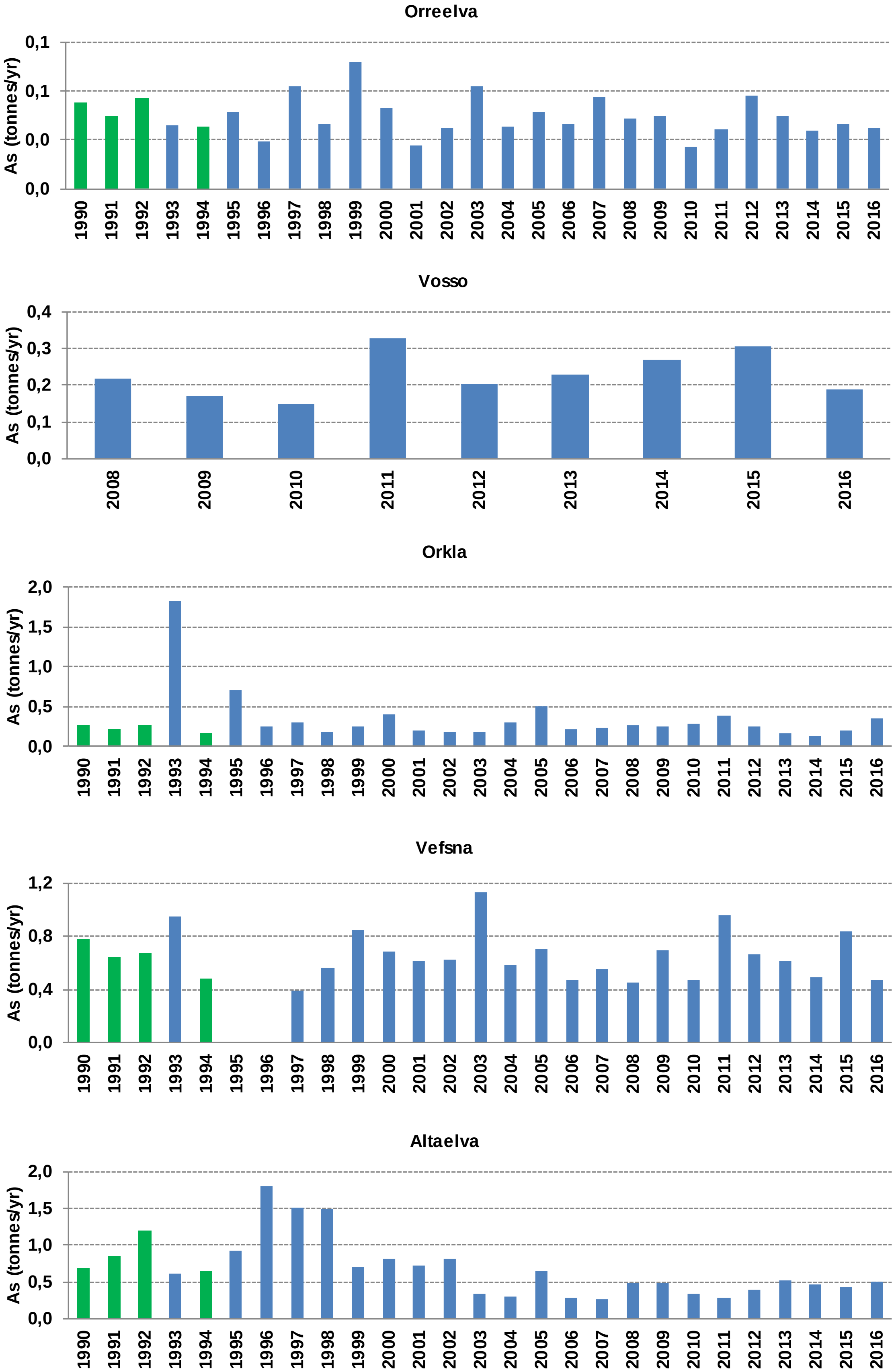


*Figure A-V-13b. Annual riverine loads of arsenic (As) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2016 (2008-2016 for River Vosso). Years with extra- or interpolated loads are given in green.*

# Addendum:

# Data from the 2016 RID Programme

# Table 1 Concentration data in 2016

## Table 1a. Concentration data with statistics for the 47 monitored rivers in 2016

The threshold levels are determined by the following limits set by the Norwegian Environment Agency (Miljødirektoratet, 2016):

| Type | Description | Table* | Pb | Cu | Zn | Ni | Cr | Hg | Cd | Ar |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Average[a] | 1.1 | 1.2** | | | 4** | | 0.070 | 0.08 | |
| 2 | Max[b] | 1.1 | 14 | | | 34 | | | 0.45 | |
| 3 | AA-EQS[c] | 2.1 | 1.2 | 7.8 | 11 | 4 | 3.4 | 0.047 | 0.08 | 0.5 |
| 4 | MAC-EQS [d] | 2.1 | 14 | 7,8 | 11 | 34 | 3.4 | 0.070 | 0.45 | 8.5 |

** Refers to tables in the of the Norwegian Environment Agency's Guidance on threshold values for prioritized substances (2016).*

*** These threshold values are the bioavailable concentrations.*

[a] Annual mean for freshwater

[b] Maximum concentration for freshwater

[c] This is the limit for Class II, it is an average concentration of all samples taken in one year, and thus the threshold value for chronic effects from long-term exposure;

[d] This is the limit for Class III, which is the actual concentration of any single sample collected, and which is the upper level for acute toxic effects at short-term exposure.

Legend:

| | |
|---|---|
| 12 | Single high value above threshold levels for single samples (Type 1 and 3, above) |
| 24 | Average concentration exceeding average threshold levels (Type 2 and 4 above). |

Glomma ved Sarpsfoss

| Date DD.MM.YYYY | Qs [m3/s] | pH [] | KOND [mS/m] | TURB860 [FNU] | SPM [mg/l] | TOC [mg C/l] | PO4-P [µg/l P] | TOTP [µg/l P] | NO3-N [µg/l N] | NH4-N [µg/l N] | TOTN [µg/l N] | SiO2 [mg SiO2/l] | Ag [µg/l] | As [µg/l] | Pb [µg/l] | Cd [µg/l] | Cu [µg/l] | Zn [µg/l] | Ni [µg/l] | Cr [µg/l] | Hg [ng/l] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 04.01.2016 15:15 | 625.88 | 7.17 | 5.04 | 8.80 | 8.25 | 4.80 | 9.00 | 19.00 | 410.00 | 6.00 | 660.00 | 4.71 | 0.01 | 0.20 | 0.28 | 0.02 | 1.57 | 6.60 | 0.85 | 0.31 | 4.00 |
| 09.02.2016 16:40 | 592.55 | 7.21 | 6.01 | 96.00 | 115.20 | 5.30 | 56.00 | 84.00 | 740.00 | 29.00 | 1110.00 | 5.91 | 0.01 | 0.48 | 1.65 | 0.03 | 2.93 | 13.50 | 1.97 | 1.00 | <1.0 |
| 07.03.2016 14:40 | 423.99 | 7.13 | 4.93 | 3.21 | 2.67 | 4.10 | 3.00 | 7.00 | 330.00 | 36.00 | 545.00 | 4.44 | <0.002 | 0.15 | 0.14 | 0.01 | 1.12 | 12.50 | 0.63 | 0.21 | 2.00 |
| 04.04.2016 14:00 | 728.01 | 7.07 | 5.98 | 34.00 | 30.50 | 4.50 | 29.00 | 35.00 | 510.00 | 15.00 | 760.00 | 5.44 | <0.002 | 0.31 | 0.67 | 0.01 | 2.01 | 7.90 | 1.27 | 0.71 | <1.0 |
| 09.05.2016 11:00 | 835.42 | 7.20 | 4.79 | 14.00 | 11.80 | 5.60 | 12.00 | 24.00 | 380.00 | 18.00 | 665.00 | 5.04 | 0.00 | 0.23 | 0.42 | 0.01 | 1.72 | 17.90 | 1.17 | 0.50 | <1.0 |
| 19.05.2016 11:50 | 894.28 | 7.11 | 4.08 | 6.90 | 7.10 | 5.30 | 7.00 | 15.00 | 250.00 | 14.00 | 535.00 | 4.09 | <0.002 | 0.21 | 0.24 | 0.01 | 1.78 | 6.70 | 0.75 | 0.18 | <1.0 |
| 31.05.2016 21:10 | 1539.88 | 7.20 | 3.39 | 4.30 | 6.85 | 5.20 | 8.00 | 16.00 | 230.00 | 5.00 | 500.00 | 3.34 | <0.002 | 0.16 | 0.28 | 0.01 | 2.04 | 9.00 | 0.78 | 0.22 | <1.0 |
| 08.06.2016 12:30 | 1351.57 | 7.28 | 3.73 | 2.30 | 4.45 | 3.90 | 4.00 | 11.00 | 220.00 | 6.00 | 435.00 | 3.39 | <0.002 | 0.16 | 0.17 | 0.01 | 1.56 | 9.20 | 0.56 | 0.22 | <1.0 |
| 21.06.2016 13:00 | 782.71 | 7.38 | 4.36 | 2.50 | 4.46 | 3.00 | 3.00 | 9.00 | 260.00 | 11.00 | 460.00 | 2.98 | <0.002 | 0.15 | 0.14 | 0.01 | 1.28 | 8.30 | 0.50 | 0.20 | <1.0 |
| 29.06.2016 14:30 | 825.87 | 7.41 | 4.45 | 2.00 | 3.79 | 2.90 | 3.00 | 7.00 | 270.00 | 10.00 | 455.00 | 3.02 | <0.002 | 0.13 | 0.12 | 0.01 | 1.24 | 10.50 | 0.46 | 0.19 | 2.00 |
| 05.07.2016 13:50 | 810.83 | 7.35 | 5.86 | 2.10 | 3.39 | 2.80 | 3.00 | 9.00 | 300.00 | 2.00 | 475.00 | 2.94 | 0.00 | 0.15 | 0.13 | 0.01 | 1.18 | 4.30 | 0.61 | 0.17 | <1.0 |
| 11.08.2016 12:30 | 883.43 | 7.43 | 4.62 | 3.10 | 4.67 | 2.70 | 12.00 | 10.00 | 260.00 | 3.00 | 450.00 | 2.74 | <0.002 | 0.15 | 0.15 | 0.01 | 1.16 | 7.20 | 0.60 | 0.19 | <1.0 |
| 06.09.2016 13:30 | 704.48 | 7.42 | 4.49 | 1.60 | 2.37 | 3.20 | 3.00 | 7.00 | 210.00 | 15.00 | 405.00 | 2.64 | <0.002 | 0.14 | 0.10 | 0.01 | 0.99 | 6.80 | 0.41 | 0.09 | <1.0 |
| 10.10.2016 11:10 | 547.43 | 7.41 | 4.53 | 0.97 | 1.84 | 3.10 | 2.00 | 6.00 | 230.00 | 5.00 | 420.00 | 2.64 | <0.002 | 0.10 | 0.07 | 0.00 | 1.13 | 3.10 | 0.50 | 0.09 | <1.0 |
| 07.11.2016 13:50 | 497.04 | 7.28 | 4.59 | 2.40 | 3.33 | 3.30 | 3.00 | 8.00 | 350.00 | 5.00 | 575.00 | 3.24 | <0.002 | 0.10 | 0.12 | 0.01 | 1.30 | 12.20 | 0.59 | 0.14 | <1.0 |
| 05.12.2016 13:10 | 496.08 | 7.16 | 5.53 | 6.30 | 5.26 | 5.10 | 6.00 | 11.00 | 500.00 | 28.00 | 735.00 | 4.65 | 0.00 | 0.27 | 0.64 | 0.03 | 1.72 | 8.00 | 1.11 | 0.50 | <1.0 |
| Avg. | 783.72 | 7.26 | 4.77 | 11.91 | 13.50 | 4.05 | 10.19 | 17.38 | 340.62 | 13.00 | 574.06 | 3.83 | 0.00 | 0.19 | 0.33 | 0.01 | 1.55 | 8.98 | 0.80 | 0.31 | 0.50 |
| Minimum | 423.99 | 7.07 | 3.39 | 0.97 | 1.84 | 2.70 | 2.00 | 6.00 | 210.00 | 2.00 | 405.00 | 2.64 | 0.00 | 0.10 | 0.07 | 0.00 | 0.99 | 3.10 | 0.41 | 0.09 | 1.00 |
| Maximum | 1539.88 | 7.43 | 6.01 | 96.00 | 115.20 | 5.60 | 56.00 | 84.00 | 740.00 | 36.00 | 1110.00 | 5.91 | 0.01 | 0.48 | 1.65 | 0.03 | 2.93 | 17.90 | 1.97 | 1.00 | 4.00 |
| More than 70%LOD | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | no |
| n | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 |
| St.dev | 299.17 | 0.12 | 0.77 | 23.85 | 27.97 | 1.06 | 13.92 | 19.36 | 142.38 | 10.22 | 181.71 | 1.07 | 0.00 | 0.10 | 0.40 | 0.01 | 0.49 | 3.68 | 0.41 | 0.25 | 0.79 |

Alna

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 05.01.2016 11:15 | 0.84 | 7.96 | 47.60 | 6.60 | 8.88 | 4.20 | 54.00 | 57.00 | 830.00 | 290.00 | 1600.00 | 7.86 | 0.02 | 0.38 | 0.53 | 0.04 | 2.68 | 10.20 | 0.99 | 0.43 | <1.0 |
| 04.02.2016 11:00 | 1.12 | 7.89 | 54.60 | 5.80 | 7.64 | 4.10 | 47.00 | 62.00 | 690.00 | 150.00 | 1340.00 | 7.31 | 0.01 | 0.31 | 0.48 | 0.04 | 2.65 | 10.20 | 0.88 | 0.38 | 3.00 |
| 02.03.2016 11:00 | 0.60 | 7.90 | 66.20 | 10.00 | 13.90 | 5.40 | 220.00 | 250.00 | 790.00 | 1000.00 | 3300.00 | 8.14 | 0.01 | 0.35 | 0.36 | 0.04 | 3.51 | **11.90** | 0.94 | 0.53 | 11.00 |
| 06.04.2016 10:00 | 3.70 | 7.69 | 39.20 | 10.00 | 15.90 | 5.20 | 36.00 | 54.00 | 780.00 | 89.00 | 1320.00 | 7.44 | 0.01 | 0.39 | 0.85 | 0.04 | 3.34 | **12.00** | 1.11 | 0.69 | <1.0 |
| 09.05.2016 10:20 | 0.85 | 8.14 | 45.40 | 2.50 | 3.00 | 4.20 | 22.00 | 34.00 | 910.00 | 40.00 | 1500.00 | 6.34 | 0.01 | 0.33 | 0.32 | 0.03 | 2.68 | 7.10 | 0.97 | 0.43 | <1.0 |
| 01.06.2016 09:50 | 0.75 | 8.06 | 43.60 | 3.40 | 5.26 | 4.10 | 36.00 | 52.00 | 1030.00 | 110.00 | 1600.00 | 7.07 | 0.01 | 0.43 | 0.49 | 0.06 | 3.19 | 10.70 | 0.89 | 0.41 | <1.0 |
| 07.07.2016 09:10 | 0.70 | 8.21 | 39.90 | 4.70 | 4.35 | 4.20 | 46.00 | 62.00 | 1050.00 | 68.00 | 1500.00 | 7.48 | 0.03 | 0.47 | 0.66 | 0.04 | 3.20 | **11.30** | 0.95 | 0.51 | <1.0 |
| 03.08.2016 10:30 | 0.57 | 8.13 | 43.90 | 4.00 | 3.93 | 4.20 | 77.00 | 100.00 | 1200.00 | 39.00 | 2000.00 | 7.52 | 0.00 | 0.42 | 0.26 | 0.03 | 2.60 | 7.60 | 0.83 | 0.18 | 2.00 |
| 06.09.2016 09:05 | 0.40 | 8.14 | 39.70 | 1.70 | 3.03 | 4.00 | 72.00 | 85.00 | 1600.00 | 140.00 | 2100.00 | 7.29 | 0.00 | 0.38 | 0.21 | 0.02 | 2.43 | 6.10 | 0.76 | 0.20 | <1.0 |
| 04.10.2016 09:00 | 0.35 | 8.02 | 38.40 | 2.20 | 1.87 | 3.70 | 55.00 | 63.00 | 1160.00 | 9.00 | 1900.00 | 6.94 | <0.002 | 0.33 | 0.25 | 0.02 | 2.05 | 5.90 | 0.65 | 0.17 | <1.0 |
| 01.11.2016 10:40 | 0.38 | 7.83 | 24.60 | 9.90 | 11.40 | 4.50 | 68.00 | 92.00 | 770.00 | 72.00 | 1450.00 | 5.76 | 0.00 | 0.41 | 0.82 | 0.03 | 4.77 | **17.40** | 1.12 | 0.71 | <1.0 |
| 06.12.2016 10:50 | 0.56 | 7.88 | 39.90 | 2.80 | 3.74 | 4.20 | 48.00 | 59.00 | 1040.00 | 300.00 | 1900.00 | 7.18 | 0.00 | 0.28 | 0.23 | 0.02 | 2.35 | 9.50 | 0.72 | 0.24 | <1.0 |
| Avg. | 0.90 | 7.99 | 43.58 | 5.30 | 6.91 | 4.33 | 65.08 | 80.83 | 987.50 | 192.25 | 1792.50 | 7.19 | 0.01 | 0.37 | 0.46 | 0.03 | 2.95 | 9.99 | 0.90 | 0.41 | 1.33 |
| Minimum | 0.35 | 7.69 | 24.60 | 1.70 | 1.87 | 3.70 | 22.00 | 34.00 | 690.00 | 9.00 | 1320.00 | 5.76 | 0.00 | 0.28 | 0.21 | 0.02 | 2.05 | 5.90 | 0.65 | 0.17 | 1.00 |
| Maximum | 3.70 | 8.21 | 66.20 | 10.00 | 15.90 | 5.40 | 220.00 | 250.00 | 1600.00 | 1000.00 | 3300.00 | 8.14 | 0.03 | 0.47 | 0.85 | 0.06 | 4.77 | 17.40 | 1.12 | 0.71 | 11.00 |
| More than 70%LOD | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | no |
| n | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 |
| St.dev | 0.91 | 0.16 | 10.00 | 3.16 | 4.65 | 0.49 | 51.30 | 56.36 | 253.56 | 270.64 | 541.36 | 0.64 | 0.01 | 0.06 | 0.22 | 0.01 | 0.72 | 3.18 | 0.14 | 0.19 | 2.87 |

Drammenselva

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 05.01.2016 10:45 | 325.64 | 7.12 | 4.17 | 1.40 | 1.35 | 3.30 | 2.00 | 5.00 | 280.00 | 9.00 | 455.00 | 3.21 | 0.01 | 0.14 | 0.08 | 0.01 | 0.71 | 2.80 | 0.48 | 0.12 | <1.0 |
| 09.02.2016 11:00 | 336.87 | 7.15 | 4.76 | 8.50 | 10.35 | 3.40 | 13.00 | 22.00 | 390.00 | 6.00 | 610.00 | 4.18 | 0.00 | 0.21 | 2.30 | 0.01 | 1.09 | 4.30 | 0.72 | 0.35 | <1.0 |
| 08.03.2016 11:00 | 178.99 | 7.13 | 3.65 | 1.27 | 1.04 | 2.70 | 3.00 | 5.00 | 220.00 | 12.00 | 370.00 | 2.74 | <0.002 | 0.12 | 1.39 | 0.01 | 0.77 | 4.40 | 0.52 | 0.13 | 2.00 |
| 05.04.2016 13:00 | 363.81 | 7.18 | 4.97 | 12.00 | 18.80 | 3.90 | 16.00 | 23.00 | 460.00 | 10.00 | 690.00 | 4.59 | <0.002 | 0.22 | 1.79 | 0.01 | 1.33 | 4.50 | 0.83 | 0.50 | <1.0 |
| 10.05.2016 17:45 | 369.34 | 7.25 | 4.16 | 2.60 | 1.98 | 3.40 | 6.00 | 14.00 | 220.00 | 10.00 | 455.00 | 3.11 | <0.002 | 0.17 | 1.45 | 0.01 | 0.89 | 3.40 | 0.49 | 0.17 | <1.0 |
| 18.05.2016 12:30 | 385.20 | 7.13 | 3.51 | 0.87 | 0.96 | 3.20 | 2.00 | 5.00 | 200.00 | 7.00 | 385.00 | 2.79 | <0.002 | 0.13 | 1.64 | 0.01 | 0.44 | 1.90 | 0.30 | <0.025 | <1.0 |
| 25.05.2016 11:00 | 462.45 | 7.19 | 3.35 | 1.40 | 3.05 | 3.10 | 2.00 | 5.00 | 230.00 | <2.0 | 410.00 | 2.68 | <0.002 | 0.11 | 3.35 | 0.01 | 0.63 | 2.30 | 0.40 | 0.11 | 2.00 |
| 09.06.2016 11:45 | 440.91 | 7.24 | 3.22 | 0.92 | 1.72 | 3.50 | 1.00 | 6.00 | 150.00 | 2.00 | 365.00 | 2.79 | <0.002 | 0.14 | 2.57 | 0.01 | 0.68 | 2.20 | 0.23 | 0.09 | <1.0 |
| 15.06.2016 11:00 | 287.84 | 7.22 | 3.56 | 0.77 | 1.41 | 3.40 | 1.00 | 5.00 | 170.00 | 15.00 | 370.00 | 2.70 | <0.002 | 0.13 | 1.44 | 0.00 | 0.62 | 1.70 | 0.31 | 0.12 | <1.0 |
| 23.06.2016 09:00 | 322.21 | 7.24 | 3.19 | 0.81 | 1.47 | 3.30 | 1.00 | 4.00 | 140.00 | 6.00 | 315.00 | 2.59 | <0.002 | 0.11 | 1.60 | 0.01 | 0.57 | 1.30 | 0.18 | 0.10 | <1.0 |
| 06.07.2016 13:15 | 304.37 | 7.25 | 3.38 | 1.10 | 1.36 | 3.40 | 1.00 | 6.00 | 150.00 | 36.00 | 355.00 | 2.55 | 0.01 | 0.14 | 0.20 | 0.01 | 0.87 | 4.10 | 0.54 | 0.14 | 3.00 |
| 08.08.2016 10:40 | 326.47 | 7.13 | 3.55 | 2.80 | 4.13 | 5.90 | 11.00 | 12.00 | 180.00 | 3.00 | 450.00 | 3.06 | <0.002 | 0.19 | 0.65 | 0.01 | 1.07 | 2.30 | 0.68 | 0.28 | <1.0 |
| 06.09.2016 07:30 | 204.23 | 7.20 | 3.36 | 0.74 | 1.56 | 3.60 | <1.0 | 5.00 | 150.00 | 16.00 | 345.00 | 2.51 | <0.002 | 0.15 | 0.42 | 0.01 | 0.59 | 1.70 | 0.38 | 0.09 | <1.0 |
| 05.10.2016 10:15 | 224.31 | 7.07 | 3.12 | 0.69 | 0.94 | 3.20 | <1.0 | 4.00 | 130.00 | 13.00 | 315.00 | 2.42 | 0.00 | 0.13 | 0.26 | 0.01 | 0.46 | 1.20 | 0.38 | 0.08 | <1.0 |
| 08.11.2016 11:15 | 303.05 | 7.09 | 3.60 | 0.97 | 1.56 | 3.40 | 1.00 | 5.00 | 230.00 | 13.00 | 435.00 | 2.89 | <0.002 | 0.15 | 0.28 | 0.01 | 0.63 | 1.80 | 0.46 | 0.12 | 1.00 |
| 06.12.2016 11:45 | 332.67 | 7.11 | 3.96 | 0.76 | 1.21 | 3.20 | 2.00 | 5.00 | 270.00 | 9.00 | 425.00 | 2.96 | <0.002 | 0.14 | 0.27 | 0.02 | 1.74 | 12.90 | 0.55 | 0.16 | <1.0 |
| Avg. | 323.02 | 7.17 | 3.72 | 2.35 | 3.31 | 3.49 | 3.88 | 8.19 | 223.12 | 10.44 | 421.88 | 2.99 | 0.00 | 0.15 | 1.23 | 0.01 | 0.82 | 3.30 | 0.47 | 0.16 | 0.50 |
| Minimum | 178.99 | 7.07 | 3.12 | 0.69 | 0.94 | 2.70 | 1.00 | 4.00 | 130.00 | 2.00 | 315.00 | 2.42 | 0.00 | 0.11 | 0.08 | 0.00 | 0.44 | 1.20 | 0.18 | 0.03 | 1.00 |
| Maximum | 462.45 | 7.25 | 4.97 | 12.00 | 18.80 | 5.90 | 16.00 | 23.00 | 460.00 | 36.00 | 690.00 | 4.59 | 0.01 | 0.22 | 3.35 | 0.02 | 1.74 | 12.90 | 0.83 | 0.50 | 3.00 |
| More than 70%LOD | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | no |
| n | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 |
| St.dev | 76.55 | 0.06 | 0.55 | 3.21 | 4.73 | 0.69 | 4.89 | 6.24 | 91.78 | 8.06 | 101.26 | 0.59 | 0.00 | 0.03 | 0.98 | 0.00 | 0.34 | 2.80 | 0.18 | 0.12 | 0.58 |

Numedalslågen

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 04.01.2016 10:15 | 104.37 | 6.96 | 3.93 | 4.20 | 3.37 | 4.10 | 6.00 | 11.00 | 320.00 | 31.00 | 540.00 | 4.89 | 0.01 | 0.18 | 0.25 | 0.02 | 0.68 | 4.40 | 0.37 | 0.21 | <1.0 |
| 01.02.2016 13:10 | 102.21 | 6.93 | 4.15 | 4.80 | 2.82 | 3.20 | 6.00 | 9.00 | 340.00 | 32.00 | 545.00 | 4.48 | 0.00 | 0.14 | 0.19 | 0.01 | 0.61 | 3.10 | 0.40 | 0.16 | <1.0 |
| 01.03.2016 09:15 | 93.81 | 6.90 | 2.92 | 1.50 | 2.48 | 2.20 | 3.00 | 6.00 | 160.00 | 41.00 | 325.00 | 3.24 | 0.00 | 0.12 | 0.13 | 0.01 | 0.42 | 2.10 | 0.36 | 0.10 | 12.00 |
| 04.04.2016 09:45 | 166.80 | 6.77 | 3.14 | 2.90 | 3.88 | 5.20 | 5.00 | 9.00 | 210.00 | 16.00 | 420.00 | 4.20 | 0.00 | 0.16 | 0.24 | 0.02 | 0.72 | 3.90 | 0.44 | 0.22 | <1.0 |
| 04.05.2016 08:45 | 133.13 | 6.93 | 3.48 | 2.70 | 3.50 | 4.00 | 4.00 | 7.00 | 220.00 | 28.00 | 445.00 | 4.07 | <0.002 | 0.16 | 0.20 | 0.01 | 0.65 | 3.10 | 0.33 | 0.14 | <1.0 |
| 06.06.2016 10:15 | 88.87 | 6.94 | 2.42 | 1.10 | 3.96 | 4.30 | 4.00 | 11.00 | 85.00 | 20.00 | 305.00 | 2.98 | 0.01 | 0.19 | 0.25 | 0.01 | 0.73 | 2.90 | 0.27 | 0.17 | 1.00 |
| 06.07.2016 10:00 | 120.83 | 7.03 | 2.35 | 1.10 | 3.40 | 3.70 | 1.00 | 5.00 | 57.00 | 17.00 | 235.00 | 2.57 | 0.01 | 0.14 | 0.17 | 0.01 | 0.58 | 1.70 | 0.28 | 0.11 | 1.00 |
| 02.08.2016 09:00 | 83.08 | 7.11 | 2.65 | 0.95 | 1.45 | 3.40 | 2.00 | 5.00 | 61.00 | 13.00 | 250.00 | 2.40 | 0.01 | 0.14 | 0.13 | 0.01 | 0.51 | 1.70 | 0.27 | 0.09 | <1.0 |
| 05.09.2016 09:00 | 49.65 | 7.09 | 3.21 | 1.10 | 1.60 | 4.20 | 1.00 | 5.00 | 110.00 | 44.00 | 330.00 | 2.83 | 0.01 | 0.20 | 0.15 | 0.01 | 0.48 | 2.00 | 0.29 | 0.10 | <1.0 |
| 05.10.2016 10:00 | 40.64 | 7.04 | 2.98 | 0.74 | 1.07 | 3.10 | <1.0 | 4.00 | 96.00 | 44.00 | 295.00 | 2.53 | 0.00 | 0.12 | 0.11 | 0.01 | 0.41 | 1.60 | 0.27 | 0.07 | <1.0 |
| 01.11.2016 09:45 | 100.70 | 6.95 | 3.20 | 1.80 | 2.02 | 5.30 | 3.00 | 7.00 | 160.00 | 29.00 | 410.00 | 3.71 | <0.002 | 0.17 | 0.21 | 0.01 | 0.59 | 3.20 | 0.32 | 0.13 | 2.00 |
| 05.12.2016 10:00 | 156.93 | 6.91 | 2.88 | 1.20 | 1.47 | 4.30 | 2.00 | 5.00 | 150.00 | 41.00 | 395.00 | 3.51 | 0.00 | 0.14 | 0.15 | 0.01 | 0.52 | 2.90 | 0.35 | 0.13 | <1.0 |
| Avg. | 103.42 | 6.96 | 3.11 | 2.01 | 2.58 | 3.92 | 3.08 | 7.00 | 164.08 | 29.67 | 374.58 | 3.45 | 0.00 | 0.15 | 0.18 | 0.01 | 0.57 | 2.72 | 0.33 | 0.14 | 1.33 |
| Minimum | 40.64 | 6.77 | 2.35 | 0.74 | 1.07 | 2.20 | 1.00 | 4.00 | 57.00 | 13.00 | 235.00 | 2.40 | 0.00 | 0.12 | 0.11 | 0.01 | 0.41 | 1.60 | 0.27 | 0.07 | 1.00 |
| Maximum | 166.80 | 7.11 | 4.15 | 4.80 | 3.96 | 5.30 | 6.00 | 11.00 | 340.00 | 44.00 | 545.00 | 4.89 | 0.01 | 0.20 | 0.25 | 0.02 | 0.73 | 4.40 | 0.44 | 0.22 | 12.00 |
| More than 70%LOD | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | no |
| n | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 |
| St.dev | 37.69 | 0.09 | 0.55 | 1.35 | 1.04 | 0.87 | 1.85 | 2.45 | 93.73 | 11.27 | 102.57 | 0.83 | 0.00 | 0.03 | 0.05 | 0.00 | 0.11 | 0.91 | 0.06 | 0.05 | 3.16 |

Skienselva

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 20.01.2016 14:15 | 308.01 | 6.77 | 4.71 | 0.35 | 0.50 | 2.70 | 1.00 | 4.00 | 140.00 | 6.00 | 290.00 | 2.34 | <0.002 | 0.09 | 0.04 | 0.01 | 0.39 | 1.70 | 0.18 | 0.05 | <1.0 |
| 09.02.2016 10:20 | 314.77 | 6.70 | 2.11 | 1.80 | 2.44 | 3.00 | 3.00 | 6.00 | 160.00 | <2.0 | 310.00 | 2.59 | 0.01 | 0.12 | 0.16 | 0.02 | 0.47 | 4.70 | 0.22 | 0.09 | <1.0 |
| 15.03.2016 10:10 | 325.46 | 6.75 | 1.89 | 0.44 | 0.55 | 2.70 | <1.0 | 3.00 | 140.00 | 4.00 | 250.00 | 2.16 | <0.002 | 0.13 | 0.04 | 0.01 | 0.39 | 1.70 | 0.16 | 0.06 | <1.0 |
| 12.04.2016 09:10 | 480.53 | 6.62 | 1.89 | 0.52 | 0.62 | 2.60 | <1.0 | 4.00 | 130.00 | 3.00 | 270.00 | 2.27 | <0.002 | 0.10 | 0.06 | 0.01 | 0.45 | 4.10 | 0.18 | 0.07 | 2.00 |
| 11.05.2016 09:30 | 364.81 | 6.75 | 1.87 | 0.39 | 0.57 | 2.60 | <1.0 | 9.00 | 140.00 | 3.00 | 285.00 | 2.36 | <0.002 | 0.11 | 0.34 | 0.01 | **11.10** | 8.70 | 0.24 | 0.09 | <1.0 |
| 08.06.2016 10:05 | 259.31 | 6.88 | 1.82 | <0.3 | 0.55 | 2.50 | <1.0 | 3.00 | 110.00 | 6.00 | 255.00 | 2.09 | <0.002 | 0.08 | 0.04 | 0.01 | 0.36 | 1.40 | 0.33 | 0.05 | <1.0 |
| 20.07.2016 09:45 | 270.73 | 6.84 | 1.65 | 0.31 | <0.2 | 2.20 | <1.0 | 3.00 | 75.00 | 5.00 | 215.00 | 1.71 | <0.002 | 0.06 | 0.04 | 0.01 | 0.44 | 1.60 | 0.17 | 0.07 | <1.0 |
| 25.08.2016 10:15 | 280.94 | 6.77 | 1.68 | 0.37 | 0.54 | 2.20 | <1.0 | 3.00 | 67.00 | 11.00 | 225.00 | 1.71 | <0.002 | 0.09 | 0.04 | 0.01 | 0.34 | 1.70 | 0.15 | 0.04 | <1.0 |
| 13.09.2016 10:00 | 182.90 | 6.80 | 1.85 | <0.3 | 0.51 | 2.30 | <1.0 | 3.00 | 67.00 | 18.00 | 210.00 | 1.72 | <0.002 | 0.12 | 0.03 | 0.01 | 0.60 | 1.30 | 0.15 | 0.05 | <1.0 |
| 19.10.2016 10:15 | 247.07 | 6.79 | 1.63 | <0.3 | 0.27 | 2.20 | <1.0 | 3.00 | 85.00 | 17.00 | 210.00 | 1.76 | <0.002 | 0.09 | 0.26 | 0.01 | 0.34 | 8.20 | 0.18 | 0.05 | <1.0 |
| 15.11.2016 13:30 | 256.65 | 6.77 | 1.81 | 0.32 | 0.51 | 2.10 | <1.0 | 3.00 | 110.00 | 15.00 | 185.00 | 1.98 | <0.002 | 0.09 | 0.04 | 0.01 | 0.40 | 2.10 | 0.16 | 0.04 | <1.0 |
| 12.12.2016 13:30 | 304.74 | 6.74 | 1.76 | <0.3 | 0.24 | 2.10 | <1.0 | 3.00 | 120.00 | 12.00 | 220.00 | 2.06 | 0.01 | 0.14 | 0.04 | 0.01 | 0.36 | 1.60 | 0.17 | 0.03 | <1.0 |
| Avg. | 299.66 | 6.76 | 2.06 | 0.38 | 0.61 | 2.43 | 0.33 | 3.92 | 112.00 | 8.33 | 243.75 | 2.06 | 0.00 | 0.10 | 0.10 | 0.01 | 1.30 | 3.23 | 0.19 | 0.06 | 0.17 |
| Minimum | 182.90 | 6.62 | 1.63 | 0.30 | 0.20 | 2.10 | 1.00 | 3.00 | 67.00 | 2.00 | 185.00 | 1.71 | 0.00 | 0.06 | 0.03 | 0.01 | 0.34 | 1.30 | 0.15 | 0.03 | 1.00 |
| Maximum | 480.53 | 6.88 | 4.71 | 1.80 | 2.44 | 3.00 | 3.00 | 9.00 | 160.00 | 18.00 | 310.00 | 2.59 | 0.01 | 0.14 | 0.34 | 0.02 | 11.10 | 8.70 | 0.33 | 0.09 | 2.00 |
| More than 70%LOD | yes | yes | yes | no | yes | yes | no | yes | yes | yes | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | no |
| n | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 |
| St.dev | 73.24 | 0.07 | 0.85 | 0.42 | 0.59 | 0.29 | 0.58 | 1.83 | 31.91 | 5.81 | 38.80 | 0.30 | 0.00 | 0.02 | 0.10 | 0.00 | 3.09 | 2.67 | 0.05 | 0.02 | 0.29 |

Otra

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 05.01.2016 11:10 | 226.06 | 6.16 | 1.82 | 0.34 | 0.54 | 2.80 | <1.0 | 3.00 | 83.00 | 13.00 | 230.00 | 1.72 | 0.01 | 0.14 | 0.26 | 0.02 | 0.59 | 4.00 | 0.61 | 0.10 | 5.00 |
| 08.02.2016 10:20 | 309.41 | 5.86 | 2.58 | 1.80 | 1.40 | 3.10 | 2.00 | 5.00 | 120.00 | 18.00 | 275.00 | 1.86 | <0.002 | 0.14 | 0.37 | 0.04 | 0.50 | 5.50 | 0.73 | 0.10 | 6.00 |
| 08.03.2016 15:02 | 157.89 | 5.99 | 1.60 | 0.46 | 0.49 | 1.90 | <1.0 | 2.00 | 73.00 | 5.00 | 170.00 | 1.56 | <0.002 | 0.08 | 0.13 | 0.01 | 0.29 | 2.10 | 0.27 | 0.06 | 5.00 |
| 05.04.2016 08:45 | 198.35 | 6.12 | 1.83 | 0.47 | 0.93 | 3.00 | <1.0 | 3.00 | 99.00 | 11.00 | 245.00 | 1.58 | <0.002 | 0.12 | 0.27 | 0.02 | 0.46 | 3.20 | 0.71 | 0.07 | <1.0 |
| 09.05.2016 07:59 | 185.55 | 6.16 | 1.45 | 0.42 | 0.66 | 2.10 | 2.00 | 2.00 | 72.00 | 6.00 | 190.00 | 1.36 | <0.002 | 0.08 | 0.16 | 0.01 | 0.36 | 2.20 | 0.31 | 0.08 | <1.0 |
| 06.06.2016 10:10 | 185.59 | 6.20 | 1.38 | <0.3 | 0.79 | 2.20 | <1.0 | 3.00 | 51.00 | <2.0 | 185.00 | 1.18 | 0.01 | 0.10 | 0.19 | 0.01 | 0.55 | 2.00 | 0.20 | 0.06 | 5.00 |
| 11.07.2016 14:45 | 69.39 | 6.07 | 1.55 | 0.52 | 0.97 | 2.80 | <1.0 | 4.00 | 49.00 | 6.00 | 210.00 | 0.92 | 0.00 | 0.12 | 0.20 | 0.01 | 0.38 | 2.50 | 0.27 | 0.08 | <1.0 |
| 15.08.2016 14:30 | 62.78 | 6.11 | 1.57 | 0.56 | 1.20 | 3.70 | <1.0 | 4.00 | 50.00 | 3.00 | 235.00 | 1.08 | <0.002 | 0.18 | 0.27 | 0.02 | 0.46 | 3.00 | 0.40 | 0.09 | <1.0 |
| 12.09.2016 14:31 | 145.63 | 6.13 | 1.21 | 0.34 | 0.93 | 2.30 | <1.0 | 3.00 | 44.00 | 3.00 | 170.00 | 0.92 | 0.00 | 0.10 | 0.14 | 0.01 | 0.90 | 1.60 | 0.24 | 0.07 | <1.0 |
| 11.10.2016 08:00 | 132.82 | 6.29 | 1.37 | 0.32 | 0.82 | 2.60 | <1.0 | 2.00 | 52.00 | 5.00 | 175.00 | 1.16 | <0.002 | 0.10 | 0.16 | 0.01 | 0.28 | 2.20 | 0.23 | 0.06 | <1.0 |
| 07.11.2016 12:50 | 101.24 | 6.08 | 1.75 | 0.50 | 0.83 | 3.30 | <1.0 | 3.00 | 90.00 | 13.00 | 270.00 | 1.71 | <0.002 | 0.13 | 0.28 | 0.02 | 0.42 | 3.20 | 0.39 | 0.09 | 2.00 |
| 07.12.2016 09:10 | 138.85 | 6.07 | 1.52 | 0.42 | 0.57 | 2.50 | <1.0 | 2.00 | 82.00 | 11.00 | 200.00 | 1.67 | <0.002 | 0.10 | 0.21 | 0.01 | 0.33 | 2.40 | 0.38 | 0.08 | <1.0 |
| Avg. | 159.46 | 6.10 | 1.64 | 0.51 | 0.84 | 2.69 | 0.33 | 3.00 | 72.08 | 7.83 | 212.92 | 1.39 | 0.00 | 0.12 | 0.22 | 0.02 | 0.46 | 2.82 | 0.40 | 0.08 | 1.92 |
| Minimum | 62.78 | 5.86 | 1.21 | 0.30 | 0.49 | 1.90 | 1.00 | 2.00 | 44.00 | 2.00 | 170.00 | 0.92 | 0.00 | 0.08 | 0.13 | 0.01 | 0.28 | 1.60 | 0.20 | 0.06 | 1.00 |
| Maximum | 309.41 | 6.29 | 2.58 | 1.80 | 1.40 | 3.70 | 2.00 | 5.00 | 120.00 | 18.00 | 275.00 | 1.86 | 0.01 | 0.18 | 0.37 | 0.04 | 0.90 | 5.50 | 0.73 | 0.10 | 6.00 |
| More than 70%LOD | yes | yes | yes | yes | yes | yes | no | yes | yes | yes | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | no |
| n | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 |
| St.dev | 68.74 | 0.11 | 0.35 | 0.41 | 0.27 | 0.53 | 0.39 | 0.95 | 23.77 | 5.05 | 37.57 | 0.33 | 0.00 | 0.03 | 0.07 | 0.01 | 0.17 | 1.07 | 0.19 | 0.01 | 2.07 |

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| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 05.01.2016 12:30 | 2.55 | 7.55 | 17.00 | 4.60 | 6.45 | 5.30 | 33.00 | 62.00 | 1300.00 | <2.0 | 2000.00 | 4.76 | 0.00 | 0.31 | 0.34 | 0.01 | 1.88 | 3.40 | 1.03 | 0.21 | 4.00 |
| 02.02.2016 12:30 | 11.85 | 7.79 | 19.60 | 20.00 | 44.21 | 6.20 | 91.00 | 200.00 | 1200.00 | <2.0 | 2600.00 | 4.16 | 0.00 | 0.55 | 2.39 | 0.07 | 3.24 | **14.30** | 2.02 | 0.58 | <1.0 |
| 01.03.2016 11:10 | 1.91 | 7.69 | 18.70 | 2.90 | 11.40 | 5.40 | 20.00 | 54.00 | 1300.00 | 13.00 | 2000.00 | 0.75 | 0.00 | 0.30 | 0.32 | 0.01 | 1.81 | 3.40 | 1.10 | 0.20 | 12.00 |
| 05.04.2016 09:15 | 6.72 | 7.52 | 18.60 | 2.50 | 5.58 | 5.20 | 12.00 | 37.00 | 1190.00 | 29.00 | 1900.00 | 0.06 | <0.002 | 0.19 | 0.15 | 0.01 | 1.63 | 2.80 | 0.95 | 0.15 | <1.0 |
| 03.05.2016 07:30 | 13.32 | 7.59 | 20.10 | 3.30 | 4.76 | 5.90 | 22.00 | 54.00 | 470.00 | 82.00 | 1600.00 | 0.21 | 0.00 | 0.25 | 0.11 | 0.01 | 1.31 | 1.10 | 0.81 | 0.09 | <1.0 |
| 07.06.2016 08:30 | 1.43 | 7.76 | 20.40 | 3.60 | 4.22 | 5.50 | 6.00 | 33.00 | 79.00 | 61.00 | 780.00 | 0.27 | <0.002 | 0.25 | 0.09 | 0.01 | 1.48 | 1.30 | 1.09 | 0.13 | <1.0 |
| 05.07.2016 10:00 | 7.06 | 7.98 | 19.60 | 1.80 | 3.38 | 5.70 | 6.00 | 36.00 | 9.00 | 91.00 | 675.00 | 1.20 | <0.002 | 0.23 | 0.05 | 0.01 | 1.43 | 1.00 | 1.12 | 0.07 | 2.00 |
| 02.08.2016 09:55 | 12.88 | 8.04 | 21.40 | 6.70 | 10.60 | 7.10 | 11.00 | 72.00 | <2.0 | 6.00 | 755.00 | 3.69 | <0.002 | 0.29 | 0.15 | 0.01 | 1.44 | 2.00 | 1.28 | 0.15 | 1.00 |
| 06.09.2016 08:30 | 3.16 | 7.80 | 19.60 | 2.70 | 4.19 | 5.30 | 12.00 | 39.00 | 110.00 | 60.00 | 720.00 | 3.54 | <0.002 | 0.31 | 0.10 | 0.01 | 0.94 | 1.20 | 1.04 | 0.08 | <1.0 |
| 04.10.2016 11:40 | 5.53 | 7.91 | 19.60 | 7.70 | 9.88 | 6.10 | 8.00 | 71.00 | 64.00 | 36.00 | 835.00 | 0.22 | <0.002 | 0.32 | 0.34 | 0.01 | 1.73 | 2.80 | 1.12 | 0.11 | <1.0 |
| 01.11.2016 09:45 | 5.35 | 7.83 | 21.90 | 6.10 | 9.21 | 5.80 | 24.00 | 67.00 | 76.00 | 61.00 | 940.00 | 0.62 | 0.00 | 0.37 | 0.23 | 0.01 | 1.25 | 1.80 | 1.08 | 0.10 | <1.0 |
| 06.12.2016 13:00 | 4.81 | 7.73 | 19.00 | 5.30 | 5.14 | 5.50 | 19.00 | 47.00 | 990.00 | 30.00 | 1600.00 | 2.02 | <0.002 | 0.28 | 0.17 | 0.01 | 1.41 | 2.30 | 1.14 | 0.18 | <1.0 |
| Avg. | 6.38 | 7.77 | 19.62 | 5.60 | 9.92 | 5.75 | 22.00 | 64.33 | 565.67 | 39.08 | 1367.08 | 1.79 | 0.00 | 0.30 | 0.37 | 0.02 | 1.63 | 3.12 | 1.15 | 0.17 | 1.58 |
| Minimum | 1.43 | 7.52 | 17.00 | 1.80 | 3.38 | 5.20 | 6.00 | 33.00 | 2.00 | 2.00 | 675.00 | 0.06 | 0.00 | 0.19 | 0.05 | 0.01 | 0.94 | 1.00 | 0.81 | 0.07 | 1.00 |
| Maximum | 13.32 | 8.04 | 21.90 | 20.00 | 44.21 | 7.10 | 91.00 | 200.00 | 1300.00 | 91.00 | 2600.00 | 4.76 | 0.00 | 0.55 | 2.39 | 0.07 | 3.24 | 14.30 | 2.02 | 0.58 | 12.00 |
| More than 70%LOD | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | no |
| n | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 |
| St.dev | 4.21 | 0.16 | 1.29 | 4.89 | 11.15 | 0.53 | 23.21 | 44.93 | 573.93 | 31.12 | 660.32 | 1.76 | 0.00 | 0.09 | 0.64 | 0.02 | 0.57 | 3.63 | 0.30 | 0.14 | 3.19 |

Vosso(Bolstadelvi)

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 04.01.2016 12:45 | 34.90 | 6.48 | 1.55 | 0.80 | 0.82 | 1.20 | 2.00 | 4.00 | 130.00 | 8.00 | 225.00 | 1.01 | 0.02 | 0.12 | 0.11 | 0.03 | 0.40 | 3.20 | 0.36 | 0.09 | <1.0 |
| 01.02.2016 11:40 | 60.13 | 6.48 | 1.88 | 0.36 | 0.69 | 0.91 | 2.00 | 4.00 | 110.00 | 3.00 | 185.00 | 0.82 | <0.002 | 0.06 | 0.08 | 0.01 | 0.30 | 1.30 | 0.33 | 0.06 | 2.00 |
| 01.03.2016 07:15 | 12.02 | 6.66 | 2.69 | 0.46 | 0.38 | 0.99 | 2.00 | 3.00 | 160.00 | 9.00 | 260.00 | 1.19 | <0.002 | 0.08 | 0.04 | 0.01 | 0.34 | 1.60 | 0.37 | 0.04 | 13.00 |
| 04.04.2016 09:30 | 33.81 | 6.50 | 2.42 | 0.56 | 0.73 | 0.95 | 1.00 | 3.00 | 150.00 | 2.00 | 230.00 | 1.11 | <0.002 | 0.10 | 0.05 | 0.01 | 0.33 | 1.50 | 0.36 | 0.05 | <1.0 |
| 09.05.2016 12:45 | 195.03 | 6.67 | 3.11 | 0.30 | 0.47 | 0.88 | <1.0 | 3.00 | 130.00 | 7.00 | 245.00 | 1.02 | <0.002 | 0.06 | 0.04 | 0.00 | 0.30 | 1.30 | 0.29 | 0.04 | <1.0 |
| 06.06.2016 13:15 | 329.18 | 6.44 | 1.70 | 0.38 | 0.41 | 0.77 | <1.0 | 2.00 | 82.00 | 3.00 | 165.00 | 0.90 | <0.002 | 0.05 | 0.07 | 0.01 | 0.64 | 4.40 | 0.23 | 0.04 | <1.0 |
| 05.07.2016 00:00 | 158.92 | 6.29 | 1.29 | 0.34 | <0.2 | 0.97 | <1.0 | 2.00 | 45.00 | 4.00 | 129.00 | 0.71 | <0.002 | 0.05 | 0.06 | 0.00 | 0.26 | 0.84 | 0.14 | 0.07 | <1.0 |
| 01.08.2016 12:25 | 162.72 | 6.35 | 1.05 | 0.31 | 0.75 | 1.40 | <1.0 | 3.00 | 39.00 | <2.0 | 148.00 | 0.72 | <0.002 | 0.06 | 0.07 | 0.00 | 0.34 | 0.86 | 0.27 | 0.08 | <1.0 |
| 06.09.2016 07:20 | 85.69 | 6.56 | 1.13 | <0.3 | 0.64 | 1.50 | <1.0 | 3.00 | 56.00 | 3.00 | 150.00 | 0.87 | <0.002 | 0.09 | 0.06 | 0.00 | 0.26 | 0.80 | 0.19 | 0.05 | <1.0 |
| 05.10.2016 00:00 | 64.35 | 6.54 | 1.38 | 0.64 | 0.93 | 1.60 | <1.0 | 4.00 | 87.00 | 17.00 | 225.00 | 0.98 | <0.002 | 0.05 | 0.08 | 0.01 | 0.35 | 1.00 | 0.28 | 0.06 | 1.00 |
| 01.11.2016 12:00 | 135.35 | 6.52 | 1.55 | 0.51 | 0.51 | 1.30 | 1.00 | 4.00 | 91.00 | 20.00 | 205.00 | 0.88 | <0.002 | 0.07 | 0.06 | 0.00 | 0.36 | 1.10 | 0.31 | 0.05 | <1.0 |
| 06.12.2016 12:40 | 36.38 | 6.58 | 1.73 | <0.3 | 0.36 | 1.40 | <1.0 | 3.00 | 140.00 | 5.00 | 220.00 | 1.08 | <0.002 | 0.07 | 0.04 | 0.00 | 0.31 | 0.90 | 0.29 | 0.06 | <1.0 |
| Lower avg. | 109.04 | 6.51 | 1.79 | 0.39 | 0.56 | 1.16 | 0.67 | 3.17 | 101.67 | 6.75 | 198.92 | 0.94 | 0.00 | 0.07 | 0.06 | 0.01 | 0.35 | 1.57 | 0.29 | 0.06 | 1.33 |
| Upper avg.. | 109.04 | 6.51 | 1.79 | 0.44 | 0.57 | 1.16 | 1.25 | 3.17 | 101.67 | 6.92 | 198.92 | 0.94 | 0.00 | 0.07 | 0.06 | 0.01 | 0.35 | 1.57 | 0.29 | 0.06 | 2.08 |
| Minimum | 12.02 | 6.29 | 1.05 | 0.30 | 0.20 | 0.77 | 1.00 | 2.00 | 39.00 | 2.00 | 129.00 | 0.71 | 0.00 | 0.05 | 0.04 | 0.00 | 0.26 | 0.80 | 0.14 | 0.04 | 1.00 |
| Maximum | 329.18 | 6.67 | 3.11 | 0.80 | 0.93 | 1.60 | 2.00 | 4.00 | 160.00 | 20.00 | 260.00 | 1.19 | 0.02 | 0.12 | 0.11 | 0.03 | 0.64 | 4.40 | 0.37 | 0.09 | 13.00 |
| More than 70%LOD | yes | yes | yes | yes | yes | yes | no | yes | yes | yes | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | no |
| n | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 |
| St.dev | 91.80 | 0.11 | 0.64 | 0.16 | 0.22 | 0.28 | 0.45 | 0.72 | 41.37 | 5.92 | 42.51 | 0.15 | 0.01 | 0.02 | 0.02 | 0.01 | 0.10 | 1.11 | 0.07 | 0.02 | 3.45 |

Orkla

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 05.01.2016 09:45 | 17.20 | 7.52 | 6.47 | 0.77 | 0.69 | 2.20 | 1.00 | 4.00 | 170.00 | 13.00 | 320.00 | 2.87 | 0.01 | 0.09 | 0.10 | 0.04 | 4.09 | 11.10 | 0.76 | 0.18 | <1.0 |
| 08.02.2016 10:10 | 47.33 | 7.53 | 6.50 | 1.20 | 6.54 | 2.00 | 1.00 | 8.00 | 120.00 | 8.00 | 285.00 | 2.85 | <0.002 | 0.10 | 0.07 | 0.02 | 2.39 | 5.50 | 0.87 | 0.34 | 3.00 |
| 09.03.2016 09:00 | 16.60 | 7.61 | 8.16 | 0.92 | 0.46 | 1.80 | 3.00 | 5.00 | 200.00 | 14.00 | 350.00 | 3.28 | <0.002 | 0.11 | 0.04 | 0.02 | 2.10 | 5.90 | 0.87 | 0.15 | 2.00 |
| 05.04.2016 12:15 | 33.45 | 7.50 | 8.26 | 0.89 | 1.45 | 4.00 | 2.00 | 7.00 | 210.00 | <2.0 | 415.00 | 2.66 | <0.002 | 0.13 | 0.03 | 0.07 | 7.62 | 23.00 | 0.94 | 0.25 | <1.0 |
| 09.05.2016 10:10 | 259.88 | 7.04 | 3.28 | 7.00 | 28.00 | 5.30 | 18.00 | 39.00 | 48.00 | <2.0 | 400.00 | 3.26 | 0.00 | 0.32 | 0.38 | 0.05 | 6.19 | 12.40 | 2.57 | 1.97 | <1.0 |
| 07.06.2016 07:50 | 55.81 | 7.58 | 5.16 | <0.3 | 0.81 | 2.40 | <1.0 | 4.00 | 87.00 | <2.0 | 255.00 | 1.96 | <0.002 | 0.08 | 0.01 | 0.01 | 2.88 | 3.00 | 0.53 | 0.18 | <1.0 |
| 06.07.2016 10:00 | 32.38 | 7.70 | 5.77 | 0.55 | 0.88 | 4.20 | <1.0 | 4.00 | 92.00 | 6.00 | 280.00 | 1.99 | <0.002 | 0.13 | 0.02 | 0.01 | 2.75 | 5.50 | 0.61 | 0.20 | <1.0 |
| 03.08.2016 10:00 | 81.63 | 7.51 | 5.42 | 0.85 | 2.49 | 6.90 | <1.0 | 7.00 | 58.00 | <2.0 | 310.00 | 2.96 | <0.002 | 0.17 | 0.04 | 0.03 | 5.34 | 11.60 | 1.34 | 0.44 | <1.0 |
| 05.09.2016 08:15 | 58.03 | 7.68 | 6.33 | 0.36 | 0.84 | 4.50 | <1.0 | 5.00 | 120.00 | <2.0 | 285.00 | 2.89 | <0.002 | 0.12 | 0.03 | 0.03 | 3.63 | 8.90 | 0.74 | 0.21 | <1.0 |
| 10.10.2016 08:00 | 16.33 | 7.71 | 8.34 | <0.3 | <0.5 | 2.60 | <1.0 | 3.00 | 250.00 | 2.00 | 420.00 | 3.24 | <0.002 | 0.12 | 0.01 | 0.04 | 4.71 | 12.10 | 0.75 | 0.12 | <1.0 |
| 07.11.2016 09:00 | 16.06 | 7.59 | 9.39 | 0.53 | 0.74 | 4.30 | 1.00 | 4.00 | 360.00 | 8.00 | 615.00 | 3.88 | <0.002 | 0.18 | 0.02 | 0.10 | 10.10 | 35.70 | 1.01 | 0.24 | 1.00 |
| 05.12.2016 13:40 | 116.57 | 7.20 | 4.90 | 29.00 | 69.10 | 6.10 | 53.00 | 78.00 | 180.00 | 2.00 | 525.00 | 4.61 | 0.00 | 0.57 | 0.87 | 0.06 | 9.61 | 18.80 | 3.90 | 3.97 | 1.00 |
| Avg. | 62.61 | 7.51 | 6.50 | 3.51 | 9.33 | 3.86 | 6.58 | 14.00 | 157.92 | 4.42 | 371.67 | 3.04 | 0.00 | 0.18 | 0.14 | 0.04 | 5.12 | 12.79 | 1.24 | 0.69 | 0.58 |
| Minimum | 16.06 | 7.04 | 3.28 | 0.30 | 0.46 | 1.80 | 1.00 | 3.00 | 48.00 | 2.00 | 255.00 | 1.96 | 0.00 | 0.08 | 0.01 | 0.01 | 2.10 | 3.00 | 0.53 | 0.12 | 1.00 |
| Maximum | 259.88 | 7.71 | 9.39 | 29.00 | 69.10 | 6.90 | 53.00 | 78.00 | 360.00 | 14.00 | 615.00 | 4.61 | 0.01 | 0.57 | 0.87 | 0.10 | 10.10 | 35.70 | 3.90 | 3.97 | 3.00 |
| More than 70%LOD | yes | yes | yes | yes | yes | yes | no | yes | yes | no | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | no |
| n | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 |
| St.dev | 69.24 | 0.20 | 1.76 | 8.22 | 20.36 | 1.69 | 15.27 | 22.44 | 89.82 | 4.54 | 109.43 | 0.73 | 0.00 | 0.14 | 0.25 | 0.03 | 2.75 | 9.22 | 1.00 | 1.15 | 0.62 |

Vefsna

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 11.01.2016 12:00 | 58.24 | 7.72 | 10.10 | <0.3 | 0.23 | 1.60 | <1.0 | 9.00 | 130.00 | 5.00 | 270.00 | 2.36 | 2.05 | 0.15 | 0.02 | <0.003 | 0.48 | 0.50 | 0.31 | 0.07 | <1.0 |
| 10.02.2016 10:00 | 47.14 | 7.68 | 8.92 | <0.3 | <0.2 | 1.20 | <1.0 | 2.00 | 110.00 | 4.00 | 210.00 | 2.05 | 0.01 | 0.17 | 0.02 | 0.01 | 0.28 | 0.20 | 0.24 | 0.06 | 2.00 |
| 01.03.2016 10:00 | 41.01 | 7.72 | 11.70 | <0.3 | <0.4 | 1.10 | <1.0 | 1.00 | 120.00 | <2.0 | 200.00 | 2.12 | <0.002 | 0.14 | 0.01 | 0.00 | 0.27 | 0.17 | 0.23 | 0.07 | 3.00 |
| 05.04.2016 10:00 | 75.03 | 7.38 | 7.62 | 0.62 | 0.83 | 2.50 | <1.0 | 2.00 | 54.00 | <2.0 | 160.00 | 1.78 | <0.002 | 0.10 | 0.04 | <0.003 | 0.36 | 0.30 | 0.29 | 0.12 | <1.0 |
| 09.05.2016 09:45 | 292.14 | 7.49 | 5.10 | 0.50 | 2.74 | 2.00 | 2.00 | 4.00 | 28.00 | <2.0 | 144.00 | 1.49 | <0.002 | 0.11 | 0.07 | 0.00 | 0.37 | 0.49 | 0.27 | 0.14 | <1.0 |
| 06.06.2016 08:45 | 277.25 | 7.50 | 4.10 | <0.3 | 0.94 | 1.10 | <1.0 | 2.00 | 28.00 | <2.0 | 111.00 | 1.18 | <0.002 | 0.11 | 0.03 | <0.003 | 0.31 | 0.15 | 0.12 | 0.07 | <1.0 |
| 06.07.2016 13:00 | 157.82 | 7.37 | 3.33 | <0.3 | 1.42 | 0.71 | <1.0 | 1.00 | 15.00 | 2.00 | 76.00 | 0.81 | <0.002 | 0.08 | 0.03 | <0.003 | 0.20 | 0.17 | 0.16 | 0.06 | <1.0 |
| 16.08.2016 08:10 | 98.81 | 7.63 | 5.00 | <0.3 | <0.4 | 1.40 | <1.0 | 2.00 | 8.00 | <2.0 | 81.00 | 1.12 | <0.002 | 0.12 | 0.02 | <0.003 | 0.29 | 0.18 | 0.23 | 0.05 | <1.0 |
| 05.09.2016 08:45 | 166.83 | 7.65 | 5.27 | 0.32 | 0.73 | 1.70 | <1.0 | 2.00 | 12.00 | <2.0 | 105.00 | 1.29 | <0.002 | 0.12 | 0.03 | <0.003 | 0.20 | 0.20 | 0.23 | 0.06 | <1.0 |
| 04.10.2016 07:30 | 163.03 | 7.60 | 5.59 | <0.3 | 0.55 | 2.50 | <1.0 | 2.00 | 15.00 | <2.0 | 111.00 | 1.45 | <0.002 | 0.09 | 0.03 | 0.00 | 0.26 | 0.22 | 0.23 | 0.08 | <1.0 |
| 07.11.2016 11:10 | 42.43 | 7.76 | 10.20 | <0.3 | <0.2 | 2.00 | <1.0 | 1.00 | 86.00 | 4.00 | 225.00 | 2.09 | <0.002 | 0.15 | 0.02 | 0.00 | 0.52 | 0.57 | 0.35 | 0.06 | 2.00 |
| 08.12.2016 10:00 | 163.01 | 7.50 | 5.58 | 0.65 | 1.58 | 2.50 | 1.00 | 3.00 | 29.00 | <2.0 | 119.00 | 1.50 | <0.002 | 0.10 | 0.05 | <0.003 | 0.34 | 0.44 | 0.26 | 0.13 | <1.0 |
| Avg. | 131.90 | 7.58 | 6.88 | 0.17 | 0.75 | 1.69 | 0.25 | 2.58 | 52.92 | 1.25 | 151.00 | 1.60 | 0.17 | 0.12 | 0.03 | 0.00 | 0.32 | 0.30 | 0.24 | 0.08 | 0.58 |
| Minimum | 41.01 | 7.37 | 3.33 | 0.30 | 0.20 | 0.71 | 1.00 | 1.00 | 8.00 | 2.00 | 76.00 | 0.81 | 0.00 | 0.08 | 0.01 | 0.00 | 0.20 | 0.15 | 0.12 | 0.05 | 1.00 |
| Maximum | 292.14 | 7.76 | 11.70 | 0.65 | 2.74 | 2.50 | 2.00 | 9.00 | 130.00 | 5.00 | 270.00 | 2.36 | 2.05 | 0.17 | 0.07 | 0.01 | 0.52 | 0.57 | 0.35 | 0.14 | 3.00 |
| More than 70%LOD | yes | yes | yes | no | no | yes | no | yes | yes | no | yes | yes | no | yes | yes | no | yes | yes | yes | yes | no |
| n | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 |
| St.dev | 87.30 | 0.13 | 2.74 | 0.13 | 0.75 | 0.61 | 0.29 | 2.19 | 45.90 | 1.08 | 62.17 | 0.48 | 0.59 | 0.03 | 0.02 | 0.00 | 0.10 | 0.16 | 0.06 | 0.03 | 0.65 |

Altaelva

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 04.01.2016 12:15 | 28.60 | 7.65 | 12.30 | <0.3 | <1.0 | 2.40 | 6.00 | 8.00 | 130.00 | 12.00 | 290.00 | 5.49 | 0.02 | 0.24 | 0.04 | 0.02 | 0.44 | 1.10 | 0.20 | 0.14 | <1.0 |
| 02.02.2016 10:45 | 28.58 | 7.50 | 8.28 | 1.00 | 0.29 | 2.90 | 3.00 | 4.00 | 77.00 | 63.00 | 305.00 | 5.57 | <0.002 | 0.11 | 0.01 | <0.003 | 0.40 | <0.15 | 0.20 | 0.15 | <1.0 |
| 07.03.2016 00:00 | 27.20 | 7.56 | 9.77 | 1.50 | 0.41 | 2.70 | 6.00 | 10.00 | 81.00 | 64.00 | 300.00 | 6.43 | <0.002 | 0.18 | 0.01 | <0.003 | 0.39 | 0.22 | 0.19 | 0.14 | 3.00 |
| 04.04.2016 14:15 | 26.91 | 7.67 | 10.30 | 5.70 | 5.40 | 2.70 | 5.00 | 7.00 | 54.00 | 6.00 | 200.00 | 6.54 | <0.002 | 0.11 | 0.07 | <0.003 | 0.75 | 0.21 | 0.40 | 0.52 | 1.00 |
| 03.05.2016 11:20 | 82.38 | 7.68 | 9.22 | 0.46 | 0.88 | 3.60 | 1.00 | 5.00 | 81.00 | 33.00 | 300.00 | 5.59 | <0.002 | 0.11 | 0.02 | <0.003 | 0.52 | 0.26 | 0.26 | 0.19 | <1.0 |
| 06.06.2016 08:40 | 183.44 | 7.63 | 7.90 | <0.3 | 1.98 | 3.60 | 3.00 | 9.00 | 49.00 | <2.0 | 225.00 | 4.01 | <0.002 | 0.15 | 0.02 | <0.003 | 0.53 | 0.17 | 0.12 | 0.17 | <1.0 |
| 11.07.2016 08:55 | 419.73 | 7.59 | 4.90 | 0.87 | 3.03 | 4.20 | 3.00 | 7.00 | 14.00 | 3.00 | 205.00 | 3.66 | <0.002 | 0.12 | 0.05 | <0.003 | 0.75 | 0.54 | 0.41 | 0.36 | <1.0 |
| 08.08.2016 12:40 | 210.52 | 7.59 | 5.59 | 0.67 | 2.14 | 4.40 | 5.00 | 5.00 | 28.00 | <2.0 | 215.00 | 3.99 | <0.002 | 0.15 | 0.01 | <0.003 | 0.59 | 0.22 | 0.35 | 0.35 | <1.0 |
| 05.09.2016 08:30 | 148.75 | 7.57 | 7.49 | <0.3 | 0.60 | 4.20 | 2.00 | 5.00 | 44.00 | 5.00 | 240.00 | 4.16 | <0.002 | 0.16 | 0.01 | <0.003 | 0.38 | <0.15 | 0.26 | 0.17 | <1.0 |
| 04.10.2016 11:45 | 161.80 | 7.52 | 5.69 | <0.3 | 0.76 | 4.70 | 1.00 | 5.00 | 24.00 | <2.0 | 195.00 | 4.50 | <0.002 | 0.10 | 0.01 | <0.003 | 0.45 | 0.17 | 0.29 | 0.20 | <1.0 |
| 11.11.2016 12:00 | 41.19 | 7.55 | 8.67 | 0.37 | 0.46 | 3.70 | 1.00 | 5.00 | 99.00 | 36.00 | 320.00 | 5.01 | <0.002 | 0.15 | 0.01 | <0.003 | 0.41 | <0.15 | 0.25 | 0.18 | <1.0 |
| 05.12.2016 11:15 | 42.48 | 7.55 | 9.12 | <0.3 | <0.33 | 3.80 | 6.00 | 10.00 | 100.00 | 59.00 | 315.00 | 5.36 | <0.002 | 0.16 | 0.01 | <0.003 | 0.42 | <0.15 | 0.40 | 0.19 | <1.0 |
| Avg. | 116.80 | 7.59 | 8.27 | 0.88 | 1.33 | 3.57 | 3.50 | 6.67 | 65.08 | 23.42 | 259.17 | 5.03 | 0.00 | 0.14 | 0.02 | 0.00 | 0.50 | 0.24 | 0.28 | 0.23 | 0.33 |
| Minimum | 26.91 | 7.50 | 4.90 | 0.30 | 0.29 | 2.40 | 1.00 | 4.00 | 14.00 | 2.00 | 195.00 | 3.66 | 0.00 | 0.10 | 0.01 | 0.00 | 0.38 | 0.15 | 0.12 | 0.14 | 1.00 |
| Maximum | 419.73 | 7.68 | 12.30 | 5.70 | 5.40 | 4.70 | 6.00 | 10.00 | 130.00 | 64.00 | 320.00 | 6.54 | 0.02 | 0.24 | 0.07 | 0.02 | 0.75 | 1.10 | 0.41 | 0.52 | 3.00 |
| More than 70%LOD | yes | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | yes | no | yes | yes | no | yes | no | yes | yes | no |
| n | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 |
| St.dev | 117.60 | 0.06 | 2.14 | 1.53 | 1.51 | 0.75 | 2.02 | 2.15 | 35.33 | 25.75 | 49.76 | 0.96 | 0.00 | 0.04 | 0.02 | 0.00 | 0.13 | 0.28 | 0.09 | 0.12 | 0.58 |

Tista utløp Femsjøen

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 10.02.2016 12:30 | 70.40 | 6.79 | 4.92 | 3.20 | 2.39 | 8.40 | 12.00 | 20.00 | 470.00 | <2.0 | 860.00 | 4.65 | 0.00 | 0.34 | 0.30 | 0.02 | 1.26 | **16.80** | 0.74 | 0.40 | <1.0 |
| 11.05.2016 13:00 | 26.43 | 6.91 | 5.19 | 5.00 | 6.76 | 8.60 | 10.00 | 24.00 | 400.00 | <2.0 | 850.00 | 4.71 | <0.002 | 0.30 | 0.43 | 0.02 | 1.43 | **13.50** | 0.78 | 0.44 | <1.0 |
| 08.08.2016 14:00 | 12.73 | 6.98 | 5.18 | 1.80 | 3.08 | 8.00 | 4.00 | 14.00 | 440.00 | <2.0 | 775.00 | 3.58 | <0.002 | 0.31 | 0.30 | 0.01 | 1.43 | 5.60 | 0.76 | 0.29 | <1.0 |
| 10.10.2016 13:15 | 3.85 | 7.10 | 5.28 | 1.80 | 2.06 | 7.80 | 4.00 | 15.00 | 430.00 | <2.0 | 755.00 | 3.56 | <0.002 | 0.30 | 0.30 | 0.01 | 1.63 | 6.90 | 0.74 | 0.33 | <1.0 |
| Avg. | 28.35 | 6.95 | 5.14 | 2.95 | 3.57 | 8.20 | 7.50 | 18.25 | 435.00 | 0.00 | 810.00 | 4.13 | 0.00 | 0.31 | 0.33 | 0.02 | 1.44 | 10.70 | 0.76 | 0.37 | 0.00 |
| Minimum | 3.85 | 6.79 | 4.92 | 1.80 | 2.06 | 7.80 | 4.00 | 14.00 | 400.00 | 2.00 | 755.00 | 3.56 | 0.00 | 0.30 | 0.30 | 0.01 | 1.26 | 5.60 | 0.74 | 0.29 | 1.00 |
| Maximum | 70.40 | 7.10 | 5.28 | 5.00 | 6.76 | 8.60 | 12.00 | 24.00 | 470.00 | 2.00 | 860.00 | 4.71 | 0.00 | 0.34 | 0.43 | 0.02 | 1.63 | 16.80 | 0.78 | 0.44 | 1.00 |
| More than 70%LOD | yes | yes | yes | yes | yes | yes | yes | yes | yes | no | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | no |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 29.53 | 0.13 | 0.16 | 1.52 | 2.17 | 0.37 | 4.12 | 4.65 | 28.87 | 0.00 | 52.76 | 0.64 | 0.00 | 0.02 | 0.07 | 0.00 | 0.15 | 5.34 | 0.02 | 0.07 | 0.00 |

Tokkeelva

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 01.02.2016 13:00 | 31.05 | 6.42 | 2.24 | <0.3 | 0.50 | 5.60 | 1.00 | 3.00 | 140.00 | 7.00 | 345.00 | 3.43 | <0.002 | 0.21 | 0.28 | 0.03 | 0.53 | 5.10 | 0.46 | 0.15 | 2.00 |
| 09.05.2016 08:25 | 29.57 | 6.20 | 2.01 | 0.34 | 0.70 | 5.30 | <1.0 | 2.00 | 140.00 | <2.0 | 350.00 | 2.94 | <0.002 | 0.19 | 0.25 | 0.03 | 0.49 | 4.80 | 0.41 | 0.14 | <1.0 |
| 02.08.2016 08:55 | 12.77 | 6.35 | 1.91 | 0.46 | 0.87 | 4.70 | <1.0 | 4.00 | 88.00 | <2.0 | 305.00 | 2.42 | <0.002 | 0.17 | 0.12 | 0.02 | 0.47 | 3.50 | 0.31 | 0.13 | 1.00 |
| 10.10.2016 08:50 | 5.83 | 6.45 | 2.00 | <0.3 | 0.61 | 4.90 | <1.0 | 3.00 | 88.00 | 12.00 | 310.00 | 2.29 | <0.002 | 0.21 | 0.12 | 0.02 | 0.55 | 4.20 | 0.42 | 0.11 | <1.0 |
| Avg. | 19.81 | 6.35 | 2.04 | 0.20 | 0.67 | 5.12 | 0.25 | 3.00 | 114.00 | 4.75 | 327.50 | 2.77 | 0.00 | 0.20 | 0.19 | 0.02 | 0.51 | 4.40 | 0.40 | 0.13 | 0.75 |
| Minimum | 5.83 | 6.20 | 1.91 | 0.30 | 0.50 | 4.70 | 1.00 | 2.00 | 88.00 | 2.00 | 305.00 | 2.29 | 0.00 | 0.17 | 0.12 | 0.02 | 0.47 | 3.50 | 0.31 | 0.11 | 1.00 |
| Maximum | 31.05 | 6.45 | 2.24 | 0.46 | 0.87 | 5.60 | 1.00 | 4.00 | 140.00 | 12.00 | 350.00 | 3.43 | 0.00 | 0.21 | 0.28 | 0.03 | 0.55 | 5.10 | 0.46 | 0.15 | 2.00 |
| More than 70%LOD | yes | yes | yes | no | yes | yes | no | yes | yes | no | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | no |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 12.47 | 0.11 | 0.14 | 0.08 | 0.16 | 0.40 | 0.00 | 0.82 | 30.02 | 4.79 | 23.27 | 0.52 | 0.00 | 0.02 | 0.08 | 0.00 | 0.04 | 0.71 | 0.06 | 0.02 | 0.50 |

Nidelva(Rykene)

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 01.02.2016 10:10 | 159.09 | 6.56 | 3.03 | 0.44 | 1.11 | 4.20 | 3.00 | 6.00 | 250.00 | 14.00 | 445.00 | 3.09 | <0.002 | 0.19 | 0.31 | 0.03 | 0.77 | 5.40 | 0.33 | 0.15 | <1.0 |
| 09.05.2016 11:25 | 209.10 | 6.50 | 2.10 | 0.81 | 0.97 | 3.50 | <1.0 | 4.00 | 150.00 | 6.00 | 335.00 | 2.06 | <0.002 | 0.13 | 0.24 | 0.02 | 0.68 | 3.50 | 0.21 | 0.10 | <1.0 |
| 02.08.2016 11:40 | 93.13 | 6.28 | 1.45 | 0.34 | 0.99 | 3.80 | <1.0 | 3.00 | 84.00 | 6.00 | 280.00 | 1.49 | <0.002 | 0.15 | 0.19 | 0.02 | 0.71 | 2.70 | 0.19 | 0.11 | 2.00 |
| 10.10.2016 11:05 | 44.45 | 6.18 | 1.28 | 0.32 | 0.61 | 3.20 | <1.0 | 3.00 | 96.00 | 6.00 | 245.00 | 1.74 | <0.002 | 0.11 | 0.14 | 0.02 | 0.52 | 2.80 | 0.18 | 0.07 | <1.0 |
| Avg. | 126.44 | 6.38 | 1.97 | 0.48 | 0.92 | 3.67 | 0.75 | 4.00 | 145.00 | 8.00 | 326.25 | 2.10 | 0.00 | 0.14 | 0.22 | 0.02 | 0.67 | 3.60 | 0.23 | 0.11 | 0.50 |
| Minimum | 44.45 | 6.18 | 1.28 | 0.32 | 0.61 | 3.20 | 1.00 | 3.00 | 84.00 | 6.00 | 245.00 | 1.49 | 0.00 | 0.11 | 0.14 | 0.02 | 0.52 | 2.70 | 0.18 | 0.07 | 1.00 |
| Maximum | 209.10 | 6.56 | 3.03 | 0.81 | 1.11 | 4.20 | 3.00 | 6.00 | 250.00 | 14.00 | 445.00 | 3.09 | 0.00 | 0.19 | 0.31 | 0.03 | 0.77 | 5.40 | 0.33 | 0.15 | 2.00 |
| More than 70%LOD | yes | yes | yes | yes | yes | yes | no | yes | yes | yes | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | no |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 72.41 | 0.18 | 0.79 | 0.23 | 0.22 | 0.43 | 1.00 | 1.41 | 75.66 | 4.00 | 87.40 | 0.70 | 0.00 | 0.03 | 0.07 | 0.01 | 0.11 | 1.25 | 0.07 | 0.03 | 0.50 |

Tovdalselva

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 08.02.2016 09:40 | 240.11 | 5.69 | 2.61 | 0.69 | 1.17 | 4.80 | <1.0 | 4.00 | 120.00 | 15.00 | 315.00 | 2.31 | <0.002 | 0.18 | 0.56 | 0.05 | 0.36 | 7.70 | 0.42 | 0.14 | 1.00 |
| 09.05.2016 08:52 | 77.28 | 6.46 | 2.03 | 0.54 | 2.32 | 4.20 | 1.00 | 5.00 | 93.00 | 8.00 | 320.00 | 1.77 | <0.002 | 0.16 | 0.38 | 0.02 | 0.35 | 4.30 | 0.24 | 0.12 | <1.0 |
| 15.08.2016 13:30 | 48.48 | 6.47 | 1.86 | 0.44 | 1.72 | 5.50 | <1.0 | 4.00 | 43.00 | 12.00 | 280.00 | 1.16 | <0.002 | 0.26 | 0.42 | 0.02 | 0.41 | 3.50 | 0.33 | 0.13 | <1.0 |
| 11.10.2016 08:45 | 20.16 | 6.55 | 2.11 | 0.71 | 1.82 | 5.30 | 1.00 | 4.00 | 58.00 | 67.00 | 340.00 | 1.26 | <0.002 | 0.27 | 0.37 | 0.02 | 0.33 | 3.60 | 0.32 | 0.13 | <1.0 |
| Avg. | 96.51 | 6.29 | 2.15 | 0.59 | 1.76 | 4.95 | 0.50 | 4.25 | 78.50 | 25.50 | 313.75 | 1.63 | 0.00 | 0.22 | 0.43 | 0.03 | 0.36 | 4.78 | 0.33 | 0.13 | 0.25 |
| Minimum | 20.16 | 5.69 | 1.86 | 0.44 | 1.17 | 4.20 | 1.00 | 4.00 | 43.00 | 8.00 | 280.00 | 1.16 | 0.00 | 0.16 | 0.37 | 0.02 | 0.33 | 3.50 | 0.24 | 0.12 | 1.00 |
| Maximum | 240.11 | 6.55 | 2.61 | 0.71 | 2.32 | 5.50 | 1.00 | 5.00 | 120.00 | 67.00 | 340.00 | 2.31 | 0.00 | 0.27 | 0.56 | 0.05 | 0.41 | 7.70 | 0.42 | 0.14 | 1.00 |
| More than 70%LOD | yes | yes | yes | yes | yes | yes | no | yes | yes | yes | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | no |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 98.53 | 0.40 | 0.32 | 0.13 | 0.47 | 0.58 | 0.00 | 0.50 | 34.70 | 27.81 | 24.96 | 0.53 | 0.00 | 0.06 | 0.09 | 0.02 | 0.03 | 1.98 | 0.07 | 0.01 | 0.00 |

Mandalselva

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 07.02.2016 18:00 | 144.25 | 5.89 | 2.59 | 0.69 | 0.98 | 3.70 | <1.0 | 5.00 | 110.00 | 12.00 | 280.00 | 1.56 | <0.002 | 0.13 | 0.45 | 0.03 | 0.28 | 5.30 | 0.22 | 0.10 | 2.00 |
| 10.05.2016 10:40 | 167.18 | 6.54 | 2.09 | 0.58 | 1.65 | 3.40 | 1.00 | 4.00 | 110.00 | 17.00 | 310.00 | 1.31 | <0.002 | 0.14 | 0.38 | 0.02 | 0.36 | 3.90 | 0.09 | 0.08 | <1.0 |
| 15.08.2016 08:10 | 64.29 | 6.25 | 1.76 | 0.63 | 1.76 | 5.40 | <1.0 | 5.00 | 91.00 | 6.00 | 320.00 | 1.09 | 0.00 | 0.22 | 0.53 | 0.02 | 0.36 | 3.20 | 0.19 | 0.12 | <1.0 |
| 10.10.2016 09:16 | 37.84 | 6.28 | 1.83 | 0.73 | 1.39 | 4.90 | 1.00 | 5.00 | 100.00 | 13.00 | 340.00 | 1.13 | 0.00 | 0.20 | 0.42 | 0.02 | 0.31 | 2.80 | 0.18 | 0.09 | 2.00 |
| Avg. | 103.39 | 6.24 | 2.07 | 0.66 | 1.44 | 4.35 | 0.50 | 4.75 | 102.75 | 12.00 | 312.50 | 1.27 | 0.00 | 0.17 | 0.44 | 0.02 | 0.33 | 3.80 | 0.17 | 0.10 | 1.00 |
| Minimum | 37.84 | 5.89 | 1.76 | 0.58 | 0.98 | 3.40 | 1.00 | 4.00 | 91.00 | 6.00 | 280.00 | 1.09 | 0.00 | 0.13 | 0.38 | 0.02 | 0.28 | 2.80 | 0.09 | 0.08 | 1.00 |
| Maximum | 167.18 | 6.54 | 2.59 | 0.73 | 1.76 | 5.40 | 1.00 | 5.00 | 110.00 | 17.00 | 340.00 | 1.56 | 0.00 | 0.22 | 0.53 | 0.03 | 0.36 | 5.30 | 0.22 | 0.12 | 2.00 |
| More than 70%LOD | yes | yes | yes | yes | yes | yes | no | yes | yes | yes | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | no |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 62.09 | 0.27 | 0.38 | 0.07 | 0.35 | 0.95 | 0.00 | 0.50 | 9.14 | 4.55 | 25.00 | 0.22 | 0.00 | 0.04 | 0.06 | 0.01 | 0.04 | 1.10 | 0.06 | 0.02 | 0.58 |

Lyngdalselva

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 07.02.2016 16:45 | 64.48 | 6.19 | 3.61 | 1.00 | 1.71 | 3.20 | 2.00 | 6.00 | 150.00 | 13.00 | 315.00 | 1.43 | <0.002 | 0.15 | 0.46 | 0.04 | 0.23 | 6.30 | 0.16 | 0.05 | 2.00 |
| 10.05.2016 14:10 | 42.97 | 6.59 | 2.66 | 0.58 | 1.18 | 3.30 | 1.00 | 5.00 | 140.00 | 7.00 | 320.00 | 1.37 | 0.00 | 0.15 | 0.41 | 0.02 | 0.20 | 3.60 | 0.06 | 0.06 | <1.0 |
| 15.08.2016 09:45 | 26.48 | 6.20 | 2.23 | 0.48 | 1.86 | 4.70 | <1.0 | 6.00 | 150.00 | <2.0 | 355.00 | 1.34 | <0.002 | 0.25 | 0.47 | 0.02 | 0.25 | 3.60 | 0.14 | 0.07 | <1.0 |
| 10.10.2016 10:50 | 15.75 | 6.33 | 2.63 | 0.43 | 1.14 | 4.60 | 1.00 | 4.00 | 220.00 | <2.0 | 425.00 | 1.78 | 0.01 | 0.18 | 0.35 | 0.02 | 0.32 | 4.40 | 0.27 | 0.06 | <1.0 |
| Avg. | 37.42 | 6.33 | 2.78 | 0.62 | 1.47 | 3.95 | 1.00 | 5.25 | 165.00 | 5.00 | 353.75 | 1.48 | 0.00 | 0.18 | 0.42 | 0.03 | 0.25 | 4.47 | 0.16 | 0.06 | 0.50 |
| Minimum | 15.75 | 6.19 | 2.23 | 0.43 | 1.14 | 3.20 | 1.00 | 4.00 | 140.00 | 2.00 | 315.00 | 1.34 | 0.00 | 0.15 | 0.35 | 0.02 | 0.20 | 3.60 | 0.06 | 0.05 | 1.00 |
| Maximum | 64.48 | 6.59 | 3.61 | 1.00 | 1.86 | 4.70 | 2.00 | 6.00 | 220.00 | 13.00 | 425.00 | 1.78 | 0.01 | 0.25 | 0.47 | 0.04 | 0.32 | 6.30 | 0.27 | 0.07 | 2.00 |
| More than 70%LOD | yes | yes | yes | yes | yes | yes | yes | yes | yes | no | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | no |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 21.23 | 0.19 | 0.59 | 0.26 | 0.37 | 0.81 | 0.50 | 0.96 | 36.97 | 5.23 | 50.72 | 0.20 | 0.00 | 0.05 | 0.06 | 0.01 | 0.05 | 1.27 | 0.09 | 0.01 | 0.50 |

Kvina

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 07.02.2016 12:20 | 123.84 | 6.16 | 3.74 | 1.40 | 8.11 | 3.10 | 7.00 | 13.00 | 140.00 | 13.00 | 315.00 | 1.44 | <0.002 | 0.12 | 0.61 | 0.04 | 0.44 | 6.40 | 0.17 | 0.06 | 1.00 |
| 10.05.2016 12:25 | 98.67 | 6.48 | 2.71 | 0.54 | 1.17 | 3.40 | 1.00 | 6.00 | 140.00 | 11.00 | 370.00 | 0.69 | 0.00 | 0.15 | 0.38 | 0.02 | 0.70 | 5.10 | 0.11 | 0.04 | <1.0 |
| 15.08.2016 10:40 | 54.71 | 5.95 | 2.20 | 0.87 | 3.84 | 7.40 | 2.00 | 9.00 | 91.00 | <2.0 | 375.00 | 1.24 | 0.01 | 0.33 | 0.75 | 0.02 | 1.09 | 4.20 | 0.27 | 0.11 | 1.00 |
| 10.10.2016 11:45 | 34.43 | 6.26 | 2.95 | 0.55 | 1.19 | 6.40 | 4.00 | 9.00 | 170.00 | <2.0 | 440.00 | 1.73 | 0.00 | 0.25 | 0.63 | 0.03 | 0.99 | 4.80 | 0.19 | 0.11 | 2.00 |
| Avg. | 77.91 | 6.21 | 2.90 | 0.84 | 3.58 | 5.08 | 3.50 | 9.25 | 135.25 | 6.00 | 375.00 | 1.28 | 0.00 | 0.21 | 0.59 | 0.03 | 0.80 | 5.12 | 0.18 | 0.08 | 1.00 |
| Minimum | 34.43 | 5.95 | 2.20 | 0.54 | 1.17 | 3.10 | 1.00 | 6.00 | 91.00 | 2.00 | 315.00 | 0.69 | 0.00 | 0.12 | 0.38 | 0.02 | 0.44 | 4.20 | 0.11 | 0.04 | 1.00 |
| Maximum | 123.84 | 6.48 | 3.74 | 1.40 | 8.11 | 7.40 | 7.00 | 13.00 | 170.00 | 13.00 | 440.00 | 1.73 | 0.01 | 0.33 | 0.75 | 0.04 | 1.09 | 6.40 | 0.27 | 0.11 | 2.00 |
| More than 70%LOD | yes | yes | yes | yes | yes | yes | yes | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 40.70 | 0.22 | 0.64 | 0.40 | 3.27 | 2.15 | 2.65 | 2.87 | 32.71 | 5.83 | 51.15 | 0.44 | 0.00 | 0.10 | 0.16 | 0.01 | 0.29 | 0.93 | 0.07 | 0.04 | 0.50 |

Sira

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 09.02.2016 08:05 | 463.61 | 5.71 | 1.78 | 0.39 | 0.51 | 2.00 | <1.0 | 3.00 | 78.00 | 16.00 | 190.00 | 0.87 | <0.002 | 0.08 | 0.26 | 0.01 | 0.22 | 2.40 | 0.09 | 0.05 | 2.00 |
| 10.05.2016 05:38 | 174.85 | 5.44 | 1.71 | <0.3 | 0.53 | 1.40 | <1.0 | 6.00 | 82.00 | 15.00 | 205.00 | 0.90 | <0.002 | 0.07 | 0.26 | 0.01 | 0.22 | 2.70 | 0.06 | 0.04 | <1.0 |
| 02.08.2016 05:00 | 154.31 | 5.61 | 1.48 | <0.3 | 0.57 | 1.80 | <1.0 | 3.00 | 82.00 | 7.00 | 215.00 | 0.71 | <0.002 | 0.08 | 0.26 | 0.01 | 0.19 | 1.80 | 0.07 | 0.08 | 2.00 |
| 17.10.2016 10:00 | 50.84 | nan | 2.58 | 0.37 | 0.62 | 2.60 | <1.0 | 4.00 | nan | 19.00 | nan | 0.78 | <0.002 | 0.12 | 0.33 | 0.01 | 0.24 | 2.20 | 0.11 | 0.10 | 1.00 |
| Avg. | 210.90 | nan | 1.89 | 0.19 | 0.56 | 1.95 | 0.00 | 4.00 | nan | 14.25 | nan | 0.81 | 0.00 | 0.09 | 0.28 | 0.01 | 0.22 | 2.27 | 0.08 | 0.07 | 1.25 |
| Minimum | 50.84 | 5.44 | 1.48 | 0.30 | 0.51 | 1.40 | 1.00 | 3.00 | 78.00 | 7.00 | 190.00 | 0.71 | 0.00 | 0.07 | 0.26 | 0.01 | 0.19 | 1.80 | 0.06 | 0.04 | 1.00 |
| Maximum | 463.61 | 5.71 | 2.58 | 0.39 | 0.62 | 2.60 | 1.00 | 6.00 | 82.00 | 19.00 | 215.00 | 0.90 | 0.00 | 0.12 | 0.33 | 0.01 | 0.24 | 2.70 | 0.11 | 0.10 | 2.00 |
| More than 70%LOD | yes | yes | yes | no | yes | yes | no | yes | yes | yes | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | yes |
| n | 4.00 | 3.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 3.00 | 4.00 | 3.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 177.00 | 0.14 | 0.48 | 0.05 | 0.05 | 0.50 | 0.00 | 1.41 | 2.31 | 5.12 | 12.58 | 0.09 | 0.00 | 0.02 | 0.04 | 0.00 | 0.02 | 0.38 | 0.02 | 0.03 | 0.58 |

Bjerkreimselva

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 01.02.2016 10:00 | 101.37 | 6.61 | 4.22 | <0.3 | 0.46 | 1.40 | 2.00 | 4.00 | 330.00 | 10.00 | 465.00 | 1.47 | <0.002 | 0.09 | 0.18 | 0.02 | 0.22 | 3.00 | 0.17 | 0.06 | 1.00 |
| 03.05.2016 08:35 | 63.38 | 6.56 | 3.81 | 0.56 | 0.76 | 1.60 | 3.00 | 8.00 | 390.00 | 14.00 | 560.00 | 1.40 | <0.002 | 0.11 | 0.20 | 0.02 | 0.40 | 3.30 | 0.25 | 0.04 | <1.0 |
| 01.08.2016 07:15 | 55.77 | 6.50 | 3.32 | 0.46 | 0.64 | 2.00 | 1.00 | 6.00 | 290.00 | <2.0 | 465.00 | 1.31 | <0.002 | 0.09 | 0.16 | 0.02 | 0.29 | 2.30 | 0.19 | 0.10 | 2.00 |
| 04.10.2016 08:00 | 45.92 | 6.51 | 3.21 | 0.38 | 0.43 | 2.10 | <1.0 | 4.00 | 290.00 | <2.0 | 450.00 | 1.27 | <0.002 | 0.10 | 0.15 | 0.02 | 0.31 | 2.50 | 0.35 | 0.05 | <1.0 |
| Avg. | 66.61 | 6.54 | 3.64 | 0.35 | 0.57 | 1.77 | 1.50 | 5.50 | 325.00 | 6.00 | 485.00 | 1.36 | 0.00 | 0.09 | 0.17 | 0.02 | 0.30 | 2.77 | 0.24 | 0.06 | 0.75 |
| Minimum | 45.92 | 6.50 | 3.21 | 0.30 | 0.43 | 1.40 | 1.00 | 4.00 | 290.00 | 2.00 | 450.00 | 1.27 | 0.00 | 0.09 | 0.15 | 0.02 | 0.22 | 2.30 | 0.17 | 0.04 | 1.00 |
| Maximum | 101.37 | 6.61 | 4.22 | 0.56 | 0.76 | 2.10 | 3.00 | 8.00 | 390.00 | 14.00 | 560.00 | 1.47 | 0.00 | 0.11 | 0.20 | 0.02 | 0.40 | 3.30 | 0.35 | 0.10 | 2.00 |
| More than 70%LOD | yes | yes | yes | yes | yes | yes | yes | yes | yes | no | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | no |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 24.25 | 0.05 | 0.47 | 0.11 | 0.16 | 0.33 | 0.96 | 1.91 | 47.26 | 6.00 | 50.50 | 0.09 | 0.00 | 0.01 | 0.02 | 0.00 | 0.07 | 0.46 | 0.08 | 0.02 | 0.50 |

Figgjoelva

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 02.02.2016 10:00 | 9.76 | 7.22 | 11.60 | 5.70 | 8.43 | 3.20 | 24.00 | 43.00 | 1000.00 | 23.00 | 1390.00 | 3.49 | <0.002 | 0.22 | 0.88 | 0.02 | 1.36 | 8.00 | 0.62 | 0.31 | 1.00 |
| 03.05.2016 07:00 | 6.65 | 7.32 | 17.30 | 9.20 | 11.90 | 6.30 | 76.00 | 120.00 | 3300.00 | 490.00 | 4200.00 | 3.66 | 0.00 | 0.34 | 1.15 | 0.03 | 2.51 | 8.80 | 1.07 | 0.42 | <1.0 |
| 02.08.2016 11:15 | 10.20 | 7.18 | 8.80 | 2.00 | 4.16 | 4.60 | 12.00 | 35.00 | 790.00 | 19.00 | 1250.00 | 2.05 | <0.002 | 0.16 | 0.74 | 0.02 | 1.31 | 5.10 | 0.51 | 0.24 | 2.00 |
| 04.10.2016 12:00 | 6.47 | 7.43 | 10.90 | 9.50 | 28.90 | 4.70 | 36.00 | 65.00 | 780.00 | 12.00 | 1390.00 | 2.83 | <0.002 | 0.28 | 2.62 | 0.04 | 4.62 | 33.40 | 0.91 | 0.55 | <1.0 |
| Avg. | 8.27 | 7.29 | 12.15 | 6.60 | 13.35 | 4.70 | 37.00 | 65.75 | 1467.50 | 136.00 | 2057.50 | 3.01 | 0.00 | 0.25 | 1.35 | 0.03 | 2.45 | 13.82 | 0.78 | 0.38 | 0.75 |
| Minimum | 6.47 | 7.18 | 8.80 | 2.00 | 4.16 | 3.20 | 12.00 | 35.00 | 780.00 | 12.00 | 1250.00 | 2.05 | 0.00 | 0.16 | 0.74 | 0.02 | 1.31 | 5.10 | 0.51 | 0.24 | 1.00 |
| Maximum | 10.20 | 7.43 | 17.30 | 9.50 | 28.90 | 6.30 | 76.00 | 120.00 | 3300.00 | 490.00 | 4200.00 | 3.66 | 0.00 | 0.34 | 2.62 | 0.04 | 4.62 | 33.40 | 1.07 | 0.55 | 2.00 |
| More than 70%LOD | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | no |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 1.98 | 0.11 | 3.63 | 3.52 | 10.84 | 1.27 | 27.78 | 38.33 | 1225.87 | 236.04 | 1429.86 | 0.73 | 0.00 | 0.08 | 0.86 | 0.01 | 1.55 | 13.15 | 0.26 | 0.14 | 0.50 |

Lyseelva

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 08.05.2016 11:00 | 13.19 | 6.20 | 2.25 | <0.3 | 0.50 | 0.82 | 2.00 | 4.00 | 140.00 | 3.00 | 235.00 | 0.98 | <0.002 | 0.05 | 0.16 | 0.01 | 0.33 | 2.40 | 0.06 | 0.04 | 3.00 |
| 07.08.2016 12:00 | 14.53 | 6.57 | 1.60 | <0.3 | <0.2 | 1.60 | <1.0 | 1.00 | 90.00 | <2.0 | 185.00 | 1.41 | <0.002 | 0.05 | 0.16 | 0.01 | 0.29 | 0.77 | 0.10 | 0.07 | <1.0 |
| 16.10.2016 00:00 | 5.94 | 6.90 | 3.27 | <0.3 | <0.2 | 0.72 | <1.0 | 2.00 | 280.00 | <2.0 | 355.00 | 2.61 | <0.002 | 0.03 | 0.06 | 0.01 | 0.18 | 1.70 | 0.08 | 0.07 | <1.0 |
| Avg. | 11.22 | 6.56 | 2.37 | 0.00 | 0.17 | 1.05 | 0.67 | 2.33 | 170.00 | 1.00 | 258.33 | 1.67 | 0.00 | 0.04 | 0.13 | 0.01 | 0.27 | 1.62 | 0.08 | 0.06 | 1.00 |
| Minimum | 5.94 | 6.20 | 1.60 | 0.30 | 0.20 | 0.72 | 1.00 | 1.00 | 90.00 | 2.00 | 185.00 | 0.98 | 0.00 | 0.03 | 0.06 | 0.01 | 0.18 | 0.77 | 0.06 | 0.04 | 1.00 |
| Maximum | 14.53 | 6.90 | 3.27 | 0.30 | 0.50 | 1.60 | 2.00 | 4.00 | 280.00 | 3.00 | 355.00 | 2.61 | 0.00 | 0.05 | 0.16 | 0.01 | 0.33 | 2.40 | 0.10 | 0.07 | 3.00 |
| More than 70%LOD | yes | yes | yes | no | no | yes | no | yes | yes | no | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | no |
| n | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 |
| St.dev | 4.62 | 0.35 | 0.84 | 0.00 | 0.17 | 0.48 | 0.58 | 1.53 | 98.49 | 0.58 | 87.37 | 0.85 | 0.00 | 0.01 | 0.06 | 0.00 | 0.08 | 0.82 | 0.02 | 0.02 | 1.15 |

Årdalselva

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 15.02.2016 10:00 | 62.97 | 6.30 | 3.00 | <0.3 | 0.25 | 0.77 | <1.0 | 1.00 | 220.00 | <2.0 | 310.00 | 1.64 | 0.00 | 0.05 | 0.09 | 0.01 | 0.25 | 2.00 | 0.12 | 0.04 | <1.0 |
| 10.05.2016 09:45 | 49.07 | 6.17 | 2.12 | <0.3 | 0.52 | 1.00 | <1.0 | 7.00 | 77.00 | <2.0 | 165.00 | 0.93 | <0.002 | 0.04 | 0.56 | 0.01 | 1.31 | 2.50 | 0.30 | 0.05 | <1.0 |
| 17.08.2016 09:00 | 56.76 | 6.20 | 2.05 | <0.3 | <0.4 | 1.70 | <1.0 | 2.00 | 160.00 | <2.0 | 260.00 | 1.16 | <0.002 | 0.07 | 0.14 | 0.01 | 0.18 | 1.30 | 0.08 | 0.06 | <1.0 |
| 17.10.2016 09:00 | 16.34 | 6.52 | 2.30 | <0.3 | <0.33 | 1.40 | <1.0 | 2.00 | 160.00 | <2.0 | 245.00 | 1.38 | <0.002 | 0.07 | 0.08 | 0.01 | 0.19 | 1.60 | 0.07 | 0.04 | <1.0 |
| Avg. | 46.29 | 6.30 | 2.37 | 0.00 | 0.19 | 1.22 | 0.00 | 3.00 | 154.25 | 0.00 | 245.00 | 1.28 | 0.00 | 0.06 | 0.22 | 0.01 | 0.48 | 1.85 | 0.14 | 0.05 | 0.00 |
| Minimum | 16.34 | 6.17 | 2.05 | 0.30 | 0.25 | 0.77 | 1.00 | 1.00 | 77.00 | 2.00 | 165.00 | 0.93 | 0.00 | 0.04 | 0.08 | 0.01 | 0.18 | 1.30 | 0.07 | 0.04 | 1.00 |
| Maximum | 62.97 | 6.52 | 3.00 | 0.30 | 0.52 | 1.70 | 1.00 | 7.00 | 220.00 | 2.00 | 310.00 | 1.64 | 0.00 | 0.07 | 0.56 | 0.01 | 1.31 | 2.50 | 0.30 | 0.06 | 1.00 |
| More than 70%LOD | yes | yes | yes | no | no | yes | no | yes | yes | no | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | no |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 20.76 | 0.16 | 0.43 | 0.00 | 0.11 | 0.41 | 0.00 | 2.71 | 58.76 | 0.00 | 60.14 | 0.31 | 0.00 | 0.02 | 0.23 | 0.00 | 0.55 | 0.52 | 0.11 | 0.01 | 0.00 |

Ulladalsåna (Ulla)

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 15.02.2016 12:10 | 34.75 | 6.31 | 3.86 | <0.3 | <0.4 | 0.73 | <1.0 | 1.00 | 130.00 | 2.00 | 195.00 | 2.04 | 0.01 | 0.05 | 0.05 | 0.02 | 0.92 | 2.90 | 0.39 | 0.03 | <1.0 |
| 10.05.2016 09:15 | 32.68 | 6.24 | 1.80 | <0.3 | 1.69 | 1.50 | <1.0 | 3.00 | 44.00 | <2.0 | 137.00 | 0.90 | <0.002 | 0.06 | 0.08 | 0.01 | 0.24 | 1.60 | 0.31 | 0.04 | <1.0 |
| 16.08.2016 12:00 | 46.17 | 6.62 | 1.98 | <0.3 | 0.41 | 3.00 | <1.0 | 3.00 | 64.00 | 5.00 | 245.00 | 1.54 | <0.002 | 0.11 | 0.14 | 0.01 | 0.62 | 2.50 | 0.55 | 0.08 | <1.0 |
| 17.10.2016 10:19 | 14.28 | 7.14 | 3.06 | <0.3 | <0.33 | 1.10 | <1.0 | 2.00 | 140.00 | 5.00 | 235.00 | 2.34 | <0.002 | 0.04 | 0.03 | 0.01 | 0.38 | 2.50 | 0.35 | 0.05 | <1.0 |
| Avg. | 31.97 | 6.58 | 2.68 | 0.00 | 0.53 | 1.58 | 0.00 | 2.25 | 94.50 | 3.00 | 203.00 | 1.70 | 0.00 | 0.06 | 0.08 | 0.01 | 0.54 | 2.38 | 0.40 | 0.05 | 0.00 |
| Minimum | 14.28 | 6.24 | 1.80 | 0.30 | 0.33 | 0.73 | 1.00 | 1.00 | 44.00 | 2.00 | 137.00 | 0.90 | 0.00 | 0.04 | 0.03 | 0.01 | 0.24 | 1.60 | 0.31 | 0.03 | 1.00 |
| Maximum | 46.17 | 7.14 | 3.86 | 0.30 | 1.69 | 3.00 | 1.00 | 3.00 | 140.00 | 5.00 | 245.00 | 2.34 | 0.01 | 0.11 | 0.14 | 0.02 | 0.92 | 2.90 | 0.55 | 0.08 | 1.00 |
| More than 70%LOD | yes | yes | yes | no | no | yes | no | yes | yes | yes | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | no |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 13.20 | 0.41 | 0.97 | 0.00 | 0.66 | 1.00 | 0.00 | 0.96 | 47.65 | 1.73 | 49.02 | 0.63 | 0.00 | 0.03 | 0.05 | 0.01 | 0.30 | 0.55 | 0.11 | 0.02 | 0.00 |

Suldalslågen

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 02.02.2016 10:30 | 274.80 | 6.37 | 4.09 | 3.50 | 11.56 | 1.50 | 11.00 | 16.00 | 180.00 | 5.00 | 320.00 | 1.30 | <0.002 | 0.11 | 0.41 | 0.03 | 0.74 | 7.40 | 0.37 | 0.20 | 2.00 |
| 10.05.2016 08:30 | 127.34 | 6.43 | 1.66 | 0.60 | 0.98 | 0.55 | 1.00 | 7.00 | 95.00 | 4.00 | 170.00 | 0.78 | <0.002 | 0.06 | 0.10 | 0.01 | 0.23 | 1.40 | 0.13 | 0.05 | <1.0 |
| 01.08.2016 08:30 | 153.75 | 6.24 | 1.48 | 1.20 | 1.90 | 3.40 | 2.00 | 6.00 | 88.00 | <2.0 | 235.00 | 1.12 | <0.002 | 0.11 | 0.26 | 0.01 | 0.53 | 3.00 | 0.20 | 0.15 | 3.00 |
| 04.10.2016 09:00 | 180.99 | 6.48 | 1.71 | <0.3 | 0.52 | 1.60 | <1.0 | 2.00 | 150.00 | <2.0 | 250.00 | 0.92 | <0.002 | 0.04 | 0.08 | 0.01 | 0.23 | 1.40 | 0.19 | 0.05 | <1.0 |
| Avg. | 184.22 | 6.38 | 2.24 | 1.32 | 3.74 | 1.76 | 3.50 | 7.75 | 128.25 | 2.25 | 243.75 | 1.03 | 0.00 | 0.08 | 0.21 | 0.02 | 0.43 | 3.30 | 0.22 | 0.11 | 1.25 |
| Minimum | 127.34 | 6.24 | 1.48 | 0.30 | 0.52 | 0.55 | 1.00 | 2.00 | 88.00 | 2.00 | 170.00 | 0.78 | 0.00 | 0.04 | 0.08 | 0.01 | 0.23 | 1.40 | 0.13 | 0.05 | 1.00 |
| Maximum | 274.80 | 6.48 | 4.09 | 3.50 | 11.56 | 3.40 | 11.00 | 16.00 | 180.00 | 5.00 | 320.00 | 1.30 | 0.00 | 0.11 | 0.41 | 0.03 | 0.74 | 7.40 | 0.37 | 0.20 | 3.00 |
| More than 70%LOD | yes | yes | yes | yes | yes | yes | yes | yes | yes | no | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | no |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 64.23 | 0.10 | 1.24 | 1.45 | 5.24 | 1.19 | 4.86 | 5.91 | 44.26 | 1.50 | 61.56 | 0.23 | 0.00 | 0.04 | 0.15 | 0.01 | 0.25 | 2.84 | 0.10 | 0.07 | 0.96 |

Saudaelva

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 23.02.2016 13:00 | 33.30 | 6.60 | 3.32 | <0.3 | <0.4 | 0.51 | <1.0 | 1.00 | 600.00 | 3.00 | 695.00 | 1.61 | <0.002 | 0.11 | 0.04 | 0.06 | 0.80 | **23.60** | 0.18 | 0.05 | <1.0 |
| 24.05.2016 09:20 | 53.04 | 6.17 | 1.93 | <0.3 | 0.32 | 1.60 | <1.0 | 1.00 | 280.00 | <2.0 | 410.00 | 1.08 | <0.002 | 0.05 | 0.08 | 0.05 | 1.01 | **16.20** | 0.06 | <0.025 | <1.0 |
| 29.08.2016 07:00 | 19.28 | 6.46 | 2.39 | <0.3 | 0.27 | 1.20 | <1.0 | 2.00 | 210.00 | <2.0 | 335.00 | 0.92 | <0.002 | 0.11 | 0.08 | 0.04 | 1.00 | **16.60** | 0.13 | 0.07 | <1.0 |
| 25.10.2016 12:30 | 9.84 | 6.58 | 2.32 | <0.3 | <0.5 | 0.68 | <1.0 | 1.00 | 460.00 | <2.0 | 525.00 | 1.25 | 0.01 | 0.12 | 0.04 | 0.07 | 0.93 | **28.80** | 0.13 | <0.025 | <1.0 |
| Avg. | 28.87 | 6.45 | 2.49 | 0.00 | 0.15 | 1.00 | 0.00 | 1.25 | 387.50 | 0.75 | 491.25 | 1.21 | 0.00 | 0.10 | 0.06 | 0.06 | 0.94 | **21.30** | 0.12 | 0.03 | 0.00 |
| Minimum | 9.84 | 6.17 | 1.93 | 0.30 | 0.27 | 0.51 | 1.00 | 1.00 | 210.00 | 2.00 | 335.00 | 0.92 | 0.00 | 0.05 | 0.04 | 0.04 | 0.80 | 16.20 | 0.06 | 0.03 | 1.00 |
| Maximum | 53.04 | 6.60 | 3.32 | 0.30 | 0.50 | 1.60 | 1.00 | 2.00 | 600.00 | 3.00 | 695.00 | 1.61 | 0.01 | 0.12 | 0.08 | 0.07 | 1.01 | 28.80 | 0.18 | 0.07 | 1.00 |
| More than 70%LOD | yes | yes | yes | no | no | yes | no | yes | yes | no | yes | yes | no | yes | yes | yes | yes | yes | yes | no | no |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 18.78 | 0.20 | 0.59 | 0.00 | 0.10 | 0.50 | 0.00 | 0.50 | 176.52 | 0.50 | 156.70 | 0.30 | 0.00 | 0.03 | 0.02 | 0.01 | 0.10 | 6.05 | 0.05 | 0.02 | 0.00 |

Vikedalselva

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 01.02.2016 11:15 | 21.88 | 6.57 | 2.93 | 1.00 | 0.80 | 0.95 | 1.00 | 3.00 | 200.00 | 9.00 | 305.00 | 0.84 | <0.002 | 0.15 | 0.14 | 0.02 | 0.33 | 2.30 | 0.34 | 0.04 | 1.00 |
| 09.05.2016 08:00 | 6.80 | 6.56 | 2.51 | <0.3 | 0.82 | 0.95 | <1.0 | 5.00 | 140.00 | 4.00 | 250.00 | 0.77 | <0.002 | 0.10 | 0.16 | 0.01 | 0.32 | 2.00 | 0.28 | 0.03 | <1.0 |
| 08.08.2016 10:00 | 10.71 | 6.48 | 2.26 | 0.49 | 1.90 | 3.10 | 2.00 | 6.00 | 200.00 | <2.0 | 380.00 | 0.72 | <0.002 | 0.27 | 0.36 | 0.02 | 0.66 | 2.30 | 0.43 | 0.09 | <1.0 |
| 17.10.2016 09:00 | 3.88 | 7.14 | 4.52 | 2.00 | 3.16 | 1.40 | <1.0 | 3.00 | 340.00 | 120.00 | 585.00 | 2.03 | <0.002 | nan | 0.05 | 0.01 | 0.48 | 2.40 | 0.63 | 0.05 | <1.0 |
| Avg. | 10.82 | 6.69 | 3.05 | 0.87 | 1.67 | 1.60 | 0.75 | 4.25 | 220.00 | 33.25 | 380.00 | 1.09 | 0.00 | nan | 0.18 | 0.02 | 0.45 | 2.25 | 0.42 | 0.05 | 0.25 |
| Minimum | 3.88 | 6.48 | 2.26 | 0.30 | 0.80 | 0.95 | 1.00 | 3.00 | 140.00 | 2.00 | 250.00 | 0.72 | 0.00 | 0.10 | 0.05 | 0.01 | 0.32 | 2.00 | 0.28 | 0.03 | 1.00 |
| Maximum | 21.88 | 7.14 | 4.52 | 2.00 | 3.16 | 3.10 | 2.00 | 6.00 | 340.00 | 120.00 | 585.00 | 2.03 | 0.00 | 0.27 | 0.36 | 0.02 | 0.66 | 2.40 | 0.63 | 0.09 | 1.00 |
| More than 70%LOD | yes | yes | yes | yes | yes | yes | no | yes | yes | yes | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | no |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 3.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 7.89 | 0.30 | 1.02 | 0.76 | 1.12 | 1.02 | 0.50 | 1.50 | 84.85 | 57.58 | 146.69 | 0.63 | 0.00 | 0.09 | 0.13 | 0.00 | 0.16 | 0.17 | 0.15 | 0.02 | 0.00 |

Jostedøla

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 09.02.2016 13:00 | 32.05 | 6.80 | 4.98 | 0.62 | 0.82 | 1.40 | 3.00 | 5.00 | 210.00 | <2.0 | 320.00 | 3.28 | <0.002 | 0.07 | 0.05 | 0.00 | 0.53 | 1.20 | 0.14 | 0.04 | 1.00 |
| 10.05.2016 13:00 | 63.72 | 6.63 | 1.75 | 1.50 | 2.89 | 1.50 | 8.00 | 10.00 | 100.00 | <2.0 | 215.00 | 2.44 | <0.002 | 0.05 | 0.06 | 0.00 | 0.47 | 1.00 | 0.19 | 0.09 | <1.0 |
| 09.08.2016 11:30 | 130.93 | 6.43 | <1.0 | 12.00 | 38.99 | 0.75 | 49.00 | 50.00 | 12.00 | <2.0 | 68.00 | 3.88 | 0.00 | 0.09 | 0.52 | 0.00 | 1.44 | 4.70 | 1.37 | 1.74 | <1.0 |
| 04.10.2016 00:00 | 114.36 | 6.83 | 1.93 | 2.30 | 2.39 | 0.93 | 3.00 | 4.00 | 98.00 | <2.0 | 175.00 | 2.51 | <0.002 | <0.025 | 0.07 | 0.00 | 0.46 | 0.71 | 0.17 | 0.10 | <1.0 |
| Avg. | 85.26 | 6.67 | 2.17 | 4.11 | 11.27 | 1.15 | 15.75 | 17.25 | 105.00 | 0.00 | 194.50 | 3.03 | 0.00 | 0.05 | 0.18 | 0.00 | 0.72 | 1.90 | 0.47 | 0.49 | 0.25 |
| Minimum | 32.05 | 6.43 | 1.00 | 0.62 | 0.82 | 0.75 | 3.00 | 4.00 | 12.00 | 2.00 | 68.00 | 2.44 | 0.00 | 0.03 | 0.05 | 0.00 | 0.46 | 0.71 | 0.14 | 0.04 | 1.00 |
| Maximum | 130.93 | 6.83 | 4.98 | 12.00 | 38.99 | 1.50 | 49.00 | 50.00 | 210.00 | 2.00 | 320.00 | 3.88 | 0.00 | 0.09 | 0.52 | 0.00 | 1.44 | 4.70 | 1.37 | 1.74 | 1.00 |
| More than 70%LOD | yes | yes | yes | yes | yes | yes | yes | yes | yes | no | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | no |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 45.56 | 0.18 | 1.76 | 5.31 | 18.50 | 0.36 | 22.29 | 21.99 | 81.13 | 0.00 | 104.17 | 0.68 | 0.00 | 0.03 | 0.23 | 0.00 | 0.48 | 1.88 | 0.60 | 0.83 | 0.00 |

Gaular

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 23.02.2016 13:30 | 44.16 | 5.93 | 3.54 | <0.3 | 0.37 | 1.30 | 2.00 | 4.00 | 160.00 | 4.00 | 260.00 | 1.32 | <0.002 | 0.04 | 0.04 | 0.01 | 0.25 | 2.90 | 0.21 | 0.04 | <1.0 |
| 31.05.2016 12:15 | 76.38 | 6.26 | 1.92 | 0.69 | 0.87 | 1.30 | <1.0 | 4.00 | 66.00 | <2.0 | 185.00 | 0.85 | <0.002 | <0.025 | 0.05 | 0.00 | 0.19 | 1.20 | 0.12 | <0.025 | <1.0 |
| 22.08.2016 12:15 | 41.21 | 6.19 | 1.35 | <0.3 | 0.62 | 1.40 | <1.0 | 5.00 | 36.00 | <2.0 | 150.00 | 0.72 | <0.002 | 0.04 | 0.04 | 0.00 | 0.23 | 0.66 | 0.09 | 0.04 | <1.0 |
| 07.11.2016 09:30 | 40.62 | 6.19 | 1.52 | <0.3 | 0.56 | 1.90 | 2.00 | 5.00 | 92.00 | 8.00 | 205.00 | 1.07 | <0.002 | 0.04 | 0.04 | 0.00 | 0.22 | 1.10 | 0.12 | 0.07 | <1.0 |
| Avg. | 50.59 | 6.14 | 2.08 | 0.17 | 0.60 | 1.48 | 1.00 | 4.50 | 88.50 | 3.00 | 200.00 | 0.99 | 0.00 | 0.03 | 0.04 | 0.01 | 0.22 | 1.46 | 0.14 | 0.04 | 0.00 |
| Minimum | 40.62 | 5.93 | 1.35 | 0.30 | 0.37 | 1.30 | 1.00 | 4.00 | 36.00 | 2.00 | 150.00 | 0.72 | 0.00 | 0.03 | 0.04 | 0.00 | 0.19 | 0.66 | 0.09 | 0.03 | 1.00 |
| Maximum | 76.38 | 6.26 | 3.54 | 0.69 | 0.87 | 1.90 | 2.00 | 5.00 | 160.00 | 8.00 | 260.00 | 1.32 | 0.00 | 0.04 | 0.05 | 0.01 | 0.25 | 2.90 | 0.21 | 0.07 | 1.00 |
| More than 70%LOD | yes | yes | yes | no | yes | yes | no | yes | yes | no | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | no |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 17.26 | 0.15 | 1.00 | 0.19 | 0.21 | 0.29 | 0.58 | 0.58 | 52.87 | 2.83 | 46.01 | 0.26 | 0.00 | 0.01 | 0.00 | 0.00 | 0.03 | 0.99 | 0.05 | 0.02 | 0.00 |

Jølstra

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 23.02.2016 11:30 | 68.08 | 6.22 | 2.38 | <0.3 | 0.44 | 0.99 | <1.0 | 4.00 | 140.00 | 3.00 | 240.00 | 1.21 | <0.002 | 0.04 | 0.03 | 0.01 | 0.24 | 1.80 | 0.10 | 0.03 | <1.0 |
| 31.05.2016 13:00 | 69.35 | 6.41 | 1.80 | 0.37 | 0.70 | 1.10 | 1.00 | 4.00 | 90.00 | <2.0 | 200.00 | 0.95 | <0.002 | 0.03 | 0.03 | 0.01 | 0.19 | 1.10 | 0.07 | <0.025 | 2.00 |
| 22.08.2016 10:15 | 40.34 | 6.37 | 1.61 | <0.3 | 0.50 | 1.10 | <1.0 | 3.00 | 82.00 | <2.0 | 195.00 | 0.85 | <0.002 | 0.03 | 0.03 | 0.00 | 0.21 | 0.97 | 0.10 | 0.03 | <1.0 |
| 07.11.2016 12:30 | 39.57 | 6.18 | 1.81 | 0.49 | 0.86 | 1.50 | 2.00 | 5.00 | 120.00 | 8.00 | 240.00 | 1.19 | <0.002 | 0.03 | 0.03 | 0.00 | 0.23 | 1.20 | 0.13 | 0.04 | <1.0 |
| Avg. | 54.33 | 6.29 | 1.90 | 0.21 | 0.62 | 1.17 | 0.75 | 4.00 | 108.00 | 2.75 | 218.75 | 1.05 | 0.00 | 0.03 | 0.03 | 0.01 | 0.22 | 1.27 | 0.10 | 0.02 | 0.50 |
| Minimum | 39.57 | 6.18 | 1.61 | 0.30 | 0.44 | 0.99 | 1.00 | 3.00 | 82.00 | 2.00 | 195.00 | 0.85 | 0.00 | 0.03 | 0.03 | 0.00 | 0.19 | 0.97 | 0.07 | 0.03 | 1.00 |
| Maximum | 69.35 | 6.41 | 2.38 | 0.49 | 0.86 | 1.50 | 2.00 | 5.00 | 140.00 | 8.00 | 240.00 | 1.21 | 0.00 | 0.04 | 0.03 | 0.01 | 0.24 | 1.80 | 0.13 | 0.04 | 2.00 |
| More than 70%LOD | yes | yes | yes | no | yes | yes | no | yes | yes | no | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | no |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 16.62 | 0.11 | 0.33 | 0.09 | 0.19 | 0.22 | 0.50 | 0.82 | 26.88 | 2.87 | 24.62 | 0.18 | 0.00 | 0.01 | 0.00 | 0.00 | 0.02 | 0.37 | 0.02 | 0.00 | 0.50 |

Nausta

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 23.02.2016 12:30 | 26.21 | 6.21 | 3.79 | <0.3 | 0.34 | 0.96 | 2.00 | 4.00 | 160.00 | 3.00 | 245.00 | 1.61 | <0.002 | 0.04 | 0.03 | 0.01 | 0.21 | 2.60 | 0.19 | 0.03 | <1.0 |
| 31.05.2016 11:20 | 26.70 | 6.06 | 1.69 | 0.43 | 2.09 | 1.30 | 2.00 | 5.00 | 41.00 | <2.0 | 145.00 | 0.73 | <0.002 | <0.025 | 0.13 | 0.01 | 0.19 | 1.30 | 0.09 | 0.05 | <1.0 |
| 22.08.2016 11:15 | 15.53 | 6.39 | 1.26 | <0.3 | 0.37 | 1.60 | 1.00 | 5.00 | 42.00 | <2.0 | 170.00 | 0.65 | <0.002 | 0.04 | 0.04 | <0.003 | 0.23 | 1.30 | 0.15 | 0.04 | <1.0 |
| 07.11.2016 13:40 | 15.24 | 6.33 | 1.68 | <0.3 | <0.2 | 1.60 | 1.00 | 3.00 | 120.00 | 2.00 | 225.00 | 1.41 | <0.002 | 0.03 | 0.03 | <0.003 | 0.17 | 0.93 | 0.09 | 0.04 | 1.00 |
| Avg. | 20.92 | 6.25 | 2.10 | 0.11 | 0.70 | 1.36 | 1.50 | 4.25 | 90.75 | 1.25 | 196.25 | 1.10 | 0.00 | 0.03 | 0.06 | 0.00 | 0.20 | 1.53 | 0.13 | 0.04 | 0.25 |
| Minimum | 15.24 | 6.06 | 1.26 | 0.30 | 0.20 | 0.96 | 1.00 | 3.00 | 41.00 | 2.00 | 145.00 | 0.65 | 0.00 | 0.03 | 0.03 | 0.00 | 0.17 | 0.93 | 0.09 | 0.03 | 1.00 |
| Maximum | 26.70 | 6.39 | 3.79 | 0.43 | 2.09 | 1.60 | 2.00 | 5.00 | 160.00 | 3.00 | 245.00 | 1.61 | 0.00 | 0.04 | 0.13 | 0.01 | 0.23 | 2.60 | 0.19 | 0.05 | 1.00 |
| More than 70%LOD | yes | yes | yes | no | yes | yes | yes | yes | yes | no | yes | yes | no | yes | yes | no | yes | yes | yes | yes | no |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 6.40 | 0.15 | 1.14 | 0.07 | 0.90 | 0.30 | 0.58 | 0.96 | 59.17 | 0.50 | 46.61 | 0.48 | 0.00 | 0.01 | 0.05 | 0.00 | 0.03 | 0.73 | 0.05 | 0.01 | 0.00 |

Gloppenelva(Breimselva)

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 23.02.2016 09:30 | 30.11 | 6.51 | 2.19 | 0.53 | 0.72 | 0.97 | 2.00 | 4.00 | 230.00 | 3.00 | 325.00 | 1.67 | <0.002 | 0.04 | 0.02 | <0.003 | 0.32 | 0.95 | 0.14 | 0.06 | <1.0 |
| 31.05.2016 09:00 | 71.27 | 6.74 | 2.11 | 0.38 | 1.25 | 0.93 | 2.00 | 5.00 | 170.00 | 2.00 | 290.00 | 1.56 | <0.002 | 0.06 | 0.02 | <0.003 | 0.28 | 0.70 | 0.15 | 0.06 | <1.0 |
| 22.08.2016 08:45 | 52.15 | 6.67 | <1.0 | <0.3 | 1.62 | 0.75 | <1.0 | 4.00 | 81.00 | 4.00 | 180.00 | 1.18 | <0.002 | 0.03 | 0.02 | <0.003 | 0.26 | 0.47 | 0.11 | 0.05 | <1.0 |
| 22.11.2016 09:30 | 26.69 | 6.56 | 1.76 | <0.3 | 0.37 | 0.97 | 1.00 | 3.00 | 180.00 | 6.00 | 270.00 | 1.47 | <0.002 | <0.025 | 0.01 | <0.003 | 0.25 | 0.52 | 0.11 | 0.03 | <1.0 |
| Avg. | 45.06 | 6.62 | 1.51 | 0.23 | 0.99 | 0.91 | 1.25 | 4.00 | 165.25 | 3.75 | 266.25 | 1.47 | 0.00 | 0.03 | 0.02 | 0.00 | 0.28 | 0.66 | 0.13 | 0.05 | 0.00 |
| Minimum | 26.69 | 6.51 | 1.00 | 0.30 | 0.37 | 0.75 | 1.00 | 3.00 | 81.00 | 2.00 | 180.00 | 1.18 | 0.00 | 0.03 | 0.01 | 0.00 | 0.25 | 0.47 | 0.11 | 0.03 | 1.00 |
| Maximum | 71.27 | 6.74 | 2.19 | 0.53 | 1.62 | 0.97 | 2.00 | 5.00 | 230.00 | 6.00 | 325.00 | 1.67 | 0.00 | 0.06 | 0.02 | 0.00 | 0.32 | 0.95 | 0.15 | 0.06 | 1.00 |
| More than 70%LOD | yes | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | yes | no | yes | yes | no | yes | yes | yes | yes | no |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 20.80 | 0.10 | 0.54 | 0.11 | 0.55 | 0.11 | 0.58 | 0.82 | 62.00 | 1.71 | 61.83 | 0.21 | 0.00 | 0.02 | 0.01 | 0.00 | 0.03 | 0.22 | 0.02 | 0.01 | 0.00 |

Driva

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 09.02.2016 10:00 | 60.02 | 7.29 | 4.23 | 1.80 | 1.32 | 0.92 | 1.00 | 2.00 | 240.00 | 2.00 | 330.00 | 3.92 | <0.002 | 0.04 | 0.02 | <0.003 | 0.55 | 0.30 | 0.27 | 0.27 | 2.00 |
| 06.06.2016 10:00 | 180.30 | 7.08 | 2.03 | 0.53 | 2.57 | 1.10 | 2.00 | 4.00 | 53.00 | <2.0 | 146.00 | 1.96 | <0.002 | 0.06 | 0.05 | <0.003 | 0.61 | 0.41 | 0.15 | 0.28 | <1.0 |
| 08.08.2016 11:00 | 62.41 | 7.24 | 2.79 | <0.3 | 0.90 | 1.10 | 1.00 | 2.00 | 39.00 | <2.0 | 121.00 | 2.53 | <0.002 | 0.03 | 0.01 | <0.003 | 0.52 | 0.20 | 0.13 | 0.12 | <1.0 |
| 31.10.2016 09:00 | 57.01 | 7.03 | 4.82 | <0.3 | <0.5 | 1.30 | <1.0 | 2.00 | 310.00 | 5.00 | 450.00 | 4.59 | <0.002 | 0.03 | 0.01 | <0.003 | 0.77 | 0.77 | 0.28 | 0.12 | <1.0 |
| Avg. | 89.93 | 7.16 | 3.47 | 0.58 | 1.20 | 1.10 | 1.00 | 2.50 | 160.50 | 1.75 | 261.75 | 3.25 | 0.00 | 0.04 | 0.03 | 0.00 | 0.61 | 0.42 | 0.21 | 0.20 | 0.50 |
| Minimum | 57.01 | 7.03 | 2.03 | 0.30 | 0.50 | 0.92 | 1.00 | 2.00 | 39.00 | 2.00 | 121.00 | 1.96 | 0.00 | 0.03 | 0.01 | 0.00 | 0.52 | 0.20 | 0.13 | 0.12 | 1.00 |
| Maximum | 180.30 | 7.29 | 4.82 | 1.80 | 2.57 | 1.30 | 2.00 | 4.00 | 310.00 | 5.00 | 450.00 | 4.59 | 0.00 | 0.06 | 0.05 | 0.00 | 0.77 | 0.77 | 0.28 | 0.28 | 2.00 |
| More than 70%LOD | yes | yes | yes | no | yes | yes | yes | yes | yes | no | yes | yes | no | yes | yes | no | yes | yes | yes | yes | no |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 60.29 | 0.12 | 1.28 | 0.72 | 0.90 | 0.16 | 0.50 | 1.00 | 135.39 | 1.50 | 156.32 | 1.21 | 0.00 | 0.02 | 0.02 | 0.00 | 0.11 | 0.25 | 0.08 | 0.09 | 0.50 |

Surna

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 03.02.2016 15:00 | 31.49 | 6.87 | 2.25 | 0.38 | 0.66 | 1.80 | <1.0 | 3.00 | 69.00 | 3.00 | 180.00 | 1.93 | <0.002 | <0.025 | 0.01 | <0.003 | 0.36 | 0.30 | 0.17 | 0.08 | <1.0 |
| 30.05.2016 08:30 | 94.49 | 6.77 | 1.75 | 0.84 | 2.04 | 1.90 | 1.00 | 6.00 | 22.00 | <2.0 | 129.00 | 1.20 | <0.002 | 0.04 | 0.03 | <0.003 | 0.45 | 0.35 | 0.23 | 0.15 | <1.0 |
| 11.08.2016 11:45 | 85.89 | 6.87 | 2.46 | 2.50 | 5.65 | 7.40 | 4.00 | 11.00 | 75.00 | <2.0 | 330.00 | 1.86 | <0.002 | 0.09 | 0.10 | 0.01 | 1.26 | 0.94 | 0.83 | 0.49 | <1.0 |
| 11.10.2016 15:00 | 23.71 | 7.01 | 2.11 | 0.52 | 1.02 | 2.20 | 1.00 | 3.00 | 81.00 | <2.0 | 180.00 | 1.53 | <0.002 | <0.025 | 0.02 | <0.003 | 0.37 | 0.23 | 0.21 | 0.12 | <1.0 |
| Avg. | 58.89 | 6.88 | 2.14 | 1.06 | 2.34 | 3.33 | 1.50 | 5.75 | 61.75 | 0.75 | 204.75 | 1.63 | 0.00 | 0.03 | 0.04 | 0.00 | 0.61 | 0.45 | 0.36 | 0.21 | 0.00 |
| Minimum | 23.71 | 6.77 | 1.75 | 0.38 | 0.66 | 1.80 | 1.00 | 3.00 | 22.00 | 2.00 | 129.00 | 1.20 | 0.00 | 0.03 | 0.01 | 0.00 | 0.36 | 0.23 | 0.17 | 0.08 | 1.00 |
| Maximum | 94.49 | 7.01 | 2.46 | 2.50 | 5.65 | 7.40 | 4.00 | 11.00 | 81.00 | 3.00 | 330.00 | 1.93 | 0.00 | 0.09 | 0.10 | 0.01 | 1.26 | 0.94 | 0.83 | 0.49 | 1.00 |
| More than 70%LOD | yes | yes | yes | yes | yes | yes | yes | yes | yes | no | yes | yes | no | no | yes | no | yes | yes | yes | yes | no |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 36.44 | 0.10 | 0.30 | 0.98 | 2.28 | 2.72 | 1.50 | 3.77 | 26.95 | 0.50 | 86.89 | 0.33 | 0.00 | 0.03 | 0.04 | 0.00 | 0.44 | 0.33 | 0.31 | 0.19 | 0.00 |

Gaula

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 08.02.2016 11:00 | 36.21 | 7.65 | 32.40 | 8.90 | 8.68 | 3.10 | 32.00 | 42.00 | 460.00 | 68.00 | 785.00 | 5.27 | <0.002 | 0.35 | 0.14 | 0.01 | 1.58 | 5.00 | 1.70 | 0.59 | 1.00 |
| 02.05.2016 12:45 | 104.48 | 7.20 | 8.49 | 2.90 | 8.62 | 6.50 | 6.00 | 11.00 | 98.00 | <2.0 | 350.00 | 3.24 | <0.002 | 0.21 | 0.17 | 0.01 | 1.45 | 2.40 | 1.85 | 0.78 | <1.0 |
| 01.08.2016 10:20 | 103.92 | 7.27 | 5.43 | 5.20 | 10.73 | 6.60 | 6.00 | 15.00 | 39.00 | <2.0 | 315.00 | 2.70 | <0.002 | 0.16 | 0.21 | 0.01 | 2.33 | 4.30 | 2.31 | 0.74 | 2.00 |
| 05.10.2016 08:30 | 48.85 | 7.76 | 31.70 | 1.10 | 1.32 | 3.80 | 2.00 | 3.00 | 95.00 | 22.00 | 310.00 | 3.77 | 0.00 | 0.16 | 0.06 | 0.01 | 1.10 | 2.00 | 1.23 | 0.21 | 2.00 |
| Avg. | 73.37 | 7.47 | 19.50 | 4.53 | 7.34 | 5.00 | 11.50 | 17.75 | 173.00 | 22.50 | 440.00 | 3.74 | 0.00 | 0.22 | 0.15 | 0.01 | 1.62 | 3.42 | 1.77 | 0.58 | 1.25 |
| Minimum | 36.21 | 7.20 | 5.43 | 1.10 | 1.32 | 3.10 | 2.00 | 3.00 | 39.00 | 2.00 | 310.00 | 2.70 | 0.00 | 0.16 | 0.06 | 0.01 | 1.10 | 2.00 | 1.23 | 0.21 | 1.00 |
| Maximum | 104.48 | 7.76 | 32.40 | 8.90 | 10.73 | 6.60 | 32.00 | 42.00 | 460.00 | 68.00 | 785.00 | 5.27 | 0.00 | 0.35 | 0.21 | 0.01 | 2.33 | 5.00 | 2.31 | 0.78 | 2.00 |
| More than 70%LOD | yes | yes | yes | yes | yes | yes | yes | yes | yes | no | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | yes |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 35.98 | 0.28 | 14.54 | 3.36 | 4.13 | 1.81 | 13.80 | 16.92 | 193.25 | 31.13 | 230.69 | 1.11 | 0.00 | 0.09 | 0.06 | 0.00 | 0.52 | 1.45 | 0.45 | 0.26 | 0.58 |

Nidelva(Tr.heim)

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 08.02.2016 13:00 | 46.59 | 7.24 | 3.97 | 1.30 | 1.07 | 2.60 | <1.0 | 4.00 | 100.00 | 8.00 | 240.00 | 1.95 | <0.002 | 0.07 | 0.03 | <0.003 | 0.73 | 0.59 | 0.73 | 0.19 | <1.0 |
| 02.05.2016 13:25 | 105.65 | 7.22 | 3.42 | 1.00 | 1.16 | 2.70 | 1.00 | 3.00 | 97.00 | <2.0 | 230.00 | 1.96 | <0.002 | 0.09 | 0.02 | <0.003 | 0.70 | 0.52 | 0.68 | 0.21 | <1.0 |
| 01.08.2016 11:20 | 94.33 | 7.22 | 3.12 | 1.00 | 1.48 | 2.50 | 1.00 | 4.00 | 41.00 | <2.0 | 175.00 | 1.73 | <0.002 | 0.07 | 0.03 | 0.00 | 0.71 | 0.48 | 0.68 | 0.24 | 2.00 |
| 05.10.2016 09:30 | 53.09 | 7.22 | 3.15 | <0.3 | 0.84 | 2.90 | <1.0 | 3.00 | 56.00 | 5.00 | 180.00 | 1.73 | <0.002 | 0.06 | 0.03 | <0.003 | 0.56 | 0.40 | 0.65 | 0.14 | <1.0 |
| Avg. | 74.91 | 7.22 | 3.42 | 0.82 | 1.14 | 2.68 | 0.50 | 3.50 | 73.50 | 3.25 | 206.25 | 1.84 | 0.00 | 0.07 | 0.03 | 0.00 | 0.67 | 0.50 | 0.69 | 0.20 | 0.50 |
| Minimum | 46.59 | 7.22 | 3.12 | 0.30 | 0.84 | 2.50 | 1.00 | 3.00 | 41.00 | 2.00 | 175.00 | 1.73 | 0.00 | 0.06 | 0.02 | 0.00 | 0.56 | 0.40 | 0.65 | 0.14 | 1.00 |
| Maximum | 105.65 | 7.24 | 3.97 | 1.30 | 1.48 | 2.90 | 1.00 | 4.00 | 100.00 | 8.00 | 240.00 | 1.96 | 0.00 | 0.09 | 0.03 | 0.00 | 0.73 | 0.59 | 0.73 | 0.24 | 2.00 |
| More than 70%LOD | yes | yes | yes | yes | yes | yes | no | yes | yes | no | yes | yes | no | yes | yes | no | yes | yes | yes | yes | no |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 29.44 | 0.01 | 0.39 | 0.42 | 0.27 | 0.17 | 0.00 | 0.58 | 29.54 | 2.87 | 33.51 | 0.13 | 0.00 | 0.01 | 0.00 | 0.00 | 0.08 | 0.08 | 0.03 | 0.04 | 0.50 |

Stjørdalselva

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 09.02.2016 09:20 | 61.76 | 7.25 | 5.20 | 7.90 | 7.52 | 3.90 | 15.00 | 21.00 | 370.00 | 12.00 | 600.00 | 2.83 | <0.002 | 0.16 | 0.15 | 0.01 | 1.34 | 2.10 | 0.90 | 0.74 | 2.00 |
| 03.05.2016 08:05 | 85.53 | 7.04 | 3.92 | 13.00 | 23.40 | 4.50 | 18.00 | 20.00 | 35.00 | <2.0 | 205.00 | 2.49 | <0.002 | 0.20 | 0.38 | 0.01 | 2.02 | 4.60 | 1.33 | 1.07 | <1.0 |
| 02.08.2016 08:00 | 57.06 | 7.04 | 2.74 | 6.40 | 15.20 | 7.80 | 9.00 | 15.00 | 32.00 | <2.0 | 310.00 | 2.07 | <0.002 | 0.14 | 0.28 | 0.01 | 2.49 | 4.80 | 1.44 | 0.90 | 2.00 |
| 05.10.2016 13:20 | 43.62 | 7.33 | 10.30 | 3.20 | 4.87 | 5.50 | 5.00 | 8.00 | 580.00 | <2.0 | 860.00 | 3.09 | 0.00 | 0.18 | 0.12 | 0.01 | 2.37 | 4.20 | 0.98 | 0.42 | <1.0 |
| Avg. | 61.99 | 7.16 | 5.54 | 7.62 | 12.75 | 5.42 | 11.75 | 16.00 | 254.25 | 3.00 | 493.75 | 2.62 | 0.00 | 0.17 | 0.23 | 0.01 | 2.06 | 3.92 | 1.16 | 0.78 | 1.00 |
| Minimum | 43.62 | 7.04 | 2.74 | 3.20 | 4.87 | 3.90 | 5.00 | 8.00 | 32.00 | 2.00 | 205.00 | 2.07 | 0.00 | 0.14 | 0.12 | 0.01 | 1.34 | 2.10 | 0.90 | 0.42 | 1.00 |
| Maximum | 85.53 | 7.33 | 10.30 | 13.00 | 23.40 | 7.80 | 18.00 | 21.00 | 580.00 | 12.00 | 860.00 | 3.09 | 0.00 | 0.20 | 0.38 | 0.01 | 2.49 | 4.80 | 1.44 | 1.07 | 2.00 |
| More than 70%LOD | yes | yes | yes | yes | yes | yes | yes | yes | yes | no | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | no |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 17.47 | 0.15 | 3.33 | 4.08 | 8.34 | 1.72 | 5.85 | 5.94 | 268.93 | 5.00 | 295.84 | 0.44 | 0.00 | 0.03 | 0.12 | 0.00 | 0.52 | 1.24 | 0.26 | 0.28 | 0.58 |

Verdalselva

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 09.02.2016 11:45 | 30.47 | 7.57 | 9.77 | 6.80 | 6.68 | 3.60 | 12.00 | 19.00 | 310.00 | 25.00 | 565.00 | 3.90 | <0.002 | 0.20 | 0.16 | 0.01 | 1.21 | 2.80 | 0.98 | 0.57 | 1.00 |
| 03.05.2016 09:45 | 69.53 | 7.07 | 2.53 | 9.10 | 25.80 | 4.10 | 23.00 | 25.00 | 29.00 | <2.0 | 180.00 | 2.55 | 0.00 | 0.28 | 0.51 | 0.01 | 1.28 | 2.50 | 1.48 | 1.12 | <1.0 |
| 02.08.2016 09:45 | 42.65 | 7.30 | 3.55 | 1.60 | 2.24 | 6.70 | 2.00 | 5.00 | 31.00 | <2.0 | 250.00 | 1.46 | <0.002 | 0.15 | 0.10 | 0.01 | 1.33 | 1.40 | 0.74 | 0.32 | 1.00 |
| 05.10.2016 11:24 | 28.06 | 7.36 | 4.03 | 0.84 | 1.00 | 4.70 | 1.00 | 3.00 | 69.00 | <2.0 | 240.00 | 1.62 | <0.002 | 0.09 | 0.05 | 0.01 | 0.70 | 0.93 | 0.59 | 0.17 | 2.00 |
| Avg. | 42.68 | 7.33 | 4.97 | 4.58 | 8.93 | 4.77 | 9.50 | 13.00 | 109.75 | 6.25 | 308.75 | 2.38 | 0.00 | 0.18 | 0.20 | 0.01 | 1.13 | 1.91 | 0.95 | 0.54 | 1.00 |
| Minimum | 28.06 | 7.07 | 2.53 | 0.84 | 1.00 | 3.60 | 1.00 | 3.00 | 29.00 | 2.00 | 180.00 | 1.46 | 0.00 | 0.09 | 0.05 | 0.01 | 0.70 | 0.93 | 0.59 | 0.17 | 1.00 |
| Maximum | 69.53 | 7.57 | 9.77 | 9.10 | 25.80 | 6.70 | 23.00 | 25.00 | 310.00 | 25.00 | 565.00 | 3.90 | 0.00 | 0.28 | 0.51 | 0.01 | 1.33 | 2.80 | 1.48 | 1.12 | 2.00 |
| More than 70%LOD | yes | yes | yes | yes | yes | yes | yes | yes | yes | no | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | yes |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 19.01 | 0.21 | 3.26 | 4.01 | 11.51 | 1.36 | 10.28 | 10.71 | 134.76 | 11.50 | 173.61 | 1.12 | 0.00 | 0.08 | 0.21 | 0.00 | 0.29 | 0.89 | 0.39 | 0.42 | 0.50 |

Snåsavassdraget

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 09.02.2016 13:35 | 23.60 | 7.31 | 4.74 | 0.62 | 0.63 | 4.50 | 2.00 | 6.00 | 170.00 | <2.0 | 340.00 | 1.57 | <0.002 | 0.11 | 0.02 | 0.00 | 0.58 | 0.81 | 0.44 | 0.14 | <1.0 |
| 03.05.2016 11:15 | 43.30 | 7.24 | 4.54 | 1.20 | 2.39 | 4.40 | 2.00 | 5.00 | 140.00 | <2.0 | 330.00 | 1.43 | <0.002 | 0.12 | 0.05 | 0.00 | 0.59 | 0.52 | 0.47 | 0.17 | <1.0 |
| 02.08.2016 11:05 | 21.61 | 7.17 | 3.87 | 2.40 | 2.80 | 6.40 | 2.00 | 7.00 | 44.00 | <2.0 | 270.00 | 1.19 | <0.002 | 0.15 | 0.09 | 0.00 | 0.75 | 0.76 | 0.61 | 0.30 | <1.0 |
| 05.10.2016 10:38 | 18.49 | 7.34 | 4.92 | 1.20 | 1.70 | 4.70 | 2.00 | 5.00 | 130.00 | 6.00 | 370.00 | 1.29 | <0.002 | 0.11 | 0.17 | 0.01 | 0.70 | 0.65 | 0.53 | 0.16 | 1.00 |
| Avg. | 26.75 | 7.26 | 4.52 | 1.35 | 1.88 | 5.00 | 2.00 | 5.75 | 121.00 | 1.50 | 327.50 | 1.37 | 0.00 | 0.12 | 0.08 | 0.00 | 0.66 | 0.68 | 0.51 | 0.19 | 0.25 |
| Minimum | 18.49 | 7.17 | 3.87 | 0.62 | 0.63 | 4.40 | 2.00 | 5.00 | 44.00 | 2.00 | 270.00 | 1.19 | 0.00 | 0.11 | 0.02 | 0.00 | 0.58 | 0.52 | 0.44 | 0.14 | 1.00 |
| Maximum | 43.30 | 7.34 | 4.92 | 2.40 | 2.80 | 6.40 | 2.00 | 7.00 | 170.00 | 6.00 | 370.00 | 1.57 | 0.00 | 0.15 | 0.17 | 0.01 | 0.75 | 0.81 | 0.61 | 0.30 | 1.00 |
| More than 70%LOD | yes | yes | yes | yes | yes | yes | yes | yes | yes | no | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | no |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 11.23 | 0.08 | 0.46 | 0.75 | 0.95 | 0.94 | 0.00 | 0.96 | 54.07 | 2.00 | 41.93 | 0.17 | 0.00 | 0.02 | 0.06 | 0.00 | 0.08 | 0.13 | 0.08 | 0.07 | 0.00 |

Namsen

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 08.02.2016 10:30 | 18.33 | 7.10 | 3.94 | 1.50 | 1.16 | 2.00 | <1.0 | 4.00 | 100.00 | 20.00 | 350.00 | 1.52 | <0.002 | 0.08 | 0.11 | 0.01 | 3.23 | 7.70 | 0.50 | 0.17 | <1.0 |
| 09.05.2016 09:40 | 127.88 | 6.76 | 2.29 | 3.60 | 4.74 | 3.10 | 2.00 | 4.00 | 27.00 | <2.0 | 149.00 | 1.65 | <0.002 | 0.09 | 0.12 | 0.00 | 0.57 | 1.20 | 0.52 | 0.42 | <1.0 |
| 09.08.2016 10:00 | 32.58 | 7.13 | 3.19 | 1.50 | 2.03 | 3.90 | 2.00 | 24.00 | 18.00 | <2.0 | 170.00 | 1.21 | <0.002 | 0.10 | 0.06 | 0.00 | 0.71 | 0.84 | 0.39 | 0.23 | <1.0 |
| 05.10.2016 08:00 | 35.50 | 6.89 | 3.56 | 1.10 | 1.38 | 5.10 | 2.00 | 4.00 | 31.00 | <2.0 | 205.00 | 1.75 | <0.002 | 0.08 | 0.07 | 0.00 | 0.59 | 1.00 | 0.44 | 0.21 | 2.00 |
| Avg. | 53.57 | 6.97 | 3.25 | 1.92 | 2.33 | 3.52 | 1.50 | 9.00 | 44.00 | 5.00 | 218.50 | 1.53 | 0.00 | 0.09 | 0.09 | 0.00 | 1.27 | 2.69 | 0.46 | 0.26 | 0.50 |
| Minimum | 18.33 | 6.76 | 2.29 | 1.10 | 1.16 | 2.00 | 1.00 | 4.00 | 18.00 | 2.00 | 149.00 | 1.21 | 0.00 | 0.08 | 0.06 | 0.00 | 0.57 | 0.84 | 0.39 | 0.17 | 1.00 |
| Maximum | 127.88 | 7.13 | 3.94 | 3.60 | 4.74 | 5.10 | 2.00 | 24.00 | 100.00 | 20.00 | 350.00 | 1.75 | 0.00 | 0.10 | 0.12 | 0.01 | 3.23 | 7.70 | 0.52 | 0.42 | 2.00 |
| More than 70%LOD | yes | yes | yes | yes | yes | yes | yes | yes | yes | no | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | no |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 50.10 | 0.18 | 0.71 | 1.13 | 1.65 | 1.31 | 0.50 | 10.00 | 37.73 | 9.00 | 90.66 | 0.24 | 0.00 | 0.01 | 0.03 | 0.00 | 1.30 | 3.35 | 0.06 | 0.11 | 0.50 |

Røssåga

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 10.02.2016 11:00 | 49.61 | 7.37 | 4.00 | <0.3 | 0.34 | 0.81 | 1.00 | 2.00 | 53.00 | 2.00 | 112.00 | 0.98 | 0.00 | 0.10 | 0.02 | 0.01 | 0.32 | 0.86 | 0.48 | 0.06 | 1.00 |
| 09.05.2016 10:45 | 145.03 | 7.47 | 4.87 | <0.3 | 0.59 | 1.20 | <1.0 | 1.00 | 43.00 | 3.00 | 155.00 | 0.99 | <0.002 | 0.06 | 0.09 | 0.01 | 0.42 | 2.80 | 0.39 | <0.025 | <1.0 |
| 16.08.2016 09:45 | 80.52 | 7.46 | 4.10 | <0.3 | 0.56 | 0.89 | <1.0 | 2.00 | 26.00 | <2.0 | 100.00 | 0.84 | <0.002 | 0.09 | 0.01 | <0.003 | 0.34 | 0.73 | 0.46 | 0.06 | <1.0 |
| 04.10.2016 08:45 | 101.56 | 7.51 | 4.93 | <0.3 | 0.70 | 1.70 | 2.00 | 3.00 | 32.00 | <2.0 | 118.00 | 0.99 | <0.002 | 0.08 | 0.04 | 0.01 | 0.31 | 2.60 | 0.43 | 0.07 | <1.0 |
| Avg. | 94.18 | 7.45 | 4.47 | 0.00 | 0.55 | 1.15 | 0.75 | 2.00 | 38.50 | 1.25 | 121.25 | 0.95 | 0.00 | 0.08 | 0.04 | 0.01 | 0.35 | 1.75 | 0.44 | 0.05 | 0.25 |
| Minimum | 49.61 | 7.37 | 4.00 | 0.30 | 0.34 | 0.81 | 1.00 | 1.00 | 26.00 | 2.00 | 100.00 | 0.84 | 0.00 | 0.06 | 0.01 | 0.00 | 0.31 | 0.73 | 0.39 | 0.03 | 1.00 |
| Maximum | 145.03 | 7.51 | 4.93 | 0.30 | 0.70 | 1.70 | 2.00 | 3.00 | 53.00 | 3.00 | 155.00 | 0.99 | 0.00 | 0.10 | 0.09 | 0.01 | 0.42 | 2.80 | 0.48 | 0.07 | 1.00 |
| More than 70%LOD | yes | yes | yes | no | yes | yes | no | yes | yes | no | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | no |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 40.06 | 0.06 | 0.49 | 0.00 | 0.15 | 0.40 | 0.50 | 0.82 | 11.96 | 0.50 | 23.71 | 0.07 | 0.00 | 0.02 | 0.04 | 0.00 | 0.05 | 1.10 | 0.04 | 0.02 | 0.00 |

Ranaelva

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 10.02.2016 12:00 | 75.80 | 7.36 | 4.45 | <0.3 | <0.5 | 0.77 | <1.0 | 2.00 | 53.00 | 10.00 | 133.00 | 1.28 | 0.01 | 0.07 | 0.02 | 0.01 | 0.26 | 0.43 | 0.32 | 0.07 | 3.00 |
| 09.05.2016 11:45 | 293.90 | 7.57 | 5.64 | <0.3 | 0.64 | 1.30 | <1.0 | 2.00 | 34.00 | 2.00 | 141.00 | 1.29 | <0.002 | 0.05 | <0.005 | <0.003 | 0.30 | 0.68 | 0.27 | <0.025 | <1.0 |
| 16.08.2016 10:50 | 233.37 | 7.51 | 4.37 | <0.3 | 0.22 | 0.92 | <1.0 | 1.00 | 23.00 | <2.0 | 84.00 | 1.33 | <0.002 | 0.09 | 0.03 | 0.00 | 0.30 | 0.67 | 0.34 | 0.13 | <1.0 |
| 04.10.2016 10:15 | 265.82 | 7.57 | 5.37 | 0.37 | 0.52 | 1.30 | 2.00 | 2.00 | 36.00 | <2.0 | 105.00 | 1.41 | <0.002 | 0.05 | 0.03 | 0.00 | 0.33 | 0.62 | 0.39 | 0.09 | <1.0 |
| Avg. | 217.22 | 7.50 | 4.96 | 0.09 | 0.34 | 1.07 | 0.50 | 1.75 | 36.50 | 3.00 | 115.75 | 1.33 | 0.00 | 0.07 | 0.02 | 0.00 | 0.30 | 0.60 | 0.33 | 0.07 | 0.75 |
| Minimum | 75.80 | 7.36 | 4.37 | 0.30 | 0.22 | 0.77 | 1.00 | 1.00 | 23.00 | 2.00 | 84.00 | 1.28 | 0.00 | 0.05 | 0.01 | 0.00 | 0.26 | 0.43 | 0.27 | 0.03 | 1.00 |
| Maximum | 293.90 | 7.57 | 5.64 | 0.37 | 0.64 | 1.30 | 2.00 | 2.00 | 53.00 | 10.00 | 141.00 | 1.41 | 0.01 | 0.09 | 0.03 | 0.01 | 0.33 | 0.68 | 0.39 | 0.13 | 3.00 |
| More than 70%LOD | yes | yes | yes | no | yes | yes | no | yes | yes | no | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | no |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 97.47 | 0.10 | 0.64 | 0.04 | 0.18 | 0.27 | 0.50 | 0.50 | 12.40 | 4.00 | 26.20 | 0.06 | 0.00 | 0.02 | 0.01 | 0.00 | 0.03 | 0.12 | 0.05 | 0.04 | 1.00 |

Beiarelva

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 22.02.2016 12:30 | 19.42 | 7.57 | 7.57 | <0.3 | <0.4 | 0.81 | 1.00 | 2.00 | 99.00 | 7.00 | 240.00 | 4.99 | <0.002 | 0.13 | 0.01 | <0.003 | 0.40 | 1.00 | 0.55 | 0.07 | <1.0 |
| 01.06.2016 12:45 | 119.16 | 7.25 | 3.43 | 1.20 | 5.13 | 0.84 | 2.00 | 1.00 | 26.00 | <2.0 | 97.00 | 1.41 | <0.002 | 0.13 | 0.08 | <0.003 | 0.52 | 1.00 | 0.47 | 0.27 | <1.0 |
| 01.08.2016 11:17 | 61.53 | 7.14 | 2.68 | 11.00 | 27.15 | 2.80 | 15.00 | 24.00 | 4.00 | <2.0 | 134.00 | 3.84 | <0.002 | 0.31 | 0.37 | 0.00 | 1.62 | 4.30 | 1.79 | 1.69 | <1.0 |
| 17.10.2016 12:45 | 23.08 | 7.67 | 7.79 | <0.3 | <0.33 | 1.00 | <1.0 | 3.00 | 49.00 | 2.00 | 116.00 | 3.51 | <0.002 | 0.10 | 0.01 | <0.003 | 0.30 | 0.29 | 0.58 | 0.07 | 2.00 |
| Avg. | 55.80 | 7.41 | 5.37 | 3.05 | 8.07 | 1.36 | 4.50 | 7.50 | 44.50 | 2.25 | 146.75 | 3.44 | 0.00 | 0.17 | 0.12 | 0.00 | 0.71 | 1.65 | 0.85 | 0.53 | 0.50 |
| Minimum | 19.42 | 7.14 | 2.68 | 0.30 | 0.33 | 0.81 | 1.00 | 1.00 | 4.00 | 2.00 | 97.00 | 1.41 | 0.00 | 0.10 | 0.01 | 0.00 | 0.30 | 0.29 | 0.47 | 0.07 | 1.00 |
| Maximum | 119.16 | 7.67 | 7.79 | 11.00 | 27.15 | 2.80 | 15.00 | 24.00 | 99.00 | 7.00 | 240.00 | 4.99 | 0.00 | 0.31 | 0.37 | 0.00 | 1.62 | 4.30 | 1.79 | 1.69 | 2.00 |
| More than 70%LOD | yes | yes | yes | no | no | yes | yes | yes | yes | no | yes | yes | no | yes | yes | no | yes | yes | yes | yes | no |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 46.33 | 0.25 | 2.69 | 5.22 | 12.80 | 0.96 | 6.85 | 11.03 | 40.71 | 2.50 | 63.98 | 1.49 | 0.00 | 0.10 | 0.17 | 0.00 | 0.61 | 1.80 | 0.63 | 0.78 | 0.50 |

Målselv

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 07.02.2016 13:00 | 24.46 | 7.61 | 9.62 | <0.3 | 0.21 | 0.83 | <1.0 | 1.00 | 89.00 | 7.00 | 170.00 | 3.41 | <0.002 | 0.04 | 0.01 | <0.003 | 0.36 | 0.15 | 0.26 | 0.04 | 1.00 |
| 08.05.2016 20:00 | 195.27 | 7.61 | 7.30 | 1.90 | 4.48 | 2.60 | 6.00 | 10.00 | 51.00 | <2.0 | 195.00 | 3.04 | <0.002 | 0.04 | 0.08 | 0.00 | 0.75 | 0.76 | 0.60 | 0.27 | <1.0 |
| 08.08.2016 07:00 | 107.20 | 7.76 | 7.57 | 0.37 | 0.73 | 1.10 | <1.0 | 2.00 | 18.00 | <2.0 | 90.00 | 2.44 | <0.002 | 0.03 | 0.02 | <0.003 | 0.43 | <0.15 | 0.40 | 0.11 | <1.0 |
| 23.10.2016 13:30 | 37.11 | 7.74 | 9.11 | <0.3 | 0.41 | 0.94 | <1.0 | 2.00 | 57.00 | 3.00 | 133.00 | 2.81 | 0.00 | 0.06 | 0.01 | <0.003 | 0.33 | <0.15 | 0.25 | 0.05 | <1.0 |
| Avg. | 91.01 | 7.68 | 8.40 | 0.57 | 1.46 | 1.37 | 1.50 | 3.75 | 53.75 | 2.50 | 147.00 | 2.93 | 0.00 | 0.04 | 0.03 | 0.00 | 0.47 | 0.23 | 0.38 | 0.12 | 0.25 |
| Minimum | 24.46 | 7.61 | 7.30 | 0.30 | 0.21 | 0.83 | 1.00 | 1.00 | 18.00 | 2.00 | 90.00 | 2.44 | 0.00 | 0.03 | 0.01 | 0.00 | 0.33 | 0.15 | 0.25 | 0.04 | 1.00 |
| Maximum | 195.27 | 7.76 | 9.62 | 1.90 | 4.48 | 2.60 | 6.00 | 10.00 | 89.00 | 7.00 | 195.00 | 3.41 | 0.00 | 0.06 | 0.08 | 0.00 | 0.75 | 0.76 | 0.60 | 0.27 | 1.00 |
| More than 70%LOD | yes | yes | yes | no | yes | yes | no | yes | yes | no | yes | yes | no | yes | yes | no | yes | no | yes | yes | no |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 78.46 | 0.08 | 1.14 | 0.79 | 2.03 | 0.83 | 2.50 | 4.19 | 29.09 | 2.38 | 45.75 | 0.41 | 0.00 | 0.01 | 0.04 | 0.00 | 0.19 | 0.30 | 0.16 | 0.10 | 0.00 |

Barduelva

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 07.02.2016 12:00 | 22.22 | 7.43 | 5.23 | <0.3 | 0.33 | 1.10 | <1.0 | 1.00 | 55.00 | <2.0 | 127.00 | 2.29 | <0.002 | 0.03 | 0.01 | <0.003 | 0.32 | 0.18 | 0.27 | 0.05 | <1.0 |
| 08.05.2016 19:00 | 177.33 | 7.62 | 8.18 | 1.20 | 2.15 | 2.00 | 2.00 | 6.00 | 73.00 | 2.00 | 270.00 | 2.25 | <0.002 | <0.025 | 0.01 | <0.003 | 0.54 | 0.38 | 0.34 | 0.04 | <1.0 |
| 08.08.2016 08:00 | 97.35 | 7.63 | 6.50 | 0.60 | 1.32 | 0.91 | <1.0 | 2.00 | 20.00 | <2.0 | 95.00 | 1.69 | <0.002 | 0.03 | 0.03 | 0.00 | 0.43 | 0.24 | 0.40 | 0.09 | <1.0 |
| 23.10.2016 15:00 | 33.70 | 7.51 | 6.52 | 0.48 | 0.74 | 1.00 | 2.00 | 2.00 | 41.00 | 6.00 | 120.00 | 2.09 | <0.002 | 0.05 | 0.02 | <0.003 | 0.29 | <0.15 | 0.41 | 0.04 | 1.00 |
| Avg. | 82.65 | 7.55 | 6.61 | 0.57 | 1.14 | 1.25 | 1.00 | 2.75 | 47.25 | 2.00 | 153.00 | 2.08 | 0.00 | 0.03 | 0.02 | 0.00 | 0.40 | 0.20 | 0.36 | 0.05 | 0.25 |
| Minimum | 22.22 | 7.43 | 5.23 | 0.30 | 0.33 | 0.91 | 1.00 | 1.00 | 20.00 | 2.00 | 95.00 | 1.69 | 0.00 | 0.03 | 0.01 | 0.00 | 0.29 | 0.15 | 0.27 | 0.04 | 1.00 |
| Maximum | 177.33 | 7.63 | 8.18 | 1.20 | 2.15 | 2.00 | 2.00 | 6.00 | 73.00 | 6.00 | 270.00 | 2.29 | 0.00 | 0.05 | 0.03 | 0.00 | 0.54 | 0.38 | 0.41 | 0.09 | 1.00 |
| More than 70%LOD | yes | yes | yes | yes | yes | yes | no | yes | yes | no | yes | yes | no | yes | yes | no | yes | yes | yes | yes | no |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 71.25 | 0.10 | 1.21 | 0.39 | 0.79 | 0.50 | 0.58 | 2.22 | 22.40 | 2.00 | 79.20 | 0.27 | 0.00 | 0.01 | 0.01 | 0.00 | 0.11 | 0.10 | 0.06 | 0.03 | 0.00 |

Tanaelva

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 08.02.2016 11:00 | 46.29 | 7.29 | 7.43 | 0.32 | 0.51 | 1.80 | 3.00 | 5.00 | 95.00 | 4.00 | 210.00 | 11.14 | <0.002 | 0.06 | 0.03 | <0.003 | 0.49 | 1.10 | 0.30 | 0.25 | <1.0 |
| 08.05.2016 19:00 | 1327.27 | 7.10 | 3.32 | 3.80 | 11.00 | 6.60 | 4.00 | 17.00 | 9.00 | 5.00 | 690.00 | 5.74 | <0.002 | 0.05 | 0.08 | 0.01 | 0.80 | 0.94 | 0.69 | 0.49 | <1.0 |
| 07.08.2016 14:30 | 316.47 | 7.42 | 3.94 | 0.64 | 1.44 | 6.00 | 1.00 | 6.00 | <2.0 | <2.0 | 220.00 | 6.17 | <0.002 | 0.05 | 0.03 | <0.003 | 0.52 | 0.58 | 0.50 | 0.45 | <1.0 |
| 09.10.2016 17:00 | 152.45 | 7.43 | 4.26 | 0.33 | 0.79 | 4.40 | 2.00 | 6.00 | 9.00 | <2.0 | 155.00 | 7.20 | <0.002 | 0.07 | 0.01 | <0.003 | 0.37 | 0.33 | 0.44 | 0.33 | <1.0 |
| Avg. | 460.62 | 7.31 | 4.74 | 1.27 | 3.43 | 4.70 | 2.50 | 8.50 | 28.25 | 2.25 | 318.75 | 7.56 | 0.00 | 0.06 | 0.04 | 0.00 | 0.55 | 0.74 | 0.48 | 0.38 | 0.00 |
| Minimum | 46.29 | 7.10 | 3.32 | 0.32 | 0.51 | 1.80 | 1.00 | 5.00 | 2.00 | 2.00 | 155.00 | 5.74 | 0.00 | 0.05 | 0.01 | 0.00 | 0.37 | 0.33 | 0.30 | 0.25 | 1.00 |
| Maximum | 1327.27 | 7.43 | 7.43 | 3.80 | 11.00 | 6.60 | 4.00 | 17.00 | 95.00 | 5.00 | 690.00 | 11.14 | 0.00 | 0.07 | 0.08 | 0.01 | 0.80 | 1.10 | 0.69 | 0.49 | 1.00 |
| More than 70%LOD | yes | yes | yes | yes | yes | yes | yes | yes | yes | no | yes | yes | no | yes | yes | no | yes | yes | yes | yes | no |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 588.36 | 0.15 | 1.84 | 1.69 | 5.06 | 2.14 | 1.29 | 5.69 | 44.29 | 1.50 | 249.14 | 2.46 | 0.00 | 0.01 | 0.03 | 0.00 | 0.18 | 0.35 | 0.16 | 0.11 | 0.00 |

Pasvikelva

| Date | Qs | pH | KOND | TURB860 | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DD.MM.YYYY | [m3/s] | [] | [mS/m] | [FNU] | [mg/l] | [mg C/l] | [µg/l P] | [µg/l P] | [µg/l N] | [µg/l N] | [µg/l N] | [mg SiO2/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [µg/l] | [ng/l] |
| 07.02.2016 10:30 | 33.12 | 7.10 | 3.33 | <0.3 | <0.25 | 2.80 | <1.0 | 2.00 | 44.00 | 6.00 | 170.00 | 5.94 | <0.002 | 0.07 | <0.005 | <0.003 | 0.42 | 0.23 | 0.59 | 0.11 | <1.0 |
| 09.05.2016 07:45 | 524.49 | 7.16 | 5.59 | 1.10 | 1.04 | 3.40 | 2.00 | 6.00 | 39.00 | 19.00 | 275.00 | 5.46 | <0.002 | 0.26 | 0.05 | 0.02 | 6.10 | 1.80 | 41.90 | 0.14 | <1.0 |
| 07.08.2016 05:40 | 233.24 | 7.29 | 3.40 | 0.95 | 2.41 | 3.70 | 2.00 | 6.00 | <2.0 | 10.00 | 190.00 | 4.54 | <0.002 | 0.24 | 0.10 | 0.01 | 3.53 | 1.20 | 6.17 | 0.17 | <1.0 |
| 09.10.2016 14:00 | 91.10 | 7.34 | 3.59 | 0.80 | 3.95 | 3.80 | 3.00 | 9.00 | 79.00 | 32.00 | 290.00 | 4.93 | <0.002 | 0.14 | 0.06 | 0.01 | 1.78 | 1.40 | 7.23 | 0.15 | <1.0 |
| Avg. | 220.49 | 7.22 | 3.98 | 0.71 | 1.85 | 3.42 | 1.75 | 5.75 | 40.50 | 16.75 | 231.25 | 5.22 | 0.00 | 0.18 | 0.05 | 0.01 | 2.96 | 1.16 | **13.97** | 0.14 | 0.00 |
| Minimum | 33.12 | 7.10 | 3.33 | 0.30 | 0.25 | 2.80 | 1.00 | 2.00 | 2.00 | 6.00 | 170.00 | 4.54 | 0.00 | 0.07 | 0.01 | 0.00 | 0.42 | 0.23 | 0.59 | 0.11 | 1.00 |
| Maximum | 524.49 | 7.34 | 5.59 | 1.10 | 3.95 | 3.80 | 3.00 | 9.00 | 79.00 | 32.00 | 290.00 | 5.94 | 0.00 | 0.26 | 0.10 | 0.02 | 6.10 | 1.80 | 41.90 | 0.17 | 1.00 |
| More than 70%LOD | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | no |
| n | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| St.dev | 219.42 | 0.11 | 1.08 | 0.35 | 1.63 | 0.45 | 0.82 | 2.87 | 31.51 | 11.53 | 60.05 | 0.61 | 0.00 | 0.09 | 0.04 | 0.01 | 2.45 | 0.67 | 18.84 | 0.03 | 0.00 |

# Table 1b. Organic contaminants – concentrations

Explanations:

- Cw, free: Freely dissolved concentrations estimated from silicone rubber passive samplers
- Cspm: contaminant concentrations for compounds associated with SPM
- Grey shaded cells are for concentrations below LOD (LOD reported)
- Repeated centrifuge/sampling failure at river Drammen on one occasion
- n.a.: Analysis for PFCs associated with SPM for the first three samples of the year. The final sample is a bottle sample with concentrations reported in ng/L

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ALNA RIVER | | | | | | | | |
| Freely dissolved concentrations (mean of replicate measurements, relative percent difference) | | | | | | | | |
| | | | | | | | | |
| Sample ID | Sil Alna P13 a | | Sil Alna P14 a | | Sil Alna P15 a | | Sil Alna P16 a | |
| Deployed | 05.02.2016 | 05.02.2016 | 28.04.2016 | 28.04.2016 | lost | lost | 12.10.2016 | 12.10.2016 |
| Retrieved | 28.04.2016 | 28.04.2016 | 09.06.2016 | 09.06.2016 | | | 12.12.2016 | 12.12.2016 |
| Exposure time(d) | 83 | | 42 | | | | 61 | |
| | MEAN | % RPD | MEAN | % RPD | MEAN | % RPD | MEAN | % RPD |
| **Cw,free (ng/L)** | | | | | | | | |
| NAP | | | | | Samplers lost | | | |
| ACY | 1.80395125 | 0.5 | 3.72764 | 30.6 | | | 2.248153 | 15.6 |
| ACE | 0.68612213 | 4.8 | 0.710534 | 12.7 | | | 0.341631 | 4.4 |
| FLUE | 0.31377296 | 4.5 | 0.810356 | 16.5 | | | 0.542645 | 2.1 |
| DBTHIO | 0.3326213 | 6.1 | 0.619535 | 10.7 | | | 0.788334 | 4.3 |
| PHE | 0.2274641 | 9.3 | 0.436439 | 9.5 | | | 0.651747 | 3.1 |
| ANT | 0.45008783 | 1.9 | 1.026568 | 9.3 | | | 0.972161 | 2.6 |
| FLUOR | 0.34847291 | 1.5 | 0.453438 | 16.9 | | | 0.253626 | 2.1 |
| PYR | 0.33845639 | 0.9 | 0.736987 | 6.2 | | | 1.185933 | 5.4 |
| BaA | 4.47688614 | 1.7 | 3.644844 | 4.5 | | | 4.63738 | 4.3 |
| CHRY | 0.04185525 | 2.7 | 0.067301 | 9.5 | | | 0.124218 | 13.2 |
| BbjF | 0.06605426 | 7.9 | 0.111634 | 3.9 | | | 0.107103 | 2.1 |
| BkF | 0.06962167 | 3.1 | 0.0785 | 14.9 | | | 0.13238 | 6.7 |
| BeP | 0.01241582 | 13.2 | 0.016069 | 11.3 | | | 0.029928 | 9.9 |
| BaP | 0.08226474 | 5.3 | 0.093395 | 7.1 | | | 0.146313 | 8.1 |
| PER | 0.02252363 | 3.9 | 0.023743 | 9.2 | | | 0.043387 | 6.7 |
| In123cdPYR | 0.00906932 | 9.1 | 0.008768 | 6.7 | | | 0.023185 | 5.2 |
| BDahANT | 0.01045936 | 5.2 | 0.011787 | 10.6 | | | 0.016096 | 4.6 |
| BghiPER | 0.00509112 | 3.9 | 0.004851 | 7.2 | | | 0.005346 | 2.9 |
| | 0.01207502 | 7.4 | 0.013084 | 24.3 | | | 0.020028 | 15.3 |
| PCB31+28 | | | | | | | | |
| CB52 | 0.0123293 | 8.8 | 0.014431 | 0.4 | | | 0.012658 | 4.4 |
| CB101 | 0.01670476 | 5.6 | 0.022095 | 4.0 | | | 0.021308 | 11.6 |
| CB118 | 0.02230239 | 8.6 | 0.017395 | 4.5 | | | 0.023458 | 6.0 |
| CB153 | 0.00722265 | 8.2 | 0.008593 | 1.7 | | | 0.010604 | 13.4 |
| CB105 | 0.002596 | 16.0 | 0.004289 | 1.8 | | | 0.002386 | 40.3 |
| CB138 | 0.00108625 | 5.3 | 0.001731 | 6.5 | | | 0.000951 | 38.3 |
| CB156 | 0.00181094 | 6.7 | 0.002806 | 10.5 | | | 0.001486 | 37.7 |
| CB180 | 0.00152402 | 4.4 | 0.00269 | 6.5 | | | 0.00113 | 37.7 |
| CB209 | 0.0005386 | 3.7 | 0.000896 | 5.1 | | | 0.00052 | |
| | | | | | | | | |
| BDE47 | 0.00063244 | 15.2 | 0.000794 | 23.0 | | | 0.000962 | 6.8 |
| BDE99 | 0.00040492 | 6.7 | 0.000539 | 18.6 | | | 0.000769 | 12.7 |
| BDE100 | 7.2845E-05 | | 9.48E-05 | 14.4 | | | 0.000151 | 2.3 |
| BDE153 | 6.8277E-05 | | 9.43E-05 | | | | 0.000334 | |
| BDE154 | 6.8277E-05 | | 9.43E-05 | | | | 9.48E-05 | |
| BDE183 | 0.00011236 | | 0.000155 | | | | 0.000275 | |
| BDE196 | not quantified | | | | | | 0.000302 | |
| BDE209 | not quantified | | | | | | | |
| BDE126 | 6.2428E-05 | | 8.61E-05 | | | | 0.000228 | |
| | | | | | | | | |
| aHBCD | 0.00416681 | 1.0 | 0.004941 | 3.5 | | | 0.004819 | 4.4 |
| bHBCD | 0.00039122 | 2.7 | 0.000609 | 85.9 | | | 0.001318 | |
| gHBCD | 0.00031886 | 24.1 | 0.000418 | 62.0 | | | 0.001271 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| DRAMMEN RIVER | | | | | | | | |
| Freely dissolved concentrations (mean of replicate measurements, relative percent difference) | | | | | | | | |
| | | | | | | | | |
| Sample ID | DRAM P13 A | | DRAM P14 A | | DRAM P15 A | | DRAM P16 A | |
| Deployed | 12.02.2016 | | 21.04.2016 | | 10.06.2016 | | 06.10.2016 | |
| Retrieved | 21.04.2016 | | 10.06.2016 | | 06.10.2016 | | 16.12.2016 | |
| Exposure time(d) | 69 | | 50 | | 118 | | 71 | |
| | | | | | | | | |
| **Cw,free (ng/L)** | | | | | | | | |
| NAP | | | | | | | | |
| ACY | 7.971077 | 8.3 | 5.238195 | 2.8 | 4.756062 | 12.3 | 12.88147 | 17.7 |
| ACE | 1.419524 | 2.9 | 0.496887 | 2.3 | 0.385262 | 6.4 | 3.367983 | 19.2 |
| FLUE | 1.579946 | 14.7 | 1.622922 | 20.2 | 0.864052 | 4.2 | 2.317004 | 25.7 |
| DBTHIO | 1.737733 | 6.7 | 1.140153 | 0.3 | 0.610903 | 5.2 | 1.479218 | 23.9 |
| PHE | 0.160869 | 8.3 | 0.211738 | 0.2 | 0.299829 | 1.0 | 0.223156 | 17.1 |
| ANT | 5.91752 | 4.1 | 3.283701 | 3.5 | 1.925653 | 6.7 | 5.979839 | 23.8 |
| FLUOR | 0.212804 | 7.8 | 0.166986 | 0.3 | 0.120084 | 7.3 | 0.273767 | 19.6 |
| PYR | 4.477867 | 5.8 | 2.475572 | 2.2 | 0.925168 | 10.5 | 5.207626 | 29.0 |
| BaA | 3.011808 | 8.3 | 1.315282 | 0.3 | 0.458997 | 10.4 | 3.622615 | 31.0 |
| CHRY | 0.421169 | 8.5 | 0.144041 | 0.3 | 0.042581 | 11.9 | 0.514403 | 32.1 |
| BbjF | 1.072773 | 4.0 | 0.554289 | 1.5 | 0.187649 | 64.4 | 0.987724 | 28.4 |
| BkF | 0.622829 | 4.3 | 0.370761 | 6.4 | 0.095567 | 9.8 | 0.568547 | 33.9 |
| BeP | 0.218047 | 14.6 | 0.105685 | 1.0 | 0.01874 | 5.8 | 0.124816 | 40.5 |
| BaP | 0.329603 | 4.6 | 0.204247 | 10.2 | 0.06205 | 11.5 | 0.296382 | 36.7 |
| PER | 0.093698 | | 0.054842 | | 0.062124 | | 0.104485 | 32.3 |
| In123cdPYR | 0.09434 | | 0.055212 | | 0.02551 | 18.8 | 0.120805 | 47.6 |
| BDahANT | 0.100207 | | 0.058612 | | 0.010625 | | 0.09895 | |
| BghiPER | 0.103561 | | 0.060564 | | 0.009959 | | 0.087937 | |
| | 0.099478 | | 1.393216 | | 0.009594 | | 0.084475 | |
| PCB31+28 | | | | | | | | |
| CB52 | 0.01315 | 30.6 | 0.009769 | 17.2 | 0.005629 | 7.7 | 0.027566 | 31.1 |
| CB101 | 0.07724 | 8.4 | 0.070069 | 3.4 | 0.025081 | 9.0 | 0.112031 | 32.6 |
| CB118 | 0.03494 | 31.4 | 0.024528 | 0.3 | 0.008258 | 15.5 | 0.050077 | 32.3 |
| CB153 | 0.019116 | | 0.013391 | | 0.004762 | 10.0 | 0.019195 | 30.1 |
| CB105 | 0.020864 | | 0.012202 | | 0.003301 | 19.0 | 0.017717 | |
| CB138 | 0.021407 | | 0.012518 | | 0.002682 | 5.0 | 0.009089 | |
| CB156 | 0.021407 | | 0.012518 | | 0.00291 | 13.1 | 0.009089 | |
| CB180 | 0.022829 | | 0.013348 | | 0.002698 | 9.6 | 0.009692 | |
| CB209 | 0.023772 | | 0.013899 | | 0.001139 | | 0.010092 | |
| | | | | | | | | |
| BDE47 | 0.006165 | 3.8 | 0.003799 | 6.1 | 0.003386 | 14.6 | 0.009896 | 35.1 |
| BDE99 | 0.008078 | 10.5 | 0.004172 | 2.5 | 0.001339 | 15.3 | 0.006187 | 23.9 |
| BDE100 | 0.004679 | | 0.002736 | | 0.00048 | 1.1 | 0.001986 | 29.2 |
| BDE153 | 0.005139 | | 0.003005 | | 0.000246 | | 0.002182 | |
| BDE154 | 0.005139 | | 0.003005 | | 0.000246 | | 0.002182 | |
| BDE183 | 0.008467 | | 0.00495 | | 0.000811 | | 0.007189 | |
| BDE196 | | | | | 0.000891 | | 0.007896 | |
| BDE209 | | | | | | | | |
| BDE126 | 0.004679 | | 0.002736 | 0.3 | 0.000673 | | 0.005959 | |
| | | | | | | | | |
| aHBCD | 0.008667 | 3.1 | 0.00567 | 13.3 | 0.004458 | | 0.046394 | |
| bHBCD | 0.00856 | | 0.005025 | | 0.003466 | | 0.029102 | |
| gHBCD | 0.008998 | | 0.005271 | | 0.003543 | | 0.030574 | |

| GLOMMA RIVER | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Freely dissolved concentrations (mean of replicate measurements, relative percent difference) | | | | | | | | |
| | | | | | | | | |
| Sample ID | Glom P13 A | | Glom P14 A | | Glom P15 A | | Glom P16 A | |
| Deployed | 26.02.2016 | | 28.04.2016 | | 09.06.2016 | | 05.10.2016 | |
| Retrieved | 28.04.2016 | | 09.06.2016 | | 05.10.2016 | | 12.12.2016 | |
| Exposure time(d | 62 | | 42 | | 118 | | 68 | |
| | MEAN | % RPD | MEAN | % RPD | MEAN | % RPD | MEAN | % RPD |
| **Cw,free (ng/L)** | | | | | | | | |
| NAP | | | | | | | | |
| ACY | 6.638094 | 1.5 | 4.524396 | 5.7 | 1.374712 | 26.4 | 19.35973 | 18.4 |
| ACE | 0.756471 | 7.5 | 0.352785 | 1.6 | 0.412905 | 8.1 | 3.218859 | 24.8 |
| FLUE | 3.047375 | 19.6 | 2.291266 | 14.6 | 0.91919 | 4.4 | 4.890076 | 30.9 |
| DBTHIO | 2.50274 | 6.9 | 1.322753 | 2.0 | 0.48892 | 10.9 | 4.006756 | 35.9 |
| PHE | 0.537318 | 1.0 | 0.454274 | 1.0 | 0.25646 | 12.2 | 0.551435 | 30.7 |
| ANT | 6.662527 | 16.0 | 4.079867 | 5.0 | 1.916469 | 4.9 | 15.70066 | 37.2 |
| FLUOR | 0.26947 | 10.6 | 0.18343 | 8.0 | 0.070371 | 6.7 | 0.563417 | 37.7 |
| PYR | 4.082378 | 15.5 | 2.29355 | 7.8 | 0.846172 | 10.7 | 11.12523 | 39.9 |
| BaA | 2.557469 | 16.2 | 1.122294 | 5.9 | 0.331445 | 10.9 | 6.894955 | 40.7 |
| CHRY | 0.153595 | 9.4 | 0.054077 | 13.2 | 0.019362 | 22.6 | 0.641714 | 36.6 |
| BbjF | 0.556606 | 16.0 | 0.165502 | 5.9 | 0.046269 | 13.3 | 1.314672 | 42.4 |
| BkF | 0.317375 | 19.7 | 0.123653 | 13.4 | 0.048656 | 22.0 | 0.73176 | 37.7 |
| BeP | 0.087722 | 20.4 | 0.034751 | 17.7 | 0.010375 | 16.6 | 0.141144 | 35.5 |
| BaP | 0.168301 | 16.3 | 0.071772 | 9.8 | 0.035477 | 21.2 | 0.405435 | 35.9 |
| PER | 0.031803 | 20.8 | 0.020438 | | 0.020001 | | 0.108967 | 36.2 |
| In123cdPYR | 0.048063 | 9.5 | 0.049361 | 13.4 | 0.027967 | 15.1 | 0.350475 | 40.1 |
| BDahANT | 0.031862 | | 0.021779 | | 0.005491 | 38.5 | 0.088844 | |
| BghiPER | 0.03291 | | 0.022488 | | 0.004339 | | 0.091814 | |
| | 0.031635 | | 0.021626 | | 0.004915 | 25.7 | 0.088198 | |
| PCB31+28 | | | | | | | | |
| CB52 | 0.011336 | 16.7 | 0.006089 | 26.2 | 0.004333 | 8.1 | 0.066872 | 38.7 |
| CB101 | 0.070549 | 15.8 | 0.040836 | 1.3 | 0.019338 | 18.3 | 0.301012 | 41.5 |
| CB118 | 0.019693 | 12.6 | 0.008366 | 13.3 | 0.004776 | 25.8 | 0.082069 | 18.2 |
| CB153 | 0.01069 | 19.7 | 0.006016 | 9.1 | 0.002447 | 25.2 | 0.026144 | 41.4 |
| CB105 | 0.00663 | | 0.00453 | | 0.0018 | 36.4 | 0.018498 | |
| CB138 | 0.006801 | | 0.004646 | | 0.000904 | 21.2 | 0.009489 | |
| CB156 | 0.006801 | | 0.004646 | | 0.001904 | 21.9 | 0.009989 | |
| CB180 | 0.00725 | | 0.004952 | | 0.001546 | 31.4 | 0.01012 | |
| CB209 | 0.007548 | | 0.005156 | | 0.000545 | 15.9 | 0.010537 | |
| | | | | | | | | |
| BDE47 | 0.003025 | 20.4 | 0.001537 | 4.0 | 0.000865 | 11.4 | 0.015171 | 33.9 |
| BDE99 | 0.002869 | 6.8 | 0.001522 | | 0.000438 | 5.7 | 0.00546 | 43.1 |
| BDE100 | 0.001486 | | 0.001015 | | 0.000125 | | 0.002074 | |
| BDE153 | 0.001632 | | 0.001114 | | 0.000107 | | 0.002278 | |
| BDE154 | 0.001632 | | 0.001114 | | 0.000107 | | 0.002278 | |
| BDE183 | 0.002688 | | 0.001836 | | 0.000351 | | 0.007506 | |
| BDE196 | | | | | 0.000386 | | 0.008244 | |
| BDE209 | | | | | | | | |
| BDE126 | 0.001486 | | 0.001015 | | 0.000292 | | 0.006222 | |
| | | | | | | | | |
| aHBCD | 0.007069 | 42.1 | 0.003163 | 5.3 | 0.001951 | | 0.03017 | |
| bHBCD | 0.002754 | | 0.001896 | | 0.001624 | | 0.030377 | |
| gHBCD | 0.002875 | | 0.001972 | | 0.001596 | | 0.031918 | |

| Concentration of contaminants associated with suspended particulate matter (SPM) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | |
| Sample code | | Alna SPM 1 | Alna SPM 2 | Alna SPM 3 | Alna SPM 4 | Drammen SPM 1 | Drammen SPM 2 | Drammen SPM 3 | Drammen SPM 4 | Glomma SPM 1 | Glomma SPM 2 | Glomma SPM 3 | Glomma SPM 4 |
| Deployed | | 05.02.2016 | 22.04.2016 | 02.06.2016 | 05.10.2016 | 12.02.2016 | 21.04.2016 | 03.06.2016 | 28.09.2016 | 21.01.2016 | 22.04.2016 | 06.06.2016 | 28.09.2016 |
| Retrieved | | 09.02.2016 | 28.04.2016 | 09.06.2016 | 12.10.2016 | 22.02.2016 | 28.04.2016 | 10.06.2016 | 06.10.2016 | 28.01.2016 | 28.04.2016 | 09.06.2016 | 05.10.2016 |
| Exposure time(d) | | 4 | 6 | 7 | 7 | 10 | 7 | 7 | 8 | 7 | 6 | 3 | 7 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| %OC | | 5.6 | 8.42 | 7.33 | 11.8 | 5.22 | 9.6 | 6.54 | 3.42 | 2.46 | 2.21 | 2.76 | 11.8 |
| | | | | | | | | | | | | | |
| NAP | ng/g dw | 63.6 | 46 | 50 | 56.7 | 25.8 | 20 | 20 | 35.7 | 10 | 20 | 20 | 20.0 |
| ACY | ng/g dw | 87 | 62 | 76 | 47.0 | 19 | 5.2 | 6.7 | 5.4 | 2 | 3.1 | 2.3 | 5.0 |
| ACE | ng/g dw | 57 | 22 | 34 | 17.2 | 8.4 | 3.1 | 6.4 | 5.0 | 4 | 4.2 | 4.3 | 5.0 |
| FLUE | ng/g dw | 160 | 26 | 52 | 26.4 | 17 | 2.6 | 3.5 | 11.9 | 3.9 | 2.8 | 2.6 | 5.0 |
| DBTHIO | ng/g dw | 47 | 21 | 29 | 19.5 | 13 | 2 | 2.2 | 5.0 | 2 | 2 | 2 | 5.0 |
| PHE | ng/g dw | 890 | 290 | 460 | 230.6 | 210 | 27 | 31 | 32.7 | 23 | 17 | 15 | 14.3 |
| ANT | ng/g dw | 240 | 67 | 140 | 71.8 | 30 | 5.3 | 5.5 | 5.0 | 2.3 | 2.4 | 2.1 | 5.0 |
| FLUOR | ng/g dw | 1900 | 610 | 900 | 567.5 | 670 | 44 | 64 | 55.7 | 42 | 34 | 19 | 25.5 |
| PYR | ng/g dw | 1800 | 770 | 910 | 601.6 | 550 | 39 | 55 | 44.3 | 32 | 31 | 16 | 20.8 |
| BaA | ng/g dw | 750 | 200 | 350 | 235.4 | 280 | 15 | 19 | 16.5 | 17 | 2 | 2 | 8.2 |
| CHRY | ng/g dw | 740 | 260 | 450 | 263.7 | 260 | 26 | 39 | 22.5 | 27 | 26 | 15 | 11.7 |
| BbjF | ng/g dw | 860 | 520 | 630 | 387.6 | 430 | 51 | 60 | 36.0 | 53 | 79 | 30 | 15.2 |
| BkF | ng/g dw | 260 | 210 | 250 | 121.2 | 140 | 14 | 24 | 10.0 | 13 | 25 | 8.2 | 5.2 |
| BeP | ng/g dw | 540 | 510 | 470 | 291.9 | 220 | 38 | 42 | 20.4 | 20 | 110 | 24 | 10.0 |
| BaP | ng/g dw | 590 | 400 | 510 | 228.9 | 290 | 28 | 29 | 17.3 | 21 | 74 | 16 | 7.2 |
| PER | ng/g dw | 170 | 73 | 90 | 78.0 | 100 | 15 | 17 | 27.6 | 36 | 55 | 26 | 28.1 |
| In123cdPY | ng/g dw | 360 | 340 | 320 | 159.5 | 230 | 31 | 31 | 18.3 | 28 | 110 | 30 | 6.4 |
| BDahANT | ng/g dw | 100 | 59 | 71 | 41.5 | 50 | 4 | 3.4 | 5.0 | 4.7 | 10 | 4.1 | 5.0 |
| BghiPER | ng/g dw | 570 | 480 | 280 | 187.9 | 250 | 37 | 26 | 20.0 | 31 | 560 | 36 | 20.0 |
| | | | | | | | | | | | | | |
| PCB31+28 | ng/g dw | 3 | 2.1 | 1.3 | 2.5 | 0.5 | 0.5 | 0.5 | 2.5 | 0.8 | 0.5 | 0.5 | 2.5 |
| CB52 | ng/g dw | 3.8 | 3.4 | 4 | 2.7 | 1.6 | 0.5 | 0.5 | 2.5 | 0.5 | 0.5 | 0.5 | 2.5 |
| CB101 | ng/g dw | 4.2 | 2.6 | 3.3 | 4.1 | 0.5 | 0.5 | 0.5 | 1.0 | 0.5 | 0.5 | 0.5 | 1.0 |
| CB118 | ng/g dw | 1.8 | 1.8 | 2.1 | 2.8 | 0.5 | 0.5 | 0.5 | 1.0 | 0.5 | 0.5 | 0.5 | 1.0 |
| CB153 | ng/g dw | 14 | 0.5 | 0.5 | 8.1 | 0.5 | 0.5 | 0.5 | 0.6 | 0.5 | 0.5 | 0.5 | 0.5 |
| CB105 | ng/g dw | | | | | | | | | | | | |
| CB138 | ng/g dw | 10 | 3.6 | 4.9 | 6.3 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| CB156 | ng/g dw | | | | | | | | | | | | |
| CB180 | ng/g dw | 11 | 2.8 | 3.4 | 4.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |

| Concentration of contaminants associated with suspended particulate matter (SPM) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample code | | | | | | | | | | | | | |
| | | Alna SPM 1 | Alna SPM 2 | Alna SPM 3 | Alna SPM 4 | Drammen SPM 1 | Drammen SPM 2 | Drammen SPM 3 | Drammen SPM 4 | Glomma SPM 1 | Glomma SPM 2 | Glomma SPM 3 | Glomma SPM 4 |
| BDE47 | ng/g dw | 0.52 | 0.8 | 0.91 | 1.1 | 0.2 | 0.2 | 0.2 | 0.17 | 0.2 | 0.2 | 0.2 | 0.1 |
| BDE99 | ng/g dw | 1.1 | 1.4 | 1.4 | 1.57 | 0.3 | 0.3 | 0.3 | 0.31 | 0.3 | 0.3 | 0.3 | 0.1 |
| BDE100 | ng/g dw | 0.2 | 0.2 | 0.23 | 0.32 | 0.2 | 0.2 | 0.2 | 0.1 | 0.2 | 0.2 | 0.2 | 0.1 |
| BDE153 | ng/g dw | 0.3 | | 0.25 | 0.29 | 0.3 | 0.2 | 0.2 | 0.1 | 0.3 | 0.2 | 0.2 | 0.1 |
| BDE154 | ng/g dw | 0.2 | 0.2 | 0.2 | 0.19 | 0.2 | 0.2 | 0.2 | 0.1 | 0.2 | 0.2 | 0.2 | 0.1 |
| BDE183 | ng/g dw | 0.8 | 0.36 | 0.3 | 0.41 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| BDE196 | ng/g dw | 0.3 | - | - | 0.4 | 0.3 | - | - | 0.3 | 0.3 | - | - | 0.3 |
| BDE209 | ng/g dw | 32 | 32 | 49 | | 7 | 2.3 | 4.5 | | 1.9 | 1 | 1.7 | |
| BDE126 | ng/g dw | 0.3 | 0.2 | 0.2 | 0.1 | 0.3 | 0.2 | 0.2 | 0.1 | 0.3 | 0.2 | 0.2 | 0.1 |
| aHBCD | ng/g dw | 5.4 | 7.5 | 5.2 | 2 | 0.5 | 0.5 | 0.5 | 2 | 0.5 | 0.5 | 0.5 | 2 |
| bHBCD | ng/g dw | 0.5 | 5.3 | 4.3 | 2 | 0.5 | 17.835 | 0.5 | 2 | 0.5 | 0.8 | 10 | 2 |
| gHBCD | ng/g dw | 5.2 | 1 | 1.3 | 2 | 0.5 | 0.5 | 0.5 | 2 | 0.5 | 2.4 | 1.3 | 2 |
| | | | | | | | | | | | | | |
| SCCP | ng/g dw | 550.0 | 564.0 | 365.0 | 1500 | 391 | 151 | 127 | 360 | 300 | 65 | 57 | 84 |
| MCCP | ng/g dw | 84.0 | 807.0 | 192.0 | 2500 | 105 | 269 | 1030 | 1400.0 | 50 | 140 | 95 | 6059 |
| BPA | ng/g dw | 103.8 | 333.9 | 200.2 | 84.22 | 4.813 | 2 | 1.687 | 2.41 | 1.726 | 1.469 | 1.247 | 22.6 |
| TBBPA | ng/g dw | 0.7 | 0.7 | 0.8 | 1.32 | 0.32 | 0.678 | 0.463 | 1 | 0.587 | 0.243 | 0.289 | 1 |

| PFC concentration in water samples (ng/l) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample code | | Alna W1 | Alna W2 | Alna W3 | Alna W4 | Alna W5 | Drammenselva W1 | Drammenselva W2 | Drammenselva W3 | Drammenselva W4 | Drammenselva W5 | Glomma W1 | Glomma W2 | Glomma W3 | Glomma W4 | Glomma W5 |
| Sampling date | | 10.02.2016 | 28.04.2016 | 28.04.2016 | 10.10.2016 | 12.12.2016 | 12.02.2016 | 21.04.2016 | 10.06.2016 | 06.10.2016 | 16.12.2016 | 28.01.2016 | 28.04.2016 | 09.06.2016 | 06.10.2016 | 12.12.2016 |
| PFHxA | | 0.2 | 1.49 | 1.8 | 2.6 | 1.9 | 0.49 | 0.3 | 0.2 | 0.5 | 0.5 | 0.25 | 0.2 | 0.2 | 0.5 | 0.5 |
| PFHpA | | 0.2 | 1.48 | 1.56 | 1.6 | 1.3 | 0.49 | 0.55 | 0.71 | 0.5 | 0.5 | 0.39 | 0.56 | 0.2 | 0.5 | 0.5 |
| PFOA | | 2.19 | 2.91 | 3.02 | 2.6 | 2 | 0.38 | 0.69 | 0.43 | 0.5 | 0.5 | 0.48 | 6.27 | 0.31 | 0.5 | 0.5 |
| PFNA | | 0.42 | 0.86 | 0.59 | 0.94 | 0.53 | 0.21 | 0.2 | 0.2 | 0.5 | 0.5 | 0.2 | 0.2 | 0.2 | 0.5 | 0.5 |
| PFDA | | 0.23 | 0.71 | 0.46 | 0.5 | 0.5 | 0.2 | 0.2 | 0.2 | 0.5 | 0.5 | 0.2 | 0.2 | 0.2 | 0.5 | 0.5 |
| PFUdA | | 0.2 | 0.2 | 0.2 | 0.5 | 0.5 | 0.2 | 0.2 | 0.2 | 0.5 | 0.5 | 0.2 | 0.2 | 0.2 | 0.5 | 0.5 |
| PFDoA | | 0.2 | 0.2 | 0.2 | 0.5 | 0.5 | 0.2 | 0.2 | 0.2 | 0.5 | 0.5 | 0.2 | 0.2 | 0.2 | 0.5 | 0.5 |
| PFTrA | | 0.2 | 0.2 | 0.2 | 0.5 | 0.5 | 0.2 | 0.2 | 0.2 | 0.5 | 0.5 | 0.2 | 0.2 | 0.2 | 0.5 | 0.5 |
| PFTeA | | 0.2 | 0.2 | 0.2 | 0.5 | 0.5 | 0.2 | 0.2 | 0.2 | 0.5 | 0.5 | 0.2 | 0.2 | 0.2 | 0.5 | 0.5 |
| PFBS | | 0.05 | 0.64 | 0.74 | 0.42 | 0.3 | 0.05 | 0.05 | 0.05 | 0.1 | 0.1 | 0.07 | 0.05 | 0.05 | 0.1 | 0.1 |
| PFHxS | | 0.53 | 1.19 | 0.92 | 0.61 | 0.45 | 0.05 | 0.05 | 0.05 | 0.1 | 0.1 | 0.05 | 0.06 | 0.05 | 0.1 | 0.1 |
| PFOS | | 1.45 | 6.68 | 2.99 | 2.97 | 1.7 | 0.27 | 0.38 | 0.24 | 0.21 | 0.17 | 0.14 | 0.21 | 0.08 | 0.37 | 0.11 |
| PFDS | | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 |
| PFDoS | | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 |
| PFOSA | | 0.4 | 0.1 | 0.1 | 0.1 | 0.1 | 0.27 | 0.51 | 0.56 | 0.1 | 0.1 | 0.22 | 0.92 | 0.39 | 0.1 | 0.1 |
| me-PFOSA | | 0.2 | 0.2 | 0.2 | 0.3 | 0.3 | 0.2 | 0.2 | 0.2 | 0.3 | 0.3 | 0.2 | 0.2 | 0.2 | 0.3 | 0.3 |
| et-PFOSA | | 0.2 | 0.2 | 0.2 | 0.3 | 0.3 | 0.2 | 0.2 | 0.2 | 0.3 | 0.3 | 0.2 | 0.2 | 0.2 | 0.3 | 0.3 |
| me-PFOSE | | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| et-PFOSE | | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| 6:2 FTS | | 0.35 | 0.32 | 0.41 | 0.54 | 0.3 | 0.2 | 0.26 | 0.2 | 0.3 | 0.3 | 0.2 | 0.2 | 0.2 | 0.3 | 0.3 |

# Table 2 Riverine inputs

## Table 2a. Riverine inputs from 155 Norwegian rivers in 2016

| River | Estimate | Flow rate | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1000 m3/d | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [kg] |
| **MAIN RIVERS (11)** | | | | | | | | | | | | | | | | | | | |
| Glomma ved Sarpsfoss | avg. | 57904.48 | 325130.37 | 86122.74 | 250.38 | 400.24 | 7487.73 | 274.85 | 12460.66 | 82122.38 | 0.05 | 4.29 | 7.83 | 0.26 | 33.21 | 187.65 | 17.84 | 7.08 | 10.86 |
| Alna | avg. | 102.08 | 364.31 | 172.32 | 2.01 | 2.62 | 33.60 | 6.09 | 60.34 | 272.42 | 0.00 | 0.01 | 0.02 | 0.00 | 0.11 | 0.40 | 0.04 | 0.02 | 0.04 |
| Drammenselva | avg. | 25869.80 | 40996.04 | 34030.48 | 49.51 | 91.89 | 2343.17 | 99.18 | 4262.55 | 29709.58 | 0.01 | 1.50 | 10.45 | 0.10 | 8.90 | 38.49 | 4.99 | 1.85 | 6.06 |
| Numedalslågen | avg. | 9675.18 | 9488.57 | 14398.93 | 11.54 | 24.77 | 593.81 | 101.82 | 1352.48 | 12561.60 | 0.01 | 0.54 | 0.66 | 0.04 | 2.09 | 10.08 | 1.21 | 0.50 | 5.18 |
| Skienselva | avg. | 24878.32 | 5616.31 | 22343.96 | 4.19 | 36.58 | 1050.33 | 68.66 | 2254.36 | 19041.63 | 0.01 | 0.91 | 0.88 | 0.08 | 12.99 | 30.34 | 1.76 | 0.55 | 2.95 |
| Otra | avg. | 13000.91 | 4119.45 | 12605.41 | 3.15 | 14.65 | 374.56 | 43.32 | 1030.46 | 6992.44 | 0.01 | 0.54 | 1.10 | 0.08 | 2.22 | 14.55 | 2.08 | 0.37 | 12.65 |
| Orreelva | avg. | 433.82 | 1930.08 | 949.90 | 4.13 | 11.95 | 83.18 | 6.30 | 224.11 | 297.67 | 0.00 | 0.05 | 0.08 | 0.00 | 0.27 | 0.58 | 0.19 | 0.03 | 0.15 |
| Vosso(Bolstadelvi) | avg. | 8483.83 | 1599.13 | 3367.32 | 1.88 | 8.89 | 267.41 | 19.40 | 571.63 | 2757.95 | 0.00 | 0.19 | 0.19 | 0.02 | 1.21 | 5.82 | 0.80 | 0.17 | 1.50 |
| Orkla | avg. | 3512.46 | 30635.10 | 6256.73 | 21.62 | 39.83 | 142.90 | 3.23 | 497.78 | 4216.27 | 0.00 | 0.36 | 0.40 | 0.05 | 7.66 | 16.31 | 2.62 | 2.01 | 0.87 |
| Vefsna | avg. | 11967.09 | 5367.21 | 7598.87 | 2.68 | 11.15 | 144.07 | 4.92 | 555.42 | 6149.02 | 0.27 | 0.47 | 0.16 | 0.01 | 1.35 | 1.30 | 0.98 | 0.40 | 1.77 |
| Altaelva | avg. | 10267.65 | 6927.23 | 15158.95 | 11.23 | 24.50 | 148.24 | 37.56 | 861.71 | 16125.52 | 0.00 | 0.50 | 0.10 | 0.00 | 2.14 | 1.11 | 1.15 | 0.99 | 0.89 |
| **TRIBUTARY RIVERS (36)** | | | | | | | | | | | | | | | | | | | |
| Tista utløp Femsjøen | avg. | 1490.86 | 1909.60 | 4573.84 | 5.66 | 11.00 | 244.64 | 0.00 | 460.83 | 2461.73 | 0.00 | 0.18 | 0.18 | 0.01 | 0.73 | 7.89 | 0.41 | 0.22 | 0.00 |
| Tokkeelva | avg. | 2003.43 | 471.22 | 3874.07 | 0.38 | 2.02 | 93.40 | 3.14 | 247.66 | 2183.17 | 0.00 | 0.14 | 0.17 | 0.02 | 0.37 | 3.42 | 0.30 | 0.10 | 0.82 |
| Nidelva(Rykene) | avg. | 9934.16 | 3531.96 | 13509.26 | 3.80 | 15.63 | 588.52 | 30.22 | 1262.77 | 8101.30 | 0.00 | 0.54 | 0.88 | 0.09 | 2.52 | 13.95 | 0.86 | 0.41 | 1.94 |
| Tovdalselva | avg. | 5116.83 | 2858.61 | 8953.07 | 1.20 | 7.90 | 189.76 | 31.06 | 587.71 | 3738.79 | 0.00 | 0.36 | 0.93 | 0.08 | 0.68 | 11.63 | 0.68 | 0.25 | 1.31 |
| Mandalselva | avg. | 6951.19 | 3602.60 | 10005.19 | 1.96 | 11.63 | 270.57 | 34.23 | 775.70 | 3412.54 | 0.00 | 0.39 | 1.09 | 0.06 | 0.83 | 10.54 | 0.40 | 0.24 | 2.95 |
| Lyngdalselva | avg. | 2391.00 | 1308.49 | 3188.32 | 1.20 | 4.75 | 136.62 | 6.78 | 294.98 | 1265.45 | 0.00 | 0.15 | 0.38 | 0.03 | 0.21 | 4.21 | 0.12 | 0.05 | 0.85 |
| Kvina | avg. | 5738.20 | 8769.83 | 9034.26 | 8.00 | 19.92 | 287.15 | 18.63 | 755.52 | 2513.28 | 0.01 | 0.38 | 1.17 | 0.06 | 1.47 | 11.36 | 0.35 | 0.14 | 2.21 |
| Sira | avg. | 10993.11 | 2145.08 | 7594.65 | 0.00 | 14.93 | 322.44 | 58.34 | 810.98 | 3371.96 | 0.00 | 0.32 | 1.06 | 0.05 | 0.87 | 9.44 | 0.32 | 0.23 | 6.67 |
| Bjerkreimselva | avg. | 3804.13 | 779.18 | 2401.10 | 2.46 | 7.45 | 456.63 | 10.03 | 675.01 | 1916.82 | 0.00 | 0.13 | 0.24 | 0.03 | 0.42 | 3.94 | 0.33 | 0.08 | 1.31 |
| Figgjoelva | avg. | 493.93 | 2427.57 | 834.25 | 6.27 | 11.32 | 245.98 | 20.89 | 349.49 | 536.04 | 0.00 | 0.04 | 0.25 | 0.01 | 0.44 | 2.55 | 0.14 | 0.07 | 0.19 |
| Lyseelva | avg. | 1254.18 | 141.23 | 470.29 | 0.58 | 1.30 | 68.12 | 0.90 | 110.25 | 625.16 | 0.00 | 0.02 | 0.07 | 0.00 | 0.14 | 0.84 | 0.03 | 0.03 | 0.83 |

| River | Estimate | Flow rate | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1000 m3/d | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [kg] |
| Årdalselva | avg. | 3770.90 | 416.43 | 1599.81 | 0.00 | 4.20 | 217.23 | 0.00 | 343.79 | 1769.25 | 0.00 | 0.07 | 0.32 | 0.01 | 0.71 | 2.62 | 0.21 | 0.07 | 0.00 |
| Ulladalsåna (Ulla) | avg. | 3018.40 | 728.92 | 1910.21 | 0.00 | 2.57 | 95.96 | 3.60 | 222.50 | 1782.55 | 0.00 | 0.08 | 0.10 | 0.01 | 0.63 | 2.62 | 0.46 | 0.06 | 0.00 |
| Suldalslågen | avg. | 10153.61 | 16782.89 | 6279.35 | 16.44 | 30.50 | 520.66 | 10.59 | 955.37 | 3923.70 | 0.00 | 0.29 | 0.83 | 0.06 | 1.68 | 13.65 | 0.90 | 0.44 | 5.29 |
| Saudaelva | avg. | 2991.51 | 295.55 | 1234.70 | 0.00 | 1.25 | 421.20 | 1.39 | 544.69 | 1351.11 | 0.00 | 0.09 | 0.07 | 0.06 | 1.03 | 21.51 | 0.12 | 0.03 | 0.00 |
| Vikedalselva | avg. | 852.82 | 416.57 | 469.54 | 0.34 | 1.26 | 64.25 | 6.02 | 107.84 | 292.11 | 0.00 | 0.06 | 0.06 | 0.01 | 0.13 | 0.71 | 0.12 | 0.02 | 0.19 |
| Jostedøla | avg. | 5839.06 | 28850.38 | 2181.71 | 38.34 | 41.05 | 174.95 | 0.00 | 346.90 | 6368.67 | 0.00 | 0.11 | 0.44 | 0.01 | 1.64 | 4.32 | 1.15 | 1.27 | 0.67 |
| Gaular | avg. | 5271.24 | 1234.58 | 2778.72 | 2.26 | 8.45 | 171.63 | 6.10 | 388.17 | 1903.05 | 0.00 | 0.06 | 0.08 | 0.01 | 0.42 | 2.89 | 0.27 | 0.08 | 0.00 |
| Jølstra | avg. | 5405.56 | 1201.31 | 2245.44 | 1.84 | 7.96 | 220.61 | 5.88 | 435.95 | 2106.82 | 0.00 | 0.07 | 0.06 | 0.01 | 0.43 | 2.65 | 0.19 | 0.06 | 1.57 |
| Nausta | avg. | 2081.41 | 651.16 | 979.00 | 1.26 | 3.27 | 73.72 | 1.43 | 151.00 | 873.94 | 0.00 | 0.02 | 0.05 | 0.00 | 0.15 | 1.28 | 0.10 | 0.03 | 0.29 |
| Gloppenelva(Breimselva) | avg. | 4156.64 | 1719.96 | 1358.49 | 2.30 | 6.47 | 240.21 | 5.03 | 400.34 | 2222.84 | 0.00 | 0.06 | 0.03 | 0.00 | 0.42 | 1.00 | 0.20 | 0.08 | 0.00 |
| Driva | avg. | 5648.23 | 3543.53 | 2281.42 | 3.01 | 6.20 | 271.18 | 3.93 | 476.66 | 5928.91 | 0.00 | 0.10 | 0.07 | 0.00 | 1.27 | 0.88 | 0.40 | 0.47 | 1.17 |
| Surna | avg. | 4109.77 | 4114.70 | 5246.81 | 2.73 | 9.93 | 77.46 | 1.29 | 300.96 | 2311.97 | 0.00 | 0.07 | 0.07 | 0.00 | 0.99 | 0.74 | 0.59 | 0.35 | 0.00 |
| Gaula | avg. | 7162.68 | 20021.36 | 14526.97 | 21.00 | 36.48 | 313.33 | 34.71 | 993.11 | 8960.13 | 0.00 | 0.52 | 0.41 | 0.03 | 4.35 | 8.37 | 4.81 | 1.62 | 3.80 |
| Nidelva(Tr.heim) | avg. | 6825.29 | 2895.37 | 6691.41 | 2.02 | 8.53 | 180.45 | 7.34 | 510.47 | 4592.69 | 0.00 | 0.18 | 0.06 | 0.00 | 1.68 | 1.22 | 1.70 | 0.50 | 1.83 |
| Stjørdalselva | avg. | 4491.86 | 22679.96 | 8646.09 | 20.48 | 26.97 | 392.44 | 5.11 | 772.38 | 4309.32 | 0.00 | 0.29 | 0.41 | 0.02 | 3.36 | 6.54 | 1.93 | 1.33 | 1.87 |
| Verdalselva | avg. | 2721.06 | 12051.39 | 4696.14 | 11.75 | 14.77 | 83.71 | 4.48 | 270.08 | 2317.76 | 0.00 | 0.20 | 0.26 | 0.01 | 1.15 | 1.96 | 1.04 | 0.64 | 1.12 |
| Snåsavassdraget | avg. | 1953.46 | 1394.02 | 3459.19 | 1.43 | 3.97 | 90.77 | 1.26 | 236.47 | 990.53 | 0.00 | 0.09 | 0.06 | 0.00 | 0.46 | 0.46 | 0.36 | 0.13 | 0.30 |
| Namsen | avg. | 3155.72 | 3960.81 | 4076.28 | 2.20 | 7.45 | 37.43 | 2.33 | 206.60 | 1858.78 | 0.00 | 0.10 | 0.12 | 0.00 | 0.92 | 1.87 | 0.56 | 0.39 | 0.71 |
| Røssåga | avg. | 7889.19 | 1706.16 | 3649.39 | 3.03 | 5.60 | 108.98 | 5.46 | 371.14 | 2783.70 | 0.00 | 0.21 | 0.16 | 0.02 | 1.04 | 6.22 | 1.23 | 0.13 | 0.98 |
| Ranaelva | avg. | 18533.02 | 3293.94 | 7986.62 | 6.08 | 12.13 | 230.01 | 13.92 | 779.92 | 9123.52 | 0.01 | 0.42 | 0.13 | 0.02 | 2.09 | 4.31 | 2.26 | 0.48 | 3.17 |
| Beiarelva | avg. | 3870.80 | 12687.38 | 1856.50 | 6.66 | 9.47 | 45.47 | 2.54 | 175.17 | 3760.71 | 0.00 | 0.24 | 0.18 | 0.00 | 1.03 | 2.35 | 1.13 | 0.77 | 0.71 |
| Målselv | avg. | 7931.01 | 7823.25 | 5452.29 | 9.79 | 18.23 | 130.78 | 4.69 | 456.29 | 8338.52 | 0.00 | 0.12 | 0.15 | 0.01 | 1.70 | 1.31 | 1.40 | 0.54 | 0.86 |
| Barduelva | avg. | 7202.35 | 4320.67 | 4018.98 | 3.95 | 10.84 | 141.02 | 5.67 | 514.16 | 5484.60 | 0.00 | 0.07 | 0.05 | 0.00 | 1.23 | 0.78 | 0.95 | 0.14 | 0.90 |
| Tanaelva | avg. | 17463.93 | 52892.57 | 39423.75 | 21.26 | 89.13 | 63.31 | 25.36 | 3537.10 | 38897.01 | 0.00 | 0.35 | 0.40 | 0.03 | 4.51 | 5.28 | 4.01 | 2.95 | 0.00 |

| River | Estimate | Flow rate | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1000 m3/d | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [kg] |
| Pasvikelva | avg. | 14669.14 | 9170.59 | 18792.49 | 11.22 | 33.60 | 193.24 | 97.89 | 1363.89 | 27921.09 | 0.00 | 1.25 | 0.34 | 0.08 | 25.47 | 8.35 | 148.90 | 0.79 | 0.00 |
| **TRIBUTARY RIVERS (108)** | | | | | | | | | | | | | | | | | | | |
| Mosselva | avg. | 674.67 | 1661.62 | 1790.23 | 0.83 | 6.89 | 126.30 | 9.14 | 263.84 | 325.42 | nan | 0.09 | 0.07 | 0.00 | 0.37 | 0.29 | 0.27 | 0.12 | 0.16 |
| Hølenelva | avg. | 94.89 | 341.74 | 345.64 | 1.16 | 2.95 | 48.93 | 1.41 | 66.99 | 307.36 | nan | 0.02 | 0.02 | 0.00 | 0.09 | 0.18 | 0.10 | 0.00 | 0.09 |
| Årungelva | avg. | 41.58 | 75.79 | 88.15 | 0.11 | 0.64 | 32.57 | 0.02 | 46.12 | 35.87 | nan | 0.01 | 0.00 | 0.00 | 0.03 | 0.02 | 0.03 | 0.00 | 0.01 |
| Gjersjøelva | avg. | 70.69 | 45.28 | 184.66 | 0.04 | 0.20 | 30.57 | 0.63 | 41.20 | 91.48 | nan | 0.01 | 0.00 | 0.00 | 0.04 | 0.01 | 0.05 | 0.00 | 0.02 |
| Ljanselva | avg. | 49.41 | 225.15 | 108.50 | 0.55 | 1.36 | 14.78 | 0.94 | 26.81 | 110.44 | nan | 0.01 | 0.00 | 0.00 | 0.07 | 0.00 | 0.04 | 0.01 | 0.08 |
| Akerselva | avg. | 271.15 | 115.32 | 405.57 | 0.30 | 2.28 | 21.19 | 3.62 | 54.78 | 343.80 | nan | 0.02 | 0.06 | 0.00 | 0.15 | 0.50 | 0.05 | 0.00 | 0.33 |
| Frognerelva | avg. | 24.10 | 53.46 | 35.68 | 0.35 | 0.46 | 10.78 | 0.59 | 13.39 | 54.82 | nan | 0.00 | 0.00 | 0.00 | 0.05 | 0.02 | 0.01 | 0.00 | 0.03 |
| Lysakerelva | avg. | 229.15 | 87.23 | 410.13 | 0.34 | 0.20 | 15.33 | 2.10 | 24.66 | 195.20 | nan | 0.03 | 0.02 | 0.00 | 0.00 | 0.00 | 0.04 | 0.03 | 0.05 |
| Sandvikselva | avg. | 240.03 | 166.91 | 456.82 | 0.70 | 1.84 | 15.46 | 2.64 | 27.94 | 395.32 | nan | 0.02 | 0.03 | 0.00 | 0.12 | 0.00 | 0.05 | 0.03 | 0.13 |
| Åroselva | avg. | 142.36 | 312.63 | 299.35 | 0.73 | 1.40 | 82.45 | 3.83 | 82.27 | 337.20 | nan | 0.03 | 0.02 | 0.00 | 0.10 | 0.19 | 0.06 | 0.04 | 0.05 |
| Lierelva | avg. | 300.73 | 4074.00 | 649.39 | 2.42 | 4.60 | 99.06 | 2.86 | 121.07 | 792.47 | nan | 0.06 | 0.05 | 0.01 | 0.21 | 1.10 | 0.15 | 0.18 | 0.11 |
| Sandeelva | avg. | 237.32 | 488.15 | 387.83 | 0.69 | 1.61 | 36.48 | 4.34 | 56.46 | 547.22 | nan | 0.05 | 0.08 | 0.01 | 0.20 | 4.33 | 0.10 | 0.07 | 0.06 |
| Aulielva | avg. | 412.54 | 1253.22 | 875.74 | 3.02 | 25.20 | 271.48 | 14.50 | 360.11 | 1223.02 | nan | 0.16 | 0.06 | 0.00 | 0.26 | 0.94 | 0.37 | 0.35 | 0.16 |
| Farriselva-Siljanvassdraget | avg. | 1096.22 | 277.06 | 1912.47 | 0.42 | 2.41 | 134.79 | 2.10 | 218.26 | 1484.50 | nan | 0.06 | 0.00 | 0.01 | 0.00 | 4.09 | 0.02 | 0.03 | 0.04 |
| Gjerstadelva | avg. | 883.08 | 381.38 | 1519.07 | 0.42 | 1.79 | 68.84 | 8.66 | 132.19 | 712.21 | nan | 0.09 | 0.14 | 0.01 | 0.23 | 1.53 | 0.24 | 0.03 | 0.50 |
| Vegårdselva | avg. | 915.08 | 458.84 | 1818.41 | 0.59 | 2.01 | 46.27 | 3.45 | 104.75 | 566.97 | nan | 0.08 | 0.12 | 0.01 | 0.20 | 0.07 | 0.18 | 0.03 | 0.33 |
| Søgneelva-Songdalselva | avg. | 741.46 | 322.94 | 1194.05 | 0.54 | 2.47 | 134.87 | 7.87 | 195.39 | 494.29 | nan | 0.08 | 0.12 | 0.01 | 0.18 | 1.45 | 0.14 | 0.00 | 0.20 |
| Audnedalselva | avg. | 1117.97 | 450.10 | 1493.50 | 0.41 | 2.66 | 130.94 | 4.57 | 196.41 | 374.01 | nan | 0.08 | 0.19 | 0.01 | 0.16 | 2.35 | 0.08 | 0.00 | 0.41 |
| Soknedalselva | avg. | 1720.61 | 547.88 | 1177.62 | 1.26 | 4.41 | 168.46 | 13.85 | 232.06 | 854.65 | nan | 0.09 | 0.18 | 0.01 | 0.31 | 2.02 | 2.12 | 0.00 | 0.36 |
| Hellelandselva | avg. | 1296.86 | 420.07 | 1108.31 | 1.30 | 3.80 | 149.52 | 4.98 | 206.00 | 457.70 | nan | 0.07 | 0.21 | 0.01 | 0.20 | 1.58 | 0.13 | 0.00 | 0.54 |
| Håelva | avg. | 362.52 | 342.32 | 636.87 | 2.26 | 5.11 | 141.30 | 8.36 | 235.77 | 398.04 | nan | 0.05 | 0.02 | 0.00 | 0.12 | 0.53 | 0.05 | 0.00 | 0.10 |
| Imselva | avg. | 311.50 | 107.17 | 387.63 | 0.10 | 0.86 | 62.93 | 1.88 | 85.73 | 53.75 | nan | 0.02 | 0.02 | 0.00 | 0.06 | 0.26 | 0.03 | 0.02 | 0.08 |

| River | Estimate | Flow rate | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1000 m3/d | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [kg] |
| Oltedalselva,utløp Ragsvatnet | avg. | 730.27 | 208.48 | 375.53 | 0.44 | 2.67 | 77.51 | 3.21 | 90.81 | 494.46 | nan | 0.02 | 0.05 | 0.00 | 0.11 | 0.79 | 0.04 | 0.00 | 0.00 |
| Dirdalsåna | avg. | 1142.40 | 181.88 | 505.92 | 0.32 | 1.15 | 99.51 | 1.18 | 133.17 | 537.58 | nan | 0.05 | 0.08 | 0.00 | 0.12 | 0.53 | 0.05 | 0.00 | 0.24 |
| Frafjordelva | avg. | 1287.00 | 231.24 | 612.36 | 0.50 | 1.45 | 89.50 | 4.95 | 122.94 | 452.20 | nan | 0.04 | 0.10 | 0.01 | 0.14 | 0.45 | 0.05 | 0.00 | 0.31 |
| Espedalselva | avg. | 997.79 | 175.29 | 405.36 | 0.29 | 1.46 | 72.67 | 1.64 | 113.21 | 663.87 | nan | 0.02 | 0.04 | 0.00 | 0.02 | 0.17 | 0.02 | 0.02 | 0.24 |
| Førrelva | avg. | 1251.91 | 117.82 | 822.46 | 0.26 | 1.60 | 44.45 | 0.69 | 60.48 | 775.66 | nan | 0.03 | 0.08 | 0.00 | 0.14 | 0.41 | 0.04 | 0.05 | 0.00 |
| Åbøelva | avg. | 694.91 | 101.74 | 228.90 | 0.25 | 0.55 | 22.89 | 0.00 | 32.37 | 179.85 | nan | 0.01 | 0.01 | 0.00 | 0.07 | 0.24 | 0.04 | 0.01 | 0.15 |
| Etneelva | avg. | 1495.82 | 279.21 | 497.29 | 0.49 | 1.44 | 156.30 | 5.20 | 221.45 | 469.26 | nan | 0.09 | 0.02 | 0.00 | 0.23 | 0.60 | 0.12 | 0.00 | 0.24 |
| Opo | avg. | 4168.34 | 4323.21 | 1182.35 | 2.27 | 3.59 | 143.30 | 12.97 | 302.07 | 1340.36 | nan | 0.09 | 0.57 | 0.00 | 0.62 | 2.43 | 0.26 | 0.00 | 1.53 |
| Tysso | avg. | 2611.76 | 395.78 | 1548.56 | 0.62 | 0.00 | 115.66 | 4.78 | 162.50 | 1310.95 | nan | 0.06 | 0.10 | 0.00 | 0.75 | 3.25 | 0.20 | 0.00 | 1.12 |
| Kinso | avg. | 1310.52 | 239.82 | 239.82 | 0.31 | 0.03 | 12.50 | 1.44 | 52.28 | 239.82 | nan | 0.02 | 0.00 | 0.00 | 0.00 | 0.03 | 0.03 | 0.10 | 0.24 |
| Veig | avg. | 2313.22 | 448.22 | 749.78 | 0.50 | 2.12 | 38.95 | 2.54 | 76.26 | 925.26 | nan | 0.04 | 0.06 | 0.01 | 0.32 | 0.00 | 0.29 | 0.01 | 0.42 |
| Bjoreio | avg. | 2760.95 | 530.52 | 2127.11 | 0.60 | 3.03 | 59.62 | 4.04 | 149.05 | 1039.38 | nan | 0.05 | 0.09 | 0.01 | 0.44 | 1.43 | 0.40 | 0.00 | 0.12 |
| Sima | avg. | 676.25 | 122.30 | 128.21 | 0.24 | 0.68 | 27.97 | 0.74 | 39.11 | 466.72 | nan | 0.01 | 0.02 | 0.00 | 0.07 | 0.24 | 0.04 | 0.00 | 0.12 |
| Austdøla | avg. | 704.38 | 98.43 | 110.86 | 0.52 | 0.00 | 30.94 | 1.29 | 41.25 | 165.73 | nan | 0.01 | 0.02 | 0.00 | 0.03 | 0.28 | 0.03 | 0.01 | 0.17 |
| Nordøla /Austdøla | avg. | 211.31 | 46.40 | 16.24 | 0.06 | 0.00 | 8.38 | 0.23 | 10.63 | 111.87 | nan | 0.01 | 0.00 | 0.00 | 0.02 | 0.02 | 0.02 | 0.02 | 0.03 |
| Tysselvi Samnangervassdraget | avg. | 1696.94 | 372.65 | 993.73 | 0.47 | 2.08 | 58.38 | 3.73 | 108.69 | 299.45 | nan | 0.05 | 0.10 | 0.01 | 0.18 | 0.87 | 0.10 | 0.00 | 0.62 |
| Oselva (HOREOSL) | avg. | 763.62 | 299.05 | 915.46 | 0.70 | 2.79 | 43.32 | 2.38 | 95.03 | 281.48 | nan | 0.03 | 0.06 | 0.00 | 0.28 | 0.00 | 0.06 | 0.00 | 0.08 |
| DaleelviBergsdalsvassdraget | avg. | 1520.88 | 339.55 | 626.22 | 0.42 | 0.87 | 45.37 | 3.34 | 86.28 | 367.38 | nan | 0.03 | 0.11 | 0.00 | 0.28 | 1.33 | 0.13 | 0.07 | 0.11 |
| Ekso -Storelvi | avg. | 3434.95 | 727.60 | 1615.49 | 1.75 | 5.03 | 99.95 | 6.29 | 208.69 | 686.97 | nan | 0.02 | 0.16 | 0.01 | 0.00 | 0.00 | 0.16 | 0.08 | 0.14 |
| Modalselva -Moelvi | avg. | 3263.36 | 597.19 | 1039.42 | 0.76 | 4.18 | 146.91 | 5.97 | 209.02 | 853.14 | nan | 0.00 | 0.18 | 0.01 | 0.00 | 0.28 | 0.17 | 0.07 | 0.00 |
| Nærøydalselvi | avg. | 1680.33 | 282.18 | 356.02 | 0.63 | 1.84 | 75.03 | 2.46 | 104.55 | 1449.64 | nan | 0.01 | 0.04 | 0.00 | 0.25 | 0.80 | 0.08 | 0.00 | 0.20 |
| Flåmselvi | avg. | 1046.93 | 303.66 | 160.32 | 0.27 | 0.63 | 35.25 | 1.92 | 52.50 | 279.72 | nan | 0.01 | 0.03 | 0.00 | 0.15 | 0.38 | 0.10 | 0.00 | 0.02 |

| River | Estimate | Flow rate | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1000 m3/d | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [kg] |
| Aurlandselvi | avg. | 3041.81 | 656.85 | 673.92 | 0.72 | 2.78 | 140.28 | 5.57 | 178.13 | 1102.17 | nan | 0.03 | 0.09 | 0.00 | 0.35 | 1.22 | 0.21 | 0.00 | 0.14 |
| Erdalselvi | avg. | 349.19 | 57.51 | 112.28 | 0.16 | 0.00 | 0.46 | 0.22 | 15.59 | 154.73 | nan | 0.00 | 0.01 | 0.00 | 0.03 | 0.03 | 0.02 | 0.00 | 0.02 |
| Lærdalselva /Mjeldo | avg. | 2965.58 | 911.74 | 792.34 | 0.88 | 2.22 | 124.60 | 5.43 | 208.40 | 1814.17 | nan | 0.05 | 0.04 | 0.00 | 0.46 | 0.28 | 0.17 | 0.16 | 0.00 |
| Årdalselvi | avg. | 3487.98 | 1787.24 | 893.62 | 0.72 | 5.23 | 85.57 | 8.94 | 144.91 | 1864.75 | nan | 0.02 | 0.01 | 0.01 | 1.28 | 1.28 | 0.28 | 0.00 | 0.38 |
| Fortundalselva | avg. | 2316.42 | 2306.37 | 452.17 | 0.85 | 2.80 | 80.54 | 2.54 | 122.08 | 1071.87 | nan | 0.03 | 0.12 | 0.00 | 0.76 | 1.27 | 0.15 | 0.13 | 0.42 |
| Mørkrisdalselvi | avg. | 1285.89 | 2041.61 | 203.94 | 0.46 | 0.94 | 48.48 | 1.88 | 70.12 | 615.19 | nan | 0.01 | 0.06 | 0.00 | 0.24 | 0.66 | 0.19 | 0.13 | 0.03 |
| Årøyelva | avg. | 2641.05 | 869.96 | 579.98 | 0.64 | 3.48 | 72.88 | 5.80 | 132.43 | 1201.38 | nan | 0.03 | 0.06 | 0.00 | 0.29 | 1.03 | 0.10 | 0.00 | 0.00 |
| Sogndalselva | avg. | 1018.52 | 287.04 | 168.99 | 0.75 | 2.24 | 43.24 | 1.86 | 74.56 | 335.50 | nan | 0.01 | 0.04 | 0.00 | 0.15 | 0.56 | 0.06 | 0.00 | 0.04 |
| Oselva (SFJEOSE) | avg. | 2274.02 | 565.96 | 2080.73 | 0.58 | 3.95 | 39.95 | 9.99 | 133.17 | 269.31 | nan | 0.07 | 0.06 | 0.00 | 0.27 | 1.41 | 0.26 | 0.04 | 0.62 |
| Hopselva | avg. | 680.72 | 133.29 | 174.40 | 0.11 | 0.50 | 23.30 | 1.25 | 33.26 | 96.10 | nan | 0.01 | 0.03 | 0.00 | 0.04 | 0.27 | 0.02 | 0.01 | 0.21 |
| Ååelva (Gjengedalselva) | avg. | 1566.60 | 298.15 | 854.33 | 0.40 | 2.29 | 37.84 | 3.44 | 75.69 | 174.85 | nan | 0.04 | 0.03 | 0.00 | 0.11 | 0.38 | 0.06 | 0.02 | 1.00 |
| Oldenelva | avg. | 1360.93 | 722.66 | 398.48 | 0.32 | 1.99 | 72.97 | 5.28 | 109.08 | 565.70 | nan | 0.00 | 0.04 | 0.00 | 0.14 | 0.35 | 0.06 | 0.00 | 0.00 |
| Loelvi | avg. | 1572.64 | 633.14 | 311.77 | 0.17 | 2.96 | 61.59 | 2.30 | 97.85 | 777.04 | nan | 0.03 | 0.05 | 0.00 | 0.23 | 0.35 | 0.05 | 0.10 | 0.00 |
| Stryneelva | avg. | 3205.76 | 1466.63 | 618.92 | 0.51 | 4.69 | 123.20 | 7.04 | 221.76 | 1357.68 | nan | 0.05 | 0.07 | 0.00 | 0.71 | 0.73 | 0.11 | 0.00 | 0.78 |
| Hornindalselva(Horndøla) | avg. | 2486.73 | 659.85 | 1092.17 | 0.61 | 3.64 | 104.21 | 6.83 | 172.02 | 1222.19 | nan | 0.07 | 0.03 | 0.00 | 0.30 | 0.61 | 0.23 | 0.00 | 0.61 |
| Ørstaelva | avg. | 950.08 | 278.18 | 462.48 | 0.22 | 7.62 | 46.94 | 4.87 | 80.33 | 570.03 | nan | 0.01 | 0.00 | 0.00 | 0.11 | 0.47 | 0.10 | 0.00 | 0.35 |
| Valldøla | avg. | 1854.24 | 407.19 | 339.33 | 0.37 | 1.60 | 0.00 | 3.39 | 0.00 | 639.87 | nan | 0.03 | 0.00 | 0.00 | 0.26 | 0.52 | 0.05 | 0.10 | 0.00 |
| Rauma | avg. | 5317.72 | 898.29 | 1323.47 | 0.97 | 3.65 | 33.09 | 9.73 | 107.90 | 2669.19 | nan | 0.10 | 0.00 | 0.00 | 0.78 | 0.54 | 0.22 | 0.00 | 0.00 |
| Isa | avg. | 782.02 | 183.18 | 228.97 | 0.22 | 1.00 | 4.03 | 0.29 | 4.72 | 466.13 | nan | 0.01 | 0.02 | 0.00 | 0.12 | 0.02 | 0.04 | 0.04 | 0.29 |
| Eira | avg. | 4615.63 | 552.87 | 1000.45 | 0.84 | 2.75 | 189.20 | 8.45 | 250.58 | 2823.58 | nan | 0.03 | 0.14 | 0.00 | 0.68 | 0.34 | 0.13 | 0.07 | 1.13 |
| Litledalselva | avg. | 765.47 | 142.24 | 168.10 | 0.22 | 0.64 | 39.08 | 0.84 | 32.78 | 1003.58 | nan | 0.00 | 0.00 | 0.00 | 0.08 | 0.06 | 0.03 | 0.06 | 0.00 |
| Ålvunda | avg. | 736.91 | 312.86 | 458.51 | 0.27 | 1.35 | 35.47 | 1.75 | 61.49 | 664.64 | nan | 0.01 | 0.03 | 0.00 | 0.25 | 0.34 | 0.04 | 0.02 | 0.35 |
| Toåa | avg. | 929.47 | 186.13 | 374.20 | 0.27 | 0.91 | 9.36 | 0.60 | 38.61 | 437.38 | nan | 0.01 | 0.01 | 0.00 | 0.12 | 0.07 | 0.02 | 0.00 | 0.00 |
| Bøvra | avg. | 832.23 | 271.09 | 776.72 | 0.20 | 0.30 | 26.96 | 1.68 | 64.27 | 356.81 | nan | 0.01 | 0.00 | 0.00 | 0.15 | 0.00 | 0.06 | 0.01 | 0.09 |

| River | Estimate | Flow rate | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1000 m3/d | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [kg] |
| Børselva (FINEBØR) | avg. | 1054.95 | 270.28 | 386.11 | 0.39 | 0.00 | 3.51 | 4.25 | 25.48 | 1158.33 | nan | 0.00 | 0.00 | 0.00 | 0.04 | 0.37 | 0.08 | 0.00 | 0.13 |
| Vigda | avg. | 294.36 | 1065.50 | 401.31 | 0.15 | 1.94 | 24.24 | 0.75 | 44.71 | 171.99 | nan | 0.03 | 0.00 | 0.00 | 0.13 | 0.00 | 0.00 | 0.00 | 0.13 |
| Homla | avg. | 345.67 | 137.90 | 714.81 | 0.03 | 1.27 | 6.45 | 2.02 | 32.26 | 187.06 | nan | 0.07 | 0.00 | 0.00 | 0.13 | 0.00 | 0.06 | 0.01 | 0.21 |
| Gråe | avg. | 197.33 | 140.83 | 353.89 | 0.50 | 0.72 | 27.48 | 1.61 | 46.84 | 13.93 | nan | 0.02 | 0.00 | 0.00 | 0.08 | 0.00 | 0.03 | 0.03 | 0.03 |
| Figgja | avg. | 506.02 | 1161.22 | 1414.95 | 0.93 | 2.41 | 54.63 | 1.85 | 86.12 | 277.80 | nan | 0.04 | 0.04 | 0.00 | 0.20 | 0.12 | 0.15 | 0.10 | 0.03 |
| Årgårdselva | avg. | 1654.12 | 1816.22 | 3632.44 | 1.82 | 10.29 | 46.01 | 10.29 | 204.63 | 908.11 | nan | 0.01 | 0.04 | 0.00 | 0.41 | 0.19 | 0.23 | 0.00 | 1.42 |
| Moelva(Salsvatenelva) | avg. | 1582.77 | 252.78 | 1129.62 | 0.42 | 0.00 | 34.76 | 2.90 | 74.73 | 579.29 | nan | 0.04 | 0.00 | 0.00 | 0.16 | 0.59 | 0.18 | 0.19 | 0.19 |
| Åelva(Åbjøra) | avg. | 2039.82 | 619.66 | 1343.83 | 0.75 | 2.69 | 18.66 | 6.79 | 69.43 | 383.95 | nan | 0.07 | 0.03 | 0.00 | 0.26 | 0.43 | 0.12 | 0.21 | 0.25 |
| Skjerva | avg. | 371.92 | 272.25 | 462.82 | 1.00 | 1.72 | 13.61 | 9.60 | 47.71 | 202.73 | nan | 0.04 | 0.04 | 0.00 | 0.14 | 0.25 | 0.13 | 0.00 | 0.30 |
| Fusta | avg. | 2173.72 | 930.83 | 875.14 | 0.80 | 3.98 | 15.51 | 16.36 | 86.32 | 361.09 | nan | 0.12 | 0.00 | 0.00 | 0.11 | 0.35 | 0.18 | 0.02 | 0.68 |
| Drevja | avg. | 704.56 | 515.74 | 232.08 | 0.52 | 0.52 | 4.20 | 0.77 | 26.04 | 79.20 | nan | 0.01 | 0.00 | 0.00 | 0.10 | 0.06 | 0.06 | 0.00 | 0.09 |
| Bjerkaelva | avg. | 1455.36 | 346.58 | 1012.06 | 0.53 | 0.27 | 10.12 | 3.73 | 51.67 | 445.15 | nan | 0.04 | 0.04 | 0.00 | 0.36 | 0.42 | 0.28 | 0.08 | 0.36 |
| Dalselva | avg. | 1016.76 | 236.93 | 632.63 | 0.37 | 1.49 | 2.47 | 2.60 | 35.17 | 330.93 | nan | 0.00 | 0.00 | 0.00 | 0.14 | 0.05 | 0.19 | 0.01 | 0.21 |
| Fykanåga | avg. | 1626.77 | 194.86 | 218.31 | 0.60 | 1.79 | 25.01 | 4.17 | 50.61 | 318.96 | nan | 0.01 | 0.00 | 0.00 | 0.07 | 0.38 | 0.00 | 0.00 | 0.00 |
| Saltelva | avg. | 5437.83 | 9971.13 | 1393.17 | 3.98 | 8.46 | 61.70 | 9.95 | 173.15 | 3155.96 | nan | 0.22 | 0.42 | 0.00 | 0.46 | 2.99 | 1.15 | 0.00 | 0.66 |
| SulitjelmavassdragetUtl Øvrevt | avg. | 2722.53 | 210.16 | 697.51 | 0.63 | 0.36 | 13.02 | 6.98 | 73.74 | 797.16 | nan | 0.07 | 0.00 | 0.03 | 0.00 | 0.00 | 0.28 | 0.00 | 0.66 |
| Kobbelva | avg. | 1337.46 | 244.75 | 195.80 | 0.49 | 0.08 | 14.20 | 1.96 | 34.76 | 461.54 | nan | 0.00 | 0.00 | 0.00 | 0.02 | 0.15 | 0.08 | 0.00 | 0.16 |
| Elvegårdselva | avg. | 3152.88 | 611.60 | 1846.33 | 1.15 | 4.04 | 13.85 | 8.08 | 69.24 | 1755.66 | nan | 0.14 | 0.10 | 0.01 | 0.58 | 1.62 | 0.38 | 0.00 | 0.77 |
| Spanselva | avg. | 389.63 | 114.08 | 128.34 | 0.14 | 0.50 | 3.14 | 0.43 | 11.84 | 180.29 | nan | 0.01 | 0.02 | 0.00 | 0.07 | 0.11 | 0.07 | 0.02 | 0.05 |
| Salangselva | avg. | 1640.97 | 504.50 | 600.60 | 0.60 | 0.60 | 9.78 | 3.00 | 43.24 | 437.58 | nan | 0.00 | 0.00 | 0.00 | 0.15 | 0.20 | 0.20 | 0.05 | 0.20 |
| Lakselva(Rossfjordelva) | avg. | 470.90 | 149.95 | 310.23 | 0.17 | 0.12 | 1.21 | 1.38 | 17.12 | 99.72 | nan | 0.01 | 0.00 | 0.00 | 0.03 | 0.09 | 0.08 | 0.00 | 0.26 |
| Nordkjoselva | avg. | 451.41 | 165.21 | 181.74 | 0.33 | 0.17 | 2.97 | 0.83 | 11.90 | 325.71 | nan | 0.02 | 0.00 | 0.00 | 0.04 | 0.05 | 0.05 | 0.01 | 0.06 |
| Signaldalselva | avg. | 1214.57 | 488.99 | 622.35 | 0.44 | 1.78 | 8.00 | 3.45 | 29.34 | 790.64 | nan | 0.04 | 0.02 | 0.00 | 0.32 | 0.22 | 0.18 | 0.12 | 0.15 |

| River | Estimate | Flow rate | SPM | TOC | PO4-P | TOTP | NO3-N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1000 m3/d | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [tonnes] | [kg] |
| Skibotnelva | avg. | 1355.89 | 397.00 | 694.76 | 0.50 | 0.25 | 11.41 | 2.48 | 35.73 | 797.55 | nan | 0.03 | 0.01 | 0.00 | 0.22 | 0.25 | 0.45 | 0.00 | 0.33 |
| Kåfjordelva | avg. | 711.03 | 108.10 | 182.17 | 0.26 | 0.00 | 12.49 | 0.78 | 27.06 | 390.36 | nan | 0.00 | 0.01 | 0.00 | 0.25 | 0.16 | 0.17 | 0.03 | 0.00 |
| Reisaelva | avg. | 4652.81 | 1668.87 | 2932.82 | 1.70 | 3.26 | 52.79 | 8.51 | 180.51 | 5108.79 | nan | 0.22 | 0.03 | 0.00 | 1.28 | 1.02 | 1.07 | 0.22 | 1.28 |
| Mattiselva | avg. | 434.62 | 60.87 | 568.68 | 0.16 | 0.16 | 2.23 | 0.58 | 14.32 | 218.15 | nan | 0.02 | 0.00 | 0.00 | 0.10 | 0.12 | 0.05 | 0.01 | 0.05 |
| Tverrelva | avg. | 311.59 | 114.04 | 656.69 | 0.27 | 0.13 | 5.13 | 0.80 | 21.10 | 244.38 | nan | 0.01 | 0.00 | 0.00 | 0.09 | 0.08 | 0.04 | 0.02 | 0.00 |
| Repparfjordelva | avg. | 1993.83 | 423.25 | 3689.46 | 0.73 | 0.55 | 17.51 | 5.84 | 86.84 | 844.42 | nan | 0.05 | 0.00 | 0.00 | 0.96 | 0.39 | 0.19 | 0.07 | 1.09 |
| Stabburselva | avg. | 1457.00 | 246.12 | 1279.83 | 0.27 | 1.33 | 10.67 | 2.67 | 33.67 | 1386.48 | nan | 0.02 | 0.00 | 0.00 | 0.16 | 0.42 | 0.07 | 0.02 | 0.00 |
| Lakseelv | avg. | 1628.84 | 1633.46 | 1550.00 | 0.60 | 2.98 | 6.56 | 4.17 | 60.21 | 1277.47 | nan | 0.02 | 0.01 | 0.00 | 0.45 | 0.13 | 0.37 | 0.02 | 0.17 |
| Børselva (STREBØR) | avg. | 196.24 | 244.92 | 362.71 | 0.45 | 1.01 | 24.20 | 0.72 | 45.46 | 67.72 | nan | 0.02 | 0.00 | 0.00 | 0.10 | 0.08 | 0.11 | 0.03 | 0.04 |
| Mattusjåkka | avg. | 118.92 | 17.41 | 56.58 | 0.05 | 0.03 | 0.54 | 0.41 | 3.48 | 52.23 | nan | 0.00 | 0.01 | 0.00 | 0.02 | 0.07 | 0.02 | 0.05 | 0.02 |
| Stuorrajåkka | avg. | 812.41 | 81.09 | 208.14 | 0.16 | 0.00 | 10.41 | 1.19 | 26.46 | 764.60 | nan | 0.01 | 0.00 | 0.00 | 0.00 | 0.16 | 0.05 | 0.00 | 0.10 |
| Soussjåkka | avg. | 108.32 | 12.97 | 51.54 | 0.04 | 0.00 | 0.99 | 0.20 | 2.97 | 118.94 | nan | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.01 |
| Adamselva | avg. | 905.81 | 78.32 | 530.44 | 0.25 | 0.00 | 1.16 | 2.15 | 31.33 | 895.12 | nan | 0.00 | 0.00 | 0.00 | 0.03 | 0.29 | 0.02 | 0.00 | 0.19 |
| Syltefjordelva(Vesterelva) | avg. | 969.28 | 147.36 | 283.80 | 0.71 | 0.93 | 2.48 | 3.19 | 21.29 | 815.94 | nan | 0.06 | 0.00 | 0.00 | 0.02 | 0.10 | 0.00 | 0.01 | 0.27 |
| Jakobselv | avg. | 1010.77 | 221.96 | 1035.83 | 1.05 | 0.74 | 0.62 | 2.59 | 47.72 | 1426.91 | nan | 0.02 | 0.00 | 0.00 | 0.03 | 0.00 | 0.03 | 0.00 | 0.12 |
| Neidenelva | avg. | 2903.66 | 1275.29 | 5096.72 | 1.06 | 1.59 | 0.00 | 11.69 | 191.29 | 2231.75 | nan | 0.09 | 0.00 | 0.00 | 0.55 | 0.03 | 0.29 | 0.01 | 0.00 |
| Grense Jakobselv | avg. | 282.98 | 88.03 | 300.35 | 0.10 | 0.10 | 0.51 | 1.35 | 13.36 | 288.52 | nan | 0.02 | 0.01 | 0.00 | 0.23 | 0.13 | 0.80 | 0.03 | 0.10 |

# Table 2b. Organic contaminants – loads (three rivers)

Table 2b i. Estimated riverine load for polycyclic aromatic (PAHs) in the rivers Alna, Drammen and Glomma for 2016.

| Compound | River | | |
|---|---|---|---|
| | Alna | Drammen | Glomma |
| | Yearly load (g $year^{-1}$) | Yearly load (kg $year^{-1}$) | Yearly load (kg $year^{-1}$) |
| Naphthalene | 95 | 73 | 144 |
| Acenaphthylene | 42 | 13 | 22 |
| Acenaphthene | 26 | 15 | 54 |
| Fluorene | 37 | 12 | 9.9 |
| Phenanthrene | 165 | 44 | 134 |
| Anthracene | 50 | 2.3 | 5.9 |
| Fluoranthene | 324 | 39 | 93 |
| Pyrene | 468 | 27 | 58 |
| Benz[a]anthracene | 117 | 6.1 | 3.9-7.7 |
| Chrysene | 130 | 10 | 17 |
| Benzo[bj]fluoranthene | 185 | 9.9 | 23 |
| Benzo[k]fluoranthene | 65 | 3.1 | 6.1 |
| Benzo[a]pyrene | 132 | 0.4-4.6 | 0.5-11 |
| Indeno[1,2,3-cd]pyrene | 94 | 0.2-3.9 | 15 |
| Dibenzo[a,h]anthracene | 21 | 0.6-1.3 | 1.7-2.7 |
| Benzo[ghi]perylene | 129 | 5.8-6.5 | 46-48* |
| Note: units are different for the different rivers<br>*This noticeably high value is the result of one very high SPM concentration | | | |

Table 2b ii. Estimated riverine load for polychlorinated biphenyls (PCBs) in the rivers Alna, Drammen and Glomma for 2016.

| | River | | |
|---|---|---|---|
| | Alna | Drammen | Glomma |
| | Yearly load (g $year^{-1}$) | Yearly load (g $year^{-1}$) | Yearly load (g $year^{-1}$) |
| PCB31 (+28) | 0.6-1.5 | 303 | 152-858 |
| CB52 | 1.3 | 17-176 | 519 |
| CB101 | 1.1 | 9-153 | 14-355 |
| CB118 | 0.65 | 7-136 | 7-317 |
| CB153 | 1.4 | 23-135 | 103-292 |
| CB138 | 1.9 | 7-140 | 15-294 |
| CB180 | 1.7 | < 141 | 4-291 |
| | | | |

Table 2b iii. Estimated riverine load for polybrominated diphenyl ethers (PBDEs) in the rivers Alna, Drammen and Glomma for 2016.

| | River | | |
|---|---|---|---|
| | Alna | Drammen | Glomma |
| | Yearly load (g $year^{-1}$) | Yearly load (g $year^{-1}$) | Yearly load (g $year^{-1}$) |
| BDE47 | 0.26 | 1-62 | 153 |
| BDE99 | 0.42 | 43-60 | 40-143 |
| BDE100 | 0.027-0.07 | 1.3-32 | 1-88 |
| BDE153 | 0.028-0.06 | < 35 | < 100 |
| BDE154 | 0.012-0.06 | < 34 | < 90 |
| BDE183 | 0.07-0.15 | < 63 | < 163 |
| BDE196 | < 0.05 | < 23 | < 112 |
| BDE209 | 8.5 | 140 | 429-498 |
| *Data for BDE28 not available | | | |

Table 2b iv. Estimated riverine load for hexabromoyclododecane (HBCDD) in the rivers Alna, Drammen and Glomma for 2016.

| | River | | |
|---|---|---|---|
| | Alna | Drammen | Glomma |
| | Yearly load (g $year^{-1}$) | Yearly load (g $year^{-1}$) | Yearly load (g $year^{-1}$) |
| α-HBDD | 1.6-1.8 | 169 | 70-465 |
| β-HBCDD | 0.82-0.98 | 347-468 | 396-776 |
| γ-HBDD | 0.63-0.75 | < 135 | 211-597 |
| | | | |

Table 2b v. Estimated riverine load for suspended particulate matter-associated short and medium chain chlorinated paraffins (S/MCCPs). bisphenol A (BPA). tetrabromobisphenol A (TBBPA) the rivers Alna, Drammen and Glomma for 2016. PFOS was monitored with bottle sampling.

| | River | | |
|---|---|---|---|
| | Alna | Drammen | Glomma |
| | Yearly load (g $year^{-1}$) | Yearly load (g $year^{-1}$) | Yearly load (kg $year^{-1}$) |
| SCCPs | 214 | 9659 | 71 |
| MCCPs | 254 | 19030 | 430 |
| BPA | 62 | 64-111 | 1.5-2.0 |
| TBBPA | 0.16-0.24 | < 24 | < 0.2 |
| PFOS | 118 | 2398 | 3.8 |
| | | | |

# Table 3. Total inputs to the sea from Norway in 2016

| **TOTAL NORWAY** | Flow rate | SPM | TOC | PO4-P | TOTP | NO3N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1000 m3/d | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | kg |
| Riverine inputs | | | | | | | | | | | | | | | | | | |
| Main Rivers | 166096 | 432174 | 203006 | 362 | 667 | 12669 | 665 | 24132 | 180246 | 0 | 9 | 22 | 1 | 63 | 307 | 34 | 14 | 43 |
| Tributary Rivers(36) | 207340 | 242799 | 216280 | 221 | 508 | 7464 | 470 | 21192 | 180299 | 0 | 8 | 11 | 1 | 67 | 184 | 179 | 15 | 45 |
| Tributary Rivers(109) | 145732 | 66502 | 85350 | 68 | 230 | 5365 | 426 | 9883 | 76152 | 0 | 4 | 5 | 0 | 24 | 61 | 17 | 4 | 27 |
| Total Riverine Inputs | 519167 | 741474 | 504635 | 651 | 1405 | 25498 | 1562 | 55206 | 436698 | 0 | 21 | 38 | 2 | 154 | 551 | 230 | 33 | 115 |
| Direct Discharges | | | | | | | | | | | | | | | | | | |
| Sewage Effluents | | 1927 | | 677 | 1128 | 681 | 10211 | 13615 | | | 0 | 0 | 0 | 4 | 12 | 2 | 1 | 5 |
| Industrial Effluents | | 15610 | 955 | 148 | 246 | 118 | 1766 | 2354 | | | 2 | 1 | 0 | 6 | 13 | 6 | 1 | 8 |
| Fish Farming | | | | 6749 | 9781 | 6236 | 45353 | 56691 | | | | | | 1088 | | | | |
| Total Direct Inputs | | 17537 | 955 | 7573 | 11155 | 7034 | 57329 | 72660 | | | 2 | 1 | 0 | 1097 | 25 | 8 | 2 | 13 |
| Unmonitored | | | | | | | | | | | | | | | | | | |
| | 408822 | | | 175 | 711 | 21738 | 1913 | 34781 | | | | | | | | | | |
| Region total | | | | | | | | | | | | | | | | | | |
| | 927989 | 759011 | 505590 | 8399 | 13271 | 54270 | 60804 | 162647 | 436698 | 0 | 23 | 39 | 2 | 1251 | 576 | 238 | 35 | 128 |

| SKAGERAK | Flow rate | SPM | TOC | PO4-P | TOTP | NO3N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1000 m3/d | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | kg |
| **Riverine Inputs** | | | | | | | | | | | | | | | | | | |
| **Main Rivers** | 131431 | 385715 | 169674 | 321 | 571 | 11883 | 594 | 21421 | 150700 | 0 | 8 | 21 | 1 | 50 | 282 | 28 | 10 | 38 |
| **Tributary Rivers (36)** | 25496 | 12374 | 40915 | 13 | 48 | 1387 | 99 | 3335 | 19898 | 0 | 2 | 3 | 0 | 5 | 47 | 3 | 1 | 7 |
| **Tributary Rivers (109)** | 7542 | 10791 | 13975 | 14 | 61 | 1321 | 73 | 2033 | 8392 | 0 | 1 | 1 | 0 | 2 | 17 | 2 | 1 | 3 |
| **Total Riverine Inputs** | 164470 | 408880 | 224564 | 347 | 680 | 14591 | 766 | 26788 | 178989 | 0 | 10 | 25 | 1 | 58 | 346 | 33 | 13 | 48 |
| **Direct Discharges** | | | | | | | | | | | | | | | | | | |
| **Sewage Effluents** | | 4 | | 72 | 120 | 292 | 4385 | 5847 | | | 0 | 0 | 0 | 2 | 8 | 1 | 0 | 4 |
| **Industrial Effluents** | | 1107 | 71 | 25 | 41 | 44 | 656 | 875 | | | 0 | 0 | 0 | 5 | 7 | 2 | 1 | 4 |
| **Fish Farming** | | | | 3 | 4 | 3 | 20 | 25 | | | | | | 0 | | | | |
| **Total Direct Inputs** | | 1111 | 71 | 99 | 165 | 339 | 5061 | 6747 | | | 0 | 0 | 0 | 8 | 15 | 3 | 1 | 8 |
| **Unmonitored** | | | | | | | | | | | | | | | | | | |
| | 9488 | | | 22 | 88 | 1822 | 160 | 2915 | | | | | | | | | | |
| **Region total** | | | | | | | | | | | | | | | | | | |
| | 173958 | 409991 | 224635 | 468 | 933 | 16752 | 5987 | 36450 | 178989 | 0 | 10 | 25 | 1 | 66 | 361 | 36 | 14 | 56 |

| NORTH SEA | Flow rate | SPM | TOC | PO4-P | TOTP | NO3N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1000 m3/d | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | kg |
| **Riverine inputs** | | | | | | | | | | | | | | | | | | |
| **Main rivers** | 8918 | 3529 | 4317 | 6 | 21 | 351 | 26 | 796 | 3056 | 0 | 0 | 0 | 0 | 1 | 6 | 1 | 0 | 2 |
| **Tributary Rivers (36)** | 68216 | 67869 | 44560 | 81 | 167 | 3717 | 156 | 6893 | 32823 | 0 | 2 | 5 | 0 | 11 | 86 | 5 | 3 | 20 |
| **Tributary Rivers (109)** | 69709 | 25238 | 27976 | 25 | 91 | 3086 | 168 | 5021 | 27778 | 0 | 1 | 3 | 0 | 10 | 29 | 7 | 1 | 11 |
| **Total Riverine Inputs** | 146843 | 96636 | 76853 | 113 | 279 | 7154 | 350 | 12709 | 63656 | 0 | 4 | 9 | 0 | 23 | 121 | 13 | 4 | 33 |
| **Direct Discharges** | | | | | | | | | | | | | | | | | | |
| **Sewage Effluents** | | 912 | | 264 | 440 | 186 | 2785 | 3714 | | | 0 | 0 | 0 | 1 | 3 | 0 | 0 | 1 |
| **Industrial Effluents** | | 7328 | 473 | 54 | 90 | 21 | 309 | 412 | | | 2 | 1 | 0 | 1 | 5 | 4 | 0 | 3 |
| **Fish Farming** | | | | 2325 | 3370 | 2152 | 15649 | 19561 | | | | | | 375 | | | | |
| **Total Direct Inputs** | | 8240 | 473 | 2643 | 3900 | 2358 | 18743 | 23687 | | | 2 | 1 | 0 | 376 | 8 | 4 | 1 | 4 |
| **Unmonitored** | | | | | | | | | | | | | | | | | | |
| | 151022 | | | 59 | 239 | 9066 | 798 | 14505 | | | | | | | | | | |
| **Region total** | | | | | | | | | | | | | | | | | | |
| | 297865 | 104876 | 77326 | 2815 | 4418 | 18578 | 19891 | 50901 | 63656 | 0 | 6 | 10 | 0 | 399 | 129 | 17 | 5 | 37 |

| **NORWEGIAN SEA** | Flow rate | SPM | TOC | PO4-P | TOTP | NO3N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1000 m3/d | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | kg |
| **Riverine inputs** | | | | | | | | | | | | | | | | | | |
| **Main Rivers** | 15480 | 36002 | 13856 | 24 | 51 | 287 | 8 | 1053 | 10365 | 0 | 1 | 1 | 0 | 9 | 18 | 4 | 2 | 3 |
| **Tributary Rivers(36)** | 66361 | 88349 | 63117 | 80 | 141 | 1831 | 82 | 5093 | 46938 | 0 | 2 | 2 | 0 | 18 | 35 | 16 | 7 | 16 |
| **Tributary Rivers(109)** | 40447 | 21594 | 20205 | 18 | 59 | 780 | 115 | 1824 | 18374 | 0 | 1 | 1 | 0 | 5 | 8 | 4 | 1 | 8 |
| **Total Riverine Inputs** | 122288 | 145945 | 97178 | 122 | 251 | 2899 | 205 | 7970 | 75677 | 0 | 4 | 3 | 0 | 33 | 61 | 24 | 10 | 26 |
| **Direct Discharges** | | | | | | | | | | | | | | | | | | |
| **Sewage Effluents** | | 891 | | 235 | 392 | 141 | 2121 | 2828 | | | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 0 |
| **Industrial Effluents** | | 2205 | 143 | 66 | 109 | 49 | 738 | 984 | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| **Fish Farming** | | | | 2740 | 3971 | 2526 | 18371 | 22964 | | | | | | 442 | | | | |
| **Total Direct Inputs** | | 3096 | 143 | 3041 | 4472 | 2717 | 21230 | 26776 | | | 0 | 0 | 0 | 443 | 2 | 0 | 0 | 1 |
| **Unmonitored** | | | | | | | | | | | | | | | | | | |
| | 143758 | | | 69 | 281 | 7739 | 681 | 12382 | | | | | | | | | | |
| **Region total** | | | | | | | | | | | | | | | | | | |
| | 266046 | 149041 | 97321 | 3232 | 5004 | 13355 | 22116 | 47128 | 75677 | 0 | 4 | 3 | 0 | 476 | 63 | 24 | 10 | 27 |

| BARENTS SEA | Flow rate | SPM | TOC | PO4-P | TOTP | NO3N | NH4-N | TOTN | SiO2 | Ag | As | Pb | Cd | Cu | Zn | Ni | Cr | Hg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1000 m3/d | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | tonnes | kg |
| **Riverine inputs** | | | | | | | | | | | | | | | | | | |
| **Main Rivers** | 10268 | 6927 | 15159 | 11 | 25 | 148 | 38 | 862 | 16126 | 0 | 1 | 0 | 0 | 2 | 1 | 1 | 1 | 1 |
| **Tributary Rivers(36)** | 47266 | 74207 | 67688 | 46 | 152 | 528 | 134 | 5871 | 80641 | 0 | 2 | 1 | 0 | 33 | 16 | 155 | 4 | 2 |
| **Tributary Rivers(109)** | 28033 | 8879 | 23194 | 11 | 19 | 178 | 70 | 1006 | 21610 | 0 | 1 | 0 | 0 | 6 | 6 | 5 | 1 | 5 |
| **Total Riverine Inputs** | 85567 | 90013 | 106040 | 69 | 196 | 855 | 241 | 7739 | 118376 | 0 | 3 | 1 | 0 | 41 | 23 | 161 | 6 | 8 |
| **Direct Discharges** | | | | | | | | | | | | | | | | | | |
| **Sewage Effluents** | | 120 | | 106 | 177 | 61 | 920 | 1226 | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Industrial Effluents** | | 4969 | 268 | 4 | 6 | 4 | 62 | 83 | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Fish Farming** | | | | 1680 | 2435 | 1555 | 11313 | 14141 | | | | | | 271 | | | | |
| **Total Direct Inputs** | | 5089 | 268 | 1790 | 2618 | 1621 | 12295 | 15450 | | | 0 | 0 | 0 | 271 | 0 | 0 | 0 | 0 |
| **Unmonitored** | | | | | | | | | | | | | | | | | | |
| | 104554 | | | 25 | 102 | 3112 | 274 | 4980 | | | | | | | | | | |
| **Region Total** | | | | | | | | | | | | | | | | | | |
| | 190121 | 95102 | 106308 | 1884 | 2916 | 5588 | 12810 | 28169 | 118376 | 0 | 3 | 1 | 0 | 312 | 23 | 161 | 6 | 8 |

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