



## HOW A COMPLETE PLC-5.5 WATER DATASET WAS OBTAINED

**Authors: Lars M. Svendsen, Håkan Staaf, Bo Gustafsson, Minna Pyhälä, Pekka Kotilainen, Jerzy Bartnicki, Seppo Knuutila, and Mikhail Durkin**

### Introduction

Pollution Load Compilation (PLC) water and airborne input data on nutrients to the Baltic Sea is used for pollution input compilation assessments<sup>1</sup>, and for developing a core pressure indicator on nutrient inputs to the Baltic Sea. Further it is the key data set used by the Baltic Nest Institute (BNI, Stockholm) for calculating new country allocated reduction targets of nutrients (CART) under the Baltic Sea Action Plan (BSAP)<sup>2</sup>, which were adopted by the 2013 HELCOM Copenhagen Ministerial Meeting (HELCOM 2013a), and for the follow up on evaluating fulfillment of reduction requirements by the Contracting Parties. One of the HELCOM principles is that the “polluter pays” and the defining of a fair share of nutrient input reduction requirements is only possible if the input data from all Contracting Parties cover the total nutrient inputs from the entire catchment including direct inputs, and that these inputs have been compiled with homogeneous and consistent methodology and the uncertainty on the data sets are comparable. This also implies that missing data/data gaps are estimated with agreed and comparable methodology.

This document should be seen as supporting information for the 2013 HELCOM Ministerial Meeting and “Updated Fifth Baltic Sea Pollution Load Compilation (PLC-5.5)” (HELCOM 2013b), as a part of the background documentation on the new CARTs adopted by the 2013 HELCOM Copenhagen Ministerial Meeting (HELCOM 2013c) and supporting information for the PLC-5.5 reporting (HELCOM, in prep)..

A lot of efforts have been used to get a complete, consistent and quality assured PLC-5.5 dataset and it has been revised several times up to July 2013. The document includes a description of the following topics regarding the PLC-5.5 dataset:

- Completeness of waterborne input to the Baltic Sea of nitrogen, phosphorus and riverine flow
- Principles for and overall how data gaps are fill in and suspicious data are treated, including for which catchments, rivers, direct inputs etc. this correction has taken place
- How input from border rivers are divided between Contracting Parties
- How transboundary waterborne inputs are divided between Contracting Parties and between Contracting and non-Contracting Parties, and how transboundary waterborne inputs from non-Contracting Parties are provided
- How retention is taken into account on inputs from non-Contracting Parties.

The PLC-5.5 data set, including estimates made by the project to fill in data gaps, has been approved by the HELCOM Contracting Parties for use in the Review of the PLC-5 for the Ministerial Meeting, the PLC-5.5 report and for revised calculations of the BSAP maximum allowable nutrient inputs (MAI) and country-wise allocation of reduction targets (CART).

---

<sup>1</sup> For example the PLC-5 report (HELCOM 2011), the *Review of the Fifth Baltic Sea Pollution Load Compilation for the 2013 HELCOM Ministerial Meeting* and the *Updated Fifth Baltic Sea Pollution Load Compilation (PLC-5.5)* (in prep).

<sup>2</sup> HELCOM 2007 (see references)

## **Major data gaps in reporting from Contracting Parties on PLC-water data 1994-2010**

The overview below is based on reviews by the PLC water database manager, Mr. Pekka Kotilainen, in November 2012 where it was identified that there is a need for further submission and/or correction of data by the Contracting Parties or where the HELCOM Load Core Group and the PLC-5.5 project team have made proposals for filling in data gaps and seeking alternative sources for the missing data. The overview focuses only on waterborne inputs of total nitrogen and total phosphorus as well as riverine flow, which are the necessary parameters regarding development of CART and for following up the fulfillment of the BSAP reduction targets. Including fractions of nitrogen and phosphorus in the overview below would require taking into account many more data gaps.

### **Missing data on monitored rivers and unmonitored area**

#### Flow:

##### 1) Latvia

- All data 2009-2010
- Unmonitored area 1994-2003 and 2007-2010

##### 2) Russia

- All data from unmonitored and coastal areas including 16 small rivers

##### 3) Germany

- Aggregated data minor rivers during 2003-2007

#### Nitrogen:

##### 1) Latvia

- All data 2009-2010

##### 2) Russia

- Only data for Pregolya has been reported with total nitrogen missing 1994-2010.
- Only data for Neva, Luga and Seleznevka reported. Total nitrogen missing for Seleznevka 1994-2010, and Luga 1994-2000. Total nitrogen missing Neva 1994-1999.
- Rivers 1994-2003 and 2007-2010 to the Baltic Proper
- 16 small rivers 1994-2010

#### Phosphorus:

##### 1) Latvia

- All data 2009-2010

##### 2) Russia

- Only data for Pregolya has been reported with total nitrogen missing 1994-2010.
- Only data for Neva, Luga and Seleznevka reported. Total phosphorus nitrogen missing for Seleznevka 1994-2010, and Luga 1994-2000.
- All data from unmonitored and coastal areas including 16 small rivers

## **Missing data on direct point sources (MWWTP and industry)**

### Flow:

- 1) Estonia
  - 1994-1999
- 2) Latvia
  - 1994-1999, 2004-2005, 2009-2010
- 3) Poland
  - 1994-2002
- 4) Russia
  - 1994-1999
- 5) Sweden
  - 1994, 1996-1999, 2001, 2007

### Nitrogen:

- 1) Estonia
  - 1994-1999 (2003)
- 2) Germany
  - 1994-2010
- 3) Latvia
  - 1994-1999, (2004-2005) 2009-2010
- 4) Poland
  - 1994-2010
- 5) Russia
  - 1994-1999, (2007-2008)

### Phosphorus:

- 1) Estonia
  - 1994-1999 (1994-2003)
- 2) Germany
  - Baltic Proper: 1994-2010; Western Baltic: 1994-2005
- 3) Latvia
  - 1994, 1996-1999, (2004-2005) 2009-2010
- 4) Poland
  - 2007, 2009-2010
- 5) Russia
  - Baltic Proper: 1994-1999; 2010 (1994-1999-2010)

Besides the above mentioned main challenges there have been questions to solve as:

- For some countries in some years direct inputs have been included in unmonitored areas/coastal areas or even in monitored riverine inputs

- Inputs from direct MWWTP and industry are for some countries in some years aggregated or missing
- For some countries it seems as not all MWWTP and industries discharging directly to the sea are reported every year
- For some countries in some years only inorganic (dissolved) nutrient fraction have been monitored/reported
- Nemunas 1994: Nitrogen and phosphorus inputs are exceptionally high. Further it has been unclear where inputs from Matrosovka Channel (a channel from Nemunas river that enters from Lithuania into Kaliningrad region) are included, i.e. included in the inputs from Russia (Kaliningrad region) or Lithuania (as a part of Nemunas inputs).
- Some other rivers have very high inputs some years without any obvious explanation (both in Poland for some rivers and Russia (Neva))
- Total nitrogen and total phosphorus data missing 1994-2010 for Pregolya and Seleznevka (Russia) but the inorganic fractions of nitrogen and phosphorus are available. Total nitrogen and total phosphorus missing 1994-2000 for Luga River, but inorganic fractions are reported. Further inputs from some years seems very low
- Total nitrogen missing 1994-1999, but inorganic fractions are reported for Neva River. The monitored phosphorus inputs seems some years only to include dissolved fractions although reported as total phosphorus, and in other years phosphorus inputs very high some years

Most of the above mentioned challenges have been solved.

### **Methodologies applied to fill in data gaps**

This sub-chapter introduces shortly different methods applied for estimating or establishing missing data. More information on statistical methods for filling in data gaps and missing can be found in HELCOM, 2013d. Regarding missing reported data from rivers which should have been monitored, we have tried to contact institutes and/or within the countries for available information. Further, we have looked for data reported to EU-institutes and to the European Environmental Agency. If nitrogen and phosphorus inputs and riverine flow are not available, sometimes it has been possible to get monitored concentrations of nitrogen and phosphorus and then based on former years riverine flow and relation to neighboring rivers to establish the missing data for some few years.

No unique method can be applied. It depends on which information is available, how many years of data are missing and whether it is a big important source or a minor one where a rough estimate is acceptable. Further, if data is missing for a point source, the annual variations in input are usually much lower than for a river and simple interpolation or average for measured years can be applied making only minor errors on the estimated.

Overall the following approaches/methodologies have been applied:

- Make use of results from published research/pilot studies
- Use available reported data to EU institutes, and other available statistics
- For direct point sources: if one or few years are missing, the missing values are estimate from interpolation. If several years are missing an average of the reported years can be used. If it is obvious that the inputs from a point source have decreased during 1994-2010, then an average is taken for early years (is available) for estimating inputs in the first half of the period, and the later part of the period for estimating inputs in the recent years
- For point source, also estimates based on P.E. (person equivalent) connected and information on treatment level can be used

- For some rivers one or two missing years can be estimated by interpolation or averaging for some monitored years, but it is preferred to make either relationships between concentration and the riverine flow (Q-C relationships) or input relationships (normalized if possible) with neighboring river catchments with corresponding soil types, land use, livestock, agricultural practices, soils types, topography and climate, and taking into account discharges from major point sources if any. If only few years are reported for a river, we have either used relation to comparable river with monitoring results or used the methodologies described below for unmonitored catchments/areas or used a constant load values based on the reported years for these rivers
- In presence of a sufficient amount of data an interpolation can be done on normalized input data and making a trend analysis to estimate “minor” data gaps in time series: This should ensure that trend in data are taken into account in the estimated data
- If only inputs of nitrogen or phosphorus are missing in one or a few years for a river or point source, the comparing of nitrogen and phosphorus inputs from other years can support an overall validation of estimated missing inputs
- For some rivers inputs are only given for dissolved nitrogen and/or phosphorus. If there are some years with both dissolved and total nutrient discharge, the total input of nitrogen (phosphorus) can be estimated based on the relationship between dissolved and total input nitrogen (phosphorus). If the input of one nutrient is missing one/some years the relationship between nitrogen and phosphorus for monitored years can be established to make estimates for years with missing data or otherwise it would be necessary to compared with figures from corresponding rivers
- For unmonitored parts of monitored catchment and coastal areas: in some cases it is possible to extrapolate from the monitored parts, either as area proportion, area coefficient or discharge weighted concentrations. If there are point sources in the unmonitored part their discharges – taking into account retention – should be considered.
- For bigger unmonitored areas it might be necessary to use standard values on nutrient losses from catchment with corresponding climate, geology, and use etc. (monitored or modeled) and take into account point source discharges and retention.
- If data and time are available more advanced models can be applied – but this has not been possible in relation to the PLC-5.5 dataset.
- Where relevant it is necessary to take into account retention.

### **Major corrections done in the PLC-5.5 data set including correcting suspicious water borne data**

*This sub-chapter describes case-by-case how missing data have been provided for major rivers, major unmonitored and coastal areas, and major direct point sources. Further it describes how some suspicious data have been corrected. When data are presented in PLC-5.5 assessment it will be indicated, where gap filling and corrections has taken place.*

In February 2013 all Contracting Parties accepted the PLC 5.5 dataset where the HELCOM LOAD Core Group had filled in data gaps, missing data, and proposed changes to values regarding suspicious data. It was agreed that the dataset should be used for the PLC-5.5 project assessment products and for calculation of revised CARTs. Some minor changes to the dataset were made in May 2013 upon request of some Contracting Parties and in June 2013 adjustments were made on how to divide some rivers with transboundary inputs.

The PLC data consultant developed a spreadsheet with the PLC-5.5 data which has been updated several times due to corrections reported by the Contracting Parties and due to decisions on how to divide some transboundary and border rivers. Further, some mistakes

were found in the spreadsheet as late as July 2013. The final dataset is from mid-July 2013 and it is available at the HELCOM web-site together with the “Updated Fifth Baltic Sea Pollution Load Compilation (PLC-5.5)” (HELCOM 2013b) .

After each change in the dataset, it has been necessary to make new normalized input data sets and make new statistical analyses on test for trends in inputs from 1994 to 2010 and to calculate changes where trends are significant.

#### Denmark:

Only one minor correction was made:

Simested Å: Nitrogen and phosphorus input and riverine flow in 2009 not reported: Values estimated as “Average of the closest reported values” (2008 and 2010).

Since 2008 five minor rivers are not monitored but included in the inputs from unmonitored/coastal area and areas adjusted accordingly.

#### Estonia:

There were some data gaps for inputs from some unmonitored areas in some years and these were filled in with estimates, and further:

- Inputs from River Pirita 1994-1996 have been included in the coastal areas to Gulf of Finland
- Inputs from River Vasalemna 2001-2010 have been included in the coastal areas to Gulf of Finland

#### Finland:

It has been clarified that some small rivers are not monitored (the corresponding data have been removed from the database) but included in inputs from unmonitored areas and areas adjusted accordingly.

Missing data on fish farms at Åland Island from some years have been provided and completed.

#### Germany

Inputs from seven minor rivers (catchment areas between 23 and 115 km<sup>2</sup>: Karower Bach, Körckwitzer Bach, Phohner Bach, Saaler Bach, Sehrower Bach, Ziese (all discharging to Baltic Proper) and Peezer Bach (discharging to Western Baltic)) are since 2003 not monitored and expected to be included in inputs from unmonitored areas.

Monitored aggregated minor rivers have been reported in 2004-07: Unclear if the inputs after 2008 are included in the unmonitored areas.

Industry direct to Baltic Proper: “The average of reported values 2006-2010 has been used” to fill in missing data for 1994, 1996-1999 and 2001-2005.

Industry direct Western Baltic: Only 1995 reported and that value has been used for the remaining years.

#### Latvia

Nutrient loads from the four major Latvian Rivers draining into the Gulf of Riga – Daugava, Lielupe, Gauja and Salaca, were estimated for the period 2009 – 2010 based on data

collected by the Latvian Environment, Geology and Meteorology Centre. Since 2009 the Latvian water quality monitoring program has been reduced from monthly sampling of nutrient concentrations to four or five measurements per year, while daily measurements of discharge were continued. Monthly hydrochemical data collected in 1991 – 2008 were used to calibrate a flow normalization model with yearly and monthly components and an exponential runoff factor. Details are provided in Lavrinovics and Müller-Karulis (2012).

For Barta, Saka and Venta rivers discharging to Baltic Sea, data from 2009 were calculated based on the average 2006-2008 total nitrogen – discharge and total phosphorus-discharge relationship, respectively using the monitored riverine flow in 2009. 2010 loads were calculated as the average from 2006-2008 as no riverine flows was available for River Barta and Saka, and using the load-discharge relationship for River Venta.

Coastal point source loads were obtained from Latvian Institute of Aquatic Ecology (2012).

#### Lithuania:

Lithuania has made major revision of reported PLC data for the period 1994-2010:

- Nemunas loads, which in some years included Matrosovka channel loads and in others not, have been solved. All Nemunas river loads have been recalculated without Matrosovka channel loads
- Data gaps of total nitrogen concentrations for Nemunas river during years 1994-1996 (there were only 4 measurements per year) have been filled using regression equation for total nitrogen concentrations and flows
- Point sources discharging directly to Curonian Lagoon have been added to PLC database supplementing reported direct discharges to the Baltic Sea.
- Stormwater direct discharges into the Baltic Sea or Curonian Lagoon have been added to loads from unmonitored areas.
- Loads from unmonitored areas have been recalculated. Other small corrections have been done as well. For instance, missing nitrogen load from Akmena-Dane River for the year 1994 has been estimated using regression between the loads of total nitrogen and nitrates.

#### Poland:

Correction of the inputs from Vistula and Oder for year 2010 has been made. To avoid overestimation of loads caused by big spring and summer floods, data was recalculated using every day flows instead of the flows taken only from the days of taking samples for quality measurement.

Poland has provided data on transboundary loads of nutrients transported by rivers from Czech Republic, Belarus and Ukraine to Poland, and loads transported from Poland to Russia. Loads from Czech Republic were calculated based on a complete set of data. Other loads were estimated using more or less complete sets of data on flows and nutrient concentrations.

#### Russia:

Because of serious gaps in input data for the Pregolya River (Kaliningrad) it was considered impossible to reconstruct a complete dataset based on measured data, and thus the river was considered unmonitored. The inputs from the major point source (Kaliningrad city) were estimated by multiplying the 430,000 inhabitants with the standard values 5kg N/person and 0.7 kg P/person (based on standard figures for annual loads per person from humans) and

assuming no retention. Input from diffuse sources and unmonitored areas have been calculated using sub-catchment area multiplied by 400 kg N/km<sup>2</sup> and 30 kg P/km<sup>2</sup>.

Inputs from Russia to the Gulf of Finland were calculated based on the data by Institute of Limnology, Russian Academy of Sciences (ILRAS), the Finnish Environment Institute (SYKE) and Vodokanal of St. Petersburg. Estimates on River Neva loads are based on 5 years monitoring data (2000-2002 and 2005-2006) and the missing data on inputs from the River Neva were calculated by SYKE based on the results of the SEGUE project (Pitkänen & Tallberg 2007). For 2007-2010, a constant load has been used for River Neva: 50,900 tonnes of total nitrogen and 2,000 tonnes of total phosphorus.

Inputs from unmonitored areas were reported only for 2000, while data for sixteen small rivers were available only for 2003. Therefore, for these inputs the same load value is used for total nitrogen and total phosphorus input, respectively every year and included in estimates of inputs from unmonitored and coastal areas.

River Luga (discharging to Gulf of Finland): Total nitrogen 1994-2000 is calculated as average of monitoring results during 2001-2010. For total phosphorus 2001-2007 loads (1,255 tonnes per year) have been added to the reported data and for 1994-2000 the average of 2001-2010 have been used.

### Sweden

Clarification on some few small rivers, which have been removed from the PLC database as they are included in unmonitored areas and areas adjusted accordingly.

Data on marine fish farms which were only reported in 2006: For all other years "Reported input values of 2006 have been used" for nitrogen and phosphorus.

### **Division of inputs from border rivers**

**Narva** is a border river between Estonia and Russia. After clarification, Estonia now reports 100 % of the input from Narva to the Baltic Sea for all years. According to the catchment size it has been agreed to divide the input with 67% to Russia and 33% Estonia. Belarus has 0.5% of the catchment and the input is therefore insignificant. Latvia has 6.3% of the catchment but Estonia and Russia accepted that these inputs are included as a part of Russian and Estonian inputs..The nitrogen and phosphorus input is divided as:

- Estonia 33 %
- Russia 67 %

**Torne älv** is a border river between Sweden and Finland. Finland and Sweden have agreed to divide the input as:

- 55 % of both nitrogen inputs and phosphorus input to Sweden
- 45 % of nitrogen inputs and phosphorus input to Finland

### **Division of transboundary inputs between two (or more) Contracting Parties**

This sub-chapter describes how transboundary input can be divided between Contracting Party. The division for the biggest rivers is based on monitored inputs at the border where the river enters another Contracting Party and taking into account retention in the downstream Contracting Party receiving the transboundary inputs (see later). For a few rivers also the location of big point sources is taken into account. There are 82 transboundary rivers, but for many of these nearly 100% of the catchment is situated in one country only and for these transboundary inputs are neglected. The HELCOM LOAD expert

group will further discuss the establishing of a threshold to determine when transboundary inputs will be taken into account.

**Table 1** summarizes how transboundary inputs per country have been divided between Contracting Parties in relation to the new Country Allocated Reduction Targets (CART) adopted by the 2013 HELCOM Copenhagen Ministerial Meeting. Below are some further comments for the biggest rivers.

**Gauja** is a transboundary river to the Gulf of Riga from Latvia with 87.5% of the catchment in Latvia and 12.5% in Estonia. Inputs at the border are known based on monitoring data by Estonia and retention has been taken into account. Included in table 1.

**Lielupe** is a transboundary river to the Gulf of Riga from Latvia with 50% of the catchment in Latvia and 50% in Lithuania. There is measurement data from Lithuania and retention has been taken into account. Included in table 1.

**Oder** is a transboundary river to the Baltic Proper from Poland. 4.8 % of the catchment is in Germany and 6.1 % in the Czech Republic, Poland has provided values on inputs from Czech Republic, and Germany has modeled their inputs to Oder taking onto account retention using the MONERIS model. Included in table 1.

**Neva** is a transboundary river that enters the Gulf of Finland from Russia. The input of the rivers discharging into the Gulf of Finland from Finland (the River Vuoksi and about 10 small transboundary rivers) via Russian territory was calculated using SYKE's WSFS-Vemala model. The input originating from Finnish territory (taking into account retention) in the Russian catchment area (especially Lake Ladoga) was subtracted from total input of the River Neva (measured at the river mouth) and added to the total input figures of Finland. In the case of the smaller transboundary rivers discharging directly to the Gulf of Finland, the input figures produced through modeling were added to the share of Finland as such. Finnish share of the Neva input to Baltic Sea, taking into account retention, is in average for 1997-2003 5,353 tonnes of nitrogen and 49 tonnes of phosphorus. Total input from Neva in the same period is 42,137 tons of nitrogen and 1,913 tons of phosphorus which lead to the following division:

- Russia 87% of nitrogen and 97% of phosphorus
- Finland 13% of nitrogen and 3% of phosphorus

The same shares were found for 2008-2010. Included in table 1.

**Pregolya** is a transboundary river entering the Baltic Proper from Russia. The Russian part of the catchment area is 48.3%, 0.6% is in Lithuania (this contribution is not taken into account) while 51% is situated in Poland. Monitoring data from Poland suggests that annual transboundary inputs for the period 1997-2003 are 4,400 tonnes of nitrogen and 320 tonnes of phosphorus. Total input to Baltic Proper from Pregolya is 6,000 tonnes of nitrogen and 450 tonnes of phosphorus. With an assumed retention of 30% and 37% for nitrogen and phosphorus respectively on the Polish inputs entering the Russian part of the watershed, the following division is proposed:

- Russia: nitrogen 50%; phosphorus 55%
- Poland: nitrogen 50%; phosphorus 45%.

Included in table 1.

**Venta** is a transboundary river entering the Baltic Proper from Latvia. 56% of the catchment is in Latvia and 44% in Lithuania. Included in table 1.

**Table1:** Transboundary riverine inputs (in tons yr<sup>-1</sup>) in the reference period. Input at the border is multiplied with the retention coefficient to estimated net waterborne transboundary inputs to the Baltic Sea. From Gustafsson & Mörth (in prep).

From	Via	To	Border		Retention		To Baltic	
			TN tons	TP tons	TN tons	TP tons	TN tons	TP tons
Lithuania	Latvia	BAP	5,516	158	0.39	0.58	3,365	66
Poland	Russia	BAP	4,400	320	0.30	0.37	3,080	202
Germany	Poland	BAP					2,337	101
<b>Total</b>		<b>BAP</b>					<b>8,782</b>	<b>369</b>
Lithuania	Latvia	GUR	7,185	282	0,27	0,32	5,245	192
Russia	Latvia	GUR	4,256	734	0,54	0,71	1,957	215
<b>Total</b>		<b>BAP</b>					<b>7,202</b>	<b>407</b>
Finland	Russia	GUF			0.48	0.82	5,353	49

### Division of transboundary input between a Contracting Party and non-Contracting Parties

If there is a monitoring station at the border between the Contracting and non-Contracting Party, results from the monitoring should be used. The transboundary input reaching to the Baltic Sea is the input entering the Contracting Party minus removal by retention in the catchment of the Contracting Party.

**Daugava** enters the Gulf of Riga via Latvia. The catchment area is divided between Estonia (0.2%), Lithuania (2.2%), Russia (31.7%), Belarus (38.5%) and Latvia (27.4%). The inputs entering Latvia from Belarus have been monitored 2004-2010 and the proportion entering Latvia these years could be used as an estimate for former years. It is necessary to make an estimate on the Russia contribution, including taking into account retention on Russian inputs. In order to simplify calculations, it was agreed that Estonian and Lithuanian inputs (which have very small portions of the catchment area) are included as a part of Latvian inputs. Using monitored inputs at the border and taking into account retention the net contribution to the Baltic Sea is calculated and is included in table 2.

**Nemunas** enters the Baltic Sea from Lithuania, but is partly also a border river with Russia (Kaliningrad Region) and has a channel (Matrosovka Channal) from Lithuania entering the Kaliningrad region (Russia) from which it drains into the Baltic Sea. Less than 2% and a little more than 2% of the catchment is situated in Poland and Russia respectively, and 47% in Belarus and 49% in Lithuania.

Lithuania informed during the PLC-5.5 3/2013 meeting that inputs from Nemunas via the channel which enters to Kaliningrad region have been deducted from Nemunas input before reporting data to HELCOM – which means that approx. 25% of Nemunas flow and inputs are

not included in either Lithuania or Russian inputs. HELCOM LOAD Core Group has agreed with Lithuania that the inputs from the channel are included in the input from Lithuania for the PLC-5.5 assessments (HELCOM 2013b, HELCOM 2013c and HELCOM in prep), but in the allocation of inputs it will be divided between the countries involved as for the remaining part of the Nemunas inputs. In the future, Russia should in future report the Matrosovka Channel inputs and the Lithuanian and Belarus contributions will be subtracted from it. Polish contribution will be included in Lithuanian/Russian inputs due to very small proportion of the catchment area. Using monitored inputs at the border and taking into account retention the net contribution to the Baltic Sea has been calculated and is included in table 2.

**Vistula** enters the Baltic Proper from Poland. 5% of the catchment is situated in Ukraine, 6% in Belarus and 1% in Slovakia and the remaining part is in Poland. Slovakian inputs are including in Polish inputs as they are a very small proportion. Poland has provided border input data from some of the border rivers from other countries. Using monitored inputs at the border and taking into account retention the net contribution to the Baltic Sea has been calculated and is included in table 2.

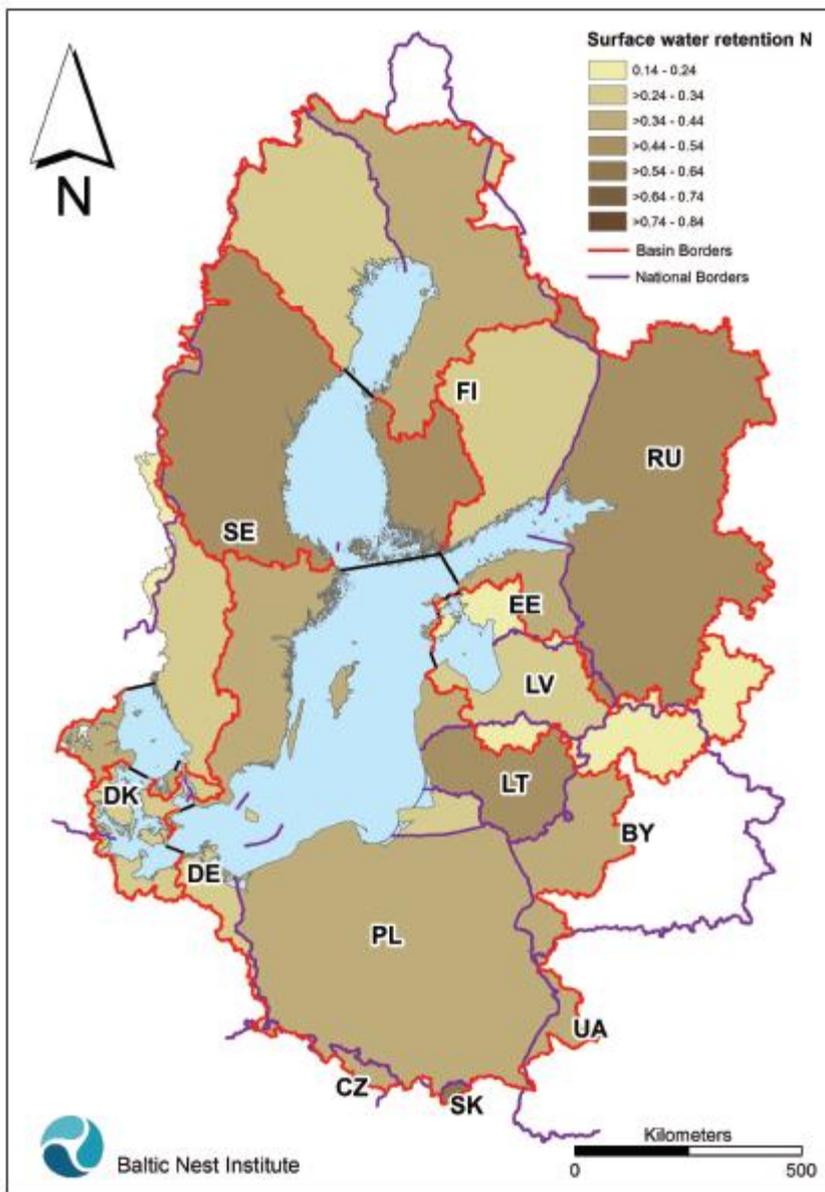
**Sweden-Norway:** Inputs from 10 Norwegian rivers are disregarded (even though 17% of the catchment of Göta Älv is situated in Norway) as it is a mountain region with only 36,000 Norwegian inhabitants.

**Table 2:** Transboundary riverine inputs (in tons yr<sup>-1</sup>) used in the CART calculations. Retention coefficient is from table 9.4 in Gustafsson and Mörth (in prep). All data are averaged 1997-2003 except for the Belarusian data which are averaged 2004-2011. Input at the border is multiplied with the retention coefficient to estimated net waterborne input to the Baltic Sea. "Share of loads the sub-basin" expresses in percentage how big proportion of total waterborne input to a sub-basin originates from the non-contracting Party when comparing with the reference period.

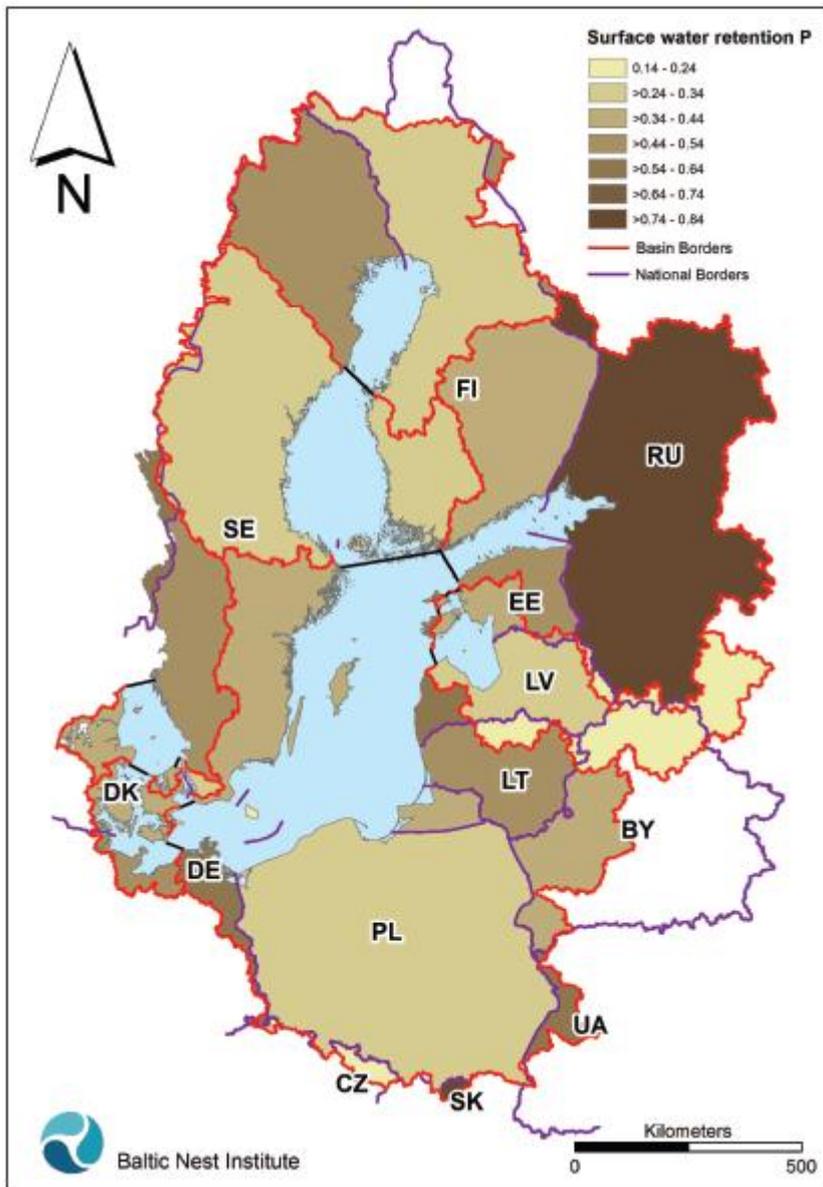
From	Via	To	Border		Retention		To Baltic		Share of load to the sub-basin	
			TN tons	TP tons	TN tons	TP tons	TN tons	TP tons	TN (%)	TP (%)
Czech	Poland	BAP	5,700	410	0.4	0.28	3,420	295	1.1	1.7
Belarus	Lithuania	BAP	13,600	914	0.54	0.53	6,256	430	2.1	2.5
Ukraine	Poland	BAP	4,124	127	0.4	0.28	2,474	91	0.8	0.5
Belarus	Poland	BAP	5,071	331	0.4	0.28	3,043	238	1.0	1.4
<b>Total</b>		<b>BAP</b>					<b>15,193</b>	<b>1,055</b>	<b>5.1</b>	<b>6.1</b>
Belarus	Latvia	GUR	8,532	1,360	0.27	0.32	<b>6,228</b>	<b>925</b>	<b>7.9</b>	<b>41.4</b>

## Retention

Retention within the catchment in surface waters has been estimated in the EU-funded Recoca project. In Gustafsson & Mörth (in prep) these results are used to make tables and maps for the retention as shown in figures 1 and 2 and table 3. These retention coefficients have been used for calculation of net contribution of transboundary inputs from both Contracting and non-Contracting Parties at rivers mouths.



**Figure 1:** Surface inland water nitrogen retention on catchments of the Baltic Sea calculated by BNI. From Magnusson & Mörtz (in prep.).



**Figure 2:** Surface inland water nitrogen retention on catchments of the Baltic Sea calculated by BNI. From Magnusson & Mörth (in prep.).

**Table 3:** Retention coefficient within catchment inland surface water given as country per basin as calculated by BNI. From Gustafsson & Mörth (in prep).

Country	Basin	Ret P	Ret N
BY	BP	0.57	0.37
BY	GR	0.14	0.24
BY	GR	0.14	0.24
CZ	BP	0.23	0.37
DE	BP	0.55	0.34
DE	DS	0.48	0.33
DK	BP	0.19	0.28
DK	DS	0.42	0.3
DK	KT	0.4	0.37
EE	BP	0.64	0.36
EE	GF	0.45	0.42
EE	GR	0.38	0.22
FI	BB	0.28	0.44
FI	BS	0.32	0.47
FI	GF	0.39	0.25
LT	BP	0.53	0.54
LT	GR	0.15	0.15
LV	BP	0.58	0.39
LV	GF	0.22	0.51
LV	GR	0.32	0.27
NO	BB	0.43	0.34
NO	BS	0.29	0.41
NO	KT	0.62	0.21
PL	BP	0.28	0.4
RU	BB	0.53	0.33
RU	BP	0.37	0.3
RU	GF	0.82	0.48
RU	GR	0.15	0.15
SE	BB	0.5	0.34
SE	BP	0.41	0.35
SE	BS	0.28	0.47
SE	DS	0.32	0.33
SE	KT	0.54	0.27
SK	BP	0.77	0.61
UA	BP	0.57	0.37

## References

Gustafsson, B.G and Mörth, C.M. (in prep.). Revision of the Maximum Allowable Inputs and Country Allocation Scheme of the Baltic Sea Action Plan V. 3 with contributions from the BNI team: Bärbel Müller-Karulis, Erik Gustafsson, Bonghi Hong, Christoph Humborg, Steve Lyon, Marmar Nekoro, Miguel Rodriguez-Medina, Oleg Savchuk, Erik Smedberg, Alexander Sokolov, Dennis Swaney, and Fredrik Wulff. Baltic Nest Institute, Stockholm University, SE-106 91 Stockholm, April, 2013.

HELCOM, 2007. HELCOM Baltic Sea Action Plan. Adopted by the HELCOM Ministerial Meeting in Krakow, Poland, on 15 November 2007.

HELCOM, 2011. Fifth Baltic Sea Pollution Load Compilation (PLC-5), BSAP 128. Authors: Seppo Knuuttila (PLC-5 Project Manager), Lars M. Svendsen, Håkan Staaf, Pekka Kotilainen, Susanne Boutrup, Minna Pyhälä and Mikhail Durkin.

HELCOM, 2013a. HELCOM Copenhagen Declaration 2013. Adopted by the HELCOM Ministerial Meeting in Copenhagen, Denmark, on 3 October 2013.

HELCOM 2013b. Review of the Fifth Baltic Sea pollution load compilation for the 2013 HELCOM Ministerial Meeting. PLC 5 min. report, HELCOM Baltic Sea Environment Proceedings No. 141, 49 pp. Authors: Lars M. Svendsen; Håkan Staaf; Bo Gustafsson; Minna Pyhälä; Pekka Kotilainen; Jerzy Bartnicki; Seppo Knuuttila; Mikhail Durkin.

HELCOM 2013c. Summary report on the development of revised Maximum Allowable Inputs (MAI) and updated Country Allocated Reduction Targets (CART) of the Baltic Sea Action Plan. Document prepared for the 2013 HELCOM Ministerial Meeting to give information on the progress in implementing the HELCOM Baltic Sea Action Plan. Authors: Mikhail Durkin, Bo Gustafsson, Monica Stankiewicz & Lars M. Svendsen. 23 pp.

HELCOM 2013d. Statistical aspects in relation to Baltic Sea Pollution Load Compilation. Authors: Søren E. Larsen, Department of Bioscience, Aarhus University and Lars M. Svendsen, DCE - Danish Centre for Environment and Energy, Aarhus University.

HELCOM in prep Updated Fifth Baltic Sea Pollution Load Compilation (HELCOM PLC-5.5). Authors: Lars M. Svendsen, Håkan Staaf, Bo Gustafsson, Minna Pyhälä, Pekka Kotilainen, Jerzy Bartnicki, Seppo Knuuttila, Mikhail Durkin.

Latvian Institute of Aquatic Ecology, 2012. Initial assessment of the state of Latvian marine waters for the EU Water Framework Directive, Part A.

Lavrinovics, A. and B. Müller-Karulis, 2012. Nutrient loads from Latvian rivers to the Gulf of Riga in 2009-2011, Latvian Institute of Aquatic Ecology, 49pp. In Latvian with English abstract.

Pitkänen, H. and Tallberg, P. (eds), 2007. Searching efficient protection strategies for the eutrophied Gulf of Finland: the integrated use of experimental and modelling tools (SEGUE). Final Report. Finnish Environment 15/2007. Finnish Environment Institute, SYKE.