NEXUS FUTURES
Nachhaltiger Umgang mit Wasser und Land

UNIVERSITÉ DU LUXEMBOURG

WaterBlitz 19

Presentation of insights of the WaterBlitz 19 Luxembourg (20th-23rd September 2019)

Hello WaterBlitzers!

Before we present our insights from the WaterBlitz 19 Luxembourg, we would like to use this opportunity to thank you all for your efforts! We very much appreciate your taking time during the weekend of the 20th-23rd September 2019 to participate in learning more about the status of our surface water bodies in Luxembourg and to contribute to research for more sustainable water governance. Together, we built an impressive database of 113 records!

Organised by the University of Luxembourg in collaboration with Earthwatch, the WaterBlitz 19 ran over four days. The overarching goal was to collect as many water samples as possible to develop a high-resolution overview of the state of Luxembourg's surface water bodies. Anyone interested in the event could register to receive a free water testing kit encompassing tests for nitrates and phosphates. Alongside these compounds, observable indicators were part of each data point, including water colour and land use in the immediate surrounding. The data was uploaded using the FreshWater Watch app or the FreshWater Watch online platform. Building on the data from the WaterBlitz, we hope to develop new knowledge for citizens, science and policy. We also hope to have promoted experience-based learning and provided people with the opportunity to learn more about the river, stream, lake or pond in their neighbourhood.

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1 NUMBER OF PARTICIPANTS AND RECORDS

1.1 OVERVIEW

To start our little tour, we would like to provide a closer look at the number of participants and the number of records.

About 80 people (the number of users, who uploaded one or multiple records) participated in the WaterBlitz 19. They sampled 56 water bodies in total, of which 17 were tested more than once. Most records have been uploaded for the rivers Alzette (19), Sure (15), and White Ernz (4). Of the 56 water bodies, 42 identify as river or stream, 11 as lake or pond, and one as a wetland (two were classified as "Other"). The complete list can be found in the Appendix.

1.2 ALZETTE

To dive in deeper, we would like to present the data for the Alzette followed by the data for the Sure.

Thanks to the high number of uploaded records for the Alzette, we have data points all along its course, from its entrance to the country in Esch-sur-Alzette to Ettelbrück, where it joins the Sure. Most samples have been collected in the communes of Hesperange (6/19), of Luxembourg City (4/19), and of Ettelbrück (2/19). The records for the Alzette can be found in Figure 1 and Figure 2.

Name of water body	Locality	Commune	Freshwater body type	What is the land use in the immediate surroundings?	What is the bank vegetation? (select all that apply)	Is there any of the following on the water surface?	Nitrate-nitrogen (NO_3^- -N) mg/L	Phosphate-phosphorus (PO_4^{3-} P) mg/L	Estimate the water colour
Alzette	Hunsdorf	Lorentzweiler	River	Agriculture	Trees/shrubsGrassOther	Floating algae	>10	0.2-0.5	Other
Alzette	Gosseldange	Lintgen	River	Agriculture	Trees/shrubsGrass	None	>10	0.1-0.2	Colourless
Alzette	Hesperange	Hesperange	River	Urban Residential	Trees/shrubs	None	5-10	0.5-1	Colourless
Alzette	Bonnevoie-Sud, Luxembourg	Luxembourg	River	Other	GrassTrees/shrubs	None	5-10	0.5-1	Colourless
Alzette	Steinsel	Steinsel	River	Grassland/shrub	Trees/shrubsGrass	None	5-10	0.5-1	Colourless
Alzette	Hesperange	Hesperange	River	Urban Park	Trees/shrubs	None	5-10	0.2-0.5	Brown
Alzette	Itzig	Hesperange	River	Forest	Trees/shrubs	LitterFoam	5-10	0.2-0.5	Colourless
Alzette	Colmarberg	Colmarberg	River	Urban Residential	Trees/shrubs	None	5-10	0.1-0.2	
Alzette	Schieren	Schieren	River	Industrial	Trees/shrubs	None	5-10	0.1-0.2	Colourless
Alzette	Esch/Alzette	Esch/Alzette	River	Urban Residential	Trees/shrubs	None	2-5	0.5-1	Colourless
Alzette	Hesperange	Hesperange	River	Urban Park	Trees/shrubs	None	2-5	0.5-1	Green
Alzette	Hesperange	Hesperange	River	Forest	Trees/shrubs	None	2-5	0.2-0.5	Brown
Alzette	Hesperange	Hesperange	River	Forest	Trees/shrubs	None	2-5	0.2-0.5	Colourless
Alzette	Grund, Luxembourg	Luxembourg	River	Urban Park	Trees/shrubs	FoamLitter	2-5	0.1-0.2	Colourless
Alzette	Ettelbrück	Ettelbrück	River	Urban Residential	GrassTrees/shrubs	Litter	2-5	0.1-0.2	Green
Alzette	Grund, Luxembourg	Luxembourg	Stream	Urban Residential	Trees/shrubs	FoamFloating algaeOily Sheen	2-5	0.1-0.2	Green
Alzette	Grund, Luxembourg	Luxembourg	Stream	Urban Park	Trees/shrubs	Litter	2-5	0.1-0.2	Colourless
Alzette	Ettelbrück	Ettelbrück	River	Urban Residential	Grass		2-5	0.02-0.05	Colourless
Alzette	Schifflange	Schifflange	Wetland	Forest	Trees/shrubsGrass	NoneFloating algae	0.2-0.5	0.02-0.05	Green

FIGURE 1. RECORDS FOR ALZETTE (ORDERED BY NITRATE-NITROGEN).

Name of water body	Locality	Commune	Freshwater body type	What is the land use in the immediate surroundings?	What is the bank vegetation? (select all that apply)	Is there any of the following on the water surface?	Nitrate-nitrogen (NO_3^--N) mg/L	Phosphate-phosphorus (PO_4^{3-}-P) mg/L	Estimate the water colour
Alzette	Hesperange	Hesperange	River	Urban Residential	Trees/shrubs	None	5-10	0.5-1	Colourless
Alzette	Bonnevoie-Sud, Luxembourg	Luxembourg	River	Other	GrassTrees/shrubs	None	5-10	0.5-1	Colourless
Alzette	Steinsel	Steinsel	River	Grassland/shrub	Trees/shrubsGrass	None	5-10	0.5-1	Colourless
Alzette	Esch/Alzette	Esch/Alzette	River	Urban Residential	Trees/shrubs	None	2-5	0.5-1	Colourless
Alzette	Hesperange	Hesperange	River	Urban Park	Trees/shrubs	None	2-5	0.5-1	Green
Alzette	Hunsdorf	Lorentzweiler	River	Agriculture	Trees/shrubsGrassOther	Floating algae	>10	0.2-0.5	Other
Alzette	Hesperange	Hesperange	River	Urban Park	Trees/shrubs	None	5-10	0.2-0.5	Brown
Alzette	Itzig	Hesperange	River	Forest	Trees/shrubs	LitterFoam	5-10	0.2-0.5	Colourless
Alzette	Hesperange	Hesperange	River	Forest	Trees/shrubs	None	2-5	0.2-0.5	Brown
Alzette	Hesperange	Hesperange	River	Forest	Trees/shrubs	None	2-5	0.2-0.5	Colourless
Alzette	Gosseldange	Lintgen	River	Agriculture	Trees/shrubsGrass	None	>10	0.1-0.2	Colourless
Alzette	Colmarberg	Colmarberg	River	Urban Residential	Trees/shrubs	None	5-10	0.1-0.2	
Alzette	Schieren	Schieren	River	Industrial	Trees/shrubs	None	5-10	0.1-0.2	Colourless
Alzette	Grund, Luxembourg	Luxembourg	River	Urban Park	Trees/shrubs	FoamLitter	2-5	0.1-0.2	Colourless
Alzette	Ettelbrück	Ettelbrück	River	Urban Residential	GrassTrees/shrubs	Litter	2-5	0.1-0.2	Green
Alzette	Grund, Luxembourg	Luxembourg	Stream	Urban Residential	Trees/shrubs	FoamFloating algaeOily Sheen	2-5	0.1-0.2	Green
Alzette	Grund, Luxembourg	Luxembourg	Stream	Urban Park	Trees/shrubs	Litter	2-5	0.1-0.2	Colourless
Alzette	Ettelbrück	Ettelbrück	River	Urban Residential	Grass		2-5	0.02-0.05	Colourless
Alzette	Schifflange	Schifflange	Wetland	Forest	Trees/shrubsGrass	NoneFloating algae	0.2-0.5	0.02-0.05	Green

FIGURE 2. RECORDS FOR ALZETTE (ORDERED BY PHOSPHATE-PHOSPHORUS).

1.3 SURE

After the Alzette, the Sure has been subject to the second-highest number of records (15). Particularly, the segment between Erpeldange and Bettendorf has been sampled 10 times. The remaining samples (5) are distributed mainly downstream, in Dillingen, Bollendorf-Pont, Echternach, and Moersdorf, while one record was uploaded upstream, in Michelau. The communes with the highest number of records are Erpeldange (5) and Bettendorf (3). The results for the Sure can be found in Figure 3 and Figure 4.

1.4 OTHER WATER BODIES

The remaining 79 records are distributed over 54 distinct water bodies. Most records have been uploaded for the White Ernz (4), Attert, Dipbech, Drosbech, Gander, Mess, and Our (3). Overall, small streams are particularly well represented. This is of great value, as there is less data available for smaller streams, even though they are, at the same time, very vulnerable to pollution incidents, because of their relatively low water flow volume, and of high importance for overall freshwater ecology. A complete list of the records can be found in the Appendix.

2 OFFICIAL DATA AND OPPORTUNITIES FOR COMPLEMENTATION[1]

To put the data collected during the WaterBlitz 19 in the context of water governance in Luxembourg, in the following, we describe the official data collection on water quality, detailing monitoring types, purposes, and quantities.

The Luxembourg Water Management Agency is the main government body tasked with the collection of water data. Its monitoring approach regarding surface water is defined by the European Water Framework Directive (2000) and by the Luxembourgish law that is its transposition into the national context (2003). It consists of three types of monitoring activities:

- Monitoring control,
- Operational control, and
- Investigative control.

Monitoring control designates the baseline monitoring activities that take place on a regular and on-going basis. In summary, its main objective is to provide a broad picture of the state of the national surface water bodies. For this, there are five active monitoring stations (Erpeldange/Sure, Ettelbrück/Alzette, Wasserbillig/Sure, and Rodange/Chiers), strategically positioned to represent the entire surface water network in Luxembourg. The set of indicators, which are monitored, varies yearly: The general physico-chemical parameters are tracked every year. The priority substances, the specific pollutants identified for each watershed area and the biological parameters are monitored every three years, alternating between stations. Only at the station 'Rodange', more intensive monitoring is taking place: The general physico-chemical parameters, the priority substances and the specific pollutants for

[1] Based on the report: Administration de la Gestion de l'Eau, 2015. Plan de gestion pour les parties des districts hydrographiques internationaux Rhin et Meuse situées sur territoire luxembourgeois (2015-2021). Administration de la Gestion de l'Eau, Esch-sur-Alzette.

the watershed area are monitored yearly, while the biological parameters remain monitored in three-year-cycles.

As monitoring control is designed to gain an overview of the state of the main Luxembourgish surface water bodies, it is not detailed enough to provide insights into the state of each surface water body, less so to identify pollution sources. For this reason, 'operational control' is in place. This kind of monitoring takes place during a specific time-frame and generally, at stations of surface water bodies that have been identified as at risk of not complying with environmental standards. This classification is based on longitudinal profiles carried out in the past. Operational control is also used to track the impact of implemented measures, and to get a picture of the state of every surface water body of the Luxembourgish surface water network in regular intervals. Logically, the list of indicators, which are monitored, is variable and is determined on a need-basis (for example, based on previously detected pollutants). Currently, operational control is also used to monitor the watershed areas of the main surface water bodies, which are the focus of monitoring control. For this, samples are taken at strategically selected stations. The indicators that are monitored are in accordance with the cycles of the monitoring control, such that every watershed area is monitored completely, every three years.

'Investigative monitoring' is performed, when the reasons for non-compliance with environmental standards are unknown and to research the impacts of accidental pollution incidents. Accordingly, indicators and monitoring frequencies are set on a need-basis. In the past, investigative monitoring has been often used to create longitudinal profiles. They are useful to monitor the status of a surface water body as a whole, and they help with identifying pollution sources.

A complete description, including a comprehensive list of indicators, can be found in the report 'Plan de gestion pour les parties des districts hydrographiques internationaux Rhin et Meuse situées sur territoire luxembourgeois (2015-2021)' by the Luxembourg Water Management Agency.

As the above description demonstrates, a lot of water data is being collected by national authorities. It can, however, also be concluded that there is room for more detailed monitoring. Monitoring control only focuses on the main surface water bodies in Luxembourg, and consequently, can only depict the state of the whole national surface water body network very broadly. In addition, operational control, even though more detailed, is by definition an irregular endeavour.

Citizen science has the potential to complement official monitoring in a meaningful way: For example, citizen science could help increase the number of sampling points on surface water bodies and/or sampling frequencies. This would be especially interesting for the surface water bodies, which are not monitored in relatively short intervals (e.g. smaller streams that are not monitored for researching the state of the watershed areas of the main national surface water bodies). In this way, citizen science could help to develop a more detailed understanding of the state of our surface water bodies and, for example, individual river or stream segments.

Regarding this matter, it has to be noted, however, that citizen science cannot substitute official monitoring. It is not possible, to monitor the same (and high) number of indicators. Citizen science can focus on a smaller, but relevant set of indicators and in this way, deliver additional (and complementary) data points.

Name of water body	Locality	Commune	Freshwater body type	What is the land use in the immediate surroundings?	What is the bank vegetation? (select all that apply)	Is there any of the following on the water surface?	Nitrate (NO3-N mg/L) - colour scale reading	Phosphate (PO4-P mg/L) - colour scale reading	Estimate the water colour
Sure	Ingeldorf	Erpeldange	River	Urban Residential	Trees/shrubs	None	5-10	0.1-0.2	Colourless
Sure	Ingeldorf	Erpeldange	River	Urban Residential	Trees/shrubsGrass	None	5-10	0.05-0.1	Colourless
Sure	Diekirch	Diekirch	River	Urban Residential	Grass	None	5-10	0.05-0.1	Colourless
Sure	Gilsdorf	Bettendorf	River	Urban Residential	Other	None	5-10	0.02-0.05	Colourless
Sure	Bettendorf	Bettendorf	River	Grassland/shrub	Trees/shrubs	None	5-10	0.1-0.2	Colourless
Sure	Bettendorf	Bettendorf	River	Industrial	Grass	None	5-10	0.1-0.2	Colourless
Sure	Moersdorf	Rosport-Mompach	River	Other	GrassTrees/shrubs	None	2-5	0.05-0.1	Green
Sure	Echternach	Echternach	River	Urban Park	Trees/shrubsGrass	None	2-5	0.05-0.1	Colourless
Sure	Dillingen	Beaufort	River	Other	Trees/shrubsGrass	Foam	2-5	0.2-0.5	Colourless
Sure	Diekirch	Diekirch	River	Urban Park	Trees/shrubsGrass	Litter	2-5	0.05-0.1	Green
Sure	Erpeldange	Erpeldange	River	Agriculture	Trees/shrubs	None	2-5	0.02-0.05	Colourless
Sure	Michelau	Bourscheid	River	Other	Trees/shrubsGrass	NoneFoam	2-5	0.02-0.05	Colourless
Sure	Erpeldange	Erpeldange	River	Grassland/shrub	Trees/shrubs	None	1-2	0.05-0.1	Colourless
Sure	Bollendorf-Pont	Berdorf	River	Urban Residential	Trees/shrubs	None	0.5-1	0.1-0.2	Colourless
Sure	Ingeldorf	Erpeldange	River	Urban Residential	Trees/shrubsGrass	Floating algae	0.5-1	0.05-0.1	Yellow

FIGURE 3. RECORDS FOR SURE (ORDERED BY NITRATE-NITROGEN).

Name of water body	Locality	Commune	Freshwater body type	What is the land use in the immediate surroundings?	What is the bank vegetation? (select all that apply)	Is there any of the following on the water surface?	Nitrate-nitrogen (NO_3^--N) mg/L	Phosphate-phosphorus (PO_4^{3-}-P) mg/L	Estimate the water colour
Sure	Dillingen	Beaufort	River	Other	Trees/shrubsGrass	Foam	2-5	0.2-0.5	Colourless
Sure	Ingeldorf	Erpeldange	River	Urban Residential	Trees/shrubs	None	5-10	0.1-0.2	Colourless
Sure	Bettendorf	Bettendorf	River	Grassland/shrub	Trees/shrubs	None	5-10	0.1-0.2	Colourless
Sure	Bettendorf	Bettendorf	River	Industrial	Grass	None	5-10	0.1-0.2	Colourless
Sure	Bollendorf-Pont	Berdorf	River	Urban Residential	Trees/shrubs	None	0.5-1	0.1-0.2	Colourless
Sure	Ingeldorf	Erpeldange	River	Urban Residential	Trees/shrubsGrass	None	5-10	0.05-0.1	Colourless
Sure	Diekirch	Diekirch	River	Urban Residential	Grass	None	5-10	0.05-0.1	Colourless
Sure	Moersdorf	Rosport-Mompach	River	Other	GrassTrees/shrubs	None	2-5	0.05-0.1	Green
Sure	Echternach	Echternach	River	Urban Park	Trees/shrubsGrass	None	2-5	0.05-0.1	Colourless
Sure	Diekirch	Diekirch	River	Urban Park	Trees/shrubsGrass	Litter	2-5	0.05-0.1	Green
Sure	Erpeldange	Erpeldange	River	Grassland/shrub	Trees/shrubs	None	1-2	0.05-0.1	Colourless
Sure	Ingeldorf	Erpeldange	River	Urban Residential	Trees/shrubsGrass	Floating algae	0.5-1	0.05-0.1	Yellow
Sure	Gilsdorf	Bettendorf	River	Urban Residential	Other	None	5-10	0.02-0.05	Colourless
Sure	Erpeldange	Erpeldange	River	Agriculture	Trees/shrubs	None	2-5	0.02-0.05	Colourless
Sure	Michelau	Bourscheid	River	Other	Trees/shrubsGrass	NoneFoam	2-5	0.02-0.05	Colourless

FIGURE 4. RECORDS FOR SURE (ORDERED BY PHOSPHATE-PHOSPHORUS).

Name of water body	Tributory of	Locality	Commune	Freshwater body type	What is the land use in the immediate surroundings?	What is the bank vegetation? (select all that apply)	Is there any of the following on the water surface?	Nitrate-nitrogen (NO_3^--N) mg/L	Phosphate-phosphorus (PO_4^{3-}-P) mg/L	Estimate the water colour
Gander	Moselle	Mondorf-les-Bains	Mondorf-les-Bains	Stream	Urban Residential	Trees/shrubsGrass	None	>10	>1	Colourless
Gander	Moselle	Aspelt	Frisange	Stream	Urban Residential	Grass	None	>10	0.02-0.05	Colourless
Kiemelbaach	Alzette	Foetz	Foetz	Stream	Industrial	Grass	Litter	>10	0.05-0.1	Green
Millebaach	Alzette	Hunsdorf	Lorentzweiler	Stream	Grassland/shrub	Trees/shrubs	None	>10	0.02-0.05	Colourless
Unnamed stream "Source de Dillingen"	Sure	Dillingen	Beaufort	Stream	Forest	Trees/shrubsGrass	None	>10	0.02-0.05	Colourless
Attert	Alzette	Redange	Redange	River	Grassland/shrub	Trees/shrubs	FoamNone	5-10	0.1-0.2	Colourless
Attert	Alzette	Colmarberg	Colmarberg	River	Urban Park	Trees/shrubsGrass	Floating algaeFoamLitter	5-10	0.1-0.2	Colourless
Ernz blanche	Sure	Steinsel	Steinsel	Stream	Forest	Trees/shrubs	None	5-10	<0.02	Colourless
Ernz blanche	Sure	Imbrange	Junglinster	Stream	Agriculture	Trees/shrubsGrass	None	5-10	0.02-0.05	Colourless
Ernz blanche	Sure	Fischbach	Fischbach	Stream	Agriculture	Trees/shrubs	None	5-10	<0.02	Colourless
Ernz blanche	Sure	Keiwelbach	Vallée de l'Ernz	Stream	Agriculture	Trees/shrubsGrass	Foam	5-10	0.5-1	Colourless
Härdbaach	Consdrëfferbaach, Ernz noire	Consdorf	Consdorf	Stream	Forest		None	5-10	0.1-0.2	Colourless
Huesebaach	n/a	Herborn	Rosport-Mompach	Stream	Agriculture	GrassTrees/shrubs	None	5-10	0.05-0.1	Colourless
Kaylbaach (unnamed)	Alzette	Hunsdorf	Lorentzweiler	Stream	Grassland/shrub	Trees/shrubsGrass	None	5-10	<0.02	Colourless
Kiselbaach	Alzette	Schieren	Schieren	Stream	Urban Residential	Trees/shrubs	None	5-10	<0.02	Colourless
Mamer	Alzette	Mersch	Mersch	River	Urban Park	Trees/shrubsGrass	None	5-10	0.1-0.2	Colourless
Pond Sivebur	n/a	Lintgen	Lintgen	Pond	Forest	No vegetation coverTrees/shrubs	None	5-10	0.02-0.05	Colourless
Schrondweilerbaach	Alzette	Cruchten	Nommern	River	Agriculture	Trees/shrubs	None	5-10	<0.02	Colourless
Schwébech	Attert	Kappweiler	Saeul	Stream	Agriculture	Trees/shrubs	None	5-10	0.5-1	Colourless
Sivebur	Kaasselterbaach, Alzette	Lintgen	Lintgen	Stream	Grassland/shrub	Trees/shrubsGrass	None	5-10	0.02-0.05	Colourless
Syre	Moselle	Moutfort	Contern	River	Urban Residential	Trees/shrubs	None	5-10	<0.02	Colourless
Syre	Moselle	Wecker	Biwer	River	Agriculture	Trees/shrubsGrass	None	5-10	0.1-0.2	Brown
Wäissbaach (unnamed)	n/a	Bofferdange	Lorentzweiler	Stream	Urban Residential	GrassTrees/shrubs	Foam	5-10	<0.02	Colourless
Wark	Alzette	Feulen	Feulen	River	Agriculture	Trees/shrubs	None	5-10	0.05-0.1	Colourless
Wuelbertsbaach	Syre	Manternach	Manternach	Stream	Other	Trees/shrubs	None	5-10	0.5-1	Brown
Zéissengerbaach	Pétrusse, Alzette	Cessange	Luxembourg	Stream	Agriculture	Trees/shrubsGrass	Floating algae	5-10	0.02-0.05	Colourless

FIGURE 5. RECORDS FOR OTHER WATERBODIES WITH ≥ 5-10 MG NITRATE-NITROGEN PER LITRE.

Name of water body	Tributory of	Locality	Commune	Freshwater body type	What is the land use in the immediate surroundings?	What is the bank vegetation? (select all that apply)	Is there any of the following on the water surface?	Nitrate-nitrogen (NO_3^--N) mg/L	Phosphate-phosphorus (PO_4^{3-}-P) mg/L	Estimate the water colour
Gander	Moselle	Mondorf-les-Bains	Mondorf-les-Bains	Stream	Urban Residential	Trees/shrubsGrass	None	>10	>1	Colourless
Ernz blanche	Sure	Keiwelbach	Vallée de l'Ernz	Stream	Agriculture	Trees/shrubsGrass	Foam	5-10	0.5-1	Colourless
Schwébech	Attert	Kappweiler	Saeul	Stream	Agriculture	Trees/shrubs	None	5-10	0.5-1	Colourless
Wuelbertsbaach	Syre	Manternach	Manternach	Stream	Other	Trees/shrubs	None	5-10	0.5-1	Brown
Gander	Moselle	Altwies	Mondorf-les-Bains	Stream	Urban Residential	Trees/shrubsGrass	None	1-2	0.5-1	Colourless
Kälbaach	Alzette	Rumelange	Rumelange	Stream	Urban Park	Trees/shrubsGrass	FoamLitter	1-2	0.5-1	Yellow
Pall	Attert	Beckerich	Beckerich	Stream	Grassland/shrub	Trees/shrubsGrass	None	2-5	0.2-0.5	Colourless
Mess	Alzette	Wickrange	Reckange/Mess	Stream	Grassland/shrub	Trees/shrubsGrass	FoamLitter	<0.2	0.2-0.5	Brown
Attert	Alzette	Redange	Redange	River	Grassland/shrub	Trees/shrubs	FoamNone	5-10	0.1-0.2	Colourless
Attert	Alzette	Colmarberg	Colmarberg	River	Urban Park	Trees/shrubsGrass	Floating algaeFoamLitter	5-10	0.1-0.2	Colourless
Härdbaach	Consdrëfferbaach, Ernz noire	Consdorf	Consdorf	Stream	Forest		None	5-10	0.1-0.2	Colourless
Mamer	Alzette	Mersch	Mersch	River	Urban Park	Trees/shrubsGrass	None	5-10	0.1-0.2	Colourless
Syre	Moselle	Wecker	Biwer	River	Agriculture	Trees/shrubsGrass	None	5-10	0.1-0.2	Brown
Attert	Alzette	Bissen	Bissen	Stream	Grassland/shrub	Trees/shrubs	None	2-5	0.1-0.2	Colourless
Dipbech	Alzette	Esch/Alzette	Esch/Alzette	Stream	Urban Residential	Trees/shrubs	Litter	2-5	0.1-0.2	Colourless
Kléngelbaach	Sernigerbaach, Sure	Mompach	Rosport-Mompach	Stream	Urban Residential	Trees/shrubs	Floating algae	1-2	0.1-0.2	Colourless
Drosbech	Alzette	Howald	Hesperange	Stream	Forest	Trees/shrubsGrass	None	0.5-1	0.1-0.2	Colourless
Our	Sure	Bettel	Tandel	River	Urban Residential	Trees/shrubsGrass	None	0.5-1	0.1-0.2	Brown
Wark	Alzette	Warken	Ettelbrück	Stream	Urban Residential	Trees/shrubsGrass	Litter	0.5-1	0.1-0.2	Colourless
Unnamed pond "Manternach am Bongert"	Lelligerbaach, Syre	Herborn	Rosport-Mompach	Pond	Forest	GrassTrees/shrubs	None	<0.2	0.1-0.2	Brown
Unnamed pond "Pétrusse, Hesperange"	Pétrusse	Dippach	Dippach	Pond	Forest	Trees/shrubs	Floating algae	<0.2	0.1-0.2	Green

FIGURE 6. RECORDS FOR OTHER WATERBODIES WITH ≥ 0.1-0.2 MG PHOSPHATE-PHOSPHORUS PER LITRE.

3 NITRATE AND PHOSPHATE IN SURFACE WATERS: IMPLICATIONS FOR HUMANS AND NATURE

As we present the data, we also need to talk about meaning. In the following, we explain some of the major implications of nitrate and phosphate pollution for humans and nature. In-between, we provide and discuss relevant thresholds for both compounds.

The anthropogenic release of nutrients (such as nitrates and phosphates) into water bodies is a growing challenge. It leads to eutrophication – a process, which is 'characterised by excessive plant and algal growth due to the increased availability of one or more limiting growth factors needed for photosynthesis, such as sunlight, carbon dioxide and nutrients'[2]. Not only the anthropogenic release of nutrients, however, is a cause of eutrophication. It also occurs naturally, as sediments accumulate in water bodies over centuries[3].

Eutrophication has many impacts on the aquatic ecosystem. Excessive plant and algal growth can come in the form of toxic algal blooms, such as of blue algae (i.e. cyanobacteria). Fish and other aquatic animals might die, as oxygen in the water is used up by the growing amount of decomposing algae[4].

For humans, eutrophication has also many adverse consequences. For instance, recreational water activities might have to be discontinued, as blue algae not only accumulate on the water surface, but also can have negative effects on health. Health problems can also be caused by extremely high concentrations of nitrates in drinking water, if, for example, nitrate pollution occurs in water bodies used for drinking water supply.

For this reason, the EU has set a threshold of 50 mg of nitrate (NO_3^-) per litre drinking water[5]. This threshold is based on the World Health Organization's nitrate threshold of the same magnitude. It is based on an in-depth assessment of the evidence of health effects on humans of nitrate intake. Nitrate intake has been associated with a reduction of the blood's ability to transport oxygen, which can lead to cyanosis and asphyxia. Infants, bottle-fed infants in particular, are among the groups most susceptible to this phenomenon. Nitrate intake has also been linked with cancer, without, however, clear proof. Considering all evidence, the World Health Organization concluded that an exposure to 50 mg/L of nitrate in drinking water can be deemed not dangerous for all population groups[6]. This concentration is equivalent to about 11.3 mg of nitrate-nitrogen[7] (NO_3^--N) per litre. Although set in the context of drinking water, the threshold is often used to interpret findings of nitrate in surface waters.

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[2] Chislock, M.F., Doster, E., Zitomer, R., Wilson, A., 2013. Eutrophication: Causes, Consequences, and Controls in Aquatic Ecosystems. Nature Education Knowledge 4, 10.

[3] Ibid.

[4] European Environment Agency, 2016. Eutrophication [WWW Document]. URL https://www.eea.europa.eu/publications/92-9167-205-X/page014.html (accessed 2.11.20).

[5] Eurostat, 2012. Agri-environmental indicator - nitrate pollution in rivers [WWW Document]. URL https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Archive:Agri-environmental_indicator_-_nitrate_pollution_of_water&oldid=104304 (accessed 2.11.20).

[6] World Health Organization, 2011. Nitrate and nitrite in drinking-water: Background document for development of WHO guidelines of drinking-water quality. World Health Organization, Geneva, Switzerland.

[7] Nitrate / 4.42 = nitrate-nitrogen

When using the 50-mg-limit to draw conclusions about potential negative health effects of surface water, one has to be careful, however, not to overvalue a reading exceeding the limit. The water body might not be used for drinking water extraction, and even if so, a sample is always only an indication of the actual concentration in the water at one very specific location and point in time. There are, in addition, ways to reduce the amount of nitrate in drinking water by, for example, mixing water sources with differing nitrate concentrations.

In terms of eutrophication, however, it is acknowledged that concentrations far below this threshold are already relevant. For this reason, the European Commission also works with the threshold of 25 mg of nitrate (NO_3) (or about 5.7 mg of nitrate-nitrogen) per litre as a 'guideline concentration'[8].

As part of the implementation of the Water Framework Directive, the Luxembourg Water Management Agency has also set a scale for the concentrations of nitrate in relation to the quality of surface water resources[9].

Indicator	Very good	Good	Moderate	Unsatisfactory	Bad
Nitrate (NO_3^-) mg/L	≤10	≤25	≤50	≤100	>100
Nitrate-nitrogen (NO_3^--N) mg/L	≤2.3	≤5.7	≤11.3	≤22.6	>22.6

FIGURE 8. SCALE OF NITRATE CONCENTRATIONS IN RELATION TO SURFACE WATER QUALITY.

As one can observe, the 50- and 25-mg-thresholds of nitrate are represented. Similarly to the European Environment Agency, the Luxembourg Water Management Agency considers concentrations of nitrate below 25 mg/L as indicating good status, and 50 mg/L as the threshold, above which quality is unsatisfactory.

Although the effects of phosphate in the process of eutrophication are widely accepted, it proves more difficult to identify relevant thresholds for phosphate-phosphorus concentrations in the interpretation of surface water resources. An indicative threshold was found in a publication by the European Environment Agency (2015)[10] on nutrient concentrations in Europe's freshwaters. They put forward a threshold of 0.1-0.2 mg phosphate-phosphorus (PO_4^{3-}-P) per litre, considered sufficient to lead to eutrophication in freshwater resources.

Along these lines, the Luxembourg Water Management Agency associates quality status with phosphate-phosphorus concentrations[11].

[8] European Environment Agency, 2016. Eutrophication [WWW Document]. URL https://www.eea.europa.eu/publications/92-9167-205-X/page014.html (accessed 2.11.20).

[9]Administration de la Gestion de l'Eau, 2009. Bewirtschaftungsplan für das Großherzogtum Luxemburg. Administration de la Gestion de l'Eau, Esch-sur-Alzette.

[10] European Environment Agency, 2019. Nutrients in freshwater in Europe [WWW Document]. URL https://www.eea.europa.eu/data-and-maps/indicators/nutrients-in-freshwater/nutrients-in-freshwater-assessment-published-9 (accessed 2.11.20).

[11]Administration de la Gestion de l'Eau, 2009. Bewirtschaftungsplan für das Großherzogtum Luxemburg. Administration de la Gestion de l'Eau, Esch-sur-Alzette.

Indicator	Very good	Good	Moderate	Unsatisfactory	Bad
Phosphate-phosphorus (PO_4^{3-}-P) mg/L	≤0.033	≤0.163	≤0.326	≤0.653	>0.653

FIGURE 9. SCALE OF PHOSPHATE-PHOSPHORUS CONCENTRATIONS IN RELATION TO SURFACE WATER QUALITY.

It sets the threshold for good water quality in terms of phosphate-phosphorus at 0.163 mg/L. This approximately corresponds to the 0.1-0.2-mg-per-litre-limit fixed by the European Environment Agency mentioned above.

Considering the colour scales in this light, for nitrate-nitrogen, the upper two categories are of particular interest. A reading of '>10' indicates a concentration in the water that is close to the 11.3-mg-per-litre-limit, discussed above. The below-category of '5-10' suggests a concentration of nitrate-nitrogen that is close to 5.7 mg per litre, the guideline concentration, above which the quality status of a surface water body is not considered good anymore and eutrophication is considered likely to occur. Similarly, the suggested phosphate-phosphorus threshold implies for the interpretation of the phosphate-phosphorus colour scale reading that all the categories equal to or above 0.1-0.2 mg per litre suggest an increased likelihood of eutrophication in the concerned water body.

In essence, what needs to be taken away from this section, are the different thresholds: for nitrate

> **11.3** mg per litre (Drinking Water Directive and) and **5.7** mg per litre (guideline for eutrophication) of nitrate-nitrogen,

and for phosphates

> **0.1-0.2** mg per litre of phosphate-phosphorus (guideline for eutrophication)

as well as the fact that these numbers represent reference values. For this reason, it is possible that concentrations below the stated thresholds lead to eutrophication, on the one hand. On the other, eutrophication might not occur for values over the thresholds for the same reason.

For more details on nitrates and phosphates, you may look at:

- "Eist Waasser" by the Administration de la Gestion de l'Eau (informative brochure, available in German)
- "Loscht op Natur: Nitrate Teil 1 und 2" by Naturpark Öewersauer (informative brochure, available in German)
- "Achtung "Blaualgen"!" by the Administration de la Gestion de l'Eau (informative Flyer, available in French, German, and Luxembourgish)

4 VARIABLES OF NITRATE-NITROGEN AND PHOSPHATE-PHOSPHORUS AND IMPLICATIONS FOR STATISTICAL ANALYSIS

In terms of statistical analysis of the data, considering nitrate-nitrogen and phosphate-phosphorus, our dataset is somewhat special. On the one hand, both are "ratio" variables, in general. That is, they are numerical, continuous, can be measured, and they have an absolute zero (i.e. the value "0" means "no value", as, for example, 0 mg/L of nitrate-nitrogen found in a sample means that no nitrate-nitrogen

was detected, in contrast to, for instance, the variable "temperature in °C", for which a measurement of 0 °C does not indicate that no temperature was found, but that there is a specific amount of heat present; Another distinction criterion is the meaningfulness of negative values. For nitrate-nitrogen concentrations negative values do not have meaning, whereas for temperature negative values do have meaning).

With ratio variables, the floor in terms of statistical analysis is open; a multitude of methods are at disposal. Other examples of ratio variables are height, weight, and duration.

On the other hand, the way we collected the data, in the form of intervals, restricts our options of analysis. Due to the level of detail conveyed through data collection, we do not know the distribution of data within the intervals and, therefore, we cannot consider nitrate-nitrogen and phosphate-phosphorus as ratio variables. They have to be seen as ordinal. Ordinal data is data in categories that can be ordered, but for which the distance from one to another is not known and cannot be compared (e.g. Likert-scale data: strongly disagree – disagree – neutral – agree – strongly agree; what is the distance between intervals "2-5" and "5-10"? Is it equal to the distance between "5-10" and ">10"?). In the analysis, the consequence is that the actual values of the intervals (e.g. "2-5" or "5-10") for calculating medians, for example, are not relevant and each interval will be associated with a number, however, in the right order (i.e. for nitrate-nitrogen "1" stands for "0.2-0.5", "2" for "0.5-1", etc.).

Calculating medians will be the main analytical tool in this section. Medians are the best method to indicate central tendency for ordinal variables. A median in the case of ordinal variables is the reading that represents the middle-interval. It is the reading, for which the same amount of higher (or readings equal to) and lower readings (or readings equal to) exist in the dataset. To use measures of central tendency helps to account for a series of limiting factors regarding our dataset, such as errors in readings and uploads as well as the accuracy of methods. While a single data point can help flag potential hotspots and pollutions sources, to get an image of the nutrient status of a water body multiple records are needed. Flagged hotspots and pollution sources also need to be confirmed with additional records over time.

Other tools, such as means (or averages), could lead to false conclusions, as the distribution of the data within the intervals is unknown. Coming back to the median, one point has to be highlighted, however. It is that a median cannot always be calculated for (sub-)datasets with an even number of records. In situations with an uneven number of records, it is clear, which interval is median. It is, in fact, the interval, for which there are as many records with readings above (or equal to) and below (or equal to) (e.g. if there were three readings of "2-5" and four of "5-10", the median would be "5-10"). If, however, we want to calculate the median for a (sub-)dataset with an even number of records, it is not as straight forward. Here the number of readings for each interval decides, if a median can be calculated. For example, if we have three readings of "1-2" and one of "2-5", the median can be calculated and would equal interval "1-2", while, if we have two readings of "1-2" and two of "2-5", we are facing the same obstacle, as we did with the mean. In this case, two intervals would come into question of being the median, but it is impossible to say, which it is. In general, in cases of an even number of records, the median is calculated by identifying the two middle-most categories and by taking the average. For this purpose, if the two

categories are the same, the median can be calculated. In the following, in cases, in which they are not, we will reference both intervals[12].

5 Discussion of data

Above, we have discussed the numbers of records, potential consequences of nutrient concentrations for nature and humans, relevant thresholds as tools for interpretation as well as implications for statistical analysis. In the following section, we will take a closer look at the data. For meaning, it will be linked to contextual factors, such as land use and location of wastewater treatment plants. It is important to note that thresholds relevant for eutrophication are the main factor considered in the interpretation.

5.1 Alzette

5.1.1 Contextual factors

As the answers to "the land use in the immediate surroundings" and a look at the land-use layer of the Government's Geoportal[13] suggest, a high portion of the adjacent areas around the Alzette is urban. Along its course, it flows through agglomerations, such as Esch/Alzette, Hesperange, Luxembourg City, Walferdange, Mersch, Colmarberg, and Ettelbrück. As a result, many wastewater treatment plants direct their effluents into the Alzette (plants of Schifflange, Bettembourg, Hesperange, Beggen, and Mersch). There are, however, also areas, where agriculture dominates. In Hunsdorf and Gosseldange, there are segments, where the Alzette is surrounded by agricultural land (according to the data).

5.1.2 Overview of nitrate-nitrogen

Nitrate-nitrogen readings depict a varied situation: two readings of ">10 mg/L", seven readings of "5-10", nine readings of "2-5", and one reading of "0.2-0.5". "2-5 mg/L" is the median.

The records uploaded in Luxembourg City for the Alzette provide a particularly good example on why single readings have their limits, and, thus, why using measures of central tendency is important. As we will see later on, identifying pollution hotspots and sources of pollution is also a difficult task.

For Luxembourg City, four records have been uploaded. One includes a nitrate-nitrogen reading of 5-10 mg/L (likely to be above the reference threshold for eutrophication), while three users have noted readings of 2-5 mg/L (below the reference threshold for eutrophication). Considering the higher reading alone might lead to the conclusion that concentrations of nitrate seem to be relatively high in this section. However, when also taking the lower measurements into account, the picture is not as negative. The median, in this case, would be interval "2-5".

As mentioned before, single readings can nevertheless flag pollution hotspots or pollution sources with the need for later confirmation. A potential pollution hotspot has been identified by the nitrate-nitrogen data in-between Walferdange and Schieren (two readings in the category ">10"). While the high

[12] For an introduction into statistical analysis, you may look at
Diamond, I., Jefferies, J., 2001. Beginning statistics: an introduction for social scientists. SAGE, London

[13] Le Gouvernement du Grand-Duché du Luxembourg, n.d. Geoportail - Environment [WWW Document]. geoportail. URL https://map.geoportail.lu/theme/emwelt?bgLayer=topo_bw_jpeg&lang=en&version=3&zoom=11&X=690638&Y=6383174&layers=163-215-167-1692-1691&opacities=1-1-1-1-1 (accessed 2.17.20).

readings could be explained by a large number of factors, and we cannot say with certainty that they correspond to the actual concentrations in the samples, they certainly justify further investigation. Regarding potential pollution sources, we can use the readings as well as contextual data to speculate. On the one hand, as the land use around the Alzette is predominantly urban (according to the data) a fair conclusion would be that high nitrate-nitrogen concentrations are down to domestic effluents. In this context, a well-covered pollution event seems relevant. A few days before the WaterBlitz 19, the wastewater treatment plant of Beggen, located just upstream of Walferdange, was subject to a technical error and released untreated wastewater into the Alzette for a period of time (see, for example, articles in Luxemburger Wort, L'essentiel, and Tageblatt). As a result, this heavily polluted water has been on the journey downstream. On the other hand, considering the particularly high readings of nitrates in Hunsdorf and Gosseldange, where land use in the immediate surroundings of the sampling sites was marked agricultural, introduces another layer of speculation. It seems, in fact, that agricultural effluents also have a role to play. It is impossible to say, which explanation is true. In this case, it is, most likely, a combination of the three (regular and exceptional wastewater as well as agricultural discharge).

5.1.3 Overview of phosphate-phosphorus

In relation to the threshold of 0.1-0.2 mg of PO_4^{-3}-P/L, the readings of phosphate-phosphorus for the Alzette paint a more serious picture. Only two of the 19 readings in total are below. The median of the readings for the entire river is "0.2-0.5".

The segments around Hesperange-Luxembourg and Walferdange-Lintgen have been subject to particularly high readings. Three records in Hesperange-centre suggest a median concentration of 0.5-1 mg phosphate-phosphorus/L. Considering all records for Hesperange the median is slightly lower: 0.2-0.5 mg/L. Both median values, as well as all individual readings, are well over the reference threshold of 0.1-0.2 for eutrophication, and the medians are close to or above the 0.326 mg/L threshold set out by the Luxembourg Water Management Agency, above which the status of the water body is considered unsatisfactory.

In Luxembourg City, the records result in a median value for phosphate-phosphorus of 0.1-0.2 mg/L, with a peak near Alzette's entry into the City (0.5-1). A similar picture can be observed between Walferdange and Lintgen, before the concentrations of phosphate-phosphorus seem to drop around Ettelbrück. To make more robust judgements on potential pollution sources than in the previous paragraphs, more records in quantity and in time are necessary. The speculations mentioned in the context of nitrate-nitrogen and causes for pollution also apply for phosphate-phosphorus concentrations.

What the data seems to suggest, however, is that agricultural effluents do not play as big a role in phosphate-phosphorus concentrations as in nitrate-nitrogen concentrations. For the Alzette, in comparison, phosphate-phosphorus readings tend to be above the thresholds for eutrophication, while for nitrate-nitrogen, readings tend to be below. As previously discussed, one has to be careful, however, with the use of indicative thresholds for interpretation, in this case especially, because nitrate-nitrogen readings are nevertheless near the limit.

5.2 Sure

5.2.1 Contextual factors

Similarly to the Alzette, most of the records for the Sure have been uploaded in or near agglomerations. Correspondingly, the predominant answer to the question "What is the land use in the immediate surroundings?" is urban, including the variations "urban residential" and "urban park".

The Sure passes some of the major agglomerations of the North of Luxembourg, with the Ettelbrück and Diekirch area (Erpeldange, Ettelbrück, Diekirch, and Bettendorf), and, further downstream, Echternach as well as Mertert, where it joins the Moselle. More rural features, such as forests, agriculture, and smaller settlements, however, characterise its watershed area before entering Erpeldange, after its entrance to the country from Belgium[13]. On some of its course, it has been modified to become the biggest dammed lake in Luxembourg with a surface area of 3.8 square kilometres. The artificial lake now serves as the main drinking water source in the country. It also provides an environment for diverse recreational activities, as well as for hydroelectric power production[14]. Along the way of the Sure, many wastewater treatments plants have been built (for example, Heiderscheidergrund, Michelau, Bleesbrück, Reisdorf, Echternach, Rosport, and Moersdorf), among which some use only mechanical processes for treatment (for example, Ringel and Tadler)[13].

5.2.2 Overview of nitrate-nitrogen

Considering nitrate-nitrogen readings for the Sure, the highest reading is 5-10 mg/L, of which six have been uploaded. Also, six readings exist for 2-5 mg/L. The intervals below are left with the remaining three, with 1 in "1-2" and 2 in "0.5-1". The readings taken together result in a median of 2-5 mg/L.

Between Ingeldorf and Bettendorf, readings indicate higher nitrate-nitrogen levels, compared with other sections of the river, with a median of 5-10 mg/L. As this section of the Sure is surrounded by some of the major agglomerations of the North of Luxembourg, and the land uses in the immediate surroundings were identified as mainly "urban residential" (5/8), one might conclude that domestic effluents play an important role in the nutrient status in this section. This, however, is only a speculation and would need to be confirmed by more long-term monitoring as well as other research.

Upstream of Ingeldorf, three records indicate a median of 2-5 mg/L, which is also the median of the four remaining records uploaded downstream of Bettendorf. All individual readings in these segments are equal to or below 2-5 mg/L, thus below the 25-mg-per-litre-threshold.

5.2.3 Overview of phosphate-phosphorus

Turning to the readings of phosphate-phosphorus, the before-mentioned section of the Sure between Ingeldorf and Bettendorf was subject to a slightly better outcome. The median for this section is, in fact, either 0.05-0.1 or 0.1-0.2 mg/L. Considering the readings for other sections of the Sure, we can observe that one reading stands out. It was uploaded in Dillingen indicating 0.2-0.5 mg/L. The remaining records result in a median of 0.05-0.1 mg/L, which is also the median of all phosphate-phosphorus readings for the Sure.

[14] Naturpark Öewersauer, n.d. Naturpark Öewersauer - Description [WWW Document]. Naturpark-Sure. URL http://www.naturpark-sure.lu/index.php?id=5;lang=en (accessed 2.17.20).

5.3 IN COMPARISON

After discussing the Alzette and Sure individually, we now move on to provide a short comparison.

5.3.1 NITRATE-NITROGEN

As Figure 10 shows, there are more records with nitrate-nitrogen readings for the Alzette in the two upper categories of "5-10" and ">10" (in percent of the total). In fact, 48 percent of the readings fall into these categories, while for the Sure, it is only 40 percent. 11 percent of total readings for the Alzette even exceed 10 mg/L.

Interval	Alzette (%)	Sure (%)
<0.2	0	0
0.1-0.2	0	0
0.2-0.5	5	0
0.5-1	0	13
1-2	0	7
2-5	47	40
5-10	37	40
>10	11	0

FIGURE 10: NITRATE-NITROGEN COUNTS PER INTERVAL IN PERCENT OF TOTAL; BOX HIGHLIGHTS INTERVALS OF SPECIAL INTEREST REGARDING THE POTENTIAL OF EUTROPHICATION (GUIDELINE THRESHOLD FOR EUTROPHICATION: 5.7 MG OF NITRATE-NITROGEN PER LITRE)

5.3.2 PHOSPHATE-PHOSPHORUS

Regarding phosphate-phosphorus, 69 percent of the readings for the Alzette are in the categories above or equal to 0.1-0.2 mg/L. In comparison, for the Sure, only 34 percent were classified in these intervals. Correspondingly, 67 percent of total readings for the Sure are below the reference threshold for eutrophication (compared with 11 percent for the Alzette).

Interval	Alzette (%)	Sure (%)
<0.02	0	0
0.02-0.05	11	20
0.05-0.1	0	47
0.1-0.2	37	27
0.2-0.5	26	7
0.5-1	26	0
>1	0	0

FIGURE 11: PHOSPHATE-PHOSPHORUS COUNTS PER INTERVAL IN PERCENT OF TOTAL; BOX HIGHLIGHTS INTERVALS OF SPECIAL INTEREST REGARDING THE POTENTIAL FOR EUTROPHICATION (GUIDELINE THRESHOLD FOR EUTROPHICATON: 0.1-0.2 MG OF PHOSPHATE-PHOSPHORUS PER LITRE)

What strikes as interesting is the rather large difference of the Alzette and the Sure in terms of phosphate-phosphorus readings. Only more detailed research of the two rivers regarding river characteristics, placements of wastewater treatment plants, and land-use data among others, could help shed light on the origins of the difference. To understand the impact of the failure of the wastewater

treatment plant in Beggen, one could, for example, compare the WaterBlitz data for the Alzette with other data sources.

5.4 Other waterbodies

5.4.1 Nitrate-nitrogen

Now that we have discussed results for both the Alzette and the Sure, we will have a look at the data for all other 54 water bodies that were sampled as part of the WaterBlitz 19. For nitrate-nitrogen, we will focus on the readings in the categories "5-10" and ">10", and point out what seems important.

5.4.1.1 Overview

About two-thirds of the readings are equal to or below 2-5 mg/L (below the reference threshold for eutrophication). About a third is equal to or above 5-10 mg/L, while 6 percent equal to ">10".

The whole dataset can be found in the Appendix, and the records with readings above or equal to 5-10 mg/L can be found in Figure 5. What stands out are two readings for the Gander in the South of the country, one reading for the Millebaach in Hunsdorf, one for the Kiemelbaach in Foetz, and one for a source in Dillingen. They account for the 6 percent of total readings that were classified as ">10". To account for the limits of single readings, we will discuss each individually.

5.4.1.2 Gander near Mondorf-les-Bains

The Gander is the only water body, for which two records have been uploaded with readings of >10 mg/L. To account for the limits of single readings, the following rule applies: The more records there are, the more weight can be put on them in interpretation. A fact that further supports the trustworthiness of the two high readings is the fact that the records have been uploaded by two different users. Although errors in readings can never be completely ruled out, it is unlikely that two users get the same result by mistake. While the records do not necessarily illustrate the general state of the Gander, they definitely should be taken seriously. We can, therefore, conclude that nitrate-nitrogen levels of the Gander should be subject to further investigation.

5.4.1.3 Kiemelbaach in Foetz

As previously introduced, a reading of >10 mg/L of nitrate-nitrogen has also been uploaded for the Kiemelbaach in Foetz. For the Kiemelbaach another record exists, with a reading of "2-5" in Mondercange. Consequently, the high reading does not seem to reflect the general status of the Kiemelbaach. It, however, suggests a pollution source near Foetz.

5.4.1.4 Millebaach in Hunsdorf

While for the Millebaach in Hunsdorf, only one record has been uploaded, a second exists in Hunsdorf for the Alzette, and it also shows a reading of >10 mg/L of nitrate-nitrogen. Considering both at the same time allows us to conclude that Hunsdorf seems to be a potential pollution hotspot. In contrast to the Gander, where different users uploaded the records, in this case, they were made by the same user. As a consequence, the records need to be treated more carefully.

5.4.1.5 Source in Dillingen

For the reading of >10 mg/L in Dillingen, our dataset, unfortunately, does not provide any data that could help confirm it. It should be taken as a flag of a potential pollution event. It is important to note that all the readings need to be confirmed with more extensive monitoring activities (in location and

time), before they can be taken to indicate the status of the water bodies or pollution events with certainty.

5.4.2 Phosphate-phosphorus

5.4.2.1 Overview

Moving on to discuss the phosphate-phosphorus readings of the 54 water bodies, 73 percent of the readings are equal to or below 0.05-0.1 mg/L. Correspondingly, 27 percent are equal to or above 0.1-0.2 mg/L, while 6 percent fall into category "0.5-1" and even one reading into ">1".

Similarly to the discussion of nitrate-nitrogen, in the following, we will focus on the readings of "0.5-1" or more. High readings have been uploaded for the Gander in Mondorf-les-Bains, White Ernz in Keiwelbach, Kälbaach in Rumelange, Schwébech in Kappweiler, and the Wuelbertsbaach in Manternach.

5.4.2.2 Gander near Mondorf-les-Bains

For the Gander, which was already a subject in our discussion concerning nitrate-nitrogen before, two records have been uploaded with readings of 0.5-1 and >1 mg/L. This indicates that both compounds, equally, are an issue involved in the status of the gander. The gander seems at high risk of eutrophication.

5.4.2.3 White Ernz in Keiwelbach

For the Ernz Blanche, four records have been uploaded in total. While a relatively high one was found with 0.5-1 mg/L of phosphate-phosphorus, three relatively low ones have also been uploaded, resulting in a median of either >0.02 or 0.02-0.05 mg/L. Taken together, these readings indicate that the state of the White Ernz in terms of phosphate-phosphorus is relatively good. The outlier reading of "0.5-1", however, suggests the presence of a potential localised pollution source around Keiwelbach, which would need to be confirmed with more extensive monitoring.

5.4.2.4 Other

As the other high readings for phosphate-phosphorus all represent only readings for the respective water bodies, we will not go into further detail in their interpretation. It suffices to say that 0.5-1 mg/L is exceeding the reference threshold for eutrophication by far, meaning that the precautionary principle should be applied and further investigation commissioned.

6 Last thoughts

At this point, we have reached the end of our tour. Before we wrap this up, however, we want to leave you with a few thoughts.

One of the main aims of the WaterBlitz 19 was to collect as many water samples as possible to get a high-resolution overview of the state of Luxembourg's water bodies. With an impressive 113 records, 56 sampled water bodies, 19 samples for the Alzette, and 15 for the Sure, we can conclude that, with your help, we have come a long way. The data will help us to further investigate potential pollution hotspots as well as sources, and to further research the nutrient status throughout Luxembourgish water bodies.

The data has shown a rather clear difference in the phosphate-phosphorus status of the Alzette and the Sure, and it has flagged potential pollution hotspots for the Gander in Mondorf-les-Bains, for the

Kiemelbaach in Foetz, for the Millebaach in Hunsdorf, and for an unidentified source in Dillingen in terms of nitrate-nitrogen, and for the Gander in Mondorf-les-Bains, White Ernz in Keiwelbach, Kälbaach in Rumelange, Schwébech in Kappweiler, and the Wuelbertsbaach in Manternach in terms of phosphate-phosphorus. For the Alzette, a potential pollution hotspot was flagged in Hunsdorf and Gosseldange in terms of nitrate-nitrogen. This list is not exhaustive.

The interpretation of the records is a very delicate matter, as thresholds can only be applied with limits and the colour scale readings are only an indication of the actual concentration at a very specific location and point in time. Following the rule "The more data points exist for a water body, the better the data represents its status", single readings have to be interpreted carefully. The limits that apply include errors in manipulation of the sampling tubes, in readings and upload. Occasional errors with the functioning of the tubes also cannot be ruled out completely. The most appropriate statistical tools need to be carefully picked and their implication for the interpretation considered.

The WaterBlitz 19 Luxembourg was organised as part of the NEXUS CITIZEN SCIENCE project.

Water quality is a topic with increasing importance. Surface water bodies are exposed to many stressors. Pollution leads to changes in ecosystems and increases the efforts needed for drinking water treatment. Due to changing weather patterns, drinking water suppliers are facing new challenges. In such complex situations, characterised by multiple and often conflicting perspectives as well as multi-layered connections, it is increasingly important to involve various actors in the elaboration of approaches to old and new challenges. This complexity and technological advancement will further increase the need for data on water quality in the times to come.

Citizen science, a type of science, in which any interested party can actively participate and make meaningful contributions, promises to involve interested citizens and other actors in knowledge generation processes. It would allow interested parties to bring in new perspectives, while taking part in the participatory monitoring of water and environment.

As part of the NEXUS CITIZEN SCIENCE project, our research team at the University of Luxembourg is trying to promote citizen science in Luxembourg by, on the one hand, carrying out contributory citizen science projects, such as the WaterBlitz, and, on the other hand, by co-creating citizen science projects with interested groups.

For further information on our approach and NEXUS CITIZEN SCIENCE, please visit our website: https://sustainabilityscience.uni.lu/.

We sincerely hope that this little tour has provided you with relevant information and we will keep you updated on any further developments in regard to the WaterBlitz 19 Luxembourg.

The data is freely accessible, and we hope that some of you will have a look and use it for one purpose or another.

Thanks again for your contributions. It would not have been possible without you.

Kind regards

The WaterBlitz Team

7 APPENDIX

7.1 ALL RECORDS

Name of water body	Tributory of	Locality	Commune	Freshwater body type	What is the land use in the immediate surroundings?	What is the bank vegetation? (select all that apply)	Is there any of the following on the water surface?	Nitrate-nitrogen (NO_3^--N) mg/L	Phosphate-phosphorus (PO_4^{3-}-P) mg/L	Estimate the water colour
Alzette	Sure	Esch/Alzette	Esch/Alzette	River	Urban Residential	Trees/shrubs	None	2-5	0.5-1	Colourless
Alzette	Sure	Hesperange	Hesperange	River	Urban Park	Trees/shrubs	None	5-10	0.2-0.5	Brown
Alzette	Sure	Hesperange	Hesperange	River	Urban Residential	Trees/shrubs	None	5-10	0.5-1	Colourless
Alzette	Sure	Hesperange	Hesperange	River	Urban Park	Trees/shrubs	None	2-5	0.5-1	Green
Alzette	Sure	Itzig	Hesperange	River	Forest	Trees/shrubs	LitterFoam	5-10	0.2-0.5	Colourless
Alzette	Sure	Hesperange	Hesperange	River	Forest	Trees/shrubs	None	2-5	0.2-0.5	Brown
Alzette	Sure	Hesperange	Hesperange	River	Forest	Trees/shrubs	None	2-5	0.2-0.5	Colourless
Alzette	Sure	Bonnevoie-Sud, Luxembourg	Luxembourg	River	Other	GrassTrees/shrubs	None	5-10	0.5-1	Colourless
Alzette	Sure	Grund, Luxembourg	Luxembourg	River	Urban Park	Trees/shrubs	FoamLitter	2-5	0.1-0.2	Colourless
Alzette	Sure	Steinsel	Steinsel	River	Grassland/shrub	Trees/shrubsGrass	None	5-10	0.5-1	Colourless
Alzette	Sure	Hunsdorf	Lorentzweiler	River	Agriculture	Trees/shrubsGrassOther	Floating algae	>10	0.2-0.5	Other
Alzette	Sure	Gosseldange	Lintgen	River	Agriculture	Trees/shrubsGrass	None	>10	0.1-0.2	Colourless
Alzette	Sure	Colmarberg	Colmarberg	River	Urban Residential	Trees/shrubs	None	5-10	0.1-0.2	
Alzette	Sure	Schieren	Schieren	River	Industrial	Trees/shrubs	None	5-10	0.1-0.2	Colourless
Alzette	Sure	Ettelbrück	Ettelbrück	River	Urban Residential	GrassTrees/shrubs	Litter	2-5	0.1-0.2	Green
Alzette	Sure	Ettelbrück	Ettelbrück	River	Urban Residential	Grass		2-5	0.02-0.05	Colourless
Alzette	Sure	Grund, Luxembourg	Luxembourg	Stream	Urban Residential	Trees/shrubs	FoamFloating algaeOily Sheer	2-5	0.1-0.2	Green
Alzette	Sure	Grund, Luxembourg	Luxembourg	Stream	Urban Park	Trees/shrubs	Litter	2-5	0.1-0.2	Colourless
Alzette	Sure	Schifflange	Schifflange	Wetland	Forest	Trees/shrubsGrass	NoneFloating algae	0.2-0.5	0.02-0.05	Green
Attert	Alzette	Redange	Redange	River	Grassland/shrub	Trees/shrubs	FoamNone	5-10	0.1-0.2	Colourless
Attert	Alzette	Colmarberg	Colmarberg	River	Urban Park	Trees/shrubsGrass	Floating algaeFoamLitter	5-10	0.1-0.2	Colourless
Attert	Alzette	Bissen	Bissen	Stream	Grassland/shrub	Trees/shrubs	None	2-5	0.1-0.2	Colourless
Bouneschbaach	Syre	Oberanven	Niederanven	Stream	Agriculture	Trees/shrubs	None	0.2-0.5	<0.02	Brown
Bouneschbaach	Syre	Oberanven	Niederanven	Stream	Agriculture	Trees/shrubs		<0.2	<0.02	Other
Brokelsgriescht	Bouneschbaach, Syre	Niederanven	Niederanven	Stream	Urban Residential	Trees/shrubs		<0.2	<0.02	Colourless
Dipbech	Alzette	Esch/Alzette	Esch/Alzette	Stream	Urban Residential	Trees/shrubs	None	1-2	<0.02	Colourless
Dipbech	Alzette	Esch/Alzette	Esch/Alzette	Stream	Urban Residential	Trees/shrubs	Litter	2-5	0.1-0.2	Colourless
Dipbech	Alzette	Esch/Alzette	Esch/Alzette	Stream	Urban Park	Trees/shrubsGrassOther	None	0.5-1	0.02-0.05	Colourless
Drosbech	Alzette	Hesperange	Hesperange	Stream	Forest	Trees/shrubs	None	2-5	0.05-0.1	Colourless
Drosbech	Alzette	Howald	Hesperange	Stream	Forest	Trees/shrubsGrass	None	0.5-1	0.1-0.2	Colourless
Drosbech	Alzette	Howald	Hesperange	Stream	Urban Residential	Trees/shrubs	None	0.5-1	<0.02	Colourless
Ernz blanche	Sure	Steinsel	Steinsel	Stream	Forest	Trees/shrubs	None	5-10	<0.02	Colourless
Ernz blanche	Sure	Imbrange	Junglinster	Stream	Agriculture	Trees/shrubsGrass	None	5-10	0.02-0.05	Colourless
Ernz blanche	Sure	Fischbach	Fischbach	Stream	Agriculture	Trees/shrubs	None	5-10	<0.02	Colourless
Ernz blanche	Sure	Keiwelbach	Vallée de l'Ernz	Stream	Agriculture	Trees/shrubsGrass	Foam	5-10	0.5-1	Colourless
Ernz noire	Sure	Junglinster	Junglinster	Stream	Agriculture	Trees/shrubs	None	2-5	0.02-0.05	Other
Etang Am Weier	n/a	Leudelange	Leudelange	Pond	Agriculture	Trees/shrubs	Floating algae	0.2-0.5	0.02-0.05	Yellow

Etang Liégeois	n/a	Esch/Alzette	Esch/Alzette	Pond	Forest	Trees/shrubs	None	0.2-0.5	<0.02	Colourless
Gander	Moselle	Mondorf-les-Bains	Mondorf-les-Bains	Stream	Urban Residential	Trees/shrubsGrass	None	>10	>1	Colourless
Gander	Moselle	Altwies	Mondorf-les-Bains	Stream	Urban Residential	Trees/shrubsGrass	None	1-2	0.5-1	Colourless
Gander	Moselle	Aspelt	Frisange	Stream	Urban Residential	Grass	None	>10	0.02-0.05	Colourless
Härdbaach	Consdrëfferbaach, Ernz noire	Consdorf	Consdorf	Stream	Forest		None	5-10	0.1-0.2	Colourless
Hielemer Baach (unnamed)	not identified	Bofferdange	Lorentzweiler	Stream	Forest	Trees/shrubsGrass	None	0.5-1	<0.02	Colourless
Huesebaach	n/a	Herborn	Rosport-Mompach	Stream	Agriculture	GrassTrees/shrubs	None	5-10	0.05-0.1	Colourless
Kailsbaach	Sure	Weiswampach	Weiswampach	Stream	Forest	Trees/shrubs		1-2	0.05-0.1	Yellow
Kailsbaach	Wemperbaach, Woltz, Sure	Weiswampach	Weiswampach	Stream	Agriculture	GrassTrees/shrubs	Foam	0.5-1	0.02-0.05	Yellow
Kälbaach	Alzette	Rumelange	Rumelange	Stream	Urban Park	Trees/shrubsGrass	FoamLitter	1-2	0.5-1	Yellow
Kaylbaach (unnamed)	Alzette	Hunsdorf	Lorentzweiler	Stream	Grassland/shrub	Trees/shrubsGrass	None	5-10	<0.02	Colourless
Kiemelbaach	Alzette	Mondercange	Mondercange	Stream	Agriculture	Trees/shrubsGrass	None	2-5	0.02-0.05	Green
Kiemelbaach	Alzette	Foetz	Foetz	Stream	Industrial	Grass	Litter	>10	0.05-0.1	Green
Kiselbaach	Alzette	Schieren	Schieren	Stream	Urban Residential	Trees/shrubs	None	5-10	<0.02	Colourless
Kléngelbaach	Sernigerbaach, Sure	Mompach	Rosport-Mompach	Stream	Urban Residential	Trees/shrubs	Floating algae	1-2	0.1-0.2	Colourless
Lac de Weiswampach	Kailsbaach, Sure	Weiswampach	Weiswampach	Lake	Urban Park	Trees/shrubsGrass	None	1-2	0.05-0.1	Colourless
Mamer	Alzette	Mersch	Mersch	River	Urban Park	Trees/shrubsGrass	None	5-10	0.1-0.2	Colourless
Mëllerbaach	Blees, Sure	Bastendorf	Tandel	Stream	Grassland/shrub	Trees/shrubsGrass	None	0.2-0.5	<0.02	Colourless
Mess	Alzette	Wickrange	Reckange/Mess	Stream	Grassland/shrub	Trees/shrubsGrass	FoamLitter	<0.2	0.2-0.5	Brown
Mess	Alzette	Reckange/Mess	Reckange/Mess	Stream	Grassland/shrub	Trees/shrubsGrass	None	0.2-0.5	0.05-0.1	Colourless
Mess	Alzette	Schouweiler	Dippach	Stream	Urban Park	Trees/shrubsGrass	None	0.5-1	<0.02	Colourless
Millebaach	Alzette	Hunsdorf	Lorentzweiler	Stream	Grassland/shrub	Trees/shrubs	None	>10	0.02-0.05	Colourless
Our	Sure	Bettel	Tandel	River	Urban Residential	Trees/shrubsGrass	None	0.5-1	0.1-0.2	Brown
Our	Sure	Vianden	Vianden	River	Urban Residential	Trees/shrubsGrass	Floating algae	0.5-1	0.02-0.05	Brown
Our	Sure	Eisenbach	Park Hosingen	River	Grassland/shrub	Trees/shrubsGrass	NoneFoam	0.2-0.5	0.02-0.05	Yellow
Pall	Attert	Beckerich	Beckerich	Stream	Grassland/shrub	Trees/shrubsGrass	None	2-5	0.2-0.5	Colourless
Pisbaach	Mess, Alzette	Pissange	Reckange/Mess	River	Urban Residential	Trees/shrubsGrass	None	0.5-1	0.02-0.05	Colourless
Pond Sivebur	n/a	Lintgen	Lintgen	Pond	Forest	No vegetation coverTrees/shrubs	None	5-10	0.02-0.05	Colourless
Schrondweilerbaach	Alzette	Cruchten	Nommern	River	Agriculture	Trees/shrubs	None	5-10	<0.02	Colourless
Schwébech	Attert	Kappweiler	Saeul	Stream	Agriculture	Trees/shrubs	None	5-10	0.5-1	Colourless
Sivebur	Kaasselterbaach, Alzette	Lintgen	Lintgen	Stream	Grassland/shrub	Trees/shrubsGrass	None	5-10	0.02-0.05	Colourless
Staflick	Bouneschbaach, Syre	Oberanven	Niederanven	Stream	Agriculture	Trees/shrubs	None	0.2-0.5	<0.02	Brown
Sure	Moselle	Moersdorf	Rosport-Mompach	River	Other	GrassTrees/shrubs	None	2-5	0.05-0.1	Green
Sure	Moselle	Echternach	Echternach	River	Urban Park	Trees/shrubsGrass	None	2-5	0.05-0.1	Colourless
Sure	Moselle	Ingeldorf	Erpeldange	River	Urban Residential	Trees/shrubs	None	5-10	0.1-0.2	Colourless
Sure	Moselle	Ingeldorf	Erpeldange	River	Urban Residential	Trees/shrubsGrass	None	5-10	0.05-0.1	Colourless
Sure	Moselle	Bollendorf-Pont	Berdorf	River	Urban Residential	Trees/shrubs	None	0.5-1	0.1-0.2	Colourless
Sure	Moselle	Dillingen	Beaufort	River	Other	Trees/shrubsGrass	Foam	2-5	0.2-0.5	Colourless
Sure	Moselle	Ingeldorf	Erpeldange	River	Urban Residential	Trees/shrubsGrass	Floating algae	0.5-1	0.05-0.1	Yellow

Sure	Moselle	Diekirch	Diekirch	River	Urban Park	Trees/shrubsGrass	Litter	2-5	0.05-0.1	Green
Sure	Moselle	Erpeldange	Erpeldange	River	Grassland/shrub	Trees/shrubs	None	1-2	0.05-0.1	Colourless
Sure	Moselle	Diekirch	Diekirch	River	Urban Residential	Grass	None	5-10	0.05-0.1	Colourless
Sure	Moselle	Erpeldange	Erpeldange	River	Agriculture	Trees/shrubs	None	2-5	0.02-0.05	Colourless
Sure	Moselle	Gilsdorf	Bettendorf	River	Urban Residential	Other	None	5-10	0.02-0.05	Colourless
Sure	Moselle	Bettendorf	Bettendorf	River	Grassland/shrub	Trees/shrubs	None	5-10	0.1-0.2	Colourless
Sure	Moselle	Bettendorf	Bettendorf	River	Industrial	Grass	None	5-10	0.1-0.2	Colourless
Sure	Moselle	Michelau	Bourscheid	River	Other	Trees/shrubsGrass	NoneFoam	2-5	0.02-0.05	Colourless
Syre	Moselle	Moutfort	Contern	River	Urban Residential	Trees/shrubs	None	5-10	<0.02	Colourless
Syre	Moselle	Wecker	Biwer	River	Agriculture	Trees/shrubsGrass	None	5-10	0.1-0.2	Brown
Turelbaach	Wark, Alzette	Mertzig	Mertzig	River	Agriculture	Trees/shrubsGrass	None	0.5-1	0.02-0.05	Colourless
Unidentified other "Schifflange am Schmettbësch"		Schifflange	Schifflange	Other	Urban Park	Trees/shrubs	None	0.5-1	<0.02	Colourless
Unidentified other "Schifflange bei der Quell"	n/a	Remerschen	Schengen	Stream	Other	Other	None	0.2-0.5	0.02-0.05	Colourless
Unidentified source "Vallée de l'Ernz"	Ernz blanche, Sure	Keiwelbach	Vallée de l'Ernz	Wetland	Forest	Trees/shrubs	None	<0.2	0.05-0.1	Colourless
Unidentified stream "Helmdange"	n/a	Helmdange	Lorentzweiler	Stream	Grassland/shrub	Trees/shrubs	None	2-5	<0.02	Colourless
Unidentified stream "Remerschen"		Schifflange	Schifflange	Other	Forest	Other	None	0.5-1	0.02-0.05	Colourless
Unnamed lake "Patou"	n/a	Hesperange	Hesperange	Lake	Urban Park	Trees/shrubs	None	0.5-1	0.02-0.05	Yellow
Unnamed pond "Junglinster Schweibësch/Godbrange"	n/a	Godbrange	Junglinster	Pond	Forest	No vegetation cover	None	0.2-0.5	<0.02	Yellow
Unnamed pond "Mamer Wuesen"	Pétrusse, Alzette	Dippach	Dippach	Pond	Forest	Trees/shrubs	Floating algaeOily Sheen	<0.2	0.02-0.05	Green
Unnamed pond "Manternach am Bongert"	Lelligerbaach, Syre	Herborn	Rosport-Mompach	Pond	Forest	GrassTrees/shrubs	None	<0.2	0.1-0.2	Brown
Unnamed pond "Mompach Hierberbësch"	n/a	Berbourg	Manternach	Pond	Grassland/shrub	Trees/shrubsGrass	Floating algae	2-5	0.02-0.05	Colourless
Unnamed pond "Pétrusse, Hesperange"	Pétrusse	Dippach	Dippach	Pond	Forest	Trees/shrubs	Floating algae	<0.2	0.1-0.2	Green
Unnamed stream "Source de Dillingen"	Sure	Dillingen	Beaufort	Stream	Forest	Trees/shrubsGrass	None	>10	0.02-0.05	Colourless
Waassertrap	n/a	Sanem	Sanem	Wetland	Urban Park	GrassOther	Floating algae	0.2-0.5	0.02-0.05	Green
Waassertrap	n/a	Sanem	Sanem	Wetland	Urban Residential	Grass	None	<0.2	0.02-0.05	Yellow
Wäissbaach (unnamed)	n/a	Bofferdange	Lorentzweiler	Stream	Urban Residential	GrassTrees/shrubs	Foam	5-10	<0.02	Colourless
Wark	Alzette	Feulen	Feulen	River	Agriculture	Trees/shrubs	None	5-10	0.05-0.1	Colourless
Wark	Alzette	Warken	Ettelbrück	Stream	Urban Residential	Trees/shrubsGrass	Litter	0.5-1	0.1-0.2	Colourless
Weiler Weier (unnamed)	Trëtterbaach, Woltz, Sure	Weiler	Winkrange	Pond	Agriculture	Trees/shrubsGrassOther	None	<0.2	<0.02	Colourless
Wemperbaach	Woltz, Sure	Breidfeld	Weiswampach	Stream	Agriculture	Trees/shrubsGrass	Foam	1-2	0.05-0.1	Colourless
Woltz	Sure	Kautenbach	Kiischpelt	River	Forest	Trees/shrubsGrass	None	2-5	0.05-0.1	Colourless
Woltz	Sure	Merkholtz	Kiischpelt	River	Forest	Trees/shrubsGrass	NoneFoam	2-5	0.05-0.1	Colourless
Wuelbertsbaach	Syre	Manternach	Manternach	Stream	Other	Trees/shrubs	None	5-10	0.5-1	Brown
Zéissengerbaach	Pétrusse, Alzette	Cessange	Luxembourg	Stream	Agriculture	Trees/shrubsGrass	Floating algae	5-10	0.02-0.05	Colourless
Zéissengerbaach	Pétrusse, Alzette	Cessange	Luxembourg	Stream	Urban Park	Trees/shrubsGrass	Floating algae	1-2	0.02-0.05	Colourless

FIGURE 12. ALL RECORDS (ON THREE PAGES).