

# **Pesticide concentrations in hydraulic shortcuts exceed environmental quality criteria**

Anne Dax, Urs Schönenberger, Birgit Beck, Bernadette Vogler, Heinz Singer, and  
Christian Stamm

# Introduction

- Numerous man-made hydraulic shortcuts exist in Swiss agricultural areas  
(see also presentation EGU2020-16396: «What pesticide legislation forgot about»)
- Hydraulic shortcuts:
  - man-made structures directing runoff to surface waters  
(e.g. manholes and inlets of road and tile drainage systems)
  - may play a major role for pesticide inputs to surface waters



Inlet of road drainage system



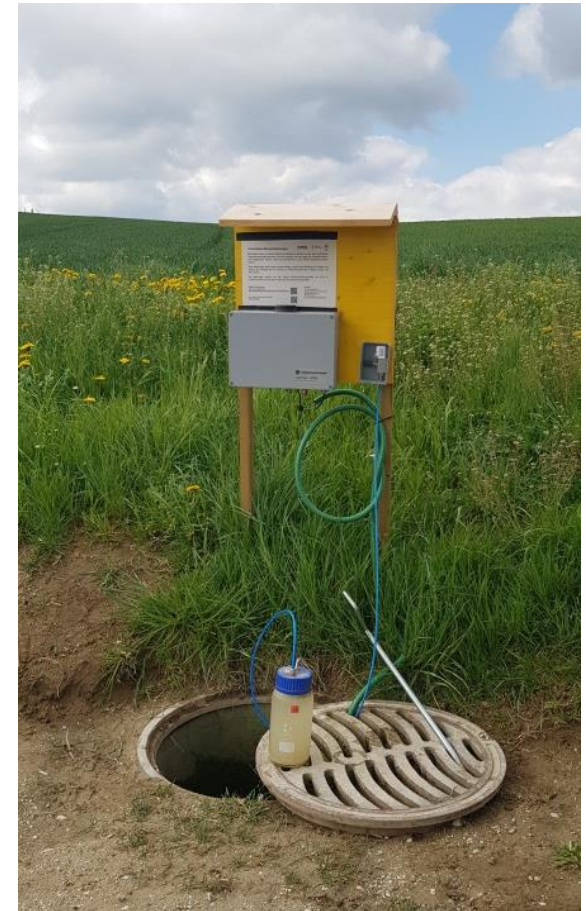
Inlet of tile drainage system

## Research question

What is the *importance of hydraulic shortcuts for pesticide transport* in our study catchment?

## Sampling strategy

- Measurement of pesticide concentrations in hydraulic shortcuts
- Comparing them to concentrations found in a small river
- Sampling of rain events producing surface runoff (16 events)





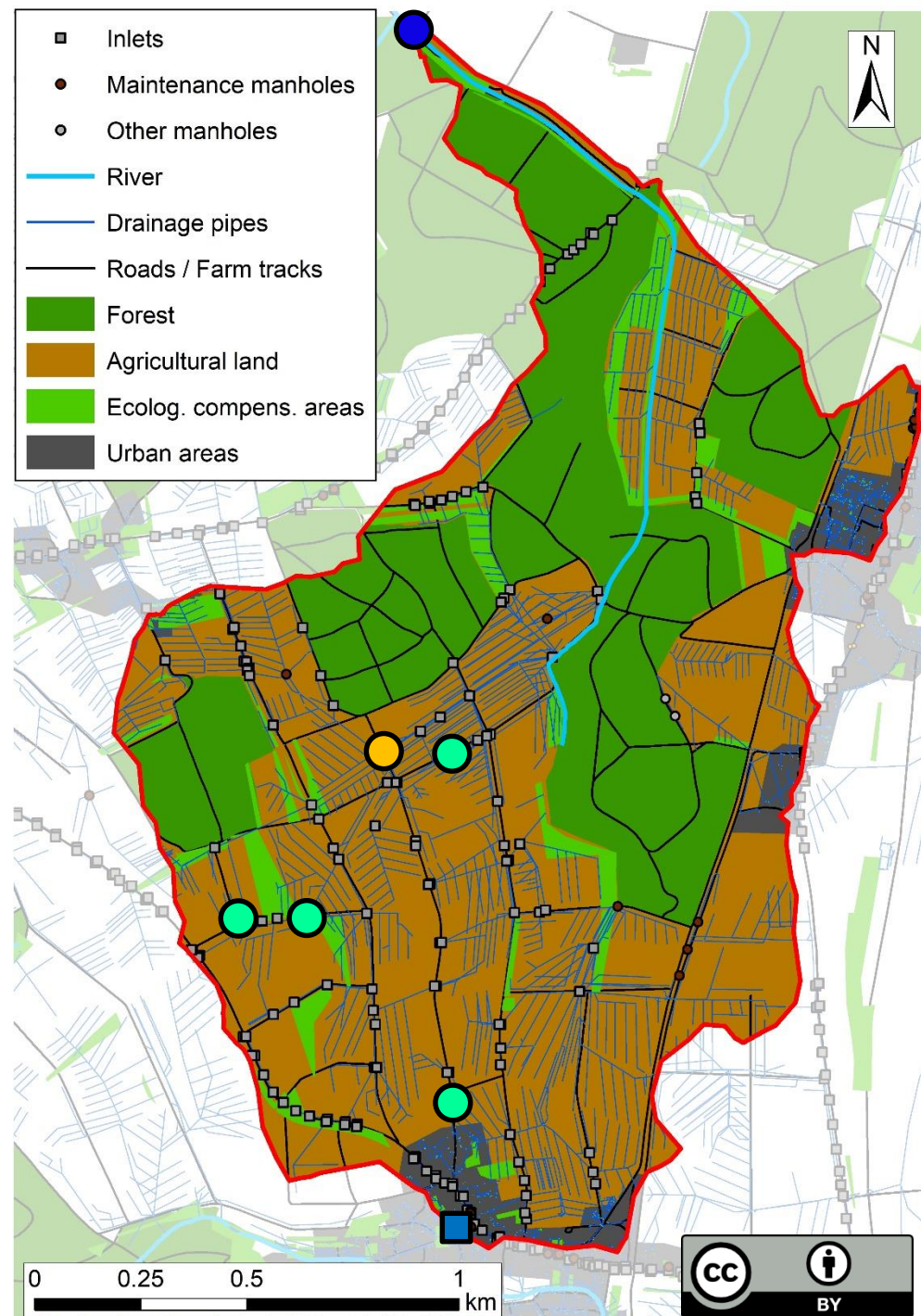
# Catchment

Small catchment (2.8km<sup>2</sup>) with predominant arable land use in the Swiss Plateau

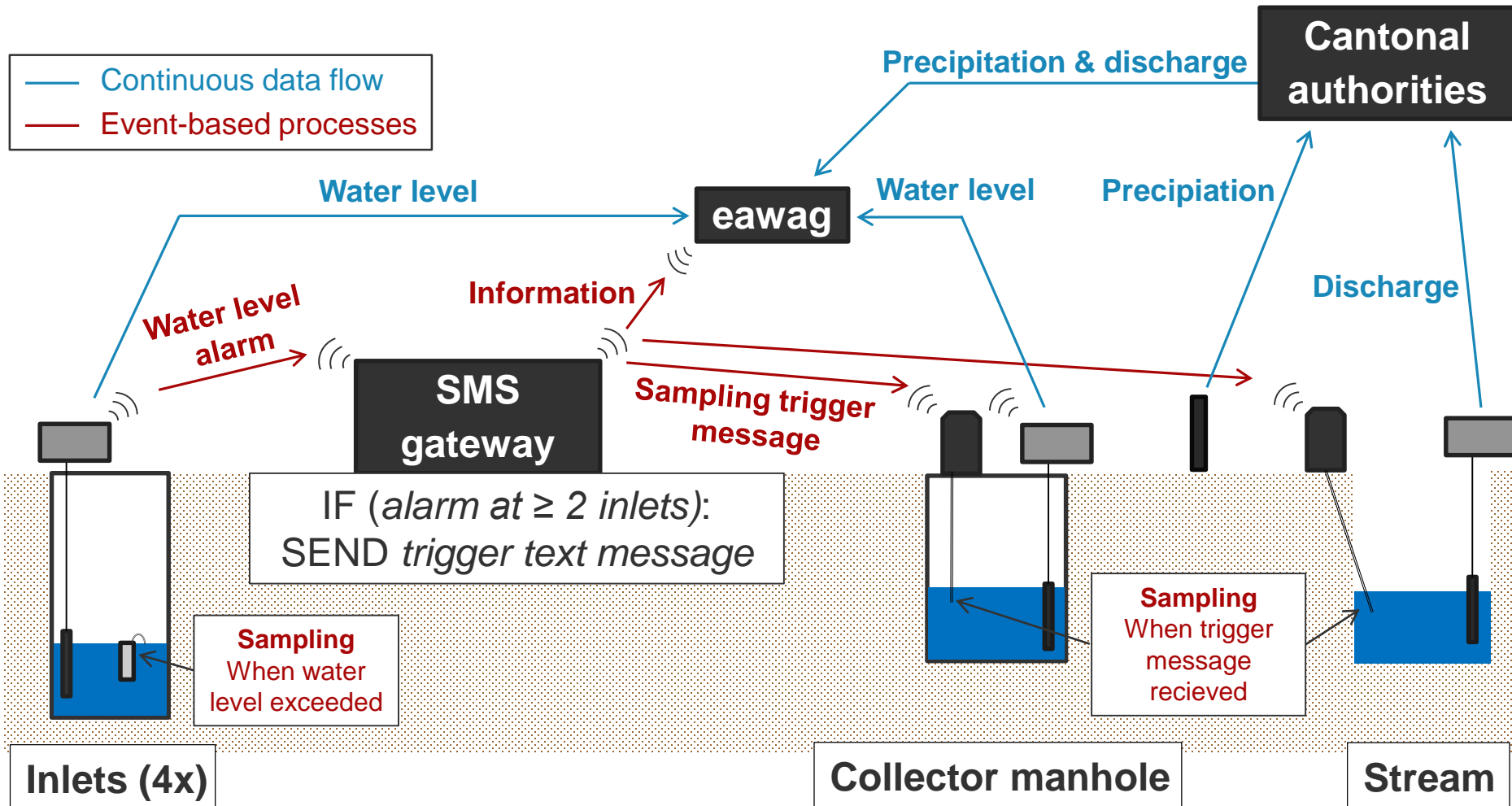
- 4x: Water level proportional samplers at road storm drainage inlets
- 1x: auto sampler in a manhole collecting water from the tile and road drainage system
- 1x: auto sampler in the stream at the outlet of the catchment

Additional measurements:

- Precipitation
  - Discharge / water levels at each of the six sampling locations



# Setup for event-based sampling



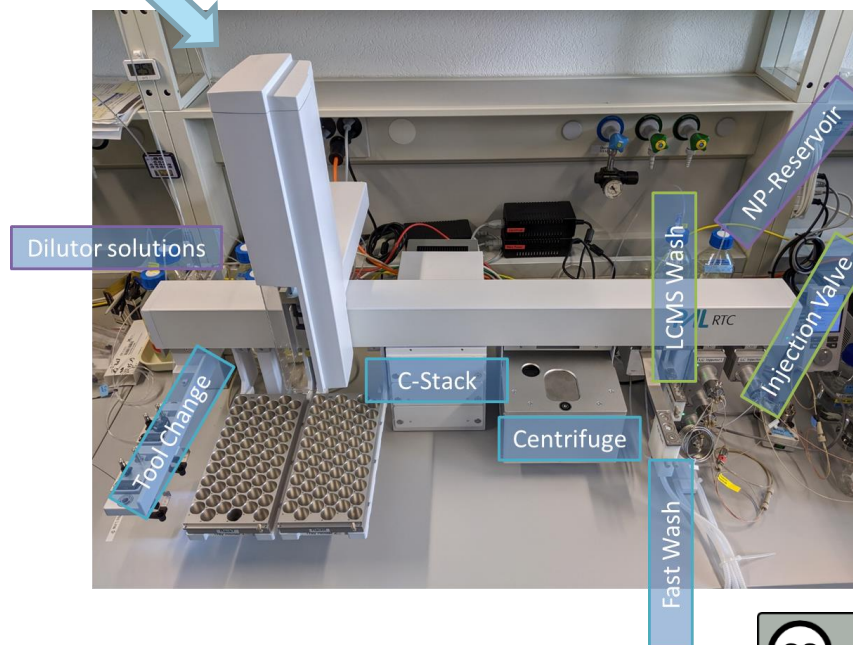
- Liquid chromatography coupled to high-resolution mass spectrometry (LC-HRMS)
- Fully automated sample preparation and acquisition
  - Reducing human error > more precise & reliable results
  - Avoiding substance loss via filtration
- Calibration curves ranging from 10 ng/L – 5 µg/L

Lumos Fusion Tribrid



<https://cdn.technologynetworks.com>

CTC PAL RTC autosampler



# Results: Overview

Fungicides	Inlets	Collector manhole	Stream
Azoxystrobin	Found	Found	Found
Bixafen	Found	Found	Found
Boscalid	Found	Found	Found
Cymoxanil	Found	Found	Found
Cyproconazol	Found	Found	Found
Difenoconazol	Found	Found	Found
Epoxiconazol	Found	Found	Found
Fenpropimorph	Not found	Not found	Found
Fluazinam	Not found	Not found	Not found
Fluopicolide	Found	Found	Found
Mandipropamid	Found	Found	Found
Metrafenone	Found	Not found	Found
Pencycuron	Found	Found	Found
Propamocarb	Found	Found	Found
Propiconazol	Found	Found	Found
Prothioconazole	Not found	Not found	Not found
Pyraclostrobin	Not found	Not found	Not found
Spiroxamin	Not found	Not found	Not found
Trifloxystrobin	Not found	Not found	Found

Insecticides	Inlets	Collector manhole	Stream
Thiacloprid	Found	Not found	Found
Thiamethoxam	Not found	Found	Found

Metabolites	Inlets	Collector manhole	Stream
Chlorothalonil-TP611968	Found	Found	Found
Chlorothalonil-TP-R417888	Found	Found	Found
Chlorothalonil-TP-R471811	Found	Found	Found
Chlorothalonil-TP-SYN507900	Not found	Found	Found
Metamitron Desamino	Found	Found	Found
Metolachlor OXA	Not found	Not found	Found

Detects report: 4 events

Found: > LOQ

Not found: < LOQ

Herbicides	Inlets	Collector manhole	Stream
Carfentrazone-ethyl	Not found	Not found	Not found
Chlortoluron	Found	Found	Found
Diflufenican	Not found	Not found	Not found
Dimethachlor	Found	Found	Not found
Dimethenamid	Found	Found	Found
Ethofumesat	Found	Found	Found
Florasulam	Not found	Not found	Not found
Fluazifop	Not found	Not found	Found
Flufenacet	Found	Found	Found
Flupyrsulfuron-methyl	Not found	Not found	Not found
Foramsulfuron	Not found	Not found	Found
Iodosulfuron-methyl	Not found	Not found	Not found
Isoproturon	Found	Found	Found
Lenacil	Found	Found	Found
Mecoprop	Not found	Not found	Not found
Mesosulfuron-methyl	Not found	Not found	Not found
Metamitron	Found	Found	Found
Metazachlor	Not found	Not found	Not found
Metolachlor	Found	Found	Found
Metribuzin	Found	Found	Found
Napropamid	Found	Not found	Found
Nicosulfuron	Found	Found	Found
Prosulfocarb	Found	Found	Found
Tembotrione	Found	Found	Found
Terbuthylazine	Found	Found	Found

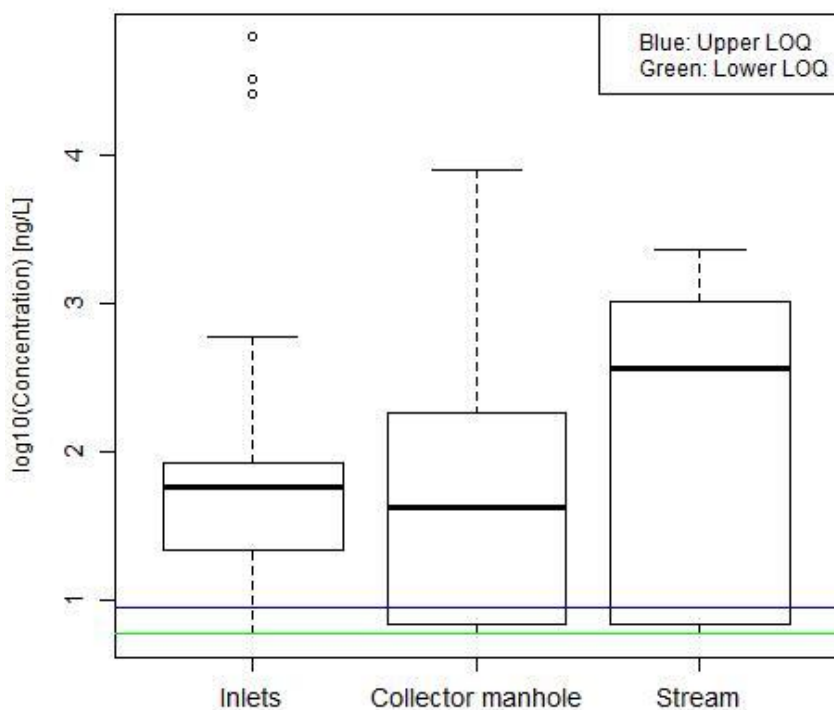
Broad compound spectrum detected across all sampling locations.

# Results: Concentration ranges

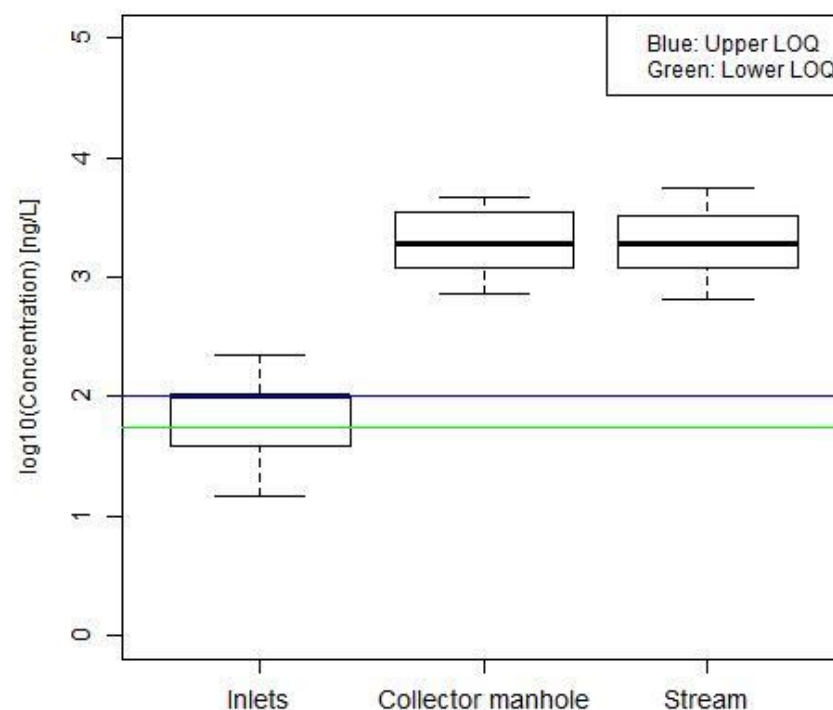
	Inlet N°1	Inlet N°2	Inlet N°3	Inlet N°4	Collector manhole	Stream
Max	20'100	1'900	75'100	1'100	18'700	54'700
Min	2'000	100	1'700	400	2'300	5'000

Tab.: Cumulative concentration (ng/L) per sampling location

**Terbuthylazine**

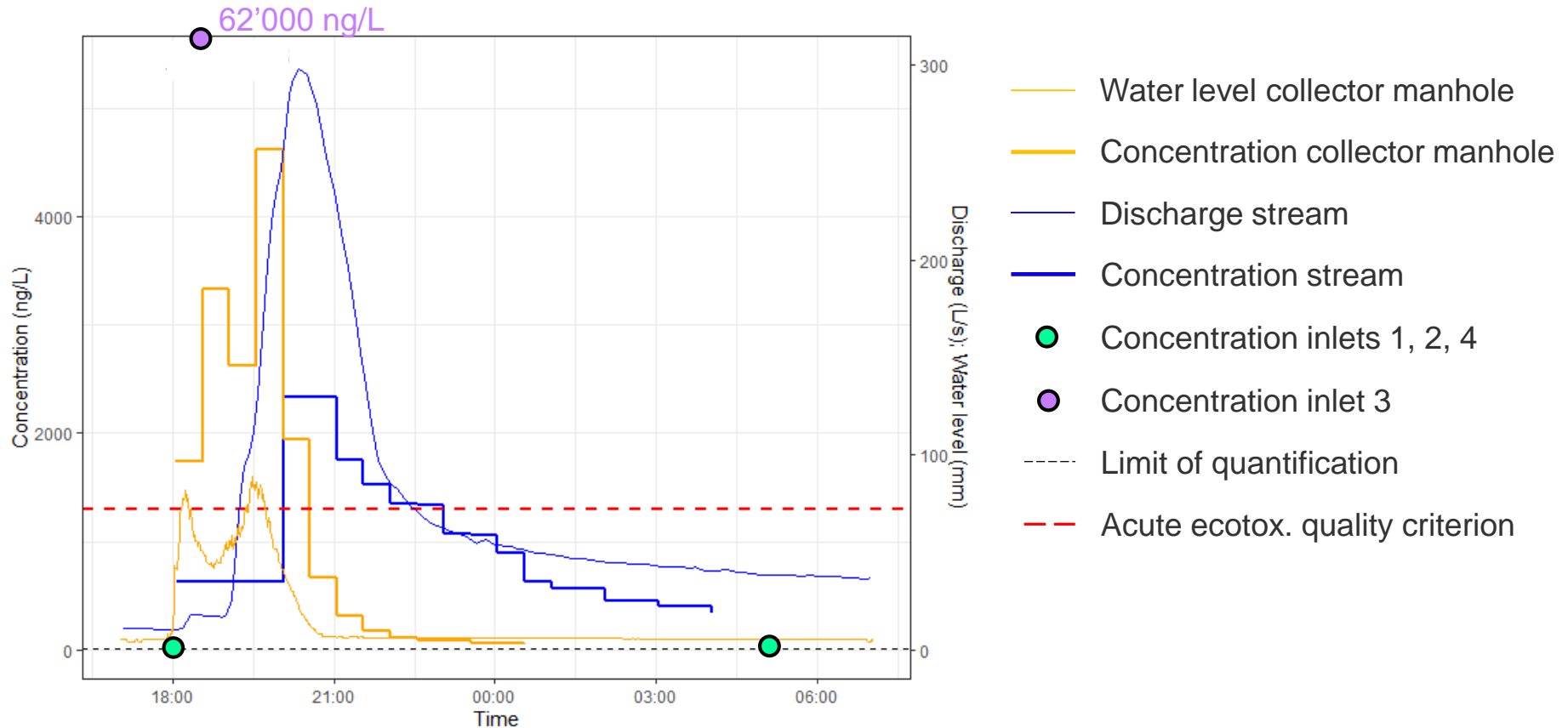


**CT-TP-R471811**





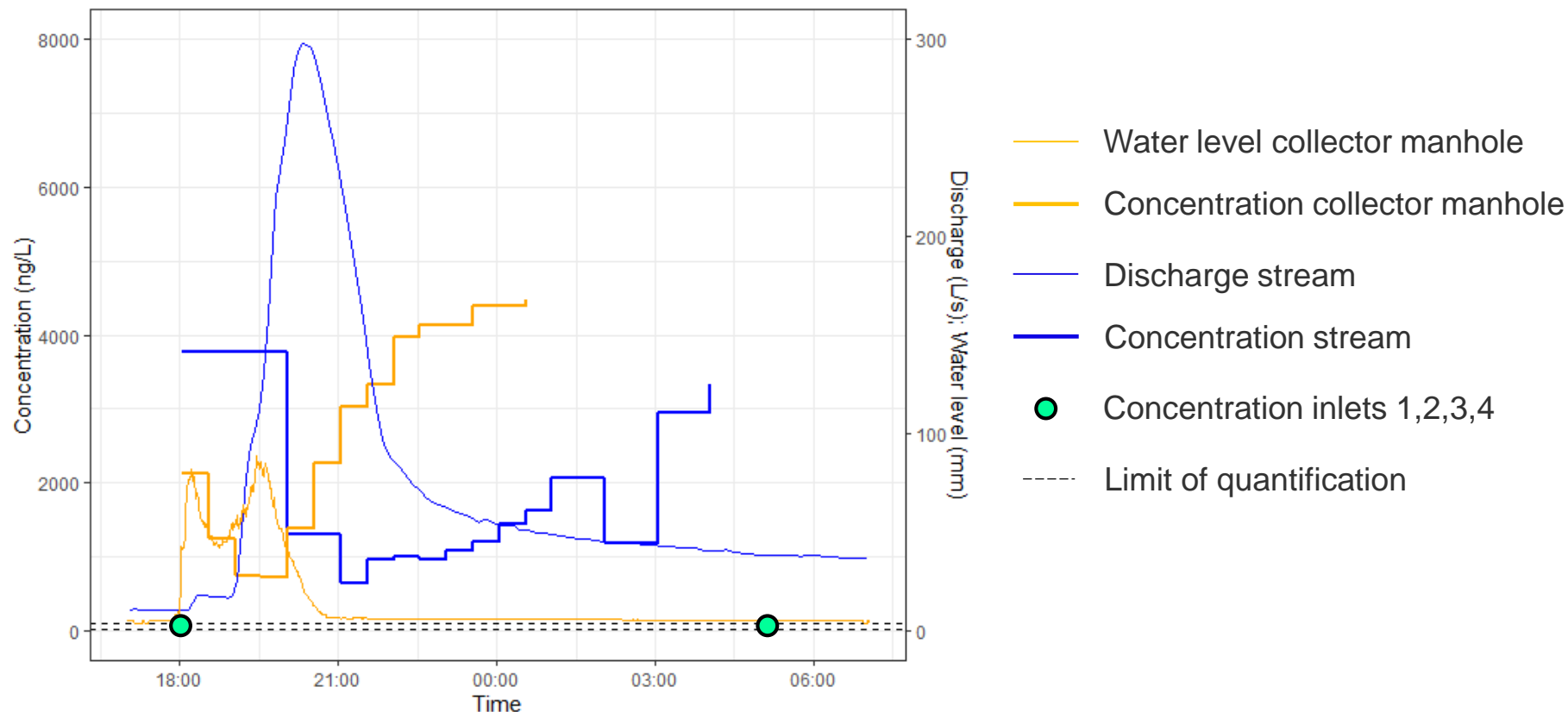
## Terbuthylazine concentration during rain event 12



### Tentative explanation for Terbuthylazine transport

Surface runoff from field → inlet 3 → collector manhole → river

## Concentration of the chlorothalonil transformation product R471811 during rain event 12

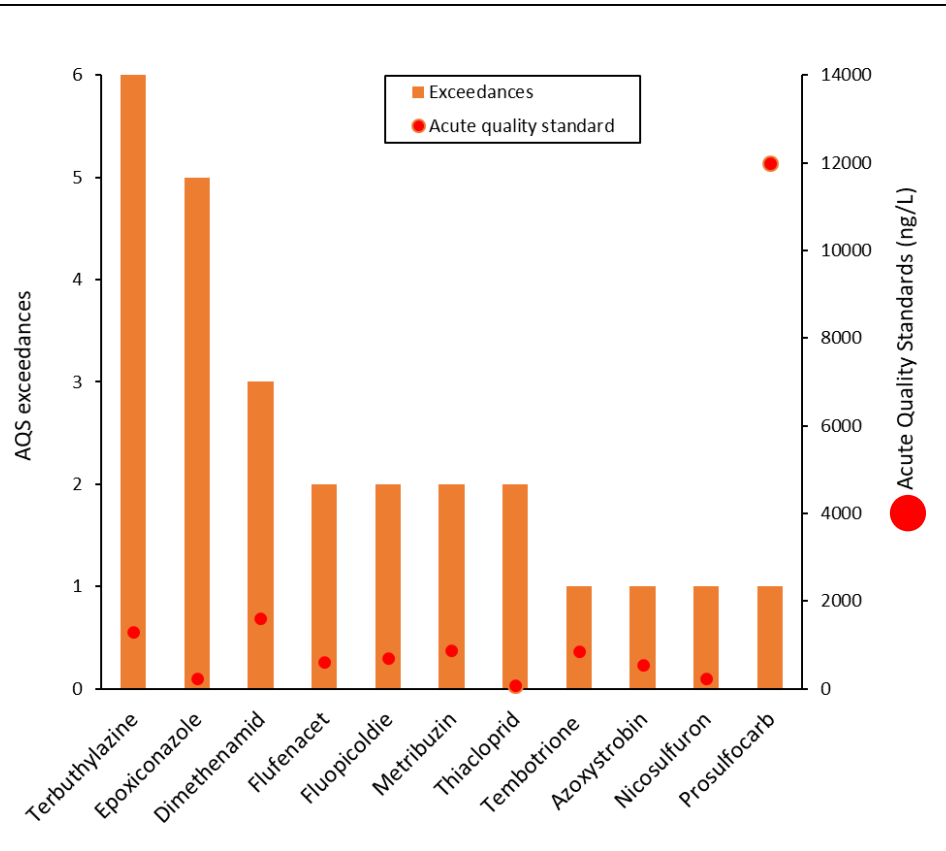


### Tentative explanation for R471811 concentration dynamics

Originating from tile drainage & groundwater

→ Dilution of R471811 during rain event by surface runoff

# Results: Ecotoxicological quality criteria



	Event 5	Event 10	Event 12	Event 13
<b>Inlet N°1</b>	Epoxiconazole	Epoxiconazole	Epoxiconazole	Epoxiconazole
<b>Inlet N°2</b>				
<b>Inlet N°3</b>	Metribuzin Prosulfocarb		Dimethenamid Tembotrione Terbutylazine	Dimethenamid Terbutylazine Thiacloprid
<b>Inlet N°4</b>				
<b>Collector Manhole</b>	Epoxiconazole		Metribuzin Terbutylazine	Dimethenamid Nicosulfuron Terbutylazine
<b>Stream</b>	Thiacloprid	Flufenacet Fluopicolde Terbutylazine	Flufenacet Fluopicolde Terbutylazine	Azoxystrobin

Tab.: Compounds exceeding AQS per sampling location and rain event

Several pesticides exceed critical thresholds at inlets.

- Hydraulic shortcuts:
  - High peak concentrations observed (up to 60  $\mu\text{g/L}$  )
  - Large spectrum of pesticides detected
- Shortcuts seem to be a relevant pathway for pesticide transport to surface waters in the studied catchment
- Different temporal dynamics for active ingredients and transformation products