Assessing metaldehyde concentrations in surface water catchments and implications on drinking water abstractions

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stream
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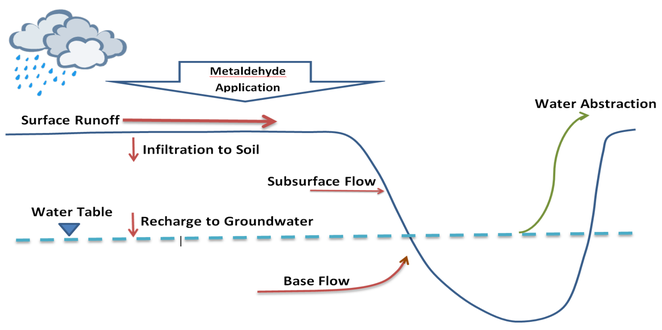
1. Background

- Metaldehyde is an active ingredient in slug control pellet and is heavily used in agriculture.
- High concentrations are often detected in raw water, particularly with peaks following rainfall events.
- Current drinking water treatment methods are not effective at completely removing metaldehyde from water.



- The principal diffuse pathways of metaldehyde to watercourses are through surface runoff and flow in tile drains.
- The project aims to develop a scheme for advanced management of surface water abstraction based on predicted levels of peak metaldehyde concetrations in raw water.

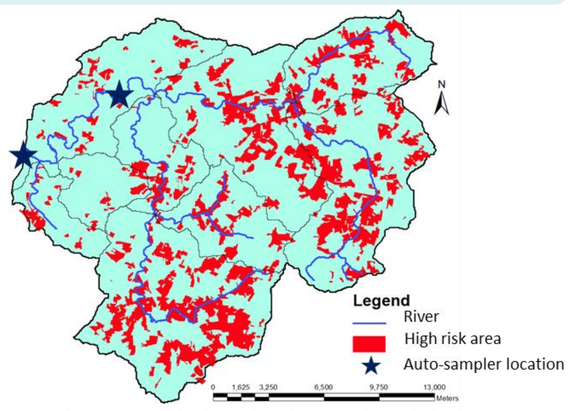
2. Build-up and Wash-off Model

The timing and intensity of rainfall events after application is a critical factor in determining metaldehyde mobility from the agricultural lands;

- Flow arising from rainfall following application typically produces events with the highest observed pesticide concentrations (Capel et al., 2001; Leu et al., 2004a).

2.1 Identifying high risk areas

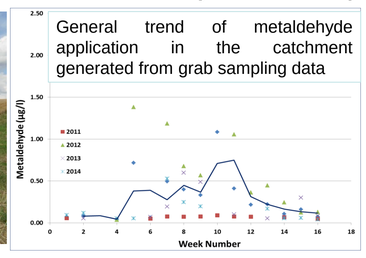
Field risk (*the likelihood of a pesticide being mobilised and reaching a watercourse*) + **Land use risk** (*the likelihood of pesticides being applied*) = **Pesticide risk**



- Areas in the study catchment where the use of metaldehyde has the highest likelihood of causing issues for water treatment.

2.2 Build-up

- Each rainfall event causes different rate of metaldehyde flux in to watercourses depending on the amount of metaldehyde build-up through applications.



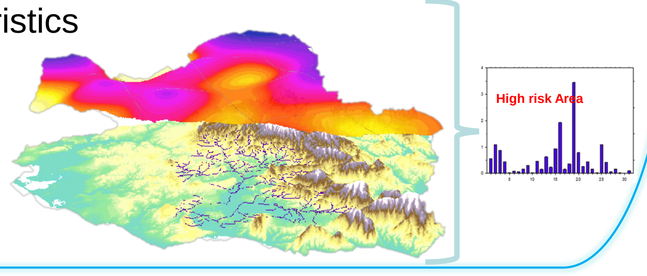
- Application guidelines
- Application data collected from farmers
- Estimated application using these data is used in active metaldehyde build-up function

2.3 Wash-off

- Wash-off is dependent on rainfall, catchment and substance characteristics
- Pesticide loss equation calculates percentage loss of metaldehyde through runoff

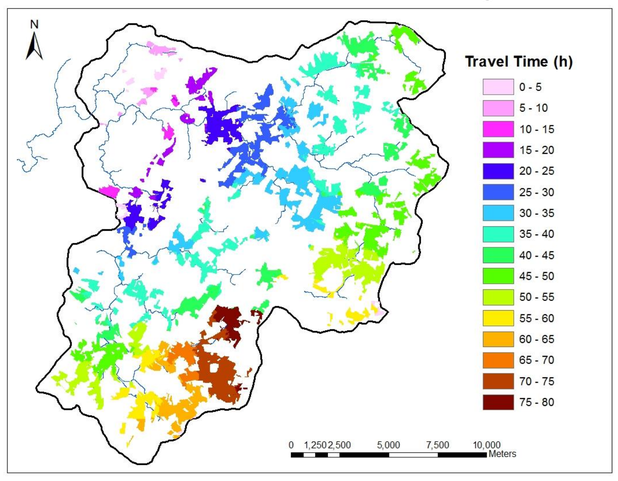
$$L\%_{\text{runoff}} = \frac{Q}{P} \cdot f \cdot e^{-3 \cdot \frac{\ln 2}{DT_{50\text{soil}}}} \cdot \frac{100}{1 + K_d}$$

Radar Rainfall (1km² and 5 minute resolution)

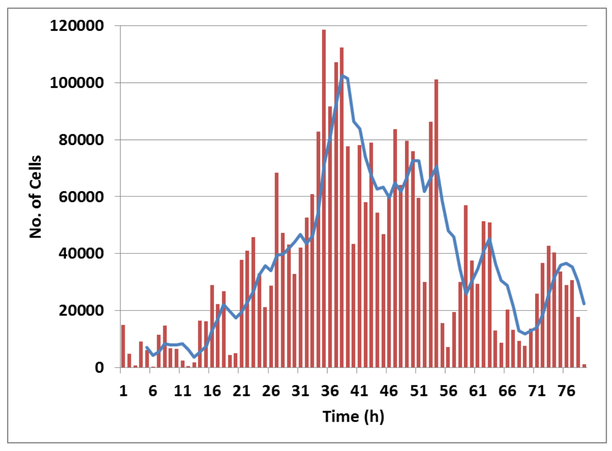


3. Travel Time from High Risk Areas

- Concentration of metaldehyde at the abstraction site depends on travel time of direct runoff from high risk areas



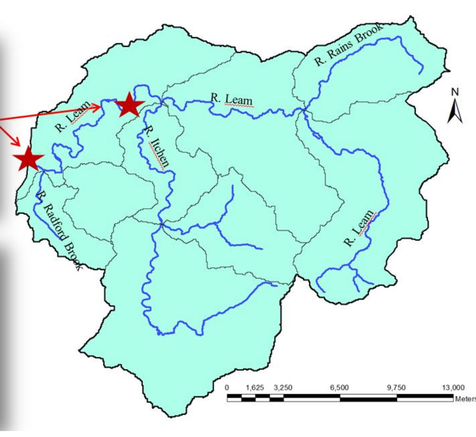
- Direct runoff travel time from high risk areas to the outlet of the catchment

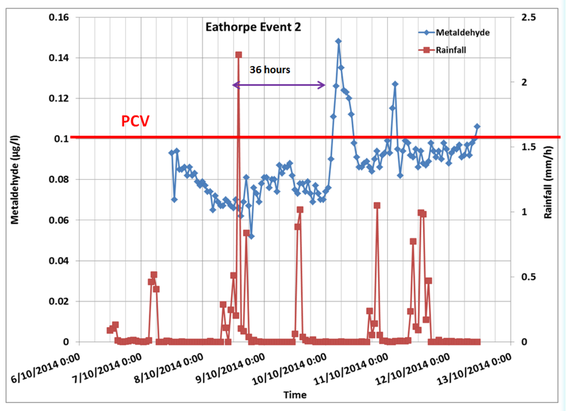


- Direct runoff contribution from high risk areas in the catchment

4. Model Calibration and Validation

- Data collected using auto-samplers in the study catchment will be used to calibrate the predictive model

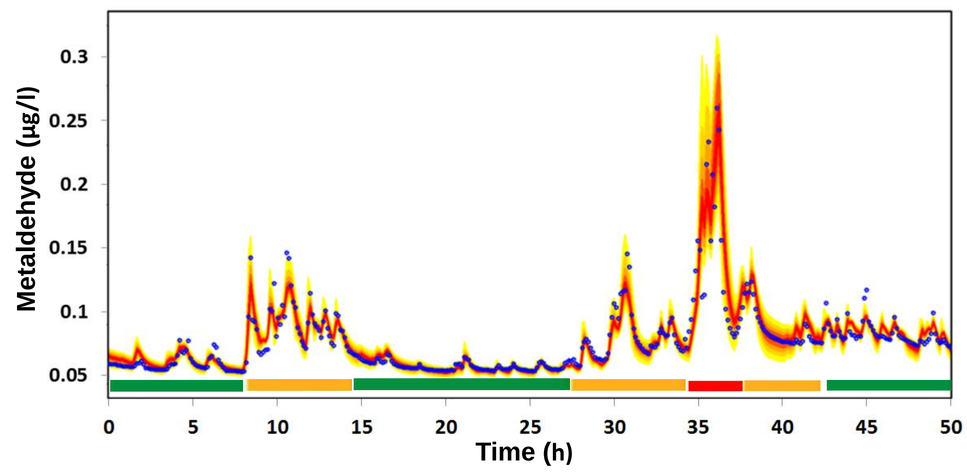




- Rainfall forecast information is used to start auto-samplers
- Hourly samples collected every day during rainfall events
- Each event lasts for five days

5. Uncertainty Analysis

- Uncertainties associated with the model parameters and input data will be analysed and presented to help in decision making



- Model results will advise abstraction decisions to prevent peak pollutant levels from entering impounding reservoirs and WTWs, thus improving compliance with the water quality standards.

References: Capel, P.D., Larson, S.J. & Winterstein, T.A. (2001) The behaviour of 39 pesticides in surface waters as a function of scale. Hydrological Processes, 15, 1251 – 1269. Leu, C., Singer, H., Stamm, C., Müller, S.R. & Schwarzenbach, R.P. (2004a) Simultaneous assessment of sources, processes, and factors influencing herbicide losses to surface waters in a small agricultural catchment. Environmental Science and Technology, 38, 3827 – 3834.

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