A risk assessment of ethinyloestradiol discharges through sewage treatment works for rivers in England and Wales

Richard Williams[1], Andrew Johnson[1] and Geoff Brighty[2]

[1] Centre for Ecology and Hydrology, [2] Environment Agency

Key issues

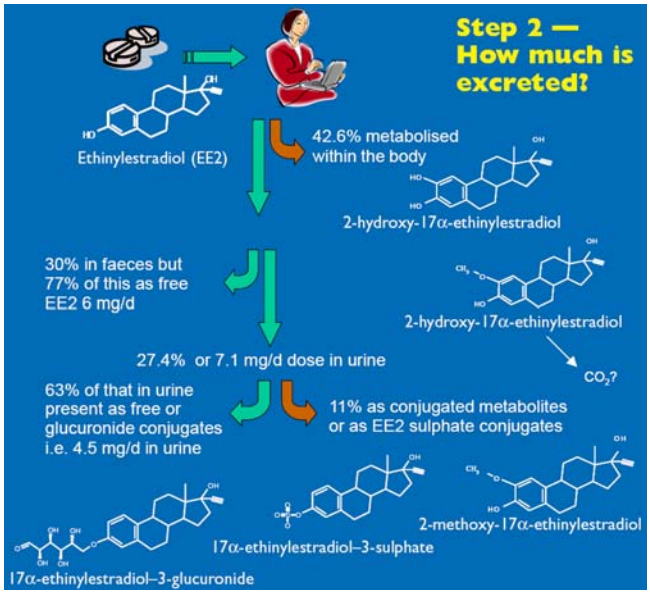
- Ethinyloestradiol (EE2) is the active ingredient of the contraceptive pill, taken by about 20% of women in the developed world.
- EE2 in treated sewage effluent is a highly active endocrine disruptor.
- Water managers should be able to estimate likely environmental concentrations, yet chemical analysis of EE2 is very expensive.

General risk assessment method

- Estimate exposure in rivers and compare predicted exposure with ecotox data
- Classify sites into H, M and L risk based on predicted no-effect conc. (PNEC) and lowest observed effect concentration (LOEC) values.

Predicting exposure level

- 1: Estimate average amount of molecule ingested per head
- 2: Estimate the fraction that is excreted in a form that can be activated
- 3: Assume all compound is activated in sewerage system and estimate amount degraded
- 4: Select appropriate value for amount removed via sewage treatment
- 5: For each STW effluent will be diluted into appropriate river (low) flow



A check after step 2

- Mean of EE2 influent concentrations (ng/L) for Roman STW (Baronti et al., 2000) compared with predicted values

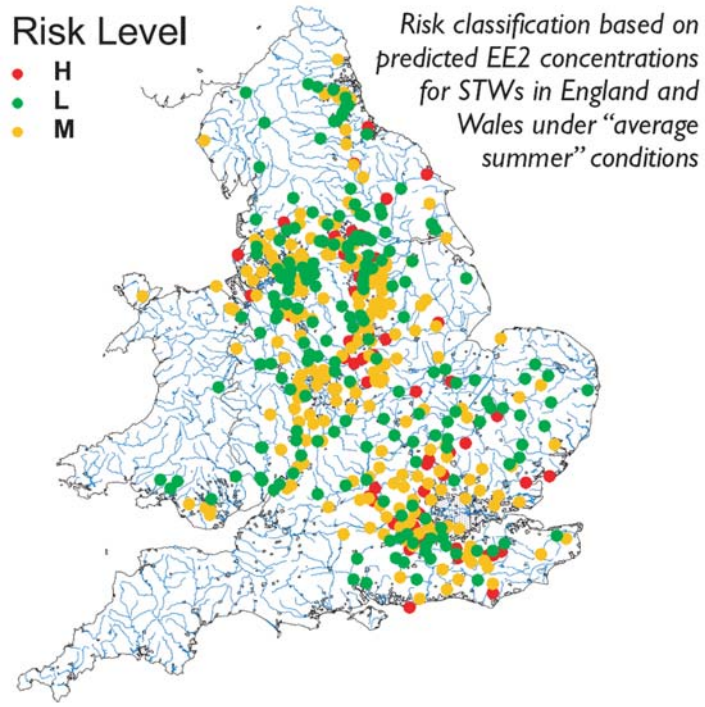
STW (with population & flow)	Mean (& range)	Model mean	Model range
Cobis (40,000 pop & 10,000 m^3/d)	4 (0.5-13)	4.2	3.8-4.6
Fregene (120,000 pop & 42,000 m3/d)	3.4 (0.5-7)	3.0	2.7-3.3
Ostia (350,000 pop & 112,000 m^3/d)	2.5 (0.5-5)	3.3	3.0-3.6
Roma Sud (1,200,000 pop & 734,000 m^3/d)	2.9 (0.5-6)	1.7	1.6-1.9
Roma Est (800,000 pop & 265,000 m^3/d)	2.3 (0.5-3)	3.2	2.9-3.5
Roma Nord (800,000 pop & 354,000 m^3/d)	2.9 (0.5-7)	2.4	2.1-2.6

Calculating effluent load + dilution

- Average 1.05 µg/day/person multiplied by no. of people served by STW;
- Use a suitable low flow value for the river it discharges into;
- Estimate "average summer" concentration and compare with risk levels:

Low Risk	Medium Risk	High Risk
< 0.1 ng/L	0.1 ng/L – 0.57 ng/L	> 0.57 ng/L
< PNEC[1]	PNEC - LOEC	> LOEC[1]

* from Young *et al.*, 2002

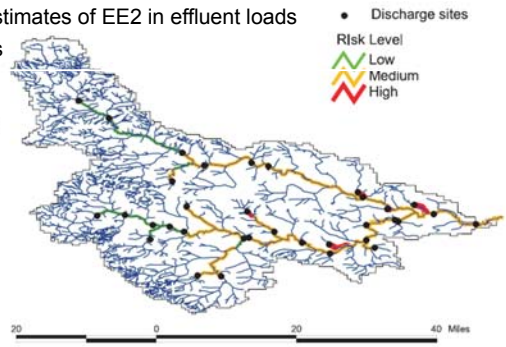


Risk classification based on predicted EE2 concentrations for STWs in England and Wales under "average summer" conditions

Catchment approach: GREAT-ER

- Multiple discharges for catchment wide predictions
- Uncertainty in the estimates of EE2 in effluent loads
- Use a range of flows

Predicted risk class based on 95 percentile concentrations of EE2 for the Rivers Aire and Calder, England



Results

- We have shown a method for estimating EE2 discharge loads to rivers,
- Estimated the risk class of STWs in England, and
- Applied the method using GREAT-ER:
- We could apply these methods to a wide range of pharmaceutical products.

Find out more…

Contact: Richard Williams rjw@ceh.ac.uk