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INLAND BATHING WATERS RIVER WATER QUALITY ASSESSMENTS & MONITORING

UDG Autumn Conference November 2022

Intertek and EMS

INTRODUCTION

Two areas identified as important bathing sites:

River Teme, Ludlow

River Avon, Leam and Sowe, Stratford, Warwick

Aim of the project is to develop and test:

Modelling Approaches
Monitoring Approaches

Integration of the two – develop **virtual monitoring** approach

FORECASTING

To forecast performance, we need to be able to accurately represent:

- River flows
- Pollution (bacterial) spills
- Decay (especially in sunny conditions)
- Transport times
- Effective concentrations
- Compliance or assessment thresholds

Performance, Significance, Source-apportionment, Management

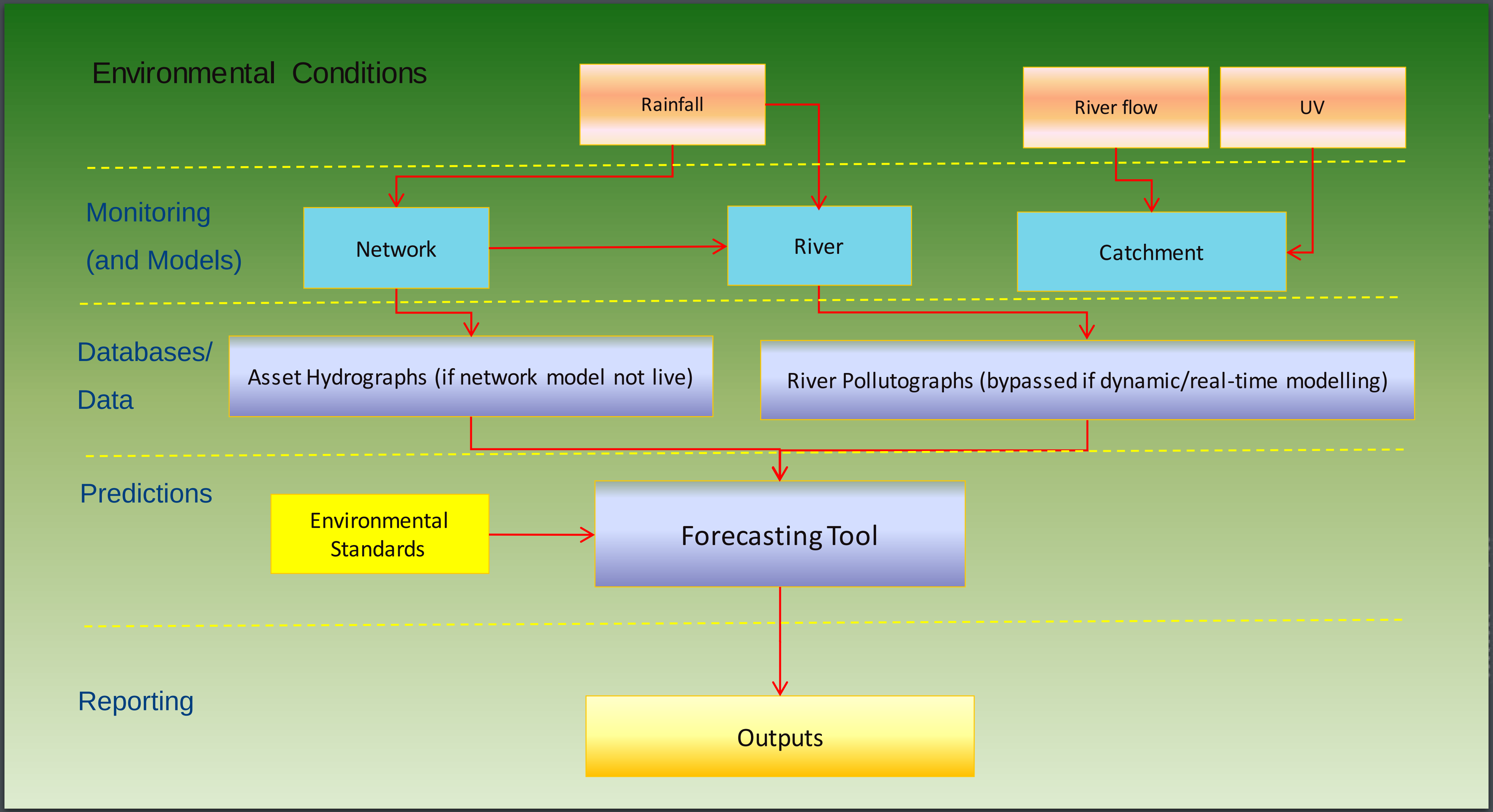
ASSESSMENT

Assessment of bathing waters is the easy bit.

- Standards are there
- Modelling approaches on coast well established
- In many ways the whole process is simpler (no tides)
- Complexities exist – the endless potential catchment responses to rainfall can pose a problem

We have started with monitoring, spot sampling and modelling approaches planned

FORECASTING TOOL SCHEMATIC



RIVER MONITORING

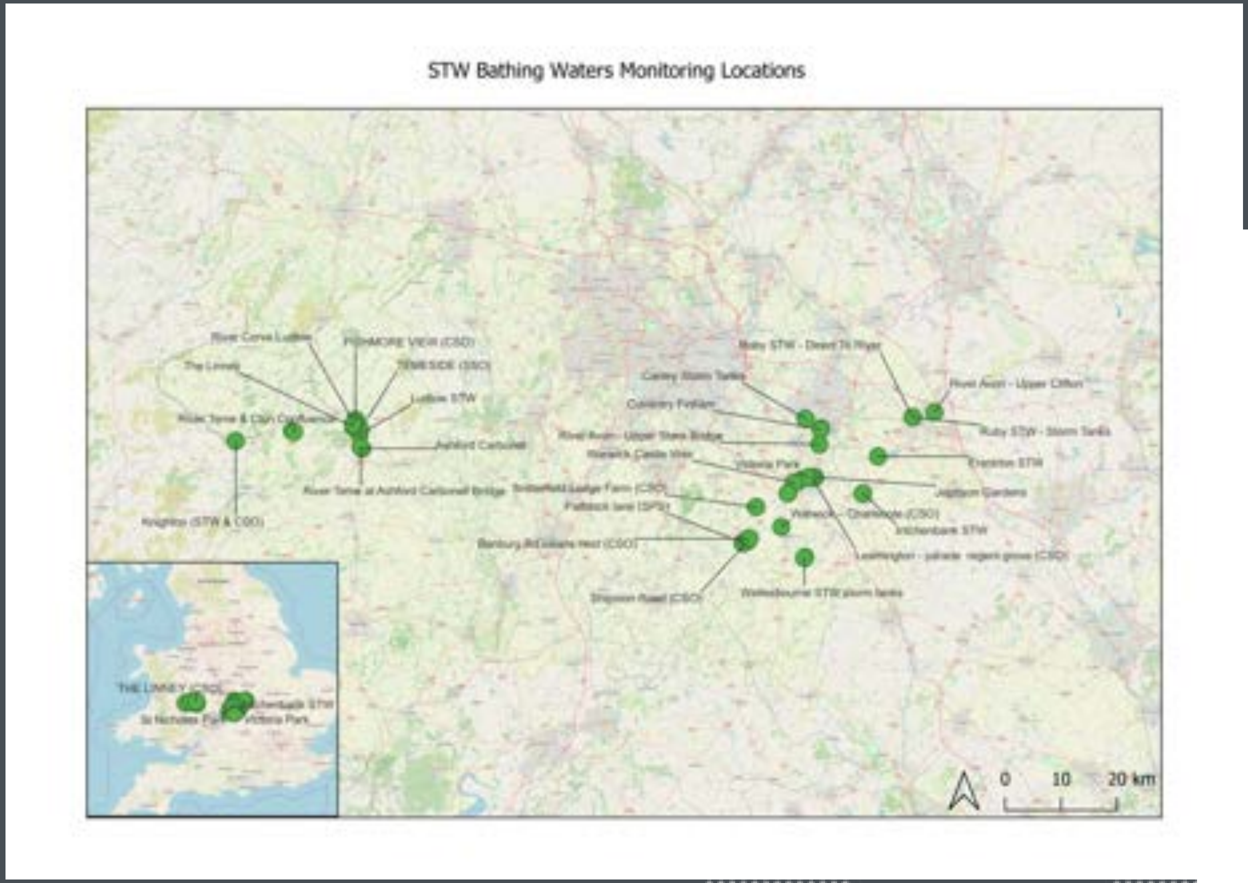
Monitoring programme established over the summer

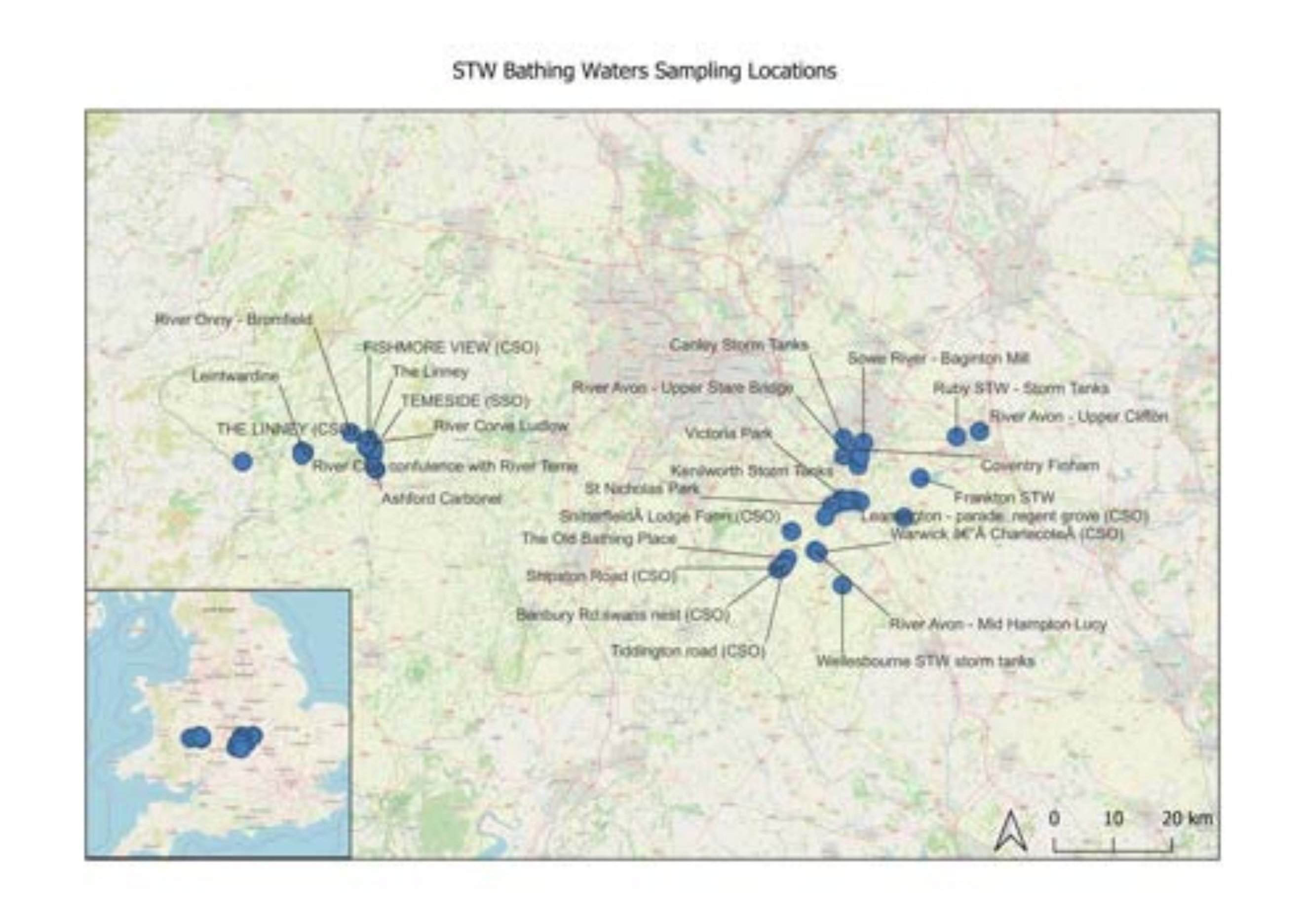
- Chemical determinands
- Bacteria
- Flow

RIVER MODELLING

MIKE11 models as test-beds

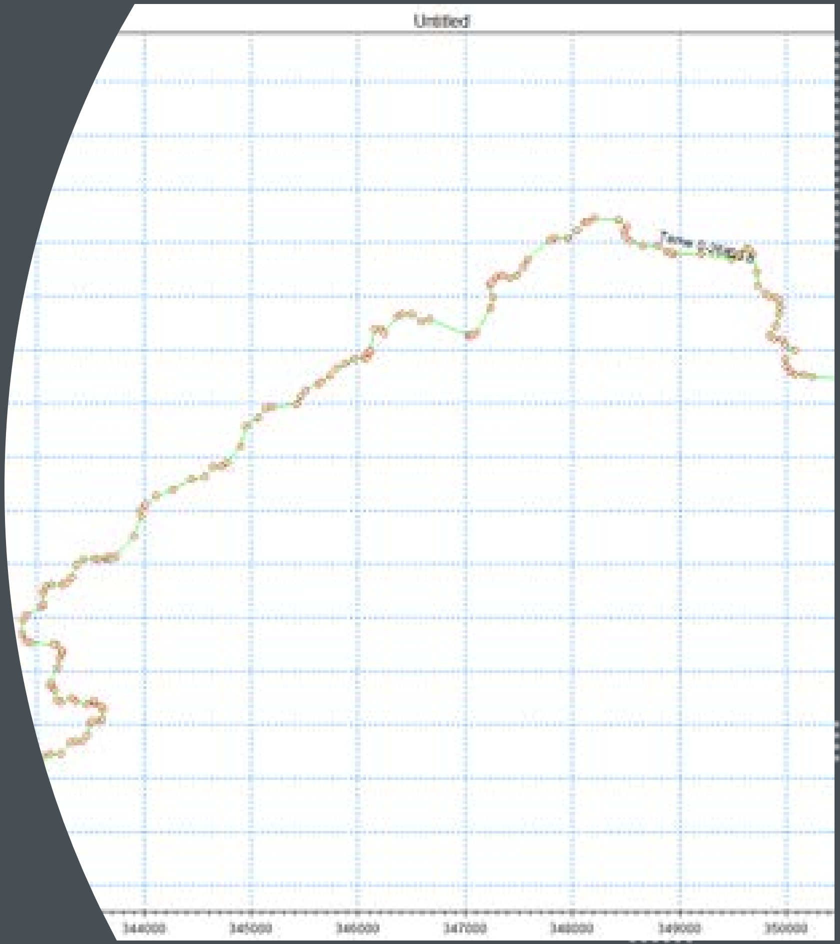
- Models currently built to stability
- Calibration underway
- Will serve to deliver datasets for forecasting, or be used live (‘real-time’ – kind of)



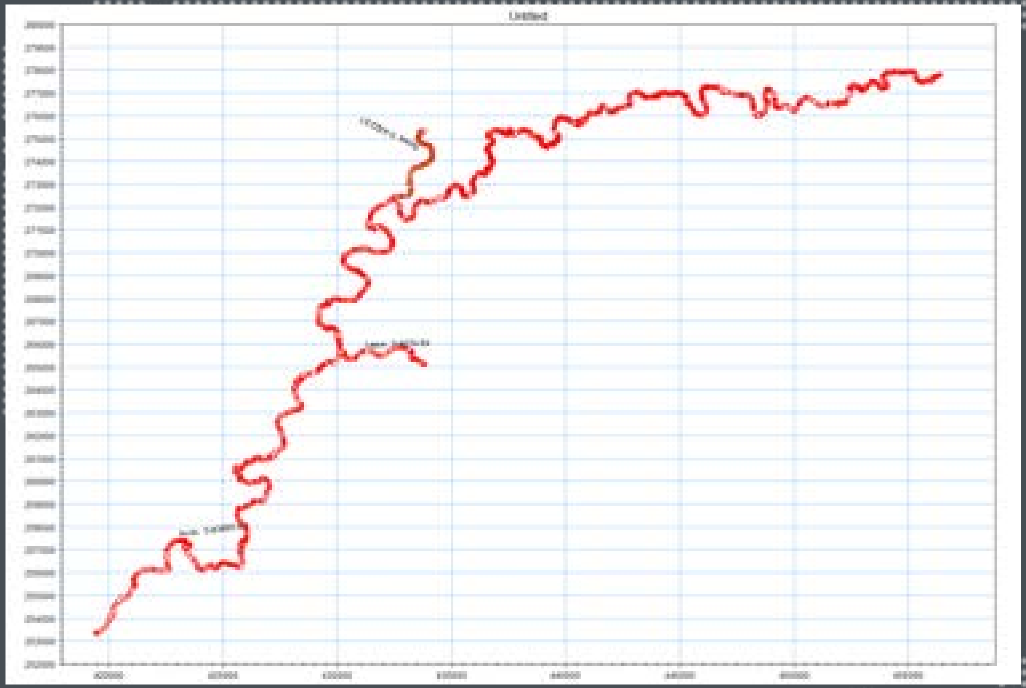


Monitoring and Sampling Locations

LUDLOW/TEME



STRATFORD/AVON



A RELEVANT ASIDE – THE ENVIRONMENT ACT, ETC

Requirement

MONITORING OF ASSETS, upstream and downstream.

'NO ECOLOGICAL HARM'

Challenge (ASSUMING THE WORST)

15,000 assets to be monitored – upper ceiling of 30,000 instruments

All require servicing and replacements – logistical and human resource challenge

Monitoring of ammonia for instance requires expertise and robust QA/QC

Vast amounts of data to be managed, interpreted and distributed

REALITIES OF FULL INSTRUMENTATION

Even assuming 5,000 assets to be monitored (not the full 15,000)

10,000 instruments will be required

There are probably <2,000 in the UK at the moment

The scale of manufacture and deployment is a challenge

This would require significant investment in assets, resources and supporting infrastructure

How is the data processed?
Where does it go?
How do we discriminate between false readings and real (e.g. ammonia drift)?

Do we need to use the EDM network to cross-reference instrumentation anyway?

USE OF EDM ALLOWS POTENTIAL FOR VIRTUAL MONITORING

MONITORING

'observing and measuring in real/near real time the operations or actions of an observed unit' as a suggested definition

In order to fulfil this, we must be able to report in these timeframes any operations or actions

Ideally, it would be useful to be able to report on the consequence of any operation or action

A combination of real and virtual monitoring provides all the information required

Local and 'fully mixed' hard points are not the same, and this is a limitation of the current guidance

Virtual instruments can provide the local data where field instruments provide the fully mixed, for instance

Monitoring detects a 'spike' or 'dip' (depending on determinand)

is this because of an asset?
is it diffuse?
is it a calibration issue?

Hard point Monitoring

Key points to baseline and ensure robustness of monitoring process, ensuring all assets will be covered by data

Significantly less field instruments, delivering an achievable deployment in terms of kit, servicing, and resourcing effort

Virtual Monitoring - Modelling

Data and predictive tools are used between hard points to provide virtual monitoring points
EDM on all assets is the key to monitoring, coupled with field hard points

Able to provide information on impact, duration and concentration, and source of impact.

Ins

VIRTUAL MONITORING

Predicting impacts from existing data, monitoring points and models and tools and new hard monitoring points

Much of the data either exists, or is available from existing tools and techniques

Key is turning this into information from this optimised monitoring strategy

FUNDAMENTAL

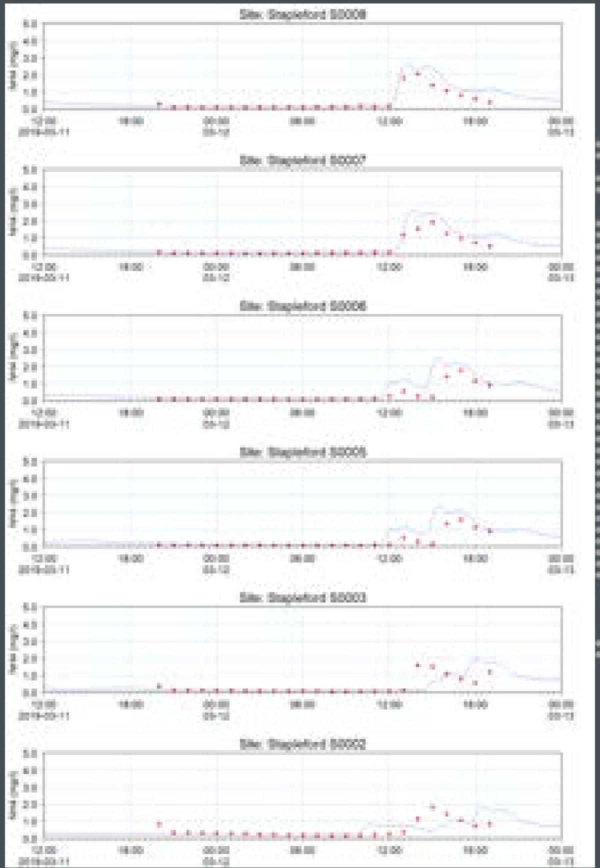
The virtual monitoring must match the field instruments and be robust and reliable

Dynamic matching of field data to ensure a good match

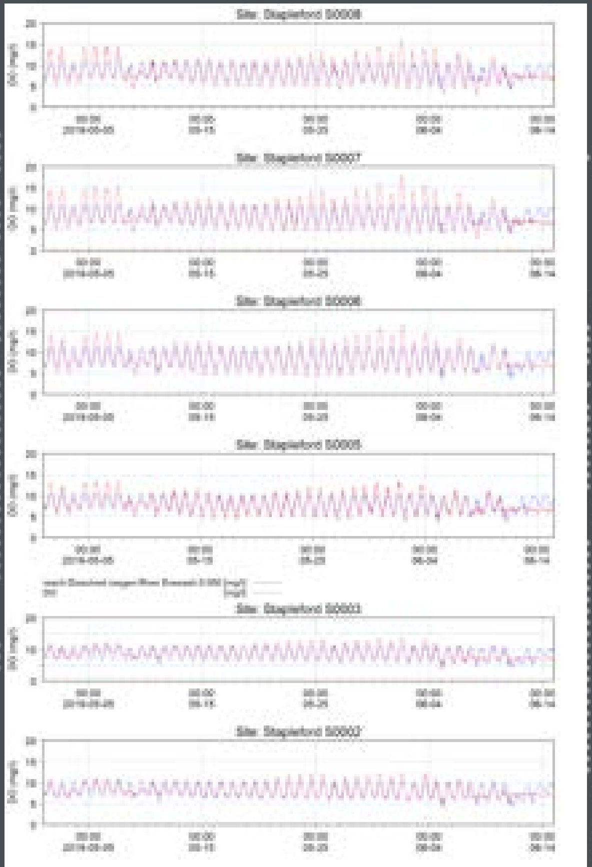
There is a good history of using such tools and verifying them against field data – i.e. matching collected data with virtual (predicted) data

THIS IS THE THOUGHT PROCESS WHICH IS GUIDING THE CURRENT PROJECT

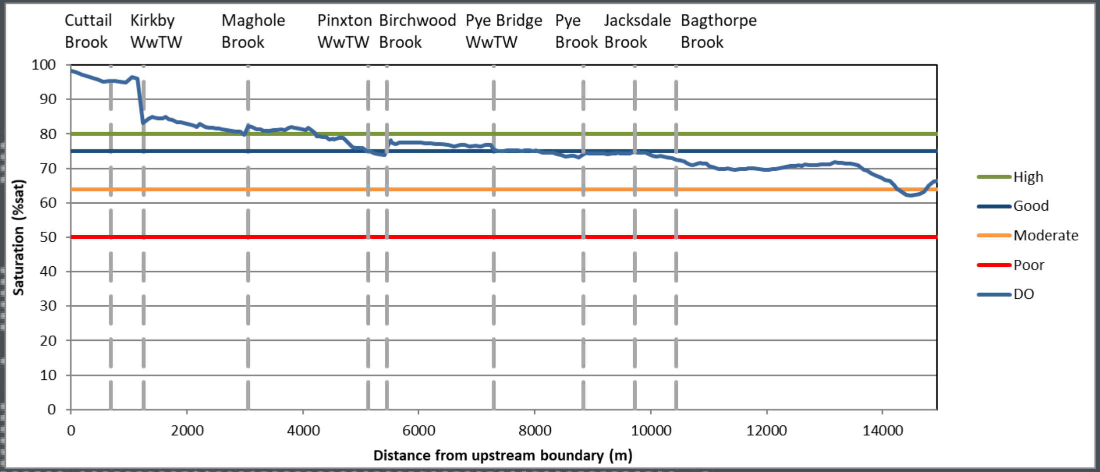
REAL AND VIRTUAL DATA



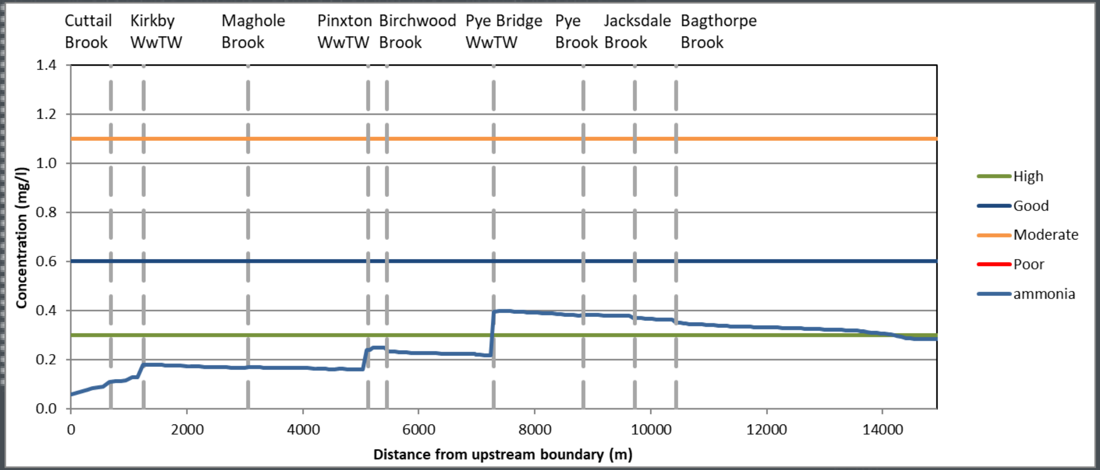
Ammonia – real and virtual data (spot data)



Dissolved Oxygen – real and virtual data (sonde data)



Virtual data along the river – dissolved oxygen



Virtual data along the river – ammonia

SO HOW TO USE THESE THOUGHTS IN OUR PROPOSED SYSTEM

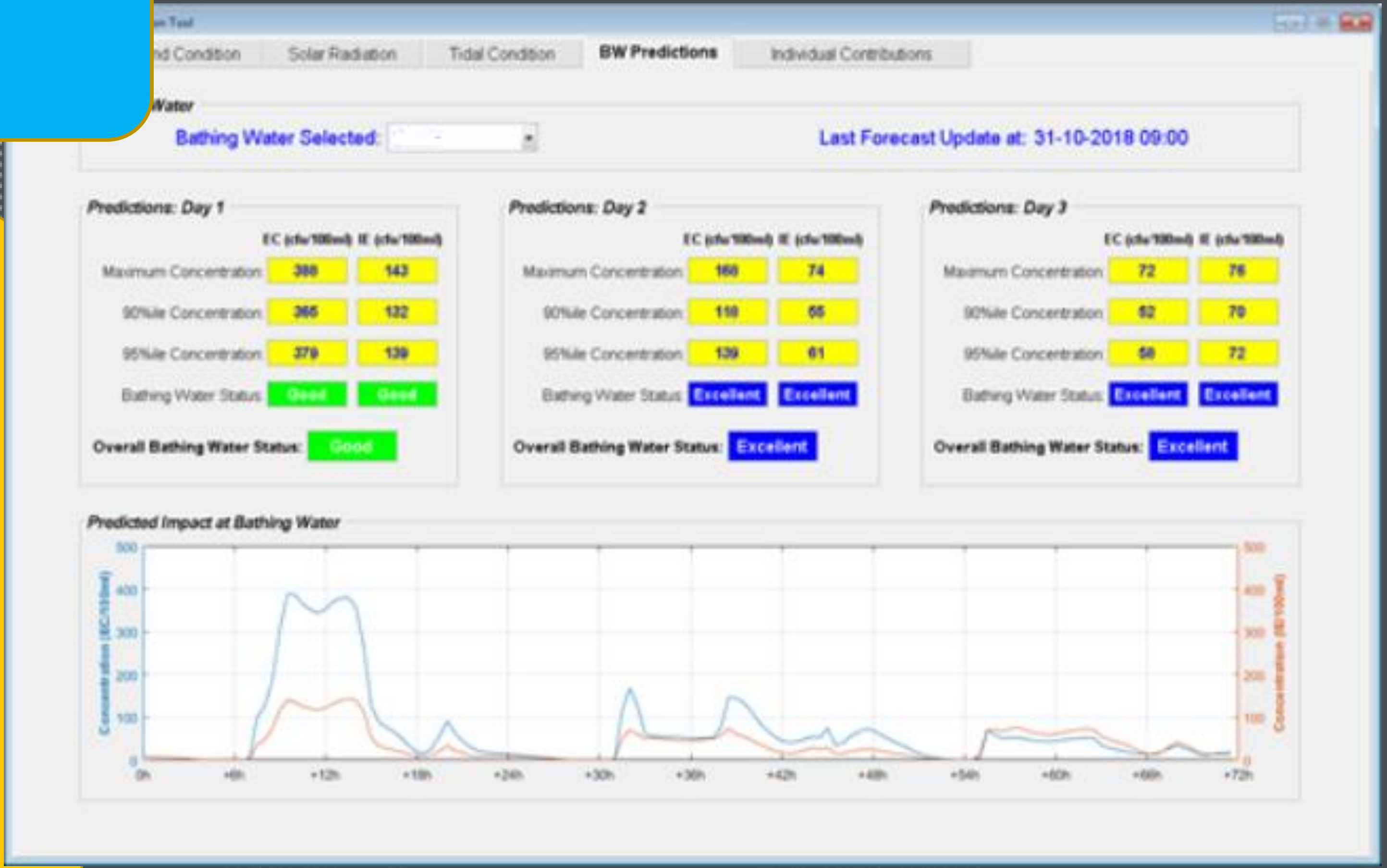
CURRENT BATHING WATERS PREDICTIVE TOOLS

Use:

- Instruments
- EDM
- Rainfall radar
- Virtual/predictive data from automated system
- Consequence – bathing waters quality warnings

Systems based on:

- Monitoring data
- EDM spill data
- Rainfall data
- Weather forecasts



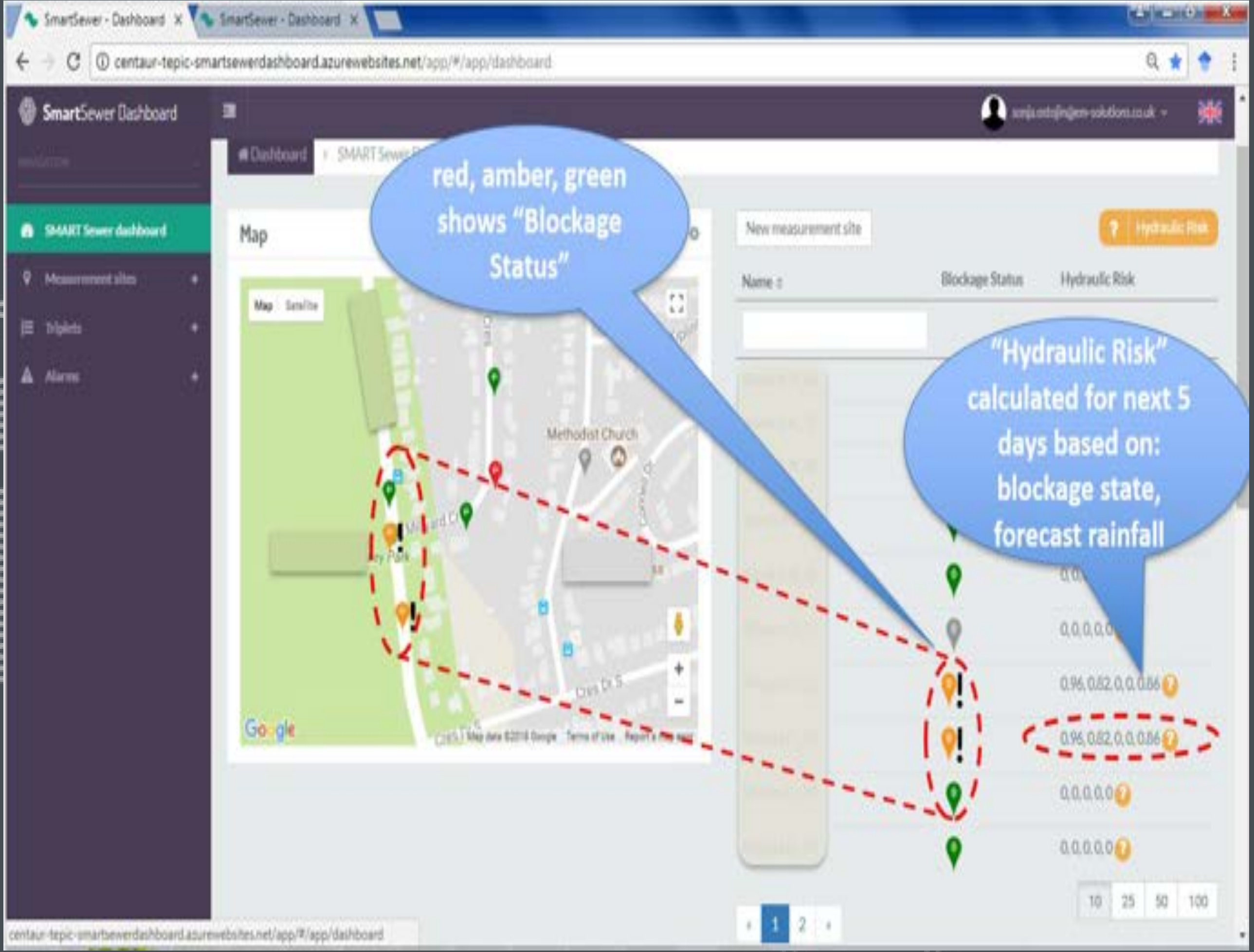
INTEGRATING SMART MONITORING APPROACHES

An example of an operational Autonomous System which has a SENSE-THINK-ACT mode of operation.

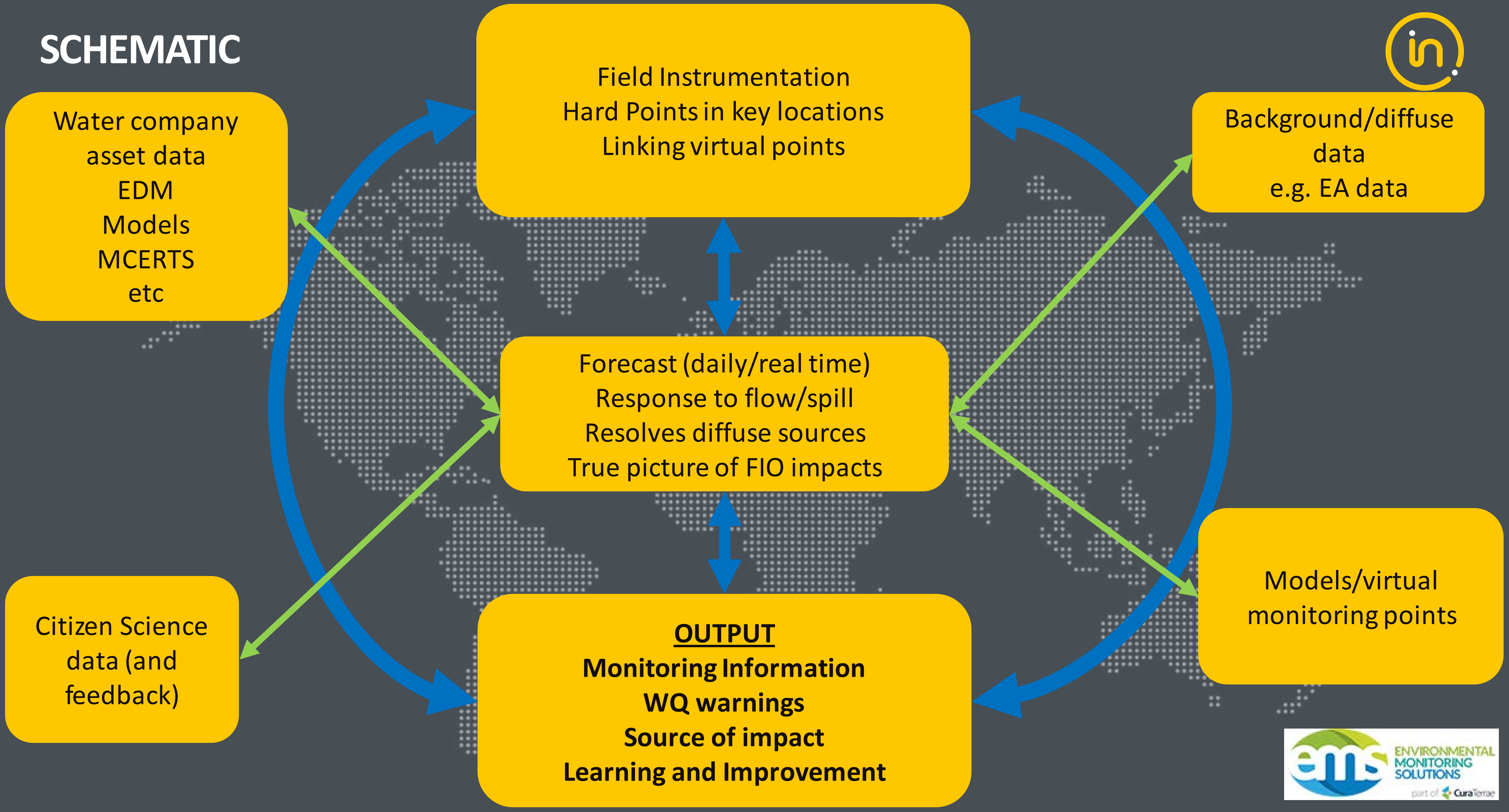
SMART Sewer® consists of wireless level monitors (SENSE), an Artificial Intelligence analysis engine (THINK), and a web hosted dashboard. It also incorporates a feed from a weather forecasting service to identify where action is required in response to detected blockages (ACT).

SMART Sewer® estimates the blockage status of each subject pipe.

The key is the difference between what is being measured and the information to enable decision support.



SCHEMATIC



ENVIRONMENTAL MONITORING SOLUTIONS
part of CuraTerrae

OUTPUTS

- Data feeds from the monitoring data
- Predictions from models/virtual monitoring points
- Comparisons against agreed thresholds (likely to be BWD concentrations)
- Transposed to a risk or warning approach – green amber, red (amber my not be an option in this type of system)
- Communicated via app/text/website/email/social
- The output is not really dependent on the communication approach chosen, but how it is handled may be different

ADVANTAGES

- **Information** – virtual monitoring being incorporated into the process will provide much better levels of information (as opposed to data) to provide the public and users knowledge about performance and consequence
- **Flexibility** – virtual monitoring points can be changed and added to with very little effort
- **Adaptability** – the system could self-manage, and would respond and adapt. If additional hard point instruments are required (or fewer can be used as the system develops) this can be accommodated. It means instrumentation could serve at multiple points, further improving the use of a constrained resource
- **Human Resource** – the field maintenance and inspection would be significantly reduced
- **Future** – the system can be developed to accommodate new determinands or requirements

SUMMARY

- Inland bathing waters studies are designed to provide good information regarding the integration of models and monitoring data
- The two studies are providing insights into more general applications
- The traditional bathing waters studies for coastal sites are helpful in evolving a river based approach
- Monitoring with full instrumentation presents a challenge in terms of logistics, maintenance and human resource with the relevant expertise
- Risk of misleading information likely to be reduced
- Integrating field and virtual monitoring provides efficiency, flexibility, and future-proofing
- Requires careful management, careful deployment of field instrumentation, and EDM data will be key to process
- Some of the data required is available and the ability to complete the picture is feasible through BAT
- Maintains requirement for full monitoring (and enhances outcome)

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THANKS