

## South Alloa Monitoring Buoy

- Monitoring buoy was established in 1988 to assess the impact of low dissolved oxygen levels in the upper Forth estuary.
- The buoy monitors continuously at 15 minute intervals providing observations not made during monthly spot sampling by boat.
- During warmer summer weather conditions a combination of reduced solubility and aerobic breakdown of organic matter by microorganisms causing dissolved oxygen levels to fall to very low levels resulting in poor water quality which impact sensitive species.



Figure.1 South Alloa monitoring Buoy.

Moderate / Poor boundary for water quality for transitional waters.

Oxygen in water is measured in its dissolved state of dissolved oxygen (DO). The higher the DO then the healthier the water body and the more diverse life it can support. If the DO declines then it can lead to a decline and even death of sensitive marine species.

### Introduction.

Continuous water quality monitoring equipment was deployed from a buoy (Figure.1) in the upper Forth estuary during 1988 in order to assess the frequency and duration of low dissolved oxygen (DO) levels regularly reported at South Alloa. The monitoring buoy is located in an area known as the Maximum Turbidity Zone (MTZ), where levels of dissolved oxygen can drop to extremely low levels, during the summer months when warm temperatures reduce the solubility of oxygen within the water column and increase the activity of oxygen using microorganisms. The extent and intensity of the MTZ is greatest during low river flows during spring tides when dissolved oxygen levels can fall well below the EU Water Framework Directive (WFD)

The Maximum Turbidity Zone (MTZ) is an area where the interaction between the incoming tide and outgoing freshwater causes the maximum re-suspension of sediments and flocculation of dissolved organic matter, increasing turbidity.

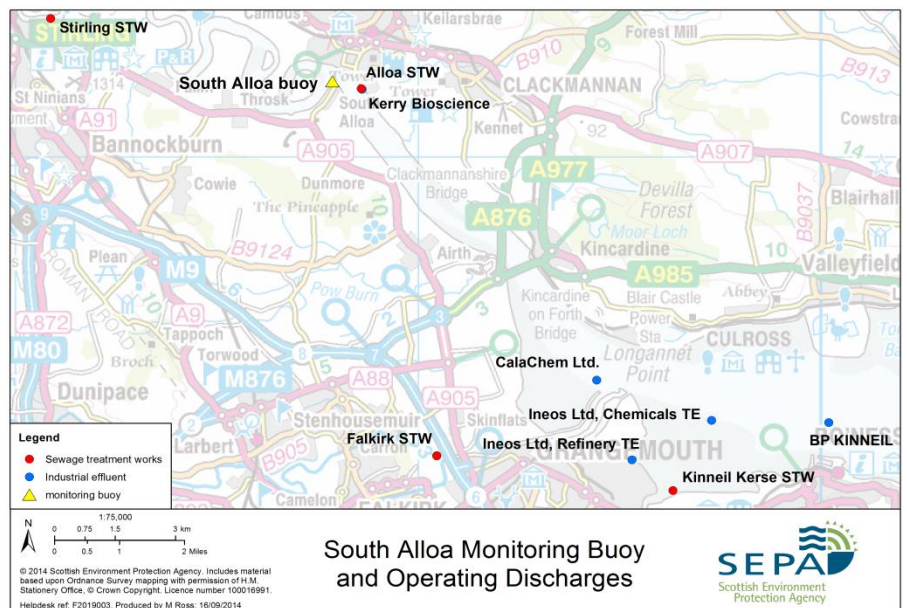


Figure.2 Operating discharges in the Forth Estuary.

### References:

<http://www.sepa.org.uk/environment/environmental-data/monitoring-buoys-network/>

## What are the sources of this organic matter?

The origins of this nutrient rich organic matter include runoff from a number of agricultural and urban diffuse sources along the Forth catchment area, as well as from point source discharges such as from industry and waste water treatment works (Figure.2).

The amount of oxygen consumed by microorganisms in the aerobic breakdown of organic matter is known as the biochemical oxygen demand (BOD).

## Why use a monitoring buoy at South Alloa?

SEPA routinely monitor the water quality by collecting spot samples by boat for nutrients, chlorophyll, turbidity, DO and salinity. Due to the nature of the upper Forth Estuary sampling by boat can only be conducted at Spring high water each month. The low frequency of sampling may result in low oxygen events being missed resulting in a misleading impression of the water quality in the upper Forth Estuary. Figure.3 displays a comparison between dissolved oxygen data collected by the buoy and spot samples collected monthly over 2013 showing the range of data missed by spot sampling alone.

To assess what is happening at the MTZ, measurements of temperature, salinity, pH, chlorophyll, turbidity and DO are taken at 15 minute intervals by a multi-parameter water quality monitoring sonde suspended 0.5m below the buoy. This high frequency data has allowed SEPA to build a picture of what happens in the upper Forth estuary not only annually and seasonally but over a tidal cycle. All spot samples collected during 2013 recorded DO values above the WFD 6mg/l High / Good boundary. However, continuous monitoring by the buoy demonstrated that DO levels regularly fell below the WFD 2mg/l Moderate / Poor boundary for water quality. These low DO events are often short lived but can cause detrimental impacts upon marine and the environment. These events can result in anoxic conditions that can prove fatal to sensitive marine life and act as a barrier to migratory fish. These events could not have been observed without the insitu monitoring buoy and it is important for SEPA to continue to monitor.

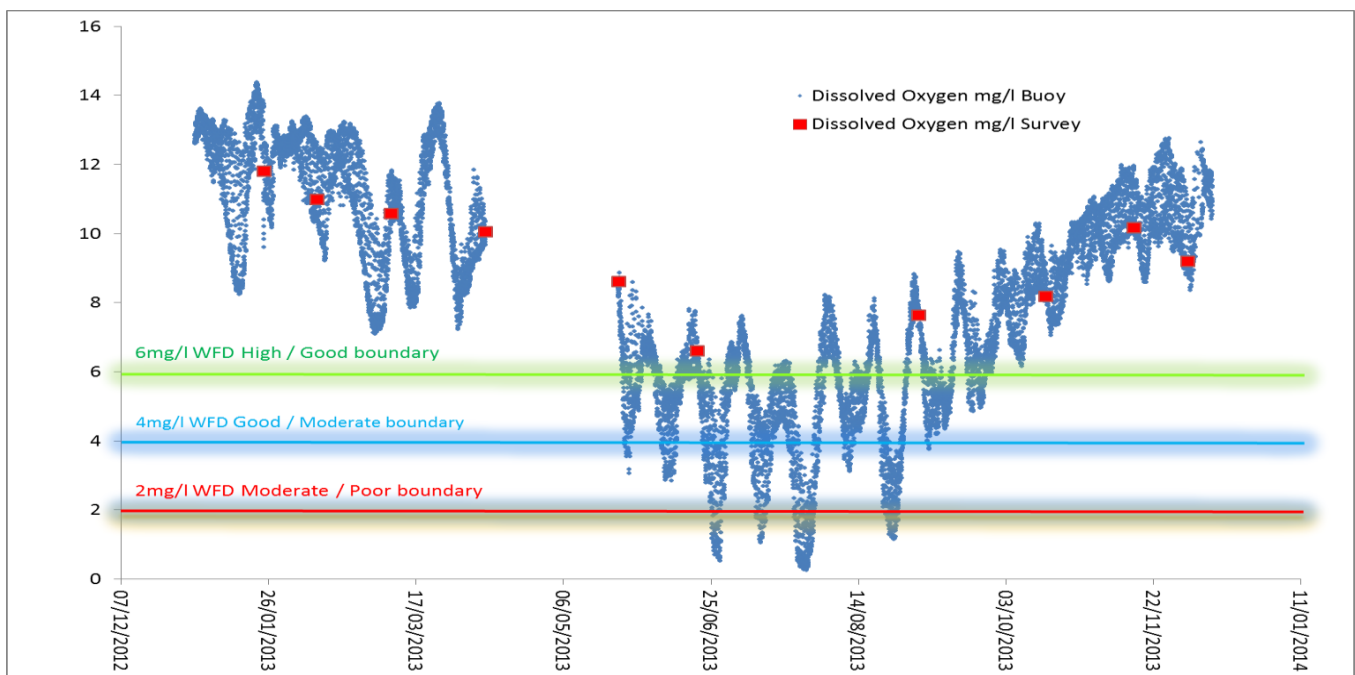


Figure.3 Comparison of dissolved oxygen data collected by monitoring buoy and survey spot sampling in 2013. The WFD classification boundaries are calculated according to salinity but have been averaged here for marine waters as a guide.

## References:

<http://www.sepa.org.uk/environment/environmental-data/monitoring-buoys-network/>