



Climate Change
and Air Quality

Development of the ambient air quality for H₂S standard and the review of the current standards

Session 6.3

National Air Quality Governance Lekgotla

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Stellenbosch



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Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA



Presentation Outline

- Purpose of the presentation
- Introduction and Background
- Standard- setting requirements
- Current status of H₂S monitoring in the country
- Regulatory considerations
- Conclusion and Way Forward

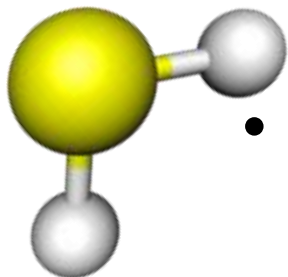
Purpose of the presentation

To brief the Lekgotla on the prioritization of hydrogen sulphide in the regulatory environment with a view to address emerging air quality issues; and to share the department's intention to review the second generation national ambient air quality standards.

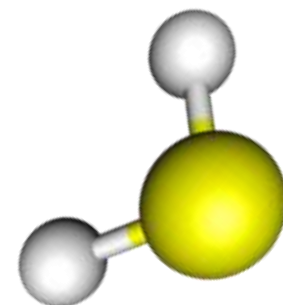
Introduction and Background

- Hydrogen Sulphide (H_2S) has been identified as one of the potential “future local pollutants” due to its hazardous and a malodorous characteristic properties.
- South Africa has various significant sources of H_2S , increasing concerns on environmental safety, and long term effects of exposure to human health.
- The absence of established safe levels of H_2S and inadequacy of regulation impacts on effective control of emission sources, and accountability.
- Thus the need to consider prioritization of H_2S , through establishment of appropriate levels of safety and improved control mechanisms.
- Furthermore, 2nd generation ambient air quality standards have not been reviewed since their promulgation, thus may be outdated and no longer protective of health and well-being.

Background to Hydrogen Sulphide



- Hydrogen sulphide (H_2S) is a colourless, flammable, and poisonous gas with a strong pungent odour, resembling rotten eggs.
 - **Flammability:** H_2S is flammable at high concentrations.
 - **Solubility:** H_2S is soluble in water, alcohol, ether, and glycerol.
 - **Malodourous characteristic:** When inhaled, the smell can be perceived at low concentrations in air (0.0005 to 0.3 parts per million).
 - **Corrosivity:** It is also a corrosive gas



Sources of Hydrogen Sulphide

- **Natural sources:**

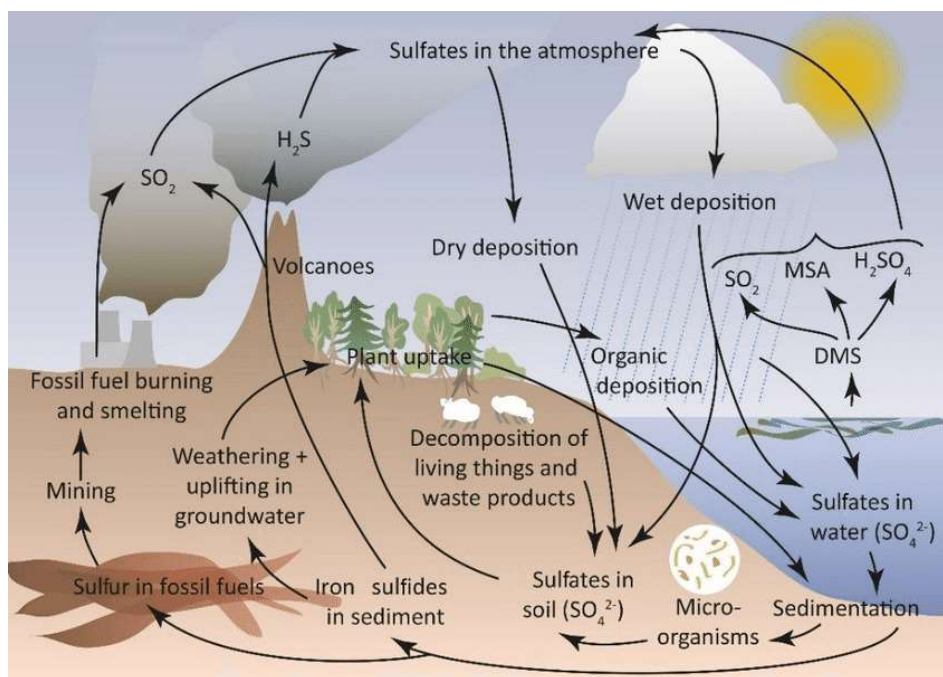
- In the environment, H_2S is often produced by sulfate-reducing bacteria through the anaerobic digestion of organic material.
- Significant environmental sources of H_2S include places where the breakdown of organic matter coupled with a lack of oxygen occurs, including swamps, hydrocarbon deposits, volcanoes, undersea vents, sulfur springs, and stagnant bodies of water.

- **Anthropogenic sources:**

- In or near sewage systems, landfill sites, and slaughterhouses.
- oil and gas processing sites, geothermal power plants, coke ovens, food processing facilities, tanneries, and pulp and paper mills.

Environmental Chemistry of H₂S

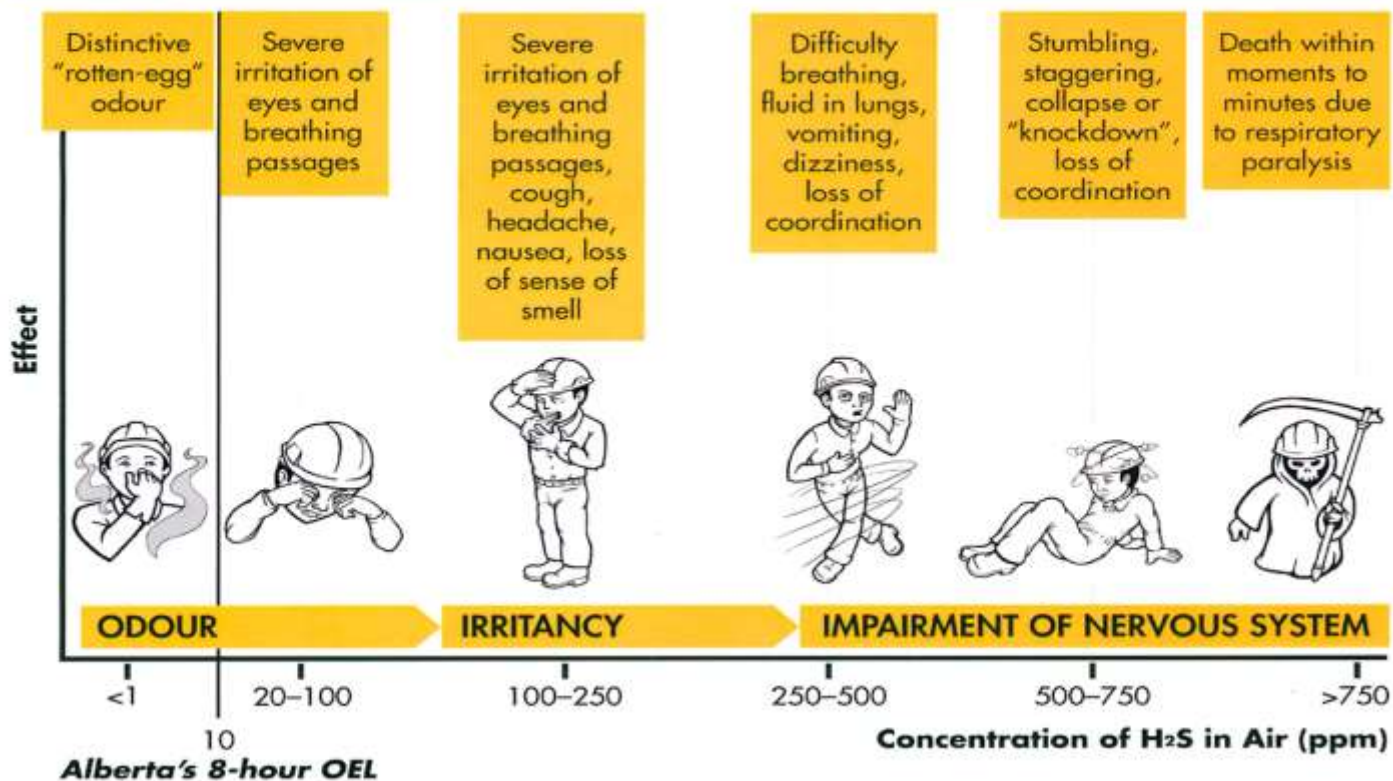
- H₂S in the air is oxidized by molecular oxygen and hydroxyl radicals, forming the sulfur dioxide or sulfate compounds.
- These products are removed from the atmosphere through absorption by plants and soils or through precipitation.
- The atmospheric residence time of H₂S is typically less than 1 day in summer, but may be as high as 42 days in winter (**resulting in prolonged exposure**).
- Background H₂S air concentrations typically range between 0.11 ppb and 0.33 ppb, although concentrations in urban areas can be as high as 1 ppb.



Health effects of Hydrogen Sulphide

- Inhalation is the main route of exposure for H₂S, with dermal/eye contact, injection, or ingestion being plausible but less likely routes.
- Highest risk of exposure is in enclosed spaces, or just below ground level (H₂S slightly heavier than air).

EFFECTS OF H₂S EXPOSURE



South African H₂S Challenges

IOL GO BOKKE!

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volt.africa power your digital ambition

Fishy fumes in 'Republic of Hout Bay'

WESTERN CAPE / 26 APRIL 2015, 10:30AM / JANIS KINNEAR



CAPE TOWN, 2015/04/23, Ike Moriz, resident of Hout Bay, shows newspaper clippings from the Sentinel, complaining about the smell from Oceana Brands Fishmeal Factory in Hout Bay by residents and how it is affecting tourism in the area. Picture: Adrian de Kock

IOL GO BOKKE!

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NEWS > SOUTH AFRICA

KingPrice INSURANCE

Landfill monster choking its neighbours

SOUTH AFRICA / 11 MARCH 2017, 2:38PM / SHEREE BEGA



eNCA

All News

Thousands stage 'Toxic Trek' over Shongweni landfill site

Sunday 5 February 2017 - 6:40am



DURBAN - About 2,000 angry residents marched in Hillcrest, Durban on Saturday to demand the closure of the hazardous Shongweni landfill waste site.

The march through central Hillcrest, dubbed the "Toxic Trek", ended at the local primary school with a memorandum being handed to authorities and a representative of the company EnviroServ.

The Shongweni landfill site is being investigated by the Department of

Criteria for pollutant identification and prioritization

- The possibility, severity and frequency of effects, with regard to human health and the environment as a whole, with irreversible effects being of special concern; (i.e. focus on LOAEL)
- Ubiquitous and high concentrations of the pollutant in the atmosphere;
- The feasibility of monitoring the air pollutant;
- Potential environmental transformations and metabolic alterations of the pollutant, as these changes may lead to the production of chemicals with greater toxicity or introduce other uncertainties;
- Persistence in the environment, particularly if the pollutant is not biodegradable and able to accumulate in humans, the environment or food chains;
- The impact of the pollutant taking the following criteria into consideration: Size of the exposed population, living resources or ecosystems;
- The existence of particularly sensitive receptors in the zone concerned;
- Pollutants that are controlled by international conventions.

Current status of H₂S ambient monitoring in South Africa



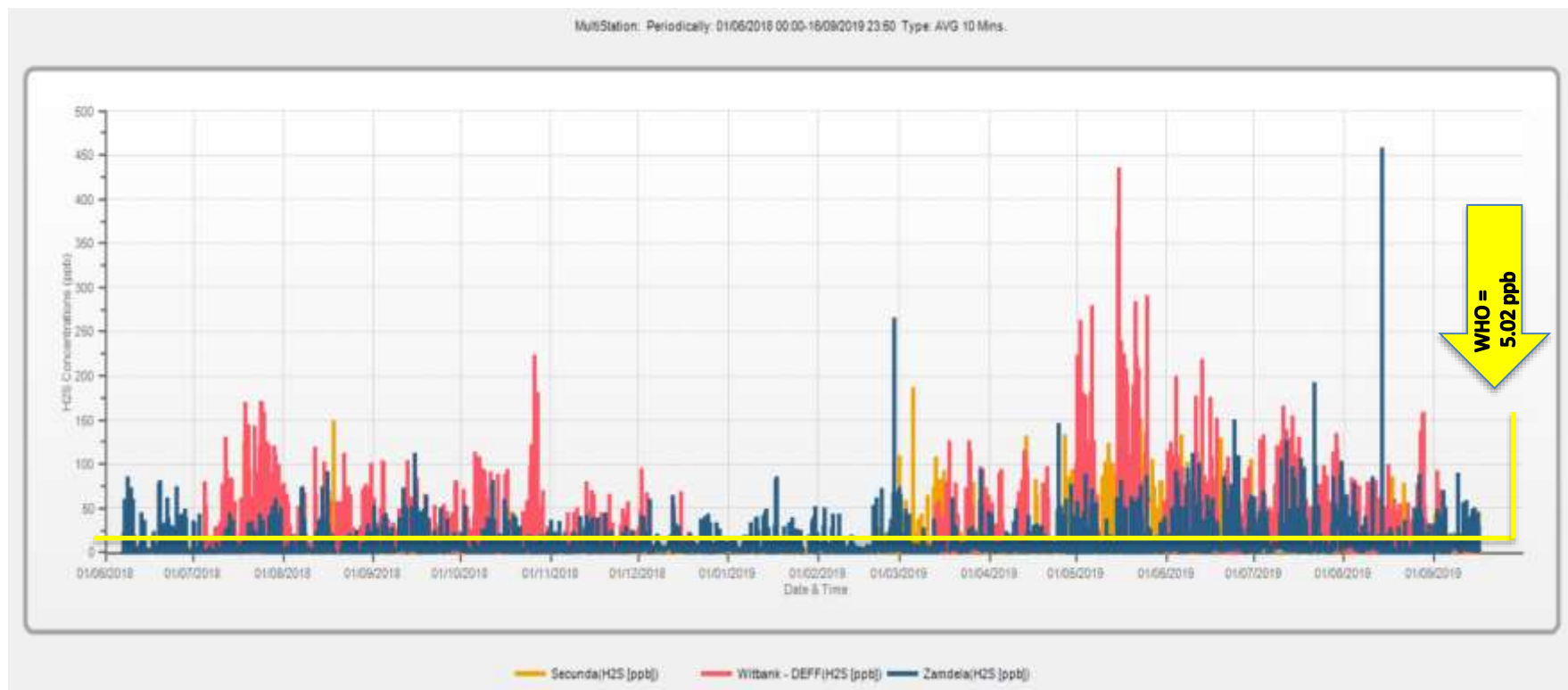
- Monitoring in the two priority areas (VTAPA & HPA); City of Cape Town and City of Tshwane
- Mostly located where known sources are located.
- 10 minute; 1 –hr; and 24 - hr averages

Current status of H₂S ambient monitoring in South Africa

- H₂S odour becomes detectable at concentrations as low as 0.0005 ppm, but the sense of smell is lost after **2 – 15** minutes at 100 ppm.
- In cases of severe acute toxicity (i.e. > 500 ppm) H₂S, unconsciousness and death may result almost immediately.
- **WHO recommended Air Quality Guideline 7 µg/m³ (5.02 ppb) 30-min averages (nuisance management)**

Current status of H₂S ambient monitoring in South Africa

- 10 minute average (expressed in ppb) for Secunda, Witbank and Zamdela

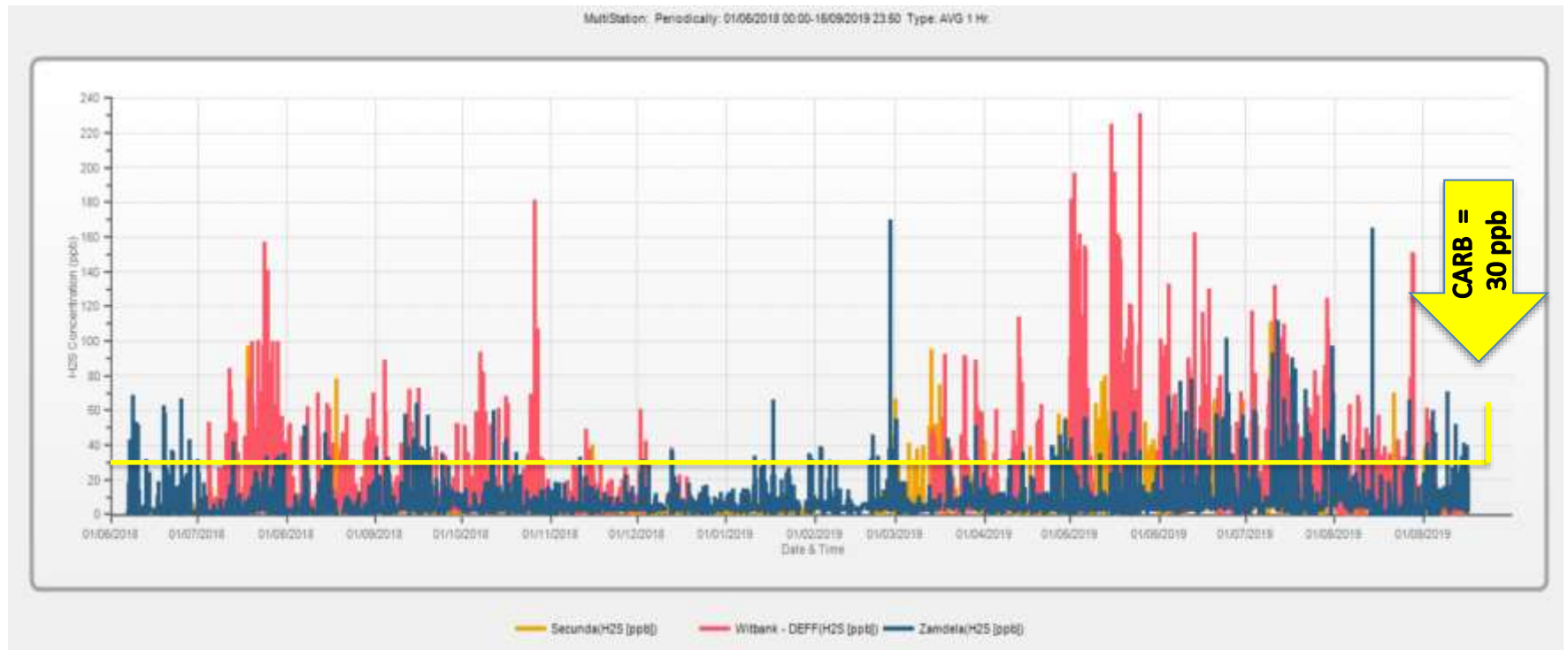


Current status of H₂S ambient monitoring in South Africa

- Although no guideline has been set for 1 hour exposure by the WHO, monitoring is currently conducted to understand the effects of post – acute exposure on human health and well-being.
- Post- acute exposure (> 100 ppm, slower onset)
 - Lower hydrogen sulfide doses over more prolonged durations results in more serious symptoms such as difficulty in breathing, noncardiogenic pulmonary edema, cyanosis and, ultimately coma/death.
- **The current California Ambient Air Quality Standard for hydrogen sulfide is 42 µg/m³ (30 ppb) , averaged over one hour.**
 - At this concentration the odour would be detectable by 83 per cent of the population and would be discomforting to 40 per cent of the population.

Current status of ambient monitoring in the South Africa

- 1 hour averages (expressed in ppb) for Secunda, Witbank and Zamdela

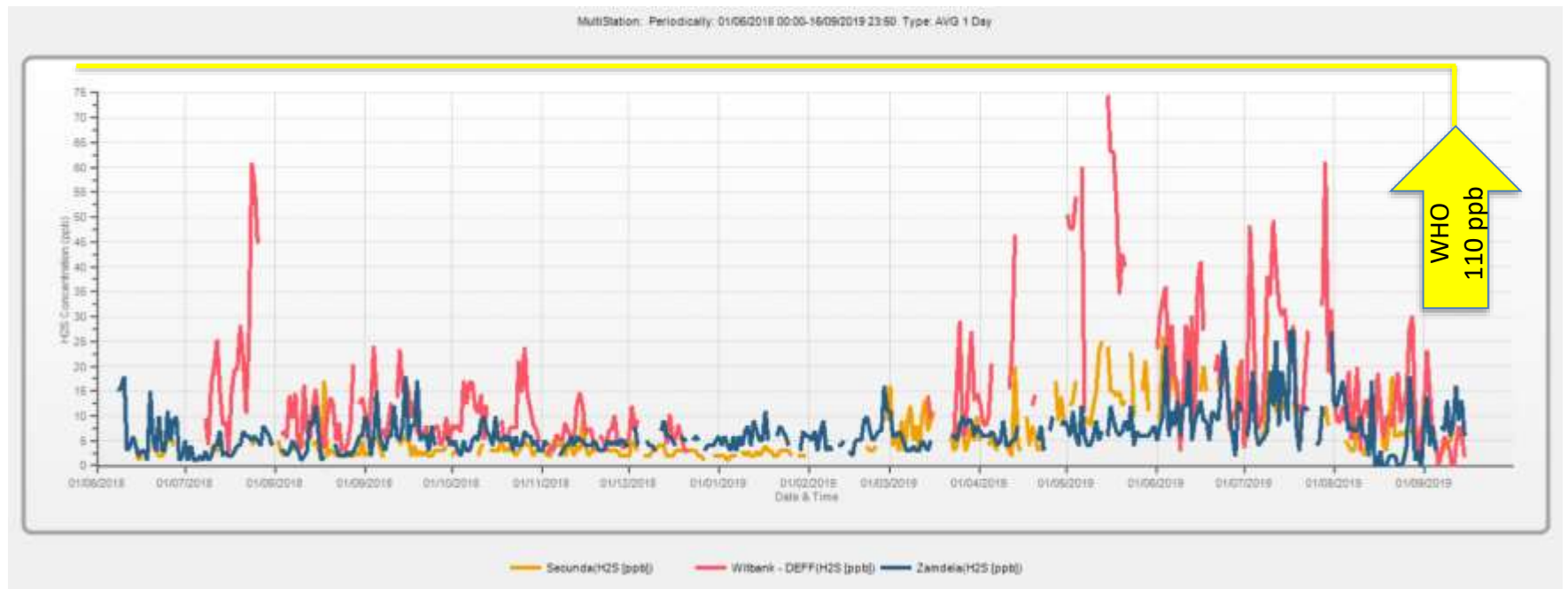


Current status of ambient monitoring in the South Africa

- **Chronic Exposures (< 1 ppm, for at least days)**
 - The effects of low-level or long-term exposure to ambient levels of hydrogen sulfide (< 1 ppm) in air are more difficult to estimate because the mechanisms for chronic toxicity are not well understood.
 - At such levels and duration, expected symptoms of exposure could include visual complications, olfactory fatigue, nausea, respiratory irritation, and possible headaches due to the sensitivity of those systems to H₂S exposure.
 - **WHO recommended Air Quality Guideline 150 µg/m³ (110 ppb) 24 hr average.**

Current status of ambient monitoring in the South Africa

- 24 hour average (expressed in ppb) for Secunda, Witbank and Zamdela



Current status of ambient monitoring in the South Africa

- Current ambient air quality trends confirms that:
 - high concentrations of the pollutant in the atmosphere close to the sources;
 - The existence of particularly sensitive receptors in the zones concerned
 - Persistence in the environment, this is also corroborated by an increased number of complaints and associated litigation.
- The current trends, coupled with the scientific information on the severity and frequency of human health and environmental effects of H₂S, confirm the need to prioritize regulatory control of this pollutant.

Regulatory Considerations

	Pros	Cons
S.9 Ambient Air Quality Standard	Established national “safe levels”	Inadequate research and databases on health effects across the range of levels to be found in environment may pose challenges on “evidence-based policy” requirements.
	Instrument for use as the basis for: <ul style="list-style-type: none"> • (i) triggering various air quality governance interventions ; and • (ii) to measure their efficacy 	Background levels
		Cost of monitoring, with minimal benefits to environmental management
		Emergence of pollution hotspots close to the sources

Regulatory Considerations

H₂S Conc.
(ppm)

1000 - 2000

530 - 1000

320 - 530

150 - 250

50 - 100

10 - 20

0.0005 - 0.3

- Immediate collapse with paralysis of respiration
- Strong CNS stimulation, hyperpnoea followed by respiratory arrest
- Pulmonary oedema with risk of death
- Loss of olfactory sense
- Serious eye damage
- Eye irritation
- Odour nuisance

Regulatory Considerations

	Pros	Cons
S.29 Declaration of Priority Pollutant	Limit control measures (including monitoring) to identified pollution sources	Does not provide for establishment of acceptable exposure levels
	Emission reduction for all significant sources, including those that cannot be managed using licensing	
	Minimal cost to the general public (polluter pays)	

Regulatory Considerations

- With the current challenges on management of ambient air monitoring networks, is the country ready for an additional pollutant?
- What will be the cost of additional pollutant on the general public (NAAQS vs. “Polluter-pays-principle” measures)?
- Are there alternative policies with less cost to general public, but achieving the same objectives?
- Opportunity for air quality regulatory community to influence regulation of other environmental media ?

Conclusion and Way Forward

- Current persistent levels of hydrogen sulphide in the ambient atmosphere in some areas indicate exposure that compromises the quality life (health and wellbeing)
- Regulatory measures required to minimize the impact, including consideration of establishment of the ambient air quality standard.
- Enhanced monitoring required to inform standard-setting process.
- Policy option that provides the best results, with minimal risks to be decided upon.
- Review (and possibly revision) of the second generation standards to ensure maximum protection of human health and well-being.



Thank You

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