National Report on Community-based Air Pollution Monitoring in South Africa
Air Pollution in Selected Industrial Areas in South Africa, 2000 - 2002

Writtten by *groundWork*

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Cover photo:
A burning flare at a Sasol industry. Photo by Denny Larson, Global Community Monitor.

CONTENTS

Forward

The release of this report comes in the wake of the World Summit on Sustainable Development (WSSD), which took place in South African in August and September 2002. For a period of time the WSSD focussed the world's attention on environment and development issues. Corporations have used their power and influence to ensure that the lens used to view environment and development is clouded with strategies that benefit polluting multinationals, such as self-regulation. It was at the WSSD that *groundWork* and its partners ensured that governments give attention to civil society's call for corporate accountability. This report calls on our government to govern, as it has been elected to do. It demands that industries be held accountable for their actions and that the owners and directors of polluting companies be prosecuted for each environmental transgression.

The industries of primary concern to us in this, our first such status report on air pollution, are those making up the South African petrochemical industry. This is due to the nature of their processes and emissions that contaminate all mediums of our environment.

This report draws on air samples taken by *groundWork* and several communities impacted upon by air pollution from petrochemical industries. It also draws on the South African Civil Society Strategy on Industrial Air Pollution which was formulated at a workshop held on the 13th and 14th July 2002 in Sasolburg. At this workshop South African refinery communities got together for the first time to develop a joint national strategy to fight industrial air pollution.

The new National Environmental Management: Air Quality Bill, which the Department of Environmental Affairs and Tourism claims heralds a new approach to air quality management in South Africa, is long over due. This report reveals that refineries operate according to out dated and inadequate legislation, and that the government's delay in passing new laws is stretching the patience of ordinary citizens who daily bear the environmental and health burden of unscrupulous industries.

The calls for environmental, social and economic justice are growing louder and stronger. Poor, black communities carry the health and environmental costs of polluting industries whilst the shareholders and directors of these same industries grow richer and fatter. These rights are indivisible across South Africa and the world.

It is recommended that this report be read in conjunction with a documentary film on pollution in South Africa, produced by groundWork, entitled "Dying to Breathe".

CHAPTER 1: INTRODUCTION

All I need is the air that I breathe"

1.1 groundWork's Air Quality Project

groundWork is recognised as the leading South African NGO working on industrial air pollution. Its work is based on the concept and values of environmental justice. A key objective is therefore to make the public aware that environmental rights are an integral part of human rights.

groundWork supports communities faced with environmental threats so that they are able to participate in environmental governance. It understands environmental governance to involve all the main stakeholders – government, industry, labour and citizens. How this works in reality is determined by power relations between these actors and the distribution of resources that enable or disable effective participation in decision-making. *groundWork* aims to build awareness and solidarity between communities and so contribute to democratic environmental governance.

In practical terms, *groundWork* provides technical, legal, research and campaigning assistance to communities who are combating and challenging industrial pollution. It tries to ensure that they are supported locally, nationally and internationally in their environmental struggles.

groundWork's Air Quality Project centres on developing community monitoring capacity using the 'bucket brigade' principles and technology as a tool for developing awareness and capacity for action on local air pollution issues. This approach also enables a rapid response to environmental incidents and *groundWork* provides follow up support in the form of strategic and technical advice and information. The project will help build the community voice by facilitating links between communities faced with similar environmental problems, supporting community campaigners in their negotiations with industry, in accessing government decision makers and officials and the media, and in linking communities with national and international civil society campaigns. The communities of south Durban, Cape Town, Secunda and Sasolburg have to date been community partners on the air quality programme.

The overall objective of the air quality project is to ensure that civil society has a greater impact on environmental governance. This report contributes to that purpose. It is intended as a tool to advocate for improved air quality management in South Africa. It will be revised every year and made available to government, NGO's and affected communities.

More specifically, it presents the findings of community air monitoring in Sasolburg, Secunda, south Durban and Cape Town. The country's main oil refineries are located in these areas and a variety of associated chemical industries are located particularly in Sasolburg and south Durban.

1.2 Governance

The South African government - be it at the national, provincial, and/or local level - has a critical responsibility in ensuring that no community is exposed to health hazards or an unclean environment. The South African Bill of Rights (Section 24 of the Constitution) guarantees every person the right to an environment that is not "detrimental" or "harmful" to health.

In response to ongoing pollution incidents and transgressions by industry, the 'regulators' have consistently failed to enforce compliance in terms of available laws and licenses through prosecution or effective sanctions, preferring to 'negotiate' the terms of continued non-compliance.

South African industries are not being held accountable for their air pollution. Although environmental pollution does not strictly respect geographic boundaries, a history of racist apartheid-era industrial planning makes black workers and communities bear the brunt of pollution. Communities living on the fence line of chemical and petrochemical industries – in areas such as south Durban, Zamdela in Sasolburg, Joe Slovo and Table View in Cape Town and eMbalenhle in Secunda – are exposed to a cocktail of toxic emissions and their health and quality of life is seriously compromised.

The applicable law, the Air Pollution Prevention Act of 1965 (APPA) is recognised as outdated but has not been replaced. The DEAT's budget allocation for air pollution control is small and getting smaller. Enforcement capacity (measured in the number of air pollution control officers) is inadequate and eroding further. To make matters worse, the maximum fine which can be imposed on a polluter in terms of the APPA is a paltry R500. These signs of collapse do not indicate some earlier 'golden era' of effective accountability and control. By the time of South Africa's democratic transition, there was already widespread concern about air pollution and the failure to hold industries accountable for it.

In democratic South Africa, voices expressing those concerns have greater impact. Citizens and civil society organisations demand and take their rightful place as stakeholders in holding corporations to account through 'multi-stakeholder' fora and through independent action. A new environmental legal framework (in the National Environment Management Act) promises government's adherence to good principles and practice. If implemented, these principles would signal the end of industry's impunity for air pollution. But, nearly a decade after apartheid, government has failed to deliver a credible regulatory regime. Despite acknowledging the many failures and weaknesses of the current system, despite the promise of a new law for air quality management, despite fine-sounding rhetoric about unacceptable industrial air pollution, government's actual performance is getting worse.

The paucity of credible information on emissions is both a symptom and cause of regulatory dysfunction. And it has been used both by industry and the regulator to dismiss the concerns of neighbour communities as uninformed. The community monitoring campaign has revealed the presence of a variety of chemicals on which there was no prior information in South Africa. It thus contributes to closing the gaps in information while also enabling communities to mobilise scientific knowledge in defence of their right to a clean environment.

Chapter 2 discusses the contribution made by community air monitoring towards verifying the concerns people have raised about industrial pollution and its effects on people's health and well being. It describes the bucket sampling method and the basis for interpreting results. It then lists what pollutants were found in which areas. Comparisons between refinery towns in South Africa and the Bay Area of San Francisco, the location of four refineries, show a number of chemicals at higher concentrations in the South African air.

1.3 Air pollution and people

Air pollution includes dust, gases, heavy metals and smoke generated mainly by human activities. It enters the body in three ways. When inhaled, many air pollutants directly affect the lungs and respiratory tract. They also settle on land, water and crops and are swallowed with food and drink. Finally, when they come in contact with the skin and eyes, a number of air pollutants cause irritation and allergic reactions. In all cases pollutants may be absorbed by the blood and distributed throughout the body.

The World Health Organization (WHO) estimates that three million people die each year because of air pollution. Millions more suffer serious health problems. Around 30-40% of cases of asthma and 20-30% of all respiratory diseases are linked to air pollution in some populations (WHO, 2000). A variety of pollutants are also associated with cardiovascular disease, nervous system disorders, reduced immunity and cancers of various sorts. The broader environmental damage to plant and animal life and to water sources ultimately threatens economic and social welfare as well as health.

The effect on people depends on what particular pollutants they are exposed to, the levels of exposure and their individual vulnerability. People suffering from respiratory conditions such as asthma, those who are very young, old or infirm, people living with HIV and people living in poverty are particularly at risk. Workers often get a double dose because they live near polluting factories as well as working in them. Indoor pollution in the workplace is the primary cause of as many as 50 million cases of occupational chronic respiratory disease each year.

The United States Environmental Protection Agency (USEPA) has identified 188 toxic – or hazardous – air pollutants. These are the chemical or metal compounds most dangerous to people and the environment because they are poisonous. Many of the pollutants found by community monitors in South Africa are on USEPA's list. Chapter 3 draws on international sources to give a breakdown of the sources and industrial uses of these chemicals, their physical characteristics and their health affects.

1.4 The Petrochemical Industry in South Africa

Most air toxics originate from anthropogenic (human-made) sources, including mobile sources (e.g. vehicles, aeroplanes, ships) and stationary sources (e.g. factories, refineries, power plants), as well as indoor sources (e.g. some building materials, indoor fuels and cleaning solvents). This report is particularly concerned with the petrochemical and chemical industries because their processes and products are serious sources of toxic pollutants. In addition to the chemical compounds found in their raw materials, additional chemical products are used to facilitate refinery operations. These include catalysts, process chemicals, performance additives and specialised dyestuffs.

The South African petrochemical industry is the largest in Africa. It is somewhat unique in that one of the largest refineries uses coal rather than crude oil as a feedstock. This technology was developed because South Africa does not have significant oil reserves and the apartheid government placed a priority on energy independence.

The oil-from-coal refining industry was established in the early 1950s when the first plant, Sasol I, was built at Sasolburg in what is now known as the Free State province. This synthetic fuel industry was expanded with the commissioning of Sasol II in 1982 and Sasol III in 1983, both located at Secunda. These two coal-based refineries operate under the name of Sasol Syn Fuels (SSF).

Crude oil refining also started in the early 1950s. The first refinery was built in Durban by the American Standard Vacuum Company. The company was subsequently bought by Mobil who disinvested from South Africa in the late 1980s. The refinery is now operated by Engen which is owned by the Malaysian company Petronas. Shell and BP followed Mobil to Durban. They jointly own the South African Petroleum Refinery (Sapref) built in 1964. Shell operates the refinery. Two years later, Caltex established Calref in Cape Town. In 1971, Sasol established its own crude oil refinery in partnership with Total. Located in Sasolburg, the Natref refinery is fed by pipeline from Durban.

Finally Mossgas, which converts natural gas to synthetic fuels, was established in 1987. About one third of current fuel demand is met by the synthetic fuels industry. The oil industry's wholesale turnover is in excess of R40 billion and provides employment to over 100,000 persons.

The table below shows the capacity of South Africa's refineries measured in equivalents of crude oil barrels per day. The figures are taken from the South African Petroleum Industries Association's (SAPIA) 2001 annual report.

Table 1: Crude oil capacity for refineries in SA (2001)

REFINERY	**Owned by**	**Location**	**Capacity (barrels pd)**
Sapref	Shell and BP	Durban	180 000
Engen	Petronas	Durban	125 000 – 150 000
Calref	Caltex	Cape Town	100 000
Natref	Total and Sasol	Sasolburg	86 000
Sasol Syn Fuels (Sasol II and III)	Sasol	Secunda	150 000
Mossgas	Mossgas	Mosselbay	45 000
Total			**666 000**

Source: SAPIA Annual Report 2001.

South Africa's non-fuel petrochemical production is largely centred on the Sasol Synfuels coal plants in Secunda and the Natref oil refinery in Sasolburg. Sasol generates various feedstocks and olefins for the downstream manufacture of polymers and other products.

Engen's crude oil refinery in South Durban produces benzene and other aromatics. Sapref produces propylene and small quantities of aromatics. The Mosref plant generates mixed alcohol and ketone streams which are exported.

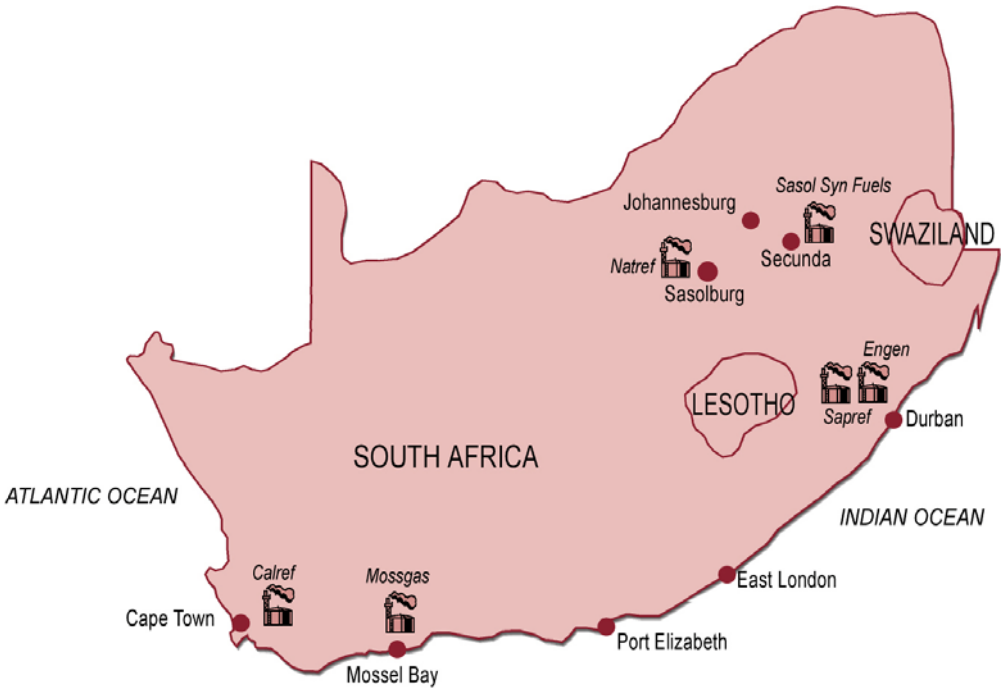


Figure 1: The location of the oil refineries in South Africa
Source: O'Connor and Hallowes 2002.

The map above shows the location of South Africa's oil refineries. Chapter 4 reports on community monitoring in Sasolburg, South Durban, Table View (Cape Town) and Secunda. It describes each area in terms of geography, local industries, monitoring and regulatory capacity, health status and the status of air quality as revealed by community monitoring. Detailed technical results of each bucket sample are given in Appendix I.

The profits of refining are very substantial. Sasol, for example, has an average operating profit of R40 million per day. Local communities, however, are not only affected by the normal operating emissions from refineries. Incidents – caused by accidents or breakdowns and resulting in massive short-term pollution – are very common and reported in Chapter 5. Detailed documentation over the last three years by the South Durban Community Environmental Alliance suggests that the frequency of industrial incidents in south Durban is actually increasing. Comparable information for other areas is not available. A high number of incidents is a critical sign of poor environmental management. It also frequently reflects cost cutting aimed at increasing profit margins.

1.5 Conclusions

The South African Constitution stipulates that everyone has a right to an environment that is not harmful to his or her health and well–being. The challenge for communities is to ensure the proper implementation and enforcement of this constitutional right. Chapter 6 reviews pollution legislation in South Africa and relevant international conventions. This chapter shows that South Africa has developed a body of progressive environmental legislation. However, laws specific to pollution are out dated and the enforcement capacity of the executive is weak and fragmented. Industry is therefore left to regulate and monitor its own actions. This chapter was informed by presentations by the Legal Resources Centre and the Department of Environmental Affairs and by a reading of relevant documents.

The concluding chapter identifies key community concerns and makes recommendations for addressing these concerns. It draws on the discussions of refinery-impacted communities at the South African Civil Society Organization Air Quality Strategy Workshop organised by *groundWork* in Sasolburg from 12th - 15th July 2002.

CHAPTER 2: COMMUNITY AIR MONITORING IN SOUTH AFRICA

> "Until recently, studies have focussed on more common pollutants like sulphur dioxide, nitrogen oxide, ozone, lead and dust particulates. Hydrocarbons are more difficult to monitor and require more sophisticated techniques, such as methods used by *groundWork*." (DEAT Chief Air Pollution Control Officer, Business Report, 3 April 2001)

2.1 Purpose of Community Air Monitoring – Bucket Brigade

groundWork, together with U.S. based organisations Communities for a Better Environment (CBE) and the South African Exchange Programme on Environmental Justice (SAEPEJ) introduced the 'bucket brigade' air monitoring system to South African refinery affected communities in 2000. This created the basis for the community air-monitoring programme.

Community air monitoring empowers people to act on air pollution. Firstly, it enables community members to become active participants in the production of scientific knowledge. It provides them with a tool to scientifically verify existing community knowledge based on their experience of industrial pollution while adding a more specific and systematic dimension to that knowledge. It thus demystifies science. As O'Rourke and Macey put it,

> "Community concerns are transformed from anecdotal complaints that something 'smells bad' or makes people 'feel sick' to hard data on pollution levels and scientific assessments of potential health effects associated with different pollutant emissions." (O'Rourke and Macey, forthcoming)

Secondly, both through the process of sampling and data collection and through report backs to community meetings, it is raising awareness within the community about the presence of toxic industrial pollutants in the air that they are breathing. Through communicating with the media, this awareness is also extended to the broader public.

Thirdly, it contributes to building a more accurate picture of the quality of air in these communities. In South Africa this is particularly important because existing official information is neither reliable nor comprehensive. Further, both officials and industry have been reluctant or unable to act in the absence of the scientific information that they have failed to produce.

Lastly, and following from this, community air monitoring establishes the basis for a new dialogue between industry, government, and community groups. It allows the latter to

enter the technical domain of monitoring that has been the preserve of industry and government. It allows community members to ask informed questions and, when necessary, challenge available information and the use made of that information. It thus provides them with a tool for holding authorities and industries accountable for pollution and for negotiating real solutions. At the same time, it points the way towards new processes and institutions for environmental regulation that gives meaning to the Constitutional commitment to community participation. Importantly, the process aims to provoke and support capacity building within the regulatory authorities. Local authority capacity is particularly important in South Africa as regulatory responsibility is being devolved to the local level.

In sum, community air monitoring puts together the basic elements of campaigning: the production of relevant and credible information, the mobilisation of community and public opinion, the specific targeting of those who hold the power of decision making and, finally, a process for changing the framework of decision making.

2.2 Community Air Monitoring Committees

Community air monitoring committees are being established in Sasolburg, Secunda, south Durban and Cape Town. This allows community action on industrial pollution to be formalised. Participants are trained in simple air pollution monitoring techniques including:

- Bucket Brigade sampling methodology
- keeping a daily or weekly pollution log
- photographing pollution
- writing up case studies
- recording the experiences of people suffering from and affected by pollution, and
- developing pollution maps which identify ‘hot spots’.

Monitoring committees are also supported in accessing legal and scientific support, information from government and industry, in developing relations with the media, and negotiating with industry and official regulators. Knowledge of pollution legislation and relevant international conventions is also an important component of the committees’ awareness programmes.

2.3 The Bucket Brigade sampling methodology

Sampling

The bucket method takes air samples using a “grab” sampling technique. This technique is well established in the environmental monitoring industry and the United States Environmental Protection Agency (USEPA) has established standard techniques and principles for taking and analysing air samples. Quality assurance and control measures

are essential for credibility and also provide additional scientific data. The bucket technique is itself approved by the USEPA.

The bucket equipment is sturdy and easy to use and sampling is relatively cheap, providing robust data on a range of pollutants. The design is thus well suited for community use while the process combines community sampling with sophisticated analysis and cross-referencing of data. Sampling is, however, subject to specific limitations:

- The buckets can collect gases from the air but cannot measure for particulate matter (such as soot, dust, heavy metals and other solids), toxins that attach themselves to particulates (such as dioxins), acid rain or radiation.
- The bucket cannot test for nitrogen oxides which are a major class of pollutants which damage the lungs and the blood.
- As with all 'grab' samples, the buckets provide a 'snap-shot' of what is in the air at a specific time and place. They do not provide a 'moving shot' to follow the dips and spikes in pollution levels over time.
- The sample bags need to be couriered to a laboratory for sampling. The costs of both the courier and the laboratory are limiting for many South African community based organisations.

The bucket provides an airtight container for a standard 'tedlar' sampling bag. At the selected sampling site, the bag is filled with air by creating a vacuum in the bucket. A second bucket, containing a 'field blank' accompanies the first and is subject to the same conditions, but no actual sample is taken. During analysis of the sample, the field blank serves to check for contamination in the field and for residual chemicals in the bags themselves. During sampling, care is taken to avoid incidental contamination such as from smoking and vehicle emissions.

Sample takers keep a 'chain of custody form'. In it, they record details of the location, date and time and duration of sampling. They also note prevailing meteorological conditions such as wind direction, clouds, fog or rain, and other observable conditions such as types of smell, visible flaring or other stack emissions or unusual smoke from other sources. Immediate health symptoms observed within the locality are also recorded.

Analysis

Analysis of the samples is undertaken by an accredited laboratory. The South African samples were taken to Columbia Performance Analytical Inc. in Columbia, U.S.A. Each sample is analysed twice for the purpose of verification. For analysis of volatile organic compounds, the USEPA Modified TO-15 Method involving combined chromatography/mass spectrometry (GC/MS) is used. For reduced sulphur gases like hydrogen sulphide, carbonyl sulphide, methyl mercaptan, ethyl mercaptan, dimethyl sulphide, and carbon disulphide, the USEPA Modified Method 16 involving a gas chromatograph equipped with a sulphur chemiluminescence detector (SCD) is used.

In the analysis, some chemicals may be below the detection level of the laboratory apparatus. A result of Non-Detect (ND) does not give absolute proof that these chemicals are not in the air.

Three limitations concerning the analysis of the South African samples should be noted:

- Ideally analysis should be carried out within 72 hours of sampling. Given the distance to the laboratory, this was challenging and a few samples did not make it within that time frame. (After 72 hours some of the chemicals may decay below the detection level.)
- Analysis is the most costly part of the process and this limited the number of samples that could be taken.

Interpretation of data

Analytical data is assessed by comparison with established benchmarks or standards. Since there are neither standards nor information on background levels in South Africa, the data was compared with data from the U.S. which falls into three categories:

1. Documented background levels

Background levels are estimates of the average concentrations of pollutants in the air. They represent a good approximation of what is in the air when there is NOT a major incident. The Bay Area in San Francisco is a major site of chemical production and the location of four refineries. It therefore provides an appropriate comparison with the South African areas under review. The Bay Area Air Quality Management District has documented background levels for a number of chemicals and table 2 gives a sample of these levels. This study finds 'elevated' readings of individual chemicals when the readings exceed the background level found in the Bay Area.

Table 2: Bay Area background levels

Chemical	***Background concentration in ppb***
Benzene	1.0
1,3 Butadiene	<0.5
Carbon Tetrachloride	0.11
Chloroform	<0.02
Ethyl dibromide	<0.02
Ethyl dichloride	<0.1
Methylene chloride	<0.5
MTBE	0.8

Tetrachloroethene	0.11
Toluene	2.0
1,1,1-Trichloroethane	0.39
Trichloroethylene	<0.8
Vinyl chloride	<0.3

Source: Communities for a Better Environment (1999)
PPB = parts per billion.

2. Screening or minimum risk levels

Screening and minimum risk levels are not legally enforceable in the U.S. They are generally based on studies of the health effects of individual pollutants. Concentration levels for these pollutants are set either in relation to a specified level of risk or to the level at which it is thought that health impacts are unlikely. The figures thus represent maximum desirable exposures. A number of these screening levels take account of the duration of exposure. For short durations, higher concentration levels are indicated. Screening levels used were:

- EPA Region 6 Screening Levels calculated for residential – not workplace – exposure. The levels are based on a 1 in a million cancer risk or a 'hazard quotient' of 1 for non-cancer effects.
- Texas Effects Screening Levels are set at the level below which health impacts are thought unlikely. Different levels are set for 'short-term' exposure – usually one hour – and 'long-term' exposure – usually one year, but only 24 hours for benzene and ethylene dichloride.
- ATSDR (American Toxic Substance and Disease Register) Minimal Risk Levels also sets levels according to duration of exposure: 'Acute' indicates a period of up to two weeks, 'intermediate' from two weeks and one year, and 'chronic' as longer than a year.

3. Standards

Standards are legally enforceable. Two standards were used for comparison in this study:

- Louisiana Ambient Air Quality Standards differentiate between 8 hour exposure and 24 hour exposure.
- North Carolina Ambient Air Standards sets annual standards, 24 hour standards and one hour standards for systemic toxicants and for irritants.

2.4 What was found

The 'bucket brigades' took seven samples at different sites in Sasolburg, and one sample each in Durban and Cape Town. The aim for this stage of the project was to take at least

one sample per target area. More samples were taken in Sasolburg because Sasol challenged the results of the first bucket sample taken in Sasolburg, and challenged the bucket brigade methodology. Consequently Sasol and the community took parallel air samples in Sasolburg, with Sasol using their technology and the community using the bucket methodology.

The first South African bucket samples found a veritable cocktail of chemicals in the air at all sites. Significantly, the 'bucket brigades' found several chemicals on which there was no prior information in South Africa including carbon disulphide, 2-butanone, toluene, ethylbenzene and xylenes. They also found particularly high readings for benzene at the majority of sites while levels for toluene and xylenes were elevated at some sites.

The analysis of the bucket samples looked for specific chemicals that fall within two distinct groups of chemicals:

1. Volatile Organic Compounds and inorganic gases. As the name suggests, Volatile Organic Compounds (VOCs) are organic compounds – i.e. they contain carbon – which generally have a low boiling point – i.e. they evaporate quickly from liquid into gas. Many VOCs are hydrocarbons which are the chemicals at the core of the petroleum business because they drive and lubricate engines. They are also found in a range of other products such as solvents, paints and poisons. VOCs found in the South African buckets included: toluene, 2-Butanone (methyl ethyl ketone), benzene, trichloroethylene, ethylbenzene, m- and p-xylenes, o-xylenes, styrene, vinyl chloride, carbon tetrachloride, methyl chloride (chloro methane), methyl tert-butyl ether (MTBE), 1,2 dichloroethene.

2. Total reduced sulphur (TRS) compounds are those that contribute to the combined concentration of sulphur. They produce offensive odours similar to rotten eggs or cabbage and produce the initial symptom of eye irritation at very low concentrations. TRS compounds found in the buckets include: carbon disulphide, carbonyl sulphide and hydrogen sulphide.

Table 3 shows what was found where and when.

Table 3: Chemicals detected in the bucket samples at the different locations

	Sasolburg (Steam Station 2)	**Sasolburg (Coal Silos SCI)**	**Sasolburg (Dannhauser Farm)**	**Sasolburg (Dithane & Raphepheng Rd)**	**Sasolburg (Library)**	**Sasolburg (Steam Station 2)**	**Sasolburg (Zamdela Main Rd)**	**Cape Town (Table View)**	**Durban (Buldana & Tara Rd)**
Date of sample	29-05-00	11-10-00	11-10-00	11-10-00	11-10-00	11-10-00	07-02-02	17-7-00	20-05-00
1,2-dichloroethane				x					
2-butanone	x	x	x	x	x	x	x	x	x
Acetone	x	x	x	x	x	x	x	x	x
Benzene	x	x	x		x	x	x	x	x
Carbon disulphide	x	x	x		x		x	x	x
Carbon tetrachloride								x	
Carbonyl sulphide		x		x	x				
Methyl chloride	x							x	x
Ethylbenzene		x					x	x	x
Hydrogen sulphide	x	x					x		
Methylene chloride	x	x						x	x
m- & p-xylene	x	x	x	x	x	x		x	x
o-xylene	x	x						x	x
Propene				x					
Styrene	x	x					x	x	
Tetrachloroethene				x				x	
Toluene	x	x	x	x	x	x	x	x	x
Trichloroethene	x	x							
Trichlorofluro-methane (cfc)								x	
Trichlorotrifluoro-ethane (cfc)	x							x	
Vinyl chloride				x					
Methyl-tert-butyl ether (MTBE)								x	
2-hexanone								x	

	USEPA toxic air pollutant (is known or suspected to cause cancer or other serious health effects
	Deplete's the ozone layer

CHAPTER 3: CHEMICALS AND THEIR HEALTH IMPACTS

This chapter describes each of the chemicals found in the bucket samples in terms of their sources and uses, their characteristics and their health effects. Most are included on the U.S. Environmental Protection Agency (USEPA) list of 188 toxic air pollutants. USEPA identifies these substances as posing a serious human and environmental threat.

It should not, however, be assumed that pollutants that do not appear on the list do not pose a risk. Hydrogen sulphide, for example, is highly toxic. It should be noted that health impacts vary between individuals, some being more vulnerable than others and reacting to lower exposures.

3.1 Volatile Organic Compounds and Inorganic Gases

1,2-Dichloroethane
Also called: dichloroethylene, ethylene dichloride (CAS 107-06-2)

Sources and uses	Characteristics	Health effects	EPA
Manufactured, not found naturally. Used to make vinyl chloride and to dissolve grease, glue, and dirt. Added to leaded petrol to remove lead. Previously used in home products such as cleaning solutions and paint removers. Such use is now rare.	Colourless liquid Pleasant smell Sweet taste Evaporates quickly at room temperature. Dissolves only slightly in water.	Damages heart, central nervous system, liver, kidneys and lungs. Induces nausea and vomiting. Probable carcinogen.	Listed toxic

2-butanone
Also called: methyl ethyl ketone (MEK) (CAS 78-93-3)

Sources and uses	Characteristics	Health effects	EPA
Manufactured primarily for use in paints and other coatings. Also used in glues and as a cleaning agent. Industrial by-product released to air from oil refineries and from car and truck exhausts. Produced naturally by some trees, fruits and vegetables in small amounts.	Colourless liquid. Sharp, fragrant, mint-like odour. Evaporates into air. Dissolves in many substances.	Causes irritation of nose, throat, skin, and eyes. Inhaled in combination with other damaging chemicals, it can increase the damage.	Listed toxic

Benzene (CAS 71-43-2)

Sources and uses	Characteristics	Health effects	EPA
Manufactured from some crude oils for use in commercial solvents and chemical feed-stocks for making plastics, resins, nylon and synthetic fibres, some types of rubbers, lubricants, dyes, detergents, drugs, and pesticides. Industrial emissions, primarily from oil refineries, are the main source of benzene in the environment. Fugitive emissions from storage tanks, leaking valves and pipes and loading operations. Occurs naturally in volcanic gases.	Colourless liquid. Sweet odour. Evaporates easily. Dissolves slightly in water. Highly flammable.	Known carcinogen associated with leukaemia and cancer of blood-forming organs. Harm to bone marrow may reduce red blood cell count and so cause anaemia. Can cause excessive bleeding. Weakens the immune system. Inhaling causes central nervous system depression: high levels result in death, low levels can cause drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion, and unconsciousness. Swallowing causes vomiting, irritation of the stomach, dizziness, sleepiness, convulsions, rapid heart rate, and death. Causes defatting of the skin. Long-term exposure (months) of women has caused irregular menstrual periods and decreased ovary size.	Listed toxic

Carbon tetrachloride

Also called: carbon chloride, methane tetrachloride, perchloromethane, tetrachloroethane, benziform. (CAS 56-23-5)

Trade names include: Benzinoform, Freon 10, Halon 104, Tetraform, Tetrasol.

Sources and uses	Characteristics	Health effects	EPA
Manufactured, does not occur naturally. Used in the production of refrigeration fluid and propellants for aerosol cans, and in pesticides, cleaning fluids and degreasing agents, spot removers and fire extinguishers. Industrial by-product from incinerators.	Colourless liquid or gas. Sweet smell detectable at low levels. Not flammable. Does not dissolve easily in water.	High exposure from inhaling, swallowing or skin contact associated especially with liver damage but also lung, kidney, and central nervous system and brain damage, heart attacks and cardiac abnormalities. Symptoms include intoxication, headaches, dizziness, sleepiness, nausea and vomiting. Severe cases result in coma and death. Damage from low or short term exposure can be repaired by the body. Probable carcinogen.	Listed toxic

Chloromethane
Also known as: methyl chloride (CAS 74-87-3)

Sources and uses	Characteristics	Health effects	EPA
By-product of burning grass, wood, charcoal, and plastics and an impurity in vinyl chloride. Also from cigarette smoke, polystyrene insulation, aerosol propellants and chlorinated swimming pools. Occurs naturally at very low concentrations in the atmosphere and breaks down very slowly in air. Also in surface water, groundwater, soil and sediment.	Colourless gas. Faint, sweet odour noticeable only at levels that may be toxic. Heavier than air. Highly flammable.	Inhaling affects central nervous system. High exposure results in convulsions and coma; Lower exposure causes staggering, blurred or double vision, dizziness, fatigue, personality changes, confusion, tremors, nausea, or vomiting. Symptoms may last for months or years. Damages liver and kidneys and affects heart rate and blood pressure. Animal studies show slower growth and brain damage from low exposure, reduced fertility in males and still births of off-spring sired by affected males.	Listed toxic

Ethyl benzene (CAS 100-41-4)

Sources and uses	Characteristics	Health effects	EPA
Manufactured for use in solvents, fuels, and other chemicals – primarily styrene. Found in inks, insecticides, and paints. Occurs naturally in crude oil and coal tar.	Colourless liquid. Smells like petrol. Evaporates in air. Flammable.	Not well known. Available evidence suggests dizziness, throat and eye irritation, tightening of the chest, and a burning sensation in the eyes from inhaling high levels.	Listed toxic

Methylene chloride
Also called: Dichloromethane, Methylene dichloride (CAS 75-09-2)

Sources and uses	Characteristics	Health effects	EPA
Manufactured, does not occur naturally. Used as industrial solvent and paint stripper and in manufacture of photographic film. Also found in aerosols and pesticides. Concentrates in poorly ventilated workplace.	Colourless liquid. Mild, sweet odour.	Inhaling or swallowing high levels causes dizziness, nausea and tingling or numbness of finger and toes. Low levels reduce mental attention and hand-eye coordination. Skin contact causes burning. Known carcinogen.	Listed toxic

Xylenes
Including ortho, meta and para isomers of xylene (CAS 1330-20-7)

Sources and uses	Characteristics	Health effects	EPA
Fugitive emission from petroleum refineries, terminals and service stations, and manufacture and use of chemicals, polyester, paints, dyes, and lacquers. Emitted from combustion of petrol, wood and other bio-mass.	Colourless gas. Practically insoluble in water and have a sweet odour.	Inhaling high levels causes irritation to eyes, nose and throat, nausea, vomiting and gastric irritation and neurological effects in the short-term. Long-term exposure affects the central nervous system causing headaches, poor muscle coordination, dizziness, confusion, and loss of balance. Also causes reduced lung function and laboured breathing, heart palpitations and chest pain and damage to blood and kidneys. Suspected developmental and reproductive damage. Suspected carcinogen.	Listed toxic

Methyl tert-butyl ether (MTBE) (CAS 1634-04-4)

Sources and uses	Characteristics	Health effects	EPA
Manufactured from isobutylene and methanol as an additive to unleaded petrol to achieve more efficient burning. Fugitive emission at service stations and from exhausts. Used medically to dissolve gallstones.	Liquid. Distinctive, disagreeable odour. Flammable	Inhaling low levels for short periods causes nose and throat irritation. Reports indicate headaches, nausea, dizziness, and mental confusion. Animal studies associate high-level, long-term exposure with kidney and liver cancer.	Listed toxic

Styrene
Also called: vinyl benzene, etheylbenzene, cinnamene, phenylethylene) (CAS 100-42-5)

Sources and uses	Characteristics	Health effects	EPA
Manufactured for use in rubber, plastic, insulation, fibreglass, pipes, automobile parts, food containers, and carpet backing. Industrial by-product, particularly of oil refining. Occurs naturally in small amounts in fruits, vegetables, nuts, beverages, and meats.	Colourless liquid. Sweet smell but often contains other chemicals to give it a sharp, unpleasant smell. Evaporates in air. Dissolves in some liquids but not water.	Affects central nervous system inducing depression, concentration problems, muscle weakness, tiredness, and nausea, and possibly eye, nose, and throat irritation. Probable carcinogen causing leukaemia.	Listed toxic

Toluene (CAS 108-88-3)

Sources and uses	Characteristics	Health effects	EPA
Manufactured for use in paints,	Colourless liquid.	Affects central nervous system.	

paint thinners, fingernail polish, lacquers, adhesives, and rubber and in some printing and leather tanning processes. Industrial by-product of oil refining and making coke from coal. Fugitive emissions from industry or consumer use of products. Found in surface water and groundwater from spills.	Sweet pungent, benzene-like odour. Evaporates easily. Flammable.	Low to moderate levels cause tiredness, confusion, weakness, nausea, intoxication, and loss of memory, appetite, hearing and colour vision for the duration of exposure. High exposure damages kidneys and can cause unconsciousness and death.	Listed toxic

Trichloroethene

Also called: Trichloroethylene (CAS 79-01-6)

Sources and uses	Characteristics	Health effects	EPA
Manufactured primarily for use as a solvent to remove grease from metal parts, but also as an ingredient in adhesives, paint removers, typewriter correction fluids, and spot removers.	Colourless liquid. Somewhat sweet odour and sweet, burning taste. Evaporates easily and is water soluble. Non-flammable.	Inhaling low levels may cause headaches, lung irritation, dizziness, poor coordination, and difficulty in concentrating. High levels impair heart function and may cause unconsciousness, and death. Prolonged exposure causes nerve, kidney, and liver damage. Skin contact for short periods results in rashes.	Listed toxic

Vinyl chloride (CAS 75-01-4)

Sources and uses	Characteristics	Health effects	EPA
Manufactured for use in making polyvinyl chloride used in plastics and vinyl products. Also used as a refrigerant gas and to make other chemicals. Found in factory exhaust gases or as emission from chemical waste stores. Also emitted from new plastic parts, e.g. in new cars.	Colourless gas, Mild, sweet odour. Slightly soluble in water. Quite flammable.	Affects central nervous system at high level short term exposure causing dizziness and headaches. Irritates eyes and respiratory tract. Long term occupational exposure causes 'vinyl chloride disease'. Symptoms include liver and lung damage, poor circulation in the fingers, changes to finger bones, changes to blood. Affects reproductive system causing birth defects in exposed women and miscarriages to the partners of exposed men. Male sexual performance may be affected.	Listed toxic

Trichlorotrifluoro-ethane

Also known as chlorofluorocarbon-113, CFC-113, 1,1,2-Trichloro-1,1,1-trifluoroethane and Refrigerant 113, Freon® 113, Genetron® 113, Halocarbon 113, TTE (CAS 76-13-1)

Sources and uses	Characteristics	Health effects	EPA
Manufactured for use as a solvent and a refrigerant.	Colourless liquid. Faint sweetish	Affects central nervous system at low levels causing headaches,	Not

At high temperatures, (>250°C), decomposes to hydrochloric acid (HCl) and hydrofluoric acid (HF).	odour. Evaporates easily. Non-flammable	dizziness, nausea, loss of concentration, and irritation. High levels also cause cardiac arrhythmia and suffocation due to vapours displacing air. Prolonged or repeated contact causes skin irritation, defatting, reddening and dermatitis. Contact irritates eyes and may cause conjunctivitis.	listed

2-Hexanone

Also called: methyl n-butyl ketone (MBK), propyl acetone (CAS 591-78-6)

Sources and uses	Characteristics	Health effects	EPA
Waste product from industrial activities including wood pulping, producing gas and oil from coal, extracting oil from shale. Previously used in paint and paint thinner, and to dissolve oils and waxes. Manufacture and use now banned in USA.	Colourless liquid. Sharp, acetone-like odour. Dissolves in water. Evaporates into air.	Toxic to liver, gastro intestines and central nervous system. Workers exposed to vapour for a year felt weakness, numbness, and tingling in the skin of the hands and feet. Similar effects are seen in different animals. A study on rats showed reduced weight gain in pregnancy, and fewer, smaller and less active babies than for the control group.	Not Listed

Tetrachloroethene

Also called: PCE, Perchlorethylene, Perk, Tetrachlorethylene (CAS 127-18-4)

Sources and uses	Characteristics	Health effects	EPA
Manufactured, not found naturally. Used in dry cleaning fabrics and metal-degreasing. Also used to make other chemicals and in some consumer products.	Sharp, sweet odour detectable at low levels. Evaporates easily.	Affects central nervous system at high levels causing dizziness, headache, sleepiness, confusion, nausea, difficulty in speaking and walking, unconsciousness, and death. Suspected association with menstrual problems and spontaneous abortions. Low level affects not obvious. Contact results in skin irritation. Probable carcinogen.	Listed toxic

Trichlorofluoro-methane

Also called: fluorotrichloromethane, fluorocarbon 11, genetron 11, propellant 11, Monofluorotrichloromethane, Trichloromonofluoromethane (CAS 75-69-4)

Sources and uses	Characteristics	Health effects	EPA
Manufactured, a chlorofluorocarbon (CFC), used as a refrigerant, a foaming or blowing agent in industry, a solvent, an aerosol propellant, and in chemical syntheses. Emitted from leaks, sprays and waste water. Industrial by-product of chlorine use including water treatment. Does not degrade, present in deep ground water, destroys ozone. Banned for use in USA except for some specialized products.	Colourless gas, liquid under pressure (in cans or refrigerators). Freezes on point of release from pressure. Odourless, but smells like ether in high concentrations. Evaporates instantly. Slightly soluble in water.	Targets the skin, respiratory system and cardiovascular system. Can lead to poor coordination, tremor; dermatitis; cardiac arrhythmias, cardiac arrest; asphyxia. Contact with liquid form causes frostbite.	Not listed

Acetone

Dimethyl ketone, Ketone propane, 2-Propanone (CAS 67-64-1)

Sources and uses	Characteristics	Health effects	EPA
Manufactured for use in plastic, fibres, drugs, and other chemicals. Also used to dissolve other substances such as paint. Industrial by-product and found in vehicle exhaust, tobacco smoke, and landfill sites. Occurs naturally in plants, trees, volcanic gases, forest fires, and as a product of the breakdown of body fat.	Colourless liquid Distinct smell and taste. Evaporates in air. Dissolves in water. Flammable.	Enters blood and is carried to all body organs. Small amounts are broken down by the liver and rendered harmless. Inhaling moderate or high levels causes nose, throat, lung, and eye irritation; headaches; light-headedness; confusion; increased pulse rate; effects on blood; nausea; vomiting; unconsciousness and possibly coma; and shortening of the menstrual cycle in women. Swallowing damages mucous membranes and can cause unconsciousness. Skin contact produces irritation and skin damage. Animal studies show that long-term exposure produces kidney, liver and nerve damage, increased birth defects, and lowered male fertility. Long term effects on people are not known.	Not listed

3.2 Total Reduced Sulphur (TRS) Compounds

Hydrogen Sulphide (CAS 7783-06-4)

Sources and uses	Characteristics	Health effects	EPA
By-product of desulphurization in oil and gas industries and from rayon production, sewage treatment and leather tanning. Remains in the air for about 18 hours, reacts in air to form sulphur dioxide and sulphuric acid. Occurs naturally in crude oil, natural gas, volcanic gases, and hot springs.	Colourless gas under normal conditions. Smells like rotten eggs at low levels – so known as stink damp or sewer gas. Flammable	Broad-spectrum poison affecting several body systems. Inhaling high levels causes rapid loss of consciousness and death. Low exposure causes irritation to eyes and throat, coughing, shortness of breath, and fluid in the lungs. Symptoms last several weeks. Long-term, low-level exposure causes fatigue, loss of appetite, headaches, irritability, poor memory, and dizziness.	Not listed

Carbon Disulphide (CAS 75-15-0)

Sources and uses	Characteristics	Health effects	EPA
Manufactured for use in: xanthate intermediates used to produce cellulosic products like viscose rayon and cellophane film; fungicides, insecticides and grain fumigants, rodenticide, and soil fumigation. Smaller quantities are used in solvent extraction. Still used for the extraction of fats, oils and waxes, but now being replaced with less toxic and flammable solvents. Industrial by-product from manufacturing starch, combustion of plastics and many other processes.	If pure: colourless liquid; pleasant odour like chloroform. If impure: yellowish liquid; unpleasant odour like rotting radishes. Flammable.	Inhaling causes drowsiness, chest pains and irritation. Long term exposure affects brain and may lead to paralysis. Skin and eye contact produces similar affects and also irritation and blurred vision. High concentrations have caused skin burns.	Listed toxic

Carbonyl Sulphide (CAS 463-58-1)

Sources and uses	Characteristics	Health effects	EPA
Manufactured for use as an intermediate in the synthesis of organic sulphur compounds and alkyl carbonates. Fugitive emission from commercial processes and combustion. Emitted naturally from volcanoes, marshes, soils, and deciduous and coniferous trees. Anthropogenic emissions estimated at one-third of natural emissions.	Colourless gas. Sulphide odour.	Inhaling produces narcotic effect. Irritates eyes and skin.	Listed toxic

CHAPTER 4: THE CHEMICAL HOTSPOTS

> "[V]isit Zamdela Township at Sasolburg where you will smell the sulphur thick in the air, feel your eyes sting and hear a hundred coughs from people who have long forgotten what is normal…." Stefaans Brümmer, *South Africa: Where breathing is a health hazard.* Mail & Guardian, 8 June 2000.

4.1 Sasolburg

Location and history

Sasolburg is a major centre for the chemical industry. It is part of the larger Vaal Triangle Industrial complex in the Free State province and close to the Witwatersrand-Vereeniging area. The Lethabo power station is about 20 kilometres away and the town is ideally situated to access both the raw materials and resources required by heavy industry and the largest markets in South Africa.

As its name implies, Sasolburg started life as a company town. Its founding in 1952 followed the construction of the first South African oil-from-coal plant by the South African Coal, Oil and Gas Corporation which soon became known as Sasol. The oil-from-coal process yielded a variety of chemical products and several large satellite chemical factories were opened to take advantage of the supply of feedstock. Major chemical companies attracted to the town included AECI, Sentrachem and Karbochem. Alongside the heavy chemical industries a number of secondary industries were also established.

Sasolburg now has a population of 81,500. Workers were drawn in first for construction and then to supply labour to the chemical plants. They were located at Zamdela which, following the pattern of apartheid planning, became the black 'township' twin to white Sasolburg. Informal housing began to appear alongside the formal township in the 1970s. Zamdela is located downwind of the heavy industry zone and residents live with the constant smell of a variety of chemical pollutants released both by normal production and by periodic incidents. Waste coal ash and mine tailings dumps are also located near to Zamdela and ash and dust is frequently blown over the town.

With the restructuring of local government under the democratic government, Sasolburg now falls within the Metsimaholo Local Authority. More detailed facts and demographics about Sasolburg are also available at www.sasolburgsouthafrica.com/facts.htm.

Industrial Profile

Sasol remains the dominant company in Sasolburg. It is a major producer of chemicals and liquid fuels products and a key player in the South African oil industry. It is best

known for its synthetic fuels processes – the name derives from South African Synthetic Oil Limited – although it no longer produces synfuels in Sasolburg itself.

In Sasolburg, the company operates the **Natref** crude oil refinery established in 1971 and jointly owned with its partner Total South Africa Pty. Ltd. (TotalFinalElf). The crude oil supply is piped from Durban. The refinery produces different types of liquid fuels including petrol, diesel, jet fuel, fuel oil, LPG and bitumen. According to Sasol's Safety Health and Environment Report (2000), the refinery emits 1,025 kilotons per year of particulates, 293 kilotons/year of sulphur dioxide, 120 kilotons/year of hydrogeh sulphide, 166 kilotons/year of nitrogen oxides and 57,713 kilotons/year of carbon dioxide.

Sasol 1, the original oil-from-coal plant, now focuses on chemical production and is operated by **Sasol Chemical Industries**. Plants located here include Sasol Agri, Sasol Solvents, Sasol Ammonia, Sasol SMX, Sasol Carbo-Tar, Sasol Infrachem, Sasol Oil, Sasol Schumann and Merisol. Sasol Chemical Industries is a major producer of olefins and other feedstock for downstream chemicals and polymer production and the major producer of ethylene and propylene in South Africa.

Sasol Polymers was originally established in 1993 as Polifin, a joint venture between Sasol and AECI. The latter company sold its 40% share to Sasol in 1999. Sasol Polymers produces polyvinyl chloride, polyethylene, polypropylene, chlorine, caustic soda, mining chemicals, and other inorganic chemicals.

Karbochem is a South African chemical company and member of the Sentrachem Group. It manufactures and distributes synthetic rubbers, mining chemicals, agricultural chemicals and industrial chemicals.

Dow Chemicals, one of the largest transnational chemical companies in the world, acquired Sentrachem in 1997. The company produces a diverse range of products including agricultural chemicals, resins, plastics, fine and custom chemicals, synthetic rubbers, detergents, ammonia and chlorine based chemicals, fine and specialty chemicals and chemical commodities.

The map below shows the location of Sasolburg's industries. AECI is depicted on the map but this is now the location of Sasol Polymers. 'ChemCity 1 and 2' is the location of approximately 40 businesses (mostly chemical industries) such as Sasol Fertilisers, SCI Ammonia Sulphur Mill, Polypos PSP plant and EWS. The map also shows the location of Zamdela to the south. The prevailing winds are northeasterly so putting the community directly in the path of the pollution plume.

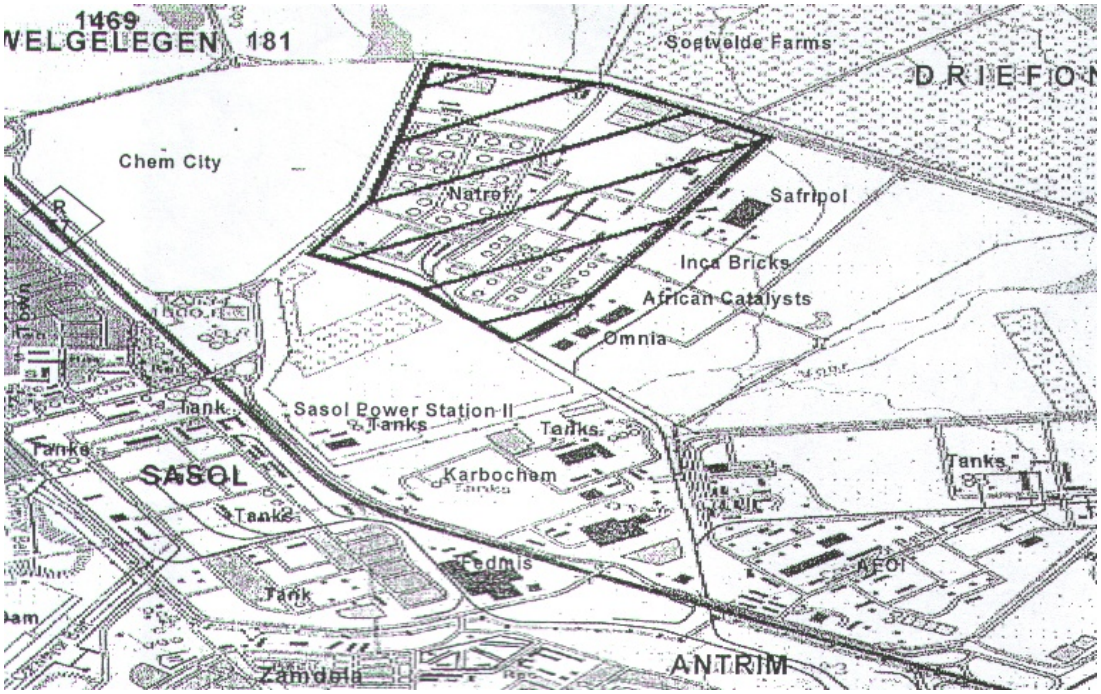


Figure 2: Map of Sasolburg's industrial area
This map shows Natref in the centre with Zamdela community in the South. The prevailing winds blow from the North.

Health Status

Health statistics recorded at clinics in and around Sasolburg show a high rate of asthma and other lung conditions. An analysis of clinic reports reveals that, during some months, respiratory illnesses can account for up to 40% of all illnesses treated at the clinics. There does not appear to be any correlation between respiratory illnesses and climatic changes. If such a correlation existed it would indicate that the burning of coal in homes during winter was a primary cause of respiratory illnesses. But this is not the case.

Ambient Air Pollution Monitoring

Apartheid security legislation – the Key Points Act – prohibited the publication of information on 'strategic' industries. The whole Sasolburg industrial area was designated as a key point in terms of this Act. Consequently there was no public access to information on the emission of pollutants from the Sasolburg chemicals industries. Although the Key Points Act is still in place, democratic government combined with public pressure has produced greater openness and some industries are now publishing annual environmental reports. Information remains very partial however. Corporate environmental reporting is not required by law. Those companies that do report (including Sasol) do not necessarily report on all their operations or give figures for each individual plant. Reporting is not verified by government regulators and therefore relies on the honesty of polluters.

The chemical industries in Sasolburg are, at present, subject to the regulatory authority of the national Department of Environmental Affairs and Tourism (DEAT). DEAT has allocated one air pollution control officer to the greater Vaal/Highveld region which incorporates both Sasolburg and Secunda. Neither emissions nor ambient air quality in Sasolburg are directly monitored by the regulatory officials.

Sasol (including its subsidiaries) does ambient air monitoring in and around Sasolburg. Five monitoring stations are located at the Sasolburg Provincial Hospital, Boiketlong Community Hall in Zamdela, A.J.Jacobs Primary School, Leitrim and Steam Station 2. Pollutants monitored include sulphur dioxide and hydrogen sulphide. At the Leitrim monitoring station nitrous oxide, ozone and benzene are also monitored.

In conjunction with the School of Chemistry at Potchestroom University, and just after *groundWork*'s bucket sampling, Sasol recently installed 14 air monitoring sample points on the Natref fenceline to monitor for BTEX (benzene, toluene, ethyl-benzene and xylene) compounds and sulphurous compounds. These monitors have detected high concentrations of benzene in excess of US guidelines.

Community Monitoring

The Bucket Brigade was introduced to Sasolburg in 2000 by *groundWork*, CBE and SAEPEJ. A community monitoring committee has been established and enabled the residents of Zamdela to take a more proactive approach to industrial pollution.

Seven bucket samples have been taken in Sasolburg. The first air sample was taken at Steam Station 2 on 29 May 2000. Five more samples were taken on 11 October 2000 at the Coal Silos, Dannhauser Farm, the corner of Dithane and Raphepheng Roads, Zamdela Library and Steam Station 2 next to the Petronet sign. The latest sample, which was part of a training exercise on community air monitoring, was taken at the corner of Eric Louw and Zamdela Main Roads on 7 February 2002.

The samples taken in Sasolburg identified 20 different chemicals. Of these, 15 are listed as toxic – or hazardous – air pollutants by the United States Environmental Protection Agency (USEPA).

The measured levels of benzene in four of the Sasolburg samples were very high and cause for concern as benzene is a known carcinogen – that is, it causes cancer.

The hydrogen sulphide concentrations were very high in three of the samples – the Coal Silos SC1, Eric Louw and Zamdela Roads and Steam Station 2 – taken on 11 October 2000. The chain of custody form for these samples noted a strong rotten egg smell. According to SDCEA-DN, "The emission of hydrogen sulphide to air is not tolerable and is a sign of unprofessional management" (2003: 36). That it could be smelt in itself indicates that tolerable emission levels were exceeded. Hydrogen sulphide is a broad spectrum poison affecting several body systems. Inhaling high levels can cause coma and death.

Vinyl chloride and 1,2 dichloroethane were detected at unhealthy levels in the samples taken at the corner of Dithane and Raphepheng Roads in Zamdela on the 11 October 2000. Vinyl chloride is known to cause cancer and 1,2 dichloroethane is a probable carcinogen. Consequent to the detection of vinyl chloride in the bucket sample, Sasol Polymers in Sasolburg contracted Integrated Safety, Health and Environmental Consulting Services (ISHECON) to model for vinyl chloride in the area.

In response to the community's air sampling initiatives, Sasol contracted the South African Regional Science Initiative (SAFARI 2000) and Leeds University to take air samples in Sasolburg. They took samples at eight sites. The analytic results confirmed the bucket brigade findings. Benzene and toluene concentrations were elevated at all sites and mixed xylenes concentrations were elevated at one site. The benzene concentration in one of these samples was 49ppb, which is 235 times the EPA Region 6 Screening level of 0.208ppb.

Detailed findings of each of the Sasolburg bucket samples are given in Appendix I. A table showing the SAFARI / Leeds results is also given.

4.2 South Durban

Location and history

Durban is the largest city of the KwaZulu-Natal province and has a population of approximately 2.3 million. The city is located on the eastern seaboard of South Africa around a flourishing harbour, which handles seven times more cargo than all of South Africa's other harbours combined.

The development of south Durban as an industrial hub was initiated in 1938 following lobbying of the pre-apartheid white local government by local industrialists. Subsequent apartheid industrial planning was substantially modelled on the precedents set by Durban. Most of south Durban was deliberately zoned for industrial development, and black people were forcibly removed to make way for industrial complexes. At the same time, residential areas for black people were located close to these dirty industries in order to facilitate easy access to cheap labour. Toxic dumps and a major sewerage works were also located in the area. In south Durban, the result is a patchwork of residential and industrial areas located cheek by jowl. Racial restrictions also led to overcrowding in many of the residential areas and local people had to bear with poverty as well as inhumane working and socioeconomic conditions.

The area now has a population of about 285,000 people, and black communities comprise an overwhelming majority of this population. Low-income communities are located in Clairwood, Jacobs, Isipingo, Merebank, Wentworth, Umlazi, Amanzimtoti and Umbogintwini. The Bluff, a white and predominantly working class area, also borders on industrial areas.

The harbour development over the years has led to the complete destruction of the once extensive mangrove swamps and highly toxic chemicals were stored in massive volumes in close proximity to the residents. In 1946, the development of an airport in south Durban resulted in most of the surrounding wetland areas being drained. During the 1950's and later, heavy petrochemical industries, Engen and Sapref (Shell & BP) refineries, were permitted to develop in close proximity to residential areas on land that had been used by local people for market gardening. For more information on the history and environmental problems of communities in South Durban, refer to http://scnc.udw.ac.za/~ub/cbos/sdcea

South Durban communities have a long history of environmental concern. The transition to democracy enabled a more robust articulation of this concern. In 1993, a group of community organisations and NGOs formed the South Durban Environmental Forum (SDEF) to coordinate civil society action on air pollution. This forum was the forerunner to the South Durban Community Environmental Alliance (SDCEA) which was constituted in 1997.

Industrial profile

South Durban is the industrial hub of Durban. It is 'home' to two of the largest oil refineries in Southern Africa. South Durban has the largest concentration of petrochemical industries in the country and it refines approximately 60% of South Africa's petroleum. There are five major industrial belts located in the South Durban Basin (SDB): the valley industrial belt; the Jacobs industrial belt; the Navy/Mobeni industrial belt; the Island View industrial belt and the Prospecton industrial belt.

The valley industrial belt, nicknamed "cancer valley" (after Cancer Alley in California) is occupied by the Engen and Sapref refineries, a Mondi paper mill, an international airport, a sewage treatment plant, a busy south coast freeway, a polluted Umlaas canal, landfill sites and various mills, processing and manufacturing industries. All are located close to residential and recreational areas.

Prospecton is an industrial area that separates the two residential areas of Isipingo. The largest employers there are Toyota Manufacturing, Sasol Fibres, South African Breweries, and Republican Press. To the south of Prospecton is the giant AECI Umbogintwini chemical complex. 15 plants are located on the site and most have been sold off to different companies as AECI 'unbundled' in the mid 1990s.

Island View is the port terminal for the import of chemicals for the whole of Southern Africa and an increasing volume of exports. This complex stores toxic chemicals, some of which are potential and known carcinogens. The odour problem emanating from this industrial belt is well noted. It is connected to the refineries by pipelines running beneath the residential streets of Merebank, Wentworth and the Bluff and is located adjacent to the Bluff. The remaining industrial belts consist of many smaller processing and manufacturing factories. In total, the South Durban Basin contains some 600 industries, including the two oil refineries.

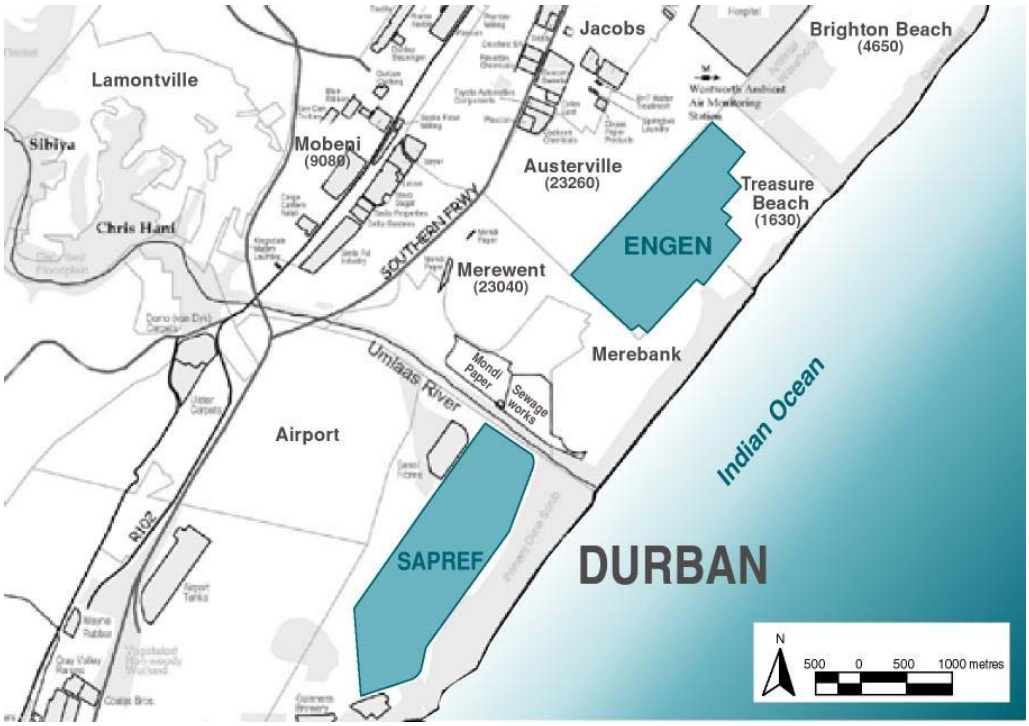


Figure 3: Map of south Durban

Health Status

Until recently, there were no formal studies examining the effects of pollution on health in the South Durban Basin. However, there is now a growing body of evidence linking increases in health problems with increased levels of noxious gases, elevations in daily average and/or maximum exposures to sulphur dioxide, and certain meteorological conditions.

Investigative studies by a local journalist suggested that the incidence of leukaemia in south Durban is as much as 24 times higher than in other parts of South Africa. One of the known causes of cancer is exposure to benzene, an organic gas emitted from, amongst other sources, oil refineries.

A study by the University of Natal Medical School found that children in the suburbs south of Durban "are up to four times more likely to suffer from chest complaints than children from other areas of the city" *(Kistnasamy, 1994, unpublished).*

School children bear a major part of the public health costs associated with petrochemical pollution. At Settlers Primary School in Merebank, located midway between Engen and Sapref, attendance figures are perceived to go down when the wind blows toxic emissions into the classrooms. Staff members report that there are constant unpleasant odours in the classrooms affecting both the pupils and teachers. Pupils complain of burning sensations in their eyes and noses, sore throats, nausea and sever headaches. During 2000 two

teachers of the school were absent for three weeks due to chronic laryngitis, respiratory problems, severe headaches and bronchial pneumonia, which their doctors attributed to pollution.

Reports by environmental consultants, Ecoserv, state that sulphur dioxide pollution in Merebank exceeded World Health Organisation guidelines on 124 occasions for the year 1 November 2000 and 31 October 2001.

Recently, a joint study was conducted by the Universities of Natal and Michigan and the Durban Institute of Technology at the Settlers Primary School for an 18-day period from 19 April – 6 May 2001, with 273 participants. The draft final results of this study showed that 52 % of the study population suffered from asthma and/or respiratory problems, and noted that this was the highest rate recorded in the scientific literature world wide. The study also found a heightened level of sensitivity – with asthmatic reactions to relatively low exposures – and suggested that this was a consequence of exposures over the long term.

The Settlers study was undertaken in response to sustained pressure from the south Durban communities. There are, however, still large gaps in the information on health status and producing hard evidence linking specific industries to localised health problems is inherently difficult. The loopholes in South Africa's environmental legislation do not make the task easier.

Air Pollution Monitoring

Ambient sulphur dioxide levels in south Durban are monitored by the Durban South Sulphur Dioxide (SO_2) Management System. The system is managed under the authority of the SO_2 Steering Committee which is established as a Section 21 company. Representation on the committee includes the national and local regulators, respectively the Department of Environmental Affairs and Tourism (DEAT) and Durban City Health, the major industries which emit SO2 and, since 1994, community representatives.

In the last two years, the system has expanded form one or two poorly managed continuous SO_2 monitoring stations and now comprises an on-line computerised dispersion model, 4 permanent and 1 mobile continuous SO_2 monitoring stations, and 7 meteorological stations which are all professionally managed and calibrated. The system is accredited by Eskom Technology Services International (TSI) and operated by environmental consultants Ecoserv. It has been awarded the National Laboratories Association's prestigious ISO Guide 25 quality certificate assuring data integrity, and is the first monitoring system in South Africa to qualify for this certificate.

The two refineries, Engen and Sapref, recently began monitoring stack emissions of SO_2 and carry out on-site monitoring for a variety of other pollutants. Durban City monitors for particulates, nitrogen oxides, sulphur dioxide and total reduced sulphur (TRS) in the core metropolitan area which includes south Durban.

Community Monitoring

SDCEA was formed in 1997 to enable local community organisations to develop a common agenda on environmental issues. Organisations currently active in SDCEA are: the Wentworth Development Forum; the Isipingo Environmental Committee; Clairwood Ratepayers' Association; Christ the King Catholic Church; Merebank Ratepayers' Association; Wentworth Co-ordinated Services; Earthlife Africa (eThekwini branch); Silverglen Civic Association; Silverglen Nature Reserve; Bluff Ridge Conservancy; and the Bluff Ratepayers Association.

SDCEA has forcefully represented the view of residents in south Durban that neither the authorities nor polluting industries have taken their concerns seriously. SDCEA's sustained pressure is largely responsible for initiatives such as the health study and the upgrading of formal monitoring systems in Durban. It has focused the attention of national and local politicians as well as the media on industrial pollution in south Durban. Its wider impact, in association with *groundWork* and other communities affected by industrial pollution, is evident in the preparation of new legislation on air quality.

One bucket sample was taken in south Durban at the corner of Buldana and Tara Roads in Wentworth on 20 May 2000 at 13h00. Seven chemicals were detected in the sample: toluene, methyl ethyl ketone (2-Butanone), mixed xylenes, benzene, methylene chloride, ethylbenzene and carbon disulphide. The sampler noted acidic, sour smells that can be attributed to the carbon disulphide. The wind was blowing from the Engen refinery towards the Merebank community.

The results indicating BTEX chemicals (Benzene, Toluene, Ethylbenzene and Xylenes) and 2-butanone (MEK) are typical of air emissions from a petroleum refinery. All the chemicals detected by this sample are categorized as toxic air pollutants by the USEPA.

Benzene and toluene concentrations were very high. The level of benzene was 139 times higher than the EPA Region 6 Screening level, 12 times higher than the Texas long term screening level, 3 times higher than the Louisiana 24-hr standard, 290 times higher than the North Carolina Annual Ambient Air Standard and 7 times higher than the ATSDR intermediate screening level. The toluene concentration was 12 times higher than the Bay Area background level. Benzene is known to cause cancer while toluene is suspected to cause cancer and is a developmental and reproductive toxin.

The methylene chloride concentration exceeded the Bay Area background level by almost 4 times. According to Wilma Subra, a Louisiana chemist, this concentration is three to four times higher than is normally found during upset conditions near petroleum refineries. A more detailed assessment and interpretation of the results appear in Appendix I.

The Settlers Primary School health study similarly found high levels of benzene, toluene and xylenes. Their results showed that levels of VOC's at the school, which is distant from dense urban traffic, were similar to those found on busy rush hour roads in the US city of Detroit. 24-hour average levels, and levels at 50 metres or more from the road,

were 2 to 5 times lower than the Settlers school's benzene, toluene, and xylene concentrations.

4.3 Table View

Location and history

Table View is located just 20 minutes from Cape Town. It looks across the bay towards Table Mountain and Cape Town's prestigious Waterfront. Cape Town is South Africa's oldest city. Its name derives from 'Cape of Good Hope', the name given to it by European seafarers in search of a sea passage to the rich spice markets of the east. The city is a cultural melting pot with its diverse and vibrant character being derived from Khoisan and other African people, and Indonesian, Malay and European settlers.

Cape Town is South Africa's second largest city with a population of approximately 3 million (2000). It is the seat of South Africa's parliament, the capital of the Western Cape province, a major port and a centre of international tourism. It is also the headquarters of the Southern African oil industry and many other businesses involved in global commerce.

The Caltex refinery (Calref) was built at Table View in the mid-1960s in what was then an undeveloped and sparsely populated area. Successive local governments have, however, promoted development in the area and the refinery now neighbours five communities: Richwood, Da Noon, Table View, Joe Slovo and Bothasig. Table View is a middle to high-income area situated about 1 kilometre from the refinery. This suburb has a population of about 50,000 people. Richwood is to the north east of Caltex. Bothasig is a low-income area and Da Noon is an informal settlement 2 kilometres north of the Caltex refinery. Joe Slovo includes both low cost housing and an informal settlement. Major housing developments for another half million people are planned for the area. Local health regulations requiring an 800 metre buffer between residents and refinery have already been transgressed, with 400 houses within the boundary and more planned.

Local residents have expressed concerns about air pollution over several decades. Since 1994, these concerns have been consistently articulated particularly by the Table View Residents Association.

Industrial profile

Calref started as a small refinery but has expanded to three times its original size. The refinery operates under a registration certificate dated September 1994. It emits approximately 14 tons of sulphur dioxide daily, 8,7 tons of VOCs and nearly 2500 tons of carbon dioxide daily.

Other major installations in the area include: two tank farms both owned by the government and managed by the Strategic Fuels Fund (SSF); and the Vissershoek high hazard (H:h) landfill site which services the Western Cape and Eastern Cape. Part of the

Vissershoek site was used as a temporary sulphur storage facility for Calref following a fire at an AECI sulphur storage in 1995. Calref has subsequently developed its own facility to store sulphur. Earlier this year, blood tests from community people living around Vissershoek revealed the presence of mercury in the blood. More tests and investigations are being undertaken, but it is suspected that the body burden of mercury came from exposure to mercury-contaminated dust blowing off the landfill site. The Potsdam Wastewater Works and several smaller industries are also located in the area.

Koeberg, South Africa's only nuclear power station, is located 20 kilometres to the north at Atlantis.

Figure 4: Map showing Table View and surrounding residential areas.

Health status

No formal studies of pollution related illnesses have been conducted in the area. Residents' health complaints include respiratory problems (especially asthma) as well as chest-related illnesses, coughs, sore throats, puffy eyes, weak immune systems, sinus complications, headaches, eye infections, ear infections, skin infections, allergies, and insomnia. Nuisance conditions in the form of unpleasant odours are particularly evident at night.

Air Pollution Monitoring

The City of Cape Town's Air Quality Monitoring Section, Scientific Services Department, has 13 continuous monitoring stations. Around Caltex there are monitoring stations in the Bothasig, Goodwood, Killarney and Table View. The 13 stations monitor for one or more of the following pollutants: Nitrogen oxides (NO_x), nitrous oxide (NO), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), ozone (O_3), carbon monoxide (CO), particulates, hydrogen sulphide (H_2S), pollen & moulds. This monitoring network is not accredited but is well run. Adherence to standard procedures & frequent instrument calibration take place. There are also video cameras for on-line monitoring of visibility.

Community Monitoring Committees

The Table View Residents Association (TVRA) has been most active in working to reduce the pollution impacts of these industries. In 1994 it began negotiating with Calref and in 1995 the company responded with a pledge to the greater community of Cape Town that it would reduce its pollution levels by 80%. To date, some eight years later, they have not honoured their pledge. TVRA continues to monitor conditions in the area.

One bucket sample was taken on 17 July 2000 on Calref's fenceline bordering Table View by members of the TVRA. Analysis detected 16 chemicals of which 12 are listed as toxic air pollutants by the USEPA. Chemicals found were: chloromethane, benzene, toluene, styrene, acetone, ethyl benzene, mixed xylenes, methyl ethyl ketone, methylene chloride, carbon tetrachloride, trichlorofluoromethane, trichlorotrifluoroethane, 2-hexanone, MTBE (methyl tert-butyl ether), carbon disulphide and tetrachloroethylene.

Six chemicals were detected at high concentrations: benzene, toluene, carbon disulphide, methylene chloride, chlormethane and carbon tetrachloride.

The benzene concentration of 1.3 ppb exceeded the Bay Area background level, the EPA Region 6 Screening level and the North Carolina Annual Ambient Air Standard. The toluene concentration of 11 ppb was 5.5 times greater than the Bay Area background concentration level. Benzene is a known carcinogen while toluene is a suspected carcinogen.

Two chlorofluorocarbons (CFCs) – trichlorofluoromethane and trichlorotrifluoroethane – were detected in this bucket sample. CFC's deplete the ozone layer which in turn results in skin cancers.

A more detailed assessment and interpretation of the results appear in Appendix I.

4.4 Secunda

Location and history

Secunda is 150km South East of Johannesburg. Adjacent to Secunda is eMbalenhle, an apartheid created township. The total population of the area is about 300,000 – 350,000 people, of which about 200,000 live in eMbalenhle. Secunda is a white middle class town with good infrastructure and tele-communication systems, banks, shopping centres etc. It is the economic heart of this sub region. eMbalenhle on the other hand is home to mainly poor African people. At the core of this community are people who once lived in Secunda which was then called Driefontein.

As with Sasolburg, the name Secunda reflects that it is a company town – the location of Sasol's second oil-from-coal plant. With the development of this refinery in the early 1980s, black people were relocated downwind at eMbalenhle. The settlement is now surrounded by mines and adjacent to the local dump. The dump fence is not maintained and children have access to it. The township has an unemployment rate of more than

50%, poor infrastructure and telecommunication systems, no banks and one or two small shopping centres. Much of the population is housed in informal settlements with limited electricity supply. Low-grade coal is the main source of domestic energy.

Sasol is the main resource provider in eMbalenhle. It builds houses, funds mathematics and science departments at schools and sponsors school competitions and clean–ups amongst other things. It is also the major employer. The line between Corporate Social Responsibility and patronage is thus blurred and it is difficult for local people to publicly criticise the company.

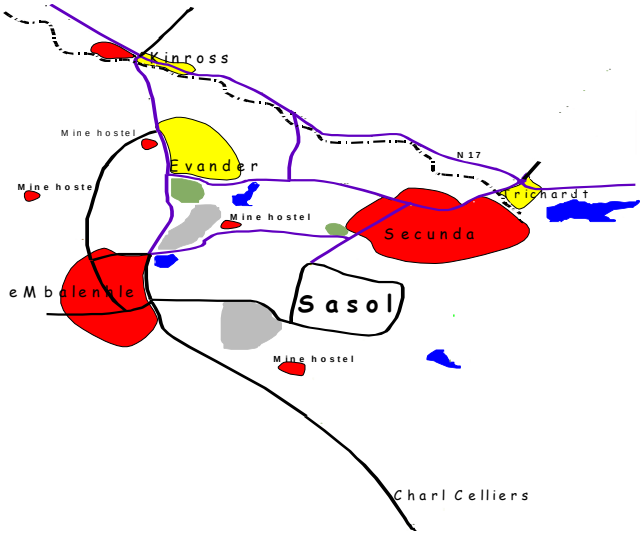
Industrial Profile

The major operations in the area are Sasol, who operate several of their own coal mines as well as their synthetic fuels and chemical plants, and Harmony Gold Mines. A number of smaller companies provide services to these two giants.

Two Sasol Syn Fuels (SSF) plants were built on a greenfield site at Secunda. The plants produce liquid fuels and chemical feedstocks from coal. The production of both Secunda plants is equivalent to a refinery with a crude capacity of between 150 and 170 barrels per day. Sasol Chemical Industries (SCI) also operates several plants in Secunda: Sasol Alpha Olefins, Sasol Polymers, Sasol Agri, Sasol Solvents, Sasol SMX and Sasol Infrachem.

According to Sasol's SHE report (2000), during the 1999/2000 year, SSF and SCI emitted 8 kilotons of particulate matter, 97 kilotons of hydrogen sulphide, 248 kilotons of sulphur dioxide, 143 kilotons of nitrogen oxides, 404 kilotons of VOC's and 49,607 kilotons of carbon dioxide from their plants in Secunda. These pollutants have been linked to various health problems and environmental degradation. For example, carbon dioxide is a greenhouse gas that contributes to global warming and climate change.

Figure 5: Map of Secunda.



Health status

The local municipality has used environmental health workshops to assess the health status of young people. A large percentage of the young people in eMbalenhle suffer from respiratory illnesses like sinus problems, asthma, burning sensations in the throat and chest, as well as from skin irritations and burning eyes.

Air Pollution Monitoring

Sasol has three air-monitoring stations around the Sasol Synfuels plants in Secunda. These stations monitor for hydrogen sulphide (H_2S) and sulphur dioxide (SO_2), as well as for wind speed and wind direction. All of the instruments take readings every 2.5 seconds. Fifteen-minute averages are calculated at the stations using a small processor. These 15-minute averages are transmitted by radio or cell phone to a central computer where hourly, daily and monthly averages are calculated and stored.

Community Monitoring

The eMbalenhle Youth Environmental Club (EYEC) is one of the community's main advocates against pollution and environmental injustice. It is a member of a broader forum, the Highveld East Community Environmental Monitoring Alliance (HECEMA). EYEC is involved in social and economic upliftment projects focusing on poverty alleviation and HIV/AIDS awareness as well as environmental health awareness.

The bucket brigade was recently introduced at eMbalenhle and air samples will be taken in the area during 2003. The results will be reported in next year's *groundWork* air quality report.

CHAPTER 5: INDUSTRIAL INCIDENTS AND EVENTS

5.1 Legal definitions and responsibilities

The Disaster Management Bill (2001) states that a 'disaster' means a progressive or sudden, widespread or localised, natural or human-caused occurrence which:

(a) causes or threatens to cause death, injury or disease; damage to property, infrastructure or the environment; or disruption of the life of a community; and
(b) is of a magnitude that exceeds the ability of those affected by the disaster to cope with its effects using only their own resources.

The Occupational Health and Safety Act (1993) states that:

An 'incident' means an incident when a dangerous substance was spilled;
A 'major incident' means an occurrence of catastrophic proportions, resulting from the use of plant or machinery, or from activities at a workplace;
An 'event' is when an incident occurs;
A 'risk' means the probability that injury or damage will occur;
'Safe' means free from any hazard; and
'Hazard' means a source of or exposure to danger.

The National Environmental Management Act (1997) also covers the control of emergency incidents in Chapter 7.

It defines an 'incident' as an unexpected sudden incidence, including a major emission, fire or explosion leading to serious danger to the public or possible serious pollution of or harm to the environment, whether immediate or delayed.

The responsible company or person must report on the nature of the incident; any risks posed by the incident to public health, safety and property; the toxicity (how poisonous) of substances or by-products released by the incident; and any steps that should be taken in order to avoid or minimise the effects of the incident on public health and the environment. This report must be submitted to the Director General; the South African Police Services and the relevant fire prevention service; the relevant provincial head of department or municipality; and all persons whose health may be affected by the incident.

The responsible company or person must, as soon as possible after knowledge of the incident, take all reasonable measures to contain and minimise the effects of the incident, including its effects on the environment and any risks posed by the incident to the health, safety and property of persons; undertake cleanup procedures; put right the effects of the incident; and assess the immediate and long-term effects of the incident on the environment and public health.

5.2 Incidents and events

What the insurance industry calls 'acts of God' – events beyond people's control – do happen. Industrial incidents, however, are in principle avoidable. Industries which use or produce toxic substances have a particular responsibility to ensure that incidents are avoided. Repeated incidents at a plant are a sign of poor and negligent environmental management.

Incidents and events recorded since 2001 in Sasolburg, south Durban and Secunda are shown below. The information on industrial incidents in south Durban is fairly comprehensive and was compiled by the South Durban Community Environmental Alliance on the basis of press articles and public observations. Civil society organisations in the other pollution hot spots have not been as diligent in keeping a record of all industrial incidents either reported or observed in their areas. Thus information on incidents in Sasolburg and Secunda was provided by Sasol, whilst information on incidents in Cape Town has still to be accessed and collated.

There is, of course, a difference between an incident occurring and the public reporting of the incident. So this record does not necessarily reflect the reality of incidents on the ground. It is more likely to reflect the state of information – or lack of it – available to the public in each area.

Sasolburg

Excessive flaring is a common practice in Sasolburg. In principle, the flare provides a necessary safety measure to prevent the accumulation of potentially explosive gases. Flares should burn clean. Excessive flaring is a sign of poor environmental management and suggests that the flare is used as a cheap way to get rid of waste gases that cannot be processed or sold. For more information of flares, visit our web site at: www/groundwork.org.za/flaring.htm.

groundWork has been unable to access a list of all industrial incidents from all industries located and operating in Sasolburg. At *groundWork*'s request, Natref provided a list of incidents at the refinery in 2001 and 2002. These incidents were reported by Natref to the DEAT and the local council.

On 6 June 2001, a catastrophic fire in the crude oil distillation unit at Natref killed two contract workers and injured another. The fire lasted eight hours and resulted in the closure of the entire refinery for three months and a crisis in the fuel supply which was partly covered by an expansion of Engen's permitted production. By comparison with the other refineries, Natref's permit allows very high SO_2 emissions at 63 tons a day. Nevertheless, during this period eight incidents – not counting the fire – resulted in it exceeding this allowance, in most cases for more than two days at a time. Emissions topped 200 tons on a number of occasions. On 31 December 2001, 'bursting disk failure' resulted in SO_2 emissions in the range of 280 tons a day for five days. A similar if less severe incident followed two weeks later. The entire plant was shut down on both occasions.

The full list of incidents reported by Natref is given in Appendix II.

South Durban

In Durban, complaints logs are kept by both refineries and by City Health. City Health only recently acquired responsibility for this and is still computerising its system. Neither the refinery nor the official complaints systems have enjoyed credibility and, in 2001, SDCEA started developing its own log of complaints from all sources.

The list of recent incidents in south Durban is alarmingly long. The examples below illustrate the pollution levels to which the south Durban community is exposed. A full list of those incidents known to and documented by SDCEA is given in Appendix II.

Sasol Polymers at Umbogintwini had three serious chlorine gas leaks during 2000 alone, resulting in hundreds of schoolchildren and residents being taken to hospital or treated by ambulance staff. This plant was subsequently shut down in Durban and moved to Sasolburg. Sasol said the move was for economic reasons and not in response to the incidents.

The number of incidents at Sapref and Engen appears to be escalating. This would indicate that the infrastructure at the two refineries is deteriorating.

Sapref incidents during 2001 included: On 9 January 2001 there was a fire in the bitumen blending area. On the same day 6,000 litres of solvent spilled from a faulty valve on a road tanker. Not long after, on the 23 January, there was another fire at the Crude Distillation Unit number 2. Also on this day 1,000 litres of bunker fuel spilled into Durban Bay. On 22 March, a tetra ethyl lead (TEL) tank failed and 25 tons of TEL leaked from the tank. The leak was caused by internal corrosion in the tank. On 19 June, a flare failure resulted in the release of unburned gases including a substantial amount of hydrogen sulphide. A petrol pipeline failure, detected by local residents on 7 July, resulted in a loss of more than a million litres of petrol. Five families were evacuated and more believed they should have been evacuated. On 3 September, the marine fuel oil pipeline failed. Bunker fuel oil leaked into the harbour on 14 October.

Engen incidents during 2001 and 2002 included: Excessive flaring on several occasions since January 2001. On 28 May 2001, an Engen worker, Mr. T van der Schiff, was killed and another, Mr. E. Mlaba, was seriously injured by hydrofluoric acid. No action was taken against the refinery. A pipeline fuel leak of between 15,000 and 25,000 litres of diesel and paraffin was detected on 25 October near houses in Wentworth. On 23 November, Engen spilled 1,000 litres of oil into the Badulla Canal. Yet again, on 22 February 2002, Engen spilled 3,000 litres oil into Badulla canal and this time was fined R500. On both these occasions, Engen claimed it was due to rain. There was a propane line rupture at the Safor unit at Engen on 21 February 2002. On 24 October 2002, the floating lids on Engen's crude oil storage tanks in Island View collapsed causing the release of noxious and offensive gases.

Secunda

The only information that was sourced on incidents at Sasol's Secunda operations came from Sasol itself.

According to the Sasol SHE Report (2000), during the 1999/2000 year there were 80 plant incidents (spillages) at Sasol's Secunda operations. In addition, workers suffered a high rate of injury. There were:

- 42 disabling injuries
- 431 total injuries
- 14,072 work hours lost due to injury.

Sasol's 2000 – 2002 Sustainable Development Report cited 14 reportable incidents at the Sasol Synfuels plant in Secunda during the two years. These included nine accidental releases, one explosion due to a process upset and five fires. One contractor died and three Sasol employees were injured in these incidents.

CHAPTER 6: LEGISLATION

The key laws dealing with air quality in South Africa are the Constitution of the Republic of South Africa Act No. 108 of 1996, the National Environmental Management Act 107 of 1998 (NEMA), the Atmospheric Pollution Prevention Act 45 of 1965 (APPA), the Occupational Health and Safety Act 85 of 1993 (OHSA) and the Environmental Conservation Act of 1989. In addition a new National Environmental Management: Air Quality Bill was gazetted in May 2003 for public comment. Government says it hopes to enact this Bill before the end of 2003. However, *groundWork* and other civil society organisations have found serious flaws with this bill.

International agreements are also important to air pollution management. This report will focus on the Montreal Protocol on Substances that Deplete the Ozone, the Stockholm Convention on Persistent Organic Pollutants (POPs) and the United Nations Framework Convention on Climate Change (UNFCCC).

This section gives a summary description of these legal instruments.

6.1 Domestic legislation

The Constitution

Section 24 of the Bill of Rights contained in South Africa's Constitution states that:

> Everyone has the right –
> (a) to an environment that is not harmful to their health or wellbeing; and
> (b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that:
> (i) prevent pollution and ecological degradation;
> (ii) promote conservation; and
> (iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

It is important to recognize that the right consists of two components. The first specifies the right – an environment that is not harmful to human health or well-being. Here, the meaning of "health" is clear. The meaning of "wellbeing" is less so. Since the Constitution makes the distinction, it must be assumed that wellbeing goes beyond physical health to include emotional, mental or spiritual dimensions.

The second component imposes an obligation to uphold the right and says what must be taken to achieve this. This obligation falls both on the State – this is called the 'vertical application' of the Bill of Rights – and on all natural and juristic persons – this is called 'horizontal application'. 'Juristic persons' includes companies and any other legally

constituted organisations. This obligation also implies a duty, subject to the limitations clause, not to infringe the right.

This right is the cornerstone of environmental law and the test against which all human conduct that has a bearing on the environment must be measured.

Clearly it is the State's duty to introduce legislative measures and, if this legislation fails to uphold the environmental right, it is unconstitutional.

"Other measures" must, logically, bind other persons as well as the State. Following from this, it would seem that industries must introduce (reasonable) measures that prevent pollution and ecological degradation, promote conservation and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development. In deciding what is reasonable, the principles and provisions of NEMA can be used as a yardstick. Reasonable measures may include installing improved technologies and monitoring systems, and implementing environmental management systems.

For the State, "other measures" might include developing the administrative and technical capacity to ensure compliance.

The National Environmental Management Act

Section 28(1) of NEMA obliges anyone who pollutes or degrades the environment to take reasonable measures to stop doing it or, if the harm to the environment is authorized by law (e.g. by a permit) or cannot be reasonably avoided, to minimize and put right the damage. The law specifies what measures should be taken, including:

(a) investigate, assess and evaluate the impact on the environment;
(b) inform and educate employees about the environmental risks of their work and the manner in which their tasks must be performed in order to avoid causing significant pollution or degradation of the environment;
(c) cease, modify or control any act, activity or process causing the pollution or degradation;
(d) contain or prevent the movement of pollutants or the causant of degradation;
(e) eliminate any source of the pollution or degradation; or
(f) remedy the effects of the pollution or degradation.

Although degradation of the environment is authorized by the APPA, industries still have a duty to minimize and correct environmental harm. If they fail to take the required measures, the Director-General of DEAT or the head of the provincial department responsible for the environment may direct them to:

(a) investigate, evaluate and assess the impact of specific activities and report thereon;

(b) commence taking specific reasonable measures before a given date;
(c) diligently continue with those measures; and
(d) complete them before a specified reasonable date.

The principles set out in section 2 of NEMA apply to any actions (which include decisions) of any organ of state, such as the department, that may significantly affect the environment. The principles include:

- That pollution and degradation of the environment are avoided or, where they cannot be altogether avoided, are minimized and remedied.
- That a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions.
- That negative impacts on the environment and on people's environmental rights be anticipated and prevented, and where they cannot be altogether prevented, are minimized and remedied.
- Environmental management must be integrated and it must take into account the effects of decisions on all aspects of the environment and all people in the environment by pursuing the selection of the best practicable environmental option.
- The social, economic and environmental impacts of activities, including disadvantages and benefits, must be considered, assessed and evaluated, and decisions must be appropriate in the light of such consideration and assessment.
- Environmental justice must be pursued so that adverse environmental impacts shall not be distributed in such a manner as to unfairly discriminate against any person, particularly vulnerable and disadvantaged persons.
- The environment is held in public trust for the people, the beneficial use of environmental resources must serve the public interest and the environment must be protected as the people's common heritage.
- The costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimizing further pollution, environmental damage or adverse health effects must be paid for by those responsible for harming the environment.

The Atmospheric Pollution Prevention Act

The APPA is widely regarded as weak and out-dated but it has governed pollution management to date. It says that anyone who operates a ‘scheduled process’ must obtain a ‘registration certificate’ allowing them to operate. A scheduled process is any large polluting industry listed in a schedule to the Act. The schedule includes refineries and, in all, about 2,500 individual plants fall within the definition. The registration certificate – or permit – is issued by the Chief Air Pollution Control Officer (CAPCO) of the Department of Environmental Affairs and Tourism (DEAT). The permit sets certain conditions for the operation of the plant.

Section 12 of the APPA says that permits will be withheld unless all equipment and appliances are properly maintained and operated. Permit holders must also ensure that all

the necessary measures are taken to prevent the escape of noxious or offensive gases – that is, to prevent air pollution.

The Act allows for 'unavoidable' pollution during start-ups, shut-downs, breakdowns or other upset conditions. The CAPCO may, however, require the permit holder to take steps to improve the operation and can cancel the permit if the holder fails to comply.

Each permit has five sections: The first describes the location and size of the plant. The next two sections describe the nature of the industry and list the raw materials and products that it uses. The fourth details what appliances and measures are used to prevent air pollution. It also sets out a number of conditions, for example, limiting emissions of SO_2 (the only pollutant regulated by the CAPCO), or requiring the company to monitor emissions and to report to the CAPCO. The fifth section deals with the disposal of effluents from purification equipment.

The Occupational Health and Safety Act of 1993

The Occupational Health and Safety Act of 1993 is intended to protect workers. Lead Regulations, Asbestos Regulations and Hazardous Chemical Substances Regulations are included in the Act. If workers are exposed to these hazards, a programme of medical surveillance must be instituted by a qualified person – usually an occupational health practitioner.

The Regulations for Hazardous Chemical Substances (1995) apply to employers whose business exposes workers to hazardous chemical substances (HCS). Briefly, the employer's legal duty is to:

- carry out risk assessments;
- carry out air monitoring by an approved inspection authority;
- prevent exposure of employees to HCS, or where this is not possible, adequately control exposures;
- where control of exposures is not possible, provide suitable personal protective equipment (PPE);
- ensure that where the concentration of a HCS in the air exceeds the recommended limit, the area is marked off as a respirator zone (where face masks or respirators must be used);
- adequately maintain all controls and protective equipment;
- inform and train workers about any health risks involved and the precautions to be taken; and
- ensure that employees at risk are under medical examination.

The Environment Conservation Act of 1989

The Environment Conservation Act of 1989 requires environmental impact assessments (EIAs) for specified developments. EIAs include air quality studies where appropriate. To prevent creeping loss of air quality due to the totally combined effect of lots of

individually-small impacts, Strategic Environmental Assessments of the entire 'air bubble' of major regions have increasingly become standard practice.

The National Environmental Management: Air Quality Bill

This Bill was released for public comment on the 24th April 2003. The Bill is intended to repeal the Atmospheric Pollution Prevention Act of 1965. *groundWork* and other civil society organisations have a number of serious concerns with the Bill:

Firstly, the main purpose for the development of the Bill is the protection of people's health. Yet, health is not mentioned in the objective of the Bill. While recognising that the "burden of health impacts" falls most heavily on the poor, the Bill is too vague to be able to address this burden, known as environmental injustice.

Secondly, provision has not been made for ***enforceable, national*** ambient and emission standards. A failure to this could result in dirty industries moving to areas of weaker provincial and/or local government.

Thirdly, technology standards are not a critical consideration in license applications. Technology must be based on BAT (Best Available Technology)/BART (Best Available Retrofit Technology) principles, with determination as to acceptable cost for technology being based on rational and transparent consideration. Also, quality control measures must be applied to the testing equipment used during monitoring and a legal test must be used to monitor technology standards.

Fourthly, the Bill does not provide guidance from the Department of Environmental Affairs and Tourism (DEAT) as to what monitoring or information systems should be used by polluters and government authorities. The Bill does not compel the Minister to develop standards for information management and leaves the onus on municipalities to undertake this information collection and monitoring. Without clear assistance from provinces and national government, this will be unachievable. Also the public has no "right to know" nor direct involvement in monitoring and information gathering.

Fifthly, section 25 of the Bill states that "in order to promote compliance" with the national environmental management principles insofar as air quality is concerned, environmental management cooperation agreements (EMCA's) may be entered into by the Minister or relevant MEC. This contradicts the White Paper on Environmental Management (July 1997) and the Integrated Pollution and Waste Management Policy (IPWM) of 2000 which both see EMCA's being used to take us ***beyond*** compliance with the law, whereas the Bill seeks to use it to ***achieve*** compliance, which is less acceptable.

Finally, by pushing air quality management to the most financially weak and poorly capacitated sectors, such as municipalities, it is doomed to fail. The resources required of municipal and provincial government to manage air quality can be substantial not to mention the technical skills.

6.2 International treaties

The Montreal Protocol on substances that deplete the ozone layer (1987)

The Montreal Protocol says that countries must control the consumption of listed substances that deplete the earth's ozone layer. The major substances regulated under the Protocol are chlorofluorcarbons (CFCs); halons; methyl chloroform; carbon tetrachloride; HCFCs; and methyl bromide.

The Montreal Protocol is based on the precautionary principle. Additional control measures are introduced as new scientific evidence points to the need for further action. This allows scientific and technical knowledge to inform decision-making.

The 'parties' – countries which have signed the agreement – must ban the production of listed substances. The Protocol also bans trade in ozone depleting substances between parties and non-parties. Countries which have signed can be declared non-parties if they do not comply.

South Africa signed on in 1990 and was then classified as a developed country under the Protocol. It was reclassified as a developing country in 1997. It will retain its existing developed country commitments, but will have more flexibility in responding to new regulations.

The Stockholm Convention on Persistent Organic Pollutants (POPs)

The Stockholm Convention on Persistent Organic Pollutants was finalised and signed by many countries (including South Africa on 23 May 2002). South Africa subsequently ratified the Convention during the World Summit on Sustainable Development hosted by South Africa in September 2002. The Convention seeks to eliminate certain harmful chemicals that persist in the environment. The Convention initially identifies 12 chemicals, of which nine are pesticides and 3 are chemicals produced or used in industrial processes – PCBs, dioxins and furans. More chemicals will be added to the list in the future. Parties to the Convention are required to take steps to ban or restrict the production and use of the listed chemicals.

The Kyoto Protocol to the United National Framework Convention on Climate Change

The Framework Convention was signed by 165 nations at the Rio 'Earth Summit' in 1992. These countries agreed that a build-up of heat-trapping 'greenhouse' gases in the atmosphere (especially carbon dioxide) was heating up the planet and so causing climate change. Some of the signing parties agreed to voluntarily cut back their greenhouse gas emissions. The plan was to return global emissions to 1990 levels by the year 2000. But the voluntary approach did not work.

Five years after Rio, the Kyoto Protocol was approved to strengthen the Convention. The 1997 Protocol says industrialized nations (Annex I parties) should reduce their emissions of six greenhouse gases: water vapour, carbon dioxide, methane, nitrous oxide, ozone and chlorofluorocarbons. They must cut their emissions to 5.2% below 1990 emission levels between 2008 and 2012.

Parties who signed the Rio Accord and the Kyoto Protocol are concerned that global warming will be economically, environmentally and socially disruptive. Burning of fossil fuels for energy and transport is the main human activity responsible for global warming. The refineries, together with Eskom, are major contributors. For example, Sasol emitted 57,713 kilo tons of carbon dioxide during the 1999/2000 year (Sasol SHE Report 2000).

CHAPTER 7: CONCLUSIONS AND RECOMMENDATIONS

Civil Society Strategy on Industrial Pollution

Based on the preliminary findings of this report, communities gathered at the Air Quality Strategy Workshop organised by *groundWork* in Sasolburg in July 2002, developed a 5 pillar strategy to fight industrial pollution:

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- AWARENESS – of the impact of pollution on health and rights of people;
- MOBILISATION – of communities and organisations locally and international around polluting industries;
- ADVOCACY / LOBBYING – by civil society of government to develop effective policy and legislation and to hold corporations accountable for their transgressions;
- COMMUNICATION and ACCESS TO INFORMTION – working together with unions, government and academic institutions to improve communication and access to information;
- MONITORING and RESEARCH – communities will develop their own air monitoring and commission their own research which will be biased towards people's health and well-being.

It is clear that communities are becoming impatient with government's failure to address poverty and degradation whilst large corporations continue to reap huge profits[1] from our natural resources and by exploiting workers. Emotions and feelings are becoming more and more clear – enough is enough!

WSSD and Corporate Accountability

Social Movements have unanimously declared WSSD a monumental failure. The outcomes contradict sustainable development principles. *groundWork*, together with other organisations and communities from around the world, launched the Corporate Accountability Campaign a week before the official WSSD. This global campaign will call for global regulation to hold corporates accountable for their actions and add strength to our local struggles and campaigns.

> People and their environments the world over are increasingly affected by, and implicated in the globalised web of corporate activities and interests. However, there is too little democratic control over corporations at the global level, and no coherent regulatory system at the global level within which appropriate social and environmental standards can be effectively enforced in relation to transnational corporations. (Butler and Hallowes 2002: 70).

[1] Sasol reports an average profit of R40 million every day.

We believe that the South African government should support the call for a global convention establishing corporate accountability and liability.

Community Air Monitoring

The Sasolburg, south Durban and Cape Town communities have identified and measured the pollutants in their air at the time of sampling. The bucket sampling technique provided scientifically validated data on air quality corroborating community concerns, enabling them to document information and providing them with a basis for asking informed questions. It empowers communities to enter the technical domain of monitoring that has been the preserve of industry and government.

The data will be used to support on-going campaigns to reduce pollution and associated health impacts, to hold both authorities and polluting industries accountable, and to campaign for an effective system of monitoring and enforcement. Through these means, communities intend to establish a new dialogue with industry and government giving real meaning to the Constitutional commitment to participation.

We believe that the national, provincial and local government environmental departments should play a pivotal role in supporting community monitoring for two principle reasons. First, it has a mandate to promote participation. Second, the NEMA places a considerable responsibility on civil society for monitoring and enforcing environmental laws. This provision was made partly in recognition of government's limited capacity. Communities, however, are aware of the limits to their own capacity. They are mostly volunteers performing the task in their spare time and they cannot access the expertise required to engage across a broad spectrum of highly technical industrial processes without support. Further, volunteer capacity is strong in a few areas and very weak in most local areas.

Practical forms of official support to communities would include:

- providing training, access to quality assurance and access to technical expertise; strengthening and expanding the bucket techniques themselves, helping to lower costs and decrease turn-around times on data analysis;
- improving environmental health data and correlating this with bucket and other monitoring data;
- disseminating bucket information more effectively; and
- supporting the integration of community monitoring into broader public disclosure systems and public education programs on industrial environmental pollution.

The community vision is of a national network of community monitors connected to a larger, integrated system of community complaints, government monitoring systems, public disclosures, and corporate accountability. The bucket brigades are only one component of this larger vision. Such a network would link community concerns with appropriate facilities and an array of monitoring and enforcement solutions. To achieve this, the network must be developed with attention to:

- the objectives of local residents;
- the pace of development of potentially polluting industries;
- the need to legitimate bucket usage through linkages with local enforcement efforts; and
- the need to maximize the flexibility of bucket samplers and data analysts through the provision of other site-specific forms of data.

Incidents and accidents

> Fires, explosions and leaks have become so common that they can almost be considered a normal operation condition for Durban's industrial plants. Both industries and authorities have appeared reluctant to inform the community of potential hazards and, as yet, there is no coherent off-site emergency or evacuation plan to cater for this community of approximately 270,000 despite sustained lobbying by SDCEA. (O'Connor and Hallowes 2002: 11)

Incidents are common at every point in the petrochemical and chemical transportation and production chain: road and sea tanker spills, pipeline leaks, storage tank failures, valve leaks, fires and explosions. Many incidents result in injury to workers and local residents and some result in death. Repeated incidents are a sign of poor and negligent environmental management and should be penalised with heavy penalties and even imprisonment.

Environmental Legislation and the new Air Quality Bill

> The chemicals and refinery industries have been leading exponents of self regulation, and the process of developing agreements was led by corporations from 1999 to the present. The key role players pushing of self-regulation have been the Refinery Managers Environmental Forum (RMEF) and the Chemical and Allied Industries Association (CAIA). They represent the environmental interests of companies collectively responsible for more than twenty five percent of South Africa's greenhouse gas emissions. These two bodies supported by their international business lobby counterparts, have aggressively pushed a particular framework and approach to the development of voluntary agreements in South Africa. (Butler and Hallowes 2002: 14)

groundWork believes that civil society and government cannot allow industry to regulate itself. Their values and interests are in direct conflict with sustainable development. Self-regulation in any case has resulted in the never-ending occurrence of pollution incidents at the refineries. Industry has shown that it is incapable of regulating itself.

The draft National Environmental Management: Air Quality Bill appears to herald a new approach to managing air pollution, which we welcome. South Africa's democratic government has a strong record of developing progressive policy and legislation. Implementing policy and enforcing the law, however, remains a critical challenge.

groundWork believes that government must commit itself to clear time-frames for the progressive and speedy realisation of all the benchmarks indicated below:

- Problems in the Air Quality Bill must be corrected before it is enacted.

- Implementation of a new law on Air Quality must be accompanied by at least the following features:
  - ***Enforceable*** ambient and emission standards must be set nationally to ensure uniformity and dissuade dirty industry to move to areas where there is weaker provincial and local government. These standards have to be adjusted (made more stringent) in local areas where industrial polluters operate in close proximity (pollution hot spots).
  - Technology standards must be a critical consideration when making decisions on license applications. Technology must be based on BAT (Best AvailableTechnology)/BART (Best Available Retrofit Technology) principles, with determination as to acceptable cost for technology being based on rational and transparent consideration.
  - Quality control measures must be applied to the testing equipment used during monitoring and a legal test must be used to monitor technology standards.
  - Emission standards must be health – based in accordance with World Health Organisation (WHO) guidelines.
  - Community "right to know" and public involvement in monitoring and information gathering must be included in the Bill.
  - The Bill must indicate what systems should be used by polluters and government authorities for information gathering, such as a Pollution Release and Transfer Registry (PRTR) or a Toxic Release Inventory (TRI).
  - The Bill must indicate how national government will support lesser-resourced local and provincial authorities with pollution monitoring and information gathering.

- Stringent regulation, nationally and at the local level, must be demonstrated through provision for, and enforcement of, sufficiently strong sanctions through prosecutions, fines, withdrawal of licenses, interdicts halting polluting processes, and so forth. There needs to be a dramatic reversal of current enforcement capacity trends which have seen the number of enforcement officers dwindle and a reliance on self-regulation by polluters.

- The fiscal implications of a number of these characteristics needs to be reflected in an increased budgetary allocation for pollution control.

- There must be a measurable reversal of declining air quality in South Africa – both nationally and in local 'pollution hot spots'.

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