



CITY OF CAPE TOWN  
ISIXEKO SASEKAPA  
STAD KAAPSTAD

# WATER QUALITY: ASSURANCE THROUGH TESTING

Making progress possible. Together.

The citizens of the City of Cape Town expect high water quality of domestic and industrial water supplies, unpolluted rivers, public amenities, and the environment. We assure excellent water quality through state of the art testing facilities and sampling managed by the Scientific Services Branch.

The purpose of the Scientific Services Branch includes the following:

- Providing monitoring services and advices to protect public health and to ensure a safe environment
- Supporting stakeholders in complying with legislative requirements through credible laboratory services
- Supporting treatment processes of water purification, wastewater, solid waste, and air quality management
- Translating scientific data into user-friendly information for our customers and other stakeholders

## **QUALITY ASSURANCE SECTION**

Currently, the Quality Management System (QMS) covers four Sections at the Scientific Services viz. Water Lab, Analytical Lab, Biological Sciences Lab and Air Quality Monitoring Section.

The laboratories, with their comprehensive range of analysis, need to deliver quality results according to specified standard requirements. The laboratories will therefore have to ensure that the results are credible, traceable and finalised within a minimal turn-around time. This is achieved by the Quality Management System (QMS) for the Laboratories - more specifically the SANAS ISO/IEC 17025 QMS, standard i.e. "General requirements for the competence of testing and calibration laboratories". Currently our Laboratory is SANAS ISO/IEC 17025 accredited.

The ISO 17025 accreditation helps to maintain the overall quality standard in the laboratories through clearly documented policies and procedures, and is supported by:

- the Laboratory Information System (LIMS) that is interfaced with instrumentation ensuring the integrity and traceability of Test Method data, as results are processed automatically;
- state of the art analytical instrumentation providing reliable and expected turnaround time of results to customers;
- data loggers used for sampling, ensuring the integrity of samples taken at sampling points; and

- a centralised Sample Receiving Area (1, 2, 3) which enables the traceability of samples received for testing in our laboratories.

## **WATER LABORATORY**

### **Introduction**

The quality of drinking water in Cape Town is of a high standard. This is due to the fact that most of the water consumed in Cape Town is abstracted largely from unpolluted mountain catchments. The Water Laboratory at the Scientific Services Branch, located within the Water and Sanitation Department of the City of Cape Town, is largely responsible for the chemical monitoring of potable water in the Cape Metropolitan Area (CMA). The Water laboratory is also responsible for the chemical monitoring of the raw (untreated) ground and surface water, and also water from the public swimming baths and distribution network.

### **Drinking water quality**

Access to safe drinking water is essential to health and considered to be a basic human right. The City of Cape Town and its Scientific Services Branch is committed to providing quality tap water to its consumers by ensuring that the drinking water supplied by its various water treatment plants does comply with the recommended guidelines as stipulated in the South African National Standards (SANS 241:2011) for Drinking Water. Every effort is made to meet the highest national and international standards for drinking water.

### **Water laboratory (Scientific Services)**

The Water Laboratory is not only equipped with some of the most sophisticated water testing instrumentation in the water industry, but also consists of a group of highly skilled, qualified and experienced scientists and technicians who ensure that the consumer is supplied with drinking water of acceptable quality. Most of the laboratory's instrumentation has been interfaced with the Laboratory Information Management System (LIMS) which provides for the automatic and instantaneous transfer of analytical data from the instrument to the LIMS in preparation for the production of the final laboratory report.

### **Laboratory instrumentation**

- **Discreet Analyser/Aquakem 250** - This selective chemistry analyser is an integrated system solution for convenient and automatic testing of routine photometric tests. It is capable of performing up to 200 tests per hour. This instrument is used by the Water Laboratory to test for nitrates, nitrites, chlorides, sulphates, fluorides and colour in the water.
- **Ultraviolet Visible (UV/Vis) Spectrophotometer** - This instrument determines the absorbance of the water by measuring the intensity of light passing through the sample. The absorbance is measured at 300 nm in a 4 cm quartz cuvette and is a measure of the organic content of the water. The absorbance of the raw

water is used to determine the dosage concentration of the treatment chemicals at the water treatment plant.

- **Gas Chromatograph Mass Spectrophotometer (GCMS)** - One of the analyses performed on the GCMS is the measure of geosmin in the water. Geosmin is a naturally occurring compound found in surface waters (rivers and dams) as an organic molecule produced by blue-green algae. This compound is responsible for the earthy, musty taste and odour sometimes found in the water and is removed with powdered activated carbon in the water treatment process.
- **Inductively Coupled Plasma Optical Emission Spectrophotometer (ICP-OES)** - The Water Laboratory uses the ICP-OES to perform weekly analyses on various water samples to determine their metal content. Some examples of these metals are sodium, calcium, magnesium, potassium, aluminium, iron, manganese, lead, copper, zinc, chromium, vanadium, etc.
- **TIAMO Analyser** - The Metrohm automated titration system is a computer controlled and fully automated titration system with a sample tray capable of analysing 59 samples. This analyser is used to automatically determine the pH, conductivity, alkalinity, and turbidity of a water sample.
- **Wet chemistry analysis** - Various wet chemistry analyses are performed in the laboratory which includes analysis of ad-hoc samples (e.g. identification of seepage samples) and water treatment chemicals (e.g. analysis of lime, ferric sulphate, aluminium sulphate, etc.). These wet chemistry analyses also include pH, conductivity, alkalinity, chloride, residual chlorine, ammonia, etc.

### Water quality monitoring

The Water Laboratory performs numerous tests on water samples which are taken from the water treatment plants, service reservoirs, various points within the distribution system, and from swimming baths. Various chemical analyses are also performed on 'ad hoc' water samples which include seepages and complaint samples from the consumer. Over 320 000 chemical and biological tests are performed each year on the raw water entering the water treatment plants and also on the treated water leaving the plants into the reservoirs and distribution network.

### Frequency of monitoring

- **Water treatment plants (WTP)** - Raw, treated and intermediate composite water samples are taken weekly at 11 water treatment plants and submitted to the Water Laboratory for chemical testing. Unlike the other water treatment plants which use conventional chemical water treatment on its raw surface water, the Atlantis WTP treats groundwater by first passing it through a softening plant after which it is blended with the treated water from the Voelvlei pipeline via the Melkbos Reservoir.
- **Reservoirs** - Treated water samples are taken weekly at 14 reservoirs of various capacities and submitted to the Water Laboratory for chemical testing.

- **Distribution** – Treated water samples are taken weekly at approximately 120 sampling points situated across the entire distribution network within the Cape Metropolitan Area and submitted to the Water Laboratory for chemical testing. These sampling points include those situated in the various informal settlements spread across the city.
- **Swimming baths** – Samples are taken at approximately 40 public swimming baths during the summer season and submitted to the Water Laboratory for chemical testing and monitoring.
- **Non-routine (ad hoc) samples** – These non-routine (ad hoc) samples, which include seepage samples for source identification and complaint samples from the consumer, are submitted daily to the Water Laboratory for chemical testing and monitoring.
- **WTP treatment chemicals** – Samples of water treatment chemicals (e.g. lime), which are used in the treatment processes at the various water treatment plants, are submitted weekly to the Water Laboratory for chemical testing and quality monitoring.

### **On-site monitoring**

Water treatment plants:

- All raw, treated and intermediate samples are sampled every 2 hours at the water treatment plants and tested for various chemical parameters e.g. pH, Alkalinity, Turbidity, UV Absorbance, Residual Chlorine, Hardness, etc.
- These results are used to optimise plant operations and to monitor the quality of the water throughout the treatment process. The Bulk Water Branch recently acquired 9 ProcessLab (ATLab) analysers for each of the water treatment plants to perform the above-mentioned analyses automatically.
- The methods used feature fully automated electrode calibration as well as record keeping of calibration data. The ProcessLab analyses samples within minutes, with a much higher repeatability and accuracy compared to the previous manual determination methods.
- All the analytical results stored in the system's database are immediately transferred, over distances greater than 80 km, to a central server where it can be viewed by the Bulk Water Management and the Water Laboratory staff at Scientific Services. These automatic ProcessLab analysers play an important part in maintaining the high quality of drinking water leaving the water treatment plants.

### **Distribution network**

- Approximately 20 online chlorine analysers have been strategically placed within the distribution network where it is expected that the residual chlorine concentration will be low (e.g. the furthest point from the reservoir, the outer perimeter of the distribution network, etc.). These online analysers constantly monitor the free chlorine in the drinking water and send the results to a central server and website where it can be accessed by the Reticulation Branch management who will then authorise the necessary operational changes accordingly. These online chlorine analysers play an important part in maintaining the desired residual chlorine concentration in the drinking water in all areas of the distribution network.

### **Water treatment plant optimisation**

The Water Laboratory plays an important role in assisting the water treatment plants with the optimisation of its various water treatment processes. The Water Laboratory's Analytical Chemists perform regular water treatment plant inspections to monitor the quality of water throughout the water treatment process and to give scientific guidance where needed. Research projects are also conducted at the various water treatment plants to monitor the quality of the water as it passes through the various water treatment processes, to monitor the efficiency of each process and to further optimise each process and the treatment as a whole.

## **LABORATORY INFORMATION MANAGEMENT SYSTEM (LIMS)**

### **LIMS as an information management system**

LIMS is the information management system used in the Analytical Laboratory, Water Laboratory, and Biological Sciences Laboratory at Scientific Services. LIMS was implemented in July 2007 to improve work processes, traceability, turn-around time, data security and accountability, and to incorporate the aspects and requirements of ISO 17025.

### **Sample lifecycle using LIMS:**

#### **Sampling of samples**

Samples are sampled by either internal or external samplers. Our internal samplers perform their sampling routes using handheld units with a built-in GPS functionality that are interfaced with the LIMS system and capture valuable data e.g. sample date and time, distance travelled, field tests performed, sampling and field test notes.

#### **Logging samples**

Samples are logged into LIMS via bar code scanning or scheduling. Once this is done, a unique sample number, which can be used as a tracking or reference number as part of the ISO 17025 standards, is assigned to it. A bar-coded label containing this number is attached to the sample bottle, and this is used in the laboratories for label scanning. Receiving, logging, bar-coding and distributing of samples is undertaken at our centralised Sample Receiving Area.

#### **Analysing and receiving of samples into the laboratory**

Samples are scanned into the various laboratories for traceability purposes, so as to define their exact location. Afterwards, laboratory technicians create work batches in LIMS which batch the samples according to preset requirements e.g. grouping samples of the same product type together in a pre-determined sequence. After completing analysis according to strict ISO 17025 requirements, the results are either manually entered into LIMS or exported directly from the laboratory instruments into the system.

#### **Authorising of samples**

Sample results are authorised by senior laboratory staff who evaluate the data against the prescribed specifications as set in LIMS. The results are then either approved for reporting purposes or rejected for further processing.

#### **Interfacing handheld units with LIMS**



Handheld units with built-in GPS functionality have been interfaced with LIMS, assisting internal samplers in the sampling of water samples and capturing exact sampling information i.e. name of sampler, sampling route, sampling time, kilometres travelled, field tests performed and any other observations made at the sampling points. This data forms a vital part in the overall sample data and ensures that samples are taken at the correct sampling sites.

### **Scanning of samples into LIMS**

Barcode scanners have been configured to allow for scanning of samples at various stages in the sample lifecycle in LIMS, e.g. logging of samples, receiving of samples into the various laboratories, inputting samples on the instrument benches, etc. and therefore improving on sample lifecycle turn-around time.

### **Interfacing laboratory instruments with LIMS**

14 laboratory instruments have been directly interfaced with LIMS, eliminating the need for result entries by users and thereby avoiding errors, improving on sample turn-around time, and storing of instrument output file records for ISO 17025 requirements.

### **Interfacing LIMS with various other systems**

LIMS has been interfaced with various other information management systems e.g. Departmental Information Management System (DIMs) which is an internal management tool, Blue Drop System (National Department of Water & Sanitation) and Green Drop System (National Department of Water & Sanitation). This has drastically improved the ability to transfer data between the different information management systems and enables a high level of data integrity to be maintained. Interfacing LIMS with these information management systems enables water quality data on management levels to be displayed. Interfacing the various information management systems has also improved the turn-around time in publishing the water quality data on the Department of Water & Sanitation's website.

### **Information and communication upgrade**

Besides the laboratory information management system, we have also upgraded our network infrastructure, hardware and software requirements e.g. we have installed additional network points, bar-code scanners, label printers and anti-virus software on instrument computers.

### **Outputs of the information management system**

Various reports which display water quality data to internal and external clients have been configured in LIMS. These range from simple to complicated and are either generated manually i.e. user input driven, or automatically i.e. no user input required.

They are produced on specific days and times. These reports have been configured inline with ISO 17025 accreditation requirements, covering all aspects of traceability, accountability, analysis methods, measurement of uncertainty and uniformity.

### **Future enhancements of the information management system**

- A statistical package will be interfaced with LIMS which will present water quality data statistically and expand on the interpretation of outliers, charting, repeatability, reproducibility, the analysis of variances, multiple comparisons of data, multiple linear regressions, distribution fittings and other statistical models. The software package is able to provide comprehensive statistical analyses and can link up to the branch's existing information management system and can work in situ (on site) or allow for the import of data from existing information systems into the statistical software.
- Liquid Crystal Display (LCD) computer screens linked to LIMS will be installed in all the Laboratories at Scientific Services, providing clear visualisation of dynamic data in the system and allowing necessary staff to react on bottle necks, urgent samples and other problem areas within the sample lifecycle promptly and therefore advancing on the reporting of the water quality data.
- Additional barcode scanners and zebra printers will be purchased and connected to the information management system. This will drastically improve the turn-around time in the sample lifecycle, as sample bottles will be scanned in faster and by various staff.
- The information management system will be upgraded to the latest version, allowing for more advanced functionality in the database and improved functionality on current applications.

### **Achievements using the Information Management System**

A variety of achievements using LIMS have been accomplished, ranging from change management at Scientific Services to productivity enhancements, to attaining Prestige Awards.

- **Change management:** When changing to the new Information Management System, different changes in work ethics, work processes and staff's approach to the relationship between the overall sample lifecycle and the Information Management System had to be altered. In-house awareness and training sessions were held which assisted staff with this adjustment. When the advantages of the System were outlined and personally experienced, the System was effortlessly accepted. Continuous improvements or suggestions are persistently encouraged by staff, making accepting changes less troublesome.
- **Productivity improvement:** The number of samples received after 2007 has increased drastically due to automation, workflows enhancements and interfaces using the same number of staff prior to 2007. This led to business

expansion in the analysis of crucial parameters in water and growth in revenue recovery for services rendered. Suspicious results are followed up proactively and necessary actions are taken before client intervention is required. Due to automation and instrument interfacing, results are more frequently and correctly transferred to LIMS, leading to increased proficiency and customer satisfaction.

- **Integration of ISO 17025 requirements:** The Information Management System has been configured inline with the requirements of ISO 17025 which focuses on the competencies of Analytical Laboratories and the traceability of data. Achieving this status will directly influence the credibility of Scientific Services and inflate business development.

## **AIR QUALITY MONITORING LABORATORY**

Air pollution is the accumulation of various substances such as gases, dust particles, odour, and smoke in ambient air. These substances contain pollutants such as SO<sub>2</sub>, NO<sub>2</sub>, CO, H<sub>2</sub>S, O<sub>3</sub>, PM<sub>10</sub> and VOCs (Volatile Organic Carbons). These pollutants have been identified as "criteria" pollutants in the National Environmental Management: Air Quality Act, 39 of 2004 (NEM:AQA) and the City of Cape Town's Air Quality Management Plan (2005).

The NEM:AQA defines the limit values for these criteria pollutants. These are known as the South African National Ambient Air Quality Standards. When pollutants exceed set limits, it could have adverse impacts on our health and well-being, as well as plant and animal life and the environment.

Measuring and monitoring the quality of the air we breathe is important to:

- provide a scientific basis for management and control of air pollution;
- determine if air quality health standards are met; and
- provide the public with ambient air quality information.

The information below covers the following:

- Where and how air pollution is measured?
- The quality of air in the city
- Data analysis and evaluation
- Long term trends
- Climate change

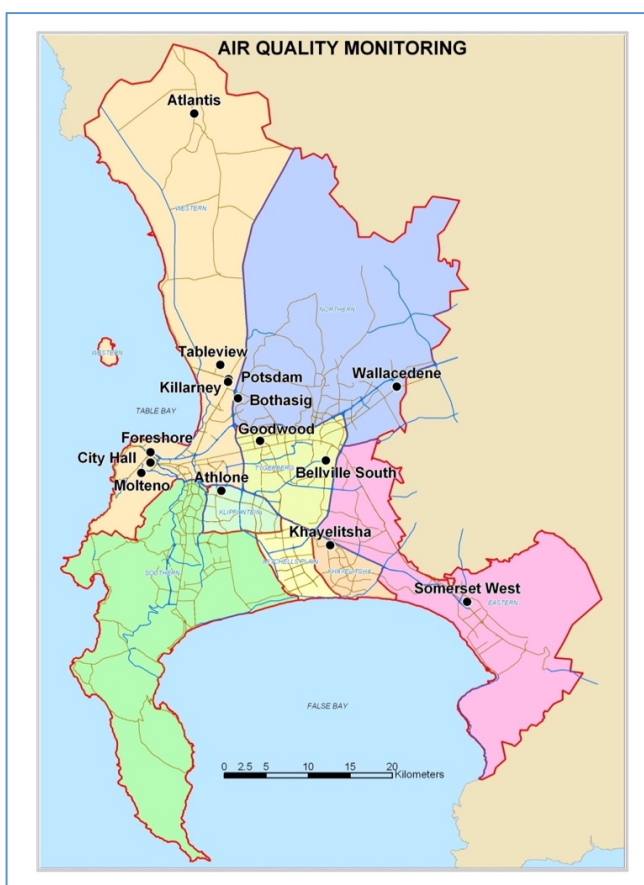
### **Where and how is air pollution measured?**

The Air Quality Laboratory of Scientific Services Branch is responsible for monitoring the air quality in the City of Cape Town.

During the 1960's the occurrence of "Black Smog", mainly as a result of pollution from coal and oil burning sources, necessitated the commissioning of a number of monitoring stations to determine concentrations of Sulphur Dioxide (SO<sub>2</sub>) and black smoke.

In the early 1970s, automated equipment was used to monitor the air. In 1984, state of the art analysers that continuously monitor the air were installed. Since then, the City's Air Quality Monitoring (AQM) network has evolved and expanded to fourteen ambient air quality monitoring stations within the City of Cape Town Metropolitan area.

You can see a map of the Air Quality Monitoring network below:



Air pollution instruments are housed in weatherproof housing units called monitoring stations. A monitoring station can be thought of as a self-contained field laboratory.

Air is continuously drawn from outside the station and is sampled by the instruments. Sulphur dioxide (SO<sub>2</sub>), oxides of nitrogen (NO<sub>x</sub>), ozone (O<sub>3</sub>), carbon monoxide (CO), hydrogen sulphide (H<sub>2</sub>S) and particulate matter 10 and 2,5 microns in size (PM<sub>10,2.5</sub>) is measured every 10 seconds using US EPA approved methods. At each site, the data is

stored on a Data Acquisition System (DAS) that is responsible for storing, pre-validation and transferring this data onto the main server.

The AQM Laboratory of Scientific Services is responsible for the installation, repairs, maintenance and calibration of these sophisticated analysers by following ISO 17025 standards. The laboratory is currently in the process of working towards being SANAS accredited.

### **The quality of air in Cape Town**

The quality of the city's air is significantly affected by meteorological conditions such as wind, cloud cover, rain and temperature.

Under stable atmospheric conditions with low-level temperature inversions, a visible brown haze hangs over the city, spoiling exciting vistas of mountain ranges and sea views. This haze occurs mainly from March to September, but of recent, has extended into the summer months as well.

Sources of pollution in Cape Town are emissions from transport, industrial processes, waste disposal, wild fires, and fuel burning from domestic cooking and heating.

### **Pollutants may be referred to as primary or secondary.**

- **Primary pollutants** are emitted directly into the atmosphere from identified sources such as transportation, industrial processes, fuel or solid waste disposal and tend to be highest around the sources, e.g. SO<sub>2</sub>, NO<sub>x</sub>, CO, H<sub>2</sub>S, PM<sub>10,2.5</sub>
- **Secondary pollutants** are formed by chemical reactions in the atmosphere among the primary pollutants. They are strongly influenced by meteorology and atmospheric chemistry, e.g. O<sub>3</sub>, NO<sub>2</sub>

### **Data collection, analysis and reporting**

Air quality is monitored using the specialised ENVISTA Air Quality Monitoring System (AQMS). Data is transmitted in real-time from the monitoring stations to the AQMS Server hosted at Scientific Services Athlone via mobile communication.

The air quality staff using the AQMS correct, edit and validate air quality monitoring data for reporting and assess if the pollutants are within limits prescribed in the NEM:AQA.

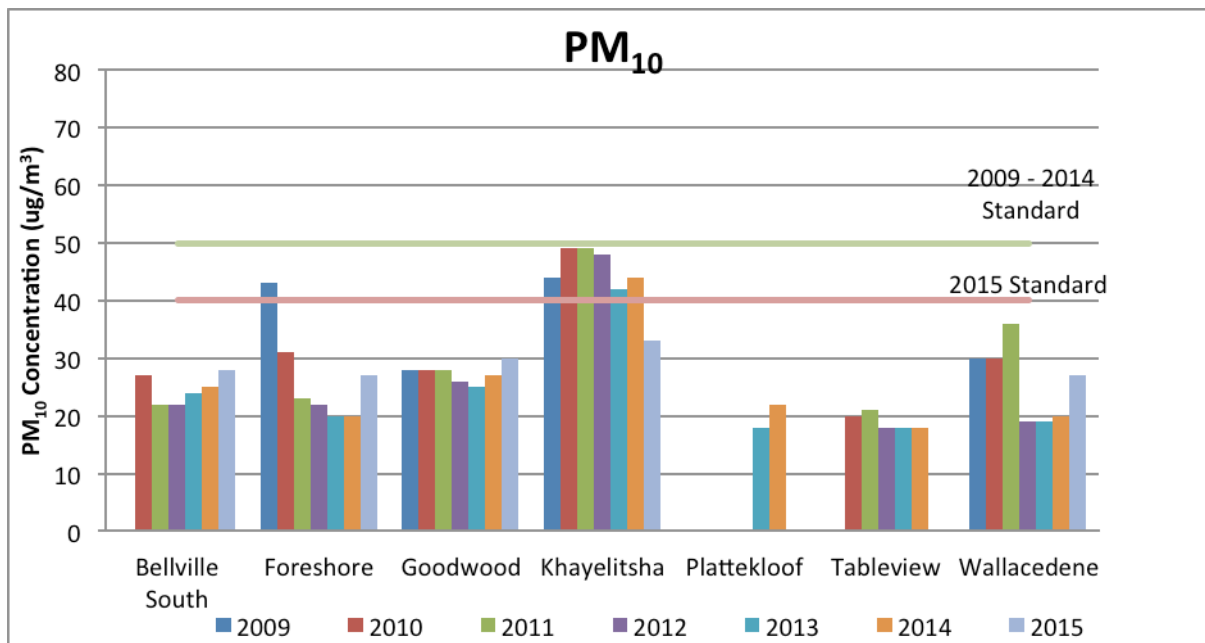
Monthly reports are generated for City of Cape Town's Specialised Health Department to enforce legislative requirements, and special reports are made available to clients and the general public.

The information is reported on the [City's Open Data Portal](#)

## Long-term trends

Concentrations of air pollutants in the atmosphere can vary over the course of a day, seasons and from year to year.

Seasonal variations show certain pollutant peaks during winter e.g. PM<sub>10</sub> and CO, while other pollutants peak in summer e.g. O<sub>3</sub> peaks in summer. The annual trend indicates that overall levels of air pollution are decreasing although the nature of air pollution events are more severe and often fall into the “Top10” category of the highest concentrations of pollutant levels monitored in the last ten years.



**Figure 2:** Annual PM<sub>10</sub> concentrations in the City of Cape Town

The information from the AQM Network feeds into the City’s “Air Quality Management Plan”.

The City aims to “be the city with the cleanest air in Africa”. Short, medium and long-term strategies for improving air quality over the entire region have been identified and are currently being addressed. One of the City’s primary objectives is to reduce the health effects of poor air quality on residents.

## Climate change

It is predicted that Cape Town will face some degree of climate change in the 2030 to 2045 period.

A number of stress factors have been identified in this regard:

- Increase in annual average temperature (1°C by 2050 & between 3°C - 5 °C by 2100)
- Increase in frequency and intensity of extreme events
- Increase in conditions conducive to wildfires (higher temperatures and increased wind velocity)
- Reduced rainfall
- Decrease in water resources
- Reduced soil moisture
- Temperature impact on crop activities

The two key ways to respond to climate change is through:

- mitigation (the reduction of the intensity of climate change effects by reducing greenhouse gases); and
- adaption (recognising the effects of climate change and adapting to these changed conditions).

The AQM Laboratory has responded to climate change by providing input on various climate change working documents and establish linkages between the projects undertaken in various departments and the role of Scientific Services.

Analysis of air quality data related to climate change can be used to inform the planning and implementation of various interventions. The AQM Laboratory is developing a monitoring and evaluation strategy for the monitoring of climate change impacts.

## **ANALYTICAL LABORATORY**

The Analytical Laboratory performs routine analyses for monitoring purposes on water from a range of sources, including wastewater treatment plants (WWTP), industries, landfills, catchments, dams and composting plants.

Our clients include City of Cape Town departments such as Wastewater, Water Demand Management and Solid Waste as well as other internal and external clients.

### **Wastewater**

Samples from 26 wastewater treatment plants in Cape Town are taken by the Wastewater Treatment Plant (WWTP) staff and submitted to the Laboratory for testing. Samples are analysed on a weekly basis for chemical and physical determinants. Heavy metals and fluorides are determined once a month. CN and Phenol levels are determined as well.

The weekly chemical determinants include the following:

- pH and conductivity
- Chemical oxygen demand
- Ammonia
- Nitrate/nitrite
- Total Kjeldahl nitrogen
- Total phosphorous
- Ortho phosphate
- Chloride
- Alkalinity

Our weekly physical analysis includes the following:

- Settleable solids
- Total suspended and volatile solids
- Solids on sludges

We also check these heavy metals:

- Aluminium
- Arsenic
- Cadmium
- Cobalt
- Chromium
- Copper
- Iron
- Manganese
- Molybdenum
- Nickel
- Lead
- Selenium
- Strontium
- Vanadium
- Zinc
- Calcium
- Magnesium
- Sodium
- Potassium
- Boron
- Sulphate



- Mercury

Samples are taken at various stages of the biological treatment process, starting with the raw influent wastewater and ending with the final effluent that is discharged into the river. The results are reported to the Wastewater Department on a weekly basis and are used in the operations of the WWTPs.

Monitoring of WWTPs' performance is important as it gives us an indication of the effluent quality that is discharged into our environment and an indication as to what extent the environment is being polluted. The Department of Water Affairs has general standards for wastewater final effluent and the percentage of compliance for each WWTP is assessed by DWA every 18 months as part of their Green Drop Certification audit.

Analyses are performed by qualified technicians and support staff that ensure that ISO 17025 requirements are met. Sophisticated equipment is employed in order to minimise errors and to improve on the testing turn-around time.

### **Industries**

More than 300 industries throughout the Cape metropole are regularly sampled. Each industry is sampled four times in a six month cycle as per the Wastewater By-law using our internal samplers. Monitoring industries is essential to prevent harmful substances entering the sewer system and negatively affecting the operation of the WWTW. All the sampling points are evaluated by Water Pollution Control Inspectors who then issue penalties for samples that are non-compliant according to the By-law. On site tests performed are pH and temperature.

The routine chemical determinants include:

- pH and conductivity; and
- COD.

Other routine determinants which are industry specific are:

- cyanide;
- chloride;
- cadmium;
- chromium;
- copper;
- iron;
- zinc; and
- lead.

## **Landfill sites**

There are six landfill sites in the Cape metropole which are also regularly monitored. Three of these are active. Boreholes in the vicinity of the sites are sampled to monitor groundwater and leachates samples are taken to determine pollution levels. Monitoring of a landfill site continues even if the site is closed for dumping.

The determinants include the following:

- pH and conductivity
- Chemical oxygen demand
- Ammonia
- Nitrate/nitrite
- Ortho phosphate
- Chloride
- Alkalinity
- Fluoride
- Cyanide
- Phenol
- Total suspended solids
- BOD
- Potassium
- Sulphate
- Sodium
- Copper
- Calcium
- Manganese
- Magnesium
- Chromium
- Cadmium
- Lead
- Mercury
- Arsenic
- Boron

## **Catchments**

More than 100 river, canal and vlei (shallow lakes) points are monitored across the Cape metropole. Samplers do monthly routine visits to all these points, recording temperatures and dissolved oxygen on site, and collecting chemical and bacteriological samples. The Analytical Laboratory performs the chemical analysis on these samples and reports it to the Bacteriological Section, which then reports to their clients.

The routine determinants analysed by the Analytical Laboratory include:

- pH, and conductivity;
- chemical oxygen demand;
- ammonia;
- nitrate/nitrite;
- total phosphorous;
- ortho phosphate;
- total persulphate oxidisable nitrogen; and
- total suspended solids.

### **Instrumentation**

Analyses are performed by qualified technicians and support staff that ensure that ISO 17025 requirements are met. Sophisticated equipment is employed in order to minimise errors and also to improve on testing turn-around time.

Instruments include:

- Lachat Flow Injection Analyser;
- Aquakem Discreet Analyser;
- ICP;
- Tiamo; and
- Direct Mercury Analyser.

## **BIOLOGICAL SCIENCES LABORATORY**

The Biological Sciences Laboratory performs routine microbiological and hydrobiological analyses for monitoring purposes on water from a range of sources, including e.g. drinking water (including springs and boreholes), wastewater effluents, municipal swimming pools, and environmental waters like rivers and wetlands.

### **Microbiology**

Various microbial tests for E.coli and fecal coliforms are performed on all types of water. Strict guidelines are adhered to during the analysis to ensure that public safety is always a priority.

### **Hydrobiology**

The Hydrobiology sub-section focuses on ecotoxicity, algal analysis and biomonitoring of surface water including river health assessment. Hydrobiology sub-section also assists with incidents investigations such as fish kills and algal blooms.

## **RESEARCH AND DEVELOPMENT SECTION**

The Section is responsible for:

- undertaking specialised Water and Sanitation research and development projects;
- contributing to Water Safety Plan to ensure monitoring compliance as required by Water Safety Plan and regulatory body;
- coordinating scientific activities associated with the Blue Drop and Green Drop audit assessment processes;
- coordinating Asset and Risk Management Registers for the Branch;
- strategic and scientific data management;
- collaborating with academia, research institute, water and environmental sector stakeholders in order to ensure business improvement as informed by research findings;
- managing the branch's Graduate Internship/Training Programme to build talent pool for scarce skills; and
- ensuring continued improvement on operational activities.