



GROUP

**BIOMONITORING
OF RIVERS AND
BIODIVERSITY**

FACT SHEET 2019

Sibanye-Stillwater is actively involved in monitoring the health of rivers and protecting biodiversity vulnerable to various land uses, including actively involved in protecting the biodiversity and in monitoring the health of mining, within its areas of operation in South Africa and the United States (US).

“The external biomonitoring performed at Sibanye-Stillwater is carefully planned and reviewed by an in-house specialist to ensure representative results and proactive management.”



Biomonitoring involves the measurement of biological indicators to assess the condition of rivers. This includes evaluating the physical features of a river, such as water quality, quantity and habitat. Biological indices are used to assign classes and categories in order to describe the state of the river reaches. The rationale for biomonitoring to determine the state of river systems is based on differences in tolerance levels that various taxonomic groups of organisms (taxa: the classification of organisms into ranks in terms of their identifying features) have on the physical and chemical properties of a freshwater system. Taxa will occur according to their tolerances and preferences in various water qualities, quantities and habitats.

Biomonitoring is a legal requirement in South Africa for all water use licences granted by the Department of Water and Sanitation to our mining operations. In the US, biomonitoring is a legal requirement of the Mine operating permits that are administered by the Montana Department of Environmental Quality and the United States Forest Service.

Sibanye-Stillwater uses biomonitoring to investigate the state of rivers during high-

flow and low-flow seasons. The purpose is to assess the variation in taxa assemblages (the combination of various types of organisms occurring within the study area) in the different hydrological periods when there is rain or drought. Assemblages vary due to the seasonal cues related to rainfall, runoff, plant growth and temperature. Multiple indicators of freshwater health are analysed to determine site-specific and catchment-based variations in species composition of aquatic organisms, as well as changes in habitat suitability, during seasonal changes in flow. Variations in water quality and quantity are assessed concurrently to aid interpretation of the results. Biomonitoring enables us to assess long-term trends and attribute changes in the environment to water quality or non-water quality related variables.

The external biomonitoring performed at Sibanye-Stillwater is carefully planned and reviewed by an in-house specialist to ensure representative results and proactive management. The synergies in biomonitoring across our SA operations have been further investigated and will continue to be enhanced into 2020 for the new operations that have been acquired.



■ *Palpopleura deceptor*

Similarly, our US operations use multimetric indices, based on the aquatic macroinvertebrates and diatom assemblages. This is similar to the monitoring conducted in the SA operations although each country uses bespoke indices. The indices are nevertheless based on the same principles and outcomes described above. Our US operations also make use of chlorophyll-a monitoring – another commonly used measure of water quality. The concentration of chlorophyll-a is a direct indication of the abundance of algae and productivity in aquatic environments. Higher concentrations typically indicate poorer water quality related to high nutrient concentrations. In Montana, the Department of Environmental Quality has established a nuisance threshold level of 125mg/m² for chlorophyll-a. This provides an indication of the level of eutrophication (excessive nutrients) in the river system.

Similar to our SA operations, the US operations' catchment-based monitoring efforts include bio-assessment monitoring and water chemistry monitoring. The purpose of sample collection and consequent study of bio-assessment results and interpretations is to determine whether Sibanye-Stillwater's activities have impacted the ecology of the Stillwater and East Boulder Rivers. The benthic invertebrate and periphyton assemblages reflect the ecological health of a stream based upon the abundance and community structure of these aquatic insects and algae, which are critical parts of the stream's food web. Monitoring evaluates spatial and temporal changes in the abundance and community structure of these aquatic insects and algae.

During bio-assessment monitoring, a representative sample is collected over selected stream reaches. The presence or absence of certain indicator species in that sample provides indices of stream quality along that reach. Since the ecological tolerances for many macroinvertebrate and periphyton species are known, changes in community composition can be used to diagnose the environmental stressors that affect ecological health and assess biotic integrity.

BIOMONITORING PROCESS

Site selection is based on

- Water use assessment
- Presence of suitable sampling habitat
- Good representation of entire river
- Availability of historic data

Water quality monitoring

Hand-held water quality meters are used for on-site monitoring of pH (acidity or alkalinity of water), conductivity, dissolved oxygen and total dissolved solids

Water samples are taken for laboratory analysis of salts, nutrients and metals in line with the requirements of the Department of Water and Sanitation

Habitat monitoring

- Assessment of the suitability of invertebrate habitats includes site-specific monitoring of biotopes:
 - stones
 - vegetation
 - gravel
 - sand
 - mud
- Reach-based assessments of the state of riparian and instream habitats

Aquatic macroinvertebrate and periphyton monitoring

- Site-specific assessment of macroinvertebrate assemblage by sampling biotopes (as defined above)
- Reach-based assessment of macroinvertebrates based on site-specific data
- Periphyton monitoring is conducted in the US operations using the composition of microalgae taxa (diatoms) found on substrate in various sites



■ *Pseudagrion subfactum*

“Biomonitoring enables us to assess long-term trends and attribute changes in the environment to water quality or non-water quality related variables.”

KEY FINDINGS

US PGM OPERATIONS

The Montana Valley and Foothill Prairie score of 83 for the Stillwater River near the Stillwater mine represents the impairment threshold for the montane and foothill regions of Western Montana. At SMC-J, scores were mostly below the impairment threshold between 2008 and 2015, exhibiting considerable vacillation at SMC-J. However, from 2016 until 2018, scores varied little and were clustered around the impairment threshold, with slight improvements in 2019. At SMC-2, scores vacillated around the impairment threshold from 1998 until 2011. After 2011, scores declined dramatically and then recovered somewhat in 2017 and 2018 although it remained below the impairment threshold. In 2019, the scores slightly improved. There was a decline at site SMC-11 in scores from 1998 to 2016. Since 2014, scores have been below the impairment threshold with a slight increase in 2017, 2018, and 2019. However, the algal data does not support nutrient enrichment at any of these sites. The habitat conditions are undisrupted at all Stillwater River sites. Metals contamination was not evident at any site.

For more detail on biomonitoring at our US PGM operations, refer to page 15.

SA OPERATIONS

Version 5 of the South African Scoring System (SASS) methodology, used for rapid assessment of invertebrates in rivers to assist in monitoring the health of the systems, is used at our SA operations to determine the taxonomic community composition of macroinvertebrate aquatic organisms.

A class can be determined for each river site based on the tolerances to water quality and habitat changes of the macroinvertebrate families found in the river systems. These classes, ranging from A to E/F, indicate the condition of the river system from pristine to severely impacted. Similarly, the Macroinvertebrate Response Assessment Index (MIRAI), the method used for more in-depth interpretation of the health of a river system, based on the invertebrate community, determines similar classes for larger catchment areas as applied at the SA operations.

The SA operations showed a concerning trend across platinum and gold in terms of the consistent pollution caused by partially and untreated municipal sewage discharges in river reaches where communities are located. Only streams for which Sibanye-Stillwater is

the source, or only have limited agricultural activities occurring within them, showed tolerable conditions. Sibanye-Stillwater has implemented the following initiatives to try and help resolve these challenges:

1. raising these concerns at numerous catchment management forums
2. presenting and educating Government and other stakeholders on the concerns
3. providing municipalities with guidance whenever requested on treatment solutions
4. conducting investigations and presenting specialist findings on the ongoing Vaal River pollution to the South African Human Rights Commission as well as other stakeholders and organisations

As a result, some actions have been taken by Government, however these remain limited and the situation continues to deteriorate.

The promulgated Resource Quality Objectives (the biological condition in which a system should be maintained for the protection of the water resource and water users – defined as numerical limits or classes) for the Upper Vaal recommend that MIRAI category D is maintained for most of the river reaches around Sibanye-Stillwater's SA gold operations. Most of the river reaches satisfy the MIRAI category D requirement with the exception of the Upper Wonderfonteinsspruit at Cooke. The Bloubankspruit (added to monitoring programme in 2019 for the Millsite Activities) at Cooke, the Klein Wes Rietspruit at Ezulwini, the Lower Wonderfonteinsspruit and the Kraalkopspruit at Driefontein showed borderline D/E categories.

The Upper Wonderfonteinsspruit and Bloubankspruit were found to be impacted significantly by inappropriate sanitation schemes leading to the raw and partially treated discharge of sewage into these systems. Further to this, several instances of unauthorised mining (unrelated to Sibanye-Stillwater) were noted within the streams leading to water quality and habitat impacts. The Klein Wes Rietspruit has shown improvements as noted in the previous 2018 annual report, improving from a category E to a category D/E, thus bordering on the required class. Continued improvement is expected, however sustainably maintaining a category D or better will be dependent on the management of habitat drivers in particular, both related and unrelated to the mining operations. The Kraalkopspruit remained the same as per the previous reporting period and is largely influenced by non-mining related impacts particularly due to flow alterations as

a result of impoundments. Finally, the Lower Wonderfonteinsspruit showed a deterioration from the 2018 reporting period due to the lack of flow as a result of the vandalism of the 1m pipeline used to convey water between the upstream and downstream catchment as well as impacts noted from sewage inputs.

The resource quality objectives for our SA PGM operations in the Crocodile catchment were promulgated on the 18 October 2019. The resource quality objectives have been set for the Hex River as a category D at the Kroondal and Rustenburg operations, for the Sterkstroom as a category C at the Aquarius and Marikana operations, and for the Kareespruit as a category C/D for the remainder of the Marikana operations. The Marikana operations have only recently been integrated into Sibanye-Stillwater and therefore have not undertaken the MIRAI assessments in order to determine the categories in compliance to the Resource Quality Objectives. In terms of the Rustenburg operations for the Hex River downstream of the Kroondal operation as well as the Dorpspruit, it can be noted that the resource quality objectives were not met due to low flow. The Sterkstroom also did not meet the resource quality objective requirements.

The resource quality objectives for the Olifants and Bloed Rivers associated with the Blue Ridge operations have not been set for the reaches potentially influenced by the operations, nevertheless it can be noted that both reaches achieved a category D. It should be noted that the Blue Ridge operations have been on care-and-maintenance for several years.

The graphs and tables (on pages 4 to 13) indicate the SASS 5 results for each of the mine sites in each river reach for the high- and low-flow assessments in 2019.



SA GOLD OPERATIONS

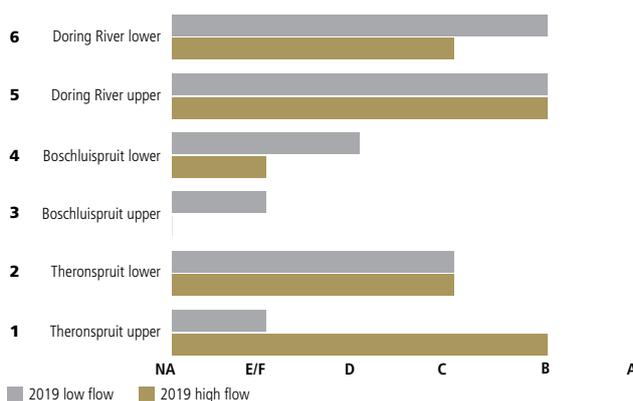
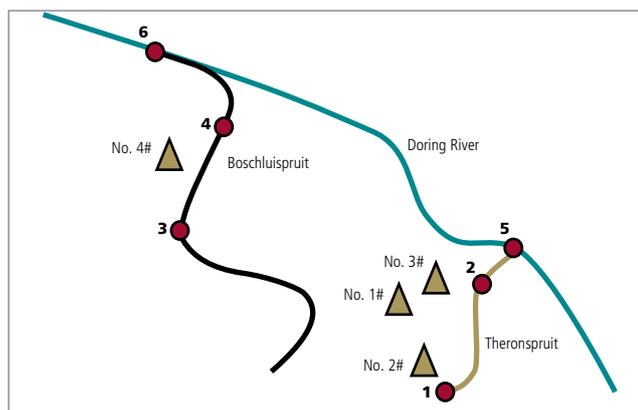
Catchments within our gold operations were affected by various land and water uses that are not limited to mining. The results presented below therefore indicate catchment-wide impacts for the 2019 high- and low-flow cycles.

INTERPRETATION OF BIOMONITORING CLASSES

Class as per index	Interpretation
E/F	Critically modified: The system has been so significantly impacted by human activities that complete deterioration has occurred, the system barely serves its ecological function and recovery will be very difficult to achieve. This is an unacceptable state and no river reach is allowed to fall within this category.
D	Largely modified: Human activities have had a clearly bad impact on the ecosystem and have significantly changed the system. Recovery will be difficult but, if this is acknowledged and the need for economic activities is prioritised, a class D is allowable.
C	Moderately modified: Some ecosystem deterioration has occurred due to anthropogenic activities. It is not significant and has a good chance of recovery.
B	Largely natural: Mostly not impacted by humans (anthropogenic impacts are minimal /acceptable).
A	Natural, unmodified: Not impacted by humans (mostly protected areas in upstream catchments).

DETAILED FINDINGS

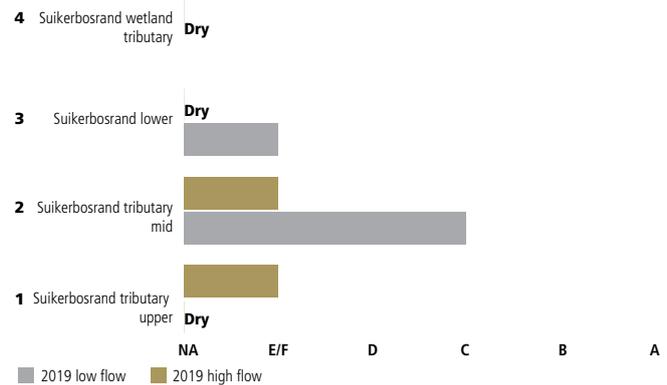
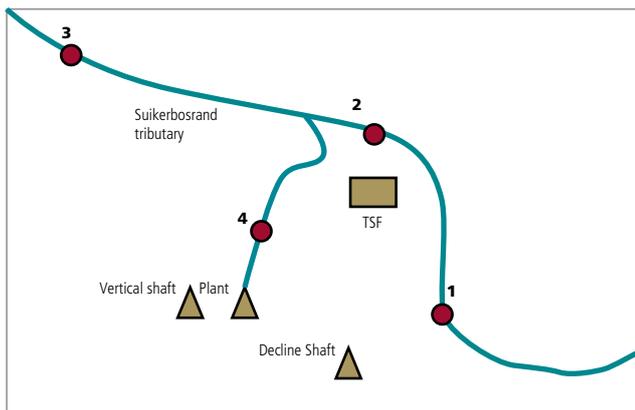
BEATRIX



Catchment	Results	Interpretation
Theronspruit	MIRAI Category: NA* SASS5 Class B to E/F: Largely natural to largely modified	<ul style="list-style-type: none"> wetland characteristics result in decreased habitat availability at upstream site improvement in state of macroinvertebrate community downstream of Beatrix evident during the low flow assessment
Boschluisspruit	MIRAI Category: NA* SASS5 Class D to E/F: Largely modified to critically modified	<ul style="list-style-type: none"> low flow conditions limited ability to sample as well as habitat availability and suitability increased salinity was also noted downstream of the Beatrix operations, likely also as a result of the decreased flow from the upstream catchment, thus reducing dilution within the catchment. Existing monitoring and mitigation measures will continue studies to inform the necessary mitigation measures for the downstream erosion noted have been conducted with implementation of recommendations to occur in 2020
Doring River	MIRAI Category: C (High Flow) SASS5 Class B to C: Largely natural to moderately modified	<ul style="list-style-type: none"> upstream and downstream sites showed consistently good conditions throughout the assessment period

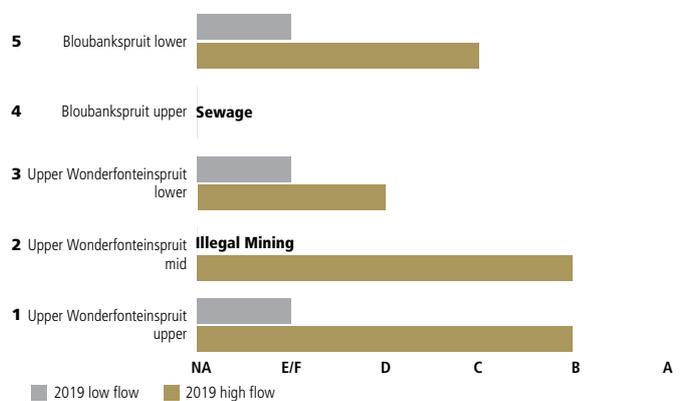
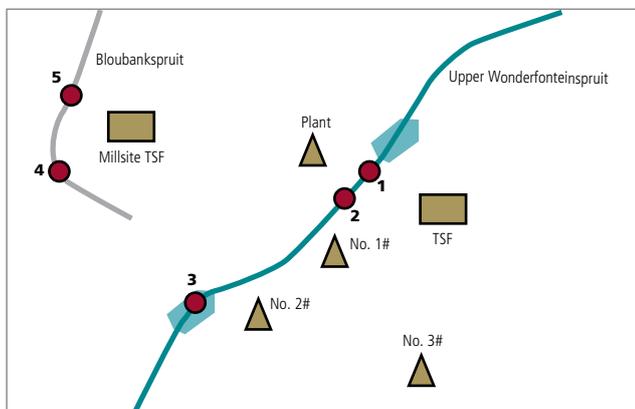
* Not assessed (NA) due to lack of habitat and flow availability and suitability

BURNSTONE



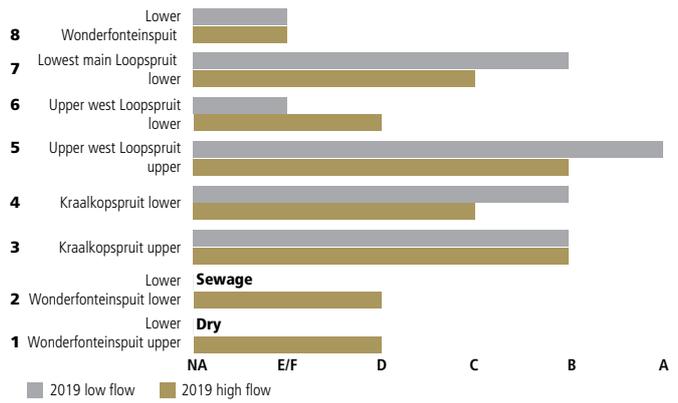
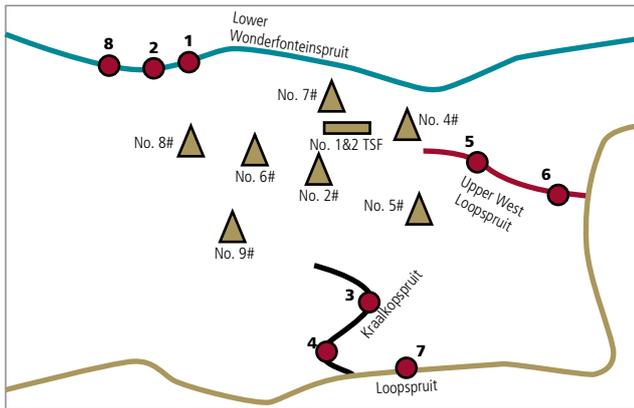
Catchment	Results	Interpretation
Suikerbosrand Tributary	MIRAI Category: D (High Flow) SASS5 Class D to E/F: Largely modified to critically modified	<ul style="list-style-type: none"> no detectable impacts from mining activities besides increased water availability in the system when discharge took place water quality affected by surrounding soils and land use low flow in the system considered to be the major ecological driver resulting in stagnating pools and decreased macroinvertebrate diversity, evident from numerous dry sites noted

COOKE



Catchment	Results	Interpretation
Upper Wonderfonteinspruit	MIRAI Category: E (High Flow) SASS5 Class B to E/F: Largely natural to critically modified	<ul style="list-style-type: none"> water quality severely impacted by municipal sewage, some temporary improvements noted during the high flow survey, hence the improvement in SASS and MIRAI categories as compared to the 2018 assessment period water quality also affected by mine water discharges sampling in the mid reaches not possible during low flow due to illegal activities occurring within the vicinity of the river
Bloubankspruit	MIRAI Category: D/E* SASS5 Class C to E/F: Moderately modified to critically modified	<ul style="list-style-type: none"> upper reaches for both the high and low flow assessments could not be sampled due to municipal sewage discharges, which furthermore impacts upon the downstream site and during low flow periods results in anoxic (oxygen deprived) conditions, thus limiting biodiversity

DRIEFONTEIN



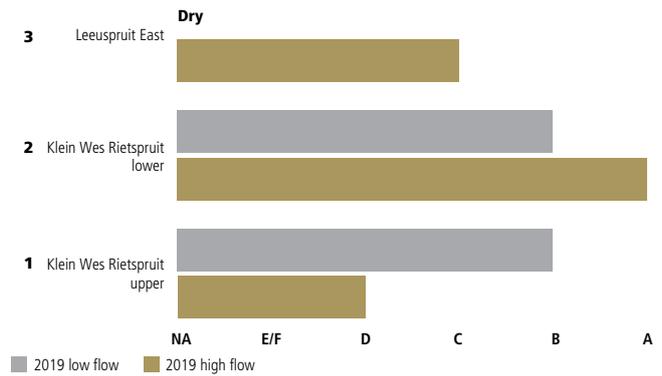
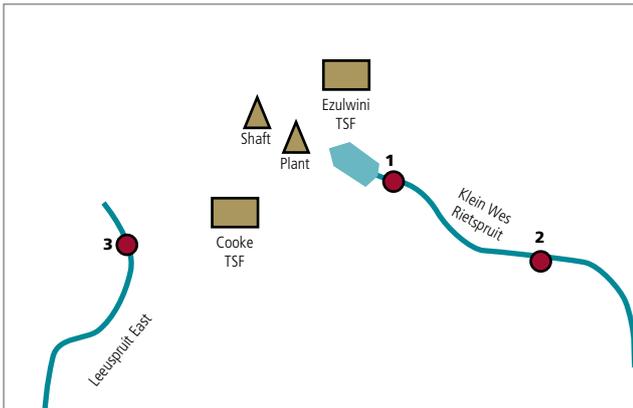
Catchment	Results	Interpretation
Lower Wonderfonteinspruit	MIRAI Category: D/E (High Flow) SASS5 Class D: Largely modified	<ul style="list-style-type: none"> habitat significantly impacted by 1m-diameter pipeline* and channels water quality impacted primarily by sewage inflows and mining discharges no sites were assessed during the low flow due to the vandalism of the 1m-diameter pipeline resulting in significantly reduced flows, and no dilution of municipal sewage discharges
Kraalkopspruit	MIRAI Category: D/E (High Flow) SASS5 Class B to C: Largely natural to moderately modified	<ul style="list-style-type: none"> SASS results show consistent and good conditions. MIRAI remains decreased due to ongoing habitat and flow modifications in the catchment, largely due to impoundments
Upper West Loopspruit	MIRAI Category: C/D (High Flow) SASS5 Class A to E/F: Natural to critically modified	<ul style="list-style-type: none"> reference stream for Upper Vaal sites at Sibanye-Stillwater not affected by mining activities good habitat and water quality at upstream site poor results at downstream site due to limited flow and poor habitat from roads and agricultural activities
Main Loopspruit	MIRAI Category: D SASS5 Class B to C: Largely natural to moderately modified	<ul style="list-style-type: none"> Good habitat Not influenced by Driefontein mining activities

* Well-known historic pipeline in Wonderfonteinspruit installed to prevent flooding of dolomitic areas to enable mining and reduce risk of sinkholes



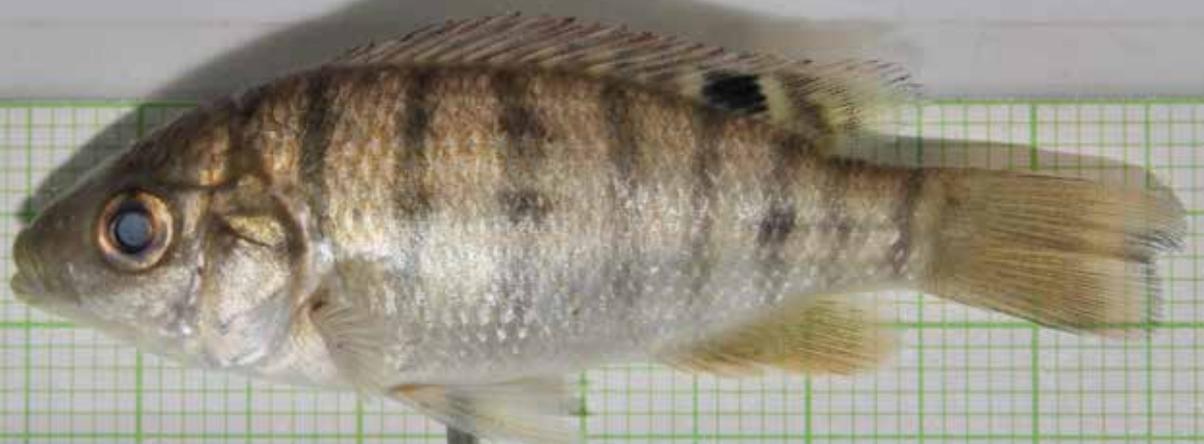
■ *Clarias gariepinus*

EZULWINI



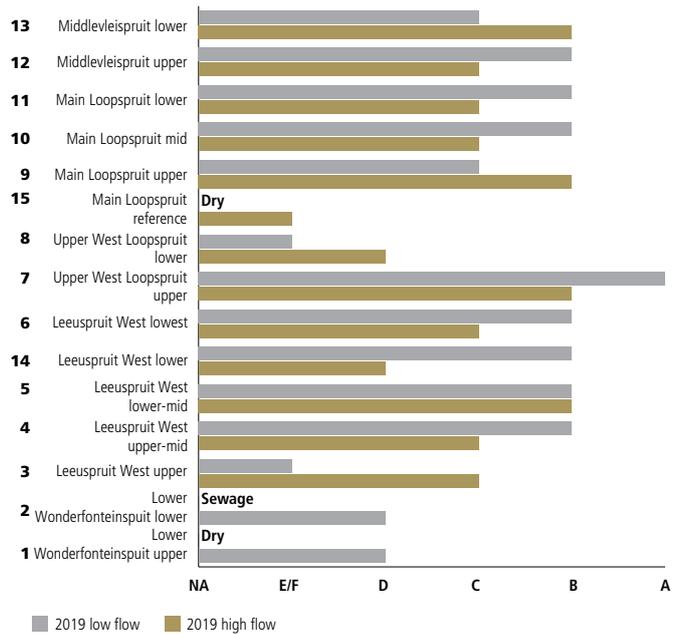
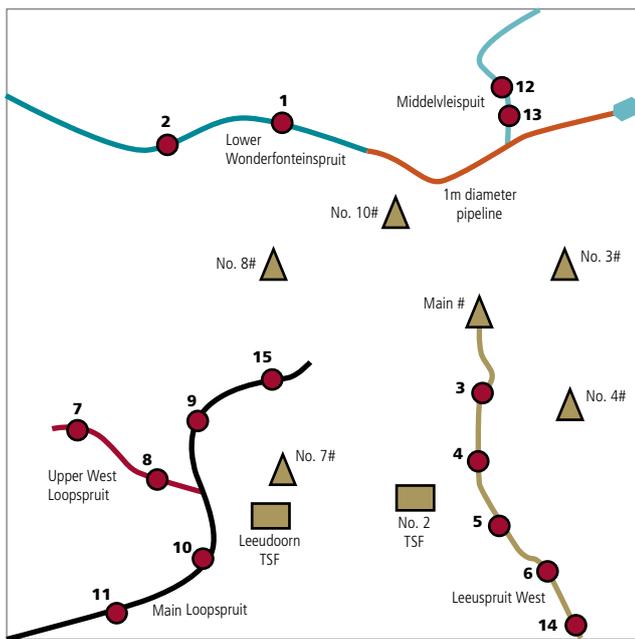
Catchment	Results	Interpretation
Klein Wes Rietspruit	MIRAI Category: D/E (High Flow) SASS5 Class A to D: Natural to largely modified	<ul style="list-style-type: none"> overall good conditions noted with a decline in the class directly downstream of the mine discharges during the high flow assessment, most likely related to high flow conditions resulting in stream bank incision and decreased habitat availability and suitability
Leeuspruit East	MIRAI Category: NA* SASS5 Class C: Moderately modified	<ul style="list-style-type: none"> no discharges from Ezulwini mine into the Leeuspruit East in 2019, however sufficient rainfall allowed for sampling to occur during the high flow assessment

* Not assessed (NA) Insufficient sites and assessment periods to determine MIRAI



■ Oreochromis mossambicus juvenile

KLOOF



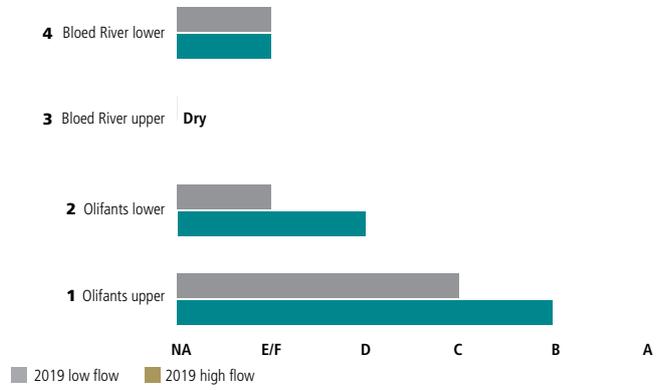
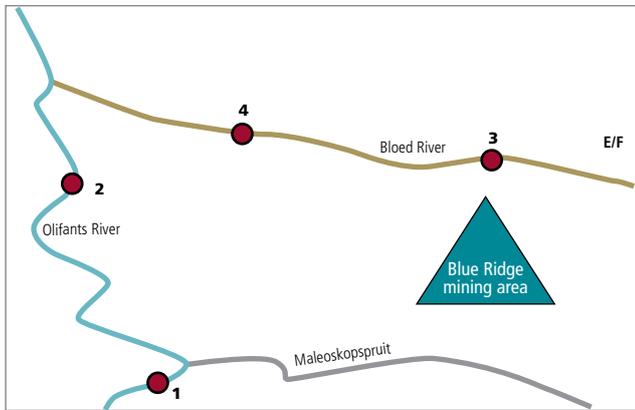
Catchment	Results	Interpretation
Lower Wonderfonteinspruit	MIRAI Category: D/E (High Flow) SASS5 Class D: Largely modified	<ul style="list-style-type: none"> habitat significantly impacted by 1m-diameter pipeline and channels water quality impacted primarily by sewage inflows and mining discharges no sites were assessed during the low flow due to the vandalism of the 1m-diameter pipeline resulting in significantly reduced flows, and no dilution of municipal sewage discharges
Leeuspruit West	MIRAI Category: C/D (High Flow) SASS5 Class B to E/F: Largely natural to critically modified	<ul style="list-style-type: none"> reduction in upstream flows due to improved shaft water management lead to decrease habitat availability and therefore a decrease in the SASS class during the low flow assessment. Not seen as a negative impact as the system would naturally be a wetland without significant surface flows
Upper West Loopspruit	MIRAI Category: C/D (High Flow) SASS5 Class A to E/F: Natural to critically modified	<ul style="list-style-type: none"> reference stream for Upper Vaal sites at Sibanye-Stillwater – not affected by mining activities good habitat and water quality at upstream site poor results at downstream site due to limited flow and poor habitat from roads and agricultural activities
Main Loopspruit	MIRAI Category: D (High Flow) SASS5 Class B to C: Largely natural to moderately modified	<ul style="list-style-type: none"> stream in good condition – impacts mainly nutrient-related as a result of mine sewage discharges and agricultural activities some impact on habitat owing to damming and road crossings recent reports of illegal mining activities in catchment: may result in deterioration in future if not curbed
Middelveispruit	MIRAI Category: D (High Flow) SASS5 Class B to C: Largely natural to moderately modified	<ul style="list-style-type: none"> illegal mining activities in catchment have not been noted during 2019, as compared to 2018, for the reach assessed and, as a result, improved habitat was noted resulting in the improvement of macroinvertebrate diversity

* Well-known historic pipeline in Wonderfonteinspruit installed to prevent flooding of dolomitic areas to enable mining and reduce risk of sinkholes

SA PGM OPERATIONS

The catchments within our SA PGM operations were affected by various land and water uses not limited to mining. The results presented below therefore indicate catchment-wide impacts for the 2019 assessment period.

BLUE RIDGE

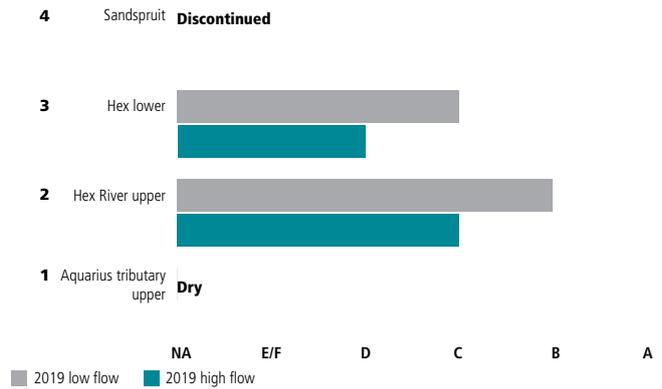
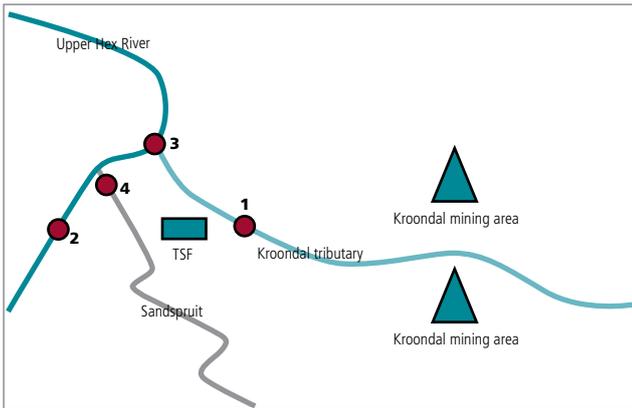


Catchment	Results	Interpretation
Olifants River	MIRAI Category: D SASS5 Class B to E/F: Largely natural to critically modified	<ul style="list-style-type: none"> • good condition • no impact as a result of Blue Ridge on care-and-maintenance
Bloed River	MIRAI Category: D SASS5 Class E/F: Critically modified	<ul style="list-style-type: none"> • due to very low-flow the upstream site could not be sampled and downstream site was a stagnant pool • deteriorated state unrelated to Blue Ridge



■ Black winged stilts (*Himantopus himantopus*) and Glossy Ibis (*Plegadis fakinellus*) along the banks of the Wonderfonteinspruit

KROONDAL

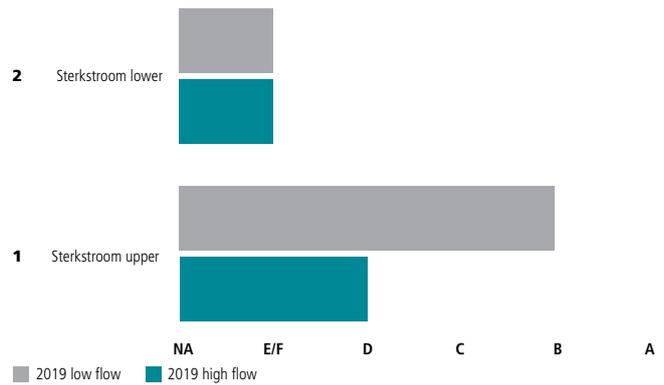
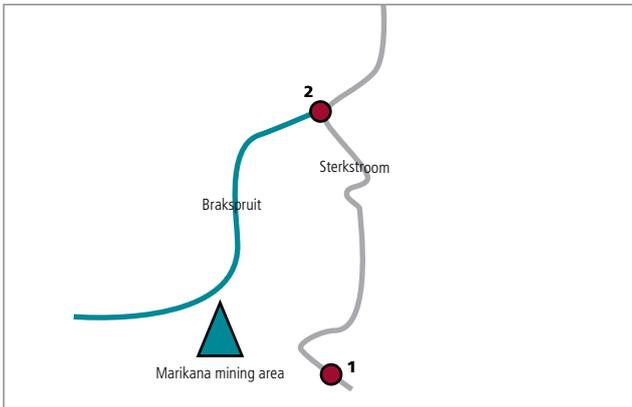


Catchment	Results	Interpretation
Aquarius Tributary	Not assessed - insufficient flow	
Upper Hex River	MIRAI Category: D SASS5 Class B to D: Largely natural to largely modified	<ul style="list-style-type: none"> improved flow likely to be the main reason for improvement noted as compared to the 2018 assessment period further investigation into the potential input of nutrients from the Kroondal operations recommended
Sandspruit	Discontinued as it was found that the stream was unlikely to be impacted by the Kroondal activities as per the catchment characteristics.	



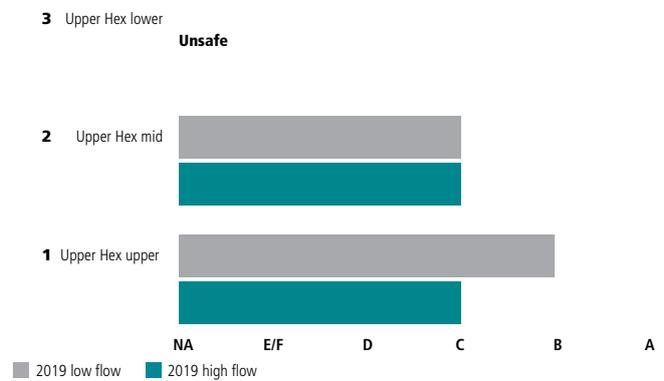
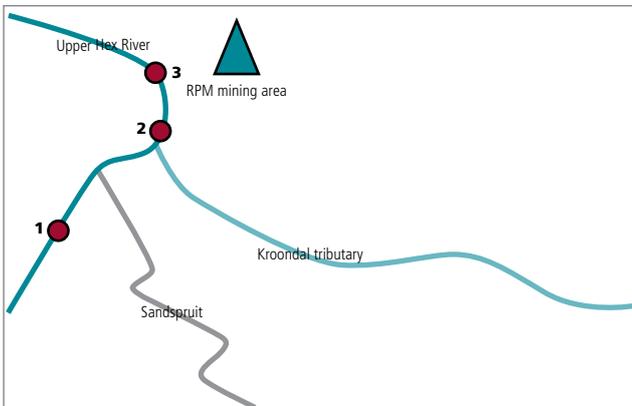
■ *Anax imperator*

MARIKANA



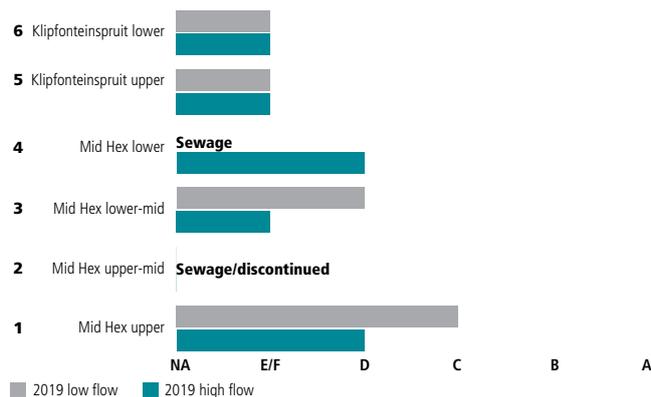
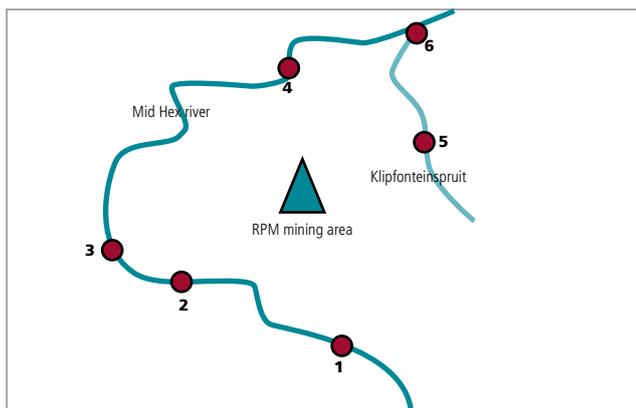
Catchment	Results	Interpretation
Sterkstroom	MIRAI Category: D SASS5 Class B to E/F: Largely natural to critically modified	<ul style="list-style-type: none"> deterioration noted at most downstream site, however clear municipal sewage impacts noted as well as potential influences from overgrazing Marikana mine is unlikely to have had an impact

RPM: UPPER HEX RIVER



Catchment	Results	Interpretation
Upper Hex River	MIRAI Category: D SASS5 Class B to D: Largely natural to largely modified	<ul style="list-style-type: none"> improved flow likely to be the main reason for improvement noted as compared to the 2018 assessment period further investigation into the potential input of nutrients from the Kroondal operations recommended

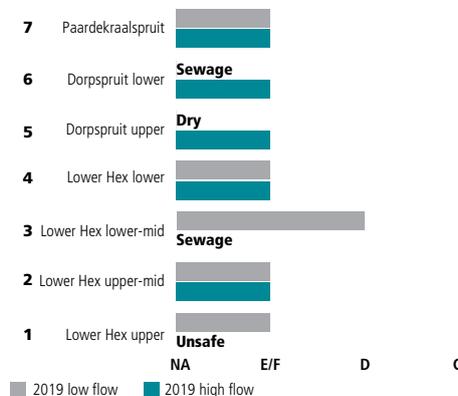
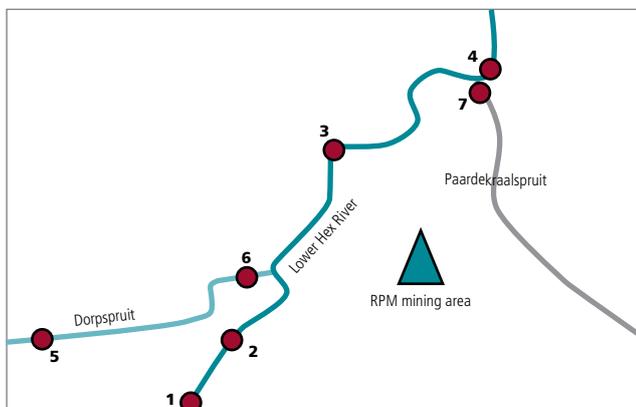
RPM: MID HEX RIVER



Catchment	Results	Interpretation
Mid Hex River	MIRAI Category: E (Mid & Lower Hex River) SASS5 Class C to E/F: Moderately modified to critically modified	<ul style="list-style-type: none"> serious impacts due to municipal sewage discharges, with improvements noted only at the sites directly downstream of Kroondal (upstream of Rustenburg) likely due to dilution from the upstream catchment increased flows in 2019
Klipfonteinspruit	MIRAI Category: NA* SASS5 Class E/F: Critically modified	<ul style="list-style-type: none"> low flow and very limited habitat availability resulted in inability to assess the MIRAI class and low SASS5 classes

* Not assessed (NA) due to lack of habitat and flow availability and suitability

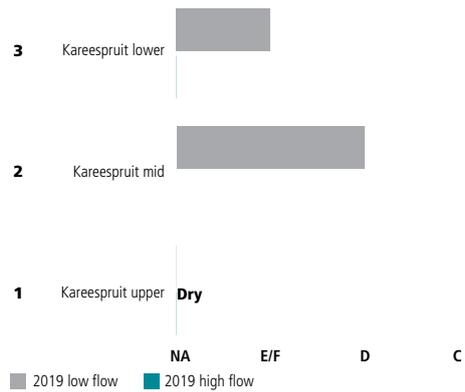
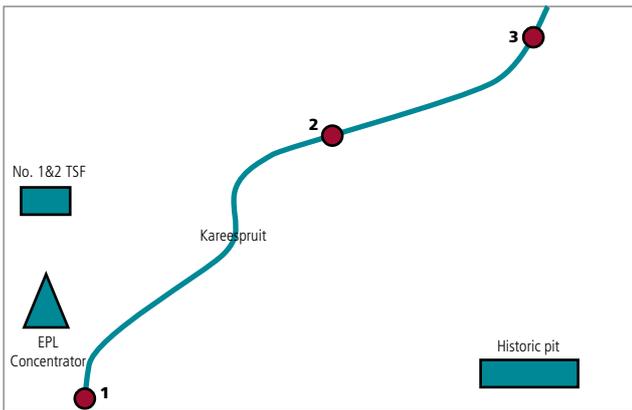
RPM: LOWER HEX RIVER



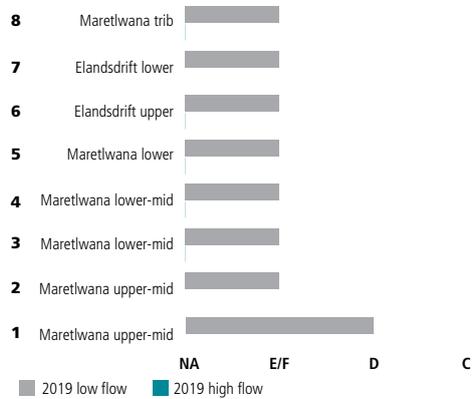
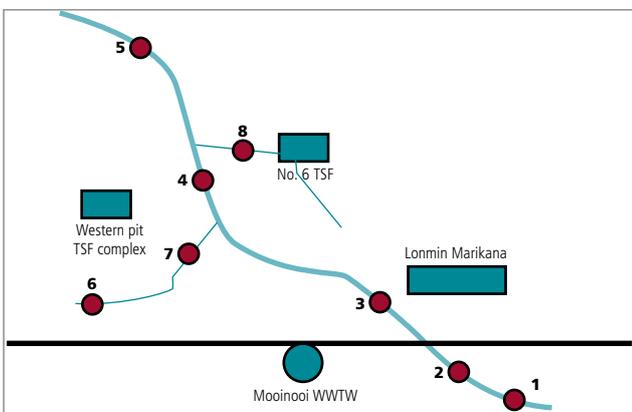
Catchment	Results	Interpretation
Lower Hex River	MIRAI Category: E (Mid & Lower Hex River) SASS5 Class C to E/F: Moderately modified to critically modified	<ul style="list-style-type: none"> serious impacts due to municipal sewage discharges
Dorpspruit	MIRAI Category: E SASS5 Class E/F: Critically modified	<ul style="list-style-type: none"> municipal sewage discharges and low flow conditions attributed for main reasons for unacceptable condition
Paardekraalspruit	MIRAI Category: NA SASS5 Class E/F: Critically modified	<ul style="list-style-type: none"> impacts along stream may be due to mining activities but also attributed to other land-use activities such as livestock, sewage discharges, solid waste disposal and informal/formal settlements

* Not assessed (NA) Insufficient sites and assessment periods to determine MIRAI

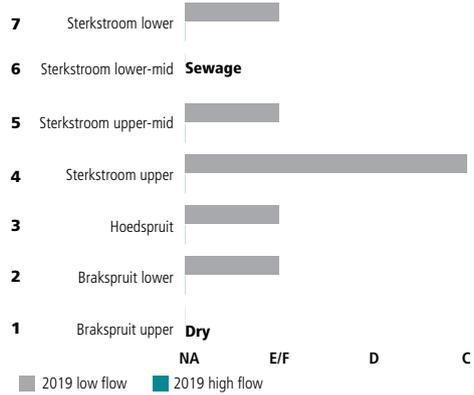
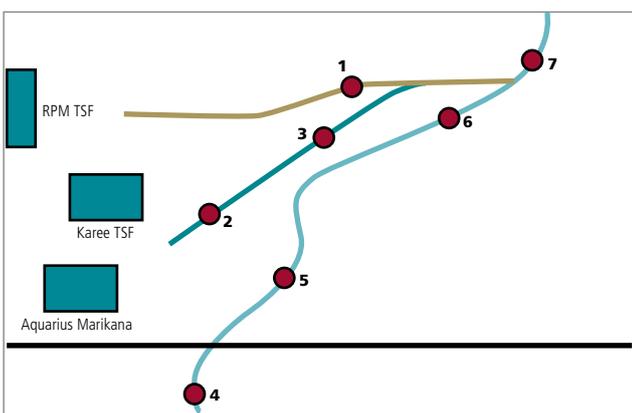
MARIKANA EASTERN OPERATIONS



MARIKANA WESTERN OPERATIONS



MARIKANA KAREE OPERATIONS



MARIKANA (2019 low flow only)

Catchment	Results	Interpretation
Kareespruit	MIRAI Category: To be determined in 2020 SASS5 Class D to E/F: Largely modified to critically modified	<ul style="list-style-type: none"> influenced by numerous catchment influences including the Eastern Platinum Limited (EPL) activities, municipal activities and agricultural return flows low flows from the upstream catchment also influenced habitat availability and dilution
Maretlwana	MIRAI Category: To be determined in 2020 SASS5 Class D to E/F: Largely modified to critically modified	<ul style="list-style-type: none"> the upper reach of the river (also known as the Elandskraalspruit) did not show significant impacts from the Mooinooi Sewage Treatment Works in terms of salinity, however impacts on the oxygen availability may have been caused by these works the lower reaches of the Maretlwana showed elevations in the salinity and mitigation measures for the potential contributions from the Western Platinum Limited (WPL) activities have been investigated and are in the process of being implemented
Elandsdrift	MIRAI Category: To be determined in 2020 SASS5 Class E/F: Critically modified	<ul style="list-style-type: none"> habitat availability was likely the most limiting factor, however detailed water quality analyses would further inform the potential influences on this reach
Maretlwana Tributary	MIRAI Category: To be determined in 2020 SASS5 Class E/F: Critically modified	<ul style="list-style-type: none"> high salinities were noted in this stream, likely influencing the salinities in the main Maretlwana River, mitigation measures for the potential contributions from TSF No. 6 have been investigated and are in the process of being implemented
Brakspruit	MIRAI Category: To be determined in 2020 SASS5 Class E/F: Critically modified	<ul style="list-style-type: none"> high salinities noted, therefore mitigation measures for the potential contributions from the Karee No. 1 to 3 tailings complex have been investigated and are being implemented
Hoedspruit	MIRAI Category: To be determined in 2020 SASS5 Class E/F: Critically modified	<ul style="list-style-type: none"> elevated salinities were noted within this stream however both Rustenburg and the Karee operations have the potential to impact upon this stream. Further investigation will be conducted in 2020 in the Rustenburg biomonitoring programme
Sterkstroom	MIRAI Category: To be determined in 2020 SASS5 Class C to E/F: Moderately modified to critically modified	<ul style="list-style-type: none"> despite the elevated salinities in the tributaries (Brakspruit and Hoedspruit) flowing into the Sterkstroom, it can be noted that significant increases were not noted in the Sterkstroom. Poor ecological conditions were noted to be influenced by low dissolved oxygen likely due to municipal sewage influences as noted adjacent to the Marikana operations



■ *Tilapia sparrmanii*

OPPORTUNITY FOR CATCHMENT-BASED MONITORING

Sibanye-Stillwater's efforts in respect of catchment-based monitoring have been advanced through the presentation of Sibanye-Stillwater's biomonitoring results at the Wonderfonteinspruit and Loopspruit Water Forum. Participants in the forum have expressed their willingness to contribute to the combined catchment monitoring efforts – a first step in supporting a collaborative approach to catchment management as promoted by the Resource Quality Objectives Framework set by the Department of Water and Sanitation. This collaborative effort between various water stakeholders, including water users, mining houses and government will enable alignment of agreed catchment management goals, objectives and strategies. This coincides with the current initiative in our SA operations to quantify liabilities associated with surface water resources as a result of mining activities and to present action plans to mitigate mining-related impacts.

US PGM OPERATIONS

Stillwater mine

Aquatic invertebrate sampling has been conducted in the Stillwater River since 1980.

In 2019, biological assessment and chlorophyll-a determination were sampled from sites SMC-J (upstream), SMC-2 and SMC-11 (proximal to the mine site). Chlorophyll-a determinations from periphyton sample collection were conducted at sites WFSC and SMC-13. Data was evaluated using current and historic Montana Department of Environmental Quality assessment methods as well as ecological interpretations of the raw taxonomic data. Scores and interpretations were used to provide insight into spatial and temporal trends in biological integrity, at sites on the Stillwater river, associated with the Stillwater mine.

In 2019, the mean chlorophyll-a concentrations at Stillwater river sites ranged from 2.25mg/m² at SMC-J to 75.35 mg/m² at SMC-2. The mean chlorophyll-a concentration was higher at SMC-2 than at the other sites. However, all mean chlorophyll-a concentrations at Stillwater river sites were below the Montana Department of Environmental Quality threshold for nuisance algae. The mean chlorophyll-a concentrations have been trending downward at all sites with the exception of the 2016 value at SMC-2. Despite the increased concentration of chlorophyll, a at SMC-2, data suggested that all sites continued to support periphyton algal growth below levels that would indicate nutrient impairment or that would be considered nuisance threshold (125mg/m²).

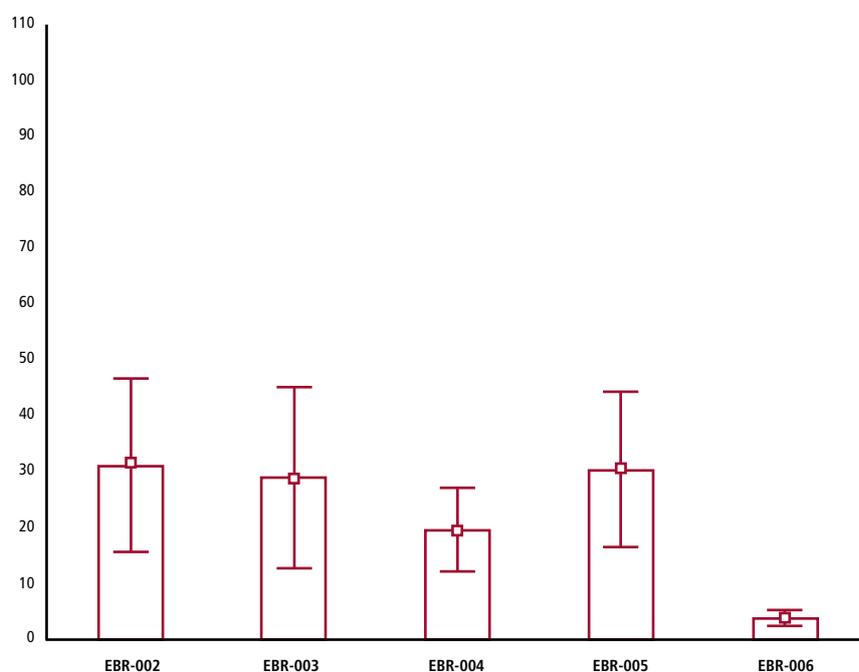
East Boulder mine

Biological assessment at the East Boulder Mine includes annual chlorophyll-a monitoring and triennial periphyton and macroinvertebrate analysis. In 2019, chlorophyll-a determinations were sampled from sites upstream (EBR-002 and EBR-003) and downstream (EBR-004 and EBR-005). The purpose of sample collection and study of chlorophyll-a results and interpretations is to assist in determining whether the East Boulder mine's activities have impacted the periphyton density and thus the ecology of the East Boulder river

Mean chlorophyll-a concentrations for the 2019 East Boulder river monitoring samples ranged from 3.9 mg/m² to 190.5 mg/m² and mean long-term (2010 – 2019) concentrations ranged from 5.7 mg/m² to 56.6 mg/m² when all data values were considered. In general,

East Boulder river chlorophyll-a concentrations have been below the perceived nuisance level concentration (125 mg/m²) since 2010; however, this level was surpassed at EBR-002 (upstream) in 2018 and 2019 and EBR-003 (upstream) and EBR-004A (downstream) in 2019. EBR-005 had much lower chlorophyll concentrations than all other sites. EBR-005 is the downstream sampling site where mine related chemistry changes (nitrogen) can be detected in the river.

Chlorophyll-a concentrations at a given riverine site are influenced by a number of factors, including ambient as well as point and non-point sources of nutrients, incident sunlight, water temperature, and water volume and flow. The data collected from the East Boulder river in 2019 were inconclusive concerning mine influence on chlorophyll-a concentrations within the sampled reaches.



East Boulder River: Long-term mean chlorophyll-a concentrations, 2010 – 2019. Outliers excluded. Bars are mean concentrations, and error bars are 95% confidence intervals.

BIODIVERSITY

Sibanye-Stillwater's vision of promoting natural resources and improving life further strongly advocates for the reduction in the degradation of natural habitats, halting the loss of biodiversity and protecting species on land and water. Our management processes contribute to the conservation of biodiversity and take integrated approaches to land use planning, as guided by the ICMM.

Sibanye-Stillwater is in the process of reviewing our environmental related policies to better align to the objectives outlined by the ICMM including specific commitments to the protection and enhancement of biodiversity within the ecosystems influenced by its operations. Based on the policy, a procedure

for defining biodiversity requirements will be outlined that will specifically address the identification and protection of areas with high biodiversity value. A South African non-profit organisation, the Endangered Wildlife Trust (EWT), has taken the lead in South Africa in developing an international voluntary reporting mechanism, called the Biological Diversity Project (BDP), similar in approach to the Carbon Disclosure Project. Sibanye-Stillwater has been a main contributor to this document, now being discussed on an international platform. Managed by the EWT, the BDP will build the capacity within Sibanye-Stillwater to manage our biodiversity risks and opportunities and enable transparent disclosure of our biodiversity performance in a standardised and comparable manner.

In addition to our participation in the development of a reporting framework, Sibanye-Stillwater participated in a research initiative lead by the North West University, in conjunction with the University of Duisburg-Essen. The objective of the research initiative, performed in the Hex River catchment within which our PGM operations are located, was to inform the impact of PGM toxicity on test organisms. This research further informs our method for testing, reporting and management.

SA OPERATIONS

At our SA operations, new mine developments undergo a detailed environmental impact assessment process in which all protected areas and the potential impacts from development are identified in line with national environmental legislation. Mitigation actions and plans are included in environmental management programmes for which approval is sought from the regulatory authorities. Where development needs to occur in ridges and wetlands, we apply for licensing, and specific mitigation measures are proposed and signed off by the relevant regulatory authority before implementation.

The removal of alien invasive species, important for biodiversity, is ongoing at our operations. In 2019, local SMMEs were identified to carry out the removal of these alien species at Driefontein and Kloof. An alien and invasive species programme is in place at the Marikana operations, which involves the annual identification of these species and their mostly mechanical removal by employees. Chemical eradication occurs at selected areas by garden services under the supervision of a registered pest control operator (PCO) and by professional pest control companies.

FOR MORE INFORMATION, CONTACT:

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Biodiversity assessments

Biodiversity assessments have been conducted at Driefontein, Kloof, Burnstone and the Marikana operations. Similar assessments are being conducted at Beatrix, Rand Uranium and Ezulwini, as well as an update at Burnstone. Assessments at the Rustenburg and Kroondal operations will be completed during 2020. Biodiversity action plans (BAPs) have been developed for most of our operations and those operations without BAPs have been scheduled for this.

The following species of interest, as per the International Union for Conservation of Nature (IUCN) and South African National Biodiversity Institute (SANBI) Red List data, have been found. Note: this is not a comprehensive list of all species in the respective areas.

IUCN/SANBI Red List status	Species observed
Near threatened	<ul style="list-style-type: none"> • <i>Eupodotis caerulescens</i> (Blue Korhaan)^{1,3} • <i>Mirafra cheniana</i> (Melodius Lark)² • <i>Adromischus umbraticola subsp umbraticola</i> (Cliff Andromischus)² • <i>Panthera pardus</i> (Leopard)² • <i>Miniopterus schreibersii</i> (Natal Clinging Bat)² • <i>Rhinolophus clivosus</i> (Geoffroy's Horseshoe Bat)² • <i>Rhinolophus darlingi</i> (Darling's Horseshoe Bat)² • <i>Myotis tricolor</i> (Temminck's Hairy Bat)² • <i>Vulpes chama</i> (Cape Fox)³ • <i>Leptailurus serval</i> (Serval)³ • <i>Atelerix frontalis</i> (Southern African Hedgehog)^{3,4} • <i>Adromischus umbraticula</i>³ • <i>Phoenicopterus minor</i> (Lesser Flamingo)⁴ • <i>Pterocles gutturalis</i> (Yellow-throated Sandgrouse)⁴ • <i>Sagittarius serpentarius</i> (Secretary Bird)⁴
Declining	<ul style="list-style-type: none"> • <i>Boophane disticha</i> (Gifbol)^{2,3} • <i>Hypoxis hemerocallidea</i> (African Potato)^{2,3} • <i>Crinum macowanii</i> (Cape Coast Lily)⁴ • <i>Eucomis autumnalis</i> (Pineapple Lily)⁴
Vulnerable	<ul style="list-style-type: none"> • <i>Rhinolophus blasii</i> (Blasius's Horseshoe Bat)² • <i>Tyto capensis</i> (African Grass Owl)³ • <i>Crocodylus niloticus</i> (Nile Crocodile)⁴
Protected	<ul style="list-style-type: none"> • <i>Protected Opisthophthalmus pugnax</i> (Burrowing Scorpion)² • <i>Cheilanthes hirta</i> (Parsley Fern)⁴ • <i>Cheilanthes viridis var. viridis</i> (Lip Fern)⁴ • <i>Combretum imberbe</i> (Leadwood)⁴ • <i>Cussonia spicata</i> (Common Cabbage Tree)⁴ • <i>Gladiolus sericeovillosus</i> (Gladiolus)⁴ • <i>Kniphofia ensifolia</i> (Torch Lily)⁴ • <i>Pellae calomelanos</i> (Hard Fern)⁴ • <i>Scadoxus puniceus</i> (Paintbrush Lily)⁴ • <i>Sclerocarya birrea</i> (Marula)⁴ • <i>Acacia erioloba</i> (Camel Thorn Tree)⁵ • <i>Boscia albitrunca</i> (Shepherd's Tree)⁵ • <i>Elaeodendron transvaalensis</i> (Transvaal Saffron)⁵
Endangered	<ul style="list-style-type: none"> • <i>Endangered Circus ranivorus</i> (African Marsh Harrier)³ • <i>Hadogenes gunningi</i> (Rock Scorpion)⁴
New species (not categorised)	<ul style="list-style-type: none"> • <i>Enteromius pallidus</i> (Goldie Barb)³

¹ Burnstone ² Driefontein ³ Kloof, ⁴ Marikana operations ⁵ Boabab operations

OUR VISION: Superior value creation for all our stakeholders through the responsible mining of our mineral resources