### Groundwater sampling

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Determinand** | **Units** | **Drinking** | **Livestock** | **Irrigation** |
| South African National Standard for drinking water SANS: 241 (2011) | South African Water Quality Guidelines for Aquatic Ecosystems DWAF (1996a) | South African Water Quality Guidelines for Aquatic Ecosystems DWAF (1996b) |
| Alkalinity | mg CaCO3/L | n/a |  |  |
| Arsenic | µg As/L |  |  |  |
| Calcium | mg Ca/L |  |  |  |
| Chloride (Soluble) | mg Cl/L |  |  |  |
| Conductivity | mS/m |  |  |  |
| Fluoride | µg F/L |  |  |  |
| Iron | mg Fe/L |  |  |  |
| Total hardness | mg CaCO3/L |  |  |  |
| Magnesium | mg Mg/L |  |  |  |
| Manganese | mg Mn/L |  |  |  |
| Sodium | mg Na/L |  |  |  |
| Ammonia (Soluble)\* | mg N/L |  |  |  |
| Nitrate (Soluble) | mg N/L |  |  |  |
| pH | pH units |  |  |  |
| Selenium | µg Se/L |  |  |  |
| Sulphate (Soluble) | mg SO4/L |  |  |  |
| Turbidity | NTU |  |  |  |

**Legend**

|  |
| --- |
| **Limit exceedance** |
| Exceeds drinking water limit (SANS, 2011) |
| Exceeds livestock watering limit (DWAF, 1996a) |
| Exceeds irrigation limit (DWAF, 1996b) |
| No limit/ no exceedance |

#### Site WW39840, Blumfelde, Namibia

##### Site Description

The site is situated directly adjacent to the Olifants River near Blumfelde, approximately 115 km north-east of Mariental, Namibia. The Olifants River is a tributary of the Auob River, with the confluence located approximately 230 km downstream. The primary land-use is livestock agriculture, with irrigated crops also present. The borehole is a Namibia Ministry of Agriculture, Water & Forestry (MWAF) monitoring borehole, which is used for monitoring purposes only. No water is drawn at this site, but with neighbouring farms drawing water for livestock watering, crop irrigation and domestic use. This borehole is 130m deep, and draws on the Auob aquifer for the purposes of monitoring the aquifer. A second monitoring borehole is located within 50m, but which draws on the deeper Nossob aquifer for monitoring purposes. The sites are routinely sampled at quarterly intervals by the Namibian Ministry of Agriculture, Water & Forestry.

|  |  |  |  |
| --- | --- | --- | --- |
| **Longitude** | 18.388726° | **Latitude** | -23.647475° |
| **Altitude (m.a.s.l.)** | 1 277 | **Country** | Namibia |
| **Date sampled** | 21 July 2015 |  |  |
| **River catchment** | Olifants/Auob | **Aquifer** | Auob |
|  | | | |

##### Water quality

***In-situ* water quality sampling**

|  |  |  |
| --- | --- | --- |
| **Determinand** | **Units** | **WW 39840** |
| pH | pH units | 8.11 |
| Temperature | (°c) | 27.5 |
| Conductivity | (µS/cm) | 914 |
| *e.coli***1** | (CFU/ml) | 0 |

**1**sampled *in-situ* using an *e.coli* hygiene and monitoring swab

**Laboratory water quality sampling**

|  |  |  |
| --- | --- | --- |
| **Determinand** | **Units** | **WW 39840** |
| Alkalinity | mg CaCO3/L | 298 |
| Arsenic | µg As/L | <2.00 |
| Calcium | mg Ca/L | 22.8 |
| Chloride (Soluble) | mg Cl/L | 59.9 |
| Conductivity | mS/m | 98.1 |
| Fluoride | µg F/L | 725 |
| Iron | mg Fe/L | <0.02 |
| Total hardness | mg CaCO3/L | 154 |
| Magnesium | mg Mg/L | 23.4 |
| Manganese | mg Mn/L | 0.03 |
| Sodium | mg Na/L | 137 |
| Ammonia (Soluble)\* | mg N/L | <0.10 |
| Nitrate (Soluble) | mg N/L | 11.6 |
| pH | pH units | 8.10 |
| Selenium | µg Se/L | 6.15 |
| Sulphate (Soluble) | mg SO4/L | 30.9 |
| Turbidity | NTU | 0.4 |

**Legend**

|  |
| --- |
| **Limit exceedance** |
| Exceeds drinking water limit (SANS, 2011) |
| Exceeds livestock watering limit (DWAF, 1996a) |
| Exceeds irrigation limit (DWAF, 1996b) |
| No limit/ no exceedance |

##### Main Impacts at the Site

| **Causes1** | **Sources2** |
| --- | --- |
| n/a | High volumes of water extracted for irrigated crops |

1 **CAUSE:** A stressor that occurs at an intensity, duration and frequency of exposure that results in a change in the ecological conditions.

2 **SOURCE:** A source is the origin of a stressor. It is an entity or action that releases or imposes a stressor into the waterbody (EPA, 2000).

#### Site WW40960, Stampriet, Namibia

##### Site Description

The site is situated in the Auob River catchment (900m from the Auob River) on the farm Boomplaas near Stampriet, approximately 65 km east of Mariental, Namibia. The primary land use is livestock agriculture, with irrigated crops also present. The borehole is a Namibia Ministry of Agriculture, Water & Forestry (MWAF) monitoring borehole. The site is routinely sampled at quarterly intervals by the Namibian Ministry of Agriculture, Water & Forestry.

**Please note: we are still awaiting laboratory results and other details of this site**

|  |  |  |  |
| --- | --- | --- | --- |
| **Longitude** | 18.562200° | **Latitude** | -24.550110° |
| **Altitude (m.a.s.l.)** | 1 163 | **Country** | Namibia |
| **Date sampled** | 23 July 2015 |  |  |
| **River catchment** | Auob | **Aquifer** |  |
| Awaiting photo | | | |

##### Water quality

***In-situ* water quality sampling**

|  |  |  |
| --- | --- | --- |
| **Determinand** | **Units** | **WW 40960** |
| pH | pH units | 7.3 |
| Temperature | (°c) | 26.2 |
| Conductivity | (µS/cm) | 1 050 |
| *e.coli* **1** | (CFU/ml) | 0 |

**1**sampled *in-situ* using an *e.coli* hygiene and monitoring swab

**Laboratory water quality sampling**

|  |  |  |
| --- | --- | --- |
| **Determinand** | **Units** | **WW 40960** |
| Alkalinity | mg CaCO3/L | Awaiting results |
| Arsenic | µg As/L | Awaiting results |
| Calcium | mg Ca/L | Awaiting results |
| Chloride (Soluble) | mg Cl/L | Awaiting results |
| Conductivity | mS/m | Awaiting results |
| Fluoride | µg F/L | Awaiting results |
| Iron | mg Fe/L | Awaiting results |
| Total hardness | mg CaCO3/L | Awaiting results |
| Magnesium | mg Mg/L | Awaiting results |
| Manganese | mg Mn/L | Awaiting results |
| Sodium | mg Na/L | Awaiting results |
| Ammonia (Soluble)\* | mg N/L | Awaiting results |
| Nitrate (Soluble) | mg N/L | Awaiting results |
| pH | pH units | Awaiting results |
| Selenium | µg Se/L | Awaiting results |
| Sulphate (Soluble) | mg SO4/L | Awaiting results |
| Turbidity | NTU | Awaiting results |

**Legend**

|  |
| --- |
| **Limit exceedance** |
| Exceeds drinking water limit (SANS, 2011) |
| Exceeds livestock watering limit (DWAF, 1996a) |
| Exceeds irrigation limit (DWAF, 1996b) |
| No limit/ no exceedance |

##### Main Impacts at the Site

| **Causes1** | **Sources2** |
| --- | --- |
| n/a | High volumes of water extracted for irrigated crops |

1 **CAUSE:** A stressor that occurs at an intensity, duration and frequency of exposure that results in a change in the ecological conditions.

2 **SOURCE:** A source is the origin of a stressor. It is an entity or action that releases or imposes a stressor into the waterbody (EPA, 2000).

#### Site BH5229, Two Rivers, Botswana

##### Site Description

The site is situated in the Nossob River catchment at Two Rivers within the Botswana side of the Kgalagadi Transfrontier Park. The borehole is sited 150m from the Nossob River, 4km downstream of the confluence with the Auob River. The primary land use is the Kgalagadi Transfrontier Park, with Two Rivers forming a small settlement in the park containing a border post, staff housing, tourist accommodation, a petrol station, shop and workshops. The borehole supplies water for domestic purposes to the Botswana staff housing in the park at Two Rivers. This borehole draws on the Nossob aquifer.

|  |  |  |  |
| --- | --- | --- | --- |
| **Longitude** | 20.617194° | **Latitude** | -26.469361° |
| **Altitude (m.a.s.l.)** | 876 | **Country** | Botswana |
| **Date sampled** | 23 July 2015 | **River catchment** | Nossob |
|  | | | |

##### Water quality

***In-situ* water quality sampling**

|  |  |  |
| --- | --- | --- |
| **Determinand** | **Units** | **BH5229** |
| pH | pH units | n/a**2** |
| Temperature | (°c) | n/a**2** |
| Conductivity | (µS/cm) | n/a**2** |
| *e.coli***1** | (CFU/ml) | 0 |

**1**sampled *in-situ* using an *e.coli* hygiene and monitoring swab

**2**Member state personnel did not sample *in-situ* determinants

**Laboratory water quality sampling**

|  |  |  |
| --- | --- | --- |
| **Determinand** | **Units** | **BH5229** |
| Alkalinity | mg CaCO3/L | 859 |
| Arsenic | µg As/L | 109 |
| Calcium | mg Ca/L | <1.00 |
| Chloride (Soluble) | mg Cl/L | 568 |
| Conductivity | mS/m | 430 |
| Fluoride | µg F/L | 6980 |
| Iron | mg Fe/L | <0.02 |
| Total hardness | mg CaCO3/L | <6.67 |
| Magnesium | mg Mg/L | <1.00 |
| Manganese | mg Mn/L | <0.01 |
| Sodium | mg Na/L | 964 |
| Ammonia (Soluble)\* | mg N/L | <0.10 |
| Nitrate (Soluble) | mg N/L | 24.0 |
| pH | pH units | 9.38 |
| Selenium | µg Se/L | 12.2 |
| Sulphate (Soluble) | mg SO4/L | 350 |
| Turbidity | NTU | 1.2 |

**Legend**

|  |
| --- |
| **Limit exceedance** |
| Exceeds drinking water limit (SANS, 2011) |
| Exceeds livestock watering limit (DWAF, 1996a) |
| Exceeds irrigation limit (DWAF, 1996b) |
| No limit/ no exceedance |

##### Main Impacts at the Site

| **Causes1** | **Sources2** |
| --- | --- |
|  |  |

1 **CAUSE:** A stressor that occurs at an intensity, duration and frequency of exposure that results in a change in the ecological conditions.

2 **SOURCE:** A source is the origin of a stressor. It is an entity or action that releases or imposes a stressor into the waterbody (EPA, 2000).

#### Site BH9087, Tsabong, Botswana

##### Site Description

The site is situated 6km south-west of the town of Tsabong in Botswana within a sparsely populated housing area on the outskirts of the town. The primary land use of the surrounding area is the town of Tsabong, with associated housing, retail and light industrial activities. The immediate area of the borehole is comprised of sparsely distributed housing, with many residents having a small number of livestock. No irrigated crops were evident. The borehole supplies water for domestic purposes to neighbouring communities. The borehole is located within the Molopo River catchment, 17 km from the river itself.

|  |  |  |  |
| --- | --- | --- | --- |
| **Longitude** | 22.374588° | **Latitude** | -26.072368° |
| **Altitude (m.a.s.l.)** | 969 | **Country** | Botswana |
| **Date sampled** | 23 July 2015 | **River catchment** | Molopo |
|  | | | |

##### Water quality

***In-situ* water quality sampling**

|  |  |  |
| --- | --- | --- |
| **Determinand** | **Units** | **BH9087** |
| pH | pH units | n/a**2** |
| Temperature | (°c) | n/a**2** |
| Conductivity | (µS/cm) | n/a**2** |
| *e.coli***1** | (CFU/ml) | 0 |

**1**sampled *in-situ* using an *e.coli* hygiene and monitoring swab

**2**Member state personnel did not sample *in-situ* determinants

**Laboratory water quality sampling**

|  |  |  |
| --- | --- | --- |
| **Determinand** | **Units** | **BH9087** |
| Alkalinity | mg CaCO3/L | 29.1 |
| Arsenic | µg As/L | <2.00 |
| Calcium | mg Ca/L | <1.00 |
| Chloride (Soluble) | mg Cl/L | 123 |
| Conductivity | mS/m | 64.0 |
| Fluoride | µg F/L | 174 |
| Iron | mg Fe/L | 0.03 |
| Total hardness | mg CaCO3/L | <6.67 |
| Magnesium | mg Mg/L | <1.00 |
| Manganese | mg Mn/L | <0.01 |
| Sodium | mg Na/L | 114 |
| Ammonia (Soluble)\* | mg N/L | <0.10 |
| Nitrate (Soluble) | mg N/L | 5.00 |
| pH | pH units | 6.49 |
| Selenium | µg Se/L | <2.00 |
| Sulphate (Soluble) | mg SO4/L | 49.9 |
| Turbidity | NTU | 0.4 |

**Legend**

|  |
| --- |
| **Limit exceedance** |
| Exceeds drinking water limit (SANS, 2011) |
| Exceeds livestock watering limit (DWAF, 1996a) |
| Exceeds irrigation limit (DWAF, 1996b) |
| No limit/ no exceedance |

##### Main Impacts at the Site

| **Causes1** | **Sources2** |
| --- | --- |
|  | Rural housing/small holdings, retail and light industrial activities |

1 **CAUSE:** A stressor that occurs at an intensity, duration and frequency of exposure that results in a change in the ecological conditions.

2 **SOURCE:** A source is the origin of a stressor. It is an entity or action that releases or imposes a stressor into the waterbody (EPA, 2000).

#### Site BH1255, Mokatako, Botswana

##### Site Description

The site is located on the outskirts of the village of Mokatako in Botswana. The borehole is sited directly adjacent (700m) to the Ramatlabama River, less than 1km upstream of the confluence with the Molopo River. The primary land use is a sparsely populated, small, rural village with a school and limited other amenities. Livestock were present in the village, with subsistence agriculture present on a limited scale. Large scale agriculture was present within the surrounding region, but all croplands observed were dryland agriculture. Commercial livestock farming was also observed in the region.

|  |  |  |  |
| --- | --- | --- | --- |
| **Longitude** | 25.226076° | **Latitude** | -25.763613° |
| **Altitude (m.a.s.l.)** | 1168 | **Country** | Botswana |
| **Date sampled** | 24 July 2015 | **River catchment** | Ramatlabama/Molopo |
|  | | | |

##### Water quality

***In-situ* water quality sampling**

|  |  |  |
| --- | --- | --- |
| **Determinand** | **Units** | **BH1255** |
| pH | pH units | n/a**2** |
| Temperature | (°c) | n/a**2** |
| Conductivity | (µS/cm) | n/a**2** |
| *e.coli***1** | (CFU/ml) | 0 |

**1**sampled *in-situ* using an *e.coli* hygiene and monitoring swab

**2**Member state personnel did not sample *in-situ* determinants

**Laboratory water quality sampling**

|  |  |  |
| --- | --- | --- |
| **Determinand** | **Units** | **BH1255** |
| Alkalinity | mg CaCO3/L | 377 |
| Arsenic | µg As/L | <2.00 |
| Calcium | mg Ca/L | 59.2 |
| Chloride (Soluble) | mg Cl/L | 34.6 |
| Conductivity | mS/m | 86.3 |
| Fluoride | µg F/L | 816 |
| Iron | mg Fe/L | 0.02 |
| Total hardness | mg CaCO3/L | 258 |
| Magnesium | mg Mg/L | 26.3 |
| Manganese | mg Mn/L | 0.02 |
| Sodium | mg Na/L | 89.2 |
| Ammonia (Soluble)\* | mg N/L | <0.10 |
| Nitrate (Soluble) | mg N/L | <0.10 |
| pH | pH units | 7.35 |
| Selenium | µg Se/L | 3.69 |
| Sulphate (Soluble) | mg SO4/L | 29.1 |
| Turbidity | NTU | 0.3 |

**Legend**

|  |
| --- |
| **Limit exceedance** |
| Exceeds drinking water limit (SANS, 2011) |
| Exceeds livestock watering limit (DWAF, 1996a) |
| Exceeds irrigation limit (DWAF, 1996b) |
| No limit/ no exceedance |

##### Main Impacts at the Site

| **Causes1** | **Sources2** |
| --- | --- |
|  |  |

1 **CAUSE:** A stressor that occurs at an intensity, duration and frequency of exposure that results in a change in the ecological conditions.

2 **SOURCE:** A source is the origin of a stressor. It is an entity or action that releases or imposes a stressor into the waterbody (EPA, 2000).

#### Site 42477, Tswalu, South Africa

##### Site Description

The site is situated within the Kuruman River catchment in the Tswalu Private Game Reserve, 100km north-west of the town of Kuruman. The Kuruman River is a tributary of the Molopo River. The primary land use is the game reserve, with the borehole supplying water to the staff accommodation of the reserve for domestic use.

|  |  |  |  |
| --- | --- | --- | --- |
| **Longitude** | 22.488683° | **Latitude** | -27.285922° |
| **Altitude (m.a.s.l.)** | 1210 | **Country** | South Africa |
| **Date sampled** | 25 July 2015 | **River catchment** | Kuruman |
|  | | | |

##### Water quality

***In-situ* water quality sampling**

|  |  |  |
| --- | --- | --- |
| **Determinand** | **Units** | **42477** |
| pH | pH units | n/a**2** |
| Temperature | (°c) | n/a**2** |
| Conductivity | (µS/cm) | n/a**2** |
| *e.coli***1** | (CFU/ml) | 0 |

**1**sampled *in-situ* using an *e.coli* hygiene and monitoring swab

**2**Member state personnel did not sample *in-situ* determinants

**Laboratory water quality sampling**

|  |  |  |
| --- | --- | --- |
| **Determinand** | **Units** | **42477** |
| Alkalinity | mg CaCO3/L | 135 |
| Arsenic | µg As/L | 2.48 |
| Calcium | mg Ca/L | 39.2 |
| Chloride (Soluble) | mg Cl/L | 41.9 |
| Conductivity | mS/m | 58.0 |
| Fluoride | µg F/L | 335 |
| Iron | mg Fe/L | 0.02 |
| Total hardness | mg CaCO3/L | 206 |
| Magnesium | mg Mg/L | 25.9 |
| Manganese | mg Mn/L | <0.01 |
| Sodium | mg Na/L | 29.2 |
| Ammonia (Soluble)\* | mg N/L | <0.10 |
| Nitrate (Soluble) | mg N/L | 15.4 |
| pH | pH units | 6.67 |
| Selenium | µg Se/L | <2.00 |
| Sulphate (Soluble) | mg SO4/L | 15.4 |
| Turbidity | NTU | 0.6 |

**Legend**

|  |
| --- |
| **Limit exceedance** |
| Exceeds drinking water limit (SANS, 2011) |
| Exceeds livestock watering limit (DWAF, 1996a) |
| Exceeds irrigation limit (DWAF, 1996b) |
| No limit/ no exceedance |

##### Main Impacts at the Site

| **Causes1** | **Sources2** |
| --- | --- |
|  |  |

1 **CAUSE:** A stressor that occurs at an intensity, duration and frequency of exposure that results in a change in the ecological conditions.

2 **SOURCE:** A source is the origin of a stressor. It is an entity or action that releases or imposes a stressor into the waterbody (EPA, 2000).

**References**

DWAF. 1996a. *South African Water Quality Guidelines (Volume 5): Agricultural Water Use: Livestock Watering.* Department of Water Affairs and Forestry (DWAF), Pretoria.

DWAF. 1996b. *South African Water Quality Guidelines (Volume 4): Agricultural Water Use: Irrigation.* Department of Water Affairs and Forestry (DWAF), Pretoria.

SANS 241. 2011. South African National Standard: Drinking water: Part 1: Microbiological, physical, aesthetic and chemical determinands. June 2011.