



***GEOTECHNICAL REPORT***

***NEW FIRE WATER INSTALLATION  
TRANSNET PIPELINES  
WITBANK DEPOT  
MPUMALANGA***

***Requested by  
GreyJones (Pty) Ltd***

***Project GA1062R1/2025  
September 2025***



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***Requested by  
GreyJones (Pty) Ltd***

***Project GA1062R1/2025  
September 2025***

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## Contents

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|          |                                                        |           |
|----------|--------------------------------------------------------|-----------|
| <b>1</b> | <b>INTRODUCTION .....</b>                              | <b>1</b>  |
| <b>2</b> | <b>SITE DESCRIPTION .....</b>                          | <b>2</b>  |
| <b>3</b> | <b>GEOLOGY.....</b>                                    | <b>3</b>  |
| <b>4</b> | <b>FIELDWORK .....</b>                                 | <b>6</b>  |
| 4.1      | Fieldwork Methods .....                                | 6         |
| 4.2      | Fieldwork Results .....                                | 7         |
| 4.2.1    | Soil Profiles.....                                     | 7         |
| 4.2.2    | Dynamic Penetrometer Light Tests .....                 | 11        |
| <b>5</b> | <b>GEOTECHNICAL ASSESSMENT .....</b>                   | <b>13</b> |
| 5.1      | Proposed Development .....                             | 13        |
| 5.2      | Geotechnical Constraints .....                         | 13        |
| 5.3      | Earthworks .....                                       | 13        |
| 5.4      | Foundations .....                                      | 13        |
| 5.5      | Quality and Re-use Potential of In-Situ Materials..... | 15        |
| 5.6      | Stormwater Drainage .....                              | 15        |
| <b>6</b> | <b>CONCLUSION.....</b>                                 | <b>16</b> |

*Appendix A – Locality Map and Trial Hole Positions*

*Appendix B – Individual Soil Profiles*

*Appendix C – Dynamic Penetrometer Light Test Results*

Project GA1062R1/2025

13<sup>th</sup> October 2025

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**NEW FIRE WATER INSTALLATION – TRANSNET PIPELINES**  
**WITBANK DEPOT - MPUMALANGA**

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## **1 INTRODUCTION**

The following report describes the findings of a geotechnical investigation undertaken on the 17<sup>th</sup> and 18<sup>th</sup> of September 2025 for the proposed construction of new fire water infrastructure at the Transnet Pipelines Witbank Depot in the town of Emalahleni (Witbank), Mpumalanga. The geotechnical investigation was undertaken by Ground Africa Consulting Geotechnical Engineers at the request of Mr Blake Jones of GreyJones (Pty) Ltd.

The proposed development comprises the provision of new firefighting infrastructure. This infrastructure will comprise a pumphouse, new water tanks and new valve banks. The new tanks and pump house will be positioned in the southern corner of the site, while the new valve banks will be located to the east and west of the existing bulk fuel storage area. Water from the fire tanks will be conveyed by a new pipe network. The pipes will be elevated above ground level in pipe racks which will be supported on bridges.

The geotechnical investigation was undertaken to ascertain the general ground conditions underlying the earmarked site and to recommend a suitable founding regime for the new infrastructure. Commentary with respect to anticipated earthworks, ground improvement, in-situ material quality and groundwater characteristics has also been discussed herein.

A drawing of the proposed new infrastructure, relative to the existing depot, was provided for the purposes of the investigation. The drawing was created by GreyJones and is entitled "PLOT PLAN OF NEW FIRE SYSTEM," with reference number 11364-F-27-DM-001 and dated 08/07/2025. Trial holes were excavated within, or as close as possible to the new positions for the infrastructure.



## 2 SITE DESCRIPTION

The existing Transnet Pipelines (TPL) Witbank Depot is located within the Ferrobank area of the town of Emalahleni (Witbank) in Mpumalanga. The depot has general *GPS co-ordinates* *S25°51'47.0; E29°09'58.8"*. The depot is a *National Keypoint*, and access is strictly controlled. The site is trapezoidal in shape, covering an area of approximately 2.3ha. The site is generally level, with a very slight overall fall to the west. The site is accessed from Schonland Drive along the eastern edge of the site.

The site boundaries are secured with concrete walls and steel mesh fencing. Existing infrastructure comprises single storey masonry buildings which house offices, change rooms, a guard house and a control room. Large fuel storage tanks cover most of the northern half of the site. These tanks are placed in concrete bunds which sit at approximately 1m to 2m below the surrounding ground level. There is a plethora of buried pipes and electrical cables cross the site area.

The proposed position for the new tanks and pump house, located in the southern corner of the site, comprises an open grass area. The grassed area lies alongside the staff parking area. This area is bounded to the east and south west by the boundary wall of the depot. This area is bounded to the north by the depot's substation. Some concrete foundations are located in the northern portion of the area, alongside covered parking bays. The development will overlap both of these existing features.

The area earmarked for the new pipe racking and bridge extends from the staff parking area, in the southern corner of the site, to the manifold slab zone in the centre of the site. The proposed alignment crosses the open, grassed areas alongside the depot's changeroom and control room. The planned alignment crosses an existing paved roadway which passes between the change rooms and control room.

The proposed position for the new valve bank on the south eastern boundary of the site is located alongside the boundary wall of the depot. The area comprises a level, unsurfaced piece of ground. This area appears to be subject to frequent flooding, resulting in ponded water at surface. Both electrical and existing firefighting services pass along this edge of the site.

The proposed position for the valve bank that will be positioned in the north eastern corner of the site comprises open area which is covered with short grass. The area is partly enclosed by the depot's boundary wall to the north and east. To the south west, the area is bounded by the bund wall of the tank farm. Services in this area comprise lighting masts and existing firefighting infrastructure.

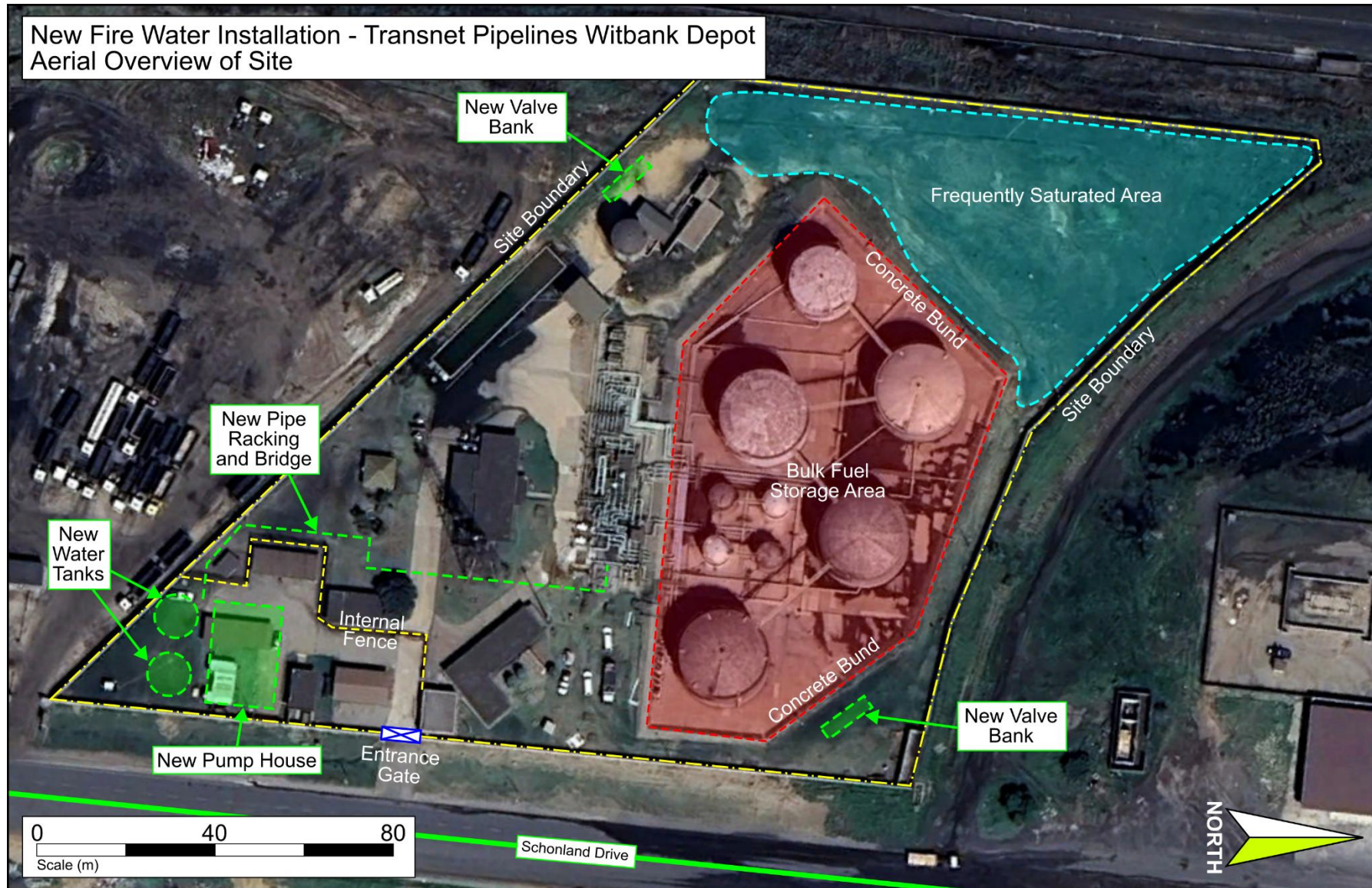
Photography of the site is strictly controlled, and may only be undertaken under supervision of Transnet personnel. Photographs included in this report were approved by on-site staff at the time of the investigation.

An aerial overview of the site as well as photographs taken of the site at the time of the investigation are included over-page for explanatory purposes.

### **3 GEOLOGY**

Geological mapping of the area indicates the site to be underlain by sedimentary rocks of the Ecca Group, Karoo Supergroup. Numerous formations are present within the Ecca Group with the most common being the coal bearing Vryheid Formation and the Pietermaritzburg Formation. Sedimentary rocks in the area comprise mostly shale, sandstone and mudstone. The coal deposits of the Vryheid Formation are extensively mined around the Witbank TPL site.

Excavation of trial holes across the site shows that the near surface ground profile comprises residual soils derived from the underlying parent sedimentary rock, with some imported fill material placed at surface to level certain areas. The rock underlying the site is estimated to lie at depths in excess of 5.0m below surface.







**Picture 1:** Looking south across the area where the new tanks and pump room will be located, in the southern corner of the site.



**Picture 2:** Looking south along the alignment of the new pipe racking and bridge, which will pass alongside the existing change rooms.



**Picture 3:** Looking west towards the proposed valve bank position on the western edge of the site. This area appears to suffer from frequent flooding.



**Picture 4:** Looking north across the proposed valve bank which will be positioned in the north eastern corner of the site.

## 4 FIELDWORK

### 4.1 Fieldwork Methods

Geotechnical fieldwork conducted on the 17<sup>th</sup> and 18<sup>th</sup> September 2025 comprised the following:

- Manual excavation of six (6x) trial holes to depths of between 0.8m and 1.2m below present ground level (PGL).
- Manual auger drilling at the base of trial holes to increase the depth of information to between 2.1m and 4.8m below PGL.
- Soil profiling of the ground layers exposed in the sidewalls of the trial holes and the material removed during auger drilling.
- Eight (8x) Dynamic Penetrometer Light tests to assess the variation in consistency of the underlying soils to depths ranging from 4.1m to 6.6m below PGL.

The locations of the trial holes are shown in **Appendix A**. Trial hole depths were determined by tape measurement from present ground level. All the trial holes were profiled according to the method of Jennings, Brink and Williams as per the paper “Revised guide to soil profiling for civil engineering purposes in Southern Africa” as published in the Transactions of the South African Institution of Civil Engineers. Individual soil profiles are included in **Appendix B**.

In the Dynamic Penetrometer Light test (DPL), a specific angle ended cone fixed to the end of a steel rod is driven into the ground using a standard weighted hammer that drops by a constant height. The distance measured from each blow as the rod moves into the ground is recorded, and these values are correlated to known values for soils. This information is then used to assess the density/consistency of the soils and obtain an indication of likely bearing capacities with the aid of numerical calculation. DPL field results have been included in **Appendix C**.

## 4.2 Fieldwork Results

### 4.2.1 Soil Profiles

Excavation of trial holes on site shows the natural profile of residual soils is overlain by fill layers of varying thicknesses across the site. A near surface groundwater table was encountered below most of the proposed development areas. The soil horizons below the site have been named according to their origin and position within the ground profile for reference purposes in this report. A table showing the soil horizons identified below the site has been included below for reference purposes.

|                                     |                                                                                                                                                                                                                                                                                                              |
|-------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Fill</b>                         | Slightly moist, light khaki orange or dark brown, loose becoming very loose with increasing depth, intact, fine to medium grained; Slightly CLAYEY SILTY SAND – <b>Fill</b> with roots and gravel.<br><br>Note: Some thin layers of fill of differing compositions were observed above and below this layer. |
| <b>Upper Residual</b>               | Very moist, mottled maroon and dark khaki, soft, fine grained; SILTY CLAYEY SAND – <b>Residual</b> .                                                                                                                                                                                                         |
| <b>Secondary Residual</b>           | Very moist, maroon with some dark khaki blotches, soft to firm, fine grained; SILTY CLAYEY SAND – <b>Residual</b> .                                                                                                                                                                                          |
| <b>Lower Residual</b>               | Very moist to wet, maroon with light khaki grey streaks, soft to firm, fine to medium grained; SILTY CLAYEY SAND – <b>Residual</b> with minor amounts of fine gravel.                                                                                                                                        |
| <b>Deep Residual</b>                | Moist, maroon with grey speckles, firm, SANDY CLAYEY SILT – <b>Residual</b> with some fine quartz gravel.                                                                                                                                                                                                    |
| <b>Residual over Weathered Rock</b> | Moist, dark orange with khaki speckles and streaks, stiff, fine grained; SILTY CLAYEY SAND – <b>Residual</b> .                                                                                                                                                                                               |

Fill material was encountered from surface across most of the site area, with the exception of the position for the valve bank in the north eastern corner of the site. The southern and western portions of the site appear to have been previously levelled by the placement of a bulk fill. The placement of this material appears to have also served to lift the site above the general groundwater level.

The various fill layers have the following characteristics;



The surface fill mostly comprises a thin layer of grey brown, fine to medium grained, slightly clayey silty sand with some roots and gravel. This layer does not exceed 0.4m thickness. In some places, a thin layer of granular fill material is present at surface. A layer of well compacted fill was encountered near surface alongside the staff parking area, and is likely the edge of the pavement layers.

The bulk fill encountered below the thin surface layers comprises light khaki orange, fine to medium grained, clayey silty sand. This material is likely reworked aeolian sand which was imported to raise the level of the site. In the area for the western valve bank, this material is dark brown in colour.

A thin layer of fill material with roots and some gravel was encountered below the bulk fill in places, and it is inferred that this layer was the original surface of the site prior to placement of the bulk fill. The total thickness of the fill layers in the southern and western portions of the site is between 1.6m and 2.2m.

A thin layer of topsoil was encountered at surface at the position for the north eastern valve bank. This layer is 0.4m thick and comprises grey brown, fine grained, slightly clayey silty sand with some roots and gravel. The bulk fill observed across the rest of the site is absent in this position.

Below the fill, a uniform profile of natural residual soils was encountered. The individual layers have been differentiated by variations in colour and composition. These layers being;

An *Upper Residual* layer which is mottled maroon and dark khaki in colour where present across the southern portion of the site, and orange below the western edge of the site. This layer comprises fine grained silty clayey sand. The *Secondary Residual* layer below this is the same in composition, but is maroon in colour, with only some dark khaki blotches, and has a higher consistency.

The *Lower Residual* layer is maroon in colour with light khaki grey streaks, and comprises fine to medium grained silty clayey sand. This shows an increase in particle size relative to the layer above. Minor amounts of fine gravel were observed within this layer.

The *Deep Residual* layer is a uniform maroon colour, with only some grey speckles. This material comprises sandy clayey silt, representing a significant decrease in particle size. Some fine quartz gravel was observed within this material.

Only one auger hole (TH1) reached residual soil, which appears to be the residual soil layer that lies directly over weathered rock which is inferred to be present at depth. This layer is dark orange in colour with khaki speckles and streaks, and comprises fine grained silty clayey sand. Manual auger drilling in this layer was very difficult, due to its dense consistency.

Groundwater was encountered in all of the trial holes across the site. In the southern portion of the site, groundwater was encountered between 1.3m and 2.5m below PGL. At the western valve bank position, the depth to groundwater decreased to 0.8m. Groundwater was encountered 1.5m below PGL in the north eastern corner of the site.

No rock was encountered within the trial holes excavated on site. Manual auger drilling was hindered by the presence of groundwater, with holes rapidly closing due to influx of water. Near refusal of the hand auger only occurred in TH1 at 4.8m below PGL.

A table listing the depths to the various soil horizons and groundwater in each test pit is given below for reference:

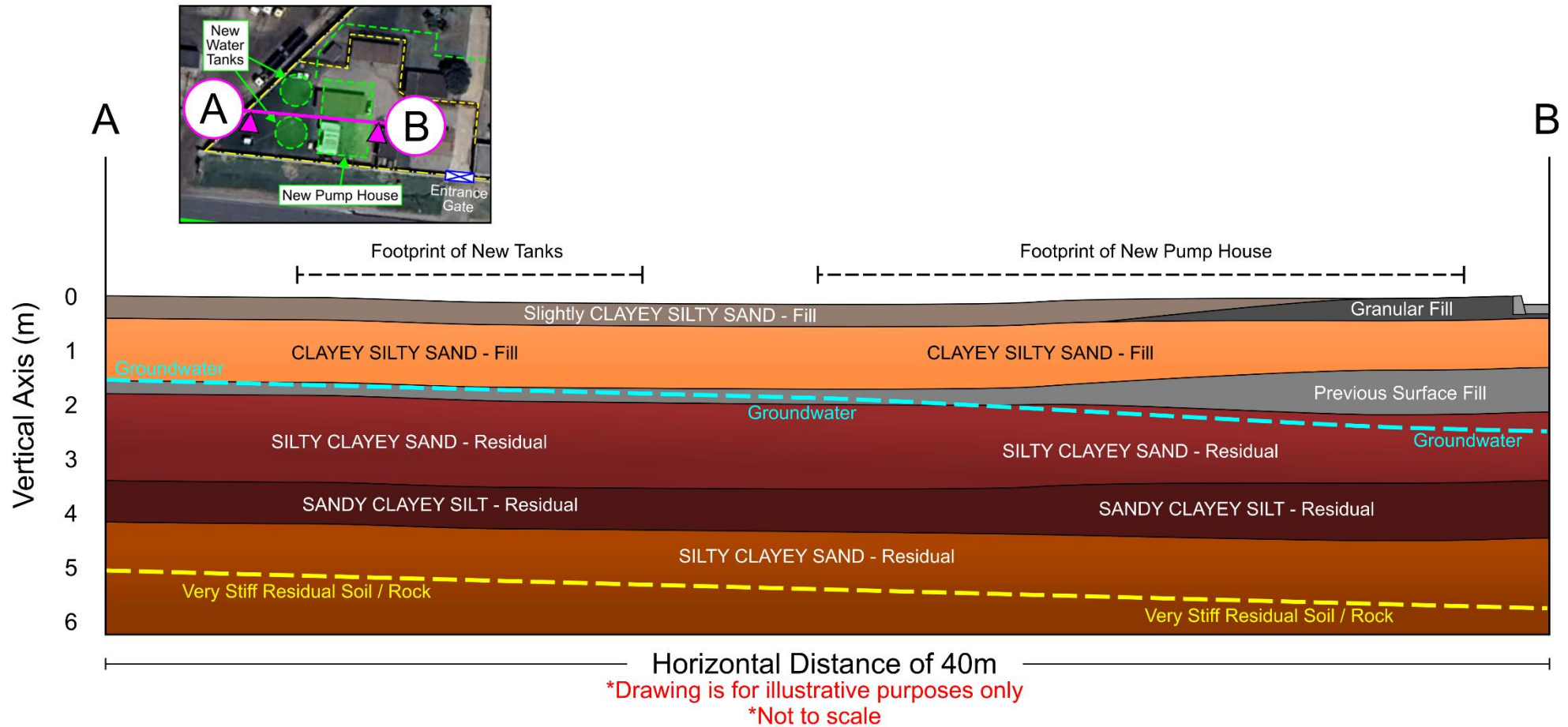
| Trial Hole | Fill Thickness  | Depth to Secondary Residual | Depth to Lower Residual | Depth to Deep Residual | Depth to Residual (over rock) | Groundwater Depth | Total Depth |
|------------|-----------------|-----------------------------|-------------------------|------------------------|-------------------------------|-------------------|-------------|
| TH1        | 1.9m            | 2.2m                        | 2.7m                    | 3.3m                   | 4.1m                          | 1.6m              | 4.8m        |
| TH2        | 2.2m            | 2.5m                        | 2.7m                    | 3.3m                   | Not encountered               | 2.5m              | 4.1m        |
| TH3        | 1.9m            | 2.4m                        | 2.8m                    | Not encountered        | Not encountered               | 1.5m              | 3.9m        |
| TH4        | 1.6m            | 2.4m                        | 3.4m                    | Not encountered        | Not encountered               | 1.3m              | 3.6m        |
| TH5        | 1.0m            | Not encountered             | Not encountered         | Not encountered        | Not encountered               | 0.8m              | 2.1m        |
| TH6        | Not encountered | 1.7m                        | 2.0m                    | Not encountered        | Not encountered               | 1.5m              | 3.0m        |

Individual soil profiles are included in **Appendix B** of the geotechnical report.

A generalised geological cross-section, depicting the general ground profile beneath the proposed position for the new tanks and pump house is shown over-page for explanatory purposes.



## Generalised Geological Cross-Section (A-B) New Fire Water Installation - Transnet Pipelines Witbank Depot



#### **4.2.2 Dynamic Penetrometer Light Tests**

Eight dynamic penetrometer light (DPL) tests were undertaken on site to assess the variation in consistency of the underlying soils with increasing depth as well as gain an indication of approximate depth to rock beneath the site. Testing was undertaken from surface to depths of between 4.1m to 6.6m below PGL, alongside respectively numbered trial holes or from existing surface level between trial holes.

Testing from surface to a depth of approximately 0.5m below PGL shows that the upper portion of fill is of medium dense consistency. Penetration rates of 14mm/blow or less were generally observed.

Below this depth, a drastic decrease in consistency was noted, with conditions becoming very loose/very soft. These very loose conditions persist to depths of between 3.0m and 4.0m below PGL. In TH3, two tests (DPL3A and 3B) were conducted within 0.5m of each other. Significant variations within the envelope of very loose/very soft conditions were also noted between tests.

Penetration in this zone were mostly between 50mm/blow and 100mm/blow. In a number of tests the apparatus was found to 'freefall' with penetration rates of up to 300mm/blow being recorded. The recorded depths where the high penetration rates were obtained occur in the saturated bulk fill and upper residual soil layers.

Continued testing within the deeper residual horizons resulted in a notable decrease in the penetration rate to values of between 20mm/blow and 4mm/blow. The results indicate that the residual soils transition from firm to stiff with increasing depth.

Near refusal of the DPL apparatus was encountered for each test conducted on site. This occurred at depths of between 4.8m and 6.0m below PGL. A table listing the depth to near refusal is given over-page for reference:

| DPL Number | Position                 | Depth to Near Refusal |
|------------|--------------------------|-----------------------|
| DPL1       | Alongside TH1            | 4.8m                  |
| DPL2       | Alongside TH2            | 5.6m                  |
| DPL3A      | Within TH3               | No refusal (4.1m)     |
| DPL3B      | Within TH3               | 5.1m                  |
| DPL3C      | Between TH1, TH2 and TH3 | 4.8m                  |
| DPL4       | Alongside TH4            | 6.0m                  |
| DPL5       | Alongside TH5            | 4.8m                  |
| DPL6       | Alongside TH6            | 6.6m                  |

Individual DPL test results have been included in **Appendix C**.

## **5 GEOTECHNICAL ASSESSMENT**

### **5.1 Proposed Development**

The development will comprise the construction of a new single storey masonry pump house and associated water storage tanks at the existing Witbank TPL facility. Elevated water pipelines as well as valve bank structures will also form part of the new infrastructure.

### **5.2 Geotechnical Constraints**

The ground profile underlying the earmarked site is deemed to have the following geotechnical constraints:

- Loose to very loose fill and residual soils. These very loose conditions extend to between 3m and 4m below PGL. Considerable post construction settlement can be expected if shallow foundations are placed in this material.
- A shallow, groundwater table is present at depths from 0.8m below PGL. This will prevent deep excavations and limit the effectiveness of any dynamic compaction of the very loose soils.

### **5.3 Earthworks**

Groundwater was intersected at shallow depths, starting from 0.8m below PGL. Trial hole sidewalls, above the groundwater table were found to be freestanding; albeit marginally stable. Any excavation to depths greater than 0.5m deep will need to be shored and pumping will be required to remove water. Manual excavation, using picks, spades and digging bars, through the fill and residual soil horizons was found to be easy as part of the geotechnical fieldwork. No rock was intersected within the trial holes excavated on site, however, DPL testing indicates that a hard stratum, inferred to be weathered rock, lies at depths of between 4.4m and 6.6m below PGL.

### **5.4 Foundations**

Placement of foundations in the underlying loose to very loose/soft fill and residual soil horizons will undergo considerable post-construction settlement. As such, it is strongly recommended that foundations are not placed within these soil horizons. It is further recommended that shallow type foundation solutions, such as the creation of a gravel mattress with concrete rafts and pads, should not be considered for the new infrastructure as the necessary foundation excavations will need to extend below the shallow groundwater

table and require temporary shoring and pumping. This will be complex and onerous as at least 3m of soil will need to be removed and replaced with competent layers of high strength gravel.

It is recommended that mini-piles are used to support the new infrastructure. These elements can be used to extend through the loose materials and shallow groundwater so that they reach, and take advantage of, underlying medium dense to dense competent ground horizons. This foundation solution will minimise the amount of foundation excavation and will be the quickest option. It is suggested that pre-fabricated steel or pre-cast concrete piles be used to support the pump room, water tanks as well as the bridge piers and valve banks. These foundations can be easily driven through the fill and residual layers to the hard stratum (inferred to be weathered rock) which lies at an approximate depth range of between 4.8m to 6.6m below ground surface level. A concrete raft and reinforced pad footings can then be placed on top of these piles.

Pre-fabricated piled foundations are deemed to serve the following purposes:

- They will negate the need for significant excavation.
- Negate the need for foundation excavations extending below the ground water table.
- The installation of these foundations will likely be significantly quicker, relative to a possible founding alternative of removing all soils down to weathered rock, placing shoring, followed by the creation of a granular mattress. Further to this, if a gravel mattress were to be utilised, the concrete rafts or pads would then require significantly more steel reinforcement than they would if supported on piles.
- All piled foundations can extend down to the underlying hard stratum, ensuring the full length of the structures rest on a uniform stiff/competent stratum. This will serve to minimise the magnitude of post-construction differential settlement.

A possible pile type to consider for the pump room and water tank could be the brand of prefabricated steel pile, known as the *Ductile Pile*, manufactured by *Bauer*. The pile type does not require specialised pile installation plant, with a normal 20ton excavator being sufficient. The piles can also be easily installed to variable depths across the same site. Contact details: +27 (0)11 966 7760, [info@geopileafrica.co.za](mailto:info@geopileafrica.co.za). The design of the pile capacity and associated lengths will need to be undertaken by the appointed piling contractor and associated design engineer. It is further recommended that the composition of the hard stratum which is deemed/inferred to be weathered rock, is positively verified during pile



installation. This will require a number of shallow rotary cored boreholes, as per the design engineer's requirements.

Prior to pile installation, 300mm of fill and surface sands must be stripped from the present ground surface. This material can be stockpiled and used for landscaping purposes upon completion of the works. The exposed sands can then be scarified and compacted to at least 98% MOD ASSHTO at 2% Optimal Moisture Content (OMC). Thereafter, imported granular material, of at least G5 quality and 150mm thick, can be placed to serve as a competent working surface and later as a base course horizon. This layer will need also to be compacted to 98% MOD ASSHTO at 2% OMC. The driven piles can then be installed through the placed granular layer. Once the prefabricated, displacement type piles are installed, the pile heads can be cast over with a concrete raft/pads which in turn will support the pump room, tanks, bridge piers and valve banks.

Vibration from the pile driving process, at installation stage, must be monitored. It is imperative that vibrations are minimised and managed so as not to affect the surrounding existing infrastructure. Vibrations, however, are not anticipated to be significant owing to the relatively small cross-sectional areas of the pile elements.

## **5.5 Quality and Re-use Potential of In-Situ Materials**

The natural aeolian and residual sands are predominantly fine grained with noticeable clay and silt contents. The sands do not have problematic plastic characteristics; albeit they are fine grained and of poor strength, which restricts their re-use potential. From on-site observation, the underlying aeolian and residual clay rich, fine grained residual sands are deemed to be of a low G10 quality or lower in accordance with the TRH 14 classification. Gravel material, for use as base course, will need to be imported for this development.

## **5.6 Stormwater Drainage**

The ground surface across the site was noted to have dried salt deposits, caked over the exposed surface soils. This, with the occurrence of a number of clogged surface drains, suggest that the site is periodically flooded. This was confirmed by staff members working at the facility. As such, the provision of surface drainage measures around the new infrastructure will be of paramount importance for this development. Subsoil drainage will have a limited effect owing to the shallow groundwater table.

## 6 CONCLUSION

Geotechnical investigation indicates the site is underlain by a succession of saturated, very loose/soft, fine grained, clay and silt rich, sands which extend to approximately 6.6m below present ground level. The sands comprise imported fill near surface and natural residual layers at depth. From observations of nearby rock outcrops in the area as well as the uniform depth to refusal recorded during DPL testing; weathered sandstone/siltstone rock is deemed to be present at approximately 4.8m to 6.6m below ground surface. Shallow groundwater is present across the site, intersected from depths of 0.8m below ground level.

Placement of shallow foundations in the very loose, saturated, soils must be avoided as differential settlement will occur and excavation below the groundwater table along with the creation of a necessary gravel mattress will be onerous. It is recommended that mini-piles be used that extend through these very loose and saturated soils to enable the underlying hard stratum (weathered rock) to be the primary supporting ground layer. Steel reinforced concrete raft and pad footings can then be placed on these piles. This solution will both limit the magnitude of differential settlements between the different infrastructure components and avoid having to excavate below the shallow groundwater table.

The site appears to undergo periodic flooding, with the accumulation of ponded water occurring at surface for long periods of time. As such, the provision of an extensive surface stormwater management system will need to be incorporated into the proposed development.

The site is deemed geotechnically acceptable for the planned development, provided the recommendations outlined herein are adhered to and cognisance of the geotechnical constraints is taken.

### GROUND AFRICA CONSULTING GEOTECHNICAL ENGINEERS

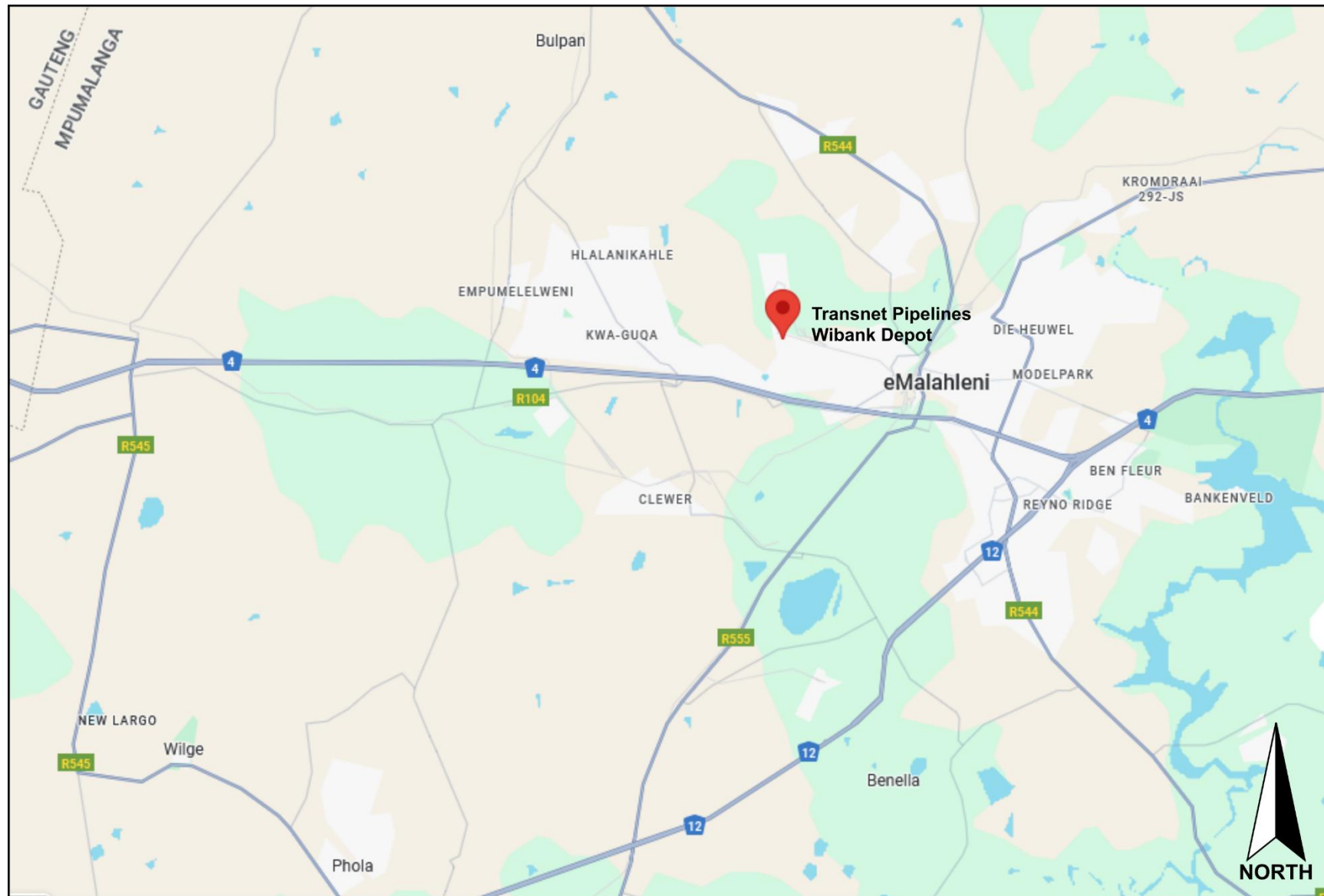


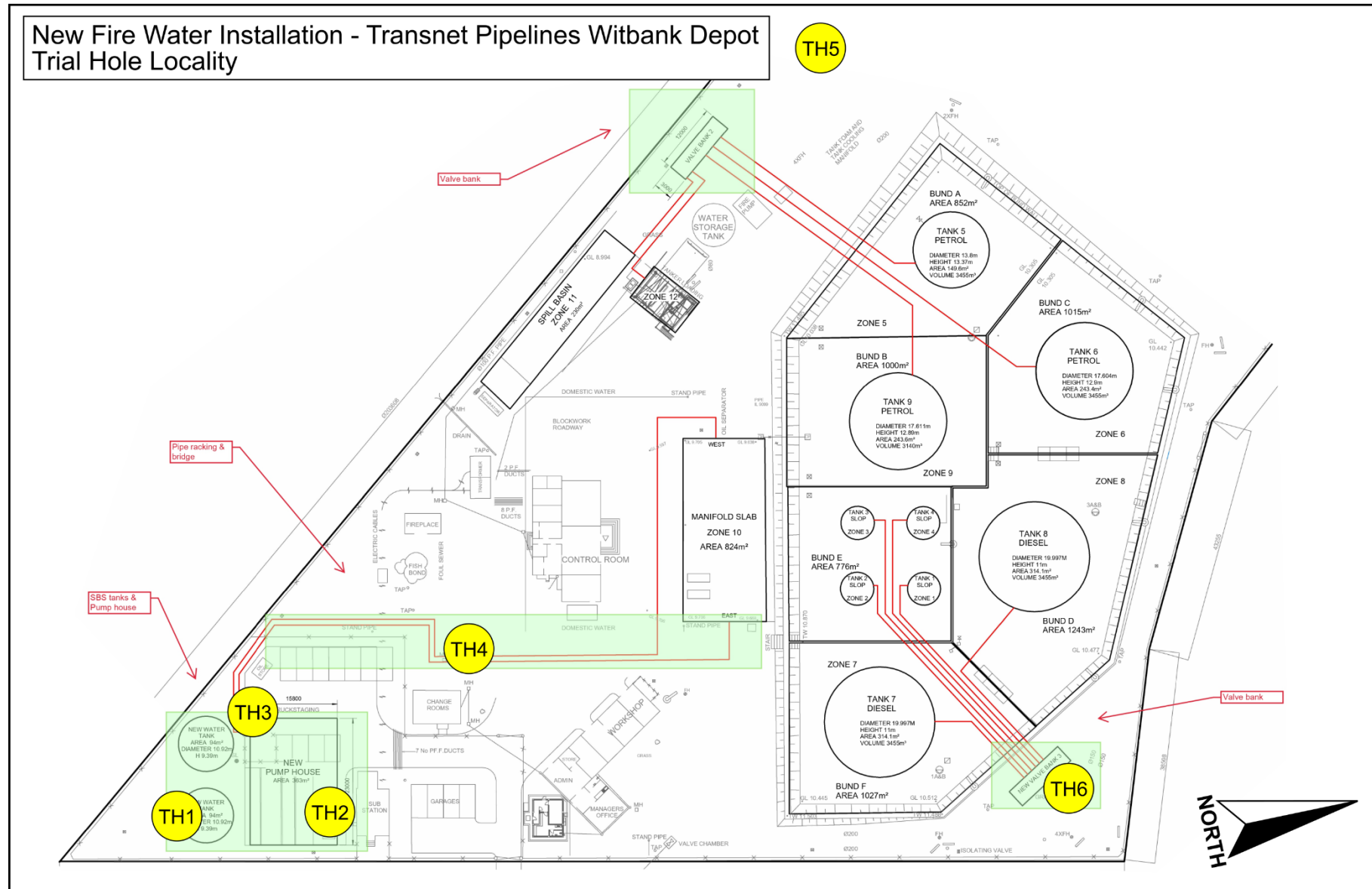
**Frederick Volbrecht MIEAust CPEng, PrEng**  
**Geotechnical Engineer**

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***APPENDIX A***  
***Locality Map***  
***Trial Hole and DPL Positions***

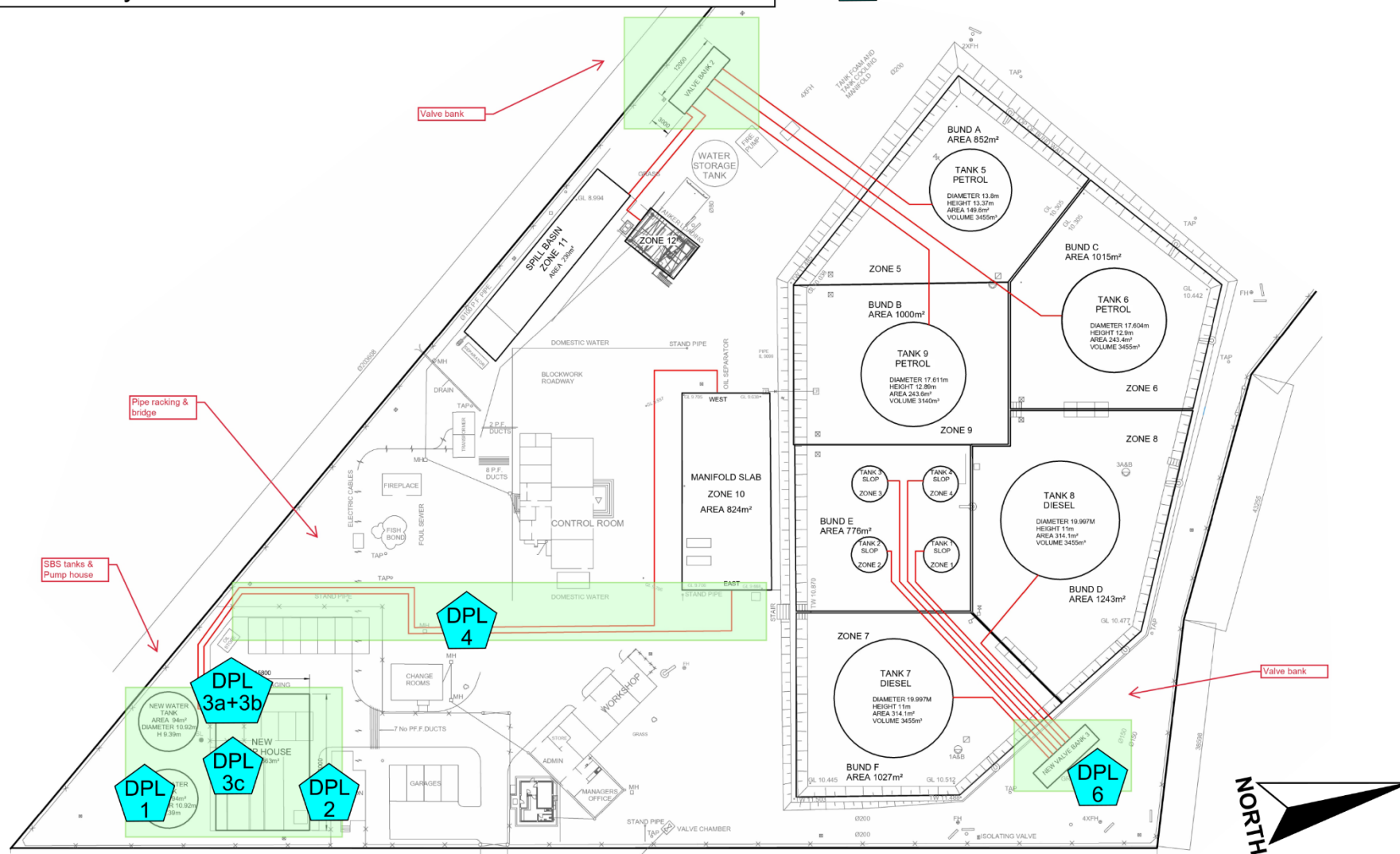
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# New Fire Water Installation - Transnet Pipelines Witbank Depot DPL Locality



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## ***APPENDIX B***

### ***Individual Soil Profiles***

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## TRIAL HOLE PROFILE

CLIENT: GreyJones (Pty) Ltd  
PROJECT: New Fire Water Installation (TPL Witbank)  
PROJECT NO: GA1062/2025  
LOCATION: New Tanks and Pump House

HOLE No: TH1  
LATITUDE: 25°51'50.9"S  
LONGITUDE: 29°10'00.5"E

Sheet 1 of 1

| Depth | Description                                                                                                                                                                                |                                                                                      |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|       | <i>Present Ground Level</i>                                                                                                                                                                |                                                                                      |
| 0.00  | <b>FILL</b><br>Dry to slightly moist, grey brown, medium dense, intact, fine to medium grained; Slightly CLAYEY SILTY SAND - Fill with roots and gravel.                                   |  |
| 0.30  | <b>FILL</b><br>Slightly moist, light khaki orange, loose becoming very loose with depth, intact, fine to medium grained; CLAYEY SILTY SAND - Fill with some roots.                         |                                                                                      |
| 0.5   |                                                                                                                                                                                            |                                                                                      |
| 1.0   |                                                                                                                                                                                            |                                                                                      |
| 1.5   |                                                                                                                                                                                            |                                                                                      |
| 1.60  | <b>FILL</b><br>Wet, grey with khaki blotches, loose, fine to medium grained; Slightly CLAYEY SILTY SAND - Fill with some roots and gravel.                                                 |                                                                                      |
| 1.90  |                                                                                                                                                                                            |                                                                                      |
| 2.0   |                                                                                                                                                                                            |                                                                                      |
| 2.20  | Note: Material has strong petrochemical smell.                                                                                                                                             |                                                                                      |
| 2.20  | <b>SILTY CLAYEY SAND</b><br>Very moist, mottled maroon and dark khaki, soft, fine grained; SILTY CLAYEY SAND - Residual.                                                                   |                                                                                      |
| 2.5   | <b>SILTY CLAYEY SAND</b><br>Very moist, maroon with some dark khaki blotches, soft to firm, fine grained; SILTY CLAYEY SAND - Residual.                                                    |  |
| 2.70  | <b>SILTY CLAYEY SAND</b><br>Very moist to wet, maroon with light khaki grey streaks, soft to firm, fine to medium grained; SILTY CLAYEY SAND - Residual with minor amounts of fine gravel. |                                                                                      |
| 3.0   |                                                                                                                                                                                            |                                                                                      |
| 3.30  | <b>SANDY CLAYEY SILT</b><br>Moist, maroon with grey speckles, firm, SANDY CLAYEY SILT - Residual with some fine quartz gravel.                                                             |                                                                                      |
| 3.5   |                                                                                                                                                                                            |                                                                                      |
| 4.0   |                                                                                                                                                                                            |                                                                                      |
| 4.10  | <b>SILTY CLAYEY SAND</b><br>Moist, dark orange with khaki speckles and streaks, stiff, fine grained; SILTY CLAYEY SAND - Residual.                                                         |                                                                                      |
| 4.5   |                                                                                                                                                                                            |                                                                                      |
| 4.80  |                                                                                                                                                                                            |                                                                                      |
|       | End of log                                                                                                                                                                                 |                                                                                      |

- NOTES:
- 1: End of hole at 4.8m
  - 2: Hand auger commenced from 1.2m
  - 3: Very slow augering at 4.8m
  - 4: Sample WT1 obtained at 2.3m
  - 5: Groundwater encountered at 1.6m

EXCAVATION METHOD: Manual Excavation and Hand Auger

DATE PROFILED: 17/09/2025

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## TRIAL HOLE PROFILE

CLIENT: GreyJones (Pty) Ltd  
PROJECT: New Fire Water Installation (TPL Witbank)  
PROJECT NO: GA1062/2025  
LOCATION: New Tanks and Pump House

HOLE No: TH2  
LATITUDE: 25°51'50.1"S  
LONGITUDE: 29°10'00.5"E

Sheet 1 of 1

| Depth | Description                                                                                                                                                                                 |  |
|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|       | <i>Present Ground Level</i>                                                                                                                                                                 |  |
| 0.00  | <b>FILL</b><br>Dry to slightly moist, light grey brown with grey speckles, medium dense, intact; CRUSHED RHYOLITE ROCK within a fine to coarse grained Silty Sand Matrix - Fill with roots. |  |
| 0.25  | <b>FILL</b><br>Dry to slightly moist, khaki orange with brown blotches, medium dense to dense, intact, fine to medium grained; Slightly CLAYEY SILTY SAND - Fill with some roots.           |  |
| 0.5   |                                                                                                                                                                                             |  |
| 0.90  | <b>FILL</b><br>Slightly moist, orange brown, loose becoming very loose with depth, intact, fine to medium grained; CLAYEY SILTY SAND - Fill with some roots.                                |  |
| 1.0   |                                                                                                                                                                                             |  |
| 1.40  | <b>FILL</b><br>Moist, olive brown with grey blotches, medium dense with loose zones, fine to medium grained; SILTY SAND - Fill with some gravel at base of layer.                           |  |
| 1.5   |                                                                                                                                                                                             |  |
| 2.0   |                                                                                                                                                                                             |  |
| 2.20  | <b>SILTY CLAYEY SAND</b><br>Very moist, mottled maroon and dark khaki, soft, fine grained; SILTY CLAYEY SAND - Residual.                                                                    |  |
| 2.5   | <b>SILTY CLAYEY SAND</b><br>Wet, mottled maroon and dark khaki, soft, fine grained; SILTY CLAYEY SAND - Residual.                                                                           |  |
| 2.70  | <b>SILTY CLAYEY SAND</b><br>Very moist, maroon with some dark khaki blotches, soft to firm, fine grained; SILTY CLAYEY SAND - Residual.                                                     |  |
| 3.0   |                                                                                                                                                                                             |  |
| 3.30  | <b>SANDY CLAYEY SILT</b><br>Moist, maroon with grey speckles, firm, SANDY CLAYEY SILT - Residual with some fine quartz gravel.                                                              |  |
| 3.5   |                                                                                                                                                                                             |  |
| 4.0   |                                                                                                                                                                                             |  |
| 4.10  | End of log                                                                                                                                                                                  |  |

NOTES: 1: End of hole at 4.1m  
2: Hand auger commenced from 1.2m  
3: Hole collapse at 4.1m  
4: No sample obtained  
5: Groundwater encountered at 2.5m

EXCAVATION METHOD: Manual Excavation and Hand Auger

DATE PROFILED: 17/09/2025

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## TRIAL HOLE PROFILE

CLIENT: GreyJones (Pty) Ltd  
PROJECT: New Fire Water Installation (TPL Witbank)  
PROJECT NO: GA1062/2025  
LOCATION: New Tanks and Pump House

HOLE No: TH3  
LATITUDE: 25°51'50.4"S  
LONGITUDE: 29°09'59.9"E

Sheet 1 of 1

| Depth | Description                                                                                                                                                                                |  |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|       | <i>Present Ground Level</i>                                                                                                                                                                |  |
| 0.00  | <b>FILL</b><br>Dry to slightly moist, grey brown, medium dense to dense, intact, fine to medium grained; Slightly CLAYEY SILTY SAND - Fill with some gravel.                               |  |
| 0.10  |                                                                                                                                                                                            |  |
| 0.30  | <b>FILL</b><br>Dry to slightly moist, orange brown with red speckles, dense, intact; Slightly CLAYEY SILTY SAND - Fill with some gravel.                                                   |  |
| 0.5   |                                                                                                                                                                                            |  |
| 0.80  | <b>FILL</b><br>Dry to slightly moist, orange brown with red blotches, medium dense, intact; Slightly CLAYEY SILTY SAND - Fill with some gravel.                                            |  |
| 1.0   | <b>FILL</b><br>Slightly moist, light khaki orange, loose becoming very loose with depth, intact, fine to medium grained; CLAYEY SILTY SAND - Fill with some roots.                         |  |
| 1.5   |                                                                                                                                                                                            |  |
| 1.90  | <b>SILTY CLAYEY SAND</b><br>Very moist, mottled maroon and dark khaki, soft, fine grained; SILTY CLAYEY SAND - Residual.                                                                   |  |
| 2.0   |                                                                                                                                                                                            |  |
| 2.40  | <b>SILTY CLAYEY SAND</b><br>Very moist, maroon with some dark khaki blotches, soft to firm, fine grained; SILTY CLAYEY SAND - Residual.                                                    |  |
| 2.5   |                                                                                                                                                                                            |  |
| 2.80  | <b>SILTY CLAYEY SAND</b><br>Very moist to wet, maroon with light khaki grey streaks, soft to firm, fine to medium grained; SILTY CLAYEY SAND - Residual with minor amounts of fine gravel. |  |
| 3.0   |                                                                                                                                                                                            |  |
| 3.5   |                                                                                                                                                                                            |  |
| 3.90  |                                                                                                                                                                                            |  |
|       | End of log                                                                                                                                                                                 |  |



- NOTES:
- 1: End of hole at 3.9m
  - 2: Hand auger commenced from 1.0m
  - 3: Slow augering and hole collapse at 3.9m
  - 4: No sample obtained
  - 5: Groundwater encountered at 1.5m

EXCAVATION METHOD: Manual Excavation and Hand Auger

DATE PROFILED: 17/09/2025

PROFILED BY: OS

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## TRIAL HOLE PROFILE

CLIENT: GreyJones (Pty) Ltd  
PROJECT: New Fire Water Installation (TPL Witbank)  
PROJECT NO: GA1062/2025  
LOCATION: Pipe Racking and Bridge

HOLE No: TH4  
LATITUDE: 25°51'48.9"S  
LONGITUDE: 29°09'59.7"E

Sheet 1 of 1

| Depth | Description                                                                                                                                                                                |                                                                                      |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|       | <i>Present Ground Level</i>                                                                                                                                                                |                                                                                      |
| 0.00  | <b>FILL</b><br>Slightly moist, dark brown becoming red with depth, medium dense, intact, fine to medium grained; Slightly CLAYEY SILTY SAND - Fill with abundant roots at surface.         |  |
| 0.40  | <b>FILL</b><br>Slightly moist, light khaki orange, loose becoming very loose with depth, intact, fine to medium grained; CLAYEY SILTY SAND - Fill with some roots.                         |                                                                                      |
| 0.5   |                                                                                                                                                                                            |                                                                                      |
| 1.30  | <b>FILL</b><br>Wet, light khaki orange, loose becoming very loose with depth, intact, fine to medium grained; CLAYEY SILTY SAND - Fill with some roots.                                    |                                                                                      |
| 1.60  | <b>SILTY CLAYEY SAND</b><br>Very moist to wet, mottled maroon and dark khaki, soft, fine grained; SILTY CLAYEY SAND - Residual.                                                            |                                                                                      |
| 2.0   |                                                                                                                                                                                            |                                                                                      |
| 2.40  | <b>SILTY CLAYEY SAND</b><br>Very moist, maroon with some dark khaki blotches, soft to firm, fine grained; SILTY CLAYEY SAND - Residual.                                                    |                                                                                      |
| 2.5   |                                                                                                                                                                                            |                                                                                      |
| 3.0   |                                                                                                                                                                                            |                                                                                      |
| 3.40  | <b>SILTY CLAYEY SAND</b><br>Very moist to wet, maroon with light khaki grey streaks, soft to firm, fine to medium grained; SILTY CLAYEY SAND - Residual with minor amounts of fine gravel. |                                                                                      |
| 3.5   |                                                                                                                                                                                            |                                                                                      |
| 3.60  |                                                                                                                                                                                            |                                                                                      |
|       | End of log                                                                                                                                                                                 |                                                                                      |

- NOTES:
- 1: End of hole at 3.6m
  - 2: Hand auger commenced from 1.1m
  - 3: Hole collapse at 3.6m
  - 4: Sample WT2 obtained at 1.0m
  - 5: Groundwater encountered at 1.3m

EXCAVATION METHOD: Manual Excavation and Hand Auger

DATE PROFILED: 18/09/2025

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## TRIAL HOLE PROFILE

CLIENT: GreyJones (Pty) Ltd  
PROJECT: New Fire Water Installation (TPL Witbank)  
PROJECT NO: GA1062/2025  
LOCATION: Valve Bank 2

HOLE No: TH5  
LATITUDE: 25°51'46.3"S  
LONGITUDE: 29°09'56.2"E

Sheet 1 of 1

| Depth | Description                                                                                                                          |                                                                                      |
|-------|--------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|       | <i>Present Ground Level</i>                                                                                                          |                                                                                      |
| 0.00  | <b>FILL</b><br>Slightly moist, brown with orange blotches, medium dense, intact, fine to medium grained; SILTY GRAVELLY SAND - Fill. |  |
| 0.30  | <b>FILL</b><br>Moist, dark brown, loose, intact, fine to medium grained; Slightly CLAYEY SILTY SAND - Fill.                          |                                                                                      |
| 0.80  | <b>FILL</b><br>Wet, dark brown, loose, intact, fine to medium grained; Slightly CLAYEY SILTY SAND - Fill.                            |                                                                                      |
| 1.00  | <b>SILTY CLAYEY SAND</b><br>Wet, orange, soft, fine to medium grained; SILTY CLAYEY SAND - Residual with some fine quartz gravel.    |                                                                                      |
| 1.50  |                                                                                                                                      |                                                                                      |
| 2.00  |                                                                                                                                      |                                                                                      |
| 2.10  |                                                                                                                                      |                                                                                      |
|       | End of log                                                                                                                           |                                                                                      |

- NOTES:
- 1: End of hole at 2.1m
  - 2: Hand auger commenced from 0.8m
  - 3: Hole collapse from 0.8m
  - 4: No sample obtained
  - 5: Groundwater encountered at 0.8m

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EXCAVATION METHOD: Manual Excavation and Hand Auger

DATE PROFILED: 18/09/2025

PROFILED BY: OS

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## TRIAL HOLE PROFILE

CLIENT: GreyJones (Pty) Ltd  
PROJECT: New Fire Water Installation (TPL Witbank)  
PROJECT NO: GA1062/2025  
LOCATION: Valve Bank 3

HOLE No: TH6  
LATITUDE: 25°51'45.8"S  
LONGITUDE: 29°10'01.2"E

Sheet 1 of 1

| Depth          |      | Description                                                                                                                                                             |                                                                                      |
|----------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|                |      | <i>Present Ground Level</i>                                                                                                                                             |                                                                                      |
|                | 0.00 | <b>Slightly CLAYEY SILTY SAND</b><br>Dry to slightly moist, grey brown, medium dense, intact, fine grained; Slightly CLAYEY SILTY SAND - Topsoil with roots and gravel. |  |
| 0.5            | 0.40 | <b>Slightly CLAYEY SILTY SAND</b><br>Slightly moist, reddish brown, loose, intact, fine to medium grained; Slightly CLAYEY SILTY SAND - Residual with some roots.       |                                                                                      |
| Auger<br>▼ 1.0 |      |                                                                                                                                                                         |                                                                                      |
| 1.5            | 1.50 | <b>Slightly CLAYEY SILTY SAND</b><br>Wet, reddish brown, loose, intact, fine to medium grained; Slightly CLAYEY SILTY SAND - Residual with some roots.                  |                                                                                      |
|                | 1.70 | <b>SILTY CLAYEY SAND</b><br>Wet, mottled maroon and dark khaki, soft, fine grained; SILTY CLAYEY SAND - Residual.                                                       |                                                                                      |
| 2.0            | 2.00 | <b>SILTY CLAYEY SAND</b><br>Wet, maroon with some dark khaki blotches, soft to firm, fine grained; SILTY CLAYEY SAND - Residual.                                        |                                                                                      |
| 2.5            |      |                                                                                                                                                                         |                                                                                      |
| 3.0            | 3.00 | End of log                                                                                                                                                              |                                                                                      |

- NOTES:
- 1: End of hole at 3.0m
  - 2: Hand auger commenced from 1.0m
  - 3: Hole collapse at 3.0m
  - 4: No sample obtained
  - 5: Groundwater encountered at 1.5m

EXCAVATION METHOD: Manual Excavation and Hand Auger

DATE PROFILED: 18/09/2025

PROFILED BY: OS

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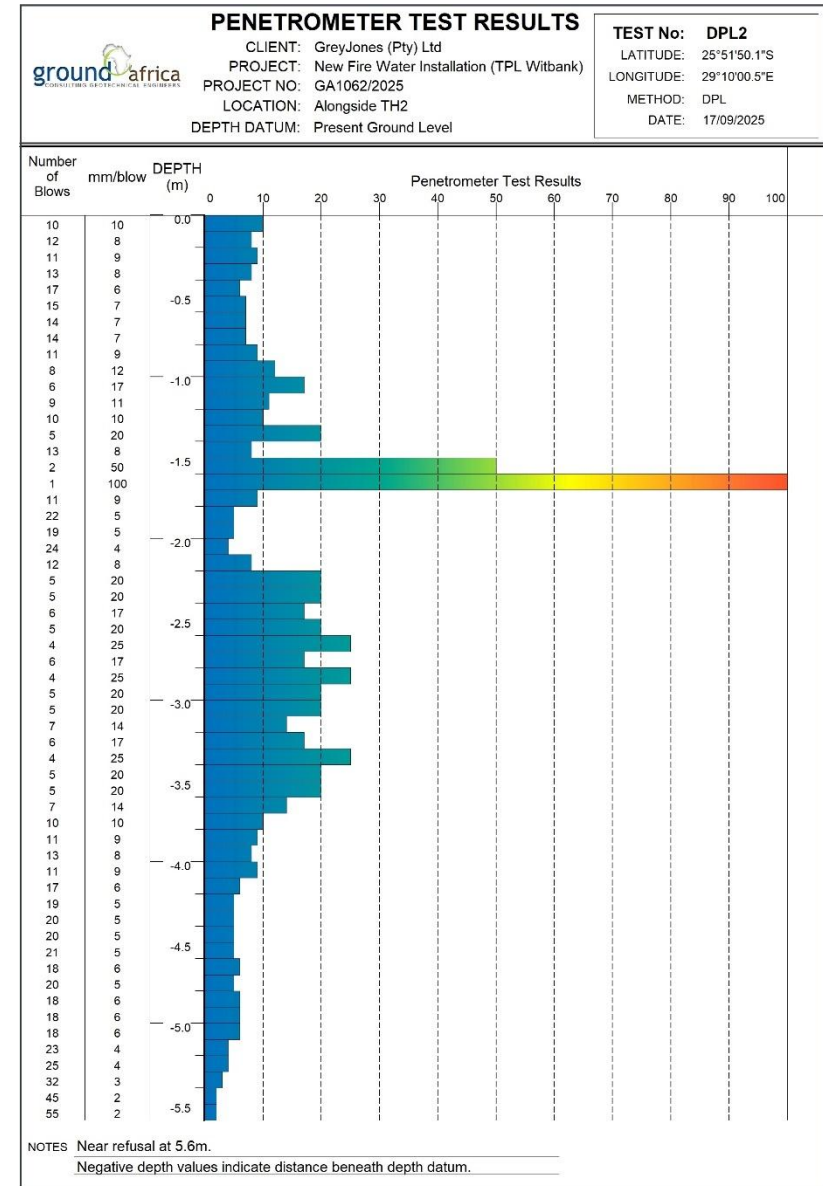
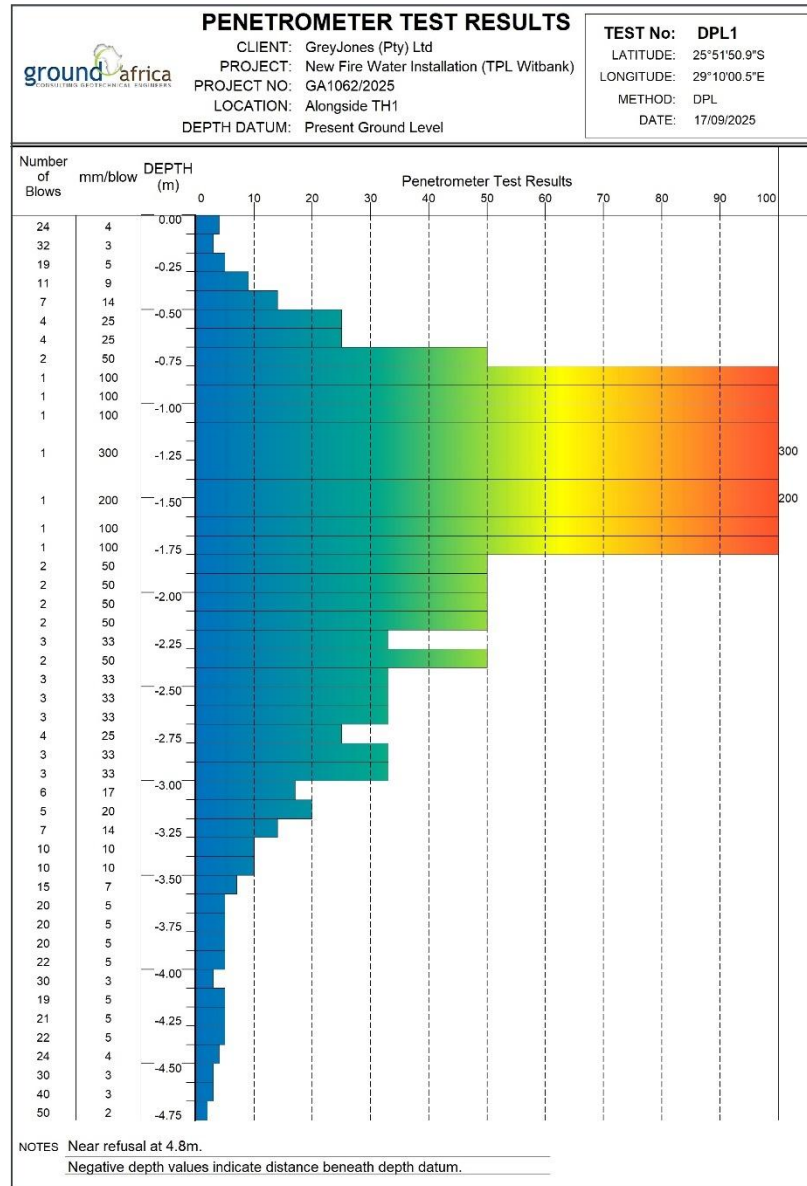
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## ***APPENDIX C***

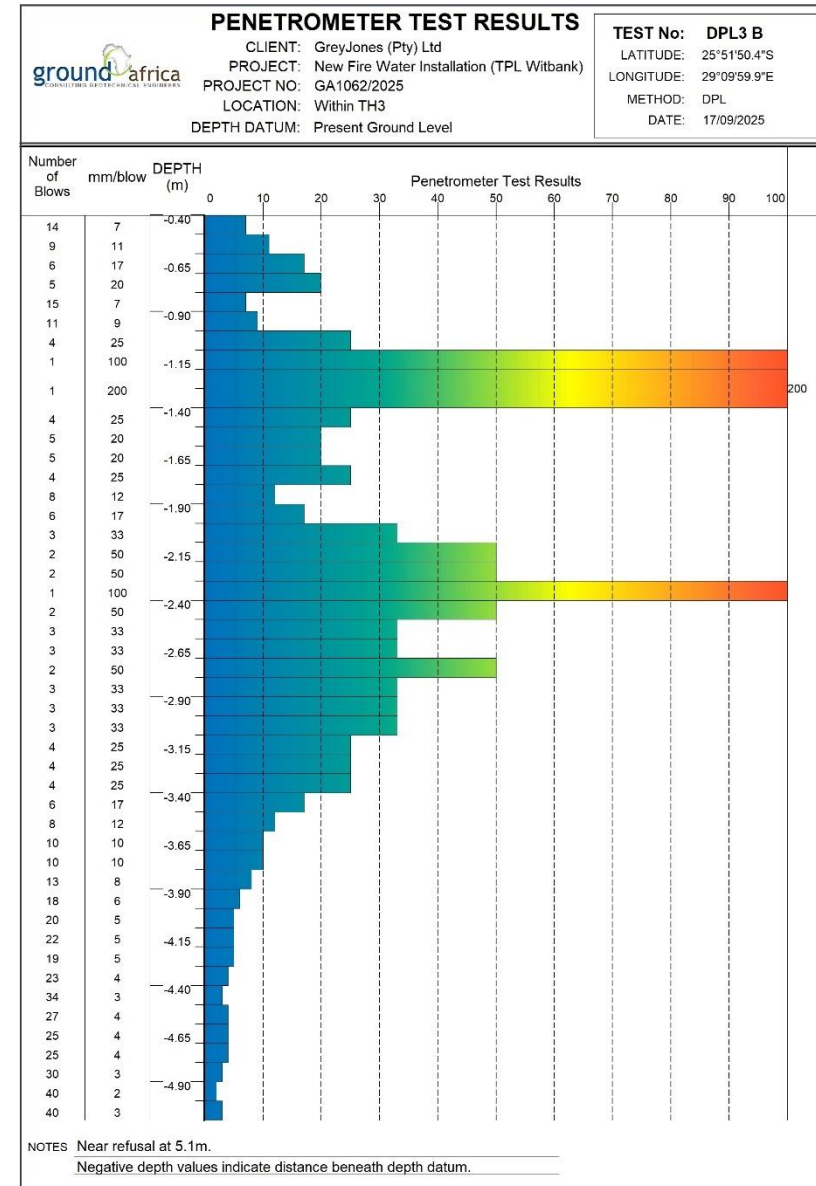
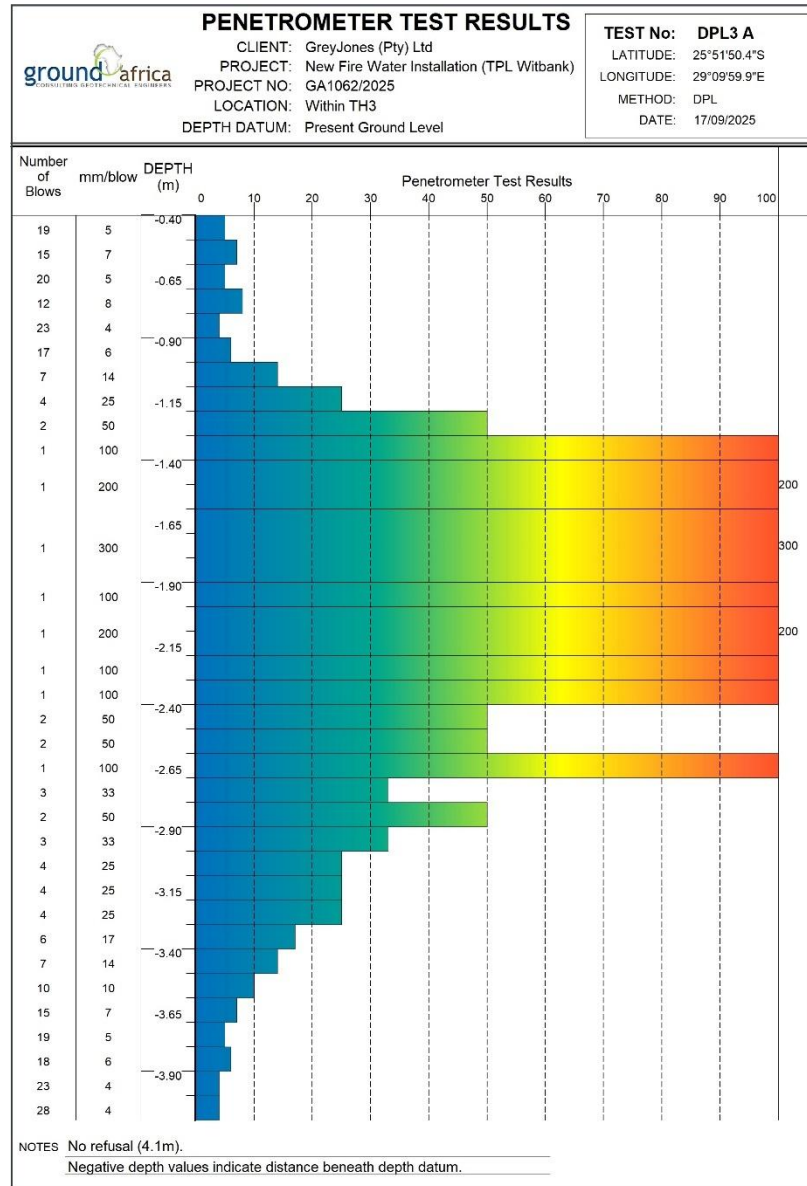
### ***Dynamic Penetrometer Light Test Results***

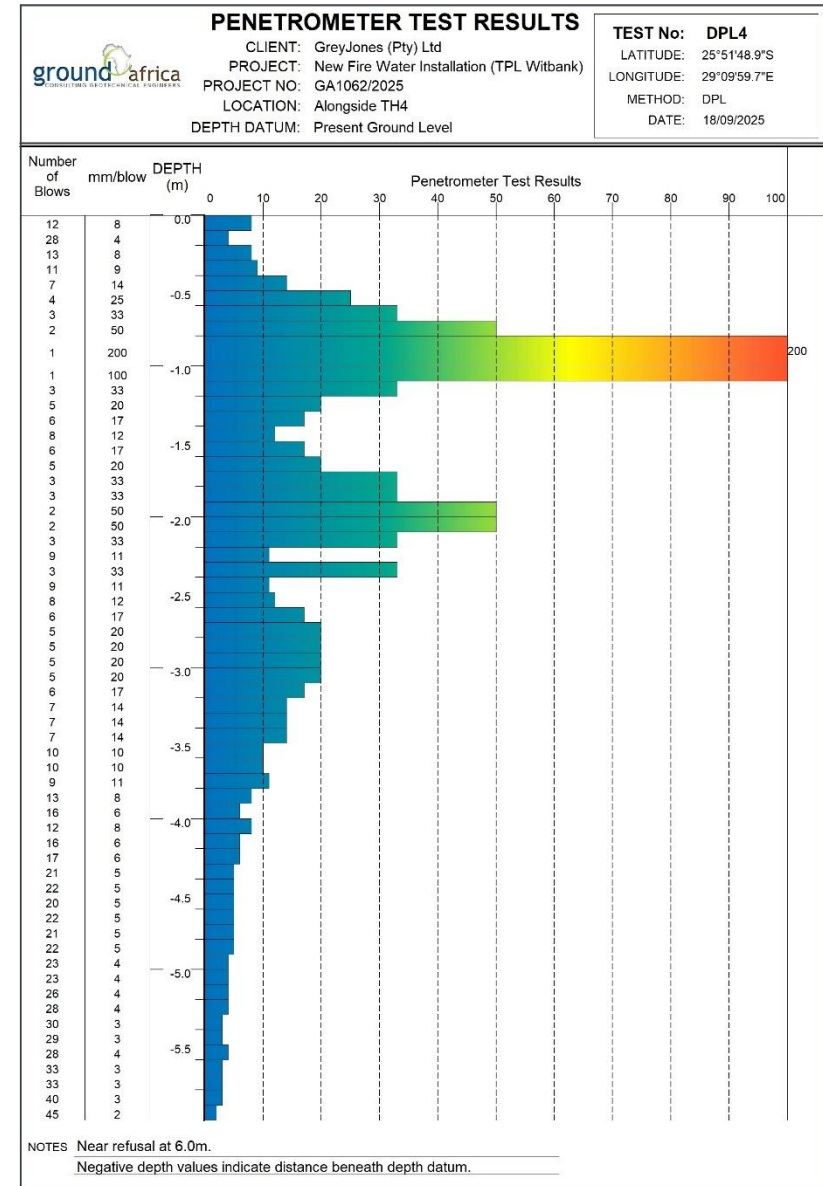
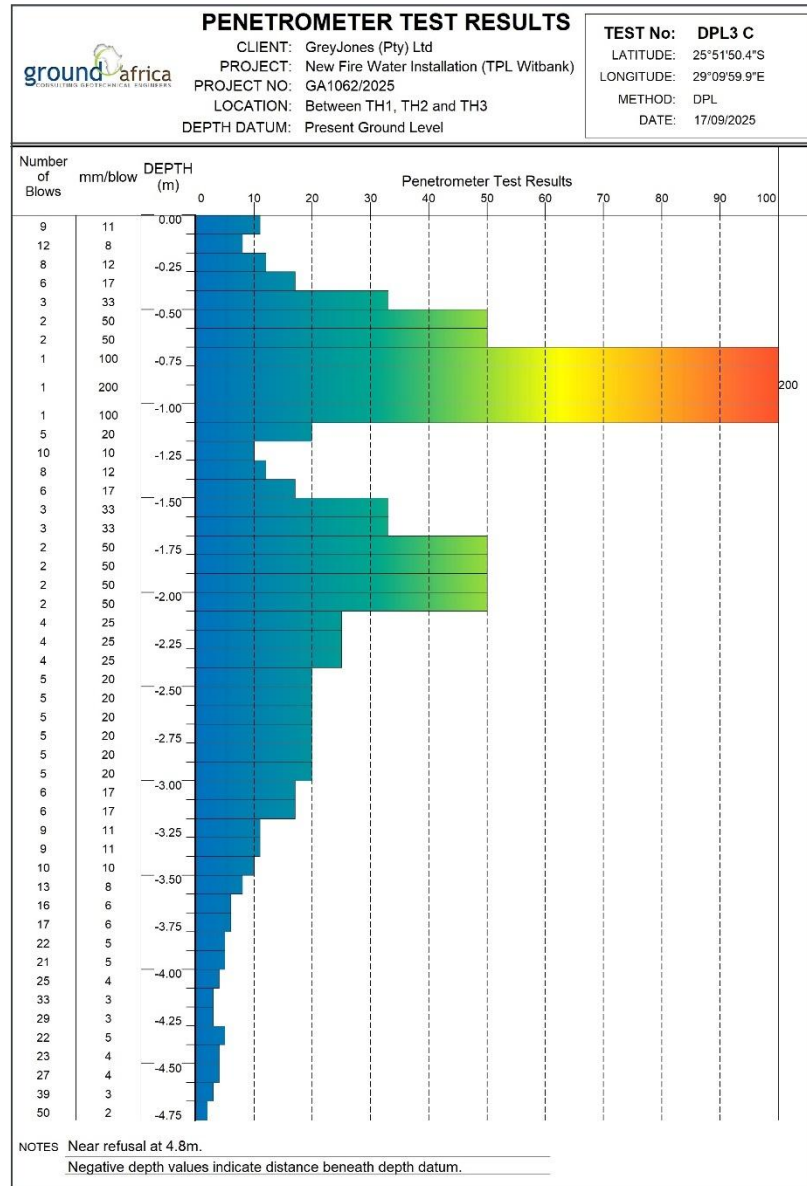
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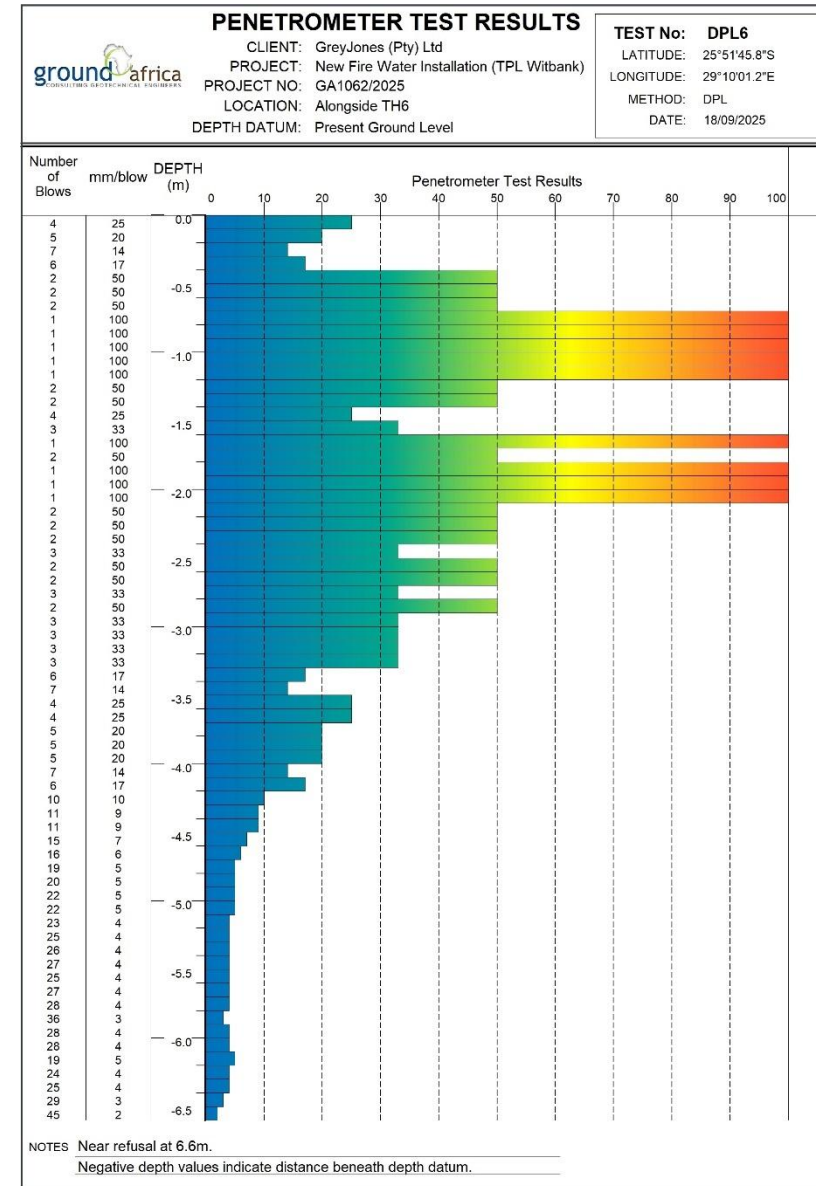
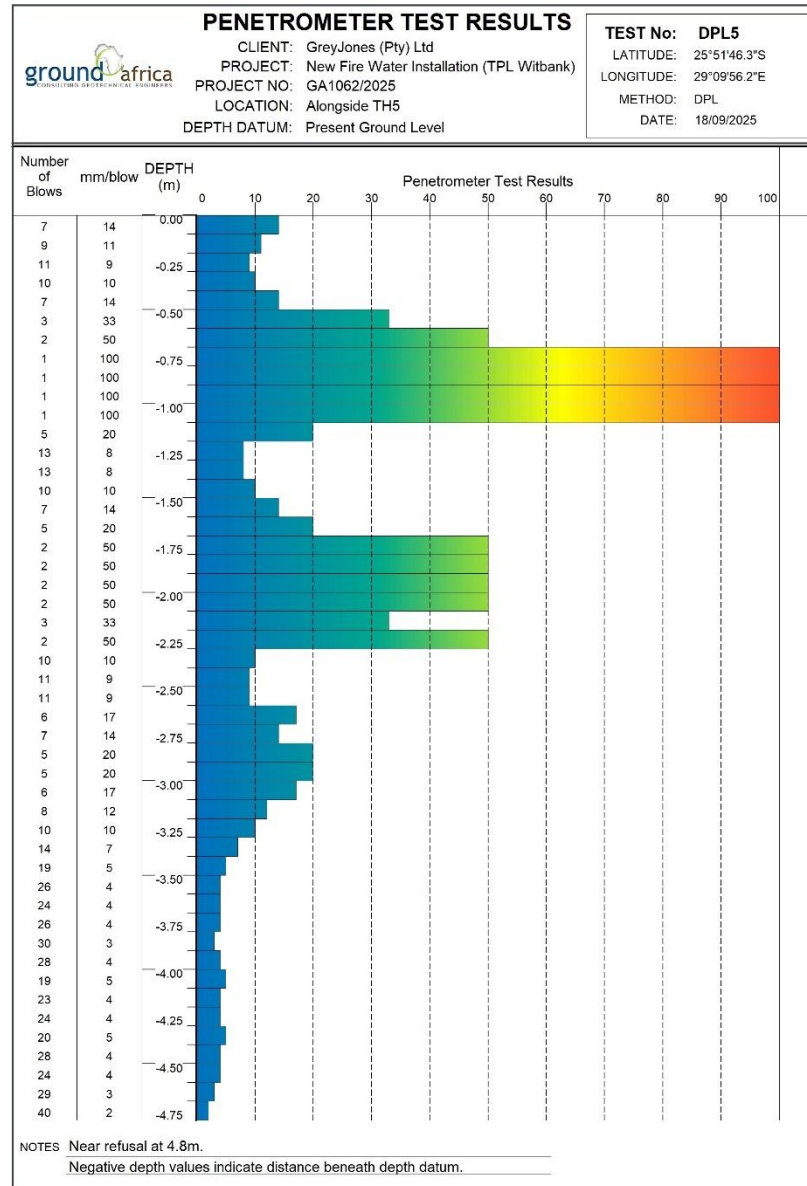












# Witbank Pump Station

Groundwater Monitoring Event  
November 2021

Transnet Pipelines  
B-04/06

Project reference: PYP/W1/6/21/1808

Project number: 60617870

60617870-GME-ACM-XX-XX-AS-GE-000001-F-0-Transnet Witbank\_November 2021

December 2 2021

## Quality information

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## Revision History

| Revision | Revision date    | Details                        | Authorized | Name          | Position        |
|----------|------------------|--------------------------------|------------|---------------|-----------------|
| 0.0      | 10 December 2021 | Final for client<br>submission | Yes        | Rannel Naidoo | Project Manager |
|          |                  |                                |            |               |                 |
|          |                  |                                |            |               |                 |
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## Table of Contents

|       |                                                   |    |
|-------|---------------------------------------------------|----|
| 1.    | Introduction.....                                 | 1  |
| 1.1   | Terms of Reference .....                          | 1  |
| 1.2   | Project Background .....                          | 1  |
| 1.3   | Site History .....                                | 1  |
| 1.4   | Project Objectives .....                          | 2  |
| 2.    | Scope of Work and Technical Approach .....        | 3  |
| 2.1   | Desktop Review and Site Walkover.....             | 3  |
| 2.2   | Groundwater Sampling.....                         | 3  |
| 2.3   | Laboratory Analyses.....                          | 3  |
| 2.4   | HSE Planning.....                                 | 4  |
| 3.    | Site Information and Environmental Setting.....   | 5  |
| 3.1   | Site Details.....                                 | 5  |
| 3.2   | Topography.....                                   | 5  |
| 3.3   | Hydrology .....                                   | 5  |
| 3.4   | Geology.....                                      | 5  |
| 3.5   | Hydrogeology.....                                 | 5  |
| 4.    | Fieldwork.....                                    | 7  |
| 4.1   | Groundwater Sampling.....                         | 7  |
| 4.2   | Groundwater Flow Direction.....                   | 8  |
| 4.3   | Field Parameters.....                             | 9  |
| 5.    | Laboratory Analytical Results.....                | 10 |
| 5.1   | Groundwater Results.....                          | 10 |
| 5.2   | Trend Analysis for Impacted Monitoring Wells..... | 12 |
| 5.3   | Quality Assurance/Control (QA/QC).....            | 17 |
| 6.    | Conceptual Site Model .....                       | 19 |
| 6.1   | Source Characterisation .....                     | 19 |
| 6.1.1 | On-Site .....                                     | 19 |
| 6.1.2 | Off-Site .....                                    | 19 |
| 6.2   | Potential Receptors .....                         | 19 |
| 6.3   | Pathways of Concern .....                         | 19 |
| 6.3.1 | Soil .....                                        | 19 |
| 6.3.2 | Groundwater .....                                 | 19 |
| 6.4   | Assessment of SPR Linkages.....                   | 20 |
| 7.    | Summary and Conclusions.....                      | 22 |
| 7.1   | Recommendations .....                             | 22 |
|       | Appendix A .....                                  | 23 |
|       | Appendix B .....                                  | 31 |

## Tables

|          |                                                                                              |    |
|----------|----------------------------------------------------------------------------------------------|----|
| Table 1. | Summary of the Laboratory Analysis Suite.....                                                | 3  |
| Table 2. | Summary of Site Details.....                                                                 | 5  |
| Table 3. | Summary of Monitoring Well Gauge Information during Groundwater Monitoring and Sampling..... | 7  |
| Table 4. | Field Parameters Measured During Groundwater Sampling.....                                   | 9  |
| Table 5. | Hydrocarbon Laboratory Results for Groundwater Samples.....                                  | 11 |
| Table 6. | Sampling Relative Percentage Difference Between MW7 and DUP .....                            | 18 |
| Table 7. | Potential Sensitive Receptors.....                                                           | 19 |
| Table 8. | Conceptual Site Model Summary.....                                                           | 20 |

## Figures

|                                                                                                                                                     |    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Figure 4 - 1: Groundwater level .....                                                                                                               | 7  |
| Figure 4 - 2: Photo A: Manhole cover for missing Monitoring well MW9, Photo B: Condition of the destroyed manhole cover on monitoring well MW6..... | 8  |
| Figure 4 - 3. Groundwater Flow Direction Contours for April 2021 .....                                                                              | 8  |
| Figure 5- 1: Benzene Concentrations in Monitoring Well MW2 and MW3 since September 2018 .....                                                       | 12 |
| Figure 5- 2: Ethylbenzene Concentrations in Monitoring Well MW3 since September 2018 .....                                                          | 13 |
| Figure 5- 3:TAME Concentrations in Monitoring Well MW1 and MW2 since September 2018 .....                                                           | 14 |
| Figure 5- 4: TAME Concentrations in Monitoring Well MW3 and MW5 since September 2018 .....                                                          | 15 |
| Figure 5- 5: TAME Concentrations in Monitoring Well MW6 and MW7 since September 2018 .....                                                          | 16 |
| Figure 5- 6: TAME Concentrations in Monitoring Well MW8 and MW9 since September 2018 .....                                                          | 17 |
| Figure 1: Orthophoto Locality .....                                                                                                                 | 24 |
| Figure 2: Site Plan Locality.....                                                                                                                   | 25 |
| Figure 3: Environmental Summary.....                                                                                                                | 26 |
| Figure 4: Hydrogeological Summary.....                                                                                                              | 27 |
| Figure 5: Site Layout.....                                                                                                                          | 28 |
| Figure 6: Groundwater Analytical Results.....                                                                                                       | 29 |
| Figure 7: Conceptual Site Model.....                                                                                                                | 30 |

**Glossary**

|        |                                                    |
|--------|----------------------------------------------------|
| AECOM  | AECOM SA (Pty) Ltd                                 |
| amsl   | above mean sea level                               |
| Avtur  | aviation turbine fuel                              |
| CSM    | Conceptual Site Model                              |
| DRO    | Diesel Range Organics                              |
| EC     | Electrical Conductivity                            |
| GME    | Groundwater Monitoring Event                       |
| GRO    | Gasoline Range Organics                            |
| HASP   | Health and Safety Plan                             |
| HSE    | Health, Safety and Environment                     |
| ITRC   | Interstate Technology and Regulatory Council       |
| LNAPL  | Light Non-Aqueous Phase Liquid                     |
| l/s    | Litres per second                                  |
| mbgl   | Meters below ground level                          |
| mm     | Millimetres                                        |
| mS/m   | Milli siemens per meter                            |
| MTBE   | Methyl tertiary butyl ether                        |
| NGA    | National Groundwater Archives                      |
| NHDES  | New Hampshire Department of Environmental Services |
| ORP    | Oxidation-reduction potential                      |
| PAH    | Polycyclic Aromatic Hydrocarbons                   |
| PID    | Photo Ionisation Detector                          |
| QA/QC  | Quality Assurance/Quality Control                  |
| RPD    | Relative Percentage Difference                     |
| SANS   | South African National Standards                   |
| SOP    | Standard Operating Procedure                       |
| SPR    | Source-Pathway-Receptor                            |
| TAME   | Tert-amyl methyl ether                             |
| Temp.  | Temperature                                        |
| TPL    | Transnet Pipelines                                 |
| US EPA | United States Environmental Protection Agency      |
| uS/cm  | Micro siemens per centimetre                       |
| VOC    | Volatile Organic Compounds                         |

## Executive Summary

AECOM was appointed by TPL as a service provider to conduct on-going groundwater and/ or soil monitoring at TPL facilities, and the pipeline network situated in the Free State, Gauteng, Mpumalanga and North West Provinces on an “as-and-when-required” basis for three years. This report specifically details the findings of the GME work conducted at the Witbank Pump Station in November 2021.

A groundwater monitoring and sampling event was conducted at the Site on 10 and 11 November 2021. The static groundwater level was measured between 0.1 and 0.9 mbgl in the on-site monitoring wells. The groundwater levels at the site have been increasing since June 2020, which is most likely due to the significant amount of rainfall received since then. None of the monitoring wells contained measurable thickness of LNAPL.

TAME concentrations were detected in the samples collected in all monitoring wells except in MW1, where all other targeted hydrocarbon compounds in MW1 were below laboratory limits of detection. TAME concentration exceeds the NHDES non-carcinogenic screening level for ingestion pathway only in monitoring well MW5, MW7 and MW8.

Benzene, ethylbenzene, and fluorene concentrations were recorded above the laboratory detection limits in monitoring well MW2 and MW3. The benzene concentration detected in monitoring well MW2 and MW3 exceeds the US EPA carcinogenic screening levels for both ingestion and inhalation pathways whilst ethylbenzene detected in monitoring wells MW2 and MW3 exceeds the US EPA carcinogenic screening level for inhalation pathway.

MTBE concentration was also detected above the laboratory limits of detection in monitoring well MW8 but did not exceed any selected screening criteria.

In terms of the conceptual site assessment, even though there are constituents above screening criteria, there are currently no complete SPR linkages between on-site potential contamination sources and both on- and off-site receptors. However, there is no hydrocensus information available regarding any boreholes in use within the radius of 1 km from Site. Therefore, the ingestion and dermal contact exposure pathway is currently incomplete but not eliminated due to insufficient hydrocensus information.

### Recommendations

AECOM recommends that:

- Groundwater monitoring is continued on a bi-annual basis at the Site considering that some constituents exceed the selected screening criteria;
- The manhole cover on MW6 is replaced to avoid further damage of the monitoring well; and,
- An updated hydrocensus survey is completed for the Site within a 1 km radius.



# 1. Introduction

## 1.1 Terms of Reference

AECOM was appointed by TPL as a service provider to conduct on-going groundwater and/ or soil monitoring at TPL facilities, and the pipeline network situated in the Free State, Gauteng, Mpumalanga and North West Provinces on an “as-and-when-required” basis for three years. The appointment followed the submission of a technical and cost proposal (RFP: PYP/W1/6/21/1808), titled “Provision of Groundwater and Soil Monitoring for Transnet Pipeline Sites Free State, Gauteng, Mpumalanga & North West Provinces for a period of three years”, dated 12 February 2019.

This report specifically details the findings of the GME work conducted at the Witbank Pump Station (hereafter referred to as the Site) in November 2021.

## 1.2 Project Background

TPL manages and operates a pipeline network and the associated infrastructure that transports crude oil, Avtur as well as petrol and diesel between Durban and Johannesburg. TPL has 30 operational facilities (depots, pump stations and workshops) and a pipeline network (Avtur, multiproduct, gas) in the following provinces: KwaZulu-Natal, Gauteng, Free State, Mpumalanga and North West. Due to the nature of TPL business (i.e. handling of petroleum products), these sites are vulnerable to historical contamination due to operational spillages that may have occurred over time.

In the provinces of Gauteng, Free State, Mpumalanga and North West, TPL has a total of 16 sites where groundwater monitoring is conducted quarterly, bi-annually and annually depending on the program of the particular site. The remaining 14 sites are located in the KwaZulu-Natal Province.

## 1.3 Site History

A report titled “Routine Groundwater Monitoring and Sampling Report for March 2019 for the TLP Witbank Site – Emalahleni – Mpumalanga Province”, which was prepared by the Geomeasure Group, was made available by TPL for AECOM’s review.

The report details the findings of a GME conducted at the Site on March 2019. The eight groundwater monitoring wells present on Site were sampled and the results recorded impacts in all monitoring wells except MW1 and MW7. None of the detected concentrations exceeded the chosen screening levels and no LNAPL was present in the groundwater monitoring network.

AECOM conducted GMEs in June 2020 and November 2020 with the following observations:

- TAME concentrations were detected above the laboratory detection limits in all the monitoring wells except for monitoring well MW1, where all other targeted hydrocarbon compounds in MW1 were also below the laboratory detection limits during both GMEs.
- In June 2020, benzene, ethylbenzene and C<sub>10</sub>-C<sub>20</sub> concentrations were detected in the sample for monitoring well MW2, whilst benzene and ethylbenzene only were detected in the sample for monitoring well MW3. The benzene concentration detected in MW2 exceeded the US EPA carcinogenic screening levels for both ingestion and inhalation, whilst ethylbenzene exceeded the carcinogenic screening level for inhalation only. The benzene and ethylbenzene concentrations detected in MW3 exceeded the US EPA carcinogenic screening levels for ingestion, dermal contact and inhalation. TAME detected in MW6 exceeded the NHDES non-carcinogenic screening level for ingestion exposure pathway.
- In November 2020, benzene, and ethylbenzene in MW2 and MTBE in MW6 were detected above laboratory detection limits. The benzene concentration exceeded the US EPA carcinogenic screening levels for both ingestion and inhalation. TAME in MW2, MW5, MW6, MW7 and MW8 exceeded the NHDES non-carcinogenic screening level for the ingestion exposure pathway.
- In terms of the conceptual site model, even though there were constituents above screening criteria, there were no complete SPR linkages between on-site contamination and both on- and off-site receptors identified at the time. However, this assessment is based on limited hydrocensus information for the Site.

Another GME was conducted in April 2020 by AECOM with the following observations:

- TAME concentrations were detected in the samples collected in all monitoring wells except in MW1, where all other targeted hydrocarbon compounds in MW1 were below laboratory limits of detection. Benzene, ethylbenzene and fluorene concentrations were recorded above the laboratory detection limits in monitoring well MW2 and MW3. Moreover, MTBE concentration was also detected in MW3 above the laboratory limits of detection.
- The benzene concentration detected in monitoring well MW2 and MW3 exceeds the US EPA carcinogenic screening levels for both ingestion and inhalation.
- Ethylbenzene detected in monitoring wells MW2 and MW3 exceeds the US EPA carcinogenic screening level for inhalation.
- TAME concentration in monitoring wells MW2, MW3, MW5, MW6, MW7, MW8 and MW9 exceed the NHDES non-carcinogenic screening level for the ingestion exposure pathway
- In terms of the conceptual site model, even though there were constituents above screening criteria, there were no complete SPR linkages between on-site contamination and both on- and off-site receptors identified at the time (based on limited hydrocensus information).

## 1.4 Project Objectives

The project objectives are to assess the status quo in terms of on-site groundwater quality and to monitor potential deterioration or improvements over time.

## 2. Scope of Work and Technical Approach

To achieve TPL's project objectives, AECOM completed the following scope of work:

- Desktop review of relevant available information;
- HSE planning;
- Site walkover and sampling;
- Laboratory analyses; and,
- Data interpretation and reporting.

### 2.1 Desktop Review and Site Walkover

- A desktop review of available information such as the NGA database, geology, hydrogeology and topography was reviewed prior to the Site visit in order for the AECOM team to familiarise itself with site conditions;
- AECOM completed a site walkover with the main objective of developing the CSM. A CSM is a strategic tool that serves to conceptualise the relationship between contaminant sources, contaminants, and receptors through consideration of potential or actual migration and exposure pathways. It represents the current understanding of the Site, helps to identify data gaps, and helps to focus the data collection efforts. During this stage, Site information, such as activities, layouts, tanks, underground structures, distribution area, oil/water separator, buried piping, etc was collected. The information gathered was confirmed through an interview with the Site Manager or anyone with intimate knowledge of the Site (where present);
- Surroundings (300 m radius from the Site) information (land use, topography, off-site contamination sources, abstraction wells registry, groundwater uses, presence of sensitive areas, etc.) was collected by AECOM to identify the SPR linkages; and
- AECOM reviewed information regarding historic site activities, available existing environmental information, compounds used at the Site, equipment layout, auxiliary services, etc. The aim of this review was to identify all potential contamination sources, both on-site and off-site, in the area surrounding the Site. Special emphasis was placed in the petroleum hydrocarbon family of compounds.

### 2.2 Groundwater Sampling

Currently, groundwater sampling is conducted on a quarterly basis at the Site. AECOM used the following procedure for the November 2021 GME:

- VOC survey: Prior to inserting any instrument in the monitoring well, once opened the VOC air concentration within the well was measured using a PID;
- Monitoring well gauging: Static groundwater level, the presence of LNAPL and the depth of each well was measured using an interphase meter. This information was recorded in an appropriate field observation form. Well depths were recorded in mbgl and LNAPL thickness in mm;
- Grab samples were collected from each monitoring well using a new clean Teflon bailer for each well.

### 2.3 Laboratory Analyses

The groundwater samples obtained during the GME were submitted to UIS Organic Laboratory for the analytical suite summarised in **Table 1**.

**Table 1. Summary of the Laboratory Analysis Suite**

| Sample Type | Analytical Suite                                                                                                                              |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Water       | <b>GRO:</b> 1,2,4-Trimethylbenzene, 1,3,5-Trimethylbenzene, Benzene, Ethylbenzene, m+p-Xylene, MTBE, Naphthalene, o-Xylene, TAME and Toluene. |
|             | <b>PAH:</b> Acenaphthene, Acenaphthylene, Anthracene, Fluoranthene, Fluorene, Phenanthrene and Pyrene.                                        |
|             | <b>DRO:</b> C <sub>10</sub> -C <sub>20</sub>                                                                                                  |

## 2.4 HSE Planning

A HSE Plan that included a risk assessment for the planned activities was developed and updated prior to the commencement of the fieldwork. The original HSE was signed by all parties involved with the site work and retained on-site for the duration of the fieldwork.

### 3. Site Information and Environmental Setting

#### 3.1 Site Details

The Site details are summarised in **Table 2** below.

**Table 2. Summary of Site Details**

|                                 |                                                                                                                   |                                                                                                    |                                                        |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|--------------------------------------------------------|
| <b>Site Name</b>                | Witbank Pump Station                                                                                              |                                                                                                    |                                                        |
| <b>Site Address</b>             | 9 Schonland Drive,<br>Emalahleni, Mpumalanga                                                                      | <b>Province</b>                                                                                    | Mpumalanga                                             |
| <b>Co-ordinates (Lat, Long)</b> | 25.8640324° South<br>29.1671447° East                                                                             | <b>Erf Number</b>                                                                                  | Portion 000025 of Farm 297<br>Driefontein <sup>1</sup> |
| <b>Municipality</b>             | Emalahleni                                                                                                        |                                                                                                    |                                                        |
| <b>Site Manager</b>             | Mr T Sithole                                                                                                      | <b>Contact Number</b>                                                                              | NA                                                     |
| <b>Site Use</b>                 | The Site is a pump station linked to the underground Transnet petroleum pipeline.                                 |                                                                                                    |                                                        |
| <b>Surrounding Land use</b>     | The surrounding land-use is summarised below and presented in <b>Figure 1 and Figure 2</b> in <b>Appendix A</b> . |                                                                                                    |                                                        |
|                                 | <b>North</b>                                                                                                      | Industrial/commercial developments adjacent to site extending more than a kilometre from the Site. |                                                        |
|                                 | <b>East</b>                                                                                                       | Informal residential area adjacent to site extending more than a kilometre from the Site.          |                                                        |
|                                 | <b>South</b>                                                                                                      | Industrial/commercial developments adjacent to site extending more than a kilometre from the Site  |                                                        |
|                                 | <b>West</b>                                                                                                       | Industrial/commercial developments adjacent to site extending more than a kilometre from the Site. |                                                        |

#### 3.2 Topography

The Site is located at approximately 1535 mamsl and is constructed on a relatively flat platform on a hillside cutting with a gentle gradient towards the south west (**Appendix A: Figures 1 and 2**).

#### 3.3 Hydrology

The Site is located within the Olifants Water Management Area, within the B11K quaternary catchment. It receives approximately 684 mm of rainfall annually and has approximately 1 700 mm of annual evaporation<sup>2</sup>. The nearest surface water body is a tributary of the Klipspruit River, located approximately 1.6 km south of the Site (**Appendix A: Figure 3**).

#### 3.4 Geology

The Site is underlain by shale, sandstone, shale sandstone, grit, conglomerate and coal of the Ecca Formation part of the Karoo Group<sup>3</sup>. (**Appendix A: Figure 3**). There were no borehole logs available for AECOM's review to determine the geology beneath the site.

#### 3.5 Hydrogeology

According to published hydrogeological maps, the underlying natural geology is considered to represent a minor<sup>4</sup> fractured rock aquifer with yields between 0.5 and 2 l/s. Regionally the hydro-geochemical water quality is good with electrical conductivities between 0 and 70 mS/m<sup>5</sup>. The aquifer is considered to have a moderate vulnerability<sup>6</sup> and a medium susceptibility<sup>7</sup> to contamination from sources at the surface (**Appendix A: Figure 4**). There was no

<sup>1</sup> Cadastral Parcels of South Africa Credits: GISCOE, Municipal Demarcation Board, National Geo-spatial Information

<sup>2</sup> 1:500 000 Hydrogeological map series of the Republic of South Africa, 2526 Johannesburg. H. C. Barnard, DWAF (1999)

<sup>3</sup> 1:250 000 Geological map series of the Republic of South Africa, 2528 Pretoria. F. Walraven, Department of Mines (1986)

<sup>4</sup> Aquifer Classification of South Africa, Department of Water Affairs; Sub-Directorate: Groundwater Information; August 2012

<sup>5</sup> Groundwater Quality of South Africa, Department of Water Affairs; Sub-Directorate: Groundwater Information; August 2012

<sup>6</sup> Aquifer Vulnerability of South Africa, Department of Water Affairs; Sub-Directorate: Groundwater Information; July 2013

<sup>7</sup> Aquifer Susceptibility of South Africa, Department of Water Affairs; Sub-Directorate: Groundwater Information; March 1999



site specific hydrogeological information available for AECOM's review to describe the aquifer characteristics beneath the site.

Previous groundwater monitoring reports indicate that groundwater flow is in a south westerly direction.

## 4. Fieldwork

Groundwater monitoring and sampling was conducted on 10 and 11 November 2021. The position of the Witbank Pump Station groundwater monitoring network is provided in the Site layout map in **Appendix A: Figure 5**.

### 4.1 Groundwater Sampling

The well gauge information recorded during the fieldwork are summarised in **Table 3** below. The groundwater levels at the site have been increasing since June 2020 (Figure 4-1), which is most likely due to the significant amount of rainfall received since then. No significant (> 100 ppm) VOC readings were measured and none of the monitoring wells contained measurable thickness of LNAPL during the current GME.

The manhole cover on monitoring well MW6 was destroyed by truck movements on and around it, as shown in **Figure 4-1 Photo A**, however, a groundwater sample was collected from this well. Monitoring well MW9 could not be located, its manhole cover was located on top of an underground cable access point as shown in **Figure 4-1 Photo B**.

*It is recommended that the manhole cover on MW6 is replaced to avoid further damage of the monitoring well.*

As was the case during the previous GMEs, AECOM could not locate monitoring well MW4 during the November 2021 sampling event as it is covered by imported gravel.

**Table 3. Summary of Monitoring Well Gauge Information during Groundwater Monitoring and Sampling**

| Sample ID | Static Groundwater Level (mbgl) | MW Elevations (m amsl) | Indicative Well Depth (m) | Static Groundwater Elevation (amsl) | LNAPL Thickness (mm) | VOC Air Concentration (ppm) |
|-----------|---------------------------------|------------------------|---------------------------|-------------------------------------|----------------------|-----------------------------|
| MW1       | 0,89                            | 1531,65                | 6,97                      | 1525,57                             | None                 | 0                           |
| MW2       | 0,79                            | 1531,53                | 6,6                       | 1525,72                             | None                 | 0                           |
| MW3       | 0,9                             | 1530,84                | 3,96                      | 1527,78                             | None                 | 44.9                        |
| MW5       | 0,44                            | 1530,54                | 6,51                      | 1524,47                             | None                 | 0                           |
| MW6       | 0,1                             | 1530,26                | 2,28                      | 1528,08                             | None                 | -                           |
| MW7       | 0,53                            | 1530,08                | 4,91                      | 1525,7                              | None                 | 0                           |
| MW8       | 0,72                            | 1530,16                | 2,55                      | 1528,33                             | None                 | 0                           |

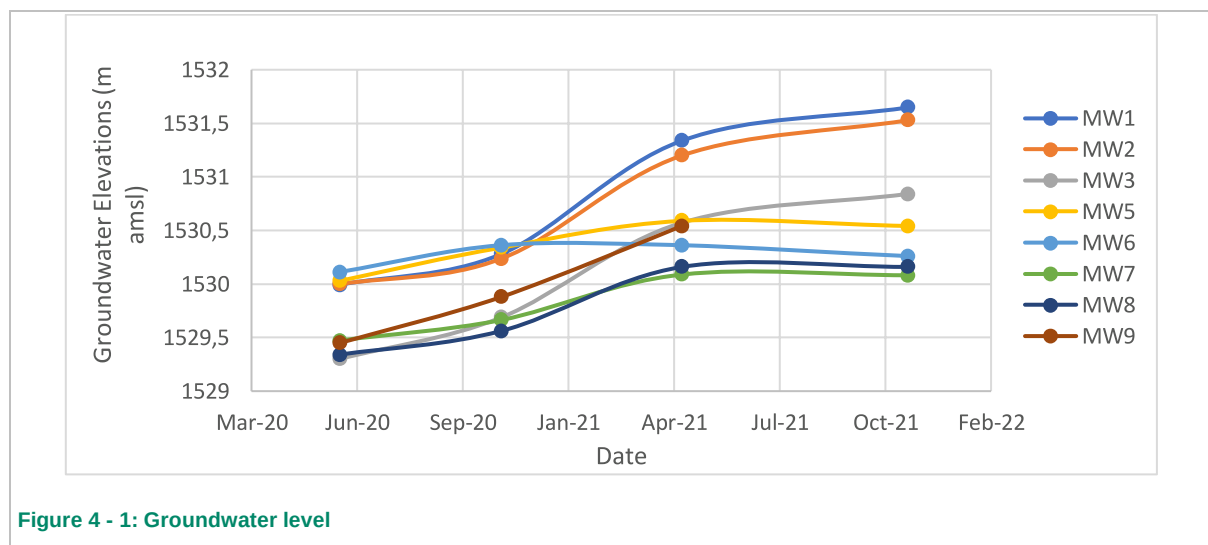




Photo A

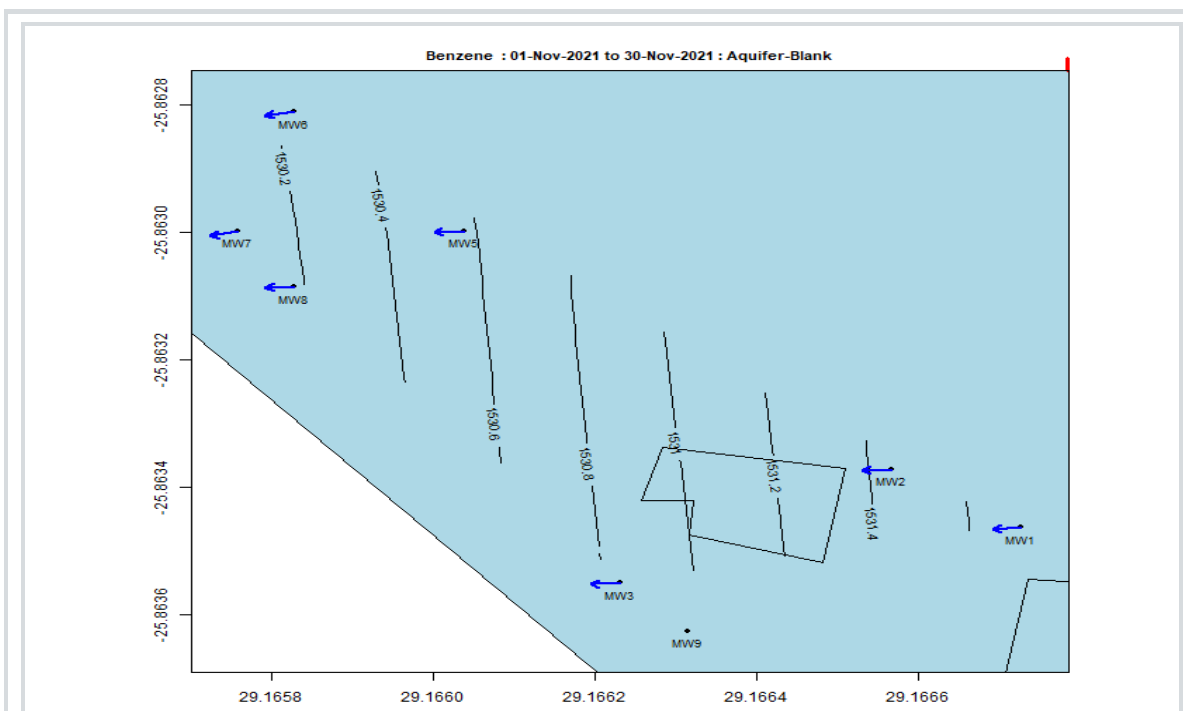


Photo B

**Figure 4 - 2: Photo A: Manhole cover for missing Monitoring well MW9, Photo B: Condition of the destroyed manhole cover on monitoring well MW6.**

## 4.2 Groundwater Flow Direction

Measured static groundwater levels were used to calculate on-site groundwater elevations. Groundwater flow direction is calculated to be towards in the westerly direction (**Figure 4-3**), which differs from the south westerly groundwater flow direction calculated in previous GMEs. This could be due to the absence of monitoring well MW9 data during the current GME.



**Figure 4 - 3. Groundwater Flow Direction Contours for April 2021**

*\*Figure orientated with North at the top of the page. Length of directional arrows is an indication of the steepness of the groundwater gradient at the sampling point.*

### 4.3 Field Parameters

The field parameters measured during the fieldwork are summarised in **Table 4** below. The pH values range from 4.96 to 6.52 which reflects acidic condition. The electrical conductivity values were measured within the documented regional range of 0 to 70 mS/m for most of the monitoring wells except for MW6 and MW8 which were measured marginally above the documented range.

The measured temperature is to be expected in the monitoring wells as a result of a small water column, shallow groundwater level and warm air temperature (summer conditions).

Both positive ORP values (aerobic conditions) and negative ORP values (anoxic to anaerobic conditions) were recorded in groundwater across the Site.

**Table 4. Field Parameters Measured During Groundwater Sampling**

| Well ID | pH   | EC (mS/m) | Temp (°C) | ORP (mV) | Description                                     |
|---------|------|-----------|-----------|----------|-------------------------------------------------|
| MW1     | 4.96 | 64.5      | 21.8      | 42       | Clear water with no odour or sheen              |
| MW2     | 6.06 | 28.3      | 22.1      | -10      | Turbid water with no odour or sheen             |
| MW3     | 6.05 | 56.9      | 23.1      | -63      | Turbid water with hydrocarbon odour and a sheen |
| MW5     | 5.92 | 58.2      | 22.9      | 40       | Clear water with no odour or sheen              |
| MW6     | 6.25 | 80.8      | 24.9      | 29       | Turbid water with no odour or sheen             |
| MW7     | 6.52 | 58.1      | 22.3      | 16       | Turbid water with no odour or sheen             |
| MW8     | 5.71 | 90.1      | 23.2      | -78      | Turbid water with no odour or sheen             |

## 5. Laboratory Analytical Results

The groundwater samples obtained during the investigation were submitted to UIS Organic Laboratory in Centurion for analyses of targeted hydrocarbon compounds. The laboratory analytical results as well as applicable US EPA<sup>8</sup> and NHDES<sup>9</sup> screening levels for the water samples collected at the Site are presented in **Table 5** and are summarised in the sections below. The original laboratory certificates are provided in **Appendix B**.

### 5.1 Groundwater Results

As shown in **Table 5**, TAME concentrations were detected in the samples collected in all monitoring wells except in MW1, where all other targeted hydrocarbon compounds in MW1 were below laboratory limits of detection. TAME concentration exceeds the NHDES non-carcinogenic screening level for ingestion pathway only in monitoring well MW5, MW7 and MW8.

Benzene, ethylbenzene and fluorene concentrations were recorded above the laboratory detection limits in monitoring well MW2 and MW3. The benzene concentration detected in monitoring well MW2 and MW3 exceeds the US EPA carcinogenic screening levels for both ingestion and inhalation pathways whilst ethylbenzene detected in monitoring wells MW2 and MW3 exceeds the US EPA carcinogenic screening level for inhalation pathway.

MTBE concentration was also detected above the laboratory limits of detection in monitoring well MW8 but did not exceed any selected screening criteria.

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<sup>8</sup> USEPA screening level - <https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables>

<sup>9</sup> NHDES screening level - <https://www.des.nh.gov/sites/g/files/ehbemt341/files/documents/2020-01/Env-Or%20600.pdf>

Table 5. Hydrocarbon Laboratory Results for Groundwater Samples

| Constituent of concern (µg/ℓ) | Screening Levels (µg/L) |                   |                |                 |              |                      | MW1 | MW2      | MW3      | MW5        | MW6 | MW7        | MW8         |
|-------------------------------|-------------------------|-------------------|----------------|-----------------|--------------|----------------------|-----|----------|----------|------------|-----|------------|-------------|
|                               | Ingestion               |                   | Dermal contact |                 | Inhalation   |                      |     |          |          |            |     |            |             |
|                               | Carcinogenic            | Noncarcinogenic   | Carcinogenic   | Noncarcinogenic | Carcinogenic | Noncarcinogenic      |     |          |          |            |     |            |             |
| Gasoline Range Organics       |                         |                   |                |                 |              |                      |     |          |          |            |     |            |             |
| MTBE                          | 43                      |                   | 2000           |                 | 22           | 6300                 | <5  | <5       | <5       | <5         | <5  | <5         | 6           |
| TAME                          |                         | 140 <sup>10</sup> |                |                 |              | 20 000 <sup>10</sup> | <5  | 90       | 130      | <b>800</b> | 26  | <b>210</b> | <b>1300</b> |
| Benzene                       | 1.4                     | 80                | 9.8            | 610             | 0.72         | 63                   | <1  | <b>4</b> | <b>8</b> | <1         | <1  | <1         | <1          |
| Toluene                       |                         | 1600              |                | 5300            |              | 10000                | <10 | <10      | <10      | <10        | <10 | <10        | <10         |
| Ethylbenzene                  | 7.1                     | 2000              | 12             | 3800            | 2.2          | 2100                 | <2  | <b>4</b> | <b>7</b> | <2         | <2  | <2         | <2          |
| m+p-Xylene                    |                         |                   |                |                 |              |                      | <2  | <2       | <2       | <2         | <2  | <2         | <2          |
| o-Xylene                      |                         | 4000              |                | 8000            |              | 210                  | <2  | <2       | <2       | <2         | <2  | <2         | <2          |
| 1,3,5-Trimethylbenzene        |                         | 200               |                | 280             |              | 130                  | <2  | <2       | <2       | <2         | <2  | <2         | <2          |
| 1,2,4-Trimethylbenzene        |                         | 200               |                | 200             |              | 130                  | <2  | <2       | <2       | <2         | <2  | <2         | <2          |
| Naphthalene                   | 0.65                    | 400               | 1.0            | 700             | 0.17         | 6.3                  | <2  | <2       | <2       | <2         | <2  | <2         | <2          |
| Poly Aromatic Hydrocarbons    |                         |                   |                |                 |              |                      |     |          |          |            |     |            |             |
| Acenaphthene                  |                         | 1200              |                | 960             |              | 530                  | <1  | <1       | <1       | <1         | <1  | <1         | <1          |
| Acenaphthylene                |                         |                   |                |                 |              |                      | <1  | <1       | <1       | <1         | <1  | <1         | <1          |
| Fluorene                      |                         | 800               |                | 460             |              | 290                  | <1  | <b>1</b> | <b>1</b> | <1         | <1  | <1         | <1          |
| Phenanthrene                  |                         |                   |                |                 |              |                      | <1  | <1       | <1       | <1         | <1  | <1         | <1          |
| Anthracene                    |                         | 6000              |                | 2500            |              | 1800                 | <1  | <1       | <1       | <1         | <1  | <1         | <1          |
| Fluoranthene                  |                         | 800               |                |                 |              |                      | <1  | <1       | <1       | <1         | <1  | <1         | <1          |
| Pyrene                        |                         | 600               |                | 150             |              | 120                  | <1  | <1       | <1       | <1         | <1  | <1         | <1          |
| Diesel Range Organics         |                         |                   |                |                 |              |                      |     |          |          |            |     |            |             |
| C10-C20                       |                         |                   |                |                 |              |                      | <1  | <1       | <1       | <1         | <1  | <1         | <1          |

**Bold:** Exceeds the screening criteria

<sup>10</sup> NHDES screening level - <https://www.des.nh.gov/sites/g/files/ehbemt341/files/documents/2020-01/Env-Or%20600.pdf>



## 5.2 Trend Analysis for Impacted Monitoring Wells

Concentrations of benzene persisted in monitoring wells MW2 and MW3 during the previous six GMEs since September 2018. Plotting the data in the time series graphs presented in **Figure 5-1** (along with groundwater elevations in black) would suggest that there may be both an increase and decrease trend in MW2 and MW3 respectively. However, this trend is only based on six data points and the Mann-Kendall P-value is greater than 0.05 which indicates that the trend currently observed in the benzene data is not statistically significant. Further monitoring of benzene is required to establish a statistically significant trend of the data set.

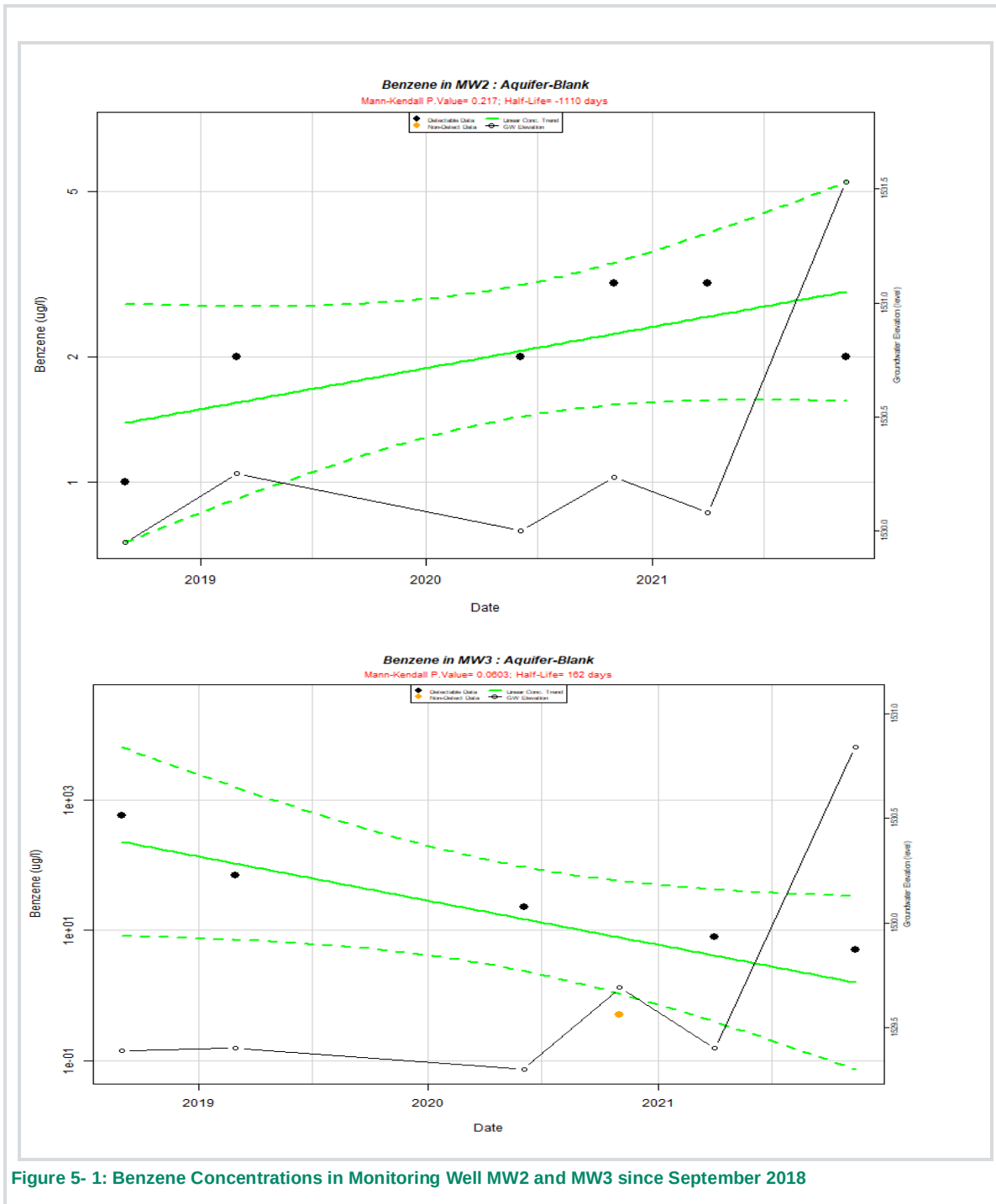


Figure 5- 1: Benzene Concentrations in Monitoring Well MW2 and MW3 since September 2018

In the information provided from the previous GME Reports, ethylbenzene concentrations have been recorded in monitoring well MW3 since September 2018 (it may have been present prior to September 2018; however, no historical analytical data has been provided). In **Figure 5-2** a time series plot of ethylbenzene has been created which seems to indicate a decreasing trend, however the Mann-Kendal P-Value for the trend is greater than 0.05

and therefore is not considered statistically significant. Further groundwater sampling is required to determine a statistically significant trend to the data set.

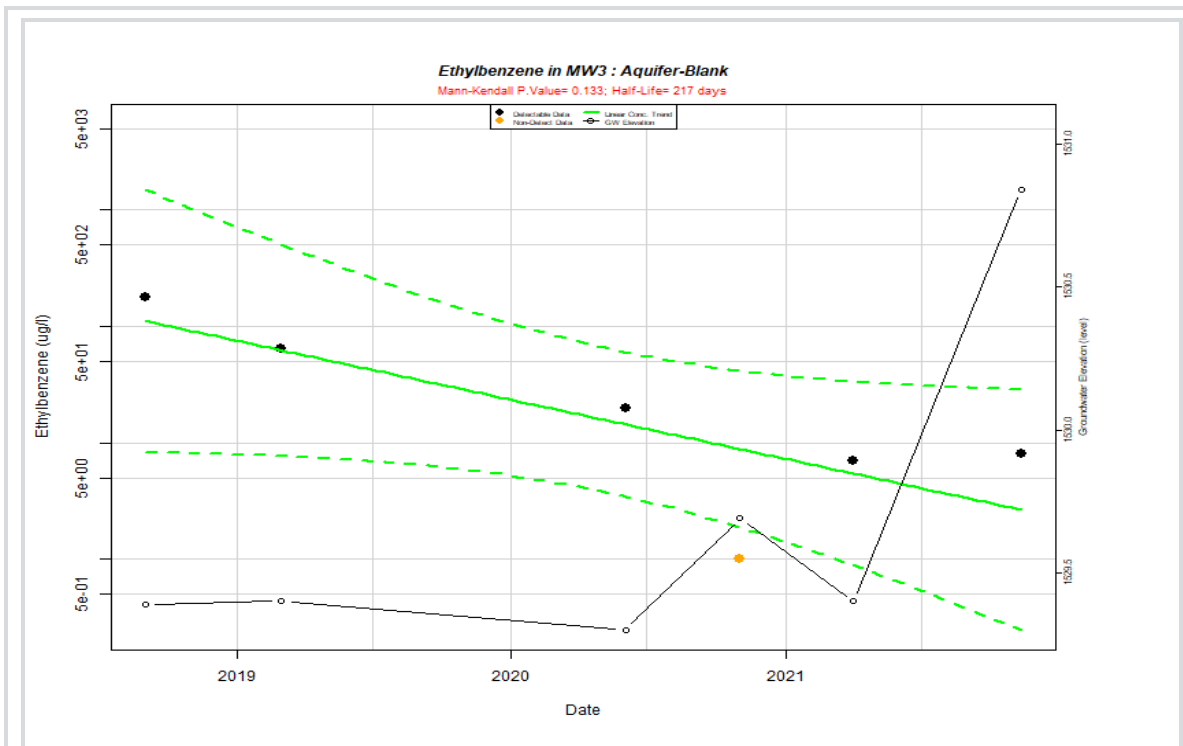
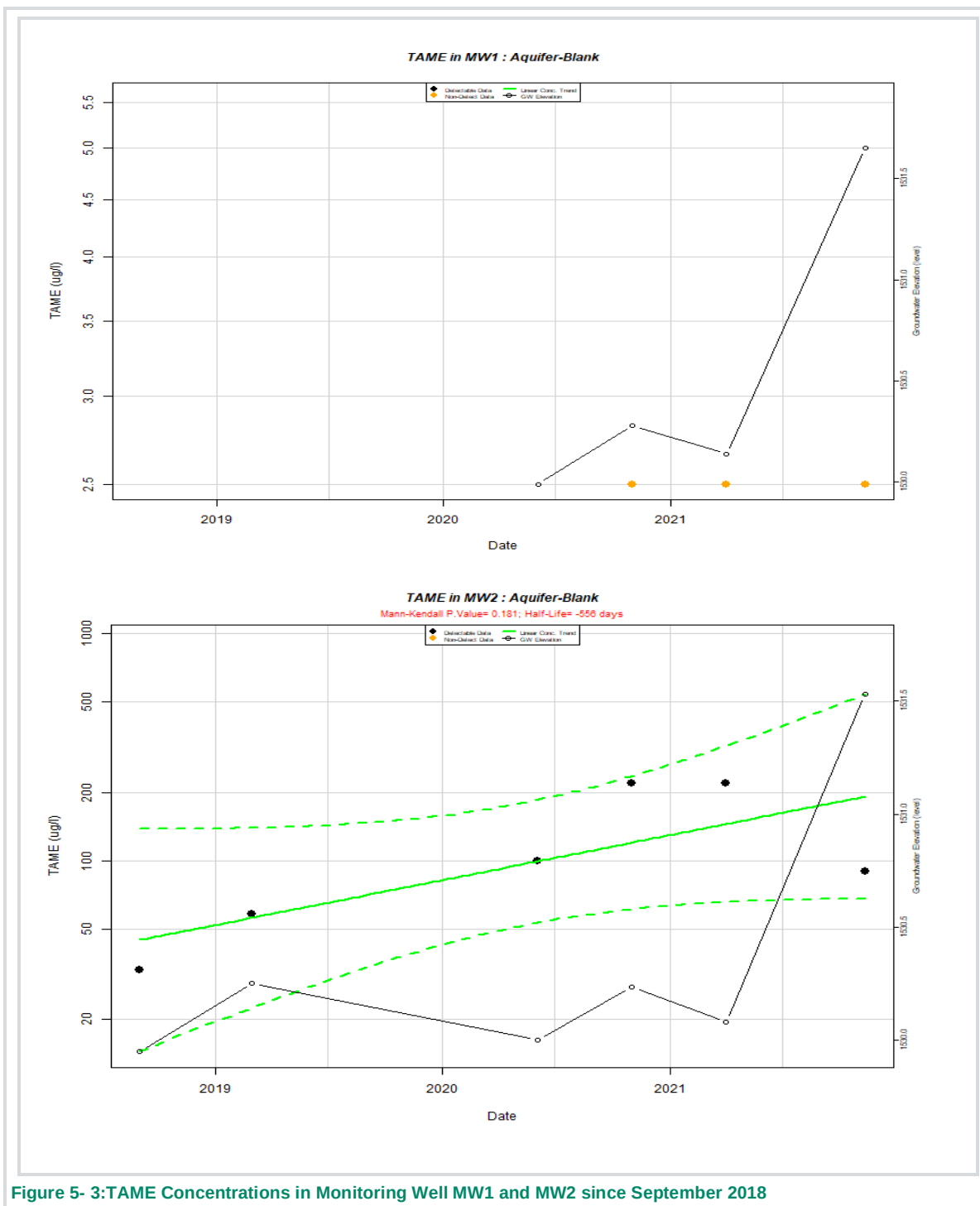


Figure 5- 2: Ethylbenzene Concentrations in Monitoring Well MW3 since September 2018

TAME concentrations are present across the Site and have been present at the Site in the previous six GMEs. Time-series graphs for TAME concentrations in each monitoring well are displayed in Error! Reference source not found. to **Figure 5-6** below. Similar to the trends for benzene and ethylbenzene, the TAME data in the figures for all the other monitoring wells is not statistically significant with further groundwater sampling required to establish a statistically significant trend. In general, TAME concentrations in monitoring wells MW2, MW7 and MW8 are increasing with downward trends noted for the remaining wells.



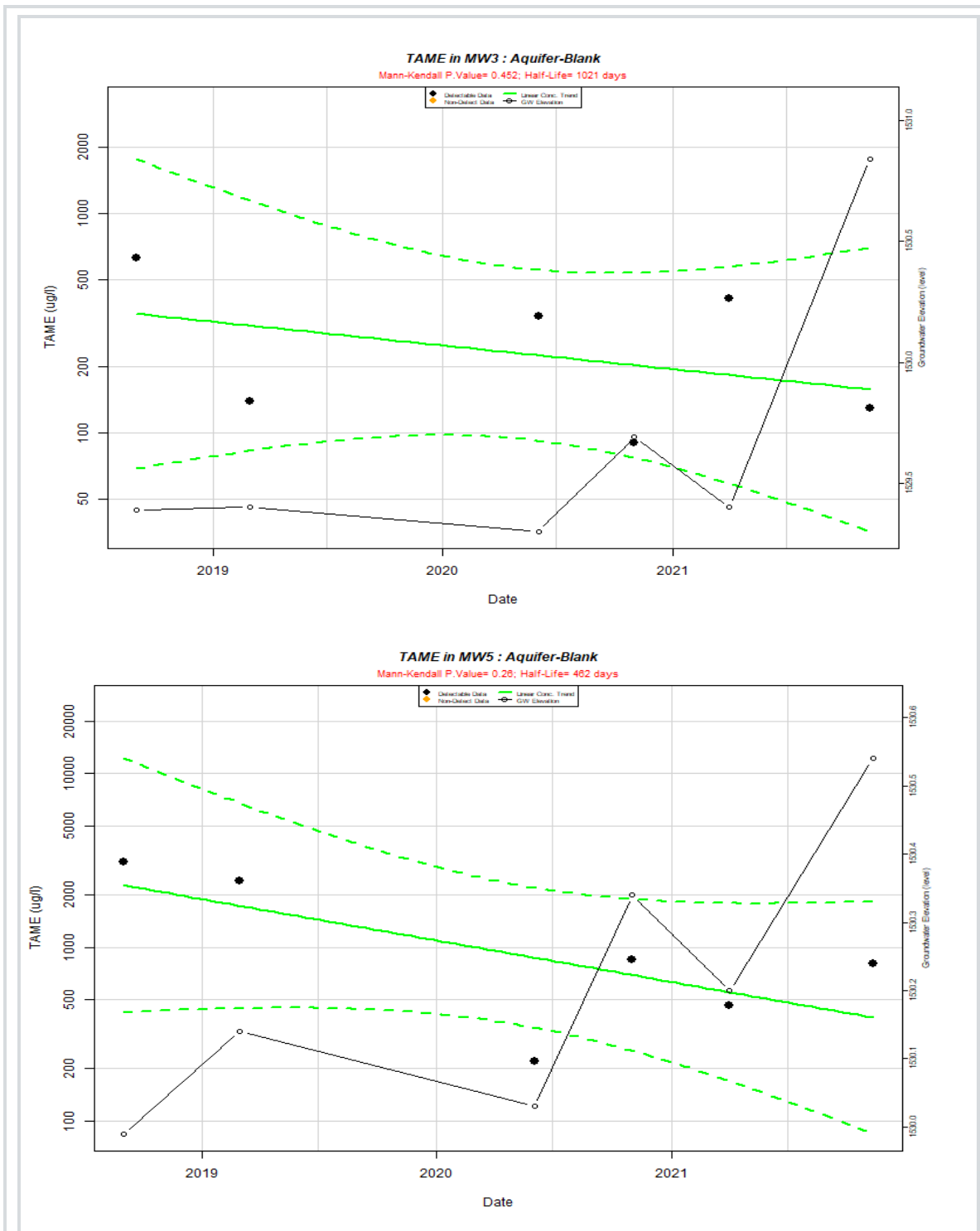


Figure 5- 4: TAME Concentrations in Monitoring Well MW3 and MW5 since September 2018

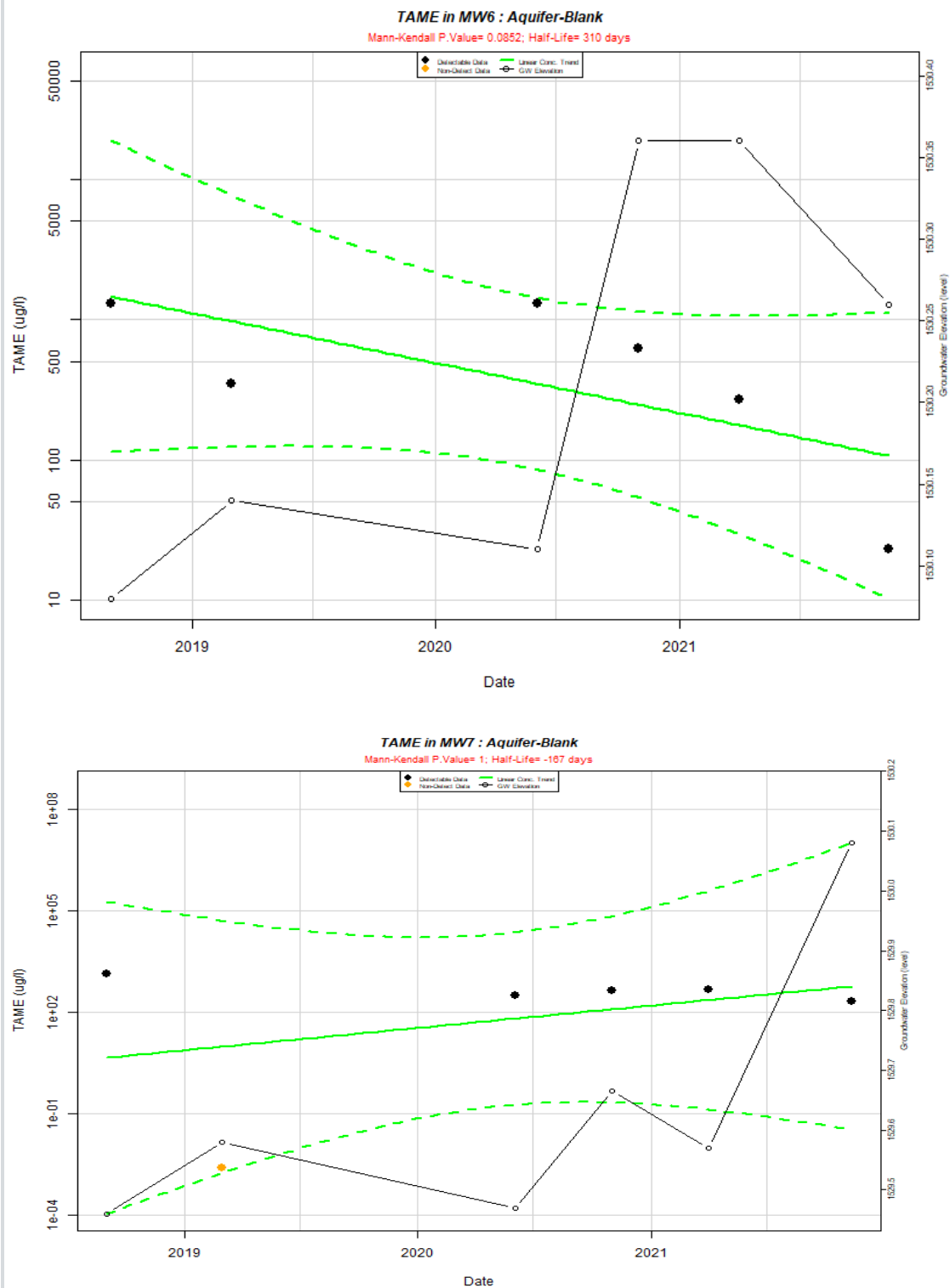


Figure 5- 5: TAME Concentrations in Monitoring Well MW6 and MW7 since September 2018

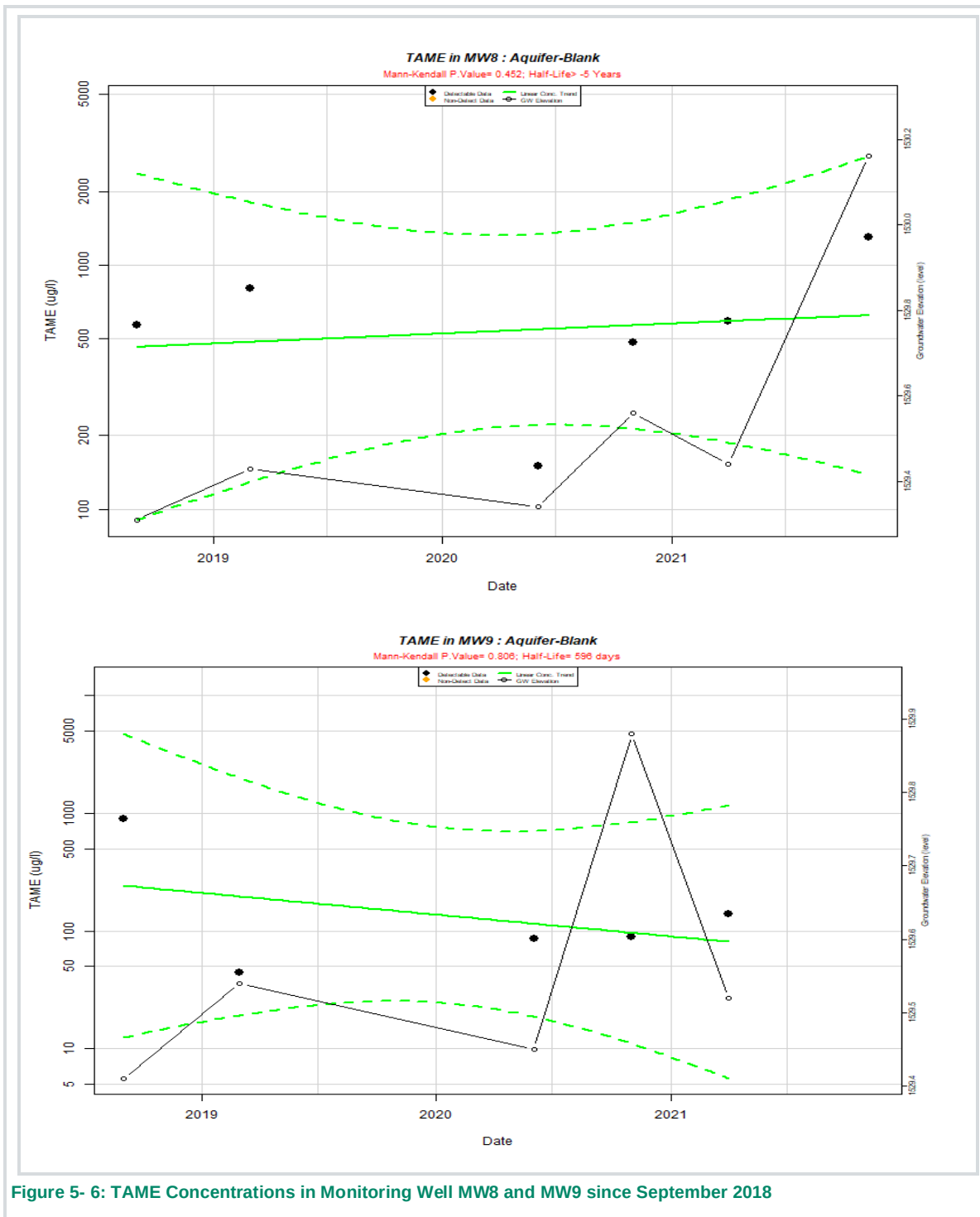


Figure 5- 6: TAME Concentrations in Monitoring Well MW8 and MW9 since September 2018

### 5.3 Quality Assurance/Control (QA/QC)

Sampling and decontamination procedures were followed during all stages of the assessment to collect representative samples and to minimise the potential for cross contamination between samples.

The samples were collected and handled according to established protocols broadly based on the US EPA methods and aligned with AECOM's standard operating procedures (SOPs) for surface and groundwater sampling.

Samples were placed in containers provided by the laboratory, and handled, stored and transported to the laboratory with accompanying chain-of-custody documentation. Chemical analysis was undertaken by an accredited laboratory.



For QA/QC purposes, a duplicate sample, DUP, was taken sequentially with sample MW7 and was submitted to the laboratory for analyses.

The RPD between two numbers is the difference between them expressed as a percentage of their mean. It is often used as a quantitative indicator of quality assurance and quality control for repeated measurements where the outcome is expected to be the same. The US EPA considers an RPD within 20% for field duplicates as accurate. The following formula is used to calculate the RPD:

$$\% Diff = \left| \frac{x_1 - x_2}{(x_1 + x_2)/2} \right| \times 100$$

The laboratory results received for sample MW7 and DUP are summarised in **Table 6**. Only one RPD value could be calculated and was recorded within the percentage accuracy of 20%. Therefore, for the purpose of this assessment, the laboratory results are considered suitably accurate.

**Table 6. Sampling Relative Percentage Difference Between MW7 and DUP**

| Constituent (µg/L)     | MW7 | DUP | RPD (%)              |
|------------------------|-----|-----|----------------------|
| MTBE                   | <5  | <5  | Cannot be calculated |
| TAME                   | 210 | 200 | 4.8                  |
| Benzene                | <1  | <1  | Cannot be calculated |
| Toluene                | <10 | <10 | Cannot be calculated |
| Ethylbenzene           | <2  | <2  | Cannot be calculated |
| m+p-Xylene             | <2  | <2  | Cannot be calculated |
| o-Xylene               | <2  | <2  | Cannot be calculated |
| 1,3,5-Trimethylbenzene | <2  | <2  | Cannot be calculated |
| 1,2,4-Trimethylbenzene | <2  | <2  | Cannot be calculated |
| Naphthalene            | <2  | <2  | Cannot be calculated |

## 6. Conceptual Site Model

Based on the Site's known history, observations made during the fieldwork and the laboratory analysis results, a CSM has been developed to define the potential SPR linkages which may be applicable under specific land-use assumptions and which, based on identification of linkages, could give rise to potential human and/or environmental risks (**Appendix A: Figure 7**).

### 6.1 Source Characterisation

#### 6.1.1 On-Site

The potential primary sources of petroleum hydrocarbons at the Site include operational leaks and spills from:

- Product distribution pipelines;
- Product dispensing areas; and
- Oil/water separator.

Contaminated groundwater represents a secondary source of contamination beneath the Site.

#### 6.1.2 Off-Site

The only potential off-site source of contamination identified within a 300 m radius of the Site, is a fuel depot located approximately 290 m north of the Site.

### 6.2 Potential Receptors

The area surrounding the Site is dominated by commercial/industrial developments to the north, west and south and residential area to the east. The nearest residential properties are informal houses located across the street from the Site followed by Ackerville approximately 600 m east from the Site. Potential sensitive receptors include adult humans and children residing at informal residents across the Site and Ackerville; and workers and visitors at the Site and neighbouring commercial/industrial buildings. The distance and direction to the potential receptors are provided in **Table 7** below.

**Table 7. Potential Sensitive Receptors**

| Receptor                  | Description                                    | Direction from site   | Distance from site |
|---------------------------|------------------------------------------------|-----------------------|--------------------|
| Children and Adult Humans | Neighbouring residential properties            | East                  | 70 m               |
| Adult Humans              | Neighbouring commercial/ industrial properties | North, south and west | Adjacent           |
| Adult Humans              | On-site workers                                | On-site               | On-site            |

### 6.3 Pathways of Concern

A pathway is the means for hydrocarbons from the Site to be transported from a source to a receptor(s). The following pathways were considered relevant for the Site.

#### 6.3.1 Soil

- Not included in the scope of this assessment.

#### 6.3.2 Groundwater

- Volatilisation of volatile compounds into indoor and outdoor environments (i.e. vapour inhalation pathway to on-site receptors and off-site receptors);
- Dermal contact and ingestion of groundwater by both on- and off-site receptors using private groundwater abstraction boreholes; and
- Migration of impacted groundwater to a surface water body in the vicinity of the Site.

## 6.4 Assessment of SPR Linkages

In summary, as shown in **Table 8** below, there are currently no complete SPR linkages present at the Site. No primary sources of contamination were identified.

**Table 8. Conceptual Site Model Summary**

| Secondary Source                          | Exposure Pathway                     | Receptors                                 |                    |                                            | Comments                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------------------------------------|--------------------------------------|-------------------------------------------|--------------------|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                           |                                      | On-site commercial / industrial employees | Off-site residents | Off-site commercial / industrial employees |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Contaminated groundwater beneath the site | Indoor/outdoor inhalation of vapours | X                                         | X                  | X                                          | <p>Benzene and ethylbenzene concentrations detected in monitoring wells MW2 and MW3 exceeded the US EPA carcinogenic screening level for inhalation.</p> <p>Conservative vertical separation distances published by the ITRC<sup>11</sup> indicate that a vertical separation distance (depth) of dissolved phase sources (impacted groundwater) of more than 1.5 m, indicates that vapour intrusion is unlikely to pose an unacceptable risk. Similarly, if the horizontal separation distance between the dissolved phase plume and potentially impacted buildings is greater than 10 m, then it is unlikely that unacceptable risks exist.</p> <p>Taking into consideration the shallow groundwater levels on-site the vertical separation distance is within 1.5 m, however the distance between the dissolved phase source and surrounding buildings is greater than horizontal separation distance of 10 m (Lahvis et al, 2015<sup>12</sup>) Therefore exposure pathway is considered incomplete.</p> |
|                                           | Ingestion and dermal contact         | X                                         | X                  | X                                          | <p>Benzene concentration in monitoring wells MW2 and MW3 exceeds the US EPA carcinogenic screening level for ingestion. In addition, TAME exceeds NHDES screening level for ingestion in MW5, MW7 and MW8.</p> <p>The informal settlement to the east is the closest potential receptor, however the informal settlement is up and cross hydraulic gradient of the impact observed at the Site and unlikely to be a significant risk.</p> <p>There is no hydrocensus information available regarding any boreholes in use within the radius of 1 km from Site. Therefore, the ingestion and dermal contact exposure pathway is currently incomplete but not eliminated due to insufficient hydrocensus information.</p>                                                                                                                                                                                                                                                                                     |

<sup>11</sup> ITRC (Interstate Technology & Regulatory Council). 2014. Petroleum Vapor Intrusion: Fundamentals of Screening, Investigation, and Management. PVI-1. Washington, D.C. Interstate Technology & Regulatory Council, Petroleum Vapor Intrusion Tram. [www.itrcweb.org/Petroleum VI-Guidance](http://www.itrcweb.org/Petroleum%20VI-Guidance).

<sup>12</sup> Lahvis, M and DeVaul G. 2015. Soil and Groundwater Technical Position Paper: Petroleum Hydrocarbons Vapor Intrusion. Report reference: SR.14.11536. Version 2.2.

| Secondary Source | Exposure Pathway                               | Receptors                                 |                    |                                            | Comments                                                                                                                                          |
|------------------|------------------------------------------------|-------------------------------------------|--------------------|--------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
|                  |                                                | On-site commercial / industrial employees | Off-site residents | Off-site commercial / industrial employees |                                                                                                                                                   |
|                  | Migrations of potentially impacted groundwater | X                                         | X                  | X                                          | The nearest surface water body is located more than 100 m from the Site, and water from the stream is not known to be used for human consumption. |

## 7. Summary and Conclusions

Based on available historic information, fieldwork observations, results of laboratory analyses and the human health risk assessment, the following conclusions can be made:

- A groundwater monitoring and sampling event was conducted at the Site on 10 and 11 November 2021. The static groundwater level was measured between 0.1 and 0.9 mbgl in the on-site monitoring wells. The groundwater levels at the site have been increasing since June 2020, which is most likely due to the significant amount of rainfall received since then. None of the monitoring wells contained measurable thickness of LNAPL.
- TAME concentrations were detected in the samples collected in all monitoring wells except in MW1, where all other targeted hydrocarbon compounds in MW1 were below laboratory limits of detection. TAME concentration exceeds the NHDES non-carcinogenic screening level for ingestion pathway only in monitoring well MW5, MW7 and MW8.
- Benzene, ethylbenzene and fluorene concentrations were recorded above the laboratory detection limits in monitoring well MW2 and MW3. The benzene concentration detected in monitoring well MW2 and MW3 exceeds the US EPA carcinogenic screening levels for both ingestion and inhalation pathways whilst ethylbenzene detected in monitoring wells MW2 and MW3 exceeds the US EPA carcinogenic screening level for inhalation pathway.
- MTBE concentration was also detected above the laboratory limits of detection in monitoring well MW8 but did not exceed any selected screening criteria.
- In terms of the conceptual site assessment, even though there are constituents above screening criteria, there are currently no complete SPR linkages between on-site potential contamination sources and both on- and off-site receptors. However, there is no hydrocensus information available regarding any boreholes in use within the radius of 1 km from Site. Therefore, the ingestion and dermal contact exposure pathway is currently incomplete but not eliminated due to insufficient hydrocensus information.

### 7.1 Recommendations

- AECOM recommends that groundwater monitoring is continued on a bi-annual basis on the Site considering that some constituents exceed the screening criteria.
- It is also recommended that the manhole cover on MW6 is replaced to avoid further damage of the monitoring well.

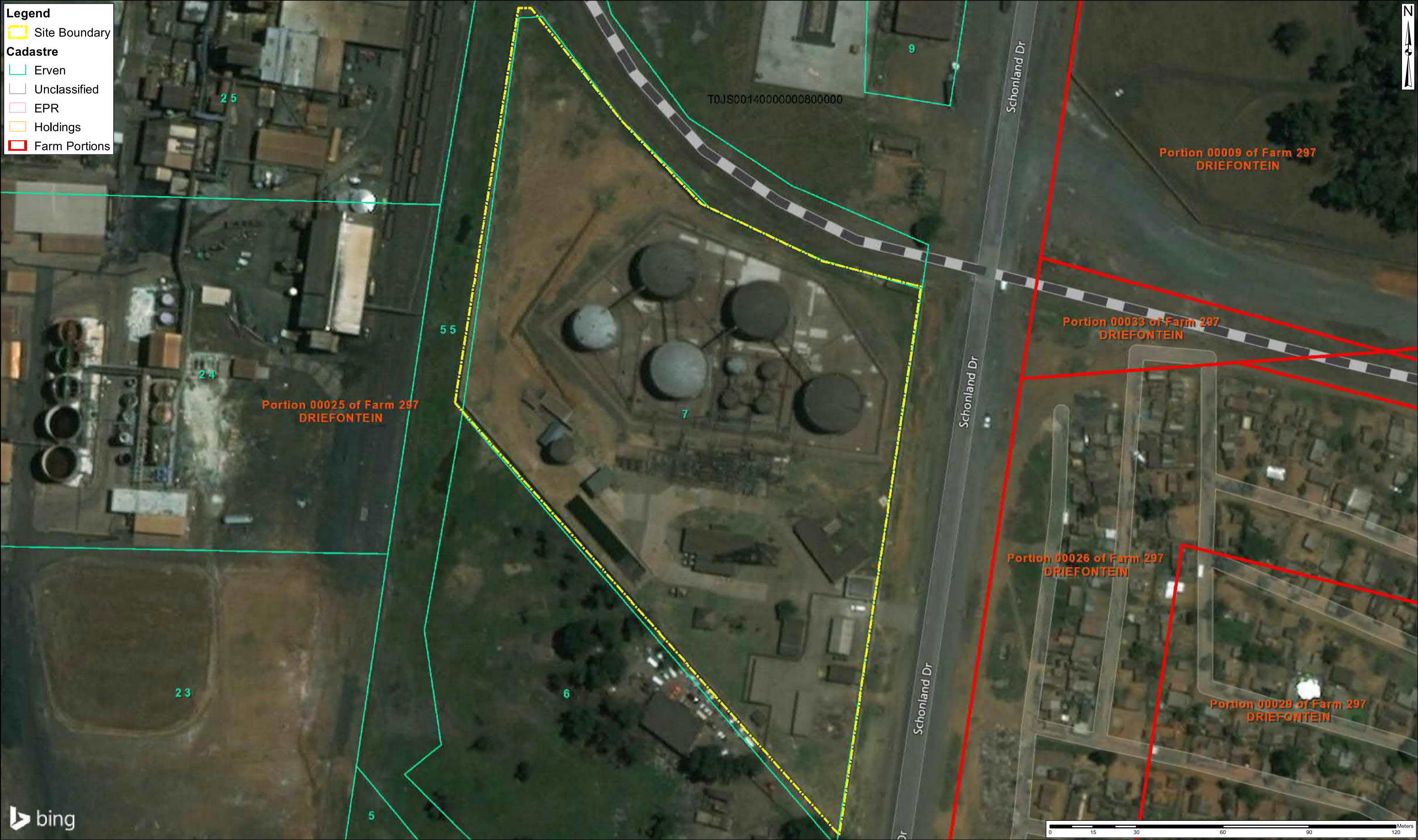
# Appendix A

## Figures









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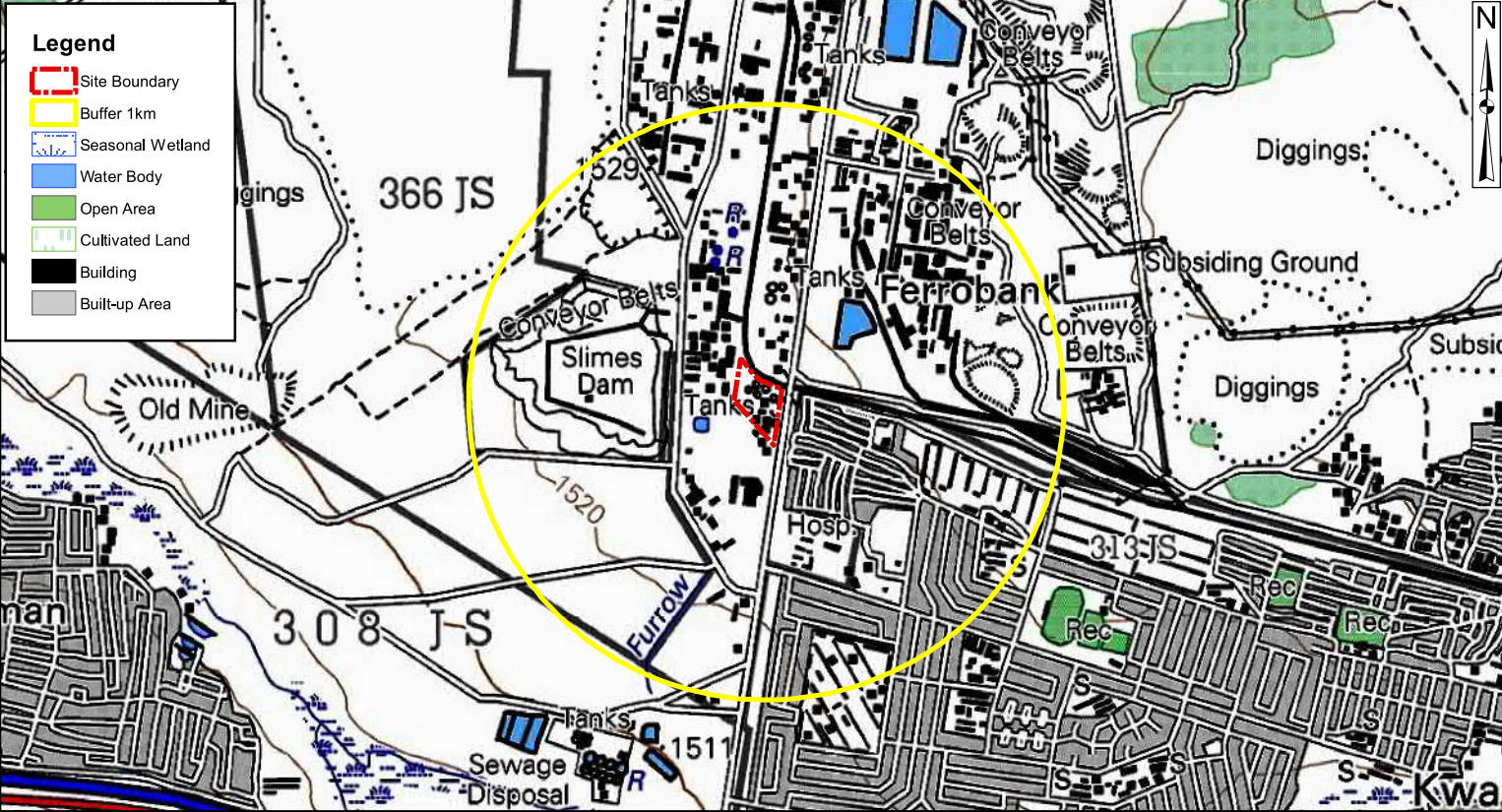
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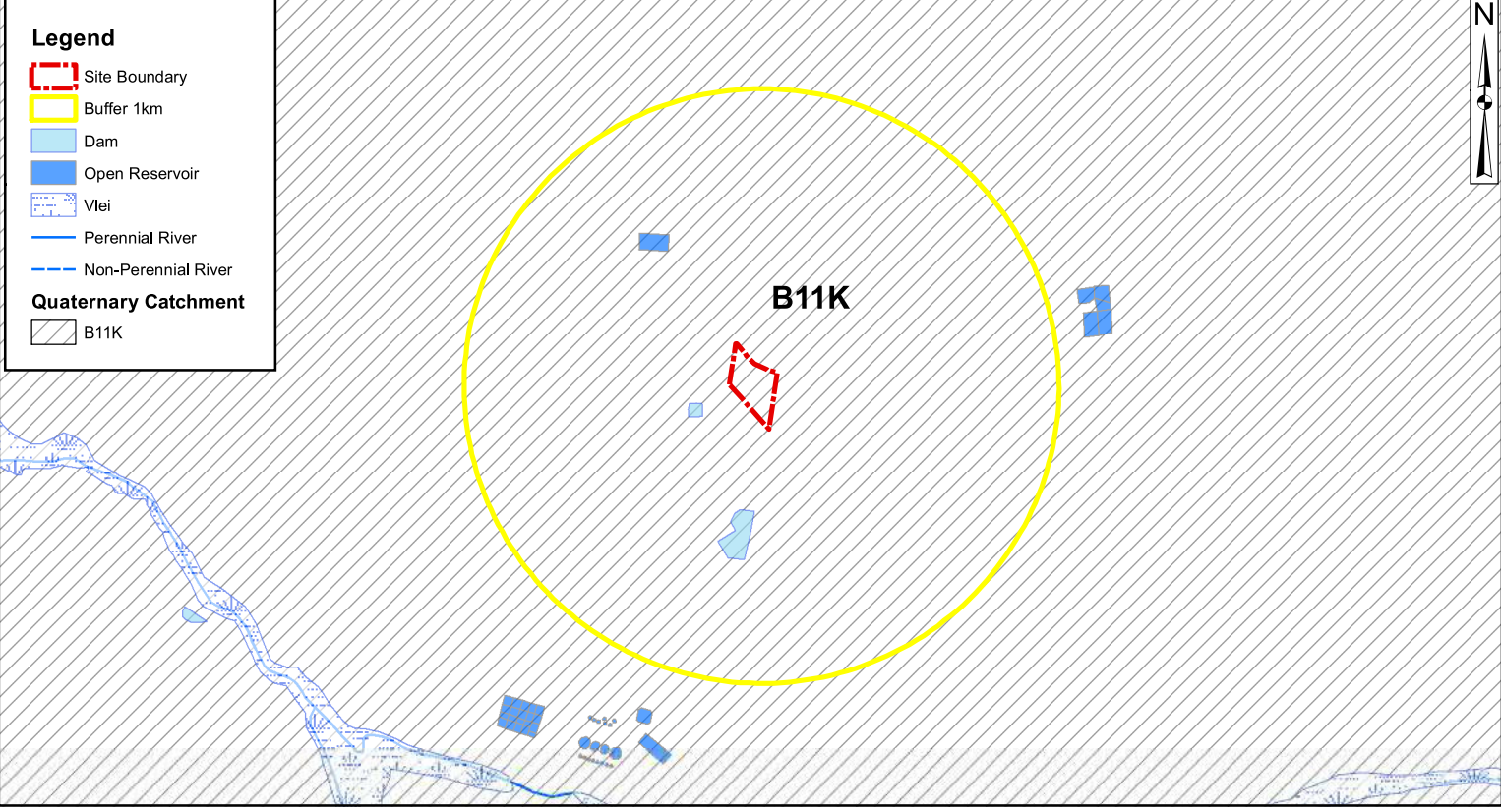
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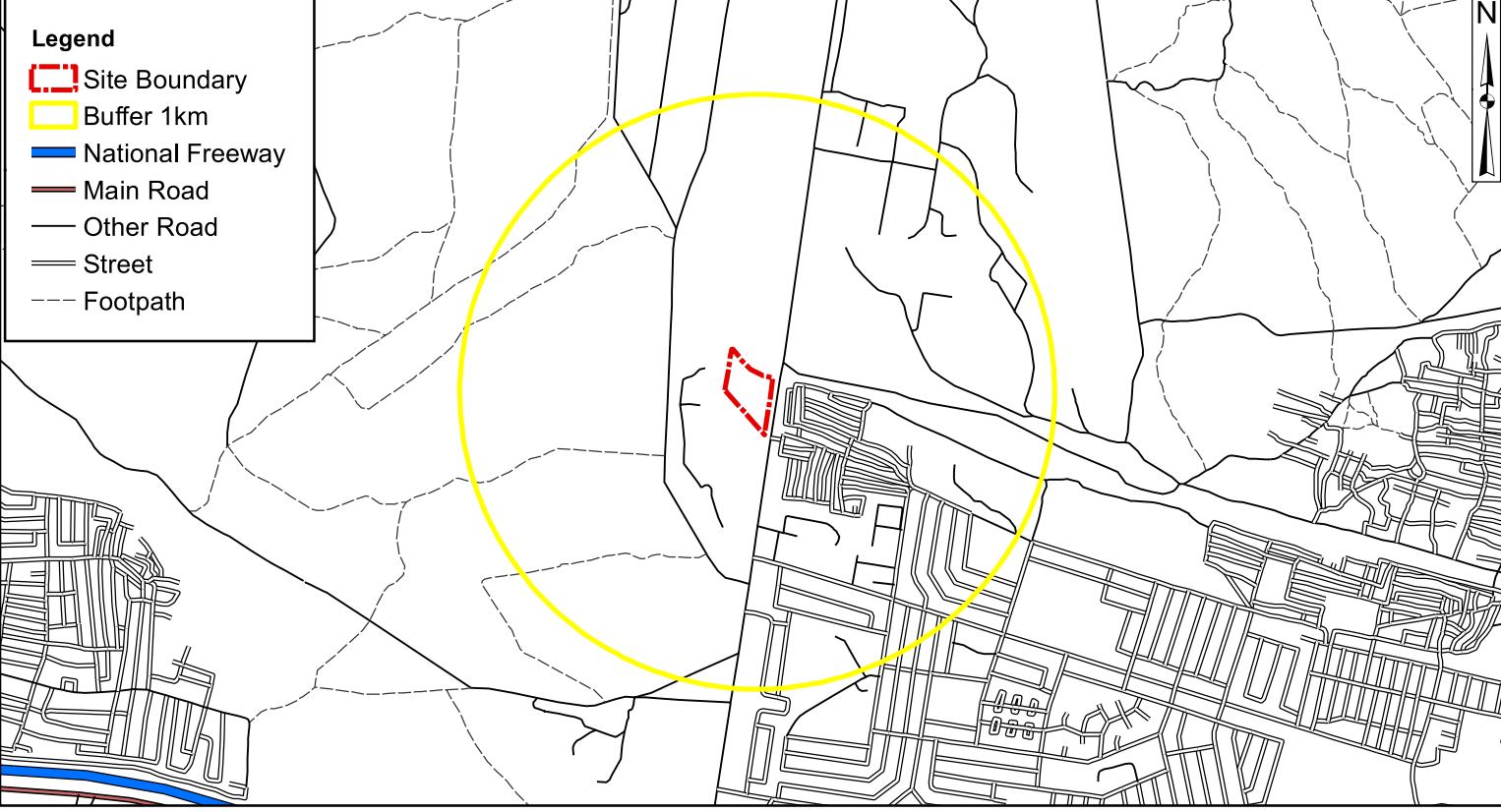
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Hydrology 1 : 25 000

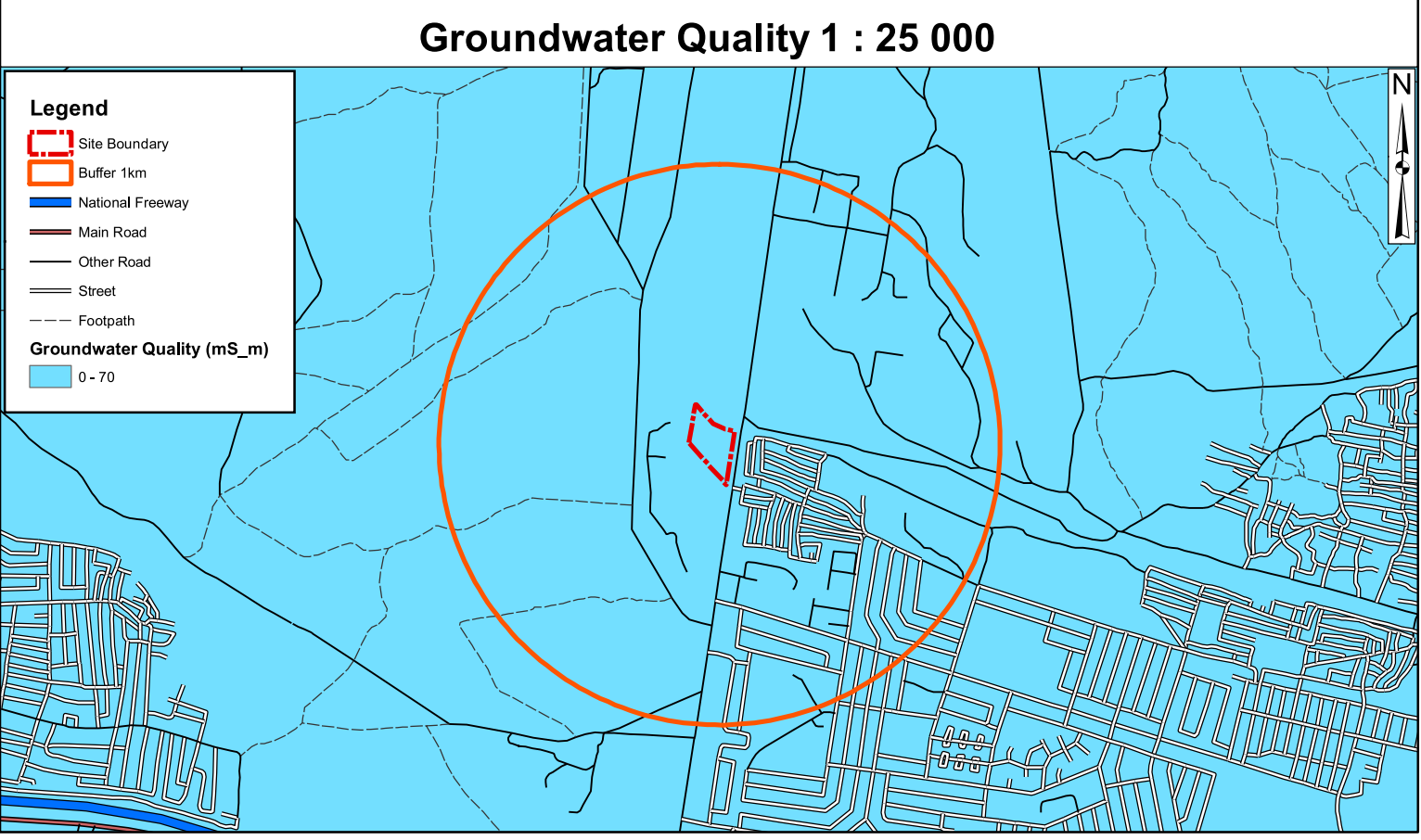
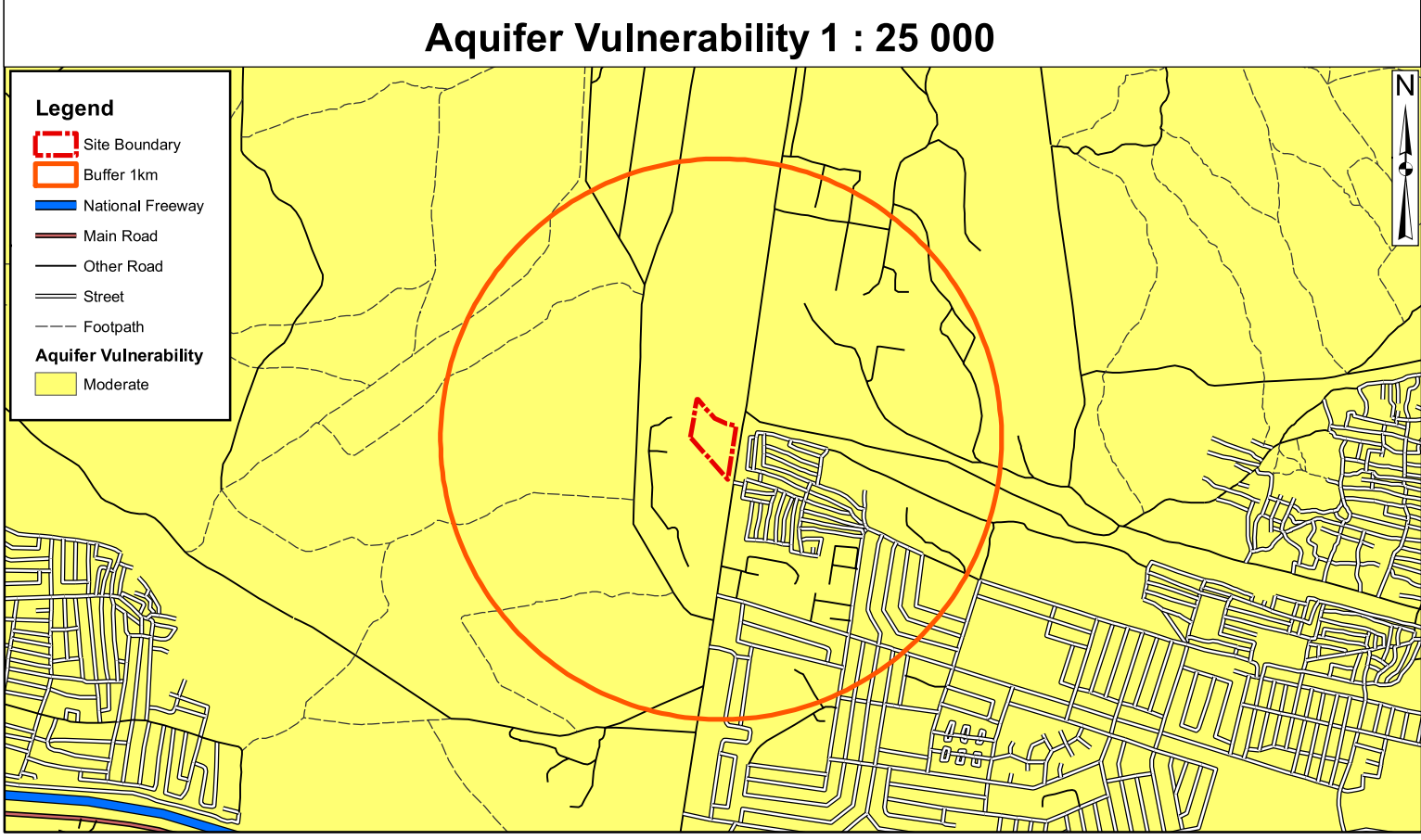
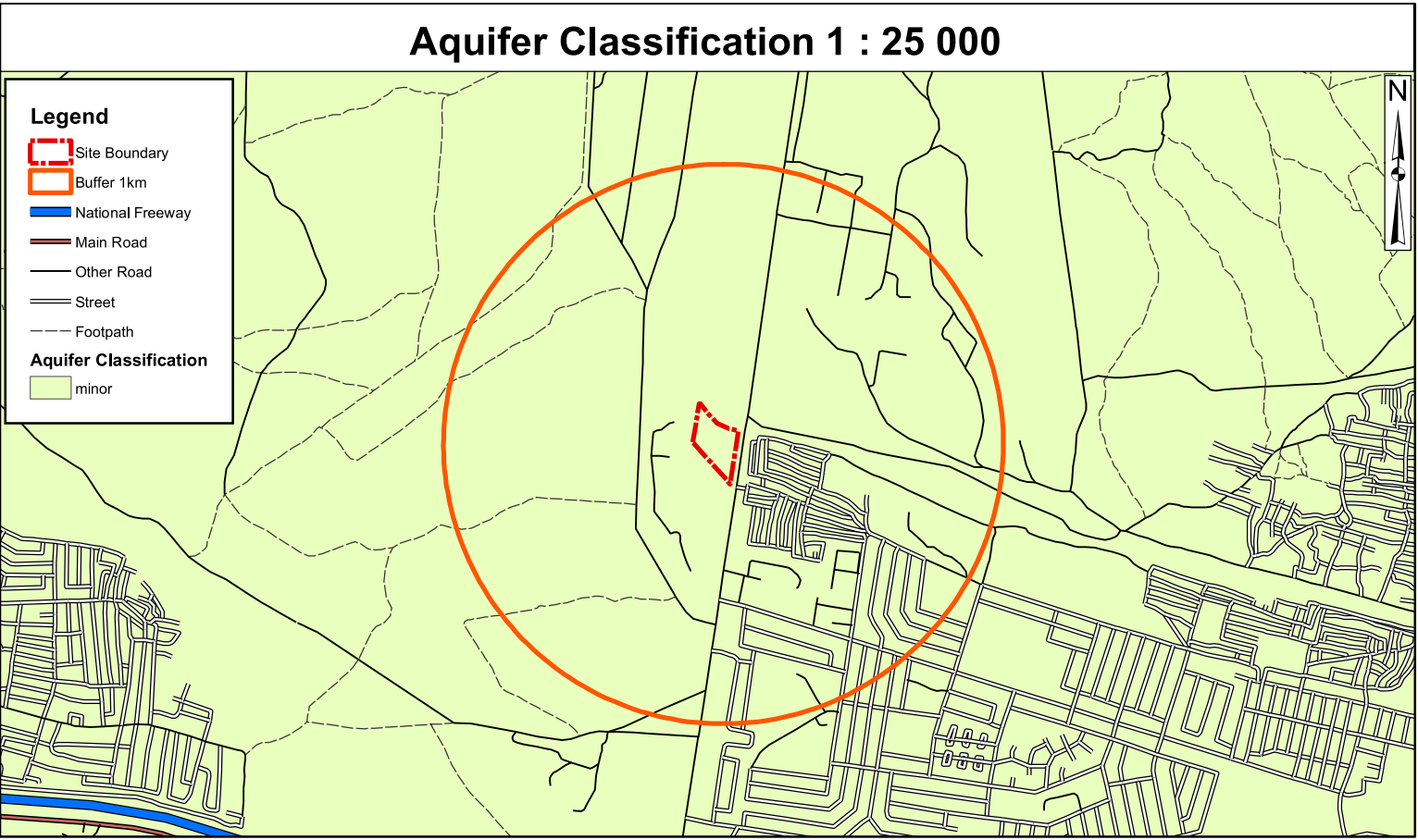
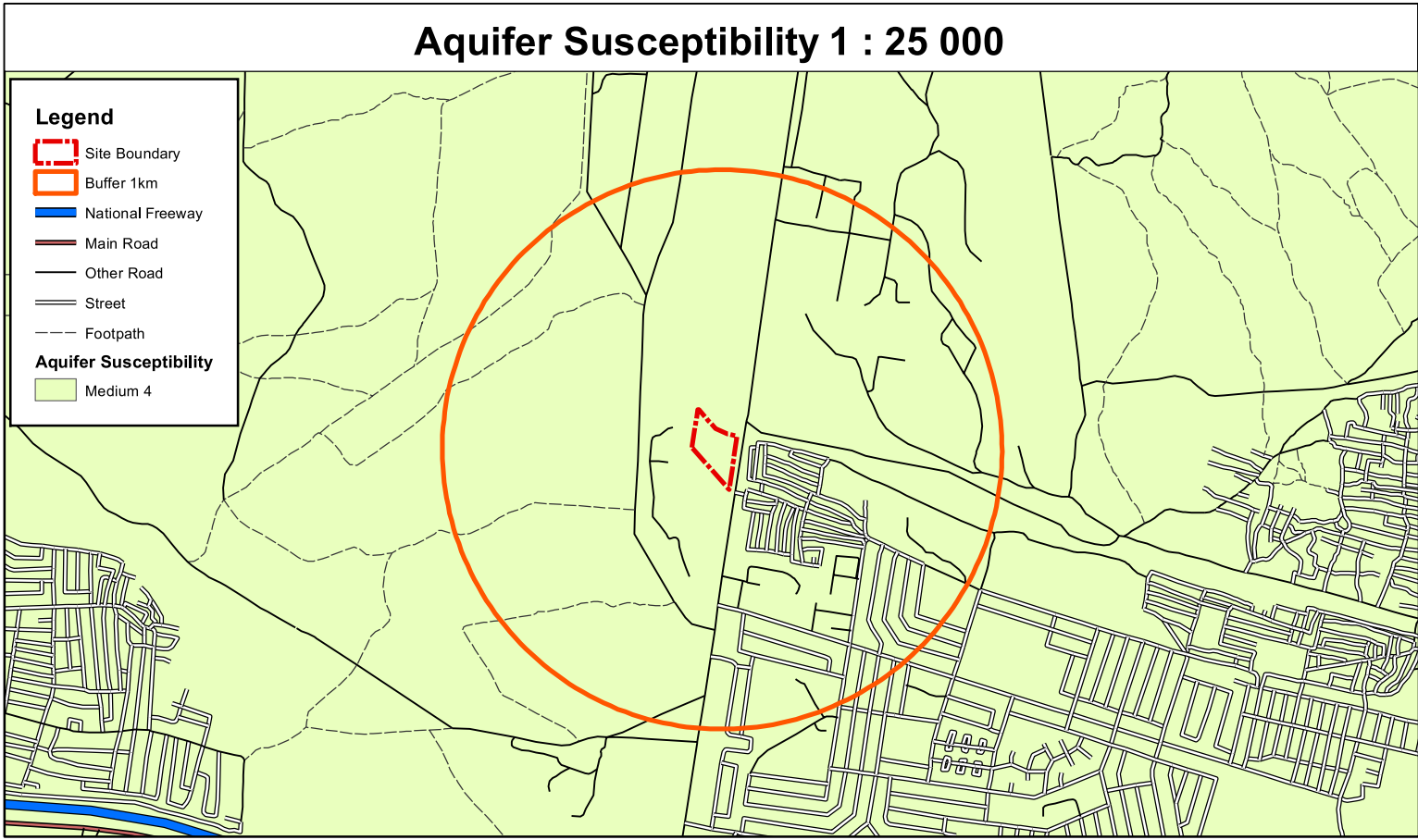


Land Use 1 : 25 000



|                                                                                                                                     |                                  |                                                                                                                                                                                     |                                                                                                                                                                                                            |
|-------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Project Title:                                                                                                                      | Transnet Pipelines: Witbank Site | Scale correct when page size is: A3 landscape                                                                                                                                       | Figure 3                                                                                                                                                                                                   |
| Map Title:                                                                                                                          | Environmental Summary            | Projection: Transverse Mercator<br>Datum: Hartbeesthoek 1994                                                                                                                        | Sources:                                                                                                                                                                                                   |
| Client:                                                                                                                             | Transnet Pipelines               | Compiled By: AC Reichle<br>GIS QC By: GA Maree<br>Approved By: A Smith<br>Date Saved: 2020/07/29<br>Project Number: 60617870<br>Map Ref: Witbank_Enviro_Summary.mxd<br>Revision: 00 | Geological Map East Rand 2628: Council for Geoscience<br><br>Topographic Sheet 2629C, Rivers, Dams, Seasonal Wetlands, Roads, Land Use: National Geo-spatial Information<br><br>Quaternary Catchments: DWS |
| Whilst every care has been taken in compiling the information on this map, AECOM cannot accept responsibility for any inaccuracies. |                                  | © Copyright                                                                                                                                                                         | L:\Legacy\GISData\7_Projects\60617870_Transnet_Pipeline_GWM\mxd\Witbank\Witbank_Enviro_Summary.mxd                                                                                                         |
|                                                                                                                                     |                                  |                                                                                                                                                                                     |                                                                                                                                                                                                            |





|                                                                                                                                     |                                  |                                                                                                                                                                                       |                                                                                                                         |
|-------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| Project Title:                                                                                                                      | Transnet Pipelines: Witbank Site | Scale correct when page size is: A3 landscape                                                                                                                                         | Figure 4                                                                                                                |
| Map Title:                                                                                                                          | Hydrogeological Summary          | Projection: Transverse Mercator<br>Datum: Hartebeesthoek 1994<br>Central Meridian: 29.0                                                                                               | Sources:                                                                                                                |
| Client:                                                                                                                             | Transnet Pipelines               | Compiled By: AC Reichle<br>GIS QC By: GA Maree<br>Approved By: A Smith<br>Date Saved: 2020/07/29<br>Project Number: 60617870<br>Map Ref: Witbank_Hydrogeo_Summary.mxd<br>Revision: 00 | Aquifer Susceptibility, Aquifer Classification, Aquifer Vulnerability, Groundwater Quality: Department of Water Affairs |
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|                                                                                                                                                    |                                  |                                                                                                                                                                                  |                                                                                                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| Project Title:                                                                                                                                     | Transnet Pipelines: Witbank Site | Scale 1:1 200<br><small>(When page size is: A3 landscape)</small>                                                                                                                | Figure 5                                                                                        |
| Map Title:                                                                                                                                         | Site Layout                      | Projection: Transverse Mercator<br>Datum: Hartebeesthoek 1994<br>Central Meridian: 29.0                                                                                          | Sources:<br><br>Site Layout: AECOM 2020                                                         |
| Client:                                                                                                                                            | Transnet Pipelines               | Compiled By: AC Reichle<br>GIS QC By: G Maree<br>Approved By: E Rambau<br>Date Saved: 2020/07/29<br>Project Number: 60560660<br>Map Ref: Witbank_Site_Layout.mxd<br>Revision: 00 |                                                                                                 |
| <small>Whilst every care has been taken in compiling the information on this map, AECOM cannot accept responsibility for any inaccuracies.</small> |                                  | © Copyright                                                                                                                                                                      | L:\Legacy\GISData\7_Projects\60617870_Transnet_Pipeline_GWM\mxd\Witbank\Witbank_Site_Layout.mxd |
| <div><div>AECOM</div></div>                                                                                                                        |                                  |                                                                                                                                                                                  |                                                                                                 |



-  Monitoring Well
-  Monitoring Well (Destroyed)
-  Above Ground Storage Tank (AST)
-  Control Room
-  Offices
-  Site Boundary
-  Spill Basin

| Sample ID              | MW6    |        |        |        |        |        |
|------------------------|--------|--------|--------|--------|--------|--------|
| Depth (m-bgl)          | 3,00   |        |        |        |        |        |
| SWL (m-bgl)            | 0,28   | 0,22   | 0,25   | 0      | 0      | 0,1    |
| PID (ppm)              | -      | -      | 13,7   | -      | -      | 2,28   |
| Sample Date            | Sep-18 | Mar-19 | Jun-20 | Nov-20 | Apr-21 | Nov-21 |
| VOCs (µg/l)            |        |        |        |        |        |        |
| Benzene                | <1     | <1     | 21,000 | <1     | <1     | <1     |
| Toluene                | <10    | <10    | <10    | <10    | <10    | <10    |
| Ethylbenzene           | <2     | <2     | <2     | <2     | <2     | <2     |
| Xylene                 | <6     | <6     | <4     | <4     | <4     | <4     |
| Naphthalene            | <2     | <2     | <2     | <2     | <2     | <2     |
| MTBE                   | 17     | <5     | <5     | 6      | <5     | <5     |
| TAME                   | 1300   | 350    | 1300   | 620    | 270    | 23     |
| 1,3,5-Trimethylbenzene | <2     | <2     | <2     | <2     | <2     | <2     |
| 1,2,4-Trimethylbenzene | <2     | <2     | <2     | <2     | <2     | <2     |
| C10-C20                | -      | <1     | <1     | <1     | <1     | <1     |

| Sample ID              | MW5    |        |        |        |        |        |
|------------------------|--------|--------|--------|--------|--------|--------|
| Depth (m-bgl)          | 6,68   |        |        |        |        |        |
| SWL (m-bgl)            | 0,60   | 0,45   | 0,56   | 0,25   | 0,39   | 0,44   |
| PID (ppm)              | -      | -      | 0      | 0      | 10,5   | 0      |
| Sample Date            | Sep-18 | Mar-19 | Jun-20 | Nov-20 | Apr-21 | Nov-21 |
| VOCs (µg/l)            |        |        |        |        |        |        |
| Benzene                | <10    | <10    | 10     | <1     | <1     | <1     |
| Toluene                | <100   | <100   | <10    | <10    | <10    | <10    |
| Ethylbenzene           | <20    | <20    | <2     | <2     | <2     | <2     |
| Xylene                 | <20    | <20    | <4     | <4     | <4     | <4     |
| Naphthalene            | <20    | <20    | <2     | <2     | <2     | <2     |
| MTBE                   | <50    | <50    | <5     | <5     | <5     | <5     |
| TAME                   | 3 100  | 2 400  | 220    | 850    | 460    | 800    |
| 1,3,5-Trimethylbenzene | <20    | <20    | <20    | <2     | <2     | <2     |
| 1,2,4-Trimethylbenzene | <20    | <20    | <20    | <2     | <2     | <2     |
| C10-C20                | -      | 144    | <1     | <1     | <1     | <1     |

| Sample ID              | MW3    |        |        |        |        |        |
|------------------------|--------|--------|--------|--------|--------|--------|
| Depth (m-bgl)          | 4,16   |        |        |        |        |        |
| SWL (m-bgl)            | 1,18   | 1,17   | 1,27   | 0,88   | 1,17   | 0,9    |
| PID (ppm)              |        |        | 0      | 127,2  | 96,3   | 44,9   |
| Sample Date            | Sep-18 | Mar-19 | Jun-20 | Nov-20 | Apr-21 | Nov-21 |
| VOCs (µg/l)            |        |        |        |        |        |        |
| Benzene                | 580    | 69     | 23     | <1     | 8      | 5      |
| Toluene                | <10    | <10    | <10    | <10    | <10    | <10    |
| Ethylbenzene           | 180    | 64     | <2     | <2     | 7      | 8      |
| Xylene                 | <6     | <6     | <4     | <4     | <4     | <4     |
| Naphthalene            | 42     | 6      | <2     | <2     | <2     | <2     |
| MTBE                   | 14     | <5     | <5     | <5     | 7      | 7      |
| TAME                   | 630    | 140    | 340    | 90     | 410    | 130    |
| 1,3,5-Trimethylbenzene | <2     | <2     | <2     | <2     | <2     | <2     |
| 1,2,4-Trimethylbenzene | <2     | <2     | <2     | <2     | <2     | <2     |
| C10-C20                | -      | <1     | <1     | <1     | <1     | <1     |

| Sample ID              | MW7    |        |        |        |        |        |
|------------------------|--------|--------|--------|--------|--------|--------|
| Depth (m-bgl)          | 4,98   |        |        |        |        |        |
| SWL (m-bgl)            | 0,63   | 0,51   | 0,62   | 0,425  | 0,52   | 0,53   |
| PID (ppm)              | -      | -      | 1,2    | 0      | 5,2    | 0      |
| Sample Date            | Sep-18 | Mar-19 | Jun-20 | Nov-20 | Apr-21 | Nov-21 |
| VOCs (µg/l)            |        |        |        |        |        |        |
| Benzene                | <1     | <1     | <5     | <1     | <1     | <1     |
| Toluene                | <10    | <10    | <10    | <10    | <10    | <10    |
| Ethylbenzene           | <2     | <2     | <2     | <2     | <2     | <2     |
| Xylene                 | <6     | <6     | <4     | <4     | <4     | <4     |
| Naphthalene            | <2     | <2     | <2     | <2     | <2     | <2     |
| MTBE                   | 17     | <5     | <5     | <5     | <5     | <5     |
| TAME                   | 1400   | <5     | 320    | 440    | 470    | 210    |
| 1,3,5-Trimethylbenzene | <2     | <2     | <2     | <2     | <2     | <2     |
| 1,2,4-Trimethylbenzene | <2     | <2     | <2     | <2     | <2     | <2     |
| C10-C20                | -      | <1     | <1     | <1     | <1     | <1     |

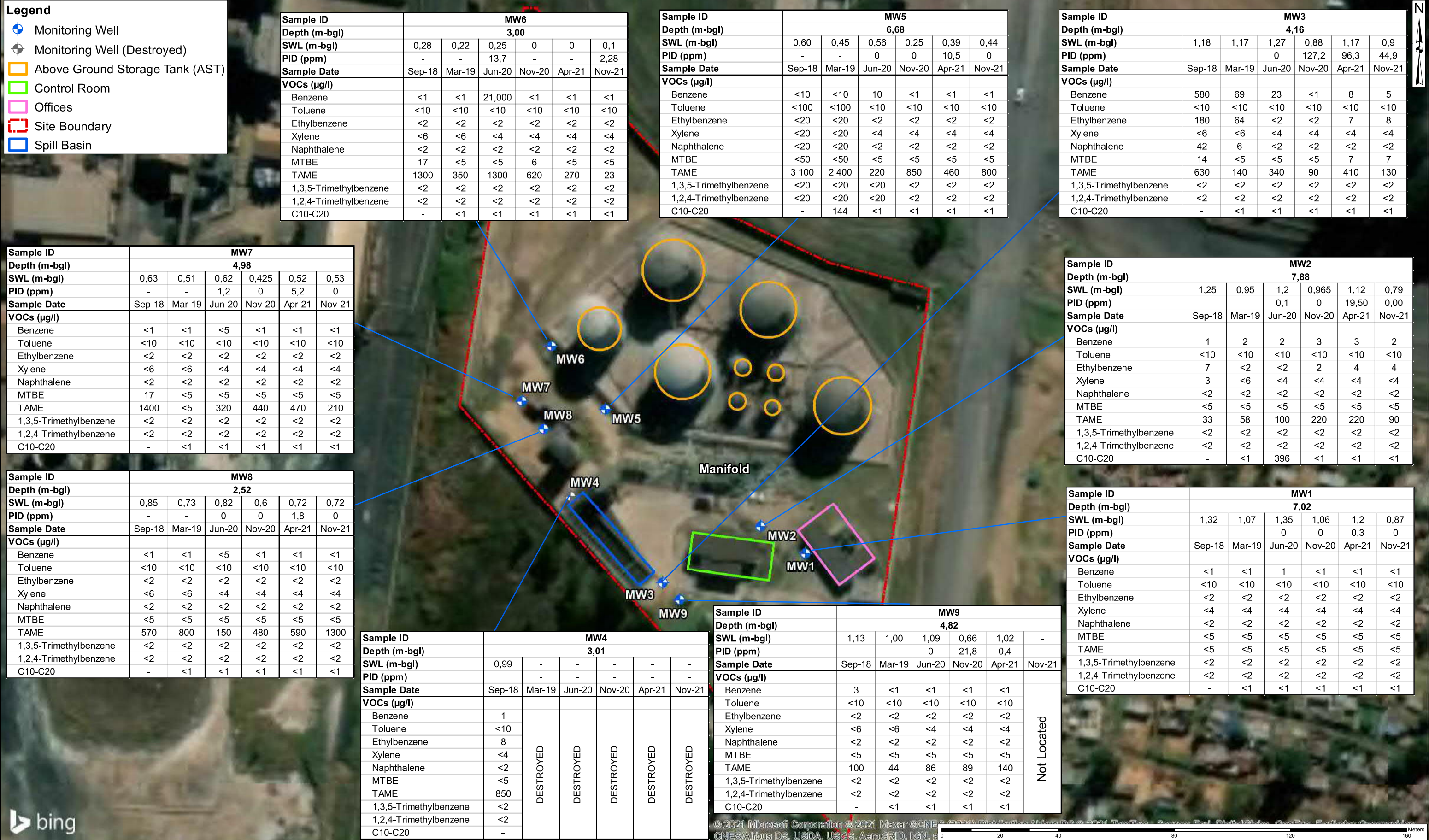
| Sample ID              | MW8    |        |        |        |        |        |
|------------------------|--------|--------|--------|--------|--------|--------|
| Depth (m-bgl)          | 2,52   |        |        |        |        |        |
| SWL (m-bgl)            | 0,85   | 0,73   | 0,82   | 0,6    | 0,72   | 0,72   |
| PID (ppm)              | -      | -      | 0      | 0      | 1,8    | 0      |
| Sample Date            | Sep-18 | Mar-19 | Jun-20 | Nov-20 | Apr-21 | Nov-21 |
| VOCs (µg/l)            |        |        |        |        |        |        |
| Benzene                | <1     | <1     | <5     | <1     | <1     | <1     |
| Toluene                | <10    | <10    | <10    | <10    | <10    | <10    |
| Ethylbenzene           | <2     | <2     | <2     | <2     | <2     | <2     |
| Xylene                 | <6     | <6     | <4     | <4     | <4     | <4     |
| Naphthalene            | <2     | <2     | <2     | <2     | <2     | <2     |
| MTBE                   | <5     | <5     | <5     | <5     | <5     | <5     |
| TAME                   | 570    | 800    | 150    | 480    | 590    | 1300   |
| 1,3,5-Trimethylbenzene | <2     | <2     | <2     | <2     | <2     | <2     |
| 1,2,4-Trimethylbenzene | <2     | <2     | <2     | <2     | <2     | <2     |
| C10-C20                | -      | <1     | <1     | <1     | <1     | <1     |

| Sample ID              | MW4    |           |           |           |           |           |
|------------------------|--------|-----------|-----------|-----------|-----------|-----------|
| Depth (m-bgl)          | 3,01   |           |           |           |           |           |
| SWL (m-bgl)            | 0,99   | -         | -         | -         | -         | -         |
| PID (ppm)              | -      | -         | -         | -         | -         | -         |
| Sample Date            | Sep-18 | Mar-19    | Jun-20    | Nov-20    | Apr-21    | Nov-21    |
| VOCs (µg/l)            |        |           |           |           |           |           |
| Benzene                | 1      | DESTROYED | DESTROYED | DESTROYED | DESTROYED | DESTROYED |
| Toluene                | <10    |           |           |           |           |           |
| Ethylbenzene           | 8      |           |           |           |           |           |
| Xylene                 | <4     |           |           |           |           |           |
| Naphthalene            | <2     |           |           |           |           |           |
| MTBE                   | <5     |           |           |           |           |           |
| TAME                   | 850    |           |           |           |           |           |
| 1,3,5-Trimethylbenzene | <2     |           |           |           |           |           |
| 1,2,4-Trimethylbenzene | <2     |           |           |           |           |           |
| C10-C20                | -      |           |           |           |           |           |

| Sample ID              | MW9    |        |        |        |        |             |
|------------------------|--------|--------|--------|--------|--------|-------------|
| Depth (m-bgl)          | 4,82   |        |        |        |        |             |
| SWL (m-bgl)            | 1,13   | 1,00   | 1,09   | 0,66   | 1,02   | -           |
| PID (ppm)              | -      | -      | 0      | 21,8   | 0,4    | -           |
| Sample Date            | Sep-18 | Mar-19 | Jun-20 | Nov-20 | Apr-21 | Nov-21      |
| VOCs (µg/l)            |        |        |        |        |        | Not Located |
| Benzene                | 3      | <1     | <1     | <1     | <1     |             |
| Toluene                | <10    | <10    | <10    | <10    | <10    |             |
| Ethylbenzene           | <2     | <2     | <2     | <2     | <2     |             |
| Xylene                 | <6     | <6     | <4     | <4     | <4     |             |
| Naphthalene            | <2     | <2     | <2     | <2     | <2     |             |
| MTBE                   | <5     | <5     | <5     | <5     | <5     |             |
| TAME                   | 100    | 44     | 86     | 89     | 140    |             |
| 1,3,5-Trimethylbenzene | <2     | <2     | <2     | <2     | <2     |             |
| 1,2,4-Trimethylbenzene | <2     | <2     | <2     | <2     | <2     |             |
| C10-C20                | -      | <1     | <1     | <1     | <1     |             |

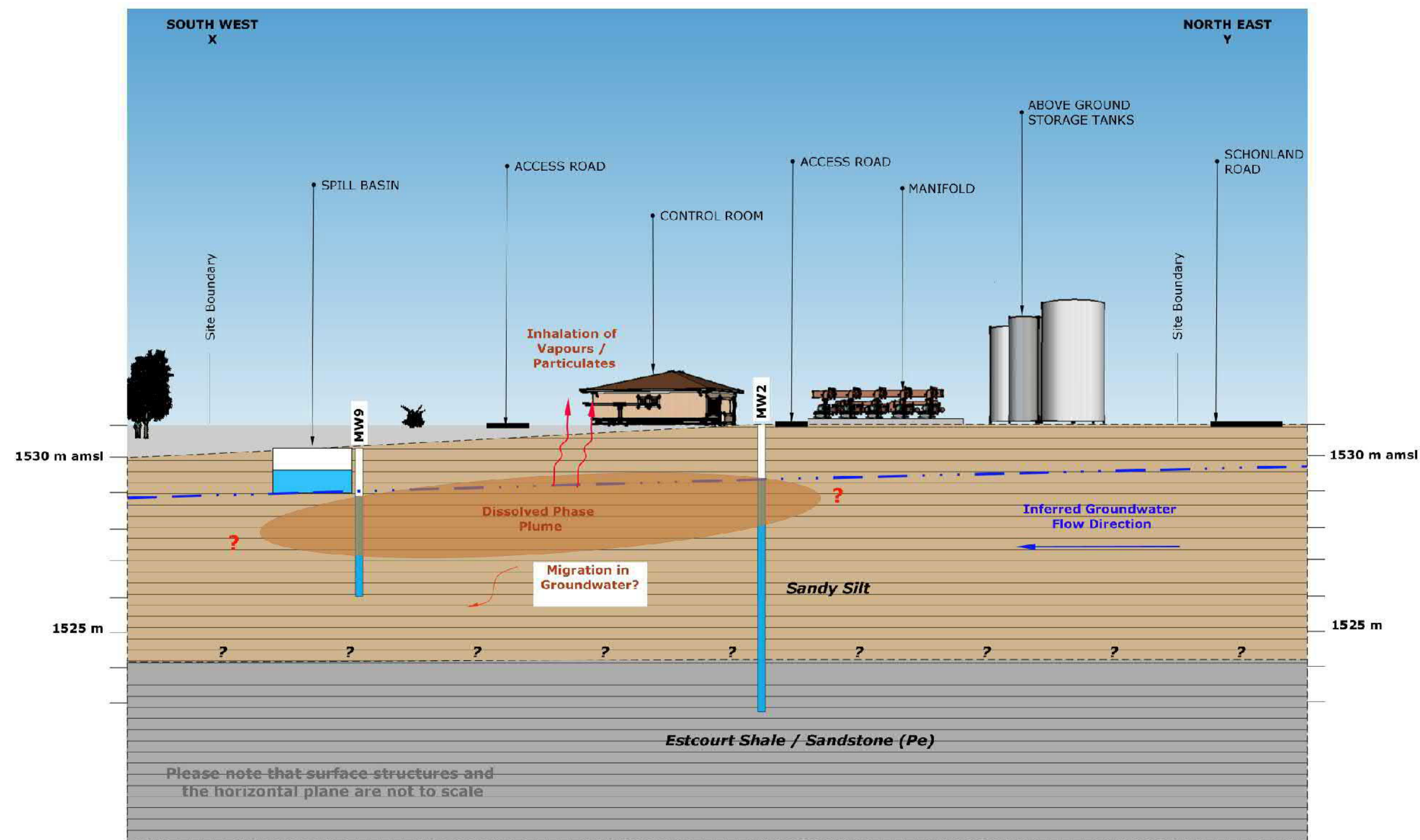
| Sample ID              | MW2    |        |        |        |        |        |
|------------------------|--------|--------|--------|--------|--------|--------|
| Depth (m-bgl)          | 7,88   |        |        |        |        |        |
| SWL (m-bgl)            | 1,25   | 0,95   | 1,2    | 0,965  | 1,12   | 0,79   |
| PID (ppm)              |        |        | 0,1    | 0      | 19,50  | 0,00   |
| Sample Date            | Sep-18 | Mar-19 | Jun-20 | Nov-20 | Apr-21 | Nov-21 |
| VOCs (µg/l)            |        |        |        |        |        |        |
| Benzene                | 1      | 2      | 2      | 3      | 3      | 2      |
| Toluene                | <10    | <10    | <10    | <10    | <10    | <10    |
| Ethylbenzene           | 7      | <2     | <2     | 2      | 4      | 4      |
| Xylene                 | 3      | <6     | <4     | <4     | <4     | <4     |
| Naphthalene            | <2     | <2     | <2     | <2     | <2     | <2     |
| MTBE                   | <5     | <5     | <5     | <5     | <5     | <5     |
| TAME                   | 33     | 58     | 100    | 220    | 220    | 90     |
| 1,3,5-Trimethylbenzene | <2     | <2     | <2     | <2     | <2     | <2     |
| 1,2,4-Trimethylbenzene | <2     | <2     | <2     | <2     | <2     | <2     |
| C10-C20                | -      | <1     | 396    | <1     | <1     | <1     |

| Sample ID              | MW1    |        |        |        |        |        |
|------------------------|--------|--------|--------|--------|--------|--------|
| Depth (m-bgl)          | 7,02   |        |        |        |        |        |
| SWL (m-bgl)            | 1,32   | 1,07   | 1,35   | 1,06   | 1,2    | 0,87   |
| PID (ppm)              |        |        | 0      | 0      | 0,3    | 0      |
| Sample Date            | Sep-18 | Mar-19 | Jun-20 | Nov-20 | Apr-21 | Nov-21 |
| VOCs (µg/l)            |        |        |        |        |        |        |
| Benzene                | <1     | <1     | 1      | <1     | <1     | <1     |
| Toluene                | <10    | <10    | <10    | <10    | <10    | <10    |
| Ethylbenzene           | <2     | <2     | <2     | <2     | <2     | <2     |
| Xylene                 | <4     | <4     | <4     | <4     | <4     | <4     |
| Naphthalene            | <2     | <2     | <2     | <2     | <2     | <2     |
| MTBE                   | <5     | <5     | <5     | <5     | <5     | <5     |
| TAME                   | <5     | <5     | <5     | <5     | <5     | <5     |
| 1,3,5-Trimethylbenzene | <2     | <2     | <2     | <2     | <2     | <2     |
| 1,2,4-Trimethylbenzene | <2     | <2     | <2     | <2     | <2     | <2     |
| C10-C20                | -      | <1     | <1     | <1     | <1     | <1     |



|                                                                                                                                     |  |                                                                                                                                                                                         |  |                                                |  |
|-------------------------------------------------------------------------------------------------------------------------------------|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|------------------------------------------------|--|
| Project Title: <b>Transnet Pipelines: Witbank Site</b>                                                                              |  | Scale 1:1 200<br><small>(When page size is: A3 landscape)</small>                                                                                                                       |  | <b>Figure 6</b>                                |  |
| Map Title: <b>Groundwater Analytical Results</b>                                                                                    |  | Projection: Transverse Mercator<br>Datum: Hartebeesthoek 1994<br>Central Meridian: 29,0                                                                                                 |  | <b>Sources:</b><br><br>Site Layout: AECOM 2020 |  |
| Client: <b>Transnet Pipelines</b>                                                                                                   |  | Compiled By: T Nembudani<br>GIS QC By: R Pretorius<br>Approved By: R Pretorius<br>Date Saved: 2021/11/22<br>Project Number: 60560660<br>Map Ref: Witbank_GW_Results.mxd<br>Revision: 00 |  |                                                |  |
| Whilst every care has been taken in compiling the information on this map, AECOM cannot accept responsibility for any inaccuracies. |  | © Copyright                                                                                                                                                                             |  |                                                |  |
|                                                   |  |                                                                                                                                                                                         |  |                                                |  |





|                                                                                                                                     |                                  |                                                                                                                        |                                   |
|-------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|------------------------------------------------------------------------------------------------------------------------|-----------------------------------|
| Project Title:                                                                                                                      | Transnet Pipelines: Witbank Site | Scale: Not to scale                                                                                                    | Figure 7                          |
| Map Title:                                                                                                                          | Conceptual Site Model            | Projection:<br>Datum:                                                                                                  | Sources:                          |
| Client:                                                                                                                             | Transnet Pipelines               | Compiled By: AC Reichle                                                                                                | Conceptual Site Model: AECOM 2020 |
| Whilst every care has been taken in compiling the information on this map, AECOM cannot accept responsibility for any inaccuracies. |                                  | Approved By: A Smith<br>Date Saved: 2020/07/31<br>Project Number: 60617870<br>Map Ref: Witbank_CSM.mxd<br>Revision: 00 |                                   |
| AECOM                                                                                                                               |                                  | L:\Legacy\GISData\7_Projects\60617870_Transnet_Pipeline_GWM.mxd\Witbank\Witbank_CSM.mxd                                |                                   |

Appendix B

# Laboratory Certificates

## TEST REPORT

### 35454A

**Test Description** Screening for Volatile Petroleum Hydrocarbons

**Test Method:** UISOL-T-012

#### Client and Project Information

**Client:** AECOM SA (Pty) Ltd

**Address:** 263A West Avenue, Centurion  
Pretoria

**Attention:** Tshilidzi Nembudani

**Tel:** (012) 421 3783

**Email:** tshilidzi.nembudani@aecom.com

**Project number:** 60617870-2.02-2

**Project name:** Transnet Witbank

#### Sample Information

**Sample ID:** DUP

**Dilution:** No Dilution

**Container:** Plastic

**Matrix:** Water

**Storage:** Fridge at 0-6°C

**Date Received:** 2021/11/12

**Date Analysed:** 2021/11/15

**Date Issued:** 2021/11/17

#### Gasoline Range Organics (GRO's)

| PARAMETER              | RESULT       |
|------------------------|--------------|
| MTBE                   | <5 µg/liter  |
| TAME                   | 200 µg/liter |
| Benzene                | <1 µg/liter  |
| Toluene                | <10 µg/liter |
| Ethylbenzene           | <2 µg/liter  |
| m+p-Xylene             | <4 µg/liter  |
| o-Xylene               | <2 µg/liter  |
| 1,3,5-Trimethylbenzene | <2 µg/liter  |
| 1,2,4-Trimethylbenzene | <2 µg/liter  |
| Naphthalene            | <2 µg/liter  |

#### Diesel Range Organics (DRO's)

| PARAMETER | RESULT      |
|-----------|-------------|
| C10 *     | <1 µg/liter |
| C11 *     | <1 µg/liter |
| C12 *     | <1 µg/liter |
| C13 *     | <1 µg/liter |
| C14 *     | <1 µg/liter |
| C15 *     | <1 µg/liter |
| C16 *     | <1 µg/liter |
| C17 *     | <1 µg/liter |
| C18 *     | <1 µg/liter |
| C19 *     | <1 µg/liter |
| C20 *     | <1 µg/liter |

#### Polycyclic Aromatic Hydrocarbons (PAH's)

| PARAMETER        | RESULT      |
|------------------|-------------|
| Acenaphthene *   | <1 µg/liter |
| Acenaphthylene * | <1 µg/liter |
| Flourene *       | <1 µg/liter |
| Phenanthrene *   | <1 µg/liter |
| Anthracene *     | <1 µg/liter |
| Fluoranthene *   | <1 µg/liter |
| Pyrene *         | <1 µg/liter |

#### Diagnostic Ratios

| PARAMETER                     | RESULT       |
|-------------------------------|--------------|
| 1,3,5TMB : 1,2,4TMB *         | #Num!        |
| (B+T)/(E+X) *                 | #Num!        |
| Total VPHs Identified *       | 200 µg/liter |
| Estimated VPHs Unidentified * | <10 µg/liter |
| Estimated TOTAL VPHs *        | 200 µg/liter |

#### Disclaimers

- 1) The results only relate to the test items provided, in the condition as received.
- 2) This report may not be reproduced, except in full, without the prior written approval of the laboratory.
- 3) Parameters marked " \*" are not included in the SANAS Schedule of Accreditation for this laboratory.
- 4) A = Concentration outside calibration range, O = Outsourced analysis, UTD = Unable to Determine.
- 5) Uncertainty of measurement for all methods included in the SANAS Schedule of Accreditation is available on request.

**Reinardt Cromhout**  
Authorised Signatory

## TEST REPORT

### 35454A

**Test Description** Screening for Volatile Petroleum Hydrocarbons

**Test Method:** UISOL-T-012

#### Client and Project Information

**Client:** AECOM SA (Pty) Ltd

**Address:** 263A West Avenue, Centurion  
Pretoria

**Attention:** Tshilidzi Nembudani

**Tel:** (012) 421 3783

**Email:** tshilidzi.nembudani@aecom.com

**Project number:** 60617870-2.02-2

**Project name:** Transnet Witbank

#### Sample Information

**Sample ID:** MW1

**Dilution:** No Dilution

**Container:** Plastic

**Matrix:** Water

**Storage:** Fridge at 0-6°C

**Date Received:** 2021/11/12

**Date Analysed:** 2021/11/15

**Date Issued:** 2021/11/17

#### Gasoline Range Organics (GRO's)

| <u>PARAMETER</u>       | <u>RESULT</u> |
|------------------------|---------------|
| MTBE                   | <5 µg/liter   |
| TAME                   | <5 µg/liter   |
| Benzene                | <1 µg/liter   |
| Toluene                | <10 µg/liter  |
| Ethylbenzene           | <2 µg/liter   |
| m+p-Xylene             | <4 µg/liter   |
| o-Xylene               | <2 µg/liter   |
| 1,3,5-Trimethylbenzene | <2 µg/liter   |
| 1,2,4-Trimethylbenzene | <2 µg/liter   |
| Naphthalene            | <2 µg/liter   |

#### Diesel Range Organics (DRO's)

| <u>PARAMETER</u> | <u>RESULT</u> |
|------------------|---------------|
| C10 *            | <1 µg/liter   |
| C11 *            | <1 µg/liter   |
| C12 *            | <1 µg/liter   |
| C13 *            | <1 µg/liter   |
| C14 *            | <1 µg/liter   |
| C15 *            | <1 µg/liter   |
| C16 *            | <1 µg/liter   |
| C17 *            | <1 µg/liter   |
| C18 *            | <1 µg/liter   |
| C19 *            | <1 µg/liter   |
| C20 *            | <1 µg/liter   |

#### Polycyclic Aromatic Hydrocarbons (PAH's)

| <u>PARAMETER</u> | <u>RESULT</u> |
|------------------|---------------|
| Acenaphthene *   | <1 µg/liter   |
| Acenaphthylene * | <1 µg/liter   |
| Flourene *       | <1 µg/liter   |
| Phenanthrene *   | <1 µg/liter   |
| Anthracene *     | <1 µg/liter   |
| Fluoranthene *   | <1 µg/liter   |
| Pyrene *         | <1 µg/liter   |

#### Diagnostic Ratios

| <u>PARAMETER</u>              | <u>RESULT</u> |
|-------------------------------|---------------|
| 1,3,5TMB : 1,2,4TMB *         | #Num!         |
| (B+T)/(E+X) *                 | #Num!         |
| Total VPHs Identified *       | <10 µg/liter  |
| Estimated VPHs Unidentified * | <10 µg/liter  |
| Estimated TOTAL VPHs *        | <10 µg/liter  |

#### Disclaimers

- 1) The results only relate to the test items provided, in the condition as received.
- 2) This report may not be reproduced, except in full, without the prior written approval of the laboratory.
- 3) Parameters marked " \*" are not included in the SANAS Schedule of Accreditation for this laboratory.
- 4) A = Concentration outside calibration range, O = Outsourced analysis, UTD = Unable to Determine.
- 5) Uncertainty of measurement for all methods included in the SANAS Schedule of Accreditation is available on request.

**Reinardt Cromhout**  
Authorised Signatory



## TEST REPORT

**Test Description** Screening for Volatile Petroleum Hydrocarbons

**Test Method:** UISOL-T-012

### 35454A

#### Client and Project Information

**Client:** AECOM SA (Pty) Ltd

**Address:** 263A West Avenue, Centurion  
Pretoria

**Attention:** Tshilidzi Nembudani

**Tel:** (012) 421 3783

**Email:** tshilidzi.nembudani@aecom.com

**Project number:** 60617870-2.02-2

**Project name:** Transnet Witbank

#### Sample Information

**Sample ID:** MW2

**Dilution:** No Dilution

**Container:** Plastic

**Matrix:** Water

**Storage:** Fridge at 0-6°C

**Date Received:** 2021/11/12

**Date Analysed:** 2021/11/15

**Date Issued:** 2021/11/17

#### Gasoline Range Organics (GRO's)

| <u>PARAMETER</u>       | <u>RESULT</u> |
|------------------------|---------------|
| MTBE                   | <5 µg/liter   |
| TAME                   | 90 µg/liter   |
| Benzene                | 2 µg/liter    |
| Toluene                | <10 µg/liter  |
| Ethylbenzene           | 4 µg/liter    |
| m+p-Xylene             | <4 µg/liter   |
| o-Xylene               | <2 µg/liter   |
| 1,3,5-Trimethylbenzene | <2 µg/liter   |
| 1,2,4-Trimethylbenzene | <2 µg/liter   |
| Naphthalene            | <2 µg/liter   |

#### Diesel Range Organics (DRO's)

| <u>PARAMETER</u> | <u>RESULT</u> |
|------------------|---------------|
| C10 *            | <1 µg/liter   |
| C11 *            | <1 µg/liter   |
| C12 *            | <1 µg/liter   |
| C13 *            | <1 µg/liter   |
| C14 *            | <1 µg/liter   |
| C15 *            | <1 µg/liter   |
| C16 *            | <1 µg/liter   |
| C17 *            | <1 µg/liter   |
| C18 *            | <1 µg/liter   |
| C19 *            | <1 µg/liter   |
| C20 *            | <1 µg/liter   |

#### Polycyclic Aromatic Hydrocarbons (PAH's)

| <u>PARAMETER</u> | <u>RESULT</u> |
|------------------|---------------|
| Acenaphthene *   | <1 µg/liter   |
| Acenaphthylene * | <1 µg/liter   |
| Flourene *       | 1 µg/liter    |
| Phenanthrene *   | <1 µg/liter   |
| Anthracene *     | <1 µg/liter   |
| Fluoranthene *   | <1 µg/liter   |
| Pyrene *         | <1 µg/liter   |

#### Diagnostic Ratios

| <u>PARAMETER</u>              | <u>RESULT</u> |
|-------------------------------|---------------|
| 1,3,5TMB : 1,2,4TMB *         | #Num!         |
| (B+T)/(E+X) *                 | 0.50          |
| Total VPHs Identified *       | 97 µg/liter   |
| Estimated VPHs Unidentified * | 270 µg/liter  |
| Estimated TOTAL VPHs *        | 367 µg/liter  |

#### Disclaimers

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- 5) Uncertainty of measurement for all methods included in the SANAS Schedule of Accreditation is available on request.

**Reinardt Cromhout**  
Authorised Signatory

## TEST REPORT

**Test Description** Screening for Volatile Petroleum Hydrocarbons

**Test Method:** UISOL-T-012

### 35454A

#### Client and Project Information

**Client:** AECOM SA (Pty) Ltd

**Address:** 263A West Avenue, Centurion  
Pretoria

**Attention:** Tshilidzi Nembudani

**Tel:** (012) 421 3783

**Email:** tshilidzi.nembudani@aecom.com

**Project number:** 60617870-2.02-2

**Project name:** Transnet Witbank

#### Sample Information

**Sample ID:** MW3

**Dilution:** No Dilution

**Container:** Plastic

**Matrix:** Water

**Storage:** Fridge at 0-6°C

**Date Received:** 2021/11/12

**Date Analysed:** 2021/11/15

**Date Issued:** 2021/11/17

#### Gasoline Range Organics (GRO's)

| <u>PARAMETER</u>       | <u>RESULT</u> |
|------------------------|---------------|
| MTBE                   | <5 µg/liter   |
| TAME                   | 130 µg/liter  |
| Benzene                | 5 µg/liter    |
| Toluene                | <10 µg/liter  |
| Ethylbenzene           | 8 µg/liter    |
| m+p-Xylene             | <4 µg/liter   |
| o-Xylene               | <2 µg/liter   |
| 1,3,5-Trimethylbenzene | <2 µg/liter   |
| 1,2,4-Trimethylbenzene | <2 µg/liter   |
| Naphthalene            | <2 µg/liter   |

#### Diesel Range Organics (DRO's)

| <u>PARAMETER</u> | <u>RESULT</u> |
|------------------|---------------|
| C10 *            | <1 µg/liter   |
| C11 *            | <1 µg/liter   |
| C12 *            | <1 µg/liter   |
| C13 *            | <1 µg/liter   |
| C14 *            | <1 µg/liter   |
| C15 *            | <1 µg/liter   |
| C16 *            | <1 µg/liter   |
| C17 *            | <1 µg/liter   |
| C18 *            | <1 µg/liter   |
| C19 *            | <1 µg/liter   |
| C20 *            | <1 µg/liter   |

#### Polycyclic Aromatic Hydrocarbons (PAH's)

| <u>PARAMETER</u> | <u>RESULT</u> |
|------------------|---------------|
| Acenaphthene *   | <1 µg/liter   |
| Acenaphthylene * | <1 µg/liter   |
| Flourene *       | 1 µg/liter    |
| Phenanthrene *   | <1 µg/liter   |
| Anthracene *     | <1 µg/liter   |
| Fluoranthene *   | <1 µg/liter   |
| Pyrene *         | <1 µg/liter   |

#### Diagnostic Ratios

| <u>PARAMETER</u>              | <u>RESULT</u> |
|-------------------------------|---------------|
| 1,3,5TMB : 1,2,4TMB *         | #Num!         |
| (B+T)/(E+X) *                 | 0.63          |
| Total VPHs Identified *       | 144 µg/liter  |
| Estimated VPHs Unidentified * | 510 µg/liter  |
| Estimated TOTAL VPHs *        | 654 µg/liter  |

#### Disclaimers

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- 4) A = Concentration outside calibration range, O = Outsourced analysis, UTD = Unable to Determine.
- 5) Uncertainty of measurement for all methods included in the SANAS Schedule of Accreditation is available on request.

**Reinardt Cromhout**  
Authorised Signatory

## TEST REPORT

### 35454A

**Test Description** Screening for Volatile Petroleum Hydrocarbons

**Test Method:** UISOL-T-012

#### Client and Project Information

**Client:** AECOM SA (Pty) Ltd

**Address:** 263A West Avenue, Centurion  
Pretoria

**Attention:** Tshilidzi Nembudani

**Tel:** (012) 421 3783

**Email:** tshilidzi.nembudani@aecom.com

**Project number:** 60617870-2.02-2

**Project name:** Transnet Witbank

#### Sample Information

**Sample ID:** MW5

**Dilution:** No Dilution

**Container:** Plastic

**Matrix:** Water

**Storage:** Fridge at 0-6°C

**Date Received:** 2021/11/12

**Date Analysed:** 2021/11/15

**Date Issued:** 2021/11/17

#### Gasoline Range Organics (GRO's)

| <u>PARAMETER</u>       | <u>RESULT</u> |
|------------------------|---------------|
| MTBE                   | <5 µg/liter   |
| TAME                   | 800 µg/liter  |
| Benzene                | <1 µg/liter   |
| Toluene                | <10 µg/liter  |
| Ethylbenzene           | <2 µg/liter   |
| m+p-Xylene             | <4 µg/liter   |
| o-Xylene               | <2 µg/liter   |
| 1,3,5-Trimethylbenzene | <2 µg/liter   |
| 1,2,4-Trimethylbenzene | <2 µg/liter   |
| Naphthalene            | <2 µg/liter   |

#### Diesel Range Organics (DRO's)

| <u>PARAMETER</u> | <u>RESULT</u> |
|------------------|---------------|
| C10 *            | <1 µg/liter   |
| C11 *            | <1 µg/liter   |
| C12 *            | <1 µg/liter   |
| C13 *            | <1 µg/liter   |
| C14 *            | <1 µg/liter   |
| C15 *            | <1 µg/liter   |
| C16 *            | <1 µg/liter   |
| C17 *            | <1 µg/liter   |
| C18 *            | <1 µg/liter   |
| C19 *            | <1 µg/liter   |
| C20 *            | <1 µg/liter   |

#### Polycyclic Aromatic Hydrocarbons (PAH's)

| <u>PARAMETER</u> | <u>RESULT</u> |
|------------------|---------------|
| Acenaphthene *   | <1 µg/liter   |
| Acenaphthylene * | <1 µg/liter   |
| Flourene *       | <1 µg/liter   |
| Phenanthrene *   | <1 µg/liter   |
| Anthracene *     | <1 µg/liter   |
| Fluoranthene *   | <1 µg/liter   |
| Pyrene *         | <1 µg/liter   |

#### Diagnostic Ratios

| <u>PARAMETER</u>              | <u>RESULT</u> |
|-------------------------------|---------------|
| 1,3,5TMB : 1,2,4TMB *         | #Num!         |
| (B+T)/(E+X) *                 | #Num!         |
| Total VPHs Identified *       | 800 µg/liter  |
| Estimated VPHs Unidentified * | 38 µg/liter   |
| Estimated TOTAL VPHs *        | 838 µg/liter  |

#### Disclaimers

- 1) The results only relate to the test items provided, in the condition as received.
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- 5) Uncertainty of measurement for all methods included in the SANAS Schedule of Accreditation is available on request.

**Reinardt Cromhout**  
Authorised Signatory

## TEST REPORT

**Test Description** Screening for Volatile Petroleum Hydrocarbons

**Test Method:** UISOL-T-012

### 35454A

#### Client and Project Information

**Client:** AECOM SA (Pty) Ltd

**Address:** 263A West Avenue, Centurion  
Pretoria

**Attention:** Tshilidzi Nembudani

**Tel:** (012) 421 3783

**Email:** tshilidzi.nembudani@aecom.com

**Project number:** 60617870-2.02-2

**Project name:** Transnet Witbank

#### Sample Information

**Sample ID:** MW6

**Dilution:** No Dilution

**Container:** Plastic

**Matrix:** Water

**Storage:** Fridge at 0-6°C

**Date Received:** 2021/11/12

**Date Analysed:** 2021/11/15

**Date Issued:** 2021/11/17

#### Gasoline Range Organics (GRO's)

| <u>PARAMETER</u>       | <u>RESULT</u> |
|------------------------|---------------|
| MTBE                   | <5 µg/liter   |
| TAME                   | 23 µg/liter   |
| Benzene                | <1 µg/liter   |
| Toluene                | <10 µg/liter  |
| Ethylbenzene           | <2 µg/liter   |
| m+p-Xylene             | <4 µg/liter   |
| o-Xylene               | <2 µg/liter   |
| 1,3,5-Trimethylbenzene | <2 µg/liter   |
| 1,2,4-Trimethylbenzene | <2 µg/liter   |
| Naphthalene            | <2 µg/liter   |

#### Diesel Range Organics (DRO's)

| <u>PARAMETER</u> | <u>RESULT</u> |
|------------------|---------------|
| C10 *            | <1 µg/liter   |
| C11 *            | <1 µg/liter   |
| C12 *            | <1 µg/liter   |
| C13 *            | <1 µg/liter   |
| C14 *            | <1 µg/liter   |
| C15 *            | <1 µg/liter   |
| C16 *            | <1 µg/liter   |
| C17 *            | <1 µg/liter   |
| C18 *            | <1 µg/liter   |
| C19 *            | <1 µg/liter   |
| C20 *            | <1 µg/liter   |

#### Polycyclic Aromatic Hydrocarbons (PAH's)

| <u>PARAMETER</u> | <u>RESULT</u> |
|------------------|---------------|
| Acenaphthene *   | <1 µg/liter   |
| Acenaphthylene * | <1 µg/liter   |
| Flourene *       | <1 µg/liter   |
| Phenanthrene *   | <1 µg/liter   |
| Anthracene *     | <1 µg/liter   |
| Fluoranthene *   | <1 µg/liter   |
| Pyrene *         | <1 µg/liter   |

#### Diagnostic Ratios

| <u>PARAMETER</u>              | <u>RESULT</u> |
|-------------------------------|---------------|
| 1,3,5TMB : 1,2,4TMB *         | #Num!         |
| (B+T)/(E+X) *                 | #Num!         |
| Total VPHs Identified *       | 23 µg/liter   |
| Estimated VPHs Unidentified * | <10 µg/liter  |
| Estimated TOTAL VPHs *        | 23 µg/liter   |

#### Disclaimers

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- 5) Uncertainty of measurement for all methods included in the SANAS Schedule of Accreditation is available on request.

**Reinardt Cromhout**  
Authorised Signatory



## TEST REPORT

**Test Description** Screening for Volatile Petroleum Hydrocarbons

**Test Method:** UISOL-T-012

### 35454A

#### Client and Project Information

**Client:** AECOM SA (Pty) Ltd

**Address:** 263A West Avenue, Centurion  
Pretoria

**Attention:** Tshilidzi Nembudani

**Tel:** (012) 421 3783

**Email:** tshilidzi.nembudani@aecom.com

**Project number:** 60617870-2.02-2

**Project name:** Transnet Witbank

#### Sample Information

**Sample ID:** MW7

**Dilution:** No Dilution

**Container:** Plastic

**Matrix:** Water

**Storage:** Fridge at 0-6°C

**Date Received:** 2021/11/12

**Date Analysed:** 2021/11/15

**Date Issued:** 2021/11/17

#### Gasoline Range Organics (GRO's)

| <u>PARAMETER</u>       | <u>RESULT</u> |
|------------------------|---------------|
| MTBE                   | <5 µg/liter   |
| TAME                   | 210 µg/liter  |
| Benzene                | <1 µg/liter   |
| Toluene                | <10 µg/liter  |
| Ethylbenzene           | <2 µg/liter   |
| m+p-Xylene             | <4 µg/liter   |
| o-Xylene               | <2 µg/liter   |
| 1,3,5-Trimethylbenzene | <2 µg/liter   |
| 1,2,4-Trimethylbenzene | <2 µg/liter   |
| Naphthalene            | <2 µg/liter   |

#### Diesel Range Organics (DRO's)

| <u>PARAMETER</u> | <u>RESULT</u> |
|------------------|---------------|
| C10 *            | <1 µg/liter   |
| C11 *            | <1 µg/liter   |
| C12 *            | <1 µg/liter   |
| C13 *            | <1 µg/liter   |
| C14 *            | <1 µg/liter   |
| C15 *            | <1 µg/liter   |
| C16 *            | <1 µg/liter   |
| C17 *            | <1 µg/liter   |
| C18 *            | <1 µg/liter   |
| C19 *            | <1 µg/liter   |
| C20 *            | <1 µg/liter   |

#### Polycyclic Aromatic Hydrocarbons (PAH's)

| <u>PARAMETER</u> | <u>RESULT</u> |
|------------------|---------------|
| Acenaphthene *   | <1 µg/liter   |
| Acenaphthylene * | <1 µg/liter   |
| Flourene *       | <1 µg/liter   |
| Phenanthrene *   | <1 µg/liter   |
| Anthracene *     | <1 µg/liter   |
| Fluoranthene *   | <1 µg/liter   |
| Pyrene *         | <1 µg/liter   |

#### Diagnostic Ratios

| <u>PARAMETER</u>              | <u>RESULT</u> |
|-------------------------------|---------------|
| 1,3,5TMB : 1,2,4TMB *         | #Num!         |
| (B+T)/(E+X) *                 | #Num!         |
| Total VPHs Identified *       | 210 µg/liter  |
| Estimated VPHs Unidentified * | <10 µg/liter  |
| Estimated TOTAL VPHs *        | 210 µg/liter  |

#### Disclaimers

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**Reinardt Cromhout**  
Authorised Signatory

## TEST REPORT

**Test Description** Screening for Volatile Petroleum Hydrocarbons

**Test Method:** UISOL-T-012

### 35454A

#### Client and Project Information

**Client:** AECOM SA (Pty) Ltd

**Address:** 263A West Avenue, Centurion  
Pretoria

**Attention:** Tshilidzi Nembudani

**Tel:** (012) 421 3783

**Email:** tshilidzi.nembudani@aecom.com

**Project number:** 60617870-2.02-2

**Project name:** Transnet Witbank

#### Sample Information

**Sample ID:** MW8

**Dilution:** No Dilution

**Container:** Plastic

**Matrix:** Water

**Storage:** Fridge at 0-6°C

**Date Received:** 2021/11/12

**Date Analysed:** 2021/11/15

**Date Issued:** 2021/11/17

#### Gasoline Range Organics (GRO's)

| <u>PARAMETER</u>       | <u>RESULT</u> |
|------------------------|---------------|
| MTBE                   | 6 µg/liter    |
| TAME                   | 1300 µg/liter |
| Benzene                | <1 µg/liter   |
| Toluene                | <10 µg/liter  |
| Ethylbenzene           | <2 µg/liter   |
| m+p-Xylene             | <4 µg/liter   |
| o-Xylene               | <2 µg/liter   |
| 1,3,5-Trimethylbenzene | <2 µg/liter   |
| 1,2,4-Trimethylbenzene | <2 µg/liter   |
| Naphthalene            | <2 µg/liter   |

#### Diesel Range Organics (DRO's)

| <u>PARAMETER</u> | <u>RESULT</u> |
|------------------|---------------|
| C10 *            | <1 µg/liter   |
| C11 *            | <1 µg/liter   |
| C12 *            | <1 µg/liter   |
| C13 *            | <1 µg/liter   |
| C14 *            | <1 µg/liter   |
| C15 *            | <1 µg/liter   |
| C16 *            | <1 µg/liter   |
| C17 *            | <1 µg/liter   |
| C18 *            | <1 µg/liter   |
| C19 *            | <1 µg/liter   |
| C20 *            | <1 µg/liter   |

#### Polycyclic Aromatic Hydrocarbons (PAH's)

| <u>PARAMETER</u> | <u>RESULT</u> |
|------------------|---------------|
| Acenaphthene *   | <1 µg/liter   |
| Acenaphthylene * | <1 µg/liter   |
| Flourene *       | <1 µg/liter   |
| Phenanthrene *   | <1 µg/liter   |
| Anthracene *     | <1 µg/liter   |
| Fluoranthene *   | <1 µg/liter   |
| Pyrene *         | <1 µg/liter   |

#### Diagnostic Ratios

| <u>PARAMETER</u>              | <u>RESULT</u> |
|-------------------------------|---------------|
| 1,3,5TMB : 1,2,4TMB *         | #Num!         |
| (B+T)/(E+X) *                 | #Num!         |
| Total VPHs Identified *       | 1306 µg/liter |
| Estimated VPHs Unidentified * | 34 µg/liter   |
| Estimated TOTAL VPHs *        | 1340 µg/liter |

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**Reinardt Cromhout**  
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**TRANSNET PIPELINES - WITBANK PUMP STATION**



# **GROUNDWATER AND SOIL MONITORING REPORT**



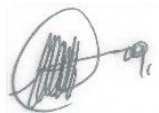
## Report Type

| Field                              | Details                                                               |
|------------------------------------|-----------------------------------------------------------------------|
| Project Name                       | Land Contamination Assessment (Groundwater and Soil Sampling)         |
| Reference Number                   | MSEC/12/112025GWM                                                     |
| Remediation Order Reference Number | 14/11/15/LR67/6.                                                      |
| Site Location                      | Transnet Pipelines- Witbank Pump Station                              |
| Compiled For                       | 9 Schonland Drive, Ferrobank, Witbank, Mpumalanga Province.           |
| Compiled By                        | Makomoto and Sebe Environmental Consulting (Pty) Ltd (MSE Consulting) |
| Date of the report                 | 03 December 2025                                                      |
| Version                            | Rev1                                                                  |

## Project Report Information

| Report Submitted To                                                                                                                                                                                                                       | Report Approved By                                                                                                                                                                                                                                                                                                           |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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## Report Authorisation

| For and on behalf of Makomoto and Sebe Environmental Consulting (Pty)Ltd. |                                                                                   |                                                                                                                                                      |
|---------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                           | <b>Completed by:</b><br><b>Phethego Kgobalala</b>                                 | <b>Reviewed &amp; approved by:</b><br><b>Martin Makomoto</b>                                                                                         |
| <b>Signature of the specialist:</b>                                       |  |                                                                   |
| <b>Designation:</b>                                                       | <b>Geohydrologist Consultant</b>                                                  | <b>Environmental Scientist<br/>Pr.Sci.Nat (No 117789)</b>                                                                                            |
| <b>Qualifications:</b>                                                    | <b>BSc Environmental Science with Geology and Geography (NWU)</b>                 | <b>BSc Hons Environmental Management (UNISA)</b><br><b>B.-TECH Environmental Management (CPUT)</b><br><b>Diploma Environmental Management (CPUT)</b> |

**Disclaimer:**

The findings, results, and conclusions presented in this report are limited to the Scope of Work agreed upon between Makomoto and Sebe Environmental Consulting (Pty) Ltd (MSE Consulting) and the Client for whom this investigation was conducted. The accuracy and reliability of this report are contingent on the accessibility and trustworthiness of relevant information, including maps, previous reports, and verbal communications provided by the Client and Contractors.

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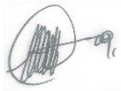
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**Declaration:**

I Freedom Martin Makomoto hereby declare:

- hereby confirm my independence as well as that Makomoto and Sebe Environmental Consulting (MSE Consulting) and declare that neither I nor Makomoto and Sebe Environmental Consulting have any business, financial, personal or other interest other than fair remuneration for work performed. I further declare that there is no conflict of interest in compiling this report.

- I have no vested interest (present or prospective) in the project that is the subject of this report as well as its attachments. I have no personal interest with respect to the parties involved in this project.
- I have no bias regarding this project or towards the various stakeholders involved in this project.
- I have not received, nor have I been offered, any significant form of inappropriate reward for compiling this report.



(Signature)

F.M Makomoto; Pr. Sci.Nat; B. Tech & BSc Hons (Environmental Management)

Makomoto and Sebe Environmental Consulting (Pty) Ltd (MSE Consulting)

## EXECUTIVE SUMMARY

Makomoto and Sebe Environmental Consulting (Pty) Ltd was appointed by Transnet Pipelines to undertake a Land Contamination Assessment at the Witbank Pump Station, in accordance with the Remediation Order issued by the Department under Reference No.: 14/11/15/LR67/6.

The assessment involved targeted soil and groundwater sampling to evaluate potential environmental liabilities associated with hydrocarbon contamination resulting from historical and current operational activities at the facility. The purpose of the investigation was to determine the presence, nature, and extent of potential soil and groundwater contamination linked to fuel-handling operations, with a particular focus on fuel storage infrastructure and associated operational areas.

The investigation comprised targeted soil and groundwater sampling to assess the presence and extent of potential contamination. Analytical results were evaluated against the Department of Forestry, Fisheries and the Environment (DFFE) Norms and Standards for Soil, as well as the Risk-Based Corrective Action (RBCA) Tier 1 Risk-Based Screening Levels (RBSLs) for groundwater. The primary objective was to determine whether fuel storage infrastructure, tank integrity issues, or associated operational activities had contributed to contamination at the site.

Prior to sampling, underground services detection was conducted to identify and demarcate subsurface infrastructure. All identified services were clearly marked using colour-coded spray paint in accordance with health and safety requirements. These measures were implemented to mitigate risks to personnel and prevent damage to underground services, thereby reducing potential secondary environmental and safety risks.

According to the site project manager, who has been responsible for operations at the facility for approximately five years, no known spillages or leakage incidents have been recorded during this period.

This assessment provides an informed evaluation of the site's contamination status and establishes a baseline for understanding potential environmental risks associated with both current and historical activities. The scope of work included a comprehensive



site overview detailing location, fuel storage history, and surrounding land use, as well as inspection and documentation of fuel storage infrastructure, including tank types, capacities, conditions, and contents. Environmental risks, with a particular focus on groundwater quality, were assessed through accredited laboratory analysis of collected soil and groundwater samples.

## SUMMARY AND CONCLUSION

### FIELD RESULTS:

The site is located within a commercial land-use zone. The surrounding area is characterised by industrial facilities and commercial businesses, with informal residential settlements present to east of the site.

- The site is situated at an elevation of approximately 1,535 meter above mean sea level (mamsl) and is developed on a relatively flat platform formed through hillside cutting. The site topography exhibits an average gradient of approximately 3.8%, sloping in a south-westerly direction towards the Furrow.
- According to the 1:250,000 geological map, the site is predominantly underlain by shale, sandstone, shale–sandstone interbeds, grit, conglomerate, and coal, characteristic of the Eccra Formation within the Karoo Group.
- Based on the geological map above, the site is underlain by shale, sandstone, shale–sandstone interbeds, grit, conglomerate, and coal of the Eccra Formation (Karoo Group). According to Department of Water Affairs (DWA) aquifer classification, the sandstone layers are moderately to highly permeable and can store and transmit groundwater, while the shale, conglomerate, and coal layers have low permeability and restrict groundwater flow. Overall, the site can be considered a mixed aquifer system, with some layers providing groundwater potential and others acting as barriers.
- With reference to the National Groundwater Archive (NGA) of the Department of Water and Sanitation, there are no registered boreholes in the region within a 1 km radius of the site.
- A soil vapour survey (SVS) comprising 10 recording points was undertaken across the manifold of the site. Vapour-phase volatile organic compound (VOC)

concentrations ranged from 0.0 ppm to 1 506 ppm. Moderately elevated VOCs were detected downstream of the tanks and manifold storing ULP 93, ULP 95, and diesel near monitoring well MW5, as well as upslope of the large tank farm and along the site boundary.

- Highly elevated Vapour-phase Volatile Organic Compound (VOC) concentrations were detected during the soil vapour survey at auger holes AH1 and AH10, based on Photoionization Detector (PID) measurements. The highest PID reading of 1,506 parts per million (ppm) was recorded at AH10 at a depth of 1.2 m, while AH1 showed a significantly elevated concentration of 568 ppm at 0.6 m.
- Moderate VOC concentrations were identified at AH2 (136.7 ppm at 0.6 m) and AH5 (100.6 ppm at 0.9 m). Slightly elevated VOC levels were also observed at AH3 (0.9 m) and AH9 (0.6 m) during PID screening.
- Overall, the findings indicate variable levels of vapour-phase hydrocarbon impact across the assessed locations, with the most pronounced contamination occurring at AH10 and AH1.
- The monitoring wells on site are constructed with PVC casings and manhole covers, providing a degree of protection against surface runoff. However, as the wells were installed flush with the ground surface, they are prone to temporary surface water accumulation during rainfall events, which may increase the risk of contamination ingress over time.
- All water samples were collected and analysed for this parameters onsite electrical conductivity (EC), dissolved oxygen (DO), oxidation-reduction potential (ORP), Temperature and Potential of Hydrogen (pH) to determine the oxidizing or reducing potential of water sample.
- Temperature (°C) Ranged from 20.0 to 21.5°C, typical for shallow groundwater in temperate climates, indicating natural ambient conditions without unusual thermal inputs. These temperatures support standard microbial and biodegradation processes.
- pH Ranged from 3.16 to 6.50, indicating generally acidic groundwater. Acidic conditions may enhance the solubility of metals (e.g., Fe, Mn, Zn) and are less favourable for hydrocarbon biodegradation, though microbial activity can still occur.

- Electrical Conductivity (EC, mS/m) Ranged from 369 to 1,664 mS/m, reflecting variable dissolved ion concentrations. Elevated EC (e.g., MW8) may result from natural mineral dissolution or anthropogenic influences and can be used to monitor potential contamination trends.
- Dissolved Oxygen (DO, mg/L) Ranged from 4.08 to 6.08 mg/L, indicating oxic to mildly oxic conditions conducive to aerobic microbial activity. Lower DO in some wells (e.g., MW5) suggests localized reducing conditions that could influence metal mobility and anaerobic degradation.
- Oxidation–Reduction Potential (ORP, mV) Ranged from -229 to +142 mV, showing spatial variability in redox conditions. Reducing conditions (negative ORP) favour anaerobic processes, while oxidising conditions (positive ORP) support aerobic degradation. This heterogeneity can affect contaminant behaviour and migration potential.
- The static water level depths in the monitoring wells were observed to range from 0.0 meters to 0.725 meters below ground level (mbgl). These measurements indicate the depth at which the water table or groundwater is located in each respective monitoring well.
- All monitoring wells identified on site were found to be in good condition, except for MW4, MW6, and MW9, which were destroyed and could not be located during the site inspection.
- Groundwater samples were collected using clean and transparent bailers from various locations, including monitoring wells. These samples were collected for the purpose of conducting analysis on a range of parameters, including: BTEXN (Benzene, Toluene, Ethylbenzene, Xylene, and Naphthalene), TAME, MTBE, 1,3,5 and 1,2,4Trimethylbenzene, TPH GRO C<sub>7</sub>–C<sub>9</sub> and TPH DRO and ORO C<sub>10</sub>–C<sub>36</sub> analysis.
- All soil samples were submitted to an accredited laboratory for comprehensive analysis, including BTEXN (Benzene, Toluene, Ethylbenzene, Xylene, and Naphthalene), TAME, MTBE, 1,2,4-Trimethylbenzene, 1,3,5-Trimethylbenzene, Total Petroleum Hydrocarbons (TPH) in the Gasoline Range Organics (C<sub>7</sub>–C<sub>9</sub>), Diesel to Heavy Hydrocarbon fractions (TPH C<sub>10</sub>–C<sub>36</sub>) and Inorganic (Cations and Heavy Metals).

- No free phase product was observed in any of the monitoring wells and tank monitoring well at the time of inspection.
- A total of six (6) water samples were collected and submitted to the laboratory for BTEXN, TAME, MTBE, 1,2,4-TMB, 1,3,5-TMB, TPH GRO C<sub>7</sub>-C<sub>9</sub> and TPH banded C<sub>10</sub>-C<sub>36</sub> analysis.
- A total of ten (10) soil samples were submitted to an accredited laboratory for comprehensive analysis, including BTEXN (Benzene, Toluene, Ethylbenzene, Xylene, and Naphthalene), TAME, MTBE, 1,2,4-Trimethylbenzene, 1,3,5-Trimethylbenzene, Total Petroleum Hydrocarbons (TPH) in the Gasoline Range Organics (C<sub>7</sub>-C<sub>9</sub>), and Diesel to Heavy Hydrocarbon fractions (TPH C<sub>10</sub>-C<sub>36</sub>).

## **LABORATORY AND RISK ANALYSIS RESULTS**

- Benzene was detected in soil sample retrieved from WAH1 at concentrations exceeding the Soil Screening Value (SSV1) for the protection of water resources and land users, indicating a potential hydrocarbon impact at this location.
- Trace concentrations of toluene, ethylbenzene, xylenes, naphthalene, TAME, 1,3,5-trimethylbenzene, 1,2,4-trimethylbenzene, and TPH (C<sub>7</sub>-C<sub>9</sub>) were also detected in sample retrieved from WAH1, located upslope of the tanks farm area with concentrations that were below the applicable SSVs.
- Trace concentrations of benzene, toluene, ethylbenzene, xylenes, naphthalene, TAME, 1,2,4-trimethylbenzene, and TPH (C<sub>7</sub>-C<sub>9</sub>) were detected in soil samples collected from hand auger holes WAH2, WAH3, WAH5, and WAH10. All detected concentrations were below the applicable Soil Screening Values (SSVs) however Toluene was not detected in WAH10 was found to be below detection limits.
- Laboratory results confirm the presence of hydrocarbons on site. The concentrations measured indicate significant contamination, which is considered to pose a potential risk to soil quality and the surrounding environment at these locations.
- Trace concentrations of Total Petroleum Hydrocarbons (TPH) fractions C<sub>10</sub>-C<sub>14</sub> and C<sub>15</sub>-C<sub>36</sub>, as well as Total TPH (C<sub>10</sub>-C<sub>36</sub>), were detected in soil samples collected from hand auger holes WAH1, WAH2, WAH3, and WAH5. All detected



concentrations were below the applicable Soil Screening Values (SSVs), indicating that hydrocarbon levels are within acceptable regulatory thresholds and are not considered to pose an immediate risk to soil quality or the surrounding environment.

- Trace concentrations of Total Petroleum Hydrocarbons (TPH; C10–C36) were detected in soil samples collected from hand auger holes WAH1, WAH2, WAH3, and WAH5. All detected concentrations were below the applicable Soil Screening Values (SSVs).
- Detectable concentrations of pyrene were identified in soil samples collected from hand auger hole WAH1, with measured concentrations exceeding the applicable Soil Screening Value (SSV1) for the protection of the water resource (all land users). This exceedance indicates a potential risk to the water resource at this location and warrants further consideration in the site risk assessment
- Trace concentrations of pyrene were identified in the soil samples collected from hand auger holes WAH2, WAH3, WAH5 and WAH10 with the concentration that did not exceed the soil screening Values (SSVs).
- Arsenic, cadmium, chromium, copper, manganese, mercury, lead, and vanadium were detected in soil samples collected from hand auger holes WAH3, WAH4, WAH5, WAH6, WAH7, WAH8, WAH9, and WAH10. All measured concentrations were below the adopted Soil Screening Values (SSVs).
- Nickel, zinc, and copper were detected in soil samples collected from hand auger holes WAH1 and WAH2 at concentrations exceeding the applicable Soil Screening Values (SSVs) for the protection of the water resource (all land uses). These exceedances indicate a potential risk to the water resource at these locations and warrant further consideration in the site risk assessment.
- A trace concentration of benzene, ethylbenzene and THP (C7-C9) were detected in the groundwater sample from monitoring well MW2 concentration that did not exceed the RBCA Tier 1 screening levels and remained within applicable regulatory thresholds. A trace concentration of ethylbenzene and naphthalene were detected in the groundwater sample from monitoring well MW5 concentration that did not exceed the RBCA Tier 1 screening levels and remained within applicable regulatory thresholds.

- All other target compounds in MW1, MW3, MW7 and MW8 were below detection limits (BDL).
- Laboratory results confirmed that there is no significant contamination present in the groundwater samples collected from the site.
- Total Petroleum Hydrocarbon (TPH) concentrations (C10–C14) in monitoring wells (MW2) was detected with the concentration that did not exceed the RBCA Tier 1 screening levels and remained within applicable regulatory threshold. These laboratory results confirmed that there is no significant contamination present in the groundwater samples collected from the site.
- Trace concentrations of TPH (C15–C36) and Total TPH (C10–C36) were below detection limits in groundwater samples collected from monitoring wells MW1, MW3, MW7, and MW8, indicating that these wells are not impacted by hydrocarbons at concentrations of regulatory concern.

## Table of Contents

|                                                                  |    |
|------------------------------------------------------------------|----|
| 1. INTRODUCTION .....                                            | 1  |
| 1.1 BACKGROUND .....                                             | 1  |
| 1.2 SITE HISTORY .....                                           | 2  |
| 1.3 Contamination Trend Analysis.....                            | 5  |
| 2. SCOPE OF WORK.....                                            | 7  |
| 2.1 DESK STUDY .....                                             | 7  |
| 2.2 SITE AND AREA WALKOVER.....                                  | 7  |
| 2.3 SITE ASSESSMENT.....                                         | 7  |
| 2.4 SOIL VAPOUR SURVEY .....                                     | 7  |
| 2.5 DRILLING OF HAND AUGER HOLES .....                           | 7  |
| 2.6 PATHWAY IDENTIFICATION .....                                 | 7  |
| 2.7 SAMPLING OF MONITORING WELLS.....                            | 7  |
| 2.8 GROUNDWATER SAMPLING.....                                    | 8  |
| 2.9 WATER LEVEL MEASUREMENT.....                                 | 8  |
| 3.0 RISK ASSESSMENT .....                                        | 9  |
| 3.1 REGULATORY COMPLIANCE.....                                   | 9  |
| 3.2 REPORT COMPILATION .....                                     | 10 |
| 3. SITE LOCATION INFORMATION.....                                | 10 |
| 3.1 GEOLOGY AND GEOHYDROLOGY.....                                | 11 |
| 3.2 FUEL INFRASTRUCTURE [TANK INFORMATION].....                  | 13 |
| 4. FIELD WORK .....                                              | 17 |
| 4.1 HEALTH AND SAFETY.....                                       | 17 |
| 4.2 DISCUSSION OF SOIL VAPOUR SURVEY (SVS) RESULTS .....         | 17 |
| 4.3. DISCUSSION OF HEADSPACE TEST RESULTS .....                  | 18 |
| 4.4 GROUNDWATER SAMPLING.....                                    | 22 |
| 5. RESULTS OF PETROLEUM HYDROCARBON ANALYSIS.....                | 23 |
| 5.1 WATER SAMPLE RESULTS.....                                    | 28 |
| 6. HUMAN HEALTH RISK ASSESSMENT.....                             | 34 |
| 6.1. POTENTIAL PATHWAYS AND RECEPTORS .....                      | 34 |
| 6.2. CONCEPTUAL SITE MODEL .....                                 | 36 |
| 7. SUMMARY AND CONCLUSIONS.....                                  | 39 |
| 7.1 FIELD RESULTS:.....                                          | 39 |
| 8. CONCLUSION AND RECOMMENDATIONS .....                          | 44 |
| Makomoto and Sebe Environmental Consulting Recommendations ..... | 45 |
| 9. REFERENCES.....                                               | 47 |

## FIGURES

|                                                                                                |    |
|------------------------------------------------------------------------------------------------|----|
| Figure 1: Aerial Image Layout.....                                                             | 14 |
| Figure 2: Site Layout Plan.....                                                                | 14 |
| Figure 3: Aerial Image Site Layout Plan showing Groundwater Flow Direction .....               | 15 |
| Figure 4: Geological Map.....                                                                  | 15 |
| Figure 5: Topographical Map .....                                                              | 16 |
| Figure 6: Map Illustrating potential off-site source of contamination.....                     | 16 |
| Figure 7: Site Aerial layout showing groundwater sampling positions and hand auger holes ..... | 31 |
| Figure 8: Site Aerial layout Map showing groundwater sampling positions .....                  | 32 |
| Figure 9: Site Aerial layout Map showing hand auger holes .....                                | 33 |
| Figure 10: Conceptual site model.....                                                          | 38 |

## TABLES

|                                                                                                                 |    |
|-----------------------------------------------------------------------------------------------------------------|----|
| Table 1: Site Location Information and Land Use.....                                                            | 10 |
| Table 2: Site Geology and Geohydrology .....                                                                    | 11 |
| Table 3: Vapour Phase VOC concentrations recorded during Soil Vapour Survey ...                                 | 18 |
| Table 4: Classification of soil vapour results.....                                                             | 18 |
| Table 5: Field observation during soil sampling in the auger holes .....                                        | 19 |
| Table 6: Field observation of groundwater levels within monitoring wells. ....                                  | 22 |
| Table 7: Results of Petroleum/Hydrocarbon analysis in soil samples BTEXMN and Gasoline Range Organics-Soil..... | 23 |
| Table 8: Total Petroleum Hydrocarbon (C10-C36).....                                                             | 25 |
| Table 9: Polycyclic Aromatic Hydrocarbon .....                                                                  | 26 |
| Table 10: Inorganic (Cations and Heavy Metals) Laboratory Results for Soil Samples .....                        | 27 |
| Table 11: BTEXMN and Gasoline Range Organics- Groundwater Analytical Results .....                              | 28 |
| Table 12: Total Petroleum Hydrocarbon (C10-C36)- Groundwater Analytical Results .....                           | 29 |
| Table 13: Conceptual Site Model Baseline Exposure .....                                                         | 37 |

## APPENDIX

|                                                  |    |
|--------------------------------------------------|----|
| APPENDIX A: LABORATORY CERTIFICATE RESULTS ..... | 48 |
|--------------------------------------------------|----|



## ACRONYMS AND ABBREVIATIONS

| Abbreviation    | Explanation                                                              |
|-----------------|--------------------------------------------------------------------------|
| ARD             | Acid Rock Drainage                                                       |
| BPG             | Best Practice Guidelines                                                 |
| BTEX            | Benzene, Toluene, Ethylbenzene, Xylenes                                  |
| CMS             | Catchment Management Strategy                                            |
| CSM             | Conceptual Site Model                                                    |
| DO              | Dissolved Oxygen                                                         |
| EC              | Electrical Conductivity                                                  |
| HDPE            | High-density polyethylene                                                |
| Km <sup>2</sup> | Square Kilometre                                                         |
| L/s             | Litres per second                                                        |
| LNAPL           | Light Non-Aqueous Phase Liquid                                           |
| m               | metre                                                                    |
| m <sup>3</sup>  | Cubic metre                                                              |
| mamsl           | Metres above mean sea level                                              |
| mbgl            | Metres below groundwater level                                           |
| mg/l            | Milligrams per litre                                                     |
| ML/d            | Megalitres per day                                                       |
| mm              | Millimetre                                                               |
| mm/a            | Millimetres per annum                                                    |
| mS/m            | Milli Siemens per metre                                                  |
| MAP             | Mean Annual Precipitation                                                |
| ORP             | Oxidation Reduction Potential                                            |
| PAH             | Polycyclic Aromatic Hydrocarbons                                         |
| PID             | Photo-Ionisation Detector (used for volatile organic compound detection) |
| SS              | Suspended Solids                                                         |
| SSV             | Soil Screening Values                                                    |
| SWL             | Static Water Level                                                       |
| TDS             | Total Dissolved Solids                                                   |
| VOC             | Volatile Organic Compounds (from hydrogeological assessment data)        |
| WMA             | Water Management Area                                                    |
| WMP             | Water Management Plan                                                    |
| Abbreviation    | Explanation                                                              |
| ARD             | Acid Rock Drainage                                                       |

## 1. INTRODUCTION

Makomoto and Sebe Environmental Consulting (Pty) Ltd was appointed by Transnet Pipelines to undertake a Land Contamination Assessment at the Witbank Pump Station, in accordance with the Remediation Order issued by the Department under Reference No.: 14/11/15/LR67/6.

The assessment involved targeted soil and groundwater sampling to evaluate potential environmental liabilities associated with hydrocarbon contamination resulting from historical and current operational activities at the facility. The purpose of the investigation was to determine the presence, nature, and extent of potential soil and groundwater contamination linked to fuel-handling operations, with a particular focus on fuel storage infrastructure and associated operational areas.

Analytical results were assessed against the Department of Forestry, Fisheries and the Environment (DFFE) Norms and Standards for Soil, and Risk-Based Corrective Action (RBCA) Tier 1 Risk-Based Screening Levels (RBSLs) were applied for groundwater evaluation.

The primary objective of the assessment was to establish whether the integrity of the fuel storage systems, including aboveground bulk storage tanks, manifold operations, or other fuel-related activities, had contributed to contamination at the site, and to provide a technical basis for further risk assessment and remediation planning in compliance with the Department's requirements.

### 1.1 BACKGROUND

Transnet Pipelines engaged Makomoto and Sebe Environmental Consulting (Pty) Ltd to undertake a Land Contamination Assessment in accordance with the requirements of Part 8 of the National Environmental Management: Waste Act (Act 59 of 2008). The purpose of the assessment was to evaluate the hydrocarbon contamination status of on-site soils, with reference to the Department of Forestry, Fisheries and the Environment (DFFE) Soil Screening Values 1 (SSV1), which are protective of water resources, including both groundwater and surface water receptors.

In addition, soil and groundwater samples were strategically collected, including sampling from an existing borehole, to support a risk-based assessment using RISC 4.03 Tier 1 Risk-Based Screening Levels (RBSLs). The data obtained were further used to inform the development of preliminary remedial objectives based on the source–pathway–receptor conceptual site model.

This report documents the methodology applied and presents the findings of the soil and groundwater sampling campaign conducted on 03 December 2025.

## 1.2 SITE HISTORY

### **Geomeasure Group – in March 2019**

A report titled “Routine Groundwater Monitoring and Sampling Report for March 2019 for the TPL Witbank Site – Emalahleni – Mpumalanga Province”, prepared by the Geomeasure Group, was made available by TPL for AECOM’s review.

The report detailed the findings of a Groundwater Monitoring Event (GME) conducted at the Site in March 2019. Eight groundwater monitoring wells were sampled. The results indicated impacts in all monitoring wells except MW1 and MW7. None of the detected concentrations exceeded the applicable screening criteria, and no Light Non-Aqueous Phase Liquid (LNAPL) was observed in any of the monitoring wells.

### **AECOM conducted additional GMEs in April 2020, June 2020, and November 2020 with the following observations:**

In April 2020, TAME was detected above laboratory detection limits in all monitoring wells except MW1, where all other targeted hydrocarbon compounds were below detection limits. Benzene, ethylbenzene, and fluorene were detected above laboratory detection limits in MW2 and MW3. MTBE was also detected in MW3 above laboratory detection limits. Benzene concentrations in MW2 and MW3 exceeded the US EPA carcinogenic screening levels for both ingestion and inhalation exposure pathways. Ethylbenzene concentrations in MW2 and MW3 exceeded the US EPA carcinogenic screening level for inhalation. TAME concentrations in MW2, MW3, MW5, MW6, MW7, MW8, and MW9 exceeded the NHDES non-carcinogenic screening level for the ingestion exposure pathway.

In June 2020, TAME was detected above laboratory detection limits in all monitoring wells except MW1, where all other targeted hydrocarbons were below detection limits. Benzene, ethylbenzene, and C10–C20 hydrocarbons were detected in MW2. Benzene and ethylbenzene were also detected in MW3. Benzene concentrations in MW2 exceeded the US EPA carcinogenic screening levels for both ingestion and inhalation, while ethylbenzene exceeded the carcinogenic screening level for inhalation only. In MW3, both benzene and ethylbenzene exceeded the US EPA carcinogenic screening levels for ingestion, dermal contact, and inhalation. TAME detected in MW6 exceeded the NHDES non-carcinogenic screening level for ingestion.

In November 2020, benzene and ethylbenzene in MW2 and MTBE in MW6 were detected above laboratory detection limits. Benzene concentrations exceeded the US EPA carcinogenic screening levels for both ingestion and inhalation. TAME concentrations in MW2, MW5, MW6, MW7, and MW8 exceeded the NHDES non-carcinogenic screening level for ingestion.

In terms of the conceptual site model, although certain constituents exceeded screening criteria, no complete source–pathway–receptor (SPR) linkages were identified between on-site contamination and on-site or off-site receptors at the time of assessment. This conclusion was based on limited hydrogeological information available for the Site.

**Another GME was conducted in April 2020 by AECOM with the following observations:**

TAME concentrations were detected in samples collected from all monitoring wells except MW1, where all other targeted hydrocarbon compounds were below laboratory detection limits. Benzene, ethylbenzene, and fluorene were detected above laboratory detection limits in MW2 and MW3. In addition, MTBE was detected in MW3 above laboratory detection limits.

Benzene concentrations detected in MW2 and MW3 exceeded the US EPA carcinogenic screening levels for both ingestion and inhalation exposure pathways. Ethylbenzene detected in MW2 and MW3 exceeded the US EPA carcinogenic screening level for inhalation.

TAME concentrations in MW2, MW3, MW5, MW6, MW7, MW8, and MW9 exceeded the NHDES non-carcinogenic screening level for the ingestion exposure pathway.

From a conceptual site model perspective, although certain constituents exceeded screening criteria, no complete source–pathway–receptor (SPR) linkages were identified between on-site contamination and potential on-site or off-site receptors at the time, based on limited hydrogeological information.

**Groundwater Monitoring Event (GME) conducted by AECOM in April 2021 led to the following conclusions:**

A groundwater monitoring and sampling event was conducted at the Site on 10 and 11 November 2021. Static groundwater levels in the on-site monitoring wells ranged between 0.1 m and 0.9 m below ground level (mbgl). Groundwater levels have shown an increasing trend since June 2020, most likely due to significant rainfall received since that time. No measurable thickness of LNAPL was observed in any of the monitoring wells.

TAME was detected in all monitoring wells except MW1, where all other targeted hydrocarbon compounds remained below laboratory detection limits. TAME concentrations exceeded the NHDES non-carcinogenic screening level for the ingestion exposure pathway in MW5, MW7, and MW8.

Benzene, ethylbenzene, and fluorene were detected above laboratory detection limits in MW2 and MW3. Benzene concentrations in MW2 and MW3 exceeded the US EPA carcinogenic screening levels for both ingestion and inhalation pathways, while ethylbenzene in MW2 and MW3 exceeded the US EPA carcinogenic screening level for inhalation.



MTBE was detected above laboratory detection limits in MW8; however, the concentration did not exceed the selected screening criteria.

In terms of the conceptual site assessment, although certain constituents exceeded screening criteria, no complete source–pathway–receptor linkages were identified between on-site potential contamination sources and on-site or off-site receptors. However, due to the absence of hydro-census information within a 1 km radius of the Site, the ingestion and dermal contact exposure pathways are considered incomplete but not fully eliminated.

### 1.3 Contamination Trend Analysis

#### Soil Contamination:

##### Hydrocarbons

In December 2025, benzene exceeded SSV1 in WAH1 and WAH10, while pyrene exceeded SSV1 in WAH1, indicating localized hydrocarbon impacts. Trace concentrations of toluene, ethylbenzene, xylenes, TAME, TPH (C7–C9), and selected trimethylbenzenes were detected in some hand auger holes but remained below applicable SSVs. Hand auger holes WAH4, WAH6, WAH7, WAH8, and WAH9 showed no detectable hydrocarbon contamination, confirming that impacts are localized.

##### Heavy Metals

Analytical results indicate elevated concentrations of nickel, zinc, copper, and lead in WAH1 and WAH2, exceeding SSV1 for the protection of water resources. Vanadium was detected above SSV1 in WAH1–WAH9, suggesting a widespread potential risk to groundwater resources. Other metals, including nickel, chromium, copper, manganese, and lead, were detected in WAH3–WAH10, and zinc in WAH5–WAH9, but concentrations were below SSVs. Mercury was detected in WAH1 below SSV1.

##### Comparison with historical soil data

Historical reports primarily focused on groundwater contamination, with limited soil exceedances reported. The 2025 soil data highlight localized hydrocarbon

exceedances and heavy metal exceedances (vanadium, nickel, zinc, copper, and lead), indicating either newly identified localized contamination or improved detection and sampling resolution compared to earlier assessments.

### **Groundwater Contamination**

December 2025 results indicate trace benzene, ethylbenzene, naphthalene, and TPH in MW2 and MW5, all below RBCA Tier 1 screening levels.

All other monitoring wells showed either non-detectable results or concentrations within regulatory thresholds.

### **Comparison with historical groundwater data (2019–2021).**

Between 2019 and 2021, benzene and ethylbenzene in MW2 and MW3 frequently exceeded US EPA carcinogenic screening levels, and TAME exceeded non-carcinogenic criteria in multiple wells. MTBE and other hydrocarbons were also detected above lab limits in some wells.

By December 2025, the exceedances are no longer observed in any wells, and all detected compounds are below screening levels, indicating a decreasing trend in groundwater contamination over time.

### **Total Petroleum Hydrocarbons (TPH)**

- Soil TPH (C10–C36) in December 2025 remained below SSVs, and groundwater TPH (C7–C36) was detected at trace levels only, well within regulatory thresholds.
- Historically, certain wells (MW2, MW3, MW5–MW8) had TPH concentrations above detection limits, with some exceedances for specific fractions.
- TPH concentrations show a stable to decreasing trend, with no current regulatory exceedances.

## **2. SCOPE OF WORK**

### **2.1 DESK STUDY**

Review of available historical monitoring reports, site information, topographical, geological and hydrogeological data, and other relevant documentation to assess the environmental sensitivity of the sites and inform the monitoring approach.

### **2.2 SITE AND AREA WALKOVER**

Visual inspection of the sites and surrounding areas to identify potential sources of contamination, exposure pathways and sensitive receptors.

### **2.3 SITE ASSESSMENT**

Verification of site infrastructure, monitoring well locations and site conditions, supported by photographic documentation.

### **2.4 SOIL VAPOUR SURVEY**

Soil samples were collected from hand auger holes during the site investigation. Headspace screening of the soil was conducted at depth intervals of 0.1 m down to a maximum depth of 1.2 m during logging to measure volatile organic compound (VOC) concentrations and to assess the potential presence of fuel-related vapours within the subsurface. This screening assisted in identifying potential hydrocarbon vapour impacts and in evaluating the vertical extent of contamination. The results were used to inform the assessment of contamination significance and to determine the need for further investigation or remedial intervention, where applicable.

### **2.5 DRILLING OF HAND AUGER HOLES**

Auger holes were drilled at strategic locations to assess the hydrocarbon contamination status in relation to DFFE Norms and Standards.

### **2.6 PATHWAY IDENTIFICATION**

The primary pathways of concern, including soil gas, soil, and groundwater, were identified and assessed.

### **2.7 SAMPLING OF MONITORING WELLS**

Six (6) groundwater samples were collected from existing monitoring wells to enable the evaluation of groundwater quality at the site. The monitoring wells provide access to the aquifer for the collection of representative groundwater samples, facilitate

accurate determination of groundwater levels, and support ongoing monitoring of potential contamination in accordance with applicable regulatory requirements.

## 2.8 GROUNDWATER SAMPLING

All groundwater samples were collected from monitoring wells drilled on site to assess the potential impact of fuel leakage on groundwater quality. All samples were submitted to a SANAS-accredited laboratory which is Environmental Pollution Laboratory for comprehensive chemical analysis in accordance with applicable DFFE guidelines and recognised analytical methods, including:

- BTEXN compounds (Benzene, Toluene, Ethylbenzene, Xylenes, and Naphthalene)
- Tertiary Amyl Methyl Ether (TAME)
- Methyl Tertiary-Butyl Ether (MTBE)
- Selected Polycyclic Aromatic Hydrocarbons (PAHs)
- Total Petroleum Hydrocarbons (TPH) in the C10–C36 range
- Inorganic (Cations and Heavy Metals)

The analytical results were used to evaluate the presence, nature, and extent of hydrocarbon contamination and to assess potential risks to groundwater resources, human health, and the receiving environment, in line with DFFE regulatory requirements.

## 2.9 WATER LEVEL MEASUREMENT

The depth to the groundwater table was measured in all six (6) monitoring wells to determine groundwater flow direction, hydraulic gradient, and potential contaminant migration pathways. Monitoring well integrity checks were conducted prior to sampling, including inspection of monitoring well casings, caps, surface seals, and protective covers, to confirm that all wells were structurally sound and suitable for sampling.

No free-phase petroleum product was identified during sampling, as confirmed by visual inspection and field screening. This indicates the absence of mobile light non-aqueous phase liquids (LNAPL) at the time of assessment. All monitoring wells were found to be in good condition and compliant with recognised industry standards and DFFE contaminated land investigation requirements.

### 3.0 RISK ASSESSMENT

Groundwater analytical results obtained from the monitoring wells were evaluated against the Risk-Based Screening Levels (RBSLs) using the RISC Tier 1 risk assessment model. The assessment focused on determining whether detected hydrocarbon concentrations in groundwater pose potential risks to human health and the environment.

Potential exposure pathways associated with groundwater contamination were assessed, including groundwater ingestion, vapour intrusion resulting from dissolved-phase hydrocarbons, and migration of contaminants to nearby receptors. The evaluated concentrations were compared to the relevant RBSLs to determine compliance and identify any exceedances.

#### 3.1 REGULATORY COMPLIANCE

Laboratory activities were conducted in accordance with applicable South African environmental legislation, including the National Environmental Management: Waste Act (NEMWA, 2008), the National Environmental Management Act (NEMA, 1998), and the associated National Norms and Standards for Contaminated Land.

Where applicable, water quality assessment and monitoring were undertaken in alignment with the National Water Act (Act No. 36 of 1998) and relevant Department of Water and Sanitation (DWS) water quality guidelines and standards.

The investigation followed recognised industry best practices and guidelines for the installation of monitoring wells, groundwater sampling, and hydrocarbon contamination assessment. Procedures were designed to generate defensible and auditable data, supporting compliance with regulatory requirements and enabling engagement with the Department of Forestry, Fisheries and the Environment (DFFE) and other relevant authorities.

All documentation, including site inspection records, groundwater monitoring results, laboratory analyses, and risk assessment outputs, has been compiled to ensure transparency, regulatory compliance, and ongoing environmental management.



### 3.2 REPORT COMPILATION

All field observations, soil sampling, groundwater level measurements, laboratory analytical results, and photographic records were compiled into a comprehensive environmental assessment report. The report presents a detailed evaluation of hydrocarbon contamination levels in soil, groundwater, and soil vapour, along with an assessment of associated environmental and human health risks.

Based on the findings, the report provides clear recommendations for either remediation or continued monitoring, as required to manage potential risks effectively. Supporting documentation has been prepared in accordance with DFFE regulatory requirements and is suitable for submission to relevant authorities to demonstrate compliance and inform future site management decisions.

### 3. SITE LOCATION INFORMATION

Table 1: Site Location Information and Land Use

|                      |                                                             |                                                                                                                                  |            |     |              |    |
|----------------------|-------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|------------|-----|--------------|----|
| Site Name            | Transnet Pipelines – Witbank Pump Station                   |                                                                                                                                  |            |     |              |    |
| Site address         | 9 Schonland Drive, Ferrobank, Witbank, Mpumalanga Province. |                                                                                                                                  |            |     |              |    |
| Coordinates          | 25°51'47.81"S 29°10'0.52"E                                  |                                                                                                                                  |            |     |              |    |
| Site Project Manager | Philisiwe Selwane                                           |                                                                                                                                  |            |     |              |    |
| Phone                | 084 381 6379                                                |                                                                                                                                  |            |     |              |    |
| Land-owner           | Transnet Pipelines – Witbank Pump Station                   |                                                                                                                                  |            |     |              |    |
| Surrounding land use | Residential                                                 | Yes                                                                                                                              | Commercial | Yes | Agricultural | No |
| Adjacent Properties  | North                                                       | Open land and industrial/commercial developments, including the Manhattan Action Bar, located approximately 105 m from the site. |            |     |              |    |
|                      | East                                                        | Informal residential land use situated approximately 122 m from the site.                                                        |            |     |              |    |
|                      | West                                                        | Industrial and commercial developments located approximately 108 m from the site.                                                |            |     |              |    |

|                                  |                          |                                                                                                                                                                                                                                                                                                                          |
|----------------------------------|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                  | South                    | <ul style="list-style-type: none"> <li>Industrial and commercial developments, including a truck stop facility, located approximately 79 m from the site.</li> </ul>                                                                                                                                                     |
|                                  | Onsite                   | <ul style="list-style-type: none"> <li>Diesel and petrol storage tanks, workshop areas, and associated underground pipework are understood to be present at the Transnet Pipelines Witbank Pump Station.</li> </ul>                                                                                                      |
| Other potential off-site sources | Off site (within 500 m)  | <ul style="list-style-type: none"> <li>Truck stop is located approximately 79 m south of the site.</li> <li>A Total Energies Service station is located approximately 693 m easterly direction of the site.</li> <li>Engen Ferrobank Motors is located approximately 699 m southerly direction from the site.</li> </ul> |
| Sensitive Receptors              | On Site:                 | <ul style="list-style-type: none"> <li>No Borehole found within the vicinity of the site</li> </ul>                                                                                                                                                                                                                      |
|                                  | Off site (within 500 m): | <ul style="list-style-type: none"> <li>Commercial, residential properties, Hospital, scrap yard and vacant land located near the site.</li> </ul>                                                                                                                                                                        |

### 3.1 GEOLOGY AND GEOHYDROLOGY

Table 2: Site Geology and Geohydrology

|            |                                                                                                                                                                                                                                                                                                                  |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Topography | The site is situated at an elevation of approximately 1,535 meter above mean sea level (mamsl) and is developed on a relatively flat platform formed through hillside cutting. The site topography exhibits an average gradient of approximately 3.8%, sloping in a south-westerly direction towards the Furrow. |
| Geology    | According to the 1:250,000 geological map, the site is predominantly underlain by shale, sandstone, shale–sandstone interbeds, grit, conglomerate, and coal, characteristic of the Eccca Formation within the Karoo Group.                                                                                       |

|                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>DWA Aquifer Classification:</b>  | Based on the geological map above, the site is underlain by shale, sandstone, shale–sandstone interbeds, grit, conglomerate, and coal of the Ecca Formation (Karoo Group). According to DWA aquifer classification, the sandstone layers are moderately to highly permeable and can store and transmit groundwater, while the shale, conglomerate, and coal layers have low permeability and restrict groundwater flow. Overall, the site can be considered a mixed aquifer system, with some layers providing groundwater potential and others acting as barriers.                                                                                                                                                                                                                                                                            |
| <b>Groundwater Levels and Flow:</b> | Groundwater at the site is typically shallow, with water levels ranging from 0.0 to 0.725 meters below ground level (mbgl), though these levels may fluctuate seasonally depending on rainfall occurred during site visit and other hydrological conditions. Despite this variability, the aquifer exhibits a moderate potential for recharge, influenced by rainfall intensity, soil permeability, and the hydraulic properties of the subsurface strata. The general direction of groundwater flow is toward the southwest.                                                                                                                                                                                                                                                                                                                  |
| <b>Aquifer description:</b>         | <p>The site is underlain by a mixed aquifer system associated with the Ecca Formation of the Karoo Group, comprising sandstone, shale–sandstone interbeds, shale, grit, conglomerate, and coal.</p> <p>The sandstone layers act as moderately to highly permeable aquifers capable of storing and transmitting groundwater, while the shale, conglomerate, and coal layers exhibit low permeability and primarily act as aquitards, restricting vertical and lateral groundwater flow.</p> <p>Groundwater is typically shallow, with levels ranging from 0.0 to 0.725 meters below ground level (mbgl), and exhibits seasonal fluctuations influenced by rainfall and hydrological conditions. Recharge potential is moderate, governed by rainfall intensity, soil permeability, and the hydraulic characteristics of the aquifer strata.</p> |
| <b>Nearby boreholes:</b>            | With reference to the NGA of the Department of Water and Sanitation, there are registered boreholes in the region but not within a 1 km radius of the site.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

### 3.2 FUEL INFRASTRUCTURE [TANK INFORMATION]

Nine aboveground fuel storage tanks were identified on site, all equipped within bund walls. All the large aboveground storage tanks are located within bund walls; however, the tank capacities, the specific products stored, and the type of construction could not be confirmed. An additional three tanks were located near the manifold, storing ULP 93, ULP 95, and 50 diesel, each with a capacity of 14,000 L.



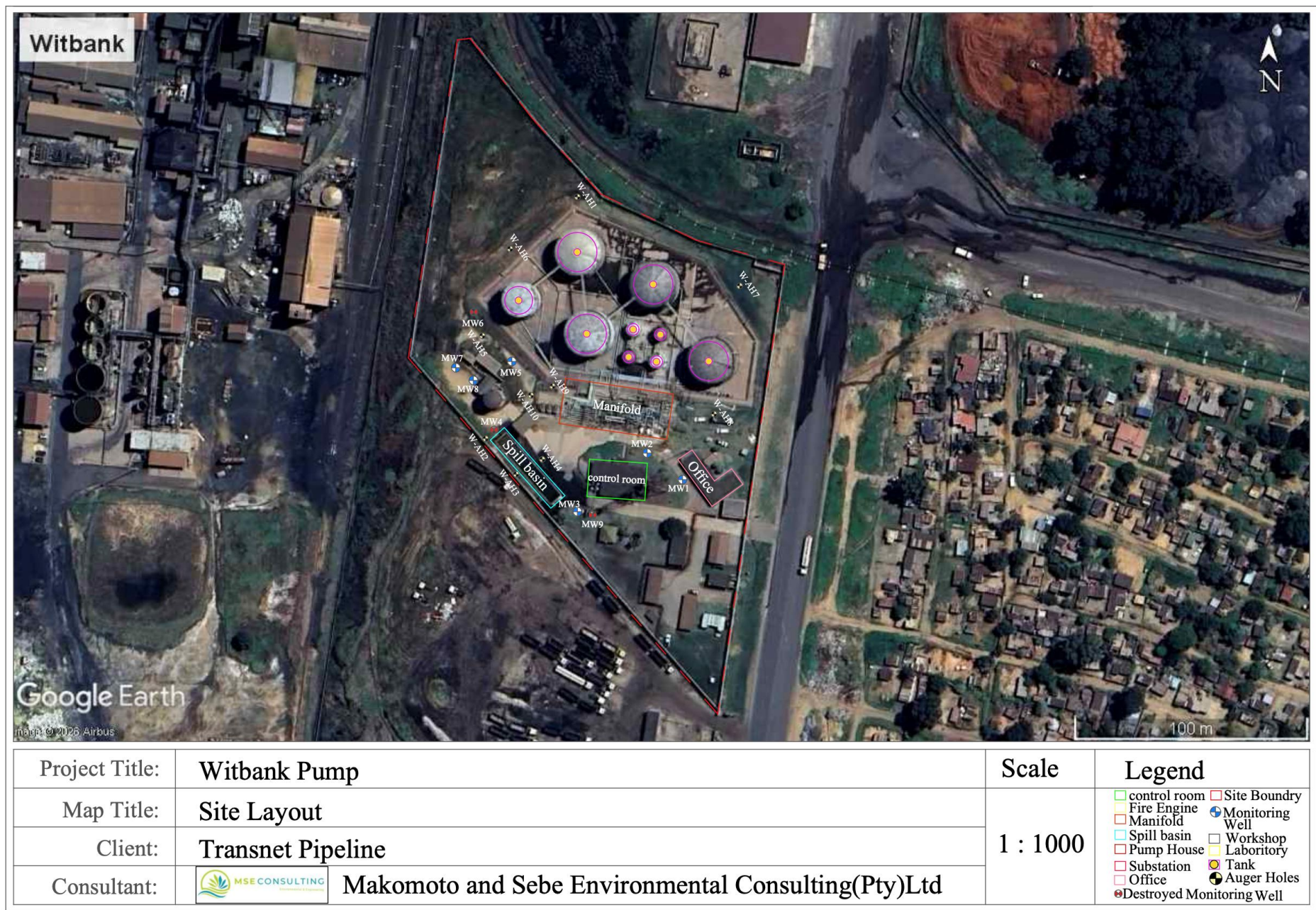


Figure 1: Aerial Image Layout

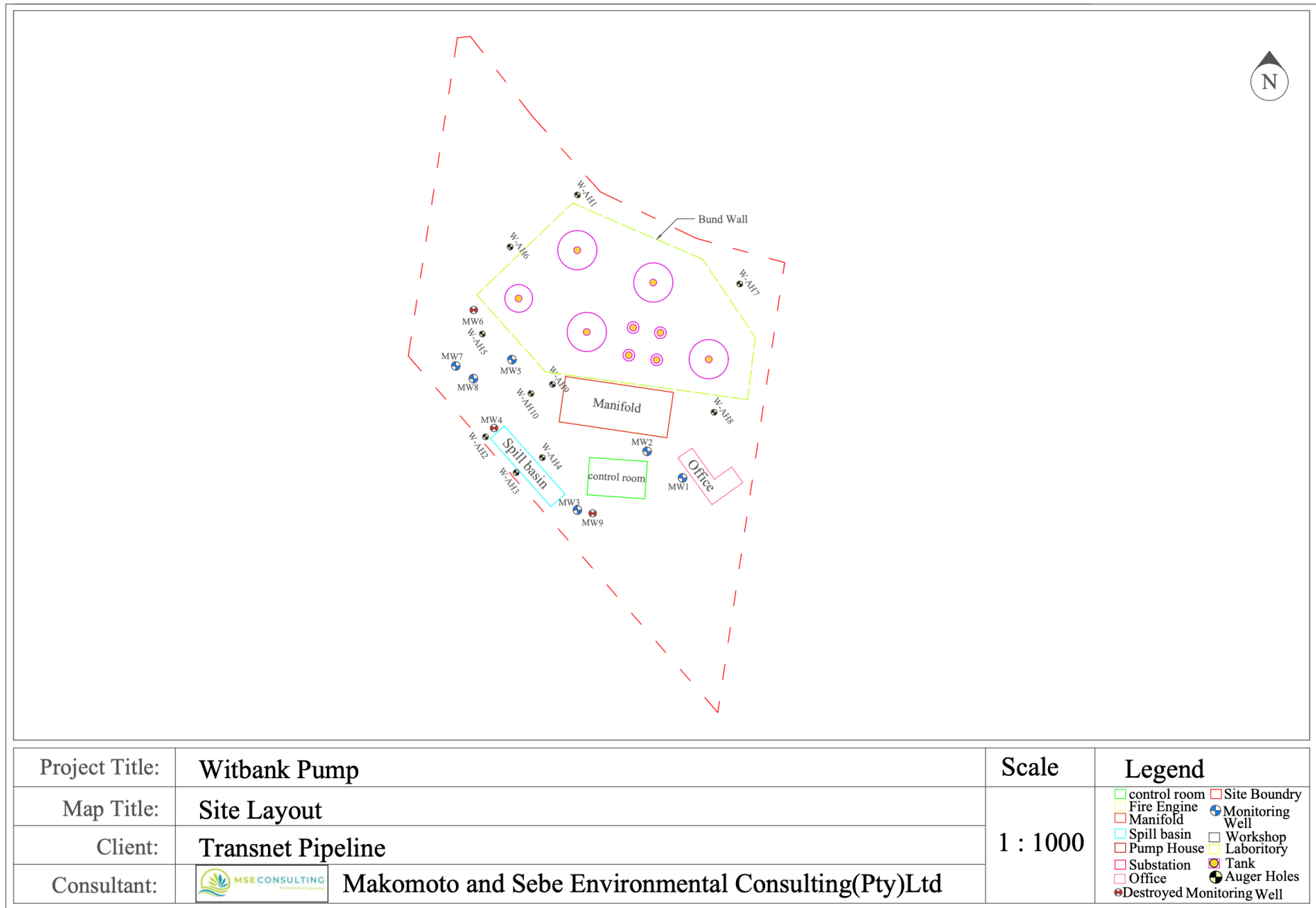


Figure 2: Site Layout Plan



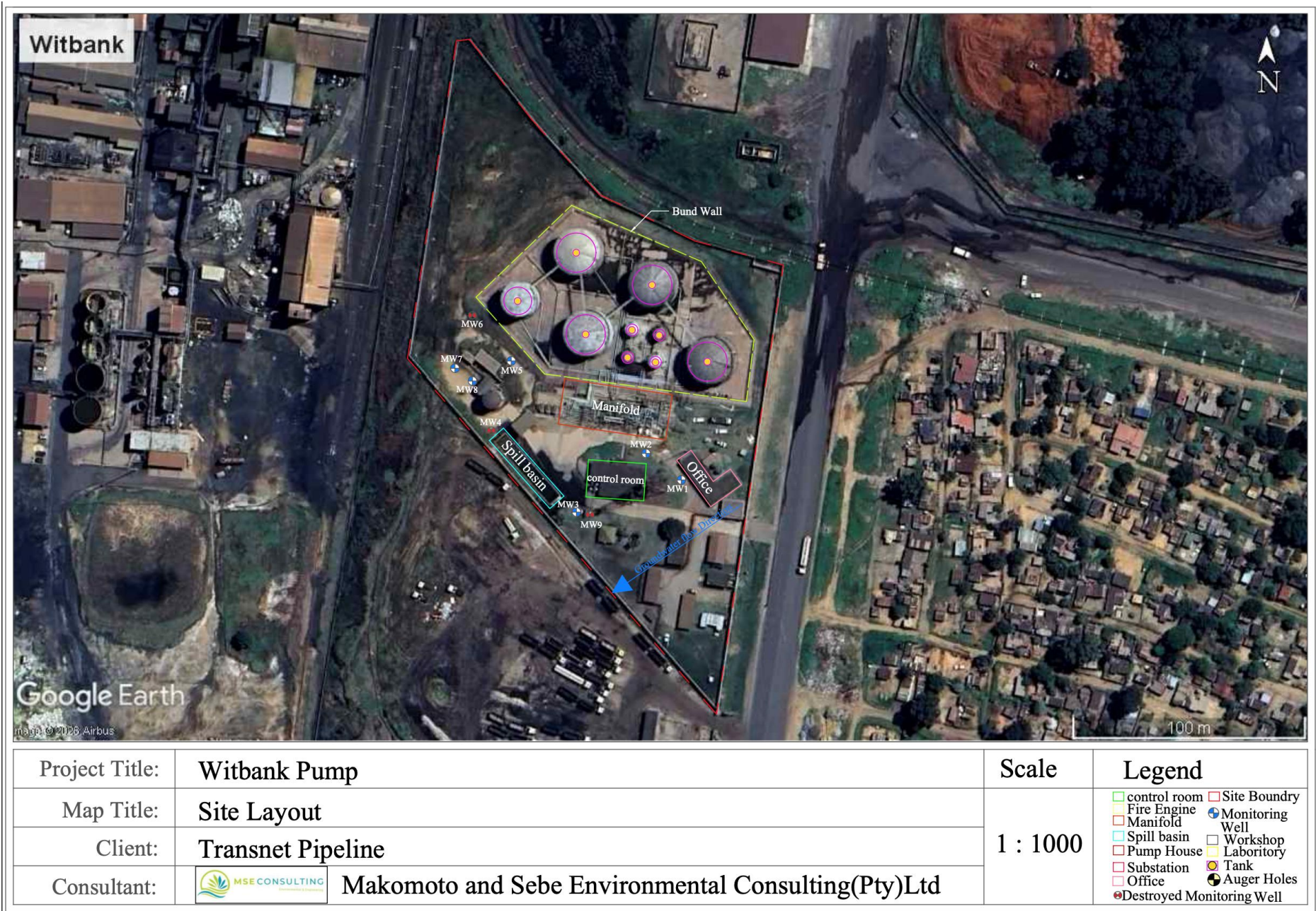


Figure 3: Aerial Image Site Layout Plan showing Groundwater Flow Direction

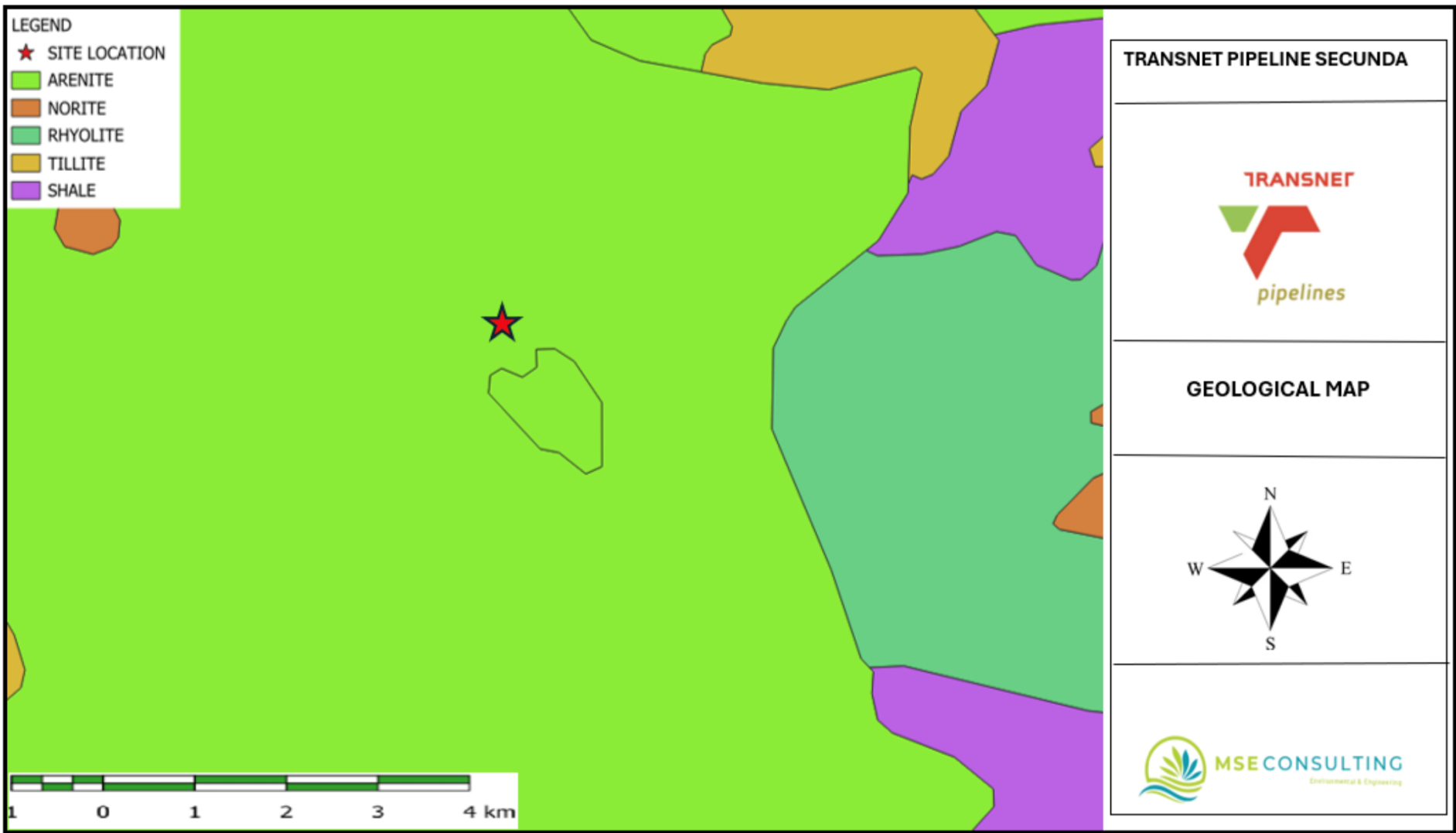


Figure 4: Geological Map



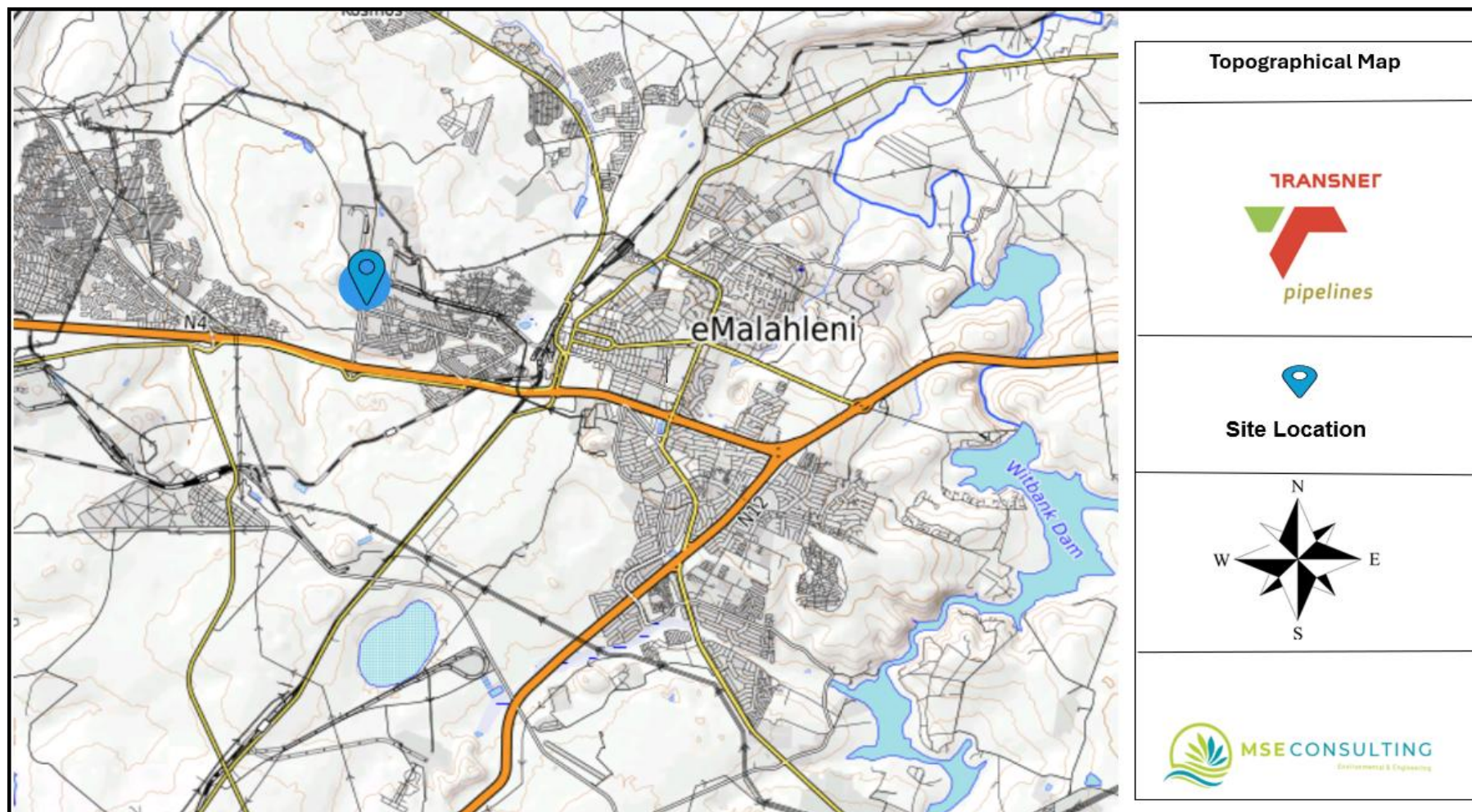


Figure 5: Topographical Map

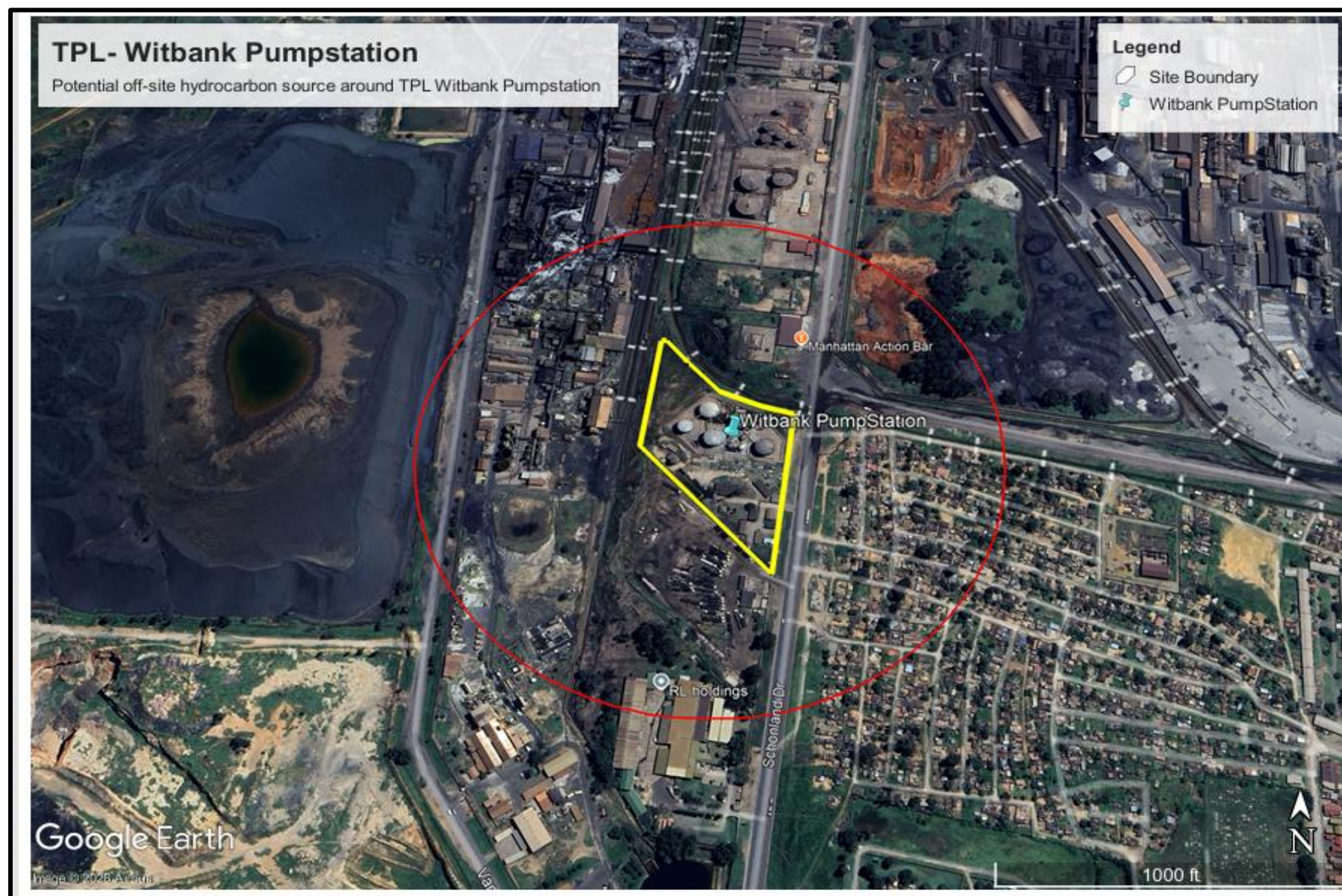


Figure 6: Map Illustrating potential off-site source of contamination



## 4. FIELD WORK

### 4.1 HEALTH AND SAFETY

Site specific health and safety plans (HASPs) and job safety analyses (JSAs) were compiled prior to Makomoto and Sebe Environmental Consulting and other contractors moving onto site. The HASP included safety information such as the contact information of emergency services as well as emergency response plans which detail the location of the nearest medical facilities. The response plans detail the courses of action to be followed should an incident occur and include the contact information of the relevant primary contractor and sub-contractor personnel who should be informed should an incident occur. Task-specific JSAs are compiled prior to work commencing. These JSAs detail the primary and secondary tasks to be completed, along with the identified possible hazards and the required mitigation measures which are to be implemented.

### 4.2 DISCUSSION OF SOIL VAPOUR SURVEY (SVS) RESULTS

The soil vapor survey technique is based on the principle that volatile organic compounds (VOC) present in the sub-surface, because of a hydrocarbon spill or leak, will attempt to reach equilibrium with the air present in voids in the soil matrix. By extracting a sample of this air, it is possible to determine the concentration of VOC's at different points over a site. This enables the surveyor to establish zones of high or low vapour phase hydrocarbon concentrations that can be used to determine the size and location of a subsurface contamination plume. The MiniRAE 2000 Photo Ionization Detector (PID) was used to conduct the survey.

A soil vapour survey (SVS) comprising 10 recording points was undertaken around the site. Vapour-phase VOC concentrations ranged from 0.0 ppm to 64 ppm refer to Table 3. Moderately elevated VOCs were detected along site of the manifold containing ULP 93, ULP 95, and 50 diesel, each with a capacity of 14,000 L.

Highly elevated VOC concentrations were identified during the soil vapour survey at auger holes AH1, AH2, AH3, AH5, and AH10. The maximum PID response of 1,506 ppm was recorded at AH10, indicating significant hydrocarbon vapour presence. Additional elevated PID readings were recorded at AH1 (568 ppm), AH2 (136.7 ppm), AH3 (45.9 ppm), and AH5 (100.6 ppm). The remaining auger holes (AH4, AH6, AH7, AH8, and AH9) generally recorded low to negligible VOC concentrations, suggesting limited vapour-phase hydrocarbon impact in those areas.

The results indicate the presence of localised subsurface vapour-phase hydrocarbon impacts within the surveyed area. The spatial distribution of PID responses is summarised in Table 3 and Table 5. with the soil vapour survey layout and sampling locations provided in Figure 2 and Figure 9. These findings warrant further investigation to delineate the extent and significance of potential hydrocarbon contamination in accordance with applicable DFFE land contamination assessment guidelines.

The SVS was strategically implemented to evaluate the extent of hydrocarbon contamination in the subsurface in alignment with the Department of Forestry, Fisheries and the Environment (DFFE) norms and standards. Soil stratigraphy encountered during hand auger holes varied from loose to coarse-grained sands, silty clayey sands, and underlying clay layers to a terminal depth of 1.2 metres. The site layout is depicted in Figure 1.

All samples were submitted to an accredited laboratory for comprehensive analysis, including BTEXN (Benzene, Toluene, Ethylbenzene, Xylene, and Naphthalene), TAME, MTBE, 1,2,4-Trimethylbenzene, 1,3,5-Trimethylbenzene, Total Petroleum Hydrocarbons (TPH) in the Gasoline Range Organics (C7–C9), and Diesel to Heavy Hydrocarbon fractions (TPH C10–C36).

The field observations during soil sampling are summarised. The collected soil samples were stored in refrigerated conditions prior to submission to the laboratory for analysis.

Table 3: Vapour Phase VOC concentrations recorded during Soil Vapour Survey

| Position                                                                                                         | VOC (ppm) |
|------------------------------------------------------------------------------------------------------------------|-----------|
| 1                                                                                                                | 18.6      |
| 2                                                                                                                | 64.0      |
| 3                                                                                                                | 2.6       |
| 4                                                                                                                | 0.0       |
| 5                                                                                                                | 10.0      |
| 6                                                                                                                | 0.4       |
| 7                                                                                                                | 0.0       |
| 8                                                                                                                | 0.0       |
| 9                                                                                                                | 0.0       |
| 10                                                                                                               | 64.0      |
| <b>Notes:</b> <ul style="list-style-type: none"> <li>VOC results expressed in parts per million (ppm)</li> </ul> |           |

Table 4: Classification of soil vapour results

| Classification | VOC Range |
|----------------|-----------|
| Low            | <1        |
| Slight         | 1-50      |
| Moderate       | 50-500    |
| High           | 500-4 000 |
| Very high      | >4 000    |

#### 4.3. DISCUSSION OF HEADSPACE TEST RESULTS

The headspace procedure is a quick and simple field screening procedure used to determine the presence of volatile organic compounds (VOC's) in soil vapours or water headspace. The procedure involves collecting a soil or water sample, placing it in an air-tight container (container half-filled) and then analysing the headspace vapour above the medium using a portable analytical instrument. The "headspace" is the area between the sample and the top of the container [Minnesota Pollution Control Agency, 1990].

To perform a headspace test, a container is half-filled with potentially contaminated soil. The sample container is sealed and then allowed to stand for 10 - 15 minutes (in ambient shady conditions) to allow the vapours in the soil to equalise with the air void within the container. A PID is then used to measure the level of VOCs in the air void.

Table 5: Field observation during soil sampling in the auger holes

| POSITION | COORDINATES                    | REFUSAL DEPTH | DEPTH | VOC (PPM) | SAMPLES COLLECTED FOR LAB ANALYSIS | ODOUR? | DESCRIPTION                                                                                                            |
|----------|--------------------------------|---------------|-------|-----------|------------------------------------|--------|------------------------------------------------------------------------------------------------------------------------|
| AH1      | 25°51'44.62"S<br>29° 9'58.64"E | 0.9 m         | 0.0   | 0.0       |                                    | Yes    | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with slightly hydrocarbon odour, transported soil. |
|          |                                |               | 0.3   | 18.6      |                                    | Yes    | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with slightly hydrocarbon odour, Residual soil.    |
|          |                                |               | 0.6   | 568       | Yes                                | Yes    | Moist, dark-brown, sandy clay soil, intact, with slightly hydrocarbon odour, Residual soil.                            |
|          |                                |               | 0.9   | 10.6      |                                    | No     | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with no hydrocarbon odour, Residual soil.          |
| AH2      | 25°51'47.62"S<br>29° 9'57.11"E | 0.9 m         | 0.0   | 15.6      |                                    | Yes    | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with slightly hydrocarbon odour, transported soil. |
|          |                                |               | 0.3   | 10.6      |                                    | No     | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with no hydrocarbon odour, transported soil.       |
|          |                                |               | 0.6   | 136.7     | Yes                                | Yes    | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with Slightly hydrocarbon odour, Residual soil.    |
|          |                                |               | 0.9   | 9.6       |                                    | No     | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with no hydrocarbon odour, Residual soil.          |
| AH3      | 25°51'48.26"S<br>29° 9'57.58"E | 0.9 m         | 0.0   | 0.0       |                                    | No     | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with no hydrocarbon odour, transported soil.       |
|          |                                |               | 0.3   | 10.0      |                                    | No     | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with no hydrocarbon odour, transported soil.       |
|          |                                |               | 0.6   | 34.7      |                                    | No     | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with no hydrocarbon odour, Residual soil.          |
|          |                                |               | 0.9   | 45.9      | Yes                                | No     | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with no hydrocarbon odour, Residual soil.          |
| AH4      | 25°51'48.20"S<br>29° 9'57.97"E | 0.9 m         | 0.0   | 0.0       |                                    | No     | Covered with concrete sands                                                                                            |
|          |                                |               | 0.3   | 0.0       |                                    | No     | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with no hydrocarbon odour, transported soil.       |



|            |                                |       |     |       |     |    |                                                                                                                  |
|------------|--------------------------------|-------|-----|-------|-----|----|------------------------------------------------------------------------------------------------------------------|
|            |                                |       | 0.6 | 12.0  | Yes | No | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with no hydrocarbon odour, Residual soil.    |
|            |                                |       | 0.9 | 0.0   |     | No | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with no hydrocarbon odour, Residual soil.    |
| <b>AH5</b> | 25°51'46.49"S<br>29° 9'57.22"E | 0.9 m | 0.0 | 0.0   |     | No | Covered with grass and concrete sands                                                                            |
|            |                                |       | 0.3 | 12.0  |     | No | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with no hydrocarbon odour, transported soil. |
|            |                                |       | 0.6 | 37.6  |     | No | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with no hydrocarbon odour, Residual soil.    |
|            |                                |       | 0.9 | 100.6 | Yes | No | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with no hydrocarbon odour, Residual soil.    |
| <b>AH6</b> | 25°51'47.08"S<br>29° 9'57.50"E | 1.2 m | 0.0 | 0.0   |     |    | Covered with grass                                                                                               |
|            |                                |       | 0.3 | 0.4   | Yes |    | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with no hydrocarbon odour, transported soil. |
|            |                                |       | 0.9 | 0.0   |     |    | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with no hydrocarbon odour, Residual soil.    |
|            |                                |       | 1.2 | 0.0   |     |    | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with no hydrocarbon odour, Residual soil.    |
| <b>AH7</b> | 25°51'45.65"S<br>29° 10'0.96"E | 0.9 m | 0.0 | 0.0   |     |    | Covered with grass                                                                                               |
|            |                                |       | 0.3 | 0.0   |     |    | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with no hydrocarbon odour, transported soil. |
|            |                                |       | 0.6 | 0.0   |     |    | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with no hydrocarbon odour, Residual soil.    |
|            |                                |       | 0.9 | 0.0   | Yes |    | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with no hydrocarbon odour, Residual soil.    |
| <b>AH8</b> | 25°51'47.48"S<br>29° 10'0.66"E | 0.9 m | 0.0 | 0.0   |     |    | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with no hydrocarbon odour, transported soil. |
|            |                                |       | 0.3 | 0.0   |     |    | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with no hydrocarbon odour, Residual soil.    |
|            |                                |       | 0.6 | 0.0   | Yes |    | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with no hydrocarbon odour, Residual soil.    |

|      |                                                            |       |     |      |     |     |                                                                                                                        |
|------|------------------------------------------------------------|-------|-----|------|-----|-----|------------------------------------------------------------------------------------------------------------------------|
|      |                                                            |       | 0.9 | 0.0  |     |     | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with no hydrocarbon odour, transported soil.       |
| AH9  | 25°51'47.06"S<br>29° 9'58.19"E                             | 0.9 m | 0.0 | 10.6 |     |     | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with slightly hydrocarbon odour, transported soil. |
|      |                                                            |       | 0.3 | 13.8 |     |     | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with slightly hydrocarbon odour, transported soil. |
|      |                                                            |       | 0.6 | 24.8 | Yes |     | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with Slightly hydrocarbon odour, Residual soil.    |
|      |                                                            |       | 0.9 | 6.8  |     |     | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with no hydrocarbon odour, Residual soil.          |
| AH10 | 25°51'47.05"S<br>29° 9'57.73"E                             | 0.9 m | 0.0 | 30.8 |     | Yes | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with slightly hydrocarbon odour, transported soil. |
|      |                                                            |       | 0.3 | 64.8 |     | Yes | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with moderate hydrocarbon odour, transported soil. |
|      |                                                            |       | 0.6 | 37.0 |     | Yes | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with Slightly hydrocarbon odour, Residual soil.    |
|      |                                                            |       | 0.9 | 75.8 |     | Yes | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with modearte hydrocarbon odour, Residual soil.    |
|      |                                                            |       | 1.2 | 1506 | Yes | Yes | Moist, dark-brown, sandy soil, consisting of fine to coarse grains, with moderate hydrocarbon odour, transported soil. |
|      | Notes:<br>VOC results expressed in parts per million (ppm) |       |     |      |     |     |                                                                                                                        |

The soil vapour screening results indicate the presence of locally elevated volatile organic compound (VOC) concentrations across the site, with measured PID values ranging from non-detect to 1,506 ppm. Elevated VOC concentrations were recorded at multiple auger holes (AH1, AH2, AH3, AH5, AH9, and AH10), demonstrating a heterogeneous distribution of vapour-phase hydrocarbon impacts within the subsurface soils.

The highest VOC concentration was recorded at AH10 (1,506 ppm at 1.2 m bgl) and was accompanied by a moderate hydrocarbon odour, suggesting a significant vapour-phase hydrocarbon source at this location. Additional elevated PID readings at depth, including measurements exceeding background levels and, in some cases, occurring in the absence of detectable odour, indicate the potential presence of residual hydrocarbon contamination below olfactory detection thresholds.

The predominance of residual soils, combined with moist sandy to sandy clay lithologies that are conducive to hydrocarbon retention, suggests that contamination may be persistent and vertically variable. Although no visible free-phase product or staining was observed, the elevated VOC responses indicate a potential risk to groundwater quality and vapour migration pathways, particularly given the shallow groundwater conditions identified on site.

#### 4.4 GROUNDWATER SAMPLING

A total of nine (9) groundwater monitoring wells were scheduled for sampling during the monitoring event. Of these, only six (6) wells were located on site and accessible refer to Figure 2 and Figure 8. Three (3) monitoring wells, namely MW4, MW6 and MW9, were found to be damaged and non-functional at the time of inspection. In the case of MW9, only the manhole cover was visible at ground level, indicating that the well structure has been completely destroyed. The damaged condition of these wells limited the groundwater monitoring coverage across the site.

It is recommended that the affected monitoring wells be reinstated and uplifted to approximately 200 mm above ground level, with appropriate protective casings installed, to prevent future damage and ensure the integrity of the groundwater monitoring network.

Groundwater levels in each accessible monitoring well were measured using a Solinst™ interface meter to determine the depth to the water table and to assess potential groundwater flow and contamination pathways. Groundwater samples were subsequently collected using a bailer and decanted into appropriate, clearly labelled sampling containers in accordance with standard sampling and quality assurance procedures.

- Groundwater samples from monitoring wells MW1, MW2, MW3, MW5, MW7, and MW8 were collected using appropriate plastic sampling containers and submitted to an accredited laboratory for analysis. The analytical suite included BTEXN, TAME, MTBE, 1,3,5- and 1,2,4-Trimethylbenzene, Total Petroleum Hydrocarbons (TPH) fractions comprising GRO (C7–C9), DRO, and ORO (C10–C36), Polycyclic Aromatic Hydrocarbons (PAHs), and inorganic parameters (cations and heavy metals).
- For QA/QC purposes, a laboratory-prepared trip blank sample, labelled as Trip Blank, was submitted to the laboratory alongside the site samples.
- YSI Equipment and Techniques Standard Operating Procedures (SOPs) were followed for all water quality assessments.
- The pH meter was turned on and calibrated using two standard solutions; pH 4, 7, and 10 buffers were recommended depending on the measurement range.
- The probe was thoroughly rinsed with deionized water between buffers and carefully blotted dry with a Kim wipe.
- pH meters were calibrated before each series of samples (not between individual samples) or when measuring a wide range of pH.
- Calibration was checked by measuring the pH of the standard solutions in measure mode rather than calibration mode.
- The physical condition of the groundwater was recorded during sampling, including observations of colour, turbidity, and any visible sheen or odour.
- Field parameters, including temperature, pH, electrical conductivity (EC), oxidation-reduction potential (ORP), and dissolved oxygen (DO), were monitored and stabilized to ensure representative sampling of the aquifer.
- All samples were kept under cooled conditions and transported to the analytical laboratory with full chain-of-custody documentation to maintain sample integrity and traceability.

Table 6: Field observation of groundwater levels within monitoring wells.

| Sample ID | Free Phase Product Thickness (m) | Water Level (mbgl) | Depth (mbgl) | Diameter (mm) | Volume Purged (ℓ) | Temp (°C) | pH   | EC (mS/m) | DO (mg/l) | ORP (mV) | Field Observation                                                                     |
|-----------|----------------------------------|--------------------|--------------|---------------|-------------------|-----------|------|-----------|-----------|----------|---------------------------------------------------------------------------------------|
| MW1       | -                                | 0.725              | 6.94         | 63 mm         | 20ℓ               | 21.5      | 3.36 | 576       | 4.80      | -229     | Clear water with suspended sediments, no hydrocarbon odour or visible sheen observed. |
| MW2       | -                                | 0.655              | 6.795        | 63 mm         | 20ℓ               | 20.8      | 3.16 | 440       | 4.78      | -55      | Clear water with suspended sediments, no hydrocarbon odour or visible sheen observed. |
| MW3       | -                                | 0.461              | 4.05         | 63 mm         | 20ℓ               | 20.1      | 4.13 | 369       | 6.08      | 32       | Clear water with suspended sediments, no hydrocarbon odour or visible sheen observed. |
| MW4       | -                                | -                  | -            | -             | -                 | -         | -    | -         | -         | -        | Destroyed                                                                             |
| MW5       | -                                | 0.0                | 6.51         | 63 mm         | 35ℓ               | 21.3      | 6.5  | 725       | 4.08      | -25      | Very turbidity, however, no hydrocarbon odour or visible sheen was detected. The      |

|            |   |       |       |       |     |      |      |      |      |     |                                                                                   |
|------------|---|-------|-------|-------|-----|------|------|------|------|-----|-----------------------------------------------------------------------------------|
|            |   |       |       |       |     |      |      |      |      |     | monitoring well was full of water to ground surface.                              |
| <b>MW6</b> | - | -     | -     | -     | -   | -    | -    | -    | -    | -   | Destroyed                                                                         |
| <b>MW7</b> | - | 0.375 | 4.965 | 63 mm | 20l | 20.4 | 5.5  | 482  | 4.08 | 142 | Very turbidity, however, no hydrocarbon odour or visible sheen was detected.      |
| <b>MW8</b> | - | 0.491 | 2.556 | 63 mm | 20l | 20.0 | 3.75 | 1664 | 5.08 | 124 | Clear water, with sediments, with no hydrocarbon odour or visible sheen observed. |
| <b>MW9</b> | - | -     | -     | -     | -   | -    | -    | -    | -    | -   | Destroyed, only manhole cover on the ground                                       |

- The results of the groundwater measurements are presented in Table 6. The site layout plan indicating the position of the groundwater monitoring wells and groundwater sampled from on-site monitoring wells presented in Figure 6. The groundwater static level in the monitoring wells ranges between 0.0 and 0.725 meter above mean sea level (mbgl).
- Temperature (°C):** Ranged from 20.0 to 21.5°C, typical for shallow groundwater in temperate climates, indicating natural ambient conditions without unusual thermal inputs. These temperatures support standard microbial and biodegradation processes.
- pH:** Ranged from 3.16 to 6.50, indicating generally acidic groundwater. Acidic conditions may enhance the solubility of metals (e.g., Fe, Mn, Zn) and are less favourable for hydrocarbon biodegradation, though microbial activity can still occur.
- Electrical Conductivity (EC, mS/m):** Ranged from 369 to 1,664 mS/m, reflecting variable dissolved ion concentrations. Elevated EC (e.g., MW8) may result from natural mineral dissolution or anthropogenic influences and can be used to monitor potential contamination trends.
- Dissolved Oxygen (DO, mg/L):** Ranged from 4.08 to 6.08 mg/L, indicating oxic to mildly oxic conditions conducive to aerobic microbial activity. Lower DO in some wells (e.g., MW5) suggests localized reducing conditions that could influence metal mobility and anaerobic degradation.
- Oxidation–Reduction Potential (ORP, mV):** Ranged from -229 to +142 mV, showing spatial variability in redox conditions. Reducing conditions (negative ORP) favour anaerobic processes, while oxidising conditions (positive ORP) support aerobic degradation. This heterogeneity can affect contaminant behaviour and migration potential.

## 5. RESULTS OF PETROLEUM HYDROCARBON ANALYSIS

The collected soil and groundwater samples were submitted to Environmental Pollution Laboratory (Pty) Ltd located in Irene, Pretoria for BTEXN, TAME, MTBE, 1,2,4-TMB, 1,3,5-TMB, TPH GRO C<sub>7</sub>-C<sub>9</sub> and TPH DRO and ORO C<sub>10</sub>-C<sub>36</sub> analysis, Polycyclic Aromatic Hydrocarbons (PAHs), and inorganic parameters (cations and heavy metals). The laboratory analysis certificates on groundwater samples are attached under APPENDIX A.

Table 7: Results of Petroleum/Hydrocarbon analysis in soil samples BTEXMN and Gasoline Range Organics-Soil.

| Sample No   | Depth (m bgl) | Benzene | Toluene | Ethyl Benzene | Xylenes | Naphthalene | TAME | MTBE | 1,3,5 Trimethylbenzene | 1,2,4 Trimethylbenzene | TPH GRO C7-C9 |
|-------------|---------------|---------|---------|---------------|---------|-------------|------|------|------------------------|------------------------|---------------|
| <b>WAH1</b> | 0.9 m         | 0.43    | 0.78    | 0.99          | 3.1     | 0.59        | 0.23 | <0.1 | 0.17                   | 1.1                    | 5             |
| <b>WAH2</b> | 0.9 m         | 0.01    | 0.026   | 0.038         | 0.061   | 0.067       | <0.1 | <0.1 | <0.008                 | 0.013                  | 0.84          |
| <b>WAH3</b> | 0.9 m         | 0.01    | 0.016   | 0.028         | 0.061   | 0.067       | <0.1 | <0.1 | <0.008                 | 0.013                  | 0.44          |
| <b>WAH4</b> | 0.9 m         | <0.008  | <0.02   | <0.008        | <0.024  | <0.008      | <0.1 | <0.1 | <0.008                 | <0.008                 | <0.2          |
| <b>WAH5</b> | 0.9 m         | 0.01    | 0.026   | 0.038         | 0.051   | 0.057       | <0.1 | <0.1 | <0.008                 | 0.013                  | 0.54          |



|                                                                |       |             |             |            |            |            |      |               |        |        |               |
|----------------------------------------------------------------|-------|-------------|-------------|------------|------------|------------|------|---------------|--------|--------|---------------|
| <b>WAH6</b>                                                    | 1.2 m | <0.008      | <0.02       | <0.008     | 0.024      | <0.008     | <0.1 | <0.1          | <0.008 | <0.008 | <0.2          |
| <b>WAH7</b>                                                    | 0.9 m | <0.008      | <0.02       | <0.008     | <0.024     | <0.008     | <0.1 | <0.1          | <0.008 | <0.008 | <0.2          |
| <b>WAH8</b>                                                    | 0.9 m | <0.008      | <0.02       | <0.008     | <0.024     | <0.008     | <0.1 | <0.1          | <0.008 | <0.008 | <0.2          |
| <b>WAH9</b>                                                    | 0.9 m | <0.008      | <0.02       | <0.008     | <0.024     | <0.008     | <0.1 | <0.1          | <0.008 | <0.008 | <0.2          |
| <b>WAH10</b>                                                   | 0.9 m | 0.074       | <0.02       | 0.48       | 0.024      | 0.32       | 1.2  | <0.1          | <0.008 | <0.008 | 22            |
| <b>SSV1: Protection of the Water Resource (All land Users)</b> |       | <b>0.03</b> | <b>25</b>   | <b>26</b>  | <b>45</b>  | <b>28</b>  | -    | <b>0.0036</b> | -      | -      | <b>2 300</b>  |
| <b>SSV2: Informal Residential</b>                              |       | <b>1.3</b>  | <b>120</b>  | <b>57</b>  | <b>91</b>  | <b>28</b>  | -    | <b>360</b>    | -      | -      | <b>2 300</b>  |
| <b>SSV2: Standard Residential</b>                              |       | <b>1.4</b>  | <b>120</b>  | <b>60</b>  | <b>95</b>  | <b>33</b>  | -    | <b>370</b>    | -      | -      | <b>2 400</b>  |
| <b>SSV2: Commercial / Industrial</b>                           |       | <b>10</b>   | <b>1100</b> | <b>540</b> | <b>890</b> | <b>290</b> | -    | <b>5 800</b>  | -      | -      | <b>23 000</b> |

Notes:

- All soil result as mg/kg
  - Screening of Soil samples by PID Headspace
  - BDL – Below method detection limit
  - SSV – Soil screening value (NEMWA Norms and Standards - Remediation of Contaminated Land & Soil Quality)
  - TPH – Total Petroleum Hydrocarbon
  - Certified analytical results attached
- 
- Benzene was detected in soil sample retrieved from WAH1 and WAH10 at concentrations exceeding the Soil Screening Value (SSV1) for the protection of water resources and land users, indicating a potential hydrocarbon impact at this location.
  - Trace concentrations of toluene, ethylbenzene, xylenes, naphthalene, TAME, 1,3,5-trimethylbenzene, 1,2,4-trimethylbenzene, and TPH (C7–C9) were also detected in sample retrieved from WAH1, located upslope of the tanks farm area with concentrations that did not exceed the applicable SSVs.
  - Trace concentrations of benzene, toluene, ethylbenzene, xylenes, naphthalene, TAME, 1,2,4-trimethylbenzene, and TPH (C7–C9) were detected in soil samples collected from hand auger holes WAH2, WAH3, and WAH5 with the concentrations that did not exceed the applicable Soil Screening Values (SSVs).
  - Trace concentrations of ethylbenzene, xylenes, naphthalene, TAME and TPH (C7–C9) were detected in soil samples collected from hand auger holes WAH10 with the concentrations that did not exceed the applicable Soil Screening Values (SSVs).

- All measured concentrations in hand auger holes WAH4, WAH6, WAH7, WAH8, and WAH9 were reported below detection limits, this indicate no detectable contamination within the sampled intervals at the time of assessment.
- Laboratory results confirm the presence of hydrocarbons on site. The concentrations measured indicate significant contamination, which is considered to pose a potential risk to soil quality and the surrounding environment at these locations.

Table 8: Total Petroleum Hydrocarbon (C10-C36)

| Sample No.                                                                                                                                                                                                                                                                                                                                                                                                           | Depth (m) | PID Headspace (ppm) | TPH (C10-C14) | TPH (C15-C36)  | Total TPH (C10-C36) |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|---------------------|---------------|----------------|---------------------|
| WAH1                                                                                                                                                                                                                                                                                                                                                                                                                 | 0.9 m     | 0.6                 | 1.1           | 14             | 15.1                |
| WAH2                                                                                                                                                                                                                                                                                                                                                                                                                 | 0.9 m     | 36.7                | 0.14          | 3.8            | 3.94                |
| WAH3                                                                                                                                                                                                                                                                                                                                                                                                                 | 0.9 m     | 12.0                | 0.14          | 3.8            | 3.94                |
| WAH4                                                                                                                                                                                                                                                                                                                                                                                                                 | 0.9 m     | 0.0                 | <0.02         | 0.065          | 0.065               |
| WAH5                                                                                                                                                                                                                                                                                                                                                                                                                 | 0.9 m     | 0.4                 | 0.18          | 3.8            | 3.98                |
| WAH6                                                                                                                                                                                                                                                                                                                                                                                                                 | 1.2 m     | 0.0                 | <0.02         | 0.045          | 0.045               |
| WAH7                                                                                                                                                                                                                                                                                                                                                                                                                 | 0.9 m     | 0.4                 | <0.02         | 0.045          | 0.045               |
| WAH8                                                                                                                                                                                                                                                                                                                                                                                                                 | 0.9 m     | 0.0                 | <0.02         | 0.035          | 0.035               |
| WAH9                                                                                                                                                                                                                                                                                                                                                                                                                 | 0.9 m     | 24.8                | <0.02         | 0.045          | 0.045               |
| WAH10                                                                                                                                                                                                                                                                                                                                                                                                                | 0.9 m     | 1506                | 0.37          | 0.32           | 0.69                |
| <b>SSV1: Protection of the Water Resource (All land Users)</b>                                                                                                                                                                                                                                                                                                                                                       |           |                     | <b>440</b>    | <b>45 000</b>  | -                   |
| <b>SSV2: Informal Residential</b>                                                                                                                                                                                                                                                                                                                                                                                    |           |                     | <b>440</b>    | <b>45 000</b>  | -                   |
| <b>SSV2: Standard Residential</b>                                                                                                                                                                                                                                                                                                                                                                                    |           |                     | <b>500</b>    | <b>91 000</b>  | -                   |
| <b>SSV2: Commercial / Industrial</b>                                                                                                                                                                                                                                                                                                                                                                                 |           |                     | <b>4400</b>   | <b>740 000</b> | -                   |
| <b>Notes:</b> <ul style="list-style-type: none"> <li>• All soil result as mg/kg</li> <li>• Screening of Soil samples by PID Headspace</li> <li>• BDL – Below method detection limit</li> <li>• SSV – Soil screening value (NEMWA Norms and Standards - Remediation of Contaminated Land &amp; Soil Quality)</li> <li>• TPH – Total Petroleum Hydrocarbon</li> <li>• Certified analytical results attached</li> </ul> |           |                     |               |                |                     |

- The concentrations of Total Petroleum Hydrocarbons (TPH) fractions C10–C14 and C15–C36, as well as Total TPH (C10–C36), were detected in soil samples collected from hand auger holes WAH1, WAH2, WAH3, WAH5 and WAH10. All detected concentrations did not exceed the applicable Soil Screening Values (SSVs), indicating that hydrocarbon levels are within acceptable regulatory thresholds and are not considered to pose an immediate risk to soil quality or the surrounding environment.
- The concentrations of Total Petroleum Hydrocarbons (TPH) C15–C36 and Total TPH (C10–C36), were detected in soil samples collected from hand auger holes WAH4, WAH6, WAH7, WAH8 and WAH9. With the concentrations that did not exceed the applicable Soil Screening Values (SSVs).

Table 9: Polycyclic Aromatic Hydrocarbon

| Sample No.                                                                                                                                                                                                                                                                                                                                                                                         | Depth (m) | PID Headspace (ppm) | Pyrene | Benzo(a)pyrene | Chloroform | Carbon Tetrachloride | 1,2-Dichloroethane | 1,1-Dichloroethane | Cis -1,2-Dichloroethane | Trans-1,2-Dichloroethane | Chlorobenzene | 1,2-Dichlorobenzene | 1,4-Dichlorobenzene | 2-Chlorophenol |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|---------------------|--------|----------------|------------|----------------------|--------------------|--------------------|-------------------------|--------------------------|---------------|---------------------|---------------------|----------------|
| WAH1                                                                                                                                                                                                                                                                                                                                                                                               | 0.9 m     | 0.6                 | 14     | <0.4           | <0.1       | <0.1                 | <0.2               | <0.2               | <0.2                    | <0.2                     | <0.04         | <0.04               | <0.04               | <0.02          |
| WAH2                                                                                                                                                                                                                                                                                                                                                                                               | 0.9 m     | 36.7                | 0.19   | <0.04          | <0.1       | <0.1                 | <0.2               | <0.2               | <0.2                    | <0.2                     | <0.04         | <0.04               | <0.04               | <0.02          |
| WAH3                                                                                                                                                                                                                                                                                                                                                                                               | 0.9 m     | 12.0                | 0.12   | <0.04          | <0.1       | <0.1                 | <0.2               | <0.2               | <0.2                    | <0.2                     | <0.04         | <0.04               | <0.04               | <0.02          |
| WAH4                                                                                                                                                                                                                                                                                                                                                                                               | 0.9 m     | 0.0                 | <0.04  | <0.04          | <0.1       | <0.1                 | <0.04              | <0.2               | <0.2                    | <0.2                     | <0.04         | <0.04               | <0.04               | <0.02          |
| WAH5                                                                                                                                                                                                                                                                                                                                                                                               | 0.9 m     | 0.4                 | 0.19   | <0.04          | <0.1       | <0.1                 | <0.2               | <0.2               | <0.2                    | <0.2                     | <0.04         | <0.04               | <0.04               | <0.02          |
| WAH6                                                                                                                                                                                                                                                                                                                                                                                               | 1.2 m     | 0.0                 | <0.04  | <0.04          | <0.1       | <0.1                 | <0.2               | <0.2               | <0.2                    | <0.2                     | <0.04         | <0.04               | <0.04               | <0.02          |
| WAH7                                                                                                                                                                                                                                                                                                                                                                                               | 0.9 m     | 0.4                 | <0.04  | <0.04          | <0.1       | <0.1                 | <0.2               | <0.2               | <0.2                    | <0.2                     | <0.04         | <0.04               | <0.04               | <0.02          |
| WAH8                                                                                                                                                                                                                                                                                                                                                                                               | 0.9 m     | 0.0                 | <0.04  | <0.04          | <0.1       | <0.1                 | <0.04              | <0.2               | <0.2                    | <0.2                     | <0.04         | <0.04               | <0.04               | <0.02          |
| WAH9                                                                                                                                                                                                                                                                                                                                                                                               | 0.9 m     | 24.8                | <0.04  | <0.04          | <0.1       | <0.1                 | <0.2               | <0.2               | <0.2                    | <0.2                     | <0.04         | <0.04               | <0.04               | <0.02          |
| WAH10                                                                                                                                                                                                                                                                                                                                                                                              | 0.9 m     | 1506                | 0.19   | <0.04          | <0.1       | <0.1                 | <0.2               | <0.2               | <0.2                    | <0.2                     | <0.04         | <0.04               | <0.04               | <0.02          |
| SSV1: Protection of the Water Resource (All land Users)                                                                                                                                                                                                                                                                                                                                            |           |                     | 5.3    | 0.34           | 0.11       | 0.25                 | 0.23               | 10                 | 0.4                     | -                        | 620           | 89                  | 26                  | 140            |
| SSV2: Informal Residential                                                                                                                                                                                                                                                                                                                                                                         |           |                     | 920    | 0.34           | 0.11       | 0.27                 | 0.23               | 10                 | 620                     | -                        | 620           | 2 700               | 1 100               | 150            |
| SSV2: Standard Residential                                                                                                                                                                                                                                                                                                                                                                         |           |                     | 1 900  | 0.71           | 0.11       | 0.26                 | 0.24               | 10                 | 1 200                   | -                        | 1 200         | 5 800               | 1 200               | 320            |
| SSV2: Commercial / Industrial                                                                                                                                                                                                                                                                                                                                                                      |           |                     | 15 000 | 1.7            | 1.7        | 4                    | 3.7                | 150                | 10 000                  | -                        | 10 000        | 47 000              | 19 000              | 2600           |
| <b>Notes:</b> <ul style="list-style-type: none"> <li>All soil result as mg/kg</li> <li>Screening of Soil samples by PID Headspace</li> <li>BDL – Below detection limit</li> <li>SSV – Soil screening value (NEMWA Norms and Standards - Remediation of Contaminated Land &amp; Soil Quality)</li> <li>TPH – Total Petroleum Hydrocarbon</li> <li>Certified analytical results attached.</li> </ul> |           |                     |        |                |            |                      |                    |                    |                         |                          |               |                     |                     |                |

- Detectable concentrations of pyrene were identified in soil samples collected from hand auger hole WAH1, with concentrations exceeding the applicable Soil Screening Value (SSV1) for the protection of the water resource (all land users). This exceedance indicates a potential risk to the water resource at this location and warrants further consideration in the site risk assessment.

- Trace concentrations of pyrene were identified in the soil samples collected from hand auger holes WAH2, WAH3, WAH5 and WAH10 with the concentration that did not exceed the soil screening Values (SSVs).
- Laboratory analytical results indicate that all other Polycyclic Aromatic Hydrocarbons (PAHs) analysed in soil samples collected from the hand auger holes WAH1 TO WAH10 were reported below detection limits.

Table 10: Inorganic (Cations and Heavy Metals) Laboratory Results for Soil Samples

| Sample No.                                                    | Depth (m bgl) | Arsenic    | Nickel        | Zinc           | Copper        | Chromium       | Cadmium    | Mercury     | Lead        | Manganese     | Vanadium     |
|---------------------------------------------------------------|---------------|------------|---------------|----------------|---------------|----------------|------------|-------------|-------------|---------------|--------------|
| WAH1                                                          | 0.9 m         | <3         | 93.83         | 1229.0         | 79.06         | 696.20         | <3         | 0.31        | 32.29       | 408.00        | 7602.0       |
| WAH2                                                          | 0.9 m         | <3         | 100.34        | 667.50         | 87.21         | 758.10         | <3         | <0.3        | 31.99       | 401.70        | 5647.0       |
| WAH3                                                          | 0.9 m         | <3         | 12.69         | <3             | 10.04         | 122.80         | <3         | <0.3        | 7.76        | 91.62         | 842.70       |
| WAH4                                                          | 0.9 m         | <3         | 12.69         | <3             | 13.4          | 122.80         | <3         | <0.3        | 8.76        | 81.62         | 812.70       |
| WAH5                                                          | 0.9 m         | <3         | 12.69         | 24.36          | 11.04         | 132.80         | <3         | <0.3        | 7.76        | 91.62         | 812.70       |
| WAH6                                                          | 1.2 m         | <3         | 14.69         | 24.36          | 10.04         | 122.8-         | <3         | <0.3        | 7.76        | 95.62         | 712.70       |
| WAH7                                                          | 0.9 m         | <3         | 12.69         | 24.36          | 10.04         | 122.80         | <3         | <0.3        | 7.76        | 91.62         | 812.70       |
| WAH8                                                          | 0.9 m         | <3         | 13.69         | 24.36          | 10.04         | 124.80         | <3         | <0.3        | 7.66        | 92.62         | 812.70       |
| WAH9                                                          | 0.9 m         | <3         | 12.69         | 24.36          | 10.04         | 122.80         | <3         | <0.3        | 7.76        | 91.62         | 812.70       |
| WAH10                                                         | 0.9 m         | <3         | 3.55          | <3             | 4.42          | 47.06          | <3         | <0.3        | 3.58        | 20.35         | 37.95        |
| <b>Dutch Intervention Levels</b>                              |               | <b>76</b>  | <b>100</b>    | <b>-</b>       | <b>-</b>      | <b>-</b>       | <b>13</b>  | <b>-</b>    | <b>-</b>    | <b>-</b>      | <b>-</b>     |
| <b>SSV1: Protective of the Water Resource (All Land Uses)</b> |               | <b>5.8</b> | <b>91</b>     | <b>240</b>     | <b>16</b>     | <b>46 000</b>  | <b>7.5</b> | <b>0.93</b> | <b>20</b>   | <b>740</b>    | <b>150</b>   |
| <b>SSV2: Informal Residential</b>                             |               | <b>23</b>  | <b>620</b>    | <b>9 200</b>   | <b>1 100</b>  | <b>46 000</b>  | <b>15</b>  | <b>0.93</b> | <b>110</b>  | <b>740</b>    | <b>150</b>   |
| <b>SSV2: Standard Residential</b>                             |               | <b>48</b>  | <b>1 200</b>  | <b>19 000</b>  | <b>2 300</b>  | <b>96 000</b>  | <b>32</b>  | <b>1.0</b>  | <b>230</b>  | <b>1500</b>   | <b>320</b>   |
| <b>SSV2: Commercial/ Industrial</b>                           |               | <b>150</b> | <b>10 000</b> | <b>150 000</b> | <b>19 000</b> | <b>790 000</b> | <b>260</b> | <b>6.5</b>  | <b>1900</b> | <b>12 000</b> | <b>2 600</b> |

**Notes:**

- All soil results as mg/kg.
- SSV – Soil screening value (Framework for the management of contaminated land, National Department of Environmental Affairs, March 2010).
- Dutch Intervention Guidelines. Ministry of House, Spatial Planning and the Environment, February 2000. Annex A: Intervention Values for serious contamination.
- AH1 is the background sample (refer to site layout).
- Certified analytical results attached.
- For Total Chromium, the values for Chromium III were used.
- BDL – below detection limit for the analytical method used.

- Nickel, zinc, copper and lead were detected in soil samples collected from hand auger holes WAH1 and WAH2 at concentrations exceeding the applicable Soil Screening Values (SSV1) for the protection of the water resource (all land uses).
- Vanadium was detected in soil samples collected from hand auger holes WAH1, WAH2, WAH3, WAH4, WAH5, WAH6, WAH7, WAH8 and WAH9 at concentrations exceeding the applicable Soil Screening Values (SSV1) for the protection of the water resource (all land uses).
- These exceedances indicate a potential risk to the water resource at these locations and warrant further consideration in the site risk assessment.



- Nickel, chromium, copper, manganese, and lead were detected in soil samples collected from hand auger holes WAH3, WAH4, WAH5, WAH6, WAH7, WAH8, WAH9, and WAH10. All measured concentrations did not exceed the applicable Soil Screening Values (SSVs).
- Zinc was detected in soil samples collected from hand auger holes WAH5, WAH6, WAH7, WAH8 and WAH9 with concentrations that did not exceed the applicable Soil Screening Values (SSVs).
- Mercury was detected in soil samples collected from hand auger holes WAH1 with concentrations that did not exceed the applicable Soil Screening Values (SSVs).

## 5.1 WATER SAMPLE RESULTS

The results of the lab analysis are presented in Table 11 Below. the concentration of targeted determinants was flagged against the applicable screening guidelines.

Table 11: BTEXMN and Gasoline Range Organics- Groundwater Analytical Results

| Sample No                                      | Static Water Level (m bgl) | Benzene | Toluene | Ethyl Benzene | Xylenes  | Naphthalene | TAME     | MTBE    | 1,3,5 Trimethylbenzene | 1,2,4 Trimethylbenzene | TPH GRO C7-C9 |
|------------------------------------------------|----------------------------|---------|---------|---------------|----------|-------------|----------|---------|------------------------|------------------------|---------------|
| MW1                                            | 0.725                      | <0.0004 | <0.001  | <0.0004       | <0.00012 | <0.0004     | <0.005   | <0.005  | <0.0004                | <0.0004                | <0.01         |
| MW2                                            | 0.655                      | 0.0028  | <0.001  | 0.012         | <0.00012 | <0.0004     | <0.005   | <0.005  | <0.0004                | <0.0004                | 0.012         |
| MW3                                            | 0.461                      | <0.0004 | <0.001  | <0.0004       | <0.00012 | <0.0004     | <0.005   | <0.005  | <0.0004                | <0.0004                | <0.01         |
| MW5                                            | 0.0                        | <0.0004 | <0.001  | 0.0017        | <0.00012 | 1.1         | <0.005   | <0.005  | <0.0004                | <0.0004                | <0.01         |
| MW7                                            | 0.375                      | <0.0004 | <0.001  | <0.0004       | <0.00012 | <0.0004     | <0.005   | <0.005  | <0.0004                | <0.0004                | <0.01         |
| MW8                                            | 0.491                      | <0.0004 | <0.001  | <0.0004       | <0.00012 | <0.0004     | <0.005   | <0.005  | <0.0004                | <0.0004                | <0.01         |
| RBCA Tier 1: Ingestion of groundwater          | Residential                | 2       | 1 564   | 782           | 1 564    | 156         | 190 (E)* | 40 (E)* | -                      | -                      | -             |
| RBCA Tier 1: Ingestion of groundwater          | Commercial / Industrial    | 99      | 20 440  | 10 220        | 20 440   | 2 044       | 190 (E)* | 40 (E)* | -                      | -                      | -             |
| RBCA Tier 1: inhalation of indoor air Vapours  | Residential                | 66      | 27 685  | 72 406        | 8 147    | 2 993       | 2.6E+05  | 2.4E+06 | -                      | -                      | -             |
| RBCA Tier 1: inhalation of indoor air Vapours  | Commercial / Industrial    | 4 757   | 445 730 | >Sol          | 131 171  | >Sol        | 5.7E+05  | 3.9E+07 | -                      | -                      | -             |
| RBCA Tier 1: Inhalation of outdoor air vapours | Residential                | 26 265  | >Sol    | >sol          | >Sol     | >Sol        | >Sol     | >Sol    | -                      | -                      | -             |
| RBCA Tier 1: Inhalation of outdoor air Vapours | Commercial / Industrial    | 573 630 | >Sol    | >Sol          | >Sol     | >Sol        | >Sol     | >SOL    | -                      | -                      | -             |

**Notes:**

- Groundwater results ug/L
  - RBCA Tier 1 – Residential and Commercial / Industrial land use scenario,  $10^6$  and  $10^5$  risk levels and hazard quotient of unity, respectively
  - TPH – Total Petroleum Hydrocarbon
  - > Sol – calculated RBSL exceeds aqueous solubility of compound of concentration.
  - Certified analytical results attached
- The concentration of benzene, ethylbenzene and THP (C7-C9) were detected in the groundwater sample from monitoring well MW2 concentration that did not exceed the RBCA Tier 1 screening levels and remained within applicable regulatory thresholds. A trace concentration of ethylbenzene and naphthalene were detected in the groundwater sample from monitoring well MW5 concentration that did not exceed the RBCA Tier 1 screening levels and remained within applicable regulatory thresholds.
  - All other target compounds in MW1, MW3, MW7 and MW8 were below detection limits (BDL).
  - Laboratory results confirmed that there is no significant contamination present in the groundwater samples collected from the site.

Table 12: Total Petroleum Hydrocarbon (C10-C36)- Groundwater Analytical Results

| Sample No                                      | Static Water Level<br>(m bgl) | TPH -DRO<br>(C10-C14) | TPH-DRO<br>(C15-C36) | Total<br>TPH (C10-C36) |
|------------------------------------------------|-------------------------------|-----------------------|----------------------|------------------------|
| MW1                                            | 0.725                         | <0.06                 | <0.412               | <0.412                 |
| MW2                                            | 0.655                         | 0.088                 | <0.412               | <0.412                 |
| MW3                                            | 0.461                         | <0.06                 | <0.412               | <0.412                 |
| MW5                                            | 0.0                           | <0.06                 | <0.412               | <0.412                 |
| MW7                                            | 0.375                         | <0.06                 | <0.412               | <0.412                 |
| MW8                                            | 0.491                         | <0.06                 | <0.412               | <0.412                 |
| RBCA Tier 1: Ingestion of groundwater          | Residential                   | 321                   | 234                  |                        |
| RBCA Tier 1: Ingestion of groundwater          | Commercial / Industrial       | 4 088                 | 4 088                |                        |
| RBCA Tier 1: inhalation of indoor air Vapours  | Residential                   | 239                   | 21 196               |                        |
| RBCA Tier 1: inhalation of indoor air Vapours  | Commercial / Industrial       | 389 688               | >Sol                 |                        |
| RBCA Tier 1: Inhalation of outdoor air vapours | Residential                   | >Sol                  | >Sol                 |                        |



|                                                |                         |      |      |
|------------------------------------------------|-------------------------|------|------|
| RBCA Tier 1: Inhalation of outdoor air vapours | Commercial / Industrial | >Sol | >Sol |
|------------------------------------------------|-------------------------|------|------|

- Total Petroleum Hydrocarbon (TPH) concentrations (C10–C14) in monitoring wells (MW2) was detected with the concentration that did not exceed the RBCA Tier 1 screening levels and remained within applicable regulatory threshold. These laboratory results confirmed that there is no significant contamination present in the groundwater samples collected from the site.
- Trace concentrations of TPH (C15–C36) and Total TPH (C10–C36) were below detection limits in groundwater samples collected from monitoring wells MW1, MW3, MW7, and MW8, indicating that these wells are not impacted by hydrocarbons at concentrations of regulatory concern.



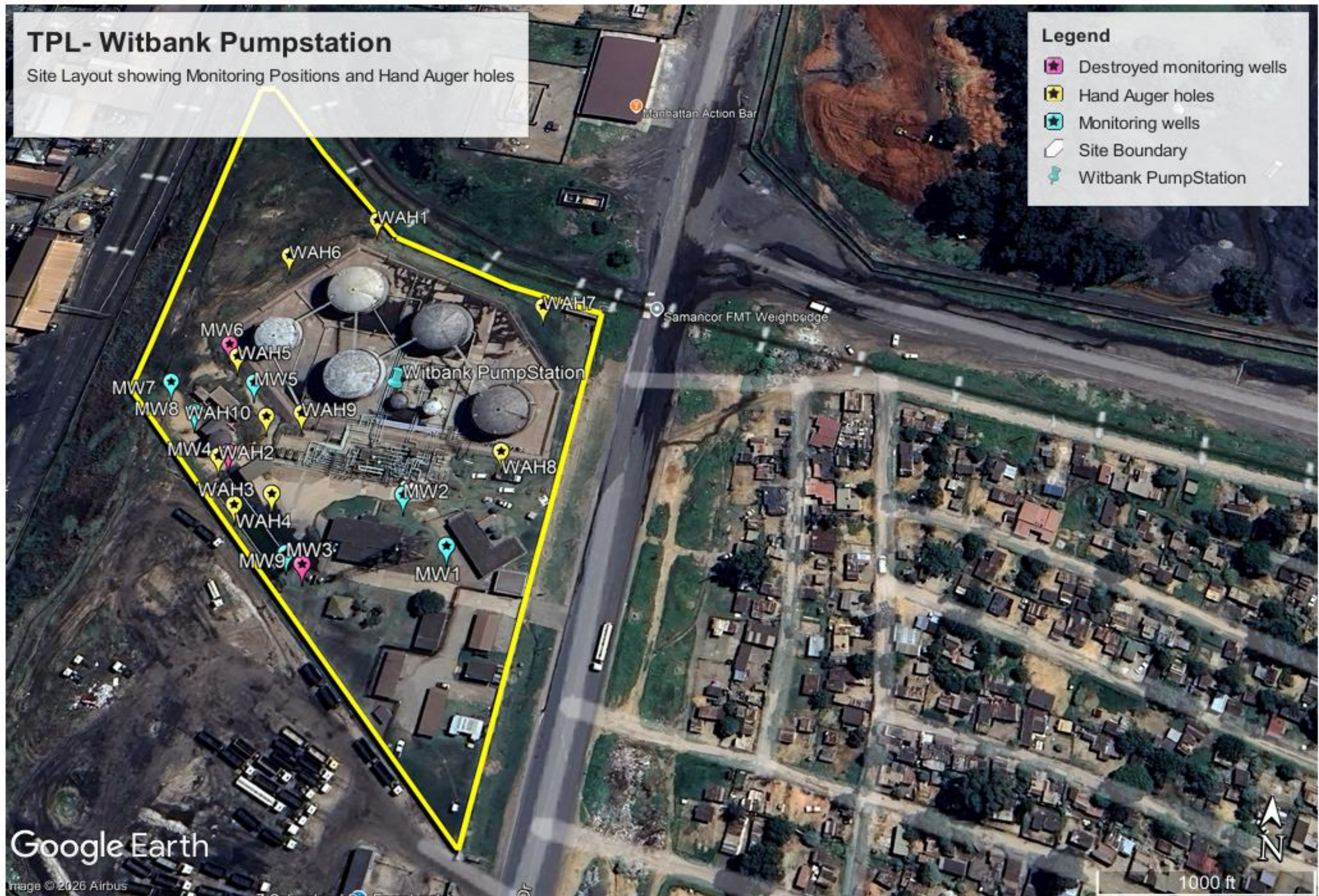


Figure 7: Site Aerial layout showing groundwater sampling positions and hand auger holes





Figure 8: Site Aerial layout Map showing groundwater sampling positions





Figure 9: Site Aerial layout Map showing hand auger holes



## 6. HUMAN HEALTH RISK ASSESSMENT

The soil concentrations were compared to the Soil Screening Values (SSVs) gazetted on 2 May 2014 in Government Notice no. 331 under the National Environmental Management Act: Waste Act (Act 59 of 2008). These SSVs will be used to determine whether a site where pollutants are present in the soil is regarded as contaminated or within an acceptable state. The concentrations of targeted hydrocarbon compounds detected in the groundwater samples were compared to Risk Based Screening Levels (RBSLs as determined by RISC 4.03) to determine the potential health risks posed to human receptors by the contamination.

### 6.1. POTENTIAL PATHWAYS AND RECEPTORS

In terms of the source, pathway and receptor assessment methodology, consideration was given to the following potential exposure pathways and likely receptors:

- Ingestion of groundwater impacted upon by leachate: The levels of hydrocarbons in the collected soil and groundwater samples did exceed this exposure pathway.
- Indoor inhalation of air vapours: Although there is no immediate human health associated with this risk exposure pathway given that the convenience store is detached from the plume and/or that the levels of hydrocarbons in soil and water samples taken at sampling points in the tank farm are acceptable, the potential for indoor inhalation is probable given the shallow depth to water table.
- Outdoor inhalation of air vapours: The exposure pathway is regarded as irrelevant given that the vapour cloud that is usually generated at the main tank farm area and manifold during storage and handling of petroleum products outweigh the possible hydrocarbon vapour from the subsurface plume.

The RISC Tier 1 Risk-Based Screening Level (RBSL) assessment involves comparing measured constituent concentrations against generic Tier 1 RBSLs, which are derived using standard exposure equations and Reasonable Maximum Exposure (RME) assumptions. These screening levels are designed to be conservative and protective of human health, even for direct exposure within the source area.

Groundwater analytical results from monitoring well MW2 at the Transnet Pipelines Witbank Pump Station indicate that all reported analytes were below the applicable

RBCA Tier 1 Risk-Based Screening Levels (RBSLs). No Tier 1 exceedances were identified in groundwater. Only trace concentrations of benzene, ethylbenzene, and TPH (C7–C8) were detected in the sample collected from MW2 and ethylbenzene and naphthalene was detected in MW5, which is located in proximity to the tank farm area. These concentrations are below the applicable screening criteria and do not indicate a significant impact to groundwater quality at the time of assessment.

Soil analytical results identified an exceedance of the applicable Soil Screening Value (SSV1) for the protection of the water resource and all land users for benzene in the sample collected from hand auger hole WAH1 and WAH10. This exceedance suggests a localized and shallow subsurface hydrocarbon impact at this specific location. WAH1 is located upslope of the tank farm area, indicating a potential source related to historical or current fuel handling activities.

In addition, trace concentrations of toluene, ethylbenzene, xylenes, naphthalene, TAME, 1,3,5-trimethylbenzene, 1,2,4-trimethylbenzene, and TPH (C7–C9) were detected in the soil sample from WAH1; however, all associated concentrations were below the applicable Soil Screening Values.

Trace concentrations of benzene, toluene, ethylbenzene, xylenes, naphthalene, TAME, 1,2,4-trimethylbenzene, and TPH (C7–C9) were also detected in soil samples collected from hand auger holes WAH2, WAH3, WAH5, and WAH10. All detected concentrations were below the applicable SSVs. Toluene was not detected in the soil sample collected from WAH10 and was reported below laboratory detection limits.

Based on the above, the source–pathway–receptor linkage is considered incomplete for groundwater, as no exceedances were identified and contaminant concentrations remain below Tier 1 screening criteria. A localized soil source is indicated at WAH1 and WAH10, however, limited spatial extent, low concentrations, and the absence of corresponding groundwater impacts suggest that the potential risk to receptors is currently low.

Should future monitoring identify concentrations above Tier 1 screening levels, potential management options may include:



- Remediation to generic Tier 1 RBSLs, where practicable;
- A Tier 2 site-specific risk assessment to develop refined remediation objectives; and/or
- Implementation of interim risk mitigation measures.

However, based on the current monitoring results, the site poses no unacceptable risk to human health or the environment, and the exposure pathways are considered incomplete.

## 6.2. CONCEPTUAL SITE MODEL

The Conceptual Site Model (CSM) is a fundamental planning and decision-support tool used in the assessment and management of potentially contaminated land and groundwater. The CSM provides a structured and transparent framework for organising available site information and supports the identification of potential data gaps, exposure pathways, and receptors.

Once developed, the CSM is refined iteratively as additional site-specific data become available. This process allows for the integration of new information, reassessment of potential risks, and adjustment of decision-making objectives over time. As the CSM matures, it enables a progressively improved understanding of site characteristics, including contamination status, hydrogeological conditions, and potential human and environmental receptors, thereby supporting robust and defensible environmental management decisions.

For the Transnet Pipelines Witbank Pump Station site, the Conceptual Site Model has been developed based on site history, field observations, monitoring well data, and laboratory analytical results for soil and groundwater. The site-specific CSM is illustrated in Table 13 and Figure 10 which present the identified sources, potential migration pathways, and receptors.

Based on the source–pathway–receptor assessment and the current laboratory analytical results, no hydrocarbon contamination was detected in soil or groundwater at concentrations exceeding analytical detection limits. Consequently, potential exposure pathways particularly groundwater ingestion are considered incomplete. As

a result, no unacceptable risk to human health or the environment has been identified under current site conditions.

**Table 13: Conceptual Site Model Baseline Exposure**

| Primary Sources                                                     | Secondary Sources                         | Transport Mechanisms                                                      | Exposure Pathway                                   | Potential Receptors                                                                                                               | Complete Pathway                                                  |
|---------------------------------------------------------------------|-------------------------------------------|---------------------------------------------------------------------------|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| Diesel & ULP Storage Tanks<br>Spill Areas<br>Maintenance Activities | Affected Surface Soils (<1 m depth)       | Wind Erosion and Atmospheric Dispersion                                   | Direct Contact (Dust)                              | On-Site: Workers<br>Off-Site: Residential Areas                                                                                   | Yes - Potential                                                   |
| Diesel & ULP Storage Tanks<br>Spill Areas<br>Maintenance Activities | Affected Subsurface Soils (>1 m depth)    | Volatilization and Enclosed-Space Accumulation                            | Inhalation of Dust (excavation)                    | On-Site: Workers                                                                                                                  | Yes - Potential                                                   |
| Diesel & ULP Storage Tanks<br>Spill Areas<br>Maintenance Activities | Dissolved Groundwater Plume               | Leaching and Groundwater Transport                                        | Groundwater: Potable Use                           | On-Site: If boreholes or sumps exist<br><br>Off-Site: Nearby private or municipal wells, local communities reliant on groundwater | No -Potential                                                     |
| Diesel & ULP Storage Tanks<br>Spill Areas<br>Maintenance Activities | Mobile Free-Phase Product (e.g., LNAPL)   | Migration via Subsurface Pathways<br>Stormwater / Surface Water Transport | Surface Water: Recreational or Ecological Exposure | Off-Site: Sensitive Habitats (wetlands, rivers)<br>Local Surface Water Users (if recreational use is nearby)                      | No (Unless migration occurs)                                      |
| Diesel & ULP Storage Tanks<br>Spill Areas<br>Maintenance Activities | Vapours in Utility Corridors (if present) | Vapour Migration through Utility Trenches or Conduits                     | Indoor Air / Enclosed Space: Inhalation of Vapors  | On-Site Workers in buildings<br>Off-Site Occupants if utilities extend off-site                                                   | - Yes (Potential) if conduits connect impacted areas to buildings |

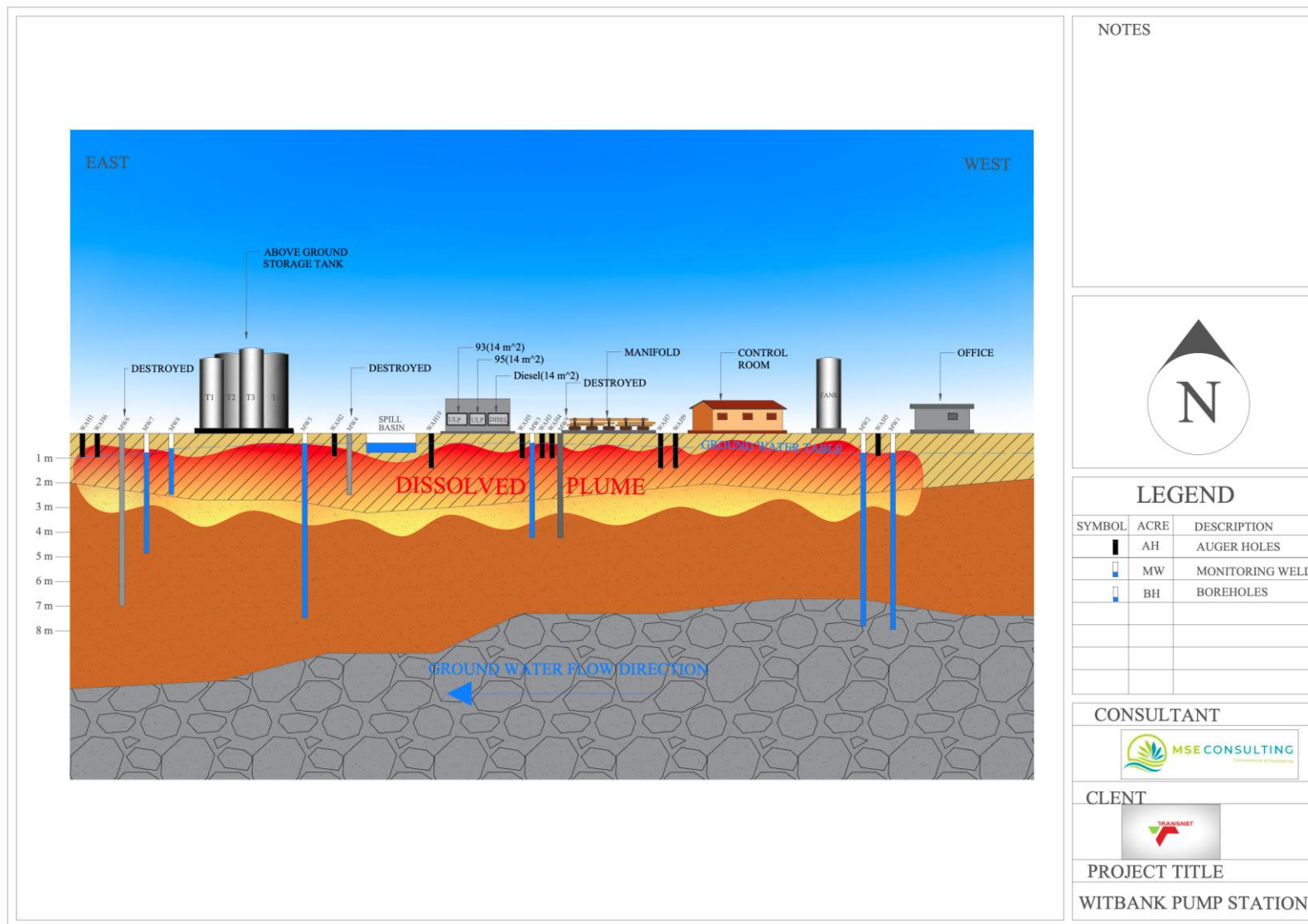


Figure 10: Conceptual site model

## 7. SUMMARY AND CONCLUSIONS.

### 7.1 FIELD RESULTS:

The site is located within a commercial land-use zone. The surrounding area is characterised by industrial facilities and commercial businesses, with informal residential settlements present to east of the site.

- The site is situated at an elevation of approximately 1,535 meter above mean sea level (mamsl) and is developed on a relatively flat platform formed through hillside cutting. The site topography exhibits an average gradient of approximately 3.8%, sloping in a south-westerly direction towards the Furrow.
- According to the 1:250,000 geological map, the site is predominantly underlain by shale, sandstone, shale–sandstone interbeds, grit, conglomerate, and coal, characteristic of the Eccra Formation within the Karoo Group.
- Based on the geological map above, the site is underlain by shale, sandstone, shale–sandstone interbeds, grit, conglomerate, and coal of the Eccra Formation (Karoo Group). According to Department of Water Affairs (DWA) aquifer classification, the sandstone layers are moderately to highly permeable and can store and transmit groundwater, while the shale, conglomerate, and coal layers have low permeability and restrict groundwater flow. Overall, the site can be considered a mixed aquifer system, with some layers providing groundwater potential and others acting as barriers.
- With reference to the National Groundwater Archive (NGA) of the Department of Water and Sanitation, there are no registered boreholes in the region within a 1 km radius of the site.
- A soil vapour survey (SVS) comprising 10 recording points was undertaken across the manifold of the site. Vapour-phase volatile organic compound (VOC) concentrations ranged from 0.0 ppm to 1 506 ppm. Moderately elevated VOCs were detected downstream of the tanks and manifold storing ULP 93, ULP 95, and diesel near monitoring well MW5, as well as upslope of the large tank farm and along the site boundary.
- Highly elevated Vapour-phase Volatile Organic Compound (VOC) concentrations were detected during the soil vapour survey at auger holes AH1 and AH10, based on Photoionization Detector (PID) measurements. The



highest PID reading of 1,506 parts per million (ppm) was recorded at AH10 at a depth of 1.2 m, while AH1 showed a significantly elevated concentration of 568 ppm at 0.6 m.

- Moderate VOC concentrations were identified at AH2 (136.7 ppm at 0.6 m) and AH5 (100.6 ppm at 0.9 m). Slightly elevated VOC levels were also observed at AH3 (0.9 m) and AH9 (0.6 m) during PID screening.
- Overall, the findings indicate variable levels of vapour-phase hydrocarbon impact across the assessed locations, with the most pronounced contamination occurring at AH10 and AH1.
- The monitoring wells on site are constructed with PVC casings and manhole covers, providing a degree of protection against surface runoff. However, as the wells were installed flush with the ground surface, they are prone to temporary surface water accumulation during rainfall events, which may increase the risk of contamination ingress over time.
- All water samples were collected and analysed for this parameters onsite electrical conductivity (EC), dissolved oxygen (DO), oxidation-reduction potential (ORP), Temperature and Potential of Hydrogen (pH) to determine the oxidizing or reducing potential of water sample.
- Temperature (°C) Ranged from 20.0 to 21.5°C, typical for shallow groundwater in temperate climates, indicating natural ambient conditions without unusual thermal inputs. These temperatures support standard microbial and biodegradation processes.
- pH Ranged from 3.16 to 6.50, indicating generally acidic groundwater. Acidic conditions may enhance the solubility of metals (e.g., Fe, Mn, Zn) and are less favourable for hydrocarbon biodegradation, though microbial activity can still occur.
- Electrical Conductivity (EC, mS/m) Ranged from 369 to 1,664 mS/m, reflecting variable dissolved ion concentrations. Elevated EC (e.g., MW8) may result from natural mineral dissolution or anthropogenic influences and can be used to monitor potential contamination trends.
- Dissolved Oxygen (DO, mg/L) Ranged from 4.08 to 6.08 mg/L, indicating oxic to mildly oxic conditions conducive to aerobic microbial activity. Lower DO in

some wells (e.g., MW5) suggests localized reducing conditions that could influence metal mobility and anaerobic degradation.

- Oxidation–Reduction Potential (ORP, mV) Ranged from -229 to +142 mV, showing spatial variability in redox conditions. Reducing conditions (negative ORP) favour anaerobic processes, while oxidising conditions (positive ORP) support aerobic degradation. This heterogeneity can affect contaminant behaviour and migration potential.
- The static water level depths in the monitoring wells were observed to range from 0.0 meters to 0.725 meters below ground level (mbgl). These measurements indicate the depth at which the water table or groundwater is located in each respective monitoring well.
- All monitoring wells identified on site were found to be in good condition, except for MW4, MW6, and MW9, which were destroyed and could not be located during the site inspection.
- Groundwater samples were collected using clean and transparent bailers from various locations, including monitoring wells. These samples were collected for the purpose of conducting analysis on a range of parameters, including: BTEXN (Benzene, Toluene, Ethylbenzene, Xylene, and Naphthalene), TAME, MTBE, 1,3,5 and 1,2,4Trimethylbenzene, TPH GRO C<sub>7</sub>-C<sub>9</sub> and TPH DRO and ORO C<sub>10</sub>-C<sub>36</sub> analysis.
- All soil samples were submitted to an accredited laboratory for comprehensive analysis, including BTEXN (Benzene, Toluene, Ethylbenzene, Xylene, and Naphthalene), TAME, MTBE, 1,2,4-Trimethylbenzene, 1,3,5-Trimethylbenzene, Total Petroleum Hydrocarbons (TPH) in the Gasoline Range Organics (C<sub>7</sub>–C<sub>9</sub>), and Diesel to Heavy Hydrocarbon fractions (TPH C<sub>10</sub>–C<sub>36</sub>).
- No free phase product was observed in any of the monitoring wells and tank monitoring well at the time of inspection.
- A total of six (6) water samples were collected and submitted to the laboratory for BTEXN, TAME, MTBE, 1,2,4-TMB, 1,3,5-TMB, TPH GRO C<sub>7</sub>-C<sub>9</sub> and TPH banded C<sub>10</sub>-C<sub>36</sub> analysis.

- A total of ten (10) soil samples were submitted to an accredited laboratory for comprehensive analysis, including BTEXN (Benzene, Toluene, Ethylbenzene, Xylene, and Naphthalene), TAME, MTBE, 1,2,4-Trimethylbenzene, 1,3,5-Trimethylbenzene, Total Petroleum Hydrocarbons (TPH) in the Gasoline Range Organics (C7–C9), and Diesel to Heavy Hydrocarbon fractions (TPH C10–C36).

## **LABORATORY AND RISK ANALYSIS RESULTS**

- Benzene was detected in soil sample retrieved from WAH1 and WAH10 at concentrations exceeding the Soil Screening Value (SSV1) for the protection of water resources and land users, indicating a potential hydrocarbon impact at this location.
- Trace concentrations of toluene, ethylbenzene, xylenes, naphthalene, TAME, 1,3,5-trimethylbenzene, 1,2,4-trimethylbenzene, and TPH (C7–C9) were also detected in sample retrieved from WAH1, located upslope of the tanks farm area with concentrations that did not exceed the applicable SSVs.
- Trace concentrations of benzene, toluene, ethylbenzene, xylenes, naphthalene, TAME, 1,2,4-trimethylbenzene, and TPH (C7–C9) were detected in soil samples collected from hand auger holes WAH2, WAH3, and WAH5 with the concentrations that did not exceed the applicable Soil Screening Values (SSVs).
- Trace concentrations of ethylbenzene, xylenes, naphthalene, TAME and TPH (C7–C9) were detected in soil samples collected from hand auger holes WAH10 with the concentrations that did not exceed the applicable Soil Screening Values (SSVs).
- All measured concentrations in hand auger holes WAH4, WAH6, WAH7, WAH8, and WAH9 were reported below detection limits, this indicates no detectable contamination within the sampled intervals at the time of assessment.
- Laboratory results confirm the presence of hydrocarbons on site. The concentrations measured indicate significant contamination, which is considered to pose a potential risk to soil quality and the surrounding environment at these locations.
- The concentrations of Total Petroleum Hydrocarbons (TPH) fractions C10–C14 and C15–C36, as well as Total TPH (C10–C36), were detected in soil samples

collected from hand auger holes WAH1, WAH2, WAH3, WAH5 and WAH10. All detected concentrations did not exceed the applicable Soil Screening Values (SSVs), indicating that hydrocarbon levels are within acceptable regulatory thresholds and are not considered to pose an immediate risk to soil quality or the surrounding environment.

- The concentrations of Total Petroleum Hydrocarbons (TPH) C15–C36 and Total TPH (C10–C36), were detected in soil samples collected from hand auger holes WAH4, WAH6, WAH7, WAH8 and WAH9. With the concentrations that did not exceed the applicable Soil Screening Values (SSVs).
- Detectable concentrations of pyrene were identified in soil samples collected from hand auger hole WAH1, with concentrations exceeding the applicable Soil Screening Value (SSV1) for the protection of the water resource (all land users). This exceedance indicates a potential risk to the water resource at this location and warrants further consideration in the site risk assessment.
- Trace concentrations of pyrene were identified in the soil samples collected from hand auger holes WAH2, WAH3, WAH5 and WAH10 with the concentration that did not exceed the soil screening Values (SSVs).
- Laboratory analytical results indicate that all other Polycyclic Aromatic Hydrocarbons (PAHs) analysed in soil samples collected from the hand auger holes WAH1 TO WAH10 were reported below detection limits.
- A trace concentration of benzene, ethylbenzene and THP (C7-C9) were detected in the groundwater sample from monitoring well MW2 concentration that did not exceed the RBCA Tier 1 screening levels and remained within applicable regulatory thresholds. A trace concentration of ethylbenzene and naphthalene were detected in the groundwater sample from monitoring well MW5 concentration that did not exceed the RBCA Tier 1 screening levels and remained within applicable regulatory thresholds.
- All other target compounds in MW1, MW3, MW7 and MW8 were below detection limits (BDL).
- Laboratory results confirmed that there is no significant contamination present in the groundwater samples collected from the site.
- Total Petroleum Hydrocarbon (TPH) concentrations (C10–C14) in monitoring wells (MW2) was detected with the concentration that did not exceed the RBCA Tier 1



screening levels and remained within applicable regulatory threshold. These laboratory results confirmed that there is no significant contamination present in the groundwater samples collected from the site.

- Trace concentrations of TPH (C15–C36) and Total TPH (C10–C36) were below detection limits in groundwater samples collected from monitoring wells MW1, MW3, MW7, and MW8, indicating that these wells are not impacted by hydrocarbons at concentrations of regulatory concern.

## 8. CONCLUSION AND RECOMMENDATIONS

Makomoto and Sebe Environmental Consulting (MSE Consulting) conducted a Phase 1 Due Diligence Contamination Assessment at the Transnet Pipelines Witbank Pump Station, Mpumalanga to evaluate the current condition of groundwater and soil onsite. The investigation was undertaken to support compliance with applicable environmental legislation and to inform ongoing environmental management and decision-making.

- The assessment indicates the presence of localized hydrocarbon contamination in soil and the potential for environmental impact. Analytical results for target compounds, including BTEXNM and Total Petroleum Hydrocarbons (C10–C36), were generally below detection limits and within the applicable RBCA Tier 1 screening levels for groundwater.
- In soil, benzene was detected in a sample retrieved from WAH1 and WAH10 at concentrations exceeding the Soil Screening Value (SSV1) for the protection of water resources and all land users, indicating a potential hydrocarbon impacted this location.
- Nickel, zinc, and copper were detected in soil samples from hand auger holes WAH1 and WAH2 at concentrations exceeding the applicable Soil Screening Values (SSVs) for the protection of water resources (all land uses). These exceedances suggest a potential risk to groundwater and surrounding soil, warranting further investigation in the site risk assessment.
- The results demonstrate evidence of localized contaminant plume development, potential migration of contaminants, and a significant environmental risk associated with the site at the time of assessment.

## **Makomoto and Sebe Environmental Consulting Recommendations**

### **1. Groundwater Monitoring**

It is recommended that quarterly groundwater monitoring be undertaken to verify that groundwater quality remains within applicable regulatory limits and to assess temporal trends in contaminant concentrations.

- Four (4) additional monitoring wells should be installed onsite to improve groundwater coverage and enhance site characterisation. The proposed locations are as follows:
- Two (2) monitoring wells installed upslope of the identified source areas to establish background groundwater quality conditions.
- One (1) monitoring well installed downslope near the manifold area to assess potential plume migration; and
- One (1) monitoring well installed near the separator pit (Spill Basin).
- The installation of these monitoring wells aligns with the requirements of the Remediation Order issued by the Department under Reference No.: 14/11/15/LR67/6.
- All existing monitoring wells should be extended and raised slightly above ground level, fitted with secure caps, and properly sealed to prevent the ingress of surface water during rainfall events, thereby ensuring sample integrity.

### **2. Soil Remediation – Bioremediation**

All areas exhibiting visible or confirmed soil contamination should undergo in-situ bioremediation treatment.

- Bioremediation involves the injection or application of specialized biological products designed to stimulate natural microbial activity within the soil. This process may include:
- The introduction of bacteria or enzymes capable of degrading hydrocarbons; and/or the enhancement of indigenous microbial populations through nutrient amendment and oxygenation.

- The objective of bioremediation is to accelerate the natural breakdown of petroleum hydrocarbons and associated contaminants, thereby reducing contaminant concentrations to acceptable levels.
- This environmentally sustainable approach is recommended due to its effectiveness in mitigating hydrocarbon contamination while minimizing site disturbance compared to more intrusive remediation techniques.

### **3. Vapour Intrusion Assessment**

- A vapour intrusion investigation should be conducted to evaluate the potential migration of volatile organic compounds (VOCs) from impacted soil and groundwater into overlying structures or confined spaces with the requirements of the Remediation Order issued by the Department under Reference No.: 14/11/15/LR67/6.
- The investigation should include soil vapour sampling and, where applicable, indoor air quality screening to assess potential human health risks associated with vapour-phase contaminants.

### **4. Ongoing Environmental Compliance:**

- Maintain routine site management and operational practices to minimise the risk of future contamination.
- The field observations and laboratory results indicate that the site currently presents a potential environmental liability. Continued quarterly monitoring is recommended to ensure early detection and management of any changes in site conditions.

## 9. REFERENCES

1. National Norms and Standards for the remediation of contaminated and land soil quality, Government Notice No. 331, 2 May 2014.
2. Framework for Management of Contaminated Land (FMCL), written in support to Part 8 of the National Environmental Management: Waste Act (NEMWA Act 59 of 2008).
3. Department of Environmental Affairs, Republic of South Africa. National Environmental Management: Waste Act, 2008 (Act no. 59 of 2008). National Norms and Standards for the Remediation of Contaminated Land and Soil Quality. 2 May 2014
4. 1:500 000 scale Hydrogeological Map Series of the Republic of South Africa, DWAF.
5. DWAF, 2005. Groundwater Resources Assessment Project, Phase II (GRAII). Department of Water Affairs and Forestry, Pretoria.
6. Department of Environmental Affairs, 2013: *National Norms and Standards for the Remediation of Contaminated Land and Soil Quality in the Republic of South Africa (GN 467 of 2013)*.
7. Department of Environmental Protection, 2020. Standards and Guidelines for Contaminants in Massachusetts Drinking Waters. <https://www.mass.gov/guides/drinking>.
8. Department of Environmental Affairs, 2016. *Remediation order for the Remediation of Contaminated Land – Witbank Pump Station*. Prepared for Transnet Pipelines. Reference No.: 14/11/15/LR67/6. Witbank, South Africa.



## APPENDIX A: LABORATORY CERTIFICATE RESULTS

## TEST REPORT

### 62573A

**Test Description:** BTEXMN/Gasoline Range Organics and Total Petroleum Hydrocarbons

**Test Method:** EPL-T-012 (BTEX/GRO) and EPL-T-011(TPH)

#### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

#### Sample Information

**Sample ID:** MW1

**Dilutions:** BTEX/GRO = No Dilution, TPH = No Dilution

**Container:** Glass

**Matrix:** Water

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/05

**Date Issued:** 2025/12/11

#### BTEXMN and Gasoline Range Organics

| PARAMETER              | RESULT        |
|------------------------|---------------|
| MTBE                   | <5 µg/liter   |
| TAME                   | <5 µg/liter   |
| Benzene                | <0.4 µg/liter |
| Toluene                | <1 µg/liter   |
| Ethylbenzene           | <0.4 µg/liter |
| m+p-Xylene             | <0.8 µg/liter |
| o-Xylene               | <0.4 µg/liter |
| 1,3,5-Trimethylbenzene | <0.4 µg/liter |
| 1,2,4-Trimethylbenzene | <0.4 µg/liter |
| Naphthalene            | <0.4 µg/liter |
| TPH GRO C7-C9          | <10 µg/liter  |

#### Total Petroleum Hydrocarbon (C10-C36)

| PARAMETER         | RESULT        |
|-------------------|---------------|
| TPH C10-C14       | <60 µg/liter  |
| TPH C15-C36       | <412 µg/liter |
| TPH C10-C36 Total | <412 µg/liter |

#### Disclaimers

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- 5) Uncertainty of measurement for all methods included in the SANAS Schedule of Accreditation is available on request.

**Reinardt Cromhout**  
Authorised Signatory

## TEST REPORT

### 62573A

**Test Description:** BTEXMN/Gasoline Range Organics and Total Petroleum Hydrocarbons

**Test Method:** EPL-T-012 (BTEX/GRO) and EPL-T-011(TPH)

#### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

#### Sample Information

**Sample ID:** MW2

**Dilutions:** BTEX/GRO = No Dilution, TPH = No Dilution

**Container:** Glass

**Matrix:** Water

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/05

**Date Issued:** 2025/12/11

#### BTEXMN and Gasoline Range Organics

| <u>PARAMETER</u>       | <u>RESULT</u> |
|------------------------|---------------|
| MTBE                   | <5 µg/liter   |
| TAME                   | <5 µg/liter   |
| Benzene                | 2.8 µg/liter  |
| Toluene                | <1 µg/liter   |
| Ethylbenzene           | 12 µg/liter   |
| m+p-Xylene             | <0.8 µg/liter |
| o-Xylene               | <0.4 µg/liter |
| 1,3,5-Trimethylbenzene | <0.4 µg/liter |
| 1,2,4-Trimethylbenzene | <0.4 µg/liter |
| Naphthalene            | <0.4 µg/liter |
| TPH GRO C7-C9          | 12 µg/liter   |

#### Total Petroleum Hydrocarbon (C10-C36)

| <u>PARAMETER</u>  | <u>RESULT</u> |
|-------------------|---------------|
| TPH C10-C14       | 88 µg/liter   |
| TPH C15-C36       | <412 µg/liter |
| TPH C10-C36 Total | <412 µg/liter |

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**Reinardt Cromhout**  
Authorised Signatory

## TEST REPORT

### 62573A

**Test Description:** BTEXMN/Gasoline Range Organics and Total Petroleum Hydrocarbons

**Test Method:** EPL-T-012 (BTEX/GRO) and EPL-T-011(TPH)

#### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
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**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

#### Sample Information

**Sample ID:** MW3

**Dilutions:** BTEX/GRO = No Dilution, TPH = No Dilution

**Container:** Glass

**Matrix:** Water

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/05

**Date Issued:** 2025/12/11

#### BTEXMN and Gasoline Range Organics

| <u>PARAMETER</u>       | <u>RESULT</u> |
|------------------------|---------------|
| MTBE                   | <5 µg/liter   |
| TAME                   | <5 µg/liter   |
| Benzene                | <0.4 µg/liter |
| Toluene                | <1 µg/liter   |
| Ethylbenzene           | <0.4 µg/liter |
| m+p-Xylene             | <0.8 µg/liter |
| o-Xylene               | <0.4 µg/liter |
| 1,3,5-Trimethylbenzene | <0.4 µg/liter |
| 1,2,4-Trimethylbenzene | <0.4 µg/liter |
| Naphthalene            | <0.4 µg/liter |
| TPH GRO C7-C9          | <10 µg/liter  |

#### Total Petroleum Hydrocarbon (C10-C36)

| <u>PARAMETER</u>  | <u>RESULT</u> |
|-------------------|---------------|
| TPH C10-C14       | <60 µg/liter  |
| TPH C15-C36       | <412 µg/liter |
| TPH C10-C36 Total | <412 µg/liter |

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**Reinardt Cromhout**  
Authorised Signatory



## TEST REPORT

### 62573A

**Test Description:** BTEXMN/Gasoline Range Organics and Total Petroleum Hydrocarbons

**Test Method:** EPL-T-012 (BTEX/GRO) and EPL-T-011(TPH)

#### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

#### Sample Information

**Sample ID:** MW5

**Dilutions:** BTEX/GRO = No Dilution, TPH = No Dilution

**Container:** Glass

**Matrix:** Water

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/05

**Date Issued:** 2025/12/11

#### BTEXMN and Gasoline Range Organics

| PARAMETER              | RESULT        |
|------------------------|---------------|
| MTBE                   | <5 µg/liter   |
| TAME                   | <5 µg/liter   |
| Benzene                | <0.4 µg/liter |
| Toluene                | <1 µg/liter   |
| Ethylbenzene           | 1.7 µg/liter  |
| m+p-Xylene             | <0.8 µg/liter |
| o-Xylene               | <0.4 µg/liter |
| 1,3,5-Trimethylbenzene | <0.4 µg/liter |
| 1,2,4-Trimethylbenzene | <0.4 µg/liter |
| Naphthalene            | 1.1 µg/liter  |
| TPH GRO C7-C9          | <10 µg/liter  |

#### Total Petroleum Hydrocarbon (C10-C36)

| PARAMETER         | RESULT        |
|-------------------|---------------|
| TPH C10-C14       | <60 µg/liter  |
| TPH C15-C36       | <412 µg/liter |
| TPH C10-C36 Total | <412 µg/liter |

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**Reinardt Cromhout**  
Authorised Signatory

## TEST REPORT

### 62573A

**Test Description:** BTEXMN/Gasoline Range Organics and Total Petroleum Hydrocarbons

**Test Method:** EPL-T-012 (BTEX/GRO) and EPL-T-011(TPH)

#### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

#### Sample Information

**Sample ID:** MW7

**Dilutions:** BTEX/GRO = No Dilution, TPH = No Dilution

**Container:** Glass

**Matrix:** Water

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/05

**Date Issued:** 2025/12/11

#### BTEXMN and Gasoline Range Organics

| <u>PARAMETER</u>       | <u>RESULT</u> |
|------------------------|---------------|
| MTBE                   | <5 µg/liter   |
| TAME                   | <5 µg/liter   |
| Benzene                | <0.4 µg/liter |
| Toluene                | <1 µg/liter   |
| Ethylbenzene           | <0.4 µg/liter |
| m+p-Xylene             | <0.8 µg/liter |
| o-Xylene               | <0.4 µg/liter |
| 1,3,5-Trimethylbenzene | <0.4 µg/liter |
| 1,2,4-Trimethylbenzene | <0.4 µg/liter |
| Naphthalene            | <0.4 µg/liter |
| TPH GRO C7-C9          | <10 µg/liter  |

#### Total Petroleum Hydrocarbon (C10-C36)

| <u>PARAMETER</u>  | <u>RESULT</u> |
|-------------------|---------------|
| TPH C10-C14       | <60 µg/liter  |
| TPH C15-C36       | <412 µg/liter |
| TPH C10-C36 Total | <412 µg/liter |

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**Reinardt Cromhout**  
Authorised Signatory

## TEST REPORT

### 62573A

**Test Description:** BTEXMN/Gasoline Range Organics and Total Petroleum Hydrocarbons

**Test Method:** EPL-T-012 (BTEX/GRO) and EPL-T-011(TPH)

#### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
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2090

**Attention:** Martin Makomoto

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**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

#### Sample Information

**Sample ID:** MW8

**Dilutions:** BTEX/GRO = No Dilution, TPH = No Dilution

**Container:** Glass

**Matrix:** Water

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/05

**Date Issued:** 2025/12/11

#### BTEXMN and Gasoline Range Organics

| <u>PARAMETER</u>       | <u>RESULT</u> |
|------------------------|---------------|
| MTBE                   | <5 µg/liter   |
| TAME                   | <5 µg/liter   |
| Benzene                | <0.4 µg/liter |
| Toluene                | <1 µg/liter   |
| Ethylbenzene           | <0.4 µg/liter |
| m+p-Xylene             | <0.8 µg/liter |
| o-Xylene               | <0.4 µg/liter |
| 1,3,5-Trimethylbenzene | <0.4 µg/liter |
| 1,2,4-Trimethylbenzene | <0.4 µg/liter |
| Naphthalene            | <0.4 µg/liter |
| TPH GRO C7-C9          | <10 µg/liter  |

#### Total Petroleum Hydrocarbon (C10-C36)

| <u>PARAMETER</u>  | <u>RESULT</u> |
|-------------------|---------------|
| TPH C10-C14       | <60 µg/liter  |
| TPH C15-C36       | <412 µg/liter |
| TPH C10-C36 Total | <412 µg/liter |

#### Disclaimers

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**Reinardt Cromhout**  
Authorised Signatory

## TEST REPORT

**Test Description:** BTEXMN/GRO, TPH and PAH

**Test Method:** EPL-T-012 (BTEX/GRO), EPL-T-011(TPH), EPL-T-020 (PAH)

**62573B**

### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

### Sample Information

**Sample ID:** WAH1

**Dilutions:** BTEX/GRO=20, TPH=10, PAH=100

**Container:** Glass

**Matrix:** Soil

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/06

**Date Issued:** 2025/12/11

### BTEXMN and Gasoline Range Organics

| PARAMETER              | RESULT     |
|------------------------|------------|
| MTBE                   | <100 µg/kg |
| TAME                   | 230 µg/kg  |
| Benzene                | 430 µg/kg  |
| Toluene                | 780 µg/kg  |
| Ethylbenzene           | 990 µg/kg  |
| m+p-Xylene             | 2500 µg/kg |
| o-Xylene               | 600 µg/kg  |
| 1,3,5-Trimethylbenzene | 170 µg/kg  |
| 1,2,4-Trimethylbenzene | 1100 µg/kg |
| Naphthalene            | 590 µg/kg  |
| TPH GRO C7-C9          | 5000 µg/kg |

### Total Petroleum Hydrocarbon (C10-C36)

| PARAMETER         | RESULT      |
|-------------------|-------------|
| TPH C10-C14       | 1100 mg/kg  |
| TPH C15-C36       | 14000 mg/kg |
| TPH C10-C36 Total | 15100 mg/kg |

### Polycyclic Aromatic Hydrocarbons

| PARAMETER      | RESULT      |
|----------------|-------------|
| Pyrene         | 14000 µg/kg |
| Benzo(a)pyrene | <400 µg/kg  |

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**Reinardt Cromhout**  
Authorised Signatory



## TEST REPORT

**Test Description:** BTEXMN/GRO, TPH and PAH

**Test Method:** EPL-T-012 (BTEX/GRO), EPL-T-011(TPH), EPL-T-020 (PAH)

**62573B**

### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

### Sample Information

**Sample ID:** WAH10

**Dilutions:** BTEX/GRO=20, TPH=No Dil, PAH=10

**Container:** Glass

**Matrix:** Soil

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/06

**Date Issued:** 2025/12/11

### BTEXMN and Gasoline Range Organics

| PARAMETER              | RESULT      |
|------------------------|-------------|
| MTBE                   | <100 µg/kg  |
| TAME                   | 1200 µg/kg  |
| Benzene                | 74 µg/kg    |
| Toluene                | <20 µg/kg   |
| Ethylbenzene           | 480 µg/kg   |
| m+p-Xylene             | <16 µg/kg   |
| o-Xylene               | <8 µg/kg    |
| 1,3,5-Trimethylbenzene | <8 µg/kg    |
| 1,2,4-Trimethylbenzene | <8 µg/kg    |
| Naphthalene            | 320 µg/kg   |
| TPH GRO C7-C9          | 22000 µg/kg |

### Total Petroleum Hydrocarbon (C10-C36)

| PARAMETER         | RESULT    |
|-------------------|-----------|
| TPH C10-C14       | 370 mg/kg |
| TPH C15-C36       | 320 mg/kg |
| TPH C10-C36 Total | 690 mg/kg |

### Polycyclic Aromatic Hydrocarbons

| PARAMETER      | RESULT    |
|----------------|-----------|
| Pyrene         | 190 µg/kg |
| Benzo(a)pyrene | <40 µg/kg |

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**Reinardt Cromhout**  
Authorised Signatory

## TEST REPORT

**Test Description:** BTEXMN/GRO, TPH and PAH

**Test Method:** EPL-T-012 (BTEX/GRO), EPL-T-011(TPH), EPL-T-020 (PAH)

**62573B**

### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

### Sample Information

**Sample ID:** WAH2

**Dilutions:** BTEX/GRO=20, TPH=No Dil, PAH=10

**Container:** Glass

**Matrix:** Soil

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/06

**Date Issued:** 2025/12/11

### BTEXMN and Gasoline Range Organics

| PARAMETER              | RESULT     |
|------------------------|------------|
| MTBE                   | <100 µg/kg |
| TAME                   | <100 µg/kg |
| Benzene                | 10 µg/kg   |
| Toluene                | 26 µg/kg   |
| Ethylbenzene           | 38 µg/kg   |
| m+p-Xylene             | 42 µg/kg   |
| o-Xylene               | 19 µg/kg   |
| 1,3,5-Trimethylbenzene | <8 µg/kg   |
| 1,2,4-Trimethylbenzene | 13 µg/kg   |
| Naphthalene            | 67 µg/kg   |
| TPH GRO C7-C9          | 840 µg/kg  |

### Total Petroleum Hydrocarbon (C10-C36)

| PARAMETER         | RESULT     |
|-------------------|------------|
| TPH C10-C14       | 140 mg/kg  |
| TPH C15-C36       | 3800 mg/kg |
| TPH C10-C36 Total | 3940 mg/kg |

### Polycyclic Aromatic Hydrocarbons

| PARAMETER      | RESULT    |
|----------------|-----------|
| Pyrene         | 190 µg/kg |
| Benzo(a)pyrene | <40 µg/kg |

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**Reinardt Cromhout**  
Authorised Signatory

## TEST REPORT

**Test Description:** BTEXMN/GRO, TPH and PAH

**Test Method:** EPL-T-012 (BTEX/GRO), EPL-T-011(TPH), EPL-T-020 (PAH)

**62573B**

### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

### Sample Information

**Sample ID:** WAH9

**Dilutions:** BTEX/GRO=20, TPH=No Dil, PAH=10

**Container:** Glass

**Matrix:** Soil

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/06

**Date Issued:** 2025/12/11

### BTEXMN and Gasoline Range Organics

| PARAMETER              | RESULT     |
|------------------------|------------|
| MTBE                   | <100 µg/kg |
| TAME                   | <100 µg/kg |
| Benzene                | <8 µg/kg   |
| Toluene                | <20 µg/kg  |
| Ethylbenzene           | <8 µg/kg   |
| m+p-Xylene             | <16 µg/kg  |
| o-Xylene               | <8 µg/kg   |
| 1,3,5-Trimethylbenzene | <8 µg/kg   |
| 1,2,4-Trimethylbenzene | <8 µg/kg   |
| Naphthalene            | <8 µg/kg   |
| TPH GRO C7-C9          | <200 µg/kg |

### Total Petroleum Hydrocarbon (C10-C36)

| PARAMETER         | RESULT    |
|-------------------|-----------|
| TPH C10-C14       | <20 mg/kg |
| TPH C15-C36       | 45 mg/kg  |
| TPH C10-C36 Total | 45 mg/kg  |

### Polycyclic Aromatic Hydrocarbons

| PARAMETER      | RESULT    |
|----------------|-----------|
| Pyrene         | <40 µg/kg |
| Benzo(a)pyrene | <40 µg/kg |

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**Reinardt Cromhout**  
Authorised Signatory

## TEST REPORT

**Test Description:** BTEXMN/GRO, TPH and PAH

**Test Method:** EPL-T-012 (BTEX/GRO), EPL-T-011(TPH), EPL-T-020 (PAH)

**62573B**

### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

### Sample Information

**Sample ID:** WAH3

**Dilutions:** BTEX/GRO=20, TPH=No Dil, PAH=10

**Container:** Glass

**Matrix:** Soil

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/06

**Date Issued:** 2025/12/11

### BTEXMN and Gasoline Range Organics

| PARAMETER              | RESULT     |
|------------------------|------------|
| MTBE                   | <100 µg/kg |
| TAME                   | <100 µg/kg |
| Benzene                | 10 µg/kg   |
| Toluene                | 16 µg/kg   |
| Ethylbenzene           | 28 µg/kg   |
| m+p-Xylene             | 42 µg/kg   |
| o-Xylene               | 19 µg/kg   |
| 1,3,5-Trimethylbenzene | <8 µg/kg   |
| 1,2,4-Trimethylbenzene | 13 µg/kg   |
| Naphthalene            | 67 µg/kg   |
| TPH GRO C7-C9          | 440 µg/kg  |

### Total Petroleum Hydrocarbon (C10-C36)

| PARAMETER         | RESULT     |
|-------------------|------------|
| TPH C10-C14       | 140 mg/kg  |
| TPH C15-C36       | 3800 mg/kg |
| TPH C10-C36 Total | 3940 mg/kg |

### Polycyclic Aromatic Hydrocarbons

| PARAMETER      | RESULT    |
|----------------|-----------|
| Pyrene         | 120 µg/kg |
| Benzo(a)pyrene | <40 µg/kg |

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**Reinardt Cromhout**  
Authorised Signatory



## TEST REPORT

**Test Description:** BTEXMN/GRO, TPH and PAH

**Test Method:** EPL-T-012 (BTEX/GRO), EPL-T-011(TPH), EPL-T-020 (PAH)

**62573B**

### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

### Sample Information

**Sample ID:** WAH4

**Dilutions:** BTEX/GRO=20, TPH=No Dil, PAH=10

**Container:** Glass

**Matrix:** Soil

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/06

**Date Issued:** 2025/12/11

### BTEXMN and Gasoline Range Organics

| PARAMETER              | RESULT     |
|------------------------|------------|
| MTBE                   | <100 µg/kg |
| TAME                   | <100 µg/kg |
| Benzene                | <8 µg/kg   |
| Toluene                | <20 µg/kg  |
| Ethylbenzene           | <8 µg/kg   |
| m+p-Xylene             | <16 µg/kg  |
| o-Xylene               | <8 µg/kg   |
| 1,3,5-Trimethylbenzene | <8 µg/kg   |
| 1,2,4-Trimethylbenzene | <8 µg/kg   |
| Naphthalene            | <8 µg/kg   |
| TPH GRO C7-C9          | <200 µg/kg |

### Total Petroleum Hydrocarbon (C10-C36)

| PARAMETER         | RESULT    |
|-------------------|-----------|
| TPH C10-C14       | <20 mg/kg |
| TPH C15-C36       | 65 mg/kg  |
| TPH C10-C36 Total | 65 mg/kg  |

### Polycyclic Aromatic Hydrocarbons

| PARAMETER      | RESULT    |
|----------------|-----------|
| Pyrene         | <40 µg/kg |
| Benzo(a)pyrene | <40 µg/kg |

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**Reinardt Cromhout**  
Authorised Signatory

## TEST REPORT

**Test Description:** BTEXMN/GRO, TPH and PAH

**Test Method:** EPL-T-012 (BTEX/GRO), EPL-T-011(TPH), EPL-T-020 (PAH)

**62573B**

### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

### Sample Information

**Sample ID:** WAH5

**Dilutions:** BTEX/GRO=20, TPH=No Dil, PAH=10

**Container:** Glass

**Matrix:** Soil

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/06

**Date Issued:** 2025/12/11

### BTEXMN and Gasoline Range Organics

| PARAMETER              | RESULT     |
|------------------------|------------|
| MTBE                   | <100 µg/kg |
| TAME                   | <100 µg/kg |
| Benzene                | 10 µg/kg   |
| Toluene                | 26 µg/kg   |
| Ethylbenzene           | 38 µg/kg   |
| m+p-Xylene             | 32 µg/kg   |
| o-Xylene               | 19 µg/kg   |
| 1,3,5-Trimethylbenzene | <8 µg/kg   |
| 1,2,4-Trimethylbenzene | 13 µg/kg   |
| Naphthalene            | 57 µg/kg   |
| TPH GRO C7-C9          | 540 µg/kg  |

### Total Petroleum Hydrocarbon (C10-C36)

| PARAMETER         | RESULT     |
|-------------------|------------|
| TPH C10-C14       | 180 mg/kg  |
| TPH C15-C36       | 3800 mg/kg |
| TPH C10-C36 Total | 3980 mg/kg |

### Polycyclic Aromatic Hydrocarbons

| PARAMETER      | RESULT    |
|----------------|-----------|
| Pyrene         | 190 µg/kg |
| Benzo(a)pyrene | <40 µg/kg |

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**Reinardt Cromhout**  
Authorised Signatory

## TEST REPORT

**Test Description:** BTEXMN/GRO, TPH and PAH

**Test Method:** EPL-T-012 (BTEX/GRO), EPL-T-011(TPH), EPL-T-020 (PAH)

**62573B**

### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

### Sample Information

**Sample ID:** WAH6

**Dilutions:** BTEX/GRO=20, TPH=No Dil, PAH=10

**Container:** Glass

**Matrix:** Soil

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/06

**Date Issued:** 2025/12/11

### BTEXMN and Gasoline Range Organics

| PARAMETER              | RESULT     |
|------------------------|------------|
| MTBE                   | <100 µg/kg |
| TAME                   | <100 µg/kg |
| Benzene                | <8 µg/kg   |
| Toluene                | <20 µg/kg  |
| Ethylbenzene           | <8 µg/kg   |
| m+p-Xylene             | <16 µg/kg  |
| o-Xylene               | <8 µg/kg   |
| 1,3,5-Trimethylbenzene | <8 µg/kg   |
| 1,2,4-Trimethylbenzene | <8 µg/kg   |
| Naphthalene            | <8 µg/kg   |
| TPH GRO C7-C9          | <200 µg/kg |

### Total Petroleum Hydrocarbon (C10-C36)

| PARAMETER         | RESULT    |
|-------------------|-----------|
| TPH C10-C14       | <20 mg/kg |
| TPH C15-C36       | 45 mg/kg  |
| TPH C10-C36 Total | 45 mg/kg  |

### Polycyclic Aromatic Hydrocarbons

| PARAMETER      | RESULT    |
|----------------|-----------|
| Pyrene         | <40 µg/kg |
| Benzo(a)pyrene | <40 µg/kg |

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**Reinardt Cromhout**  
Authorised Signatory

## TEST REPORT

**Test Description:** BTEXMN/GRO, TPH and PAH

**Test Method:** EPL-T-012 (BTEX/GRO), EPL-T-011(TPH), EPL-T-020 (PAH)

**62573B**

### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

### Sample Information

**Sample ID:** WAH8

**Dilutions:** BTEX/GRO=20, TPH=No Dil, PAH=10

**Container:** Glass

**Matrix:** Soil

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/06

**Date Issued:** 2025/12/11

### BTEXMN and Gasoline Range Organics

| PARAMETER              | RESULT     |
|------------------------|------------|
| MTBE                   | <100 µg/kg |
| TAME                   | <100 µg/kg |
| Benzene                | <8 µg/kg   |
| Toluene                | <20 µg/kg  |
| Ethylbenzene           | <8 µg/kg   |
| m+p-Xylene             | <16 µg/kg  |
| o-Xylene               | <8 µg/kg   |
| 1,3,5-Trimethylbenzene | <8 µg/kg   |
| 1,2,4-Trimethylbenzene | <8 µg/kg   |
| Naphthalene            | <8 µg/kg   |
| TPH GRO C7-C9          | <200 µg/kg |

### Total Petroleum Hydrocarbon (C10-C36)

| PARAMETER         | RESULT    |
|-------------------|-----------|
| TPH C10-C14       | <20 mg/kg |
| TPH C15-C36       | 35 mg/kg  |
| TPH C10-C36 Total | 35 mg/kg  |

### Polycyclic Aromatic Hydrocarbons

| PARAMETER      | RESULT    |
|----------------|-----------|
| Pyrene         | <40 µg/kg |
| Benzo(a)pyrene | <40 µg/kg |

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**Reinardt Cromhout**  
Authorised Signatory



## TEST REPORT

**Test Description:** BTEXMN/GRO, TPH and PAH

**Test Method:** EPL-T-012 (BTEX/GRO), EPL-T-011(TPH), EPL-T-020 (PAH)

**62573B**

### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

### Sample Information

**Sample ID:** WAH7

**Dilutions:** BTEX/GRO=20, TPH=No Dil, PAH=10

**Container:** Glass

**Matrix:** Soil

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/06

**Date Issued:** 2025/12/11

### BTEXMN and Gasoline Range Organics

| PARAMETER              | RESULT     |
|------------------------|------------|
| MTBE                   | <100 µg/kg |
| TAME                   | <100 µg/kg |
| Benzene                | <8 µg/kg   |
| Toluene                | <20 µg/kg  |
| Ethylbenzene           | <8 µg/kg   |
| m+p-Xylene             | <16 µg/kg  |
| o-Xylene               | <8 µg/kg   |
| 1,3,5-Trimethylbenzene | <8 µg/kg   |
| 1,2,4-Trimethylbenzene | <8 µg/kg   |
| Naphthalene            | <8 µg/kg   |
| TPH GRO C7-C9          | <200 µg/kg |

### Total Petroleum Hydrocarbon (C10-C36)

| PARAMETER         | RESULT    |
|-------------------|-----------|
| TPH C10-C14       | <20 mg/kg |
| TPH C15-C36       | 45 mg/kg  |
| TPH C10-C36 Total | 45 mg/kg  |

### Polycyclic Aromatic Hydrocarbons

| PARAMETER      | RESULT    |
|----------------|-----------|
| Pyrene         | <40 µg/kg |
| Benzo(a)pyrene | <40 µg/kg |

### Disclaimers

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**Reinardt Cromhout**  
Authorised Signatory

## TEST REPORT

**Test Description** Volatile Organic Compounds

**Test Method:** EPL-T-012

**62573C**

### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

### Sample Information

**Sample ID:** WAH1

**Dilution:** 20

**Container:** Glass & Plastic

**Matrix:** Soil

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/06

**Date Issued:** 2025/12/11

### Volatile Brominated/Chlorinated Hydrocarbon

| PARAMETER                | RESULT     |
|--------------------------|------------|
| Chloroform               | <100 µg/kg |
| Carbon Tetrachloride     | <100 µg/kg |
| 1,2-Dichloroethane       | <200 µg/kg |
| 1,1-Dichloroethene       | <200 µg/kg |
| cis-1,2-Dichloroethene   | <200 µg/kg |
| trans-1,2-Dichloroethene | <200 µg/kg |
| Chlorobenzene            | <40 µg/kg  |
| 1,2-Dichlorobenzene      | <40 µg/kg  |
| 1,4-Dichlorobenzene      | <40 µg/kg  |

### Disclaimers

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- 2) This report may not be reproduced, except in full, without the prior written approval of the laboratory.
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**Reinardt Cromhout**  
Authorised Signatory

## TEST REPORT

**Test Description** Volatile Organic Compounds

**Test Method:** EPL-T-012

**62573C**

### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

### Sample Information

**Sample ID:** WAH2

**Dilution:** 20

**Container:** Glass & Plastic

**Matrix:** Soil

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/06

**Date Issued:** 2025/12/11

### Volatile Brominated/Chlorinated Hydrocarbon

| <u>PARAMETER</u>         | <u>RESULT</u> |
|--------------------------|---------------|
| Chloroform               | <100 µg/kg    |
| Carbon Tetrachloride     | <100 µg/kg    |
| 1,2-Dichloroethane       | <200 µg/kg    |
| 1,1-Dichloroethene       | <200 µg/kg    |
| cis-1,2-Dichloroethene   | <200 µg/kg    |
| trans-1,2-Dichloroethene | <200 µg/kg    |
| Chlorobenzene            | <40 µg/kg     |
| 1,2-Dichlorobenzene      | <40 µg/kg     |
| 1,4-Dichlorobenzene      | <40 µg/kg     |

### Disclaimers

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**Reinardt Cromhout**  
Authorised Signatory

## TEST REPORT

**Test Description** Volatile Organic Compounds

**Test Method:** EPL-T-012

**62573C**

### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

### Sample Information

**Sample ID:** WAH3

**Dilution:** 20

**Container:** Glass & Plastic

**Matrix:** Soil

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/06

**Date Issued:** 2025/12/11

### Volatile Brominated/Chlorinated Hydrocarbon

| PARAMETER                | RESULT     |
|--------------------------|------------|
| Chloroform               | <100 µg/kg |
| Carbon Tetrachloride     | <100 µg/kg |
| 1,2-Dichloroethane       | <200 µg/kg |
| 1,1-Dichloroethene       | <200 µg/kg |
| cis-1,2-Dichloroethene   | <200 µg/kg |
| trans-1,2-Dichloroethene | <200 µg/kg |
| Chlorobenzene            | <40 µg/kg  |
| 1,2-Dichlorobenzene      | <40 µg/kg  |
| 1,4-Dichlorobenzene      | <40 µg/kg  |

### Disclaimers

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- 2) This report may not be reproduced, except in full, without the prior written approval of the laboratory.
- 3) Parameters marked " \* " are not included in the SANAS Schedule of Accreditation for this laboratory.
- 4) A = Concentration outside calibration range, O = Outsourced analysis, UTD = Unable to Determine.
- 5) Uncertainty of measurement for all methods included in the SANAS Schedule of Accreditation is available on request.

**Reinardt Cromhout**  
Authorised Signatory



## TEST REPORT

**Test Description** Volatile Organic Compounds

**Test Method:** EPL-T-012

**62573C**

### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

### Sample Information

**Sample ID:** WAH4

**Dilution:** 20

**Container:** Glass & Plastic

**Matrix:** Soil

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/06

**Date Issued:** 2025/12/11

### Volatile Brominated/Chlorinated Hydrocarbon

| PARAMETER                | RESULT     |
|--------------------------|------------|
| Chloroform               | <100 µg/kg |
| Carbon Tetrachloride     | <100 µg/kg |
| 1,2-Dichloroethane       | <200 µg/kg |
| 1,1-Dichloroethene       | <200 µg/kg |
| cis-1,2-Dichloroethene   | <200 µg/kg |
| trans-1,2-Dichloroethene | <200 µg/kg |
| Chlorobenzene            | <40 µg/kg  |
| 1,2-Dichlorobenzene      | <40 µg/kg  |
| 1,4-Dichlorobenzene      | <40 µg/kg  |

### Disclaimers

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**Reinardt Cromhout**  
Authorised Signatory

## TEST REPORT

**Test Description** Volatile Organic Compounds

**Test Method:** EPL-T-012

**62573C**

### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

### Sample Information

**Sample ID:** WAH5

**Dilution:** 20

**Container:** Glass & Plastic

**Matrix:** Soil

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/06

**Date Issued:** 2025/12/11

### Volatile Brominated/Chlorinated Hydrocarbon

| <u>PARAMETER</u>         | <u>RESULT</u> |
|--------------------------|---------------|
| Chloroform               | <100 µg/kg    |
| Carbon Tetrachloride     | <100 µg/kg    |
| 1,2-Dichloroethane       | <200 µg/kg    |
| 1,1-Dichloroethene       | <200 µg/kg    |
| cis-1,2-Dichloroethene   | <200 µg/kg    |
| trans-1,2-Dichloroethene | <200 µg/kg    |
| Chlorobenzene            | <40 µg/kg     |
| 1,2-Dichlorobenzene      | <40 µg/kg     |
| 1,4-Dichlorobenzene      | <40 µg/kg     |

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**Reinardt Cromhout**  
Authorised Signatory

## TEST REPORT

**Test Description** Volatile Organic Compounds

**Test Method:** EPL-T-012

**62573C**

### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

### Sample Information

**Sample ID:** WAH6

**Dilution:** 20

**Container:** Glass & Plastic

**Matrix:** Soil

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/06

**Date Issued:** 2025/12/11

### Volatile Brominated/Chlorinated Hydrocarbon

| <u>PARAMETER</u>         | <u>RESULT</u> |
|--------------------------|---------------|
| Chloroform               | <100 µg/kg    |
| Carbon Tetrachloride     | <100 µg/kg    |
| 1,2-Dichloroethane       | <200 µg/kg    |
| 1,1-Dichloroethene       | <200 µg/kg    |
| cis-1,2-Dichloroethene   | <200 µg/kg    |
| trans-1,2-Dichloroethene | <200 µg/kg    |
| Chlorobenzene            | <40 µg/kg     |
| 1,2-Dichlorobenzene      | <40 µg/kg     |
| 1,4-Dichlorobenzene      | <40 µg/kg     |

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- 5) Uncertainty of measurement for all methods included in the SANAS Schedule of Accreditation is available on request.

**Reinardt Cromhout**  
Authorised Signatory

## TEST REPORT

**Test Description** Volatile Organic Compounds

**Test Method:** EPL-T-012

**62573C**

### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

### Sample Information

**Sample ID:** WAH7

**Dilution:** 20

**Container:** Glass & Plastic

**Matrix:** Soil

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/06

**Date Issued:** 2025/12/11

### Volatile Brominated/Chlorinated Hydrocarbon

| PARAMETER                | RESULT     |
|--------------------------|------------|
| Chloroform               | <100 µg/kg |
| Carbon Tetrachloride     | <100 µg/kg |
| 1,2-Dichloroethane       | <200 µg/kg |
| 1,1-Dichloroethene       | <200 µg/kg |
| cis-1,2-Dichloroethene   | <200 µg/kg |
| trans-1,2-Dichloroethene | <200 µg/kg |
| Chlorobenzene            | <40 µg/kg  |
| 1,2-Dichlorobenzene      | <40 µg/kg  |
| 1,4-Dichlorobenzene      | <40 µg/kg  |

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**Reinardt Cromhout**  
Authorised Signatory



## TEST REPORT

**Test Description** Volatile Organic Compounds

**Test Method:** EPL-T-012

**62573C**

### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

### Sample Information

**Sample ID:** WAH8

**Dilution:** 20

**Container:** Glass & Plastic

**Matrix:** Soil

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/06

**Date Issued:** 2025/12/11

### Volatile Brominated/Chlorinated Hydrocarbon

| PARAMETER                | RESULT     |
|--------------------------|------------|
| Chloroform               | <100 µg/kg |
| Carbon Tetrachloride     | <100 µg/kg |
| 1,2-Dichloroethane       | <200 µg/kg |
| 1,1-Dichloroethene       | <200 µg/kg |
| cis-1,2-Dichloroethene   | <200 µg/kg |
| trans-1,2-Dichloroethene | <200 µg/kg |
| Chlorobenzene            | <40 µg/kg  |
| 1,2-Dichlorobenzene      | <40 µg/kg  |
| 1,4-Dichlorobenzene      | <40 µg/kg  |

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**Reinardt Cromhout**  
Authorised Signatory

## TEST REPORT

**Test Description** Volatile Organic Compounds

**Test Method:** EPL-T-012

**62573C**

### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

### Sample Information

**Sample ID:** WAH9

**Dilution:** 20

**Container:** Glass & Plastic

**Matrix:** Soil

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/06

**Date Issued:** 2025/12/11

### Volatile Brominated/Chlorinated Hydrocarbon

| PARAMETER                | RESULT     |
|--------------------------|------------|
| Chloroform               | <100 µg/kg |
| Carbon Tetrachloride     | <100 µg/kg |
| 1,2-Dichloroethane       | <200 µg/kg |
| 1,1-Dichloroethene       | <200 µg/kg |
| cis-1,2-Dichloroethene   | <200 µg/kg |
| trans-1,2-Dichloroethene | <200 µg/kg |
| Chlorobenzene            | <40 µg/kg  |
| 1,2-Dichlorobenzene      | <40 µg/kg  |
| 1,4-Dichlorobenzene      | <40 µg/kg  |

### Disclaimers

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- 5) Uncertainty of measurement for all methods included in the SANAS Schedule of Accreditation is available on request.

**Reinardt Cromhout**  
Authorised Signatory

## TEST REPORT

**Test Description** Volatile Organic Compounds

**Test Method:** EPL-T-012

**62573C**

### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

### Sample Information

**Sample ID:** WAH10

**Dilution:** 20

**Container:** Glass & Plastic

**Matrix:** Soil

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/06

**Date Issued:** 2025/12/11

### Volatile Brominated/Chlorinated Hydrocarbon

| PARAMETER                | RESULT     |
|--------------------------|------------|
| Chloroform               | <100 µg/kg |
| Carbon Tetrachloride     | <100 µg/kg |
| 1,2-Dichloroethane       | <200 µg/kg |
| 1,1-Dichloroethene       | <200 µg/kg |
| cis-1,2-Dichloroethene   | <200 µg/kg |
| trans-1,2-Dichloroethene | <200 µg/kg |
| Chlorobenzene            | <40 µg/kg  |
| 1,2-Dichlorobenzene      | <40 µg/kg  |
| 1,4-Dichlorobenzene      | <40 µg/kg  |

### Disclaimers

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- 2) This report may not be reproduced, except in full, without the prior written approval of the laboratory.
- 3) Parameters marked " \* " are not included in the SANAS Schedule of Accreditation for this laboratory.
- 4) A = Concentration outside calibration range, O = Outsourced analysis, UTD = Unable to Determine.
- 5) Uncertainty of measurement for all methods included in the SANAS Schedule of Accreditation is available on request.

**Reinardt Cromhout**  
Authorised Signatory

## TEST REPORT

### 62573A

#### Client and Project Information

|                                                                                    |                                            |                                    |
|------------------------------------------------------------------------------------|--------------------------------------------|------------------------------------|
| <b>Client:</b> Makomoto and Sebe Environmental Consulting (Pty) Ltd                | <b>Attention:</b> Martin Makomoto          | <b>Project number:</b> N/A         |
| <b>Address:</b> 22 Magwa Crescent, Gateway West<br>Waterfall City, Midrand<br>2090 | <b>Tel:</b> (010) 023-1576                 | <b>Project name:</b> TPL - Witbank |
|                                                                                    | <b>Email:</b> martin@makomotoandsebe.co.za |                                    |

#### Sample Information

|                                                     |                         |                                  |
|-----------------------------------------------------|-------------------------|----------------------------------|
| <b>Sample ID:</b> WAH 1                             | <b>Matrix:</b> Soil     | <b>Date Received:</b> 2025/12/04 |
| <b>Units:</b> mg/kg [ppm] (unless stated elsewhere) | <b>Container:</b> Glass | <b>Date Analysed:</b> 2025/12/12 |
|                                                     |                         | <b>Date Issued:</b> 2025/12/17   |

#### Cations and Metals

|           |        |            |         |
|-----------|--------|------------|---------|
| <b>As</b> | <3     | <b>Hg*</b> | 0.31    |
| <b>Cd</b> | <3     | <b>Ni</b>  | 93.83   |
| <b>Cr</b> | 696.20 | <b>Pb</b>  | 32.29   |
| <b>Cu</b> | 79.06  | <b>V</b>   | 7602.00 |
| <b>Mn</b> | 408.00 | <b>Zn</b>  | 1229.00 |

#### Disclaimers

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- 2) This report may not be reproduced, except in full, without the prior written approval of the laboratory.
- 3) Parameters marked " \* " are not included in the SANAS Schedule of Accreditation for this laboratory.
- 4) A = Concentration outside calibration range, \*\* = Outsourced analysis, UTD = Unable to Determine, RTF = Results To Follow, NR = Not Requested.
- 5) Methods: EPL-WL-001 (Conductivity), EPL-WL-002 (Alkalinity), EPL-WL-003 (pH), EPL-WL-004 (TDS), EPL-WL-005 (Anions by IC), EPL-WL-006 (Cations by IC), EPL-WL-007 (Metals), EPL-WL-008 (Cr(VI)), EPL-WL-009 (TOC), EPL-WL-010 (Hg by DMA), EPL-WL-011 (Anions by Discrete Analyser), EPL-HPLC-001 (Formaldehyde), EPL-ML-001 (Micro).
- 6) Uncertainty of measurement for all methods included in the SANAS Schedule of Accreditation is available on request.
- 7) Cr(III) and Cr(VI) are assumed to be the two major oxidative states of Chromium.

**Miche Kannemeyer**  
Authorised Signatory

Page 1 of 10



## TEST REPORT

### 62573A

#### Client and Project Information

|                                                                                    |                                            |                                    |
|------------------------------------------------------------------------------------|--------------------------------------------|------------------------------------|
| <b>Client:</b> Makomoto and Sebe Environmental Consulting (Pty) Ltd                | <b>Attention:</b> Martin Makomoto          | <b>Project number:</b> N/A         |
| <b>Address:</b> 22 Magwa Crescent, Gateway West<br>Waterfall City, Midrand<br>2090 | <b>Tel:</b> (010) 023-1576                 | <b>Project name:</b> TPL - Witbank |
|                                                                                    | <b>Email:</b> martin@makomotoandsebe.co.za |                                    |

#### Sample Information

|                                                     |                         |                                  |
|-----------------------------------------------------|-------------------------|----------------------------------|
| <b>Sample ID:</b> WAH 10                            | <b>Matrix:</b> Soil     | <b>Date Received:</b> 2025/12/04 |
| <b>Units:</b> mg/kg [ppm] (unless stated elsewhere) | <b>Container:</b> Glass | <b>Date Analysed:</b> 2025/12/12 |
|                                                     |                         | <b>Date Issued:</b> 2025/12/17   |

#### Cations and Metals

|           |       |            |       |
|-----------|-------|------------|-------|
| <b>As</b> | <3    | <b>Hg*</b> | <0.3  |
| <b>Cd</b> | <3    | <b>Ni</b>  | 3.55  |
| <b>Cr</b> | 47.06 | <b>Pb</b>  | 3.58  |
| <b>Cu</b> | 4.42  | <b>V</b>   | 37.95 |
| <b>Mn</b> | 20.35 | <b>Zn</b>  | <3    |

#### Disclaimers

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- 4) A = Concentration outside calibration range, \*\* = Outsourced analysis, UTD = Unable to Determine, RTF = Results To Follow, NR = Not Requested.
- 5) Methods: EPL-WL-001 (Conductivity), EPL-WL-002 (Alkalinity), EPL-WL-003 (pH), EPL-WL-004 (TDS), EPL-WL-005 (Anions by IC), EPL-WL-006 (Cations by IC), EPL-WL-007 (Metals), EPL-WL-008 (Cr(VI)), EPL-WL-009 (TOC), EPL-WL-010 (Hg by DMA), EPL-WL-011 (Anions by Discrete Analyser), EPL-HPLC-001 (Formaldehyde), EPL-ML-001 (Micro).
- 6) Uncertainty of measurement for all methods included in the SANAS Schedule of Accreditation is available on request.
- 7) Cr(III) and Cr(VI) are assumed to be the two major oxidative states of Chromium.

**Miche Kannemeyer**  
Authorised Signatory

## TEST REPORT

### 62573A

#### Client and Project Information

|                                                                                    |                                            |                                    |
|------------------------------------------------------------------------------------|--------------------------------------------|------------------------------------|
| <b>Client:</b> Makomoto and Sebe Environmental Consulting (Pty) Ltd                | <b>Attention:</b> Martin Makomoto          | <b>Project number:</b> N/A         |
| <b>Address:</b> 22 Magwa Crescent, Gateway West<br>Waterfall City, Midrand<br>2090 | <b>Tel:</b> (010) 023-1576                 | <b>Project name:</b> TPL - Witbank |
|                                                                                    | <b>Email:</b> martin@makomotoandsebe.co.za |                                    |

#### Sample Information

|                                                     |                         |                                  |
|-----------------------------------------------------|-------------------------|----------------------------------|
| <b>Sample ID:</b> WAH 2                             | <b>Matrix:</b> Soil     | <b>Date Received:</b> 2025/12/04 |
| <b>Units:</b> mg/kg [ppm] (unless stated elsewhere) | <b>Container:</b> Glass | <b>Date Analysed:</b> 2025/12/12 |
|                                                     |                         | <b>Date Issued:</b> 2025/12/17   |

#### Cations and Metals

|           |        |            |         |
|-----------|--------|------------|---------|
| <b>As</b> | <3     | <b>Hg*</b> | <0.3    |
| <b>Cd</b> | <3     | <b>Ni</b>  | 100.34  |
| <b>Cr</b> | 758.10 | <b>Pb</b>  | 31.99   |
| <b>Cu</b> | 87.21  | <b>V</b>   | 5647.00 |
| <b>Mn</b> | 401.70 | <b>Zn</b>  | 667.50  |

#### Disclaimers

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- 5) Methods: EPL-WL-001 (Conductivity), EPL-WL-002 (Alkalinity), EPL-WL-003 (pH), EPL-WL-004 (TDS), EPL-WL-005 (Anions by IC), EPL-WL-006 (Cations by IC), EPL-WL-007 (Metals), EPL-WL-008 (Cr(VI)), EPL-WL-009 (TOC), EPL-WL-010 (Hg by DMA), EPL-WL-011 (Anions by Discrete Analyser), EPL-HPLC-001 (Formaldehyde), EPL-ML-001 (Micro).
- 6) Uncertainty of measurement for all methods included in the SANAS Schedule of Accreditation is available on request.
- 7) Cr(III) and Cr(VI) are assumed to be the two major oxidative states of Chromium.

**Miche Kannemeyer**  
Authorised Signatory

Page 3 of 10

## TEST REPORT

### 62573A

#### Client and Project Information

|                                                                                    |                                            |                                    |
|------------------------------------------------------------------------------------|--------------------------------------------|------------------------------------|
| <b>Client:</b> Makomoto and Sebe Environmental Consulting (Pty) Ltd                | <b>Attention:</b> Martin Makomoto          | <b>Project number:</b> N/A         |
| <b>Address:</b> 22 Magwa Crescent, Gateway West<br>Waterfall City, Midrand<br>2090 | <b>Tel:</b> (010) 023-1576                 | <b>Project name:</b> TPL - Witbank |
|                                                                                    | <b>Email:</b> martin@makomotoandsebe.co.za |                                    |

#### Sample Information

|                                                     |                         |                                  |
|-----------------------------------------------------|-------------------------|----------------------------------|
| <b>Sample ID:</b> WAH 9                             | <b>Matrix:</b> Soil     | <b>Date Received:</b> 2025/12/04 |
| <b>Units:</b> mg/kg [ppm] (unless stated elsewhere) | <b>Container:</b> Glass | <b>Date Analysed:</b> 2025/12/12 |
|                                                     |                         | <b>Date Issued:</b> 2025/12/17   |

#### Cations and Metals

|           |        |            |        |
|-----------|--------|------------|--------|
| <b>As</b> | <3     | <b>Hg*</b> | <0.3   |
| <b>Cd</b> | <3     | <b>Ni</b>  | 12.69  |
| <b>Cr</b> | 122.80 | <b>Pb</b>  | 7.76   |
| <b>Cu</b> | 10.04  | <b>V</b>   | 812.70 |
| <b>Mn</b> | 91.62  | <b>Zn</b>  | 24.36  |

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- 5) Methods: EPL-WL-001 (Conductivity), EPL-WL-002 (Alkalinity), EPL-WL-003 (pH), EPL-WL-004 (TDS), EPL-WL-005 (Anions by IC), EPL-WL-006 (Cations by IC), EPL-WL-007 (Metals), EPL-WL-008 (Cr(VI)), EPL-WL-009 (TOC), EPL-WL-010 (Hg by DMA), EPL-WL-011 (Anions by Discrete Analyser), EPL-HPLC-001 (Formaldehyde), EPL-ML-001 (Micro).
- 6) Uncertainty of measurement for all methods included in the SANAS Schedule of Accreditation is available on request.
- 7) Cr(III) and Cr(VI) are assumed to be the two major oxidative states of Chromium.

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Authorised Signatory

Page 4 of 10

## TEST REPORT

### 62573A

#### Client and Project Information

|                                                                                    |                                            |                                    |
|------------------------------------------------------------------------------------|--------------------------------------------|------------------------------------|
| <b>Client:</b> Makomoto and Sebe Environmental Consulting (Pty) Ltd                | <b>Attention:</b> Martin Makomoto          | <b>Project number:</b> N/A         |
| <b>Address:</b> 22 Magwa Crescent, Gateway West<br>Waterfall City, Midrand<br>2090 | <b>Tel:</b> (010) 023-1576                 | <b>Project name:</b> TPL - Witbank |
|                                                                                    | <b>Email:</b> martin@makomotoandsebe.co.za |                                    |

#### Sample Information

|                                                     |                         |                                  |
|-----------------------------------------------------|-------------------------|----------------------------------|
| <b>Sample ID:</b> WAH 3                             | <b>Matrix:</b> Soil     | <b>Date Received:</b> 2025/12/04 |
| <b>Units:</b> mg/kg [ppm] (unless stated elsewhere) | <b>Container:</b> Glass | <b>Date Analysed:</b> 2025/12/12 |
|                                                     |                         | <b>Date Issued:</b> 2025/12/17   |

#### Cations and Metals

|           |        |            |        |
|-----------|--------|------------|--------|
| <b>As</b> | <3     | <b>Hg*</b> | <0.3   |
| <b>Cd</b> | <3     | <b>Ni</b>  | 12.69  |
| <b>Cr</b> | 122.80 | <b>Pb</b>  | 7.76   |
| <b>Cu</b> | 10.04  | <b>V</b>   | 842.70 |
| <b>Mn</b> | 91.62  | <b>Zn</b>  | <3     |

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- 5) Methods: EPL-WL-001 (Conductivity), EPL-WL-002 (Alkalinity), EPL-WL-003 (pH), EPL-WL-004 (TDS), EPL-WL-005 (Anions by IC), EPL-WL-006 (Cations by IC), EPL-WL-007 (Metals), EPL-WL-008 (Cr(VI)), EPL-WL-009 (TOC), EPL-WL-010 (Hg by DMA), EPL-WL-011 (Anions by Discrete Analyser), EPL-HPLC-001 (Formaldehyde), EPL-ML-001 (Micro).
- 6) Uncertainty of measurement for all methods included in the SANAS Schedule of Accreditation is available on request.
- 7) Cr(III) and Cr(VI) are assumed to be the two major oxidative states of Chromium.

**Miche Kannemeyer**  
 Authorised Signatory

## TEST REPORT

### 62573A

#### Client and Project Information

|                                                                                    |                                            |                                    |
|------------------------------------------------------------------------------------|--------------------------------------------|------------------------------------|
| <b>Client:</b> Makomoto and Sebe Environmental Consulting (Pty) Ltd                | <b>Attention:</b> Martin Makomoto          | <b>Project number:</b> N/A         |
| <b>Address:</b> 22 Magwa Crescent, Gateway West<br>Waterfall City, Midrand<br>2090 | <b>Tel:</b> (010) 023-1576                 | <b>Project name:</b> TPL - Witbank |
|                                                                                    | <b>Email:</b> martin@makomotoandsebe.co.za |                                    |

#### Sample Information

|                                                     |                         |                                  |
|-----------------------------------------------------|-------------------------|----------------------------------|
| <b>Sample ID:</b> WAH 4                             | <b>Matrix:</b> Soil     | <b>Date Received:</b> 2025/12/04 |
| <b>Units:</b> mg/kg [ppm] (unless stated elsewhere) | <b>Container:</b> Glass | <b>Date Analysed:</b> 2025/12/12 |
|                                                     |                         | <b>Date Issued:</b> 2025/12/17   |

#### Cations and Metals

|           |        |            |        |
|-----------|--------|------------|--------|
| <b>As</b> | <3     | <b>Hg*</b> | <0.3   |
| <b>Cd</b> | <3     | <b>Ni</b>  | 12.69  |
| <b>Cr</b> | 122.80 | <b>Pb</b>  | 8.76   |
| <b>Cu</b> | 13.04  | <b>V</b>   | 812.70 |
| <b>Mn</b> | 81.62  | <b>Zn</b>  | <3     |

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- 5) Methods: EPL-WL-001 (Conductivity), EPL-WL-002 (Alkalinity), EPL-WL-003 (pH), EPL-WL-004 (TDS), EPL-WL-005 (Anions by IC), EPL-WL-006 (Cations by IC), EPL-WL-007 (Metals), EPL-WL-008 (Cr(VI)), EPL-WL-009 (TOC), EPL-WL-010 (Hg by DMA), EPL-WL-011 (Anions by Discrete Analyser), EPL-HPLC-001 (Formaldehyde), EPL-ML-001 (Micro).
- 6) Uncertainty of measurement for all methods included in the SANAS Schedule of Accreditation is available on request.
- 7) Cr(III) and Cr(VI) are assumed to be the two major oxidative states of Chromium.

**Miche Kannemeyer**  
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## TEST REPORT

### 62573A

#### Client and Project Information

|                                                                                    |                                            |                                    |
|------------------------------------------------------------------------------------|--------------------------------------------|------------------------------------|
| <b>Client:</b> Makomoto and Sebe Environmental Consulting (Pty) Ltd                | <b>Attention:</b> Martin Makomoto          | <b>Project number:</b> N/A         |
| <b>Address:</b> 22 Magwa Crescent, Gateway West<br>Waterfall City, Midrand<br>2090 | <b>Tel:</b> (010) 023-1576                 | <b>Project name:</b> TPL - Witbank |
|                                                                                    | <b>Email:</b> martin@makomotoandsebe.co.za |                                    |

#### Sample Information

|                                                     |                         |                                  |
|-----------------------------------------------------|-------------------------|----------------------------------|
| <b>Sample ID:</b> WAH 5                             | <b>Matrix:</b> Soil     | <b>Date Received:</b> 2025/12/04 |
| <b>Units:</b> mg/kg [ppm] (unless stated elsewhere) | <b>Container:</b> Glass | <b>Date Analysed:</b> 2025/12/12 |
|                                                     |                         | <b>Date Issued:</b> 2025/12/17   |

#### Cations and Metals

|           |        |            |        |
|-----------|--------|------------|--------|
| <b>As</b> | <3     | <b>Hg*</b> | <0.3   |
| <b>Cd</b> | <3     | <b>Ni</b>  | 12.69  |
| <b>Cr</b> | 132.80 | <b>Pb</b>  | 7.76   |
| <b>Cu</b> | 11.04  | <b>V</b>   | 812.70 |
| <b>Mn</b> | 91.62  | <b>Zn</b>  | 24.36  |

#### Disclaimers

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- 6) Uncertainty of measurement for all methods included in the SANAS Schedule of Accreditation is available on request.
- 7) Cr(III) and Cr(VI) are assumed to be the two major oxidative states of Chromium.

**Miche Kannemeyer**  
Authorised Signatory

## TEST REPORT

### 62573A

#### Client and Project Information

|                                                                                    |                                            |                                    |
|------------------------------------------------------------------------------------|--------------------------------------------|------------------------------------|
| <b>Client:</b> Makomoto and Sebe Environmental Consulting (Pty) Ltd                | <b>Attention:</b> Martin Makomoto          | <b>Project number:</b> N/A         |
| <b>Address:</b> 22 Magwa Crescent, Gateway West<br>Waterfall City, Midrand<br>2090 | <b>Tel:</b> (010) 023-1576                 | <b>Project name:</b> TPL - Witbank |
|                                                                                    | <b>Email:</b> martin@makomotoandsebe.co.za |                                    |

#### Sample Information

|                                                     |                         |                                  |
|-----------------------------------------------------|-------------------------|----------------------------------|
| <b>Sample ID:</b> WAH 6                             | <b>Matrix:</b> Soil     | <b>Date Received:</b> 2025/12/04 |
| <b>Units:</b> mg/kg [ppm] (unless stated elsewhere) | <b>Container:</b> Glass | <b>Date Analysed:</b> 2025/12/12 |
|                                                     |                         | <b>Date Issued:</b> 2025/12/17   |

#### Cations and Metals

|           |        |            |        |
|-----------|--------|------------|--------|
| <b>As</b> | <3     | <b>Hg*</b> | <0.3   |
| <b>Cd</b> | <3     | <b>Ni</b>  | 14.69  |
| <b>Cr</b> | 122.80 | <b>Pb</b>  | 7.76   |
| <b>Cu</b> | 10.04  | <b>V</b>   | 712.70 |
| <b>Mn</b> | 95.62  | <b>Zn</b>  | 24.36  |

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- 7) Cr(III) and Cr(VI) are assumed to be the two major oxidative states of Chromium.

**Miche Kannemeyer**  
Authorised Signatory

## TEST REPORT

### 62573A

#### Client and Project Information

|                                                                                    |                                            |                                    |
|------------------------------------------------------------------------------------|--------------------------------------------|------------------------------------|
| <b>Client:</b> Makomoto and Sebe Environmental Consulting (Pty) Ltd                | <b>Attention:</b> Martin Makomoto          | <b>Project number:</b> N/A         |
| <b>Address:</b> 22 Magwa Crescent, Gateway West<br>Waterfall City, Midrand<br>2090 | <b>Tel:</b> (010) 023-1576                 | <b>Project name:</b> TPL - Witbank |
|                                                                                    | <b>Email:</b> martin@makomotoandsebe.co.za |                                    |

#### Sample Information

|                                                     |                         |                                  |
|-----------------------------------------------------|-------------------------|----------------------------------|
| <b>Sample ID:</b> WAH 7                             | <b>Matrix:</b> Soil     | <b>Date Received:</b> 2025/12/04 |
| <b>Units:</b> mg/kg [ppm] (unless stated elsewhere) | <b>Container:</b> Glass | <b>Date Analysed:</b> 2025/12/12 |
|                                                     |                         | <b>Date Issued:</b> 2025/12/17   |

#### Cations and Metals

|           |        |            |        |
|-----------|--------|------------|--------|
| <b>As</b> | <3     | <b>Hg*</b> | <0.3   |
| <b>Cd</b> | <3     | <b>Ni</b>  | 12.69  |
| <b>Cr</b> | 122.80 | <b>Pb</b>  | 7.76   |
| <b>Cu</b> | 10.04  | <b>V</b>   | 812.70 |
| <b>Mn</b> | 91.62  | <b>Zn</b>  | 24.36  |

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- 6) Uncertainty of measurement for all methods included in the SANAS Schedule of Accreditation is available on request.
- 7) Cr(III) and Cr(VI) are assumed to be the two major oxidative states of Chromium.

**Miche Kannemeyer**  
Authorised Signatory

## TEST REPORT

### 62573A

#### Client and Project Information

|                                                                                    |                                            |                                    |
|------------------------------------------------------------------------------------|--------------------------------------------|------------------------------------|
| <b>Client:</b> Makomoto and Sebe Environmental Consulting (Pty) Ltd                | <b>Attention:</b> Martin Makomoto          | <b>Project number:</b> N/A         |
| <b>Address:</b> 22 Magwa Crescent, Gateway West<br>Waterfall City, Midrand<br>2090 | <b>Tel:</b> (010) 023-1576                 | <b>Project name:</b> TPL - Witbank |
|                                                                                    | <b>Email:</b> martin@makomotoandsebe.co.za |                                    |

#### Sample Information

|                                                     |                         |                                  |
|-----------------------------------------------------|-------------------------|----------------------------------|
| <b>Sample ID:</b> WAH 8                             | <b>Matrix:</b> Soil     | <b>Date Received:</b> 2025/12/04 |
| <b>Units:</b> mg/kg [ppm] (unless stated elsewhere) | <b>Container:</b> Glass | <b>Date Analysed:</b> 2025/12/12 |
|                                                     |                         | <b>Date Issued:</b> 2025/12/17   |

#### Cations and Metals

|           |        |            |        |
|-----------|--------|------------|--------|
| <b>As</b> | <3     | <b>Hg*</b> | <0.3   |
| <b>Cd</b> | <3     | <b>Ni</b>  | 13.69  |
| <b>Cr</b> | 124.80 | <b>Pb</b>  | 7.66   |
| <b>Cu</b> | 10.04  | <b>V</b>   | 812.70 |
| <b>Mn</b> | 92.62  | <b>Zn</b>  | 24.36  |

#### Disclaimers

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**Miche Kannemeyer**  
Authorised Signatory

## TEST REPORT

**Test Description** Speciated Phenols

**Test Method:** EPL-T-021

**62573D**

### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

### Sample Information

**Sample ID:** WAH1

**Dilution:** No Dilution

**Container:** Glass & Plastic

**Matrix:** Soil

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/06

**Date Issued:** 2025/12/11

### PARAMETER

2-Chlorophenol

### RESULT

<20 µg/kg



### Disclaimers

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- 3) A = Concentration outside calibration range, O = Outsourced analysis, UTD = Unable to Determine.

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Authorised Signatory

Page 1 of 10



## TEST REPORT

**Test Description** Speciated Phenols

**Test Method:** EPL-T-021

**62573D**

### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

### Sample Information

**Sample ID:** WAH2

**Dilution:** No Dilution

**Container:** Glass & Plastic

**Matrix:** Soil

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/06

**Date Issued:** 2025/12/11

### PARAMETER

2-Chlorophenol

### RESULT

<20 µg/kg

### Disclaimers

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- 3) A = Concentration outside calibration range, O = Outsourced analysis, UTD = Unable to Determine.

**Reinardt Cromhout**  
Authorised Signatory

Page 2 of 10

## TEST REPORT

**Test Description** Speciated Phenols

**Test Method:** EPL-T-021

**62573D**

### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

### Sample Information

**Sample ID:** WAH3

**Dilution:** No Dilution

**Container:** Glass & Plastic

**Matrix:** Soil

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/06

**Date Issued:** 2025/12/11

### PARAMETER

2-Chlorophenol

### RESULT

<20 µg/kg

### Disclaimers

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**Reinardt Cromhout**  
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Page 3 of 10

## TEST REPORT

**Test Description** Speciated Phenols

**Test Method:** EPL-T-021

**62573D**

### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

### Sample Information

**Sample ID:** WAH4

**Dilution:** No Dilution

**Container:** Glass & Plastic

**Matrix:** Soil

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/06

**Date Issued:** 2025/12/11

### PARAMETER

2-Chlorophenol

### RESULT

<20 µg/kg

### Disclaimers

- 1) The results only relate to the test items provided, in the condition as received.
- 2) This report may not be reproduced, except in full, without the prior written approval of the laboratory.
- 3) A = Concentration outside calibration range, O = Outsourced analysis, UTD = Unable to Determine.

**Reinardt Cromhout**  
Authorised Signatory

Page 4 of 10

## TEST REPORT

**Test Description** Speciated Phenols

**Test Method:** EPL-T-021

**62573D**

### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

### Sample Information

**Sample ID:** WAH5

**Dilution:** No Dilution

**Container:** Glass & Plastic

**Matrix:** Soil

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/06

**Date Issued:** 2025/12/11

### PARAMETER

2-Chlorophenol

### RESULT

<20 µg/kg

### Disclaimers

- 1) The results only relate to the test items provided, in the condition as received.
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**Reinardt Cromhout**  
Authorised Signatory

Page 5 of 10

## TEST REPORT

**Test Description** Speciated Phenols

**Test Method:** EPL-T-021

**62573D**

### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

### Sample Information

**Sample ID:** WAH6

**Dilution:** No Dilution

**Container:** Glass & Plastic

**Matrix:** Soil

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/06

**Date Issued:** 2025/12/11

### PARAMETER

2-Chlorophenol

### RESULT

<20 µg/kg

### Disclaimers

- 1) The results only relate to the test items provided, in the condition as received.
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Authorised Signatory

Page 6 of 10



## TEST REPORT

**Test Description** Speciated Phenols

**Test Method:** EPL-T-021

**62573D**

### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

### Sample Information

**Sample ID:** WAH6

**Dilution:** No Dilution

**Container:** Glass & Plastic

**Matrix:** Soil

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/06

**Date Issued:** 2025/12/11

### PARAMETER

2-Chlorophenol

### RESULT

<20 µg/kg

### Disclaimers

- 1) The results only relate to the test items provided, in the condition as received.
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Page 7 of 10

## TEST REPORT

**Test Description** Speciated Phenols

**Test Method:** EPL-T-021

**62573D**

### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

### Sample Information

**Sample ID:** WAH8

**Dilution:** No Dilution

**Container:** Glass & Plastic

**Matrix:** Soil

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/06

**Date Issued:** 2025/12/11

### PARAMETER

2-Chlorophenol

### RESULT

<20 µg/kg

### Disclaimers

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Page 8 of 10

## TEST REPORT

**Test Description** Speciated Phenols

**Test Method:** EPL-T-021

**62573D**

### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

### Sample Information

**Sample ID:** WAH9

**Dilution:** No Dilution

**Container:** Glass & Plastic

**Matrix:** Soil

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/06

**Date Issued:** 2025/12/11

### PARAMETER

2-Chlorophenol

### RESULT

<20 µg/kg

### Disclaimers

- 1) The results only relate to the test items provided, in the condition as received.
- 2) This report may not be reproduced, except in full, without the prior written approval of the laboratory.
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Page 9 of 10

## TEST REPORT

**Test Description** Speciated Phenols

**Test Method:** EPL-T-021

**62573D**

### Client and Project Information

**Client:** Makomoto and Sebe Environmental Consulting (Pty) Ltd

**Address:** 22 Magwa Crescent, Gateway West  
Waterfall City, Midrand  
2090

**Attention:** Martin Makomoto

**Tel:** (010) 023-1576

**Email:** martin@makomotoandsebe.co.za

**Project number:** N/A

**Project name:** TPL - Witbank

### Sample Information

**Sample ID:** WAH10

**Dilution:** No Dilution

**Container:** Glass & Plastic

**Matrix:** Soil

**Storage:** Fridge at 0-6°C

**Date Received:** 2025/12/04

**Date Analysed:** 2025/12/06

**Date Issued:** 2025/12/11

### PARAMETER

2-Chlorophenol

### RESULT

<20 µg/kg

### Disclaimers

- 1) The results only relate to the test items provided, in the condition as received.
- 2) This report may not be reproduced, except in full, without the prior written approval of the laboratory.
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Page 10 of 10

SALLAB (Pty) Ltd trading as:



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## CLIENT DETAILS

TRANSNET PIPELINES  
202 ANTON LEMBEDE STREET  
DURBAN  
4001

Client order no:  
TPL/EXP/HAZ-141003-02  
Enquiries: J Venter  
Page 1 of 23

Date: 02/10/2014

Client contact person: Mr. Bernard Burger.

## HAZARDOUS AREA CLASSIFICATION GUIDELINES REPORT FOR TRANSNET PIPELINE (TPL) INFRASTRUCTURE

Explolabs report no XPS/1015/13013Rev3

| Revision | Details                                                  |
|----------|----------------------------------------------------------|
| -        | First edition of report.                                 |
| 1        | Changes made as requested by Mr. Chris Murray.           |
| 2        | Addition of the test rooms on request of Bernard Burger. |
| 3        | Addition of the Additives Dosing Gantry.                 |

## INDEX

**In co-operation with:**



T0104

The South African National Accreditation System (SANAS) is a member of the International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Arrangement (MRA). This Arrangement allows for the mutual recognition of technical test and calibration data by the member accreditation bodies worldwide. For more information on the Arrangement please consult [www.ilac.org](http://www.ilac.org)

DIRECTOR: JG AURET



| Clause                                        | Page                                      |
|-----------------------------------------------|-------------------------------------------|
| 1                                             | SCOPE..... 3                              |
| 2                                             | BACKGROUND..... 4                         |
| 3                                             | SOURCES OF INFORMATION ..... 4            |
| 4                                             | FLAMMABLE MATERIALS LIST ..... 4          |
| 5                                             | TRANSNET PIPE LINE INFRASTRUCTURE ..... 6 |
| 6                                             | GENERAL ..... 17                          |
| ANNEX A: DISCUSSION OF ZONING TABLES ..... 18 |                                           |
| ANNEX B: AC DRAWINGS ..... 20                 |                                           |
| ANNEX C: EQUIPMENT SELECTION ..... 21         |                                           |
| ANNEX D: DEMARCATION ..... 23                 |                                           |

## 1 SCOPE

This area classification guide covers infrastructure used on the TPL including:

1. Pig Receivers
2. Pig Launchers
3. Mainline Pump sets
4. Booster Pump sets
5. Sumps
6. Strainers
7. Storage Tanks
8. Provers
9. LP Delivery manifolds
10. HP Routing manifolds
11. Density Huts
12. Oily and Storm Water Separators/Spill Basins
13. Motorised Block Valve Chambers
14. Road Loading and Offloading Gentries
15. Test facilities
16. Additives Dosing Gantry

This area classification was done in terms of and complies with **SANS 10108 Edition 5: 2005 “The classification of hazardous locations and the selection of apparatus for use in such locations”**. Compliance with this standard is legally required.

The following standard:

**Edition 3: 2005 of Part 15 of the IP Model Code of Safe Practice in the Petroleum Industry, “Area Classification Code for Installations Handling Flammable Fluids”**, IP Part 15 for short;

was used as the basis for the classification. (Such a classification complies with SANS 10108.)

The following conclusions were drawn in deriving the classification results:

- That the properties of flammable materials applicable to this project are within the scope of IP Part 15;
- That the facilities and operational conditions are within the scope of IP Part 15;

## 2 BACKGROUND

Transnet Pipelines currently maintains and operates pipeline infrastructure within the Republic of South Africa. This infrastructure comprises refined multi-product pipelines, avtur pipelines, crude oil pipelines, natural gas pipelines and associated intake, pumping, storage and delivery depots.

The information that was used in this guide was obtained from the NMPP (New Multiproduct Pipe Line) and the original assessments were captured in a series of reports with reference number: XPS/0253/08194 and are therefore typical “worst case” values for the pipe transfer system. (XPS/1012/13010 for NMPP TM2 test facility)

In order to cover all existing pipeline infrastructure, a Hazardous Classification exercise was originally completed by De Villiers & Khan in 1999. More recently, a Hazardous Classification exercise was completed by ExploLabs(Pty) Ltd for all pipeline infrastructure installed as part of the New Multi-products Pipeline (Ref: ExploLabs Report no XPS/0253/08194AtoD).

Because all the TPL sites handle the same product <sup>(1)</sup> as detailed in the NMPP Report at similar process conditions <sup>(2)</sup>, using similar equipment, it was deemed acceptable to produce a generic report covering all remaining installations not covered by the NMPP Report.

[<sup>(1)</sup> Crude Oil is also handled on these sites, in addition to the products listed in the NMPP Report, <sup>(2)</sup> Sites do differ in terms of the volume of product stored in accumulator and intermix tanks]

TPL is desirous of updating existing Hazardous Area Classification documentation for existing infrastructure (excluding NMPP), comprising of approx. 25 intake and delivery depots and pump stations. This generic report can be used by TPL as a basis for reviewing and updating of site specific Hazardous Area Classification drawings in the future.

An Additives Dosing Gantry was added to the report in 2014.

## 3 SOURCES OF INFORMATION

Information on the plant examined was gathered from project documentation, particularly the following:

- Transnet/NMPP Alliance/Uhde Piping and Instrumentation Diagrams.
- Scope of Work issued by Mr. Chris Murray.(Email format)
- NMPP Area Classification reports.
- Detailed information was sent via Email from Mr. Chris Murray on the processes of the Additives Dosing Gantry as well as an layout drawing.

## 4 FLAMMABLE MATERIALS LIST

Generally, fluids (a) with flash points within the ambient temperature range (eg ≤55°C) or within the operational temperature range and (b) being used in significant quantities i.e.

| Material state | Ventilation |                 |
|----------------|-------------|-----------------|
|                | Open Air    | Inside Building |
| Liquefied gas  | 100 litres  | 5 litres        |
| Liquid         | 200 litres  | 25 litres       |
| Gas            | 1000 litres | 50 litres       |

are considered capable of forming explosive atmospheres.

The Table below lists the flammable fluids currently handled by TPL within their infrastructure and their explosive properties are listed below (as obtained from the NMPP reports):

| No. | Material                 | Composition                                                                                                  | Relative density (air=1) | Flash point (°C) | LEL % (v/v) | UEL % (v/v) | Boiling Point (°C) | Vapour pressure at operating T (kPa) <sup>1</sup> | Auto-ignition temperature (°C) | Gas group <sup>2</sup> | Temperature Class <sup>3</sup> |
|-----|--------------------------|--------------------------------------------------------------------------------------------------------------|--------------------------|------------------|-------------|-------------|--------------------|---------------------------------------------------|--------------------------------|------------------------|--------------------------------|
| 1   | 95 ULP                   | Natural Gasoline; Low boiling point naphtha                                                                  | >1                       | -20              | 1.3         | 7.1         | 38.05-200          | 45-75                                             | 250                            | IIA                    | T3                             |
| 2   | 93 ULP                   | Natural Gasoline; Low boiling point naphtha                                                                  | >1                       | -20              | 1.3         | 7.1         | 38.05-200          | 45-75                                             | 250                            | IIA                    | T3                             |
| 3   | LSD                      | Fuel, diesel gas oil – unspecified. Sulphur content 0-0.05% (m/m)                                            | >1                       | 55               | 1.3         | 6.0         | 160-380            | 0.5                                               | 225                            | IIA                    | T3                             |
| 4   | ULSD                     | Fuel, diesel gas oil – unspecified. Sulphur content 0-0.005% (m/m)                                           | >1                       | 55               | 1.3         | 6.0         | 160-380            | 0.5                                               | 225                            | IIA                    | T3                             |
| 5   | Jet Fuel (Avtur)         | Hydrodesulphurized heavy naphtha; kerosene; methylcyclohexane; heptane; octane; xylene; toluene, cyclohexane | >1                       | >46              | 1.0         | 6.0         | 158                | <0.1                                              | 210                            | IIA                    | T3                             |
| 6   | Seal and Lubricating Oil | Heavy hydrocarbons                                                                                           | >1                       | >100             |             |             | 171-371            |                                                   |                                | IIA                    | T3                             |
| 7   | Additives <sup>4</sup>   | HiTEC 4646 SDS                                                                                               | >1                       | 65               | -           | -           | -                  | -                                                 | -                              | IIA<br>(Typical Value) | T3<br>(Typical Value)          |
|     |                          | HiTec6421                                                                                                    |                          | 65               | 1           | 8           | -                  | -                                                 | >200                           |                        |                                |
|     |                          | Keropur 3597                                                                                                 |                          | 65               | -           | -           | -                  | -                                                 | >200                           |                        |                                |
|     |                          | Nemo2011                                                                                                     |                          | 68               | -           | -           | -                  | -                                                 | -                              |                        |                                |
|     |                          | Nemo 2041                                                                                                    |                          | 78               | -           | -           | -                  | -                                                 | -                              |                        |                                |
|     |                          | Optimise D3037 SDS                                                                                           |                          | 63               | 0.6         | 7           | -                  | -                                                 | 425                            |                        |                                |
|     |                          | Optimise G2003 SDS                                                                                           |                          | 63               | 0.6         | 7           | -                  | -                                                 | 425                            |                        |                                |
|     |                          | Ultrazol 9013S (2)                                                                                           |                          | 75               | -           | -           | -                  | -                                                 | -                              |                        |                                |
|     |                          | Ultrazol 9013S                                                                                               |                          | 75               | -           | -           | -                  | -                                                 | -                              |                        |                                |

| <b>NOTES</b>      | <p>1. Vapour pressure is taken from Fluor NMPP Operating Philosophy Rev. 1. Jet Fuel LEL and UEL are taken from the Sapref MSDS. Rest of flammability data is taken from Sasol MSDSs for Sasol products.</p> <p>2. Flammable gases and liquids are generally divided into groups to distinguish their ignition properties, as follows:</p> <ul style="list-style-type: none"> <li>– Group I: mines susceptible to firedamp;</li> <li>– Group II: explosive gas atmospheres occurring in areas other than mines susceptible to firedamp (surface applications).</li> <li>– Group III: explosive dust atmospheres occurring in areas mines susceptible to firedamp (surface applications).</li> </ul> <p>Group II is applicable here. The explosive gas atmospheres are divided based on spark ignition energies into IIA, IIB and IIC, IIC gases having the lowest ignition energies.</p> <p>3. Likewise, Group II gases are divided into the following 6 temperature classes based on their auto-ignition temperatures</p> <table border="1"> <thead> <tr> <th>Temperature class</th><th>Auto ignition temp. range of gas (°C)</th></tr> </thead> <tbody> <tr> <td>T1</td><td>&gt;450</td></tr> <tr> <td>T2</td><td>&gt;300 to 450</td></tr> <tr> <td>T3</td><td>&gt;200 to 300</td></tr> <tr> <td>T4</td><td>&gt;135 to 200</td></tr> <tr> <td>T5</td><td>&gt;100 to 135</td></tr> <tr> <td>T6</td><td>&gt;85 to 100</td></tr> </tbody> </table> <p>4. Typical values were used where not indicated on MSDSs. The flash points for Nemo4006 and Nemo6101 were obtained for Kerosene that was only 39% of the volume of the material and this value can possibly be much higher if better data is available.</p> | Temperature class | Auto ignition temp. range of gas (°C) | T1 | >450 | T2 | >300 to 450 | T3 | >200 to 300 | T4 | >135 to 200 | T5 | >100 to 135 | T6 | >85 to 100 |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|---------------------------------------|----|------|----|-------------|----|-------------|----|-------------|----|-------------|----|------------|
| Temperature class | Auto ignition temp. range of gas (°C)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                   |                                       |    |      |    |             |    |             |    |             |    |             |    |            |
| T1                | >450                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                   |                                       |    |      |    |             |    |             |    |             |    |             |    |            |
| T2                | >300 to 450                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                   |                                       |    |      |    |             |    |             |    |             |    |             |    |            |
| T3                | >200 to 300                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                   |                                       |    |      |    |             |    |             |    |             |    |             |    |            |
| T4                | >135 to 200                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                   |                                       |    |      |    |             |    |             |    |             |    |             |    |            |
| T5                | >100 to 135                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                   |                                       |    |      |    |             |    |             |    |             |    |             |    |            |
| T6                | >85 to 100                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                   |                                       |    |      |    |             |    |             |    |             |    |             |    |            |

## 5 TRANSNET PIPE LINE INFRASTRUCTURE

### 5.1 Equipment and Process Overview

Transnet Pipeline infrastructure included the following equipment, operated under the following process conditions:

- Maximum Allowable Operating Pressure (MAOP): 10 200 kPa(g)
  - Maximum Pipeline Design Pressure: 95% MAOP
  - Minimum Design Temperature: -20 °C
  - Maximum Design Temperature: 50 °C
  - Design velocity for the pipelines is 2 m/s with a maximum of 3 m/s.
- a. Receivers –Sources of release include:vents, drains (inclusive of free draining and with use of pump), and TRVs (thermal relief valves), which were all piped to buried sump tanks i.e. a closed system. The Receiver had a barrel door which was routinely opened to permit the removal of spheres/batching pigs etc. The door was mechanically interlocked to prevent the door from being opened while the system was under pressure. Product was not present during normal operations.
- b. Launchers - Sources of release include: vents, drains (inclusive of free draining and with use of pump), and TRVs (thermal relief valves), which were all piped to buried sump tanks i.e. a closed system. The Launcher has a barrel and magazine door which was routinely opened to permit the insertion of spheres/batching pigs etc. The door was mechanically interlocked to prevent the door from being opened while the system is under pressure. Product was not present during normal operations.



- c. Mainline Pump sets and associated Lube Oil systems - Sources of release include: pump seals, vents and drains. Pump seals were fitted with either pressure or level switches/transmitters to detect seal failure.
- d. Booster Pump sets - Sources of release include: pump seals, vents and drains. Pump seals are fitted with either pressure or level switches/transmitters to detect seal failure.
- e. Sumps - sumps comprised of buried tank systems used to capture product from routine maintenance activities such as draining of receivers, launchers, strainers etc. Drain lines routed to these sumps consisted of pressurised and non-pressurised drain lines. A mixture of products may be present in these sumps during normal operations. Sump vents were fitted with flame arrestors.
- f. Strainers and De-aerators - were installed to remove foreign particles from the product. Sources of release include: strainer and de-aerator drains and vents. Strainer lids were routinely opened to facilitate cleaning of strainer baskets. Product was not present during normal operations.
- g. Storage Tanks (accumulator and intermix) of varying storage capacities and designs. The tanks vented to atmosphere.
- h. Provers - Sources of release include: vents, drains (inclusive of free draining and with use of pump), and TRVs (thermal relief valves), which are all piped to buried sump tanks i.e. a closed system. The Prover has a barrel door which is routinely opened to permit the removal of spheres for inspection purposes. The door is mechanically interlocked to prevent the door from being opened while the system is under pressure. Product is not present during normal operations.
- i. LP Delivery manifolds - Sources of release include: TRVs, high point vents and low point drains.
- j. HP Routing manifolds - Sources of release the same as for LP Delivery manifolds (for the purpose of Explosion Prevention Hazardous Area Classification according to IP 15, the zoning accommodates pressures up to 100Bar and LP and HP can therefore be considered to be the same).
- k. Density Huts and Sample Points. Density Huts contained hydrometers and sample points, and were used for taking regular samples of product during normal operations. A mixture of products was expected to be present in these Density Huts during normal operations. Sample points are also located at various points on the manifolds. Excess product is routed via open top tung-dishes and drain piping to the waste collection sumps or buried tanks.
- l. Oily Water and Storm Water Separators/Spill Basins (Oil/Water separators). Storm water (and product during a loss of containment situation) was drained via open concrete trenches installed under manifolds and in tank bunds to the Oil/Water separator and to the spill basin for containment purposes. A mixture of products was expected in the Oil/Water Separator and Spill Basin during normal operations.
- m. Motorised Block Valve Chambers (Buried below ground). These chambers contained flanged isolation valves, both inline and for instrument process connections.
- n. Road Loading and offloading gantries. These gantries were used for loading and offloading of product to road tankers. Loading Arms with API couplers, flexible hoses,

strainer/de-aerators, vents drains and EPVs were all located within these facilities. Some gantries were equipped with roofs, all were naturally ventilated.

- o. Test and product sample rooms. Product samples were received from sample points on the plant and stored in the Product Sample Store Room. The room was ventilated by an extraction ventilation system and equipped with spillage containment by means of a lowered floor that acted as a spillage containment sump. No decanting was done in the sample room. The samples were retrieved from the store room and transferred to the Test Room where it were prepared and analyzed. Only small volumes of solvent and samples were handled in the test room (<25 liter). Flammable waste was discharged into a sink that drained to an open top waste collection sump outside the room. *As extracted from test facility on the NMPP.*
- p. An Additives Dosing Gantry was added to the table and was based on the following processes: The additives were received from road tankers and transferred with centrifugal pumps (Decanting Pumps) to Storage tanks. From the tanks positive displacement pumps were used to dose the additives to road tankers. The Storage tanks were installed in an open well naturally ventilated area with a solid roof and had a spillage containment bund around them. Spillage in the offloading bay and tank bund was collected in a sump and was transferred to an oil/water separator pit with a pipe (information was captured from a provided drawing and should be verified, Fluor Igoda drawing, A4XY-001/65/AC/001R1). Large volumes of additives were not dosed to road tankers in this are but the additives were received, stored and transferred from this facility.

## 5.2 Zoning

| Equipment             |                                    | SOR                                    | Grade of release (C/P/S) | Flammable Material |                                                |        |                             | Ventilation |                             |                      | Hazardous Area |                                        |          | Reference                                                                           |
|-----------------------|------------------------------------|----------------------------------------|--------------------------|--------------------|------------------------------------------------|--------|-----------------------------|-------------|-----------------------------|----------------------|----------------|----------------------------------------|----------|-------------------------------------------------------------------------------------|
| ID                    | Item                               |                                        |                          | Material No.       | P (kPa)                                        | T (°C) | State (S/A/B/C/G (I)/G(ii)) | Type (N/A)  | Degree (Open-air/Adq/Inadq) | Availability (G/F/P) | Zone           | Horiz (m)                              | Vert (m) |                                                                                     |
| Receiver and launcher |                                    |                                        |                          |                    |                                                |        |                             |             |                             |                      |                |                                        |          |                                                                                     |
|                       | Pig launcher/ receiver doors.      | Opening and seals                      | P                        | 1-6                | 10 000 (max)                                   | Amb    | C                           | N           | O                           | G                    | 1              | 3                                      | 3        | IP 15 Section5.4.6. Pig launchers.                                                  |
|                       | Pig launcher/ receiver doors.      | Spreading of vapours.                  | S                        | 1-6                | <10 000 (max)                                  | Amb    | C                           | N           | O                           | G                    | 1              | 6                                      | 6        | IP 15 Section5.4.6. Pig launchers. (release on hatch <2mm hole)                     |
|                       | Pig Launcher/ receiver drain pump. | Single mechanical seal, flanged joints | S                        | 1-6                | 5 500 (obtained from process engineer on NMPP) | Amb    | C                           | N           | O                           | G                    | 2              | 4                                      | 4        | IP 15 Table C9. SD <20mm, throttle bush (if SD< 10mm).                              |
|                       | Pig Launcher/ receiver drain.      | Refer to Drains.                       |                          |                    |                                                |        |                             |             |                             |                      |                |                                        |          |                                                                                     |
|                       | Pig Launcher/ receiver vent.       | Vent opening                           | P                        | 1-6                | N/A                                            | Amb    | C                           | N           | O                           | G                    | 2              | 3                                      | 3        | IP 15 Table 5.5 (vent diameter of <50mm; release of <250m³/hr) and section 5.4.4.5. |
|                       |                                    |                                        |                          |                    |                                                |        |                             |             |                             |                      |                | 1m if only pressure relief valve vents |          |                                                                                     |

| Equipment                      |                        | SOR                                               | Grade of release (C/P/S) | Flammable Material |         |        |                             | Ventilation |                             |                      | Hazardous Area |                                                                                                    |          | Reference                                                                                     |
|--------------------------------|------------------------|---------------------------------------------------|--------------------------|--------------------|---------|--------|-----------------------------|-------------|-----------------------------|----------------------|----------------|----------------------------------------------------------------------------------------------------|----------|-----------------------------------------------------------------------------------------------|
| ID                             | Item                   |                                                   |                          | Material No.       | P (kPa) | T (°C) | State (S/A/B/C/G (I)/G(ii)) | Type (N/A)  | Degree (Open-air/Adq/Inadq) | Availability (G/F/P) | Zone           | Horiz (m)                                                                                          | Vert (m) |                                                                                               |
| Mainline and Booster Pump sets |                        |                                                   |                          |                    |         |        |                             |             |                             |                      |                |                                                                                                    |          |                                                                                               |
|                                | Mainline/Booster pump. | High integrity double seal.                       | S                        | 1-6                | <50 000 | Amb    | C                           | N           | O                           | G                    | 2              | 5                                                                                                  | 5        | IP 15 Table C6 and Table C9 (refer to Note 4 below this table).                               |
|                                | Mainline/Booster pump. | Single mechanical seal                            | S                        | 1-6                | <50 000 | Amb    | C                           | N           | O                           | G                    | 2              | Were considered open with no vapour barriers such as walls/buildings (radius of 22m for 10 000kPa) |          | IP 15 Table C6 and Table C9 (shaft diameter of <10mm, shaft located >1m above floor level).   |
| Sumps and drains               |                        |                                                   |                          |                    |         |        |                             |             |                             |                      |                |                                                                                                    |          |                                                                                               |
|                                | Open drain.            | Liquid surfaces                                   | S                        | 1-6                | Atm     | Amb    | C                           | N           | O                           | G                    | 1              | Interior of drains up to sides.                                                                    |          | IP 15 Section 5.4.2. Sample points and equipment drains and section 5.4.10.                   |
|                                | Closed drain.          | Liquid surfaces                                   | S                        | 1-6                | Atm     | Amb    | C                           | N           | O                           | F                    | 1              | Interior (if closed).                                                                              |          | IP 15 Section 5.4.2. Sample points and equipment drains                                       |
| Strainers and De-aerators      |                        |                                                   |                          |                    |         |        |                             |             |                             |                      |                |                                                                                                    |          |                                                                                               |
|                                | Strainer.              | Manhole covers, flanged joints and screwed joints | S                        | 1-6                | <10 000 | Amb    | C                           | N           | O                           | G                    | 2              | 2.5                                                                                                | 2.5      | IP 15 table 5.6.                                                                              |
|                                | De-aerator.            | Flanged and screwed joints                        | S                        | 1-6                | <10 000 | Amb    | C                           | N           | O                           | G                    | 2              | 2.5                                                                                                | 2.5      | IP 15 table 5.6.                                                                              |
|                                | Strainer.              | Liquid surfaces                                   | C                        | 3                  | N/A     | Amb    | C                           | N           | I                           | G                    | 0              | Interior                                                                                           |          | IP 15 Section 3.2.                                                                            |
|                                | De-aerator.            | Liquid surfaces                                   | C                        | 3                  | N/A     | Amb    | C                           | N           | I                           | G                    | 0              | Interior                                                                                           |          | IP 15 Section 3.2.                                                                            |
|                                | Strainer.              | Vents                                             | S                        | 1-6                | <10 000 | Amb    | C                           | N           | O                           | G                    | 2              | 3                                                                                                  | 3        | IP 15 table 5.5 (for vent with diameter of 50mm and release of <10m³/hr) and section 5.4.4.5. |
|                                |                        |                                                   |                          |                    |         |        |                             |             |                             |                      |                | 1m if only pressure relief valve vents                                                             |          |                                                                                               |

| Equipment                                                        |                                          | SOR                                       | Grade of release (C/P/S) | Flammable Material |                                        |        |                            | Ventilation |                             |                       | Hazardous Area |           |          | Reference                                                                                                  |
|------------------------------------------------------------------|------------------------------------------|-------------------------------------------|--------------------------|--------------------|----------------------------------------|--------|----------------------------|-------------|-----------------------------|-----------------------|----------------|-----------|----------|------------------------------------------------------------------------------------------------------------|
| ID                                                               | Item                                     |                                           |                          | Material No.       | P (kPa)                                | T (°C) | State (S/A/B/C/G(i)/G(ii)) | Type (N/A)  | Degree (Open-air/Adq/Inadq) | Availa=bility (G/F/P) | Zone           | Horiz (m) | Vert (m) |                                                                                                            |
|                                                                  | De-aerator.                              | Vents                                     | S                        | 1-6                | <10 000                                | Amb    | C                          | N           | O                           | G                     | 2              | 3         | 3        | IP 15 table 5.5 (for vent with diameter of 50mm and release of <10m <sup>3</sup> /hr) and section 5.4.4.5. |
| Storage Tanks (accumulator and intermix, not bulk storage tanks) |                                          |                                           |                          |                    |                                        |        |                            |             |                             |                       |                |           |          |                                                                                                            |
|                                                                  | Accumulator/intermix tank.               | Openings on tank cover and vents          | P                        | 1-6                | Atm                                    | Amb    | C                          | N           | O                           | G                     | 1              | 4         | 4        | IP 15 Section 5.4.4.2. Table 5.4. (vent diameter ≤250mm and vent rate of ≤500Nm <sup>3</sup> /hr)          |
|                                                                  | Accumulator/intermix tank.               | Release from floating cover (if used)     | P                        | 1-6                | Atm                                    | Amb    | C                          | N           | O                           | G                     | 1              | Interior. |          | IP 15 Section 3.2.2. <i>Floating roof tankage.</i>                                                         |
|                                                                  | Accumulator/intermix tank.               | Liquid surfaces                           | C                        | 1-6                | Atm                                    | Amb    | C                          | N           | I                           | P                     | 0              | Interior. |          | IP 15 Section 1.                                                                                           |
|                                                                  | Accumulator/intermix tank transfer pump. | Single mechanical seal, flanged joints    | S                        | 1-6                | <500                                   | Amb    | C                          | N           | O                           | G                     | 2              | 5         | 5        | IP 15 Table C9. SD 30mm, throttle bush.                                                                    |
| Provers                                                          |                                          |                                           |                          |                    |                                        |        |                            |             |                             |                       |                |           |          |                                                                                                            |
|                                                                  | Prover transfer tanks.                   | Liquid surfaces                           | C                        | 1-6                | Atm                                    | Amb    | C                          | N           | I                           | P                     | 0              | Interior  |          | IP 15 Section 3.2.                                                                                         |
|                                                                  | Prover transfer tanks.                   | Manhole covers.                           | P                        | 1-6                | Atm                                    | Amb    | C                          | N           | O                           | G                     | 2              | 2.5       | 2.5      | IP 15 Section 5.4.5.                                                                                       |
|                                                                  | Prover transfer tanks.                   | Vent.                                     | P                        | 1-6                | Atm                                    | Amb    | C                          | N           | O                           | G                     | 1              | 2         | 2        | IP 15 Section 5.4.4. (flow assumed to be <250Nm <sup>3</sup> /h)                                           |
| LP Delivery manifolds                                            |                                          |                                           |                          |                    |                                        |        |                            |             |                             |                       |                |           |          |                                                                                                            |
|                                                                  | Pipes and instrumentation.               | Valve stems, flanged and threaded joints. | S                        | 1-6                | <10 000 (Assumed Maximum as from NMPP) | Amb    | C                          | N           | O                           | G                     | 2              | 2.5       | 2.5      | IP 15 Section 5.4.5. (located in open well naturally ventilated area).                                     |

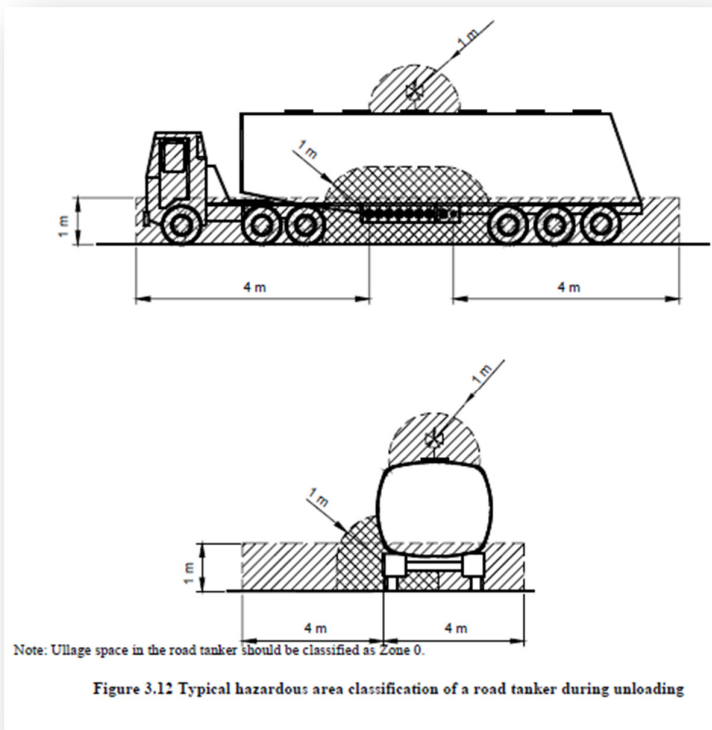
| Equipment                                                 |                                             | SOR                                        | Grade of release (C/P/S) | Flammable Material |         |        |                             | Ventilation |                             |                      | Hazardous Area |                                                             |                    | Reference                                                                                                                                      |
|-----------------------------------------------------------|---------------------------------------------|--------------------------------------------|--------------------------|--------------------|---------|--------|-----------------------------|-------------|-----------------------------|----------------------|----------------|-------------------------------------------------------------|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| ID                                                        | Item                                        |                                            |                          | Material No.       | P (kPa) | T (°C) | State (S/A/B/C/G (i)/G(ii)) | Type (N/A)  | Degree (Open-air/Adq/Inadq) | Availability (G/F/P) | Zone           | Horiz (m)                                                   | Vert (m)           |                                                                                                                                                |
|                                                           | Manifold.                                   | High point vents (limited data available). | P                        | 1-6                | <10 000 | Amb    | C                           | N           | O                           | G                    | 1              | 2.5                                                         | 2.5                | IP 15 table C9(a), for release hole diameter of 2mm. Section (5.4.4.4. suggest instrumentation vents should be limited to release of <10m³/h). |
| HP Routing manifolds                                      |                                             |                                            |                          |                    |         |        |                             |             |                             |                      |                |                                                             |                    |                                                                                                                                                |
| Same as above for pressures of <10 000kPa.                |                                             |                                            |                          |                    |         |        |                             |             |                             |                      |                |                                                             |                    |                                                                                                                                                |
| Density Huts and Sample Points                            |                                             |                                            |                          |                    |         |        |                             |             |                             |                      |                |                                                             |                    |                                                                                                                                                |
|                                                           | Sampling cabinet.                           | Sample point outlet                        | P                        | 1-6                | <2 000  | Amb    | C                           | N           | A                           | G                    | 1              | 4.5                                                         | 4.5                | IP 15 Section 5.4.2. (Sampling opening diameter ø9mm, linear adapted from 10mm release and 10 000kPa)                                          |
|                                                           |                                             |                                            |                          |                    |         |        |                             |             |                             |                      |                | Interior of enclosure/ shed + 7m to open side (if enclosed) |                    |                                                                                                                                                |
|                                                           | Sampling cabinet.                           | Vapour drifting from sample points         | S                        | 1-6                | Atm     | Amb    | C                           | N           | O                           | G                    | 2              | 1m above ground level                                       | 1                  | IP 15, adapted from figure 5.4. (for liquid pool with surface area of 9m²)                                                                     |
|                                                           | Draining sumps/trenches from sample points. | Liquid surface in open top drains          | C                        | 1-6                | Atm     | Amb    | C                           | N           | O                           | G                    | 0              | Interior                                                    |                    | IP 15 section 5.4.1.0.                                                                                                                         |
|                                                           | Draining sumps/trenches from sample points. | Top sides of open top drains               | P                        | 1-6                | Atm     | Amb    | C                           | N           | O                           | G                    | 1              | 1                                                           | 1                  | IP 15 figure 5.5.                                                                                                                              |
| Oil/Water separators and spillage collection basins/sumps |                                             |                                            |                          |                    |         |        |                             |             |                             |                      |                |                                                             |                    |                                                                                                                                                |
|                                                           | Oil/water separators.                       | Interior of the separator tank.            | C                        | 1-6                | Atm     | Amb    | C                           | N           | O/I                         | G/P                  | 0              | Interior up to the height of the tank/sump walls            |                    | IP 15 section 5.4.8.                                                                                                                           |
|                                                           | Oil/water separator (open top).             | Top sides of the separator.                | C                        | 1-6                | Atm     | Amb    | C                           | N           | O                           | G                    | 1              | Up to 1m above release point and down to ground level       | 2                  | IP 15 figure 5.4, for a liquid surface of up to 5x3m.                                                                                          |
|                                                           | Oil/water separator (closed).               | Top sides of the separator.                | C                        | 1-6                | Atm     | Amb    | C                           | N           | O                           | G                    | 1              | Up to 1m above release point and down to ground level       | 2 from any opening | IP 15 figure 5.4, for a liquid surface of up to 5x3m.                                                                                          |



| Equipment                                            |                                                                                                                      | SOR                                          | Grade of release (C/P/S) | Flammable Material |                                        |        |                             | Ventilation |                             |                      | Hazardous Area |                                         |          | Reference                                                                                                      |
|------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|----------------------------------------------|--------------------------|--------------------|----------------------------------------|--------|-----------------------------|-------------|-----------------------------|----------------------|----------------|-----------------------------------------|----------|----------------------------------------------------------------------------------------------------------------|
| ID                                                   | Item                                                                                                                 |                                              |                          | Material No.       | P (kPa)                                | T (°C) | State (S/A/B/C/G (i)/G(ii)) | Type (N/A)  | Degree (Open-air/Adq/Inadq) | Availability (G/F/P) | Zone           | Horiz (m)                               | Vert (m) |                                                                                                                |
|                                                      | Open top basins.                                                                                                     |                                              |                          |                    |                                        |        |                             |             |                             |                      |                | Refer to open top Oil/water separators. |          |                                                                                                                |
|                                                      | Open top sumps with no primary release points in them but located in a hazardous area (typically rain water drains). | Liquid contaminant surface and vapour drift. | C                        | 1-6                | Atm                                    | Amb    | C                           | N           | I                           | G                    | 1              | Interior                                |          | IP 15 section 5.4.10.                                                                                          |
| Motorised Block Valve Chambers (buried below ground) |                                                                                                                      |                                              |                          |                    |                                        |        |                             |             |                             |                      |                |                                         |          |                                                                                                                |
|                                                      | Pipes and instrumentation.                                                                                           | Valve stems, flanged and threaded joints.    | S                        | 1-6                | <10 000 (Assumed maximum as from NMPP) | Amb    | C                           | N           | I                           | P                    | 1              | 2.5                                     | 2.5      | IP 15 Section 5.4.5. (can be zone 2 if well ventilate, >12air changes per hour over the volume of the chamber) |
| Loading Gantries                                     |                                                                                                                      |                                              |                          |                    |                                        |        |                             |             |                             |                      |                |                                         |          |                                                                                                                |
|                                                      | Road tanker loading bay (covered, see sketch below).                                                                 | Loading island                               | S                        | 1-6                | 344                                    | Atm    | C                           | N           | O                           | G                    | 1              | 1                                       | 1        | IP 15 Fig. 3.8.                                                                                                |
|                                                      | Road tanker loading bay (covered).                                                                                   | Spillage bund                                | S                        | 1-6                | Atm                                    | Atm    | C                           | N           | O                           | G                    | 2              | Under the roofing                       |          | IP 15 Fig. 3.8.                                                                                                |
|                                                      | IP 15 Fig. 3.8.                                                                                                      |                                              |                          |                    |                                        |        |                             |             |                             |                      |                |                                         |          |                                                                                                                |

| Equipment                                                             |                                 | SOR                                      | Grade of release (C/P/S) | Flammable Material |         |        |                             | Ventilation |                             |                        | Hazardous Area |                                                                                   |          | Reference              |
|-----------------------------------------------------------------------|---------------------------------|------------------------------------------|--------------------------|--------------------|---------|--------|-----------------------------|-------------|-----------------------------|------------------------|----------------|-----------------------------------------------------------------------------------|----------|------------------------|
| ID                                                                    | Item                            |                                          |                          | Material No.       | P (kPa) | T (°C) | State (S/A/B/C/G (i)/G(ii)) | Type (N/A)  | Degree (Open-air/Adq/Inadq) | Availa= bility (G/F/P) | Zone           | Horiz (m)                                                                         | Vert (m) |                        |
|                                                                       | Road tanker loading bay (open). | Flexible hose connection point           | P                        | 1-6                | Atm     | Atm    | C                           | N           | O                           | G                      | 1              | 1                                                                                 | 1        | IP 15 Section 3.3.4.1. |
|                                                                       | Road tanker loading bay (open). | Flexible hose connection point           | P                        | 1-6                | Atm     | Atm    | C                           | N           | O                           | G                      | 1              | 1 and up to 1m above the flexible hose connection point's storage height.         | 1        | IP 15 Section 3.3.     |
| <b>Road tanker offloading</b>                                         |                                 |                                          |                          |                    |         |        |                             |             |                             |                        |                |                                                                                   |          |                        |
|                                                                       | Road tanker (top loading).      | Tanker fill covers                       | P                        | 1-6                | Atm     | Atm    | C                           | N           | O                           | G                      | 1              | 1                                                                                 | 1        | IP 15 Section 3.3.     |
|                                                                       | Road tanker.                    | Liquid surfaces in tank                  | C                        | 1-6                | Atm     | Atm    | C                           | N           | I                           | P                      | 0              | Interior                                                                          |          | IP 15 section 1.       |
|                                                                       | Road tanker (bottom loading).   | Manhole covers or vents                  | S                        | 1-6                | Atm     | Atm    | C                           | N           | O                           | G                      | 2              | 1                                                                                 | 1        | IP 15 Section 3.3.     |
|                                                                       | Road tanker (bottom loading).   | Connection points on side of road tanker | P                        | 1-6                | Atm     | Atm    | C                           | N           | O                           | G                      | 1              | 1                                                                                 | 1        | IP 15 Section 3.3.     |
|                                                                       | Road tanker (bottom loading).   | spillages                                | S                        | 1-6                | Atm     | Atm    | C                           | N           | O                           | G                      | 2              | 1                                                                                 | 4        | IP 15 Section 3.3.     |
| <b>Test and product sample rooms (As extracted from the NMPP TM2)</b> |                                 |                                          |                          |                    |         |        |                             |             |                             |                        |                |                                                                                   |          |                        |
|                                                                       | Product sample room.            | Liquid surfaces in containers            | C                        | 1-6                | Atm     | Amb    | C                           | A           | I                           | P                      | 0              | Interior of containers                                                            |          | IP 15 Section 1.       |
|                                                                       | Product sample room             | Spillages                                | S                        | 1-6                | Atm     | Amb    | C                           | A           | A                           | G                      | 1              | Interior of the spillage containment system up to a height of 1m above the floor. |          | IP 15, section 5.4.7.  |

| Equipment                                                                                                                                                                                                                                                                                                                    |                               | SOR                                                                                                | Grade of release (C/P/S) | Flammable Material |         |        |                             | Ventilation |                             |                       | Hazardous Area |                                                                                           |          | Reference                                                                                    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|----------------------------------------------------------------------------------------------------|--------------------------|--------------------|---------|--------|-----------------------------|-------------|-----------------------------|-----------------------|----------------|-------------------------------------------------------------------------------------------|----------|----------------------------------------------------------------------------------------------|
| ID                                                                                                                                                                                                                                                                                                                           | Item                          |                                                                                                    |                          | Material No.       | P (kPa) | T (°C) | State (S/A/B/C/G (i)/G(ii)) | Type (N/A)  | Degree (Open-air/Adq/Inadq) | Availa=bility (G/F/P) | Zone           | Horiz (m)                                                                                 | Vert (m) |                                                                                              |
|                                                                                                                                                                                                                                                                                                                              | Product sample room.          | Spillages                                                                                          | S                        | 1-6                | Atm     | Amb    | C                           | A           | A                           | G                     | 2              | Interior of the room.                                                                     |          | IP 15, section 5.4.7.                                                                        |
|                                                                                                                                                                                                                                                                                                                              | Test room fume hood/cupboard. | Liquid in containers                                                                               | C                        | 1-6                | Atm     | Amb    | C                           | A           | I                           | P                     | 0              | Interior of containers.                                                                   |          | IP 15, Annex E and section 1.                                                                |
|                                                                                                                                                                                                                                                                                                                              | Test room fume hood/cupboard  | Liquid in during decanting                                                                         | S                        | 1-6                | Atm     | Amb    | C                           | A           | A                           | G                     | 2              | Volume under fume hood.                                                                   |          | IP 15, conservative zoning, can be fire hazard only, if <25liter flammable material is used. |
|                                                                                                                                                                                                                                                                                                                              | Test room.                    | Liquid surfaces in waste sinks and waste collection sump.                                          | P                        | 1-6                | Atm     | Amb    | C                           | A/N         | A                           | G                     | 1              | Volume of the sink and the interior of the waste sump up to the height of the bund walls. |          | IP 15, adapted from section 5.4.7.                                                           |
|                                                                                                                                                                                                                                                                                                                              | Test room.                    | Liquid surfaces in waste drain pipes.                                                              | P                        | 1-6                | Atm     | Amb    | C                           | N           | I                           | P                     | 0              | Interior of drain pipes.                                                                  |          | IP 15 Section 1.6.8.                                                                         |
| The extraction ventilation system in the Sample Store Room was assumed to always be operational as well as the extraction ventilation on the fume cupboards located in the sample test room. Spillages must be cleaned promptly. Self-closing mechanisms to be placed on doors leading to the Test room and the Sample room. |                               |                                                                                                    |                          |                    |         |        |                             |             |                             |                       |                |                                                                                           |          |                                                                                              |
| <b>Tarlton Additives Dosing Gantry</b>                                                                                                                                                                                                                                                                                       |                               |                                                                                                    |                          |                    |         |        |                             |             |                             |                       |                |                                                                                           |          |                                                                                              |
|                                                                                                                                                                                                                                                                                                                              | Road tanker for offloading.   | Refer to Figure 3.12 below for zoning around the Additives carrying road tanker during offloading. |                          |                    |         |        |                             |             |                             |                       |                |                                                                                           |          | IP 15 Fig. 3.12. (conservatively adapted since the flashpoint was >55°C)                     |

| Equipment |                                | SOR                                                                                                                                                                                                                                                                    | Grade of release (C/P/S) | Flammable Material |                                     |        | Ventilation                 |            |                             | Hazardous Area       |      |                                                                                                                                                             | Reference |                                                                                                  |
|-----------|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|--------------------|-------------------------------------|--------|-----------------------------|------------|-----------------------------|----------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|--------------------------------------------------------------------------------------------------|
| ID        | Item                           |                                                                                                                                                                                                                                                                        |                          | Material No.       | P (kPa)                             | T (°C) | State (S/A/B/C/G (i)/G(ii)) | Type (N/A) | Degree (Open-air/Adq/Inadq) | Availability (G/F/P) | Zone | Horiz (m)                                                                                                                                                   |           | Vert (m)                                                                                         |
|           | IP 15 Fig. 3.12.               | <div></div> <p>Note: Ullage space in the road tanker should be classified as Zone 0.</p> <p>Figure 3.12 Typical hazardous area classification of a road tanker during unloading</p> |                          |                    |                                     |        |                             |            |                             |                      |      |                                                                                                                                                             |           |                                                                                                  |
|           | Additives Tanks.               | Liquid surfaces.                                                                                                                                                                                                                                                       | C                        | 7                  | Amb                                 | Amb    | C                           | N          | I                           | P                    | 0    | Interior of the tanks.                                                                                                                                      |           | IP 15, Section 1.                                                                                |
|           | Additives Tanks.               | Breather vents (gooseneck type vents assumed).                                                                                                                                                                                                                         | S                        | 7                  | Amb                                 | Amb    | C                           | N          | A                           | G                    | 2    | 2                                                                                                                                                           | 2         | IP 15, Section 5.4.4.2. and Section 6.2 (conservatively adapted since the flashpoint was >55°C). |
|           | Additives Tanks.               | Spillages in bund.                                                                                                                                                                                                                                                     | S                        | 7                  | Amb                                 | Amb    | C                           | N          | A                           | G                    | 1    | Extend to cover area below roof and down to ground level (in order to simplify).<br>Interior of the bund and drain pipes and up to height of the bund wall. |           |                                                                                                  |
|           | Additives Tank transfer pumps. | Shaft seals (Centrifugal pumps).                                                                                                                                                                                                                                       | S                        | 7                  | <500 (obtained from similar plants) | Amb    | C                           | N          | A                           | G                    | 2    | 4                                                                                                                                                           | 4         | IP 15 adapted from Table C9(a) (conservatively adapted since the flashpoint was >55°C).          |

| Equipment |                                | SOR                              | Grade of release (C/P/S) | Flammable Material |                                     |        |                            | Ventilation |                             |                       | Hazardous Area |           |          | Reference                                                                                                                 |
|-----------|--------------------------------|----------------------------------|--------------------------|--------------------|-------------------------------------|--------|----------------------------|-------------|-----------------------------|-----------------------|----------------|-----------|----------|---------------------------------------------------------------------------------------------------------------------------|
| ID        | Item                           |                                  |                          | Material No.       | P (kPa)                             | T (°C) | State (S/A/B/C/G(i)/G(ii)) | Type (N/A)  | Degree (Open-air/Adq/Inadq) | Availa=bility (G/F/P) | Zone           | Horiz (m) | Vert (m) |                                                                                                                           |
|           | Additives Tank transfer pumps. | Shaft seals (Peristaltic pumps). | S                        | 7                  | <500 (obtained from similar plants) | Amb    | C                          | N           | A                           | G                     | 2              | 2.5       | 2.5      | IP 15, adapted from Section 5.4.1.1. (conservative Zone, fine mist or spray forming not regularly expected and FP >55°C). |
|           | Oil/Water separator.           | Refer to entry higher in table.  |                          |                    |                                     |        |                            |             |                             |                       |                |           |          |                                                                                                                           |

Zoning in the Additives Storage Area can be read as conservative since the flash point is relatively high with regards to the handling temperatures.

NOTE 1 – Abbreviations used:

**SOR** source of release

**Grade of release:** C Continuous  
P Primary  
S Secondary

**P:** Pressure

**T:** Temperature

**State:** S solid  
A fluid category A  
B fluid category B  
C fluid category C  
G(i) fluid category G(i)  
G(ii) fluid category G(ii)

**Ventilation type:** N Natural  
F Forced/artificial

**Ventilation availability:** G Good  
F Fair  
P Poor

NOTE 2 - This table must be read in conjunction with Annex A.

NOTE 3 - A release frequency of Level I was considered appropriate.

NOTE 4- A release hole size of 2mm was specified in IP15 if data on the release of these seals were not available.

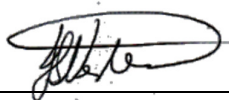


## 6 GENERAL

- 6.1 Where a condition or conditions (shown in *italics*) are specified in conjunction with the classification such conditions must be met to validate the classification. Non-compliance with the condition will normally require a more severe zone to be declared.

It is normally required that such conditions be displayed in affected areas and listed on area classification drawings, and that operators are trained on their necessity and application.

- 6.2 An area classification drawing (refer to ANNEX B for guidance) must be prepared referring to classification report and must be approved as a true reflection of this report. This drawing must include the explosive properties of the flammable materials as well as a reference to this report.
- 6.3 Suitable signage must be displayed to identify hazardous locations (refer to SANS 10086-1 and ANNEX D for guidance), including signage to prohibit smoking and open flames and to control the usage of standard equipment.
- 6.4 **Fixed** electrical equipment and instrumentation installed in hazardous areas must be suitably explosion protected. Any **mobile** electrical or electronic equipment that may be used in these hazardous areas (e.g. radios, electronic testers, etc.) must be explosion protected, unless used under suitable hot work permit conditions (refer to ANNEX C for guidance).
- 6.5 This document should be used as a guide only. If there are additional sources of release on the plant they should be additionally evaluated. A site specific area classification report should also be prepared, especially to capture spillage containment and to consider obstructions like walls and buildings in hazardous areas.



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## ANNEX A: DISCUSSION OF ZONING TABLES

### A.1 REFERENCES

SANS 60079-10 Ed 4.0: 2002  
IP Part 15

Suggested format  
Role of RD

### A.2 APPLICATION

**State:** When finely divided, i.e. in dust form (typically with particle size less than 500 micron), a flammable **solid** material can form an explosive atmosphere when suspended in air.

The rate of vaporization (volatility) of a **fluid** depends on vapour pressure, or alternatively flash point and boiling point compared to ambient temperature. Therefore, IP Part 15 allocates the hazard radius in terms of the following fluid categories:

- Fluid category A: that, on release, would vapourize rapidly and substantially. This category includes:
- a) Any liquefied petroleum gas or lighter flammable liquid.
  - b) Any flammable liquid at a temperature sufficient to produce, on release, more than about 40% by volume vaporization with no heat input other than from the surroundings.
- Fluid Category B: A flammable liquid, not in category A, but at a temperature sufficient for boiling to occur on release.
- Fluid Category C: A flammable liquid, not in categories A or B but that can, upon release, be at a temperature above its flash point, or form a flammable mist or spray.
- Fluid Category G(i): A typical methane-rich natural gas.
- Fluid Category G(ii): Refinery hydrogen.

These can be compared with the flammable material State (Gas, Liquid, and Liquefied Gas) referred to in IEC/SANS 60079-10.

When the fluid consists of more than one phase i.e. liquid and vapour the major phase will be stated.

**Degree of ventilation:** According to SANS 60079-10, the degree of ventilation for mainly indoors situations can be determined by calculating a hypothetical volume  $V_z$  in comparison to the ventilated area  $V_0$ ; if  $V_z$  is not larger than  $V_0$  then the degree of ventilation is sufficient to prevent stagnation and facilitate dispersion and dilution (medium or high ventilation) and the zone is directly related to the grade of release:

|                    |         |
|--------------------|---------|
| Continuous release | Zone 0  |
| Primary release    | Zone 1  |
| Secondary release  | Zone 2. |

Low ventilation will cause a more severe zone in the case of a primary or secondary grade release.

In outdoor (open-air) locations the natural ventilation rate is accepted to be a minimum of 0,5m/s and frequently >2m/s. Turbulent flow requires 2m/s but due to turbulence induced by

obstacles even at low ventilation rates, open-air ventilation can be assumed to be fair (medium ventilation).

In practice, high ventilation can generally be applied only to a local artificial ventilation system around a source, to small enclosed areas or to very low release rates.

Low ventilation will not generally occur in open-air situations except where there are restrictions to air flow, for example, in pits.

IP Part 15 uses slightly different terminology (open-air, adequate or inadequate ventilation) but applies the same principles.

**Ventilation availability:**      Good: ventilation is present virtually continuously;  
Fair: ventilation is expected to be present during normal operation. Discontinuities are permitted provided they occur infrequently and for short periods;  
Poor: ventilation, which does not meet the standard of fair or good, but discontinuities are not expected to occur for long periods.

The availability of natural ventilation is rated as good. Artificial ventilation should not be worse than poor (discontinuities is not expected to occur for long periods) if such ventilation is to be taken into account. This requires backup fans or power or shutting down of flammable material release in case of ventilation failure.

## ANNEX B: AC DRAWINGS

Examples of area classification drawing as described in SANS 60079-10-2: 2009 and SANS 10089-3: 2007.

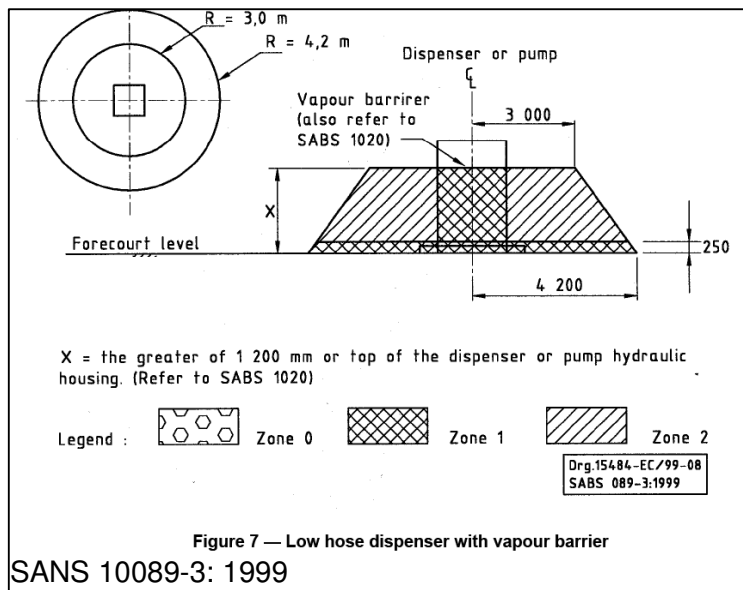
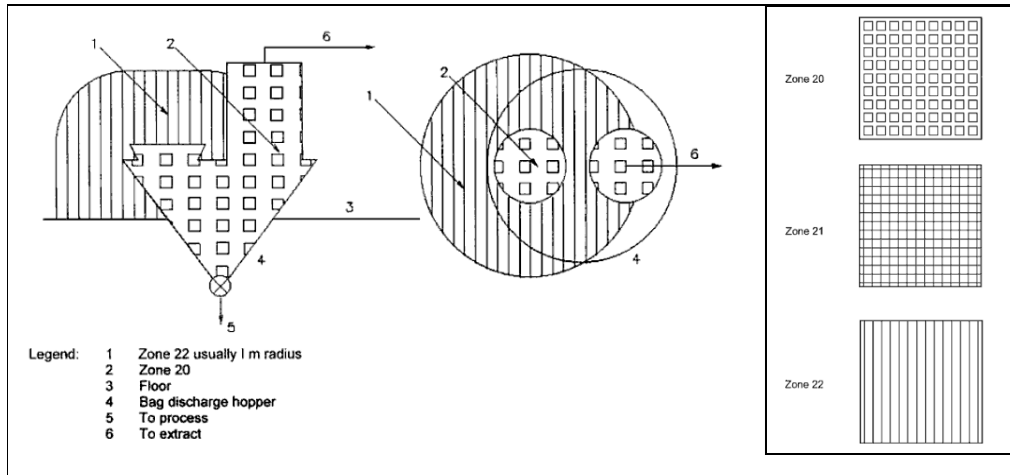


Figure 7 — Low hose dispenser with vapour barrier

SANS 10089-3: 1999

## ANNEX C: EQUIPMENT SELECTION

### Selection of equipment according to EPL

In the past, a statistical approach to equipment selection was followed, whereby the probability of an explosion was limited.

The equipment selection standard now also allows for a risk-based approach. In a risk-based approach, the **consequence** of an explosion is also taken into account, **together with the probability** of an explosion.

To facilitate the risk-based approach, the concept of Equipment Protection Level (EPL) was introduced. The EPL for each explosion protection technique has been determined and ranges from “Very High” to “High” to “Normal”. The table below shows the relationship between type of protection and EPLs.

| Protection afforded                                                      | EPL     |               |           | Type of protection                                                       | Code                  | According to standard          | Conditions of operation                                         |
|--------------------------------------------------------------------------|---------|---------------|-----------|--------------------------------------------------------------------------|-----------------------|--------------------------------|-----------------------------------------------------------------|
|                                                                          | Group I | Group II      | Group III |                                                                          |                       |                                |                                                                 |
| Very High                                                                | 'Ma'    |               |           | Same as 'Ga'                                                             |                       |                                | Equipment remains functioning when explosive atmosphere present |
| Very High                                                                |         | 'Ga'          |           | Intrinsically safe                                                       | 'ia'                  | SANS 60079-11                  | Equipment remains functioning in Zones 0, 1 and 2               |
|                                                                          |         |               |           | Encapsulation                                                            | 'ma'                  | SANS 60079-18                  |                                                                 |
|                                                                          |         |               |           | Two independent type of protection each meeting EPL 'Gb'                 |                       | SANS 60079-26                  |                                                                 |
|                                                                          |         |               |           | Protection of equipment and transmission systems using optical radiation |                       | SANS 60079-28                  |                                                                 |
| Very High                                                                |         |               | 'Da'      | Intrinsically safe                                                       | 'iD'                  | SANS 60079-11                  | Equipment remains functioning in Zones 20, 21 and 22            |
|                                                                          |         |               |           | Encapsulation                                                            | 'mD'                  | SANS 60079-18                  |                                                                 |
|                                                                          |         |               |           | Protection by enclosure                                                  | 'tD'                  | SANS 60079-31 (IP65 enclosure) |                                                                 |
| High                                                                     | 'Mb"    |               |           | Same as 'Gb'                                                             |                       |                                | Equipment de-energized when explosive atmosphere present        |
| High                                                                     |         | 'Gb'          |           | Flameproof enclosures                                                    | 'd'                   | SANS 60079-1                   | Equipment remains functioning in Zones 1 and 2                  |
|                                                                          |         |               |           | Increased safety                                                         | 'e'                   | SANS 60079-7                   |                                                                 |
|                                                                          |         |               |           | Intrinsically safe                                                       | 'ib'                  | SANS 60079-11                  |                                                                 |
|                                                                          |         |               |           | Encapsulation                                                            | 'm'<br>'mb'           | SANS 60079-18                  |                                                                 |
|                                                                          |         |               |           | Oil immersion                                                            | 'o'                   | SANS 60079-6                   |                                                                 |
|                                                                          |         |               |           | Pressurized enclosures                                                   | 'p', 'px'<br>'or 'py' | SANS 60079-2                   |                                                                 |
|                                                                          |         |               |           | Powder filling                                                           | 'q'                   | SANS 60079-5                   |                                                                 |
|                                                                          |         |               |           | Fieldbus intrinsically safe concept (FISCO)                              |                       | SANS 60079-27                  |                                                                 |
| Protection of equipment and transmission systems using optical radiation |         | SANS 60079-28 |           |                                                                          |                       |                                |                                                                 |
| High                                                                     |         |               | 'Db'      | Intrinsically safe                                                       | 'iD'                  | SANS 60079-11                  | Equipment remains functioning in Zones 21 and 22                |
|                                                                          |         |               |           | Encapsulation                                                            | 'mD'                  | SANS 60079-18                  |                                                                 |
|                                                                          |         |               |           | Protection by enclosure                                                  | 'tD'                  | SANS 60079-31 (IP65 enclosure) |                                                                 |
|                                                                          |         |               |           | Pressurized enclosures                                                   | 'pD'                  | SANS 61241-4                   |                                                                 |



| Protection afforded | EPL     |          |           | Type of protection                                                      | Code        | According to standard          | Conditions of operation                  |
|---------------------|---------|----------|-----------|-------------------------------------------------------------------------|-------------|--------------------------------|------------------------------------------|
|                     | Group I | Group II | Group III |                                                                         |             |                                |                                          |
| Normal              |         | 'Gc'     |           | Intrinsically safe                                                      | 'ic'        | SANS 60079-11                  | Equipment remains functioning in Zone 2  |
|                     |         |          |           | Encapsulation                                                           | 'mc'        | SANS 60079-18                  |                                          |
|                     |         |          |           | Non-sparking                                                            | 'n' or 'nA' | SANS 60079-15                  |                                          |
|                     |         |          |           | Restricted breathing                                                    | 'nR'        | SANS 60079-15                  |                                          |
|                     |         |          |           | Energy limitation                                                       | 'nL'        | SANS 60079-15                  |                                          |
|                     |         |          |           | Sparking equipment                                                      | 'nC'        | SANS 60079-15                  |                                          |
|                     |         |          |           | Pressurized enclosures                                                  | 'pz'        | SANS 60079-2                   |                                          |
|                     |         |          |           | Fieldbus non-incendive concept (FNICO)                                  |             | SANS 60079-27                  |                                          |
|                     |         |          |           | Protection of equipment and transmission system using optical radiation |             | SANS 60079-28                  |                                          |
| Normal              |         |          | 'Dc'      | Intrinsically safe                                                      | 'iD'        | SANS 60079-11                  | Equipment remains functioning in Zone 22 |
|                     |         |          |           | Encapsulation                                                           | 'mD'        | SANS 60079-18                  |                                          |
|                     |         |          |           | Protection by enclosures                                                | 'tD'        | SANS 60079-31 (IP65 enclosure) |                                          |
|                     |         |          |           | Pressurized enclosures                                                  | 'pD'        | SANS 61241-4                   |                                          |

If risk is normal, which is mostly the case, the probability of an explosion is the only controlling factor and a direct relationship between EPL and Zone exists that is used to select equipment:

| Zone | Minimum Equipment Protection Level (EPL) |
|------|------------------------------------------|
| 0    | Ga                                       |
| 1    | Gb                                       |
| 2    | Gc                                       |
| 20   | Da                                       |
| 21   | Db                                       |
| 22   | Dc                                       |

## ANNEX D: DEMARCATION

### Demarcation of hazardous areas:

**SANS 10108:2005**  
Edition 5

#### **Annex D** (informative)

### **Demarcation of hazardous locations**

**D.1** An international convention for demarcation does not at present exist. The information provided through demarcation should identify the location as hazardous and should define the hazard level (zone or zones). The flammable materials present and the corresponding gas groups and temperature classes or dust layer and dust cloud ignition temperatures could additionally be provided.

**D.2** The following are practical methods of demarcation:

- a) In a surface plant, elect a central (dominant) point that regulates access to the area, for example a control room. Display the area classification drawing(s) identifying zoned areas and the relevant flammable materials.
- b) At entry points to (or borders of) the plant, display a triangle marked "Ex" (recommended side length 150 mm, black border and letters, yellow background).

**Examples of marking on plants** (these examples might be out of date and it should be considered not to include too much info on the marking that may change regularly):

