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28 July 2016
501573

Granor Passi Langkloof (Pty) Ltd
Main Road
Louterwater

Attention: Gert van Zyl

Dear Gert

Groundwater Investigation for Evaporation Ponds at Granor Passi Langkloof (Louterwater) – Revision 1

1. Introduction and Scope of Report

Granor Passi Langkloof (Pty) Ltd (the Client) owns and operates the Louterwater plant where juice concentrate is extracted. Effluent from the various processes is collected and pumped to the existing effluent evaporation ponds located approximately 1.5 km north east of the plant. The existing effluent evaporation ponds are operational and functioning as intended. However, routine maintenance cannot be carried out on the ponds as there is no alternative system to dispose of the effluent. Additional effluent evaporation ponds are therefore required for the system to operate in a duty / standby configuration to allow maintenance to be carried out when needed.

SRK Consulting (SRK) (Pty) Ltd. was appointed by Granor Passi to conduct the design, associated environmental authorisation and permitting applications for the proposed effluent evaporation ponds (the Site). An Integrated Waste License and Environmental Authorisation as well as a Water Use License are required in terms of the relevant legislation for the proposed plant. A Basic Assessment process has commenced and a groundwater investigation (this report) is a requirement for this process as well as the Water Use License Application (WULA).

The following Scope of Works is applicable for this investigation and is quoted from the proposal document submitted by SRK:

- "*Conduct a desktop assessment of the geology and hydrogeology within a radius of approximately 1 km of the proposed Site. This will include an assessment of the geological, hydrogeological and* *topographical maps; and the National Groundwater Archives (NGA) – a database of the Department of Water and Sanitation (DWS).*

- *Undertake a hydrocensus of boreholes within a 1 km radius of the proposed Site. The hydrocensus will be limited to identifying existing boreholes and recording any available information, including its position, depth, water level, water pH and conductivity. Exiting potential pollution sources will also be noted.*
- *Describe the potential impact of the proposed development on the hydrogeological regime in general, particularly during the operational phase; and*
- *Recommend appropriate mitigatory measures, to reduce the impact of the proposed development upon the groundwater of the area*."

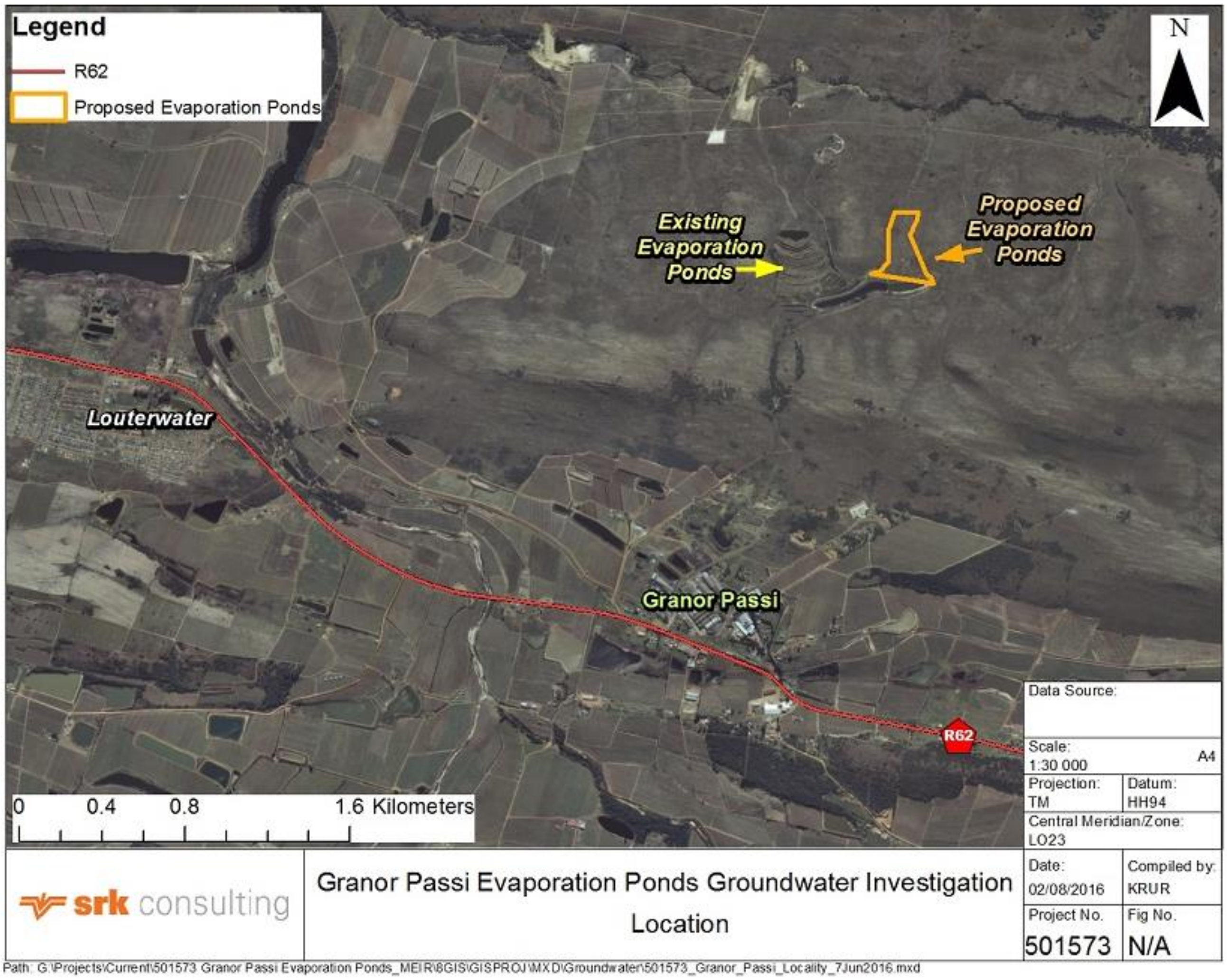


Figure 1: Site Location with Updated Pond Footprint

2. Additional Information

The paragraphs below summarise information from the SRK report "*Effluent Evaporation Ponds Design Report*", 501573/1 Revision 1.

The effluent that is discharged from Granor Passi is regarded acidic with very high Chemical Oxygen Demand (COD) measurements, when viewing against the effluent quality results to the General Authorisation in Terms of Section 39 of the National Water Act, Schedule 2, Table 2.1: "*Wastewater limit values applicable to discharge of wastewater into a water resource",* General Limit of the Department of Water Affairs (2013).

According to the design report by SRK, the design philosophy is based on the assumption that the proposed evaporation ponds will not discharge effluent to the environment, save for emergency situations. It is accepted that the proposed evaporation ponds will significantly increase the quality of the effluent, but it is noted that the system is not designed as an effluent treatment system.

The proposed evaporation ponds will only consist of secondary and tertiary ponds as the existing primary ponds will be utilised for both the new and proposed evaporation ponds. The new secondary ponds will consist of a series of channels connected with overflow weirs. They will be constructed down valley with one below the other. The flow will cascade down into the channels, only flowing from one to the next when the preceding channel is full.

The channels will be constructed using a cut to fill operation with selected excavated clay material from the upstream channel being used to construct the downstream channel embankment. The in situ clay material will be ripped and compacted to form a clay liner.

The tertiary, or emergency pond will be constructed downstream of the secondary ponds. Selected excavated clay material will be used to construct the embankment. The in situ clay material will be ripped and compacted to form a clay liner. The pond will have a capacity to store more than one month's discharge from the plant during the peak season. This should provide sufficient storage for effluent while providing enough time to take remedial action to prevent effluent from being discharged into the downstream environment.

The effluent channels will be lined with clay and be trapezoidal in shape.

3. Results

The results of the investigation are discussed in the section below.

3.1 Desktop Study

3.1.1 Geology

According to the booklet "*The Geology of the Oudtshoorn Area*" by D.K. Toerien (1979) of the Geological Survey (that includes the Louterwater area), the geology of the proposed Site and immediate surroundings comprises formations of the Table Mountain Group (TMG) (refer to Figure 2). The TMG formations are mainly arenaceous (sandstone) except for the Cedarberg Formation which is argillaceous (shaley). The Site itself is underlain by the Goudini Formation which comprises supermature quartzitic sandstone and is between 280 and 330 m thick. The formation is rich in iron and manganese often weathers to have a brownish appearance at the surface. To the south and overlying the Goudini Formation is the Skurweberg Formation (300 to 400 m thick), consisting of supermature quartzitic sandstone with a whiter appearance than the Goudini Formation. To the north of the Site and underlying the Goudini Formation is the Cedarberg Formation. This formation comprises black shale that is between 35 and 55 m thick. The Cedarberg Formation is underlain by the Peninsula Formation which comprises supermature quartzitic sandstone, is the thickest and most massive formation and outcrops extensively to build the highest ranges in the area.

According to the map, the formations dip to the south at 30°.

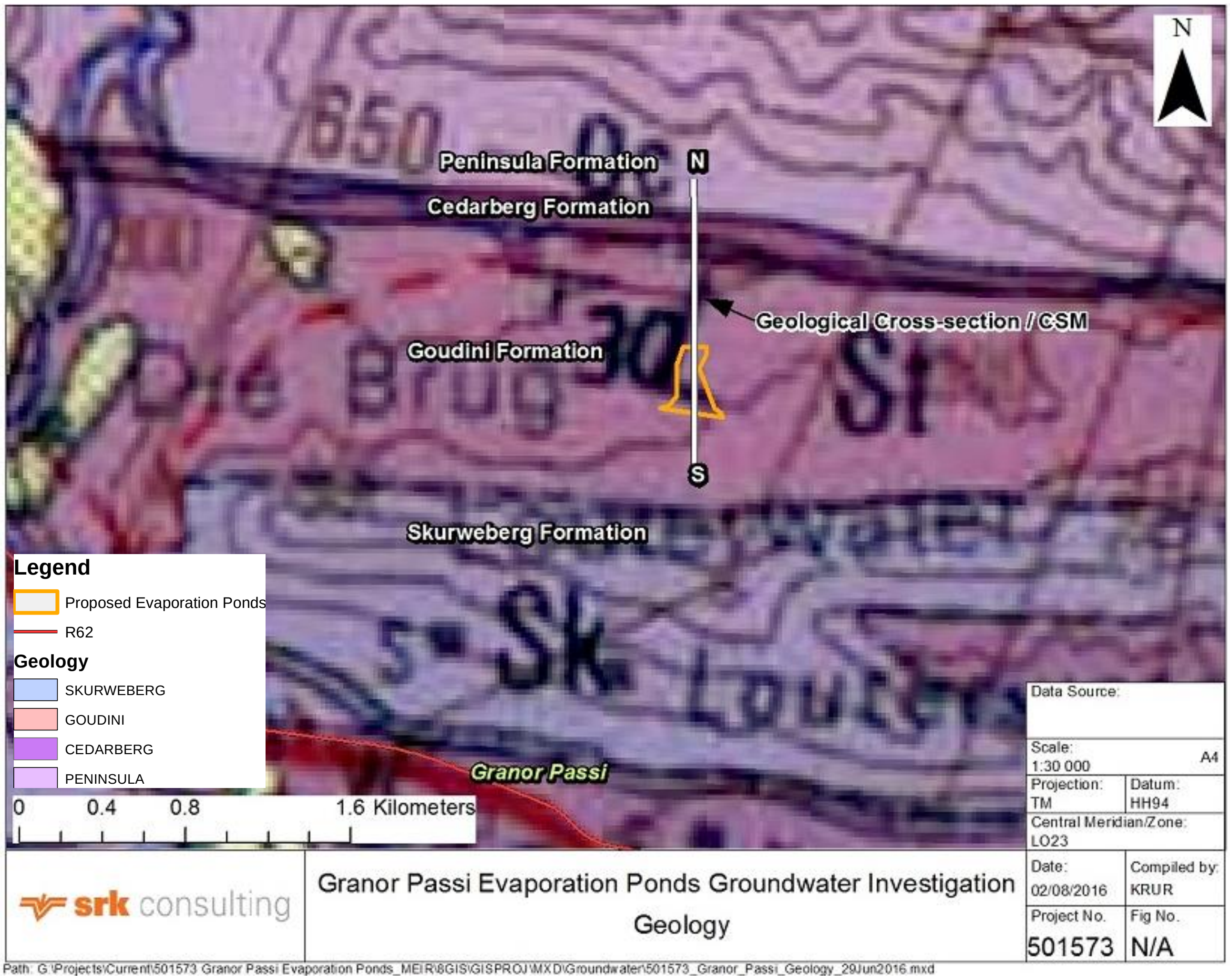


Figure 2: Geology

3.1.2 Hydrogeology

According to the hydrogeological booklet "*An Explanation of the 1:500 000 General Hydrogeological Map of Oudtshoorn*" by P.S Meyer (1999) of the former Department of Water Affairs and Forestry, networks of joints and fractures control the infiltration, recharge, storage and movement of groundwater in the competent and often brittle-natured sandstone units of the TMG. Fracturing may extend down to several hundred meters in many areas and deeper groundwater circulation is one of the notable groundwater characteristics of the TMG.

Despite the often highly fractured nature of the TMG sandstones, secondary groundwater storage is often limited which could result in rapid depletion of an aquifer under conditions of significant groundwater abstraction. The TMG rock generally constitutes mountainous areas, which influences precipitation. Due to the fractured nature of the TMG sandstones in higher rainfall areas, recharge is favourable and infiltration rates of up to 15% of the mean annual precipitation in certain areas are not unrealistic. Springs are often found within the TMG rocks.

High yielding boreholes can be developed in the TMG if scientific methods for borehole siting (e.g. geophysical surveys) are used. The electrical conductivity of groundwater from the TMG is generally between 10 and 100 mS/m, but less potable water is occasionally produced from boreholes drilled into shaley layers. The limit for electrical conductivity according to the SANS 241:2015 Standard for Drinking Water is ≤17 mS/m.

Despite the generally favourable groundwater potential of the TMG, permeability inhibiting material in the form of micro-breccia, mylonite, iron and manganese oxides and silica formed and deposited in many of the fractures and joints may render some of them less effective as groundwater conduits.

3.1.3 National Groundwater Archive (NGA) Database

During the desk study, the NGA database of the Department of Water and Sanitation (DWS) was searched for information on existing boreholes within a 1 km radius of the proposed Site. This database contains information on boreholes that have been registered or licensed with the DWS. No boreholes were identified within a 1 km radius of the proposed Site. In order to gather information on boreholes drilled into the TMG, the NGA was searched for a wider area, up to a 10 km radius. Information was found on 14 boreholes, and given in Table 1 and Figure 3 below.

The data indicates the following:

- Water levels ranged between 1.41 and 34 m bgl. Water levels of the five boreholes closest to the Site (between 1.8 and 5 km) ranged between 3 and 34 m bgl.
- During drilling, water was mainly intersected at deeper depths than where water levels were measured, indicating semi-confined conditions.
- Borehole depths ranged between 13 and 120 m bgl.

Table 1: NGA Data

Borehole ID	Latitude	Longitude	Water Level (m bgl)	Depth (m bgl)	Water Strike Depth (m bgl)
3323DC00001	-33.84961	23.72808	15.7	20	0.01
EC/L82/003	-33.84611	23.73472	10	104	17, 21, 30, 37, 42, 59, 70
3323DC00025	-33.84609	23.73486	10	104	17, 21, 30, 37, 42, 59, 70
EC/L82/017	-33.84602	23.7349	3.56	N/A	N/A
EC/L82/004	-33.84433	23.73224	12	62	N/A
EC/L82/018	-33.84414	23.73288	1.41	N/A	N/A
3323DC00021	-33.84408	23.73277	12	13	14
3323DC00023	-33.819	23.73905	14	67	26, 58, 62
EC/L82/001	-33.81888	23.73916	14	67	26, 58, 62
3323DC00002	-33.80267	23.7192	34	100	63
3323DC00004	-33.80017	23.66447	3	120	9.14, 30.48, 54.86
3323DD00001	-33.79878	23.67724	6	81	78
EC/L82/013	-33.79375	23.63582	6.53	N/A	N/A
EC/L82/026	-33.77182	23.63875	29.5	120	66

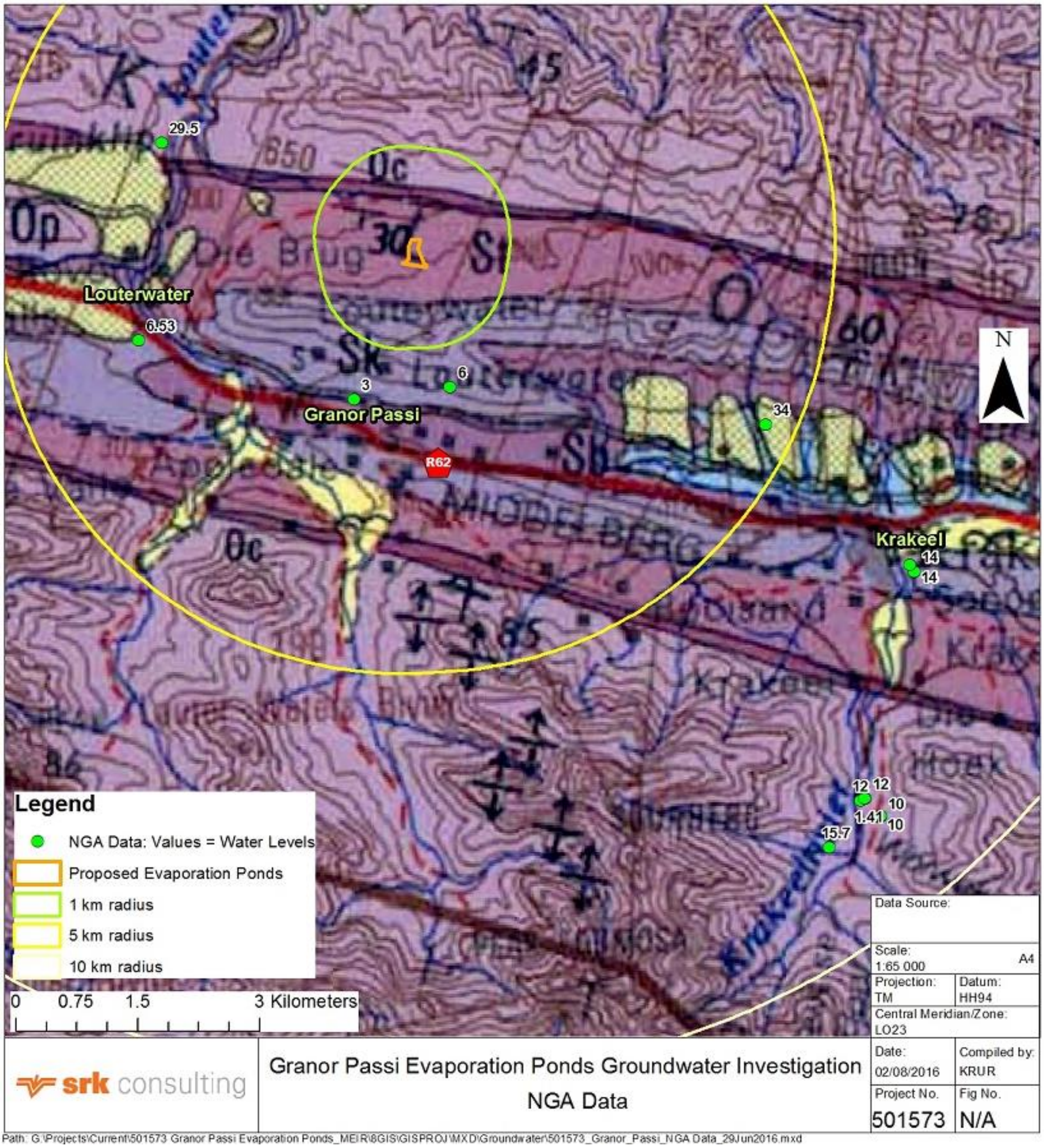


Figure 3: NGA Data

3.1.4 Surface Water and Shallow Groundwater Drainage

The Site is situated on a gradient that dips towards the north. The drainage from the Site is therefore in a northern direction towards a drainage situated approximately 450 m to the north of the Site. From here, flow is in a western direction towards a larger drainage (refer to Figure 4). There is insufficient data to calculate the groundwater flow direction and is therefore assumed to be in the same direction as surface drainage, i.e. north.

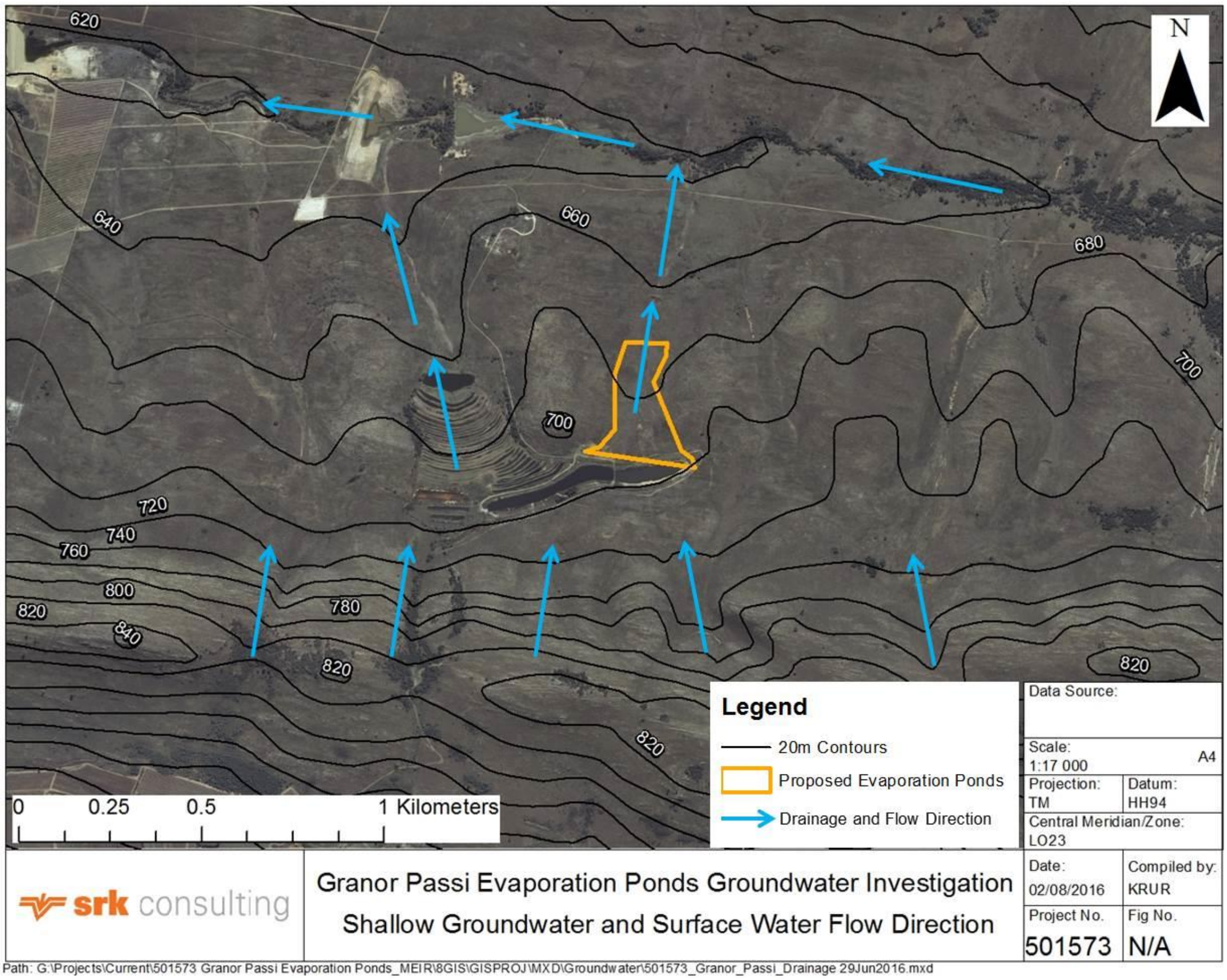


Figure 4: Contour and Assumed Surface Water and Shallow Groundwater Flow Direction

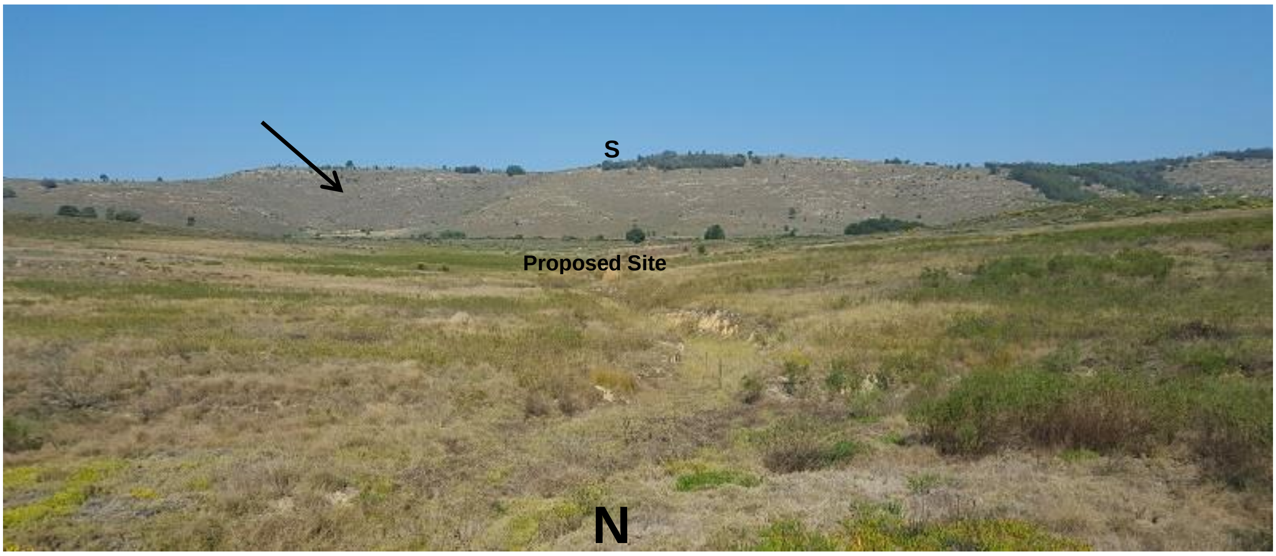
3.2 Hydrocensus and Site Visit

A hydrocensus and site visit was conducted on 8 June 2016. A representative of Granor Passi escorted SRK to the existing evaporation ponds and also the proposed location of the new evaporation ponds. Granor Passi confirmed that they do not use borehole water for their processes, and that they are not aware of existing boreholes within a 1 km radius of the planned evaporation ponds. SRK conducted the hydrocensus and did not identify any boreholes. A drainage was visible positioned in a south-north direction across the proposed Site, indicating the preferred flow path for surface water run-off.

Approximately 500 m to the south of the Site, the Skurweberg Formation was identified as the higher-lying (up to 820 m amsl) lighter coloured quartzitic sandstones (Table 3). Immediately to the south of the Site, the brown weathered quartzitic sandstones of the Goudini Formation were visible (Table 3); and approximately 450 m to the north of the Site, a drainage was observed that originated on the eroded softer shales of the Cedarberg Formation.

During the site visit, no perennial springs were noticed, but seasonal seepage / runoff may occur during periods of high rainfall; and indications of run-off was visible in the north-south drainage of the Site.

Table 2: Photographs



3.3 Geotechnical Investigation

A geotechnical investigation was conducted by SRK between April and July 2016 and was summarised as a part of the report "*Effluent Evaporation Ponds, Design Report, 501573/1 Rev 1*" (July 2016). Existing test pits that was excavated by the Client on and around the Site was inspected during this investigation; and additional test pits were then excavated in the proposed footprint area of the planned pond.

The dominant ground profile is characterised by a top layer of aeolian fine sand with a thickness ranging 0.3 - 0.7 m; which is underlain by thin gravel layer (~0.1 m thick); which is underlain by a fissured clay with a minimum thickness ranging between 0.6 and 1.6 m. The basal contact of the clay was not intersected. Subordinate ground profiles include aeolian sand overlying coarse gravel; clay overlying clayey gravel and quartzitic sandstone bedrock.

A sample of the excavated clay material was collected and submitted to a laboratory for testing. The average hydraulic conductivity of the clay was determined to be 9.5×10^{-9} m/s, which is considered to be practically impervious.

It was recommended that the footprint of the development be moved so that it is situated on the clay material identified as the dominant ground profile. It was also recommended that the aeolian sand horizon and the discontinuous gravel should be removed, as these pose a risk due to estimated high permeability.

4. Impact Assessment

Considering the source - pathway - receptor concept, the following can be concluded for the planned establishment of the evaporation ponds:

- Potential sources of contamination: Effluent with organic pollutants, potentially containing acidic substances, carbon and chlorine.
- Potential pathways: Inconsistent clay layer
- Potential receptors: Groundwater as natural resource and groundwater users.

Risk is considered to be present when a complete link between the source, pathway and receptor is present.

4.1 General Site Assessment

Please refer to Figure 5 for a conceptual site model (CSM) of the groundwater setting, and Figure 2 for the position where the CSM have been drawn. The CSM model reflects the geological formations underlying the Site and surrounding area, the inferred water level (inferred from NGA) and the potential flow direction of surface water and shallow groundwater.

The water level immediately below the Site is unknown. NGA data indicates that, within a 5 km radius, water levels in five boreholes ranged between 3 and 34 m bgl; and within a 10 km radius, water levels in 14 boreholes ranged between 1.4 and 34 m bgl. According to the hydrogeological booklet, the nature of the groundwater surrounding the Site is considered mostly suitable for consumption by humans (according to the SANS 241:2015 Standard for Drinking Water), but manganese and iron concentrations may be elevated, and the water may have to be treated.

Geological structures like folding, fracturing and faulting are often targeted as groundwater supply features. The Site is situated on the northern limb of a synclinal fold, which stretches roughly in an east west direction. In terms of future groundwater development, it cannot be ruled out that the Goudini Formation in this area may be targeted for groundwater supply.

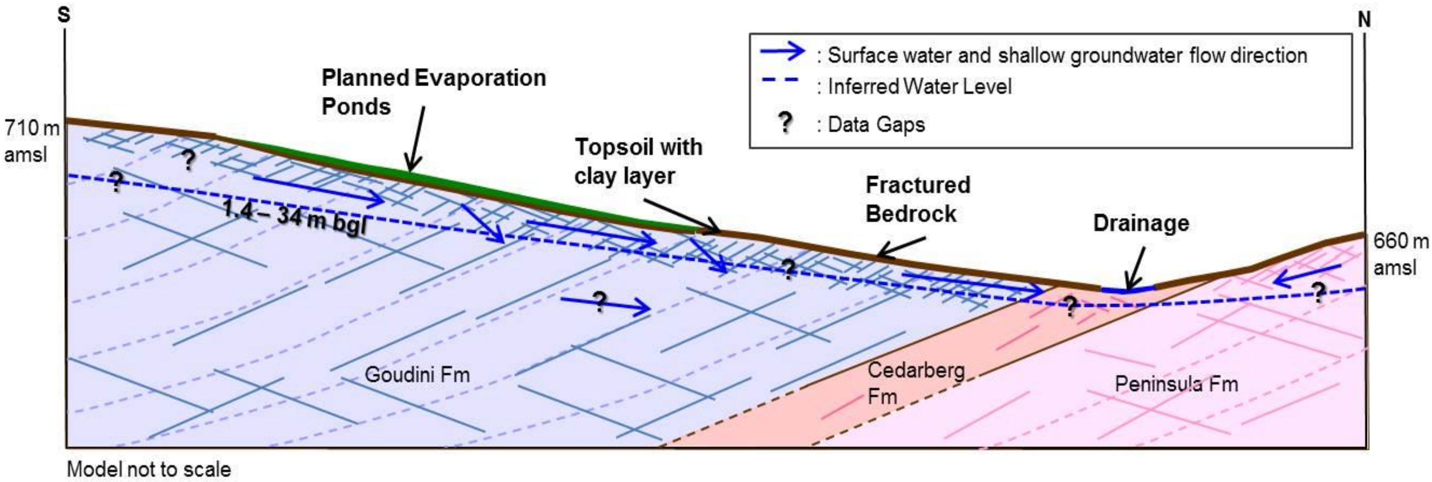


Figure 5: Conceptual Site Model

4.2 Data Gaps

The following data gaps are identified:

- Distance to the water table below the Site, i.e. the thickness of the unsaturated zone.
- Calculated groundwater flow direction of the water table (not a part of the surface water / shallow groundwater flow direction).

4.3 Potential Impact: Pollution of Groundwater Resource by Effluent from the Ponds

According to the design report, the ponds will not be deeper than 1 m bgl, and are planned to be founded in the clay material, which is practically impermeable. If the clay layer is laterally consistent / continuous (it is assumed that this is the case from the geotechnical investigation), the potential for contaminants from the ponds to reach the groundwater is regarded slim. Using the "*National Norms and Standards for Disposal of Waste to Landfill*", of the Department of Environmental Affairs, as published in the Government Gazette on 23 August 2013, as a guideline, it is recommended that the clay layer below the base of the ponds must be between 300 and 600 mm in thickness across the entire Site. The clay must also be present on the sidewalls of the ponds in order to prevent lateral movement in e.g. the sand or gravel material.

4.4 Rating of Potential Impact

4.4.1 Pollution of Groundwater Resource by Effluent from the Ponds

This rating is given for circumstances where pollutants are able to reach the fractured rock aquifer and the groundwater, where a complete link exists between the source, pathway and receptor. This would be from the ponds (source), through the clay / an inconsistency in the clay layer (pathway) and to the groundwater (receptor) in the fractured rock aquifer.

- The *spatial extent* is considered to be regional since the pollutant will move off the Site with time;
- The *intensity* is described as low (currently there are no know groundwater users for this area), where natural and/or social functions and processes continue albeit in a slightly modified way. Should the water be used as a resource, then the intensity is described as medium (groundwater supply may have to be seized and an alternative source used) where natural and/or social functions and processes continue albeit in a modified way.
- The *duration* is regarded long term (> 20 years) since it is assumed that the source of the pollution will be present over the long term.

4.4.2 Mitigation Measures

During excavation to found the ponds, it must be ensured that the clay is present throughout the base of the ponds. Since the ponds are planned to be situated on the clays exposed during the geotechnical investigation, the chances of exposing fractured bedrock is slim. However, should fractured bedrock be exposed during excavation, then excess clay that has been exposed in other parts of the site must be used to cover the fractured bedrock completely to a thickness between 300 and 600 mm. The sidewalls of the ponds should also comprise clays in order to prevent lateral movement of the pollutants.

5. Conclusions and Recommendations

Based on the information obtained and analysed above, the following can be summarised:

- The geology underlying and surrounding the Site comprises formations of the TMG. These formations comprise mainly quartzitic sandstones, except for the Cedarberg Formation, which comprises shale. No faults have been mapped for the study area and the beds dip 30° to the south.
- The electrical conductivity of groundwater within the TMG varies between 10 and 100 mS/m (the limit in drinking water according to the SANS 241:2015 Standard is 170 mS/m). The water may be manganese and iron rich. High yielding boreholes can be developed in the TMG if scientific methods for borehole siting are used.
- According to the NGA of the DWS, no registered or licensed boreholes are recorded within a 1 km radius of the Site. Within a 5 km radius, five boreholes were identified; and within a 10 km radius, 14 boreholes (with data recorded) were identified. Water levels in the boreholes ranged between 1.4 and 34 m bgl.
- The surface water and shallow groundwater flow direction is assumed to follow the surface contours, and from the Site, will be in a northern direction towards a drainage, from where it will move in a western direction.
- During the hydrocensus, no boreholes were located within a 1 km radius of the Site.

- According to the geotechnical investigation, a clay layer was intersected below the site, with a minimum thickness of between 0.6 and 1.6 m bgl. The average hydraulic conductivity of the clay was determined to be practically impervious.
- The potential impact that was identified for the Site and surrounding area is pollution of the groundwater resource by the effluent from the ponds. The pathway of effluent to the groundwater is via the clay / an inconsistency in the clay layer, to the fractures of the fractured bedrock and the groundwater. The project engineer have designed the ponds be founded in the clay layer underlying the Site. The clays are practically impermeable and, should the layer be laterally consistent, will create a barrier to prevent the effluent from seeping into the groundwater. However, should the clay layer not be laterally present across the Site, then contaminants from the effluent may reach the groundwater.

- Mitigation measures include the following:
  - During excavation to found the ponds, it must be ensured that the clay is present throughout the base of the ponds. Should fractured bedrock be exposed during excavation, then excess clay that has been exposed in other parts of the site must be used to cover the fractured bedrock completely, with the clay layer being between 300 and 600 mm thick. The sidewalls of the ponds should also comprise clays in order to prevent lateral movement of the pollutants.

Yours faithfully,

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Principal Hydrogeologist and Partner

SRK Consulting (South Africa) (Pty) Ltd

Disclaimer

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