

8 Synthesis

8.1 Conclusions

The aim of this research was to compile a DRMS for the municipality of Tlokwe to facilitate safe development on dolomitic areas. In order to develop the DRMS, the following objectives were set:

1. What geological, geohydrological and geotechnical conditions determine the stability of dolomite?
2. What other factors are playing a role and how can all factors and conditions be reflected in a risk zone classification and identification of priority focus areas?
3. What research and management actions need to be included in the DRMS?
4. What social awareness is needed to optimise research and management actions?

All four objectives were met in the study, and the main findings can be summarised as follows:

There are in general two main factors that contribute to the risk with regard to development on dolomite that need to be researched in order to develop a DRMS. The first factor is related to the physical environment, such as geology, geohydrology and engineering geology. The anthropogenic environment is the second factor, which includes existing infrastructure and development, land use planning and the social structure within the study area. It is necessary to have a clear understanding of these contributing factors in order to be able to develop a DRMS.

The exact extent and location of dolomite was determined during this research. It is important to consider the regional setting in which the study area falls. In this case, the Vredefort Dome impact event has a significant effect on the local geology resulting in a complex structural geological environment, which may enhance the risk for instability. All the geological maps and information, drilling results and structural data were used to understand the simplified geological zone map and the relationship between dolomite and other formations within the study area. This was used to assess the geology expected deeper

than the available drilling results, in order to compile the risk zoning of the area. The indicated risk based on the probable occurrence of dolomite was ranked from low to high based on the geological investigation (Figure 5-12).

The geohydrological investigation revealed that there is no significant large-scale groundwater abstraction in the direct vicinity of the study area. The groundwater level was found to be at an average depth of less than 30 m from surface. Although fluctuations in groundwater levels are natural, the range thereof can be critically important and should be closely monitored. Although the acceptable natural water fluctuation is believed to be 6 m, a reduction of as little as 1.35 m could be catastrophic in some areas. It is also concluded that the local authority has no handle on the groundwater regime in the area. Safe development on dolomite can only be achieved if the local authority does have a handle on the groundwater regime. Although there is no large scale dewatering taking place, the absence of the local authority's involvement in groundwater management enhances the risk.

The inherent character of dolomite plays a significant role in its instability as this is where the degree of weathering determines the extent of karst formation, and therefore its susceptibility to form instability features. The geotechnical properties within the study area vary. There are areas with a lower inherent hazard where development may take place, and areas with a higher inherent hazard where development is not encouraged. However, most of the study area has not been investigated in detail in order to determine this inherent hazard. This information will form the basis on which further development and mitigation planning will be conducted. The absence of adequate detail information enhances the risk and necessitates further research. The measured risk based on the proven occurrence of dolomite was ranked from low to high based on the inherent hazard classes for the applicable areas.

The combination of the three major contributing factors within the physical environment results in an estimated and average overall high risk.

Infiltration from ponding or leaking infrastructure is a major contributing factor to instability features. A preliminary survey of the existing infrastructure was conducted. Sixteen main infrastructural features have been identified and their current situations have been quantified. Based on similar characteristics (i.e. age, type, etc.), the 16 infrastructure focus points were grouped into 6 broad manageable categories in order to quantify the risk associated with the dolomitic land (Figure 5-14). Most of the sub-surface water-bearing infrastructure in the

study area was found to be old and not on the current standards for such development on dolomite. Some of the infrastructure is very old and leaking is almost a given. This enhances the risk significantly. The infrastructure within the study area was ranked in order of risk.

Existing land use as well as future planning includes high-density residential development on dolomite, which increases the overall risk.

Probably the most significant factor to consider in the management of development on dolomite is the people living on the dolomite. It was found that neither the local authority nor the residents was aware of the presence of dolomite and the associated risk. It was also confirmed that many of the affected residents are very vulnerable to such risk as they are mostly from a low-income bracket. This also contributes to the final disaster risk score.

The three main anthropogenic factors also culminate to an estimated overall average high risk.

A risk assessment was done where the two main contributing factors was combined into one final disaster risk score. The formula explains the method used: R (risk or priority) = H (hazard or physical factors) + V (vulnerability or anthropogenic factors). The low, medium and high risk scores for the physical factors was designated with a score of 1 for low, 2 for medium and 3 for high risk. The anthropogenic factors received scores of between 0 and 3 depending on the type and age of infrastructure. The combination of these two factors therefore yielded results of between 2 and 6, with 6 being the highest and also the areas with the highest priority for further research or intervention, as the risk is the highest.

From this prioritization process, 16 priority focus areas was identified and ranked. Basically, areas with no information appeared to have the highest priority for further research. Without information, the risk related to dolomite cannot be managed. A pro-active phased approach is adopted as part of the strategic planning for the implementation of a DRMS. The four processes consist of a basic process, research process, management and monitor process and a mitigation, management and monitor process. During this investigation, the basic process was completed.

In order to establish a DRMS, the second process has to be completed which mainly involves further basic research. Upon completion thereof, decisions can be made on how to mitigate, manage and monitor the risk based on the DRMS.

8.2 *Recommendations*

During the investigation, several ad-hoc concerns were identified that required interim mitigation measures. These issues were attended to by an ad-hoc committee.

The final DRMS should be compliant to the SANS 1936-4 guideline documents (2011) (still in draft format by the date of writing, see Appendix I). This document stipulates general requirements for risk management, requirements for the preparation of a provisional DRMS and specific requirements for local authorities, specific requirements for new developments as well as interconnected complexes.

It is further recommended that ongoing social awareness be created. No matter what the eventual mitigation may entail, it is almost certain that it will not be accepted by the community if there is not an in-depth understanding of their social structure, and if they are not involved and informed right from the start, even during basic research.

The final aim is to capacitate the local authority to manage the risk. This may include the involvement of dolomite specialists and the implementation of a comprehensive computer based management system that consist of a GIS-based database, workflow automisation programmes and task management systems. Risk management and related systems or infrastructure should not be confined to the knowledge and skills of a particular single official or specialist, but should be accessible and transparent in order to ensure sustainable risk management implementation measures.