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## **Development of the groundwater theme of the interactive vulnerability map for unconventional oil and gas in South Africa**

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Unconventional oil and gas (UOG) extraction, its related impacts and the management of this activity to ensure environmental protection, is a controversial issue in many countries worldwide. Various impacts may be associated with UOG extraction, with one of the main aspects of concern being water resources. South Africa is classified as a water-stressed country according to the Falkenmark indicator [1] and with most of its surface water resources already allocated, groundwater is an extremely important resource that must be used wisely and protected from contamination. In order to protect South African water resources, an interactive vulnerability map with the themes of surface water, groundwater, vegetation, socio-economics and seismicity was developed for UOG extraction. Such a map that shows the location of vulnerable entities in relation to prospective UOG exploration and extraction areas may assist government in their decisions to allow or not allow unconventional oil and gas UOG extraction in certain fragile areas. It may also assist government in specifying license conditions if a license is awarded.

The process that was followed for the development of the regional scale vulnerability map for UOG extraction included 1) identification of sensitivity indicators for vulnerability mapping (both indicators that were to be classified, as well as indicators that were only to be flagged on the map and not classified); 2) vulnerability indicator classification; 3) aggregation of the indicators in a theme, where relevant; and 4) development of the browser-based structure for the interactive vulnerability map. Experts were used throughout the vulnerability mapping process to ensure proper adherence to policy goals, and also encourage transparency, credibility and pragmatism. The normative approach (described in more detail in Esterhuysen et al. [2]) was followed for the identification of sensitivity indicators. Although this approach requires time and resources and is limited in its application and transferability to other regions, the integration of expert knowledge provides support for the identification, classification and aggregation of indicators and may increase the acceptability of the results. It is also widely acknowledged that stakeholder involvement during the development of indicators is key to identifying relevant vulnerability indicators [3,4].

This paper will discuss the development of the groundwater theme of the UOG extraction vulnerability map, by describing the process and reasons for the identification and classification of the indicators that were included and those that were not included on the groundwater theme of the map. The groundwater theme of the interactive vulnerability map will also be briefly demonstrated.

### *References:*

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