

**EFFECTS OF PRODUCED WATER ON PHYSICOCHEMICAL PROPERTIES  
OF GROUNDWATER IN LOKICHAR BASIN, TURKANA COUNTY, KENYA**

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**DECLARATION**

This thesis is my original work and has not been presented for a degree or other awards in any other University.

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We confirm that the work reported in this thesis was carried out by the candidate under our supervision.

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## ABSTRACT

Globally, there has been an increase in wastewater generation from oil mining activities that pollutes freshwater resources. Inadequate handling of oil mining wastes in Africa has caused water bodies to become contaminated. The advent of oil exploration and mining activities in south Lokichar basin in Turkana County, Kenya (Ngamia 1 oil well pad) has led to the generation of wastes such as drilling muds, drilling cuttings, and Produced Water. In Kenya, there are relatively few studies that have been done on the effects of the oil mining wastes on the environmental resources since oil exploration is a new phenomenon in the country. This study's goal was to determine if Produced Water from oil mining operations at Ngamia 1 oil well pad leads to contamination of the groundwater resources in the study area. The specific objectives were to: 1) determine the physicochemical properties of Produced Water; 2) determine the physicochemical properties of boreholes water; and 3) determine the effects of Produced Water on groundwater quality. To achieve these objectives water samples were collected from ten boreholes within the catchment divide, and one sample collected from outside the divide as the control of the study in the month of August 2020. Data on the selected physicochemical water quality parameters for both the Produced Water and groundwater was obtained from the field measurements and using standard laboratory procedures at Kenya Water Institute (KeWI), Water Resources Management Authority (WRMA) and the National Materials Testing and Research Division (NMTRD) laboratories. The outcomes were compared to the established requirements for drinking water quality by both WHO (2017) and NEMA (2006). Produced Water was found to be highly contaminated with heavy metals and salts whose levels were found to exceed the set drinking water quality standards by WHO and NEMA as follows: Lead by 15,680%, Zinc by 22%, Iron by 16,567%, Chlorides by 8,128%, Fluorides by 2,500%, and Nitrates by 480%. This was attributed to the usage of production chemicals to enhance oil recovery through hydraulic fracturing. The heavy metals present and salts in levels not within the set drinking water quality standards by both WHO and NEMA were observed at the following boreholes: Nalemsekon borehole whose Iron level exceeded these standards by 250%, Chloride level by 10.4%, and Fluoride level by 148%; RCEA borehole whose Lead level exceeded these standards by 1,500% while Fluoride level exceeded by 56%; Nakwakipi borehole whose Lead level exceeded by 5,180% and Nitrate level by 287%; Nakukulas 10 borehole whose Zinc level exceeded by 51% and Nitrate level by 111%; Nakwakitela borehole whose Fluoride level exceeded by 36% and Nitrate level by 428%; Nitrates levels at Irir 1, Chinese 1 and Nawoyatira boreholes exceeded these standards by 604%, 463% and 322% respectively. The study discovered that the high concentrations of salts and heavy metals observed in these boreholes could be as a result of contamination from Produced Water. Therefore, strategies on safe handling and disposal of Produced Water should be put in place to safeguard the study area's groundwater supplies.