Chapter 5 Geology and Hydrogeology

5.1 Geologic conditions of the Study Area

The geologic distribution in the Mtwara and Lindi Regions has been studied by reviewing the past study reports (Mtwara-Lindi Water Master Plan, Finnwater 1977 and Mtwara -Lindi Revised Water Master Plan, Finnwater 1986) and through field surveys during Stage 1 of the Study. The geological formations in the area are classified into the following four typical geological units:

- Pre-Cambrian basement rocks
- Paleozoic and Mesozoic continental sedimentary rocks (Karoo)
- Mesozoic and Tertiary marine sedimentary rocks (Coastal Sediments)
- Recent river, marine and terrace deposits (alluvium)

A geological map with the location of the villages is shown in Figure 5-1.

5.1.1 Pre-Cambrian basement rocks

Basement rocks (X) consist mainly of various metamorphic rocks such as marble, schist and gneiss. Basic intrusive rocks and dike rocks, as well as quartzite and pegmatite are also included in basement rocks. A wide exposure of basement rocks is found in the districts of Masasi, Newala, Liwale and Nachingwea.

Since these rocks are generally hard, massive and virtually impermeable, potential of groundwater development in this formation is very low except in the fissure-abundant zones related to the faults and weathering. Outcrops of the fresh basement rock are generally limited to the monad nocks (island mountains).

The surface of these rocks is weathered to soil in most of the area to a depth of tens of meters, averaging 20 meters. Therefore, the extraction of stored groundwater in the weathered portion is possible by construction of shallow wells. The majority of existing shallow wells in this area, however, dry up in the dry season.

The survey for groundwater development in the basement rock areas should put emphasis on locating the fissure- abundant zone.

5.1.2 Karoo Formations

The Karoo formations(K) consist mainly of sandstone and limestone. The surface of the formation is covered by lateritic sandstone, which is predominated by sand and gravel. Since the fresh rocks in this formation are generally compact and massive, groundwater development potential is not high except in the deep weathered portion or on and around the faults, similar to the area of basement rocks.

There are Karoo formation outcrops in the districts of Liwale, Ruangwa and Tandahimba. About 70% of the total land of the two regions are difficult areas (Karoo and Basement) for groundwater development.

5.1.3 Mesozoic and Tertiary Sedimentary Formations

The other sedimentary formations are from Mesozoic (MS) to Tertiary (TS). The sediments of the Cretaceous Period are composed of sandstone, siltstone, conglomerate and alternating beds of clay, sand and sandstone, while the Tertiary system consists mainly of silt, clay, sand and loose sandstone (half-consolidated sandstone). The sandstone in these formations is almost horizontally stratified. Sandy bed and semi-consolidated high permeable sandstone bed may have the highest potential for groundwater development in the formations.

The sedimentary formations are wide spread in the eastern coastal area of the two regions, i.e., the Newala, Tandahimba and Mtwara Rural districts in the Mtwara region, and the Kilwa and Lindi districts, and the eastern part of Ruangwa district in Lindi region.

5.1.4 Recent Deposit

Recent deposits (ND), which consist of sand, clay and gravel, are distributed along the coastal line and rivers (especially at the rivers of Ruvuma, Mbwemkuru, Matandu and Lumesule). Sandy and gravelly beds of these deposits are normally good aquifers for shallow groundwater development.

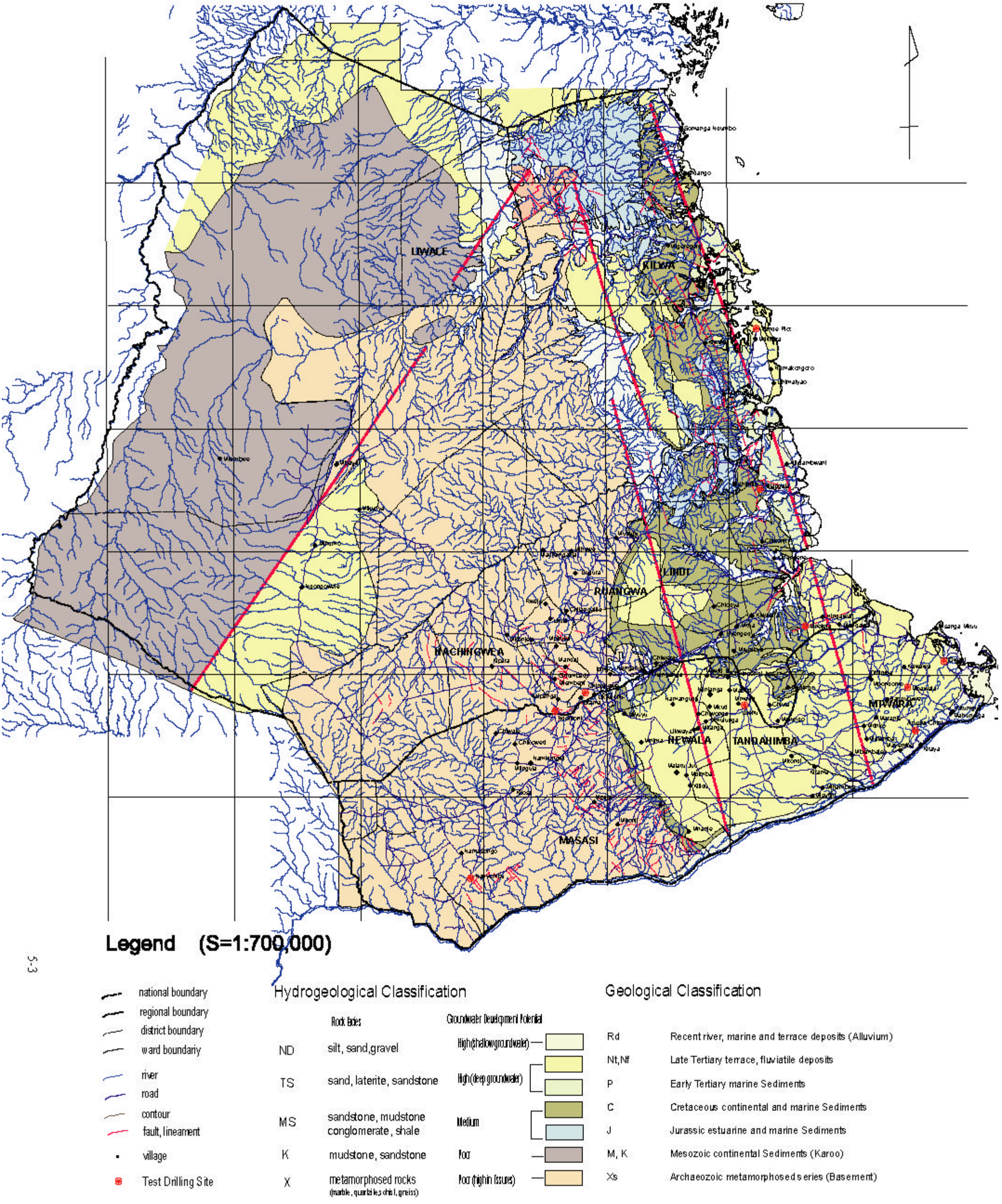

Figure 5-1 Geological Map with the Location of Village

Table 5-1 Summary of the Aquifer Distribution by Geological Classification

Geological Classification (rock facies)	Distribution (Districts)	Major Aquifer	Remarks	Solution
Pre Cambrian Basement Rocks (Xs) (gneiss, pegmatite, migmatite, quartzite, mica schist)	Hilly terrain at the western part of the area. (Natingwea, Ruangwa, Masasi)	fissure abundant zone (lower confined aquifer exists at weathered gneiss (GL - 10 - 20))	Anxiety of high conductivity and high SO4 content groundwater existence.	Further study is required to clarify the relation between location of saline well and the direction of fissure.
Mesozoic Sedimentary Rocks (C) (mudstone, shale, sandstone, conglomerate, alteration of sandstone and conglomerate)	Plateau of the eastern part of the area (east of Ruangua, east of Masasi, Newala, Tandahimba, Mtwara Rural, Lindi Rural, Kilwa)	sandstone and fissure abundant zone in shale	Horizontal distribution and depth of the aquifer varies at plateau area. The layer become soft by the moisture (very dry lateritic sediments).	Further study is required to clarify the distribution of aquifer at the drilling location. Drilling with mud rotary should take care of the nature of those rock (which become clayey when wet).
Tertiary Sedimentary Rocks (P, Nf, Nt) (limestone, sandstone, conglomerate,)	Lowland near by the coast (Mtwara Rural, west of Lindi Rural, part of Ruangwa, part of Liware)	limestone and sandstone	Saline water exists in some aquifer.	Those aquifer with saline water shall be sealed at the drilling construction stage.
Recent Deposits (N) (clay, sand, gravel, limestone, agregarates)	Along the major rivers, coasts and upper portion of plateau	sand, gravel, limestone	Some part of the area covered with thick clay layer.	Drilling point shall be surveyed by electrical resistivity sounding.