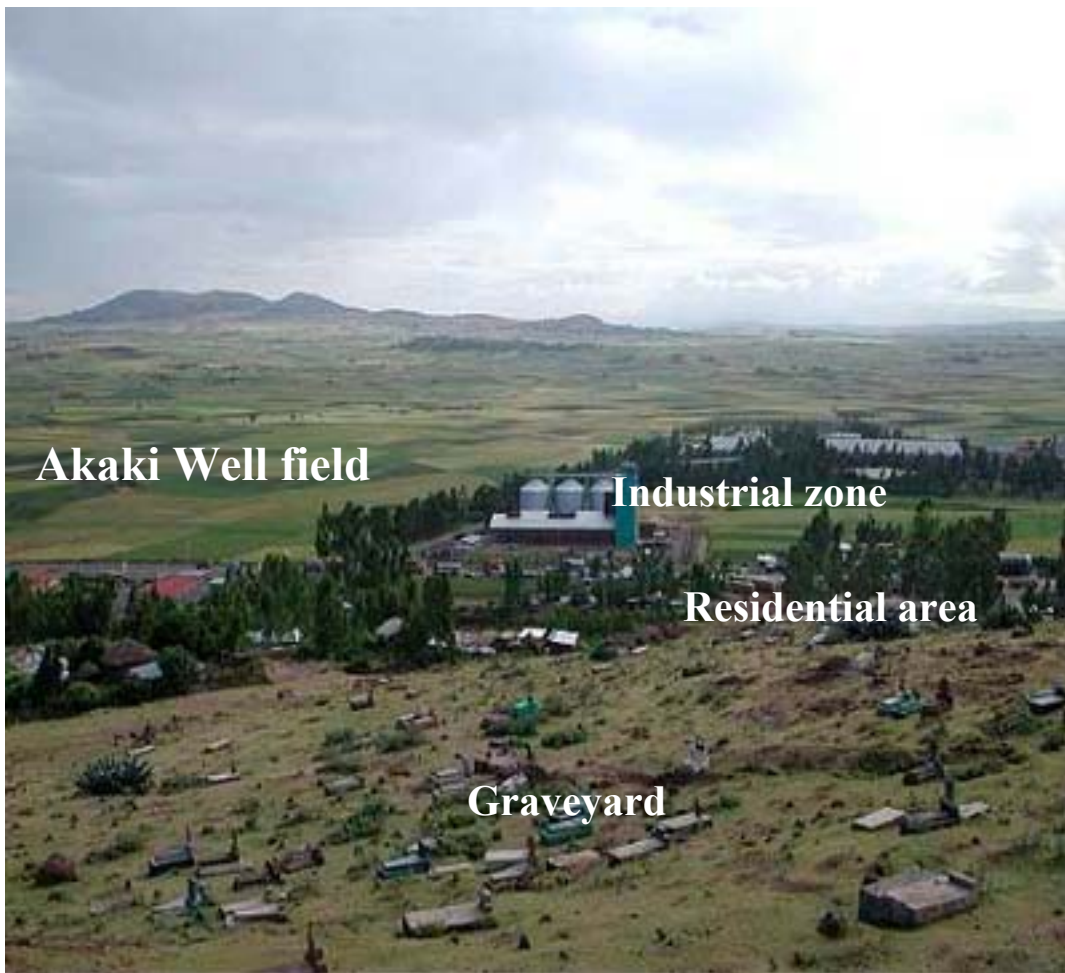


**ASSESSMENT OF POLLUTION STATUS AND GROUNDWATER  
VULNERABILITY MAPPING OF THE ADDIS ABABA WATER  
SUPPLY AQUIFERS, ETHIOPIA**

**Tamiru Alemayehu, Dagnachew Legesse, Tenalem Ayenew, Yirga Tadesse  
Solomon Waltenigus, Nuri Mohammed**



(Final)

2005

## Addis Ababa, Ethiopia

### INTRODUCTION

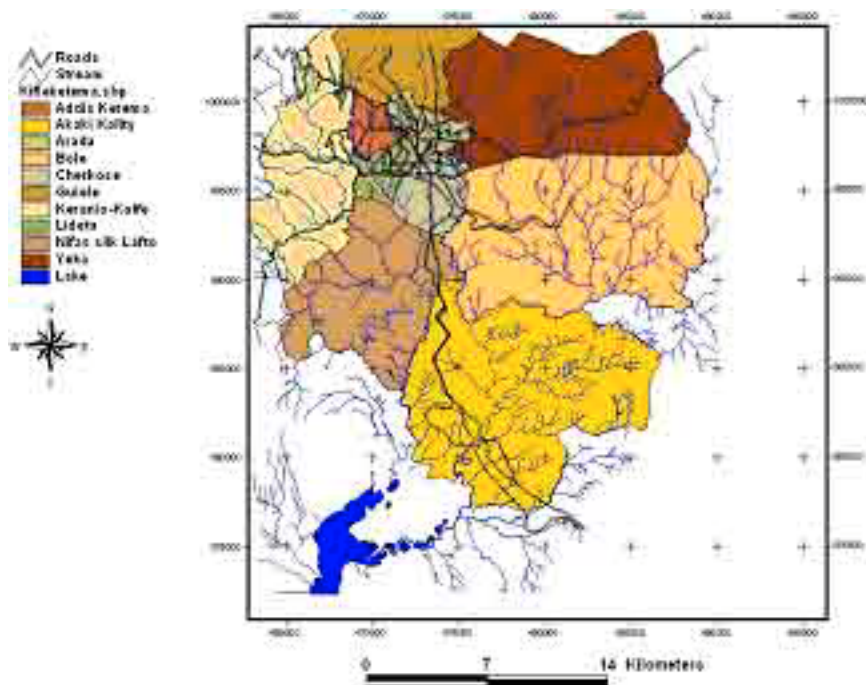
After the mid term evaluation that was held in Mombassa, Kenya, the comments forwarded by the consultants were thoroughly evaluated and analyzed to come up to the required level.

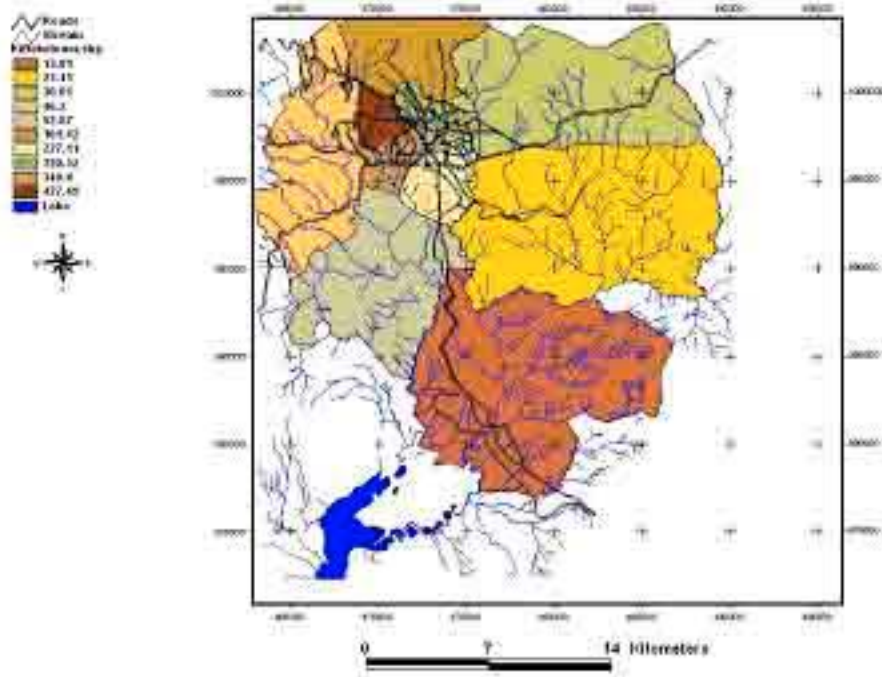
The main comments were:

1. Revisit loosing stream concept
2. Surface and groundwater interaction
3. Remote sensing vs fracture lineaments
4. Consider BOD/COD vs NH<sub>4</sub>, DO vs NO<sub>3</sub>/NH<sub>4</sub> etc...

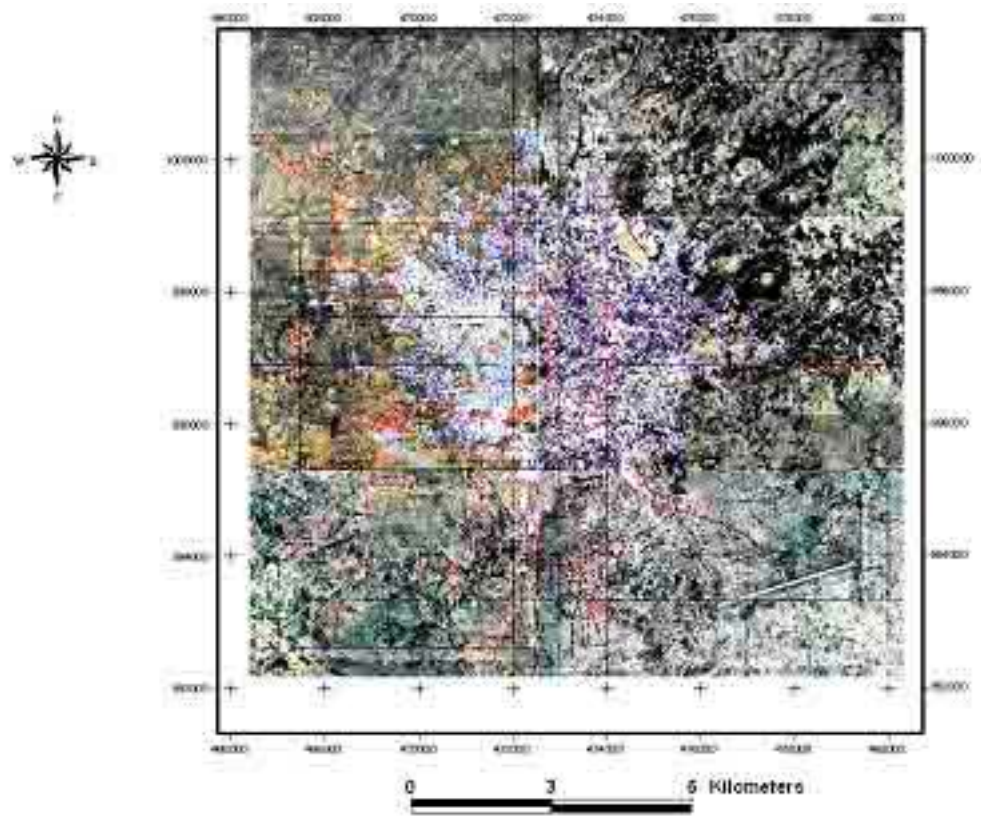
### PERFORMED TASKS

#### Population density map





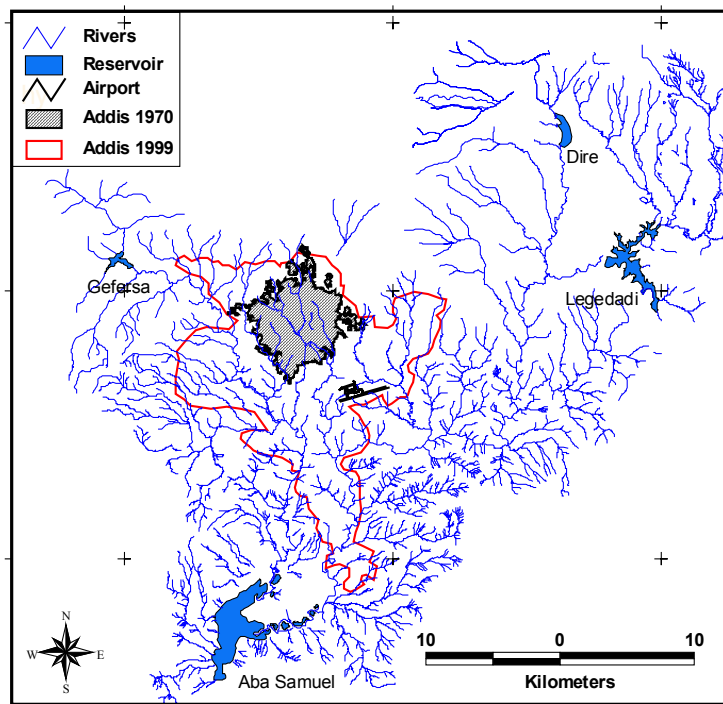
Urban expansion rate



City map in 1970

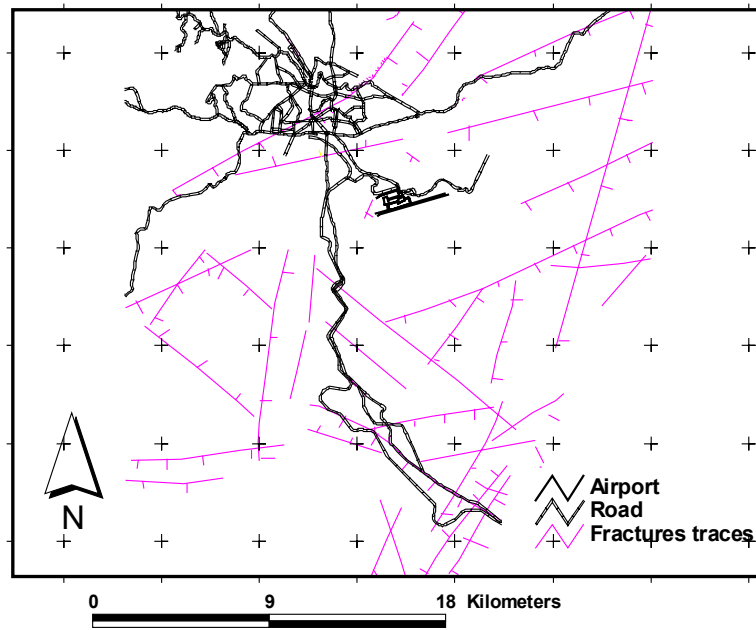


City map in 1993



Urban development from 1965 to 1999

In 1970 the size of the city was 37.4 km<sup>2</sup> while in the year 1999 the size was 230.35km<sup>2</sup>. Within 29 years the city expanded for 129.95km<sup>2</sup>. The rate of increase is 6.65 km<sup>2</sup>/yr, which demanded huge volume of water supply for urban use.



Fracture trace map of the project area



Chemically polluted little Akaki river



Organic pollution in Kebena river

| BH   | Date     | Tot. Coliform/100ml | E. Coli/100ml |
|------|----------|---------------------|---------------|
| BH6  | 23-12-04 | 16                  | 16            |
| EP4  | 23-12-04 | 1                   | 1             |
| BH6  | 13-01-04 | 89                  | 89            |
| BH14 | 23-12-04 | 1                   | 1             |
| BH12 | 23-12-04 | 1                   | 1             |

Bacterial population in the well field

### EFFECTS ON HEALTH

#### Impacts from industrial effluents:

1. Disposal of sulphide containing chemicals could increase soil acidity that can facilitate mobilization of heavy metals that causes cancer and abortion.
2. Disposal of lime containing effluents increases soil alkalinity that in turn binds heavy metals into soil by reducing agricultural production.
3. Drastically change the quality of both surface and groundwater.

#### Bacterial effect:

Bacterial pathogens cause some of the well-known and most feared infectious diseases such as cholera, typhoid, and dysentery. The symptoms tend to be severe and the control of such pathogens was the original target in sanitary improvement. For the detected bacteria the main source is human and animal faeces.

#### Attenuation:

Natural processes in the geological media can remove or reduce bacterial contaminants. Attenuation is most effective in the vadose zone made of fine sediments. In the case of Addis Ababa, vadose zone is made of fractured aquifer that has less attenuation capacity. The main attenuation mechanisms are filtration, adsorption, die-off and dilution.