Wastewater Industrial Database for Total Nitrogen in Shuaiba Area in Kuwait

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Overview

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- Methodology.
- Results and Discussion.
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Introduction

- Kuwait is a modern industrialized nation that meets most of its domestic, commercial and industrial water needs by desalination of seawater.
- Kuwait is in dire need of an integrated water resources management scheme that includes aspects of water conservation and reuse wherever possible. The foundation block of such a management scheme is a sound database of all potential sources of water supply, supply locations, use, after-use discharge, recycle potential, reuse, environmental impacts, and sustainability of the national resources and developmental systems.

Introduction

- One of the major sectors involved in such a scheme is industrial (petroleum and non-petroleum) water use and wastewater generation, including areas of after-use discharges, wastewater quality at origins and discharge points, locations of discharge and/or reuse, and recycle potential.
- A basic and comprehensive database utilizing ArcGIS in this sector is presently lacking in the country. A comprehensive, centralized, well formatted and compiled data system on the type and quality of industrial wastewater produced with specifics of location, quality, provision of treatment and discharge and/or reuse in the country is presently missing.

Objective of the Study

- **The objective of the study was to determine the quality and quantity of 17 petroleum industrial wastewater from different sources at Shuaiba area, in Kuwait over a period of one year as well as developing a database of such characteristics and attributes using geographic information system (GIS) technique.**

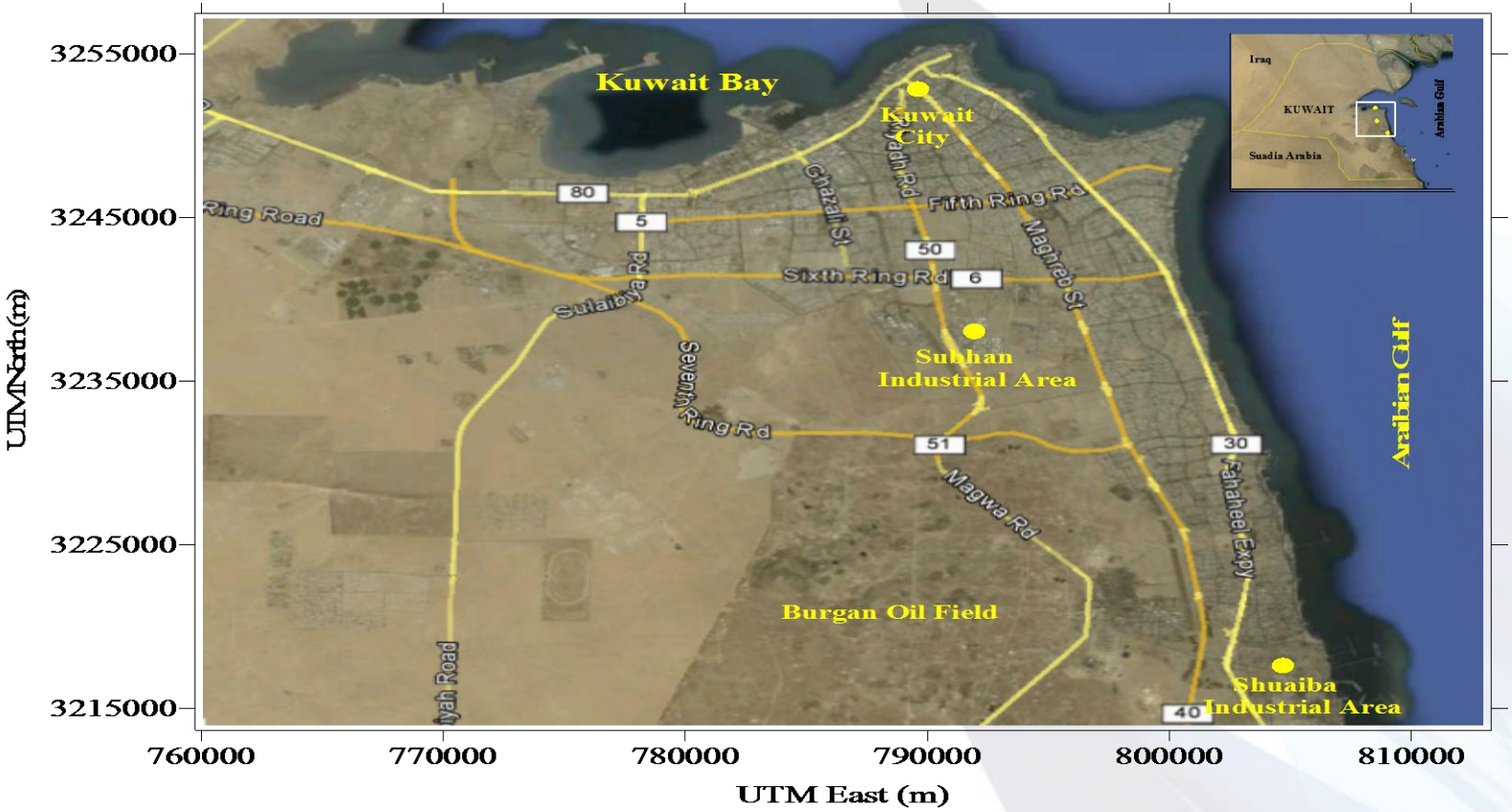
Methodology

- Mobilization and Survey of Industries.
- Industrial Wastewater Sampling and Laboratory Analysis.
- Preparation of Database and Data Entry.
- Results and Discussion.

Mobilization and Survey of Industries

- As part of this task, the procurement of instruments, associated training, and experimental supplies was completed.
- Field survey was conducted during which a specially designed questionnaire was distributed among the targeted industries.
- Industries in Kuwait are mainly distributed in three areas, namely Kuwait City, Sabhan, and Shuaiba industrial areas. Shuaiba industrial area represents factories of petroleum wastewater origin, while the other sites (Kuwait City, Sabhan) represent factories of non-petroleum wastewater origin.

Location Map of the Study Areas



English Field Survey for Industries

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Survey Questions	Circle Answer or Fill Blank
Letter from Public Authority for Industry (PAI) provided?	Yes /No
Letter to factory representatives/owner provided? (include name of representative)	
What is the name of factory?	
Where is the location of factory area?	
Factory coordinates;	
Industrial purposes of water use (if other please specify):	
Factory activities/productions?	
Factory category?	
Number of production lines active?	
Sampling point(s) coordinates;	
Has the surveyor examined the sampling point?	Yes /No
Is there a need for any personal protective equipment (PPE)?	Yes /No
Flow meter available?	Yes /No
If a flow meter is not available, will the factory allow installation?	Yes /No
Depth of sampling point?	Yes /No
Sampling method?	

English Field Survey for Industries

Survey Questions	Circle Answer or Fill Blank
Is there sufficient space to collect samples at the location?	Yes /No
Is there sufficient space to perform fluid measurements?	Yes /No
Can the factory accommodate 20 mo. of sampling?	Yes /No
Does the factory produce sufficient industrial wastewater flow for sampling?	Yes /No
Does the factory perform pretreatment on wastewater before discharge?	Yes /No
Is there any data within the past 5 years on the quality of discharge?	Yes /No
Is there any data within the past 5 years on the quantity of discharge?	Yes /No
Is the industrial wastewater discharge mixed with domestic wastewater?	
Methods of wastewater discharge?	
How many tankers/week are sent to Wafra Industrial Wastewater Plant?	
Does the factory participate in industrial wastewater reuse?	Yes /No
Pretreatment of wastewater streams (if other please specify):	Yes /No
Total freshwater consumption in factory:	Yes /No
Number of wastewater streams	
Raw materials used	
Are there any adverse environmental impacts of industrial wastewater?	Yes /No

Industrial Wastewater Sampling and Laboratory Analysis

- Based on the field surveys of the targeted industries, the total number of factories and sites to be visited for wastewater sampling and associated measurements was determined.
- Industrial Wastewater samples were collected from 41 Sites/ Factories distributed as followed: 10 factories at Kuwait City, 14 factories at Sabahan Industrial area and 17 factory at Shuaiba Industrial area.
- Field wastewater measurements were carried out for all sites including Temperature, pH, Electrical conductivity (EC), dissolved oxygen (DO)and oxidation Reduction potential (ORP) parameters.
- The collected samples were analysed according to Standard Methods for the Examination of water and Wastewater (APHA, 2017) for physical, chemical, biological, organic, heavy metals, toxicity and microbial (bacteria, viruses, fungi) parameters.

Collection of Industrial Wastewater Samples

Onsite Wastewater Field Measurements near Factory Collection Point

Laboratory Instruments

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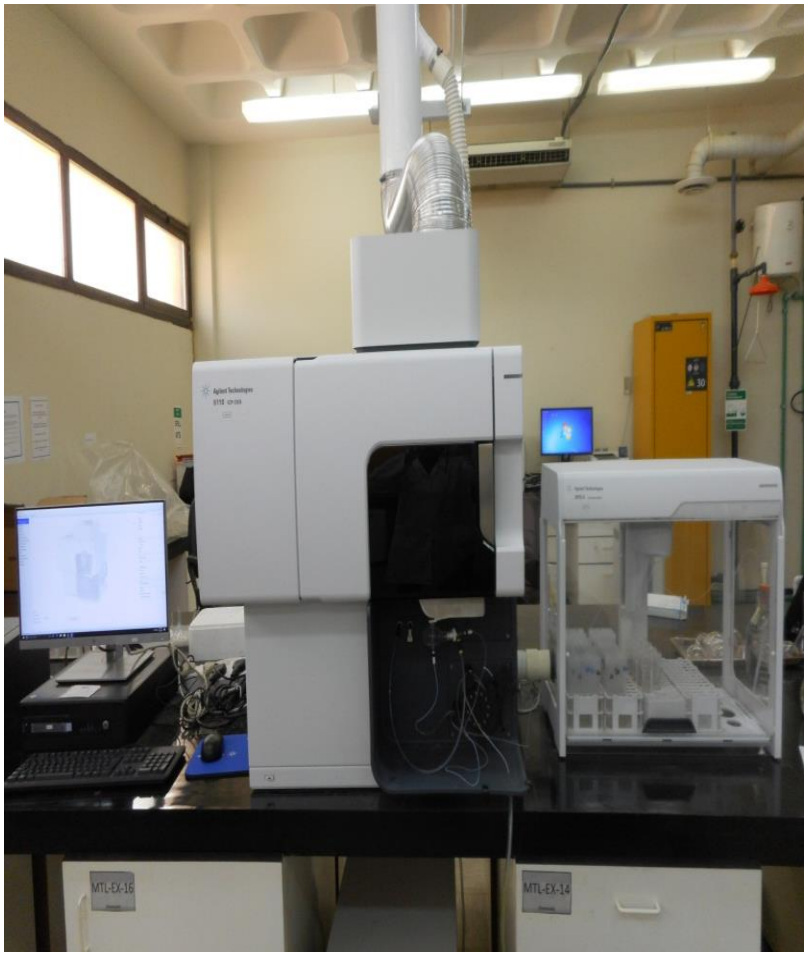


Laboratory Instruments

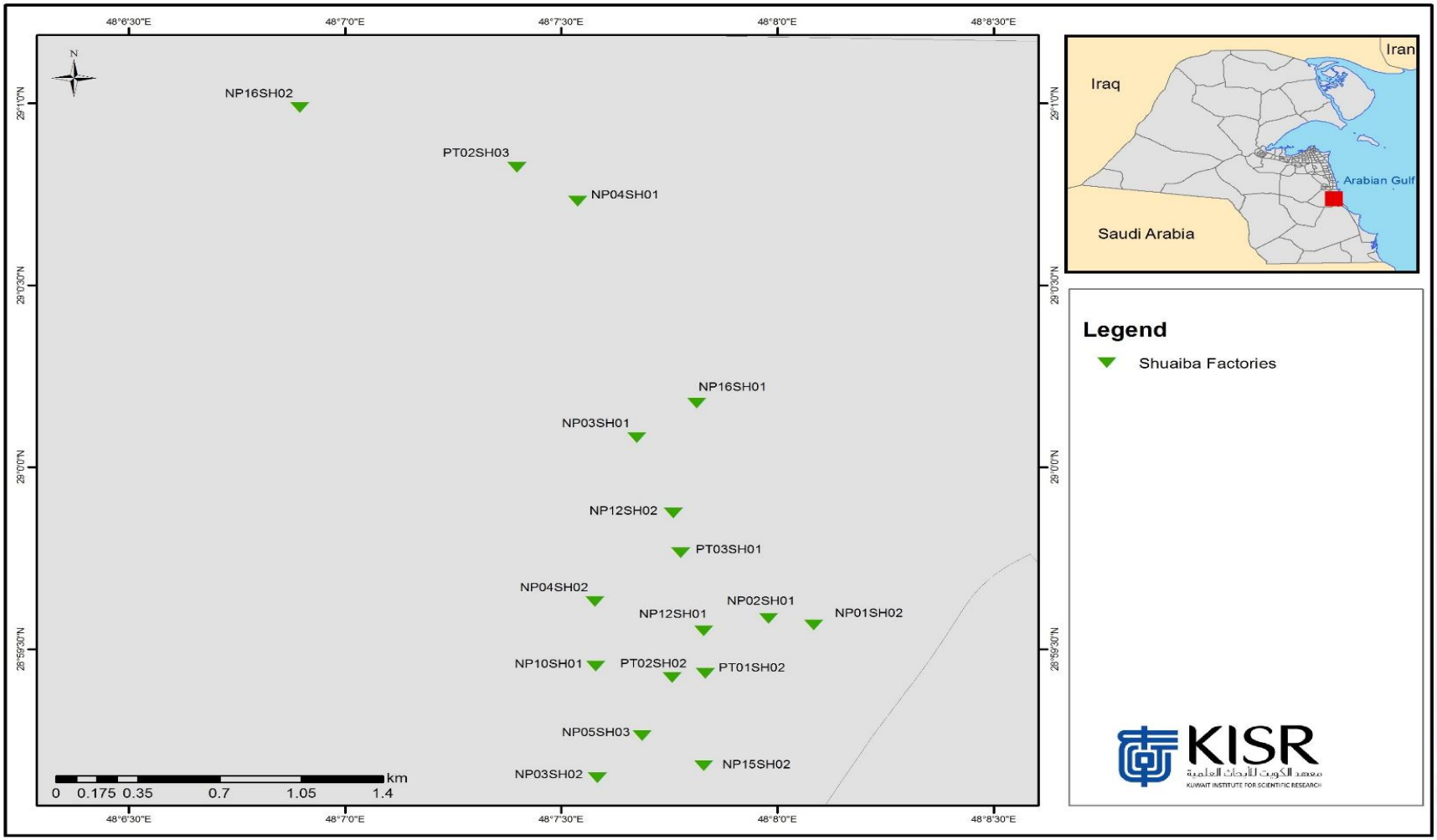
Preparation of Database and Data Entry

- All factories from which wastewater samples are being collected were coded.
- Excel spread-sheet database was prepared and was continuously updated with obtained field and laboratory results.
- ArcGIS software was used to convert the Excel database into GIS database, from which a number of GIS maps were produced.

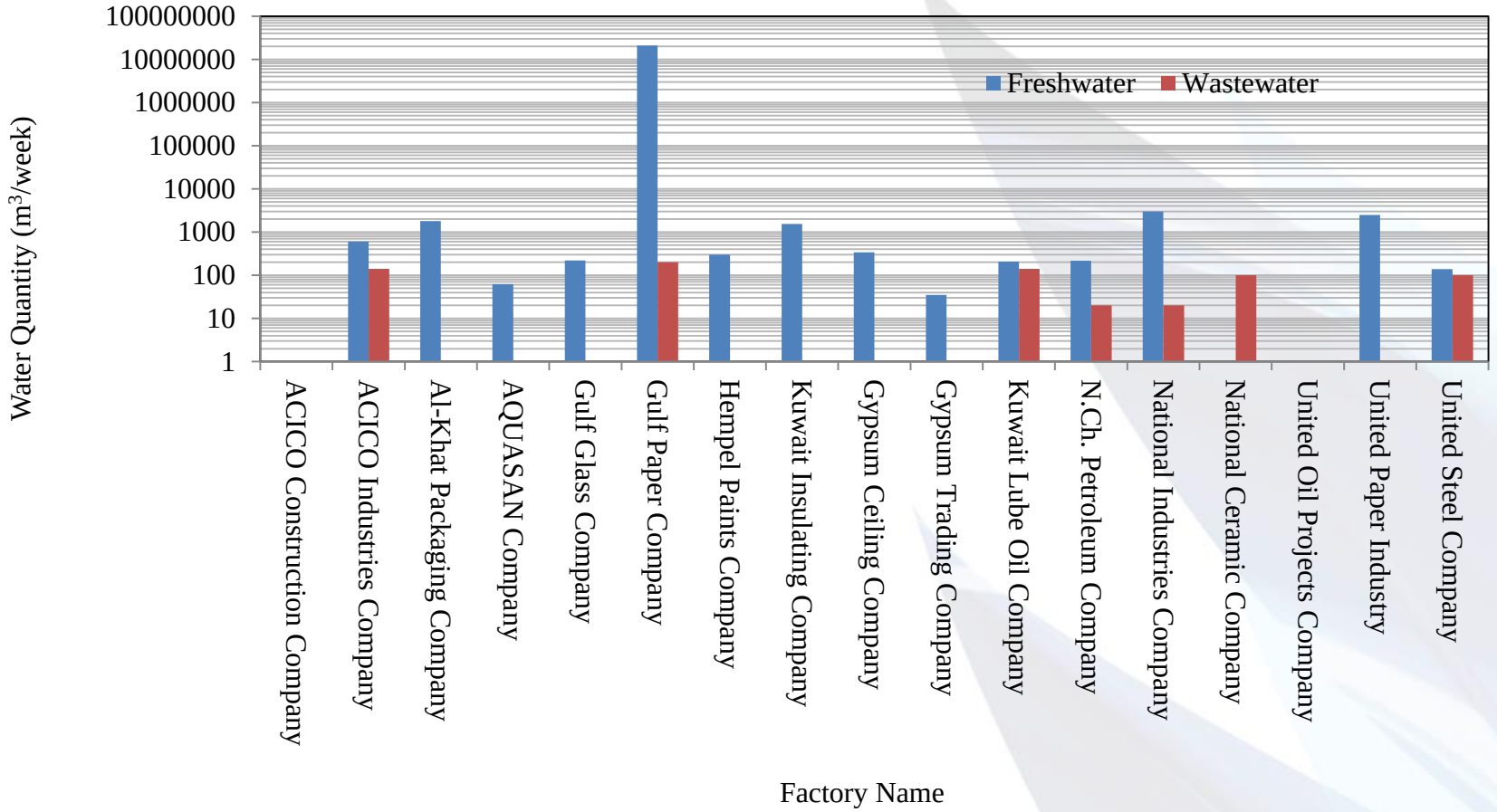
Selected Factories Names, Codes and Coordinates

	Factory Code No.	Factory Name	North	East
1	PT02SH03	National industries co.	29.013721	48.123287
2	NP04SH01	Kuwait gypsum ceiling company	29.012163	48.125629
3	NP12SH01	Gulf paper co.	28.992502	48.130495
4	NP04SH02	Kuwait gypsum manfacturing co.	28.993843	48.1263
5	NP15SH02	Al-khat packaging co.	28.986341	48.130486
6	NP03SH02	ACICO industries	28.985778	48.126397
7	NP02SH01	Gulf glass co.	28.993068	48.132995
8	PT03SH01	hempel paints co.	28.996074	48.129608
9	NP01SH02	KIMMCO	28.992772	48.134731
10	NP03SH01	ACICO cement	29.001353	48.127914
11	NP05SH03	United steel industries	28.987705	48.12811
12	NP10SH01	United oil projects co.	28.990886	48.126334
13	NP12SH02	United paper co.	28.997894	48.129324
14	NP16SH01	Aquasan	29.002925	48.130212
15	PT01SH02	Kuwait Lube co.	28.990565	48.130554
16	PT02SH02	National chemical petroleum industries	28.990364	48.12927
17	NP16SH02	National industries for ceramic	29.016453	48.11492

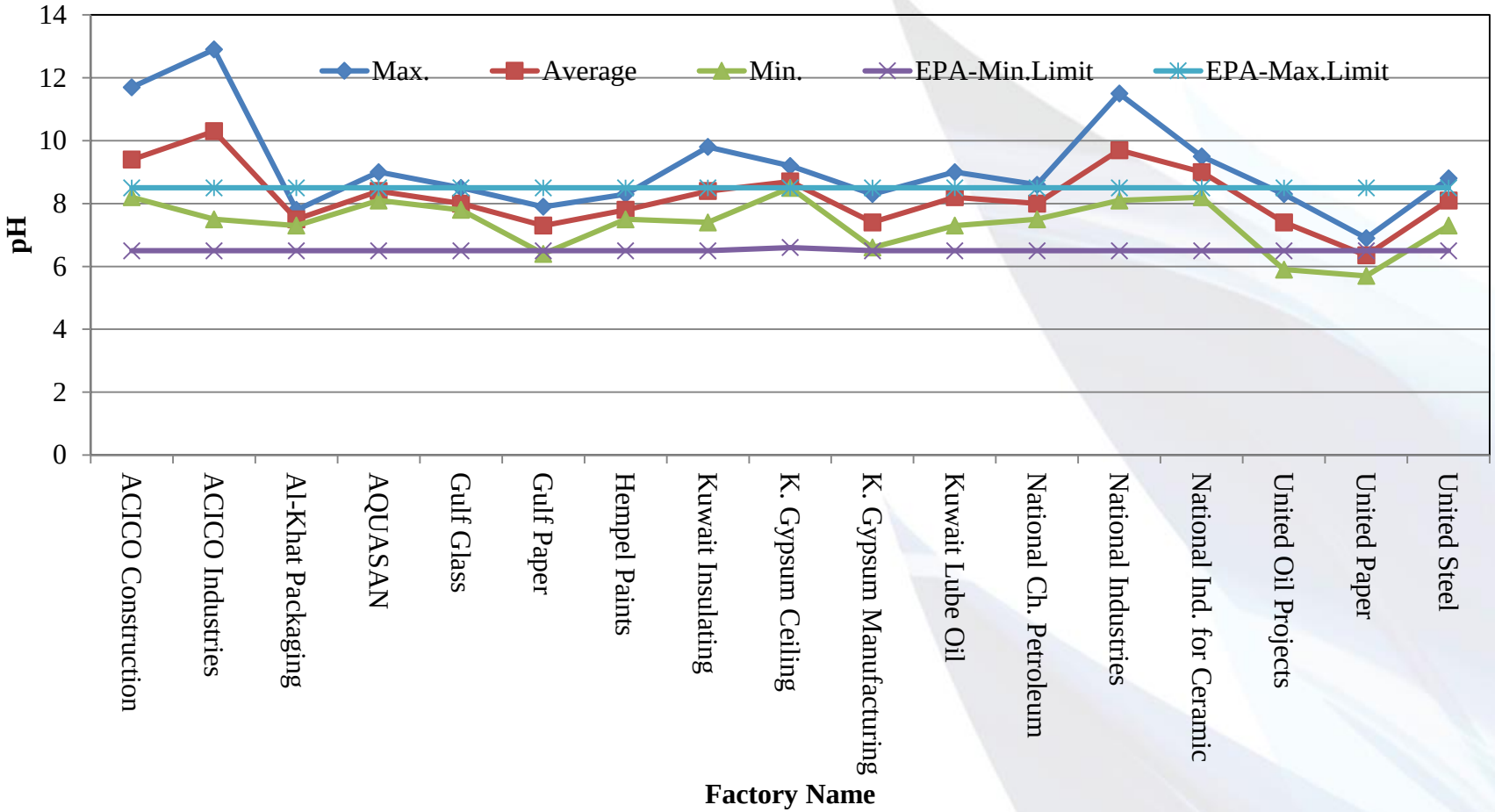
Location Map of Selected Factories at Shuaiba Industrial Area



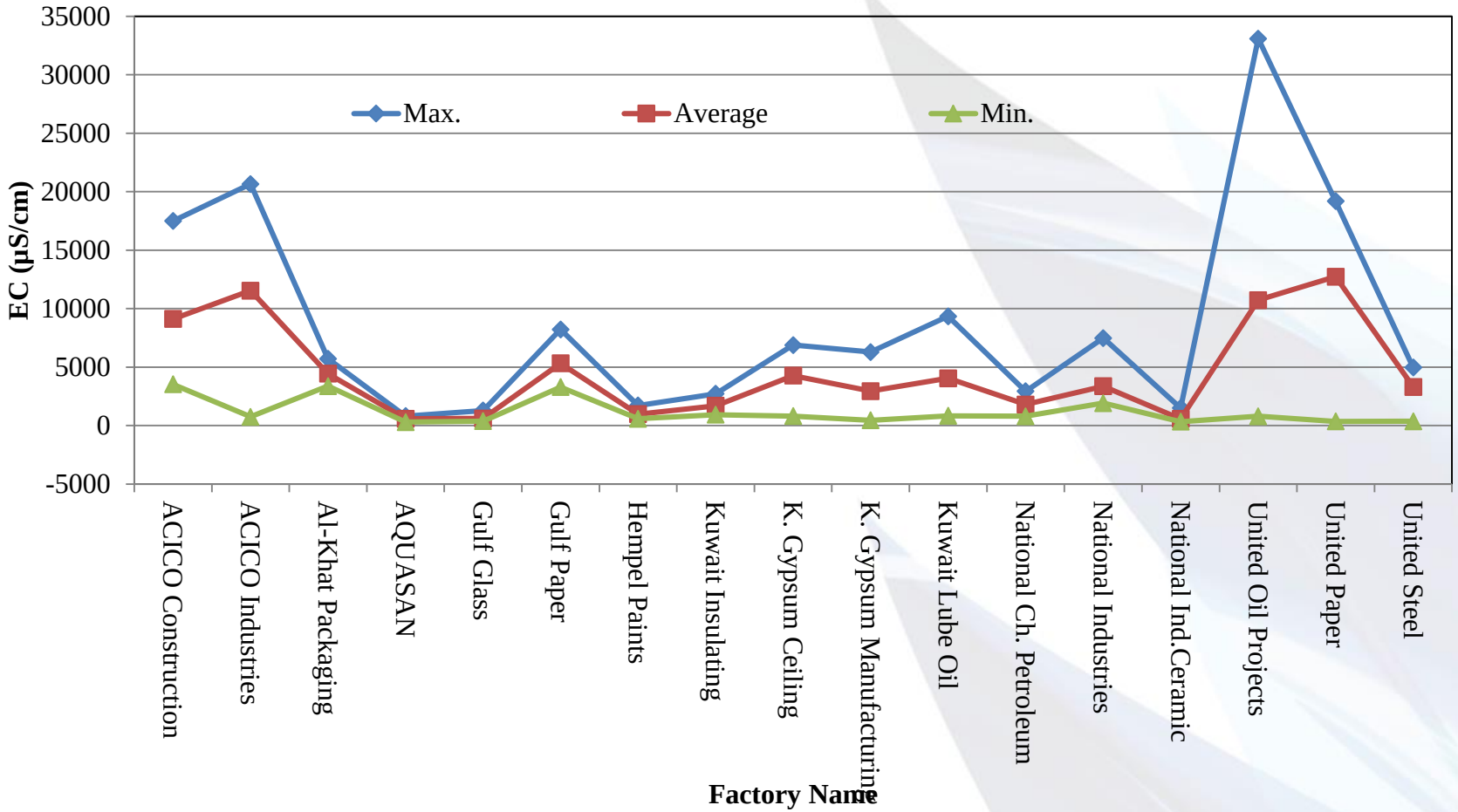
Quantities of Freshwater and Wastewater for each Factory of Shuaiba Industrial Area



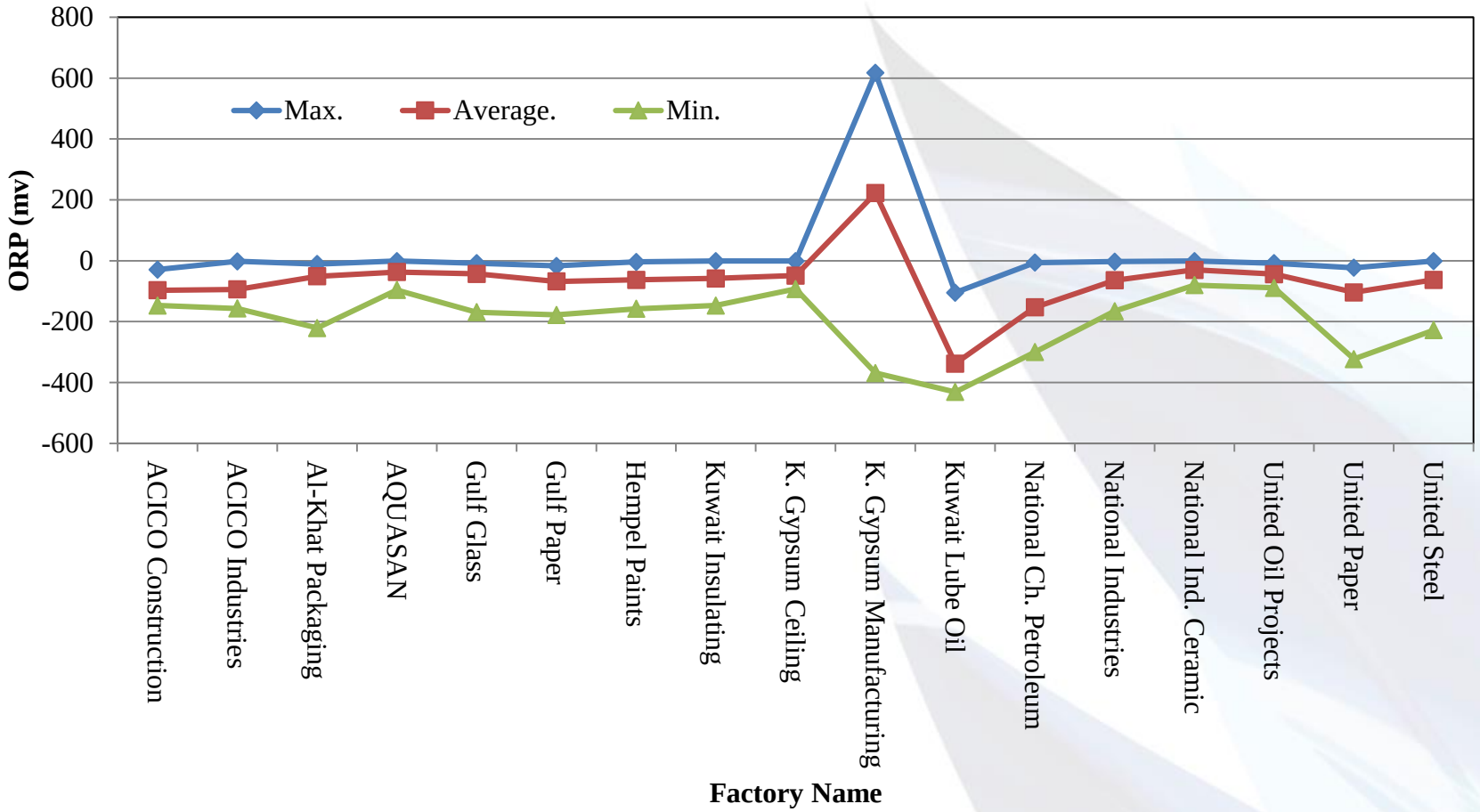
Changes in pH values of wastewater for Shuaiba factories



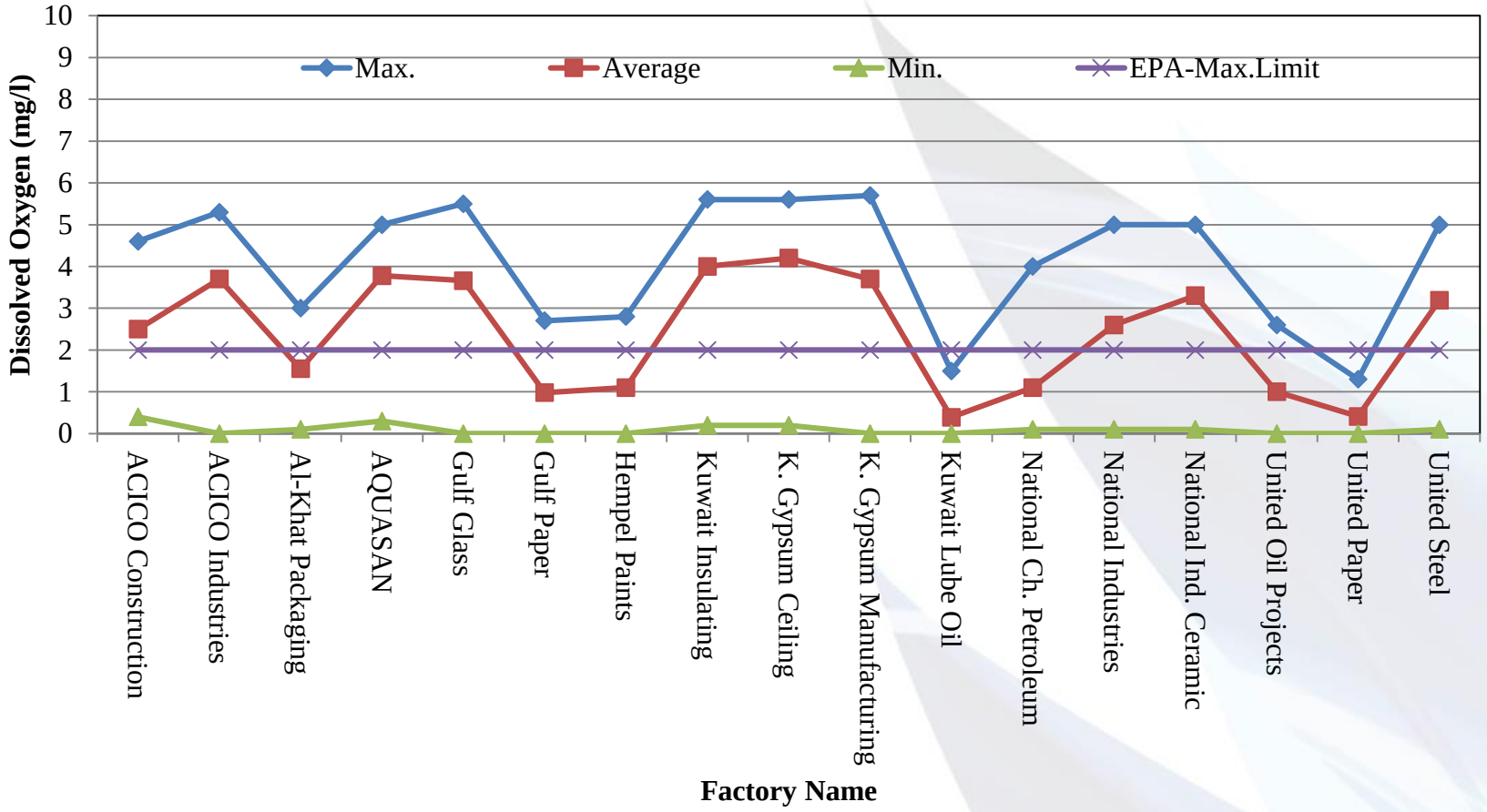
Changes in Electrical Conductivity Values of Wastewater for Shuaiba Factories



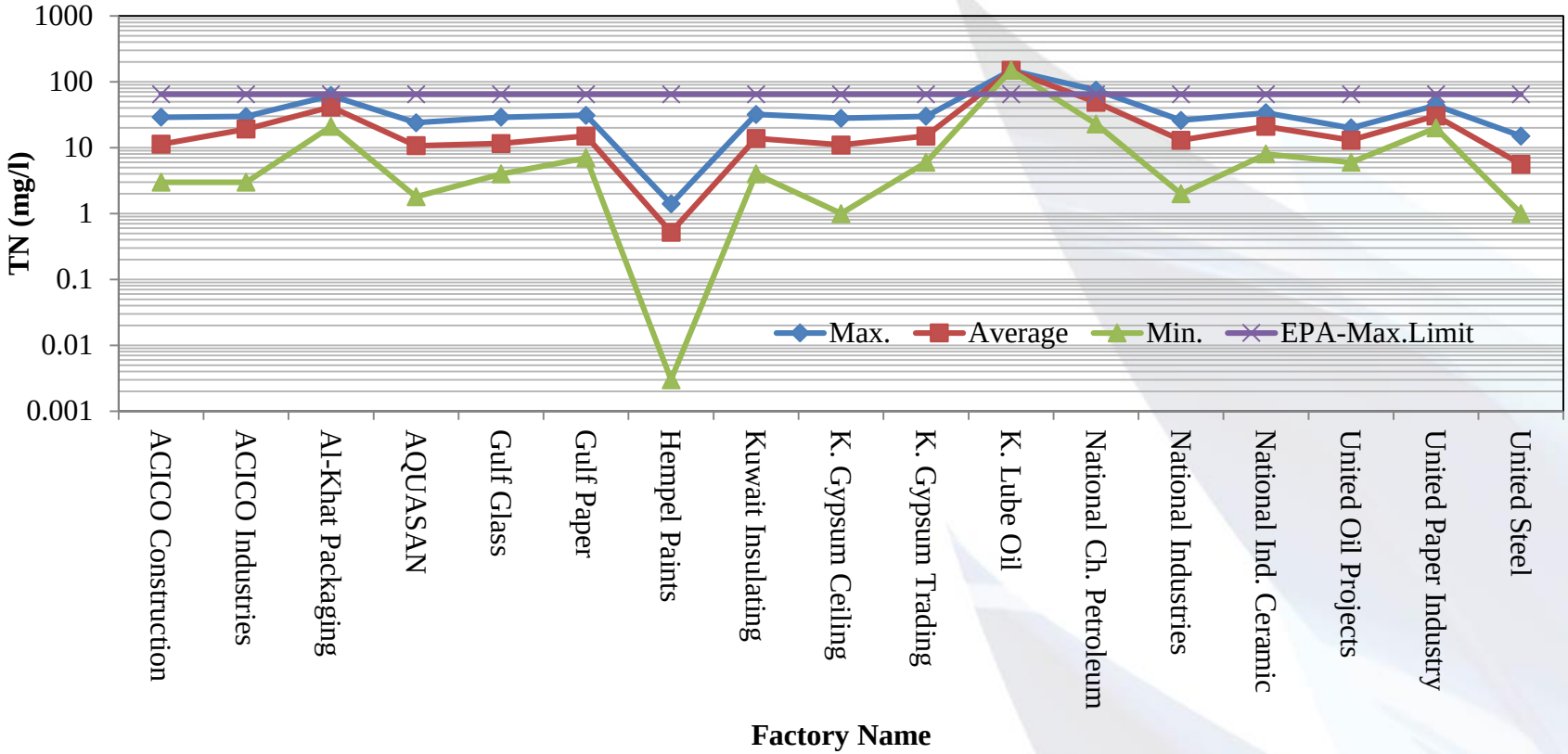
Changes in Oxidation Reduction Potential Values of Wastewater for Shuaiba Factories



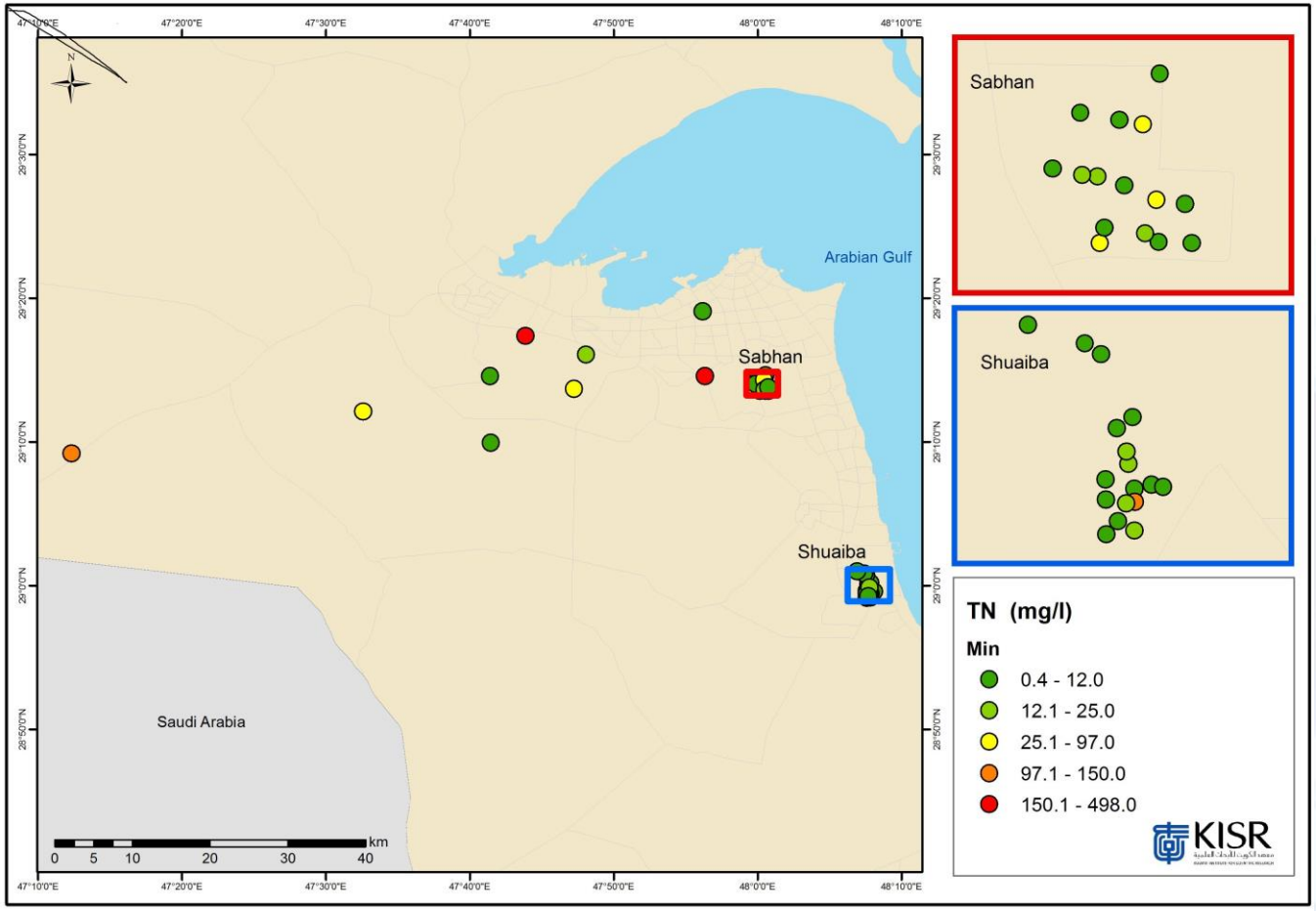
Changes in Dissolved Oxygen Values of Wastewater for Shuaiba Factories



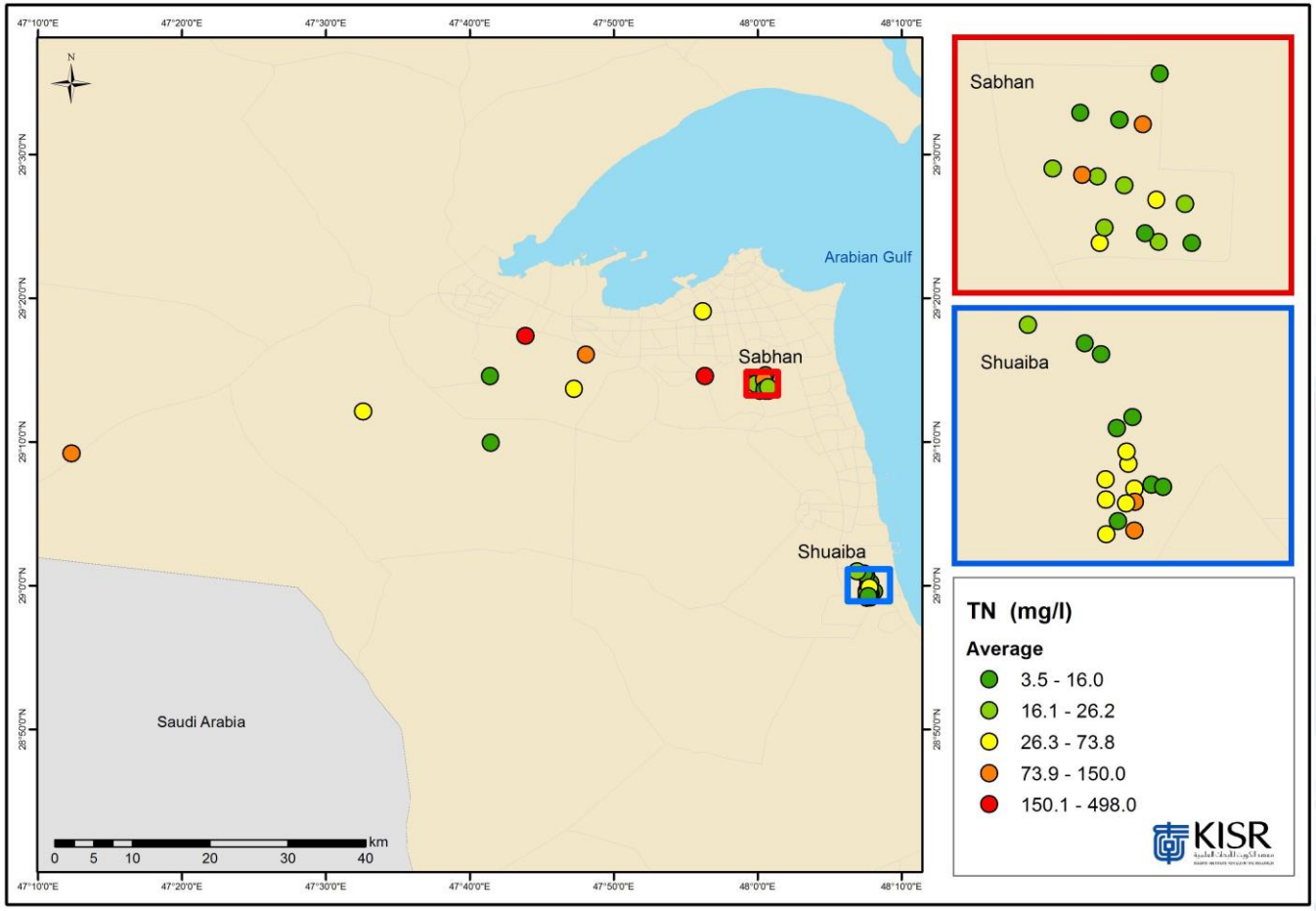
Changes in Total Nitrogen (mg/l) of Wastewater for Shuaiba Factories



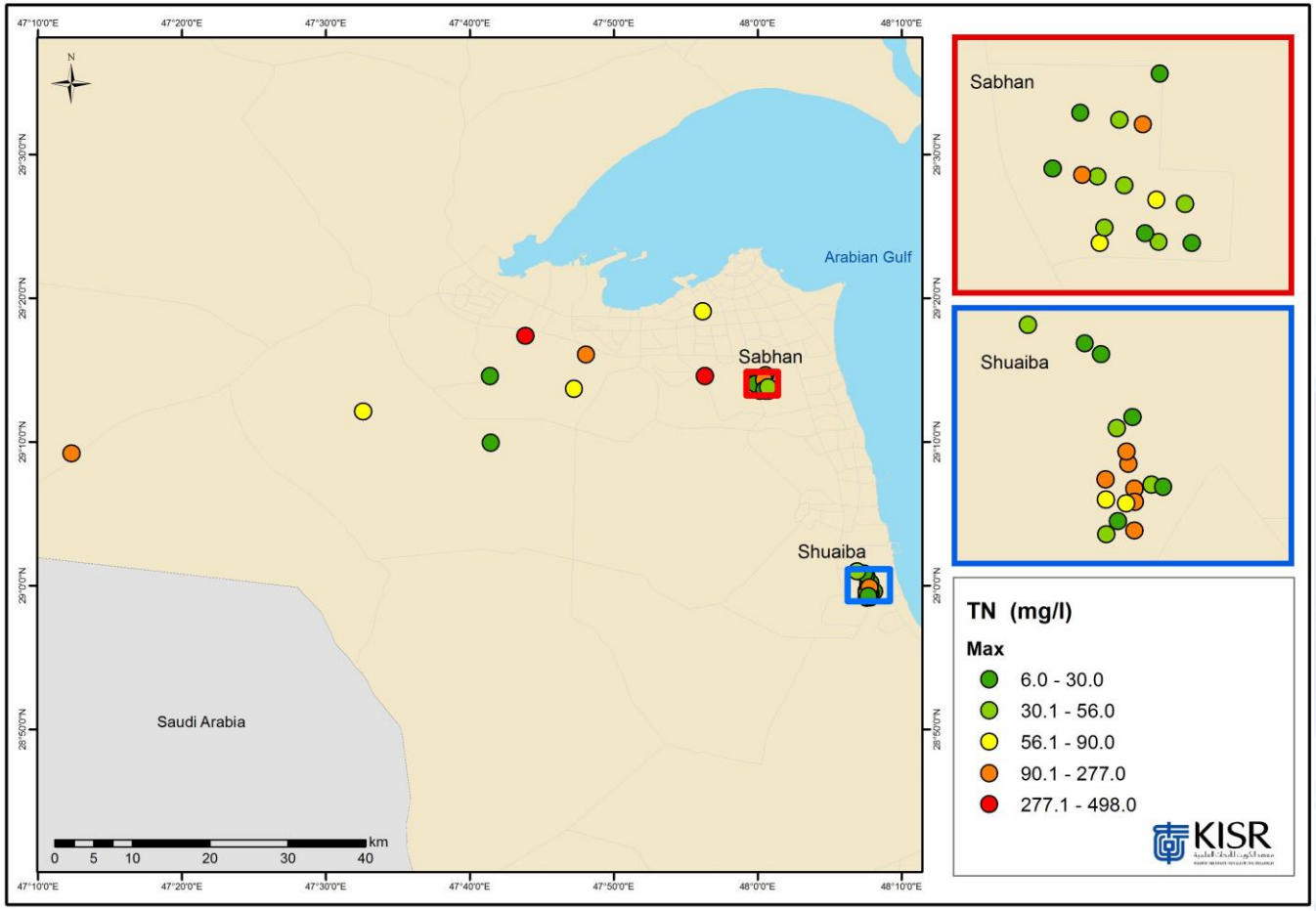
Distribution Map of Minimum Values of Total Nitrogen (mg/l) in Wastewater for Various Industries in Kuwait



Distribution Map of Average Values of Total Nitrogen (mg/l) in Wastewater for Various Industries in Kuwait



Distribution Map of Maximum Values of Total nitrogen (mg/l) in Wastewater for Various Industries in Kuwait



Conclusions

- A field study was carried out to collect data on the quality and quantity of petroleum industrial wastewater from different sources in Shuaiba area, Kuwait and developing a database for the target industries using ArcGIS technique.
- The laboratory results of total nitrogen indicated that their concentrations in the raw wastewater are meeting KEPA irrigation water standards except for those values of total nitrogen (above 65 mg/l) for one factory (Kuwait Lube Oil Company).
- The obtained field data suggest that only a few industries use on-site wastewater treatment systems.

Recommendations

- The industrial wastewater database should be updated continuously by Public Authority Industry (PAI) including all factories.
- GIS is a suitable platform for industrial wastewater management.
- Onsite treatment systems such as pH buffer tank, sand and carbon filtration and disinfection units should be installed to treat the industrial wastewater for group of industries of similar sources to ensure that the quality of industrial wastewater should meet the irrigation water standards set by KEPA.

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Thank you for your attention…