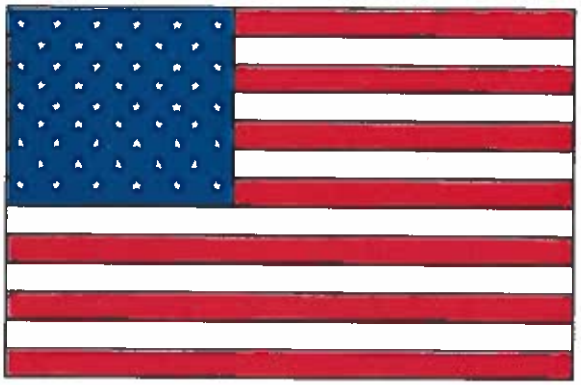
# BINATIONAL NOGALES WASH UNITED STATES/MEXICO GROUNDWATER MONITORING PROGRAM

## FINAL REPORT, AUGUST 2001

# PROGRAMA BINACIONAL DE MONITOREO DE AGUAS SUBTERRANEAS SOBRE EL ARROYO LOS NOGALES

## INFORME FINAL, AGOSTO 2001



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# I. AUTHORITY, JUSTIFICATION AND PARTICIPANTS

## A. Authority

This study and study reports were undertaken by the United States and Mexico pursuant to the International Boundary and Water Commission (IBWC) Joint Report of Principal Engineers Relative to the Joint Monitoring of the Quality of the Groundwaters in the Ambos Nogales Area, dated January 25, 1996 and pursuant to IBWC Minute No. 289.

The Joint Report approves the formation of a binational team of water quality experts from the United States and Mexico to monitor the quality of the water in the alluvial aquifer along the Nogales Wash in Nogales, Arizona and Nogales, Sonora.

An interim report was issued by the Governments of the United States and Mexico through the two sections of the International Boundary and Water Commission in June 1998. The interim report included information collected during the first two groundwater monitoring events in Nogales, Arizona and Nogales, Sonora in July 1996 and April 1997. This final report includes information collected during three monitoring events and the soil data collected during the drilling phase of the study.

Copies of this report in English may be obtained from the United States Section of the International Boundary and Water Commission, 4171 N. Mesa, Suite C-310, El Paso, Texas, 79902. Questions regarding the United States information contained in this report may be directed to Ms. Sylvia A. Waggoner at (915) 832- 4740 or by e-mail at sylviawaggoner@ibwc.state.gov.

Copies of this report in Spanish may be obtained from the Mexican Section of the International Boundary and Water Commission, Ave. Universidad No. 2180, Zona Chamizal, C.P. 32310 Cd. Juárez, Chihuahua. Questions regarding the information from Mexico contained in this report may be directed to Ing. Luis A. Rascón M. at 011-52-1613-9942 or by E-mail at arascon@cilamexeua.gob.mx.

## B. List of Participating Agencies

United States

U.S. Environmental Protection Agency
Arizona Department of Environmental Quality
Santa Cruz County Health Department
City of Nogales, Arizona

Mexico

Comisión Nacional del Agua
Gerencia de Aguas Subterráneas
Gerencia de Saneamiento y Calidad del Agua
Gerencia Regional Noroeste
Comisión de Agua Potable y Alcantarillado del Estado de Sonora

International

International Boundary and Water Commission

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**D. Justification**

The Nogales, Arizona and Nogales, Sonora area is in an accelerated growth phase, due to the migration and installation of an important number of industries in the region. The accelerated growth along with the topographical conditions in the region and its archaic potable and wastewater conveyance systems, make it difficult to provide adequate sewerage services. The combination of these factors can cause undesirable and uncontrolled infiltration of contaminating substances into the shallow groundwaters in the region. This shallow aquifer is a drinking water aquifer used by private wells in Nogales, Arizona.

After consultations with the responsible agencies in the two countries, the IBWC decided to coordinate the development of a study so as to obtain reliable information on soils and groundwater quality in the shallow aquifer along the Nogales Wash.

The United States Environmental Protection Agency, Region IX (USEPA) provided funds to the United States Section of the IBWC and to the Arizona Department of Environmental Quality (ADEQ) to implement this binational project.

Funding for Mexico's participation in this project was provided by the Comisión Nacional del Agua (CNA) and by the Mexican Section of the IBWC.

## II. EXECUTIVE SUMMARY

Based on a binational agreement between the United States and Mexico, "Joint Report of the Principal Engineers Relative to the Joint Monitoring of the Quality of the Groundwaters to Determine the Presence of Anthropogenic Contaminants in the Transboundary Aquifer in the Nogales, Arizona/Nogales, Sonora Area," dated January 25, 1996, a joint study was conducted of the quality of groundwaters along the alluvial aquifer of the Nogales Wash. The Nogales Wash originates 8.6 km (5.4 miles) south of the international boundary between the United States and Mexico, and flows north through Nogales, Sonora and Nogales, Arizona. The objective of the study is to obtain reliable data concerning the quality of the groundwaters and the soil along the Nogales Wash. The collection of these data can document whether or not surface activities and discharges into the Nogales Wash have impacted the quality of the groundwater.

The following United States agencies were participants of the study: United States Section, IBWC; USEPA, Region IX; ADEQ; Santa Cruz County Health Department; and the City of Nogales, Arizona. From Mexico, the participants in the study were representatives from the Mexican Section, IBWC; CNA; and the State Commission on Potable Water and Sewerage in Sonora (COAPAES). The groundwater sampling teams were comprised, as close as possible, of the same number of water quality professionals from each country. Thirteen sampling wells on either side of the border were established, the majority of them drilled specifically for this study. The exceptions were two pre-existing monitoring wells just north of the international boundary in Nogales, Arizona, one abandoned well at the COAPAES offices, and a potable water well in Nogales, Sonora. The collection of soil samples was conducted during the well drilling phase. Well NGW-1 through 7 are located in Nogales, Sonora and NGW-8 through 13 are located in Nogales, Arizona. The groundwater samples were collected during a total of five sampling events.

This report presents the final results obtained from the last three sampling events. During June 1997 all the wells in Nogales, Arizona and Nogales, Sonora were sampled. Well NGW-5 was destroyed during a flood. Therefore, it was not sampled in September 1997 nor February 1998. The last sampling event on February 1998 included only the wells that were not sampled during the first sampling event in July 1996 because they were still under construction. Well NGW-13 was also included in the last sampling event since it was not sampled in July 1996 due to a faulty pump. In addition, a sample from the international interceptor was collected just north of the international border to provide additional information regarding the quality of the wastewater conveyed through the interceptor and the influence that the interceptor may have on the groundwater in wells NGW-8 and 9.

In June 1997, tetrachloroethylene (PCE) was detected in NGW-9 at a concentration exceeding the Arizona's Aquifer Water Quality Standards (AWQS) of 0.005 mg/l. PCE was also detected in wells NGW-5, NGW-6 and NGW-7. The concentrations found at NGW-5 and NGW-7 exceeded the Mexican ecological water quality criteria for drinking water supplies (Criterios Ecológicos de Calidad del Agua de Mexico (CECA) Para Fuente de Abastecimiento de Agua Potable) of 0.008 mg/l for that compound. In addition, arsenic was detected in wells NGW-10 and NGW-11, however, the levels did not exceed the AWQSs of 0.05 mg/l. High concentrations of nitrate as nitrogen were detected in NGW-5, NGW-6, and NGW-7 exceeding the standard of 5 mg/l. High concentrations of nitrate as nitrogen were also detected in NGW-8, and NGW-10 exceeding the AWQS of 10 mg/l. Fecal coliform bacteria was present in NGW-1 and NGW-7 at levels that did not exceed the CECA for drinking water sources.

In September 1997, PCE was detected in NGW-9, however, the concentration did not exceed the AWQS

of 0.005 mg/l. Low levels of PCE were also detected in NGW-11. PCE was also detected in wells NGW-1, NGW-6 and NGW-7. The concentrations found at NGW-6 and NGW-7 exceeded the Mexican drinking water standard of 0.008 mg/l and the AWQS of 0.005 mg/l. Arsenic was detected in NGW-11 exceeding the AWQSs of 0.05 mg/l. High concentrations of nitrate as nitrogen as were detected in NGW-6 and NGW-7 exceeding the Mexican drinking water standard of 5 mg/l. The nitrate concentrations found in NGW-8, and NGW-10 also exceeded the AWQS of 10 mg/l. Total coliform bacteria were present in NGW-1, NGW-6 and NGW-7.

In February 1998, PCE was detected in NGW-6, NGW-7 and NGW-9. The concentrations in NGW 7 and NGW 9 exceeded the AWQS of 0.005 mg/l. The concentrations found at NGW-7 exceeded the Mexican CECA of 0.008 mg/l. Low concentrations of arsenic were detected in wells NGW-8 and NGW-9, however, the levels did not exceed the AWQSs of 0.05 mg/l. Concentrations of nitrate as nitrogen were also detected in NGW-8 and NGW-9. The nitrate concentrations found in NGW-8 exceeded the AWQS of 10 mg/l. Total coliform were present in NGW-1, NGW-4 and.

## III. DESCRIPTION OF THE STUDY AREA

The Nogales Wash originates north of Santa Elena, Sonora about 8.6 km (5.4 mi) south of the international boundary between the United States and Mexico. It then flows north through Nogales, Sonora, and Nogales, Arizona. Perennial flow in the Nogales Wash is fed by springs near its head, however, storm flows and uncontrolled sewage discharges also contribute to the flow. Its widest point is located south of the City of Nogales, Sonora where it reaches up to 1.2 km (0.75 mi) in width. The Nogales Wash is encased with concrete close to the international boundary (7 m (23 ft) in width by 5 m (16.4 ft) in height). A description of the aquifer characteristics can be found in the June 1998 Interim Report.

### A. Aquifer Characteristics

The erosion action caused by the Nogales Wash formed quaternary alluvial deposits (alluvial fans), referred to in the United States literature as the Younger Alluvium (IBWC and ADEQ, 1995). The deposits consist of subangular gravel 2 to 5 cm (0.8-2 in) in diameter, subrounded sand of various grain sizes and yellowish clay. The thickness of the alluvium is over 25 m (82 ft) south of Nogales, Sonora (CNA, 1997) and less than 15 m (49 ft) north of the international boundary (John Carollo Engineers, 1979).

The main aquifer in the area is comprised of quarternary deposits, continental tertiary sedimentary conglomerates and tertiary volcanic sedimentary deposits. The aquifer may be locally confined, however, it is generally unconfined. The main recharge is from infiltration of rainfall through the fractures in the granite, the volcanic rocks and also through the clastic material that forms the aquifer. Since part of the flows in the Nogales Wash that contribute to the recharge of the alluvial aquifer are uncontrolled wastewater discharges, the aquifer is vulnerable to anthropogenic contamination.

A registered surveyor was contracted to perform a wellhead elevation survey having an accuracy of plus or minus 0.003 m (0.01 ft). The survey was used to calculate actual elevations of the groundwater and evaluate the direction of groundwater flow. Tables 1 and 2 present the well construction information as well as survey elevation data for all the wells. The regional groundwater flow is generally from south to north as indicated by the groundwater elevations. The depth to the static water level varies from 5 to 30 m (16.4 to 98.4 ft) close to the international boundary and downtown Nogales, Sonora; from 60 to 140 m (197 to 459

ft) near the industrial area; and from 100 to 140 m (328 to 459 ft) at the southern limit.

The alluvial aquifer formed by the Nogales Wash is not the principal source of water for the City of Nogales, Sonora nor for Nogales, Arizona. However, it is tapped by several drinking water wells in Nogales, Arizona. There is a concern regarding the groundwater quality due to low levels (below Arizona maximum contaminant levels) of VOCs found during monitoring activities performed by ADEQ at several monitoring and drinking water wells located along the Nogales Wash in Nogales, Arizona (Earth Technology, 1990 in IBWC and ADEQ, 1995).

**B. Sampling Sites**

This study tested thirteen wells at twelve different sites within approximately 8 km (5 mi) north and south of the international boundary. Representatives of the participating agencies from the United States and Mexico selected and agreed upon sites for monitoring well placement. All sites were located along the Nogales Wash or its tributaries in areas where the shallow alluvial aquifer is present. Most of the sites lie down gradient of or adjacent to areas where past or present land use includes industrial activity or development that may have had an impact on groundwater quality. In this manner, the location of potential sources of groundwater contamination can be narrowed to a smaller region within the urban area for a more focused study by the appropriate authorities. Such detailed source investigations are beyond the scope of this joint groundwater monitoring program. Specific site descriptions and the rationale for the selection are discussed below. The location of the wells are shown in Figure 1.

Parque Industrial (NGW-1): This site is the closest to the origin of the Nogales Wash . The objective of this well was to obtain information on the original natural condition of the groundwater as it is influenced by the Nogales Wash, and due to its location, it will also test for effects of any past industrial discharges to the wash or to the groundwater system.

Planta PEMEX (NGW-2): This site will test for petroleum products which may have come from spillage at the PEMEX storage facility. It is located adjacent to the railroad tracks and the Nogales Wash. This is a dry well.

Ferrocarril (NGW-3): This site is down gradient from the railroad yard in Nogales, Sonora. The location should determine whether or not groundwater has been affected by spills from fueling and maintenance operations.

Camino Viejo a Cananea (NGW-4): This site is down gradient from a light industrial area located near the Nogales Wash and to the west along the old road to Cananea.

Cruz Roja (NGW-5): This site is at the confluence of the Nogales Wash and the Cinco de Febrero Wash.

La Tomatera (NGW-6): This existing well (noria) is located in the shallow alluvium near the confluence of the Nogales Wash with one of its major tributaries.

Noria Oficina (NGW-7): This existing shallow well was previously used as a public water supply well. It is located in the same building as the COAPAES offices.

ADEQ #1 and #2 (NGW-8 and NGW-9): These existing wells are monitoring wells drilled by ADEQ in early 1993 to measure groundwater quality at different depths within the alluvial aquifer. NGW-8 is screened near the base of the aquifer while NGW-9 is screened at the water table. This location at the border represents a local point of constriction of the groundwater basin. Most of the flow moving from Mexico into the United States must pass through this narrow zone.

Trickey Wash (NGW-10): This location is adjacent to the former railroad yard in Nogales, Arizona, where fuel spills have caused problems with petroleum contaminated soils. The surrounding land use is primarily retail but has had light industrial use. The Trickey Wash enters the concrete-lined Nogales Wash at this location bringing storm water flows and some wastewater from Mexico.

Old Nogales Landfill (NGW-11): This location is the site of a former sewage treatment plant and a closed municipal landfill site that has not been monitored. Nearby wells have shown trace levels of VOCs. The Nogales Wash is no longer concrete lined at this location.

Wingfield Area (NGW-12): The nearby Wingfield Tire Co. is a gas station and truck wash. Other light industry and produce trucking operations are located south and southeast of this location. Trace levels of VOCs and a parasite, Cryptosporidium, have been detected at a well at the Wingfield station.

Potrero Creek (NGW-13): This site is near the confluence of the Potrero Creek with the Nogales Wash. Potrero Creek is a major tributary and the site of a wetland marsh. West of this site is the United Musical Instruments facility where metal plating sludge and waste solvents were disposed in a lagoon. The lagoon has been cleaned up, however, a trichloroethylene (TCE) plume still exists in the groundwater below this site.

International Wastewater Collector (sampled in February 1998 only): The collector was sampled at a manhole just north of the international boundary about 10 m (30 ft) from NGW-8 and NGW-9. The international wastewater collector conveys wastewater from Nogales, Sonora to the Nogales International Wastewater Treatment Plant located in Rio Rico, Arizona about 16 km (10 miles) north of the international boundary. The binational group agreed to sample this location in an effort to explain the unexpected groundwater level in NGW- 8.

## IV. DESCRIPTION OF THE STUDY

The objective of this groundwater sampling project was to collect reliable groundwater quality data from the alluvial aquifer along the Nogales Wash. Information regarding the groundwater sampling methodology can be found in the Binational Nogales Wash United States/Mexico Groundwater Monitoring Program, Interim Report, 1998 and in the project work plan (International Boundary and Water Commission and Arizona Department of Environmental Quality, 1995).

As indicated above, this study includes 13 wells, among which are two existing wells in Mexico (NGW-6 and NGW-7) and two existing wells in the United States (NGW-8 and NGW-9). The remaining nine wells were constructed in accordance with the design proposed in the Well Construction Plan, Nogales Wash Joint United States/Mexico Groundwater Monitoring Program by the International Boundary and Water Commission and Arizona Department of Environmental Quality (IBWC and ADEQ, 1993). This type of design made it possible to collect representative groundwater samples from the saturated zone within the alluvial aquifer for water quality testing.

The existing wells in Nogales, Sonora, NGW-6 and NGW-7, are hand dug wells completed in the shallow part of the aquifer. NGW-6 (La Tomatera) is approximately 2.5 m (8.2 ft) in diameter with a total depth of 7.7 m (25.3 ft). NGW-7 (Noria Oficina COAPAES) is located in the offices of COAPAES. This well is about 2.5 m (8.2 ft) wide on the surface, about 15.24 m (50 ft) deep. It is equipped with a 25 hp, 220V pump.

NGW-8 and NGW-9, the two existing monitoring wells in Nogales, Arizona, were constructed with a 4-inch schedule 40 PVC casing and completed similarly to the binational wells (IBWC and ADEQ, 1993). NGW-8 is screened close to the bottom of the aquifer with a total depth of 18.07 m (59.3 ft) and NGW-9 is screened at the water table with a total depth of 9.14 m (30 ft). Table 1 provides the well construction details for the monitoring wells in Nogales, Sonora. Table 2 provides the well construction details for the monitoring wells in Nogales, Arizona.

Detailed information regarding drilling activities can be found in their respective well construction reports, Ajay Environmental Consultants, Inc., 1996 and Comisión Nacional del Agua, 1997.

**A. Soil Sampling**

During the drilling phase of this project, representative soil samples of the lithology through which each well was drilled was collected according to the Soil Collection Procedures described in the Well Construction Plan developed for this project. Soil samples were collected in duplicate for delivery to the appropriate laboratories in both countries. The samples were analyzed in each country using available laboratory methodology with their respective detection limits. The samples collected from the wells in Nogales, Sonora were sent for analysis to Laboratorios ABC in Mexico, D.F., which had been contracted for this purpose. Soil samples collected during the drilling activities of the Nogales, Arizona wells were submitted to Copper State Analytical Lab, Inc. for analysis for VOCs (aromatic and halogenated organic compounds), and trace metals. Detailed information regarding the soil sampling activities can be found in the Binational Nogales Wash United States/Mexico Groundwater Monitoring Program, Interim Report, May 1998 and in the respective well construction reports, Ajay Environmental Consultants, Inc., 1996 and Comisión Nacional del Agua, 1997.

Tables 3a and 3b contain a summary of the laboratory results for metals and volatile organic compounds, respectively, for the soil samples collected in Mexico. Tables 4a and 4b contain the summary of the laboratory results for the soil samples collected in the United States for volatile organic compounds and metals, respectively.

**B. Groundwater Sampling**

The groundwater sampling program in the Nogales, Arizona/Nogales, Sonora area was started on July 15, 1996. Only the Nogales, Arizona wells were sampled during the first sampling event except for NGW-13 which could not be sampled because of a faulty submersible pump. The second sampling event was conducted on April 1-3, 1997. It included all the wells in Nogales, Sonora and Nogales, Arizona except for two, NGW-3 which was inaccessible due to paving work in the vicinity and NGW-2 which is a dry well. The results of these two monitoring events were presented in the Binational Nogales Wash United States/Mexico Groundwater Monitoring Program, Interim Report, May 1998. The third monitoring event was conducted on June 17 and 18, 1997. It included all the wells available for monitoring in Nogales,

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Arizona and Nogales, Sonora. The fourth monitoring event was conducted on September 23-24, 1997 and included all the wells in Nogales, Arizona and Nogales, Sonora except for NGW-5. NGW-5 was damaged beyond repair during a storm event. This well was dropped from the monitoring program. The fifth and last monitoring event was conducted on February 10, 1998. It included the wells in Nogales, Sonora that were not included in the first monitoring event of July 1996. Wells sampled in Nogales, Arizona included NGW-8, NGW-9 and NGW-13.

A wastewater sample was also collected from the international interceptor just north of the international boundary. The sample was analyzed for inorganics only. Table 5 contains information on the field parameters measured during all the project sampling events. Well groundwater elevation data show that the groundwater flow direction in this area was principally to the north in every sampling event.

All wells were sampled in accordance with the Arizona Department of Environmental Quality, Quality Assurance Project Plan (ADEQ QAPP), Manual on the Groundwater Sampling Process (EPA RCRA), Groundwater Monitoring Technical Application Guide (TEGD) (OSWER. 9950) and the project work plan (International Boundary and Water Commission and ADEQ, 1995). This report presents the results obtained from only the last three sampling events.

## C. Quality Assurance/Quality Control (QA/QC)

### 1. QA/QC in the Field

#### a. Chain of Custody

The chain-of-custody for possession and responsibility of samples was documented from the time and place of sample acquisition to the time and place of their final destination. Strict chain-of-custody procedures outlined in the work plan were followed and documented in the field log books.

#### b. Transportation of Samples

Samples were stored in portable ice chests and cooled to 4°C with ice immediately after sample collection until transported to the laboratory. Custody seals were placed on each bottle cap. The VOC vials and the total and fecal coliform bottles were placed in a plastic bag and sealed. The custody seals were placed on the plastic bags. Glass containers were wrapped with bubble wrap. Additional ice was added to the ice chest prior to shipping as needed. The ice chests were stored in a shady location during sample collection.

The chain of custody form and other sample paperwork were enclosed in the ice chest by placing it in a plastic bag and taping the bag to the inside of the ice chest lid.

The ice chests were sealed with strapping tape. Two custody seals were placed on the front of the cooler so that the custody seals extended from the lid to the main body of the ice chest. Clear tape was placed over each custody seal on the outside of the ice chest. The drain plug was checked to ensure that it was closed prior to shipping.

Total and fecal coliform samples required transport to the laboratory within six hours for immediate sample extraction and incubation. Field personnel or a courier service hand delivered the samples to the laboratory

as soon as practicable after sample collection.

**c. Preservation**

All samples were placed in ice immediately after sample collection to lower the temperature to 4° C until they were delivered to the laboratory for analysis. When required, samples were preserved by adding hydrochloric acid, sulfuric acid or nitric acid, as requested by the laboratory, to reduce the pH of the samples to less than 2.

**d. Duplicate Samples**

In June 1997 duplicate samples were collected at NGW-5 (NGW-15) and NGW-9 (NGW-14). In September 1997, duplicate samples were collected at NGW-4 (NGW-15) and NGW-9 (NGW-14). Only one duplicate sample was collected during February 1998 at NGW-9 (NGW-15). All duplicate samples were analyzed for VOCs, TPH, conventional parameters, metals, nitrate and bacteriological parameters, except for the duplicate for February 1998 which was not analyzed for bacteriological parameters.

**e. Field Blanks**

Two field blanks were collected during the June 1997 and September 1997 sampling events (NGW-16 and 17). NGW-16 was collected at NGW-10 and NGW-17 was collected at NGW-4 during the June and September 1997 monitoring events. The field blank collected at NGW-10 (NGW-17) for metals during the September 1997 sampling event was filtered. This filtered sample also served as the blank for a new box of filters. One field blank was collected during the February 1998 sampling event (NGW-17) at NGW-6. The field blanks were analyzed for VOCs, TPH, conventional parameters, metals, nitrate and bacteriological parameters.

**f. Trip Blanks**

During the June and September 1997 sampling events, trip blanks were included in every shipping container. These samples were analyzed for VOCs. During the February 1998 sampling event, all the VOCs samples were placed in a single container and only one trip blank was included in that container for the sampling event.

**2. QA/QC in the Laboratory**

Laboratory QA/QC was accomplished by using such items as surrogate spikes, matrix spikes, duplicates, reagent blanks and calibration checks.

## V. RESULTS

All groundwater samples collected by the United States were analyzed by Bolin Laboratories, Inc., of Tucson and Phoenix, Arizona. The analytical methods and parameters are presented in the Interim Report of May 1998. Bolin Laboratory is an Arizona certified laboratory. Groundwater samples collected by Mexico were analyzed by Laboratorio Central de la Gerencia de Saneamiento y Calidad del Agua, CNA, México, D.F. (heavy metals), Laboratorio de Saneamiento y Calidad del Agua de la Gerencia Regional Noroeste, CNA,

Hermosillo, Sonora (conventional parameters) and Laboratorio ABC in México, D.F. (volatile organic compounds). Laboratorio ABC is approved by CNA based on the law of metrology and standardization (Ley de Metrologia y Normalizacion) and is accredited by the Department of Standards (Direccion General de Normas (DGN)) through the national system of accreditation for testing laboratories (Sistema Nacional de Acreditamiento de Laboratorios de Prueba (SINALP)).

**A. June 1997**

Table 6 presents a summary of the detected constituents for the groundwater samples collected by the United States and Mexico during the sampling event of June 17 and 18, 1997.

**U.S. Laboratory Results**

The analysis for the modified EPA Method 8015-Diesel for the total petroleum hydrocarbon samples collected by the U.S. could not be performed by Bolin Laboratories for the following samples collected during the June 1997 sampling activity: NGW-1, NGW-3, NGW-7, NGW-10, NGW-12 and NGW-15. These samples were broken in transit to a Bolin subcontract laboratory in Ohio. Total petroleum hydrocarbons were detected in NGW-4 (0.27 mg/l).

Tetrachloroethylene (PCE) was detected in wells NGW-1 (0.0008 mg/l), NGW-5 (0.260 mg/l), NGW-6 (0.0039 mg/l), NGW-7 (0.075 mg/l), NGW-9 (0.012 mg/l) and NGW-11 (0.0009 mg/l) during the June 1997 sampling event.

Low levels of additional VOCs were detected in monitoring well NGW-3 (Benzene (0.0007 mg/l), n-Butylbenzene (0.0048 mg/l), sec-Butylbenzene (0.0049 mg/l), Isopropylbenzene (0.0061 mg/l), and Propylbenzene (0.010 mg/l)). NGW-4 showed low levels of sec-Butylbenzene (0.0019 mg/l), cis-1,2-Dichloroethylene (0.0031 mg/l) and Isopropylbenzene (0.0008 mg/l). Cis-1,2-Dichloroethylene (0.011 mg/l) was also detected in NGW-5. Trichloroethylene (TCE) was detected in NGW-6 (0.0021 mg/l) and NGW-7 (0.0014 mg/l). Chloroform was detected in NGW-9 (0.0014 mg/l) and was also detected in the field blank (NGW-17) at a higher concentration (0.0062 mg/l).

In June 1997, nitrate (as nitrogen) was detected in wells NGW-1 (5.1 mg/l), NGW-4 (0.3 mg/l), NGW-5 (6.4 mg/l), NGW-6 (6.8 mg/l), NGW-7 (9.5 mg/l), NGW-8 (21.2 mg/l), NGW-9 (6.4 mg/l), NGW-10 (11 mg/l), NGW-11 (3 mg/l), NGW-12 (3 mg/l), and NGW-13 (2.9 mg/l).

Iron was detected in NGW-1 (0.025 mg/l), NGW-3 (5.14 mg/l), and NGW-4 (4.99 mg/l).

Manganese was detected in monitoring wells NGW-3 (2.56 mg/l) and NGW-4 (5.3 mg/l).

Arsenic was detected in monitoring wells NGW-1 (0.005 mg/l), NGW-8 (0.016 mg/l), NGW-10 (0.036 mg/l), NGW-11 (0.048 mg/l), and NGW-12 (0.01 mg/l).

Total coliforms were detected in NGW-9 in Nogales, Arizona and fecal coliforms were detected in NGW-1, NGW-4, NGW-6, and NGW-7 in Nogales, Sonora.

**Mexican Laboratory Results**

The samples collected by Mexico for VOCs for NGW-1 were broken in transit.

The results from the Mexican laboratories for the samples collected in June 1997 show the following concentrations of PCE: NGW-3 (0.00071 mg/l), NGW-5 (0.52169 mg/l), NGW-6 (0.00408 mg/l) NGW-7 (0.11513 mg/l), NGW-11 (0.00151 mg/l) and NGW-12 (0.0006 mg/l).

Total petroleum hydrocarbons were detected in NGW-4 (1.52 mg/l). Low levels of additional VOCs were detected in NGW-3 (1,1,2-Trichloroethane (0.00186 mg/l) and m-Xylene (0.00054 mg/l). TCE was detected in NGW-5 (0.00216 mg/l), NGW-6 (0.00145 mg/l) and NGW-7 (0.00118 mg/l).

Nitrate (as nitrogen) was detected in wells NGW-1 (13.8 mg/l), NGW-5 (4.8 mg/l), NGW-6 (4.8 mg/l), NGW-7 (8.1 mg/l), NGW-8 (20.4 mg/l), NGW-9 (6 mg/l), NGW-10 (10.3 mg/l), NGW-11 (2.3 mg/l), NGW-12 (2.7 mg/l), and NGW-13 (2.8 mg/l).

Iron was detected in NGW-3 (1.78 mg/l), and NGW-4 (2.7 mg/l).

Manganese was detected in monitoring wells NGW-3 (1 mg/l) and NGW-4 (2.75 mg/l).

Arsenic was detected in wells NGW-1 (0.0028 mg/l), NGW-3 (0.0009 mg/l), NGW-4 (0.0014 mg/l), NGW-5 ( 0.0017 mg/l), NGW-7 (0.0018 mg/l), NGW-8 (0.0085 mg/l), NGW-9 (0.0029 mg/l), NGW-10 (0.0203 mg/l), NGW-11 (0.0231 mg/l), and NGW-12 (0.0059 mg/l).

Total and fecal coliform were detected in NGW-1 and NGW-7 and total coliform in NGW-9.

**B. September 1997**

Table 7 presents a summary of the detected constituents for the groundwater samples collected by the United States and Mexico during the sampling event of September 23 and 24, 1997.

**U.S. Laboratory Results**

PCE was detected in wells NGW-3 (0.0011 mg/l), NGW-6 (0.0053 mg/l), NGW-7 (0.0449 mg/l), NGW-9 (0.0042 mg/l) and NGW-11 (0.0012 mg/l).

Low levels of additional VOCs were detected in monitoring well NGW-3 (Benzene (0.0006 mg/l), n-Butylbenzene (0.0039 mg/l), sec-Butylbenzene (0.0047 mg/l), Isopropylbenzene (0.0058 mg/l), and Propylbenzene (0.0091 mg/l)). NGW-4 showed low levels of sec-Butylbenzene (0.0020 mg/l), cis-1,2-Dichloroethylene (0.0015 mg/l), Isopropylbenzene (0.0009 mg/l), 1,1-Dichloroethane (0.0008 mg/l), Vinyl Chloride (0.0006 mg/l) and Benzene (0.0005 mg/l). TCE was detected in NGW-6 (0.0034 mg/l). Chloroform was detected in NGW-6 (0.0016 mg/l) and NGW-9 (0.0017 mg/l). Total Trihalomethanes were detected in NGW-6 (0.0016 mg/l) and NGW-9 (0.0017 mg/l). NGW-9 also showed low levels of m-Xylene (0.0017 mg/l).

Nitrate (as nitrogen) was detected in wells NGW-1 (3.1 mg/l), NGW-6 (6.5 mg/l), NGW-7 (9.9 mg/l),

NGW-8 (18.5 mg/l), NGW-9 (8.8 mg/l), NGW-10 (10.7 mg/l), NGW-11 (2.8 mg/l), NGW-12 (2.6 mg/l) and NGW-13 (2.2 mg/l).

Iron was detected in NGW-3 (5.58 mg/l), NGW-4 (4.63 mg/l) and NGW-6 (9.00 mg/l).

Manganese was detected in monitoring wells NGW-3 (2.93 mg/l) and NGW-4 (5.17 mg/l).

Arsenic was detected in monitoring wells NGW-8 (0.014 mg/l), NGW-9 (0.005 mg/l), NGW-10 (0.033 mg/l), NGW-11 (0.052 mg/l), and NGW-12 (0.010 mg/l).

Neither total nor fecal coliforms were detected in the wells in Nogales, Arizona. Total and fecal coliform were present in NGW-1, NGW-6, and NGW-7 in Nogales, Sonora.

**Mexican Laboratory Results**

PCE was detected in wells NGW-1 (0.0025 mg/l), NGW-6 (0.00962 mg/l), NGW-7 (0.0662 mg/l), NGW-9 (0.0038 mg/l) and NGW-11 (0.0027 mg/l) during the September 1997 sampling event. TCE was detected in NGW-6 (0.0037 mg/l) and NGW-7 (0.0014 mg/l). Total petroleum hydrocarbons were detected in NGW-7 (1.2 mg/l), NGW-11 (0.6 mg/l) and NGW-12 (1.7 mg/l). Benzene was detected in NGW-3 (0.00078 mg/l) and NGW-4 (0.0006 mg/l).

Nitrate (as nitrogen) was detected in wells NGW-1 (3.3 mg/l), NGW-6 (6.4 mg/l), NGW-7 (12 mg/l), NGW-8 (16.2 mg/l), NGW-9 (9.6 mg/l), NGW-10 (13.7 mg/l), NGW-11 (3.0 mg/l), NGW-12 (2.8 mg/l), and NGW-13 (2.3 mg/l).

Iron was detected in NGW-3 (0.35 mg/l), and NGW-4 (0.25 mg/l).

Manganese was detected in monitoring wells NGW-3 (2.8 mg/l) and NGW-4 (4.8 mg/l).

Arsenic was detected in monitoring wells NGW-1 (0.0068 mg/l), NGW-3 (0.0006 mg/l), NGW-4 (0.0029 mg/l), NGW-6 (0.0009 mg/l), NGW-7 (0.0039 mg/l), NGW-8 (0.0141 mg/l), NGW-9 (0.0055 mg/l), NGW-10 (0.0290 mg/l), NGW-11 (0.0403 mg/l), NGW-12 (0.0093 mg/l) and NGW-13 (0.0008 mg/l).

Total coliform and fecal coliform were not detected in the wells from Nogales, Arizona. Total coliform were present in NGW-1, NGW-6 and NGW-7, however fecal coliform were not detected.

**C. February 1998**

Table 8 presents a summary of the detected constituents for the groundwater samples collected by the United States and Mexico during the sampling event of February 10, 1998.

**U.S. Laboratory Results**

PCE was detected in wells NGW-6 (0.0029 mg/l), NGW-7 (0.0194 mg/l) and NGW-9 (0.0065 mg/l) during the February 1998 sampling event.

Low levels of additional VOCs were detected in monitoring well NGW-3 (Benzene (0.0013 mg/l), n-Butylbenzene (0.0052 mg/l), sec-Butylbenzene (0.0056 mg/l), Isopropylbenzene (0.0061 mg/l), and Propylbenzene (0.0103 mg/l)). NGW-4 showed low levels of sec-Butylbenzene (0.0016 mg/l), cis-1,2-Dichloroethylene (0.0015 mg/l), Isopropylbenzene (0.0006 mg/l), 1,1-Dichloroethane (0.0009 mg/l) and Vinyl Chloride (0.0005 mg/l). NGW-6 showed low levels of Trichloroethylene (0.0006 mg/l). Chloroform was detected in NGW-6 (0.0005 mg/l) and NGW-9 (0.001 mg/l). Total Trihalomethanes were detected in NGW-6 (0.0005 mg/l) and NGW-9 (0.001 mg/l).

Nitrate (as nitrogen) was detected in wells NGW-1 (2.8 mg/l), NGW-6 (3.6 mg/l), NGW-7 (2.7 mg/l), NGW-8 (11.1 mg/l), NGW-9 (6.1 mg/l), and NGW-13 (2.2 mg/l).

Iron was detected in NGW-3 (5.91 mg/l) and NGW-4 (4.08 mg/l).

Manganese was detected in monitoring wells NGW-3 (2.76 mg/l) and NGW-4 (5.01 mg/l).

Arsenic was detected in monitoring wells NGW-8 (0.012 mg/l) and NGW-9 (0.005 mg/l).

Neither total nor fecal coliform were detected in the Nogales, Arizona wells. Total and fecal coliform bacteria were present in NGW-1, NGW-4, NGW-6 and NGW-7 in Nogales, Sonora.

Table 8 presents a summary of the detected constituents for the groundwater samples collected by the United States and Mexico during the sampling event of February 10, 1998.

The results of the wastewater sample collected from the international collector are presented in Table 9.

The following metals were detected by the U.S. laboratory: aluminum (4.26 mg/l), antimony (0.005 mg/l), arsenic (0.014 mg/l), barium (0.16 mg/l), boron (0.10 mg/l), chromium (0.026 mg/l), copper (0.168 mg/l), iron (4.45 mg/l), lead (0.068 mg/l), manganese (0.68 mg/l), mercury (0.0003 mg/l) and zinc (0.22 mg/l).

Other parameters reported for this sample were: total hardness (150 mg/l), alkalinity (218 mg/l), chloride (38 mg/l), fluoride (0.4 mg/l), nitrate (0.4 mg/l), sulfate (53 mg/l), ammonia nitrogen (10.1 mg/l), total Kjeldahl nitrogen (11 mg/l) and total dissolved solids (436 mg/l)

**Mexican Laboratory Results**

PCE was detected in wells NGW-6 (0.00478 mg/l), NGW-7 (0.02568 mg/l) and NGW-9 (0.0065 mg/l) during the February 1998 sampling event.

In February 1998, nitrate (as nitrogen) was detected in wells NGW-1 (5.1 mg/l), NGW-6 (8.8 mg/l), NGW-7 (10.1 mg/l), NGW-8 (17.6 mg/l), NGW-9 (9.1 mg/l), and NGW-13 (3.2 mg/l).

Iron was detected in NGW-3 (3.56 mg/l) and NGW-4 (3.02 mg/l).

Manganese was detected in monitoring wells NGW-3 (2.46 mg/l) and NGW-4 (4.44 mg/l).

Arsenic was detected in wells NGW-1 (0.004 mg/l), NGW-3 (0.0011 mg/l), NGW-4 (0.0009 mg/l), NGW-6

(0.0145 mg/l), NGW-7 (0.0031 mg/l), NGW-8 (0.0145 mg/l), NGW-9 (0.005 mg/l) and NGW-13 (0.0007 mg/l).

Fecal coliform and total coliform were present in NGW-1, NGW-4, NGW-7 and in the duplicate sample for NGW-9 (NGW-15).

The results of the wastewater sample collected from the international collector are presented in Table 9. The following metals were detected by the Mexican laboratory: aluminum (7.6 mg/l), arsenic (0.0115 mg/l), copper (0.22 mg/l), iron (8.5 mg/l), lead (0.11 mg/l), and manganese (0.89 mg/l).

### D. Quality Control/Quality Assurance Results

Appendix A presents the quality control/quality assurance data for all the groundwater samples collected during the three sampling events. Precision and accuracy for the United States data were within the project established data quality objectives. Cation and anion balance differences were less than 10% for all groundwater samples collected by the United States, with the exception of NGW-9 (13.03%) for February 1998. The U.S. laboratory reported a sulfate concentration of <5.0 mg/l. However, previous sampling data for this well indicated a sulfate concentration in the order of 50 mg/l. The sulfate concentration from NGW-14 (a duplicate of NGW-9) of 54 mg/l was used for re-computing the ion balances. The difference in the new ion balance was below 10%.

Appendix A also presents procedures and calculations concerning quality control and quality assurance for the analytical methods used in Mexico. The project precision goal (as relative percent difference) of 30% or less for PCE was not achieved by the Mexican sampling team for the U.S. monitoring wells during the September 1997 and February 1998 sampling events. Calculated relative percent differences were 87% and 41%, respectively for these sampling dates.

Travel blanks were used to check for contamination during shipping and handling during both sampling events. The travel blanks were prepared by the laboratory and analyzed for the same VOC parameters as the groundwater samples. None of the U.S. travel blanks show the presence of VOCs.

The June 1997 samples did not include a travel blank for the Mexican samples. Total petroleum hydrocarbons (1.70 mg/l) were detected in the September 1997 travel blank for the Mexican samples. Chloroform (0.002320 mg/l) and Methylene Chloride (0.00524 mg/l) were also detected in the trip blank. Chloroform (0.02637 mg/l) was detected in the February 1998 the travel blank for the Mexican samples.

## VI. OBSERVATIONS AND COMMENTS

This final project report presents the groundwater monitoring data gathered in the June and September 1997, and February 1998 sampling events for the project monitoring wells installed in Nogales, Arizona and Nogales, Sonora. These observations are focused on detected constituent concentrations that exceeded the respective Arizona Aquifer Water Quality Standards (AWQS) (Presented in Table 10) or Mexico's Water Quality Criteria for drinking water sources (Criterios Ecologicos de Calidad de Agua, CECA) (Presented in Table 11).

For the project wells located in Arizona:

Arsenic was detected in NGW-11 in September 1997 with a concentration exceeding the Arizona aquifer water quality standard (AWQS) of 0.050 mg/l.

Nitrates (as nitrogen) were detected in NGW-8 and NGW-10 in June and September 1997 and in NGW-8 in February 1998 with concentrations exceeding the Arizona AWQS of 10 mg/l for nitrates.

PCE was also detected in NGW-9 in June 1997, and February 1998 at concentrations exceeding the Arizona AWQS of 0.005 mg/l for PCE.

Total coliform bacteria were detected in NGW-9 in June 1997 at concentrations exceeding the AWQS.

For the project wells located in Sonora:

Iron and manganese were detected in NGW-3 and NGW-4 at concentrations exceeding the Mexican CECA for aquifers considered as a drinking water source (0.3 mg/l for iron and 0.1 mg/l for manganese). The exceedence was reported for the June and September 1997, and February 1998 sampling events.

Nitrates as nitrogen were also detected in NGW-1, NGW-5, NGW-6 and NGW-7 (June 1997); NGW-6 and NGW-7 (September 1997); and NGW-1, NGW-6 and NGW-7 (February 1998) at concentrations exceeding the Mexican CECA guideline of 5 mg/l for nitrates as nitrogen.

PCE was detected in NGW-5 and NGW-7 (June 1997), NGW-6 and NGW-7 (September 1997), and in NGW-7 (February 1998) at concentrations exceeding the Mexican CECA of 0.008 mg/l for PCE.

Fecal coliform concentrations did not exceed the Mexican CECA limits in any sampling event.

In general, the project data quality objectives for precision and accuracy were met by the binational sampling team during all the project quarterly sampling events. Precision for VOCs (specifically PCE) was the most difficult data quality objective to be achieved in this project. In some cases there were data differences when comparing the U.S. and Mexican data sets. The use of performance standard samples could have been a useful reference for the discrepant data. These data differences should be considered when exchanging water quality data between both countries.

The analytical results of the laboratories in the United States and Mexico were compared for cations (calcium, magnesium, sodium, potassium and arsenic), silica, for certain anions (chlorides, sulfates, nitrates and fluoride), as well as for pH, alkalinity and PCE in the sampling events of April, June and September 1997, and February 1998. These comparisons can be seen graphically in Figures 2, 3, 4 and 5 in which the results of the Mexican laboratories can be read on the abscissa axis, while the United States lab results are shown on the ordinate axis. The 45° line (slope 1) indicates the distribution of values theoretically equal between both laboratories, such that the closer the actual values approximate this theoretical line, the less analytical discrepancy there is between the laboratories in both countries. Mexico detected and reported higher values for silica, alkalinity, and pH than the United States. The United States detected and reported higher values of nitrates and arsenic than the Mexican laboratory. It can be seen that the greatest correlations exist for sodium, potassium, magnesium, chlorides, calcium, sulfates, nitrates and alkalinity; and lesser for fluorides, arsenic, silica, PCE and pH.

The pH values determined by the Mexican laboratories were consistently greater than those reported by the

United States labs. Both alkalinity and pH were determined in the laboratory and not in the field. It is probable that the pH of the samples analyzed in Mexico increased slightly due to possible losses of $CO_2$ (degasification), reflecting also in lower values for dissolved calcium (e.g., precipitation of calcite). The levels of calcium reported by the Mexican laboratories were noticeably lower than the analytical data from the United States labs.

During the sampling in April 1997, the analytical results for PCE reported by the United States labs were up to two times greater than the results reported by the Mexican labs. Nevertheless, for the later sampling events, the situation was the opposite ( the greater values were reported by the Mexican labs), with the least discrepancy being found during the February 1998 sampling. It is worth noting that the United States and Mexico utilized different analytical techniques for the quantification of PCE (EPA 502.2 for the United States labs, and EPA 8240 for the Mexican labs).

The values for Arsenic reported by the Mexican labs were somewhat less than those obtained by the United States labs, especially for the April, June and September 1997 sampling events.

During the April and June 1997 sampling events, the United States labs reported levels of nitrates (as N) slightly greater than those determined by the binational counterpart. For the last two sampling events, especially the one for February 1998, this tendency reversed. Of special mention are those levels below the detection limit (<0.1 mg/l) reported by the United States labs at NGW- 8 during the first two sampling events (July 1996 and April 1997), contrasted with the levels greater than 19 mg/l determined by the Mexican labs. In the later sampling events, both labs would report concentrations higher than the respective standards for potable water in that same well.

Significant to note is the fact that the presence of PCE was reported only for NGW- 9 and not for NGW- 8, even though they are close together (only 3-5 m apart) just north of the border in the United States. One explanation for this finding can be found in the analyses of the hydraulic and well completion data for both wells. As can be seen in Table 2, NGW- 8 is deeper (slotted interval 15.03-18.07 m) than NGW- 9 (slotted interval 4.57-9.14 m). Yet, its static level is shallower (3.74 vs. 4.63 m). Since both wells are at the same elevation (1177.6 m), it follows that the greater hydraulic head would be found at the greater depth (NGW- 8), and that the lesser head would correspond to a shallower depth (NGW- 9). Further evaluation of this issue is beyond the scope of this project. ADEQ, under a different program, will evaluate all relevant available information in order to explain the difference in hydraulic head between these two wells.

Also, the greater concentrations of nitrates are found in the deep well (NGW - 8, "ADEQ #1"), and not in the shallow well (NGW - 9, "ADEQ #2"). It is very probable that the nitrates derive from the oxidation of ammonia nitrogen present in the wastewaters that infiltrate into the subsurface from the sanitary sewer lines both in Nogales, Arizona and in Nogales, Sonora.

Regarding the hydrogeochemical characteristics of the groundwaters in the Nogales Wash, we can make the following comments referring to the Piper triangular diagrams (Figures 6 to 9) corresponding to the April and June 1997 sampling events (United States labs), the September 1997 sampling event (Mexican labs), and the February 1998 sampling event (Mexican labs).

Generally, it can be seen that the groundwater is fresh water of the bicarbonate-calcium type. It can also be seen from NGW - 1 ( the most southerly and therefore the one closest to the origin of the Nogales Wash) that there is an increase in calcium-magnesium and chlorides-sulfates in the groundwater in its flow north.

Yet it is significant to note the fact that NGW - 13 ( the most northerly) does not follow this evolution since it is directly affected by the groundwater associated with the Potrero Wash. Another significant aspect is we found the greater concentration of bicarbonates and the lower concentration of chlorides in NGW - 3 and 4, which may indicate a more or less continuous flow of dissolved $CO_2$ associated with a very localized recharge zone due to the fractured granodioritic outcropping near the east side of both wells. The relatively higher potassium and sodium content found here might be related to the dissolution of the feldspar in these rocks.

Without a doubt, the location of NGW - 8 in the Piper diagram stands out for its low proportion of sodium and potassium in contrast to the higher levels of magnesium, chlorides and sulfates. In fact, as can be seen in the comparative diagrams between the U.S. and Mexican laboratory analytical results, the groundwater in this well shows the highest levels of magnesium and chlorides. In the Piper diagram, this point stands out from the data for the other wells suggesting a distinct geochemical nature, especially when one compares the results of its neighbor NGW - 9, located only a few meters from NGW - 8.

In the last sampling event (February 1998), samples were taken from the international wastewater collector. The position of these samples was also shown on the Piper diagram along with the well water samples in the February 1998 diagram (U.S. labs). The most important geochemical characteristic is that the waters in the collector at this point are not of the same type as the groundwater. They belong to the bicarbonate-sodium/potassium type and not to the bicarbonate-calcium type. It should simply be recalled that the potable water supply for Nogales, Sonora does not come from the Nogales Wash aquifer, but from other basins with different hydrogeochemical and geologic characteristics. The same could be said for Nogales, Arizona.

The source of arsenic detected in the Nogales Wash aquifer in Arizona could be natural or anthropogenic. However, Well NGW-11 (where the AWQS for arsenic was exceeded) is located down gradient of the City of Nogales' old landfill. This source needs to be identified and addressed by pertinent authorities.

The spatial distribution of nitrates presented in Figures 12 and 13 show the highest nitrate concentration detected in Well NGW-8. As stated before, nitrates concentrations reported by the U.S. in July 1996 and April 1997 were not consistent with later data. The sources of nitrates in the monitoring wells could be the leaking wastewater trunk line that runs parallel to the Nogales Wash. Other potential sources of nitrates could be septic tanks located in the area and/or raw sewage flowing in the Nogales Wash. The flow of raw sewage has been observed and documented in the past in the Nogales Wash, especially because of the Nogales, Sonora wastewater collection system overflows during storm events.

The spatial distribution of PCE is presented in Figures 10 and 11. The PCE analytical result in NGW-9 was 0.012 milligrams per liter, however, the contaminant was not detected in Well NGW-8. This is due to the fact that NGW-8 is a deeper well located in the same general vicinity as Well NGW-9. The source(s) of PCE need to be identified and addressed by pertinent authorities in Nogales, Sonora.

Regarding the evolution of nitrates over time, as well as PCE and arsenic levels found in the Nogales Wash groundwater, we developed the respective graphs summarizing all the sampling events (time) for each binational laboratory (concentrations). Even considering the different PCE values found, Figures 11 and 12 show a maximum peak for June 1997. From here, the values in general decrease following the rainy months, a possible diluting effect. The tendency for the nitrate concentrations (Figures 12 and 13) are more variable, but definitely the nitrate values at NGW - 8 decrease over time. It is not known if the delayed response could be related in some way to the increase or decrease in flows, in the international outfall. In

the rest of the wells, the tendency is to increase after April 1997, to later decrease or stabilize by February 1998. This could be related to the warmer season when there is a higher water demand, and consequently an increase in the generation of wastewater. What does remain clear is that the greatest concentrations of nitrates were detected in locations near the international outfall which conveys wastewater from Nogales, Arizona and Nogales, Sonora to the international wastewater treatment plant at Rio Rico, Arizona where secondary treated wastewater is discharged into the Santa Cruz River in the United States.

This apparently stable behavior of the levels of arsenic found over time (Figures 14 and 15) could be masked by the analytical differences of the involved laboratories. Nevertheless, maximum values can be expected in the low flow months, and minimum values during the rainy season due to dilution.

Figures 10 through 15 present the spatial distribution of arsenic, nitrates, and PCE, respectively for the April, June, and September 1997 sampling activities that included most of the project monitoring wells. Well NGW-3 was not sampled in April 1997 (it was not constructed yet) and Well NGW-5 was not sampled in September 1997 (this well was destroyed during a flooding event).

## VII. CONCLUSIONS AND RECOMMENDATIONS

Data from this project showed the presence of contaminated groundwater exceeding the Arizona AWQS and the Mexican CECA for nitrates and coliforms in the Arizona and Sonora Nogales Wash aquifers, respectively. The sources of nitrates and coliforms in the monitoring wells could be the leaking wastewater trunk line that runs parallel to the Nogales Wash. Recent infiltration/inflow studies on this trunk line during the ongoing binational wastewater plant facility planning project have shown that this line was leaking. The trunk line was repaired in both cities as part of the "quick fixes" activities of the upgrade and improvements to the NIWTP. Other potential sources of nitrates and coliforms could be septic tanks located in the area and/or raw sewage flowing in the Nogales Wash. The flow of raw sewage has been observed and documented in the past in the Nogales Wash, especially because of the Nogales, Sonora wastewater collection system overflows during storm events.

The project data also showed the presence of iron and manganese in NGW-3 and NGW-4 exceeding the Mexican CECA criteria in the Sonora Nogales Wash aquifer. In addition, the project found contaminated groundwater in NGW-11 exceeding the Arizona AWQS for arsenic. Monitoring well NGW-11 is located down gradient of the old landfill in the City of Nogales, Arizona. These findings were supported by laboratory data from both countries.

The results indicate the presence of PCE in the groundwater greatly exceeding the Mexican CECA standards for drinking water in wells # 5 and # 7 in Nogales, Sonora and well # 9 exceeding AWQS in Nogales, Arizona.

The sources of PCE have not been identified yet in Nogales, Sonora, nor in Nogales, Arizona; however, measures are being taken to identify these sources.

PCE has also been detected in the past by the ADEQ Water Quality Assurance Revolving Fund (WQARF) program (An Arizona superfund program) in the Arizona groundwater in Nogales. The WQARF program sampled selected private wells located in the Nogales Wash area and detected levels of PCE not exceeding the AWQS in the groundwater. However, no sources of PCE have been identified in Nogales, Arizona yet.

ADEQ has already sent letters to identified private well owners along the Nogales Wash in Arizona advising them to take appropriate precautions before using their water for domestic or potable purposes.

The USEPA in coordination with USIBWC and ADEQ placed three additional groundwater monitoring wells in 1999 in the area as part of the City of Nogales, Arizona early warning monitoring system to protect their drinking water sources. These three additional monitoring wells were located between monitoring wells NGW-10 and NGW-11 in an effort to locate additional PCE potential sources in Nogales, Arizona. These wells (in addition to the existing binational groundwater wells located in Arizona) will be monitored for three additional quarters by ADEQ. All of these monitoring wells detected levels of PCE below AWQS. The reports are included in the reference list.

Additional steps are being discussed by both countries to locate and assess potential PCE sources in the Nogales, Sonora area. The USEPA, through its federal superfund program, may continue coordination with, ADEQ, IBWC and Mexican authorities to explore possible alternatives for binational actions for a better understanding and a remedy of these problems. If these sources still exist, every effort should be made to locate and remove them to control the source and avoid the continued impact of PCE to the groundwater. Also, additional information on the local hydrogeology needs to be collected to understand the general movement and velocity of the detected contaminants.

The USEPA federal superfund program will be coordinating with ADEQ and the local community to inventory and sample additional private wells in the Nogales Wash area in Arizona that might be potentially impacted by the PCE-contaminated groundwater and to continue monitoring the groundwater in an effort to locate potential sources of PCE. In addition, the State of Arizona WQARF is evaluating the site information to secure funding for remedial investigation activities in the Nogales Wash groundwater aquifer.

The Mexican authorities have indicated that the most important actions will be focused on the prevention of contamination and the elimination of the sources of contamination, if they still exist or are still active. Efforts will be focused on managing the hazardous substances. It is still also very important to allocate funding to guarantee proper sanitation for both cities.

# Figure 1: Binational Nogales Wash Groundwater Monitoring Wells Location

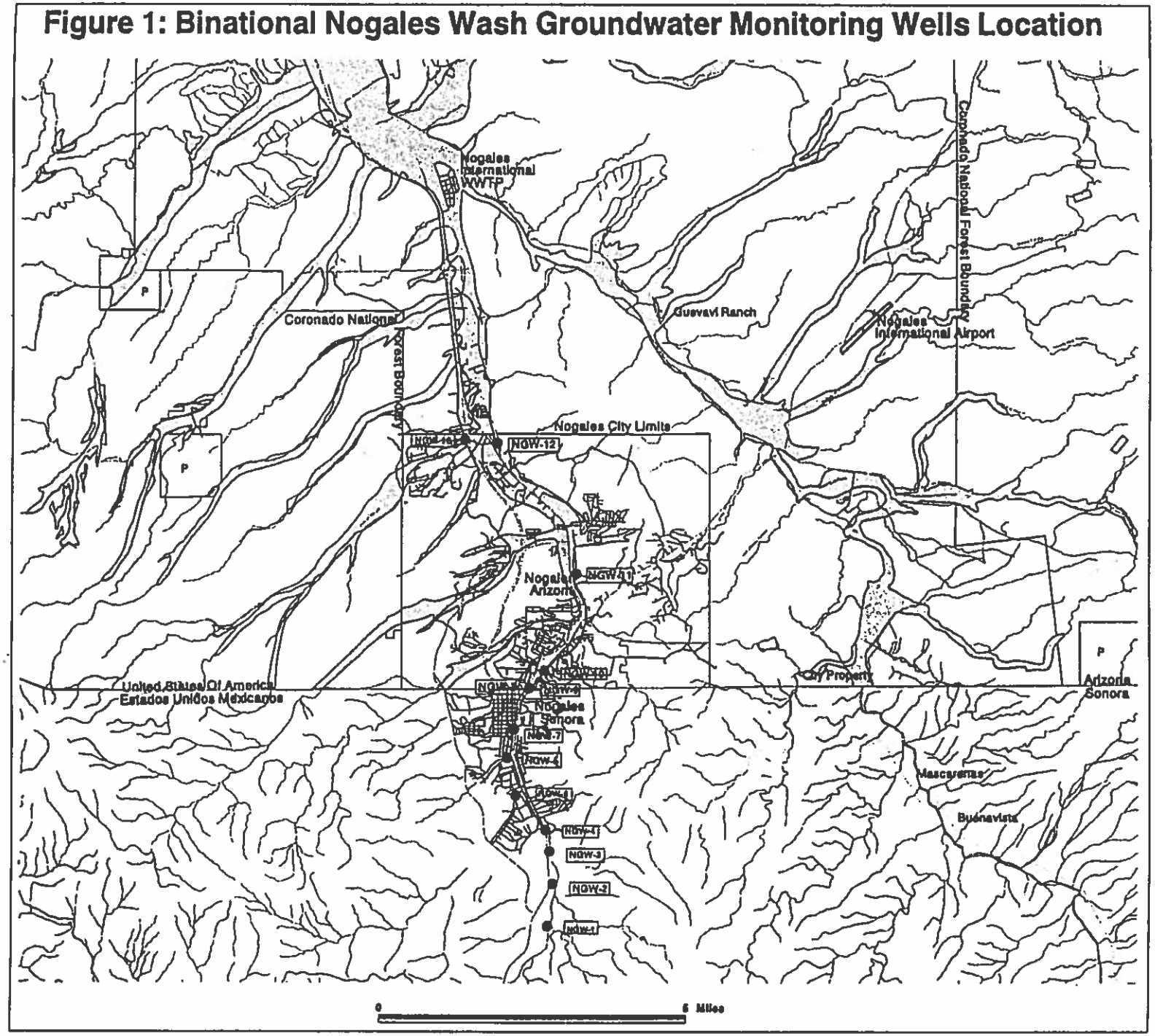


Table 1 - Well Construction Details for the Monitoring Wells in Nogales, Sonora

| Site Number | Site Name | Location | | Well Elevation (top of casing) (m) (ft) | Depth Drilled (m) (ft) | Total Casing Length (m) (ft) | 4" PVC Casing | | Gravel Pack (m) (ft) | Bento-nite Seal (m) (ft) | Cement Grout (m) (ft) | Static Water Level (m) (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Latitude | Longitude | | | | Plain (m) (ft) | Screen (m) (ft) | | | | |
| NGW - 1 | PARQUE INDUSTRIAL | 31°16' 37.12" | 110°56'12.42" | 1,243.67<br>4,080 | 7.21<br>23.7 | 7.19<br>23.6 | 4.04<br>13.26 | 3.15<br>10.34 | 4.20<br>13.78 | 1.20<br>3.94 | 1.49<br>4.89 | 6.10<br>20.02 |
| NGW - 2 | PEMEX | 31°16' 48.79" | 110°56' 11.9" | † | 15.15<br>49.71 | 14.50<br>47.58 | 11.35<br>37.24 | 3.15<br>10.34 | 9.48<br>31.10 | 2.00<br>6.56 | 2.72<br>8.92 | Dry |
| NGW - 3 | FERROCARRILES | 31°17' 33.24" | 110°56' 9.48" | 1,226.47<br>4,024.04 | 6.80<br>22.31 | 6.70<br>21.98 | 2.03<br>6.66 | 4.67<br>15.32 | 4.87<br>16.0 | 0.53<br>1.74 | 1.00<br>3.28 | 4.55<br>14.93 |
| NGW - 4 | CAMINO VIEJO A CANANEA | 31°17' 58.62" | 110°56'14.28" | 1,213.76<br>3,932.34 | 6.85<br>22.47 | 6.74<br>22.11 | 3.59<br>11.78 | 3.15<br>10.34 | 4.12<br>13.52 | 1.00<br>3.28 | 1.32<br>4.33 | 4.21<br>13.81 |
| NGW - 5 | CRUZ ROJA | 31°18' 59.69" | 110°56' 51" | †† | 8.70<br>28.54 | 8.01<br>26.28 | 3.34<br>10.96 | 4.67<br>15.32 | 5.67<br>18.60 | 1.00<br>3.28 | 1.04<br>3.41 | 6.61<br>21.69 |
| NGW - 6 | LA TOMATERA | 31°18' 28.55" | 110°56' 43.97" | 1,210.06<br>3,970.20 | 2.5<br>8.2 | ■ | ■ | ■ | ■ | ■ | ■ | 3.31<br>10.86 |
| NGW - 7 | OFICINA COAPAES | 31°18' 24.36" | 110°56' 45.80" | 1,192.04<br>3,911.08 | 15.24<br>50 | ■ | ■ | ■ | ■ | ■ | ■ | 4.32<br>14.18 |

† This well was dry, its elevation was not calculated
†† This well was destroyed, its elevation was not calculated
■ These are hand-dug wells for which these characteristics do not apply
* Includes end cap of 0.10 m (0.3 ft)
The sum of the casing length does not include the 0.30 m (0.3 ft) end cap

Table 2- Well Construction Details for the Monitoring Wells in Nogales, Arizona

| Site Number | Site Name | ADWR# | Latitude and Longitude | Well Elevation (top of casing) (m) (ft) | Well Depth (m) (ft) | Casing Diameter (cm) (in) | Screened Interval (m) (ft) | Depth to Water (m) (ft) |
|---|---|---|---|---|---|---|---|---|
| NGW-8 | ADEQ #1 | 55-537956 | 31° 19' 58.4"<br>110° 56' 28.2" | 1,177.68<br>3,863.97 | 18.07<br>59.3 | 10.16<br>4.0 | 15.03-18.07<br>49.3-59.3 | 3.25<br>10.65 |
| NGW-9 | ADEQ #2 | 55-537957 | 31° 19' 58.5"<br>110° 56"28.0" | 1,177.68<br>3,863.97 | 9.14<br>30.0 | 10.16<br>4.0 | 4.57-9.14<br>15.0-30.0 | 3.63<br>11.9 |
| NGW-10 | Trickey Wash | 55-553009 | 31° 20' 34.12"<br>110° 56' 3.0" | 1,174.87<br>3,854.75 | 14.94<br>49.0 | 10.16<br>4.0 | 8.23-14.94<br>27.0-49.0 | 10.24<br>33.6 |
| NGW-11 | Old Landfill | 55-553010 | 31° 21' 59.21"<br>110° 55' 48.0" | 1,148.19<br>3,767.21 | 13.26<br>43.5 | 10.16<br>4.0 | 7.01-13.26<br>23.0-43.5 | 8.72<br>28.6 |
| NGW-12 | Wingfield Area | 55-553011 | 31° 23' 34.75"<br>110° 57' 27.2" | 1,115.04<br>3,658.45 | 9.30<br>30.5 | 10.16<br>4.0 | 1.68-9.30<br>5.5-30.5 | 3.23<br>10.6 |
| NGW-13 | Potrero Creek | 55-554080 | 31° 23' 32.91"<br>110° 57' 59.5" | 1,120.58<br>3,676.62 | 46.63<br>153.0 | 10.16<br>4.0 | 34.44-46.63<br>113.0-153.0 | 37.58<br>123.3 |

Table 3a - Mexican Laboratory Results for Metal Analyses from Soil Samples Collected at Specific Depths (mg/kg)

| Depth | 1.5 M | | | | 3.0 M | | | | 4.5 M | | 7.5 M |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Well # | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 5 | 2 | 3 | 5 |
| Aluminum | 7707.94 | 11808.49 | 6188 | 12640 | 7113.58 | 24405.02 | 6011 | 5790.16 | 12761.36 | 8573 | 5864.6 |
| Molybdenum | N.D. | 4.365 | 2.957 | 4.877 | N.D. | 7.514 | 2.801 | 3.186 | 4.819 | 3.351 | 2.477 |
| Nickel | 15.43 | 8.904 | 7.641 | 10.65 | 7.759 | 12.594 | 15.55 | 4.786 | 11.111 | 11.42 | 3.412 |
| Silver | < 1.4 | < 1.4 | N.D. | N.D. | < 1.4 | < 1.4 | 4.384 | N.D. | < 1.4 | N.D. | N.D. |
| Thallium | 41.35 | < 40 | 18.55 | N.D. | < 40 | 42.18 | 17.74 | 21.7 | < 40 | 21.27 | 17.38 |
| Vanadium | 25.811 | 17.62 | 17.71 | 28.57 | 16.255 | 31.33 | 22.79 | 17.45 | 26.16 | 26.67 | 17.89 |
| Zinc | 49.086 | 57.011 | 73.17 | 56.69 | 39.38 | 64.791 | 31 | 65.12 | 36.193 | 33.58 | 32.47 |
| Silica | 5340.58 | 3777.63 | 53051.29 | 51411.88 | 5259.48 | 4788.77 | 47313.9 | 51480.71 | 4767.3 | 52885.12 | 5e+06 |
| Antimony | < 6.4 | 20.262 | 11.58 | 21.99 | < 6.4 | 37.596 | 11.34 | 2.248 | 23.375 | 14.31 | 0.634 |
| Cadmium | 2.648 | 2.903 | 3.342 | N.D. | 1.493 | 3.984 | 2.98 | 2.866 | 2.878 | 3.523 | 2.241 |
| Chromium | 10.919 | 9.024 | 8.371 | 11.74 | 5.696 | 13.379 | 10.66 | N.D. | 11.589 | 13.19 | N.D. |
| Cobalt | 8.243 | 7.949 | 4.280 | 8.003 | 5.967 | 7.210 | 5.702 | 4.546 | 7.266 | 5.971 | 2.949 |
| Copper | 22.650 | 22.946 | 29.98 | 15.93 | 17.2 | 29.280 | 17.52 | 16.250 | 15 | 19.03 | 13.22 |
| Iron | 10966.05 | 16237.82 | 13930 | 18820 | 10517.54 | 21142.7 | 12740 | 17477.73 | 16005.62 | 15550 | 13518.67 |
| Lead | 11.404 | 12.166 | 29.84 | N.D. | 13.372 | 8.958 | 13.88 | 20.940 | < 8.4 | 17.62 | 10.16 |
| Manganese | 717.829 | 332.56 | 404.10 | 593 | 926.015 | 325.43 | 386.5 | 657.373 | 316.08 | 411.2 | 12.093 |
| Mercury | < 0.005 | < 0.005 | N.D. | N.D. | < 0.005 | < 0.005 | N.D. | N.D. | < 0.005 | N.D. | N.D. |
| Boron | 31.312 | 39.64 | 33.49 | 55.69 | 17.693 | 50.69 | 30.12 | 68.71 | 39.32 | 35.6 | 54.08 |
| Arsenic | < 10.6 | < 10.6 | 16.13 | 31.52 | < 10.6 | < 10.6 | 12.36 | 23.24 | < 10.6 | 14.11 | 14.75 |
| Selenium | < 15 | < 15 | N.D. | N.D. | < 15 | < 15 | N.D. | 13.44 | < 15 | N.D. | 12.38 |
| Sodium | 210.83 | 191.417 | 265.1 | 426.4 | 223.48 | 278.99 | 257.5 | 82.43 | 157.89 | 323.2 | 94.21 |
| Potassium | 2632.41 | 2180.66 | 1840 | 2596 | 2234.19 | 3783.75 | 1862 | 14.52 | 2644.16 | 2505 | 1106 |
| Calcium | 4074.97 | 3877.96 | 3860 | 3885 | 2653.69 | 4489.7 | 3023 | 1411 | 3369.9 | 2955 | 1695 |
| Magnesium | 3415.7 | 3992.83 | 1747 | 4473 | 1936.08 | 4684.9 | 2297 | 1583 | 4007.5 | 2130 | 1809 |
| Barium | 165.05 | 182.77 | 104.3 | 192.8 | 263.35 | 138.24 | 182.6 | 232.1 | 190.99 | 217.5 | 208.079 |
| Beryllium | < 0.06 | 0.808 | 0.513 | 1.009 | < 0.06 | 1.328 | 0.52 | 0.971 | 0.759 | 0.74 | 0.630 |
| Tin | | | | | | | | 8.598 | | | 7.706 |

Depth: refers to the depth at which the sample was collected

Table 3b- Mexican Laboratory Results for Organic Compounds from Soil Samples Collected at Specific Depths (Ug/kg)

| Depth | 1.5 M | | | | 3.0 M | | | | 4.5 M | | 7.5 M |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Well # | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 5 | 2 | 3 | 5 |
| Acetone | < 1.0 | < 2.5 | | N.S. | < 1.0 | < 2.5 | | | < 2.5 | | |
| Total Xylenes | < 0.5 | < 2.5 | 16.06 | N.S. | < 0.5 | < 2.5 | 9.12 | 7.7 | < 2.5 | 28.54 | 4.7 |
| Methyl Isobutyl Ketone | < 1.0 | < 2.5 | | N.S. | < 1.0 | < 2.5 | | | < 2.5 | | |
| Bromodichloromethane | < 0.8 | < 2.5 | N.D. | N.S. | < 0.8 | < 2.5 | N.D. | N.D. | < 2.5 | N.D. | N.D. |
| Bromoform | < 1.2 | < 2.5 | N.D. | N.S. | < 1.2 | < 2.5 | N.D. | N.D. | < 2.5 | N.D. | N.D. |
| Carbon Disulfide | 5.61 | < 2.5 | | N.S. | 3.39 | < 2.5 | | | < 2.5 | | |
| Carbon Tetrachloride | 5.8 | < 2.5 | N.D. | N.S. | 5.14 | < 2.5 | N.D. | N.D. | < 2.5 | 18 | N.D. |
| Chlorobenzene | 57.44 | < 2.5 | N.D. | N.S. | 61.5 | < 2.5 | N.D. | N.D. | < 2.5 | N.D. | N.D. |
| Chloroethane | < 1.0 | < 2.5 | | N.S. | < 1.0 | < 2.5 | | | < 2.5 | | |
| Chloroform | 14.56 | < 2.5 | N.D. | N.S. | 12.8 | 9.19 | N.D. | 13.93 | 7.47 | N.D. | 10.92 |
| Chloromethane | < 1.3 | < 2.5 | | N.S. | < 1.3 | < 2.5 | | | < 2.5 | | |
| Acrylonitrile | < 5.0 | < 2.5 | | N.S. | < 5.0 | < 2.5 | | | < 2.5 | | |
| Dibromochloromethane | < 0.5 | < 2.5 | | N.S. | < 0.5 | < 2.5 | | | < 2.5 | | |
| 1,2-Dichlorobencene | < 0.3 | < 2.5 | N.D. | N.S. | < 0.3 | < 2.5 | N.D. | N.D. | < 2.5 | N.D. | N.D. |
| 1,4-Dichlorobencene | < 0.3 | < 2.5 | N.D. | N.S. | < 0.3 | < 2.5 | N.D. | N.D. | < 2.5 | N.D. | N.D. |
| 1,3-Dichlorobencene | < 0.12 | < 2.5 | N.D. | N.S. | < 0.12 | < 2.5 | N.D. | N.D. | < 2.5 | N.D. | N.D. |
| 1,2-Dichloroethane | 155.21 | < 2.5 | N.D. | N.S. | 151.91 | < 2.5 | N.D. | N.D. | < 2.5 | N.D. | N.D. |
| 1,1-Dichloroethylene | < 1.2 | < 2.5 | N.D. | N.S. | < 1.2 | < 2.5 | N.D. | N.D. | < 2.5 | N.D. | N.D. |
| Styrene | < 1.4 | < 2.5 | | N.S. | < 1.4 | < 2.5 | | | < 2.5 | | |
| Ethylbenzene | < 0.6 | < 2.5 | N.D. | N.S. | < 0.6 | < 2.5 | N.D. | 1.82 | < 2.5 | N.D. | 1.2 |
| Methyl Ethyl Ketone | < 1.0 | < 2.5 | | N.S. | < 1.0 | < 2.5 | | | < 2.5 | | |
| Benzene | 104.910 | 2.8 | N.D. | N.S. | 102.51 | 3.64 | N.D. | 3.77 | 3.83 | | 1.64 |
| Methylene Chloride | 202.31 | < 2.5 | 5.34 | N.S. | 178.92 | < 2.5 | 13.35 | 21.09 | < 2.5 | 172.72 | 15.36 |
| 1,1,1,2-Tetrachloroethane | < 0.4 | < 2.5 | N.D. | N.S. | < 0.4 | < 2.5 | N.D. | N.D. | < 2.5 | N.D. | N.D. |
| 1,1,2,2-Tetrachloroethane | < 0.4 | < 2.5 | N.D. | N.S. | < 0.4 | < 2.5 | N.D. | N.D. | < 2.5 | N.D. | N.D. |
| Tetrachloroethylene | < 1.4 | < 2.5 | | N.S. | < 1.4 | < 2.5 | | | < 2.5 | | |
| Toluene | 27.49 | < 2.5 | 3.44 | N.S. | 30.25 | 3.51 | 3.35 | 3.37 | 3.56 | | 1.86 |
| 1,1,2-Trichloroethane | 1.574 | < 2.5 | N.D. | N.S. | 1.27 | < 2.5 | N.D. | N.D. | < 2.5 | N.D. | N.D. |
| 1,1,1-Trichloroethane | < 0.8 | < 2.5 | N.D. | N.S. | < 0.8 | < 2.5 | N.D. | N.D. | < 2.5 | N.D. | N.D. |
| Trichloroethylene | 47.33 | < 2.5 | | N.S. | 55.84 | < 2.5 | | | < 2.5 | | |
| Trichlorofluoromethane | < 0.8 | < 2.5 | | N.S. | < 0.8 | < 2.5 | | | < 2.5 | | |
| Vinyl Chloride | < 1.7 | < 2.5 | N.D. | N.S. | < 1.7 | < 2.5 | N.D. | N.D. | < 2.5 | N.D. | N.D. |

Depth: refers to the depth at which the sample was collected. N.D.: Not detected; N.S.: Not Sampled.

Table 4a- U.S. Data Summary for VOCs from Soil Samples Collected at Specific Depths

| | NGW-10 | NGW-11 | NGW-12 | NGW-13 |
|---|---|---|---|---|
| **Depth of Sample (m) (ft)** | **6.55 21.5** | **3.51 11.5** | **1.98 6.5** | **4.88 16.0** |
| Date Sampled | 2/8/96 | 1/30/96 | 1/25/96 | 1/23/96 |
| Methylene Chloride | <0.040 | 65 | <0.040 | <0.040 |
| 1,1,1-Trichloroethane | <0.040 | 38 | <0.040 | <0.040 |

Note: All concentration values in mg/kg

Table 4b- U.S. Data Summary for Trace Metals from Soil Samples Collected at Specific Depths

| | NGW-10 | NGW-11 | NGW-12 | NGW-13 |
|---|---|---|---|---|
| **Depth of Sample (m) (ft)** | **6.55 21.5** | **3.51 11.5** | **1.98 6.5** | **4.88 16.0** |
| Date Sampled | 2/8/96 | 1/30/96 | 1/25/96 | 1/23/96 |
| Arsenic | 17.2 | 10.8 | 14.4 | <0.10 |
| Aluminum | 8710 | 12020 | 17650 | 10147 |
| Antimony | <0.10 | <0.10 | <0.10 | <0.10 |
| Barium | 73 | 92.3 | 130 | 65.8 |
| Beryllium | 0.68 | 0.2 | <0.01 | <0.10 |
| Boron | 3 | 18.7 | 18.5 | 16.8 |
| Cadmium | 0.55 | <0.10 | <0.10 | <0.10 |
| Calcium | 4913 | 5944 | 4850 | 2465 |
| Chromium | 7.38 | 6.2 | 10.1 | 4.2 |
| Cobalt | 1.45 | 3.2 | 5.7 | 0.79 |
| Copper | 6.46 | 11.35 | 23.7 | 3.6 |
| Iron | 6557 | 13960 | 13600 | 14355 |
| Lead | 20 | <0.10 | <0.10 | <0.10 |
| Magnesium | 1330 | 4045 | 39.73 | 2225 |
| Manganese | 364 | 200 | 96.5 | 276 |
| Mercury | <0.10 | <0.10 | <0.10 | <0.10 |
| Molybdenum | <0.01 | <0.01 | <0.01 | 4.9 |
| Nickel | 4.32 | 6.6 | 13.8 | 4 |
| Potassium | 1586 | 1240 | 1868 | 1125 |
| Silica | 11.49 | 18.5 | 25 | 24.2 |
| Selenium | <0.10 | 5.8 | 14.2 | <0.10 |
| Silver | <0.10 | <0.10 | <0.10 | <0.10 |
| Sodium | 138 | 260 | 405 | 218 |
| Thallium | <0.10 | <0.10 | <0.10 | <0.10 |
| Vanadium | 14.24 | 12.8 | 26.7 | 15.6 |
| Zinc | 43.6 | 30.1 | 69.5 | 21.8 |

Note: All concentration values in mg/kg

Table 5 - Field Parameters Collected by The Binational Team

| WELL ID | DATE | DEPTH TO WATER (m) (ft) | DEPTH TO WATER | GW ELEVATION (m) (ft) | pH | TEMP °C | COND mS/cm | TURBIDITY NTU |
|---|---|---|---|---|---|---|---|---|
| NGW-8 | 7/15/96 | 3.81 | 12.50 | 1,173.87<br>3,851.47 | 7.02 | 20.98 | 275 | 5.92 |
| NGW-9 | 7/15/96 | 4.97 | 16.31 | 1,172.71<br>3,847.66 | 6.39 | 20.57 | 180 | 3.61 |
| NGW-10 | 7/15/96 | 8.09 | 26.54 | 1,166.78<br>3,828.21 | 7.56 | 22.02 | 281 | 0.30 |
| NGW-11 | 7/15/96 | 8.46 | 27.76 | 1,139.73<br>3,739.45 | 6.57 | 20.39 | 172 | 0.31 |
| NGW-12 | 7/15/96 | 3.19 | 10.47 | 1,111.85<br>3,647.98 | 6.56 | 20.69 | 485 | 0.58 |
| NGW-13 | 7/15/96 | 37.55 | 123.20 | 1,083.03<br>3,553.42 | NS | NS | NS | NS |
| NGW-1 | 4/2/97 | 6.10 | 20.01 | 1,237.57<br>4,060.27 | 6.46 | 20.76 | 133 | 0* |
| NGW-2 | 4/2/97 | NS | NS | NS | NS | NS | NS | NS |
| NGW-3 | 4/2/97 | NS | NS | NS | NS | NS | NS | NS |
| NGW-4 | 4/2/97 | 4.34 | 14.24 | 1,209.39<br>3,967.81 | 6.58 | 19.15 | 181 | 0* |
| NGW-5 | 4/2/97 | 6.60 | 21.65 | NS | 6.64 | 21.53 | 160 | 0* |
| NGW-6 | 4/2/97 | 3.29 | 10.79 | 1,206.77<br>3,959.22 | 6.53 | 20.07 | 492 | 0* |
| NGW-7 | 4/2/97 | 4.34 | 14.24 | 1,187.70<br>3,896.65 | 6.76 | 20.10 | 610 | 7.7 |
| NGW-8 | 4/1/97 | 3.74 | 12.27 | 1,173.94<br>3,851.70 | 6.73 | 20.62 | 845 | 0* |
| NGW-9 | 4/1/97 | 4.63 | 15.19 | 1,173.05<br>3,848.78 | 6.48 | 19.89 | 207 | 0* |
| NGW-10 | 4/1/97 | 5.85 | 19.19 | 1,169.02<br>3,835.56 | 6.84 | 22.10 | 312 | 0* |
| NGW-11 | 4/1/97 | 8.45 | 27.72 | 1,139.74<br>3,739.49 | 6.59 | 20.20 | 215 | 0* |
| NGW-12 | 4/1/97 | 3.38 | 11.09 | 1,111.66<br>3,647.36 | 6.61 | 20.50 | 229 | 0* |

Table 5 - Field Parameters Collected by The Binational Team (Cont)

| WELL ID | DATE | DEPTH TO WATER (m) | DEPTH TO WATER (ft) | GW ELEVATION (m) (ft) | pH | TEMP °C | COND mS/cm | TURBIDITY NTU |
|---|---|---|---|---|---|---|---|---|
| NGW-13 | 4/1/97 | 37.09 | 121.69 | 1,083.49<br>3,554.93 | 7.30 | 21.20 | 485 | |
| NGW-1 | 6/18/97 | 6.13 | 20.10 | 1,237.54<br>4,060.18 | 6.37 | 20.12 | 132 | 0 |
| NGW-2 | 6/18/97 | NS | NS | NS | NS | NS | NS | NS |
| NGW-3 | 6/18/97 | 4.63 | 15.19 | 1,221.84<br>4,008.66 | 6.33 | 19.58 | 145 | 0 |
| NGW-4 | 6/18/97 | 4.38 | 14.38 | 1,209.35<br>3,967.67 | 6.47 | 20.69 | 176 | 0 |
| NGW-5 | 6/18/97 | 6.71 | 22.03 | NA | 6.62 | 20.92 | 149 | 0 |
| NGW-6 | 6/18/97 | 3.85 | 12.62 | 1,206.21<br>3,957.39 | 6.68 | 21.74 | 164 | 0 |
| NGW-7 | 6/18/97 | 4.61 | 15.13 | 1,187.43<br>3,895.76 | 6.68 | 21.31 | 594 | 0 |
| NGW-8 | 6/17/97 | 3.80 | 12.46 | 1,173.88<br>3,851.51 | 6.66 | 21.76 | 788 | 0 |
| NGW-9 | 6/17/97 | 4.79 | 15.73 | 1,172.89<br>3,848.24 | 6.43 | 21.86 | 487 | 0 |
| NGW-10 | 6/17/97 | 7.70 | 25.25 | 1,167.17<br>3,829.50 | 6.82 | 22.05 | 280 | 0 |
| NGW-11 | 6/17/97 | 8.75 | 28.71 | 1,139.44<br>3,738.50 | 6.52 | 19.71 | 578 | 0 |
| NGW-12 | 6/17/97 | 3.51 | 11.51 | 1,111.53<br>3,646.94 | 6.56 | 20.92 | 209 | 0 |
| NGW-13 | 6/17/97 | 37.67 | 123.60 | 1,082.91<br>3,553.02 | 7.21 | 21.49 | 142 | 0 |
| NGW-1 | 9/24/97 | 5.58 | 18.30 | 1,238.09<br>4,061.98 | 6.51 | 21.90 | 124 | 1.18 |
| NGW-2 | 9/24/90 | NS | NS | NS | NS | NS | NS | NS |
| NGW-3 | 9/24/97 | 3.23 | 10.60 | 1,223.24<br>4,013.25 | 6.44 | 23.17 | 171 | 0.52 |
| NGW-4 | 9/24/97 | 4.39 | 14.40 | 1,209.34<br>3,967.65 | 6.56 | 22.05 | 161 | 0.37 |
| NGW-5** | 9/24/97 | NS | NS | NA | NS | NS | NS | NS |

Table 5 - Field Parameters Collected by The Binational Team (Cont)

| WELL ID | DATE | DEPTH TO WATER (m) | DEPTH TO WATER (ft) | GW ELEVATION (m) (ft) | pH | TEMP °C | COND mS/cm | TURBIDITY NTU |
|---|---|---|---|---|---|---|---|---|
| NGW-6 | 9/24/97 | 3.63 | 11.90 | 1,206.43<br>3,958.11 | 6.67 | 21.16 | 423 | 1.18 |
| NGW-7 | 9/24/97 | 4.39 | 14.40 | 1,187.65<br>3,896.49 | 6.76 | 22.38 | 557 | 0.00 |
| NGW-8 | 9/23/97 | 3.19 | 10.46 | 1,174.49<br>3,853.51 | 6.67 | 21.24 | 247 | 6.11 |
| NGW-9 | 9/23/97 | 3.78 | 12.40 | 1,173.90<br>3,851.57 | 6.47 | 21.92 | 169 | 1.47 |
| NGW-10 | 9/23/97 | 7.95 | 26.10 | 1,166.91<br>3,828.65 | 6.88 | 22.64 | 259 | 0.60 |
| NGW-11 | 9/23/97 | 8.82 | 28.93 | 1,139.37<br>3,738.28 | 6.59 | 21.05 | 184 | 0.43 |
| NGW-12 | 9/23/97 | 3.54 | 11.63 | 1,111.50<br>3,646.82 | 6.60 | 20.90 | 555 | 0.63 |
| NGW-13 | 9/23/97 | 38.81 | 127.32 | 1,081.77<br>3,549.30 | 7.36 | 21.34 | 121 | 16.6 |
| NGW-1 | 2/10/98 | 5.57 | 18.29 | 1,238.10<br>4,061.99 | 6.41 | 19.22 | 169 | 0.90 |
| NGW-2 | 2/10/98 | NS | NS | no water | NS | NS | NS | NS |
| NGW-3 | 2/10/98 | 3.52 | 11.55 | 1,222.95<br>4,012.30 | 6.45 | 19.9 | 188 | 0.57 |
| NGW-4 | 2/10/98 | 4.39 | 14.41 | 1,209.34<br>3,967.64 | 6.47 | 18.6 | 181 | 0.47 |
| NGW-5 | 2/10/98 | NS | NS | NA | NS | NS | NS | NS |
| NGW-6 | 2/10/98 | 2.47 | 8.10 | 1,207.59<br>3,961.91 | 6.21 | 18.42 | 474 | 0.46 |
| NGW-7 | 2/10/98 | 4.18 | 13.72 | 1,187.86<br>3,897.17 | 6.58 | 17.59 | 237 | 2.07 |
| NGW-8 | 2/10/98 | 2.99 | 9.80 | 1,174.69<br>3,854.17 | 6.74 | 20.43 | 713 | 10.6 |
| NGW-9 | 2/10/98 | 3.74 | 12.28 | 1,173.94<br>3,851.69 | 6.59 | 19.73 | 445 | 9.06 |
| NGW-10 | 2/10/98 | NS | NS | NS | NS | NS | NS | NS |
| NGW-11 | 2/10/98 | NS | NS | NS | NS | NS | NS | NS |
| NGW-12 | 2/10/98 | NS | NS | NS | NS | NS | NS | NS |

Table 5 - Field Parameters Collected by The Binational Team (Cont)

| WELL ID | DATE | DEPTH TO WATER (m) | DEPTH TO WATER (ft) | GW ELEVATION (m) (ft) | pH | TEMP °C | COND mS/cm | TURBIDITY NTU |
|---|---|---|---|---|---|---|---|---|
| NGW-13 | 2/10/98 | 39.20 | 128.63 | 1,081.37<br>3,547.99 | 7.44 | 21.07 | 367 | 38.9 |

* Faulty Turbidity Meter
** Well destroyed during a storm event
NS - not sampled
NA-information not available

## TABLE 6 - DATA SUMMARY FOR JUNE 1997

| | NGW-1 (U.S.) | NGW-1 (MEXICO) | Percent Difference | NGW-3 (U.S.) | NGW-3 (MEXICO) | Percent Difference | NGW-4 (U.S.) | NGW-4 (MEXICO) | Percent Difference | NGW-5 (U.S.) | NGW-15 Dup of NGW-5 (U.S.) | RPD (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date of Sample | 6-18-97 | 6-18-97 | | 6-18-97 | 6-18-97 | | 6-18-97 | 6-18-97 | | 6-18-97 | 6-18-97 | |
| Alkalinity, Phenolphthalein | <2 | NA | NC | <2 | N/A | NC | <2 | N/A | NC | <2 | <2 | NC |
| Alkalinity, Total | 142 | 138 | 2.9 | 200 | 196 | 2.0 | 224 | 229 | 2.2 | 148 | 140 | 5.6 |
| Arsenic | 0.005 | 0.0028 | 56.4 | <0.005 | 0.0009 | NC | <0.005 | 0.0014 | NC | <0.005 | <0.005 | NC |
| Barium | 0.02 | <0.5 | NC | 0.03 | <0.5 | NC | 0.06 | <0.5 | NC | 0.08 | 0.08 | 0.0 |
| Boron | 0.09 | NA | NC | 0.11 | N/A | NC | 0.09 | N/A | NC | 0.04 | 0.03 | 28.6 |
| Cadmium | <0.001 | <0.02 | NC | <0.001 | <0.02 | NC | <0.001 | <0.02 | NC | <0.001 | <0.001 | NC |
| Calcium | 43 | 35.7 | 18.6 | 46 | 35.9 | 24.8 | 56 | 43.4 | 25.4 | 43 | 44 | 2.3 |
| Hardness | 156 | 137 | 13.0 | 164 | 150 | 8.9 | 189 | 180 | 4.9 | 156 | 159 | 1.9 |
| Iron | 0.025 | <0.04 | NC | **5.14** | **1.78** | 97.1 | **4.99** | **2.07** | 82.7 | <0.015 | <0.015 | NC |
| Magnesium | 12 | 11.6 | 3.4 | 12 | 11.1 | 7.7 | 12 | 12.69 | 5.6 | 12 | 12 | 0.0 |
| Manganese | <0.02 | <0.03 | NC | **2.56** | **1** | 87.6 | **5.3** | **2.75** | 63.4 | <0.02 | <0.02 | NC |
| Potassium | 6 | 5.2 | 14.3 | 5.5 | 4.8 | 13.6 | 7 | 5.9 | 17.1 | 4 | 4 | 0.0 |
| Silica | 17 | 20.1 | 16.7 | 16.8 | 18.6 | 10.2 | 19.2 | 19.4 | 1.0 | 14.5 | 17.1 | 16.5 |
| Sodium | 22 | 22 | 0.0 | 25 | 23.0 | 8.3 | 31 | 29.0 | 6.7 | 30 | 30 | 0.0 |
| Zinc | <0.02 | <0.02 | NC | <0.02 | <0.02 | NC | <0.02 | <0.02 | NC | <0.02 | <0.02 | NC |
| Chloride | 12 | 16 | 28.6 | 15 | 17 | 12.5 | 22 | 20 | 9.5 | 16 | 17 | 6.1 |
| Fluoride | <0.4 | 0.2 | NC | <0.4 | 0.2 | NC | <0.4 | 0.2 | NC | 0.6 | 0.6 | 0.0 |
| Nitrite as Nitrogen | <0.1 | NA | NC | <0.1 | NA | NC | <0.1 | NA | NC | <0.1 | <0.1 | NC |
| Nitrate as Nitrogen | **5.1** | 3.8 | 29.2 | <0.1 | <0.1 | NC | 0.3 | <0.1 | NC | **6.4** | **6.5** | 1.6 |
| Sulfate | 17 | 17 | 0.0 | <5 | 7 | NC | <5 | <5 | NC | 40 | 40 | 0.0 |
| Total Dissolved Solids | 223 | N/A | NC | 245 | N/A | NC | 281 | N/A | NC | 292 | 269 | 8.2 |
| Coliform, Fecal | 186 | 900 | 131.5 | 1 | <2 | NC | <1 | <2 | NC | <1 | <1 | NC |
| Coliform, Total | TNTC | 900 | NC | 1 | 4 | NC | 1 | <2 | NC | <1 | <1 | NC |
| pH | 6.9 | 7.75 | 11.6 | 6.6 | 8.3 | 22.7 | 7.0 | 7.8 | 10.8 | 6.9 | 6.8 | 1.5 |
| Total Petroleum Hydrocarbons | * | ND | NC | * | ND | NC | 0.27 | 1.52 | 139.7 | <0.05 | * | NC |
| Benzene | <0.0005 | * | NC | 0.0007 | NA | NC | <0.0005 | NA | NC | <0.0005 | <0.0005 | NC |
| n-Butylbenzene | <0.0005 | * | NC | 0.0048 | NA | NC | <0.0005 | NA | NC | <0.0005 | <0.0005 | NC |
| sec-Butylbenzene | <0.0005 | * | NC | 0.0049 | ND | NC | 0.0019 | ND | NC | <0.0005 | <0.0005 | NC |
| Chloroform | <0.0005 | * | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | <0.0005 | NC |
| cis 1,2-Dichloroethylene | <0.0005 | * | NC | <0.0005 | ND | NC | 0.0031 | ND | NC | 0.011 | 0.011 | 0.0 |
| 1,1-Dichloroethane | <0.0005 | * | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | <0.0005 | NC |
| Isopropylbenzene | <0.0005 | * | NC | 0.0061 | ND | NC | 0.0008 | ND | NC | <0.0005 | <0.0005 | NC |
| Propylbenzene | <0.0005 | * | NC | 0.010 | ND | NC | <0.0005 | NA | NC | <0.0005 | <0.0005 | NC |
| Tetrachloroethylene (PCE) | 0.0008 | * | NC | <0.0005 | 0.00071 | NC | <0.0005 | ND | NC | **0.260** | **0.260** | 0.0 |
| 1,1,2-Trichloroethane | <0.0005 | * | NC | <0.0005 | 0.00186 | NC | <0.0005 | ND | NC | <0.0005 | <0.0005 | NC |
| Trichloroethylene (TCE) | <0.0005 | * | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | <0.0005 | NC |
| Total Trihalomethanes | <0.0005 | * | NC | <0.0005 | NA | NC | <0.0005 | NA | NC | <0.0005 | <0.0005 | NC |
| Vinyl Chloride | <0.0005 | * | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | <0.0005 | NC |
| m-Xylene | <0.0005 | * | NC | <0.0005 | 0.00054 | NC | <0.0005 | ND | NC | <0.0005 | <0.0005 | NC |
| Chlorodibromomethane | <0.0005 | * | NC | <0.0005 | <0.0005 | NC | <0.0005 | ND | NC | <0.0005 | <0.0005 | NC |

Results in mg/l, coliform results in CFU/100 ml and pH in standard units

**11.1** Indicates exceedance of U.S. Drinking Water Standards

**11.1** Indicates exceedance of Mexican Drinking Water Standards

* Sample broken in transit NC - Not Calculated ND - Not Detected NA - Not Analyzed TNTC - Too numerous to count

RPD - Relative Percent Difference- calculated only for duplicate results that were > 10 times the detection limit

## TABLE 6 - DATA SUMMARY FOR JUNE 1997

| | NGW-5 (MEXICO) | NGW-15 Dup of NGW-5 (MEXICO) | RPD (%) | NGW-6 (U.S.) | NGW-6 (MEXICO) | Percent Difference | NGW-7 (U.S.) | NGW-7 (MEXICO) | Percent Difference | NGW-8 (U.S.) | NGW-8 (MEXICO) | Percent Difference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date of Sample | 6-18-97 | 6-18-97 | | 6-18-97 | 6-18-97 | | 6-18-97 | 6-18-97 | | 6-17-97 | 6-17-97 | |
| Alkalinity, Phenolphthalein | N/A | N/A | NC | <2 | N/A | NC | <2 | N/A | NC | <2 | N/A | NC |
| Alkalinity, Total | 140 | 138 | 1.4 | 148 | 147 | 0.7 | 172 | 168 | 2.4 | 192 | 199 | 3.6 |
| Arsenic | 0.0017 | 0.0015 | 12.5 | <0.005 | <0.0005 | NC | <0.005 | 0.0018 | NC | 0.016 | 0.0085 | 61.2 |
| Barium | <0.5 | <0.5 | NC | 0.10 | <0.5 | NC | 0.17 | <0.5 | NC | <0.01 | <0.5 | NC |
| Boron | N/A | N/A | NC | 0.04 | N/A | NC | 0.05 | N/A | NC | 0.02 | N/A | NC |
| Cadmium | <0.02 | <0.02 | NC | <0.001 | <0.02 | NC | <0.001 | <0.02 | NC | <0.001 | <0.02 | NC |
| Calcium | 41.68 | 41.24 | 1.1 | 54 | 52.14 | 3.5 | 64 | 58.28 | 9.4 | 100 | 46.34 | 73.3 |
| Hardness | 152 | 150 | 1.3 | 176 | 164 | 7.1 | 214 | 196 | 8.8 | 415 | 368 | 12.0 |
| Iron | <0.04 | <0.04 | NC | <0.015 | <0.04 | NC | <0.015 | <0.04 | NC | <0.015 | <0.04 | NC |
| Magnesium | 11.61 | 11.25 | 3.1 | 10 | 9.46 | 5.5 | 13 | 13.41 | 3.1 | 40 | 37.06 | 7.6 |
| Manganese | <0.03 | <0.03 | NC | <0.02 | <0.03 | NC | <0.02 | <0.03 | NC | <0.02 | <0.03 | NC |
| Potassium | 3.6 | 3.6 | 0.0 | 2 | 1.6 | 22.2 | 7 | 6.6 | 5.9 | 3 | 2.53 | 17.0 |
| Silica | 16.5 | 15.8 | 4.3 | 15.6 | 17.2 | 9.8 | 15.8 | 17.9 | 12.5 | 19.6 | 22.9 | 15.5 |
| Sodium | 28 | 28 | 0.0 | 27 | 25 | 7.7 | 38 | 35 | 8.2 | 18 | 17.89 | 0.6 |
| Zinc | <0.02 | <0.02 | NC | <0.02 | <0.02 | NC | <0.02 | <0.02 | NC | <0.02 | <0.02 | NC |
| Chloride | 17 | 17 | 0.0 | 19 | 20 | 5.1 | 28 | 27 | 3.6 | 45 | 45 | 0.0 |
| Fluoride | 0.5 | 0.6 | 18.2 | 0.4 | 0.4 | 0.0 | <0.4 | 0.4 | NC | <0.4 | 0.2 | NC |
| Nitrite as Nitrogen | NA | NA | NC | <0.1 | NA | NC | <0.1 | NA | NC | <0.1 | NA | NC |
| Nitrate as Nitrogen | 4.8 | 5.5 | 13.6 | 6.8 | 4.8 | 34.5 | 9.5 | 8.1 | 15.9 | 21.2 | 20.4 | 3.8 |
| Sulfate | 37 | 37 | 0.0 | 27 | 24 | 11.8 | 47 | 45 | 4.3 | 63 | 67 | 6.2 |
| Total Dissolved Solids | N/A | N/A | NC | 292 | N/A | NC | 375 | N/A | NC | 500 | N/A | NC |
| Coliform, Fecal | <2 | <2 | NC | <1 | <2 | NC | <1.0 | <200 | NC | <1 | <2 | NC |
| Coliform, Total | <2 | <2 | NC | 2 | 2 | 0.0 | TNTC | 200 | NC | <1 | <2 | NC |
| pH | 7.7 | 7.9 | 3.2 | 7.0 | 7.6 | 8.5 | 7.1 | 7.8 | 9.4 | 6.7 | 8.0 | 17.2 |
| Total Petroleum Hydrocarbons | ND | ND | NC | <0.05 | ND | NC | * | ND | NC | <0.05 | ND | NC |
| Benzene | NA | NA | NC | <0.0005 | NA | NC | <0.0005 | NA | NC | <0.0005 | NA | NC |
| n-Butylbenzene | NA | NA | NC | <0.0005 | NA | NC | <0.0005 | NA | NC | <0.0005 | NA | NC |
| sec-Butylbenzene | ND | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Chloroform | ND | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| cis 1,2-Dichloroethylene | ND | ND | NC | <0.0005 | ND | NC | 0.0014 | ND | NC | <0.0005 | ND | NC |
| 1,1-Dichloroethane | ND | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Isopropylbenzene | ND | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Propylbenzene | NA | NA | NC | <0.0005 | NA | NC | <0.0005 | NA | NC | <0.0005 | NA | NC |
| Tetrachloroethylene (PCE) | 0.52169 | 0.50919 | 2.4 | 0.0039 | 0.00408 | 4.5 | 0.075 | 0.11513 | 42.2 | <0.0005 | ND | NC |
| 1,1,2-Trichloroethane | ND | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Trichloroethylene (TCE) | 0.00216 | 0.00296 | 31.3 | 0.0021 | 0.00145 | 36.6 | 0.0014 | 0.00118 | 17.1 | <0.0005 | ND | NC |
| Total Trihalomethanes | NA | ND | NC | <0.0005 | NA | NC | <0.0005 | NA | NC | <0.0005 | NA | NC |
| Vinyl Chloride | ND | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| m-Xylene | ND | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Chlorodibromomethane | NA | NA | NC | <0.0005 | NA | NC | 0.0006 | NA | NC | <0.0005 | NA | NC |

## TABLE 6 - DATA SUMMARY FOR JUNE 1997

| | NGW-9 (U.S.) | NGW-14 Dup of NGW-9 (U.S.) | RPD (%) | NGW-9 (MEXICO) | NGW-14 Dup of NGW-9 (MEXICO) | RPD (%) | NGW-10 (U.S.) | NGW-10 (MEXICO) | Percent Difference | NGW-11 (U.S.) | NGW-11 (MEXICO) | Percent Difference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date of Sample | 6-17-97 | 6-17-97 | | 6-17-97 | 6-17-97 | | 6-17-97 | 6-17-97 | | 6-17-97 | 6-17-97 | |
| Alkalinity, Phenolphthalein | <2 | <2 | NC | N/A | N/A | NC | <2 | N/A | NC | <2 | N/A | NC |
| Alkalinity, Total | 148 | 142 | 4.1 | 147 | 147 | 0.0 | 238 | 268 | 11.9 | 206 | 220 | 6.6 |
| Arsenic | <0.005 | 0.005 | NC | 0.0029 | 0.0029 | 0.0 | 0.036 | 0.0203 | 55.8 | 0.048 | 0.0231 | 70.0 |
| Barium | 0.1 | 0.1 | 0.0 | <0.5 | <0.5 | NC | 0.09 | <0.5 | NC | 0.02 | <0.5 | NC |
| Boron | 0.06 | 0.07 | 15.4 | N/A | N/A | NC | 0.07 | N/A | NC | 0.05 | N/A | NC |
| Cadmium | <0.001 | <0.001 | NC | <0.02 | <0.02 | NC | <0.001 | <0.02 | NC | <0.001 | <0.02 | NC |
| Calcium | 50 | 50 | 0.0 | 47.31 | 47.31 | 0.0 | 113 | 71.38 | 45.1 | 79 | 71.38 | 10.1 |
| Hardness | 179 | 170 | 5.2 | 158 | 157 | 0.6 | 373 | 352 | 5.8 | 251 | 230 | 8.7 |
| Iron | <0.015 | <0.015 | NC | <0.04 | <0.04 | NC | <0.015 | <0.04 | NC | <0.015 | <0.04 | NC |
| Magnesium | 13 | 11 | 16.7 | 11.25 | 12.04 | 6.8 | 22 | 22.15 | 0.7 | 13 | 13.05 | 0.4 |
| Manganese | <0.02 | <0.02 | NC | <0.03 | <0.03 | NC | <0.02 | <0.03 | NC | <0.02 | <0.03 | NC |
| Potassium | 8 | 6 | 28.6 | 7.1 | 7 | 7.8 | 2 | 2.1 | 4.9 | 2 | 3.4 | 51.9 |
| Silica | 12.8 | 13.2 | 3.1 | 16.5 | 16.8 | 1.8 | 15.8 | 20.1 | 24.0 | 15.2 | 19.4 | 24.3 |
| Sodium | 36 | 40 | 10.5 | 37.26 | 37.04 | 0.6 | 44 | 45.13 | 2.5 | 36 | 34.7 | 3.7 |
| Zinc | <0.02 | <0.02 | NC | <0.02 | <0.02 | NC | <0.02 | <0.02 | NC | <0.02 | <0.02 | NC |
| Chloride | 20 | 19 | 5.1 | 20 | 20 | 0.0 | 35 | 37 | 5.6 | 24 | 25 | 4.1 |
| Fluoride | <0.4 | <0.4 | NC | 0.3 | 0.3 | 0.0 | 0.7 | 0.6 | 15.4 | <0.4 | 0.4 | NC |
| Nitrite as Nitrogen | <0.1 | <0.1 | NC | NA | NA | NC | <0.1 | NA | NC | <0.1 | NA | NC |
| Nitrate as Nitrogen | 6.4 | 5.9 | 8.1 | 6 | 5.6 | 6.9 | 11 | 10.3 | 6.6 | 3 | 2.3 | 26.4 |
| Sulfate | 43 | 42 | 2.4 | 47 | 51 | 8.2 | 76 | 82 | 7.6 | 35 | 36 | 2.8 |
| Total Dissolved Solids | 299 | 308 | 3.0 | N/A | N/A | NC | 548 | N/A | NC | 390 | N/A | NC |
| Coliform, Fecal | <1.0 | 1 | NC | <2 | <2 | NC | <1 | <2 | NC | <1 | <2 | NC |
| Coliform, Total | 6 | <1 | NC | 20 | 2 | 163.6 | <1 | <2 | NC | <1 | <2 | NC |
| pH | 6.6 | 6.6 | 0.0 | 7.6 | 7.7 | 2.2 | 6.9 | 8.0 | 14.1 | 6.8 | 7.7 | 12.4 |
| Total Petroleum Hydrocarbons | <0.05 | <0.05 | NC | ND | ND | NC | * | ND | NC | <0.05 | ND | NC |
| Benzene | <0.0005 | <0.0005 | NC | NA | NA | NC | <0.0005 | NA | NC | <0.0005 | NA | NC |
| n-Butylbenzene | <0.0005 | <0.0005 | NC | NA | NA | NC | <0.0005 | NA | NC | <0.0005 | NA | NC |
| sec-Butylbenzene | <0.0005 | <0.0005 | NC | ND | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Chloroform | 0.0014 | 0.0013 | NC | ND | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| cis 1,2-Dichloroethylene | <0.0005 | <0.0005 | NC | ND | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| 1,1-Dichloroethane | <0.0005 | <0.0005 | NC | ND | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Isopropylbenzene | <0.0005 | <0.0005 | NC | ND | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Propylbenzene | <0.0005 | <0.0005 | NC | NA | NA | NC | <0.0005 | NA | NC | <0.0005 | NA | NC |
| Tetrachloroethylene (PCE) | 0.012 | 0.011 | 8.7 | 0.0157 | 0.01402 | 11.3 | <0.0005 | ND | NC | 0.0009 | 0.00151 | 50.6 |
| 1,1,2-Trichloroethane | <0.0005 | <0.0005 | NC | ND | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Trichloroethylene (TCE) | <0.0005 | <0.0005 | NC | ND | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Total Trihalomethanes | <0.0005 | <0.0005 | NC | NA | NA | NC | <0.0005 | NA | NC | <0.0005 | NA | NC |
| Vinyl Chloride | <0.0005 | <0.0005 | NC | ND | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| m-Xylene | <0.0005 | <0.0005 | NC | ND | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Chlorodibromomethane | <0.0005 | <0.0005 | NC | NA | NA | NC | <0.0005 | NA | NC | <0.0005 | NA | NC |

## TABLE 6 - DATA SUMMARY FOR JUNE 1997

| | NGW-12 (U.S.) | NGW-12 (MEXICO) | Percent Difference | NGW-13 (U.S.) | NGW-13 (MEXICO) | Percent Difference | NGW-16 (FB) (U.S.) | NGW-16 (FB) (MEXICO) | Percent Difference | NGW-17 (FB) (U.S.) | NGW-17 (FB) (MEXICO) | Percent Difference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date of Sample | 6-17-97 | 6-17-97 | | 6-17-97 | 6-17-97 | | 6-17-97 | 6-17-97 | | 6-18-97 | 6-18-97 | |
| Alkalinity, Phenolphthalein | <2 | N/A | NC | <2 | N/A | NC | <2 | N/A | NC | <2 | N/A | NC |
| Alkalinity, Total | 232 | 240 | 3.4 | 140 | 158 | 12.1 | <2.0 | 1 | NC | <2.0 | 2 | NC |
| Arsenic | 0.01 | 0.0059 | 51.6 | <0.005 | <0.0005 | NC | <0.005 | <0.0005 | NC | <0.005 | <0.0005 | NC |
| Barium | 0.03 | <0.5 | NC | 0.01 | <0.5 | NC | <0.01 | <0.5 | NC | <0.01 | <0.5 | NC |
| Boron | 0.08 | N/A | NC | 0.03 | N/A | NC | 0.22 | N/A | NC | <0.02 | N/A | NC |
| Cadmium | <0.001 | <0.02 | NC | <0.001 | <0.02 | NC | <0.001 | <0.02 | NC | <0.001 | <0.02 | NC |
| Calcium | 80 | 73.45 | 8.5 | 61 | 44.55 | 31.2 | <1.0 | 79.65 | NC | <1.0 | <0.20 | NC |
| Hardness | 258 | 242 | 6.4 | 177 | 172 | 2.9 | <7 | ND | NC | <7 | ND | NC |
| Iron | <0.015 | <0.04 | NC | <0.015 | <0.04 | NC | <0.015 | <0.04 | NC | <0.015 | <0.04 | NC |
| Magnesium | 14 | 15.05 | 7.2 | 6 | 6.09 | 1.5 | <1.0 | <0.02 | NC | <1.0 | <0.02 | NC |
| Manganese | <0.02 | <0.03 | NC | <0.02 | <0.03 | NC | <0.02 | <0.03 | NC | <0.02 | <0.03 | NC |
| Potassium | 2 | 2.7 | 29.8 | 2 | 2.12 | 5.8 | <1.0 | <0.2 | NC | <1.0 | <0.20 | NC |
| Silica | 34.7 | 20.8 | 50.1 | 12.5 | 17.2 | 31.6 | 3.2 | 4.4 | 31.6 | <2.0 | <2.1 | NC |
| Sodium | 42 | 40.66 | 3.2 | 19 | 17.89 | 6.0 | <2.0 | ND | NC | <2.0 | <3 | NC |
| Zinc | <0.02 | <0.02 | NC | <0.02 | <0.02 | NC | <0.02 | <0.02 | NC | <0.02 | <0.02 | NC |
| Chloride | 26 | 28 | 7.4 | 19 | 21 | 10.0 | <5.0 | ND | NC | <5.0 | ND | NC |
| Fluoride | <0.4 | 0.4 | NC | <0.4 | 0.2 | NC | <0.4 | ND | NC | <0.4 | ND | NC |
| Nitrite as Nitrogen | <0.1 | NA | NC | <0.1 | NA | NC | <0.1 | NA | NC | <0.1 | NA | NC |
| Nitrate as Nitrogen | 3 | 2.7 | 10.5 | 2.9 | 2.8 | 3.5 | <0.1 | ND | NC | <0.1 | ND | NC |
| Sulfate | 35 | 39 | 10.8 | 15 | 17 | 12.5 | 74 | ND | NC | <5.0 | ND | NC |
| Total Dissolved Solids | 402 | N/A | NC | 240 | N/A | NC | 20 | N/A | NC | <1 | N/A | NC |
| Coliform, Fecal | <1 | <2 | NC | <1 | <2 | NC | <1 | <2 | NC | <1 | <2 | NC |
| Coliform, Total | <1 | <2 | NC | <1 | <2 | NC | <1 | <2 | NC | <1 | <2 | NC |
| pH | 6.8 | 7.8 | 13.4 | 7.5 | 8.0 | 6.0 | 5.2 | 5 | 3.9 | 6.93 | 5.85 | 16.9 |
| Total Petroleum Hydrocarbons | * | ND | NC | <0.05 | ND | NC | <0.05 | ND | NC | <0.05 | ND | NC |
| Benzene | <0.0005 | NA | NC | <0.0005 | NA | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| n-Butylbenzene | <0.0005 | NA | NC | <0.0005 | NA | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| sec-Butylbenzene | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Chloroform | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | 0.0062 | 0.0076 | 20.3 |
| cis 1,2-Dichloroethylene | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| 1,1-Dichloroethane | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Isopropylbenzene | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Propylbenzene | <0.0005 | NA | NC | <0.0005 | NA | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Tetrachloroethylene (PCE) | <0.0005 | 0.0006 | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| 1,1,2-Trichloroethane | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Trichloroethylene (TCE) | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | | ND | NC |
| Total Trihalomethanes | <0.0005 | NA | NC | <0.0005 | NA | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Vinyl Chloride | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| m-Xylene | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Chlorodibromomethane | <0.0005 | NA | NC | <0.0005 | NA | NC | <0.0005 | ND | NC | | | |

## TABLE 7 - DATA SUMMARY FOR SEPTEMBER 1997

| | NGW-1 (U.S.) | NGW-1 (MEXICO) | Percent Difference | NGW-3 (U.S.) | NGW-3 (MEXICO) | Percent Difference | NGW-4 (U.S.) | NGW-15 Dup of NGW-4 (U.S.) | RPD (%) | NGW-4 (MEXICO) | NGW-15 Dup of NGW-4 (MEXICO) | RPD (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date of Sample | 9-24-97 | 9-24-97 | | 9-24-97 | 9-24-97 | | 9-24-97 | 9-24-97 | | 9-24-97 | 9-24-97 | |
| Alkalinity, Phenolphthalein | <2 | N/A | NC | <2 | N/A | NC | <2 | <2 | NC | N/A | N/A | NC |
| Alkalinity, Total | 144 | 141 | 2.1 | 226 | 221 | 2.2 | 250 | 224 | 11.0 | 236 | 232 | 1.7 |
| Arsenic | <0.005 | 0.0068 | NC | <0.005 | 0.0006 | NC | <0.005 | <0.005 | NC | 0.0029 | 0.0015 | NC |
| Barium | 0.02 | <0.50 | NC | 0.04 | <0.50 | NC | 0.06 | 0.06 | NC | <0.50 | <0.50 | NC |
| Boron | 0.06 | N/A | NC | 0.12 | N/A | NC | 0.10 | 0.11 | NC | N/A | N/A | NC |
| Cadmium | <0.001 | <0.02 | NC | <0.001 | <0.02 | NC | <0.001 | <0.001 | NC | <0.02 | <0.02 | NC |
| Calcium | 39 | 30 | 24.8 | 54 | 44 | 21.0 | 55 | 55 | 0.0 | 43 | 45 | 3.1 |
| Hardness | 138 | 140 | 1.4 | 184 | 193 | 4.8 | 186 | 186 | 0.0 | 197 | 199 | 1.0 |
| Iron | <0.015 | <0.04 | NC | 5.58 | 0.35 | 176.4 | 4.63 | 4.7 | 1.50 | 0.25 | 0.30 | NC |
| Magnesium | 10 | 9.94 | 0.6 | 12 | 11.2 | 6.9 | 12 | 12 | 0.0 | 11.1 | 11.1 | 0.0 |
| Manganese | <0.02 | <0.03 | NC | 2.93 | 2.8 | 6.0 | 5.17 | 5.17 | 0.0 | 4.8 | 4.9 | 1.0 |
| Potassium | 6.0 | 4.66 | 25.1 | 6.0 | 2.66 | 77.1 | 7.0 | 7.0 | NC | 5.47 | 5.47 | 0.0 |
| Silica | 16.7 | 22.9 | 31.2 | 15.2 | 20.4 | 29.1 | 17.2 | 17.4 | 1.2 | 21.0 | 21.6 | 3.0 |
| Sodium | 25 | 24.11 | 3.6 | 30 | 28.83 | 4.0 | 34 | 32.0 | 6.1 | 32.79 | 32.79 | 0.0 |
| Zinc | <0.02 | <0.02 | NC | <0.02 | <0.02 | NC | <0.02 | <0.02 | NC | <0.02 | <0.02 | NC |
| Chloride | 17 | 15 | 12.5 | 24 | 20 | 18.2 | 21 | 22 | NC | 19 | 19 | NC |
| Fluoride | 0.5 | 0.3 | 50.0 | <0.4 | 0.2 | NC | <0.4 | <0.4 | NC | 0.2 | 0.3 | NC |
| Nitrite as Nitrogen | <0.1 | N/A | NC | <0.1 | N/A | NC | <0.1 | <0.1 | NC | N/A | N/A | NC |
| Nitrate as Nitrogen | 3.1 | 3.3 | 6.2 | <0.1 | <0.1 | NC | <0.1 | <0.1 | NC | <0.1 | <0.1 | NC |
| Sulfate | 17 | 19 | 11.1 | <5 | <5 | NC | <5 | <5 | NC | <5 | <5 | NC |
| Total Dissolved Solids | 265 | N/A | NC | 278 | N/A | NC | 278 | 272 | 2.2 | N/A | N/A | NC |
| Coliform, Fecal | 69 | <2 | NC | 1 | <2 | NC | <1 | <1 | NC | <2 | <2 | NC |
| Coliform, Total | TNTC | 170 | NC | <1 | <2 | NC | <1 | <1 | NC | <2 | <2 | NC |
| pH | 6.3 | 7.9 | 22.5 | 7.2 | 8.3 | 13.8 | 7.3 | 7.4 | 1.1 | 7.8 | 8.6 | 9.8 |
| Total Petroleum Hydrocarbons | ND | ND | NC | ND | ND | NC | ND | ND | NC | ND | 0.0009 | NC |
| Benzene | <0.0005 | ND | NC | 0.0006 | 0.00078 | 26.1 | 0.0005 | 0.0005 | NC | 0.0006 | 0.0006 | NC |
| n-Butylbenzene | <0.0005 | NA | NC | 0.0039 | NA | NC | <0.0005 | <0.0005 | NC | NA | NA | NC |
| sec-Butylbenzene | <0.0005 | NA | NC | 0.0047 | NA | NC | 0.0020 | 0.0019 | NC | NA | NA | NC |
| Chloroform | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | <0.0005 | NC | ND | ND | NC |
| cis 1,2-Dichloroethylene | <0.0005 | ND | NC | <0.0005 | ND | NC | 0.0015 | 0.0015 | NC | ND | ND | NC |
| 1,1-Dichloroethane | <0.0005 | ND | NC | <0.0005 | ND | NC | 0.0008 | 0.0007 | NC | ND | ND | NC |
| Isopropylbenzene | <0.0005 | NA | NC | 0.0058 | NA | NC | 0.0009 | 0.0009 | NC | NA | NA | NC |
| Propylbenzene | <0.0005 | NA | NC | 0.0091 | NA | NC | <0.0005 | <0.0005 | NC | NA | NA | NC |
| Tetrachloroethylene (PCE) | 0.0011 | 0.0025 | 77.8 | <0.0005 | ND | NC | <0.0005 | <0.0005 | NC | ND | ND | NC |
| 1,1,2-Trichloroethane | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | <0.0005 | NC | ND | ND | NC |
| Trichloroethylene (TCE) | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | <0.0005 | NC | ND | ND | NC |
| Total Trihalomethanes | <0.0005 | NA | NC | <0.0005 | NA | NC | <0.0005 | <0.0005 | NC | NA | ND | NC |
| Vinyl Chloride | <0.0005 | ND | NC | <0.0005 | ND | NC | 0.0006 | 0.0005 | NC | ND | ND | NC |
| m-Xylene | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | <0.0005 | NC | ND | ND | NC |
| Chlorodibromomethane | <0.0005 | NA | NC | <0.0005 | NA | NC | <0.0005 | <0.0005 | NC | NA | NA | NC |
| 1,4-Dichlorobenzene | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | <0.0005 | NC | ND | ND | NC |

Results in mg/l, coliform results in CFU/100 ml and pH in standard units

**11.1** Indicates exceedance of U.S. Drinking Water Standards

**11.1** Indicates exceedance of Mexican Drinking Water Standards

* Sample broken in transit NC - Not Calculated ND - Not Detected NA - Not Analyzed TNTC - Too numerous to count

RPD - Relative Percent Difference- calculated only for duplicate results that were > 10 times the detection limit

## TABLE 7 - DATA SUMMARY FOR SEPTEMBER 1997

| | NGW-6 (U.S.) | NGW-6 (MEXICO) | Percent Difference | NGW-7 (U.S.) | NGW-7 (MEXICO) | Percent Difference | NGW-8 (U.S.) | NGW-8 (MEXICO) | Percent Difference | NGW-9 (U.S.) | NGW-14 Dup of NGW -9 (U.S.) | RPD (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date of Sample | 9-24-97 | 9-24-97 | | 9-24-97 | 9-24-97 | | 9-23-97 | 9-23-97 | | 9-23-97 | 9-23-97 | |
| Alkalinity, Phenolphthalein | <2 | N/A | NC | <2 | N/A | NC | <2 | N/A | NC | <2 | <2 | NC |
| Alkalinity, Total | 150 | 146 | 2.7 | 162 | 171 | 5 | 204 | 201 | 1.5 | 136 | 140 | 2.9 |
| Arsenic | <0.005 | 0.0009 | NC | <0.005 | 0.0039 | NC | 0.0140 | 0.0141 | 0.7 | 0.005 | <0.005 | NC |
| Barium | 0.1 | <0.50 | NC | 0.18 | <0.50 | NC | <0.01 | <0.50 | NC | 0.10 | 0.10 | 0.00 |
| Boron | 0.04 | N/A | NC | 0.06 | N/A | NC | 0.03 | N/A | NC | 0.08 | 0.08 | 0.0 |
| Cadmium | <0.001 | <0.02 | NC | <0.001 | <0.02 | NC | <0.001 | <0.02 | NC | <0.001 | <0.001 | NC |
| Calcium | 55 | 43 | 23.6 | 68 | 56 | 20 | 96 | 75 | 23.9 | 49 | 50 | 2.0 |
| Hardness | 174 | 166 | 4.7 | 224 | 215 | 4 | 380 | 381 | 0.3 | 167 | 170 | 1.8 |
| Iron | <0.015 | <0.04 | NC | <0.015 | <0.04 | NC | <0.015 | <0.04 | NC | <0.015 | <0.015 | NC |
| Magnesium | 9 | 8.8 | 2.2 | 13 | 12.8 | 1.55 | 34 | 31.9 | 6.5 | 11 | 11 | 0.0 |
| Manganese | <0.02 | <0.03 | NC | <0.02 | <0.03 | NC | <0.02 | <0.03 | NC | <0.02 | <0.02 | NC |
| Potassium | 2 | 1.65 | 19.2 | 8 | 7.55 | 5.8 | 2 | 2.60 | 26.1 | 8 | 8 | 0.0 |
| Silica | 14.2 | 18.5 | 26.3 | 14.5 | 19.1 | 27.5 | 18.2 | 24.8 | 30.5 | 14 | 13.5 | 3.6 |
| Sodium | 30 | 29.96 | 0.1 | 42 | 41.28 | 1.7 | 19 | 18.83 | 0.9 | 40 | 39 | 2.5 |
| Zinc | <0.02 | <0.02 | NC | <0.02 | <0.02 | NC | <0.02 | <0.02 | NC | <0.02 | <0.02 | NC |
| Chloride | 21 | 20 | 4.9 | 31 | 30 | 3 | 63 | 46 | 31.2 | 17 | 18 | 5.7 |
| Fluoride | 0.7 | 0.5 | 33.3 | 0.7 | 0.5 | 33.3 | 0.5 | 0.3 | 50.0 | 0.6 | 0.6 | 0.0 |
| Nitrite as Nitrogen | <0.1 | N/A | NC | <0.1 | N/A | NC | <0.1 | N/A | NC | <0.1 | <0.1 | NC |
| Nitrate as Nitrogen | 6.5 | 6.4 | 1.6 | 9.9 | 12 | 19.2 | 16.5 | 16.2 | 13.3 | 8.8 | 8.8 | 0.0 |
| Sulfate | 27 | 32 | 16.9 | 49 | 54 | 10 | 68 | 75 | 9.8 | 48 | 47 | 2.1 |
| Total Dissolved Solids | 285 | N/A | NC | 424 | N/A | NC | 440 | N/A | NC | 296 | 296 | 0.0 |
| Coliform, Fecal | TNTC | <2 | NC | TNTC | <2 | NC | <1 | <2 | NC | <1 | 1 | NC |
| Coliform, Total | TNTC | 1700 | NC | TNTC | >16000 | NC | <1 | <2 | NC | <1 | <1 | NC |
| pH | 6.5 | 7.6 | 15.6 | 6.6 | 7.6 | 14.1 | 7.0 | 8.2 | 15.8 | 7.0 | 7.2 | 2.3 |
| Total Petroleum Hydrocarbons | ND | NA | NC | ND | 1.2 | NC | ND | ND | NC | ND | ND | NC |
| Benzene | <0.0005 | ND | NC | <0.001 | NA | NC | <0.0005 | ND | NC | <0.0005 | <0.0005 | NC |
| n-Butylbenzene | <0.0005 | NA | NC | <0.001 | NA | NC | <0.0005 | ND | NC | <0.0005 | <0.0005 | NC |
| sec-Butylbenzene | <0.0005 | NA | NC | <0.001 | ND | NC | <0.0005 | NA | NC | <0.0005 | <0.0005 | NC |
| Chloroform | 0.0016 | ND | NC | <0.001 | ND | NC | <0.0005 | NA | NC | 0.0017 | 0.0017 | 0.0 |
| cis 1,2-Dichloroethylene | <0.0005 | ND | NC | <0.001 | ND | NC | <0.0005 | ND | NC | <0.0005 | <0.0005 | NC |
| 1,1-Dichloroethane | <0.0005 | ND | NC | <0.001 | ND | NC | <0.0005 | ND | NC | <0.0005 | <0.0005 | NC |
| Isopropylbenzene | <0.0005 | NA | NC | <0.001 | NA | NC | <0.0005 | NA | NC | <0.0005 | <0.0005 | NC |
| Propylbenzene | <0.0005 | NA | NC | <0.001 | NA | NC | <0.0005 | NA | NC | <0.0005 | <0.0005 | NC |
| Tetrachloroethylene (PCE) | 0.0053 | 0.00962 | 57.9 | 0.0449 | 0.0662 | 38.3 | <0.0005 | ND | NC | 0.00420 | 0.0043 | 2.4 |
| 1,1,2-Trichloroethane | <0.0005 | ND | NC | <0.001 | ND | NC | <0.0005 | ND | NC | <0.0005 | <0.0005 | NC |
| Trichloroethylene (TCE) | 0.0034 | 0.0037 | 7.9 | <0.001 | 0.0014 | NC | <0.0005 | ND | NC | <0.0005 | <0.0005 | NC |
| Total Trihalomethanes | <0.0005 | ND | NC | <0.001 | ND | NC | <0.0005 | NA | NC | 0.0017 | 0.0017 | 0.0 |
| Vinyl Chloride | 0.0005 | ND | NC | <0.001 | NA | NC | <0.0005 | ND | NC | <0.0005 | <0.0005 | NC |
| m-Xylene | <0.0005 | ND | NC | <0.001 | ND | NC | <0.0005 | ND | NC | <0.0005 | 0.0017 | NC |
| Chlorodibromomethane | 0.0005 | NA | NC | <0.001 | NA | NC | <0.0005 | NA | NC | <0.0005 | <0.0005 | NC |
| 1,4-Dichlorobenzene | <0.0005 | ND | NC | <0.001 | ND | NC | <0.0005 | ND | NC | <0.0005 | <0.0005 | NC |

## TABLE 7 - DATA SUMMARY FOR SEPTEMBER 1997

| | NGW-9 (MEXICO) | NGW-14 Dup of NGW-9 (MEXICO) | RPD (%) | NGW-10 (U.S.) | NGW-10 (MEXICO) | Percent Difference | NGW-11 (U.S.) | NGW-11 (MEXICO) | Percent Difference | NGW-12 (U.S.) | NGW-12 (MEXICO) | Percent Difference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date of Sample | 9-23-97 | 9-23-97 | | 9-23-97 | 9-23-97 | | 9-23-97 | 9-23-97 | | 9-23-97 | 9-23-97 | |
| Alkalinity, Phenolphthalein | N/A | N/A | NC | <2 | N/A | NC | <2 | N/A | NC | <2 | N/A | NC |
| Alkalinity, Total | 141 | 142 | 0.7 | 276 | 264.0 | 4.4 | 224 | 228 | 1.8 | 240 | 232 | 3.4 |
| Arsenic | 0.0055 | 0.0061 | 10.3 | 0.0330 | 0.029 | 12.9 | 0.052 | 0.0403 | 25.4 | 0.01 | 0.0093 | 7.3 |
| Barium | <0.50 | <0.50 | NC | 0.08 | <0.50 | NC | 0.02 | <0.50 | NC | 0.03 | <0.50 | NC |
| Boron | N/A | N/A | NC | 0.07 | N/A | NC | 0.07 | N/A | NC | 0.08 | N/A | NC |
| Cadmium | <0.02 | <0.02 | NC | <0.001 | <0.02 | NC | <0.001 | <0.02 | NC | <0.001 | <0.02 | NC |
| Calcium | 41 | 41 | 0.0 | 117 | 91.2 | 24.8 | 79 | 61 | 24.9 | 77 | 62 | 21.3 |
| Hardness | 160 | 164 | 2.5 | 370 | 357.0 | 3.6 | 246 | 235 | 4.6 | 246 | 240 | 2.5 |
| Iron | <0.04 | <0.04 | NC | <0.015 | <0.04 | NC | <0.015 | <0.04 | NC | <0.015 | <0.04 | NC |
| Magnesium | 10.4 | 10.1 | 3.3 | 19 | 17.9 | 5.8 | 12 | 11 | 8.7 | 13 | 11.70 | 10.5 |
| Manganese | <0.03 | <0.03 | NC | <0.02 | <0.03 | NC | <0.02 | <0.03 | NC | <0.02 | <0.03 | NC |
| Potassium | 6.29 | 6.44 | 2.4 | 2 | 2.22 | 10.4 | 4 | 3.92 | 2.0 | 2 | 2.49 | 21.8 |
| Silica | 19.1 | 19.1 | 0.0 | 16.2 | 21.6 | 28.7 | 16.2 | 20.4 | 22.9 | 17 | 20.4 | 18.1 |
| Sodium | 39.02 | 38.83 | 0.5 | 45 | 45.06 | 0.1 | 39 | 38.45 | 1.4 | 43 | 42.23 | 1.8 |
| Zinc | <0.02 | <0.02 | NC | <0.02 | <0.02 | NC | <0.02 | <0.02 | NC | <0.02 | <0.02 | NC |
| Chloride | 18 | 18 | 0.0 | 37 | 36.0 | 2.7 | 26 | 25 | 3.9 | 30 | 28 | 6.9 |
| Fluoride | 0.4 | 0.4 | 0.0 | 0.9 | 0.7 | 25.0 | 0.7 | 0.4 | 54.5 | 0.7 | 0.5 | 33.3 |
| Nitrite as Nitrogen | N/A | N/A | NC | <0.1 | N/A | NC | <0.1 | N/A | NC | <0.1 | N/A | NC |
| Nitrate as Nitrogen | 9.6 | 9.7 | 1.0 | 10.7 | 13.7 | 24.6 | 2.8 | 3.0 | 6.9 | 2.6 | 2.8 | 7.4 |
| Sulfate | 50 | 51 | 2.0 | 85 | 90.0 | 5.7 | 37 | 40 | 7.8 | 38 | 43 | 12.3 |
| Total Dissolved Solids | N/A | N/A | NC | 512 | N/A | NC | 350 | N/A | NC | 352 | N/A | NC |
| Coliform, Fecal | <2 | <2 | NC | <1 | <2 | NC | <1 | <2 | NC | <1 | <2 | NC |
| Coliform, Total | 2 | <2 | NC | <1 | <2 | NC | <1 | <2 | NC | <1 | <2 | NC |
| pH | 8.0 | 7.8 | 2.5 | 7.2 | 8.3 | NC | 6.5 | 7.6 | 15.6 | 6.5 | 7.8 | 18.2 |
| Total Petroleum Hydrocarbons | ND | 0.20 | NC | ND | ND | NC | ND | 0.6 | NC | ND | 1.7 | NC |
| Benzene | ND | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| n-Butylbenzene | NA | NA | NC | <0.0005 | NA | NC | <0.0005 | NA | NC | <0.0005 | NA | NC |
| sec-Butylbenzene | NA | NA | NC | <0.0005 | NA | NC | <0.0005 | NA | NC | <0.0005 | NA | NC |
| Chloroform | ND | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| cis 1,2-Dichloroethylene | ND | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| 1,1-Dichloroethane | ND | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Isopropylbenzene | NA | NA | NC | <0.0005 | NA | NC | <0.0005 | NA | NC | <0.0005 | NA | NC |
| Propylbenzene | NA | NA | NC | <0.0005 | NA | NC | <0.0005 | NA | NC | <0.0005 | NA | NC |
| Tetrachloroethylene (PCE) | 0.0038 | 0.00958 | 87.0 | <0.0005 | ND | NC | 0.00120 | 0.0027 | 77.2 | <0.0005 | ND | NC |
| 1,1,2-Trichloroethane | ND | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Trichloroethylene (TCE) | ND | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Total Trihalomethanes | NA | NA | NC | <0.0005 | NA | NC | <0.0005 | NA | NC | <0.0005 | NA | NC |
| Vinyl Chloride | ND | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| m-Xylene | ND | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Chlorodibromomethane | NA | NA | NC | <0.0005 | NA | NC | <0.0005 | NA | NC | <0.0005 | NA | NC |
| 1,4-Dichlorobenzene | ND | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |

## TABLE 7 - DATA SUMMARY FOR SEPTEMBER 1997

| | NGW-13 (U.S.) | NGW-13 (MEXICO) | Percent Difference | NGW-16 FB (U.S.) | NGW-16 FB (MEXICO) | Percent Difference | NGW-17 FB (U.S.) | NGW-17 FB (MEXICO) | Percent Difference |
|---|---|---|---|---|---|---|---|---|---|
| Date of Sample | 9-23-97 | 9-23-97 | | 9-23-97 | 9-23-97 | | 9-23-97 | 9-23-97 | |
| Alkalinity, Phenolphthalein | <2 | N/A | NC | <2 | NA | NC | <2 | NA | NC |
| Alkalinity, Total | 138 | 132 | 4.44 | <2 | 2 | NC | <2 | 4 | NC |
| Arsenic | <0.005 | 0.0008 | NC | <0.005 | <0.0005 | NC | <0.005 | <0.0005 | NC |
| Barium | <0.01 | <0.50 | NC | <0.01 | <0.50 | NC | <0.01 | <0.50 | NC |
| Boron | 0.03 | N/A | NC | <0.02 | NA | NC | 0.22 | NA | NC |
| Cadmium | <0.001 | <0.02 | NC | <0.001 | <0.02 | NC | <0.001 | <0.02 | NC |
| Calcium | 54 | 41 | 27 | <1. | <0.10 | NC | <1. | <0.10 | NC |
| Hardness | 156 | 148 | 5 | <7. | ND | NC | <7. | ND | NC |
| Iron | <0.015 | <0.04 | NC | <0.015 | <0.04 | NC | <0.015 | <0.04 | NC |
| Magnesium | 5 | 4.8 | 4.08 | <1. | <0.01 | NC | <1. | <0.01 | NC |
| Manganese | <0.02 | <0.03 | NC | <0.02 | <0.03 | NC | <0.02 | <0.03 | NC |
| Potassium | 2 | 1.93 | 3.6 | <1. | <0.03 | NC | <1. | <0.03 | NC |
| Silica | 14 | 18.5 | 27.7 | <0.100 | <2.1 | NC | 0.1 | <2.1 | NC |
| Sodium | 18 | 16.57 | 8.3 | <2. | <1.1 | NC | <2. | <1.1 | NC |
| Zinc | <0.02 | <0.02 | NC | <0.02 | <0.02 | NC | <0.02 | <0.02 | NC |
| Chloride | 18 | 18 | 0 | <5. | ND | NC | <5. | ND | NC |
| Fluoride | <0.4 | <0.1 | NC | <0.4 | <0.1 | NC | <0.4 | <0.1 | NC |
| Nitrite as Nitrogen | <0.1 | N/A | NC | <0.1 | NA | NC | <0.1 | NA | NC |
| Nitrate as Nitrogen | 2.2 | 2.3 | 4.4 | <0.1 | <0.1 | NC | <0.1 | <0.1 | NC |
| Sulfate | 15 | 16 | 6 | <5 | <5 | NC | <5. | <5 | NC |
| Total Dissolved Solids | 221 | N/A | NC | 4 | NA | NC | <1. | NA | NC |
| Coliform, Fecal | <1 | <2 | NC | <1 | <2 | NC | <1 | <2 | NC |
| Coliform, Total | <1 | <2 | NC | <1 | <2 | NC | <1 | <2 | NC |
| pH | 7.7 | 8.2 | 6.7 | 5.3 | 5.4 | 1.9 | 7.79 | 5.8 | 29.3 |
| Total Petroleum Hydrocarbons | ND | ND | NC | ND | 4.00 | NC | ND | 0.50 | NC |
| Benzene | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| n-Butylbenzene | <0.0005 | NA | NC | <0.0005 | NA | NC | <0.0005 | NA | NC |
| sec-Butylbenzene | <0.0005 | NA | NC | <0.0005 | NA | NC | <0.0005 | NA | NC |
| Chloroform | <0.0005 | ND | NC | 0.0057 | 0.00423 | 29.6 | 0.0095 | 0.00775 | 20.3 |
| cis 1,2-Dichloroethylene | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| 1,1-Dichloroethane | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Isopropylbenzene | <0.0005 | NA | NC | <0.0005 | NA | NC | <0.0005 | NA | NC |
| Propylbenzene | <0.0005 | NA | NC | <0.0005 | NA | NC | <0.0005 | NA | NC |
| Tetrachloroethylene (PCE) | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| 1,1,2-Trichloroethane | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Trichloroethylene (TCE) | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Total Trihalomethanes | <0.0005 | NA | NC | 0.0057 | ND | NC | 0.0095 | ND | NC |
| Vinyl Chloride | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| m-Xylene | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Chlorodibromomethane | <0.0005 | NA | NC | <0.0005 | NA | NC | <0.0005 | NA | NC |
| 1,4-Dichlorobenzene | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |

## TABLE 8 - DATA SUMMARY FOR FEBRUARY 1998

| | NGW-1 (U.S.) | NGW-1 (MEXICO) | Percent Difference | NGW-3 (U.S.) | NGW-3 (MEXICO) | Percent Difference | NGW-4 (U.S.) | NGW-4 (MEXICO) | Percent Difference | NGW-6 (U.S.) | NGW-6 (MEXICO) | Percent Difference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date of Sample | 2-10-98 | 2-10-98 | | 2-10-98 | 2-10-98 | | 2-10-98 | 2-10-98 | | 2-10-98 | 2-10-98 | |
| Alkalinity, Phenolphthalein | <2.0 | NA | NC | <2.0 | NA | NC | <2.0 | NA | NC | <2.0 | NA | NC |
| Alkalinity, Total | 92 | 103 | 11 | 206 | 211 | 2 | 206 | 215 | 4 | 158 | 168 | 6 |
| Arsenic | <0.005 | 0.004 | NC | <0.005 | 0.0011 | NC | <0.005 | 0.0009 | NC | <0.005 | 0.0145 | NC |
| Barium | <0.01 | <0.50 | NC | 0.04 | <0.50 | NC | 0.06 | <0.50 | NC | 0.15 | <0.50 | NC |
| Boron | 0.06 | NA | NC | 0.11 | NA | NC | 0.11 | NA | NC | 0.05 | NA | NC |
| Cadmium | <0.001 | <0.02 | NC | <0.001 | <0.02 | NC | <0.001 | <0.02 | NC | <0.001 | <0.02 | NC |
| Calcium | 31 | 28.64 | 8 | 51 | 40.10 | 24 | 56 | 45.01 | 22 | 65 | 97.38 | 40 |
| Hardness | 110 | 105 | 5 | 172 | 168 | 2 | 185 | 184 | 1 | 203 | 201 | 1 |
| Iron | <0.015 | <0.04 | NC | **5.91** | **3.56** | 50 | **4.08** | **3.02** | 30 | <0.015 | <0.04 | NC |
| Magnesium | 8 | 7.75 | 3 | 11 | 10.59 | 4 | 11 | 11.68 | 6 | 10 | 10.48 | 5 |
| Manganese | <0.02 | <0.03 | NC | **2.76** | **2.46** | 11 | **5.01** | **4.44** | 12 | <0.02 | <0.03 | NC |
| Potassium | 4 | 4.4 | 10 | 5 | 5.0 | 0 | 6 | 5.5 | 9 | 2 | 1.8 | 11 |
| Silica | 24.2 | 23 | 5 | 24.1 | 19.6 | 21 | 26 | 18.6 | 33 | 22.1 | 20.6 | 7 |
| Sodium | 18 | 17.1 | 5 | 27 | 25.0 | 8 | 32 | 28.7 | 11 | 32 | 28.0 | 13 |
| Zinc | <0.02 | NA | NC | <0.02 | NA | NC | <0.02 | NA | NC | <0.02 | NA | NC |
| Chloride | 13 | 15 | 14 | 20 | 19 | 5 | 25 | 24 | 4 | 23 | 28 | 20 |
| Fluoride | <0.4 | 0.1 | NC | <0.4 | 0.1 | NC | <0.4 | <0.1 | NC | 0.5 | 0.4 | 22 |
| Nitrite as Nitrogen | <0.01 | NA | NC | <0.1 | NA | NC | <0.1 | NA | NC | <0.01 | NA | NC |
| Nitrate as Nitrogen | 2.8 | **5.1** | 58 | <0.1 | <0.1 | NC | <0.1 | <0.1 | NC | 3.6 | **8.8** | 84 |
| Sulfate | 19 | 21 | 10 | <5.0 | 7 | NC | 23 | 24 | NC | 32 | 40 | 22 |
| Total Dissolved Solids | 244 | NA | NC | 298 | NA | NC | 336 | NA | NC | 372 | NA | NC |
| Coliform, Fecal | **190** | **140** | 30 | <1.0 | <2 | NC | <1.0 | <2 | NC | **10** | <2 | NC |
| Coliform, Total | **TNTC** | **500** | NC | <1.0 | <2 | NC | **2** | **2** | 0 | **116** | <2 | NC |
| pH | 7.03 | 7.8 | 10 | 6.74 | 8.3 | 21 | 6.76 | 7.4 | 9 | 7.01 | 7.7 | 9 |
| Total Petroleum Hydrocarbons | 0.17 | ND | NC | 0.48 | NA | NC | 0.32 | ND | NC | 0.13 | ND | NC |
| Benzene | <0.0005 | ND | NC | 0.0013 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| n-Butylbenzene | <0.0005 | NA | NC | 0.0052 | NA | NC | <0.0005 | NA | NC | <0.0005 | NA | NC |
| sec-Butylbenzene | <0.0005 | NA | NC | 0.0056 | NA | NC | 0.0016 | NA | NC | <0.0005 | NA | NC |
| Chloroform | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | 0.0005 | ND | NC |
| cis 1,2-Dichloroethylene | <0.0005 | NA | NC | <0.0005 | NA | NC | 0.0015 | NA | NC | <0.0005 | NA | NC |
| 1,1-Dichloroethane | <0.0005 | ND | NC | <0.0005 | ND | NC | 0.0009 | ND | NC | <0.0005 | ND | NC |
| Isopropylbenzene | <0.0005 | NA | NC | 0.0061 | NA | NC | 0.0006 | NA | NC | <0.0005 | NA | NC |
| Tetrachloroethylene (PCE) | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | 0.0029 | 0.00478 | 49 |
| Propylbenzene | <0.0005 | NA | NC | 0.0103 | NA | NC | <0.0005 | NA | NC | <0.0005 | NA | NC |
| Trichloroethylene (TCE) | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | 0.0006 | ND | NC |
| Total Trihalomethanes | <0.0005 | NA | NC | <0.0005 | NA | NC | <0.0005 | NA | NC | 0.0005 | NA | NC |
| Vinyl Chloride | <0.0005 | ND | NC | <0.0005 | ND | NC | 0.0005 | ND | NC | <0.0005 | ND | NC |
| m/p-Xylene | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Chlorodibromomethane | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| 1,4-Dichlorobenzene | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Toluene | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | ND | NC |

Results in mg/l, coliform results in CFU/100 ml and pH in standard units

**11.1** Indicates exceedance of U.S. Drinking Water Standards

**11.1** Indicates exceedance of Mexican Drinking Water Standards

* Sample broken in transit NC - Not Calculated ND - Not Detected NA - Not Analyzed TNTC - Too numerous to count

RPD - Relative Percent Difference- calculated only for duplicate results that were > 10 times the detection limit

## TABLE 8 - DATA SUMMARY FOR FEBRUARY 1998

| | NGW-7 (U.S.) | NGW-7 (MEXICO) | Percent Difference | NGW-8 (U.S.) | NGW-8 (MEXICO) | Percent Difference | NGW-9 (U.S.) | NGW-15 Dup of NGW-9 (U.S.) | RPD (%) | NGW-9 (MEXICO) | NGW-15 Dup of NGW-9 (MEXICO) | RPD (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date of Sample | 2-10-98 | 2-10-98 | | 2-10-98 | 2-10-98 | | 2-10-98 | 2-10-98 | | 2-10-98 | 2-10-98 | |
| Alkalinity, Phenolphthalein | <2.0 | NA | NC | <2.0 | NA | NC | <2.0 | <2.0 | NC | <2.0 | NA | NC |
| Alkalinity, Total | 180 | 191 | 6 | 204 | 211 | 3 | 146 | 146 | 0 | 146 | 148 | 1 |
| Arsenic | <0.005 | 0.0031 | NC | 0.012 | 0.0145 | 19 | 0.005 | 0.005 | 0 | 0.005 | 0.0044 | 13 |
| Barium | 0.16 | <0.50 | NC | 0.02 | <0.50 | NC | 0.11 | 0.11 | 0 | 0.11 | <0.50 | NC |
| Boron | 0.07 | NA | NC | 0.04 | NA | NC | 0.07 | 0.07 | 0 | 0.07 | NA | NC |
| Cadmium | <0.001 | <0.02 | NC | <0.001 | <0.02 | NC | <0.001 | <0.001 | NC | <0.001 | <0.02 | NC |
| Calcium | 70 | 65.47 | 7 | 97 | 97.38 | 0 | 52 | 52 | 0 | 52 | 49.10 | 6 |
| Hardness | 229 | 221 | 4 | 374 | 340 | 10 | 171 | 171 | 0 | 171 | 156 | 9 |
| Iron | <0.015 | <0.04 | NC | <0.015 | <0.04 | NC | <0.015 | <0.015 | NC | <0.015 | <0.04 | NC |
| Magnesium | 13 | 13.32 | 2 | 32 | 31.53 | 1 | 10 | 10 | 0 | 10 | 9.93 | 1 |
| Manganese | <0.02 | <0.03 | NC | <0.02 | <0.03 | NC | <0.02 | <0.02 | NC | <0.02 | <0.03 | NC |
| Potassium | 7 | 6.8 | 3 | 2 | 2.6 | 26 | 7 | 7 | 0 | 7 | 7.2 | 3 |
| Silica | 21 | 21.8 | 4 | 29 | 19.6 | 39 | 21.2 | 21.4 | 1 | 21.2 | 14.6 | 37 |
| Sodium | 43 | 39.1 | 10 | 19 | 16.4 | 15 | 38 | 38 | 0 | 38 | 35.3 | 7 |
| Zinc | <0.02 | NA | NC | <0.02 | NA | NC | <0.02 | <0.02 | NC | <0.02 | NA | NC |
| Chloride | 31 | 31 | 0 | 45 | 47 | 4 | 22 | 21 | 5 | 22 | 21 | 5 |
| Fluoride | 0.5 | 0.4 | 22 | <0.4 | 0.1 | NC | <0.4 | <0.4 | NC | <0.4 | 0.3 | NC |
| Nitrite as Nitrogen | <0.01 | NA | NC | <0.01 | NA | NC | <0.01 | 7.4 | NC | 0.005 | NA | NC |
| Nitrate as Nitrogen | 2.7 | 10.1 | 116 | 11.1 | 17.6 | 45 | 6.1 | 7.4 | NC | 9.1 | 7.7 | 17 |
| Sulfate | 56 | 56 | 0 | 66 | 74 | 11 | <5.0 | 54 | NC | <5.0 | 53 | NC |
| Total Dissolved Solids | 387 | NA | NC | 468 | NA | NC | 335 | 297 | NC | 335 | NA | NC |
| Coliform, Fecal | 16 | 4 | 120 | NA | <2 | NC | NA | NA | NC | NA | 4 | NC |
| Coliform, Total | 80 | 20 | 120 | NA | <2 | NC | NA | NA | NC | NA | 4 | NC |
| pH | 6.97 | 7.7 | 10 | 7.05 | 7.6 | 8 | 7.08 | 7.01 | 1 | 7.08 | 7.9 | 11 |
| Total Petroleum Hydrocarbons | 0.23 | ND | NC | 0.12 | ND | NC | 0.14 | 0.16 | 13 | 0.14 | ND | NC |
| Benzene | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | <0.0005 | NC | <0.0005 | ND | NC |
| n-Butylbenzene | <0.0005 | NA | NC | <0.0005 | NA | NC | <0.0005 | <0.0005 | NC | <0.0005 | NA | NC |
| sec-Butylbenzene | <0.0005 | NA | NC | <0.0005 | NA | NC | <0.0005 | <0.0005 | NC | <0.0005 | NA | NC |
| Chloroform | 0.0006 | ND | NC | <0.0005 | ND | NC | 0.001 | 0.001 | 0 | 0.001 | ND | NC |
| cis 1,2-Dichloroethylene | <0.0005 | NA | NC | <0.0005 | NA | NC | <0.0005 | <0.0005 | NC | <0.0005 | NA | NC |
| 1,1-Dichloroethane | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | <0.0005 | NC | <0.0005 | ND | NC |
| Isopropylbenzene | <0.0005 | NA | NC | <0.0005 | NA | NC | <0.0005 | <0.0005 | NC | <0.0005 | NA | NC |
| Tetrachloroethylene (PCE) | 0.0194 | 0.02568 | 28 | <0.0005 | ND | NC | 0.0065 | 0.0065 | 0 | 0.0065 | 0.00981 | 41 |
| Propylbenzene | <0.0005 | NA | NC | <0.0005 | NA | NC | <0.0005 | <0.0005 | NC | <0.0005 | NA | NC |
| Trichloroethylene (TCE) | 0.0008 | ND | NC | <0.0005 | ND | NC | <0.0005 | <0.0005 | NC | <0.0005 | ND | NC |
| Total Trihalomethanes | <0.0005 | NA | NC | <0.0005 | NA | NC | 0.001 | 0.001 | 0 | 0.001 | NA | NC |
| Vinyl Chloride | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | <0.0005 | NC | <0.0005 | ND | NC |
| m/p-Xylene | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | <0.0005 | NC | <0.0005 | ND | NC |
| Chlorodibromomethane | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | <0.0005 | NC | <0.0005 | ND | NC |
| 1,4-Dichlorobenzene | 0.0006 | ND | NC | <0.0005 | ND | NC | <0.0005 | <0.0005 | NC | <0.0005 | ND | NC |
| Toluene | <0.0005 | ND | NC | <0.0005 | ND | NC | <0.0005 | <0.0005 | NC | <0.0005 | ND | NC |

## TABLE 8 - DATA SUMMARY FOR FEBRUARY 1998

| | NGW-13 (U.S.) | NGW-13 (MEXICO) | RPD (%) | NGW-17 FB (U.S.) | NGW-17 FB (MEXICO) | Percent Difference |
|---|---|---|---|---|---|---|
| Date of Sample | 2-10-98 | 2-10-98 | | 2-10-98 | 2-10-98 | |
| Alkalinity, Phenolphthalein | <2.0 | NA | NC | <2.0 | NA | NC |
| Alkalinity, Total | 134 | 135 | 1 | <2.0 | 6 | NC |
| Arsenic | <0.005 | 0.0007 | NC | <0.005 | <0.0005 | NC |
| Barium | <0.01 | <0.50 | NC | <0.01 | <0.50 | NC |
| Boron | 0.03 | NA | NC | <0.02 | NA | NC |
| Cadmium | <0.001 | <0.02 | NC | <0.001 | <0.02 | NC |
| Calcium | 57 | 49.92 | 13 | <1.0 | <1.00 | NC |
| Hardness | 163 | 150 | 8 | <7 | ND | NC |
| Iron | <0.015 | <0.04 | NC | <0.015 | <0.04 | NC |
| Magnesium | 5 | 4.81 | 4 | <1.0 | <1.00 | NC |
| Manganese | <0.02 | <0.03 | NC | <0.02 | <0.03 | NC |
| Potassium | 2 | 2.0 | 0 | <1.0 | <1.00 | NC |
| Silica | 20.6 | 15.6 | 28 | <0.10 | 3.6 | NC |
| Sodium | 17 | 14.9 | 13 | <2.0 | <2.0 | NC |
| Zinc | <0.02 | NA | NC | <0.02 | NA | NC |
| Chloride | 25 | 24 | 4 | <5.0 | ND | NC |
| Fluoride | <0.4 | <0.1 | NC | <0.4 | ND | NC |
| Nitrite as Nitrogen | <0.1 | NA | NC | <0.01 | NA | NC |
| Nitrate as Nitrogen | 2.2 | 3.2 | 37 | <0.1 | ND | NC |
| Sulfate | 7 | 19 | 92 | <5.0 | ND | NC |
| Total Dissolved Solids | 245 | NA | NC | 14 | NA | NC |
| Coliform, Fecal | <1.0 | <2 | NC | <1.0 | 13 | NC |
| Coliform, Total | <1.0 | <2 | NC | <1.0 | 13 | NC |
| pH | 7.59 | 7.9 | 4 | 7.96 | 6.2 | 25 |
| Total Petroleum Hydrocarbons | 0.13 | ND | NC | 0.27 | ND | NC |
| Benzene | <0.0005 | ND | NC | <0.0005 | ND | NC |
| n-Butylbenzene | <0.0005 | NA | NC | <0.0005 | NA | NC |
| sec-Butylbenzene | <0.0005 | NA | NC | <0.0005 | NA | NC |
| Chloroform | <0.0005 | ND | NC | <0.0005 | 0.02518 | NC |
| cis 1,2-Dichloroethylene | <0.0005 | NA | NC | <0.0005 | NA | NC |
| 1,1-Dichloroethane | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Isopropylbenzene | <0.0005 | NA | NC | <0.0005 | NA | NC |
| Tetrachloroethylene (PCE) | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Propylbenzene | <0.0005 | NA | NC | <0.0005 | NA | NC |
| Trichloroethylene (TCE) | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Total Trihalomethanes | <0.0005 | NA | NC | <0.0005 | NA | NC |
| Vinyl Chloride | <0.0005 | ND | NC | <0.0005 | ND | NC |
| m/p-Xylene | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Chlorodibromomethane | <0.0005 | ND | NC | <0.0005 | ND | NC |
| 1,4-Dichlorobenzene | <0.0005 | ND | NC | <0.0005 | ND | NC |
| Toluene | <0.0005 | ND | NC | <0.0005 | 0.0029 | NC |

Table 9 - Data Summary for the International Collector (2/98)

| | International Collector (U.S.) | International Collector (Mexico) |
|---|---|---|
| Date of Sample | 2-10-98 | 2-10-98 |
| Alkalinity, Phenolphthalein | <2 | |
| Alkalinity, Total | 218 | 263 |
| Hardness | 150 | 126 |
| Alumimun | 4.26 | 7.6 |
| Antimony | 0.005 | <0.0005 |
| Arsenic | 0.014 | 0.0115 |
| Barium | 0.16 | <0.50 |
| Boron | 0.10 | |
| Cadmium | <0.004 | <0.02 |
| Calcium | 47 | 45.83 |
| Chromium | 0.026 | <0.04 |
| Copper | 0.168 | 0.22 |
| Iron | 4.45 | 8.5 |
| Lead | 0.068 | 0.11 |
| Magnesium | 8 | 10.04 |
| Manganese | 0.68 | 0.89 |
| Mercury | 0.0003 | <0.0005 |
| Potassium | 11 | 10.78 |
| Silica | 32.6 | 48.6 |
| Sodium | 68 | 70.9 |
| Zinc | 0.22 | |
| Chloride | 38 | 43 |
| Fluoride | 0.4 | 0.2 |
| Nitrogen as Nitrite | <0.1 | 0.559 |
| Nitrogen as Nitrate | 0.4 | 1.7 |
| Sulfate | 53 | 62 |
| Total Dissolved Solids | 436 | |
| pH | 7.87 | 7.4 |
| Total Kjeldahl Nitrogen | 11 | |
| Nitrogen as Ammonia | 10.1 | 13.5 |

Results in mg/l, pH in standard units

Table 10 - Arizona Aquifer Water Quality Standards
for Inorganic Chemicals

| Pollutant | (mg/L) |
|---|---|
| Antimony | 0.006 |
| Arsenic | 0.05 |
| Asbestos | 7 million fibers/liter (longer than 10 mm) |
| Barium | 2 |
| Beryllium | 0.004 |
| Cadmium | 0.005 |
| Chromium | 0.1 |
| Coliform, Total | shall not be present |
| Cyanide (As Free Cyanide) | 0.2 |
| Fluoride | 4 |
| Lead | 0.05 |
| Mercury | 0.002 |
| Nickel | 0.1 |
| Nitrate (as N) | 10 |
| Nitrite (as N) | 1 |
| Nitrate and nitrite (as N) | 10 |
| Selenium | 0.05 |
| Thallium | 0.002 |

Table 10 - Arizona Aquifer Water Quality Standards (Cont)
for Organic Chemicals

| Pollutant | (mg/L) | Pollutant | (mg/L) |
|---|---|---|---|
| Benzene | 0.005 | Pentachlorophenol | 0.001 |
| Benzo (a) pyrene | 0.0002 | Styrene | 0.1 |
| Carbon Tetrachloride | 0.005 | 2,3,78-TCDD (Dioxin) | 0.00000003 |
| o-Dichlorobenzene | 0.6 | Tetrachloroethylene (PCE) | 0.005 |
| para-Dichlorobenzene | 0.075 | Toluene | 1 |
| 1,2-Dichloroethane | 0.005 | Trihalomethane (Total) | 0.1 |
| 1,1-Dichloroethylene | 0.007 | 1,2,4-Trichlorobenzene | 0.07 |
| cis-1,2-Dichloroethylene | 0.07 | 1,1,1-Trichloroethane | 0.2 |
| trans-1,2-Dichloroethylene | 0.1 | 1,1,2-Trichloroethane | 0.005 |
| 1,2-Dichloropropane | 0.005 | Trichloroethylene (TCE) | 0.005 |
| Dichloromethane | 0.005 | Vinyl Chloride | 0.002 |
| Di (2-ethylhexyl) adipate | 0.4 | Xylenes (Total) | 10 |
| Di (2-ethylhexyl) pthalate | 0.006 | | |
| Ethylbenzene | 0.7 | | |
| Hexachlorobenzene | 0.001 | | |
| Hexachlorocyclopentadiene | 0.05 | | |
| Monochlorobenzene | 0.1 | | |

Table 11 - Mexican Water Quality Standards
CRITERIOS ECOLOGICOS DE CALIDAD DEL AGUA
Maximum Levels in mg/l, except when otherwise indicated

| SUBSTANCE | DRINKING Source | RECREATION | AGRICULTURAL | ANIMAL USE | FRESH WATER* | SEA WATER* |
|---|---|---|---|---|---|---|
| Aluminum | 0.02 | | 5 | 5 | 0.05 | 2 |
| Antimony | 0.1 | | 0.1 | | 0.09 | |
| Arsenic | 0.05 | | 0.1 | 0.2 | 0.2 | 0.04 |
| Barium | 1 | | | | 0.01 | 0.5 |
| Benzene | 0.01 | | | | 0.05 | 0.005 |
| Beryllium | 0.00007 | | | | 0.001 | |
| bis (2-ethylhexyl) Phthalate | 32 | | | | | |
| Boron | 1 | | 0.7 | 5 | | 0.009 |
| Bromoform | 0.002 | | | | | |
| Methyl Bromide | 0.002 | | | | | |
| Cadmium | 0.01 | | 0.01 | 0.02 | | 0.0009 |
| Chlorobenzene | 0.02 | | | | | |
| Chloroform | 0.03 | | | | 0.3 | |
| Chlorides (as Cl-) | 250 | | 147.5 | | 250 | |
| Methylene Chloride | 0.002 | | | | | |
| Methyl Chloride | 0.002 | | | | | |
| Vinyl Chloride | 0.02 | | | | | |
| Copper | 1 | | 0.2 | 0.5 | | 0.003 |
| Coliforms, fecal (MPN/100 ml) | 1000 | 100 | | | | |
| Coliforms, total (MPN/100 ml) | No limit | | | | | |
| Color (Pt-Co unit) | 20 | | 1 | | | |
| Electric Conductivity (mmhos/cm) | NA | | 1 | 1 | 0.01 | 0.05 |
| Hexavalent Chromium | .05 | | | | | |
| 1,2-Dichloroethylene | 0.003 | | | | | 0.5 |
| Ethylbenzene | 1.4 | | 1 | 2 | 1 | 0.5 |
| Fluoride (as F-) | 1.5 | | | | 0.0009 | 0.0003 |
| Hexachlorobutadiene | 0.004 | | 5 | | 1 | 0.05 |

Table 11 - Mexican Water Quality Standards (Cont)
CRITERIOS ECOLOGICOS DE CALIDAD DEL AGUA
Maximum Levels in mg/l, except when otherwise indicated

| SUBSTANCE | DRINKING | RECREATION | AGRICULTURAL | ANIMAL USE | FRESH WATER* | SEA WATER* |
|---|---|---|---|---|---|---|
| Iron | 0.3 | | | | | |
| Manganese | 0.1 | | | 0.003 | 0.00001 | 0.00002 |
| Mercury | 0.001 | | | | 0.02 | 0.02 |
| Naphthalene | | | 2 | 1 | | |
| Nickel | 0.01 | | | 90 | | 4 |
| Nitrate (as N) | 5 | | | 10 | | 0.002 |
| Nitrite (as N) | 0.05 | | 4.5-9 | | | |
| Hydrogen (pH) | 5-9 | | | | | 0.002 |
| Silver | 0.05 | | 5 | 0.1 | | 0.006 |
| Lead | 0.05 | | 0.02 | 0.05 | 0.008 | 0.4 |
| Selenium | 0.01 | | | | | |
| Total Solids | 1000 | | 130 | | 0.005 | |
| Sulfate | 500 | | | | 0.01 | 0.02 |
| Thallium | 0.01 | | | | 0.09 | 0.09 |
| 1,1,2,2-Tetrachloroethane | 0.002 | | | | 0.05 | 0.1 |
| Tetrachloroethylene (PCE) | 0.008 | | | | 0.2 | 0.06 |
| Toluene | 14.3 | | | | 0.2 | |
| 1,1,2-Trichloroethane | 0.006 | | | | 0.01 | 0.02 |
| Trichloroethylene (TCE) | 0.03 | | 2 | 50 | | 0.09 |

* Protection of aquatic life

Figure 2. - U.S.-Mexico Data Comparison for Selected Parameters - April 1997

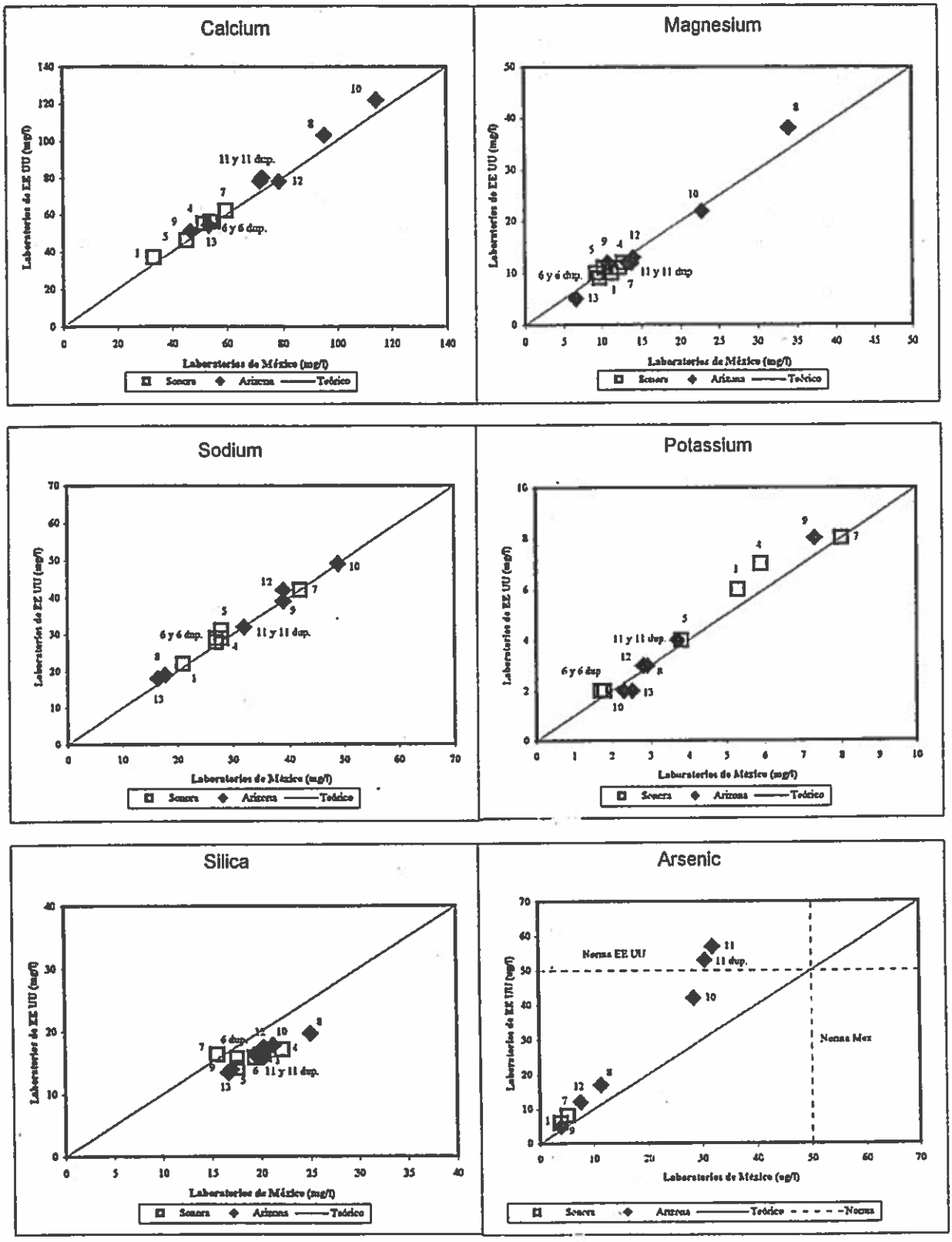


Figure 2. - U.S.- Mexico Data Comparison for Selected parameters - April 1997

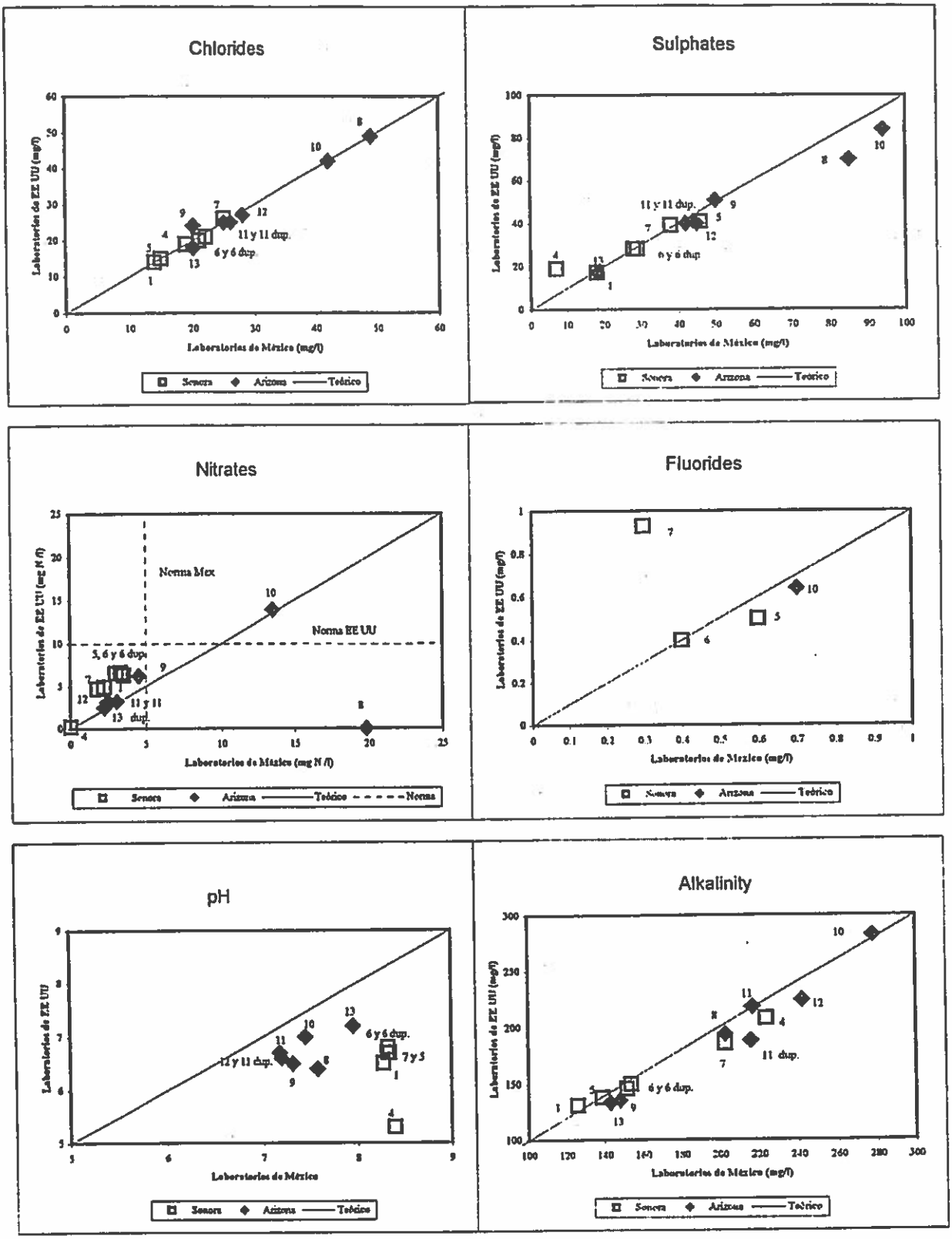


Figure 2. - U.S. - Mexico Data Comparison for Selected Parameters - April 1997

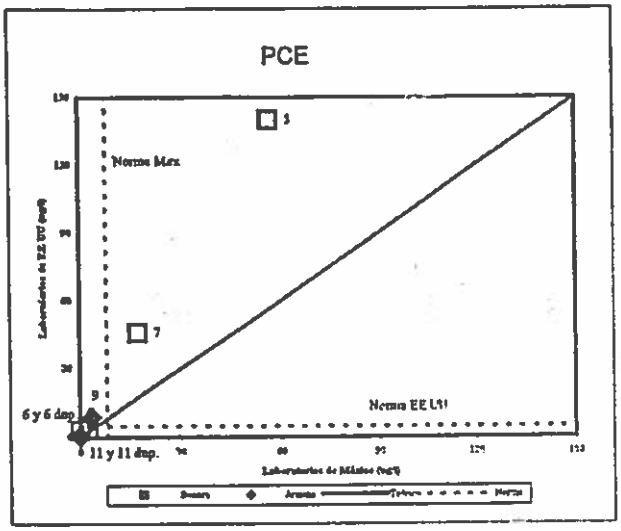


Figure 3. - U.S. - Mexico Data Comparison for Selected Parameters - June 1997

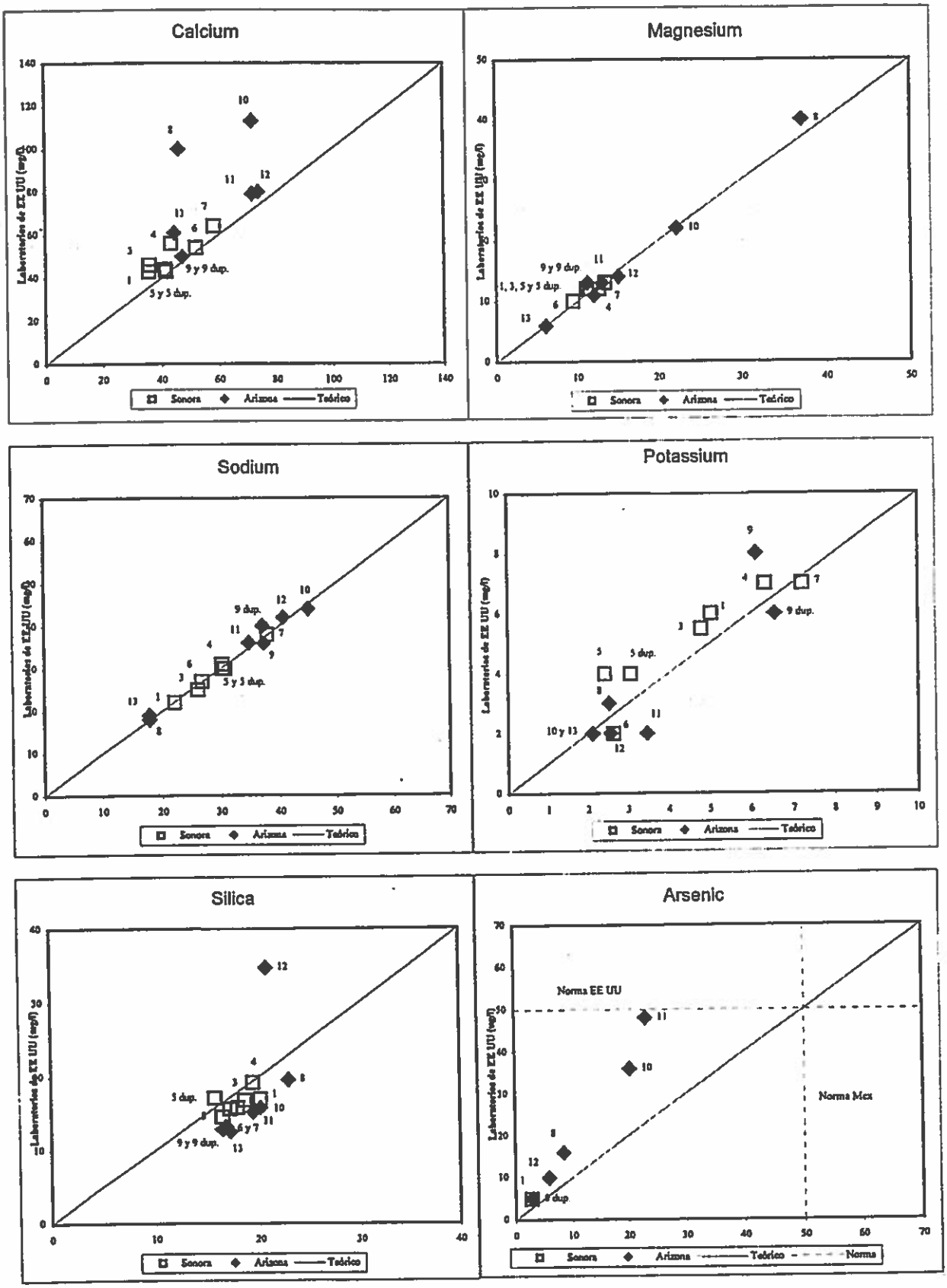


Figure 3. - U.S. - Mexico Data Comparison for Selected Parameters - June 1997

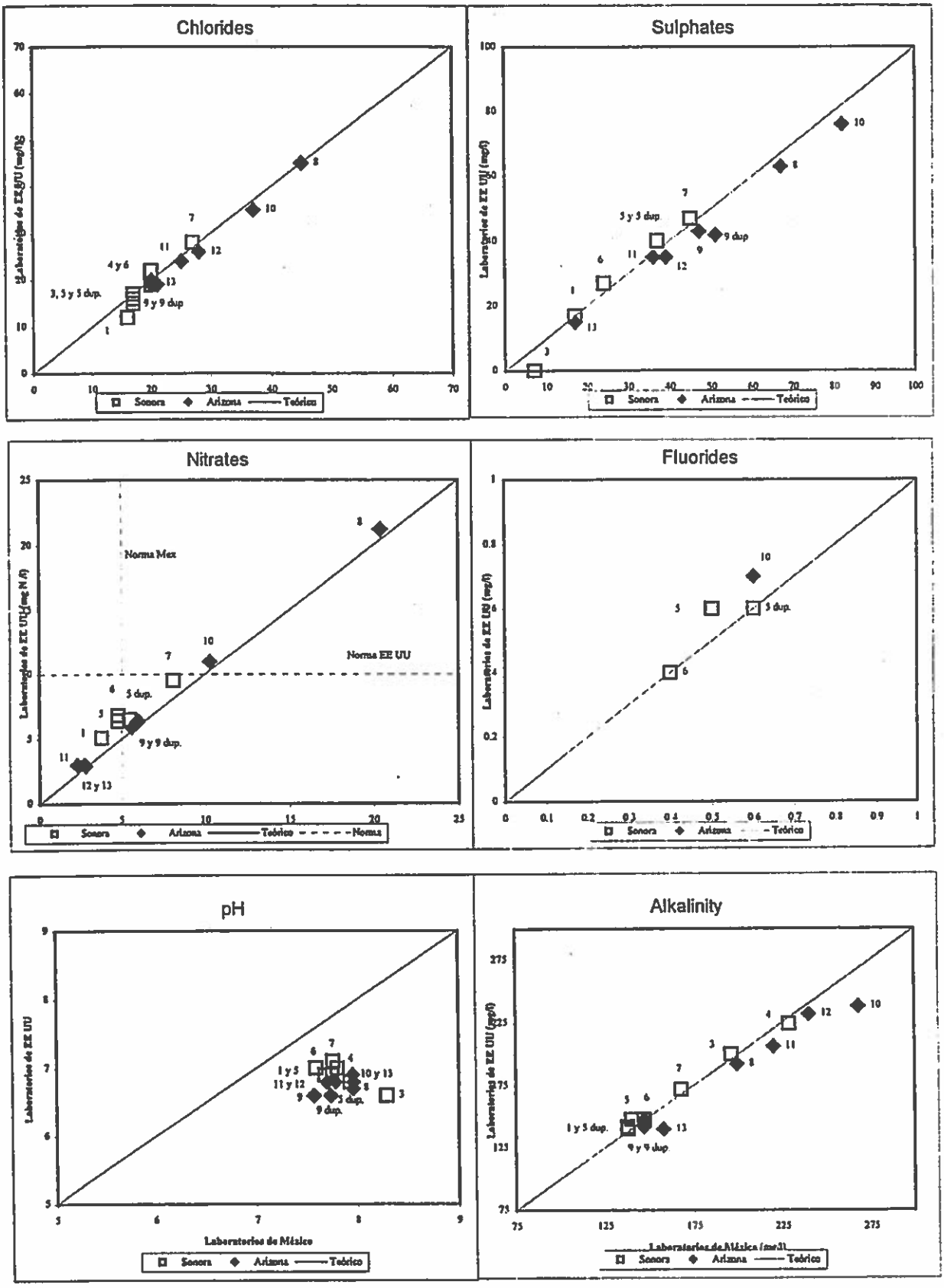


Figure 3. - U.S. - Mexico Data Comparison for Selected Parameters - June 1997

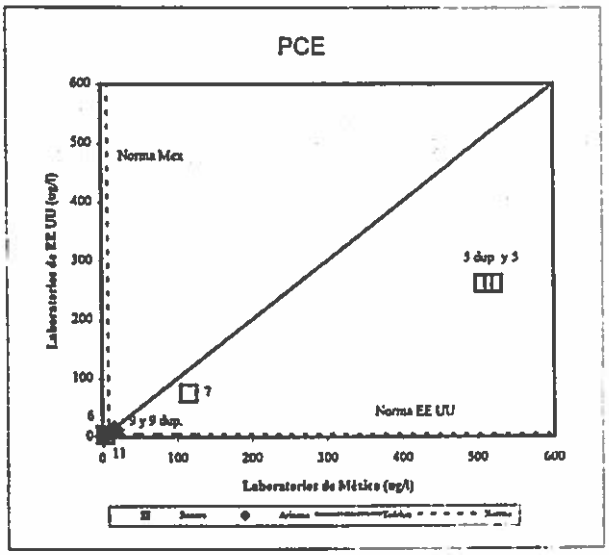


Figure 4. - U.S. - Mexico Data Comparison for Selected Parameters - September 1997

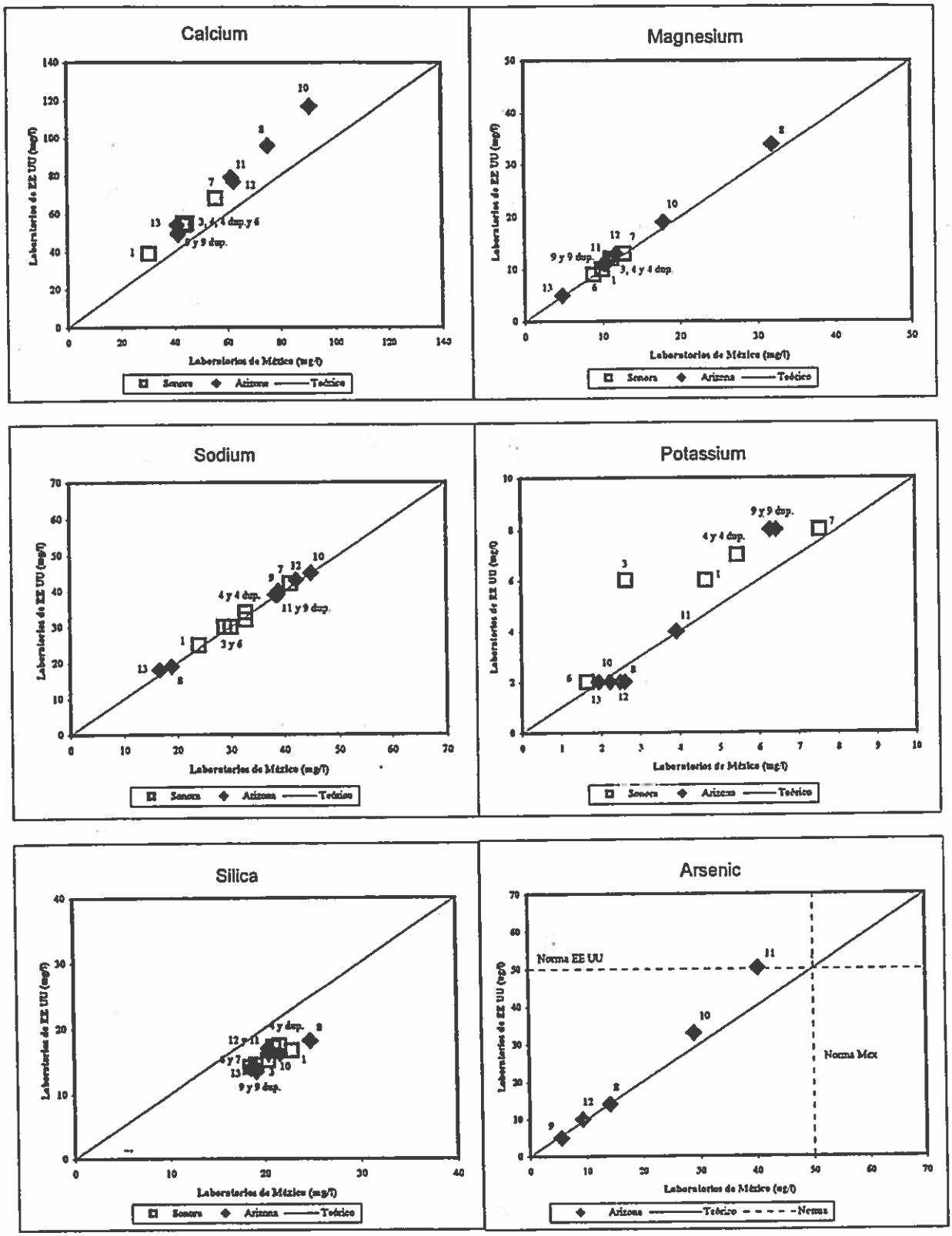


Figure 4. - U.S. - Mexico Data Comparison for Selected Parameters - September 1997

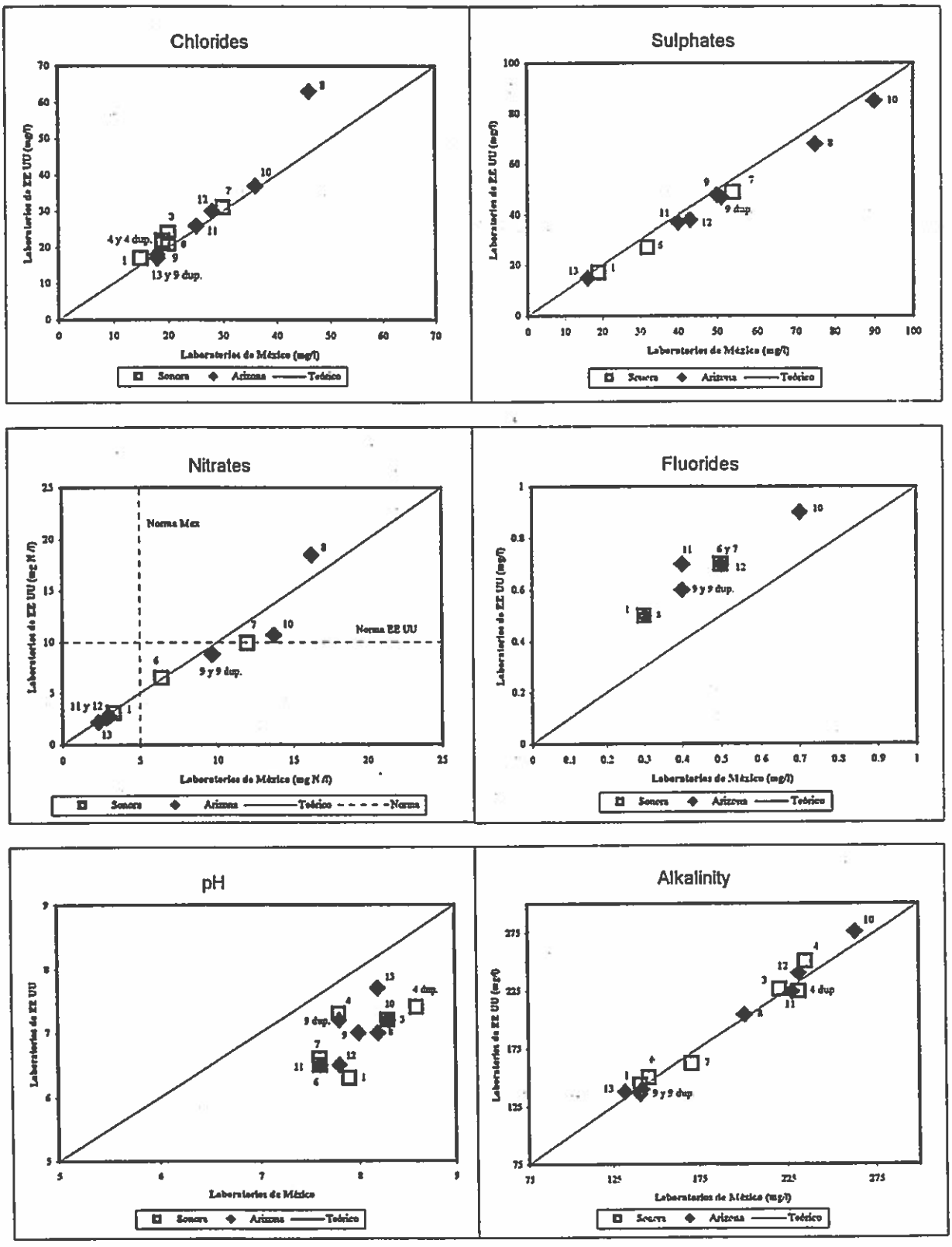


Figure 4. - U.S. - Mexico Data Comparison for Selected Parameters - September 1997

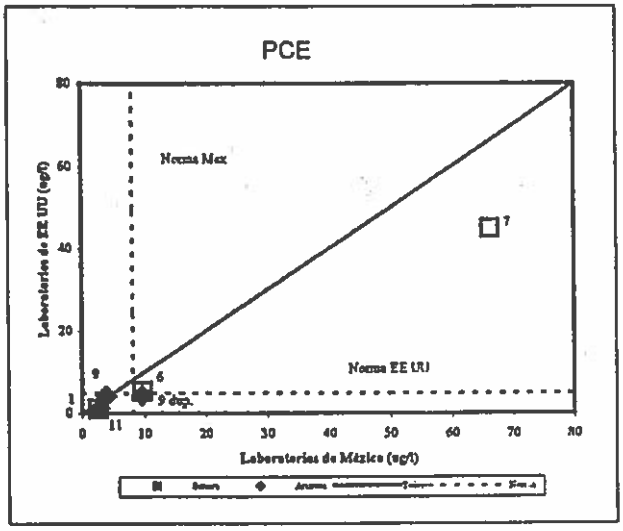


Figure 5. - U.S. - Mexico Data Comparison for Selected Parameters - February 1998

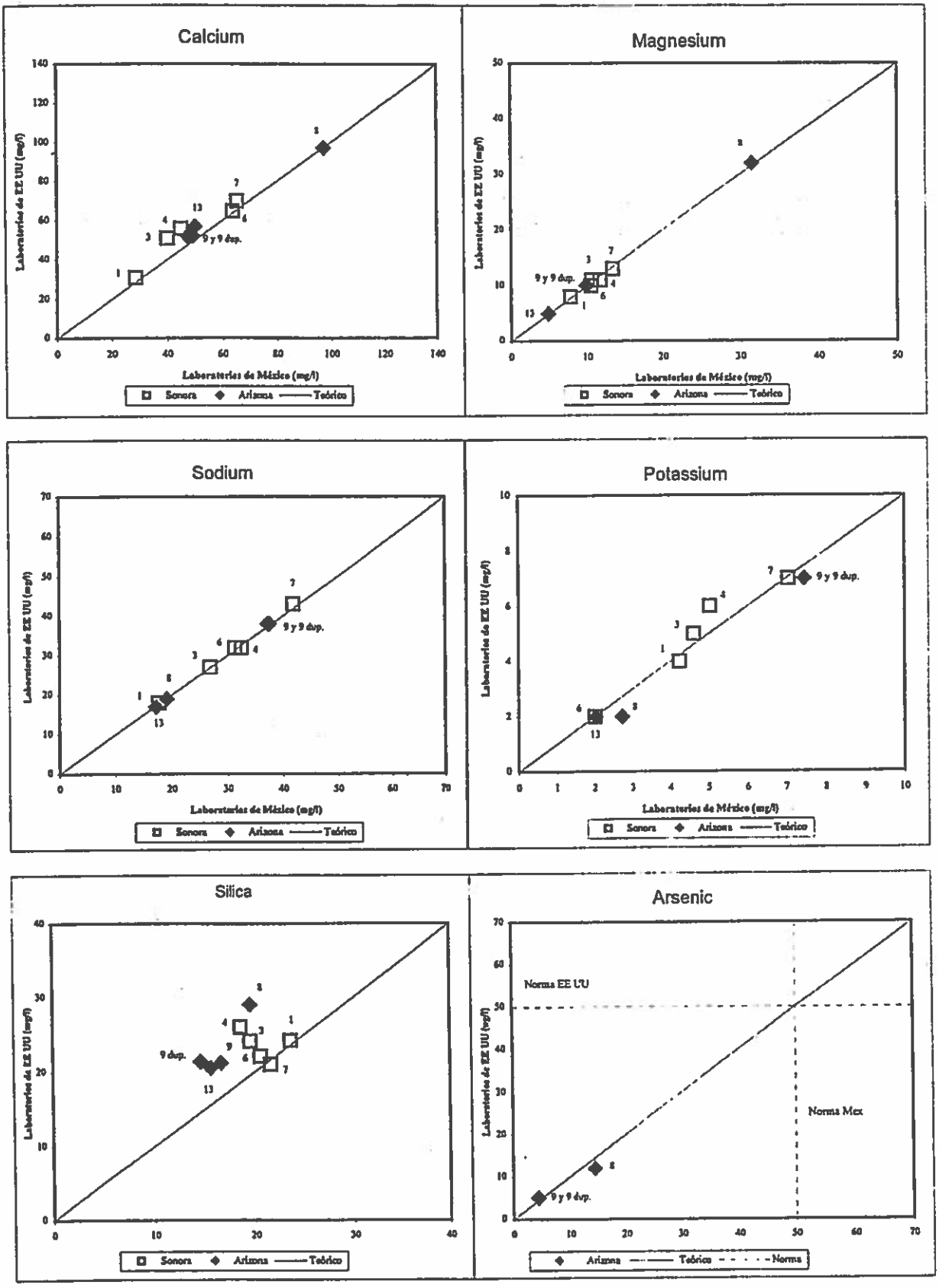


Figure 5. - U.S. - Mexico Data Comparison for Selected Parameters - February 1998

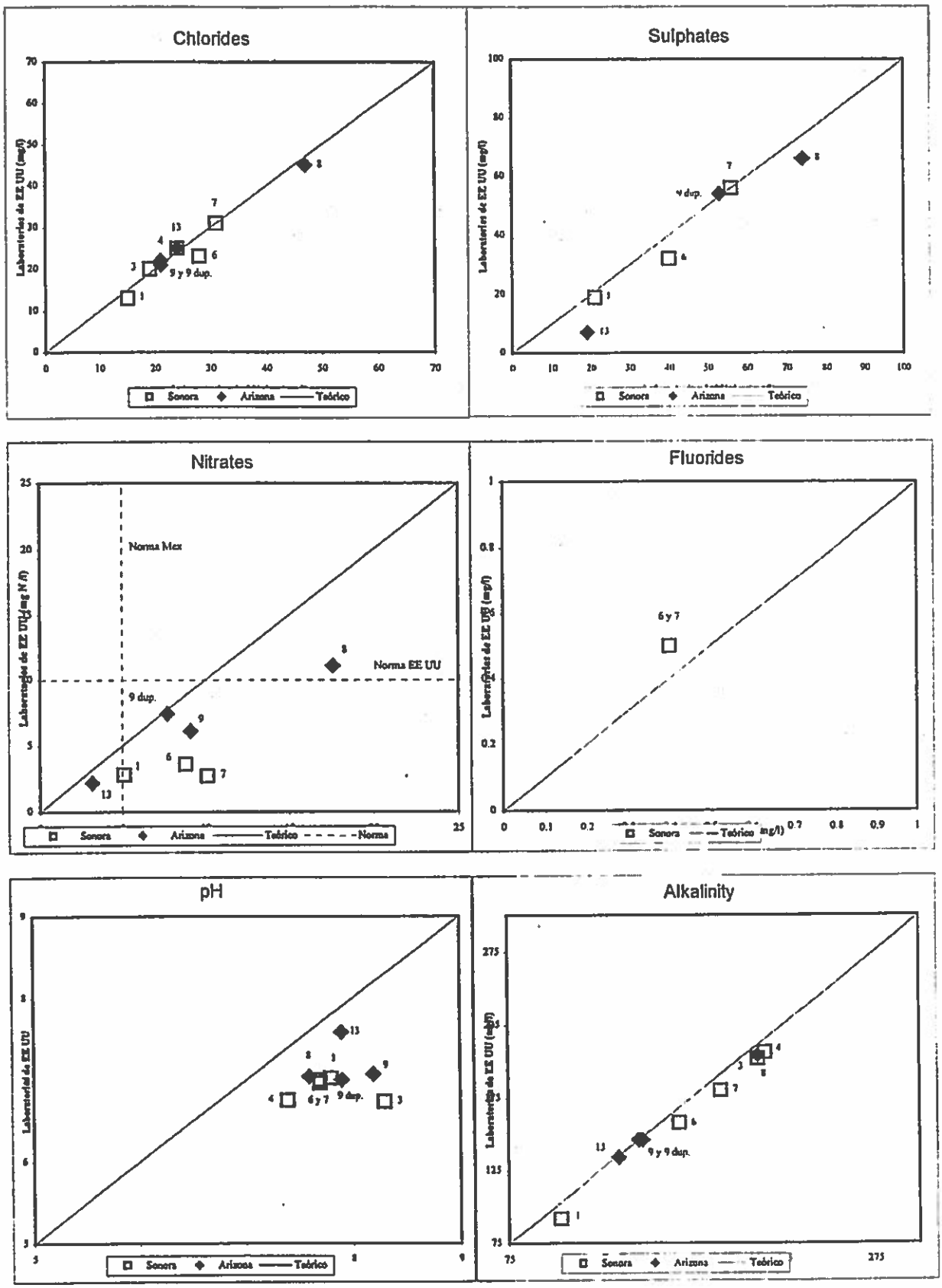
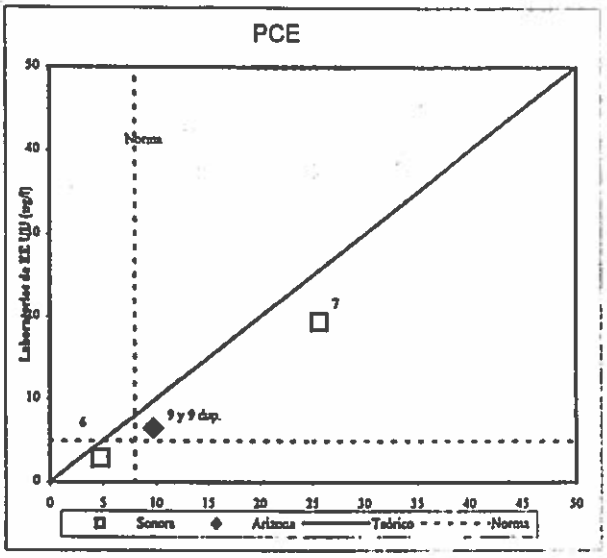
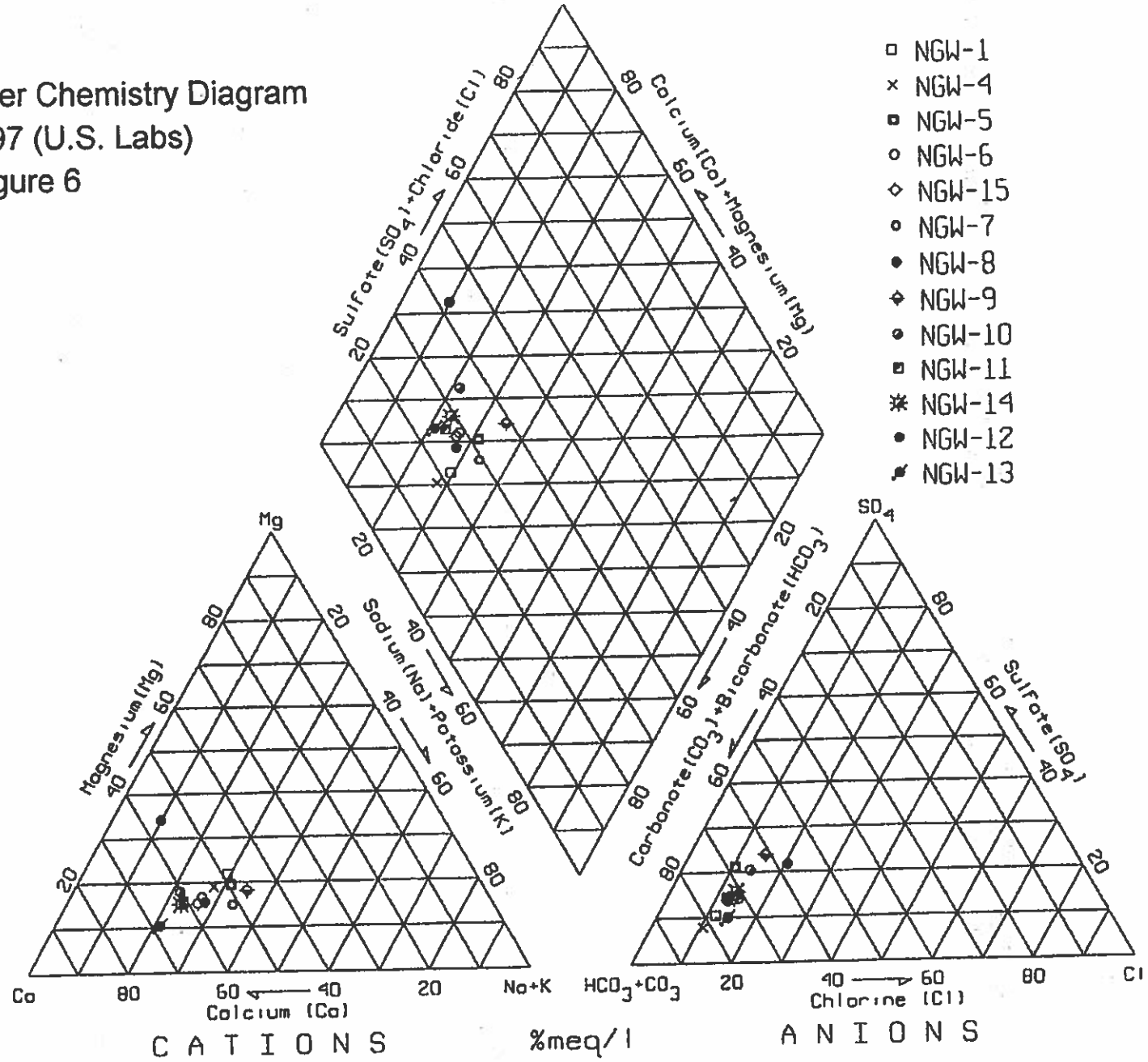


Figure 5. - U.S. - Mexico Data Comparison for Selected Paramters - February 1998



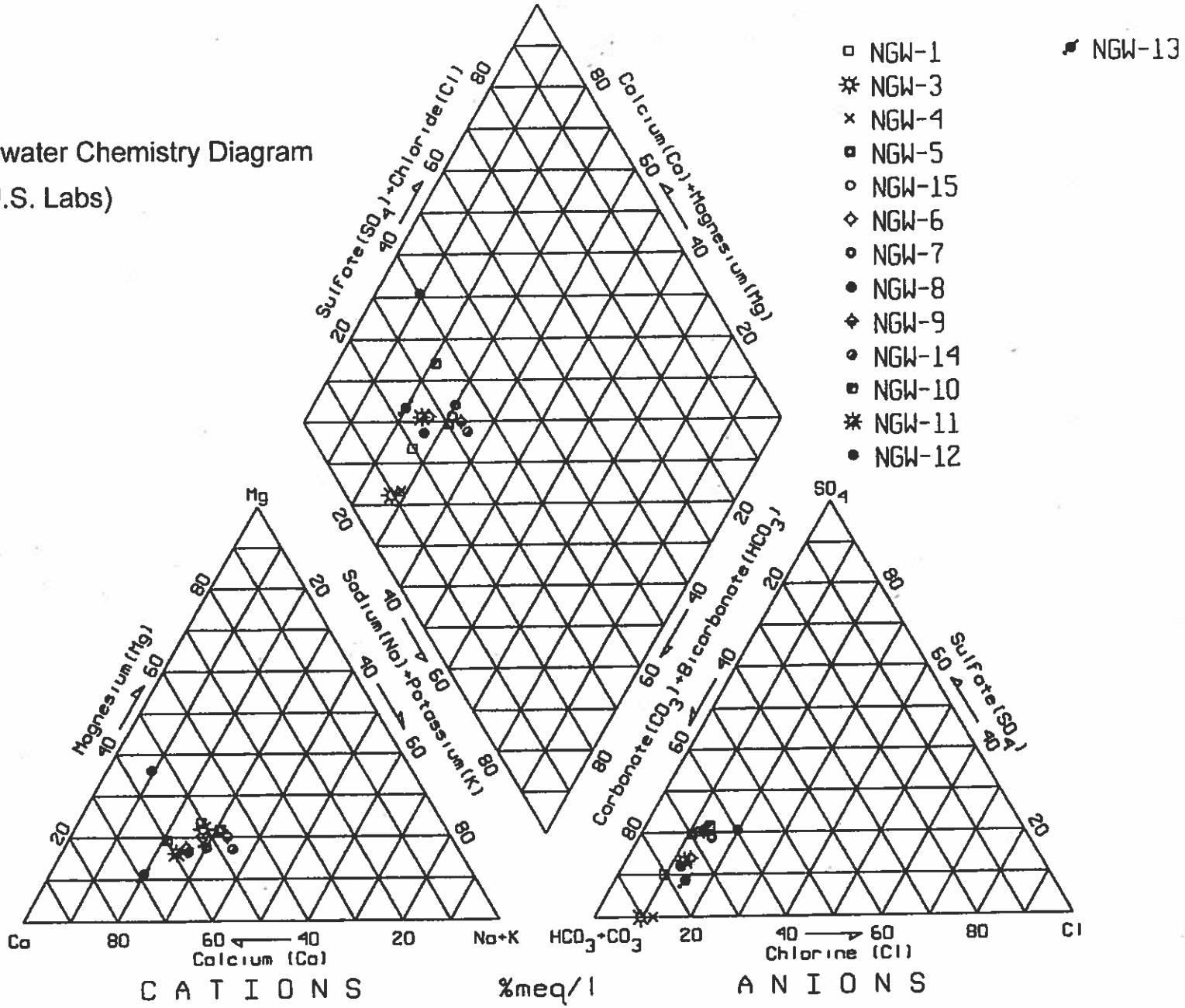
Piper Groundwater Chemistry Diagram
April 1997 (U.S. Labs)
Figure 6



Piper Groundwater Chemistry Diagram

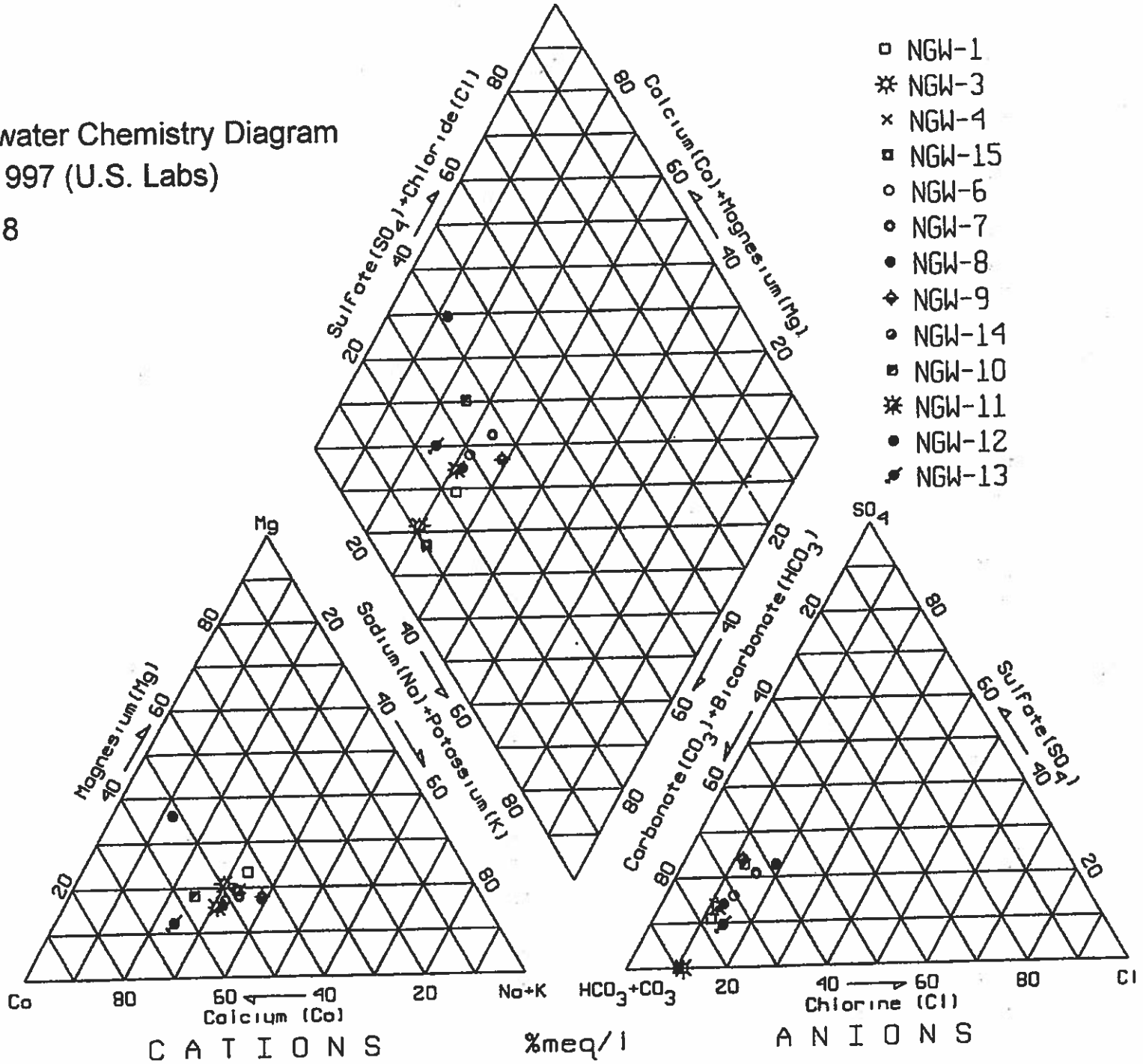
June 1997 (U.S. Labs)

Figure 7

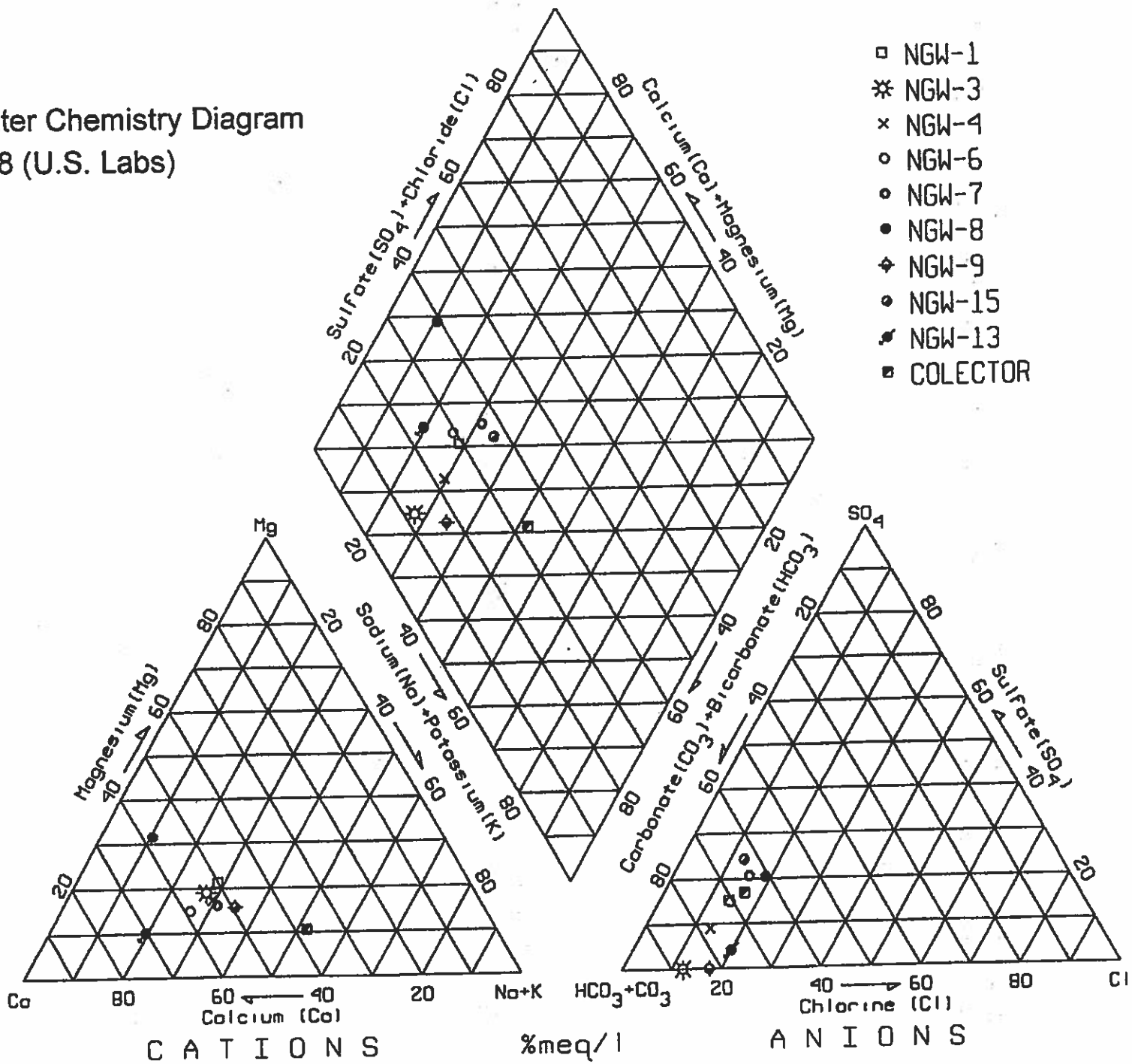


Piper Groundwater Chemistry Diagram
September 1997 (U.S. Labs)

Figure 8



Piper Groundwater Chemistry Diagram
February 1998 (U.S. Labs)
Figure 9



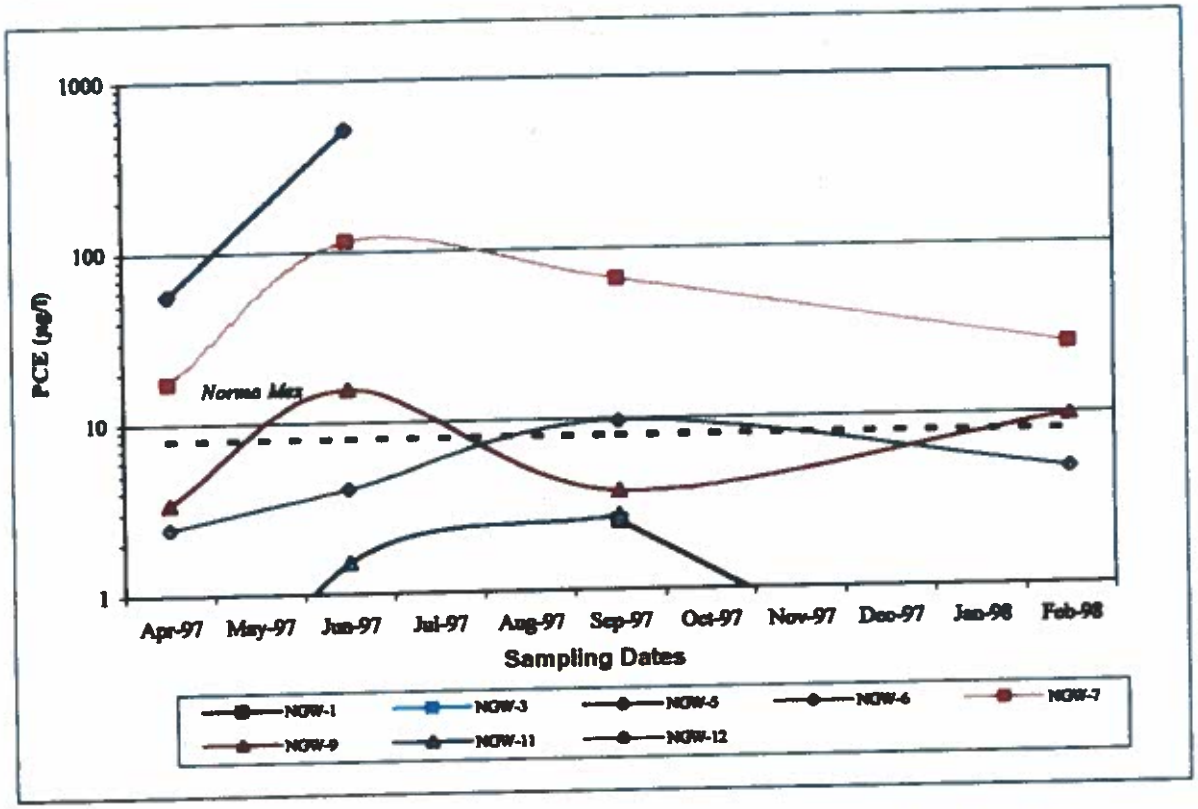



**Figure 10. Evolution of PCE concentrations with time. Binational Monitoring Program of the Nogales, Sonora-Arizona Aquifer. (Mexican Laboratory)**

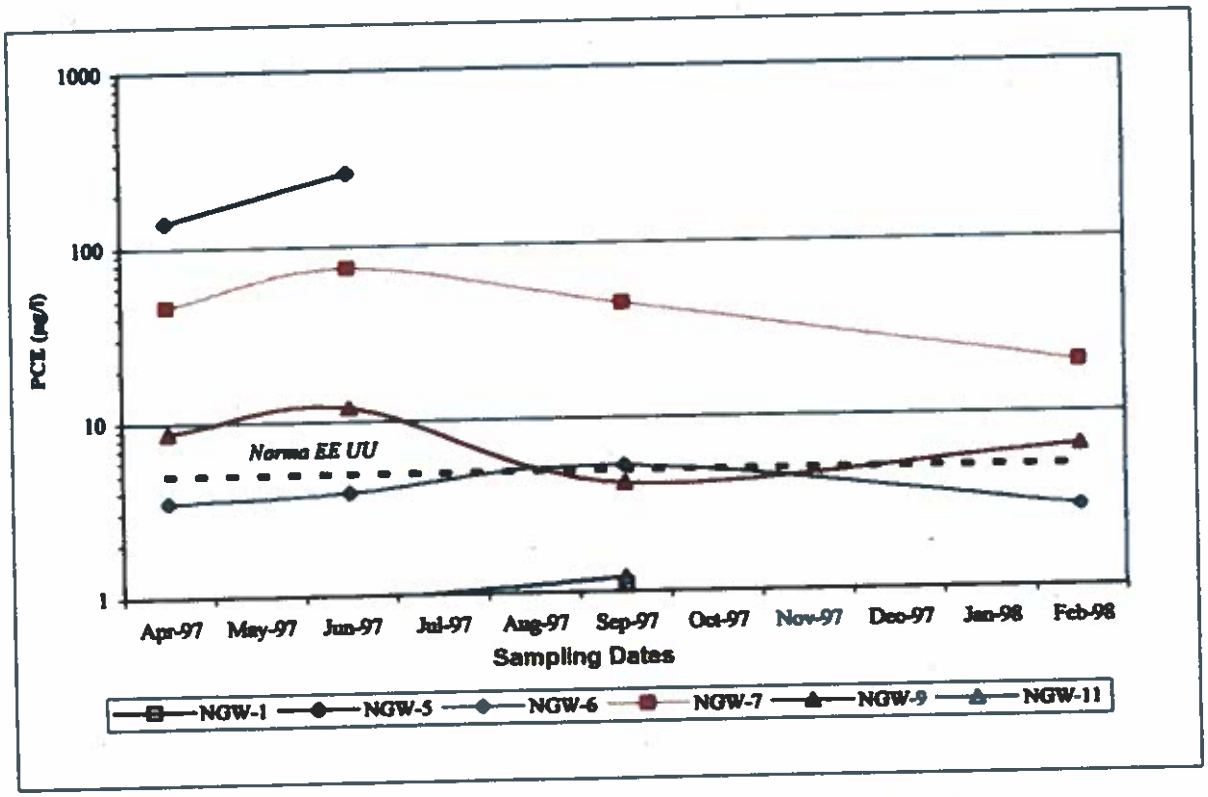



**Figure 11. Evolution of PCE concentrations with time. Binational Monitoring Program of the Nogales, Sonora-Arizona Aquifer. (U.S. Laboratory)**

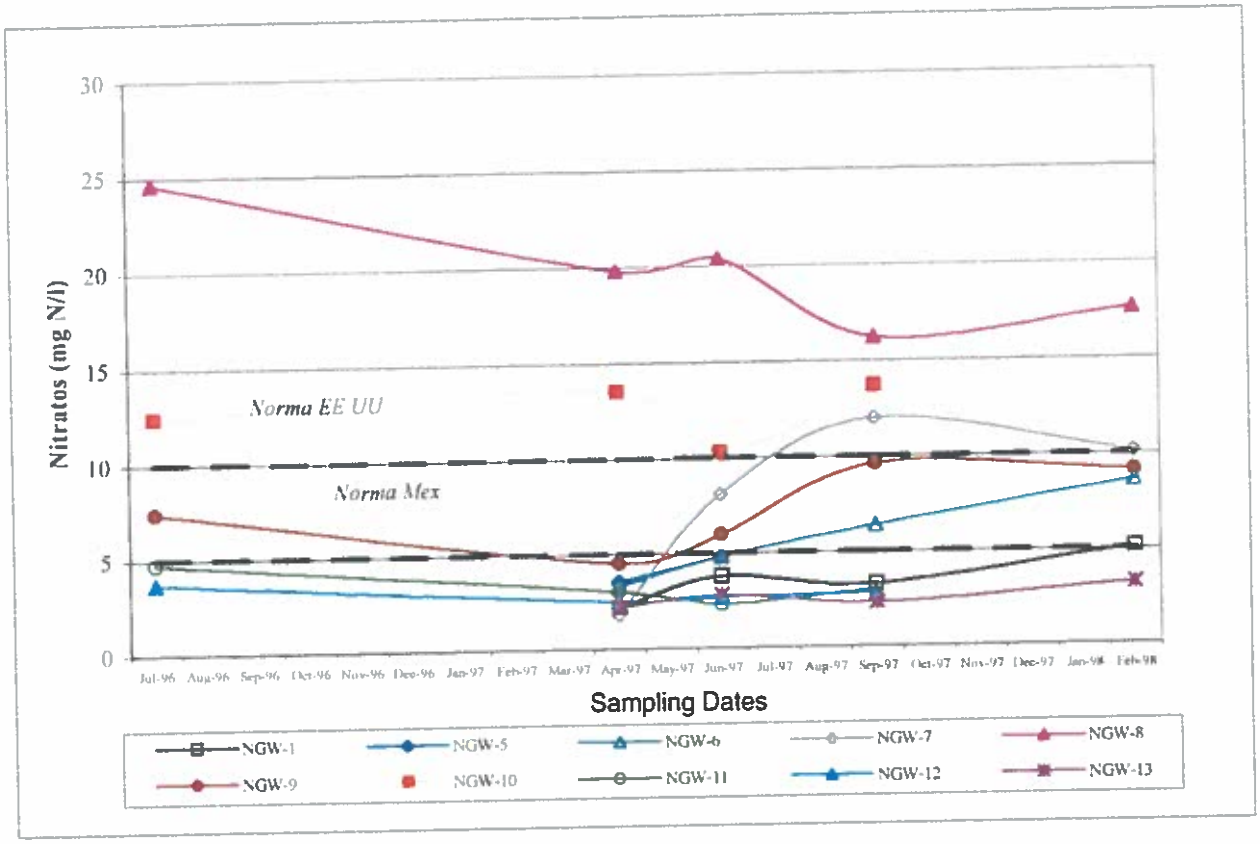



Figure 12. Evolution of nitrate concentrations with time. Binational Monitoring Program of the Nogales, Sonora-Arizona Aquifer. (Mexican Laboratory)

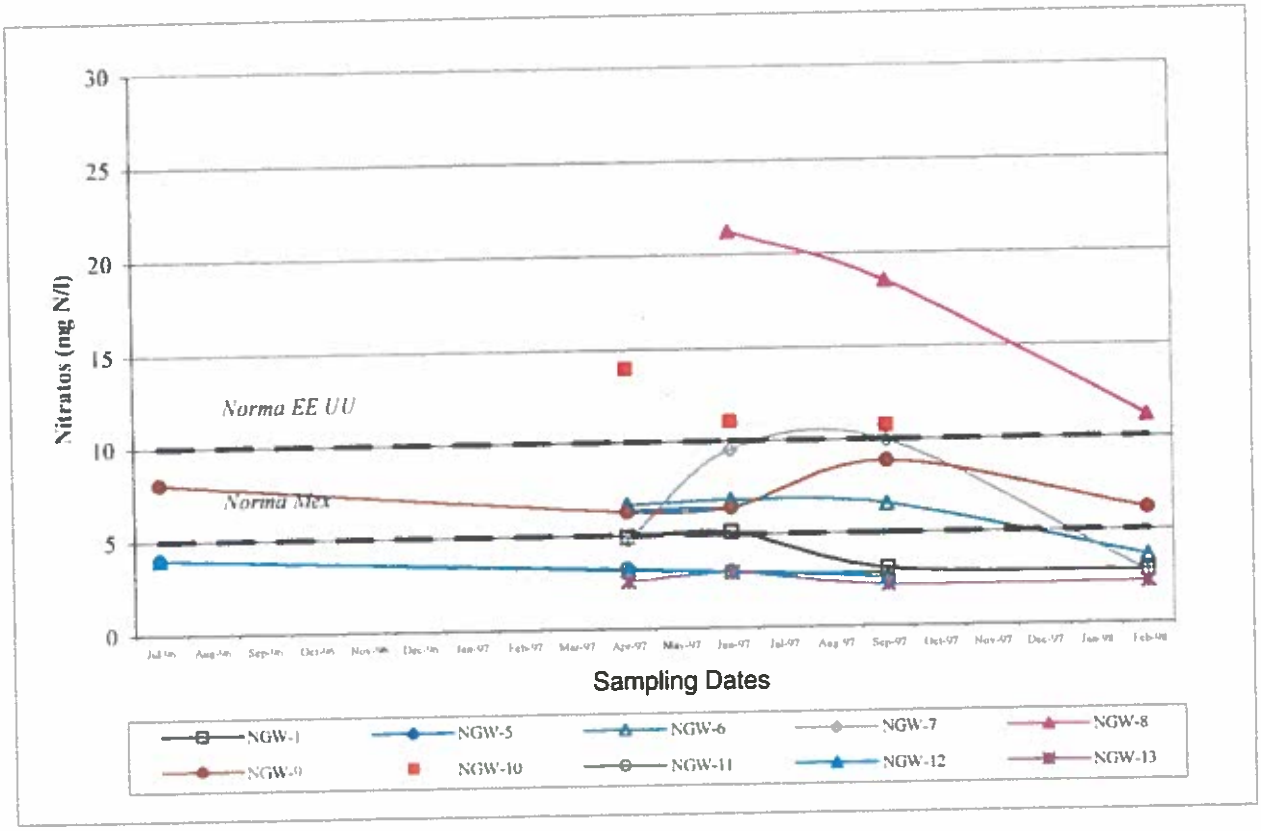



Figure 13. Evolution of nitrate concentrations with time. Binational Monitoring Program of the Nogales, Sonora-Arizona Aquifer. (U.S. Laboratory)

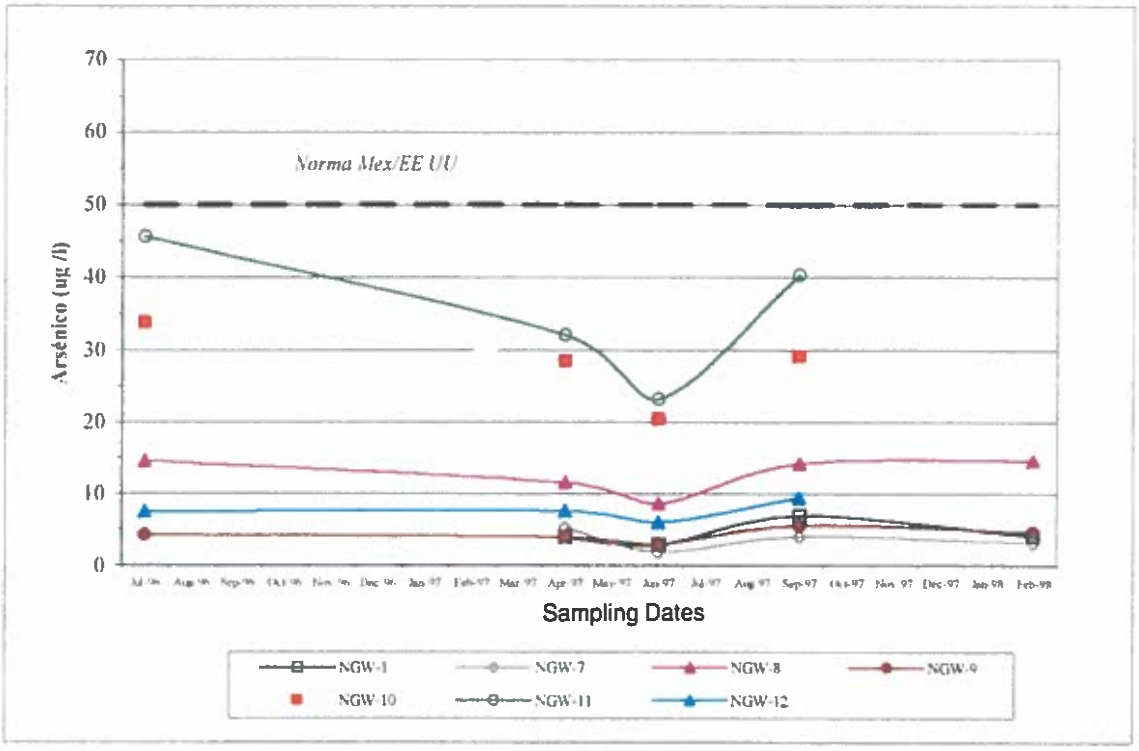



Figure 14. Evolution of arsenic concentrations with time. Binational Monitoring Program of the Nogales, Sonora-Arizona Aquifer. (Mexican Laboratory)

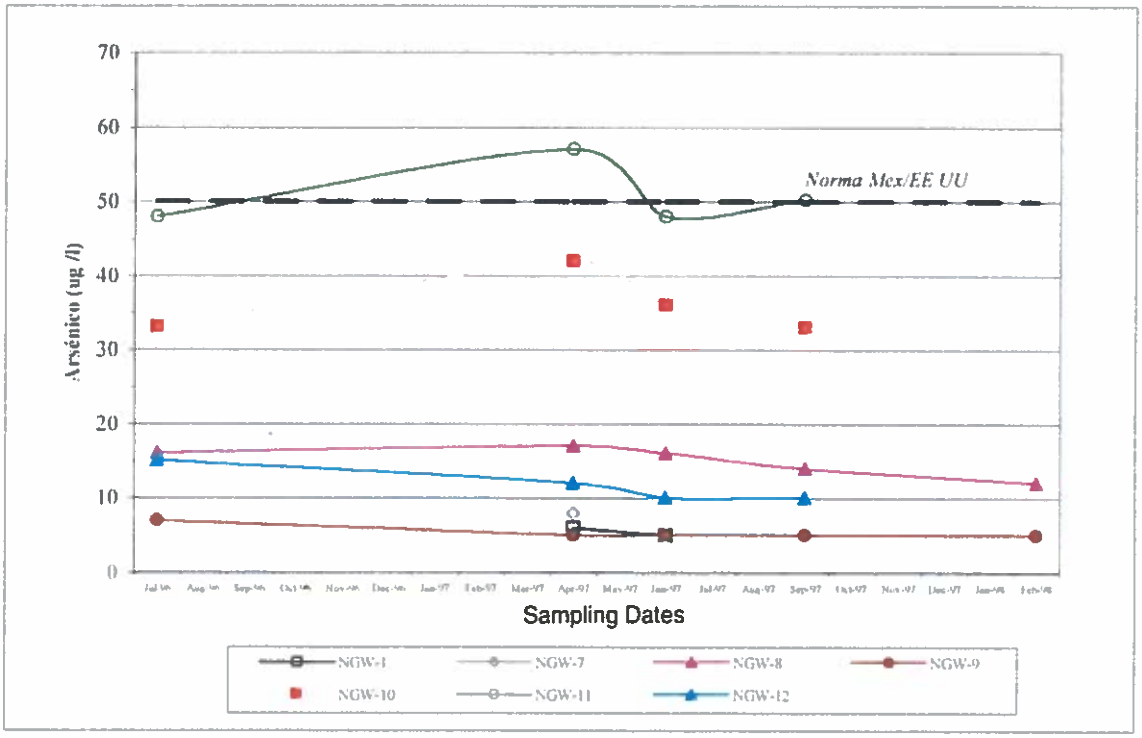



Figure 15. Evolution of arsenic concentrations with time. Binational Monitoring Program of the Nogales, Sonora-Arizona Aquifer. (U.S. Laoratory)

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# APPENDIX A - DATA VALIDATION REVIEW

The following deviation from the proposed field sampling protocols occurred during the sampling:

a) Samples for VOCs compounds were sampled at the lowest possible non-disruptive purging rate. Maximum sampling flow rate for VOCs observed was 250 ml/min.

b) Samples for total and fecal coliform were collected in two plastic 100-ml containers and not with whirl bags. These containers arrived sterilized from the respective laboratory. The containers from the United States laboratory were sealed with a plastic heat-shrunk rap around the lid. The seal was not broken until right before the sample was collected. The containers prepared in Mexico were autoclaved for sterilization and were sealed with a special autoclave adhesive tape.

c) Samples to be analyzed for major cations and anions and for trace metals were collected in three plastic one-liter bottles. The first one-liter bottle was used for collecting samples for analysis of major cations and anions. This sample was not acidified or filtered. The second one-liter bottle was used for collecting samples for analysis for nitrate. The samples for the Mexican laboratory were preserved with sulfuric acid ($H_2SO_4$) to a pH of <2. The sample for the United States laboratory was not preserved since the laboratory would be analyzing the samples within the 48-hour holding time. The other one-liter bottle, for trace metals analysis, was preserved with nitric acid ($HNO_3$) and was filtered. Duplicate samples sent to the Arizona State Laboratory were collected according to the project sampling plan.

d) Performance standard samples were not used at this time.

e) The labs used for this project did not require doubling the sampling volume for their laboratory QA/QC sample.

f) Field carbonate and bicarbonate alkalinity and dissolved oxygen parameters were not determined in the groundwater samples at this time. All samples were collected within the established well purging criteria.

## SAMPLES HOLDING TIME REQUIREMENTS

Chain of Custody records and laboratory reports were checked for appropriate sample holding times requirements. All samples were analyzed within the required holding times.

## TRAVEL BLANKS

Travel blanks were used to check for contamination during shipping and handling during both sampling events. The travel blanks were prepared by the laboratory and analyzed for the same VOCs parameters as the groundwater samples. None of the U.S. travel blanks show the presence of any VOCs.

The June 1997 samples did not include a trip blank for the Mexican samples. Total petroleum hydrocarbons (1.70 mg/l) were detected in the September 1997 travel blank for the Mexican samples. Chloroform (0.002320 mg/l) and Methylene Chloride (0.00524 mg/l) were also detected in the travel

blank. Chloroform (0.02637 mg/l) was detected in the February 1998 the trip blank for the Mexican samples. Analytical results did not present any constituent in significant amounts.

FIELD BLANKS

Five field blanks were collected during the three sampling activities. All of the field blanks were prepared using Arizona State Laboratory-supplied DI water.

Field blank NGW-16 was collected on June 17, 1997 at NGW-10. The U.S. laboratory detected boron (0.22 mg/l), silica (3.2 mg/l), sulfate (74 mg/l) and TDS (20 mg/l) in this field blank. The Mexican laboratory detected calcium (79.65 mg/l) and silica (4.4 mg/l).

Field blank NGW-17 was collected on June 18, 1997 at the location of NGW-4. The U.S. and Mexican laboratories detected chloroform at concentrations of 0.0062 mg/l and 0.0076 mg/l, respectively.

On September 23, 1997, field blank NGW-16 was collected at the location of NGW-10. Both the U.S. and Mexican laboratories detected chloroform at concentrations of 0.0057 mg/l and 0.00423 mg/l, respectively. The Mexican laboratory also detected TPH (4 mg/l ).

On September 24, 1997, field blank NGW-17 was collected at the location of NGW-4.Both the U.S. and Mexican laboratories detected chloroform at concentrations of 0.0095 mg/l and 0.00775 mg/l, respectively. The Mexican laboratory also detected TPH (0.50 mg/l ).

One field blank was collection on February 10, 1998, NGW-17, at the location of NGW-6. The U.S. laboratory detected TPH (0.27 mg/l). The Mexican laboratory detected silica (3.6 mg/l), fecal and total coliform (13 MPN/100 ml), chloroform (0.02158 mg/l) and toluene (0.0029 mg/l).

PRECISION

Precision was determined through duplicate analyses. Precision was calculated as a relative percent difference (RPD) as follows:

$$\text{Precision} = \frac{(a-b)}{((a+b)/2)} \times 100$$

where:
a = larger value of two duplicate analyses
b = smaller value of two duplicate analyses

Duplicate samples were collected at NGW-5 (duplicate NGW-15) and NGW-9 (duplicate NGW-14) during the June 1997 sampling activity, at NGW-4 (duplicate NGW-15) and NGW-9 (duplicate NGW-15) during the September 1997 sampling activity and at NGW-9 (duplicate NGW-15) during the February 10, 1998 sampling activity. These duplicate samples were used to determine the project sampling precision. Precision was defined in the project sampling plan as the relative percent difference using a field duplicate sample. Targeted precision for VOCs is 30% or lower and for metals

35% or lower. These limits apply to any measurement that is at least ten times greater than the background level of the detector or the method detection limit. For the U.S. laboratory, all detected metals and VOCs that had a concentration ten times or higher than the respective method detection limit, met the project precision criteria. The Mexican laboratory results exceeded the target precision for TCE and silica in June 1997, for PCE in September 1997 and for silica and PCE in February 1998. The relative percent differences are included in Tables 6, 7 and 8.

ACCURACY

Accuracy was determined by the analyses of surrogate and matrix spiked samples. Accuracy was calculated as percent recovery as follows:

$$\text{Accuracy} = \frac{(a-b)}{c} \times 100$$

where:
a = measured concentration in spiked sample
b = measured concentration in unspiked sample
c = actual concentration of spike added

Recovery is generally expected to be within 70-130%

Accuracy was determined by the analysis of surrogate and matrix spiked samples and calculated as percent recovery. Targeted percent recovery for VOCs was within 70-130 %. The contract laboratory analytical reports submitted to ADEQ were reviewed for surrogate recovery data. All surrogate recoveries reported by these labs were within these criteria. The evaluation of the analytical lot is shown in Table A1.

For the data from the Mexican laboratories, for volatile organic compounds, the accuracy was determined through the analysis of additional samples with known concentration surrogate standards. It is calculated as a percentage of recovery. The recommended range is 70 - 130%. The evaluation of the analytical lot is shown in Table A2. The accuracy for the data from the Mexican laboratories was calculated as follows:

$$\%\ \text{Recovery} = \frac{b}{a} \times 100$$

where:
a = theoretical concentration in spiked sample
b = measured concentration in spiked sample

ION BALANCES

A cation/anion balance was calculated for all groundwater samples collected by the United States. Targeted ion balance was set to be 10% or less discrepant. All samples indicated a balance with no more than 10% difference.

Table A1 - Evaluation of the Analytical Lot of Samples for VOCs for July 1996 through February 1998 (U.S. Laboratory)

| SAMPLE NO. | SAMPLE ID | DATE | SURROGATE | % RECOVERY |
|---|---|---|---|---|
| 9607-03529-1 | NGW-8 | 7-18-96 | 2-Chloro-m-Xylene | 88.9 |
| 9607-03529-2 | TRAVEL BLANK | 7-18-96 | 2-Chloro-m-Xylene | 86 |
| 9607-03529-3 | NGW-9 | 7-18-96 | 2-Chloro-m-Xylene | 88.7 |
| 9607-03529-4 | TRAVEL BLANK | 7-18-96 | 2-Chloro-m-Xylene | 93.9 |
| 9607-03529-5 | NGW-10 | 7-18-96 | 2-Chloro-m-Xylene | 97.1 |
| 9607-03529-6 | TRAVEL BLANK | 7-18-96 | 2-Chloro-m-Xylene | 95.8 |
| 9607-03545-1 | NGW-11 | 7-18-96 | 2-Chloro-m-Xylene | 98.5 |
| 9607-03545-2 | TRAVEL BLANK | 7-18-96 | 2-Chloro-m-Xylene | 102 |
| 9607-03545-3 | NGW-12 | 7-18-96 | 2-Chloro-m-Xylene | 99.8 |
| 9607-03545-4 | TRAVEL BLANK | 7-18-96 | 2-Chloro-m-Xylene | 104 |
| 9704-02055-001 | NGW-9 | 4-15-97 | 2-Bromo-3-Chloropropane | 109 |
| | | | Fluorobenzene | 100 |
| 9704-02055-002 | NGW-8 | 4-15-97 | 2-Bromo-3-Chloropropane | 124 |
| | | | Fluorobenzene | 109 |
| 9704-02055-004 | TRAVEL BLANK | 4-15-97 | 2-Bromo-3-Chloropropane | 86 |
| | | | Fluorobenzene | 122 |
| 9704-01989-001 | NGW-13 | 4-14-97 | 2-Bromo-3-Chloropropane | 114 |
| | | | Fluorobenzene | 96 |
| 9704-01989-002 | NGW-12 | 4-14-97 | 2-Bromo-3-Chloropropane | 117 |
| | | | Fluorobenzene | 94 |
| 9704-01989-003 | NGW-16 | 4-14-97 | 2-Bromo-3-Chloropropane | 113 |
| | | | Fluorobenzene | 99 |
| 9704-01989-004 | TRAVEL BLANK | 4-15-97 | 2-Bromo-3-Chloropropane | 124 |
| | | | Fluorobenzene | 119 |
| 9704-01995-001 | NGW-11 | 4-14-97 | 2-Bromo-3-Chloropropane | 111 |
| | | | Fluorobenzene | 105 |
| 9704-01995-002 | NGW-14 | 4-14-97 | 2-Bromo-3-Chloropropane | 104 |
| | | | Fluorobenzene | 97 |
| 9704-01995-003 | NGW-10 | 4-14-97 | 2-Bromo-3-Chloropropane | 109 |
| | | | Fluorobenzene | 103 |
| 9704-01995-004 | TRAVEL BLANK | 4-15-97 | 2-Bromo-3-Chloropropane | 108 |
| | | | Fluorobenzene | 100 |
| 9704-02019-001 | NGW-4 | 4-15-97 | 2-Bromo-3-Chloropropane | 91 |
| | | | Fluorobenzene | 76 |
| 9704-02019-002 | NGW-5 | 4-15-97 | 2-Bromo-3-Chloropropane | 106 |
| | | | Fluorobenzene | 89 |
| 9704-02019-003 | NGW-17 | 4-15-97 | 2-Bromo-3-Chloropropane | 118 |
| | | | Fluorobenzene | 99 |

Table A1 - Evaluation of the Analytical Lot of Samples for VOCs for July 1996 through February 1998 (U.S. Laboratory) (Cont)

| SAMPLE NO | SAMPLE ID | DATE | SURROGATE | % RECOVERY |
|---|---|---|---|---|
| 9704-02019-004 | TRAVEL BLANK | 4-15-97 | 2-Bromo-3-Chloropropane | 106 |
| | | | Fluorobenzene | 99 |
| 9704-02030-001 | NGW-6 | 4-14-97 | 2-Bromo-3-Chloropropane | 102 |
| | | | Fluorobenzene | 94 |
| 9704-02030-002 | NGW-15 | 4-14-97 | 2-Bromo-3-Chloropropane | 110 |
| | | | Fluorobenzene | 102 |
| 9704-02030-003 | NGW-7 | 4-14-97 | 2-Bromo-3-Chloropropane | 108 |
| | | | Fluorobenzene | 117 |
| 9704-02030-004 | NGW-1 | 4-14-97 | 2-Bromo-3-Chloropropane | 109 |
| | | | Fluorobenzene | 106 |
| 9704-02030-005 | TRAVEL BLANK | 4-15-97 | 2-Bromo-3-Chloropropane | 115 |
| | | | Fluorobenzene | 112 |
| 9706-03821-3 | NGW-1 | 6-28-97 | 1,2-Dichlorobenzene-d4 | 99 |
| | | | Bromofluorobenzene (BFB) | 85 |
| 9706-03821-4 | NGW-4 | 6-28-97 | 1,2-Dichlorobenzene-d4 | 87 |
| | | | Bromofluorobenzene (BFB) | 81 |
| 9706-03820-3 | NGW-3 | 6-27-97 | 1,2-Dichlorobenzene-d4 | 108 |
| | | | Bromofluorobenzene (BFB) | 92 |
| 9706-03820-1 | NGW-5 | 6-30-97 | 1,2-Dichlorobenzene-d4 | 88 |
| | | | Bromofluorobenzene (BFB) | 85 |
| 9706-03820-2 | NGW-15 | 6-30-97 | 1,2-Dichlorobenzene-d4 | 100 |
| | | | Bromofluorobenzene (BFB) | 89 |
| 9706-03820-4 | TRAVEL BLANK | 6-27-97 | 1,2-Dichlorobenzene-d4 | 103 |
| | | | Bromofluorobenzene (BFB) | 82 |
| 9706-03821-2 | NGW-6 | 6-28-97 | 1,2-Dichlorobenzene-d4 | 100 |
| | | | Bromofluorobenzene (BFB) | 85 |
| 9706-03821-1 | NGW-7 | 6-27-97 | 1,2-Dichlorobenzene-d4 | 99 |
| | | | Bromofluorobenzene (BFB) | 89 |
| 9706-03821-5 | NGW-17 | 6-28-97 | 1,2-Dichlorobenzene-d4 | 101 |
| | | | Bromofluorobenzene (BFB) | 87 |
| 9706-03821-6 | TRAVEL BLANK | 6-28-97 | 1,2-Dichlorobenzene-d4 | 97 |
| | | | Bromofluorobenzene (BFB) | 84 |
| 9706-03795-3 | NGW-8 | 6-27-97 | 1,2-Dichlorobenzene-d4 | 88 |
| | | | Bromofluorobenzene (BFB) | 85 |
| 9706-03795-4 | NGW-9 | 6-27-97 | 1,2-Dichlorobenzene-d4 | 97 |
| | | | Bromofluorobenzene (BFB) | 88 |
| 9706-03795-5 | NGW-14 | 6-27-97 | 1,2-Dichlorobenzene-d4 | 97 |
| | | | Bromofluorobenzene (BFB) | 92 |
| 9706-03795-1 | NGW-10 | 6-27-97 | 1,2-Dichlorobenzene-d4 | 99 |

Table A1 - Evaluation of the Analytical Lot of Samples for VOCs for July 1996 through February 1998 (U.S. Laboratory) (Cont)

| SAMPLE NO | SAMPLE ID | DATE | SURROGATE | % RECOVERY |
|---|---|---|---|---|
| | | | Bromofluorobenzene (BFB) | 86 |
| 9706-03795-2 | NGW-16 | 6-27-97 | 1,2-Dichlorobenzene-d4 | 95 |
| | | | Bromofluorobenzene (BFB) | 87 |
| 9706-03795-6 | TRAVEL BLANK | 6-27-97 | 1,2-Dichlorobenzene-d4 | 91 |
| | | | Bromofluorobenzene (BFB) | 90 |
| 9706-03782-3 | NGW-11 | 6-27-97 | 1,2-Dichlorobenzene-d4 | 106 |
| | | | Bromofluorobenzene (BFB) | 91 |
| 9706-03782-2 | NGW-12 | 6-27-97 | 1,2-Dichlorobenzene-d4 | 101 |
| | | | Bromofluorobenzene (BFB) | 88 |
| 9706-03782--1 | NGW-13 | 6-27-97 | 1,2-Dichlorobenzene-d4 | 97 |
| | | | Bromofluorobenzene (BFB) | 94 |
| 9706-03782-4 | TRAVEL BLANK | 6-27-97 | 1,2-Dichlorobenzene-d4 | 100 |
| | | | Bromofluorobenzene (BFB) | 87 |
| 9709-06170-3 | NGW-1 | 10-08-97 | 4-Bromofluorobenzene | 81 |
| | | | 1,4-Dichlorobenzene | 76 |
| 9709-06170-2 | NGW-6 | 10-08-97 | 4-Bromofluorobenzene | 82 |
| | | | 1,4-Dichlorobenzene | 76 |
| 9709-06170-1 | NGW-7 | 10-07-97 | 4-Bromofluorobenzene | 80 |
| | | | 1,4-Dichlorobenzene | 75 |
| 9709-06170-4 | TRAVEL BLANK | 10-08-97 | 4-Bromofluorobenzene | 82 |
| | | | 1,4-Dichlorobenzene | 75 |
| 9709-06205-1 | NGW-4 | 10-08-97 | 4-Bromofluorobenzene | 98 |
| | | | 1,4-Dichlorobenzene | 89 |
| 9709-06205-2 | NGW-15 | 10-08-97 | 4-Bromofluorobenzene | 98 |
| | | | 1,4-Dichlorobenzene | 92 |
| 9709-06205-3 | NGW-17 | 10-08-97 | 4-Bromofluorobenzene | 99 |
| | | | 1,4-Dichlorobenzene | 92 |
| 9709-06205-4 | NGW-3 | 10-08-97 | 4-Bromofluorobenzene | 98 |
| | | | 1,4-Dichlorobenzene | 92 |
| 9709-06205-5 | TRAVEL BLANK | 10-09-97 | 4-Bromofluorobenzene | 96 |
| | | | 1,4-Dichlorobenzene | 84 |
| 9709-06160-1 | NGW-10 | 9-26-97 | 4-Bromofluorobenzene | 90 |
| | | | 1,4-Dichlorobenzene | 79 |
| 9709-06160-2 | NGW-8 | 9-26-97 | 4-Bromofluorobenzene | 88 |
| | | | 1,4-Dichlorobenzene | 75 |
| 9709-06160-3 | NGW-9 | 9-26-97 | 4-Bromofluorobenzene | 89 |
| | | | 1,4-Dichlorobenzene | 75 |
| 9709-06160-4 | NGW-14 | 9-26-97 | 4-Bromofluorobenzene | 89 |
| | | | 1,4-Dichlorobenzene | 76 |

Table A1 - Evaluation of the Analytical Lot of Samples for VOCs for July 1996 through February 1998 (U.S. Laboratory) (Cont)

| SAMPLE NO | SAMPLE ID | DATE | SURROGATE | % RECOVERY |
|---|---|---|---|---|
| 9709-06160-5 | NGW-13 | 9-30-97 | 4-Bromofluorobenzene | 72 |
| | | | 1,4-Dichlorobenzene | 74 |
| 9709-06160-6 | TRAVEL BLANK | 10-07-97 | 4-Bromofluorobenzene | 87 |
| | | | 1,4-Dichlorobenzene | 80 |
| 9709-06128-1 | NGW-12 | 9-25-97 | 4-Bromofluorobenzene | 92 |
| | | | 1,4-Dichlorobenzene | 82 |
| 9709-06128-2 | NGW-11 | 9-25-97 | 4-Bromofluorobenzene | 91 |
| | | | 1,4-Dichlorobenzene | 78 |
| 9709-06128-3 | NGW-16 | 9-25-97 | 4-Bromofluorobenzene | 92 |
| | | | 1,4-Dichlorobenzene | 80 |
| 9709-06128-4 | TRAVEL BLANK | 9-30-97 | 4-Bromofluorobenzene | 72 |
| | | | 1,4-Dichlorobenzene | 70 |
| 9802-01013-004 | NGW-1 | 2-14-98 | 4-Bromofluorobenzene | 95 |
| | | | 1,4-Dichlorobenzene-d4 | 89 |
| 9802-01013-004 | NGW-3 | 2-14-98 | 4-Bromofluorobenzene | 99 |
| | | | 1,4-Dichlorobenzene-d4 | 99 |
| 9802-01013-006 | NGW-4 | 2-14-98 | 4-Bromofluorobenzene | 95 |
| | | | 1,4-Dichlorobenzene-d4 | 100 |
| 9802-01013-003 | NGW-6 | 2-14-98 | 4-Bromofluorobenzene | 95 |
| | | | 1,4-Dichlorobenzene-d4 | 90 |
| 9802-01013-001 | NGW-7 | 2-13-98 | 4-Bromofluorobenzene | 96 |
| | | | 1,4-Dichlorobenzene-d4 | 92 |
| 9802-01013-008 | NGW-8 | 2-14-98 | 4-Bromofluorobenzene | 92 |
| | | | 1,4-Dichlorobenzene-d4 | 94 |
| 9802-01013-009 | NGW-9 | 2-14-98 | 4-Bromofluorobenzene | 93 |
| | | | 1,4-Dichlorobenzene-d4 | 96 |
| 9802-01013-007 | NGW-13 | 2-14-98 | 4-Bromofluorobenzene | 92 |
| | | | 1,4-Dichlorobenzene-d4 | 96 |
| 9802-01013-010 | NGW-15 | 2-14-98 | 4-Bromofluorobenzene | 92 |
| | | | 1,4-Dichlorobenzene-d4 | 94 |
| 9802-01013-011 | TRAVEL BLANK | 2-14-98 | 4-Bromofluorobenzene | 93 |
| | | | 1,4-Dichlorobenzene-d4 | 93 |
| 9802-01013-002 | NGW-17 | 2-14-98 | 4-Bromofluorobenzene | 95 |
| | | | 1,4-Dichlorobenzene-d4 | 91 |

Table A2 - Evaluation of the Analytical Lot of Samples for VOCs for July 1996 through February 1998 (Mexican Laboratory)

| SAMPLE NO. | SAMPLE ID | DATE | SURROGATE | % RECOVERY |
|---|---|---|---|---|
| 4563-1 | NGW-13 | 4/2/97 | Toluene | 106.64 |
| | | | Bromofluorobenzene | 80.4 |
| | | | 1,2-Dichlorobenzene-d4 | 92.69 |
| 4563-2 | NGW-10 | 4/2/97 | Toluene | 114.29 |
| | | | Bromofluorobenzene | 81.92 |
| | | | 1,2-Dichlorobenzene-d4 | 100.22 |
| 4563-3 | NGW-11 | 4/2/97 | Toluene | 117.88 |
| | | | Bromofluorobenzene | 88.08 |
| | | | 1,2-Dichlorobenzene-d4 | 105.47 |
| 4563-4 | NGW-14 | 4/2/97 | Toluene | 108.24 |
| | | | Bromofluorobenzene | 82.52 |
| | | | 1,2-Dichlorobenzene-d4 | 104.18 |
| 4563-5 | NGW-12 | 4/2/97 | Toluene | 109.69 |
| | | | Bromofluorobenzene | 77.6 |
| | | | 1,2-Dichlorobenzene-d4 | 92.35 |
| 4563-6 | NGW-16 | 4/2/97 | Toluene | 110.69 |
| | | | Bromofluorobenzene | 80.12 |
| | | | 1,2-Dichlorobenzene-d4 | 92.93 |
| 4563-7 | NGW-9 | 4/2/97 | Toluene | 112.93 |
| | | | Bromofluorobenzene | 81.12 |
| | | | 1,2-Dichlorobenzene-d4 | 104.11 |
| 4563-8 | NGW-8 | 4/2/97 | Toluene | 111.02 |
| | | | Bromofluorobenzene | 77.25 |
| | | | 1,2-Dichlorobenzene-d4 | 93.76 |
| 4563-9 | NGW-18 | 4/2/97 | Toluene | 113.98 |
| | | | Bromofluorobenzene | 79.31 |
| | | | 1,2-Dichlorobenzene-d4 | 98.4 |
| 4563-10 | NGW-11 | 4/2/97 | Toluene | 107.12 |
| | | | Bromofluorobenzene | 81.35 |

Table A2 - Evaluation of the Analytical Lot of Samples for VOCs for July 1996 through February 1998 (Mexican Laboratory) (Cont)

| SAMPLE NO. | SAMPLE ID | DATE | SURROGATE | % RECOVERY |
|---|---|---|---|---|
| | | | 1,2-Dichlorobenzene-d4 | 103 |
| 4563-11 | NGW-7 | 4/2/97 | Toluene | 113.76 |
| | | | Bromofluorobenzene | 81.62 |
| | | | 1,2-Dichlorobenzene-d4 | 104.49 |
| 4563-12 | NGW-6 | 4/2/97 | Toluene | 111.72 |
| | | | Bromofluorobenzene | 84.33 |
| | | | 1,2-Dichlorobenzene-d4 | 103.85 |
| 4563-13 | NGW-15 | 4/2/97 | Toluene | 111.54 |
| | | | Bromofluorobenzene | 80.12 |
| | | | 1,2-Dichlorobenzene-d4 | 101.16 |
| 4563-14 | NA | 4/2/97 | Toluene | 113.53 |
| | | | Bromofluorobenzene | 80.81 |
| | | | 1,2-Dichlorobenzene-d4 | 105.6 |
| 4563-15 | NGW-4 | 4/2/97 | Toluene | 112.95 |
| | | | Bromofluorobenzene | 80.98 |
| | | | 1,2-Dichlorobenzene-d4 | 106.67 |
| 4563-16 | NGW-17 | 4/2/97 | Toluene | 114.03 |
| | | | Bromofluorobenzene | 80.92 |
| | | | 1,2-Dichlorobenzene-d4 | 103.15 |
| 4563-17 | NGW-5 | 4/2/97 | Toluene | 108.82 |
| | | | Bromofluorobenzene | 78.92 |
| | | | 1,2-Dichlorobenzene-d4 | 101.64 |
| 5103-1 | NGW-13 | 4/2/97 | Toluene | 105.31 |
| | | | Bromofluorobenzene | 99.92 |
| | | | 1,2-Dichlorobenzene-d4 | 84.03 |
| 5103-2 | NGW-12 | 4/2/97 | Toluene | 106.97 |
| | | | Bromofluorobenzene | 98.21 |
| | | | 1,2-Dichlorobenzene-d4 | 84.16 |

Table A2 - Evaluation of the Analytical Lot of Samples for VOCs for July 1996 through February 1998 (Mexican Laboratory) (Cont)

| SAMPLE NO. | SAMPLE ID | DATE | SURROGATE | % RECOVERY |
|---|---|---|---|---|
| 5103-3 | NGW-11 | 4/2/97 | Toluene | 99.23 |
| | | | Bromofluorobenzene | 102.41 |
| | | | 1,2-Dichlorobenzene-d4 | 83.42 |
| 5103-4 | NGW-10 | 4/2/97 | Toluene | 103.76 |
| | | | Bromofluorobenzene | 105.82 |
| | | | 1,2-Dichlorobenzene-d4 | 87.87 |
| 5103-5 | NGW-16 | 4/2/97 | Toluene | 103.32 |
| | | | Bromofluorobenzene | 98.29 |
| | | | 1,2-Dichlorobenzene-d4 | 82.67 |
| 5103-6 | NGW-8 | 4/2/97 | Toluene | 103.54 |
| | | | Bromofluorobenzene | 99.15 |
| | | | 1,2-Dichlorobenzene-d4 | 84.16 |
| 5103-7 | NGW-9 | 4/2/97 | Toluene | 101.22 |
| | | | Bromofluorobenzene | 98.52 |
| | | | 1,2-Dichlorobenzene-d4 | 79.08 |
| 5103-8 | NGW-14 | 4/2/97 | Toluene | 98.89 |
| | | | Bromofluorobenzene | 103.42 |
| | | | 1,2-Dichlorobenzene-d4 | 82.67 |
| 5103-9 | NGW-7 | 4/2/97 | Toluene | 104.76 |
| | | | Bromofluorobenzene | 108.00 |
| | | | 1,2-Dichlorobenzene-d4 | 83.17 |
| 5103-10 | NGW-6 | 4/2/97 | Toluene | 98.67 |
| | | | Bromofluorobenzene | 98.29 |
| | | | 1,2-Dichlorobenzene-d4 | 80.45 |
| 5103-12 | NGW-4 | 4/2/97 | Toluene | 102.43 |
| | | | Bromofluorobenzene | 99.38 |
| | | | 1,2-Dichlorobenzene-d4 | 86.39 |
| 5103-13 | NGW-17 | 4/2/97 | Toluene | 98.34 |
| | | | Bromofluorobenzene | 96.66 |
| | | | 1,2-Dichlorobenzene-d4 | 76.86 |

Table A2 - Evaluation of the Analytical Lot of Samples for VOCs for July 1996 through February 1998 (Mexican Laboratory) (Cont)

| SAMPLE NO. | SAMPLE ID | DATE | SURROGATE | % RECOVERY |
|---|---|---|---|---|
| 5103-14 | NGW-18 | 4/2/97 | Toluene | 102.43 |
| | | | Bromofluorobenzene | 105.20 |
| | | | 1,2-Dichlorobenzene-d4 | 77.97 |
| 5103-15 | NGW-15 | 4/2/97 | Toluene | 101.99 |
| | | | Bromofluorobenzene | 92.55 |
| | | | 1,2-Dichlorobenzene-d4 | 77.23 |
| 5103-16 | NGW-3 | 4/2/97 | Toluene | 101.00 |
| | | | Bromofluorobenzene | 94.64 |
| | | | 1,2-Dichlorobenzene-d4 | 81.81 |
| 6214-1 | NGW-17 | 10/4/97 | Toluene | 89.40 |
| | | | Bromofluorobenzene | 104.90 |
| | | | 1,2-Dichlorobenzene-d4 | NA |
| 6214-3 | NGW-9 | 10/4/97 | Toluene | 89.90 |
| | | | Bromofluorobenzene | 105.60 |
| | | | 1,2-Dichlorobenzene-d4 | NA |
| 6214-4 | NGW-3 | 10/4/97 | Toluene | 89.30 |
| | | | Bromofluorobenzene | 90.90 |
| | | | 1,2-Dichlorobenzene-d4 | NA |
| 6214-5 | NGW-13 | 10/4/97 | Toluene | 88.70 |
| | | | Bromofluorobenzene | 94.30 |
| | | | 1,2-Dichlorobenzene-d4 | NA |
| 6214-6 | NGW-12 | 10/4/97 | Toluene | 90.50 |
| | | | Bromofluorobenzene | 97.70 |
| | | | 1,2-Dichlorobenzene-d4 | NA |
| 6214-7 | NGW-10 | 10/4/97 | Toluene | 91.40 |
| | | | Bromofluorobenzene | 86.40 |
| | | | 1,2-Dichlorobenzene-d4 | NA |

| SAMPLE NO. | SAMPLE ID | DATE | SURROGATE | % RECOVERY |
|---|---|---|---|---|
| 6214-8 | NGW-4 | 10/4/97 | Toluene | 89.90 |
| | | | Bromofluorobenzene | 92.70 |
| | | | 1,2-Dichlorobenzene-d4 | NA |
| 6214-9 | NGW-16 | 10/4/97 | Toluene | 89.10 |
| | | | Bromofluorobenzene | 97.20 |
| | | | 1,2-Dichlorobenzene-d4 | NA |
| 6214-10 | NGW-8 | 10/4/97 | Toluene | 89.70 |
| | | | Bromofluorobenzene | 111.20 |
| | | | 1,2-Dichlorobenzene-d4 | NA |
| 6214-11 | NGW-1 | 10/4/97 | Toluene | 92.00 |
| | | | Bromofluorobenzene | 96.50 |
| | | | 1,2-Dichlorobenzene-d4 | NA |
| 6214-13 | NGW-11 | 10/4/97 | Toluene | 89.30 |
| | | | Bromofluorobenzene | 90.20 |
| | | | 1,2-Dichlorobenzene-d4 | NA |
| 6214-14 | NGW-7 | 10/4/97 | Toluene | 93.20 |
| | | | Bromofluorobenzene | 90.80 |
| | | | 1,2-Dichlorobenzene-d4 | NA |
| 6214-17 | NGW-18 | 10/4/97 | Toluene | 91.40 |
| | | | Bromofluorobenzene | 109.40 |
| | | | 1,2-Dichlorobenzene-d4 | NA |
| 6220-1 | NGW-6 | 10/7/97 | Toluene | 88.40 |
| | | | Bromofluorobenzene | 94.10 |
| | | | 1,2-Dichlorobenzene-d4 | NA |
| 6220-2 | NGW-15 | 10/7/97 | Toluene | 88.50 |
| | | | Bromofluorobenzene | 102.90 |
| | | | 1,2-Dichlorobenzene-d4 | NA |
| 7688-1 | NGW-7 | 2/19/98 | Toluene | 97.90 |
| | | | Bromofluorobenzene | 93.80 |
| | | | 1,2-Dichlorobenzene-d4 | 109.90 |

Table A2 - Evaluation of the Analytical Lot of Samples for VOCs for July 1996 through

February 1998 (Mexican Laboratory) (Cont)

| SAMPLE NO. | SAMPLE ID | DATE | SURROGATE | % RECOVERY |
|---|---|---|---|---|
| 7688-2 | NGW-17 | 2/19/98 | Toluene | 101.70 |
| | | | Bromofluorobenzene | 95.20 |
| | | | 1,2-Dichlorobenzene-d4 | 97.90 |
| 7688-7 | NGW-13 | 2/19/98 | Toluene | 102.20 |
| | | | Bromofluorobenzene | 89.30 |
| | | | 1,2-Dichlorobenzene-d4 | 100.10 |
| 7688-8 | NGW-9 | 2/19/98 | Toluene | 96.00 |
| | | | Bromofluorobenzene | 96.20 |
| | | | 1,2-Dichlorobenzene-d4 | 106.60 |
| 7688-9 | NGW-15 | 2/19/98 | Toluene | 104.00 |
| | | | Bromofluorobenzene | 93.90 |
| | | | 1,2-Dichlorobenzene-d4 | 94.30 |
| 7688-10 | NGW-8 | 2/19/98 | Toluene | 102.50 |
| | | | Bromofluorobenzene | 94.80 |
| | | | 1,2-Dichlorobenzene-d4 | 96.40 |
| 7688-11 | NGW-18 | 2/19/98 | Toluene | 97.40 |
| | | | Bromofluorobenzene | 87.10 |
| | | | 1,2-Dichlorobenzene-d4 | 109.00 |
| Trip Blank | | 2/19/98 | Toluene | 109.70 |
| | | | Bromofluorobenzene | 88.20 |
| | | | 1,2-Dichlorobenzene-d4 | 93.90 |
| 7688-3 | NGW-6 | 2/19/98 | Toluene | 100.60 |
| | | | Bromofluorobenzene | 87.10 |
| | | | 1,2-Dichlorobenzene-d4 | 109.60 |
| 7688-4 | NGW-1 | 2/19/98 | Toluene | 103.70 |
| | | | Bromofluorobenzene | 87.80 |
| | | | 1,2-Dichlorobenzene-d4 | 111.10 |
| 7688-5 | NGW-3 | 2/19/98 | Toluene | 93.70 |
| | | | Bromofluorobenzene | 96.70 |
| | | | 1,2-Dichlorobenzene-d4 | 105.00 |

Table A2 - Evaluation of the Analytical Lot of Samples for VOCs for July 1996 through

| SAMPLE NO. | SAMPLE ID | DATE | SURROGATE | % RECOVERY |
|---|---|---|---|---|
| 7688-6 | NGW-4 | 2/19/98 | Toluene | 99.90 |
| | | | Bromofluorobenzene | 94.90 |
| | | | 1,2-Dichlorobenzene-d4 | 93.30 |

NA - Not Available
**Note:** Data includes April 1997 through February 1998. July 1996 through April 1997 will be made part of this report when it becomes available.

# APPENDIX B - METHOD DETECTION LIMITS

## Table B1 - Detection Limits for Volatile Organic Compounds in Soils (Mexican Laboratory) EPA Method 8240

| ANALYTE | PQL (mg/Kg) | MDL (mg/Kg) |
|---|---|---|
| Chloromethane | 0.24 | 0.08 |
| Chloroethane | 0.24 | 0.08 |
| Vinyl Chloride | 0.054 | 0.18 |
| Acetone | 0.09 | 0.03 |
| Carbon Bisulfide | 0.15 | 0.05 |
| Methylene Chloride | 0.31 | 0.1 |
| 1,1-Dichloroethane | 0.405 | 0.13 |
| Methyl Ethyl Ketone | 0.16 | 0.05 |
| Chloroform | 0.092 | 0.03 |
| 1,1,1-Trichloroethane | 0.165 | 0.05 |
| 1,2-Dichloroethane | 0.165 | 0.05 |
| Benzene | 0.165 | 0.05 |
| Carbon Tetrachloride | 0.091 | 0.03 |
| 1,2-Dichloropropane | 0.25 | 0.08 |
| Trichloroethylene | 0.165 | 0.05 |
| Dichlorobromomethane | 0.31 | 0.09 |
| Methyl Isobutyl Ketone | 0.35 | 0.11 |
| Toluene | 0.22 | 0.07 |
| 1,1,2-Trichloroethane | 0.22 | 0.09 |
| Chlorobenzene | 0.38 | 0.12 |
| Ethylbenzene | 0.29 | 0.09 |
| Dibromochloromethane | 0.375 | 0.12 |
| m,p-xylenes | 0.51 | 0.15 |
| Bromoform | 0.51 | 0.15 |
| Styrene | 0.51 | 0.15 |
| O-xylene | 0.51 | 0.15 |
| 1,1,2,2-Tetrachloroethane | 0.22 | 0.07 |
| Trichlorofluoromethane | 0.51 | 0.15 |
| Tetrachloroethylene | 0.165 | 0.05 |
| 1,2 Dichloroethane | 0.31 | 0.1 |
| Bromodichloromethane | 0.25 | 0.08 |
| 1,3-Dichloropropane | 0.35 | 0.11 |

PQL = PRACTICAL QUANTITATION LIMIT
MDL = MINIMUM DETECTION LIMITS

Table B2 - Detection Limits for Metals in Soil (Mexican Laboratory)
EPA Method 6010

| ANALYTE | DETECTION LIMITS (mg/Kg) |
|---|---|
| Silver (Ag) | 4.12 |
| Aluminum (Al) | 4.59 |
| Arsenic (As) | 22.15 |
| Barium (Ba) | 2.80 |
| Cadmium (Cd) | 2.92 |
| Chromium (Cr) | 3.30 |
| Copper (Cu) | 3.23 |
| Iron (Fe) | 23.64 |
| Potassium (K) | 35.01 |
| Magnesium (Mg) | 1.81 |
| Manganese (Mn) | 1.37 |
| Nickel (Ni) | 5.62 |
| Lead (Pb) | 20.19 |
| Selenium (Se) | 33.19 |
| Zinc (Zn) | 1.08 |
| Calcium (Ca) | 12.90 |
| Antimony (Sb) | 36.69 |
| Beryllium (Be) | 2.79 |
| Boron (B) | 5.78 |
| Cobalt (Co) | 2.78 |
| Molybdenum (Mo) | 14.07 |
| Mercury (Hg)* | 1.90 |
| Vanadium (V) | 1.24 |
| Thallium (Tl) | 6.45 |

* = EPA 7470

Table B3 - Detection Limits for VOCs in Soils (U.S. Laboratory)
By EPA Methods 8010/8020

| | Detection Limit (mg/kg) | | Detection Limit (mg/kg) |
|---|---|---|---|
| Benzene | 0.100 | Cis-1,2-Dichloroethylene | 0.050 |
| Bromodichloromethane | 0.050 | Trans-1,2-Dichloroethylene | 0.050 |
| Bromoform | 0.100 | 1,2-Dichloropropane | 0.050 |
| Bromomethane | 0.250 | Total-1,3-Dichloropropylene | 0.050 |
| Carbon Tetrachloride | 0.050 | Ethylbenzene | 0.100 |
| Chlorobenzene | 0.100 | Methylene Chloride | 0.250 |
| Chloroethane | 0.100 | 1,1,2,2-Tetrachloroethene | 0.050 |
| Chloroform | 0.050 | Tetrachloroethylene | 0.050 |
| Chloromethane | 0.250 | Toluene | 0.100 |
| Dibromochloromethane | 0.050 | 1,1,1-Trichloroethane | 0.050 |
| 1,2-Dichlorobenzene | 0.050 | 1,1,2-Trichloroethane | 0.050 |
| 1,3-Dichlorobenzene | 0.050 | Trichloroethylene | 0.050 |
| 1,4-Dichlorobenzene | 0.050 | Trichlorofluoromethane | 0.100 |
| Dichlorodifluoromethane | 0.100 | Vinyl Chloride | 0.100 |
| 1,1-Dichloroethane | 0.050 | m,p-Xylene | 0.100 |
| 1,2-Dichloroethane | 0.050 | o-Xylene | 0.100 |
| 1,1-Dichloroethylene | 0.050 | | |

Table B4 - Detection Limits for Trace Metals in Soils (U.S. Laboratory)
By EPA Method 6010 (except where noted)

| | Detection Limits (mg/kg) | | Detection Limits (mg/kg) |
|---|---|---|---|
| Aluminum (Al) | 20 | Magnesium (Mg) | 500 |
| Antimony (Sb) | 5 | Manganese (Mn) | 5 |
| Arsenic (As) | 1 | Mercury (Hg) (Method 7470) | 0.04 |
| Barium (Ba) | 20 | Molybdenum (Mo) | 5 |
| Beryllium (Be) | 0.5 | Nickel (Ni) | 5 |
| Boron (B) | 20 | Potassium (K) | 500 |
| Cadmium (Cd) | 0.5 | Selenium (Se) | 0.5 |
| Calcium (Ca) | 500 | Silicon (Si) | 10 |
| Chromium (Cr) | 1 | Silver (Ag) | 2.5 |
| Cobalt (Co) | 20 | Sodium (Na) | 500 |
| Copper (Cu) | 5 | Thallium (Tl) | 1 |
| Iron (Fe) | 10 | Vanadium (V) | 5 |
| Lead (Pb) | 0.5 | Zinc (Zn) | 5 |

Table B5 - U.S. and Mexico Groundwater Sample Containers and Preservation

| Parameters | Containers | Preservation | Laboratory Holding Times |
|---|---|---|---|
| VOCs | 3-40 ml Glass Vials Teflon™-lined septum | Cool, 4 ° C, HCl (pH<2) and no Headspace | 14 days |
| Total Petroleum Hydrocarbons | 2-250 ml amber bottles | Cool, 4 ° C, HCl (pH<2), and no Headspace | 14 days |
| Total & Fecal Coliform | 2 plastic 100-ml containers | Cool, 4 ° C, $Na_2S_2O_3$ | 6 hours |
| Major Cations & Anions, Nitrates & Trace Metals | 3-1 Liter Plastic Bottles | Cool, 4 ° C, 0.008% $HNO_3$ (pH<2) in one 1-Liter Plastic bottle (for Metals), and one 2-Liter Plastic Bottles unpreserved (for Anions, nitrates and general parameters) | 28 days (Mercury) 6 months (Metals) 14 hours (Nitrates) |

Table B6 - Detection Limits for VOCs in Groundwater (U.S. Laboratory)
EPA Method 502.2

| | Detection Limit (ug/L) | | Detection Limit (ug/L) |
|---|---|---|---|
| Benzene | 0.5 | 1,2-Dichloropropane | 0.5 |
| Bromobenzene | 0.5 | 1,3-Dichloropropane | 0.5 |
| Bromochloromethane | 0.5 | 2,2-Dichloropropane | 2.0 |
| Bromodichloromethane | 0.5 | 1,1-Dichloropropane | 0.5 |
| Bromoform | 1.0 | Total-1,3-Dichloropropylene | 0.5 |
| Bromomethane | 5.0 | Ethylbenzene | 0.5 |
| n-Butylbenzene | 0.5 | Hexachloro butadiene | 0.5 |
| sec-Butylbenzene | 1.0 | Isopropylbenzene | 0.5 |
| tert-Butylbenzene | 1.0 | p-Isopropyltoluene | 1.0 |
| Carbon Tetrachloride | 0.5 | Methylene Chloride | 2.0 |
| Chlorobenzene | 0.5 | Naphthalene | 0.5 |
| Chloroethane | 1.0 | n-propylbenzene | 1.0 |
| Chloroform | 2.0 | Styrene | 0.5 |
| Chloromethane | 5.0 | 1,1,1,2-Tetrachloroethane | 1.0 |
| 2-Chlorotoluene | 0.5 | 1,1,2,2-Tetrachloroethane | 0.5 |
| 4-Chlorotoluene | 1.0 | Tetrachloroethylene | 0.5 |
| Dibromochloromethane | 1.0 | Toluene | 0.5 |
| Dibromomethane | 1.0 | 1,2,3-Trichlorobenzene | 1.0 |
| 1,2-Dichlorobenzene | 0.5 | 1,2,4-Trichlorobenzene | 1.0 |
| 1,3-Dichlorobenzene | 0.5 | 1,1,1-Trichloroethane | 0.5 |
| 1,4-Dichlorobenzene | 0.5 | 1,1,2-Trichloroethane | 0.5 |
| Dichlorodifluoromethane | 1.0 | Trichloroethylene | 0.5 |
| 1,1-Dichloroethane | 0.5 | Trichlorofluoromethane | 1.0 |
| 1,2-Dichloroethane | 0.5 | 1,2,3-Trichloropropane | 1.0 |
| 1,1-Dichloroethylene | 0.5 | 1,2,4-Trimethylbenzene | 1.0 |
| Cis-1,2-Dichloroethylene | 0.5 | Vinyl Chloride | 1.0 |
| Trans-1,2-Dichloroethylene | 0.5 | Xylenes | 0.5 |

Table B7 - Detection Limits for VOCs in Groundwater (Mexican Laboratory)
EPA Method 8240

| ANALYTE | PQL (ug/L) | MDL (ug/L) |
|---|---|---|
| Chloromethane | 0.24 | 0.08 |
| Chloroethane | 0.24 | 0.08 |
| Vinyl Chloride | 0.054 | 0.18 |
| Acetone | 0.09 | 0.03 |
| Carbon Bisulfide | 0.15 | 0.05 |
| Methylene Chloride | 0.31 | 0.1 |
| 1,1-Dichloroethane | 0.405 | 0.13 |
| Methyl Ethyl Ketone | 0.16 | 0.05 |
| Chloroform | 0.092 | 0.03 |
| 1,1,1-Trichloroethane | 0.165 | 0.05 |
| 1,2-Dichloroethane | 0.165 | 0.05 |
| Benzene | 0.165 | 0.05 |
| Carbon Tetrachloride | 0.091 | 0.03 |
| 1,2-Dichloropropane | 0.25 | 0.08 |
| Trichloroethylene | 0.165 | 0.05 |
| Dichlorobromomethane | 0.31 | 0.09 |
| Methyl Isobutyl Ketone | 0.35 | 0.11 |
| Toluene | 0.22 | 0.07 |
| 1,1,2-Trichloroethane | 0.22 | 0.09 |
| Chlorobenzene | 0.38 | 0.12 |
| Ethylbenzene | 0.29 | 0.09 |
| Dibromochloromethane | 0.375 | 0.12 |
| Tetrachloroethylene | 0.165 | 0.05 |
| m,p-xylenes | 0.51 | 0.15 |
| Bromoform | 0.51 | 0.15 |
| Styrene | 0.51 | 0.15 |
| O-xylene | 0.51 | 0.15 |
| 1,1,2,2-Tetrachloroethane | 0.22 | 0.07 |
| Trichlorofluoromethane | 0.51 | 0.15 |
| Trichloroethane | 0.165 | 0.05 |
| 1,2-Dichloroethane | 0.31 | 0.10 |
| Bromodichloromethane | 0.25 | 0.08 |
| 1,3-Dichloropropane | 0.35 | 0.11 |

PQL = Practical Quantitation Limits
MDL = Minimum Detection Limits

Table B8- Detection Limits for Major Cations & Anions in Groundwater (U.S. Laboratory)
EPA Method 200.7 (except where noted)

| | Detection Limit (ug/l) | | Detection Limit (ug/l) |
|---|---|---|---|
| Calcium (Ca) | 5000 | Chloride (Cl) (Method 300.0) | 5000 |
| Sodium (Na) | 5000 | Sulfate ($SO_4$) (Method 300.0) | 5000 |
| Potassium (K) | 5000 | Total Dissolved Solids SM2540C | 1000 |
| Magnesium (Mg) | 5000 | Fluoride (F) (Method 300.0) | 100 |
| Iron (Fe) | 100 | Nitrate ($NO_3$) (Method 300.0) | 100 |
| Nitrogen as Nitrate (Method 300.0) | 100 | Nitrate plus Nitrite (Method 300.0) | |
| Total and Phenolthalein alkalinity ($CO_3$) (Method 310.11) | 5000 | Total Alkalinity (as CACO3) | 2000 |
| Carbonate | 500 | Bicarbonate | 500 |

Table B9 -Detection Limits for Conventional Parameters and Coliforms in Groundwater (Mexican Laboratory)

| PARAMETER | METHOD* | MINIMUM DETECTABLE (mg/L) |
|---|---|---|
| TOTAL HARDNESS | MA-FQ-17 | 2 |
| CALCIUM HARDNESS | MA-FQ-17 | 2 |
| SODIUM | FLAMOMETRIA | 0.1 |
| POTASSIUM | FLAMOMETRIA | 0.1 |
| CHLORIDE | MA-FQ-10 | 2 |
| FLUORIDE | MA-FQ-19 | 0.02 |
| NITRATE | MA-FQ-23 | 0.1 |
| SULFATE | MA-FQ-31 | 5 |
| COLIFORM | MA-MB-01<br>MA-MB-03 | |

* Manual de Metodo de Análisis. 1995. Comision Nacional del Agua. Subdireccion General Tecnica. Gerencia de Saneamiento y Calidad del Agua

Table B10 - Detection Limits for Trace Metals in Groundwater (U.S. Laboratory)
EPA Method 200.7 (except where noted)

| | Detection Limit (ug/l) | | Detection Limit (ug/l) |
|---|---|---|---|
| Aluminum (Al) | 200 | Magnesium (Mg) | 5000 |
| Antimony (Sb) (Method 200.9) | 5 | Manganese (Mn) | 50 |
| Arsenic (As) (Method 200.9) | 10 | Mercury (Hg) (Method 245.1) | 0.2 |
| Barium (Ba) | 200 | Molybdenum (Mo) | 50 |
| Beryllium (Be) | 5 | Nickel (Ni) | 50 |
| Boron (B) | 200 | Potassium (K) | 5000 |
| Cadmium (Cd) | 5 | Selenium (Se) (Method 200.9) | 5 |
| Calcium (Ca) | 5000 | Silicon (Si) | 100 |
| Chromium (Cr) | 10 | Silver (Ag) | 10 |
| Cobalt (Co) | 200 | Sodium (Na) | 5000 |
| Copper (Cu) | 50 | Thallium (Tl) (Method 200.9) | 10 |
| Iron (Fe) | 100 | Vanadium (V) | 50 |
| Lead (Pb) (Method 200.9) | 5 | Zinc (Zn) | 50 |

Table B11 - Detection Limits for Metals in Groundwater (Mexican Laboratory)
Method MA-AA-01*

| ANALYTE | DETECTION LIMIT (mg/l) |
|---|---|
| Silver (Ag) | 0.03 |
| Aluminum (Al) | 1.1 |
| Arsenic (As) | 0.0005 |
| Barium (Ba) | 0.5 |
| Cadmium (Cd) | 0.02 |
| Chrome (Cr) | 0.04 |
| Copper (Cu) | 0.04 |
| Iron (Fe) | 0.04 |
| Potassium (K) | 0.20 |
| Magnesium(Mg) | 0.20 |
| Manganese (Mn) | 0.03 |
| Nickel (Ni) | 0.05 |
| Lead (Pb) | 0.08 |
| Selenium (Se) | 0.0005 |
| Zinc (Zn) | 0.02 |
| Calcium (Ca) | 0.20 |
| Antimony (Sb) | 0.0005 |
| Beryllium (Be) | 0.03 |
| Silica (Si) | 2.1 |
| Cobalt (Co) | 0.08 |
| Molybdenum (Mo) | 0.70 |
| Mercury (Hg)* | 0.0005 |
| Vanadium (V) | 1.9 |
| Sodium (Na) | 3.0 |

*Manual de Metodos de Análisis. 1995. Comision Nacional del Agua Subdireccion General Tecnica. Gerencia de Saneamiento y Calidad del Agua

LIST OF ACRONYMS

| | |
|---|---|
| ADEQ | Arizona Department of Environmental Quality |
| AW | Drilling pipe manufactured by Long Year used in drilling the wells in Nogales, Sonora |
| bls | below land surface |
| CFU | Colony Forming Units |
| CNA | Comisión Nacional del Agua |
| COAPAES | Comisión de Agua Potable y Alcantarillado del Estado de Sonora |
| DI | Deionized Water |
| DOT | United States Department of Transportation |
| EC | Electrical Conductivity |
| EPA | United States Environmental Protection Agency |
| ft | feet |
| gal | gallon |
| gpm | gallons per minute |
| HCl | Hydrochloric Acid |
| $HNO_3$ | Nitric Acid |
| hp | horsepower |
| IBWC | International Boundary and Water Commission |
| lps | liters per second |
| m | meters |
| AWQS | Arizona Aquifer Water Quality Standards |
| mi | miles |
| ml | milliliter |
| NMP | Número Más Probable (MPN-Most Probable Number) |
| $NO_3$ | Nitrate |
| NTu | Nephelometric Turbidity Units |
| PCE | Tetrachloroethylene |
| PID | Photo Ionization Detector |
| ppb | parts per billion |

| | |
|---|---|
| PPE | Personal Protective Equipment |
| ppm | parts per million |
| PQL | Practical Quantitation Limit |
| QA/QC | Quality Assurance/Quality Control |
| RPD | Relative Percent Difference |
| SINALP | Sistema Nacional de Acreditamiento de Laboratorios de Prueba |
| $SO_4$ | Sulfate |
| TCE | Trichloroethylene |
| THM's | Trihalomethanes |
| TNTC | Too Numerous To Count |
| V | Volts |
| VOCs | Volatile Organic Compounds |

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