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UZBEKISTAN

FIELD REPORT

Water Quality Laboratory Equipment Installation Program: Nukus and Urgench, Uzbekistan

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A USAID Project Consortium Led by CH2M HILL

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WATER QUALITY LABORATORY EQUIPMENT INSTALLATION PROGRAM: NUKUS AND URGENCH, UZBEKISTAN

INTRODUCTION

This project is a part of the program as defined in the Memorandum of Understanding executed between the Government of the United States and the Government of Uzbekistan on 20 April 1994 to "promote improved environmental health" in the environmental disaster areas around the Aral Sea.

Environmental Policy and Technology (EPT) field investigations completed in June 1994 defined several improvements at the Nukus and Urgench water treatment plants that if implemented could help improve potable water quality being delivered to these cities. Specific recommendations included: a) the Government of Uzbekistan adopts international standards for drinking water quality, (b) install new chlorination equipment to replace existing chlorination equipment, (c) provide new laboratory equipment to replace antiquated equipment, and (d) improve operation and maintenance of other unit processes including the clarifiers and filters. Follow up studies on risk assessment of pesticides in the raw water and downstream (transmission and distribution system) chlorination were also recommended.

Review of the EPT Field report (Interim Field Investigations in Uzbekistan: Nukus and Urgench Water Treatment Plants, September 1994) supported proceeding with the design, procurement, delivery, and installation of the proposed laboratory and chlorination equipment. This report summarizes the water quality laboratory installation pogrom to date.

As part of the Aral Sea Program, being conducted by EPT, analytical instrumentation and reagents were to be installed in laboratories in Nukus and Urgench. The instrumentation was intended to increase the laboratories' ability to monitor water quality in the region. Water quality has potentially been linked to health issues in the regions around the Aral Sea. A technical team had previously conducted field investigations and defined that the laboratories required additional support with instrumentation and supplies. Based on those investigations, specific instrumentation was selected and extended reagent supplies identified. Another technical team was scheduled to install the instrumentation and conduct training of the laboratory staffs. Concurrent with the primary scope of work, an assessment of the technical competence of the subject laboratories was made. That assessment was to include an evaluation of the laboratories requirements for extended and expanded support of the Aral Sea Program.

DISCUSSION

The equipment and reagents were requisitioned from Hach Co. (Boulder, CO). Hach equipment was selected because of its ease in operation and maintenance. Hach also provides a structured and organized reagent packaging, which contributes to the ease of

operation. The equipment and reagents were assembled and packaged into "lab sets" prior to shipment to Uzbekistan.

Installation of the instrumentation and training of the staffs was organized with the technical team in the EPT/Almaty office. Logistics and coordination with local officials and laboratory management was handled by that office with the assistance of USAID office in Tashkent. The EPT/Almaty office staff was instrumental in the overall success of the installation and training efforts.

The shipment of "lab sets" for Uzbekistan was sent to Tashkent and shipped by truck by the local authorities to the following water quality laboratories:

- Nukus Sanitary and Epidemiological Services (SES) Laboratory
- Tuyamuyun-Nukus Water Treatment Plant Laboratory
- Tuyamuyun-Urgench Water Treatment Plant Laboratory

The "lab sets" primarily consisted of laboratory and portable models of instrumentation. Attachment 1 is a summary of the analytical parameters which can be conducted with each "lab set". Attachment 2 is a more defined summary of parameters and methodologies provided to the laboratories. The attachment also lists the additional parameters which can be analyzed with the DR/2000 spectrophotometer.

The laboratories in Uzbekistan use a water quality standard from the former Soviet Union (GOST Standard). Comparison of GOST standard to the guidelines from the World Health Organization (WHO) or US Environmental Protecting Agency (EPA) reveals that the water quality acceptance levels are lower than the WHO guidelines. For example, turbidity is expressed in terms of milligrams per liter (mg/l). In the U.S. (and elsewhere) turbidity is expressed in terms of Nephelometric Turbidity Units (NTU). The World Health Organization guidelines for drinking water quality is turbidity less than 1.0 NTU; the EPA standard is water quality less than 0.5 NTU. The GOST standard for turbidity is 1.5 mg/l. Preliminary comparative tests were completed by EPT which indicated that 1.0 mg/l turbidity was approximately equivalent to 18 NTU. Attachment 3 is a chart illustrating the comparison.

During the equipment installation, it became evident that more information is necessary to properly assess the comparison of the GOST standard to other guidelines. Additionally, the laboratory staff's confidence level have to be established for utilizing the new instrumentation and methodologies. It was requested that for applicable analytical parameters, the laboratory should complete the analysis using both their own instruments and methodology the new Hach equipment and methodology. Charts for recording their comparative analyses were provided. Attachment Group 4 illustrates the charts provided. EPT/Almaty should periodically send new forms to the laboratories and request that they return the completed forms.

The comparative data could be compiled into information which may be used to convince the Uzbekistan office, responsible for the GOST standard, to review their guidelines. It was evident that an educational process may be required to gradually incorporate more appropriate standards for water quality. The mere fact that most countries have developed more stringent standards was enough to convince the laboratory staff. But they are required to adhere to the GOST standard. Uzbekistan should be encouraged to begin to develop their own quality standards and environmental regulations to improve drinking water quality and related health issues. Especially since the Russian Federation is apparently unable to support the republics in these matters.

Nukus SES laboratory was provided a DR/2000 spectrophotometer and reagents for free chlorine and nitrate tests. Attachment 5 is a list of the equipment provided. The laboratory has regional responsibility for monitoring water quality. Samples are periodically collected from the region for analysis. The director of the Nukus SES laboratory supervises the Nukus Water Treatment Plant laboratory. Training on the instrument and analytical procedures for free chlorine and nitrate were conducted. The SES laboratory is capable of more extensive and in-depth analyses for water quality.

Nukus Water Treatment Plant laboratory was provided the Hach basic water quality laboratory (with DR/2000), laboratory/portable pH instrument, laboratory/portable turbidimeter, and other instruments. Attachment 6 is a list of the equipment provided. The laboratory is responsible for monitoring water quality within the water treatment plant. Samples are periodically (daily and/or weekly) collected for bacterial and chemical analyses. The laboratory is equipped for only the basic parameter analyses.

Urgench Water Treatment Plant laboratory was provided the Hach basic water quality laboratory (with DR/2000), laboratory/portable pH instrument, laboratory/portable turbidimeter, and other instruments Attachment 7 is a list of the equipment provided. The laboratory monitors water quality within the water treatment plant. Samples are collected daily and weekly for bacterial and chemical analysis. The laboratory is equipped for only the basic parameter analyses.

The Urgench SES laboratory was visited, but did not receive any equipment at this time.The conditions and requirements for this laboratory were similar to the Nukus SES Laboratory.

The staff in each Uzbekistan laboratory were found to competent and qualified. In the SES laboratory (and to a degree other labs) the staff members were university educated. They technically are very familiar with water quality chemistry and analytical methodologies. It is obvious that the Soviet System had repressed and sheltered these scientists from advancements that the rest of the world are utilizing in laboratory Procedures.

In each laboratory, some instruments were inoperable due to broken electrodes or other malfunctions. Glassware, and chemical reagents were in very short supply or non-existent. The Uzbekistan laboratories were dependent upon the former Soviet system for supply and

technical support. This system is now incapable of continuing the support and the laboratory managers are struggling to sustain their operations, when supplies are disappearing and instruments are not functioning.

The equipment and supplies provided during this phase of the program will allow the laboratories to conduct the basic water quality analyses (pH, turbidity, TDS, chlorine, nitrate, and coliform bacteria). The more advanced physical and chemical parameters are not addressed. While it may not be appropriate for the Nukus or Urgench Water Treatment Plant laboratories to conduct more extensive analyses. The SES laboratory can and should serve the role of more extensive and in-depth analyses (arsenic, lead, pesticides, herbicides, radioactivity, bacteriological, etc.).

The team did not have the opportunity to visit the distribution system pumping stations in Nukus and Urgench. These facilities receive, chlorinate, store in reservoirs, and repump water into the system. Some water quality parameters can and should be analyzed on the water at these pumping stations. pH, turbidity, TDS and free chlorine would be sufficient to provide the operators with a measure of the water being received and repumped into the system. More immediate response to water quality deviations can be initiated if these stations were provided with portable equipment and reagents.

Training of the laboratory staffs were completed using the Hach procedures and operating manuals. The EPT/Almaty office provided Russian translations for some of the material. It was evident that complete translation of the manuals will be necessary to allow the laboratories to efficiently utilize the analytical equipment. Maintenance on the instruments will be critical and vital to reliable data. While the scientists and technicians are educated and competent, nearly all do not speak or read English (at least at this point in time). With more exposure to Americans and Western Europeans, the laboratory staff's English will improve. Until that time, more of the technical material should be translated into Russian.

The Hach equipment and reagents are designed to be easy to use by scientists, technicians, and operators. It is the favored type of analytical equipment in American water treatment plants. The Uzbekistan laboratories may have problems with the Hach equipment and reagents in the future, especially with USAID support is no longer available. The Uzbekistan laboratories are struggling to find the financial resources to operate day-to-day. In the U.S., the Hach equipment and reagents are relatively inexpensive. The economic system in Uzbekistan laboratories can not afford the "expensive" reagent pillows developed for the Hach equipment. The Uzbekistan society reuses everything; the idea of using something and throwing it away is illogical to them. For example, water samples bottles are sterilized vodka bottles. Therefore, the disposal petri dishes, and reagent vials of the MEL/MF laboratory are difficult concepts for the staffs to grasp. The laboratories will have a nearly impossible task of finding hard currency to purchase Hach supplies, especially when Hach's nearest supply source is Belgium. It may be more appropriate to provide conventional instruments and reagents as the Uzbekistan labs could more easily have found conventional chemicals and reagents. The most abundant resources the labs have are time and man-power.

Additionally, instruments and methodologies used in Uzbekistan laboratories may be required to be certified. This certification is a "hold-over" from the former Soviet system. The Uzbekistan laboratories do not stress the same degree of potential problems, as expressed by the Kazakhstan laboratories, which would be encountered unless the Hach instruments and methodologies were certified by the office in Tashkent. This relates to the previous discussion of gathering comparative data and revising the standard. The process of laboratory certification in the U.S. should be explained to the Uzbekistan authorities. Hopefully, the discussion would lead to a more appropriate system of certification. The EPT office may have to assist in obtaining interim certification of the Hach instruments and methodologies.

Providing the laboratories with analytical instruments and reagents is a logical step in improving water quality in the Aral Sea area. Technical support in evaluating analytical data is also critical. Currently, the laboratories manually log data onto sheets of paper. Unless there are water quality deviations above the GOST standard, the data is relegated to a storage area. Any trends or fluctuations of individual analytical data are lost, unless it exceeds the standard.

The program should include the computerization of all analytical data for review and evaluation. Neither the Nukus or Urgench SES laboratories have no computer system which could be used to enter the analyses into a database. Each laboratory's management were favorable to the idea, if assistance was provide with appropriate software. The other laboratories would send copies of the laboratory log sheets for entry into the system. The database could then send reports to the EPT/Almaty office for review.

In support of the Uzbekistan laboratories, additional training and support should be provided on the instruments and analytical methodologies. This could be accomplished in a number of configurations. The EPT/Almaty office could organize a centralized meeting of the applicable technicians from each laboratory to receive re-training and support. Or, a Uzbekistan native with fluency in Russian-English and knowledge of chemistry could be retained to periodically visit each laboratory and provide re-training. The training and support will be critical to the quality of water quality analyses completed by the laboratories. A comparison of international guidelines for water quality is presented in Attachment 8.

RECOMMENDATIONS

*Obtain comparative analytical data between the Hach methodologies and GOST Standard methodologies.

* Discuss with the Uzbekistan office in Tashkent the possibility of revising the GOST standard to incorporate the World Health Organization guidelines or other standards.

* Consider placing portable instruments and reagents in the pumping stations for more immediate response to water quality.

* Provide the Nukus and Urgench Water Treatment Plant laboratories with extended support to conduct the basic water quality analyses (pH, turbidity, free chlorine, TDS, coliform bacteria).

* Provide the Nukus and Urgench SES laboratories with extended support for more advanced water quality analyses (arsenic, lead, pesticides, herbicides, radiological, etc.).

* Provide Russian translations for all of the technical materials required for the operation and maintenance of the instruments and analytical procedures.

* Consider implementing a reagent system for the Uzbekistan laboratories which utilize conventional (and easier to acquire) chemicals and reagents.

* Assist in the certification of the Hach instruments and methodologies with the Tashkent Certification Office.

* Implement a computerization program for the analytical data generated by each laboratory, for review and evaluation.

* Provide additional re-training and support using period centralized meeting and/or more frequent technical visits by a Uzbekistan native, who has knowledge of chemistry.

Water Quality Laboratory Analytical Procedures
(Listed by Analytical Parameter)

Parameter	Range	Analytical Method/Reference Pages	Instrument Method
Alkalinity (*)	10-4000 mg/L as CaCO3	Method 8203, pages 1-5 (DREL Lab Manual)	Digital Titrator
Bromine	0-4.5 mg/L as Br2	Method 8016, pages 79-80, 83-84 (Supplement Methods)	DR/2000
Carbon Dioxide	10-1000 mg/L as CO2	Method 8205, pages 7-9 (DREL Lab Manual)	Digital Titrator
Chloride	10-10,000 mg/L as Cl-	Method 8207, pages 11-14 (DREL Lab Manual)	Digital Titrator
Chlorine, Free (*)	0-2 mg/L as Cl2	Method 8021, pages 15-16, 19-20 (DREL Lab Manual)	DR/2000
Chlorine, Free (*)	0-2 mg/L as Cl2	Method 8021, pages 19-22, 26-28 (DREL Lab Manual)	Pocket Colorimeter
Chlorine, Total, High Range (*)	0-4.5 mg/L as Cl2	Method 8167, pages 37-43 (DREL Lab Manual)	Pocket Colorimeter
Chlorine, Total, Low Range (*)	0-2 mg/L as Cl2	Method 8167, pages 21-22, 25-26 (DREL Lab Manual)	DR/2000
Chlorine, Total, Low Range (*)	0-2 mg/L as Cl2	Method 8167, pages 29-32, 26-28 (DREL Lab Manual)	Pocket Colorimeter
Chromium, Hexavalent	0-0.60 mg/L as Cr6+	Method 8023, pages 27-28, 31 (DREL Lab Manual)	DR/2000
Conductivity (*)	0.2-4.0 mS/cm	Pocket Pal Method, pages 33-36 (DREL Lab Manual)	Pocket Conductivity/TDS Meter
Conductivity (*)	0.2-4.0 mS/cm	Pages 10-13 (Portable Conductivity/TDS Instrument Manual)	Portable Conductivity/TDS Meter
Copper, Complexed & Free	0-5 mg/L as Cu Bicn	Method 8506, pages 3738, 41-42 (DREL Lab Manual)	DR/2000
Dissolved Oxygen	1-10+ mg/L DO	Method 8332, pages 79-82 (DREL Lab Manual)	Digital Titrator
Fluoride	0-2 mg/L as F-	Method 8029, pages 43-44, 47-48 (DREL Lab Manual)	DR/2000
Hardness	10-4000 mg/L as CaCO3	Method 8213, pages 49-53 (DREL Lab Manual)	Digital Titrator
Iodine	0-7 mg/L as I2	Method 8031, pages 207-208, 211 (Supplemental Methods)	DR/2000
Iron, Total	0-3 mg/L as Fe FV	Method 8008, pages 55-56, 59-60 (DREL Lab Manual)	DR/2000
Nitrogen, Ammonia	0-0.50 mg/L	Method 8155, pages 71-75 (DREL Lab Manual)	DR/2000
Nitrogen, Nitrate (*)	0-30 mg/L as NO3- -N	Method 8039, pages 61-63, 66-69 (DREL Lab Manual)	DR/2000
pH (*)	0-14 pH	Method 8156, pages 83-85 (DREL Lab Manual)	Hach One Laboratory pH Instrument
pH (*)	0-14 pH	Method 8156, pages 83-85 (DREL Lab Manual)	Hach One Portable pH Instrument
Phosphorus, Reactive	0-2.5 mg/L as PO4---	Method 8048, pages 89-90, 93-96 (DREL Lab Manual)	DR/2000
Phosphorus, Total	0-2.5 mg/L	Method 8180, pages 87-90, 93-96 (DREL Lab Manual)	DR/2000
Sulfate	0-70 mg/L SO4--	Method 8051, pages 97-98, 100-101 (DREL Lab Manual)	DR/2000
Total Dissolved Solids	10-1999 mg/L TDS	Pocket Pal Method, pages 33-36 (DREL Lab Manual)	Pocket Conductivity/TDS Meter
Total Dissolved Solids	10-1999 mg/L TDS	Pages 10-13 (Portable Conductivity/TDS Instrument Manual)	Portable Conductivity/TDS Meter
Turbidity (*)	0-1000 NTU	Pages 4-13 (2100N Instrument Manual)	2100N Turbidimeter Instrument
Turbidity (*)	0-1000 NTU	Pages 103-104 (2100P Instrument Manual)	2100P Turbidimeter Instrument
Total Coliform (*)		Method 8074, pages 19-24, 38-40 (MEL/MF Laboratory Manual)	MEL/MF Laboratory

(*) Denotes Analytical Parameter Being Supplied With Extended Quantity of Reagents

ATTACHMENT 1

Hach Instruments and Reagents
For Uzbekistan Laboratories

The following analytical methods (and reagents) are provided with the DR/2000 Spectrophotometer to Nukus SES laboratory:

Chlorine, Free	Method 8021	0 - 2.00 mg/L	(DR/2000 Lab Manual, Pages 85-96, 99-100)
Nitrate, MR	Method 8171	0 - 4.5 mg/L	(DR/2000 Lab Manual, Pages 323-324, 329-330)

The following analytical methods (and reagents) were provided to the Nukus and Urgench WTP Laboratories:
The list includes methods applicable to the DR/2000 spectrophotometer, pH, turbidimeter, titrator, conductivity, and microbiological.
The methods denotes with (*) were supplied with extended quantity of reagents.

Alkalinity (*)	10-4000 mg/L as CaCO3	Method 8203, pages 1-5 (DREL Lab Manual)	Digital Titrator
Bromine	0-4.5 mg/L as Br2	Method 8016, pages 79-80, 83-84 (Supplement Methods)	DR/2000
Carbon Dioxide	10-1000 mg/L as CO2	Method 8205, pages 7-9 (DREL Lab Manual)	Digital Titrator
Chloride	10-10,000 mg/L as Cl-	Method 8207, pages 11-14 (DREL Lab Manual)	Digital Titrator
Chlorine, Free (*)	0-2 mg/L as Cl2	Method 8021, pages 15-18, 19-20 (DREL Lab Manual)	DR/2000
Chlorine, Free (*)	0-2 mg/L as Cl2	Method 8021, pages 19-22, 26-28 (DREL Lab Manual)	Pocket Colorimeter
Chlorine, Total, High Range (*)	0-4.5 mg/L as Cl2	Method 8167, pages 37-43 (DREL Lab Manual)	Pocket Colorimeter
Chlorine, Total, Low Range (*)	0-2 mg/L as Cl2	Method 8167, pages 21-22, 25-26 (DREL Lab Manual)	DR/2000
Chlorine, Total, Low Range (*)	0-2 mg/L as Cl2	Method 8167, pages 29-32, 26-28 (DREL Lab Manual)	Pocket Colorimeter
Chromium, Hexavalent	0-0.60 mg/L as Cr6+	Method 8023, pages 27-28, 31 (DREL Lab Manual)	DR/2000
Conductivity (*)	0.2-4.0 mS/cm	Pocket Pal Method, pages 33-36 (DREL Lab Manual)	Pocket Conductivity/TDS Meter
Conductivity (*)	0.2-4.0 mS/cm	Pages 10-13 (Portable Conductivity/TDS Instrument Manual)	Portable Conductivity/TDS Meter
Copper, Complexed & Free	0-5 mg/L as Cu Bicn	Method 8506, pages 3738, 41-42 (DREL Lab Manual)	DR/2000
Dissolved Oxygen	1-10+ mg/L DO	Method 8332, pages 79-82 (DREL Lab Manual)	Digital Titrator
Fluoride	0-2 mg/L as F-	Method 8029, pages 43-44, 47-48 (DREL Lab Manual)	DR/2000
Hardness	10-4000 mg/L as CaCO3	Method 8213, pages 49-53 (DREL Lab Manual)	Digital Titrator
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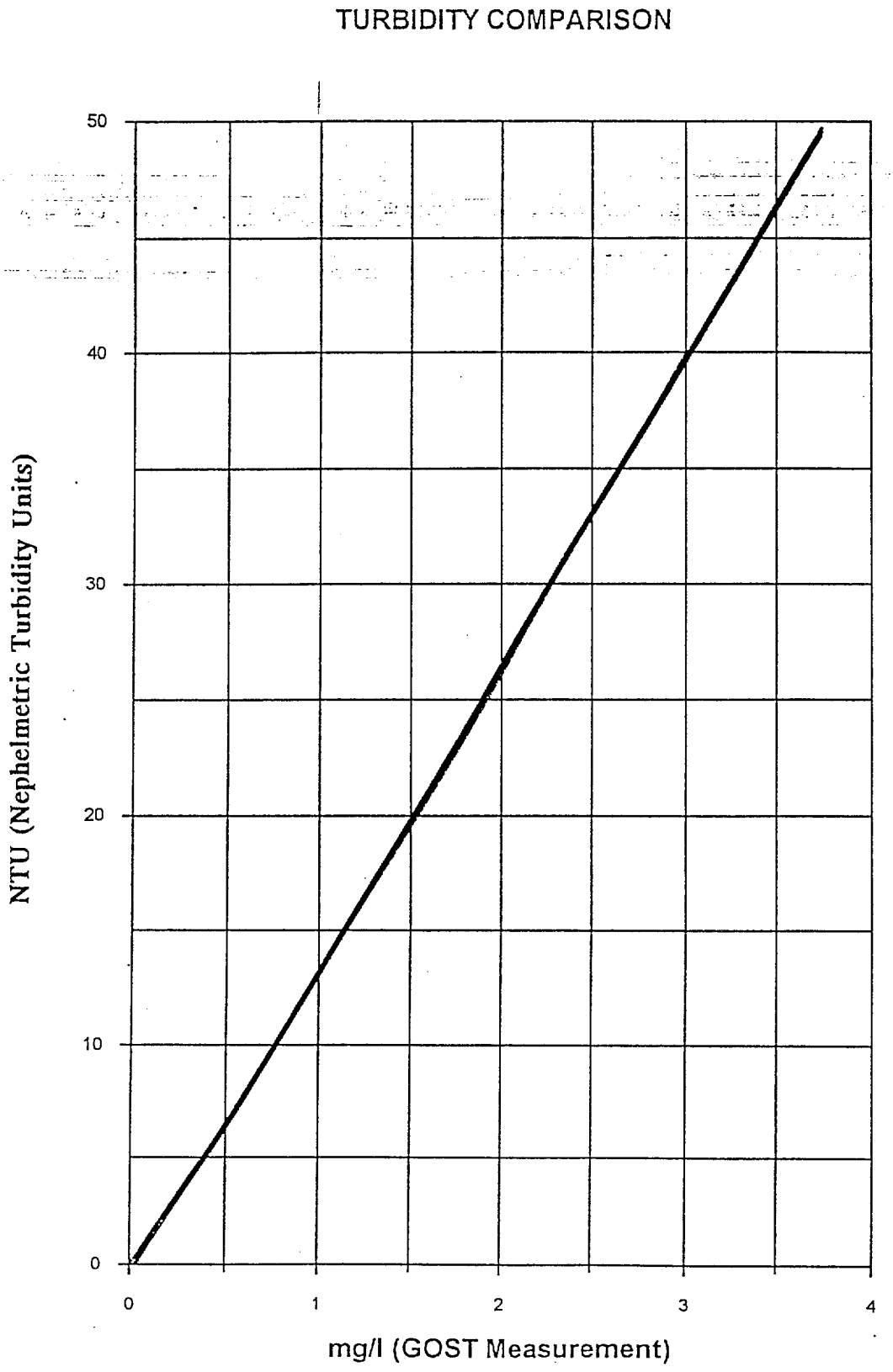
Iron, Total	0-3 mg/L as Fe FV	Method 8008, pages 55-56, 59-60 (DREL Lab Manual)	DR/2000
Nitrogen, Ammonia	0-0.50 mg/L	Method 8155, pages 71-75 (DREL Lab Manual)	DR/2000
Nitrogen, Nitrate (*)	0-30 mg/L as NO3- -N	Method 8039, pages 81-83, 88-89 (DREL Lab Manual)	DR/2000
pH (*)	0-14 pH	Method 8156, pages 83-85 (DREL Lab Manual)	Hach One Laboratory pH Instrument
pH (*)	0-14 pH	Method 8156, pages 83-85 (DREL Lab Manual)	Hach One Portable pH Instrument
Phosphorus, Reactive	0-2.5 mg/L as PO4---	Method 8048, pages 89-90, 93-96 (DREL Lab Manual)	DR/2000
Phosphorus, Total	0-2.5 mg/L	Method 8180, pages 87-90, 93-96 (DREL Lab Manual)	DR/2000
Sulfate	0-70 mg/L SO4--	Method 8051, pages 97-98, 100-101 (DREL Lab Manual)	DR/2000
Total Dissolved Solids	10-1999 mg/L TDS	Pocket Pal Method, pages 33-36 (DREL Lab Manual)	Pocket Conductivity/TDS Meter
Total Dissolved Solids	10-1999 mg/L TDS	Pages 10-13 (Portable Conductivity/TDS Instrument Manual)	Portable Conductivity/TDS Meter
Turbidity (*)	0-1000 NTU	Pages 4-13 (2100N Instrument Manual)	2100N Turbidimeter Instrument
Turbidity (*)	0-1000 NTU	Pages 103-104 (2100P Instrument Manual)	2100P Turbidimeter Instrument
Total Coliform (*)		Method 8074, pages 19-24, 38-40 (MEL/MF Laboratory Manual)	MEL/MF Laboratory

ATTACHMENT 2

The following analytical methods can be accomplished with the DR/20000, but may not included in the above lists:

Aluminium, Alumnon Method
Amluminum, ECR Method
Arsenic, Silver Diethyldithiocarboate Method
Barium, Turbidimetric Method
Benzotriazole or Tolyltriazole, UV Photolysis Method
Boron, Carmine Method
Bromine, DOD Method
Cadmium, Dithizone Method
Chloride, Mercuric Thiocyanate Method
Chlorine, Free, DPD Method
Chlorine, Total, DPD MEthod
Chlorine, Total, Ultra Low Range for Clean Water, Low in Color and Turbidity
Chlorine, Total, Ultra Low Range, for Treated Waters
Chlorine Dioxide, LR, Chlorophenol Red Method
Chromium, Hexavalent, 1,5 Diphenylcarbohydrazide Method
Chromium, Total, Alkaline Hypobromite Oxidation Method
Cobalt, P.A.N. Method
Color, True and Apparent, APHA Pt-Co Method
Copper, Autocatalytic
Copper, Bicinchoninate Method
Copper, Porphyrin Method
Cyanide, Pyridine-Pyrazalone Method
Cyanide, Pyridine-Pyrazalone Method
Cyanuric Acid
DEHA, Iron Reduction Method
Fluoride, SPADNS Method
Formaldehyde, MBTH Method
Hardness, Calcium and Magnesium, Colorimetric Calmagite Method
Hardness, Ultra Low Range, Chlorophosphonazo method
Hydrazine, p-dimethylaminobenzaldehyde Method
Iodine, DPD Method
Iron, Ferrous, 1,10-phenanthroline Method
Iron, Ferrozine Method
Iron, Total, FerroVer Method
Iron, Total, TPTZ Method
Lead, Dithizone Method
Lead, Fast Column Extraction Method
Manganese, HR, Periodate Oxidation Method
Manganese, LR, P.A.N. Method
Molybdenum, Molybdate, HR, Mercaptoacetic Acid Method
Molybdenum, Molybdate, LR, Ternary Complex Method
Nickel, Heptoxime Method
Nickel, P.A.N. Method
Nitrate, HR, Cadmium Reduction Method
Nitrate, LR, Cadmium Reduction Method
Nitrate, MR, Cadmium Reduction Method
Nitrite, HR, Ferrous Sulfate Method
Nitrite, LR, Diazotization Method
Nitrogen, Ammonia, Nessler Method
Nitrogen, Ammonia, Salicylate Method
Nitrogen, Total Kjeldahl, Nessler Method
Oil in Water, Colorimetric Method
Oxygen, Disolved, HR, HRDO Method
Oxygen, Dissolved, LR, Indigo Carmine Method
Oxygen, Dissolved, SHR, SHRDO Method
Oxygen Demand, Chemical, Dichromate Reflux Method
Oxygen Demand, Chemical, Reactor Digestion Method
Ozone, Indigo Trisulfonate Method
Palladium, N,N'Dimethyldithiooxamide Method
Phenols, 4,Aminoantipyrine Method
Phosphonates, Persulfate UV Oxidation Method
Phosphorus, Reactive, Amino Acid Method
Phosphorus, Acid Hydrolyzable Method
Phosphorus, Reactive, Molybdovanadate Method
Phosphorus, Reactive, Ascorbic Acid Method
Phosphorus, Total
Polyacrylic Acid, Adsorption-Colorimetric Method
Potassium, Tetraphenylborate Method
Quaternary Ammonium Compounds, Direct Binary Complex Method
Selenium, Diaminobenzidene Method
Silica, HR, Silicomolybdate Method
Silica, LR, Heteropoly Blue Method
Silica, Ultra Low Range, Heteropoly Blue Method
Silver, Colorimetric Method
Sodium Chromate, Direct Colorimetric Method
Suspended Solids, Photometric Method
Sulfate, SulfaVer Method
Sulfide, Methylene Blue Method
Surfactants, Anionic, Crystal Violet Method
Tannin and Lignin, Tyrosine Method
Volatile Acids, Esterification Method
Zinc, Zincon Method


TURBIDITY COMPARISON
NTU (Nephelmetric Turbidity Units)
50
40
30
20
10
0
0
1
2
3
4
mg/l (GOST Measurement)

Laboratory Method Comparison Record (pH)

Date	Sample ID	SES pH	Hach pH	Date	Sample ID	SES pH	Hach pH	Date	Sample ID	SES pH	Hach pH	Date	Sample ID	SES pH	Hach pH

ATTACHMENT GROUP 4

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Laboratory Method Comparison Record (Turbidity)

Date	Sample ID	SES Turb (mg/L)	Hach Turb (NTU)	Date	Sample ID	SES Turb (mg/L)	Hach Turb (NTU)	Date	Sample ID	SES Turb (mg/L)	Hach Turb (NTU)	Date	Sample ID	SES Turb (mg/L)	Hach Turb (NTU)

Laboratory Method Comparison Record (Chlorine, Free, mg/L Cl2)

Date	Sample ID	SES Cl2 (mg/L)	Hach Cl2 (mg/L)	Date	Sample ID	SES Cl2 (mg/L)	Hach Cl2 (mg/L)	Date	Sample ID	SES Cl2 (mg/L)	Hach Cl2 (mg/l)	Date	Sample ID	SES Cl2 (mg/L)	Hach Cl2 (mg/L

Laboratory Method Comparison Record (Nitrate, mg/L N NO4)

Date	Sample ID	SES NO4 (mg/L)	Hach NO4 (mg/L)	Date	Sample ID	SES NO4 (mg/L)	Hach NO4 (mg/L)	Date	Sample ID	SES NO4 (mg/L)	Hach NO4 (mg/l)	Date	Sample ID	SES NO4 (mg/L)	Hach NO4 (mg/L

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Laboratory Method Comparison Record (Alkalinity, mg/l as CaCO3)

Date	Sample ID	SES Alk (mg/L)	Hach Alk (mg/L)	Date	Sample ID	SES Alk (mg/L)	Hach Alk (mg/L)	Date	Sample ID	SES Alk (mg/L)	Hach Alk (mg/l)	Date	Sample ID	SES Alk (mg/L)	Hach Alk (mg/L

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Laboratory Method Comparison Record (Hardness, Hdn, mg/L CaCO3)

Date	Sample ID	SES Hdn (mg/L)	Hach Hdn (mg/L)	Date	Sample ID	SES Hdn (mg/L)	Hach Hdn (mg/L)	Date	Sample ID	SES Hdn (mg/L)	Hach Hdn (mg/l)	Date	Sample ID	SES Hdn (mg/L)	Hach Hdn (mg/L

Laboratory Method Comparison Record (Chloride, mg/L Cl)

Date	Sample ID	SES Cl (mg/L)	Hach Cl (mg/L)	Date	Sample ID	SES Cl (mg/L)	Hach Cl (mg/L)	Date	Sample ID	SES Cl (mg/L)	Hach Cl (mg/l)	Date	Sample ID	SES Cl (mg/L)	Hach Cl (mg/L

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INVENTORY OF LABORATORY EQUIPMENT
(NUKUS SES LABORATORY)

44800-60	DR/2000 Spectrophotometer
30331-00	Case Assembly, HC-7
20950-00	Sample Cell, Match Pair
14034-99	NitraVer 5 Powder Pillows, 25 ml, 100/pk
14070-99	DPD Free Chlorine 25 ml, 100/pk
46647-00	Lamp Assembly

INVENTORY OF LABORATORY EQUIPMENT
(NUKUS WTP)

	45250-19	**Basic Water Quality Laboratory**
2 ea	1057-66	Chloride 2 Indicator Powder Pillows
2 ea	12065-66	SulfaVer 4 Powder Pillows
2 ea	12066-66	ChromaVer Powder Pillows
1 ea	1269-39	Silicon Oil, 15 ml
2 ea	14034-46	NitrVer 5 Powder Pillows
1 ea	14064-49	DPD Total Chlorine Powder Pillows
1 ea	14070-49	DPD Free Chlorine Powder Pillows
1 ea	14299-00	Demineralizer Bottle
1 ea	14364-01	TitraVer EDTA Cartridge, 0.0800M
1 ea	14378-01	Sodium Hydroxide Cartridge 0.3636N
1 ea	14380-01	Sodium Hydroxide Cartridge, 3.63600N
1 ea	14388-01	Sulfuric Acid Cartridge, 0.1600N
1 ea	14389-01	Sulfuric Acid Cartridge, 1.6N
1 ea	14396-01	Silver Nitrate Cartridge, 0.2256N
1 ea	14397-01	Silver Nitrate Cartridge1.128N
1 ea	14399-01	TitraVer EDTA Cartridge 0.8M
1 ea	14651-00	Safety Bulb
1 ea	16900-02	Digital Titrator
1 ea	17205-00	Delivery Tubes, 5/pk
1 ea	1877-01	Thermometer, -20 deg to 105 deg C
1 ea	1896-41	Cylinder, Mixing, 50 ml
1 ea	1909-02	Bottle, BOD, 60 ml
1 ea	20950-00	Sample Cells, DR/2000
2 ea	2118-02	Stopper, Rubber #2, 12/pk
2 ea	2125-46	PhosVer 3 Powder Pillows
1 ea	2179-00	Stove Cover
2 ea	21882-46	CuVer 2 Powder Pillows
1 ea	2206-00	Stove w/Fuel Tablets
1 ea	22675-01	Sodium Thiosulfate Cartridge, 0.2N
4 ea	23953-68	Ammonia Salicylate Powder Pillows
4 ea	23955-68	Ammonia Cyanurate Powder Pillows
1 ea	2449-32	Sulfuric Acid, 5.25N
1 ea	2450-32	Sodium Hydroxide, 5.0N
1 ea	2461-14	Formazin, 4000 NTU
1 ea	24641-05	Turbidity Standard Kit
1 ea	424-32	Hardness 1 Buffer Solution
NOTE BELOW	43800-00	pH Meter
2 ea	444-42	SPADNS Reagent Solution
1 ea	44400-00	TDS Pocket Pal
NOTE BELOW	44800-00	DR/2000 Spectrophotometer
NOTE BELOW	46500-00	2100P Turbidmeter
1 ea	505-41	Flask, Erlenmeyer, 50 ml
1 ea	505-46	Flask, Erlenmeyer, 250 ml
1 ea	690-00	Brush, Test Tube
2 ea	851-99	ManVer 2 Powder Pollows
1 ea	854-49	FerroVer Powder Pillows
1 ea	942-49	Phenolphthalein Powder Pillows
1 ea	943-49	Bromcresol Green-Methyl Red Powder Pillows
1 ea	981-99	Dissolved Oxygen 1 Powder Pillows
1 ea	982-99	Dissolved Oxygen 2 POwder Pillows
4 ea	987-68	Dissolved Oxygen 3 Powder Pillows

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	44800-60	DR/2000 Spectrophotometer
	43800-00	Portable Hach One pH Meter, Kit
1 ea	21950-01	Electrolyte Solution Cartridge
10 ea	22992-64	Buffer Powder Pillows, pH 4 (red), pH 7 (yellow)
2 ea	22994-42	Beaker, 100 ml
1 ea	4380-88	Hach One pH Meter Instruction Manual
1 ea	43816-88	Battery, 6v
1 ea	44200-21	Hach One Combination pH Electrode w/Temp Sensor, BNC Connectro, 36" Cable
1 ea	44701-44	Card, Reference
1 ea	968-00	Clipper, Large
	44600-00	Conductivity/TDS Meter
4 ea	19380-04	Battery, Alkaline, (AA)
1 ea	44600-88	Conductivity/TDS Meter Instruction Manual
1 ea	44606-00	Probe, Conductivity
	19700-10	TenSette Pipet
1 ea	19700-08	TenSette Instruction Manual
1 ea	21997-96	Pipet Tips, 50/pk
	46500-00	Portable Turbidimeter
1 ea	1269-36	Silicone Oil, 15 ml
1 ea	19380-04	Battery, 4/pk, (AA)
1 ea	24347-06	Sample Cells, 1" w/Cap, 6/pk
1 ea	2461-42	Formazine, 4000 NTU, 100 ml
1 ea	24641-05	Gelex Standards, Set
1 ea	41093-00	Mounting Feet,4/pk
1 ea	46005-00	Battery Door
1 ea	46500-88	Portable Turbidimeter Instruction Manual
1 ea	46539-00	Lamp Assembly, w/Leads
	16900-01	Digital Titrator Kit
1 ea	16900-08	Digital Titrator Instruction Manual
1 ea	17295-00	Delivery Tubes, Straight
	47000-02	2100N Laboratory Turbidimeter
1 ea	1269-36	Silicone Oil, 15 ml Dropper Bottle
1 ea	20849-00	Sample Cells,6/pk
1 ea	2461-42	Formazine Primary Turbidity Stock Solution, 4000 NTU, 100 ml
1 ea	25890-00	Gelex Secondary Turbidity Standardization Kit
1 ea	25891-00	Stray Light Standard
1 ea	25891-01	Gelex, 0-2 NTU Standard
1 ea	25891-02	Gelex, 0-20 NTU Standard
1 ea	25891-03	Gelex, 0-200 NTU Standard
1 ea	25891-04	Gelex, 200-4000 NTU Standard
1 ea	46836-00	Power Cord, 230 Vac
1 ea	47000-44	Reference Card
1 ea	47000-88	2100N Instruction Manual
1 ea	47030-00	Dust Cover
1 ea	47032-00	Cover, Lamp Compartment

	47089-00	Lamp Assembly
1 ea	47089-00	Oiling Cloth
1 ea	47713-00	Cover Assembly, Sample Cell Compartment

	46700-00	**Pocket Colorimeter (Chlorine)**
2 ea	21261-02	Sample Cell, 1-cm, w/Cap
2 ea	24276-06	Sample Cell, 10-ml, w/Cap
1 ea	46704-00	Instrument Cap/Light Shild
1 ea	46739-00	Adapter, 1-cm Cell
1 ea	46743-00	Battery, Akaline, (AAA)
1 ea	46760-88	Pocket Colorimeter Instruction Manual

	44701-00	**Laboratory pH Instrument**
4 ea	17074-00	Battery, Alkaline, C (4 required)
1 ea	18010-00	Power Cord
1 ea	21950-00	Reference Electrode Solution Cartridge
10 ea	22992-64	Buffer Powder Pillows, pH 4 & pH 7
2 ea	22994-42	Beaker, 100 ml
1 ea	23138-01	Dust Cover
1 ea	44200-21	Electrode Assembly, Hach One Combination pH w/Temp Sensor
1 ea	44701-44	Reference Card
1 ea	44701-88	Lab pH Instrument Instruction Manual
1 ea	44789-00	Fuse, 1/32 A (230 Vac Service)
1 ea	968-00	Clippers, Large

	25697-00	**MEL/MF Laboratory**
3 ea	13530-01	Membrane Filter, 0.45 u, 72/pk (w/ MEL/MF Lab)
2 ea	14717-99	Petri Dish w/Pad, 100/pk (w/ MEL/MF Lab)
1 ea	1877-01	Pocket Thermometer (w/ MEL/MF Lab)
2 ea	20753-33	Whirlpak Bags, 100/pk (w/ MEL/MF Lab)
1 ea	20877-60	Alcohol Burner (w/ MEL/MF Lab)
1 ea	20920-00	Laboratory Pen (w/ MEL/MF Lab)
1 ea	21411-00	Forceps (w/ MEL/MF Lab)
10 ea	23735-20	m-Endo Broth Ampules, 20/pk (w/ MEL/MF Lab)
5 ea	24632-00	Germicidal Cloth (w/ MEL/MF Lab)
1 ea	24846-00	Ampule Breaker (w/ MEL/MF Lab)
1 ea	25681-00	Vacuum Syringe (w/ MEL/MF Lab)
1 ea	25699-00	Portable Incubator (w/ MEL/MF Lab)
1 ea	25699-88	MEL/MF Procedures Manual (w/ MEL/MF Lab)
1 ea	25805-02	MF Dish (w/ MEL/MF Lab)
1 ea	25854-00	Portable Illuminated Magnifier (w/ MEL/MF Lab)
1 ea	25862-00	Field Vacuum Support (w/ MEL/MF Lab)
3 ea	25863-00	Push-Fit Funnels, 72/pk (w/ MEL/MF Lab)

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Additional Reagents and Supplies

15 ea	14034-99	NitraVer 5 Powder Reagents, 100/pk
19 ea	14070-99	DPD Free Chlorine Reagent, 100/pk
10 ea	14400-42	Sodium Chloride Solution, 491 mg/l, 100 ml
2 ea	14574-42	Flask, Volumetric, 100 ml
2 ea	14574-45	Flask, Volumetric, 200 ml
2 ea	17074-00	Battery, Alkaline, 1.5v, C Size
4 ea	19380-04	Battery, Alkaline, 1.5v, 4/pk (AA)
1 ea	19700-10	Tensette Pipet, 1-10 ml
5 ea	20849-00	Sample Cell, 6/pk, Lab Turbidmeter
5 ea	20950-00	Sample Cell, Matched Pair
4 ea	21950-01	Hach One Reference Electrolyte Cartridge
2 ea	21997-96	Pipet Tip, 50/pk
15 ea	22719-00	Reagent Set, Alkalinity
20 ea	22834-49	Buffer Solution, pH 4, Red
20 ea	22835-49	Buffer Solution, pH 7, Yellow
20 ea	22836-49	Buffer Solution, pH 10, Blue
5 ea	23678-00	Battery zinc-Air, 1.4v, 4/pk
5 ea	24276-06	Sample Cell, 6/pk, 25x60mm, 10 ml Mark, Pocket Colorimeter
2 ea	24347-06	Sample Cell, 6/pk, 2100P Turbidmeter
20 ea	2461-42	Formazin Turbidity Standard, 4000 NTU, 100 ml
1 ea	25697-00	MEL/MF Laboratory
4 ea	25801-00	MEL/MF Reagent Sets
1 ea	25803-00	Battery Pack, 12V, w/Charger
1 ea	25959-02	Recharger Adaptor w/230/Adapter
2 ea	43816-00	Battery, Alkaline, 6v
1 ea	44600-00	Conductivity/TDS Meter
1 ea	44701-00	Laboratory pH Meter Kit
1 ea	45250-19	Basic Water Quality Laboratory
1 ea	46539-00	Lamp Assembly, Portable Turbidmeter
1 ea	46647-00	Lamp Assembly, DR2000 Spec
1 ea	46700-02	Pocket Colorimeter Kit (Chlorine)
2 ea	46743-00	Battery, Alkaline, 1.5v, 4/pk (AAA), Pocket Colorimeter
1 ea	47000-02	Laboratory Turbidmeter Kit
1 ea	47089-00	Lamp Assembly, Laboratory Turbidmeter
1 ea	505-53	Flask, Erlenmeyer, 1000 ml

INVENTORY OF LABORATORY EQUIPMENT
(URGENCH WTP)

	45250-19	Basic Water Quality Laboratory
2 ea	1057-66	Chloride 2 Indicator Powder Pillows
2 ea	12065-66	SulfaVer 4 Powder Pillows
2 ea	12066-66	ChromaVer Powder Pillows
1 ea	1269-39	Silicon Oil, 15 ml
2 ea	14034-46	NitrVer 5 Powder Pillows
1 ea	14064-49	DPD Total Chlorine Powder Pillows
1 ea	14070-49	DPD Free Chlorine Powder Pillows
1 ea	14299-00	Demineralizer Bottle
1 ea	14364-01	TitraVer EDTA Cartridge, 0.0800M
1 ea	14378-01	Sodium Hydroxide Cartridge 0.3636N
1 ea	14380-01	Sodium Hydroxide Cartridge, 3.63600N
1 ea	14388-01	Sulfuric Acid Cartridge, 0.1600N
1 ea	14389-01	Sulfuric Acid Cartridge, 1.6N
1 ea	14396-01	Silver Nitrate Cartridge, 0.2256N
1 ea	14397-01	Silver Nitrate Cartridge1.128N
1 ea	14399-01	TitraVer EDTA Cartridge 0.8M
1 ea	14651-00	Safety Bulb
1 ea	16900-02	Digital Titrator
1 ea	17205-00	Delivery Tubes, 5/pk
1 ea	1877-01	Thermometer, -20 deg to 105 deg C
1 ea	1896-41	Cylinder, Mixing, 50 ml
1 ea	1909-02	Bottle, BOD, 60 ml
1 ea	20950-00	Sample Cells, DR/2000
2 ea	2118-02	Stopper, Rubber #2, 12/pk
2 ea	2125-46	PhosVer 3 Powder Pillows
1 ea	2179-00	Stove Cover
2 ea	21882-46	CuVer 2 Powder Pillows
1 ea	2206-00	Stove w/Fuel Tablets
1 ea	22675-01	Sodium Thiosulfate Cartridge, 0.2N
4 ea	23953-68	Ammonia Salicylate Powder Pillows
4 ea	23955-68	Ammonia Cyanurate Powder Pillows
1 ea	2449-32	Sulfuric Acid, 5.25N
1 ea	2450-32	Sodium Hydroxide, 5.0N
1 ea	2461-14	Formazin, 4000 NTU
1 ea	24641-05	Turbidity Standard Kit
1 ea	424-32	Hardness 1 Buffer Solution
NOTE BELOW	43800-00	pH Meter
2 ea	444-42	SPADNS Reagent Solution
1 ea	44400-00	TDS Pocket Pal
NOTE BELOW	44800-00	DR/2000 Spectrophotometer
NOTE BELOW	46500-00	2100P Turbidmeter
1 ea	505-41	Flask, Erlenmeyer, 50 ml
1 ea	505-46	Flask, Erlenmeyer, 250 ml
1 ea	690-00	Brush, Test Tube
2 ea	851-99	ManVer 2 Powder Pollows
1 ea	854-49	FerroVer Powder Pillows
1 ea	942-49	Phenolphthalein Powder Pillows
1 ea	943-49	Bromcresol Green-Methyl Red Powder Pillows
1 ea	981-99	Dissolved Oxygen 1 Powder Pillows
1 ea	982-99	Dissolved Oxygen 2 POwder Pillows
4 ea	987-68	Dissolved Oxygen 3 Powder Pillows

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	44800-60	DR/2000 Spectrophotometer
	43800-00	Portable Hach One pH Meter, Kit
1 ea	21950-01	Electrolyte Solution Cartridge
10 ea	22992-64	Buffer Powder Pillows, pH 4 (red), pH 7 (yellow)
2 ea	22994-42	Beaker, 100 ml
1 ea	4380-88	Hach One pH Meter Instruction Manual
1 ea	43816-88	Battery, 6v
1 ea	44200-21	Hach One Combination pH Electrode w/Temp Sensor, BNC Connectro, 36" Cable
1 ea	44701-44	Card, Reference
1 ea	968-00	Clipper, Large
	44600-00	Conductivity/TDS Meter
4 ea	19380-04	Battery, Alkaline, (AA)
1 ea	44600-88	Conductivity/TDS Meter Instruction Manual
1 ea	44606-00	Probe, Conductivity
	19700-10	TenSette Pipet
1 ea	19700-08	TenSette Instruction Manual
1 ea	21997-96	Pipet Tips, 50/pk
	46500-00	Portable Turbidimeter
1 ea	1269-36	Silicone Oil, 15 ml
1 ea	19380-04	Battery, 4/pk, (AA)
1 ea	24347-06	Sample Cells, 1" w/Cap, 6/pk
1 ea	2461-42	Formazine, 4000 NTU, 100 ml
1 ea	24641-05	Gelex Standards, Set
1 ea	41093-00	Mounting Feet,4/pk
1 ea	46005-00	Battery Door
1 ea	46500-88	Portable Turbidimeter Instruction Manual
1 ea	46539-00	Lamp Assembly, w/Leads
	16900-01	Digital Titrator Kit
1 ea	16900-08	Digital Titrator Instruction Manual
1 ea	17295-00	Delivery Tubes, Straight
	47000-02	2100N Laboratory Turbidimeter
1 ea	1269-36	Silicone Oil, 15 ml Dropper Bottle
1 ea	20849-00	Sample Cells,6/pk
1 ea	2461-42	Formazine Primary Turbidity Stock Solution, 4000 NTU, 100 ml
1 ea	25890-00	Gelex Secondary Turbidity Standardization Kit
1 ea	25891-00	Stray Light Standard
1 ea	25891-01	Gelex, 0-2 NTU Standard
1 ea	25891-02	Gelex, 0-20 NTU Standard
1 ea	25891-03	Gelex, 0-200 NTU Standard
1 ea	25891-04	Gelex, 200-4000 NTU Standard
1 ea	46836-00	Power Cord, 230 Vac
1 ea	47000-44	Reference Card
1 ea	47000-88	2100N Instruction Manual
1 ea	47030-00	Dust Cover
1 ea	47032-00	Cover, Lamp Compartment

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	47089-00	Lamp Assembly
1 ea	47089-00	Oiling Cloth
1 ea	47713-00	Cover Assembly, Sample Cell Compartment

	46700-00	**Pocket Colorimeter (Chlorine)**
2 ea	21261-02	Sample Cell, 1-cm, w/Cap
2 ea	24276-06	Sample Cell, 10-ml, w/Cap
1 ea	46704-00	Instrument Cap/Light Shild
1 ea	46739-00	Adapter, 1-cm Cell
1 ea	46743-00	Battery, Akaline, (AAA)
1 ea	46760-88	Pocket Colorimeter Instruction Manual

	44701-00	**Laboratory pH Instrument**
4 ea	17074-00	Battery, Alkaline, C (4 required)
1 ea	18010-00	Power Cord
1 ea	21950-00	Reference Electrode Solution Cartridge
10 ea	22992-64	Buffer Powder Pillows, pH 4 & pH 7
2 ea	22994-42	Beaker, 100 ml
1 ea	23138-01	Dust Cover
1 ea	44200-21	Electrode Assembly, Hach One Combination pH w/Temp Sensor
1 ea	44701-44	Reference Card
1 ea	44701-88	Lab pH Instrument Instruction Manual
1 ea	44789-00	Fuse, 1/32 A (230 Vac Service)
1 ea	968-00	Clippers, Large

	25697-00	**MEL/MF Laboratory**
3 ea	13530-01	Membrane Filter, 0.45 u, 72/pk (w/ MEL/MF Lab)
2 ea	14717-99	Petri Dish w/Pad, 100/pk (w/ MEL/MF Lab)
1 ea	1877-01	Pocket Thermometer (w/ MEL/MF Lab)
2 ea	20753-33	Whirlpak Bags, 100/pk (w/ MEL/MF Lab)
1 ea	20877-60	Alcohol Burner (w/ MEL/MF Lab)
1 ea	20920-00	Laboratory Pen (w/ MEL/MF Lab)
1 ea	21411-00	Forceps (w/ MEL/MF Lab)
10 ea	23735-20	m-Endo Broth Ampules, 20/pk (w/ MEL/MF Lab)
5 ea	24632-00	Germicidal Cloth (w/ MEL/MF Lab)
1 ea	24846-00	Ampule Breaker (w/ MEL/MF Lab)
1 ea	25681-00	Vacuum Syringe (w/ MEL/MF Lab)
1 ea	25699-00	Portable Incubator (w/ MEL/MF Lab)
1 ea	25699-88	MEL/MF Procedures Manual (w/ MEL/MF Lab)
1 ea	25805-02	MF Dish (w/ MEL/MF Lab)
1 ea	25854-00	Portable Illuminated Magnifier (w/ MEL/MF Lab)
1 ea	25862-00	Field Vacuum Support (w/ MEL/MF Lab)
3 ea	25863-00	Push-Fit Funnels, 72/pk (w/ MEL/MF Lab)

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Additional Reagents and Supplies

15 ea	14034-99	NitraVer 5 Powder Reagents, 100/pk
19 ea	14070-99	DPD Free Chlorine Reagent, 100/pk
10 ea	14400-42	Sodium Chloride Solution, 491 mg/l, 100 ml
2 ea	14574-42	Flask, Volumetric, 100 ml
2 ea	14574-45	Flask, Volumetric, 200 ml
2 ea	17074-00	Battery, Alkaline, 1.5v, C Size
4 ea	19380-04	Battery, Alkaline, 1.5v, 4/pk (AA)
1 ea	19700-10	Tensette Pipet, 1-10 ml
5 ea	20849-00	Sample Cell, 6/pk, Lab Turbidmeter
5 ea	20950-00	Sample Cell, Matched Pair
4 ea	21950-01	Hach One Reference Electrolyte Cartridge
2 ea	21997-96	Pipet Tip, 50/pk
15 ea	22719-00	Reagent Set, Alkalinity
20 ea	22834-49	Buffer Solution, pH 4, Red
20 ea	22835-49	Buffer Solution, pH 7, Yellow
20 ea	22836-49	Buffer Solution, pH 10, Blue
5 ea	23678-00	Battery zinc-Air, 1.4v, 4/pk
5 ea	24276-06	Sample Cell, 6/pk, 25x60mm, 10 ml Mark, Pocket Colorimeter
2 ea	24347-06	Sample Cell, 6/pk, 2100P Turbidmeter
20 ea	2461-42	Formazin Turbidity Standard, 4000 NTU, 100 ml
1 ea	25697-00	MEL/MF Laboratory
4 ea	25801-00	MEL/MF Reagent Sets
1 ea	25803-00	Battery Pack, 12V, w/Charger
1 ea	25959-02	Recharger Adaptor w/230/Adapter
2 ea	43816-00	Battery, Alkaline, 6v
1 ea	44600-00	Conductivity/TDS Meter
1 ea	44701-00	Laboratory pH Meter Kit
1 ea	45250-19	Basic Water Quality Laboratory
1 ea	46539-00	Lamp Assembly, Portable Turbidmeter
1 ea	46647-00	Lamp Assembly, DR2000 Spec
1 ea	46700-02	Pocket Colorimeter Kit (Chlorine)
2 ea	46743-00	Battery, Alkaline, 1.5v, 4/pk (AAA), Pocket Colorimeter
1 ea	47000-02	Laboratory Turbidmeter Kit
1 ea	47089-00	Lamp Assembly, Laboratory Turbidmeter
1 ea	505-53	Flask, Erlenmeyer, 1000 ml

INTERNATIONAL GUIDELINES FOR WATER QUALITY

Drinking water standards. GOST 2674–82

Microbiological indicators

Indicator	Standard	Method of testing
Number of microorganism in 1mm3 of water	100	GOST 18963–73
Number of bacteria of E.coli in 1 l of water (coli–index)	3	GOST 18963–73

Chemical indicators

Chemical component	Standard	Method of testing
Aluminum residual (Al)	0.5	GOST 18165–81
Beryllium (Be)	0.0002	GOST 18291–81
Molybdenum (Mo)	0.25	GOST 18308–72
Arsenic (As)	0.05	GOST 4152–81
Nitrate (NO3)	45.0	GOST 18826–73
Polyacrilamide, residual	2.0	GOST 19353–74
Lead (Pb)	0.03	GOST 19413–81
Selenium (Se)	0.001	GOST 19413–81
Strontium (Sr)	7.0	GOST 23950
Fluoride (F) not exceed for climatic regions		
I & II	1.5	
II	1.2	
III	0.7	

Esthetic indicators

Chemical component	Standard	Method of testing
pH	6.0–9.0	pH meter
Iron (Fe)	0.3	GOST 4011–72
Total hardness mg x eqv/l	7.0	GOST 4151–72
Manganese (Mn)	1.0	GOST 4388–72
Polyphosphate residual (PO4– – –)	3.5	GOST 18309–72
Sulfate (SO4– –)	500	GOST 4389–72
Dried precipitates	1000	GOST 18164–72
Chloride (Cl–)	350	GOST 4245–72
Cincum (Zn2+)	5.0	GOST 18289–72
Odor 20oC rate	2	GOST 3351–74
Taste 20oC	2	GOST 3351–74
Color degree	200	GOST 3351–74
Turbidity mg/l	1.5	GOST 3351–74

Note: Standards are not to exceed values expressed in mg/l

World Health Organization Guidelines for Microbiological Quality

Organism	Unit	Guideline value	Remarks
A. Piped Water Supplies			
A.1 *Treated water entering the distribution system*			
Fecal coliforms	number/100 mL	0	Turbidity <1 NTU; for disinfection with chlorine, pH preferably < 8.0; free chlorine residual
Coliform organisms	number/100 mL	0	0.2–0.5 mg/L following 30 min (minimum) contact
A.2 *Untreated water entering the distribution system*			
Fecal coliforms	number/100 mL	0	
Coliform organisms	number/100 mL	0	In 98% of samples examined throughout the year
Coliform organisms	number/100 mL	3	In an occasional sample, but not in consecutive samples
A.3 *Water in the distribution system*			
Fecal coliforms	number/100 mL	0	
Coliform organisms	number/100 mL	0	In 95% of samples examined throughout the year
Coliform organisms	number/100 mL	3	In an occasional sample, but not in consecutive samples
B. Unpiped Water Supplies			
Fecal coliforms	number/100 mL	0	
Coliform organisms	number/100 mL	10	Should not occur repeatedly
C. Bottled Drinking Water			
Fecal coliforms	number/100 mL	0	Source should be free from fecal contamination
Coliform organisms	number/100 mL	0	
D. Emergency Water Supplies			
Fecal coliforms	number/100 mL	0	Advise public to boil water in case of failure to meet guideline value
Coliform organisms	number/100 mL	0	

World Health Organization Guidelines for Aesthetic Quality

Constituent	Guideline value*	Remarks
Aluminum	0.2	
Chloride	250	
Chlorobenzenes and chlorophenols	No guideline value set	These compounds may affect taste and odor
Color	15 TCU†	
Copper	1.0	
Detergents	No guideline value set	There should not be any foaming, taste, or odor problem
Hardness	500 (as $CaCO_3$)	
Hydrogen sulfide	Not detectable by consumers	
Iron	0.3	
Manganese	0.1	
Oxygen, dissolved	No guideline value set	
pH	6.5–8.5	
Sodium	200	
Solids, total dissolved	1000	
Sulfate	400	
Taste and odor	Inoffensive to most consumers	
Temperature	No guideline value set	
Turbidity	5 NTU‡	Preferably <1 for disinfection efficiency
Zinc	5.0	

*Unless otherwise specified, all units are mg/L.
†TCU—true color unit.
‡NTU—nephelometric turbidity unit.

Comparison of International Drinking Water Guidelines

Parameter	USEPA Max. Contamination Level	EEC Guide Line	EEC Max. Admissable Conc.	WHO Guide Line	Canada Max. Admissable Conc.
Aluminum		0.05 mg/L	0.2 mg/L	0.2 mg/L	
Ammonium		0.05mg/L	0.5 mg/L		
Antimony			10 µg/L		
Arsenic	0.05 mg/L		0.05 mg/L	0.05 mg/L	0.05 mg/L
Barium	1.0 mg/L	0.1 mg/L	0.1 mg/L	NS*	1.0 mg/L
Boron		1000 µg/L	NS*		5.0 mg/L
Cadmium	0.01 mg/L		0.005 mg/L	0.005 mg/L	0.005 mg/L
Calcium		100 mg/L			
Chloride	250 mg/L	25 mg/L	NS*	250 mg/L	250 mg/L
Chromium	0.05 mg/L		0.05 mg/L	0.05 mg/L	0.05 mg/L
Chloride	250 mg/L	25 mg/L	NS*	250 mg/L	250 mg/L
Coliforms (oraganisms/100 mL)	1		10	0	0
Color	15 cu	1 mg Pt-Co/L	20 mg Pt-Co/L	15 cu	15 cu
Copper	1 mg/L**	100 µg at treatment plant	NS*	1 mg/L	1.0 mg/L
Cyanides			50 µg/L		
Fluoride	4.0 mg/L	varies w/temperature in area	NS*	1.5 mg/L	1.5 mg/L
Iron	0.3 mg/L**	50 µg/L	300 µg/L	0.3 mg/L	0.3 mg/L
Lead	0.05 mg/L		0.05 mg/L	0.05 mg/L	0.05 mg/L
Magnesium		30 mg/L	50 mg/L		
Manganese	0.05 mg/L**	20 µg/L	50 µg/L	0.1 mg/L	0.05 mg/L
Mercury	0.002 mg/L		0.001 mg/L	0.001 mg/L	0.001 mg/L
Molybdenum					
Nickel			50 µg/L		
Nitrates	10.0 mg/L (as N)	25 mg/L (as NO_3)	50 mg/L	10.0 mg/L (as N)	10.0 mg/L (as N)
Nitrites			0.1 mg/L		1.0 mg/L
Odor	3 TON	0 dilution number	2 Dilution number @ 12 °C; 3 dil. No. @ 25 °C		
pH	6.5-8.6**	6.5-8.5	NS*	6.5-8.5	6.5-8.5
Phosphorus		400 µg/L	5000 µg/L		
Phenols			0.5 µg/L C_6H_5OH		0.002 mg/L
Potassium		10 mg/L	12 mg/L		
Selenium	0.01 mg/L		0.01 mg/L	0.01 mg/L	0.01 mg/L
Silica dioxide		1 mg/L	10 mg/L		
Silver	0.05 mg/L		0.01 mg/L	NS*	0.05 mg/L
Solids, Total dissolved	500 mg/L**	NS*	NS*	1000 mg/L	500 mg/L
Sodium		30 mg/L			
Sulfate	250 mg/L**	25 mg/L	NS*	400 mg/L	500 mg/L
Turbidity (non microbial)		0-4 JTU	4 JTU	5 NTU	5 NTU
Zinc	5 mg/L**	100 µg at treatment plant	NS*	5.0 mg/L	5 mg/L

*NS = No standard
**U.S. Secondary MCL

New Independent States (NIS)

★ **EPT Regional Offices**

The Environmental Policy and Technology (EPT) Project: Environmental degradation and natural resource mismanagement threaten public health, biodiversity and economic vitality in the New Independent States (NIS). To assist the NIS in alleviating these problems, the U.S. Agency for International Development (USAID) began the EPT Project in 1993. EPT provides technical assistance and policy advice in the environmental sector and promotes environmentally sound economic development through public and private, U.S. and NIS partnerships. The EPT Project is managed by USAID with support from the U.S. Environmental Protection Agency (USEPA). For assistance in project design, management and implementation, USAID has agreements with CH2M HILL International, Harvard Institute for International Development and ISAR. As the primary EPT contractor, CH2M HILL International has the lead role in delivering technical assistance, logistical support and policy support for selected projects. EPT Regional Offices are located in: Washington, D.C.; Moscow, Russia; Kiev, Ukraine; and Almaty, Kazakhstan.

CH2M HILL International Consortium of Subcontractors: Center for International Environmental Law; Clark Atlanta University/Historically Black Colleges, Universities and Minority Institutions Technology Consortium; Consortium for International Development; Ecojuris; Environmental Compliance Inc.; Harvard Institute for International Development; Hughes Technical Services Company; International Programs Consortium; International Resources Group; Interfax; K&M Engineering; Ogden Environmental and Energy Services; Price Waterhouse; the World Wildlife Fund; and numerous local subcontractors and cooperators throughout the NIS.

Environmental Policy and Technology Project
A USAID Project Consortium led by CH2M HILL

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