# Shuttle-Mir Science Program Phase 1A Research Postflight Science Report

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# Introduction

The Shuttle-Mir Science Program, also known as the Phase 1A program, was developed as a result of a joint agreement between the United States and the Russian Federation which initiated a cooperative human space flight program. The program consisted of two long duration missions, Mir 18 and Mir 19, and one Shuttle docking mission, Spacelab-Mir (SL-M) STS-71.

The Mir 18 mission began with the launch of the Soyuz TM21 on March 14, 1995, carrying two Russian cosmonauts, Mission Commander Lieutenant Colonel Vladimir N. Dezhurov and Flight Engineer Gennady M. Strekalov, Ph.D., and U.S. Astronaut, Mission Specialist Norman E. Thagard, M.D. The Soyuz TM21 docked with the Mir on March 16, 1995. After a 116 day stay in space, most of it on the Russian Space Station Mir, the Mir 18 crew landed at Kennedy Space Center on July 7, 1995. The STS-71 crew consisted of Commander Captain Robert L. "Hoot" Gibson, Pilot Lieutenant Colonel Charles J. Precourt, Mission Specialist Ellen S. Baker, M.D., Mission Specialist Gregory J. Harbaugh and Mission Specialist Bonnie J. Dunbar, Ph.D. The SL-M mission also provided return transportation for the Mir 18 crew and transportation for the Mir 19 crew to the Mir.

The Mir 19 mission continued the joint science program and began with the launch of U.S. Space Shuttle Atlantis carrying two Russian cosmonauts, Mission Commander Colonel Anatoly Y. Solovyev and Flight Engineer Nikolai M. Budarin, to the space station Mir. Mir 19 was concluded on September 11, 1995, with the landing of Soyuz TM21 in Russia.

The Shuttle-Mir science program used the U.S. Space Shuttle and the Russian Space Station Mir capabilities to conduct joint research activities in space. Seven research areas encompassing 28 investigations were conducted on Mir and/or the Shuttle. The overall objectives of the Shuttle-Mir missions were to obtain engineering and operational experience in conducting research on an orbital space station; to conduct specific investigations in medical support, life sciences, fundamental biology, microgravity sciences, Earth observations, and life support technology; and to characterize the environment relative to microgravity and life sciences research on Mir to better understand past and future investigations. Included in this report are the final science reports from the investigations performed on Mir 18, STS-71, and/or Mir 19.

# Section 4: Hygiene, Sanitation and Radiation Reports


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| | *U.S. Principal Investigator:* **DUANE L. PIERSON, Ph.D.,** NASA/Johnson Space Center<br>*Russian Principal Investigator:* **ALEKSANDR N. VIKTOROV, M.D.,** Institute of Biomedical Problems | |
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| | *U.S. Principal Investigator:* **DUANE L. PIERSON, Ph.D.,** NASA/Johnson Space Center<br>*Russian Principal Investigator:* **ALEKSANDR N. VIKTOROV, M.D.,** Institute of Biomedical Problems | |
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| | *U.S. Principal Investigator:* **GAUTAM D. BADHWAR, Ph.D.,** NASA/Johnson Space Center<br>*Russian Principal Investigator:* **V. M. PETROV,** Institute of Biomedical Problems | |
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| | *U.S. Principal Investigator:* **RICHARD W. SAUER, P.E.,** NASA/Johnson Space Center<br>*Russian Principal Investigator:* YURI SINYAK, M.D., Institute of Biomedical Problems | |
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| | *U.S. Principal Investigator:* **RICHARD W. SAUER, P.E.,** NASA/Johnson Space Center<br>*Russian Principal Investigator:* **YURI SINYAK, Ph.D.,** Institute of Biomedical Problems | |

# Trace Chemical Contamination: Water Quality

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*Russian Principal Investigator:* **YURI SINYAK, Ph.D.,** Institute of Biomedical Problems

*Co-Investigator:* John Schultz, Ph.D.

*Co-Author:* Lizanna M. Pierre

## (Mir 19 Final Science Report)

## INTRODUCTION

APPROXIMATELY FIFTY PERCENT of the potable water supplied to the Russian cosmonauts, American astronauts, and other occupants of the current Russian Mir Space Station is produced by the direct recycle of water from humidity condensate. The remainder comes from ground supplied potable water that is delivered on a Progress resupply spacecraft, or fuel cell water from the Shuttle. This experiment is being conducted to determine the potability of the recycled water, to assess the reliability of these systems, and to provide inflight testing of water collection hardware.

### Objectives

Characterize the chemical composition of Mir humidity condensate to support development and testing of the water recycling and monitoring systems for the International Space Station (ISS).

Characterize the chemical composition of the ground-resupply water prior to launch and on orbit.

Characterize the chemical composition of Mir recycled water to evaluate the efficiency of on board water processors and aid in the development of ISS water processing and monitoring technology.

Compare the chemical composition of Mir and Shuttle humidity condensate.

Provide inflight testing of water collection hardware being developed to collect water samples on ISS.

Provide a better understanding of the interaction between atmospheric and water contaminants.

### Hypothesis

Detailed analysis of reclaimed waters will confirm that the design of the Mir purification system is adequate to maintain the concentrations of potentially harmful contaminants at acceptably safe levels.

### Background/History

Historically, water during U.S. space missions has either been launched from the ground or produced as a byproduct of fuel cell operation. Reclamation and purification of spacecraft wastewaters, as is currently done on the Russian Space Station Mir, will be required for supplying crewmembers of the International Space Station with potable and hygiene water. To date, both U.S. and Russian programs have limited information on the composition of spacecraft and reclaimed waters.

## METHODS/SCIENCE OPERATIONS

### Functional Objectives

**FO1.** Preflight collection of ground-supplied water at RSC Energia, Kalingrad, Russia

**FO2.** Water Sampling Hardware Setup

**FO3.** Inflight collection of hot, cold, and SVO-ZV (ground supplied) water

**FO4.** Inflight collection of humidity condensate

**FO5.** Postflight analysis of samples

### Hardware Items

*Major hardware items used in flight for this experiment:*

**HW1.** Water Sampling Kit - NASA provided

**HW2.** Disinfectant/Antiseptic Wipes - NASA provided

**HW3.** Potable Water Samplers (with Mir port adapter interfaces) - NASA provided

**HW4.** Waste bags and Archival Chemical Sample Bags - NASA provided

**HW5.** Ziploc® Storage Bags - NASA provided

**HW6.** Atmopheric Condensate Sampler - RSA provided

*Major hardware items used postflight for this experiment:*

**HW7.** HP 5890 Gas Chromatograph (GC) with HP5971A Mass Spectrometer (MS) - NASA provided

**HW8.** Waters Quanta 4000 Capillary Electrophoresis System - NASA provided

**HW9.** OI 1010 Carbon Analyzer - NASA provided

**HW10.** Sievers Model 800 Total Organic Carbon Analyzer - NASA provided

**HW11.** HP 7694 Headspace sampler with a HP 5890 GC and 5972 Mass Selective Detector - NASA provided

**HW12.** HP 5989 Mass Spectrometer (MS) with a 1090 Liquid Chromatograph with Particle beam & Thermospray interfaces - NASA provided

**HW13.** pH electrode - RSA and NASA provided

**HW14.** Conductivity instrument - NASA provided

### Method/Protocol

During inflight water sampling sessions on board Mir, the water sampling kit was unstowed from its storage location. The water sampling kit contained disinfectant wipes, potable water samplers, waste bags, archival chemical sample bags, and storage bags needed for water sampling. A disinfectant wipe was retrieved from the kit and used to disinfect the Mir galley water port. Next, a potable water sampler was connected to the galley port. A waste bag was then connected to the potable water sampler. Using the waste bag, 200 ml of water was collected and discarded. Next, 1000 ml of water was collected into the archival chemical sample bag. (See Figure 1) The archival chemical sample bag was placed in a ziploc® bag and stowed for return on the Shuttle. These procedures were used to collect hot, cold, and SVO-ZV (ground supplied) water.

Postflight analysis of samples occurred at Johnson Space Center (JSC) and the Institute for Biomedical Problems (IBMP). Parameters tested at JSC included total carbon (total inorganic carbon, purgeable organic carbon, nonpurgeable organic carbon and total organic carbon), specific organics (alcohols, organic acids, semivolatiles, volatiles, diols, urea, amines, formaldehyde), selected anions and cations, silver, and turbidity. Parameters tested by IBMP included conductivity, pH, color, chemical oxygen demand, odor, taste, calcium, magnesium, total hardness, and silver.

## RESULTS

### List of Pre-, In-, and Postflight Anomalies

*Preflight Anomalies*

Not applicable to this experiment

*Inflight Anomalies*

A water collection session had to be rescheduled due to crew confusion over procedures and sample collection requirements. This session was performed 12 days later.

No recycled water samples were collected during STS-74 docking because of a 1,2 ethanediol (ethylene glycol) leak into the Mir atmosphere from one of the Kvant coolant loops. To protect the health of the crew, condensate generated between November 2, 1995 and November 16, 1995 was routed into 3 collapsible 22-liter water tanks known as EDVs, instead of being recycled for drinking. So, instead of collecting 2 recyled water samples as planned, one condensate sample was collected from each of the 3 water tanks.

*Postflight Anomalies*

Discrepancies in cross referencing sample identifications for samples returned on STS-74 have caused difficulty in correlating U.S. and Russian sample analysis data. In addition, data for eight samples have not been reported by the IMBP laboratory.

### Completeness/Quality of Data

The quality of the available data is good. Because of the unavailability of data from the Russian analyses, taste, odor, color, chemical oxygen demand, total solids, and total hardness for the Mir 19 and Mir 20 (STS-74) missions are not included in this report.

### Tables, Graphs, and Figures Index

**Table 1.** Data Collection Sessions/Functional Objectives

**Table 2.** Joint U.S./Russian Potable Water Specifications for International Space Station

**Table 3.** Regenerated Water Results

**Table 4.** Ground Supplied Water Results

**Table 5.** Humidity Condensate Results

**Figure 1.** Sample Collection Methodology

## DISCUSSION

### Status of Data Analysis

All U.S. analyses of Mir 19 and Mir 20 (STS-74) samples have been completed. However, taste, odor, color, chemical oxygen demand, total solids, and total hardness results have not been submitted for Mir 19 and Mir 20 (STS-74) missions. Data obtained from Mir 18 is combined with data from Mir 19 and Mir 20 (STS-74).

## Research Findings

Three recycled water samples were collected during Mir 18 and three were collected during Mir 19. All parameters tested met the Joint U.S./Russian water quality specifications (see Table 2) except the NASA standards for turbidity, total phenols, and total organic carbon. The U.S. Environmental Protection Agency (EPA) drinking water standard for methylene chloride was also exceeded. Although turbidity levels were not determined on Mir 18 samples, measurements on Mir 19 samples show levels ranging from 0.95 nephlometric turbidity units (NTU) to 1.91 NTU. The NASA limit for turbidity is 1 NTU. Total organic carbon (TOC) levels in the reclaimed water also exceeded NASA spacecraft limits. TOC levels ranged from 1.3 to 6.7 mg/L compared to the NASA limit of 0.5 mg/L. These levels do not exceed the Russian water quality limit of 25 mg/L. Total phenol levels were exceeded in three samples collected during Mir 19, although the Mir 18 samples had no detectable levels of phenol. The Mir 19 levels were 5.7 $\mu$g/L, 5.9 $\mu$g/L, and 6.0 $\mu$g/L; the standard for total phenols is 1 $\mu$g/L. Finally, methylene chloride was detected in one of the Mir 18 samples above the U.S. EPA drinking water standards. The methylene chloride concentration of this sample was 92.85 $\mu$g/L; the EPA standard for this compound is 5 $\mu$g/L.

Ground supplied samples were collected prior to Mir 18 and in flight during Mir 18 and Mir 19. Preflight samples were collected from RSC Energia in Kalingrad, Russia on January 19 and March 6, 1995. Inflight samples were taken on July 3 and November 17, 1995. Tap water from Johnson Space Center was also collected for comparison. Turbidity levels on the preflight samples exceeded the Joint U.S./Russian water quality specification of 1 NTU. These samples showed turbidity levels ranging from 7.19 to 7.43 NTU. Both the preflight and inflight ground supplied water samples exceeded the U.S. standard of 0.5 mg/L for TOC. TOC levels ranged from 6.56 mg/L to 9.30 mg/L in these samples. Also, methylene chloride and chloroform concentrations in some of the ground supplied water samples exceeded the current EPA maximum contaminant levels of 5 µg/L for methylene chloride and 100 $\mu$g/L for chloroform. At this time, there are no NASA or Russian Space Agency (RSA) specifications for these compounds.

Humidity condensate samples were collected during Mir 19 and Mir 20. During Mir 18, one sample was reported to have been collected, but it was not returned to Earth. One sample was collected during Mir 19 and four samples were collected during Mir 20. Three of the Mir 20 samples were collected as a result of a 1,2 ethanediol (ethylene glycol) coolant leak in the Kvant. Ionic species identified in these samples include chloride (0.321 - 1.120 mg/L), nitrate (2.09 - 9.30 mg/L), sulfate (0.237 - 1.01 mg/L), lithium (0.51 - 0.64 mg/L), sodium (1.25 - 9.38 mg/L), potassium (0.40 - 0.57 mg/L), ammonium (4.93 - 61.8 mg/L), magnesium (0.34 - 1.15 mg/L) and calcium (0.73 - 2.49 mg/L). Volatile organic compounds detected above method detection limits include acetaldehyde, acetone, 2-butanone, carbon disulfide, chloroform, diethyl ether, iodomethane, perfluoro-1,3-dimethylcyclohexanone, methylene chloride, and o-xylene. Approximately sixty different semivolatile organic compounds were present in the Mir humidity condensate. Those detected at the highest levels include 3-t-butylphenol (70.6-195.8 µg/L), diethylene glycol monoethyl ether (50.1 - 96.5 µg/L), n,n-dimethylacetamide (58.2 - 132.1 µg/L), n,n-dimethylformamide (nondetectable - 701.8 µg/L), 2-ethoxyethanol (nondetectable - 147.7 µg/L), 4-ethylmorpholine (66.1 - 166.7 µg/L) and 2-hydroxybenzothiazole (nondetectable levels - 359.7 µg/L). Methanol, 1-methoxy-2-propanol, 1,2-propanediol, formaldehyde, and 1,2 ethanediol were also detected above minimum detection limits in these samples. 1,2 Ethanediol (ethylene glycol) was nondetectable in the Mir 20 sample taken before the coolant leak and was detected at levels of 149.2 µg/L, 152.8 µg/L, and 76.8 µg/L in samples collected after the leak.

As part of Detailed Supplementary Objective 317 (1,2) humidity condensate samples were collected on board the Shuttle during STS-45, STS-47, and STS-68. These results were averaged and compared to the Mir humidity condensate results to identify any potential interchanges of constituents between the Shuttle and Mir atmospheres during the docking of the Shuttle to the Mir, and to aid in the design of the International Space Station water processors. Approximately 60 compounds identified in the Shuttle condensate were not detected in the Mir condensate, and about 10 compounds found in the Mir condensate were not detected in the Shuttle condensate. The average organic carbon recovery from the Shuttle condensate samples was 72.0% compared to the Mir condensate average organic carbon recovery of 58.3%. Alcohol, organic acid, formaldehyde, and caprolactam levels were significantly higher in the Shuttle condensate as compared to the Mir condensate. Those compounds present in larger quantities in the Mir condensate include 1,2-Ethanediol, 1,2-methoxy-2-propanol, acetaldehyde, and acetone.

## Conclusions

Findings from the analysis of the reclaimed water show that the water met all requirements of the Joint NASA/RSA spacecraft water quality standards. It is noted, however, that the NASA requirements for TOC, turbidity, and phenol were exceeded. In addition, the regenerated water did not meet U.S. EPA water quality standards for methylene chloride. The ground supplied water exceeded the NASA requirements for TOC and turbidity, and the U.S. EPA maximum contaminant levels for chloroform and methylene chloride. As noted, selected parameters were

exceeded, but not to a degree which would adversely affect the potability of the water.

The humidity condensate had significantly lower levels of alcohols and organic acids as compared to the Shuttle condensate. TOC levels were also much lower than levels previously measured in the Shuttle. Compounds detected in the Mir condensate which were much higher than those measured on the Shuttle include acetaldehyde, acetone, 1,2-ethanediol, and 1,2-methoxy-2-propanol. One source of 1,2-methoxy-2-propanol is from the Sharpie® markers used in a number of experiments on board Mir. Also, the high levels of 1,2 ethanediol were due to a leak of this compound from a coolant loop in the Mir core module. The ability to collect humidity condensate was critical in planning the operational response to this leak.

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3. Straub, J.E., Schultz, J.R., Michalek, W.F., and Sauer, R.L., Further Characterization and Multifiltration Treatment of Shuttle Humidity Condensate, SAE #951685, 25th International Conference on Environmental Systems, San Diego, California, July 1995.

## TABLE 1. DATA COLLECTION SESSIONS/FUNCTIONAL OBJECTIVES

| Mission | Session Name | FO# | HW# | Scheduled Day | Actual Day | Scheduled Subject(s) | Actual Subject(s) | Samples/ Parameters | Method |
|---|---|---|---|---|---|---|---|---|---|
| Mir 19 | hot water collection | 2,3 | 1,2,3,4,5,7, 8,9,10,11, 12,13,14 | MD8 | MD23 27 Jul 95 | N/A | N/A | 821.5 ml of water Split: 537.5 ml US, 284 ml RSA | N/A |
| Mir 19 | hot water collection | 2,3 | 1,2,3,4,5,7, 8,9,10,11, 12,13,14 | MD32 | MD42 15 Aug 95 | N/A | N/A | 1003 ml of water Split: 582.5 ml US, 448 ml RSA | N/A |
| Mir 19 | hot water collection | 2,3 | 1,2,3,4,5,7, 8,9,10,11, 12,13,14 | MD55 | MD55 28 Aug 95 | N/A | N/A | 1024 ml of water Split: 582.5 ml US, 442 ml RSA | N/A |
| Mir 19 | humidity condensate collection | 4 | 6,7,8,9, 10,11,12, 13,14 | unknown | MD62-MD65 4-7 Sept 1995 | N/A | N/A | ?? ml of condensate Split: 21 ml US, ?? ml RSA | N/A |
| Mir 20 | humidity condensate collection | 4 | 6,7,8,9, 10,11,12, 13,14 | unknown | MD43 30 Oct 95 | N/A | N/A | 78.5 ml of condensate Split: 73 ml US, 5.5 ml RSA | N/A |
| | ground supplied water collection at RSC-Energia, Kalingrad, Russia | 1 | N/A | N/A | L-? 2 Nov 95 | N/A | N/A | 1000 ml of water Split: 1000 ml US, 0 ml RSA | N/A |
| Mir 20 | humidity condensate collection from EDV #1 | 4 | 1,2,3,4,5,7, 8,9,10,11, 12,13,14 | MD60 | MD60 16 Nov 95 | N/A | N/A | 848 ml of condensate Split: 537.5 ml US, 310.5 ml RSA | N/A |
| Mir 20 | humidity condensate collection from EDV #2 | 4 | 1,2,3,4,5,7, 8,9,10,11, 12,13,14 | MD60 | MD60 16 Nov 95 | N/A | N/A | 910 ml of condensate Split: 537.5 ml US, 372.5 ml RSA | N/A |
| Mir 20 | humidity condensate collection from EDV #3 | 4 | 1,2,3,4,5,7, 8,9,10,11, 12,13,14 | MD60 | MD60 16 Nov 95 | N/A | N/A | 976.5 ml of condensate Split: 582.5 ml US, 400 ml RSA | N/A |
| Mir 20 | SVO-ZV (ground supplied) water collection | 2,3 | 1,2,3,4,5,7, 8,9,10,11, 12,13,14 | MD60 | MD61 17 Nov 95 | N/A | N/A | 914 ml of water Split: 537.5 ml US, 376 ml RSA | N/A |

## TABLE 2. JOINT U.S./RUSSIAN POTABLE WATER SPECIFICATIONS FOR INTERNATIONAL SPACE STATION

| Water Parameter | U.S. Maximum Contaminant Level (MCL) | Russian Maximum Contaminant Level (MCL) |
|---|---|---|
| pH[1] | 5.5-9.0 pH units | 5.5-9.0 pH units |
| Color[2] | 15 Pt-Co units | 20 degrees |
| Taste[2] | 3 TTN | 2 grade |
| Odor[2] | 3 TON | 2 grade |
| Total Dissolved Solids[3] | 100-1,000 mg/L | 100-1,000 mg/L |
| Turbidity[2] | 1 NTU | 1.5 mg/L |
| Total Gas | 5% volume @1 ATM, 20oC | 5% volume @1 ATM, 20oC |
| Ammonia ($NH_3$-N) | 2 mg/L | 2 mg/L |
| Arsenic | 0.01 mg/L | 0.01 mg/L |
| Barium | 1 mg/L | 1 mg/L |
| Cadium | 0.005 mg/L | 0.005 mg/L |
| Calcium | 100 mg/L | 100 mg/L |
| Chlorine-total (includes Cl-) | 200 mg/L | 200 mg/L |
| Chromium | 0.1 mg/L | 0.1 mg/L |
| Copper | 1 mg/L | 1 mg/L |
| Fluorine | 1.5 mg/L | 1.5 mg/L |
| Iodine-total (includes I-) | 15 mg/L | 15 mg/L |
| Iodine-residual[4] | 1.0-4.0 mg/L | 1.0-4.0 mg/L |
| Iron | 0.3 mg/L | 0.3 mg/L |
| Lead | 0.05 mg/L | 0.05 mg/L |
| Magnesium | 50 mg/L | 50 mg/L |
| Manganese | 0.05 mg/L | 0.05 mg/L |
| Mercury | 0.002 mg/L | 0.002 mg/L |
| Nickel | 0.1 mg/L | 0.1 mg/L |
| Nitrate ($NO_3$-N) | 10 mg/L | 10 mg/L |
| Selenium | 0.01 mg/L | 0.01 mg/L |
| Silver | 0.5 mg/L | 0.5 mg/L |
| Sulfate | 250 mg/L | 250 mg/L |
| Zinc | 5 mg/L | 5 mg/L |
| Total Hardness (Ca & Mg) | 7 meq/L | 7 meq/L |
| Total Bacteria[2] | 100 CFU/100 ml | 10,000 CFU/100 ml |
| Coliform Bacteria | <1 CFU/100 ml | <1 CFU/100 ml |
| Virus | <1 PFU/100 ml | <1 PFU/100 ml |
| Cyanide | 200 $\mu$g/L | 200 $\mu$g/L |
| Total Phenols | 1 $\mu$g/L | 1 $\mu$g/L |
| Total Organic Carbon (TOC) | 500 $\mu$g/L | 25,000 $\mu$g/L |
| Uncharacterized TOC | 100 $\mu$g/L | no limit |
| Oxygen Consumption-COD | no limit | 100 mg/L |

[1]pH range applies only before iodination

[2]Parameters have different values for U.S. and Russian supplied water because of different analytical methods used

[3]The 100 mg/L limit applies to the water before mineralization. After mineralization, this parameter will not exceed 1,000 mg/L

[4]Range of required level if iodine is used as a biocide

# TABLE 3. REGENERATED WATER RESULTS

| Sample Location<br>Sample Description<br>Sample Date<br>Analysis/Sample ID | Units | Test Conducted by | Maximum Contaminant Level (MCL) | Maximum Contaminant Level Source | Mir 18 hot regenerated water 3/28/95 95-0708-01 | Mir 18 hot regenerated water 6/20/95 95-0708-02 | Mir 18 hot regenerated water 7/3/95 95-0708-04 | Mir 18 hot regenerated water 7/3/95 95-0708-05 | Mir 19 hot regenerated water 7/27/95 95-1122-01 | Mir 19 hot regenerated water 8/15/95 95-1122-02 | Mir 19 hot regenerated water 8/28/95 95-1122-03 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **pH** | | Russia | 5.5-9.0 | NASA/RSA | 7.6 | 8.0 | 7.6 | NA | 7.06 | 6.77 | 6.75 |
| **Color** | degrees | Russia | 15 Pt-Co units/20 | NASA/RSA | 10 | 10 | 10 | NA | NS | NS | NS |
| **Odor at 20°C** | grade | Russia | 3 TON/2 | NASA/RSA | 0 | 0 | 0 | NA | NS | NS | NS |
| **Taste at 20 °C** | grade | Russia | 3 TTN/2 | NASA/RSA | 0 | 0 | 0 | NA | NS | NS | NS |
| **Total Solids** | mg/L | Russia | 1.5 | NASA/RSA | 0 | 0 | 0 | NA | NS | NS | NS |
| **Total Hardness** | meq/L | Russia | 7 | NASA/RSA | 1.12 | NA | 2.00 | NA | NS | NS | NS |
| **Chemical Oxygen Demand** | mg $O_2$/L | Russia | no limit/100 | NASA/RSA | 32 | 50 | 35 | NA | NS | NS | NS |
| **Conductivity** | µS/cm | U.S. | | | 63.9 | 140.1 | 100.3 | 62.0 | 60.6 | 39.3 | 36.5 |
| **Turbidity** | NTU | U.S. | 1/1.5 mg/L | NASA/RSA | NA | NA | NA | NA | 1.74 | 1.91 | 0.95 |
| **Anions** | | | | | | | | | | | |
| Chloride | mg/L | U.S. | 200 | NASA/RSA | NA | NA | NA | NA | 0.92 | 0.418 | 0.198 |
| Nitrate ($NO_3$-N) | mg/L | U.S. | 10 | NASA/RSA | NA | NA | NA | NA | 2.86 | ND | ND |
| Phosphate | mg/L | U.S. | | | NA | NA | NA | NA | ND | ND | ND |
| Flouride | mg/L | U.S. | 1.5 | NASA/RSA | NA | NA | NA | NA | ND | ND | ND |
| Sulfate | mg/L | U.S. | 250 | NASA/RSA | NA | NA | NA | NA | 0.88 | 0.22 | ND |
| **Cations** | | | | | | | | | | | |
| Lithium | mg/L | U.S. | | | NA | NA | NA | NA | ND | ND | ND |
| Sodium | mg/L | U.S. | | | NA | NA | NA | NA | 0.95 | 0.87 | 0.95 |
| Potassium | mg/L | U.S. | | | NA | NA | NA | NA | ND | ND | ND |
| Ammonium ($NH_3$-N) | mg/L | U.S. | 2 | NASA/RSA | NA | NA | NA | NA | ND | 0.38 | 0.44 |
| Magnesium | mg/L | U.S. | | | NA | NA | NA | NA | 0.96 | 0.33 | 0.33 |
| Calcium | mg/L | U.S. | | | NA | NA | NA | NA | 8.44 | 6.15 | 6.54 |
| **Metals** | | | | | | | | | | | |
| Calcium | µg/L | U.S. | 100000 | NASA/RSA | NA | NA | NA | NA | NA | NA | NA |
| Magnesium | µg/L | U.S. | 50000 | NASA/RSA | NA | NA | NA | NA | NA | NA | NA |
| Sodium | µg/L | U.S. | | | NA | NA | NA | NA | NA | NA | NA |
| Potassium | µg/L | U.S. | | | NA | NA | NA | NA | NA | NA | NA |
| Silver | µg/L | U.S. | 500 | NASA/RSA | 44.5 | 74.5 | 141.5 | NA | 55.0 | 62.0 | 65.0 |
| Aluminum | µg/L | U.S. | | | NA | NA | NA | NA | NA | NA | NA |
| Arsenic | µg/L | U.S. | 10 | NASA/RSA | NA | NA | NA | NA | NA | NA | NA |
| Barium | µg/L | U.S. | 1000 | NASA/RSA | NA | NA | NA | NA | NA | NA | NA |
| Chromium | µg/L | U.S. | 100 | NASA/RSA | NA | NA | NA | NA | NA | NA | NA |
| Cobalt | µg/L | U.S. | | | NA | NA | NA | NA | NA | NA | NA |
| Copper | µg/L | U.S. | 1000 | NASA/RSA | NA | NA | NA | NA | NA | NA | NA |
| Iron | µg/L | U.S. | 300 | NASA/RSA | NA | NA | NA | NA | NA | NA | NA |
| Mercury | µg/L | U.S. | 2 | NASA/RSA | NA | NA | NA | NA | NA | NA | NA |
| Manganese | µg/L | U.S. | 50 | NASA/RSA | NA | NA | NA | NA | NA | NA | NA |
| Molybdate | µg/L | U.S. | | | NA | NA | NA | NA | NA | NA | NA |
| Nickel | µg/L | U.S. | 100 | NASA/RSA | NA | NA | NA | NA | NA | NA | NA |
| Lead | µg/L | U.S. | 50 | NASA/RSA | NA | NA | NA | NA | NA | NA | NA |

# TABLE 3. REGENERATED WATER RESULTS

| Sample Location<br>Sample Description<br>Sample Date<br>Analysis/Sample ID | Units | Test Conducted by | Maximum Contaminant Level (MCL) | Maximum Contaminant Level Source | Mir 18 hot regenerated water 3/28/95 95-0708-01 | Mir 18 hot regenerated water 6/20/95 95-0708-02 | Mir 18 hot regenerated water 7/3/95 95-0708-04 | Mir 18 hot regenerated water 7/3/95 95-0708-05 | Mir 19 hot regenerated water 7/27/95 95-1122-01 | Mir 19 hot regenerated water 8/15/95 95-1122-02 | Mir 19 hot regenerated water 8/28/95 95-1122-03 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Metals (contd.)** | | | | | | | | | | | |
| Selenium | µg/L | U.S. | 10 | NASA/RSA | NA | NA | NA | NA | NA | NA | NA |
| Zinc | µg/L | U.S. | 5000 | NASA/RSA | NA | NA | NA | NA | NA | NA | NA |
| Silicon | µg/L | U.S. | | | NA | NA | NA | NA | NA | NA | NA |
| **Total Organic Carbon** | | | | | | | | | | | |
| TIC (OI 1010) | mg/L | U.S. | | | 0.057 | 0.093 | 0.07 | NA | 5.50 | 3.45 | 3.07 |
| NPOC (OI 1010) | mg/L | U.S. | | | 1.24 | 6.63 | 5.87 | NA | 2.54 | 1.83 | 1.04 |
| TOC (OI 1010) | mg/L | U.S. | | | 1.30 | 6.72 | 5.94 | NA | NA | NA | NA |
| TIC (Sievers 800) | mg/L | U.S. | | | 31.47 | 30.72 | 10.62 | NA | 6.97 | 5.57 | 5.03 |
| TOC (Sievers 800) | mg/L | U.S. | 0.5/25 | NASA/RSA | NA | NA | NA | NA | 2.79 | 2.86 | 1.48 |
| **Volatile Organics** | | | | | | | | | | | |
| Acetaldehyde | µg/L | U.S. | | | ND | ND | ND | ND | ND | ND | ND |
| Acetone | µg/L | U.S. | | | 7.21 | ND | ND | ND | 99.60 | 131.70 | 78.2 |
| Bromodichloromethane | µg/L | U.S. | 100 | EPA | ND | ND | ND | 0.92 | ND | ND | ND |
| Bromoform | µg/L | U.S. | 100 | EPA | ND | ND | ND | ND | ND | ND | ND |
| 2-Butanone | µg/L | U.S. | | | ND | ND | ND | ND | ND | ND | ND |
| Carbon disulfide | µg/L | U.S. | | | ND | ND | ND | ND | ND | ND | ND |
| Chloroform | µg/L | U.S. | 100 | EPA | 1.11 | ND | ND | 31.79 | 8.61 | 2.17 | ND |
| 1,4-Dichlorobenzene | µg/L | U.S. | 75 | EPA | 0.51 | ND | ND | ND | ND | ND | ND |
| Dibromochloromethane | µg/L | U.S. | 100 | EPA | ND | ND | ND | ND | ND | ND | ND |
| Dichlorodifluoromethane | µg/L | U.S. | 1000 | EPA | ND | ND | ND | 0.94 | ND | ND | ND |
| Diethyl ether | µg/L | U.S. | | | ND | ND | ND | ND | ND | ND | ND |
| Iodomethane | µg/L | U.S. | | | ND | ND | ND | ND | ND | ND | ND |
| Methylene chloride | µg/L | U.S. | 5 | EPA | 92.85 | ND | ND | ND | ND | ND | ND |
| Perfluoro-1,3-dimethylcyclohexane | µg/L | U.S. | | | ND | ND | ND | ND | ND | ND | ND |
| m&p-Xylene | µg/L | U.S. | 10000 | EPA | 0.45 | ND | ND | ND | ND | ND | ND |
| o-Xylene | µg/L | U.S. | 10000 | EPA | ND | ND | ND | ND | ND | ND | ND |
| **Extractable Organics** | | | | | | | | | | | |
| Acetophenone | µg/L | U.S. | | | 7.4 | NA | 7.4 | NA | 3.8 | ND | 3.4 |
| 2-Aminonaphthalene | µg/L | U.S. | | | NA | NA | NA | NA | ND | 0.5 | ND |
| Aniline | µg/L | U.S. | | | ND | NA | ND | NA | 0.5 | 0.9 | 0.9 |
| Azobenzene | µg/L | U.S. | | | ND | NA | ND | NA | ND | ND | ND |
| Benzaldehyde | µg/L | U.S. | | | ND | NA | ND | NA | 2.2 | 2.3 | 2.8 |
| Benzoic acid | µg/L | U.S. | | | ND | NA | ND | NA | ND | ND | ND |
| Benzothiazole | µg/L | U.S. | | | 8.2 | NA | 4.0 | NA | 7.8 | 12.6 | 23.3 |
| Benzyl alcohol | µg/L | U.S. | | | ND | NA | ND | NA | 1.9 | 1.0 | 2.2 |
| 2-Butoxyethanol | µg/L | U.S. | | | ND | NA | ND | NA | ND | ND | ND |
| Butylated hydroxyanisole (BHA) | µg/L | U.S. | | | ND | NA | ND | NA | ND | ND | ND |
| 3-t-Butylphenol | µg/L | U.S. | | | ND | NA | ND | NA | ND | 0.4 | ND |
| Caffeine | µg/L | U.S. | | | ND | NA | ND | NA | ND | ND | ND |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| **Extractable Organics (contd.)** | | | | | | | | | | | |
| Cyclohexanone | µg/L | U.S. | | | ND | NA | ND | NA | 0.4 | ND | ND |
| Decamethylcyclopentasiloxane | µg/L | U.S. | | | 1.5 | NA | 0.4 | NA | ND | ND | ND |
| 1,4 Diacetylbenzene | µg/L | U.S. | | | ND | NA | ND | NA | ND | ND | ND |
| 1,3-Dichlorobenzene | µg/L | U.S. | 600 | EPA | ND | NA | 1.4 | NA | ND | ND | ND |
| 1,4-Dichlorobenzene | µg/L | U.S. | 75 | EPA | ND | NA | ND | NA | ND | 0.9 | ND |
| Dibutyl phthalate | µg/L | U.S. | | | 1.7 | NA | 1.6 | NA | ND | ND | ND |
| Di-n-butylamine | µg/L | U.S. | | | ND | NA | ND | NA | ND | ND | ND |
| n,n-Dibutylformamide | µg/L | U.S. | | | ND | NA | ND | NA | ND | ND | ND |
| 2,6-Di-t-butyl-1,4-benzoquinone | µg/L | U.S. | | | ND | NA | ND | NA | ND | ND | ND |
| 2,4-Di-t-butylphenol | µg/L | U.S. | | | ND | NA | ND | NA | ND | ND | ND |
| n,n-Diethylformamide | µg/L | U.S. | | | ND | NA | ND | NA | ND | ND | ND |
| Diethylene glycol monoethyl ether | µg/L | U.S. | | | ND | NA | ND | NA | ND | ND | ND |
| Diethyl phthalate | µg/L | U.S. | 5000 | EPA HA | 0.7 | NA | 0.1 | NA | ND | ND | ND |
| n,n-Dimethylacetamide | µg/L | U.S. | | | ND | NA | ND | NA | ND | ND | ND |
| Dimethylcarbamyl chloride | µg/L | U.S. | | | NA | NA | NA | NA | 1.7 | 2.1 | 2 |
| Dimethylthiocarbamoyl chloride | µg/L | U.S. | | | ND | NA | ND | NA | ND | ND | ND |
| Dimethyl phthalate | µg/L | U.S. | | | ND | NA | ND | NA | ND | ND | ND |
| Dioctyl phthalate | µg/L | U.S. | 700 | EPA | 1.3 | NA | 2.8 | NA | ND | ND | ND |
| Dipropylene glycol methyl ether | µg/L | U.S. | | | ND | NA | ND | NA | ND | ND | ND |
| Dodecamethylcyclohexasiloxane | µg/L | U.S. | | | ND | NA | ND | NA | ND | 0.2 | ND |
| Eicosane | µg/L | U.S. | | | 2.0 | NA | ND | NA | ND | ND | ND |
| 2-Ethylhexanoic acid | µg/L | U.S. | | | ND | NA | ND | NA | ND | 3.9 | ND |
| 2-Ethyl-1-hexanol | µg/L | U.S. | | | ND | NA | ND | NA | ND | ND | ND |
| bis-Ethylhexyl adipate | µg/L | U.S. | | | 0.5 | NA | 0.2 | NA | ND | ND | ND |
| 4-Ethylmorpholine | µg/L | U.S. | | | ND | NA | ND | NA | ND | ND | ND |
| 1-Formypiperidine | µg/L | U.S. | | | ND | NA | ND | NA | ND | ND | ND |
| Heneicosane | µg/L | U.S. | | | 5.4 | NA | ND | NA | ND | ND | ND |
| 2-Hexanol | µg/L | U.S. | | | ND | NA | ND | NA | ND | ND | ND |
| 2-Hydroxybenzothiazole | µg/L | U.S. | | | ND | NA | ND | NA | 3.4 | 3.6 | 5.5 |
| 4-Hydroxy-4-methyl-2-pentanone | µg/L | U.S. | | | ND | NA | ND | NA | 2.1 | 1.9 | 3.0 |
| Isophorone | µg/L | U.S. | 100 | EPA HA | ND | NA | ND | NA | ND | ND | ND |
| Menthol | µg/L | U.S. | | | ND | NA | ND | NA | ND | ND | ND |
| Methyl sulfone | µg/L | U.S. | | | ND | NA | ND | NA | ND | ND | ND |
| 4-Methylphenol | µg/L | U.S. | | | ND | NA | ND | NA | 0.1 | 0.1 | ND |
| 1-Methyl-2-pyrrolidinone | µg/L | U.S. | | | ND | NA | ND | NA | ND | ND | ND |
| 2-Methylthiobenzothiazole | µg/L | U.S. | | | 7.7 | NA | 7.1 | NA | 8.8 | 12.5 | 13.8 |
| Monomethyl phthalate | µg/L | U.S. | | | ND | NA | ND | NA | ND | ND | ND |
| Octadecanol | µg/L | U.S. | | | 0.9 | NA | ND | NA | ND | ND | ND |
| Octamethylcyclotetrasiloxane | µg/L | U.S. | | | 0.4 | NA | ND | NA | ND | ND | ND |

# TABLE 3. REGENERATED WATER RESULTS

| Sample Location<br>Sample Description<br>Sample Date<br>Analysis/Sample ID | Units | Test Conducted by | Maximum Contaminant Level (MCL) | Maximum Contaminant Level Source | Mir 18 hot regenerated water 3/28/95 95-0708-01 | Mir 18 hot regenerated water 6/20/95 95-0708-02 | Mir 18 hot regenerated water 7/3/95 95-0708-04 | Mir 18 hot regenerated water 7/3/95 95-0708-05 | Mir 19 hot regenerated water 7/27/95 95-1122-01 | Mir 19 hot regenerated water 8/15/95 95-1122-02 | Mir 19 hot regenerated water 8/28/95 95-1122-03 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Extractable Organics (contd.)** | | | | | | | | | | | |
| 4-t-Octylphenol | µg/L | U.S. | | | ND | NA | ND | NA | ND | ND | ND |
| Pentacosane | µg/L | U.S. | | | ND | NA | ND | NA | ND | ND | ND |
| Phenol | µg/L | U.S. | 1/4000 | NASA/EPA HA | ND | NA | ND | NA | 5.7 | 6.0 | 5.9 |
| s-Phenethyl alcohol | µg/L | U.S. | | | ND | NA | ND | NA | ND | ND | ND |
| 2-Phenylphenol | µg/L | U.S. | | | ND | NA | ND | NA | ND | ND | ND |
| 2-Phenyl-2-propanol | µg/L | U.S. | | | ND | NA | ND | NA | ND | ND | ND |
| N-Phenyl-2-naphthylamine | µg/L | U.S. | | | 13.1 | NA | 4.3 | NA | ND | 0.3 | 1.8 |
| 1-alpha-Terpineol | µg/L | U.S. | | | ND | NA | ND | NA | ND | ND | ND |
| Tetramethylthiourea | µg/L | U.S. | | | ND | NA | ND | NA | 3.0 | 3.2 | 3.4 |
| Tetramethylurea | µg/L | U.S. | | | NA | NA | NA | NA | 3.0 | ND | ND |
| Toluene | µg/L | U.S. | 1000 | EPA | ND | NA | ND | NA | ND | ND | ND |
| Tricosane | µg/L | U.S. | | | ND | NA | ND | NA | ND | ND | ND |
| Triethyl Phosphate | µg/L | U.S. | | | ND | NA | ND | NA | ND | ND | ND |
| 2,2,4-Trimethyl-1,3-pentanediol diisobutyrate | µg/L | U.S. | | | ND | NA | ND | NA | ND | 0.1 | ND |
| Urethane | µg/L | U.S. | | | ND | NA | ND | NA | 2.3 | 2.8 | 2.2 |
| **Alcohols** | | | | | | | | | | | |
| Ethanol | | U.S. | | | | | | | | | |
| Methanol | µg/L | U.S. | | | ND | ND | ND | ND | ND | ND | ND |
| 1-Methoxy-2-propanol | µg/L | U.S. | | | NA | NA | NA | NA | ND | ND | ND |
| 1,2-Propanediol | µg/L | U.S. | | | NA | NA | NA | NA | ND | ND | ND |
| 1,2-Ethanediol | µg/L | U.S. | 7000 | EPA HA | NA | NA | NA | NA | ND | ND | ND |
| **Organic Acids** | | | | | | | | | | | |
| Acetic acid | µg/L | U.S. | | | ND | ND | ND | ND | ND | ND | ND |
| Lactic acid | µg/L | U.S. | | | ND | ND | ND | ND | ND | ND | ND |
| Propanoic acid | µg/L | U.S. | | | ND | ND | ND | ND | ND | ND | ND |
| **Aldehydes** | | | | | | | | | | | |
| Formaldehyde | µg/L | U.S. | 1000 | EPA HA | 9.8 | 10.9 | 10.9 | 57.3 | ND | ND | ND |
| **Carboxylates** | | | | | | | | | | | |
| Acetate | mg/L | U.S. | | | ND | ND | ND | ND | ND | ND | ND |
| Lactate | mg/L | U.S. | | | ND | ND | ND | ND | ND | ND | ND |
| **Amines** | | | | | | | | | | | |
| Methylamine | mg/L | U.S. | | | ND | ND | ND | ND | ND | ND | ND |
| **Urea** | | U.S. | | | | | | | | | |
| **Organic Carbon Recovery** | percent | U.S. | | | 4.58 | NA | 0.47** | | 3.29 | 4.03 | 6.22 |

# TABLE 4. GROUND SUPPLIED WATER RESULTS

| Sample Location<br>Sample Description<br>Sample Date<br>Analysis/Sample ID | Units | Test Conducted by | Maximum Contaminant Level (MCL) | Maximum Contaminant Level Source | Mir 18 preflight RSC supplied water 1/19/95 95-0126-01 | Mir 18 preflight RSC supplied water 3/6/95 95-0313-01 | Mir 18 ground supplied water 7/3/95 95-0708-03 | Mir 20 ground supplied water 11/17/95 95-1122-04 | JSC Bldg 37 Room 1132 tap water 11/29/95 95-1129-01 |
|---|---|---|---|---|---|---|---|---|---|
| **pH** | | Russia | 5.5-9.0 | NASA/RSA | 7.30 | 7.60 | 7.8 | NA | 7.33 |
| **Color** | degrees | Russia | 15 Pt-Co units/20 | NASA/RSA | NA | NA | 10 | NS | NA |
| **Odor at 20°C** | grade | Russia | 3 TON/2 | NASA/RSA | NA | NA | 0 | NS | NA |
| **Taste at 20°C** | grade | Russia | 3 TTN/2 | NASA/RSA | NA | NA | 0 | NS | NA |
| **Total Solids** | mg/L | Russia | 1.5 | NASA/RSA | NA | NA | 0 | NS | NA |
| **Total Hardness** | meq/L | Russia | 7 | NASA/RSA | NA | NA | 1.24 | NS | NA |
| **Chemical Oxygen Demand** | mg $O_2$/L | Russia | no limit/100 | NASA/RSA | NA | NA | 30 | NS | NA |
| **Conductivity** | µS/cm | U.S. | | | 291.0 | 296.0 | 163.5 | NA | 344.0 |
| **Turbidity** | NTU | U.S. | 1/1.5 mg/L | NASA/RSA | 7.43 | 7.19 | NA | NA | 0.424 |
| **Anions** | | | | | | | | | |
| Chloride | mg/L | U.S. | 200 | NASA/RSA | 9.5 | 15.3 | NA | 13.2 | 29.1 |
| Nitrate ($NO_3$-N) | mg/L | U.S. | 10 | NASA/RSA | 2.3 | 4.1 | NA | 1.48 | ND |
| Phosphate | mg/L | U.S. | | | 0.10 | ND | NA | ND | ND |
| Flouride | mg/L | U.S. | 1.5 | NASA/RSA | 0.10 | ND | NA | ND | 0.68 |
| Sulfate | mg/L | U.S. | 250 | NASA/RSA | 11.3 | 14.8 | NA | 14.1 | 20.7 |
| **Cations** | | | | | | | | | |
| Lithium | mg/L | U.S. | | | ND | ND | NA | ND | ND |
| Sodium | mg/L | U.S. | | | 6.80 | 7.50 | NA | 5.96 | 28.0 |
| Potassium | mg/L | U.S. | | | 2.10 | 2.00 | NA | 2.45 | 4.36 |
| Ammonium ($NH_3$-N) | mg/L | U.S. | 2 | NASA/RSA | ND | ND | NA | ND | ND |
| Magnesium | mg/L | U.S. | | | 10.20 | 11.30 | NA | 11.9 | 3.42 |
| Calcium | mg/L | U.S. | | | 38.2 | 16.2 | NA | 30.0 | 39.3 |
| **Metals** | | | | | | | | | |
| Calcium | µg/L | U.S. | 100000 | NASA/RSA | NA | NA | NA | NA | 41600 |
| Magnesium | µg/L | U.S. | 50000 | NASA/RSA | NA | NA | NA | NA | 3440 |
| Sodium | µg/L | U.S. | | | NA | NA | NA | NA | 21900 |
| Potassium | µg/L | U.S. | | | NA | NA | NA | NA | 3710 |
| Silver | µg/L | U.S. | 500 | NASA/RSA | 625.0 | 480.0 | 76.8 | 77.0 | 1.2 |
| Aluminum | µg/L | U.S. | | | 23.2 | 17.9 | NA | NA | 85.9 |
| Arsenic | µg/L | U.S. | 10 | NASA/RSA | ND | ND | NA | NA | 3.1 |
| Barium | µg/L | U.S. | 1000 | NASA/RSA | NA | NA | NA | NA | 102.0 |
| Chromium | µg/L | U.S. | 100 | NASA/RSA | ND | ND | NA | NA | ND |
| Cobalt | µg/L | U.S. | | | NA | NA | NA | NA | 1.2 |
| Copper | µg/L | U.S. | 1000 | NASA/RSA | ND | 3.1 | NA | NA | 171.0 |
| Iron | µg/L | U.S. | 300 | NASA/RSA | 68.0 | 81.5 | NA | NA | 37.9 |
| Mercury | µg/L | U.S. | 2 | NASA/RSA | ND | ND | NA | NA | ND |
| Manganese | µg/L | U.S. | 50 | NASA/RSA | 5.5 | 6.4 | NA | NA | 3.7 |
| Molybdate | µg/L | U.S. | | | ND | ND | NA | NA | 3.0 |
| Nickel | µg/L | U.S. | 100 | NASA/RSA | 1.5 | 1.0 | NA | NA | 2.3 |
| Lead | µg/L | U.S. | 50 | NASA/RSA | 1.2 | 1.0 | NA | NA | 2.5 |
| Selenium | µg/L | U.S. | 10 | NASA/RSA | ND | ND | NA | NA | 4.0 |

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| Sample Location<br>Sample Description<br><br>Sample Date<br>Analysis/Sample ID | Units | Test Conducted by | Maximum Contaminant Level (MCL) | Maximum Contaminant Level Source | Mir 18 preflight RSC supplied water 1/19/95 95-0126-01 | Mir 18 preflight RSC supplied water 3/6/95 95-0313-01 | Mir 18 ground supplied water 7/3/95 95-0708-03 | Mir 20 ground supplied water 11/17/95 95-1122-04 | JSC Bldg 37 Room 1132 tap water 11/29/95 95-1129-01 |
|---|---|---|---|---|---|---|---|---|---|
| **Metals (contd.)** | | | | | | | | | |
| Zinc | µg/L | U.S. | 5000 | NASA/RSA | 5.7 | 18.7 | NA | NA | 6.7 |
| Silicon | µg/L | U.S. | | | 2630.0 | 4030.0 | NA | NA | ND |
| **Total Organic Carbon** | | | | | | | | | |
| TIC (OI 1010) | mg/L | U.S. | | | 0.01 | 0.153 | 0.104 | 20.4 | NA |
| NPOC (OI 1010) | mg/L | U.S. | | | 9.24 | 8.56 | 6.46 | 8.40 | 3.90 |
| TOC (OI 1010) | mg/L | U.S. | | | 9.30 | 8.72 | 6.56 | NA | NA |
| TIC (Sievers 800) | mg/L | U.S. | | | 31.62 | 32.86 | 17.73 | 16.85 | 21.10 |
| TOC (Sievers 800) | mg/L | U.S. | 0.5/25 | NASA/RSA | NA | NA | NA | 6.99 | 2.66 |
| **Volatile Organics** | | | | | | | | | |
| Acetaldehyde | µg/L | U.S. | | | ND | ND | NA | 3034.0 | ND |
| Acetone | µg/L | U.S. | | | ND | ND | NA | 125.9 | 123.2 |
| Bromodichloromethane | µg/L | U.S. | 100 | EPA | 5.06 | 6.56 | NA | 4.9 | 50.5 |
| Bromoform | µg/L | U.S. | 100 | EPA | ND | ND | NA | ND | 1.9 |
| 2-Butanone | µg/L | U.S. | | | ND | ND | ND | ND | ND |
| Carbon disulfide | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| Chloroform | µg/L | U.S. | 100 | EPA | 125.49 | 189.09 | NA | 205.5 | 112.0 |
| 1,4-Dichlorobenzene | µg/L | U.S. | 75 | EPA | ND | ND | NA | ND | ND |
| Dibromochloromethane | µg/L | U.S. | 100 | EPA | ND | ND | NA | ND | 19.3 |
| Dichlorodifluoromethane | µg/L | U.S. | 1000 | EPA | ND | ND | NA | ND | ND |
| Diethyl ether | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| Iodomethane | µg/L | U.S. | | | ND | ND | ND | ND | ND |
| Methylene chloride | µg/L | U.S. | 5 | EPA | 180.12 | 158.91 | NA | ND | ND |
| Perfluoro-1,3-dimethylcyclohexane | µg/L | U.S. | | | ND | ND | ND | ND | ND |
| m&p-Xylene | µg/L | U.S. | 10,000 | EPA | ND | ND | NA | ND | ND |
| o-Xylene | µg/L | U.S. | 10000 | EPA | ND | ND | NA | ND | ND |
| **Extractable Organics** | | | | | | | | | |
| Acetophenone | µg/L | U.S. | | | ND | ND | NA | 0.1 | ND |
| Aniline | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| Azobenzene | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| Benzaldehyde | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| Benzoic acid | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| Benzothiazole | µg/L | U.S. | | | ND | ND | NA | 6.9 | ND |
| Benzyl alcohol | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| 2-Butoxyethanol | µg/L | U.S. | | | 1.2 | ND | NA | ND | ND |
| Butylated hydroxyanisole (BHA) | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| 3-t-Butylphenol | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| Caffeine | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| Cyclohexanone | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| Decamethylcyclopentasiloxane | µg/L | U.S. | | | 0.2 | ND | NA | ND | ND |
| 1,4 Diacetylbenzene | µg/L | U.S. | | | ND | ND | NA | ND | ND |

# TABLE 4. GROUND SUPPLIED WATER RESULTS

| Sample Location<br>Sample Description<br>Sample Date<br>Analysis/Sample ID | Units | Test Conducted by | Maximum Contaminant Level (MCL) | Maximum Contaminant Level Source | Mir 18 preflight RSC supplied water 1/19/95 95-0126-01 | Mir 18 preflight RSC supplied water 3/6/95 95-0313-01 | Mir 18 ground supplied water 7/3/95 95-0708-03 | Mir 20 ground supplied water 11/17/95 95-1122-04 | JSC Bldg 37 Room 1132 tap water 11/29/95 95-1129-01 |
|---|---|---|---|---|---|---|---|---|---|
| **Extractable Organics (contd.)** | | | | | | | | | |
| 1,3-Dichlorobenzene | µg/L | U.S. | 600 | EPA | ND | ND | NA | ND | ND |
| 1,4-Dichlorobenzene | µg/L | U.S. | 75 | EPA | ND | ND | NA | ND | ND |
| Dibutyl phthalate | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| Di-n-butylamine | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| n,n-Dibutylformamide | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| 2,6-Di-t-butyl-1,4-benzoquinone | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| 2,4-Di-t-butylphenol | µg/L | U.S. | | | ND | ND | NA | 0.8 | ND |
| n,n-Diethylformamide | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| Diethylene glycol monoethyl ether | µg/L | U.S. | | | 1.4 | ND | NA | 3.2 | ND |
| Diethyl phthalate | µg/L | U.S. | 5000 | EPA HA | ND | ND | NA | ND | ND |
| n,n-Dimethylacetamide | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| n,n-Dimethylbenzylamine | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| Dimethylcarbamyl chloride | µg/L | U.S. | | | ND | ND | NA | 1.6 | ND |
| n,n-Dimethylformamide | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| Dimethylthiocarbamoyl chloride | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| Dimethyl phthalate | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| Dioctyl phthalate | µg/L | U.S. | 700 | EPA | 0.3 | 3.0 | NA | ND | 2.2 |
| Dipropylene glycol methyl ether | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| Dodecamethylcyclohexasiloxane | µg/L | U.S. | | | ND | ND | NA | 0.2 | ND |
| Eicosane | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| 2-Ethoxyethanol | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| 2-Ethylhexanoic acid | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| 2-Ethyl-1-hexanol | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| bis-Ethylhexyl adipate | µg/L | U.S. | | | ND | ND | NA | 0.7 | ND |
| 4-Ethylmorpholine | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| 1-Formypiperidine | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| Heneicosane | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| 2-Hexanol | µg/L | U.S. | | | 3.8 | ND | NA | ND | ND |
| 2-Hydroxybenzothiazole | µg/L | U.S. | | | ND | ND | NA | 2.9 | ND |
| 4-Hydroxy-4-methyl-2-pentanone | µg/L | U.S. | | | 9.4 | ND | NA | ND | ND |
| Isophorone | µg/L | U.S. | 100 | EPA HA | ND | ND | NA | ND | ND |
| Menthol | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| 2-Mercaptobenzothiazole | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| Methyl sulfone | µg/L | U.S. | | | 4.7 | ND | NA | ND | ND |
| 2-Methyl-2,4-pentanediol | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| 4-Methylphenol | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| 1-Methyl-2-pyrrolidinone | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| 2-Methylthiobenzothiazole | µg/L | U.S. | | | ND | ND | NA | 0.7 | ND |
| Monomethyl phthalate | µg/L | U.S. | | | 0.1 | ND | NA | ND | ND |
| Octadecanol | µg/L | U.S. | | | ND | ND | NA | ND | ND |

# TABLE 4. GROUND SUPPLIED WATER RESULTS

| Sample Location<br>Sample Description<br>Sample Date<br>Analysis/Sample ID | Units | Test Conducted by | Maximum Contaminant Level (MCL) | Maximum Contaminant Level Source | Mir 18 preflight RSC supplied water 1/19/95 95-0126-01 | Mir 18 preflight RSC supplied water 3/6/95 95-0313-01 | Mir 18 ground supplied water 7/3/95 95-0708-03 | Mir 20 ground supplied water 11/17/95 95-1122-04 | JSC Bldg 37 Room 1132 tap water 11/29/95 95-1129-01 |
|---|---|---|---|---|---|---|---|---|---|
| **Extractable Organics (contd.)** | | | | | | | | | |
| Octamethylcyclotetrasiloxane | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| 4-t-Octylphenol | µg/L | U.S. | | | ND | ND | NA | 0.1 | ND |
| Pentacosane | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| Phenol | µg/L | U.S. | 1/4000 | NASA/EPA HA | ND | ND | NA | ND | ND |
| Phenoxyacetic acid | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| s-Phenethyl alcohol | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| 2-Phenylphenol | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| 2-Phenyl-2-propanol | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| N-Phenyl-2-naphthylamine | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| Phenyl sulfone | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| 1-alpha-Terpineol | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| Tetramethylsuccinonitrile | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| Tetramethylthiourea | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| Tetramethylurea | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| Toluene | µg/L | U.S. | 1000 | EPA | 1.6 | ND | NA | 2.3 | 0.4 |
| Tricosane | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| Triethyl Phosphate | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| Triethylamine | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| 2,2,4-Trimethyl-1,3-pentanediol diisobutyrate | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| Urethane | µg/L | U.S. | | | ND | ND | NA | ND | ND |
| **Alcohols** | | | | | | | | | |
| Ethanol | µg/L | U.S. | | | 1800 | ND | ND | ND | ND |
| Methanol | µg/L | U.S. | | | ND | ND | ND | ND | ND |
| 1-Methoxy-2-propanol | µg/L | U.S. | | | NA | NA | NA | ND | ND |
| 1,2-Propanediol | µg/L | U.S. | | | NA | NA | ND | ND | ND |
| 1,2-Ethanediol | µg/L | U.S. | 7000 | EPA HA | NA | NA | NA | ND | ND |
| **Organic Acids** | | | | | | | | | |
| Acetic acid | µg/L | U.S. | | | ND | ND | ND | ND | ND |
| Lactic acid | µg/L | U.S. | | | NA | NA | ND | ND | ND |
| Propanoic acid | µg/L | U.S. | | | ND | 144.0 | ND | ND | ND |
| **Aldehydes** | | | | | | | | | |
| Formaldehyde | µg/L | U.S. | 1000 | EPA HA | 8.3 | 5.3 | 9.2 | ND | 17.7 |
| **Carboxylates** | | | | | | | | | |
| Acetate | mg/L | U.S. | | | NA | NA | ND | ND | ND |
| Lactate | mg/L | U.S. | | | NA | NA | ND | ND | |
| **Amines** | | | | | | | | | |
| Methylamine | mg/L | U.S. | | | NA | NA | ND | ND | ND |
| **Urea** | | U.S. | | | 200.0 | NA | ND | ND | ND |
| **Organic Carbon Recovery** | percent | U.S. | | | NA | NA | NA | 25.26 | 3.82 |

# TABLE 5. HUMIDITY CONDENSATE RESULTS

| Sample Location<br>Sample Description<br>Sample Date<br>Analysis/Sample ID | Units | Test Conducted by | Mir 19 CRS humidity condensate 8/28/95 95-0928-01 | Mir 20 CRS humidity condensate 10/30/95 95-1122-08 | Mir 20 EDV #1 humidity condensate 11/16/95 95-1122-05 | Mir 20 EDV #2 humidity condensate 11/16/95 95-1122-06 | Mir 20 EDV #3 humidity condensate 11/16/95 95-1122-07 | Average Mir condensate levels | Average Shuttle condensate levels |
|---|---|---|---|---|---|---|---|---|---|
| **pH** | | Russia | NA | 6.79 | 6.57 | 6.28 | 6.95 | 6.65 | 6.83 |
| **Color** | degrees | Russia | NA | NS | NS | NS | NS | NA | NA |
| **Odor at 20°C** | grade | Russia | NA | NS | NS | NS | NS | NA | NA |
| **Taste at 20°C** | grade | Russia | NA | NS | NS | NS | NS | NA | NA |
| **Total Solids** | mg/L | Russia | NA | NS | NS | NS | NS | NA | NA |
| **Total Hardness** | meq/L | Russia | NA | NS | NS | NS | NS | NA | NA |
| **Chemical Oxygen Demand** | mg $O_2$/L | Russia | 195 | NS | NS | NS | NS | 195.00 | NA |
| **Conductivity** | µS/cm | U.S. | NA | 168.0 | 160.0 | 156.0 | 150.0 | 158.50 | 131.32 |
| **Turbidity** | NTU | U.S. | NA | 8.0 | 8.04 | 12.2 | 7.43 | 8.92 | 1.67 |
| **Anions** | | | | | | | | | |
| Chloride | mg/L | U.S. | 1.12 | 0.395 | 0.45 | 0.77 | 0.32 | 0.61 | 1.51 |
| Nitrate ($NO_3$-N) | mg/L | U.S. | ND | ND | 2.10 | 1.85 | 0.47 | 1.47 | ND |
| Phosphate | mg/L | U.S. | ND | ND | ND | ND | ND | ND | ND |
| Flouride | mg/L | U.S. | ND | ND | ND | ND | ND | ND | ND |
| Sulfate | mg/L | U.S. | 1.01 | 0.260 | ND | 0.24 | ND | 0.50 | 0.12 |
| Bromide | mg/L | U.S. | ND | ND | ND | ND | ND | ND | 0.13 |
| Nitrite | mg/L | U.S. | ND | ND | ND | ND | ND | ND | 0.57 |
| **Cations** | | | | | | | | | |
| Lithium | mg/L | U.S. | ND | ND | 0.62 | 0.64 | 0.51 | 0.59 | 0.10 |
| Sodium | mg/L | U.S. | 1.25 | 1.44 | 9.38 | 1.81 | 1.29 | 3.03 | 0.10 |
| Potassium | mg/L | U.S. | 0.57 | 0.45 | 0.40 | ND | ND | 0.47 | 0.45 |
| Ammonium ($NH_3$-N) | mg/L | U.S. | 4.93 | 22.4 | 48 | 14.4 | 11.0 | 20.15 | 13.12 |
| Magnesium | mg/L | U.S. | 1.15 | 0.36 | 0.49 | 0.48 | 0.34 | 0.56 | 0.26 |
| Calcium | mg/L | U.S. | 1.22 | 0.73 | 2.49 | 1.02 | 0.82 | 1.26 | 0.10 |
| **Metals** | | | | | | | | | |
| Calcium | µg/L | U.S. | NA | NA | NA | N/A | NA | NA | NA |
| Magnesium | µg/L | U.S. | NA | NA | NA | N/A | NA | NA | NA |
| Sodium | µg/L | U.S. | NA | NA | NA | NA | NA | NA | NA |
| Potassium | µg/L | U.S. | NA | NA | NA | NA | NA | NA | NA |
| Silver | µg/L | U.S. | NA | NA | 56.0 | 100.0 | 55.0 | 70.33 | NA |
| Aluminum | µg/L | U.S. | NA | NA | NA | NA | NA | NA | NA |
| Arsenic | µg/L | U.S. | NA | NA | NA | NA | NA | NA | NA |
| Barium | µg/L | U.S. | NA | NA | NA | NA | NA | NA | NA |
| Chromium | µg/L | U.S. | NA | NA | NA | NA | NA | NA | 0.96 |
| Cobalt | µg/L | U.S. | NA | NA | NA | NA | NA | NA | NA |
| Copper | µg/L | U.S. | NA | NA | NA | NA | NA | NA | 3.86 |
| Iron | µg/L | U.S. | NA | NA | NA | NA | NA | NA | 15.05 |
| Mercury | µg/L | U.S. | NA | NA | NA | NA | NA | NA | NA |
| Manganese | µg/L | U.S. | NA | NA | NA | NA | NA | NA | 37.75 |
| Molybdate | µg/L | U.S. | NA | NA | NA | NA | NA | NA | 9.40 |

# TABLE 5. HUMIDITY CONDENSATE RESULTS

| Sample Location<br>Sample Description<br>Sample Date<br>Analysis/Sample ID | Units | Test Conducted by | Mir 19 CRS humidity condensate 8/28/95 95-0928-01 | Mir 20 CRS humidity condensate 10/30/95 95-1122-08 | Mir 20 EDV #1 humidity condensate 11/16/95 95-1122-05 | Mir 20 EDV #2 humidity condensate 11/16/95 95-1122-06 | Mir 20 EDV #3 humidity condensate 11/16/95 95-1122-07 | Average Mir condensate levels | Average Shuttle condensate levels |
|---|---|---|---|---|---|---|---|---|---|
| **Metals (contd.)** | | | | | | | | | |
| Nickel | µg/L | U.S. | NA | NA | NA | NA | NA | NA | 93.25 |
| Lead | µg/L | U.S. | NA | NA | NA | NA | NA | NA | 0.96 |
| Selenium | µg/L | U.S. | NA | NA | NA | NA | NA | NA | NA |
| Zinc | µg/L | U.S. | NA | NA | NA | NA | NA | NA | 19107.27 |
| Silicon | µg/L | U.S. | NA | NA | NA | NA | NA | NA | 4171.82 |
| Cadmium | µg/L | U.S. | NA | NA | NA | NA | NA | NA | 0.95 |
| Lithium | µg/L | U.S. | NA | NA | NA | NA | NA | NA | 89.55 |
| **Total Organic Carbon** | | | | | | | | | |
| TIC (Sievers 800) | mg/L | U.S. | 13.01 | 20.62 | 22.00 | 22.68 | 21.66 | 19.99 | NA |
| POC (OI 1010) | mg/L | U.S. | 3.93 | NA | NA | NA | NA | 3.93 | 0.57 |
| NPOC (OI 1010) | mg/L | U.S. | 14.52 | 31.96 | 72.18 | 74.72 | 46.65 | 48.01 | 132.49 |
| TIC (OI 1010) | mg/L | U.S. | | | 19.7 | 24.3 | 28.9 | 24.30 | 7.83 |
| TOC (OI 1010) | mg/L | U.S. | 18.45 | NA | NA | NA | NA | 18.45 | 133.06 |
| TOC (Sievers 800) | mg/L | U.S. | 17.55 | 36.82 | 70.85 | 79.79 | 44.03 | 49.81 | NA |
| **Volatile Organics** | | | | | | | | | |
| Acetaldehyde | µg/L | U.S. | ND | ND | 2538.2 | 2563.2 | 2145.6 | 2415.67 | 16.48 |
| Acetone | µg/L | U.S. | 1613.6 | 11.6 | 78.1 | 73.8 | 46.5 | 364.72 | 23.10 |
| Bromodichloromethane | µg/L | U.S. | ND | ND | ND | ND | ND | ND | ND |
| Bromoform | µg/L | U.S. | ND | ND | ND | ND | ND | ND | ND |
| 2-Butanone | µg/L | U.S. | 4.71 | ND | ND | ND | ND | 4.71 | 6.45 |
| Carbon disulfide | µg/L | U.S. | ND | 2.0 | ND | ND | ND | 2.00 | ND |
| Chloroform | µg/L | U.S. | ND | ND | ND | 1.4 | ND | 1.40 | 0.75 |
| 1,4-Dichlorobenzene | µg/L | U.S. | ND | ND | ND | ND | ND | ND | ND |
| Dibromochloromethane | µg/L | U.S. | ND | ND | ND | ND | ND | ND | ND |
| 1,2 Dichlorobenzene | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 1.00 |
| Dichlorodifluoromethane | µg/L | U.S. | ND | ND | ND | ND | ND | ND | ND |
| Diethyl ether | µg/L | U.S. | ND | ND | 2.1 | ND | ND | 2.10 | ND |
| 2,6-Dimethyl-4-Heptanone | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 3.40 |
| Ethyl butyrate | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 0.52 |
| Ethyl valerate | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 1.48 |
| 2-Heptanone | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 2.31 |
| 4-Heptanone | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 6.03 |
| Iodomethane | µg/L | U.S. | 1.3 | ND | ND | ND | ND | 1.30 | ND |
| Methylene chloride | µg/L | U.S. | 28296.0 | 1.7 | ND | ND | ND | 14148.85 | 83.02 |
| 4-Methyl-2-Pentanone | | U.S. | ND | ND | ND | ND | ND | ND | 1.80 |
| Perfluoro-1,3-dimethylcyclohexane | µg/L | U.S. | 13.0 | ND | ND | ND | ND | 13.01 | NA |
| Tetrachloroethene | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 4.43 |
| Toluene | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 0.40 |
| Toluene (extractable organics) | µg/L | U.S. | ND | ND | ND | 0.6 | 0.7 | 0.65 | NA |

# TABLE 5. HUMIDITY CONDENSATE RESULTS

| Sample Location<br>Sample Description<br>Sample Date<br>Analysis/Sample ID | Units | Test Conducted by | Mir 19 CRS humidity condensate 8/28/95 95-0928-01 | Mir 20 CRS humidity condensate 10/30/95 95-1122-08 | Mir 20 EDV #1 humidity condensate 11/16/95 95-1122-05 | Mir 20 EDV #2 humidity condensate 11/16/95 95-1122-06 | Mir 20 EDV #3 humidity condensate 11/16/95 95-1122-07 | Average Mir condensate levels | Average Shuttle condensate levels |
|---|---|---|---|---|---|---|---|---|---|
| **Volatile Organics (contd.)** | | | | | | | | | |
| 1,2,4-Trichlorobenzene | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 0.62 |
| 1,2,3-Trichlorobenzene | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 0.62 |
| 1,1,1-Trichloroethane | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 0.25 |
| m&p-Xylene | µg/L | U.S. | ND | ND | ND | ND | ND | ND | ND |
| o-Xylene | µg/L | U.S. | ND | 1.5 | ND | ND | ND | 1.50 | ND |
| **Extractable Organics** | | | | | | | | | |
| Acetophenone | µg/L | U.S. | 3.3 | 23.2 | 2.7 | 2.8 | 3.4 | 7.08 | 57.64 |
| Adipic acid, bis-2-ethylhexyl ester | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 23.19 |
| Adipic acid, diisopropyl ester | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 62.33 |
| Aniline | µg/L | U.S. | ND | ND | ND | ND | ND | ND | ND |
| Azobenzene | µg/L | U.S. | ND | ND | ND | ND | ND | ND | ND |
| Benzaldehyde | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 5.90 |
| Benzoic acid | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 133.51 |
| Benzothiazole | µg/L | U.S. | 131.6 | 60.1 | 15.6 | 16.2 | 5.1 | 45.72 | 4.00 |
| Benzyl alcohol | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 136.92 |
| 2-Butoxyethanol | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 355.95 |
| 2-(2-Butoxyethoxy) ethanol | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 1655.19 |
| 2-(2-Butoxyethoxy) ethanol acetate | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 4.60 |
| Butylated hydroxyanisole (BHA) | µg/L | U.S. | ND | 4.6 | 2.7 | 3.2 | 3.4 | 3.48 | 46.23 |
| n-Butylbenzenesulfonamide | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 16.79 |
| n-Butyl Palmitate | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 14.21 |
| 3-t-Butylphenol | µg/L | U.S. | 70.6 | 195.8 | 118.6 | 141.7 | 156.8 | 136.70 | 102.51 |
| Caffeine | µg/L | U.S. | ND | 2.7 | ND | ND | ND | 2.70 | ND |
| Caprolactam | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 14975.00 |
| Trans-Cinnamic Acid | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 2.60 |
| Tris-2-Chloroethyl phosphate | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 16.70 |
| Cyclohexanone | µg/L | U.S. | ND | 3.1 | 2.8 | 3.8 | 3.3 | 3.25 | 71.29 |
| Decamethylcyclopentasiloxane | µg/L | U.S. | 1.0 | ND | ND | 0.1 | ND | 0.55 | 7.58 |
| Decanoic Acid | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 238.23 |
| 1,4 Diacetylbenzene | µg/L | U.S. | ND | ND | 0.2 | 0.7 | 1.8 | 0.90 | 2.87 |
| 1,3-Dichlorobenzene | µg/L | U.S. | ND | ND | ND | ND | ND | ND | ND |
| 1,4-Dichlorobenzene | µg/L | U.S. | ND | ND | ND | ND | ND | ND | ND |
| Dibutyl phthalate | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 26.10 |
| Di-n-butylamine | µg/L | U.S. | ND | ND | 13.1 | 13.7 | 13.3 | 13.37 | 9.13 |
| n,n-Dibutylformamide | µg/L | U.S. | ND | 0.8 | 1.4 | 1.7 | 2.9 | 1.70 | 13.73 |
| 2,6-Di-t-butyl-1,4-benzoquinone | µg/L | U.S. | ND | 2.0 | 5.1 | 5.4 | 5.9 | 4.60 | 2.95 |
| 2,4-Di-t-butylphenol | µg/L | U.S. | ND | ND | 1.8 | 1.2 | 1.5 | 1.50 | 33.50 |
| n,n-Diethylformamide | µg/L | U.S. | ND | 15.8 | 15.8 | 15.5 | 16.7 | 15.95 | 8.98 |
| Diethylene glycol monoethyl ether | µg/L | U.S. | ND | 50.1 | 63.6 | 74.3 | 96.5 | 71.13 | 209.40 |

# TABLE 5. HUMIDITY CONDENSATE RESULTS

| Sample Location<br>Sample Description<br>Sample Date<br>Analysis/Sample ID | Units | Test Conducted by | Mir 19 CRS humidity condensate 8/28/95 95-0928-01 | Mir 20 CRS humidity condensate 10/30/95 95-1122-08 | Mir 20 EDV #1 humidity condensate 11/16/95 95-1122-05 | Mir 20 EDV #2 humidity condensate 11/16/95 95-1122-06 | Mir 20 EDV #3 humidity condensate 11/16/95 95-1122-07 | Average Mir condensate levels | Average Shuttle condensate levels |
|---|---|---|---|---|---|---|---|---|---|
| **Extractable Organics (contd.)** | | | | | | | | | |
| n,n-Diethyl-m-Toluamide | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 154.39 |
| Diethyl phthalate | µg/L | U.S. | ND | 1.0 | ND | ND | ND | 1.00 | 827.26 |
| Diisobutyl phthlate | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 1.00 |
| n,n-Dimethylacetamide | µg/L | U.S. | ND | 132.1 | 58.2 | 79.2 | 90.2 | 89.93 | 165.75 |
| n,n-Dimethylbenzylamine | µg/L | U.S. | ND | 5.5 | ND | 2.2 | ND | 3.85 | NA |
| Dimethylcarbamyl chloride | µg/L | U.S. | ND | 6.1 | 2.3 | 2.4 | 3.6 | 3.60 | NA |
| n,n-Dimethylformamide | µg/L | U.S. | ND | 701.8 | 13.8 | 267.9 | 318.6 | 325.53 | NA |
| Dimethylthiocarbamoyl chloride | µg/L | U.S. | ND | 56.1 | ND | ND | ND | 56.10 | ND |
| Dimethyl phthalate | µg/L | U.S. | ND | 0.5 | ND | ND | ND | 0.50 | 15.14 |
| Dioctyl phthalate | µg/L | U.S. | ND | 25.4 | 43.2 | 93.6 | ND | 54.07 | 303.94 |
| Dipropylene glycol methyl ether | µg/L | U.S. | ND | 52.4 | 67.1 | 67.4 | 62.2 | 62.28 | 96.15 |
| Dodecamethylcyclohexasiloxane | µg/L | U.S. | 10.8 | 1.1 | ND | 0.4 | 0.1 | 3.10 | NA |
| Dodecanoic Acid | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 244.27 |
| Eicosane | µg/L | U.S. | ND | ND | ND | ND | ND | ND | ND |
| 2-Ethoxyethanol | µg/L | U.S. | ND | ND | 56.6 | 90.4 | 147.7 | 98.23 | NA |
| 2-Ethylhexanoic acid | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 481.48 |
| 2-Ethyl-1-hexanol | µg/L | U.S. | ND | ND | ND | 3.8 | 4.7 | 4.25 | 10.68 |
| bis-Ethylhexyl adipate | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 65.93 |
| 4-Ethylmorpholine | µg/L | U.S. | 66.1 | 144.0 | 120.5 | 126.0 | 166.7 | 124.66 | 366.90 |
| 1-Formypiperidine | µg/L | U.S. | ND | ND | ND | ND | 0.4 | 0.40 | 2.55 |
| Heneicosane | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 31.60 |
| Heptanoic Acid | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 185.18 |
| 2-Hexanol | µg/L | U.S. | ND | ND | ND | ND | ND | ND | ND |
| Hexanoic Acid | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 392.73 |
| 2-Hydroxybenzothiazole | µg/L | U.S. | ND | 359.7 | 9.3 | 4.6 | 4.4 | 94.50 | 6.23 |
| 4-Hydroxy-3-Methoxybenzaldehyde | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 9.83 |
| 4-Hydroxy-4-methyl-2-pentanone | µg/L | U.S. | ND | 30.6 | 28.6 | 28.7 | 46.5 | 33.60 | 57.35 |
| Isophorone | µg/L | U.S. | ND | 4.6 | 1.6 | 1.7 | 1.7 | 2.40 | 30.76 |
| Menthol | µg/L | U.S. | ND | 5.4 | 2.7 | 3.4 | 3.4 | 3.73 | 3.08 |
| 2-Mercaptobenzothiazole | µg/L | U.S. | ND | 58.5 | 9.3 | 10.2 | 10.3 | 22.08 | NA |
| Methyl sulfone | µg/L | U.S. | ND | 16.8 | 16.7 | 15.1 | 16.8 | 16.35 | NA |
| Methyl 4-Hydroxybenzoic Acid | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 10.03 |
| 2-Methyl-2,4-pentanediol | µg/L | U.S. | ND | 9.3 | 2.4 | 6.9 | 3.9 | 5.63 | NA |
| 4-Methylphenol | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 3.72 |
| 1-Methyl-2-pyrrolidinone | µg/L | U.S. | ND | 26.6 | 22.1 | 23.8 | 24.6 | 24.28 | 84.46 |
| 2-Methylthiobenzothiazole | µg/L | U.S. | 21.4 | 132.1 | 14.5 | 4.1 | 3.9 | 35.20 | ND |
| Monomethyl phthalate | µg/L | U.S. | ND | ND | 1.4 | ND | 1.5 | ND | 53.05 |
| Nonadecane | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 4.15 |
| Nonanoic Acid | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 291.28 |

# TABLE 5. HUMIDITY CONDENSATE RESULTS

| Sample Location<br>Sample Description<br>Sample Date<br>Analysis/Sample ID | Units | Test Conducted by | Mir 19 CRS humidity condensate 8/28/95 95-0928-01 | Mir 20 CRS humidity condensate 10/30/95 95-1122-08 | Mir 20 EDV #1 humidity condensate 11/16/95 95-1122-05 | Mir 20 EDV #2 humidity condensate 11/16/95 95-1122-06 | Mir 20 EDV #3 humidity condensate 11/16/95 95-1122-07 | Average Mir condensate levels | Average Shuttle condensate levels |
|---|---|---|---|---|---|---|---|---|---|
| **Extractable Organics (contd.)** | | | | | | | | | |
| Octadecanol | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 73.20 |
| Octamethylcyclotetrasiloxane | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 2.77 |
| Octanoic Acid | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 766.44 |
| 4-t-Octylphenol | µg/L | U.S. | ND | ND | ND | ND | ND | ND | NA |
| Pentacosane | µg/L | U.S. | ND | 15.0 | ND | ND | ND | 15.00 | 4.40 |
| Pentanoic Acid | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 60.90 |
| Phenol | µg/L | U.S. | ND | ND | 6.2 | ND | 6.7 | 6.45 | 85.06 |
| Phenoxyacetic acid | µg/L | U.S. | ND | 17.6 | 19.4 | 57.0 | 35.6 | 32.40 | NA |
| s-Phenethyl alcohol | µg/L | U.S. | ND | 11.1 | 5.6 | 7.0 | 7.5 | 7.80 | 80.24 |
| 2-Phenylphenol | µg/L | U.S. | ND | 6.7 | 0.9 | 1.1 | 1.1 | 2.45 | NA |
| 2-Phenyl-2-propanol | µg/L | U.S. | ND | 24.9 | 15.9 | 19.5 | 19.9 | 20.05 | 30.83 |
| N-Phenyl-2-naphthylamine | µg/L | U.S. | ND | 75.3 | 0.3 | 0.5 | 0.5 | 19.15 | ND |
| Phenyl sulfone | µg/L | U.S. | ND | 48.5 | 18.0 | 21.4 | 20.9 | 27.20 | NA |
| 2-Phenoxyethanol | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 28.06 |
| Propylene glycol methyl ether acetate | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 59.10 |
| Stearic Acid, Butyl Ester | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 17.90 |
| 1-alpha-Terpineol | µg/L | U.S. | ND | 10.9 | ND | ND | ND | 10.90 | 27.17 |
| Tetramethylsuccinonitrile | µg/L | U.S. | ND | 21.8 | 27.3 | 26.7 | 28.1 | 25.98 | NA |
| Tetramethylthiourea | µg/L | U.S. | 151.8 | 23.8 | 5.1 | ND | 7.7 | 47.10 | ND |
| Tetramethylurea | µg/L | U.S. | ND | 15.4 | 13.7 | 14.1 | 16.0 | 14.80 | NA |
| Tributyl Phosphate | | U.S. | ND | ND | ND | ND | ND | ND | 27.07 |
| Tricosane | µg/L | U.S. | ND | 8.1 | ND | ND | ND | 8.10 | 3.70 |
| 1,3,5-Triazine-2,4,6(1H,3H,5H)-Trione, 1,3,5-Tri-2-Propenyl | | U.S. | ND | ND | ND | ND | ND | ND | 539.06 |
| Triethyl Phosphate | µg/L | U.S. | ND | ND | 1.1 | 1.3 | ND | 1.20 | 21.29 |
| Triethylamine | µg/L | U.S. | ND | 16.2 | 9.2 | 9.5 | 10.8 | 11.43 | NA |
| 2,2,4-Trimethyl-1,3-pentanediol diisobutyrate | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 3.90 |
| Urethane | µg/L | U.S. | ND | ND | 17.2 | 14.2 | 13.6 | 15.00 | ND |
| **Alcohols** | | | | | | | | | |
| Ethanol | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 52163.33 |
| Methanol | µg/L | U.S. | 427.0 | ND | ND | ND | ND | 427.00 | 3098.33 |
| 1-Methoxy-2-propanol | µg/L | U.S. | NA | 3964.0 | ND | 3262.0 | 3426.0 | 3550.67 | NA |
| 2-Propanol | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 19756.25 |
| **Glycols** | | | | | | | | | |
| 1,2-Propanediol | mg/L | U.S. | 1.0 | ND | 3.9 | 3.0 | 2.8 | 2.68 | 50.23 |
| 1,2-Ethanediol | mg/L | U.S. | NA | ND | 149.2 | 152.8 | 76.8 | 126.27 | NA |
| **Organic Acids** | | | | | | | | | |
| Acetic acid | µg/L | U.S. | ND | ND | ND | ND | ND | #DIV/0! | 18352.50 |
| Lactic acid | µg/L | U.S. | 140.0 | ND | ND | ND | ND | 140.00 | NA |

# TABLE 5. HUMIDITY CONDENSATE RESULTS

| Sample Location<br>Sample Description<br>Sample Date<br>Analysis/Sample ID | Units | Test Conducted by | Mir 19 CRS humidity condensate 8/28/95 95-0928-01 | Mir 20 CRS humidity condensate 10/30/95 95-1122-08 | Mir 20 EDV #1 humidity condensate 11/16/95 95-1122-05 | Mir 20 EDV #2 humidity condensate 11/16/95 95-1122-06 | Mir 20 EDV #3 humidity condensate 11/16/95 95-1122-07 | Average Mir condensate levels | Average Shuttle condensate levels |
|---|---|---|---|---|---|---|---|---|---|
| **Organic Acids (contd.)** | | | | | | | | | |
| Propanoic acid | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 3645.00 |
| Formic Acid | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 12113.75 |
| Butyric | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 542.50 |
| Pentanoic | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 733.33 |
| Hexanoic | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 1100.00 |
| Heptanoic | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 133.33 |
| Octanoic | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 233.33 |
| Nonanoic | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 333.33 |
| Decanoic | µg/L | U.S. | ND | ND | ND | ND | ND | ND | 233.33 |
| **Aldehydes** | | | | | | | | | |
| Formaldehyde | µg/L | U.S. | 60.4 | 35.0 | 19.5 | 25.5 | 22.0 | 32.48 | 7513.67 |
| **Carboxylates** | | | | | | | | | |
| Acetate | mg/L | U.S. | ND | ND | 0.244 | 0.220 | ND | 0.23 | NA |
| Lactate | mg/L | U.S. | 0.14 | ND | ND | ND | ND | 0.14 | NA |
| **Amines** | | | | | | | | | |
| Methylamine | mg/L | U.S. | ND | 0.24 | 0.33 | 0.30 | ND | 0.29 | ND |
| Ethylamine | mg/L | U.S. | ND | ND | ND | ND | ND | ND | 0.00 |
| **Urea** | | U.S. | ND | ND | ND | ND | ND | ND | ND |
| Organic Carbon Recovery | percent | U.S. | 32.45 | 8.61 | 89.98 | 81.12 | 79.31 | 58.29 | 72.00 |

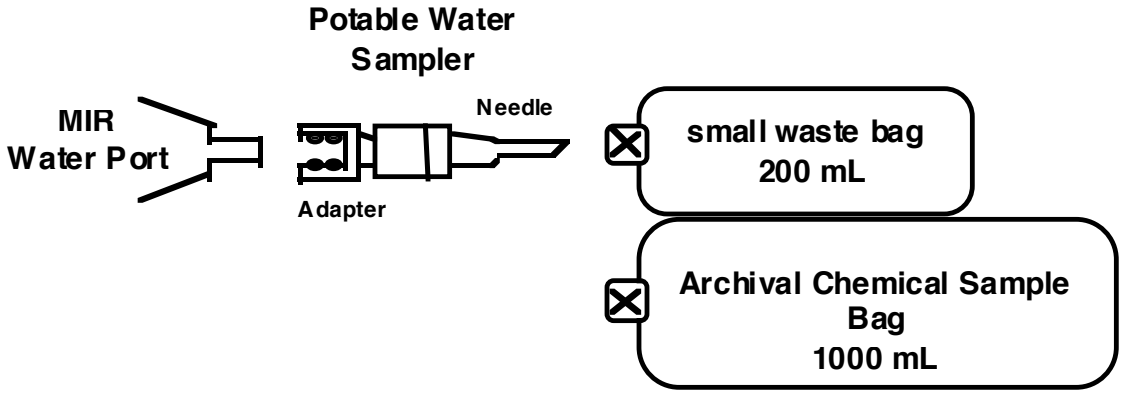


**Figure 1.** Sample Collection Methodology