The Marshall Islands Water Resources and the Hydrogen Sulfide (H₂S) test

Presented by:
- Abraham Hicking - RMI EPA Chief, WQ Monitoring Lab;
- Amlet Kalemen - CMI / CRE, WQ Specialist

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Purpose of Presentation

- Show briefly what are the main water resources for the Republic of the Marshall Islands (RMI).
  - How they are operated on atoll islands, especially at the Urban Centers of Majuro Atoll and Ebeye on Kwajalein Atoll and
  - How RMI deal with drought conditions
- How we set up the Outer Islands Water Quality Monitoring Program using the H$_2$S test.
The islands are scattered in an archipelago consisting of two roughly parallel island chains – the western “Ralik” chains (“sunset”) and the eastern “Ratak” chains (“sunrise”). These extend about 700 miles north to south (4-14° N Lat) and about 800 miles from east to west (160° to 173° E Long.).

Total land area of only 70 sq.mi. The sea, on the other hand, including our Exclusive Economic zone covers over 750,000 sq.mi.- a ratio of about 1:10,000 land to sea.

Total population of about 51,000 last census (1999) of which 70% reside in Majuro and Ebeye.
Majuro Average Rainfall

Mean Monthly Rainfall (inches), Majuro Atoll: 1959 to 2001

Source: Ben Graham 2007
The RMI International Airport on Majuro serves as the rainwater catchment with approximately 2-3 million gallons capacity.

Both rainwater and groundwater (Laura Lens) are pumped into a 38 million gallons capacity reservoirs. This water undergoes sand filtration and chlorination at Treatment Plant C prior to distribution.

The groundwater from Laura is one of the largest lens in the islands and it’s our primary source of drinking water during the drought.
MAJURO PUBLIC WATER RESERVOIRS

- The six (6) raw water storage tanks that provide potable water for the people residing at the DUD Area - total capacity of 38 million gallons
- One tank is covered and contains the finished water - water that has been sand-filtered and chlorinated and is ready for distribution.

Source: GIS Photo Coastal Dept. RMI EPA
The Majuro Water Treatment Plant C

- The Majuro Public Water supply is operated and managed by the Majuro Water & Sewer Company (MWSC). It delivers about 900,000 gallons per day.

- Water undergoes sand filtration, chlorination and then stored for distribution.

- Water is serviced twice a week – Mondays and Fridays for 6-8 hrs only.

- RMI EPA is responsible for monitoring the quality of the water serviced and water used at public places such as at restaurants, hotels, and apartments.
Bacteria Quality of the Majuro Public Water Supply 2006-07

Source: RMI EPA WQ Lab, 2007
Ebeye Public Water Supply is provided by three RO units - a total of 150,000gpd but undergoes chlorination before distribution.

Due to lack of pressurized water, illegal tapping is a common practice among water consumers. Like Majuro, water is rationed an hour or two a day and the problem can be exacerbated by lack of power on the island.

Alternate source of potable water is from Kwajalein, Kwajalein where the US military installation base is located.
RMI’s Water Situation - Drought

Recent MI Journal News Headlines:

- “Stand By For Some Weird, Wild Weather”
  (Journal December 8, 2006)
- “It’s Time To Pray For Rain”
  (January 12, 2007)
- “Reservoir Levels Getting Low”
  (January 19, 2007)
- “RMI on Drought Alert”
  (February 23, 2007)
- “Water Situation Really Bad”
  (March 2, 2007)

Source: Ben Graham, 2007
RMI responses to Drought Conditions -2007

- The National Disaster Management Task Force has to declare a State of Disaster/Emergency in order to access the Emergency relief fund - Feb. 2007.

- The Task Force, comprised of all Government Secretaries, Head of Departments and the Chair - Chief Secretary, formulated the declaration and approved/signed by the Cabinet/President.

- Only Majuro and the Northern Islands were declared State of Disaster due to lack of potable drinking water.
Activities For Outer Islands

- Deployment of the first available RMI government vessel to dispatch water supplies to the mostly affected atolls in the north (3 atolls) declared as having no drinking water on the island.
- One Officer from the MWSC, RMI EPA and the Internal Affairs Offices joined the crew to assist in water delivery and to advise people to boil water thoroughly 1-5 minutes before use.
- RMI EPA investigated groundwater that can be used for human consumption – test for conductivity, total dissolved solids (TDS) and nitrates.
- Submit data gathered to the Office of Disaster and to the Task Force.
Drought Condition on Majuro

- MWSC supplies rationed water every other Mondays for 2-4 hours only.
- To supplement availability of potable water, MWSC installed and operated smaller Reverse Osmosis (RO) Units at three major sites on the island – 2 with 2000 gpd capacity and 1 with 6000 gpd capacity.
- These RO units provided the residence of Majuro with daily potable water during the drought.
Lessons Learned/Problems encountered

- No appropriate containers to fill or a transport to deliver water to individual homes.
  - People have to collect water using plastic gallons or 3-5 gallons buckets and hand carry back to the homes which may cover several hundreds yards or even a mile away from the ship.
- When water supplies are out, the ship desalination machine is used to re-fill the bladders or fill individual containers.
- Re-direct the ship to visit Kwajalein Atoll (a military base) to have their water bladders refilled with potable water.
The Outer Islands Community-Based WQ Monitoring Program using the H2S test

SET OF OBJECTIVES:

1. To establish an Outer Island Community-Based Water Quality Monitoring Program.
   • Develop baseline data on bacterial quality of all drinking water sources using the H2S test.

2. Train Representatives from each atoll on:
   • how to perform the H2S test,
   • how to conduct a sanitary survey on rainwater tanks and wells
   • How to perform other environmental monitoring—such as hazardous wastes

3. To increase the number of safe drinking water sources from the current 20% to about 50% by the end of the year, 2005.
Objectives (cont’d)

4. To help reduce incidences of water borne illness in the Outer Islands.

5. To survey household for availability of toilet facilities and include the report in the water testing data.

6. To meet or comply with the national, regional (SOPAC) and international (MDG/WHO) strategic action plan on water related issues.
Funds for the Outer Islands Water Quality Monitoring using the H2S

Source - WHO, RMI EPA & the CMI/CRE Matching Fund

2000-2003: WHO/SOPAC initiated both the training and the purchase of the H2S test reagents and tubes

RMI EPA submitted 3 proposals, with an amount to be matched on:

• First Match (2003) : $20,000
• Second (2004-2005) : $30,000
• Third Match (2006-2007) : $20,000

Ex. of Break down (2003)

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<td>Equipment</td>
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<td>Others</td>
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Outer Island Community Awareness

Outer Island Local Policeman
THE H2S Test Costs

Cost of tube/ vial $0.52
Cost of H2S media (20ml) $0.13
Total cost for H2S $0.65

Cost of 1 Test strip 5-1 $0.21
Cost of Nitrate test $0.53
Chlorine Test $0.42

Total cost of tests $1.81
Preparing the H₂S (strip) test

1. Sterilizing using UV Light
2. Boiling using Steamer - Outer Islands
3. Sampling
Where $\text{H}_2\text{S}$ can be used

- Rainwater tanks
- Groundwater
- Public Water
- Bottled Waters
- Coastal waters
There are no surface water in the Islands, except rainwater and groundwater. No reticulated water supply system exists in the Outer Islands - self reliant on individual rainwater tanks and wells. Rainwater tanks systems are poorly constructed and no maintenance nor ever cleaned. The government helped the people provide potable plastic tanks (1500 gals.) but some houses are so poorly constructed that the tanks is hardly filled with rain.
Typical groundwater or wells in the Outer Islands

- Most groundwater are also poorly constructed and are susceptible to surface contamination.
- No hand pumps available therefore people resort to using quarts or buckets to bail water out of the well.
- Most wells are used for household (laundry and bath) and others used for cooking and drinking.
- Contamination are mostly bacterial in nature.
- Wells that contain >10mg/L Nitrate (nitrogen) are identified and advised owners not to use it for human consumption, esp. pregnant mothers.
Sharing the Test Results
Training and Workshops

- We carry out the training as stated in our objectives so that the islanders can perform their own water quality monitoring using the H2S and to be able to perform other environmental monitoring.

- Where possible, we invite doctors to talk about water borne diseases and their impact on people’s health, especially the young and the elderly, or attend to invited speakers like Dr. Patrisha during her visit to Majuro.

- Distribute pamphlets, brochures on what RMI EPA does and how to treat water with bleach.
Achievements
## Achievements: Outer Islands Water Quality & Sanitation

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<th>Total No. Unsafe</th>
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OUTER ISLANDS H2S TEST RESULTS

% Contamination

Percentage (%)

Years

2003 2004 2005 2006 2007

% Safe
% Unsafe
Conclusions

• Since both Public Water Supplies on Majuro and Ebeye not serviced 24 hours, it cannot be guaranteed to produce 100% coliform free water.

• People have to rely on best hygienic practice to protect themselves from drinking contaminated water sources.
  - Boil water 1-5 minutes before use
  - Treat water with Bleach: 3 drops per gallon of water or 1 cup of bleach to 1000 gallon of water
  - Use other means of purifying water sources – install filters, distills, or UV or RO units.

• Improved rainwater catchments systems for Outer Islands;
  - Regular tank cleaning, sanitizing practices and personal hygiene practices.

• Better/improved construction of groundwater to protect from contamination from surface runoffs, and to install pumps properly that can control extraction of water to maintain the quality and depletion of groundwater sources.

• We need more community involvement in implementing best hygienic practices for the homes, schools and at public places.
  - Community-based activities such as water testing, proper food handling, hand-washing practices and other community hygiene promotions should be encouraged at all levels...

• Need water quality awareness materials to be translated into local language so they can be used in the Outer Islands Water Quality awareness programs.
We would like to thank and acknowledge the following individuals and agencies/departments for their support to get us to attend this very important meeting:

- Dr. Patrisha Macomber and sponsors of the ARCSA, 2007.
- Mrs. Diane M. Debrum, CMI/CRE
- Dr. Warmsley, John; (HHS/OPHS)
- Mr. John Bungitak, General Manager RMI EPA
Thank you