



MEMORANDUM

To: Andrew Lees Trust UK
From: Stella Swanson, Ph.D.
Date: April 6, 2022. Revised April 20, 2022
RE: Suggested Near-Term Actions Regarding the QMM releases

The Situation as I Understand It

- Overflow releases of mine-affected water from the QMM site on February 17 and March 5, 2022 coincided with fish kills
- Releases from the QMM mine in November and December of 2019 also coincided with fish kills
- The releases were permitted for 7 weeks and have now ceased.
- Local people have been advised by Malagasy officials not to eat the fish

QMM Laboratory Reports

- QMM has released reports produced by Lab Chimie Madagascar presenting analysis of samples taken on March 6, 11 and 14, 2022 .
 - The report on radionuclides and metals concluded that analyses of water from the QMM site and in river, wetland and lake water “show compliance for all elements analyzed except aluminum”. The report goes on to state that the radiological and chemical signature of the analyzed water reflects local background conditions.
 - The report on hydrocarbons, oils and greases concluded that “oils and greases and total hydrocarbons of all surface water around the water points of the mine comply with the standards imposed by national legislation. The discharge water leaving the mine complies with the specifications to which QMM is committed. Furthermore, it should also be noted that the anthropogenic sources of these parameters come from the activities that exist within the entire Mandromondromotra watershed and not just from a particular site”
 - QMM analyzed an unspecified number of large and small fish for chromium, arsenic, lead, cadmium and mercury. Results were described as “lower than the standards”, but the standards were not specified. The report went on to suggest that the combined effect of micropollutants on fish would be determined “by a more detailed study”

My Review of the QMM Reports Concluded That:

- The two reports do not provide sufficient information for a confident evaluation of effects of the two overflow incidents on water quality, fish, or human health
- The reports do not discuss possible connections between the analytical results and reported fish kills, nor do they provide sufficient information on the potential risk to human health from consumption of fish exposed to contaminants in the overflow water

Suggested Steps Given the Available Information

Based on my understanding of the situation, there are three primary questions:

1. Are the fish kills caused by water releases from QMM?
2. Is water which receives QMM release water safe to drink?
3. Are fish from the area safe to eat?

Causes of Fish Kills

As I state in my memo of April 4, 2022, the combination of low pH and elevated aluminum in the water released from the QMM site is a plausible cause of fish kills. Other contributing factors could include high turbidity, and low dissolved oxygen. It is quite possible that a plume of low pH, turbid, low-oxygen water with elevated aluminum could persist long enough to kill fish. The dead fish could then be carried by tidal currents to other locations farther away from the discharge locations. Thus, dead fish collected farther along the shoreline from locations of QMM releases did not necessarily die at those locations.

I recommend in my April 4, 2022 memo that investigation of causation of fish kills should use approaches such as the US EPA CADDIS guidance. However, the CADDIS approach is time-consuming, expensive, and requires multi-disciplinary expertise.

Local people rely on fish as a vital source of protein. Given the urgency of understanding and preventing fish kills, I suggest the following steps:

1. Government technical personnel (with possible support of independent contractors) conduct independent monitoring of at least 1 additional incident of fish kills (if any fish kills occur) – focusing on water and fish samples taken according to international standards. Samples to be analysed by an ISO certified laboratory for metals and possibly for microbiological indicators.
2. Now that releases of QMM mine process water have ceased, independent monitoring of water quality should be conducted at the same mine site, river and lake sites as used in March, 2022 in order to investigate differences between the period of mine water discharge and the period after discharge ceased. Such monitoring should take place as soon as possible.
3. Compare water quality before and after cessation of water releases from QMM. Ensure that the same parameters measured by Lab Chimie Madagascar in March 2022 are measured again. Add hardness, dissolved organic carbon and pH to the analyses.



4. While waiting for comparisons of before and after cessation of water releases, require QMM to prepare and submit water treatment plans focusing on pH and aluminum issues but also turbidity, conductivity, dissolved oxygen and iron issues. This is because all of these parameters may be interacting to create cumulative effects on fish and other aquatic life.

Is the Water Safe to Drink?

Safe drinking water is a long-standing issue in the Anosy region. Safe drinking water meets microbiological, physical and chemical standards. I have not seen comprehensive drinking water quality data for the region, so my suggestions are based on basic principles.

1. Conduct independent water quality sampling of surface and groundwater drinking water sources and compare results to national and, if needed, international standards. Include samples collected at QMM discharge points for comparison with other locations.
2. Ensure that supporting information for each water sample includes the land use and land cover context (e.g. cropland, pasture, forested, bare/eroded), and proximity to QMM-related water discharges (both surface and groundwater).
3. Identify and prioritize exceedances of standards
4. Apply public health measures as necessary
E.g. boil-water advisories; provision of bottled water; deployment of accessible, low-cost domestic water treatment such as simple sand filtration systems

Understanding the relative contribution of releases from the QMM mine to exceedances of drinking water standards will require time and effort. I suggest that protection of public health can't wait for resolution of the issue of QMM's effect on drinking water quality. However, that does not mean that there is no role for QMM in contributing to the provision of safe drinking water to local communities.

Suite of Drinking Water Analyses: (See WHO Drinking Water Quality Guidelines 2022 <https://www.who.int/teams/environment-climate-change-and-health/water-sanitation-and-health/water-safety-and-quality/drinking-water-quality-guidelines>)

Physical: (these parameters can affect the chemical form and thus bioavailability of organic and inorganic chemicals and/or the growth of micro-organisms). High turbidity can reduce the effectiveness of treatments such as chlorination.

Turbidity
Colour
Temperature
pH
Hardness

Microbiological: Select Reference Pathogens appropriate for the region.

Examples:

Viruses: Noroviruses

Bacteria: *E. coli* 0157, *Salmonella*, *Shigella*, *Vibrio*, *Campylobacter*

A certified microbiological laboratory in the region would be a great asset in terms of ensuring safe drinking water. However, equipping and running a microbiology laboratory requires substantial effort and time. I suggest that for now, samples taken by government personnel or independent contractors be sent to accredited laboratories elsewhere. Turn-around times for microbiological results are rapid and can support timely public health decisions.

Chemical: Select Chemicals for Monitoring According to Assessment of Natural and Anthropogenic Sources in the Region

Suggested list:

- Arsenic
- Cadmium
- Chromium
- Lead
- Manganese
- Mercury
- Nickel
- Nitrate
- Nitrite
- Uranium

Plus – if possible –
analysis of pesticides commonly used in the region
benzene, ethylbenzene, toluene, xylene (BTEX)
cyanobacterial (blue-green algal) toxins

Are the Fish Safe to Eat?

The QMM data on concentrations of five metals in dead fish collected from the area are not sufficient and cannot be used to support confident decisions related to protection of human health. It is very important that reliable, credible data are collected and interpreted using international standards and approaches to assessing risk to health from fish consumption.

I suggest that independent collection of fish and shellfish which are commonly consumed by local people be conducted as soon as possible. The samples should be submitted for analysis to an accredited laboratory experienced in analysis of fish and shellfish tissue. The same 5 metals analyzed by QMM should be measured, with the addition of analysis for uranium and aluminum. An independent assessment of risk to human health via consumption of local fish should then be conducted, using standard human health risk assessment methods.

It is important to confirm or reject concerns about risk to human health from consumption of fish as soon as possible because of the reliance on the local fishery as a food source. Although it is firm conclusions cannot be drawn from the Lab Chimie Madagascar fish data, the limited data do not raise any immediate concerns. The primary concern would be related to mercury.