Preliminary Comments on Panama Cobre
Panama

Expert Report prepared by:

Science Team, Environmental Law Alliance Worldwide

For:

Centro de Incidencia Ambiental (CIAM) Panama

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Executive Summary

This document describes the following critical points:

- Available semi-annual reports describing the status of the mine and monitoring results are presented in a very fragmented and time-discontinuous way, and predominantly in tables, making access to data and information cumbersome and difficult. This prevents the presentation of a clear and transparent image of the situation and does not provide the required knowledge to safely and responsibly manage the effects of mining and take adequate decision to preserve biodiversity.
- One of the most fundamental methods for monitoring the stability of a TMF is the use of inclinometers for detecting any changes in position of the embankment of a TMF. We know that MPSA is not in compliance with the Global Industry Standard on Tailings Management because none of its inclinometers at the TMF are functioning.
- The Semi-Annual Monitoring Reports of Cobre Panamá indicate that MPSA is not monitoring pore waters of its waste rock piles or the TMF for the early detection of acid mine drainage. This failure constitutes a violation of the requirements of the GARD guide and, by operation of Resolución DIEORA 0871 del 5 de diciembre de 2013, a violation of the laws of Panama.
- Water quality has been reported to meet the project requirements when it was not the case.
- In ELAW's view, the risk of failure of the dam due to internal erosion – piping, as also warned by New Fields, combined with its lack of monitoring caused by non-operational inclinometers is a **VERY SERIOUS and IMMEDIATE CONCERN.**
- Acid Mine Drainage has been triggered at the mine and this is negatively impacting the environment. Monitoring is not completed at an adequate level to characterize its negative effects.
- The monitoring plan does not seem to have any methodologies incorporated that aim to understand impacts to biodiversity. They focus on some mitigation and monitoring basics in a very isolated and disjointed way for some species/categories, but they are not doing anything to monitor for impacts to ecosystem services, connectivity, population dynamics, food web impacts or diversity.

Introduction

This report has been produced following the review of the following semi-annual monitoring reports covering the period November 2020 through May 2024, except June 2023 – November 2023, and recent audits documents.

Reviewing the recent Cobre Panama environmental reports has revealed the following:

The information about the state of the mine and how it impacts the environment is presented in reports submitted to the Panama Ministry of Environment twice a year. These reports contain hundreds of documents presented in numerous appendices. For example, "Noveno Informe de Seguimiento 9", issued September 2024 and covering the period December 2023, May 2024 includes 173 appendices. Some of these appendices contain themselves several appendices. Therefore, some of the critical pieces of data are buried in tables that require going through thousands of pages of document. This requires time, knowledge of the meaning of the information, and a lot of patience and dedication to try to understand, visualize, build a 3D picture covering a long-enough time period, and also compare to thresholds, regulations and standards.

The information is presented in a very fragmented and time-discontinuous way, and predominantly in tables. Therefore, it is impossible to visualise and understand how the presence of contaminants is increasing over time at sensitive locations or how the environment, fish species, plants and animals are showing signs of degradation due to deteriorating conditions resulting from the mine. Using the illustration of a puzzle made of hundreds of pieces, going through all the environmental reports is like having to place enough pieces of the puzzle to reveal its picture. Until you have placed enough pieces of the puzzle the story is not told and the picture meaningless. Presenting data is one thing. Building knowledge is different, more complex. It requires more time, capacity, effort, and money.

Typically, ministries and regulatory agencies responsible to review the information, and verify whether the laws and regulations are met and whether the sensitive environment and ultimately biodiversity are protected don't have the capacity and resources to do so. Therefore, they rely on the conclusions provided by the mining companies.

Monitoring must be completed with the intent to develop an understanding and an increasing knowledge of the complex nature of the site, how water flows through it at surface and in the subsurface, and how noise, and pollutants carried by air and water, and bioaccumulated through generations of thousands of species affect biodiversity. It is complex, extremely important, and costly (several $100,000s to millions, per year). It requires a sequence of events (collection, presentation, interpretation of information) and many people involved. One of the key aspects of monitoring is to act as a sentinel. To identify how the ancient equilibrium of nature has been disturbed, how pollutants start to appear, how their presence and concentrations increase, to take measures to control, reduce, treat and mitigate negative

effects. Therefore, completing a monitoring that only presents fragmented information, with data buried among thousands of pages of documents prevents the presentation of a clear and transparent image of the situation, and does not provide the required knowledge to safely and responsibly manage the effects of mining and take adequate decision to preserve biodiversity.

We understand, too, that in Panama, there is a 2-year limitation for the environmental sanctioning process. Therefore, a claim must be filed for an infraction that occurred within 2 years of filing. Pollution by a mine is a slow process that will happen over decades. Therefore, due to the time it takes for the effects of a pollution to be observed, monitored, confirmed, reported, this 2-year limitation prevents any meaningful protection of the environment and biodiversity according to the present legal framework. This 2-year limitation should be abolished.

In this document, excerpts from the reviewed documents are shown *in italics*.

This document is presented to CIAM with the objective to highlight some key points and priorities for Cobre Mine which is under a safe preservation and management plan, awaiting the definition of a closure plan.

Key Findings

Non-compliance

Non-compliance with national and international norms

The Semi-Annual Monitoring Reports of Cobre Panamá contain the following statements:

> *"El Proyecto Categoría III "Mina de Cobre Panamá", cuyo Estudio de Impacto Ambiental y Social y su consecuente viabilidad ambiental y social, fue aprobado el 28 de diciembre de 2011 por la Autoridad Nacional del Ambiente (ANAM) actual Ministerio de Ambiente (MiAMBIENTE) mediante la Resolución DIEORA IA 1210-2011; consiste en el minado a cielo abierto de tres (3) yacimientos de cobre correspondientes a los tajos Botija, Colina y Valle Grande.*
>
> *"La concesión y derecho de explotación y procesamiento de mineral de sulfuro de cobre otorgada a la Sociedad Minera y Promotora Minera Panamá, S.A. (MPSA), fue establecida por la Dirección Nacional de Recursos Minerales del Ministerio de Comercio e Industrias, a través de la Ley 9 del 26 de febrero de 1997, denominada Ley Petaquilla, para una concesión de 13,000 hectáreas, ubicadas en los distritos de Donoso y Omar Torrijos Herrera, provincia de Colón; en la zona Nor-Central de Panamá.*

> *"Minera Panamá, S.A., presenta ante la ANAM (hoy MiAMBIENTE), el 25 de noviembre de 2013, la solicitud de modificación del Plan de Manejo Ambiental. La misma fue aprobada mediante Resolución DIEORA 0871 del 5 de diciembre de 2013 y consistió en la condensación de las seiscientas diecisiete (617) medidas de mitigación contempladas en el EsIA aprobado, sus adendas y la Resolución aprobatoria; en un total de trescientos setenta y tres (373) compromisos, de los cuales tres (3) compromisos referentes al uso de Cianuro, no aplican al Proyecto debido a que el mismo no se utilizará en ninguna de las etapas del Proyecto.*
>
> *"El 15 de diciembre de 2015, se aprobó mediante la Resolución DIEORA-IAM-040-2015, la modificación al diseño y ubicación de la captación y descarga de agua de mar para enfriamiento de la Planta de Generación Eléctrica, del Estudio de Impacto Ambiental Categoría III del Proyecto y se añade una medida de mitigación; para un total de 371 compromisos ambientales adquiridos por MPSA."*[1]

Assuming that the 373 commitments approved by Resolución DIEORA 0871 del 5 de diciembre de 2013 were approved validly in accordance with law, then these 373 commitments that Minera Panamá, S.A (MPSA) must abide are part of the national laws of Panama.

The first commitment (Código 13001) approved by Resolución DIEORA 0871 del 5 de diciembre de 2013 states:

> "*Cumplir con los estándares internacionales para factores de seguridad y diseños de ingeniería en: estructuras de la mina, caminos y puentes; incluyen los que conectan Colina con Penonomé y el Camino a la Costa.*"

Therefore, compliance by MPSA with international standards for safety factors and engineering designs in mine structures is also a part of the national laws of Panama.

The Tailings Management Facility (TMF) and waste rock piles that MPSA are mine structures for which there are international standards for safety factors and engineering designs.

An important standard for the design, construction and operation by MPSA of the TMF is the Global Industry Standard on Tailings Management.[2] Because of Resolución DIEORA 0871 del 5 de diciembre de 2013 and Código 13001, compliance by MPSA with Global Industry Standard on Tailings Management is a requirement of the laws of Panama. One the most important requirements of Global Industry Standard on Tailings Management is that the operator of TMF use robust methods for monitoring the stability of the TMF. Principle 7 of the Global Industry Standard on Tailings Management states.

[1] Séptimo Informe de Seguimiento sobre la Implementación de los Compromisos Ambientales y Sociales Proyecto "Mina de Cobre Panamá": Capítulo 9. Aspectos Técnicos.
[2] Available in Spanish at: https://globaltailingsreview.org/wp-content/uploads/2020/08/global-industry-standard_ES.pdf

> "*PRINCIPIO 7: DISEÑAR, ESTABLECER Y OPERAR SISTEMAS DE MONITOREO PARA LA GESTIÓN DE RIESGOS EN TODAS LAS FASES DEL CICLO DE VIDA DE LA INSTALACIÓN DE RELAVES, INCLUSO SU CIERRE.*
>
> *"Requisito 7.1: Diseñar, implementar y operar un programa de monitoreo amplio e integrado sobre el desempeño de la instalación de relaves y sus estructuras anexas, como parte del SGR y de los aspectos del SGAS relacionados con la instalación de relaves, de conformidad con los principios de gestión adaptativa.*
>
> *"Requisito 7.2: Diseñar, implementar y operar un sistema completo e integrado de monitoreo para la ingeniería que sea adecuado para verificar los supuestos de diseño y monitorear los modos creibles de falla. Para los modos creíbles de falla de comportamiento no frágil se implementará el método observacional. Los mecanismos de falla frágiles se abordan mediante criterios de diseño conservadores.*
>
> *"Requisito 7.3: Establecer objetivos, indicadores, criterios y parámetros de desempeño específicos y medibles, e incluirlos en el diseño del programa de monitoreo que mide el desempeño durante todo el ciclo de vida de las instalaciones de relaves. Registrar y evaluar los datos con las frecuencias adecuadas. En función de los datos obtenidos, actualizar los programas de monitoreo durante todo el ciclo de vida de la instalación de relaves para confirmar que sigue siendo eficaz para la gestión de los riesgos.*"

One of the most fundamental methods for monitoring the stability of a TMF is the use of **inclinometers** for detecting any changes in position of the embankment of a TMF. We know that MPSA is not in compliance with the Global Industry Standard on Tailings Management because none of its inclinometers at the TMF are functioning!

According to the Eighth Semi-Annual Monitoring Reports of Cobre Panamá:

> "*6 inclinómetros (ninguno operativo)*"

According to the Ninth Semi-Annual Monitoring Reports of Cobre Panamá:

> "*De igual forma, la IMR albergó un total de cinco (5) inclinómetros; de cuales, actualmente solo dos están operativos. Estos equipos fueron instalados en la Fase 3 de Instrumentación de la IMR y su interpretación de datos se iniciará en los próximos meses. Los inclinómetros restantes se consideran como unidades dañadas y se planea su reinstalación.*"

The ongoing failure of MPSA to operate an adequate number of inclinometers for detecting any changes in position of the embankment of a TMF in good working condition constitutes a threat to public safety, a violation of the Global Industry Standard on Tailings Management, and by operation of Resolución DIEORA 0871 del 5 de diciembre de 2013, a violation of the laws of Panama.

Another important standard for the design, construction and operation by MPSA of the TMF and waste rock piles is the Acid Rock Drainage Guide, often called the GARD guide, developed by the International Network for Acid Prevention.[3] Most of the major mining companies in the world follow the GARD guide including: Anglo American, Barrick, Freeport McMoRan, Newmont, Rio Tinto and Xstrata.

Copper ore contains about 35% sulfur by weight, so the mining of all copper ores involves the problem of managing sulfur, which can acidify when exposed to air and rain. Acid mine drainage (AMD) is a significant environmental problem. When sulfuric acid is produced, it the acidity dissolves toxic metals. The resulting acidic and metal-laden water can contaminate nearby rivers, groundwater, and ecosystems, posing risks to aquatic life. The problem can persist for decades or even centuries after mining operations cease, requiring ongoing mitigation and treatment efforts. The best practice is to prevent acid formation minimizing exposure of acid-generating materials to air and rain, using covers or liners to limit contact with oxygen. At TMF operated by MPSA vast quantities of tailings form a large beach directly exposed to air and rain – unfortunately perfect conditions for the formation of acid mine drainage.

Chapter 8 of the GARD guide calls for the regular monitoring of waste rock piles and tailings storage facility, especially pore water within the tailings facility, for pH, electrical conductivity, and sulphate and metals of interest, to provide early detection of acid mine drainage. The following are required components of monitoring for early detection of acid mine drainage in waste rock piles.

Table 8-6: Components of Waste Rock Pile Monitoring Program

Objective	Data Collection	Method/Instrument	Reference
ARD/ML leaching - water quality	Pore water - unsaturated Zone	Pressure-vacuum (suction) lysimeters	
	Pore water - saturated zone	Piezometers/wells	
	Runoff	Weirs	
	Seepage	Weirs/wells	

The following are some of the required components of monitoring for early detection of acid mine drainage in tailings management facilities (TMFs):

[3] The Acid Rock Drainage Guide is available here: https://www.gardguide.com

Table 8-7: Components of Tailings Storage Facility Monitoring Program

Objective	Data Collection	Method/Instrument
ARD/ML leaching water quality	Pore water- unsaturated zone	Core sample extraction (e.g., centrifugation, pressurised consolidation – squeezing, pore water displacement)
	Pore water – saturated zone	Suction lysimeters
	Runoff	Weirs
	Seepage	Weirs/wells
	Water cover (subaqueous disposal)	

We know from the Semi-Annual Monitoring Reports of Cobre Panamá that MPSA is not monitoring pore waters of its waste rock piles or the TMF for the early detection of acid mine drainage. This failure constitutes a violation of the requirements of the GARD guide and, by operation of Resolución DIEORA 0871 del 5 de diciembre de 2013, a violation of the laws of Panama.

Non-compliance with project requirements (Water Quality)

In VII Informe - Dic 2022 - May 2023, 3.22 X15 230501- Calidad de agua subterranea Pozos Ambientales Mina, published in July 2023, the pH in GW-RDM-001A is 5.4 on February 10, 2023. This is outside of the acceptable range of 5.5 – 8.5. Therefore, it does not meet the requirements defined in DGNTI – COPANIT 35 2019.

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4. RESULTADOS

A continuación, se estarán presentando las tablas y graficas de tendencia con los diferentes resultados obtenidos con los diferentes muestreos realizados mensualmente a los puntos GW-RDM-001A y GW-UVR-001A.

Tabla 4: Resultados de Monitoreo

Estación			GW-RDM-001A		GW-UVR-001A	
Variable	Unidad	Límite Permisible COPANIT 35-2019	07-Dec-22	10-Feb-23	07-Dec-22	09-Apr-23
pH	unidades de pH	5.5-8.5	5.7	5.4	6.4	6.5
Sólidos Totales Suspendidos	mg/L	35	10.5	6.8	1.6	1.6
Cianuro Total	mg/L	0.2	0.001	0.001	0.001	0.001
Mercurio Total	mg/L	0.001	0.00005	0.00005	0.00005	0.00003
Arsénico Total	mg/L	0.5	0.0004	0.0001	0.0001	0.0001
Cadmio Total	mg/L	0.01	0.0001	0.0001	0.0001	0.0001
Cobre Total	mg/L	1	0.0023	0.0019	0.0003	0.0006
Níquel Total	mg/L	0.2	0.0008	0.0005	0.0002	0.0002
Plomo Total	mg/L	0.005	0.0006	0.0006	0.0002	0.0002
Zinc Total	mg/L	3	0.023	0.033	0.019	0.013
Aceites y Grasas	mg/L	20	0.1	0.1	0.1	0.1
Demanda Química de Oxígeno	mg/L	100				10
Nitrógeno Total	mg/L	15	0.117	0.141	0.112	0.081
Fósforo Total	mg/L	10		0.01		0.133

Fuente: Departamento de monitoreo ambiental Cobre Panama

However, the conclusions of the report state:

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5. Conclusiones

- En todos los casos, los niveles freáticos se mantuvieron constantes en el periodo actual de evaluación, denotando poca o nula influencia de las actividades desarrolladas en el proyecto.
- Se observa que los parámetros están dentro de los valores de cumplimiento con la normativa COPANIT 35-2019 a manera referencial.

The conclusions are wrong and misleading.

Risk of Instability of the North Tailings Dam.

The conclusion section of Anexo 3.83 - Instalación de Manejo de Relave Presa de Arranque y Presa de Arena Informe Técnico de Instrumentación" of the ninth Semi-Annual Monitoring Report of Cobre Panamá states:

> "En cuanto a los niveles piezométricos en los terraplenes, la mayoría, el 70%, de los instrumentos registran rangos normales, indicados por niveles de umbral en verde, mientras que el 30% restante muestra niveles de umbral en amarillo. Es importante destacar que la presencia de lecturas en amarillo no genera preocupaciones inmediatas, ya que los niveles freáticos mantienen consistentemente una distancia segura del filtro de drenaje primario de la Presa de Arena. No obstante, el monitoreo semanal continuo sigue siendo imperativo para detectar rápidamente cualquier desviación de la norma.
>
> "El seguimiento de las celdas de asentamiento revela una perspectiva predominantemente positiva, con un 69% de los instrumentos dentro de los niveles del umbral verde. Sin embargo, una pequeña proporción (el 5%) indica niveles de umbral amarillos, mientras que el 5% y el 21% muestran niveles de umbral naranja y rojo, respectivamente. Es importante mencionar que los instrumentos que activan los umbrales amarillo y rojo han sido marcados como poco confiables, ya sea mediante referencias cruzadas con instrumentos vecinos o debido a patrones de datos históricos sospechosos. Además, el único instrumento que indica un nivel de advertencia naranja se encuentra más allá de la huella de la presa y es parte de la fase 3 de instrumentación recientemente instalada. Una vez más, el monitoreo semanal sostenido es esencial para una gestión proactiva.
>
> "Con respecto a los inclinómetros, persisten los desafíos, particularmente con las unidades dañadas en las fases de instrumentación 1 y 2. Hay planes en marcha para verificar esto reinstalando todos los inclinómetros dañados en la Fase de Instrumentación 3 parcialmente terminada. Si bien la instalación parcial ha comenzado, contratiempos como los daños recientes a uno de los inclinómetros recién instalados

subrayan la urgencia de completar esta fase. La inclusión de resultados de inclinómetros operativos en próximos informes promete mejores conocimientos sobre la estabilidad de las presas.

"Mirando hacia adelante, la finalización de la Fase 3 de Instrumentación es primordial. Esta fase no solo reemplazará los instrumentos dañados, sino que también introducirá nuevos, mejorando significativamente el monitoreo integral de la integridad estructural de la presa. Esta fase requiere de ciertas acciones contempladas en el Plan de Gestión Segura entregado al Gobierno de Panamá y a la espera de su aprobación.

"En resumen, aunque el monitoreo actual indica estabilidad general, la vigilancia y la acción rápida siguen siendo imperativas para abordar problemas emergentes y garantizar la seguridad y la resiliencia continuas de la infraestructura de la presa."

However, Anexo 3.98, "RE: Rerequisitos Para La Reubicación De La Posición Del Aliviadero Del Deposito De Relaves En Cobre Panamá" a report produced by an external expert (New Fields) and dated 17 May 2024 highlights the risk of failure of the North Wall of the tailings dam.

According to New Fields, the risk of failure of the North Wall of the tailings dam is because liquids in the TMF are approaching too close to the North Wall, creating the risk of erosion by seepage of liquids through the North Wall – this phenomena is referred to as "piping". To prevent failure of the North Wall by internal erosion by this seepage pathway, liquids in the TMF should approach no closer than 400 meters to the North Wall (

Figure 1). However, in practice, liquids in the TMF are approaching as close as 195 meters to the North Bank, causing a serious risk of failure by internal erosion.

According to New Fields, the root cause of liquids in the TMF approaching too close to the North Wall is the location of the spillway, which is too close to the North Wall. According to New Fields, the solution to the problem would be to move the spillway several hundred meters to the south, which would draw liquids away from the North Wall.

What is "piping"?

Piping occurs when high hydraulic forces applied on soil particles trigger the movement of particles, starting with the smallest one. Once the smallest ones are removed, the size of the pores in the material increases, allowing larger particles to move. Gradually the size of the pores (i.e., pipes) keep increasing and as more soil is being removed, it can quickly trigger a "domino effect" resulting in a catastrophic failure of the structure (dam) due to internal erosion.

Hydraulic forces are directly proportional to the hydraulic gradient in the dam, which is the ratio between the difference in elevation between the high water level in the reservoir upstream of the dam and the low level at the base of the dam divided by the distance between these two locations.

However, as New Fields points out, relocation of the spillway in the TMF is construction activity that is likely prohibited by the Supreme Court judgment of last year.

During the November 25, 2024, flight over the mine, a picture was taken showing the narrow beach (in the order of 200 m,
Figure 2). This confirms the high risk of failure of the North wall (north dam).

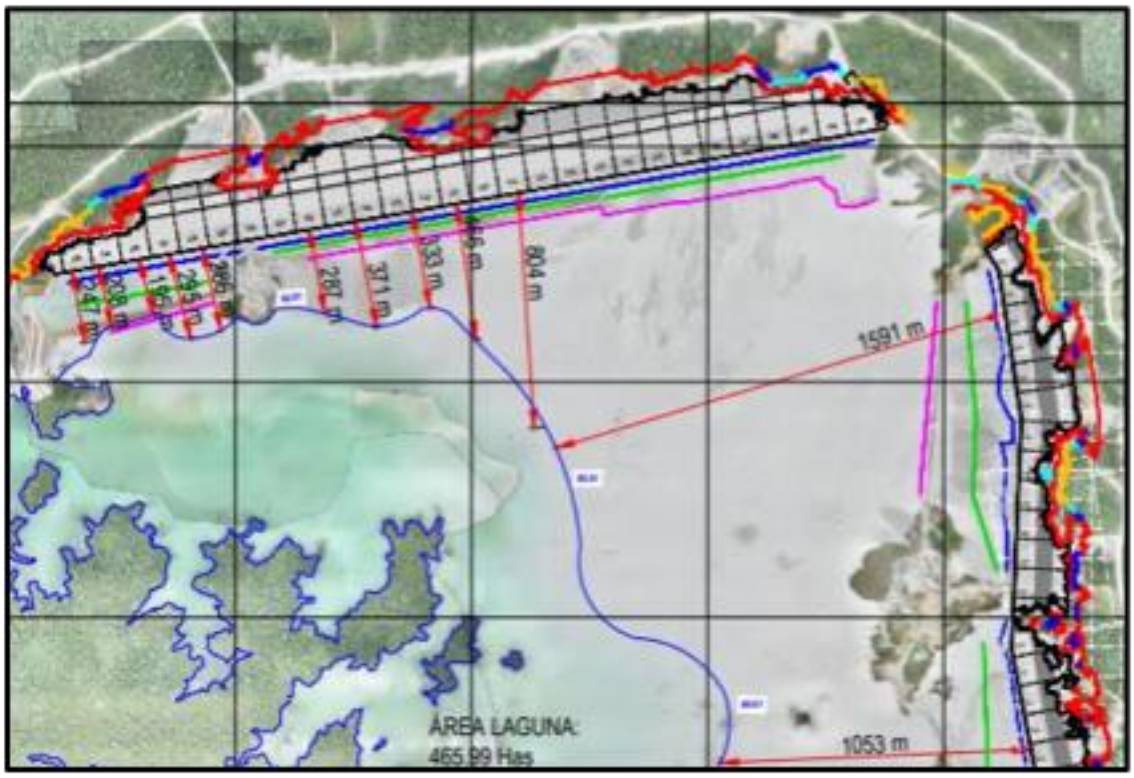

Figure 1: Ortofoto del 19 de octubre del 2023 que ilustra longitudes de playa de menos 400 m durante las operaciones (Source: New Field report May 17, 2024)

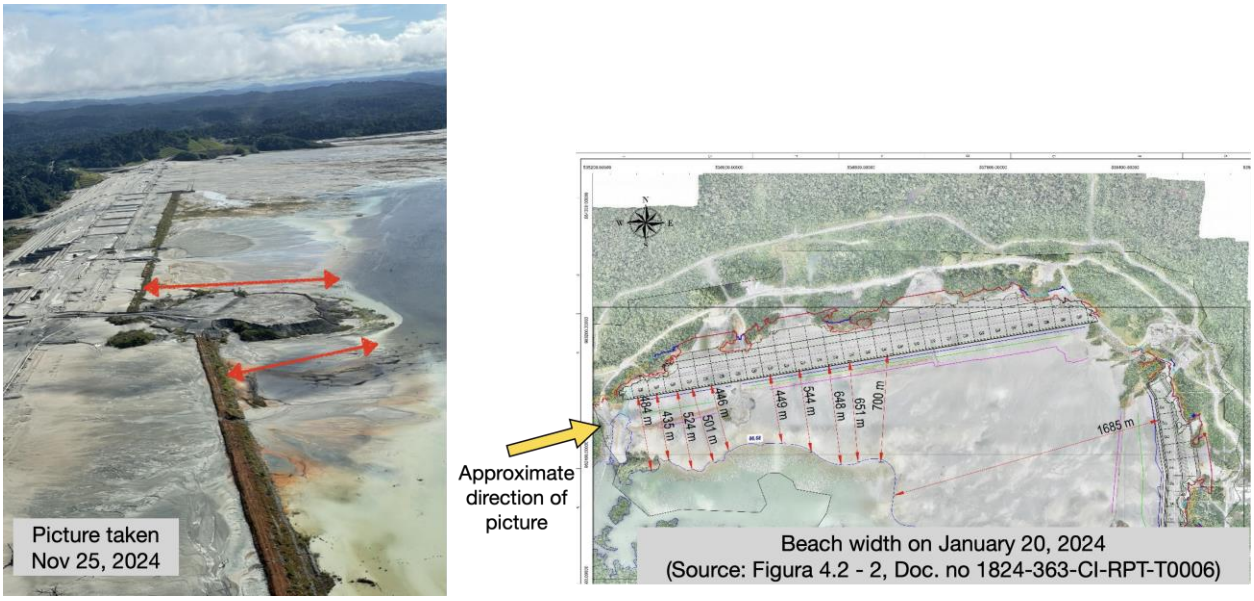

Figure 2: Photo of beach width taken November 25, 2024, compared to ortophoto of beach width January 20, 2024

In ELAW's view, this risk of failure of the dam, combined with its lack of monitoring caused by non-operational inclinometers is a **VERY SERIOUS and IMMEDIATE CONCERN.** This is another reason why there should not be any further delay in closing the Cobré Panamá mine. For example, one way of reducing the possibility of failure of the North Wall, aside from relocating the spillway, would be to move material (liquids and tailings) out of the TMF, perhaps to the Botija open pit. However, these are measures that are only compatible with closure of Cobré Panamá mine and are not compatible with resumption of mining activities.

Uncontrolled Release of Contaminants To The Environment

According to Appendix 3.21 of Volume VII Informe – Dic 2022 – May 2023, X14 rep manejo de infiltraciones TMF, it states in Section 6:

- *"El IMR debe operar en conjunto con un Sistema de Recolección de Filtraciones las cuales se posicionan en cada una de las Plataformas de Roca Residual (WRP). Estos sistemas tienen el propósito de recolectar el agua entrante (por filtraciones, lluvia y descargas hidráulicas) para luego bombearla al estanque principal del IMR. Durante lluvias extremas, los flujos de agua exceden la capacidad de bombeo del sistema. En estos casos, el flujo excedente drena hacia fuera de las presas del IMR, y en última instancia hacia el medio ambiente bajo el permiso de descarga Res. DM-0167-2022.*

- *El sistema de recolección de filtraciones de la presa norte requiere de tres (3) bombas cada una con una capacidad de 500 l/s y estas bombas se encuentran instaladas y operativas.*

- *Los diseños del sistema de colección de filtraciones en la Presa Este han sido finalizados y oficialmente distribuidos. Algunos detalles clave, como lo capacidad de bombeo y escorrentías por lluvia, aún no se han incorporado al reporte los cuales serán agregados en una nueva revisión (E).*

- *La escorrentía dentro del TMF está siendo monitoreada regularmente por el Departamento de Recursos Hídricos del TMF junto con el departamento ambiental de MPSA. Los resultados de las pruebas indican que la calidad del agua es buena considerando que cumple con los parámetros relevantes."*

Therefore, it clearly acknowledges that:

- During extreme rainfall, water flows exceed the pumping capacity of the system. In these cases, the excess flow drains out of the TMF dams, and ultimately into the environment under discharge permit Res. DM-0167-2022.

- Seepage exfiltrating from the TMF is returned to the TMF by a system of pumps. However, the pumps are limited in pumping capacity and cannot pump enough during extreme events. Under these conditions (100 year returned period) a portion of the seepage from the TMF (half to three quarters) is directly discharged to the environment.

- Water quality of water (runoff within the TMF and surface water from the receiving environment) is monitored. Unfortunately, the locations where monitoring is conducted does not allow to properly assess neither the volume of groundwater impacted nor the loading by toxic elements such as copper, sulfate and selenium, etc. Copper, sulfate and selenium, among other contaminants, would be very detrimental to fish, benthic

invertebrates, and aquatic habitat. Figure 3 shows areas likely impacted by contaminants where water quality should be much better monitored (locations presented for illustration only – to be defined following additional review).

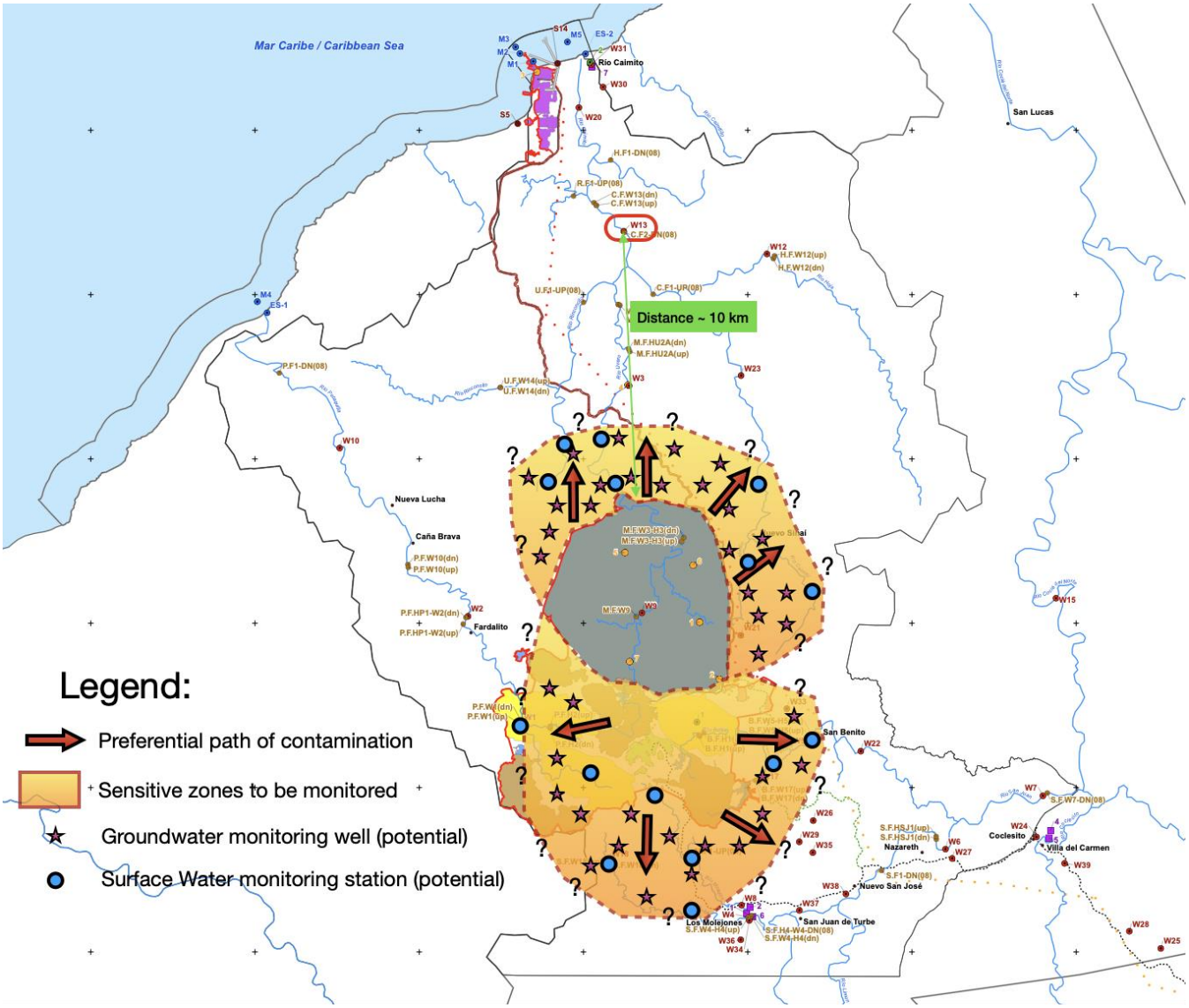

Figure 3: Zones likely impacted by mining and need for improved monitoring (Modified from Map 36, Golder, June 2010)

Impacts on biodiversity

The EIA did a baseline study of biodiversity that included different levels of the food web and important fisheries species etc. (for example, quantified the different classes of phytoplankton in the marine waters and found mostly diatoms...). In the completed work since mining started, we haven't found reports describing continuing to survey biodiversity in this food-web framework or looking at trends in key species abundances, distributions, etc. From the most recent report (Informe IX Dec'23-May'24) reviewed, biodiversity really doesn't seem to be something monitored. How are the impacts to biodiversity really being monitored and are they collecting information that would signal if there's a problem/negative impact? Are there changes in the base of the food web (plankton species for example)? Would we know with the monitoring they're doing?

For a little more context, we see that they are reporting roadkill incidents (Informe IX, 3.11) and flora relocations (3.14), but it's not clear WHY the flora needs to be moved or what impacts it is suffering at this stage with the mine not in operation. It looks like a lot of listed species of concern that they're still working with on the flora front, so it's certainly a point of concern. It appears more than 100 individual plants were moved in the Informe IX reporting period, as reported (p.6):

> "*INFORME SEMESTRAL DE RESCATE DE FLORA*
> *Fecha: Periodo de octubre 2023 a marzo 2024*
> *"4. RESULTADOS*
> *Durante el monitoreo y rescate de flora para el periodo de octubre 2023 – marzo 2024, se realizaron visitas recurrentes a las áreas del Sitio Mina, específicamente, en el Tajo de Colina: zonas 276 y 269; en las plataformas COW030, COW031 y COW033. En el área de TMF, sitios en la Presa de Relaves Este: polígono WDR05 y WDR06, y en la zona de Instalaciones de Manejo de Relaves (IMR): polígonos 6 y 7.*
>
> *Del listado actual de especies EdI, se localizaron y rescataron 24 especies de interés (Tabla 01). De las 24 especies rescatadas; dos (2) se encuentran en estado de En Peligro Crítico (CR), seis (6) se encuentran En Peligro (EN), tres (3) son Vulnerables (VU+) y 13 están bajo la categoría de Datos Deficientes (DD), según la lista roja de la UICN. De las especies reportadas y rescatadas en este periodo; Calyptrogyne sp. 1, fue la especie con mayor número de individuos rescatados con un total de 15, seguido de Ardisia sp. 3 con 12 individuos, Anthurium monticola con 8 individuos, Strychnos puberula y Phragmotheca sp. 1 con 7 individuos cada una, Anthurium sp. 7 y Danaea grandifolia ambas con 6 individuos, entre otras; para un total de 109 individuos rescatados para este periodo (Figura 01 y Anexos).*"

With respect to compliance, some for the monitoring plan says that parameters should be measured 4 times per month, but it seems they're only reporting quarterly measurements in Informe IX. It is also unclear how some of the site names (particularly around the port/marine

stations) correlate between the original monitoring plan and the Informes, which makes it challenging to know how parameters are changing through time.

Sitios, Parámetros y Frecuencia de Monitoreo

Los parámetros de muestreo para los ***puntos de descargas*** son los señalados en la Tabla 4-1. Las regulaciones de Panamá especifican la frecuencia de los muestreos basada en el volumen de la descarga y qué constituyentes están siendo descargados. El protocolo más estricto exige que se lleven a cabo muestreos 4 veces al mes, aplicable a las descargas de TMF y Central Eléctrica, cuya ubicación se indica en la Tabla 4-2 y Figura 4-1.

Tabla 4-2: Ubicación puntos de muestreo en descargas de Planta de Energía y TMF

Estaciones	Localización Geográfica	
	E UTM WGS84	N UTM WGS84
Descarga de Agua de Mar Unidad 1	533519	997138
Descarga de Agua de Mar Unidad 2	533512	997134
Toma de Agua de Mar	533402	997175
Descarga TMF	536056	983148

Minera Panamá S.A. - Plan de Monitoreo Ambiental – Fase Operación

34

Many specific thresholds seem higher than US EPA limits. Still, focusing on the compliance aspects, sulfide should have been measured and it WAS NOT DONE. They only seem to report on sulfates. In particular, the listed limit for sulfates in the monitoring plan are high (1,000 mg/L) while sulfide is much lower at 1 mg/L. For information, this sulfide limit much higher than what the EPA allows (2 ug/L chronic limit for either salt or fresh water - https://www.epa.gov/wqc/national-recommended-water-quality-criteria-aquatic-life-criteria-table)

In any case, the sulfate measurements were relatively modest compared to today's levels at sites W-13 (See location - red circle, on Figure 3) and W-15 for example during the baseline

studies for the 2010 EIA ranging from 0.7-6 mg/L:

Tabla 12 Datos Recogidos de Calidad del Agua para el Monitoreo del Sitio W13, de Septiembre de 2007 a Febrero de 2009 (continuación)

Parámetro	Unidades	Criterio Ambiental Seleccionado[a]	Monitoreo del Sitio W13			Resumen de Estadística[b]					
			Oct-08	Nov-08	Feb-09	Mínimo	Máximo	Mediana	Promedio	Desv. Stand.	Conteo
Parámetros de Campo											
temperatura	°C	<2°C[c]	28.6	23.7	25.7	23.7	30.9	25.6	26.1889	2.18371	9
pH	-	6.5 a 8.5	7.6	7.47	7.26	5.7	7.67	7.36	6.5	-	8
conductividad	µS/cm	[d]	70	60	244	30	244	60	79.875	69.5217	8
potencial de reducción	mV	[d]	318	217	60	57	318	138	153.857	92.825	7
turbidez	UNT	50 (estación seca)	8.56	11.5	1.71	1.71	11.5	8.56	7.566	3.82624	5
Parámetros Generales											
pH	-	6.5 a 8.5	7.4	6.7	7.38	6.63	7.54	7.38	7.05486	-	9
conductividad	µS/cm	[d]	61	21	48	21	62	48	46.8889	13.3083	9
dureza	mg/L como $CaCO_3$	[d]	15.4	4.7	12.5	4.7	15.6	12	11.5778	3.61344	9
dureza total	mg/L como $CaCO_3$	[d]	17.2	5.2	12.6	5.2	17.2	12	11.8889	3.63196	9
total de sólidos disueltos (TSD)	mg/L	500	36	10	32	10	60	48	41.6667	15.9452	9
total de sólidos en suspensión (TSS)	mg/L	[d]	45	27	3	<1	45	5	13.1667	14.5344	9
alcalinidad total	mg/L como $CaCO_3$	[d]	29.1	8	21.9	8	29.1	19.9	18.8222	6.87328	9
bicarbonato	mg/L como HCO_3-	[d]	35.5	9.8	26.7	9.8	35.5	24.3	22.9778	8.37806	9
carbonato	CO_3^{2-}	[d]	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	9
hidróxido	mg/L como OH-	[d]	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	9
Nutrientes											
amoníaco	mg/L como N	1	0.06	0.03	0.01	<0.01	0.06	<0.01	0.01944	0.02186	9
nitrato y nitrito (NO_3 + NO_2)	mg/L como N	[d]	0.04	0.07	0.03	<0.01	0.24	0.05	0.065	0.06856	9
nitrato (NO_3)	mg/L como N	10	-	-	0.03	<0.01	0.24	0.05	0.06786	0.07841	7
nitrito (NO_2)	mg/L como N	0.06	0.008	<0.002	<0.002	<0.002	0.008	<0.002	0.00211	0.00242	9
nitrógeno total kjeldahl (NTK)	mg/L como N	[d]	0.3	<0.2	<0.2	<0.2	1.7	0.2	0.36667	0.5172	9
Aniones											
cloruro	mg/L	100	3.9	1.93	4.25	1.93	4.33	3.66	3.61556	0.72431	9
fluoruro	mg/L	0.75	<0.05	<0.05	<0.05	<0.05	<0.1	-	-	-	9
sulfato	mg/L	250	0.84	0.77	0.74	<0.72	0.94	0.76	0.77	0.12923	9

Tabla 13 Datos Recogidos de Calidad del Agua para el Monitoreo del Sitio W15, de Septiembre de 2007 a Febrero de 2009

Parámetro	Unidades	Criterio Ambiental Seleccionado[a]	Monitoreo del Sitio W15								
			Sep-07	Oct-07	Nov-07	Dec-07	Ene-08	Mar-08	May-08	Jun-08	Sep-08
Parámetros de Campo											
temperatura	°C	<2°C[c]	-	26	-	24.4	28.5	-	-	26.6	28.5
pH	-	6.5 a 8.5	n/a	-	-	-	8.1	-	-	7.2	7.64
conductividad	µS/cm	[d]	-	50	-	60	80	-	-	70	-
potencial de reducción	mV	[d]	-	175	-	127	-	-	-	146	-
turbidez	UNT	50 (estación seca)	-	-	-	45	-	-	-	6.13	-
Parámetros Generales											
pH	-	6.5 a 8.5	-	7.28	-	6.61	7.44	-	-	7.38	7.75
conductividad	µS/cm	[d]	-	49	-	52	73	-	-	70	75
dureza	mg/L como $CaCO_3$	[d]	-	16	-	14	22	-	-	21	28
dureza total	mg/L como $CaCO_3$	[d]	-	16	-	15	21	-	-	24	24
total de sólidos disueltos (TSD)	mg/L	500	-	61	-	33	66	-	-	74	65
total de sólidos en suspensión (TSS)	mg/L	[d]	-	30	-	35	2	-	-	7	1
alcalinidad total	mg/L como $CaCO_3$	[d]	-	18.2	-	19.1	23.7	-	-	20.5	30
bicarbonato	mg/L como HCO_3^-	[d]	-	22.2	-	23.2	28.9	-	-	25	36.6
carbonato	CO_3^{2-}	[d]	-	<0.5	-	<0.5	<0.5	-	-	<0.5	<0.5
hidróxido	mg/L como OH^-	[d]	-	<0.5	-	<0.5	<0.5	-	-	<0.5	<0.5
Nutrientes											
amoníaco	mg/L como N	1	-	<0.01	-	<0.01	<0.01	-	-	0.02	0.02
nitrato y nitrito (NO_3 + NO_2)	mg/L como N	[d]	-	0.08	-	0.14	<0.05	-	-	0.06	<0.05
nitrato (NO_3)	mg/L como N	10	-	0.08	-	0.14	<0.05	-	-	0.06	<0.05
nitrito (NO_2)	mg/L como N	0.06	-	<0.002	-	<0.002	<0.002	-	-	<0.002	<0.002
nitrógeno total kjeldahl (NTK)	mg/L como N	[d]	-	0.4	-	0.5	<0.2	-	-	0.3	<0.2
Aniones											
cloruro	mg/L	100	-	2.99	-	3.62	4.25	-	-	3.79	3.84
fluoruro	mg/L	0.75	-	<0.05	-	<0.05	<0.05	-	-	<0.05	<0.05
sulfato	mg/L	250	-	2.05	-	2.28	3.36	-	-	6.16	3.81

Looking at 2021_B.pdf, the levels in 2021 have significantly increased. For example, Table 5.5 shows sulfate to be greater than 50mg/L at W-13:

5.5. Resultados/Tabla Comparativa #5

IDENTIFICACIÓN DEL LABORATORIO:			LOCALIZACIÓN:	NOMBRE DEL PUNTO MP5:	FECHA DE COLECTA:
1957-M3-2021			Rio Caimito (W-13)	W-13	21-07-21 8:38
PARÁMETRO			MÉTODO	LD	RESULTADO
1	*	Alcalinidad Total $CaCO_3$ (mg/L)	SM-2320-B	<0.10 mg/L	21,87
2	*	Aceites y Grasas (mg/L)	SM-5520-B	<2.0 mg/L	<2,0
3	*	Cianuro Total CN^- (mg/L)	EPA 335.2	<0.0020 mg/L	0,0028
4	*	Cloruros- Cl^- (mg/L)	SM-4110-B	<0,0001 mg/L	4,2652
5	*	Nitritos- NO_2 (mg/L)	SM-4110-B	<0,0001 mg/L	0,0477
6	*	Nitratos- NO_3 (mg/L)	SM-4110-B	<0,0001 mg/L	0,3605
7	*	Sulfatos-SO_4 (mg/L)	SM-4110-B	<0,0001 mg/L	50,9234
8	*	E. Coli	SM-9223-B	<1,0 NMP/100 mL	1100
9	*	Coliformes totales (NMP/100mL)	SM-9223-B	<1,0 NMP/100 mL	52470
10	*	Coliformes fecales (NMP/100mL)	Defined Substrate Colilert-18 Quanti-Tray	<1,0 NMP/100 mL	15650
11	*	Conductividad (uS/cm)	SM-2510-B	<0,01 µS/cm	159,7

And then in the most recent report for 2024 (Informe IX), the levels at W-13 are greater than 200 mg/L, as reported in the table below.

Tabla 3.2-3: Resultados de monitoreo

Parámetro	Unidad	Decreto N°33903 - MINAE-S Costa Rica Clase 2	Estaciones de Monitoreo													
			DD-SP1-001 284/2024	DD-SP1-001 16752/2024	DD-SP9-001 284/2024	DD-SP9-001 16752/2024	W-13 291/2024	W-13 16766/2024	W-15 39289/2024	W-15 314/2024	W-2 335/2024	W-2 16785/2024	W-4 298/2024	W-4 16785/2024	W-5 367/2024	W-5 16766/2024
			8/1/2024 13:24	9/4/2024 8:44	8/1/2024 10:11	9/4/2024 10:21	12/1/2024 14:17	18/4/2024 13:43	10/5/2024 10:48	20/1/2024 9:33	5/2/2024 11:47	26/4/2024 12:05	14/1/2024 10:12	26/4/2024 9:39	26/2/2024 11:21	18/4/2024 9:27
Alcalinidad Total	mg/L	-	27	33	24	20	33	36	22.6	35	12	9	35	19	15	18
Conductividad Especifica	µS/cm	-	124	249	69	88	503	539	64	83	56	51	88	65	65	81
pH	unidades de pH	6.5 - 8.5	7.41	7.38	7.26	7.55	7.70	7.37	6.85	7.59	7.57	7.30	7.58	7.20	7.10	7.14
Sólidos Totales Suspendidos	mg/L	25	4	3	3	11	14	17	4	3	3	3	3	4	3	3
Turbidez	NTU	100	22	6	9	22	45	25	16	0	0	0	1	6	3	12
Cloruro	mg/L	200	10	16	5	6	4	5	3	8	3	3	4	4	4	4
Nitrito	mg/L	-	0.006	0.004	0.002	0.002	0.012	0.002	0.005	0.009	0.005	0.004	0.003	0.006	0.002	0.005
Nitratos	mg/L	10	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Sulfato	mg/L	250	22	53	7	8	212	207	4	6	8	8	3	4	8	12

This is critical because of the following reasons:

- The measured concentrations are much higher than initially projected according to the model presented in the EIA (See Table 1, replicate of table 4-13 of EIA, below). Therefore, the conclusions drawn in the EIA and the original assumptions about the acceptability of the negative effects of the mine must be seriously challenged.
- Such high sulfate concentrations confirm the fact that geochemical reactions associated with acid mine drainage are occurring. Therefore, other contaminants such as heavy

metals are and will be mobilized and have a high risk of impacting the sensitive receiving environment.

- W13 is located approximately 10 km from the base of the tailings dam. Therefore, a large area may be impacted by the migration of pollutants, including many wetlands, streams, and all the species that would suffer from a deterioration of the quality of both surface water and groundwater.
- This could become much worse with time. What we are observing could be the beginning of a process that will evolve with increasing trends of concentrations over decades.

<u>This triggers the urgent need of a proper monitoring program and designing/implementing corrective actions.</u>

Table 1: Projected concentrations at W13 (during mining and post closure)

Minera Panamá S.A. 62 Mina de Cobre Panamá
Anexo XXVIII Setiembre 2010
Análisis de la Calidad del Agua

Tabla 4-13 Calidad de Agua Simulada en el Lugar de Monitoreo W13 Para las Operaciones y el Cierre/Post-cierre

Parámetro	Unidades	Criterio Seleccionado Para el Agua Superficial [a]	Calidad de Agua de Línea Base (W13)	Años 0 - 22[b]			Años 23 - 24[b]			Años 25 - 28[b]			Años 29 - 30[b]			Años >30[b]		
				Mínima	Máxima	Promedio	Mínima	Máxima	Promedio	Mínima	Máxima	Promedio	Mínima	Máxima	Promedio	Mínima	Máxima	Promedio
General																		
sulfato	mg/L	250	0.8	0.6	**7**	**6**	**1**	**9**	**6**	**1**	**9**	**8**	**1**	**8**	**6**	**0.9**	**7**	**2**
amonio	mg/L	1	0.02	0.02	**0.03**	0.02	0.02	**0.04**	**0.03**	0.02	**0.08**	**0.06**	0.02	**0.07**	**0.05**	0.02	**0.05**	0.02
nitrato	mg/L	10	0.07	0.06	**0.3**	**0.2**	**0.08**	**0.3**	**0.2**	**0.09**	**0.4**	**0.3**	**0.09**	**0.4**	**0.3**	**0.09**	**0.3**	**0.1**
STS	mg/L	-	10	10	**20**	**20**	10	**20**	**20**	10	**20**	**20**	10	**20**	**20**	**20**	**20**	**20**
cloruro	mg/L	100	4	3	4	3	3	4	3	3	4	3	3	4	3	3	3	3
fluoruro	mg/L	0.75	<0.05	0.04	0.05	0.04	0.04	0.05	0.04	0.04	0.05	0.04	0.04	0.05	0.04	0.04	0.05	0.04
Metales Totales																		
aluminio	mg/L	0.005	0.5	*0.4*	*0.5*	*0.4*	*0.4*	*0.5*	*0.4*	*0.4*	*0.5*	*0.4*	*0.4*	*0.5*	*0.5*	*0.4*	*0.5*	*0.4*
antimonio	mg/L	0.005	<0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
arsénico	mg/L	0.005	<0.0002	0.0002	**0.001**	**0.0009**	**0.0003**	**0.0008**	**0.0006**	0.0002	**0.0007**	**0.0004**	0.0002	**0.0003**	0.0002	0.0002	0.0002	0.0002
bario	mg/L	0.07	0.02	0.02	**0.03**	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
berilio	mg/L	0.1	<0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
boro	mg/L	0.5	<0.01	0.008	0.01	0.008	0.008	0.01	0.009	0.009	0.01	0.009	0.009	0.01	0.01	0.009	0.01	0.01
cadmio	mg/L	0.000017	<0.00004	*0.00003*	**0.00008**	**0.00007**	*0.00004*	**0.00009**	**0.00008**	*0.00004*	**0.0001**	**0.00009**	*0.00004*	**0.0001**	**0.00008**	*0.00004*	**0.00009**	**0.00005**
cromo	mg/L	0.05	0.0004	2	**7**	**6**	3	**6**	**5**	3	**6**	**5**	3	**4**	**4**	3	**4**	3
cobalto	mg/L	0.05	0.0004	0.0003	0.0004	0.0004	0.0004	**0.0005**	0.0004	0.0004	**0.0005**	**0.0005**	0.0004	**0.0005**	**0.0005**	0.0003	**0.0005**	0.0004
cobre	mg/L	0.002	0.003	0.0003	**0.001**	**0.001**	0.0004	**0.002**	**0.001**	**0.0005**	**0.002**	**0.002**	**0.0005**	**0.002**	**0.001**	**0.0005**	**0.002**	**0.0007**
hierro	mg/L	0.3	0.4	0.002	**0.005**	**0.004**	*0.003*	**0.006**	**0.005**	*0.003*	**0.006**	**0.006**	*0.003*	**0.006**	**0.005**	0.002	**0.005**	*0.003*
plomo	mg/L	0.001	<0.0002	*0.4*	*0.4*	*0.4*	*0.4*	*0.4*	*0.4*	*0.4*	*0.4*	*0.4*	*0.4*	*0.4*	*0.4*	*0.4*	*0.4*	*0.4*
manganeso	mg/L	0.1	0.01	0.0002	0.0002	0.0002	0.0002	**0.0003**	**0.0003**	0.0002	**0.0003**	**0.0003**	0.0002	**0.0003**	**0.0003**	0.0002	**0.0003**	0.0002
mercurio	mg/L	0.0001	<0.00002	0.01	**0.02**	**0.02**	0.01	**0.02**	**0.02**	0.01	**0.02**	**0.02**	0.01	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**
molibdeno	mg/L	0.01	0.0002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002
níquel	mg/L	0.02	<0.0002	0.0002	**0.006**	**0.005**	**0.0006**	**0.005**	**0.003**	**0.0003**	**0.004**	**0.002**	**0.0003**	**0.002**	**0.001**	0.0002	**0.001**	**0.0004**
selenio	mg/L	0.001	0.0004	0.02	0.03	0.03	0.03	**0.04**	0.03	0.03	**0.04**	**0.04**	0.03	**0.04**	**0.04**	0.03	**0.04**	0.03
plata	mg/L	0.0001	<0.00005	0.0003	**0.0006**	**0.0005**	0.0004	**0.0006**	**0.0005**	0.0004	**0.0005**	**0.0005**	0.0004	**0.0005**	**0.0005**	0.0004	**0.0005**	0.0004
sodio	mg/L	-	4	0.00004	**0.00006**	**0.00006**	0.00005	**0.00007**	**0.00006**	0.00005	**0.00007**	**0.00007**	0.00005	**0.00007**	**0.00007**	0.00005	**0.00007**	0.00005
uranio	mg/L	0.01	<0.0001	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4
vanadio	mg/L	0.1	0.001	0.00008	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
zinc	mg/L	0.03	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001

[a] Ver Tabla 2-5 para conocer los detalles sobre la selección del criterio del efluente.
[b] Ver Tabla 2-3 para conocer los detalles sobre los periodos de tiempo utilizados.
Notas: Los valores en negrita exceden los valores para la calidad del agua de línea base promedio. Los valores subrayados y en cursiva exceden los criterios seleccionados para el agua superficial.
STS = sólidos totales suspendidos; mg/L = miligramos por litro.

1. For other parameters (e.g., turbidity, pH, and coliforms) all seem concerning. Although still within the range of compliance pH seems quite acidic in some of the marine measurements (the 2021_B.pdf for example). In addition, turbidity seems very high at some sites (22 NTU) and the level reported as the allowable threshold in the report is 100 NTU while the original monitoring plan stated 30 NTU. In either case, they are inappropriately high for a marine environment. More importantly, turbidity is typically regulated based on an allowable increase over background levels rather than by a specific numeric value. For example, not exceeding 10% increase in background levels is common throughout the US while the numeric restrictions range from stating no more than 0.5-10 NTU above background for any water typically <50 NTU depending on location and jurisdiction. (https://www.epa.gov/system/files/documents/2022-01/list-of-state-specific-water-quality-standards.pdf)

2. The monitoring plan does not seem to have any methodologies incorporated that aim to understand impacts to biodiversity. They focus on some mitigation and monitoring basics in a very isolated and disjointed way for some species/categories, but they are not doing anything to monitor for impacts to ecosystem services, connectivity, population dynamics, food web impacts or diversity.