

PROJECT REPORT · PHILIPPINES

Cyanide-Free Gold: A Pilot for Small-Scale Mines near Baguio

Small-scale miners around Baguio have already moved away from mercury. This report explains why cyanide is the next target, how our process was designed and reviewed, and how the full-scale pilot will be run and judged.

PILOT PLANNED FOR EARLY 2027

UPDATED

September 28, 2026

PARTNER

AppelGlobal

PREPARED BY

Clean Water Help volunteers

WEB

cleanwaterhelp.org/projects/baguio

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At a glance

LOCATION

**Baguio and Benguet,
Philippines**

PARTNER

AppelGlobal

LOCAL SUPPORT

**Local government; mining
association**

STAGE

Licenses and chemicals

PILOT

Early 2027

CWH ROLE

Chemistry, protocol, funding

~600

small mines in the region

500+

mines moved off mercury

15

process versions

2027

full-scale pilot

1 Executive summary

KEY FINDING

Around Baguio, mercury has largely been replaced by gravity methods, but cyanide is still used to recover the gold locked in copper-rich ore. Our thiosulfate-based process is designed to recover that gold without cyanide. Whether miners adopt it will depend on a real test: full-scale batches side by side with cyanide at a working mine in early 2027.

Clean Water Help met AppelGlobal and its local expert, Leoncio Na-oy, in January 2026 while looking for mercury-free mining methods for our Ghana project. Leoncio's gravity methods helped more than 500 Philippine mines stop using mercury. In February 2026 our executive director visited small-scale mines near Baguio to see the cyanide step first-hand.

Between February and July 2026, CWH chemists developed and refined a thiosulfate-based process through 15 versions, supported by geochemical modeling and an independent technical review. The design focuses on copper-rich ore, a shorter processing cycle, gold capture on resin, and tailings that can be neutralized before discharge.

The project is now securing licenses and chemicals, with support from local government and the local small-scale mining association. The pilot is scheduled for early 2027.

What happens next

1. Complete licensing and buy reagents, resin and safety equipment (gas monitors, aeration).
2. Agree pilot dates and batch plan with Leoncio Na-oy and the host mine.
3. Run full-scale batches (about 1.5 tons of ore) side by side with the normal cyanide process; compare recovery, time and cost.
4. Test treated tailings and water before discharge.
5. If results are promising, invite local universities to optimize the method with local government and the mining association.

THE ISSUE TO WATCH

Safety and real-world performance. The method has not yet been run on real ore at scale. Ammonia and hydrogen sulfide safety, pH control and the lack of an on-site assay laboratory are the main practical risks, which is why the first batches will be closely monitored and compared directly with cyanide.

Key numbers and how solid they are

Each number is labeled by its basis: **MEASURED** counted or tested, **REPORTED** reported by a partner or a document, **RECORD** from our own payments, contracts and correspondence, **ESTIMATE** a calculation or assumption, **PLANNED** a plan or target, not yet done.

ITEM	VALUE	BASIS	SOURCE
Small-scale mines around Baguio/Benguet	about 600	REPORTED	AppelGlobal and local partners
Philippine mines moved off mercury with our partner's methods	500+	REPORTED	AppelGlobal
Process versions	15 (Feb–Jul 2026)	RECORD	CWH protocol files
Typical cyanide recovery on this ore	about 50–70%	ESTIMATE	CWH analysis and literature
Target processing cycle	about 72 hours vs ~96 for cyanide	PLANNED	CWH protocol v14
Pilot batch size	about 1.5 tons of ore	PLANNED	CWH plan, Sep 2026
Research funding approved	\$1,000 (+\$250 travel)	RECORD	CWH board, Jul 20, 2026

2 Background and progress

Gold mining around Baguio

Small-scale gold mining is a major part of the local economy in Benguet Province, with roughly 600 small mines in the region. Miners first recover free gold by gravity methods, without mercury. The gold that remains is locked in copper-rich sulfide ore and is usually leached with cyanide. Cyanide waste, combined with acid mine drainage, can reach streams and rivers used downstream.



Ore-processing equipment inside a mine shed



Mine drainage in a mountain stream

The partner

AppelGlobal works on mercury-free gold mining. Its local expert, Leoncio Na-oy, has about 40 years of experience and helped miners in the Philippines and elsewhere replace mercury with gravity methods. Only a handful of mines around Baguio still use mercury.

What we did

In February 2026, CWH's executive director spent a week at small-scale mines near Baguio with Leoncio, observing the cyanide process and collecting information on the ore. CWH chemists then developed the process through 15 versions, with geochemical modeling by a CWH geochemist and an independent review of an early version by an outside geochemist in June 2026, which led to a simpler and safer design.

Timeline

Jan 19–22, 2026	First contact and call with AppelGlobal.
Feb 9–13, 2026	Site visit to small-scale mines near Baguio.
Feb 23, 2026	Early version of the method shared with partners.
Mar 2026	Chemistry meeting; geochemical modeling.
May 2026	Versions 12 and 13; one chemical route dropped for health reasons.
Jun 9, 2026	Independent technical review.
Jun 21, 2026	Version 14 package: procedure, decision guide, cost model.
Jul 2026	Version 15; board approves research funding; sourcing begins.
Sep 2026	Pilot scheduled for early 2027; licenses and chemicals in progress.
Early 2027	<i>Side-by-side pilot at a working mine.</i>

3 Technical foundation

Design goals

- Recover the gold locked in copper-rich ore without cyanide
- Match or beat cyanide on gold recovered per batch
- Shorter processing cycle, so more batches per month
- Reagent costs covered by extra recovery and throughput
- Tailings that can be neutralized and tested before discharge

Approach, in general terms

The process uses thiosulfate with a copper catalyst to dissolve gold, then captures the gold on an ion-exchange resin, which works even when copper levels are high. Gold is then recovered from the resin and smelted. We are not publishing operating details, doses or recipes until the pilot confirms the process is safe and effective.

How the pilot will be judged

MEASURE	HOW
Gold recovered	Side-by-side batches of the same ore, thiosulfate vs cyanide
Processing time	Hours per batch
Cost	Reagent cost per batch vs value of extra gold
Safety	Gas monitoring, pH and temperature logs
Environment	Tailings and water tests before discharge

Decisions and the options we set aside

DECISION	OPTIONS CONSIDERED	WHY
Thiosulfate route	Glycine, thiourea, phosphate and oxidation-only routes	Works at alkaline pH, suits copper-rich ore, gold can be captured on resin; thiourea dropped for health concerns.
Full-scale, side-by-side pilot	Laboratory tests only	Miners will adopt only what works on their own ore and economics.
Keep the recipe private for now	Publish the protocol immediately	Unproven methods can cause harm if copied; publish after the pilot.
Hand optimization to universities	CWH continues alone	Local institutions can sustain and adapt the method long term.

Risks and how we respond

RISK	LEVEL	RESPONSE
Ammonia or hydrogen sulfide exposure	High	Gas monitors, aeration, trained operators, small first steps.
Lower recovery than expected	Medium	Batch-by-batch comparison; decision guide for adjustments.
Reagent supply and licensing	Medium	Multiple suppliers; local partner support; licenses before purchase.
Arsenic in the ore	Medium	pH control and tailings neutralization; testing before discharge.

4 What we learned and what is still open

- **Build on local success.** Miners here already abandoned mercury when shown a better way; that is the model for cyanide.
- **Outside review improves the work.** An independent review made the design simpler and safer.
- **Supply chains take time.** Securing specialty chemicals in the Philippines took longer than the chemistry.

Open questions

- Will the process match cyanide recovery on real ore at full scale?
- What is the real cost per batch once reagents are bought locally?
- Which local universities are best placed to optimize and teach the method?
- Can the same approach help small-scale miners in Ghana?

5 How you can help

Help test a safer way to recover gold

Gifts fund pilot chemicals, safety equipment and water testing. We also welcome review from chemists, metallurgists and mining engineers.

- Contact: impact@cleanwaterhelp.org
- cleanwaterhelp.org/contact#partner

References and sources

1. Clean Water Help. Gold extraction process development, versions 1–15 (February–July 2026). Internal; available to technical reviewers on request.

2. Independent technical review of the version 12 method (June 9, 2026). Internal.
3. AppelGlobal. appelglobal.com
4. Clean Water Help board approvals, July 20, 2026.