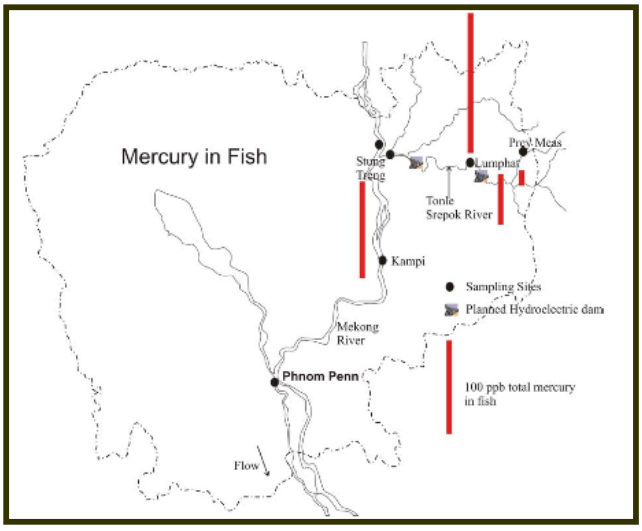
Project Completion Report:
Cambodian Mercury Pollution from Gold Mines

- **Project Details:**

Location:	Ratanakirri, Cambodia
Contaminant:	Mercury
Project Duration:	April, 2006 – July 2007
Project Cost:	$17,500
Implementing Partners	Redlog Environmental Ltd., Dr. Tom Murphy – lead technical advisor
Other Partners:	



- **Background and Scope:**

Mercury:

Almost a quarter of the world's gold supply can be traced back to 10-15 million poor small-scale gold miners, or ASM, scattered about the globe. These miners are also the third largest source of mercury pollution today, however, comprising about 30% of the world's anthropogenic mercury releases. ASM miners extract gold-laden rock, grind it into a fine sand, then mix it with mercury to form an amalgam. The amalgam is then subjected to high heat, either with a blow torch or over an open flame, and the mercury evaporates into the atmosphere leaving behind a substance that is roughly 80% pure gold.

One of three things will happen once the mercury has evaporated. The gaseous mercury may be inhaled by the workers and their families, leading to serious health issues. It may also settle into the surrounding environment, seeping into the ground and contaminating the water supply. It could also rise into the atmosphere, where it circulates for about three months before raining down again. It takes roughly one month for anything that rises into the atmosphere to circulate the globe; this means that mercury that has circulated for three months is dispersed more or less evenly about the earth by the time it rains back down. The effects of evaporated mercury effect not just the area in which it is released but the entire globe equally, and this is reflected in elevated mercury counts in organisms located far from artisinal gold mining activity or other sources of mercury pollution.

This process transforms elemental mercury into methylmercury. Methylmercury is one of the most toxic organic substances and a powerful neurotoxin that works its way up the food chain through bioaccumulation.

There are a number of cleaner technology alternatives to current methods of mercury amalgamation. The use of retorts during the mercury burn-off stage is a very simple and highly cost-effective method of controlling the release of mercury into the environment. They allow for the efficient capture and reuse of mercury and minimizing occupational exposure.

Experience has shown that the biggest barrier to the uptake of such technology is educational. This project sought to break the cycle of dangerous mercury use by supplying ASM miners with the education and technology needed to minimize their exposure to mercury and its release into the environment.

Cambodian Gold Mining

Cambodia is amongst the poorer countries in the world, ranking 130 or 177 countries in the 2003 Human Development Index, as reported by the UN. The GNI per capita in 2004 was $320, while life expectancy was 57 years. Mortality due to waterborne illnesses is high, in part reflecting the fact that many Cambodians have less access to adequate sanitation and clean drinking water compared to other Asian nations. The country is still struggling to recover from recent civil war (1970-5), and Khmer Rouge tragedy (1075-9) and subsequent occupation by Vietnam (1979-89). A generation of technically-skilled people was killed or fled the country and all government institutions were mantled. As such, there is a great need to capacity building in the areas of natural resource, environment, and basic health management.

The province of Ratanakirri is an isolated underdeveloped area of northeast Cambodia with a small population of about 72,000. About 80% of the people are tribal who subsist by slash and burn agriculture and fishing. Gold and gem stones are fathered in crude mines at times using

mercury to extract gold. A review by Sotham (2004) estimated that about 1000 miners are working at six Prey Meas mines. They use mercury amalgamation, without retorts, to extract the gold. The concentration of mercury in the hair of the miners was extremely high; in April 2006 retorts were successfully introduced into a goldmine in Prey Meas to recover mercury. The technology was readily understood, and the miners were glad to be both protecting their health and recouping some of their expense. This initial project was quite small and more effort should be directed at introduction of retorts at more mines. Any effort to introduce retorts at more mines should be associated with an attempt to measure the total amount of mercury escaping from the mines. The objective of this project is to reduce the negative, mercury-related, community health impacts of artisanal gold mining operations.

- **Project Metrics and Results:**

Study Objectives:

i) through the sampling of human hair, organisms (mussels/fish), soils/mine tailings, and river water, assess the potential environmental and health impacts of gold mines in Ratanakirri province.
ii) Provide locally-produced ceramic water filters to reduce incidence of diaherra in two mining communities.
iii) Build capacity, through the provision and training in the use of simple retorts, management of mine tailings, and basic clean water practices for domestic use, to improve local environmental and health conditions.

Study Approach:
The study team looked at two gold mines in Ratanakirri province that are very isolated and the communities suffer greatl from a lack of clean water and basic education. Mercury analysis from samples taken (from human hair, fish, soil, mine tailings) were performed at Environment Canada's laboratories in Burlington, Ontario. The tailings were analyzed for acid volatile sulfide (AVS) and the pH of local waterways was measured.

Successful introduction of simple retorts and approaches to environmental and health management must include a component of capacity building and education. Simple pit latrines and ceramic filters were provided to the families at the two study mine, and were accompanied by an education program on proper sanitation and clean drinking water practices. Health surveys were performed before and after these introductions.

- **Outcomes and Follow-up:**

First, one retort was made in Canada as a model for local craftsmen in Cambodia. Although not all materials used in the Canadian model were available in Cambodia, there was no trouble making adjustments. Retorts were made in the area and local craftsmen were trained to make and use them. Mercury was effectively trapped in the retorts and miners preferred the glass top retort.

The assimilation of mercury into people and its conversion into methylmercury can be easily measured in human hair. Fifty kilometers downstream, hair samples demonstrated a level of mercury high enough to be associated with fertility problems; some individuals had levels high enough to result in peripheral vision loss, stunted child development, and nervous system dysfunction. Workers in the mine showed a slightly lower than local average level of mercury,

but this could be due to amount of time spent working at the mine, and specific duties performed.

Blacksmith also measured severe bacterial contamination in the community drinking water well and provided a ceramic water filter that removes all bacteria.

Table 2 Well water bacteria [per ml]

Colony Type	F-1	F-2	Raw-1	Raw-2
E. coli	0	0	6	4
Unidentified	1	0	12	80
General coliforms	0	0	41	75

- **Additional Information:**

·Going up the Tonle Srepok River to Collect Fish Samples.

·Villagers swimming in the river near gold mines

·Close-up of a heating retort

· Collecting hair samples