BGET Trip report
Nov 29 to 1 December 2005

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Trip goals:

- Micro-hydro site survey at Huai Kra Thing
- Ram pump survey at Mae U Su
- Determine cause of low power at Mae Sa Pau micro-hydro and fix if possible.

Monday 28 November

Chris arrived by night bus from Bangkok and met up with Watit, Salinee, Andrew, Rob Landau and TOPS intern Dtae. We traveled by truck to Huai Krating village, Mae Ramat amphoe. The village currently has solar electric systems. The loads that remain to be powered are:

Location	**Appliance**	**Quantity**	**Load**	**Power (watts)**
Clinic	Light	3	20	100
School	Light	3	20	60
School	Computer	1	200	240
School	TV	1	100	100
Meeting hall	Light	3	20	60
Roman Catholic church	Light	3	20	60
Baptist church	Light	3	20	60
Headman's House	Light	1	20	20
Teacher's house	Light	1	20	20
Total				**720**

Note: Andrew will re-survey these loads. We expect these loads to grow over time.

Previously, Rob and Andrew had conducted a survey of the stream using a GPS and had tentatively selected two candidate powerhouse locations and a couple candidate intake locations. The survey included GPS coordinates of these and other features in the stream, as well as GPS coordinates of electrical loads in the village.

This time we re-surveyed the stream using a tape and inclinometer, and we selected preferred locations for powerhouse and intake. We found the gross head to be 38 meters and distance (following the stream bed) to be 153 meters. The preferred powerhouse location is marked with a stone cairn (**pic 1**). It's more than 2 meters above the stream level (and about half a meter above the 30-year flood level that our local guide reported). The intake will be situated above a waterfall. We found a midstream "permanent" rock formation and large tree that may be useful in constructing a partial weir. A nearby excavate-able bank is suitable for a siltation tank. We used the bucket method to measure streamflow at 53.9 liters/second (average of 3 trials).

On the way back we stopped by the school. When we did a solar technician training in this village in September 2005 we visited the school and saw there were parts for a solar electric system. There were no instructions provided – just a pile of parts. At that time we gave some pointers and drew some diagrams explaining how to install the system. This time around, the system was installed. We're not sure who installed it but it is working well powering lights and a computer/satellite internet connection but with no working satellite sightline and no computer.

After a late lunch we drove to Mae U Su, arriving in the late afternoon. We stayed in a beautiful adobe house (**pic 2**) built by a local Karen man named "David" or "Thawet". David works with Jon, a young French fellow. Together they're putting together a large training centre to train Karen on organic farming. They were interested in having BGET build them a hydraulic ram pump to provide water for bathing and agriculture.

Tuesday 29 November

We inspected the Mae U Su site: the dormitories and training center, orchards, sports field, meal area. All is under construction and only a few foundations and a water tank are in place now. Then we went to see the river that would be the water source for the ram (**pic 3**).

Unfortunately, it just isn't a good site, or at least not suitable for the first ram pump installation we try. The water source is a big, fairly flat river. Getting a few meters of drive head would take a channel over a hundred meters long. The water tanks that we needed to pump to are 38 meters higher than the river surface.

We discussed a number of possibilities and ended up with a solar water pump as one option. Another, perhaps less expensive and more sustainable option, would be to extend a water supply pipe about 4 km to another water source at an elevation higher than the water tanks. We decided to try to find another location for BGET's first ram pump.

We left Mae U So in late morning, and traveled to Mae Ookee to replace a battery that had exploded during the training 23-25 November. The village also had two 24 volt solar electric systems identical to the one we saw the previous day in Mae – except that these weren't installed properly. The main problem is that the 12 volt modules were wired in parallel, not series, so the batteries never charged. We found the systems with batteries each at about 7 volts. The second problem was that module orientation was off by more than 90 degrees, pointing somewhat northeast rather than south. We fixed the series/parallel issue in both systems and fixed the panel orientation in one (in the other, gaining access to the roof was impossible). We are concerned because we were told that there are a number of other systems just like this who apparently were installed by the same fellow.

We drove to Mae Sa Pau and walked to the micro-hydro installation. We found the water pipe full, but no power. We were told the pipe was blocked, for the second time. The first time, several months ago, villagers had cut the pipe and cleared the blockage which had occurred near the nozzle.

Wednesday 30 November

Spent the day working to improve the micro-hydro. We found that with the valve open, the turbine spun up to 300 volts or so… and then in the course of a few minutes dropped to zero and the water dropped to a trickle and the pipe was mostly filled with air (entering from the nozzle). Culprit: blocked pipe at the inlet. We cleaned out hundreds of buckets of muck (bark, leaves, twigs, silt) that had settled in the "reservoir" at the top of the waterfall.

Then we rebuilt the intake filter, which had clogged up with leaves. It was grossly deficient: just a piece of mesh across the 4" pipe inlet. We used bamboo and mild steel wire to sew a basket of plastic mesh about the size of a medium sized pig (at least a hundred-fold increase in intake filter surface area). We fastened the mouth of the basket to the pipe inlet and kept it from floating by tying it down with two rocks (**pic 4**). Result: pipe didn't fill up with air anymore.

But still the micro-hydro behaved strangely. As we turned up the water flow, open circuit voltage at the generator increased up to a point around 400 volts. Just a little bit more, voltage collapsed, and we could hear a change in the way the turbine sounded. When we tried to light lights in the village, we could only get 2 or 3 at most. This is 60 watts – pretty pathetic when we figured that we should be able to get P = 5 * 20 meters * 20 liters/second = 2,000 watts total. The outflow water only filled a quarter to a third of the 4" tailrace pipe so it really didn't look like the outlet pipe was too small. What was going on???

One clue: Rob measured out flow volume and velocity as we turned open the valve. At the point where voltage/power collapsed, the flow remained constant in the outflow pipe even as we opened the valve allowing more water to flow into the turbine.

We eventually figured it out: the water was getting backed up as it was exiting the turbine. It couldn't get into the 4" pipe fast enough. At low flows, the turbine was operating in the air as it should have (it was a turgo). But at some threshold flow, the water level under the turbine rose to the point where it started to clip the turbine cups. As we turned water flow even higher, the turgo became submerged and bogged down. The power from the pipe was going to churn water, not generate electricity!

We proved the problem to Watit by temporarily cupping a hand over the outflow from the exit of the tailrace when it as at the "just before collapse" state. A second later, collapse happened.

Watit asked we were absolutely positive that that was the problem (we couldn't actually see what was going on under the turbine since it was all encased in concrete). "Yes, we're positive".

We took care of the problem by using pick axes and cold chisels to remove the 4" outlet pipe and carve a big channel for the water to exit We turned on the water and VOILA! LOTS OF POWER!!! (**pic 5**).

Thursday 1 December

We tested the new arrangement and found that we could easily light up every light in the village (there were only 11), with lots of water left over. The new channel is somewhat erosion prone, though, as soil is directly exposed. The villagers will take care of that with some digging and cement work. The other new challenge is that the open circuit voltage can now rise way above 500 volts, which will almost certainly fry the windings in the generator. We've got to keep it down. But with no controller, and no assurance that folks won't turn out lights, we decided to allow them to only open water to the point where the open-circuit voltage is 420 volts (still deemed "safe") and then they can turn on as many lights as that amount of water will support (6 lights, if I recall). A diversion load controller is the ultimate solution.

This is probably a problem at Kre Khi as well. And possibly E Wi Jo. The outcome, I suspect, is that we can generate quite a bit more power than we have been able to. But that without a controller we're guaranteed to fry the turbine if it's running near full throttle and anyone should turn off the load. We need a load controller at the power house so that any possible disconnection of load (either from people turning off equipment, or from a power line open-circuit) won't cause generator overspeed.

Pic 1 (Back)

Pic 2 (Back)

Pic 3 (Back)

Pic 4 ([Back](#))

Pic 5 ([Back](#))