GENCAPD
MINING

GUYANA ENVIRONMENTAL CAPACITY DEVELOPMENT PROJECT

(GENCAPD)

SMALL SCALE DEMONSTRATION PROJECT

PURUNI RIVER /TAKATU AREAS

Prepared for

Canadian International Development Agency (CIDA)

Natural Resources Canada (CANMET)

Guyana Geology and Mines Commission

And

Guyana Gold and Diamond Miners Association

By

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December 2000

DECEMBER 2000

EXECUTIVE SUMMARY

The objectives of this field program were to demonstrate small-scale exploration methods, gold recovery, and mining practices with an emphasis on worker safety, environmental mitigation, and efficiency in the Puruni River and Takatu areas of Guyana. Ronald Glasgow from the Guyana Geology and Mines Commission (GGMC) and Glenrick Miller (CIDA) assisted the author and gained more experience in the delivery of the demonstrations.

The site of the demonstrations was at Jubilee Creek, near Puruni Landing, and at Takatu in the Puruni River area of Guyana, South America (figures 1, 2 & 3). Similar demonstrations were conducted in the Northwest District in April 2000 and in Mahdia in September 1999. The author has worked in the Puruni area previously, and most recently with three Yukon alluvial miners in February 2000.

Miners from neighboring camps and from Puruni Landing were transported to Roy Bacchus' camp at Jubilee Creek for two evenings of technical seminars (November 22 and 23). Miners from Lion Mountain other neighboring areas were transported to two more evenings of technical sessions at Collin Jacobs' unused discotheque at Takatu (November 24 and 25). The author and Ronald Glasgow (GGMC) presented information to inform local miners and workers in all aspects of alluvial mining including exploration, mine planning, gold recovery, safe mercury amalgamation, water management and environmental restoration. The seminars also provided the proof that was required to convince the miners to build and refit new sluiceboxes.

There were several delays due to unseasonable rainy weather, poor roads, and workers sick with malaria. However, three sluiceboxes were constructed (from raw logs) and fitted with Canadian riffle systems at small alluvial mines on Grandmother Creek near Puruni Landing (Errol Baptise), at Jubilee Creek (Roy Bacchus) and at Takatu (Colin Jacobs). The water and solids flow rates from several sluiceboxes were measured at Million Mountain, Grandmother Creek, Jubilee Creek, China Creek, Tiger Creek and at Takatu. Several other sluiceboxes in the Koniwaruk River (Errol Tempo) and Mahdia areas, including the GGMC demonstration mine site at St. Elizabeth, were inspected by the author and another Yukon alluvial miner (Allen Radford) in December, 2000.

Radiotracers were prepared by the author and were irradiated and shipped to Guyana to do comparative testing. However, the radiotracers were lost by Air Canada and had decayed to very low radiation levels when they finally arrived in the Puruni River area (November 24). The shipment was examined, but the particles were too weak for radiotracer testing.

The author's small testing sluice was demonstrated at the seminars. Safe mercury handling and retorting methods were first demonstrated at the both of the seminar locations by the author and then by the participants. The retorts were left with Errol Baptise (Puruni Landing), Roy Bacchus, Enzo Richmond (Jubilee Creek), Colin Jacobs (Takatu) and a miner from (Lion Mountain) to reduce the occupational and environmental hazards associated with "burning" mercury.

This program is part of the Guyana Environmental Capacity Development Project (GENCAPD), which is being sponsored by the Canadian International Development Agency (CIDA), and delivered by Natural Resources, Canada (CANMET) and its consultants. The refitting and technical seminars were conducted by the autor and Ronald Glasgow (GGMC) with the assistance of Jean-Marc Barbera (CANMET) and Glenrick Miller (CIDA).

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1.0 INTRODUCTION

The site of the demonstrations was at Jubilee Creek, Grandmother Creek near Puruni Landing, and at Takatu in the Puruni River area of Guyana, South America (figures 1, 2 & 3). Similar demonstrations were conducted in the Northwest District in April 2000 and in Mahdia in September 1999. The author has worked in the area previously for Alfro Alphonso at Million Mountain and most recently with three Yukon Placer miners (John Zogas, Chris Faucus and John Alton) who toured the Million Mountain, Tiger Creek, Jubilee Creek and Puruni Landing area in February 2000.

Access to Takatu and the Puruni River area is by a newly reconstructed dirt road from Bartica (figure 2). Bartica is an inland river port at the junction of the Essequibo and Mazaruni Rivers. From Georgetown, you must first cross the floating bridge over the Demerara River and drive to Parika, a port on at the mouth of the Essequibo River. From Parika, a ferry for cars and trucks departs three times per week. Several smaller open outboard boats for foot passengers depart several times a day for Bartica. The route from Bartica to the Puruni River area consists of a short section of the older Bartica-Issano road to the pontoon crossing of the Mazaruni River at Itabali. From Itabali the newly reconstructed Kartabu-Puruni road passes Takatu, Lion Mountain, the Junction to Tiger Creek and Million Mountain, Jubilee Creek and then on to Puruni Landing. The route continues across the Puruni River to Peter's Mine and beyond, but is not passable beyond Puruni Landing with a vehicle. Peter's Mine was a historic lode gold producing mine.

The Peter's Mine/Puruni Landing/Jubilee Creek area is at the intrusive contact of younger granitic rocks with an older greenstone belt. This is a classic host for gold deposits and several gold occurrences have been noted in this area (Mineral Exploration Map, figure 3). The Takatu River area is near a similar intrusive granitic and older Migmatite (indistinguishable igneous and metamorphic rocks) contact. However, gold occurrences are not noted on the map in this area. All of the mines observed (except Million Mountain area) were typical alluvial placer deposits with 1.5 m (5 feet) to 3 m (10 feet) of silty/clay-rich overburden overlying about 0.6 m (2 feet) of irregular white quartz gravels. Bedrock was decomposed to hard clays. At Million Mountain, the lode gold deposit consisted of quartz/schist in an oxidized shear zone.

Prior to the recent reconstruction of the Kartabu-Puruni road, most of the alluvial mining in the area was concentrated near its access corridor, the Puruni River. The road has increased the accessibility and number of alluvial miners significantly, especially in the Takatu River area. Several miners have completed rough roads and tractor trails from the Kartabu-Puruni road to their operations and opened up new areas to mining (China Creek, Tiger Creek and Million Mountain).

The miners used hand-held water jets to erode the alluvial gold gravels and overburden (photos 3, 9, 14, 21, & 24). The miners all used Brazilian gravel pumps to pump the gravels to a raised wooden sluicebox (land dredging). At most mines, except Million Mountain and Tiger Creek (photos 23 & 28), all of the soils, including barren overburden and clays were moved with the gravel pumps. This resulted in excessive dilution of the ore with barren overburden, which could otherwise be stripped (if heavy equipment is available and used) and moved prior to mining. Heavy equipment, including bulldozers, were used Million Mountain and excavators were used at ETK's operations at Tiger Creek (photo 23) to strip the overburden soils prior to jetting. A lack of exploration and delineation of the deposits by drilling, trenching or pitting, at most mines meant that the deposits were advanced on a day-to-day basis.

The scale of the operations was generally smaller and less mechanized than those encountered in the Northwest District, but similar in scale to those in Mahdia. Several of the sluiceboxes were already using Nomad matting and expanded metal riffles due to previous work in the area by the author for Alfro Alphonso in 1996 and 1997. However, in most cases the sluiceboxes were not fitted properly for optimum gold recovery. Only Mr. Alphonso's miners were using mercury retorts prior to the demonstrations (photo 19). Mr. Alphonso's general managers learned about retorts and built their own after participation at the Mahdia seminars in 1999.

This was only the third small-scale demonstration in Guyana. The miners were very enthusiastic in their conversions to more efficient gold recovery and mercury handling/recycling technology. The demonstrations here and in the Northwest District should result in a significant improvement in gold recovery and mercury safety. However, access and communication is difficult in the interior of Guyana and more interior mining areas need these demonstrations.

Malaria, typhoid and diseases associated with poor sanitation are endemic in many Guyanese mining areas. Mercury is an important environmental and occupational safety hazard but the miners also need instruction on the avoidance/control of malaria, typhoid and other tropical diseases.

2.0 RECOMMENDATIONS

This was only the third small-scale demonstration in Guyana. Access and communication is difficult in the interior of Guyana and more interior mining areas need these demonstrations. It is recommended that other sluiceboxes in various mining districts of Guyana be refitted and tested with radiotracers to verify and increase the gold recovery improvements. This should be done in conjunction with evening seminars to inform local small scale miners, and to train government officials in efficient methods of alluvial exploration, mine planning, gold recovery, safe mercury usage and environmental mitigation.

Mercury is an important environmental and occupational safety hazard but the miners also need instruction on the control of malaria, typhoid and other tropical diseases. Additional demonstrations should also include education component on malaria, typhoid, waste disposal, and general camp sanitation.

The remaining field demonstrations in the remote mining communities should be conducted with the author and 2 or 3 Guyanese government and/or education (GGMC, IAST, U of Guyana, EPA) employees. This would facilitate the efficient transfer of alluvial mining training skills to local agency personnel and would not overwhelm the limited local lodging and other facilities in the remote mining districts. In many remote areas it will be necessary to stay with miners who have space available in their camps because there are often no other facilities. Larger training seminars with more detailed alluvial mine engineering and gold recovery technology and should be held in Georgetown or other major centers where there are adequate facilities.

3.0 CONCLUSIONS

There were several delays due to unseasonable rainy weather, poor roads (photo 27), and workers sick with malaria. Water and gravel flows were measured at several sluiceboxes at Million Mountain, Grandmother Creek, Jubilee Creek, China Creek, Tiger Creek and at Takatu. Several other sluiceboxes in the Koniwaruk River (Errol Tempo) and Mahdia areas, including the GGMC demonstration mine site at St. Elizabeth, were inspected by the author and another Yukon Miner (Allen Radford) in December (photos 33 & 34).

The slurry flows were measured with the float method and separate samples were collected from the sluice runs at various times with a small sample cutter to estimate the mass flows. The flows produced by the gravel pumps were highly variable. The appended data and calculations indicate that the mining rate from the seven mines measured varied from about 7 cubic yards (5 cubic meters) per hour at Collin Jacob's operation to about 15 cubic yards (12 cubic meters) per hour at Roy Bacchus' operation. The previous demonstration in the Northwest District reported that the same type and size of gravel pumps processed from 6 to 22 cubic yards (5 to 17 cubic meters) per hour. During the Mahdia demonstrations, the same size of pumps in the St. Elizabeth area processed from 11 to 21 cubic yards (8-16 cubic meters) per hour.

All of the mines used 6 by 6 inch Brazilian gravel pumps but the production varied depending on the power and speed of the motor driving the pump, and on the density of the slurry. Soils that were relatively loose such as tailings and sands (Roy Bacchus operation) or where heavy equipment was used to break up the working face (ETK) had the greatest slurry density and greatest throughputs. These production rates are very low compared to similarly manned and equipped North American mines.

New wooden sluiceboxes were constructed from raw logs at Errol Baptise's, Roy Bacchus's and at Collin Jacob's operations (photos 5, 6, 7, 8, 11, 12, & 16). These three sluiceboxes were refitted with Canadian riffle systems including coarse expanded metal, one-inch angle iron riffles and unbacked Nomad matting. The sluiceboxes were much narrower than the original sluiceboxes and were constructed in two or three sections. The miners liked them because they were more efficient, passed cobbles easily, and were much easier to disassemble and move to new locations by hand.

The miners were very eager to learn new technology. Mr. Roy Bacchus generously provided accommodation and meals, his camp for two nights of seminars, and six hours of tractor transport to China Creek (photo 17). He was keen to build a new narrow sluicebox to replace another sluicebox after the demonstration was over. Mr. Collin Jacobs provided facilities for two nights of seminars that were attended by miners from Takatu, Lion Mountain and Million Mountain (photos 1 & 2). Mr. Jacobs and Mr. Baptise performed their own tests and recovered more gold than expected and all in the very top section of the sluicebox.

Unfortunately comparative radiotracer testing was not conducted during this demonstration. Radiotracers were prepared by the author and were irradiated and shipped to Guyana to do comparative testing. However, the radiotracers were lost by Air Canada and had decayed to very low radiation levels when they finally arrived in the Puruni River area (November 24). The shipment was examined, but the particles were too weak for radiotracer testing.

Based on the author's previous experience and on radiotracer testing at Mahdia and the Northwest District, the new sluiceboxes should increase in gold recovery about 15 to 25%. Sluiceboxes that were originally fitted with dredge riffles and/or bare Brazilian carpet would have the highest recovery increases (28% at Charlie DeSliva). Sluiceboxes that already had some section of coarse expanded metal riffles with Nomad matting should have recovery increases of about 17% (Moen Insanalli). Alluvial gold grades can vary dramatically from day to day, however, the operation of the refitted versus original sluiceboxes should demonstrate the increased gold recovery efficiency of from 15 to 25% over a period of time.

Alluvial gold grades vary dramatically from mine to mine in Guyana. Assuming that a six by six land dredge recovered about 2 ounces per day with the original sluiceboxes there would be an increase in income of from about 0.5 to 1 ounce per day. This gold would be recovered with essentially the same costs as before and therefore would be mostly additional profit.

Safe mercury handling and retorting methods were demonstrated at the seminars at Roy Bacchus' camp at Jubilee Creek and at Takatu. Five retorts were left with miners in the area after they had safely demonstrated their operation. All of these operators and others were keen to use the retorts to recycle their mercury and save money. The use of retorts will also reduce the occupational and environmental hazards associated with "burning" mercury.

The author and another Yukon Miner (Allen Radford) inspected the Guyana Geology and Mines Commission's demonstration mine site at the St. Elizabeth near Mahdia in December (photos 33 & 34). The layout included a four-inch gravel pump, wooden sluicebox and tailings pond. The design of the sluicebox was similar to traditional sluiceboxes already used in the area. Unfortunately, it did not appear to be based on any of the alluvial gold recovery technology or research from the author's previous lectures or small-scale mining demonstrations.

Feed rate estimates are based on sampler cuts and timed flow measurements as indicated. Variations could result from surging or varying feed rates. Water and slurry flow rates are estimated by measuring the speed of the slurry in the sluice runs and their cross sectional areas.

The previous conclusions are based on the pay material processed during the sampling period. Pay gravels, which are significantly different in character, gold content and particle size distribution, may require different processing considerations.

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4.0 SITE VISITS AND COMMENTS

4.1 Colin Jacobs – Takatu - (photos 3, 4, 5 & 6)

Colin Jacobs was mining shallow alluvial gravels on weathered bedrock near Takatu. The deposits were about 1 to 2 feet (0.3 to 0.6 m) thick and about 6 to 7 feet (2 m) deep. The gold-bearing gravels consisted of white clay-rich irregular fragments of quartz gravel.

The miners excavated the overburden and gravels from small pits using three small hydraulic jets. A gravel pump pumped the dilute gravel and slurry from a bedrock sump to a wooden sluicebox. The 6 by 4 inch Berkley water supply pump and 6 by 6 inch Brazilian gravel pumps were each powered with four cylinder diesel engines. The trees were not cleared in advance of the mining.

The original sluicebox was 6 feet (1.8 m) wide and was fitted with a wooden boil box, and sections of bare backed Nomad matting, dredge riffles and bare ribbed Brazilian carpet (photo 4). This sluicebox was too wide for the water available from the gravel pump and had to be raked by hand to keep rocks from building up on the deck. Mr. Jacobs indicated that the bare Nomad matting wore out very quickly. The wooden boil box and dredge riffles were packed hard with clay and gravels.

Another newer wide (6 feet) sluicebox was temporarily narrowed and refitted with a 3 feet (0.9 m) wide by 8 feet (2.4 m) long section of coarse expanded metal riffles over unbacked Nomad matting. The next section was 2 feet (0.6 m) wide by eight feet (2.4 m) long and was fitted with one-inch angle iron riffles over unbacked Nomad matting. Mr. Jacobs mined a small pit with the temporary box and recovered more gold than he had expected and all in the very top section of the sluicebox.

Mr. Jacob then built a new narrow sluicebox in three sections. The top section was 3 feet (0.9 m) wide and 8 feet (2.4 m) long and was fitted with coarse expanded metal riffles over unbacked Nomad matting. The middle section was the same size and was fitted with another 4 feet (1.2 m) length of expanded metal riffles, 2 feet (0.6 m) of bare Nomad matting and a transition. The bottom section was also 8 feet (2.4 m) long but was only 2 feet (0.6 m) wide and was fitted with one inch angle iron riffles over unbacked Nomad matting (photo 6).

The production from this land dredge (with one six inch pump and four cylinder motor) is about 7 loose cubic yards per hour (5 cubic meters per hour). The gravel pump produced from 410 to 480 Igpm or about 31 to 36 liters per second of water. The pumps only operate at full output for about 75% of the time. The daily production is about 45 cubic yards (35 cubic meters) per day. All of the soils surrounding the vein are commonly processed through the pump and this creates some dilution of the gold grades. The relatively low throughput was due to compact hard soils.

The sluicebox slurry was discharged into previous pits or onto the jungle floor. Radiotracer tests were not conducted but it is expected that new refitted sluicebox should increase the gold recovery by about 15 to 25%.

Mr. Jacobs provided a disco for two nights of seminars that were attended by miners from Takatu, Lion Mountain and Million Mountain (photos 1 & 2). He and another miner from Lion Mountain demonstrated the use of the two mercury retorts that they were given.

4.2 Roy Bacchus – Jubilee Creek – (photos 8, 9, 10, 11 &12)

Due to recent rains and subsequent flooding, Roy Bacchus had just moved his two sluiceboxes up to a higher location on Jubilee Creek. The gold was located in shallow (12 to 15 feet, 2.5 to 4.5 m) alluvial deposits. The overburden soils were red silts and fine sands. The gravel zone was about 2 to 4 feet (0.6 to 1.2 m) thick coarse quartz gravels overlying clay bedrock. Several pits had been previously mined with jets in the immediate area. Mr. Bacchus was now mining areas between and beyond the old pits (photo 9).

In each of two pits, the miners were using two or three hand-held water monitors to wash down the loose soils and tailings into a clay/bedrock sump. Dilute gravel slurry was pumped from this sump to two wooden sluiceboxes using a six-inch (150 mm) Brazilian gravel pumps powered by a four-cylinder diesel engines.

The two-piece original wooden sluicebox was 6 feet (1.8 m) wide and was fitted with a deep wooden boil box, a 7 feet (2 m) long section of packed dredge riffles, a 7 feet (2 m) long section of fine warped expanded metal riffles over Brazilian carpet and a 7 feet (2 m) long section of bare ribbed Brazilian. The sluicebox was too wide for the water available from the gravel pump and had to be raked by hand to keep rocks from building up on the deck. Both the deep dredge riffles and expanded metal sections were packed with solids.

The one-piece original wooden sluicebox was also 6 feet (1.8 m) wide and was fitted with a deep wooden boil box (photo 10). The top 7 feet (2 m) was fitted with cobbles and deep dredge riffles. The following sections were a 4 feet (1.2 m) length of coarse expanded metal riffles over Nomad matting and a 5.5 feet (1.7 m) length of bare ribbed Brazilian carpet. This sluicebox was also too wide for the water available from the gravel pump and had to be raked by hand to keep rocks from building up on the deck. The cobbles, deep dredge riffles and expanded metal sections were packed with solids.

A new narrower two-piece sluicebox was constructed from raw lumber. It had a 12 feet (3.7 m) long by 3 feet (0.9 m) wide section of coarse expanded metal riffles over unbacked Nomad matting, a transition and a 2 feet (0.6 m) wide by 8 feet (2.4 m) long section of one inch angle iron riffles over unbacked Nomad matting (photos 11 & 12).

The production from each land dredge (with one six inch pump and four cylinder motor) is about 15 loose cubic yards per hour (12 cubic meters per hour). The gravel pump produced from 480 to 520 Igpm or about 36 to 40 liters per second of water. The pumps only operated at full output for about 75% of the time. The daily production is about 114 cubic yards (88 cubic meters) per day. All of the soils overlying the pay gravel are commonly processed through the pump and this creates some dilution of the gold grades. The relatively high throughput was due to previously worked sandy tailings and the looser sandy/silty overburden soils.

The sluicebox slurry was discharged into previous pits or onto the jungle floor. Radiotracer tests were not conducted but it is expected that new refitted sluicebox should increase the gold recovery by about 15 to 25%.

Mr. Roy Bacchus generously provided accommodation and meals at his camp for the author, Jean-Marc Barbera and Glenrich Miller. He allowed the use of his camp for two nights of seminars that were attended by miners from Jubilee Creek and Puruni Landing. Mr. Bacchus also provided tractor transport to the author for the six-hour return trip to Alfro Alphonso's operations at China Creek (photo 17). He was keen to build a new narrow sluicebox to replace his other sluicebox as soon as the Christmas holidays were over. Mr. Bacchus and his neighbor Enzo Richmond also demonstrated the use of the two mercury retorts that they were given.

4.3 Errol Baptise – Grandmother Creek – Puruni River – (photos 13, 14, 15 &16)

Errol Baptise was mining shallow alluvial gravels on Catch-cow (iron-rich cemented gravels) and weathered bedrock at Grandmother Creek. This left limit tributary of the Puruni was located about 6 kilometers southwest of Puruni Landing. Grandmother Creek and its valley are relatively small. The gravel deposits were about 1 to 3 feet (0.3 to 0.9 m) thick and about 6 to 10 feet (1.8 to 3 m) deep. Porknockers had worked several small pits in the area previously. The gold-bearing material was sandy angular gravels rich in quartz fragments with minor clay. In places, the cemented gravel layer (catch-cow) was too hard and thick to penetrate with jets and hand tools.

The miners excavated the overburden and gravels from small pits using three small hydraulic jets (photo 14). A gravel pump pumped the dilute gravel and slurry from a bedrock sump to a wooden sluicebox. The 6 by 4 inch Berkley water supply pump and 6 by 6 inch Brazilian gravel pumps were each powered with four cylinder diesel engines. The trees were not cleared in advance of the mining.

The original sluicebox was 6 feet (1.8 m) wide and was fitted with a wooden boil box, a short section of cobbles, a 5 feet (1.5 m) length of deep dredge riffles and then sections of Brazilian carpet either bare or covered coarse expanded metal riffles (photo 15). This sluicebox was too wide for the water available from the gravel pump and had to be raked by hand to keep rocks from building up on the deck. The wooden boil box, cobbles and dredge riffles were packed hard with clay and gravels.

A new narrower three-section sluicebox was constructed from raw lumber (photo 16). The first section consisted of a head box and 3 feet (0.9 m) wide top sluice fitted with and 8 feet (2.4 m) length of coarse expanded metal riffles over unbacked Nomad matting. The next sluice section was slightly wider and fitted another 8 feet (2.4 m) length of coarse expanded metal riffles over Nomad and a short diverter. The final section was 2 feet (0.6 m) wide and fitted with an 8 feet length of one inch angle iron riffles over unbacked Nomad matting.

The production from this land dredge (with one six inch pump and four cylinder motor) is about 6 loose cubic yards per hour (5 cubic meters per hour). The gravel pump produced from 520 to 580 Igpm or about 40 to 44 liters per second of water. The pumps only operate at full output for about 50 to 75% of the time. The daily production is about 45 cubic yards (35 cubic meters) per day. All of the soils are processed through the pump and this dilutes the gold grades significantly. The relatively low throughput was due to the hard catch-cow at the bottom of the pit.

The sluicebox slurry was discharged into previous pits or onto the jungle floor. Radiotracer tests were not conducted but it is expected that new refitted sluicebox should increase the gold recovery by about 15 to 25%.

Mr. Baptise was very impressed with the small size of the sluices that were much easier to move than his older sluicebox. He enthusiastically reported that almost all of the alluvial gold was recovered in the very top of the sluicebox. Mr. Baptise also demonstrated the use of the mercury retort that he was given.

4.4 L. Bacchus – Jubilee Creek

Mr. L. Bacchus was mining downstream of his brother (Roy Bacchus) operations. His two-piece wooden sluicebox was similar to his brother's. The dimensions and mass flows were measured but it was not refitted at this time.

The production from this land dredge (with one six inch pump and four cylinder motor) was about 14 loose cubic yards per hour (11 cubic meters per hour). The gravel pump produced about 560 Igpm or about 43 liters per second of water. The pumps only operate at full output for about 60% of the time. The daily production was about 104 cubic yards (80 cubic meters) per day. All of the soils are processed through the pump and this dilutes the gold grades significantly.

This sluicebox was not refitted. Mr. L. Bacchus should build and fit a new wooden sluicebox similar to this brother's. This should result in an increase in gold recovery of about 15 to 25% and would be much easier to move.

4.5 El Tigre Kaikoree (ETK) – Tiger Creek – (photos 23, 24, 25 & 26)

ETK was mining very large shallow pits on Tiger Creek, another tributary of the Puruni River. The gravels were thick and sandy with some clay. The overburden had a very high clay content.

The mining operation used hydraulic excavators to clear the jungle and strip the overburden above the pay gravels. The miners excavated the pay gravels using three hand-held hydraulic jets (photo 23). A gravel pump pumped the dilute gravel and slurry from a bedrock sump to several steel skid-mounted sluiceboxes. The 6 by 4 inch Berkley water supply pumps were powered by four cylinder diesel engines. The 6 by 6 inch Brazilian gravel pumps had to pump a long distance from the mining area and were powered with six cylinder diesel engines. Only the pay gravels are processed through the gravel pump and this would increase the mining rate and gold production significantly.

The steel sluiceboxes were mounted on steel skids and consisted of a steel boil box, a top sluice section of dredge riffles and a bottom sluice section of fine expanded metal riffles over Nomad and Brazilian carpet (photo 25). The sluiceboxes were 26 feet (8 m) long by 6.7 feet (2 m) wide. The expanded metal was too light, warped in areas, and was welded to overhead metal restraints (photo 26).

Only one sluicebox was measured. The production from each land dredge (with one six inch pump and six cylinder motor) was about 33 loose cubic yards per hour (25 cubic meters per hour). The gravel pump produced about 670 Igpm or about 51 liters per second of water. The pumps operated more consistently at about 80% of the time. The daily production was relatively high at about 268 cubic yards (206 cubic meters) per day per dredge due to the high solids volume density of the slurry (18%).

The measured solids volume density of 18% was very high and would reduce gold recovery efficiency significantly. It should be reduced to a maximum density of 12% to improve gold recovery efficiency.

The sluiceboxes were too wide for the volume of water provided and should either be reduced in width, or the water volume increased to 1100 Igpm. At the present water volume they should be reduced to 4 to 4.5 feet (1.3 m) in width for the expanded metal section that should be at least 12 feet (3.6 m) long. This should be followed by a narrower (2 to 3 feet, 0.6 to 0.9 m) wide by 8 feet (2.4 m) long one-inch angle iron riffle sluice section. This sluicebox design would increase gold recovery and be lighter and easier to move with heavy equipment.

The weight of the expanded metal should be increased to 4 to 6 lbs per square foot and should be anchored so that the sections can be easily flipped over if they warp and/or replaced when worn. Expanded metal should fit tightly over the full area of unbacked Nomad matting to optimize gold recovery.

This sluicebox was not refitted nor tested with radiotracers.

4.6 Alfro Alphonso – China Creek – (photos 17 to 22)

Mr. Alphonso's China Creek camp was located 3 hours by tractor from the Puruni road (photo 17). His miners were using mercury retorts prior to the demonstrations (photo 19). Mr. Alphonso's general managers learned about retorts and built their own after participation at the Mahdia seminars in 1999.

Unseasonable rains also caused some flooding at China Creek and Mark Motayne (Mr. Alphonso's general manager) had moved his jet men to new pits. The gold was located in shallow (10 feet, 3 m) alluvial deposits in the valley bottom and into the hillside near smaller tributaries of China Creek. Porknockers had previously mined the area by hand. The soils were coarse sandy angular gravels rich in quartz fragments (photo 21).

Mr. Alphonso had nine land dredges working at China Creek. There were also reported to be four more dredges downstream, closer to the confluence with the Puruni River. The author only inspected two of Mr. Alphonso's dredges. In each of the two pits, the miners were using two or three hand-held water monitors to wash down the loose soils and tailings into a clay/bedrock sump. Dilute gravel slurry was pumped from this sump to the wooden sluiceboxes using a six-inch (150 mm) Brazilian gravel pumps powered by a four-cylinder diesel engines.

The first wooden sluicebox (SD 1896) consisted of two sections, each about 6 feet (1.8 m) wide by 12.5 feet long. The first section was fitted with a wooden boil box and 10.5 feet (3.2 m) length of coarse expanded metal riffles held down tightly over Nomad matting. The lower section was fitted with bare Brazilian carpet (photo 20).

The second wooden sluicebox (SD 2676) consisted of three sections. The top section was 4 feet wide and was fitted with a wooden boil box and 7 feet (2 m) of one-inch angle iron riffles. The angle iron riffle trays were narrower than the sluice run (only 3 feet, 0.9 m, wide). The middle and lower sections were about 6 feet (1.8 m) wide by 14 feet (4.3 m) long. The middle sluice was fitted with another wooden boil box and coarse expanded metal riffles held down tightly over unbacked Nomad matting. The bottom sluice run was fitted with bare Brazilian carpet.

The production from each land dredge (with one six inch pump and four cylinder motor) is about 13 to 15 loose cubic yards per hour (10 to 12 cubic meters per hour). The gravel pumps produced from 470 to 700 Igpm or about 36 to 53 liters per second of water. The pumps only operated at full output for about 75% of the time. The daily production is about 94 to 113 cubic yards (72 to 87 cubic meters) per day. All of the soils overlying the pay gravel are commonly processed through the pump and this creates some dilution of the gold grades. The relatively high throughput was due to previously worked sandy Porknocker tailings.

The riffles performed well except that both sluiceboxes were too wide for the water available from the gravel pumps. The expanded metal sluice runs should be narrowed to 4 feet (1.2 m) on both sluices. Each sluice should be fitted with a section of one inch angle riffles that is 2 to 3 feet (0.8 m) wide and 8 feet (2.4 m) long either in front of the expanded metal riffles section (as in SD2676) or downstream of the expanded metal riffle sections (as in the new sluiceboxes built by Jacobs, Bacchus or Baptise). The narrower boxes would be lighter and easier to move, would pass cobble size rocks more easily and should improve gold recovery by about 10%.

The sluicebox slurry was discharged into previous pits or onto the jungle floor.

4.7 Million Mountain Mining – Puruni River – (photos 27, 28, 29 &30)

At Million Mountain, the lode gold deposit consisted of quartz/schist in an oxidized shear zone. The surrounding bedrock was decomposed to clay but often still displaying the original geology. The shear zone contained oxidized stained white quartz and schist fragments.

A small bulldozer was used to rip and push the oxide to a feed hopper (photo 28). The ore was washed with a stationary water manifold into a steel column. The steel column was fitted with a screen and the undersize slurry flowed through into a pump box (photo 29). The oversize spilled off into a pile for later processing. A 6 by 4 inch Warman hardened steel slurry pump pumped the gravels to a stationary sluicebox about 400 feet (122 m) away. Two submersible water pumps provided water at the feed hopper and additional water at the top of the sluicebox.

The steel sluicebox was in three sections, each 6 feet (1.8 m) wide (photo 30). The top section consisted of a boil box and 15 feet of (4.6 m) of one-inch angle iron riffles sitting on top of Nomad matting. The middle section was fitted with a 15 feet (4.6 m) length of coarse expanded metal sitting on top of Nomad matting. The final section was fitted with 18 feet (5.5 m) of bare Brazilian carpet. More Brazilian carpet was placed further downstream in narrow (2 feet, 0.6 m) launders.

The production was 8 loose cubic yards per hour (6 cubic meters per hour). The gravel and water pumps produced a total of about 844 to 1074 Igpm or about 64 to 81 liters per second of water. The pumps operated at about 75% of the time. The daily production was only about 62 cubic yards (48 cubic meters) per day) due to low solids volume densities of about 3%.

The angle iron and expanded metal riffles should be anchored down tightly on top of the Nomad matting. The top angle iron sluice run is probably too wide for the volume of water provided and should either be reduced in width to about 3 feet (0.9 m). The slope of this run will have to be reduced once the runs are narrowed to maintain a slurry velocity of about 6 feet per second (1.8 m/s) The water velocity in the middle expanded metal run is too low and should be increased slightly by increasing the slope of the sluice run until the velocity is about 5 feet per second (1.5 m/s).

The sluicebox tailings were discharged into a pit for further processing at a later date. This sluicebox was not refitted nor tested with radiotracers.

5.0 STANDARD RECOMMENDATIONS

Field and laboratory test work has indicated that sluicebox runs should be designed to the following specifications for optimum recovery levels:

a) Every sluice run should have a section of expanded metal riffles and a section of angle iron riffles in series;

b) The expanded metal section should be sized to handle 8 loose cubic yards per foot of width and consist of coarse expanded metal mesh (4 to 6 lbs/ft2) fitted tightly on top of Nomad matting;

c) Optimum slurry velocities for the expanded metal riffles section will range from 5 to 6 feet per second (1.5 to 1.8 m/s);

d) The expanded metal section of the sluicebox should preferably be at least 16 feet long and followed or preceded by an 8 feet long section of angle iron riffles;

e) The angle iron riffle section should be approximately one half the width of the expanded metal riffle section and may have to be set at a steeper gradient of up to 3 inches/foot to achieve a slurry velocity of 6 to 8 feet per second (1.8 to 2.4 m/s), care must be taken to reduce rooster tails where runs are narrowed;

f) The one inch angle iron riffles should be aligned at 15 degrees from the sluicebox's vertical towards to top of the box and they should be located with a clear distance of 2 to 2.5 inches (50 to 65 mm) between each riffle;

g) The angle iron riffles should be fitted tightly on top of Nomad matting (light expanded metal may be inserted between the riffles and the matting to prolong the life of the matting); and

h) Nuclear tracers indicated that the gold particles can migrate down the sluice run (especially during start up periods) therefore sluice runs that are easily washed down will allow more frequent clean ups (preferably every 24 hours) to further reduce gold losses.

Randy Clarkson P.Eng.

APPENDIX

Figures

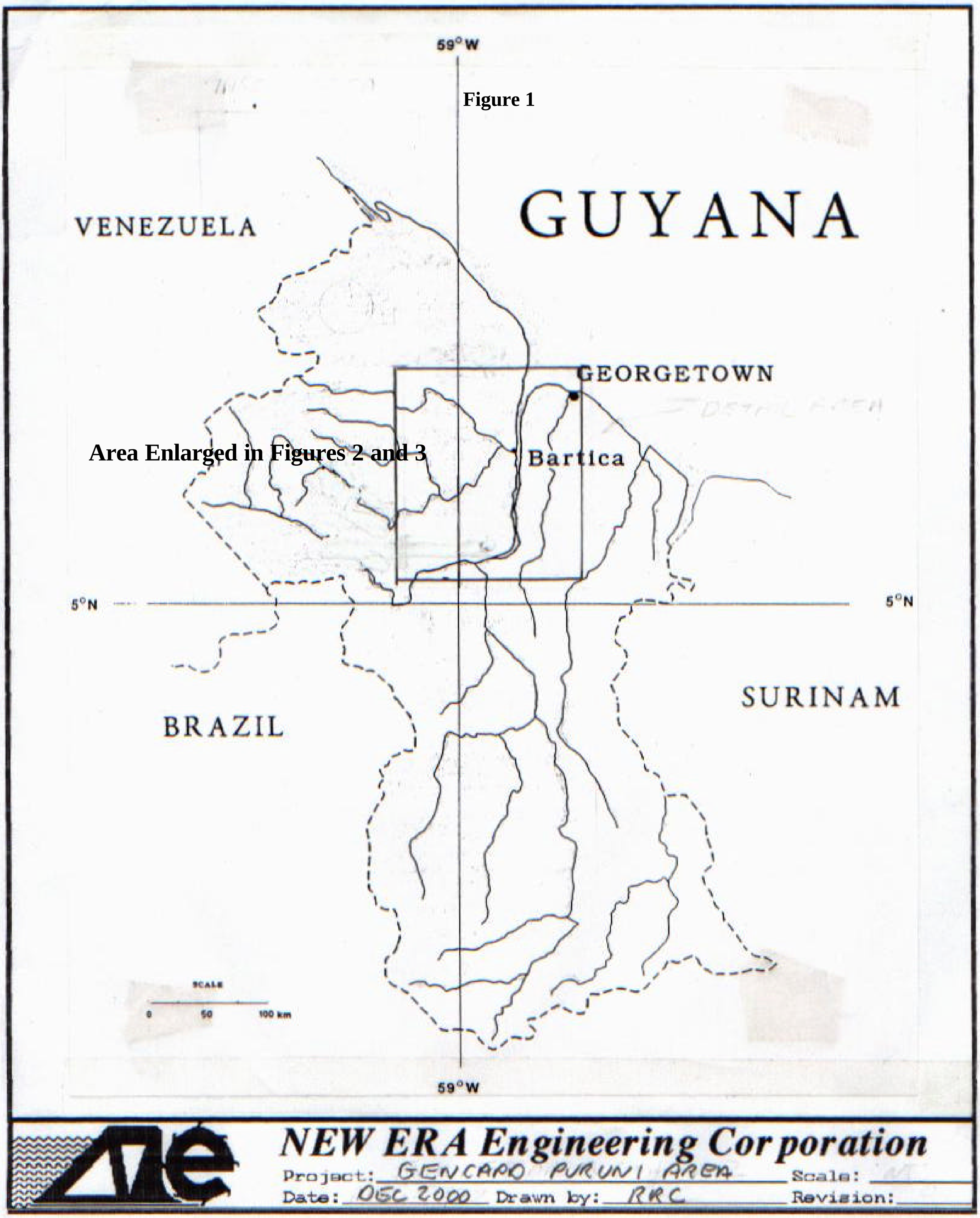


Figure 1
59° W
GUYANA
VENEZUELA
GEORGETOWN
Area Enlarged in Figures 2 and 3
Bartica
5°N
5°N
SURINAM
BRAZIL
SCALE
0
50
100 km
59° W
NEW ERA Engineering Corporation
Project: GENCAPD PURUNI AREA
Scale:
Date: DEC 2000
Drawn by: RRC
Revision:

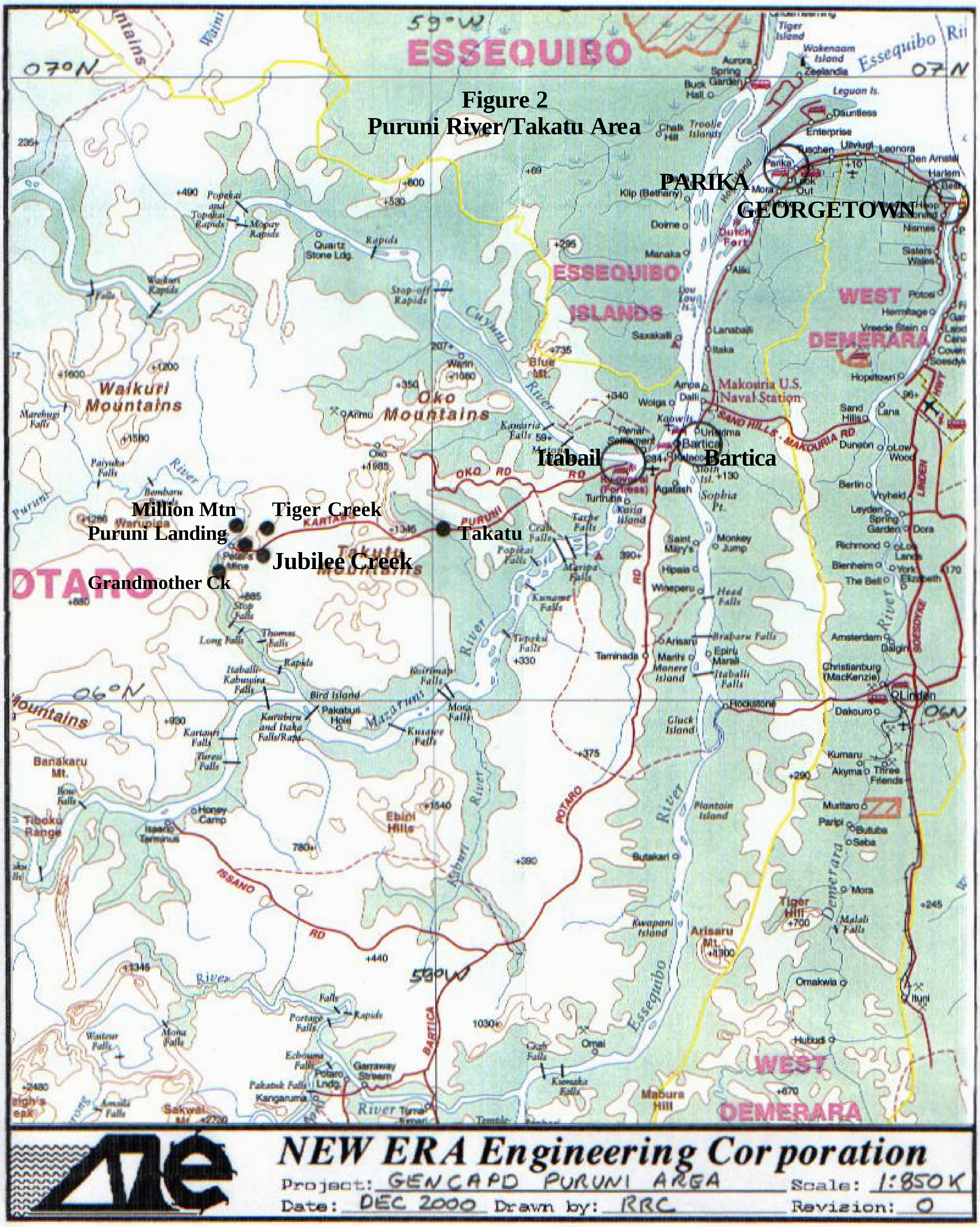


Figure 2
Puruni River/Takatu Area
ESSEQUIBO
ESSEQUIBO ISLANDS
WEST DEMERARA
PARIKA
GEORGETOWN
Itabail
Bartica
Million Mtn
Tiger Creek
Puruni Landing
Takatu
Jubilee Creek
Grandmother Ck
Waikuri Mountains
Oko Mountains
OKO RD
POTARO RD
ISSANO RD
BARTICA
59°W
07°N
06°N
NEW ERA Engineering Corporation
Project: GENCAPD PURUNI AREA
Scale: 1:850K
Date: DEC 2000
Drawn by: RRC
Revizion: 0

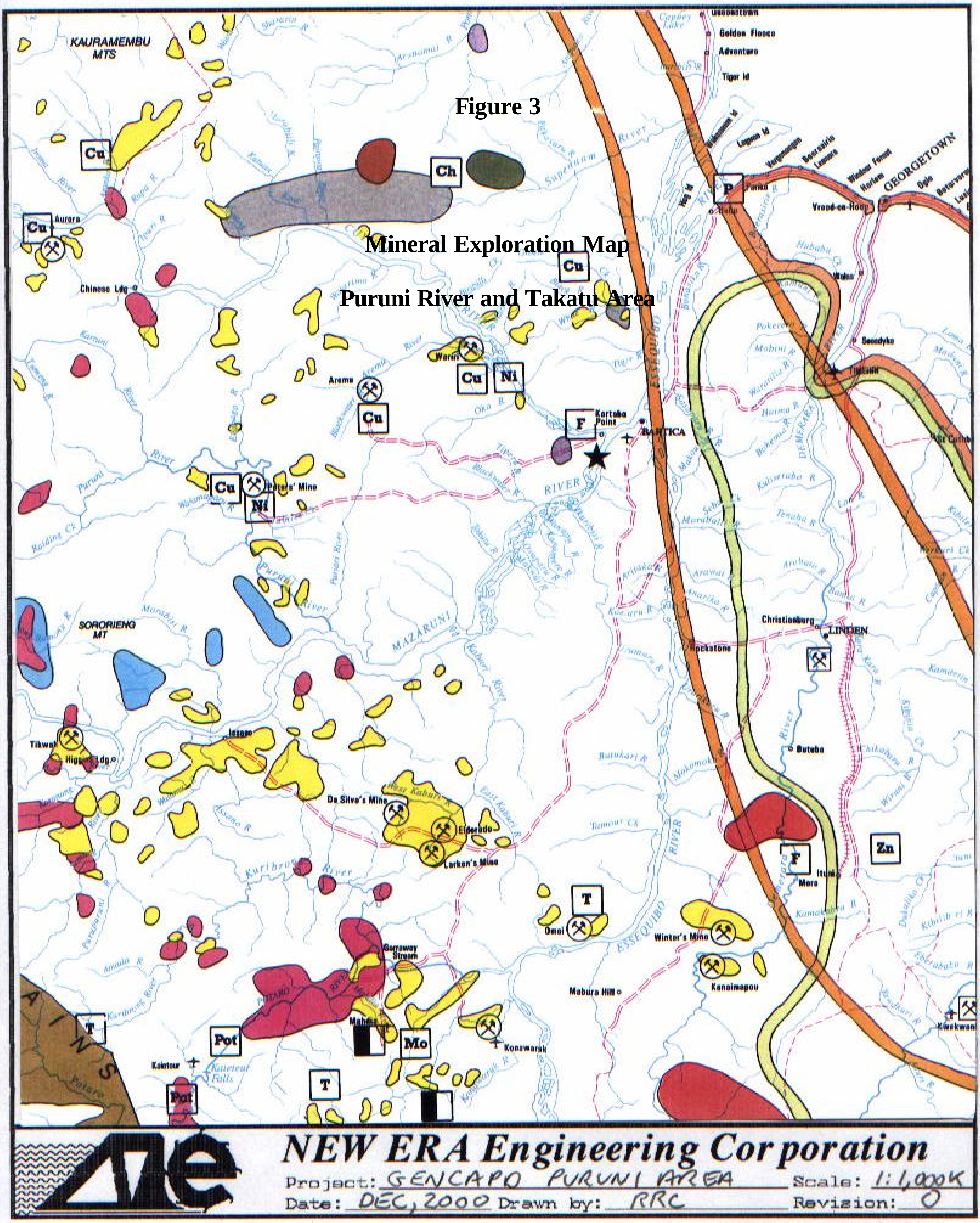


Figure 3

Mineral Exploration Map

Puruni River and Takatu Area

PRELIMINARY RECOMMENDATIONS FOR LAND DREDGE SLUICEBOXES

Gold recovery is very important for small-scale land dredging. More recovery means more profit for the miners. This handout describes preliminary sluicebox designs for a variety of land-dredging operations typical to Guyana.

The sluicebox design is shown on the other side of this sheet. The design has three sections of a wooden box; each section fits inside the lower section and is about 10 feet long so that it can be moved easily. All floors of the sluicebox should be sealed with cotton or epoxy to stop the loss of gold. The sluicebox should be sloped at 1 & ½ to 2 inches for every 12 inches horizontal (8-10 degrees). The expanded metal should be very heavy (see minimum size & weight) so that it makes a good riffle and does not warp. The trays of one-inch angle iron riffles are also sketched on the other side. They must be welded from several sections of 1 inch by 1 inch by 1/8-inch thick angle iron welded to 1 & ¼ inch by 1/8 inch flat bar sides. Nomad (magic) matting should be used under the expanded metal and one inch angle iron riffles. The riffle sections must be held down (or nailed) tight on top of the Nomad matting to stop gold loss.

The sluicebox is made up of several sections including:

I. The **sluice head** where the gravel slurry from the pump is stopped and spread wide across the top of the box. It must be watertight and made of hard woods or protected from wear with conveyor belts or steel. The floor (bottom) of the sluice head should be about 1& ¼ inches higher than the rest of the top sluice. There should be a 1-foot opening into the top sluice to let the gravel slurry out. Some miners use a 45-gallon drum for the sluice head, but it does not work as well.

II. The **top sluice** run should be 7 feet long and is fitted with a 4 feet length of coarse expanded metal riffles held tightly over Nomad matting. The rest (3 feet) of the run should be covered with smooth steel or Brazilian carpet.

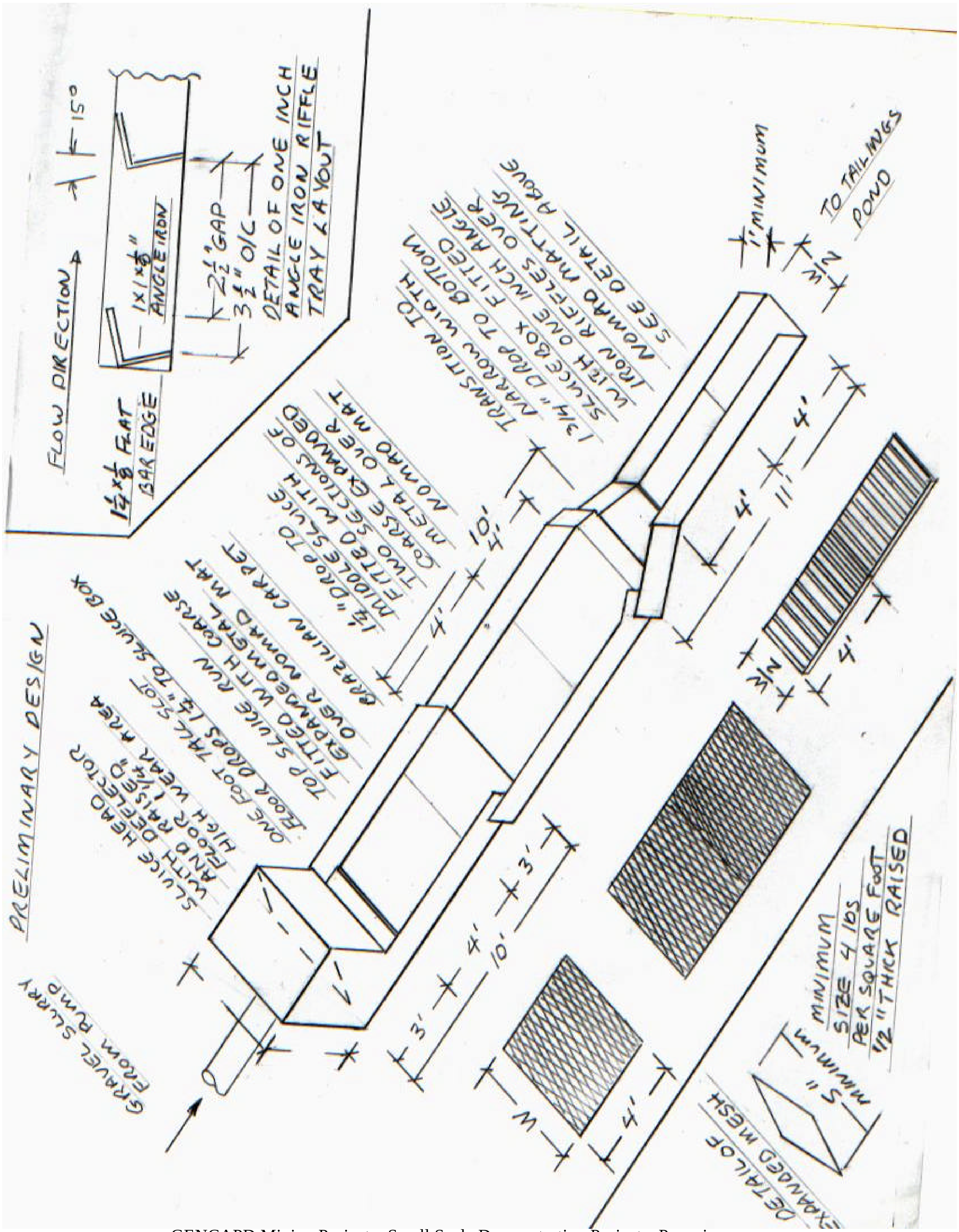
III. The **middle sluice** is a little wider than the top sluice run and should sit about 1 & ¼ inches lower than the top run. The middle run should be fitted with two 4 feet lengths of coarse expanded metal riffles held tightly over Nomad matting. The lowest section of the middle sluice run is narrowed.

IV. The **bottom sluice** narrows to about half the width of the middle sluicebox and should be fitted with two sections of one-inch angle iron riffle trays held tightly over Nomad matting. The floor of the bottom sluicebox should be 1& ¾ inches lower than the narrowing transition.

These recommendations assume the use of a Brazilian (Dambrose) cast steel gravel pumps. The amount of gravel slurry the pumps will push depends on the size of the pump, the speed of rotation, the power of the engine driving the pump, the length, diameter and lift of the outlet pipe, and the general condition of the pump. The right width of the sluicebox depends mostly on the size of the gravel pump and motor:

Pump and Motor	Width of top sluice	Bottom Sluice
4 by 4 inch pump powered by a 4 cylinder motor	2 feet	1 feet
6 by 6 inch pump powered by a 4 cylinder motor	3 to 4 feet	2 feet
6 by 6 inch pump powered by a 6-cylinder motor	4 to 5 feet	2 to 3 feet
8 by 8 inch pump powered by an 8-cylinder motor	7 to 8 feet	4 feet

Make the riffle sections slightly narrower than the sluice runs so they fit easily.


PRELIMINARY DESIGN
FLOW DIRECTION
15°
DETAIL OF ONE INCH ANGLE IRON RIFFLE TRAY LAYOUT
ANGLE IRON
BAR EDGE
TO TAILINGS POND
GRAVEL SLURRY FROM PUMP
DETAIL OF EXPANDED MESH
MINIMUM SIZE 4 lbs PER SQUARE FOOT 1/2" THICK RAISED

APPENDIX 3

Photographs

Photo 1 Ronald Glasgow lecturing seminars at Takatu

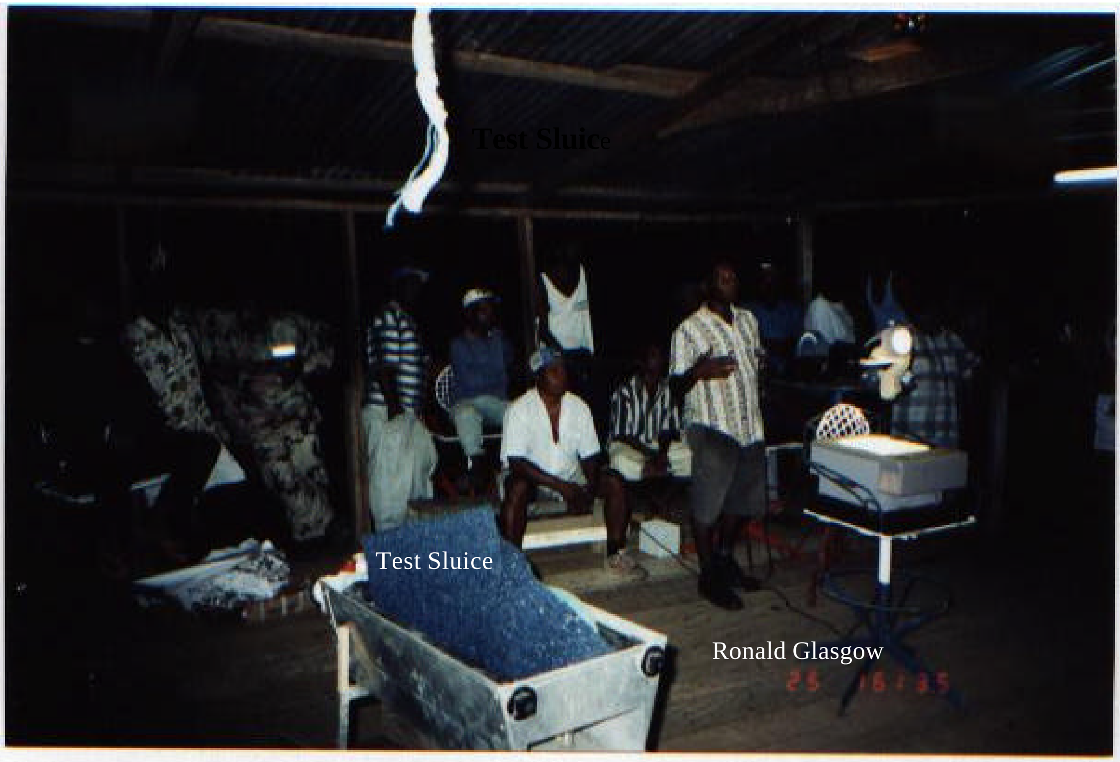


Photo 2 Randy Clarkson lecturing seminars at Takatu

Photo 3 Hydraulic Jet Mining at Collin Jacobs' Mine at Takatu

Photo 4 Collin Jacobs' Old Wide Sluicebox at Takatu

Photo 7 Collin Jacobs' New Narrow Refitted Sluicebox

Photo 8 Collin Jacobs' New Sluicebox Operating

Photo 9 Chain Sawing Boards from Logs in the Forest

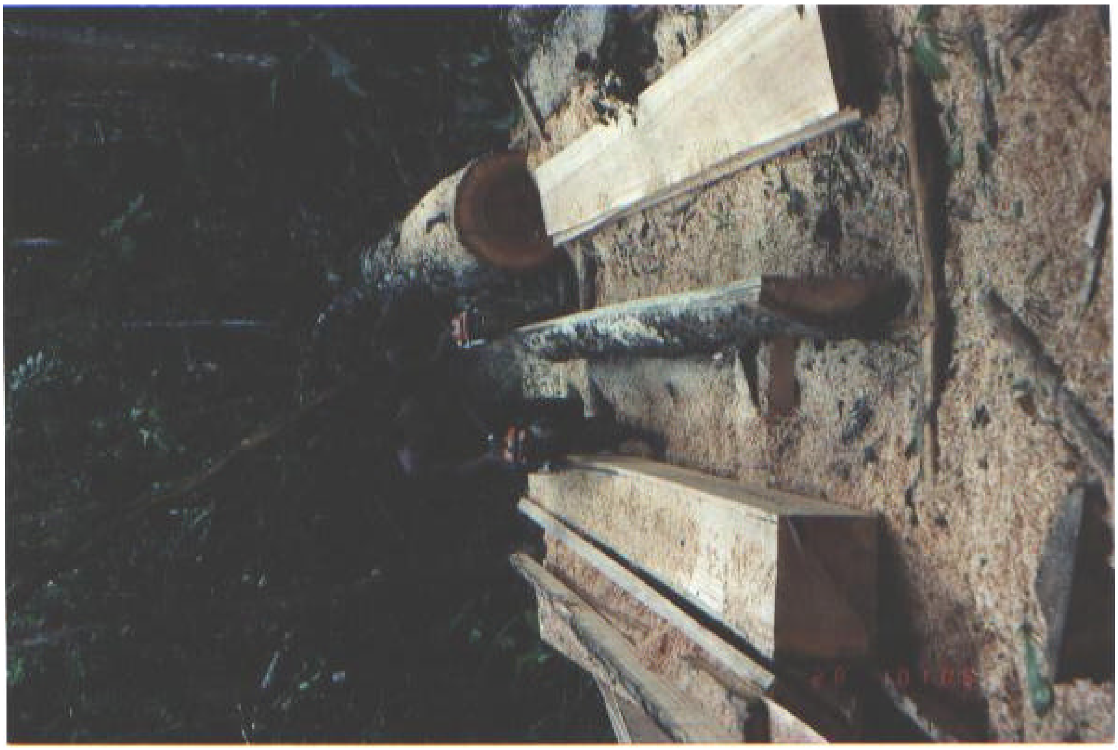


Photo 10 Constructing a New Narrow Sluicebox for Roy Bacchus at Jubilee Creek

Photo 11 Jetting at Roy Bacchus' Mine on Jubilee Creek

Photo 12 Roy Bacchus' Old Wide Sluicebox

Photo 13 Raising Roy Bacchus' New Narrow Refitted Sluicebox up on Poles

Photo 14 Operating Roy Bacchus' New Narrow Refitted Sluicebox

Roy Bacchus

Photo 15 Hand Wheel Barrow to Lug Pumps Through the Jungle

Photo 16 Jet Mining at Errol Baptise's Mine at Grandmother Creek

Photo 17 The Three-Hour Tractor Transport into China Creek

Photo 18 Alfro Alphonso's Camp at China Creek

Photo 19 A Home-made Mercury Retort made at Alphonso's China Creek

Photo 20 A Typical Sluicebox at Alphonso's China Creek

Photo 21 An Excavator Stripping Overburden at ETK's Tiger Creek

Photo 22 Jet Mining of Pre-Stripped Gravels at ETK's Tiger Creek

Photo 23 Steel Skid-Mounted Sluicebox at ETK

Photo 24 Inside the Steel Skid-Mounted Sluicebox at ETK

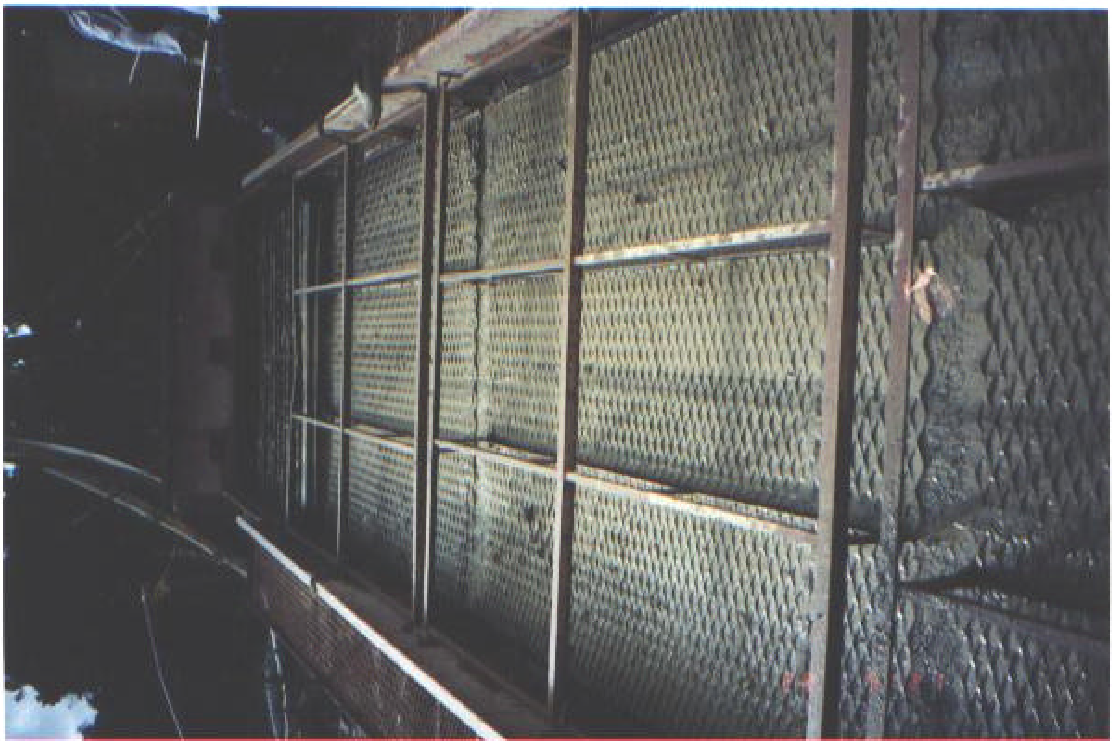


Photo 25 Winching Out of Muddy Access Road at Million Mountain

Photo 26 Feed Hopper and Screen Arrangement at Million Mountain

Photo 27 Pump Box and Gravel Pump at Million Mountain

Photo 28 Metal Sluicebox at Million Mountain

Photo 29 Flat Tire on Kartabu-Puruni Road

Photo 30 Small Dam Constructed with Boards and Filled with a Gravel Pump

Photo 31 GGMC Demonstration Sluicebox at St Elizabeth, Mahdia

Photo 32 GGMC's Small Settling Pond at St. Elizabeth, Mahdia