GENCAPD MINING

GUYANA ENVIRONMENTAL CAPACITY DEVELOPMENT PROJECT

(GENCAPD)

SMALL SCALE DEMONSTRATION PROJECT

OKO AREA

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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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 Oko area of Guyana. A mines officer from the Guyana Geology and Mines Commission (GGMC) assisted the author and learned about the delivery of the demonstrations.

The site of the demonstrations was at Oko area of Guyana, South America (figures 1, 2 & 3). Similar demonstrations were conducted in the Puruni and Takatu areas in November 2000, the Northwest District in April 2000 and in Mahdia in September 1999 (photo 1).

Due to a lack of roads, miners in the Oko area walked up to four hours to see the demonstrations and the three evening seminars (photo 2). The seminars were held in a covered area built especially by Michael Vieira's crew for the small-scale demonstration. The author and the GGMC mines officer 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 (photos 3 & 4). The seminars also provided the proof that was required to convince the miners to build and refit new sluiceboxes. The seminars were translated simultaneously into Portuguese by a local miner for the benefit of the many Brazilian miners who attended.

The mangers of both demonstration sluiceboxes became sick with malaria. One had to be flown out while the author tested the other and recovered after medicine was administered. There were other minor delays but thanks to the assistance of General Manager Andrew DeAbreu, two sluiceboxes were constructed and refitted with Canadian riffle systems at small alluvial mines near the Oko airstrip (Fazal Sheriff, photos 9 & 10, and Peter Thompson, photos 19 & 20). The water and solids flow rates from several sluiceboxes were measured in the Oko areas, Crack Creek, and at Baramalli Creek.

Radiotracers were prepared by the author and were irradiated and shipped to Guyana to do comparative testing. The previous radiotracers (Puruni Demonstration) were lost by Air Canada in November 1999. The author's associate (Laura Clarkson) diligently tracked the shipment with several persistent phone calls to ensure prompt delivery. Radiotracers indicated an increase in gold recovery efficiency from 31% to 65% with the high clay pay gravels after construction and refitting with recommended matting and riffles.

The author's small testing sluice was demonstrated at the seminars and used to upgrade sluicebox concentrates (photo 18). Safe mercury handling and retorting methods were first demonstrated at the seminars and by Andre DeAbreu (photo 4). Due to the short notice of this demonstration, six retorts were fabricated in Whitehorse hastily and three of the retorts required field repairs. All were left with Mr. DeAbreu and other miners in the Oko area 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 author and ______ ______ (GGMC) with the assistance of Jean-Marc Barbera (CANMET).

TABLE OF CONTENTS

Page No.

APPENDICES

1.0 INTRODUCTION

The site of the demonstrations was near the main airstrip in the Oko area of Guyana, South America (figures 1 & 2). Similar demonstrations were conducted in the Puruni River and Takatu area in November 2000, the Northwest District in April 2000 and in Mahdia in September 1999. Access to Oko area is by light aircraft (photo 1) or via a rough track from the newly reconstructed Puruni River dirt road from Bartica (figure 2, photo 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 comes to a junction with a rough track (for all wheel drive Bedford Trucks) to Oko. The trip from Bartica requires about 8 hours by Bedford truck on rough trails.

All of the mines observed were typical alluvial placer deposits with 1.5 m (5 feet) to 3 m (11 feet) of silty/clay-rich overburden overlying about 0.3 to 1 m (1-3 feet) of irregular white quartz gravels. Some of the gold-bearing gravels were cemented with iron to form rock-hard layers of catch-cow. Bedrock was decomposed to hard clays. In at least one case, the bedrock clays appeared to be forced into and throughout the pay gravels.

Most of the mining in the Oko area occurred in the previous ten years where supplies and personnel were flown in to the airstrip. Since the recent reconstruction of the Kartabu-Puruni road, most of the supplies come by Bedford truck in the dry seasons. Originally, personnel hired directly by Michael Vieira did the mining. Other small-scale miners now conduct most of the mining with a royalty based on gross gold production.

The miners used hand-held water jets to erode the alluvial gold gravels and overburden (photos 12, 13, & 14). The miners all used Brazilian gravel pumps to pump the gravels to a raised wooden sluicebox (land dredging). At all of the mines, 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. Only one bulldozer was in the area and was used primarily for roadwork. 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 Puruni and Northwest Districts, but similar in scale to those in Mahdia and Takatu. Several of the sluiceboxes were already using Nomad matting and expanded metal riffles due to attendance by Andrew DeAbreu at the previous Mahdia demonstration 1999 and work in the area by the author for Alfro Alphonso in 1996 and 1997. However, in many cases the sluiceboxes were not fitted properly for optimum gold recovery. Only Michael Vieira's operations had a mercury retort on hand prior to the demonstrations. Mr. Vieira's general manager learned about retorts and built one after participation at the Mahdia seminars in 1999.

This was only the fourth 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 Puruni and Northwest Districts 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 fourth 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 who display initiative 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 minor delays (due in part to malaria) but the demonstrations went relatively well due to the assistance of General Manager Andrew DeAbreu and his crew. Water and gravel flows were measured at several sluiceboxes in the Oko area and at the Crack Creek and Baramalli Creek.

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 ten mines measured varied from about 6 cubic yards (4.6 cubic meters) per hour at Peter Thompson's and Katchia's operations to about 33 cubic yards (25 cubic meters) per hour at Fazil Rahaman's operation. The previous demonstration in the Puruni Takatu area reported that the same type of gravel pumps processed from 7 to 15 cubic yards (5 to 12 cubic meters). In the Northwest District the pumps processed from 6 to 22 cubic yards (5 to 17 cubic meters) per hour. During the Mahdia demonstrations, the same type 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 4 by 4 inch or 5 by 5 inch or 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 (Rahaman's and Gomes' operation) 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 Fazal Sheriff's and Peter Thompson's operations (photos 9, 10, 19 & 20). These two sluiceboxes were refitted with Canadian riffle systems including medium weight (local) 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. Andrew DeAbreu generously provided accommodation and meals, a newly constructed shelter at his camp for two nights of seminars, two saw men, and three hours of tractor transport to Baramalli Creek (photo 2). He was keen to build the two new sluiceboxes and to demonstrate the use of mercury.

Comparative radiotracer testing was conducted at Peter Thompson's original and new refitted sluiceboxes during this demonstration. Radiotracers were prepared by the author and were irradiated and shipped to Guyana to do comparative testing. The previous radiotracers (Puruni Demonstration) were lost by Air Canada in November 1999. The author's associate (Laura Clarkson) diligently tracked the shipment with several persistent phone calls to ensure prompt delivery.

The thin seam of pay gravel at Peter Thompson's operation was extremely difficult to wash due to the presence of plastic clays throughout the gravel (photo 13). It appeared as if the gravel had been forced down into the decomposed clay bedrock. The average weighted recovery in this high clay gravel with the original sluicebox was only 31%. This was improved to 65% after the new sluicebox was refitted and constructed. The gold losses in the new sluicebox were due to incomplete washing from the clay balls. Radiotracer tests of the new refitted sluicebox at Fazal Sheriff's operation indicated no gold losses to the tailings. However this pay gravel was very sandy and easy to wash.

Based on the author's previous experience and on radiotracer testing at Mahdia and the Northwest District 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). Gold recovery for pay gravels containing very sticky clays will be lower but are still increased (31% to 65%) with optimum sluicebox designs. 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 2 ounces 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 Andrew DeAbreu's camp (photo 4). Six 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.

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 there 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 Fazal Sheriff – Oko - (photos 9-12)

Fazal Sheriff was mining shallow alluvial gravels on weathered bedrock in a pit adjacent to the airstrip at Oko. The pay gravels were about 3 feet (0.9 m) thick and covered with about 8 feet of red/brown silt. Some of the pay gravels were cemented into an iron-rich catch-cow layer but were mostly sandy and easily washed.

The miners excavated the overburden and gravels from small pits using two 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 dredge riffles and bare 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. The wooden boil box and dredge riffles were packed hard with clay and gravels.

A new narrower sluicebox was built from raw logs. The top two sections were 10 feet (3 m) long by 4 feet (1.3 m) wide and were fitted with medium weight expanded metal riffles over unbacked Nomad matting. The final (third) section was 8 feet long (2.4 m) by 2 feet (0.6 m) wide and was fitted with one-inch angle iron riffles over Nomad matting.

The production from this land dredge (with one six inch pump and four cylinder motor) is about 21 loose cubic yards per hour (16 cubic meters per hour). The gravel pump produced from 510 to 670 Igpm or about 39 to 51 liters per second of water. The pumps only operate at full output for about 75% of the time. The daily production is about 92 cubic yards (71 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 sluicebox slurry was discharged on top of the next mining area. When the new sluicebox was finished the operator was going to direct the tailings into a previous pit. Radiotracer tests were conducted on the new sluicebox. No gold losses were detected.

4.2 Peter Thompson – Ainton Vieira - Oko – **(photos 14-22)**

Ainton Vieira, general manager of Peter Thompson's operation was mining a shallow alluvial deposit. The clay bedrock appeared to have been squeezed into the thin (1.5 ft, 0.5 m) layer of pay gravels. The material was very clay-rich with irregular quartz fragments and extremely difficult to wash.

In the pit Mr. Vieira was using one hand-held water monitor to wash down the loose soils and tailings into a clay/bedrock sump. Dilute gravel slurry was pumped from this sump to the wooden sluicebox using a four-inch (100 mm) Brazilian gravel pumps powered by a one-cylinder diesel engine. Water for the monitor was supplied by a three-inch (75 mm) centrifugal pump powered by a three-cylinder diesel engine.

The original three-piece wooden sluicebox was a total of 20 feet (6 m) long and ranged in width from 2.5 feet (0.8 m) to 4 feet (1.2 m, photo 15). The top section was fitted with a wooden boil box, unbacked bar Nomad matting, and fine plastic mesh over ribbed Brazilian carpet. The bare unbacked Nomad was swollen and hard (photo 16). Radiotracer mixed in the pay gravels were added to the sluicebox but most ended up in the tailings (photo 17) and very few were recovered in the swollen bare Nomad matting.

The new sluicebox was constructed from raw logs. It also consisted of three sections. The top two sections were each 9 feet (2.7 m) long by 2 feet (0.6 m) and were fitted with medium weight expanded metal over unbacked Nomad matting. The bottom section was 8 feet (2.4 m) long by 1.3 feet (0.4 m) wide and was fitted with one inch angle iron riffles over Nomad matting (photos 19 & 20).

The production from this land dredge (with one four inch pump and one cylinder motor) was about 6 loose cubic yards per hour (5 cubic meters per hour). The gravel pump produced from 220 to 320 Igpm or about 17 to 22 liters per second of water. The pumps only operated at full output for about 75% of the time. The daily production was about 31 cubic yards (24 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 low throughput was due to the small pump size and the difficulty eroding the clay-rich gravels.

The sluicebox slurry was discharged into a previous pit. Radiotracer tests were conducted on the original and new sluiceboxes. The average weighted gold recovery was increased from 31% to 65% with the new sluicebox. The relatively low gold recovery of the new sluicebox was due to the incomplete washing of the clay-rich pay gravels.

4.3 Fazil Rahama – Oko

Fazil Rahama's general manager, Antonne Chico, was mining shallow alluvial gravels on weathered bedrock. The pay gravel layer was about 2 feet (0.6 m) deep and covered by 8 (2.4 m) of silt overburden. The miners excavated the overburden and gravels from small pits using small hydraulic jets. A gravel pump pumped the dilute gravel and slurry from a bedrock sump to a wooden sluicebox. The 4 by 4 inch water supply pump and 5 by 5 inch Brazilian gravel pumps were each powered with three cylinder MWM diesel engines. The trees were not cleared in advance of the mining.

The sluicebox was 4.4 feet (1.3 m) wide and a total of 16 feet (4.9 m) long. It was fitted with a wooden boil box, medium weight expanded metal riffles over Nomad matting and Brazilian matting and a short section of bare Brazilian matting. This sluicebox was narrower than most others with the same size of gravel pump. The sluice runs were slightly wider than the sheets of expanded metal. The sluicebox should be made as narrow as the sheets of expanded metal however appeared to be operating well. It should also include a narrower (2 feet, 0.6 m) sluice section fitted with one-inch angle iron riffles.

The gravel pump produced about 13 loose cubic yards (10 m3) per hour or about 49 cubic yards (38 cubic meters) per day. All of the soils are processed through the pump and this dilutes the gold grades significantly. The sluicebox slurry was discharged into previous pits or onto the jungle floor. Radiotracer tests were not conducted but it is expected that minor modifications would increase the gold recovery slightly.

4.4 Ivan Godtite – Oko (photo 5)

Mr. Ivan Godtite was mining downstream of the airstrip at Oko and had just started mining a new pit. His crew constructed a diversion dam by driving two lines of wooden planks into the river channel and filling between the planks with pumped gravels. The small dam illustrated an innovative method of dam construction without the use of heavy equipment. Later the crew was "cutting down the land" or removing silty overburden soils with a 6 by 6 inch gravel pump.

The two-piece wooden sluicebox was fitted with a wooden boil box, a section of dredge riffles and two sections of bare Brazilian carpet. The sluicebox was about 6 feet (1.8 m) wide and a total of 19 ft (5.8 m) long.

The production from this land dredge (with one six inch pump and four cylinder motor) was about 23 loose cubic yards per hour (17 cubic meters per hour). The gravel pump produced about 440 Igpm or about 33 liters per second of water. The pumps only operate at full output for about 60% of the time. The daily production was about 102 cubic yards (78 cubic meters) per day. All of the soils are processed through the pump and this dilutes the gold grades significantly. The measured solids volume density of 15% was higher than recommended and would reduce gold recovery efficiency significantly. It should be reduced to a maximum density of 12% to improve gold recovery efficiency.

This sluicebox was not refitted. Mr. Godtite should build and fit a new wooden sluicebox similar to Fazal Sheriffs. This should result in an increase in gold recovery of about 15 to 25% and would be much easier to move.

4.5 Mohamed Kadir – Oko

Mr. Kadir's general manager Sherland Williams was mining shallow (11 feet, 3.3 m) pits near Oko. The overburden was extremely rich in clays and silts and difficult to wash. There was only about a 1-foot (0.3) thick pay gravel section at the bottom of the pit.

The mining operation used three hand held jets and a 6 by 6 inch gravel pump to a wooden sluicebox. The wooden sluicebox consisted of a boil box, a short section of dredge riffles, and bare Brazilian carpet. It was a total of 20 feet (6 m) long by about 6 feet (1.8 m) wide.

The production from the six-inch gravel pump was bout 23 cubic yards (18 cubic meters) per hour or about 127 cubic yards (100 cubic meters) per day due to the high solids volume density of the slurry (15%). All of the soils are processed through the pump and this dilutes the gold grades significantly. The measured solids volume density of 14% was higher than recommended and would reduce gold recovery efficiency significantly. It should be reduced to a maximum density of 12% to improve gold recovery efficiency.

The gravel pump produced about 750 Igpm or about 57 liters per second of water. The pumps operate at full output for about 75% of the time. The sluiceboxes were a bit too wide for the volume of water provided and should be reduced in width to 5 feet (1.5 m), otherwise the recommended sluicebox design would be similar to Fazil Sheriff's. 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 Fazil Rahaman – Oko

Mr. Fazil Rahaman's operation was located close to Oko. The alluvial deposit was shallow (12 feet, 3.7 m) with a thin gravel seam (1 foot, 0.3 m) resting on decomposed clay bedrock.

The three-piece wooden sluicebox was a total of 27 feet (8.2 m) long and from 5 to 2 feet (1.5 to 0.6 m) wide. It had already fitted medium weight expanded metal riffles and Nomad matting. It also had some sections of Brazilian carpet covered with plastic mesh. The expanded mesh was alternating, forward and reverse, and was raised above the carpet. Otherwise the sluicebox is operating very well and close to optimum water and maximum pay gravel feed rates.

The production from this land dredge (with one six inch pump and four cylinder motor) was about 33 loose cubic yards per hour (25 cubic meters per hour). The gravel pump produced about 760 Igpm or about 58 liters per second of water. The pump operated at full output for about 75% of the time. The daily production was about 188 cubic yards (145 cubic meters) per day. All of the soils are processed through the pump and this dilutes the gold grades significantly. The measured solids volume density was at maximum recommended levels (12%). The sluicebox slurry was discharged into previous pits.

This sluicebox was not refitted. Mr. Rahman should install the entire existing expanded metal sot that it is tight to the Nomad matting. This should result in a small increase in gold recovery.

4.7 Capishava – Crack Creek, tributary to Oko

Mr. Capishava's operation was located at what is locally know as the Crack, a narrow gulch about one hour's walk from Oko. Alluvial deposits at the Crack are particularly shallow (4 to 6 feet, 1.2 to 1.8 m) and there are a very high percentage of cobble size gravels. This area was intensely worked in the past by Porknockers.
The small wooden sluicebox had a total length of only 14 feet (3.3 m) and was narrow (3 feet, 0.9 m). It was fitted with a wooden boil box and Brazilian carpet covered with plastic screen.

This operation is typical to others observed in the Crack. It used a small (4 inch) gravel pump powered by a one-cylinder diesel engine, smaller 4-inch (100 mm) diameter pipe, one jet-man, and a 3-inch (75 mm) water supply pump.

The production was relatively high for such as small pump (14 loose cubic yards per hour, 11 cubic meters per hour) due to the processing of tailings. The gravel and water pump produced a total of about 300 Igpm or about 23 liters per second of water. The pumps operated at about 80% of the time. The daily production was about 89 cubic yards (68 cubic meters) per day) due to high solids volume densities of about 13%.

This sluicebox was not refitted nor tested with radiotracers. Mr. Capishava should build and fit a new wooden sluicebox similar to Peter Thompson's. This should result in an increase in gold recovery of about 15 to 25% and would be easier to move.

4.8 James Gomes – Crack Creek, tributary to Oko – (photo 7)

James Gomes' operation was also located at the Crack, a narrow gulch about one and one half hour's walk from Oko. Alluvial deposits at the Crack are particularly shallow (4 to 6 feet, 1.2 to 1.8 m) and there are a very high percentage of cobble size gravels. This area was also intensely worked in the past by Porknockers.

The small wooden sluicebox was had a total length of only 14 feet (3.3 m) and was also narrow (3 feet, 0.9 m). However, it was fitted with a wooden boil box, medium weight expanded metal riffles over Nomad matting and Brazilian carpet.

This operation is typical to others observed in the Crack. It used a small (4 inch) gravel pump powered by a one-cylinder diesel engine, smaller 4-inch (100 mm) diameter pipe, one jet-man, and a 3-inch (75 mm) water supply pump.

The production was relatively high for such as small pump (16 loose cubic yards per hour, 12 cubic meters per hour) due to the processing of tailings. The gravel and water pump produced a total of about 360 Igpm or about 27 liters per second of water. The pumps operated at about 80% of the time. The daily production was about 104 cubic yards (80 cubic meters) per day) due to high solids volume densities of about 13%.

This sluicebox was not refitted nor tested with radiotracers. Mr. Gomes's sluicebox was operating fairly well but was a bit too wide. He should build and fit a new wooden sluicebox similar to Peter Thompson's. This should result in an increase in gold recovery of about 10% and would be easier to move.

4.9 Mike Vieira – Baramalli Creek - (photo 7)

Mike Vieira's operation was located at Baramalli Creek, about three hours by tractor on a rough trail from the Oko airstrip (photo 2). The alluvial deposit was about 12 feet (3.7 m) deep with a 3 feet (0.9 m) thick layer of cemented catch-cow gravels overlying clay bedrock. There were a high proportion of rocks due to the coarse gravels and catch-cow. The mine pit was about 70 feet (21 m) by 180 feet (55m) and was very difficult to work with the hand-held jets. A creek bypass was constructed with a bulldozer (photo 7).

The two-piece sluicebox was a total of 20 feet (6 m) long and about 4.5 feet (1.4 m) wide. It was fitted with a wooden boil box, medium expanded metal riffles over Nomad matting and medium weight expanded metal over Brazilian matting.

The production from this land dredge (with one six inch pump and four cylinder motor) was about 14 loose cubic yards per hour (10 cubic meters per hour). The gravel pump produced about 620 Igpm or about 47 liters per second of water. The pump operated at full output for about 75% of the time. The daily production was about 81 cubic yards (62 cubic meters) per day. All of the soils are processed through the pump and this dilutes the gold grades significantly. The sluicebox was a little bit wide and too short however, measured water flow was near optimum levels and the sluicebox was operating fairly well. The sluicebox slurry was discharged into previous pits.

This sluicebox was not refitted. Mr. Vieira should install Nomad matting under the existing expanded metal in the lower sluicebox and install a narrower sluice section fitted with one inch angle iron riffles similar to Fazil Sheriff's new sluicebox. This should result in a small increase in gold recovery. Mr. Vieira also should consider the use of a hydraulic excavator to break up the cemented gravels and increase production from his pit.

4.10 Katchia – Baramalli Creek - (photo 8)

This operation was located just downstream of Mike Vieira's operation but was a smaller scale operation. The geology was also similar to Vieira's pit.

The sluicebox was very short at 13 feet (4 m) in length and narrow at 3 feet (0.9 m). It was fitted with a wooden boil box, plastic mesh over Nomad matting, bare Brazilian carpet and plastic mesh over Brazilian carpet. Strips of wood were located every 8 inches (20 cm) along both sections of the sluicebox that were clogging up the sluice runs. The plastic mesh was also clogging up the sluice runs and it allowed the Nomad matting to bulge and become packed.

The production from this land dredge was only 6 cubic yards (4 cubic meters) per hour due to the small size of the pump (4 inch), small motor (2 cylinder) and the cemented catch-cow pay gravels. The water flow of only 250 Igpm or 19 liters per second was too little for the width of the box. The daily production was estimated with a 75% operation time of about 35 cubic yards (27 cubic meters) per day. This sluicebox was not refitted nor tested with radiotracers. The owner should build and fit a new wooden sluicebox similar to Peter Thompson's. This should result in an increase in gold recovery of 25 to 30%.

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 A

OKO ARE Mines Data, Sluicebox Data and Calculations

APPENDIX B

Photographs