Giant Yellowknife Mines Limited
Yellowknife Division

TAILINGS RETREATMENT PLANT

COMPILATION AND UPDATE OF 1988 OPERATING PERFORMANCE REPORTS

November 7, 1988

D.R. Bartlett
Sr. Project Metallurgist

B. Cross
Plant Metallurgist

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INTRODUCTION

To allow maximum time to plan for the 1989 season, all TRP technical and performance reports have been compiled and updated. This information is presented herein as an interim report on the status of TRP improvement activities. Data analysis and conclusions on key performance trends have only been completed in limited cases. In the spirit of this information sharing - the reader is encouraged to:

- Participate in the data analysis.
- Contribute to a sound operating strategy for 1989.

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GIANT YELLOWKNIFE MINES LIMITED
TIMMINS DIVISION

November 11, 1988

MEMO TO: S. McAlpine

FROM: J. Bartrum

SUBJECT: **Report by Bartlett & Cross**

1.0 I think we should get one very important point clear Re - "The Introduction" of this report. This particular "reader" will not only "participate" and "contribute" to a "sound" operating strategy for 1989 but he will also be directing that activity in his many diverse roles of General Manager - Metallurgical Development - Giant Resources.

2.0 Your "Metallurgists" may "participate" and "contribute" by setting themselves a somewhat higher standard than that expected in the average kindergarten so that this reader can in reality "participate", "contribute" and direct.

3.0 Specifically

3.1 Section No.10 This section can only be described as distressingly pathetic!

a) I would have expected at the very least all the information that was requested via Ken Blower. That memo is attached.

b) Once again and I'm taking every risk in assuming someone had the professional competence to measure them during the trial, one week before, during and after what were the feed grades, tailings losses, pH levels by tank, oxygen levels in each tank, carbon distributions and profiles, feed densities, actual solids retention time, cyanide residuals by stage, tonnage rates, pulp temperatures, total cation concentration, CIL feed sizings, soluble sulphide levels, etc. etc. etc.?

c) I would then expect at the very least that a metallurgist would have collated this data put it through a factor analysis, R. correlation analysis or some multivariate statistical technique.

d) I would suggest extremely strongly that someone reads Fiedler's Report which I find reasonably simple and straight forward to understand and answer a fundamentally simple and basic question.

- The average dissolution from the pilot plant test programme was 38.9%.

- It was achieved at a pH of greater than 10.0.
- It was achieved at 1.23 lb/t of lime.
- It was achieved at 2.01 lb/t of cyanide.
- It was achieved at free cyanide values of "<u>generally greater than 0.7 lbs/t</u>".
- It was achieved with sufficient dissolved oxygen.
- **<u>It simply was achieved</u>.**

e) The person who wrote section 10 summary states there was at least 0.6 lbs NaCN/t solution but he's not sure. For heaven's sake so what!! The test was a farce in that Pilot Plant free cyanide levels were generally greater than 0.7 lbs/t. In other words you didn't even do the test on the basis of the feasibility study which justified the capital for the project in the first place. What else didn't you do???

f) So the fundamental basic question is what are the difference between the pilot plant and the TRP operations?

g) **<u>I will now "contribute" & "participate" one difference is you didn't have the pilot plant cyanide dosage level set in the TRP plant properly since day one</u>(!)**

h) This question(f) was asked before and detailed on a bar chart August 22, 1988 - 81 days ago - 0.22 years ago - just how long do Cooper, Bartlett & Cross need?? This sort of simple exercise would normally take me a part of an hour assuming all the information was in front of me.

i) Cross's attempt point 5 - section 2 - is interesting with respect to depth but why can't some metallurgist sit down and do the following??

VARIABLE	PILOT PLANT	TRP PLANT	DIFFERENCES
NaCN addition	>0.7 lbs/t	<<<0.7 lbs/t	More cyanide used in the Pilot Plant
Depth of reclaimed Material			
Feed Sizing			
Feed Assay			
Soluble Gold in Feed			
Preaeration			
Feed Density			
Soluble Sulphides			
Soluble Cations			
Dissolved Oxygen each tank	Refer Cross excellent	Very badly saturated most of the operating time.	
Carbon Loading each tank			

	PILOT PLANT	TRP PLANT	DIFFERENCES
Carbon Concentration each tank		For a long time extremely badly distributed.	
Gold Dissolution each tank			
Gold Solution Strength each tank			
Cyanide Residual each tank			
Density each tank			
Pulp pH each tank			
Retention Time each tank		Varied all over the shop	
Retention Time Total			
Pulp Temperature			
Organics - wood			
Humic acids			
Tannic accids			
$Fe_2 O_3.xH_2O$ levels			
Cyanide stage Additions	Tanks 1,2,3		
Anything you can think of.	**Very Little**	**Nothing**	

j) Basically, due to a lack of problem analysis, serious metallurgical thinking the TRP project lost the opportunity of making an additional $1.0 M Cdn per operating month. **I sincerely hope its not due to not running the plant at "generally greater than 0.7 lb/t free cyanide and some other simple variable missed!!**

k) Re-emphasizing that the test is a farce it was supposed to be a 7 day trial.

(1) Was the data listed in the Pilot Plant vs TRP schedule monitored during the "trial".

(2) If anyone can interpret a simple graph in your metallurgical department look at the one you supplied this "reader", "cyanide versus time".

- What pathetic control - why does it take 3 days to get to over 2.0 lbs/t??

- Then on the 4th day it is lost to less than 1.5 lbs/t. The residence time the circuit is 28 hours at 8,000 tonnes - so this day is useless.
- Days 5, 6, 7, congratulations you got over 2.0 lbs /ton but look at the control over it! Day 5, 2.5 lbs/t; day 6, 3.? lbs/t; day 7, 2.? lbs/t.
- There are 24 hours between 5 & 6, and 24 hours between 6 & 7 this as a matter of interest totals 48 hours.
- If you ran at 6,000 TPD residence time is 37.3 hours if 8,000 then 28 hours.
- The total "trial" lasted 48 hours!

3.2 Section 2

Activity 2(a) - Control the density - why has it taken 6 months not to achieve this? Cooper's pathetic management ability?

Activity 2(b) - Some 84 days ago I recommended replacing the carbon loaded screen for a larger unit.

Activity 2(d) - Recommended 81 days ago so that you could operate with the then new carbon inventory. So instead operating costs were increased by adding more & more carbon.

Activity 3 - Calculate differential head required to achieve flow under all conditions - also control feed density. Why is there still uncertainty with respect to aeration? Why don't you know what causes the problem pre cisely by now?

Activity 5 - Why hasn't the report been completed? 81 days not long enough????

Activity 7 - Once again 81 days not long enough?

Activity 9(a) - Once again 81 days not long enough?

Activity 9(b) - Suggests even with extra aeration agitation is very poor - will have to be addressed and fixed during winter.

Activity 9(e) - What have you been doing since Sept. 7th besides losing gold?? Why weren't they repeated long ago?? It may have improved the recovery.

Activity 11 - The lab results indicated that "recovery improved slightly for longer dissolution times".
- Why can't you see this in the Plant?? In

at about 38 hours and was still climbing. What's wrong with the TRP Plant - cyanide?? Feed density control at 8,000 TPD adding an additional 18% increase in volume due to poor control, agitation???

<u>Activity 14</u> - What was the dissolved oxygen?? Was it anywhere near enough??

<u>Activity 15</u> - "Is arranging" <u>after 81 days</u> - for heaven's sake!!!!!!!!

<u>Activity 17</u> - Running compressors is expensive what are the cost/benefits of gearing up the agitators?

<u>Activity 18</u> - Seems to be a waste of time! (81 days)

<u>Activity 19</u> - I am dealing with turkeys. Pilot Plant states 2.01 lbs/t, residual greater than 0.7 lbs free cyanide. Do you think if I repeat this enough time the message will finally sink in?

<u>Activity</u> 20 - Oh really? Once again 81 days not enough?

<u>Activity 22</u> - What other priorities? - read this report at least 5 times, the overall message may sink in.

<u>Activity 23</u> - Amazing - truly amazing.[n] The recommendation from Cooper to McAlpine was (in writing) the last action to be taken on the solution loss was to add carbon!!!!

3.3 <u>Section 3</u>

Totally ignored by TRP personnel.

3.4 <u>Section 4</u>

You don't solve multivariate problems with extremely simple single line regressions.

- Graphs are pretty though!
- "Graph 7 shows that decreasing tonnage is associated with increasing gold extraction to solution". Amazing! But does anyone at Yellowknife know what this means?
- Graph 8, I don't care whether the linear regression line is horizontal, consider the dilution effect on cyanide if you had the right amount to start with.
- 9-12 if you had the right amount of cyanide on, would they be statistically weak??

3.5 <u>Section 5</u>

Anaemic

3.6 Section 7

3.7 Section 7

So what's the conclusion?

3.8 Section 8

"TRP tailings recyanidation showed further leaching". **Would this perhaps suggest more cyanide or you have mechanical problems?** "The unwillingness of the CIL operators to take samples" - "limits the amount of data available". Just pathetic management".

3.9 Section 9

Possible.

3.10 Section 10

Comments as above.

3.11 Section 11

What a waste of paper!

4.0 **Conclusions**

4.1 The report is in the waste paper basket where it is accompanied by garbage of significantly higher quality!

4.2 TRP personnel have set themselves a ridiculously low metallurgical standard, more disappointingly, they can't even achieve that.

4.3 Within 2 days, I identified the problem areas, set a list of simple metallurgical activities and after 81 days - very little achieved.

4.4 Worse than that, while working for Placer Dome Inc., I sent a fax to you requesting certain work to be done. That fax was received and on Cooper's desk when I arrived there; that was 20 days earlier. So now we are up to 101 days on some items.

4.5 The net result of the incredible inaction since start up has been a loss of \$6.0 M at least on not achieving solids dissolution efficiency and \$2.78 M on solution losses because some simpleton didn't add or move carbon.

4.6 What is totally incredible and totally unacceptable is that 2 consultants, myself & then Fiedler gave you the recipes or the actions required for success and they have either been ignored, or they have been attempted but unprofessionally or they are still being done.

Giant
YELLOWKNIFE MINES LIMITED

MEMO TO: Steve McAlpine

CC: Doug Bartlett; Bryan Cross

FROM: Don Cooper

DATE: November 2, 1988

SUBJECT: **METALLURGICAL SUMMARY REPORT - 1988 SEASON**

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1. Pilot Plant/Lakefield/Mine Plan - Summary. (Doug)
2. Tank Profile Data. (Bryan)
3. Summary of Action Plan. (Bryan)
4. Dan's Reports. (Doug)
5. Kelvin Fiedler's Report - Summary of Action. (Doug, Bryan)
6. Month End Reports. (Bryan)
7. Barringer's Report - Summary of Sample Names. (Bryan, Doug)
8. Feed and Tails Size Analysis. (Doug)
9. Requirement for New Tanks. (Doug, Bryan)
10. Graphs - Production Data. (Doug, Bryan)
11. Cyanide Addition/Tonnage Effects. (Doug, Bryan)

Don Cooper

/kid

Giant
Giant Yellowknife Mines Limited

Tel: 416/363-5470 • Telex: 06-22014 • Fax No: 416/363-5477

MEMORANDUM

TO: D.J. Emery

CC: J.Bartrum, J.S. McAlpine, A. Fleming

FROM: K. Blower

SUBJECT: **TRP METALLURGY - MEETING 17 NOVEMBER 1988**

DATE: November 21, 1988

The TRP metallurgical review meeting was held at the Schumacher Mine office. In attendance were D. Bartlett, J. Bartrum, K. Blower, D. Cooper, S. ElAlfy and J.S. McAlpine.

Critical metallurgical issues were identified and discussed with reference to both laboratory testwork and plant operating results. Concerns raised by J. Bartrum in earlier memos were identified and information reviewed that related to those concerns.

From these discussions an action plan skeleton was developed with assignment of responsibilities and activity deadlines set. J.S. McAlpine and D. Cooper will flesh out the skeleton with more detailed descriptions of the activity procedures and objectives by November 30. These detailed action plans will be circulated to those concerned.

ACTION	DESCRIPTION	RESPONSIBILITY	COMPLETION DATE	REPORT DATE
Carbon Stripping	Complete 1988 Carbon Removal, stripping, and reactivation	D. Cooper	31Jan89	15Fe89
Action Plan	Detailing of this skeleton plan	J.S. McAlpine, D. Cooper	30Nov88	30No88

ACTION	DESCRIPTION	RESPONSIBILITY	COMPLETION DATE	REPORT DATE
Dry Feed Tests	Comprehensive mineralogical examination including carbon	D. Bartlett	15Jan89	31Ja89
Dry Tails Samples	Comprehensive mineralogical examination(incl. carbon)	D. Bartlett	15Jan89	31Ja89
Wet Feed Samples	Examine critical variables including: ($S^{=}$, Tanic, Humic, CN^{-}, pH, Ø)	D.Bartlett, Lakefield	15Jan89	31Ja89
Agitators	Specialist to examine agitation with existing setup.	D. Cooper, D. Bartlett	Immediate	15De88
Flotation Testwork	Maximize concentrate values and examine for subsequent treatment.	D. Bartlett, Lakefield	Immediate	31De89 In'l Report
Drilling Program	1989 Feed Evaluation	Bailey,Doerkson, Cooper	01De88	15De88
Core Testing	Bottle tests (standard procedure)	D. Bartlett	31Jan89	10Fe89
Retention/ Economics	1988 Experience (Aug. 22 - Oct. 10)	D. Cooper	30No88	07DE89
Feed Density Control	Written procedures including follow-up program to maintain	Chapman/ Doerkson	Immediate	30No88

ACTION	DESCRIPTION	RESPONSIBILITY	COMPLETION DATE	REPORT DATE
Thickener	Flow sheet development - Pro's, Con's, Costs Chemical Criteria & Costs	K. Morton	Mid. Dec.	Xmas
Aeration Evaluation	Examine existing conditions - Degree of Saturation - Need for present volumes	D. Cooper, B. Cross	Immediate	15Ja89
Cyanide Procurement	Ensure 3 lbs/T available	McAlpine, Jarvis	Immediate	15De88
Solution Loss Study	Develop Procedures for avoiding losses in 1989	Cooper, Bartlett	31De88	28Fe89
1989 Stripping	Increase capacity to 10 T/Day	D. Cooper	15De88	31De88
Mag. Separation	Distribute/update reports	K. Morton	01De88	01De88
Follow-up Action Plan	Distribute monthly update of action plan to those attending	J.S. McAlpine	30No88	Mthly

Ken Blower

TO: Don Cooper Nov. 15, 1988

CC. CONFIDENTIAL.

From: Bryan Cross

Subject: <u>JOHN BARTRUM'S ATTACK ON YK DIVISION METALLURGISTS.</u>

This man is frightened of explaining both YK Division TRP and ERG at home. His last brief visit led to him generating a lot of time and money expenditures that have not solved the basic problem of this plant not meeting the expectation the Australians bought and paid for. Bartrum's visit laid a great deal of "priority" work that lets face it we were not adequately staffed to address while going through a shaky start up season. Total up the O/T we each have not been congratulated for. The man spent an admitted hour reviewing what took a weekend to prepare then garbaged the information and then vented his spleen on us. He did not even have the decency to address Section 1 of our report which pointed out that he is kidding himself if he believes overall recoveries much more than 30% can be expected at the TRP with our current flowsheet. Kilborn metallurgists brought in helped us get over some operating difficulties but did not contribute a great deal in preparing the documentation necessary to satisfy Mr. Bartrum's list of diagnostic metallurgical testwork.

The lack of proper slurry density control mystified the carbon concentrations and eliminated proper distribution. I adjusted with S. Waller's encouragement the daily Met balance to reflect the total amount of gold in solution in comparison to the reclaim water shot at the mining face. The amount of gold value in the 30% moisture in the interstices of stored solids has never been determined but the calculation method is consistent with those performed on Pilot Plant data. Doing this shifted the thinking at the TRP to optimizing carbon adsorption efficiency. Sufficient cyanide was no problem in the Pilot tests as when tails cyanide concentrations dropped to 0.25 lb/ton, overall leaching and adsorption efficiency did not change. Shifting improvement intentions from the leach to the adsorption efficiency was hampered by low slurry density contributed to by both mining operator boredom and loaded carbon elutriation water going into the Surge Tank. The automatic programmable monitor controls were not available until the end of the operating season and the need for the thickener expenditure was not pressed. I spent some time down at the monitor operating stations while shifting and agree with Sadek that with constant attention the miners can give the desired density control. I have never spent more than 2 out of 12 hours doing this. Constant whip cracking, a competitive bonus system or the memory units performing with 1/2 hour adjustments should do it. A thickener would float of much of our woodchip problems, ensure the desired density for retention time and yield good carbon distribution in the tanks.

Bartrum's constant demand for dissolved oxygen readings amaze and flabbergast me. Why insist on more readings when every reading seems greater than the maximum saturation concentration at all temperatures. Cold water only can hold about 10 ppm of dissolved oxygen, perhaps it is residual flotation frother in the slurry holding bubbles together that leads to our consistently greater than saturation dissolved oxygen readings.

We now know that we have settling occuring in the CIL. So why did we not scrap the seven 100 Hp agitators and put new ones in? As Bartrum suggests we had 81 days to do so thereby his hindsite tells us we lost $9 million. First one should say that the CIL froze up exactly two months after his August 22nd Action Plan memo and we operated for a month under winter conditions prior to that. Does Bartrum not know we have been struggling to retreive our froze in carbon and save the plant from winters full fury since October 22nd? Even with Bartrum's automatic expenditure approval for new agitators nothing could have been done about delivery times nor would we have been willing to shutdown an agitator to replace it under freezing conditions.

Doug Bartlett's introduction to our report seems to have made Mr. Bartrum particularly antagonistic. Doug has only been with us a month or so and has barely gotten over picking our brains in his orientation. Doug's evaluation of expected mining grades, recoveries and the expectations due to the Pilot Report are valid to me. Mr. Bartrum failed to even comment on this part of our report. John Bartrum is very angry with us and I suppose I at him as the man states he spent one hour perusing the report put together over four days (2 on our own time). Then he says he did not even retain it but garbaged it!!!

Well I've had a chance to expend some of my anger by writting this and will get back to the job of trying to improve our metallurgical performance.

One last comment is regarding cyanide. We do not have a statistically sound base to say that increased cyanide dosage will not give us higher recoveries from any particular area undergoing reclamation. Operations to date including Pilot work indicates to me the solids do not respond to higher dosage. The last analysis had the N.W. Pond sitting with 40 ppm total cyanide in solution. The increased effluent treatment costs some of which we have put off a year will be calculated as this cost is another that has to be included when we talk about increased TRP cyanide useage.

SECTION 1.

TO: Bryan Cross

CC. Don Cooper, J.S. McAlpine, S.E. El-Alfy

From: Doug Bartlett

Subject: INVENTORY OF NORTH POND/CENTRAL POND DRILL CORES

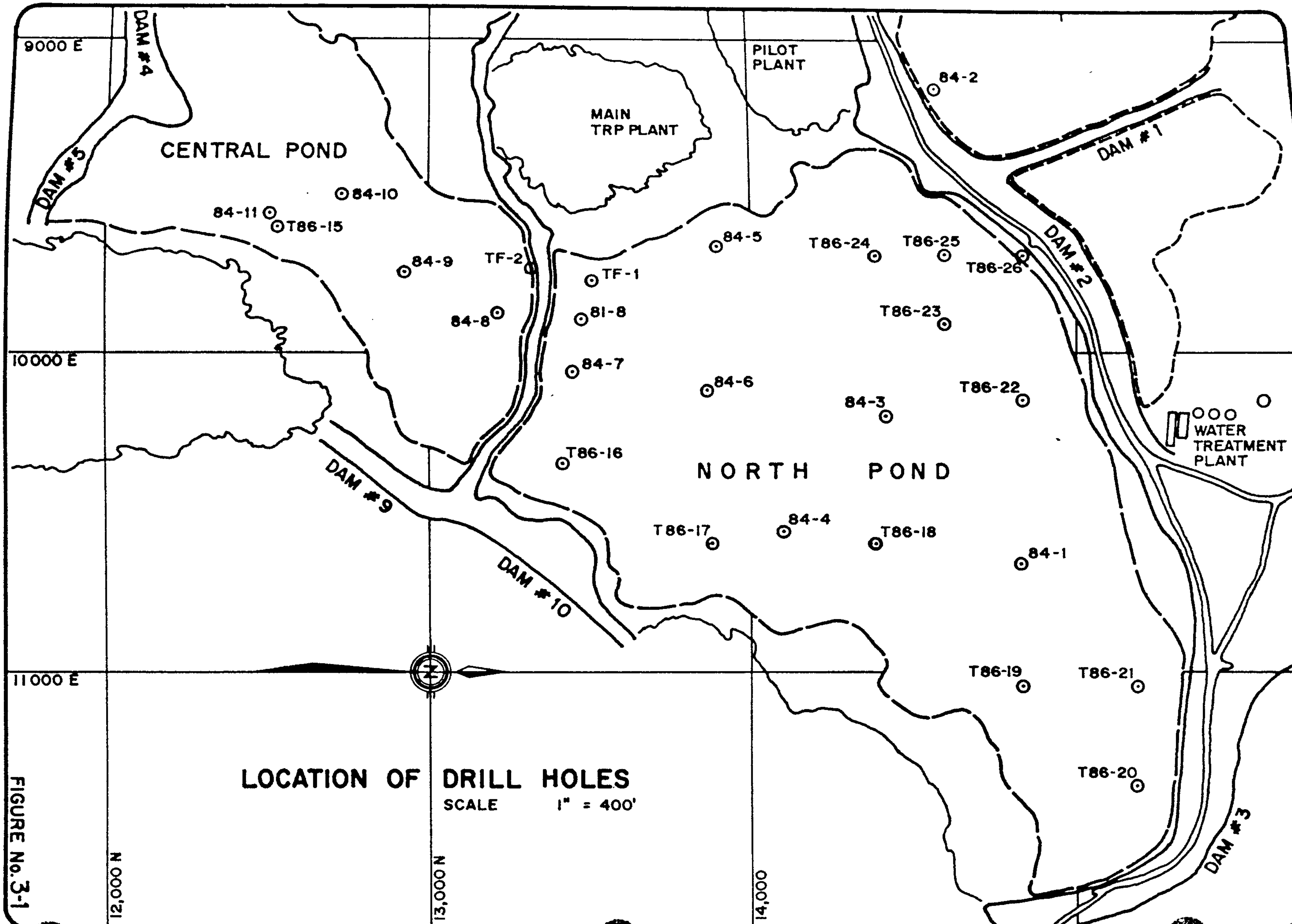
To assess the best stategy to mine the remaining 4 years of tailings, Giant needs to know the 'processability' of each drill hole location.

Attached is a drawing showing the 27 drill holes. The plan is to prepare a composite of each drill core (top to bottom excluding muskeg), and run three bottle roll tests on each one over this winter.

Lakefield Research are investigating what samples they have left in storage. We must document what we have available in the Mill Lab basement. Listing should include hole#, depth, sample weight, 'eyeball' % moisture, and any odd characteristics.

All the core inventory information will be required to develop our winter plan for technical activities. Please start as soon as possible so that a draft plan can be prepared by the end of next week.

D Bartlett



LOCATION OF DRILL HOLES
SCALE 1" = 400'

FIGURE No. 3-1

Giant
YELLOWKNIFE MINES LIMITED

MEMO TO: D. W. Cooper

CC: J. S. McAlpine; S. E. El-Alfy

FROM: D. Bartlett

DATE: November 7, 1988

SUBJECT: 1988 T.R.P. RECOVERY SHORTFALL

Please find attached my report entitled "T.R.P. 1988 Gold Extraction vs. Mine Plan."

The conclusion of the report is that there was insufficient basis for having set the target gold recovery at 40% for the tailings area mined during 1988. Review of laboratory work has yielded no indication that process operating variables can significantly affect final gold extractions in the T.R.P. flowsheet.

Recommendations to improve planning for the 1989 season have been included. I look forward to your comments.

D. Bartlett

Doug Bartlett
Sr. Project Metallurgist

Giant Yellowknife Mines Limited
Yellowknife Division

TAILINGS RETREATMENT PLANT

1988 GOLD EXTRACTION VERSUS MINE PLAN

A REVIEW OF PRE START-UP INVESTIGATIONS

November 7, 1988

Respectfully submitted by:

D R Bartlett

D. R. Bartlett
Sr. Project Metallurgist

SUMMARY

Examination of TRP project files has shown that gold "extraction to solution" for the 1988 operating season is within the bounds predicted by the database (very limited) for the area mined. Cumulative testwork indicates the liberated gold in tailings is readily solubilized, however the ratio of liberated/refractory gold (% recoverable) varies over large sections of the tailings ponds. Thus, without changing the TRP process flowsheet, there is an opportunity to improve the project cash flow in 1989 by mining of more favourable feed stock. Further core drilling and laboratory testing are required to support this mine planning option. Samples representing the total core depth must be tested to be consistent with the current mining method.

TRP gold production is a complex function of feed grade, refractory index, dam location, mining method, and tonnage rate. Thus the TRP operating budget objective may best be simplified to a basis of ounces gold production.

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LIST OF FIGURES AND TABLES

1.0 INTRODUCTION

Laboratory work by the Giant Mill and Lakefield Research to determine the response of GYML tailings to conventional cyanidation showed that gold extractions can vary from 25% to 45% depending on pond location, sample depth and grade. A pilot plant campaign was operated on a Central Pond/Polishing Pond blended (top 10-15') sample to check for any major operating and process problems. No insurmountable problems were evident and the pilot plant averaged 38.9% gold extraction. An 8000 tpd TRP facility was constructed and the budget for the first season's operation was set at 40% gold recovery. By the end of September, 1988 the TRP had averaged 30.3% gold extraction to solution and there were no obvious reasons to explain this shortfall.

It was felt that a review of the documented project history (especially by a newcomer to Giant) might spark a fresh perspective on 1988 TRP plant performance and indicate a strategy for increasing project revenues.

2.0 FINDINGS

All four Lakefield reports (Ref 1-4) and applicable GYML reports (Ref 5-15) were reviewed.

About 7.5 million tons of tailings in several pond areas was characterized using 27 drill holes. All drill holes were assayed in detail. However, not all holes were subjected to metallurgical evaluation. For that laboratory work completed, the basis for preparing test composites was varied widely between test programs, i.e.:

- Select several 2 ft sections from an 80 ft core depth.
- Composite several adjacent holes in total.
- Prepare top or bottom composites from several holes.

All documented laboratory test data are included in Appendix I by tailings dam source. The individual test results were mathematically combined where appropriate to provide an indication of the cyanidation response of the total depth of core.

From the data in Appendix I, and other key research results, my comments have been structured into the following sections:

2.1 Variation in Metallurgical Factors with Dam Depth

There are two general metallurgical trends within the dams:

- The gold assay increases with sample depth - effect of general mill efficiency improvements over the years.
- The % extractable gold decreases with sample depth - non refractory gold in flotation tailings may be currently forming a higher ratio to refractory calcine losses.

On net balance, the amount of recoverable gold/ton mined does increase with depth within the tailings dams. These trends are evident in the data of Appendix I for those drill holes subjected to laboratory cyanidation tests by sectional depth.

2.2 Variation in Metallurgical Factors Between Drill Holes

Figure 1 shows the location of the 27 drill holes over the area of the North and Central tailings dams. Table 1 contains a summarized list of metallurgical factors (from Appendix I) for those drill holes with sufficient supporting laboratory data. The recoverable ounces/100 tons mined is noted versus dam location in Figure 2. Data for the Polishing Pond and southeast corner of the North Pond are lumped over wide areas due to the method of laboratory sample compositing.

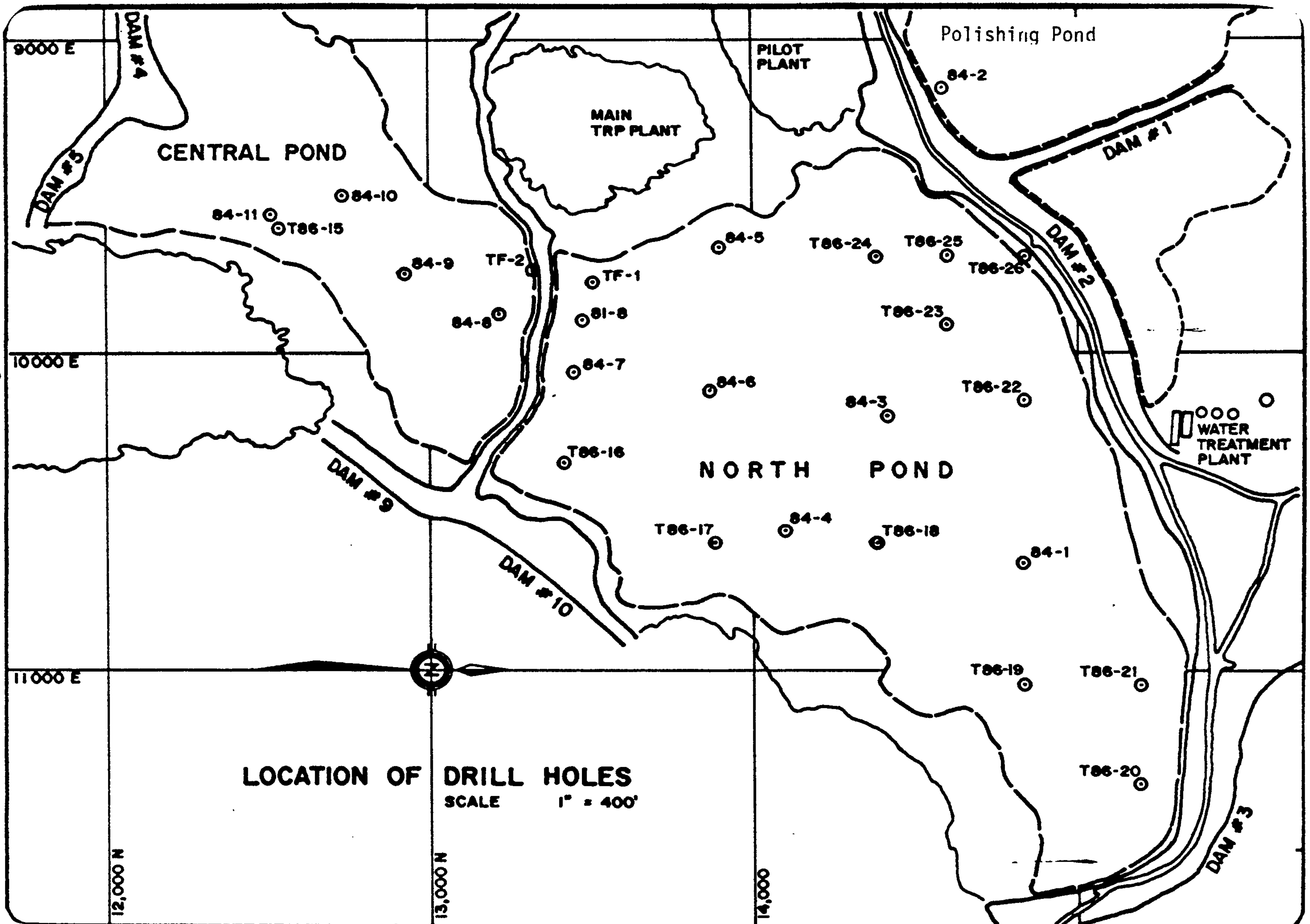


FIGURE 1

TAILINGS DAM DRILL HOLE LOCATIONS

TABLE 1

GOLD EXTRACTABILITY VS. DRILL HOLE

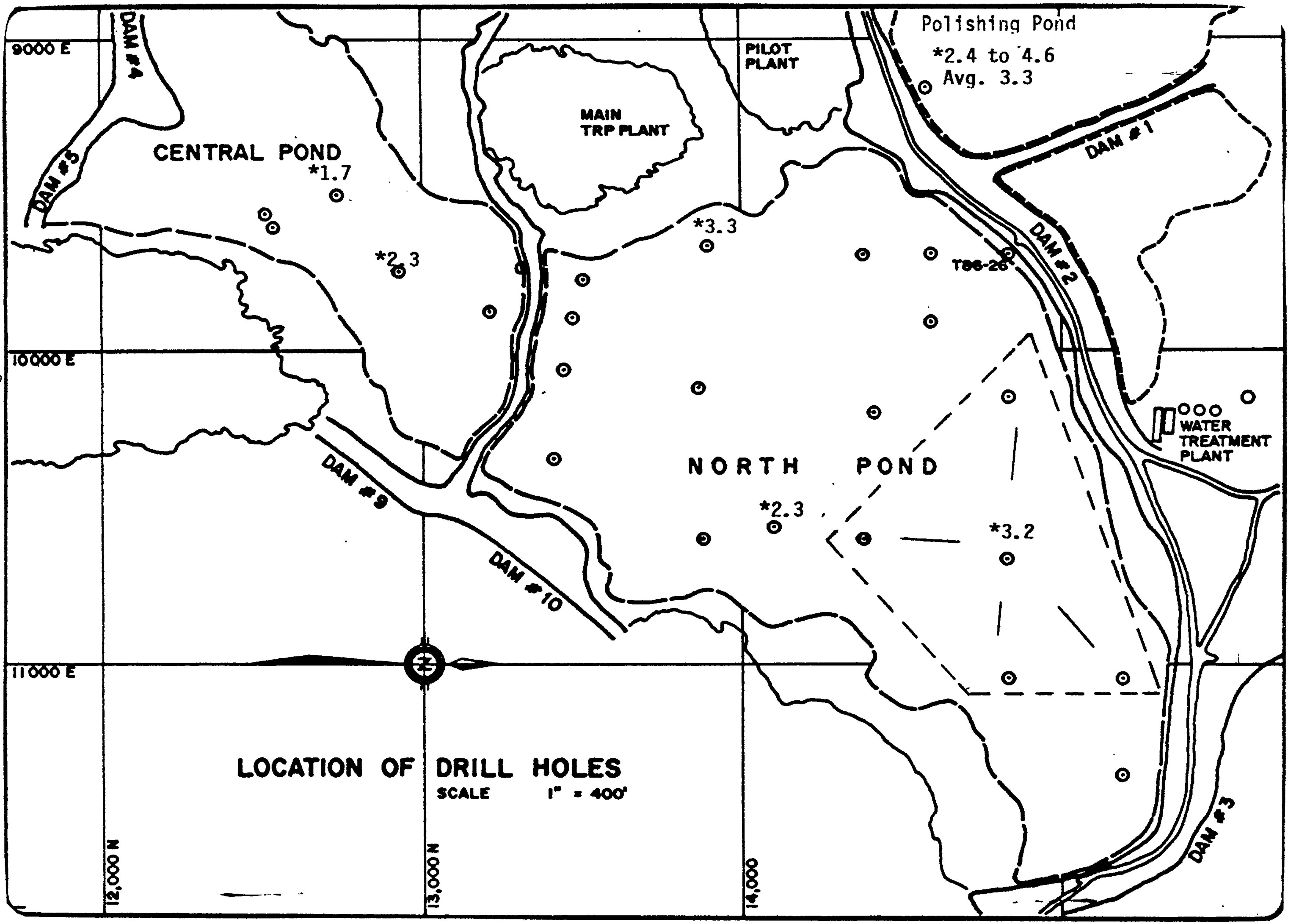
Hole No.	Gold Grade oz/ton	24 hr. Gold Extraction %	24 hr. Gold Extraction (1)oz/100 tons
84-4	0.078	*30.2	2.3
84-5	0.104	*31.5	3.3
84-9	0.087	*26.1	2.3
84-10	0.055	*31.5	1.7
84-1, 86-18, 19} 86-21, 22 }	0.073	43.4	3.2
(2) Polishing Pond			
Hole Groups -		30.1 to 39.0	2.4 to 4.6
Overall -	0.087	34.2	3.3

Notes:

* Data averaged from variable numbers of core section results. Tests on total drill hole composites required for confidence.

(1) Carbon adsorption losses not included.

(2) Lakefield Research Data.



DISTRIBUTION OF RECOVERABLE GOLD INDEX

*Oz Recoverable Gold/100 Tons Mined

FIGURE 2

Due to the coarse hole spacing and the wide hole to hole variations in % extraction (26 to 43) and recovery index (1.7 to 4.6 ounces/100 tons), it is difficult to gauge how large an area is affected by the data from a single drill hole. Alternatively, for composites of many holes (southeast North Pond), it is impossible to assess the degree of variation in performance within the drilled off block.

A potential planning pitfall is trying to predict recovery or recoverable ounces from grade data alone. Each pond seems to have its own general level of gold refractory index. Within a pond, the refractory index (or extraction variation for a single grade range) can also vary widely, eg. for North Pond:

Hole 84-4	.078 oz/ton Au	30.2% Extraction
Southeast Area	.073 oz/ton Au	43.4% Extraction

Clearly, several recommendations are in order to allow meaningful budget preparation and mine planning, i.e.:

- o Drill off the area to be mined with a close drill grid during the preceding winter.
- o Conduct laboratory gold extraction tests on samples representing the total depth of each core.
- o Standardize and document the laboratory test procedure in detail.

Nov 7, 1988 TRP Vs [illegible] + [illegible] D. BARNETT

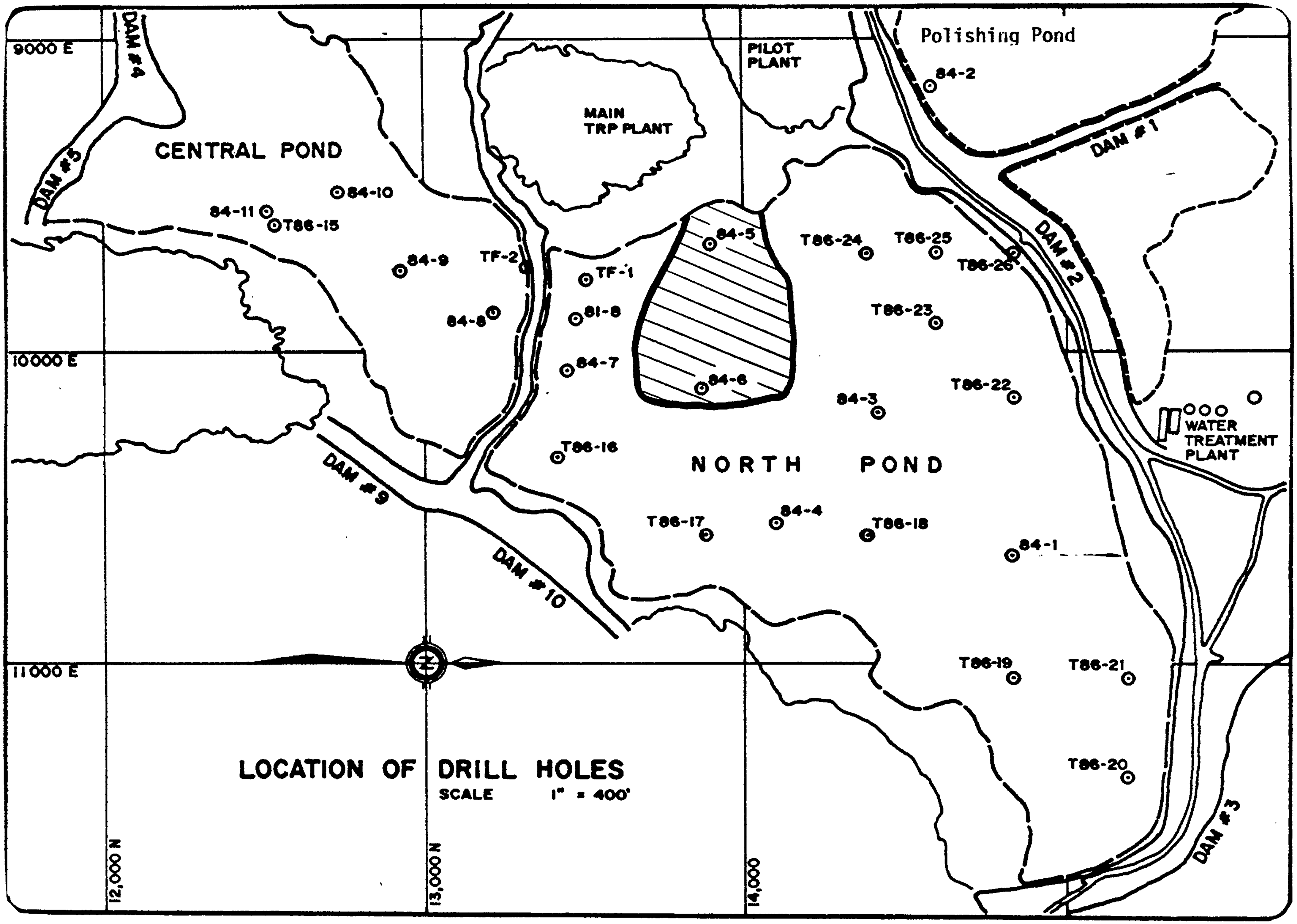
2.3 Mine Planning - General

Adequate work was done to establish the total gold reserve of the tailings dams. However, the metallurgical evaluation was sufficient only to show that in the order of 30-40% of the gold could be recovered over the life of the project. There was not enough test data for yearly budget preparation on gold production (mine planning). The % extractable gold is not determined solely by tailings dam gold grade. Available data suggest that the refractory index of the contained gold also varies over the area of the dams.

2.4 1988 Gold Extraction Performance Vs. Target

The TRP budget for 1988 was 40% gold recovery from material grading 0.067 oz/ton. To September 23, 1988 (prior to the bulldozing of surface material) TRP performance was a gold extraction to solution of 30.4% from material grading 0.079 oz/ton.

The bulk of the mining for the 1988 season occurred in that area of the North Pond highlighted in Figure 3. To September 23, over 90% of the TRP feed originated from this source. There are only two drill holes within this area, ie. Holes 84-5 and 84-6.



1988 MINED AREA (crosshatched)

FIGURE 3

Laboratory cyanidation testwork was only conducted on Hole 84-5; and this was done in several 2 ft sections versus the total core depth. The complete gold extraction data available on this hole from three separate laboratory reports (Ref 1,2 and 5) is detailed in Appendix I. Overall gold recovery would be less, depending on carbon adsorption efficiency. Integrating all the extraction information yields a gold extraction of 31.5%. This is the highest extraction that could be expected from the area mined.

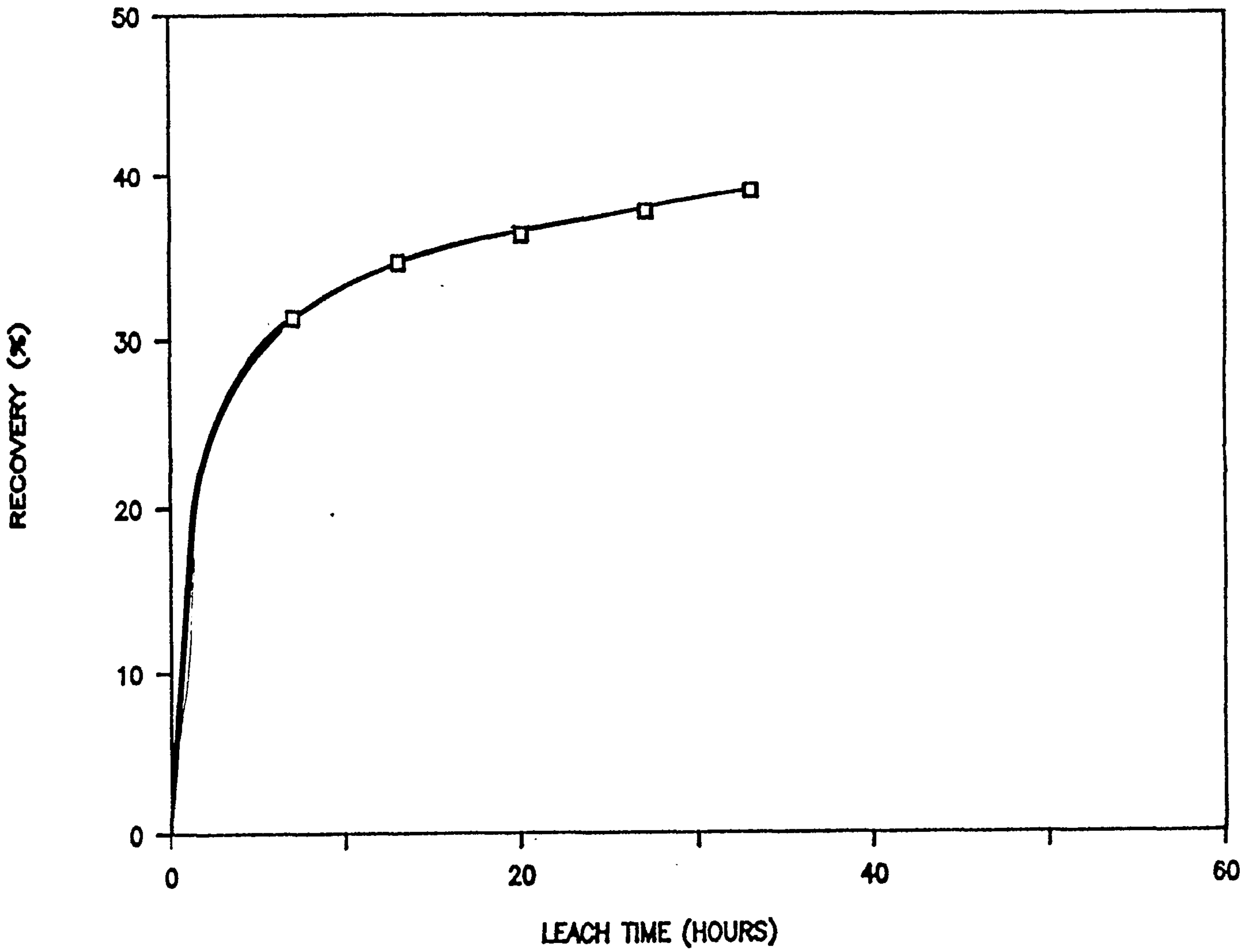
The conclusion is that 1988 TRP gold cyanidation performance is within the bounds of the very limited data available that could have been used to set targets. This does not necessarily mean that gold extraction was optimum, only that a major deviation is not evident.

2.5 Extraction Characteristic of GYML Tailings

Figure 4 contains the pilot plant recovery vs. time curve or gold extraction characteristic of GYML tailings. This cyanidation response curve was typical of all the laboratory results as well. The bulk of the contained gold is solubilized within the first 4 to 8 hours; thereafter the rate of extraction is slow but steady. There are two different leaching regimes in operation:

FIGURE 4

PILOT PLANT GOLD EXTRACTION CURVE



A. 4 to 8 hours - the gold is already soluble in the in-situ tailings or dissolves readily on contact with cyanide.

B. Greater than 8 hours - the gold here is hindered from dissolving by the following likely mechanisms:

- o surface area - coarse nuggets
- o access channels - solution flow through pores and micro-fissures
- o gold surface tarnish on coating.

The point here is that the leaching characteristic contributes to two expected extraction performance trends:

- o insensitivity to test method
- o insensitivity to operating variables.

2.6 Methods for Extraction Evaluation

On a laboratory scale, various testing techniques have been used on the same tailings samples to yield equivalent extraction dresults in 24 hours, i.e.:

- o bottle rolls and agitated vat techniques
- o various speeds for agitated vat tests, 400 - 700 ppm
- o fresh moist samples and those pre-dried at 450°F.

The inference is that gold extraction is not sensitive to mixing regime and that no preg robbing species are present. Thus, equivalent extraction results should be expected from any size of suitably mixed reactor - lab bottle, pilot plant, or commercial plant.

The corollary is that extraction of gold to solution in the TRP Plant should be adequately predicted by laboratory evaluation of representative feed material.

2.7 Sensitivity to Operating Parameters

In the laboratory, process variables have been changed in an effort to increase gold extraction. These have included:

- NaCN concentrations, 0.33 to 2.0 g/L
- Pulp density, 30 to 50%
- Retention time, >24 hours
- pH, 10.5 to 11.0
- Degree of grinding, Nil to 13.2 kWh/t
- Intensive pre-scrubbing, 10 min.
- Acid pre-reaction, 0.1 M HCl (Ref 7)

Within testing error, final gold extractions have not been sensitive to any of the above variables. Roasting the TRP feed at 1500° F (Ref 15) is the only process which has had a major impact - an increase in extraction from 37% to 67%. This indicates the basic refractory nature of the tailings.

The inference is that there will be little metallurgical control over a tailings cyanidation plant. As long as free cyanide exists in solution, most of the obtainable gold will yield easily, and the rest will require a long wait. In a 6 stage CIL process on GYML tailings, it is expected that the extraction will be essentially finished after the second tank; the remaining four tanks being required for carbon adsorption.

2.8 Pilot Plant Performance

The TRP pilot plant operated for two months and yielded gold extractions chiefly in the 35 to 40% range, and averaged 38.9%. The question is can this extraction result be used to predict performance for the 1988 season or for the 5 year project life as a whole? The answer is no - unless the specific pilot plant feed material is representative of that mined for 1988 or to be mined during the project life. This may have been difficult and/or cost prohibitive.

The four sources of pilot plant feed material are indicated in Figure 5. For accessibility, these areas were chosen close to roads. As a backhoe was used to dig the samples, the maximum retrievable depth was 25 feet and most of the sample trenchs were a nominal 10-15 feet deep.

Coincidentally, the grade of the pilot plant feed was very close to the 5 year project average (0.0645 oz/ton vs. 0.0670 oz/ton). However, the top portion of a number of drill holes have shown much higher gold extractions than average and thus the sample locations may have been partially "high-graded". The data in Table 2 shows this trend for Holes 88-1, 88-12 (Ref 13,14).

Laboratory work by T.R. Raponi (Ref 9) on stockpiled pilot plant feed composite showed that gold extractions of 36-38% could be expected. This prediction was fairly close and demonstrated that laboratory bottle rolls testwork could be used to characterize the performance of TRP feed. This also implied that the TRP flowsheet could be scaled-up to commercial size with no sacrifice in gold extraction from equivalent feed material.

With the variation in drill hole extraction results throughout the tailings ponds, it would be meaningless to compare the performance of 60 tons from four edge spots (pilot plant feed) to the 7.5 million tons in the dams. The pilot plant served other purposes, which was to:

- Identify mechanical problem areas
- Obtain process flowsheet and design data
- Demonstrate the process and train staff.

TABLE 2

POLISHING POND CYANIDATION RESULTS
GIANT MILL LAB *PROGRAM

Drill Hole	Depth	Gold Head, oz/ton Assay	Gold Head, oz/ton Calculated	Gold Extraction %
88-1	Total Core	0.103	0.114	30.0
88-2	" "	0.107	0.113	26.5
88-3	" "	0.106	0.106	29.8
88-4	" "	0.103	0.098	29.9
88-5	" "	0.100	0.104	28.6
88-6	" "	0.103	0.100	27.0
88-7	" "	0.102	0.102	30.6
88-8	" "	0.105	0.105	33.4
88-9	" "	0.103	0.104	27.5
88-10	" "	0.102	0.104	24.5
88-12	" "	0.099	0.102	30.1
Avg.		0.103	0.105	28.91
88-12	0-10	0.101	0.124	49.6
	10-20	0.138	0.152	24.1
88-1	0-10	0.101	0.125	49.6
	10-20	0.138	0.151	24.1
	20-30	0.104	0.119	26.1
88-10	Total, CIL	0.095	0.106	30.7
	Total, repulp	0.095	0.101	30.8

NOTE:

* Data from References 10 to 14

2.9 Extraction from the Polishing Pond

The most recent Lakefield report (Ref. 4) has a spurious extraction prediction for overall polishing pond composite tailings. This leach curve in Figure 6 is from one test and it indicates that over 40% extraction can be achieved in 24 hours. However, as shown in Appendix I, testwork on the five components of this composite would have predicted 34.2% gold extraction. Clearly, the work must be repeated to validate any synergistic effect.

Of a more serious nature, the work completed by Giant Mill staff (see Table 2) suggests that overall gold extractability from the polishing pond is 29%. The Giant program is very credible in that excellent gold mass balances were achieved:

Comparison of Testwork Average Gold Mass Balances

	Giant	Lakefield
Assayed Head, oz/ton Au	0.103	0.086
Calculated Head, oz/ton Au	0.105	0.096
Mass Balance	102%	112%

1988 Perf.
vs. Pilot Plant
& LABS

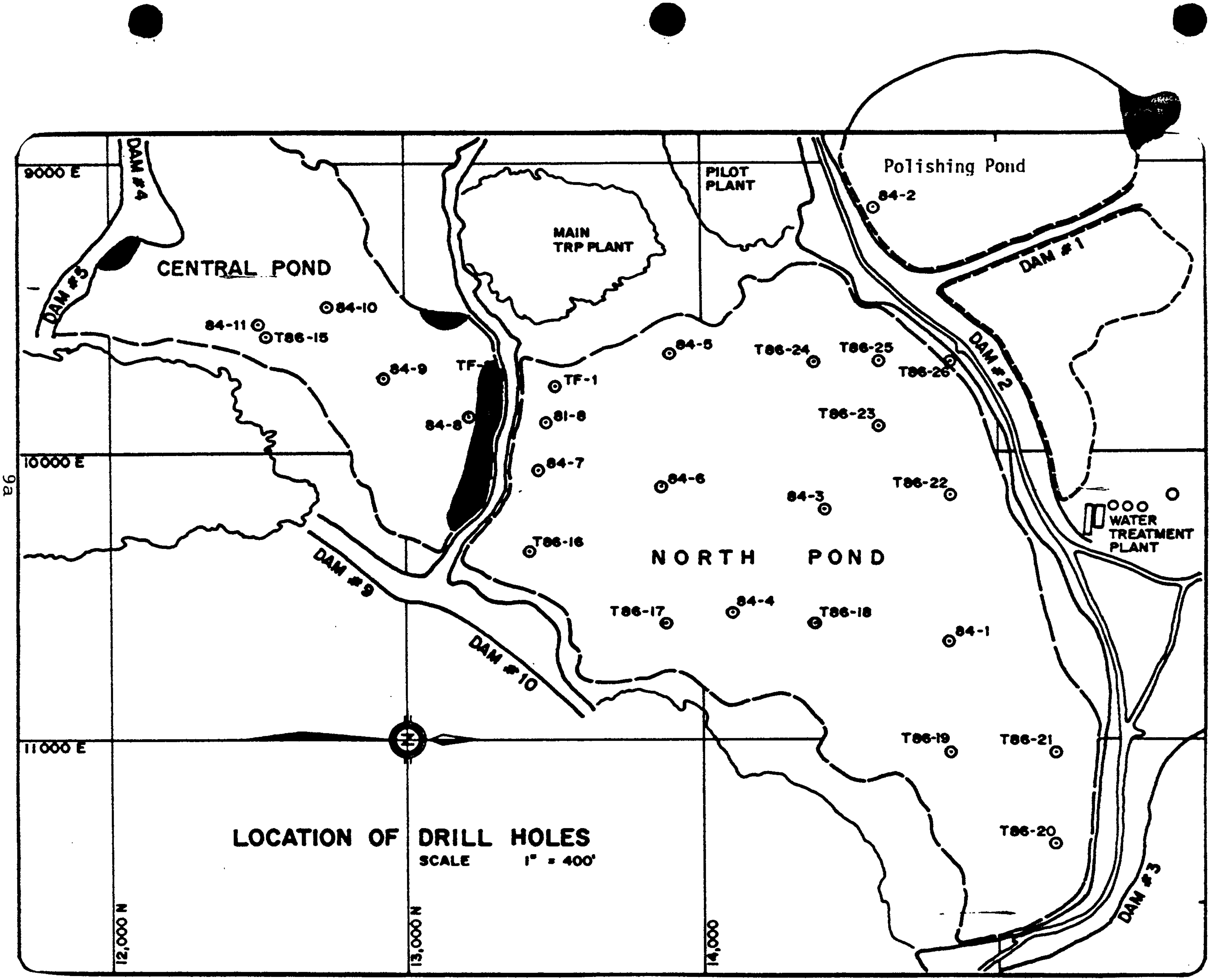
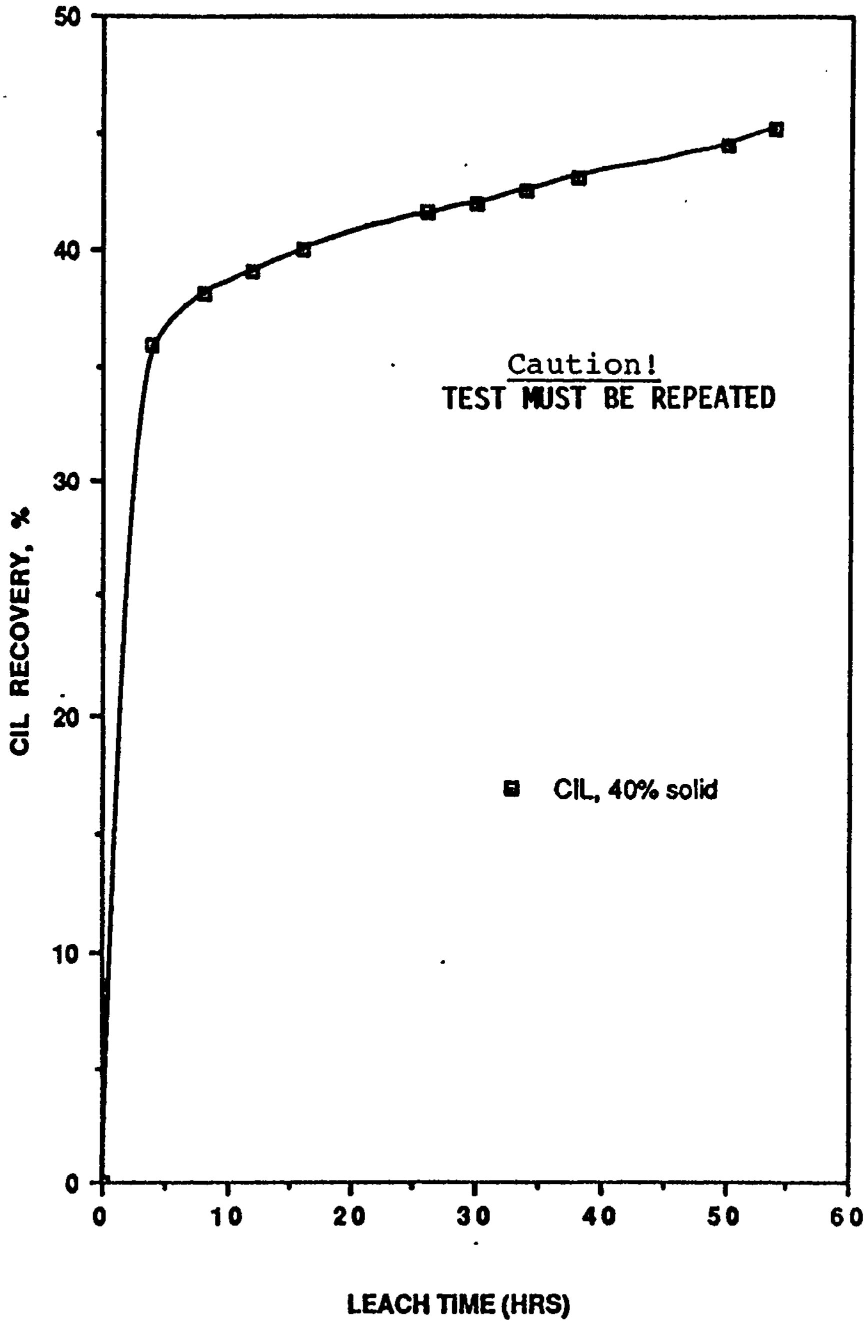


FIGURE 5

PILOT PLANT FEED SOURCES (shaded)

POLISHING POND GOLD EXTRACTION CURVE (Ref. 4)



3.0 CONCLUSIONS

The September 23, 1988 YTD TRP recovery of 30.4% is close to what would be expected for the area mined based on the limited metallurgical database available to characterize that feed. Thus any shortfall relative to the plant budget figure may be more a failure in mine planning than in TRP plant process performance. There is no documented evidence (laboratory, pilot plant or commercial plant) to indicate that gold extraction by cyanidation of GYML tailings is sensitive in any process variable - controllable or not.

4.0 RECOMMENDATIONS

1. Mine planning for the 1989 season should take into consideration a "laboratory recovery index" for the area in question. The key planning criteria should be:

   - Sufficient detail - say 8 to 10 drill cores to describe the 1.53 million tons

   - Test the whole core length - cyanidation must be on samples representing the total core to be consistent with the mining method

   - Sensitivity analysis - a structured laboratory program should be conducted to indicate the sensitivity of gold extraction to process variables using an overall composite sample. This work will flag any opportunities for process optimization during the coming season.

   - Standardize the laboratory cyanidation test in detail - i.e. speed of bottle rolls, sample size, leach time, residue cake washing procedure, etc.

2. Where possible, core samples from historical drill holes should be tested on a "whole depth" basis. This will assist in categorizing the recovery potential of major tailings areas and contribute to the development of a 4 year mine plan.

3. On the basis of metallurgy alone, the southeast corner of the North Pond has good gold production potential, i.e.:

   - Grade - 0.073 oz/ton
   - Cyanidation performance - 43.8% extraction
   - Recovery - 3.17 oz Au/100 tons.

   Available data should be firmed up (hole by hole evaluation) and consideration be given to increasing project cash flow by mining the "sweet areas" as early as possible.

4. Efforts should be continued to investigate flowsheet changes/additions for enhanced project gold recovery. Ways to concentrate the refractory gold in TRP tailings should be a key program. Flotation and magnetic separation are potential processes.

5.0 REFERENCES

1. "The Recovery of Gold from Tailings Samples Submitted by Giant Yellowknife Mines Limited", Lakefield Research Project No. LR 3173, Progress Report No. 1, September 4, 1986.

2. Ibid, Progress Report No. 2, February 16, 1987.

3. Ibid, Progress Report No. 3, March 30, 1987.

4. "The Recovery of Gold from Samples Submitted by Giant Yellowknife Mines Limited", Lakefield Research Project No. LR 3515, Progress Report No. 1, August 24, 1988.

5. "Tailings Retreatment Program", Memo: B. Cross to K.S. Morton, March 30, 1984.

6. "Tailings Dam Drilling Project - 1984 Results and Conclusions", Memo: G. Halverson to K. Morton, February 22, 1984.

7. "Tailings Retreatment Program", Memo: B. Cross to K.S. Morton, March 5, 1984.

8. "Tailings Reclaim Project", Feasibility Study Report by S.E. El-Alfy, September 1987.

9. "Cyanidation Testwork on Feed Material for the T.R.P. Pilot Plant", Memo: T.R. Raponi to G.B. Halverson, April 21, 1987.

10. "Cyanidation Testwork on Polishing Pond Composite Samples", Memo: M.E. Goodfellow to T.R. Raponi, April 22, 1988.

11. "Cyanidation Testwork on Polishing Pond Composite Samples", Memo: M.E. Goodfellow to T.R. Raponi, April 27, 1988.

12. "Cyanidation Testwork on Polishing Pond Composite Samples - #3", Memo: M.E. Goodfellow to T.R. Raponi, May 5, 1988.

13. "Cyanidation Testwork on Top, Middle and Bottom Composite Samples from the Polishing Pond", Memo: M.E. Goodfellow to T.R. Raponi, May 11, 1988.

14. "Cyanidation Testwork on Top 20' of a Composite Sample from the Polishing Pond", Memo: M.E. Goodfellow to T.R. Raponi, May 26, 1988.

15. "Roasting/Cyanidation Testwork on Composite Samples of Test Hole #7 From the Polishing Pond", Memo: L. Dufour to T.R. Raponi, June 27, 1988.

APPENDIX I

Metallurgical Characterization

Of Drill Core Samples

METALLURGICAL CHARACTERIZATION OF DRILL CORE SAMPLES

Pond/Hole #	Core Depth Feet	GOLD Grade oz/ton	Extraction %	Oz Recoverable per 100 tons
North Pond				
T 84-2	16-18	0.033	46.1	1.52
	30-32	0.076	29.6	2.25
	Avg.	(1) 0.062		
T 84-3	28-30	0.072	47.4	3.41
	64-66	0.139	29.6	4.11
	Avg.	0.081		
T 84-4	14-16	0.030	46.0	1.38
	20-22	0.046	39.5	1.82
	*24-26	0.079	29.4	2.32
	*34-36	0.081	50.5	4.09
	36-38	0.070	33.1	2.32
	44-46	0.070	26.5	1.86
	*54-56	0.142	19.1	2.71
	Avg.	0.078	30.2	2.34
T 84-5	24-26	0.056	33.4	1.87
	*26-28	0.064	39.0	2.50
	36-38	0.084	27.0	2.27
	*40-42	0.140	24.7	3.46
	58-60	0.164	30.9	5.07
	*68-70	0.139	32.3	4.49
	Avg.	0.104	31.5	3.28
T 84-6		0.081	NO DATA	
T 84-7	18-20	0.051	42.7	2.18
	60-62	0.142	29.0	4.12
	Avg.	0.073		
T 84-1, 86-18, 86-19,21,22	Top Composite	0.041	45.2	1.85
	Bottom Composite	0.106	42.4	4.49
	Avg.	0.073	43.4	3.17

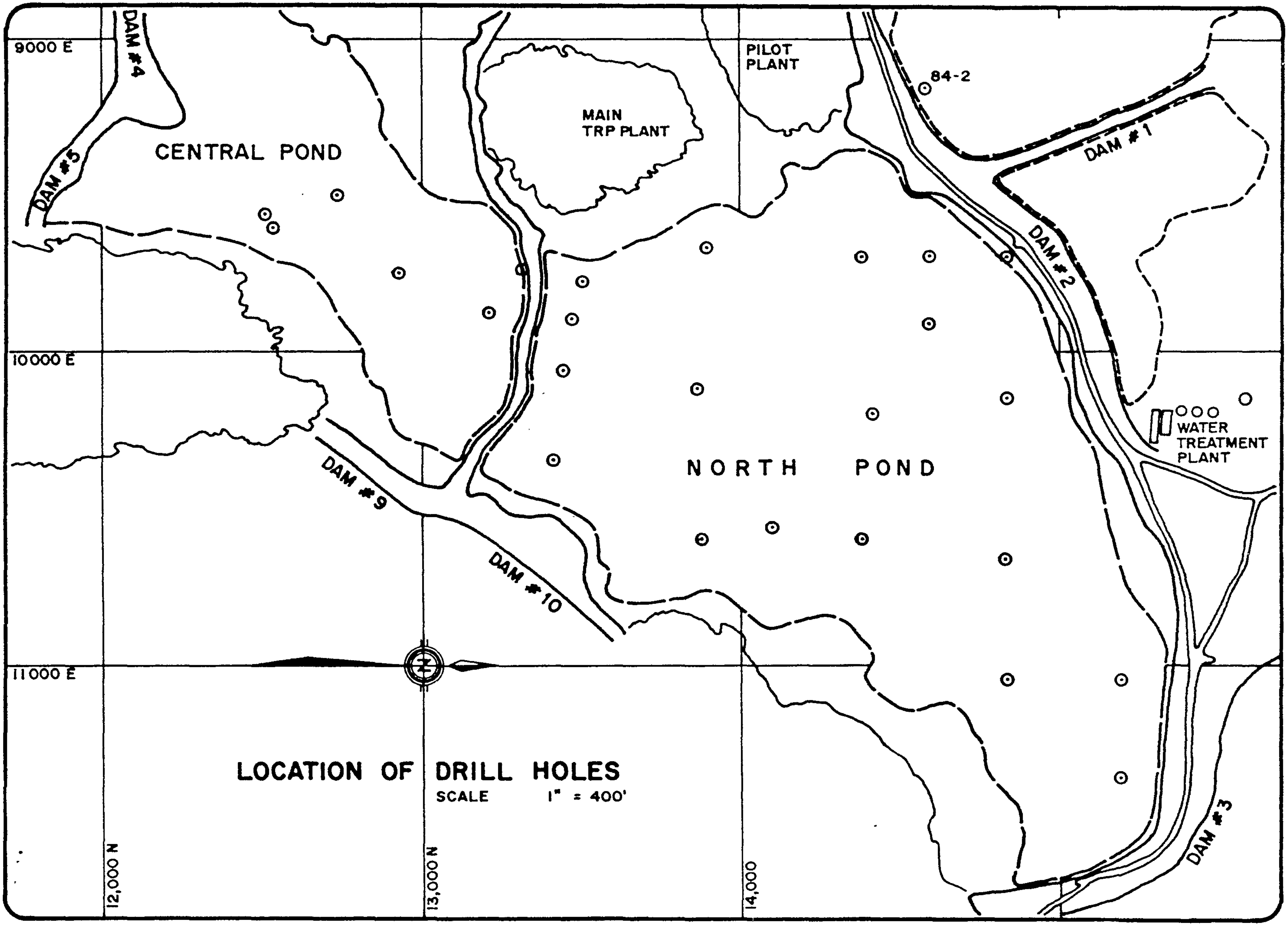
Pond/Hole #	Core Depth Feet	GOLD Grade oz/ton	Extraction %	Oz Recoverable per 100 tons
Central Pond				
T 84-8	22-24	0.035	32.0	1.12
	52-54	0.086	23.5	2.02
	Avg.	0.068		
T 84-9	8-10	0.038	29.3	1.11
	30-32	0.043	36.3	1.56
	*32-34	0.054	42.3	2.28
	*44-46	0.071	27.8	1.97
	62-64	0.176	22.6	3.98
	*70-72	0.100	24.0	2.40
	74-76	0.106	24.6	2.61
	Avg.	0.087	26.1	2.27
T 84-10	8-10	0.040	28.0	1.12
	*26-28	0.045	37.5	1.69
	*32-34	0.086	27.8	2.39
	Avg.	0.055	31.5	1.73
T 84-11	10-12	0.036	32.6	1.17
	*20-22	0.043	42.0	1.81
	Avg.	0.051		
(2) Polishing Pond				
88-1,2,3	Complete holes	0.095	35.0	3.32
88-4,5	" "	0.079	30.5	2.41
88-6,7	" "	0.119	39.0	4.64
88-8,12	" "	0.098	37.0	3.63
88-9,10	" "	0.084	31.1	2.61
88-1 to 88-12 Composite		0.097	34.2	3.32
Pilot Plant				
Areas per Figure 5	Nominal 10-12 ft	0.064	38.9	2.49

Notes:

*Samples were pulverized prior to cyanidation (Ref. 5).

(1) Average assays from detailed drill log data (Ref. 6).

(2) Lakefield Research Data (Ref 4).



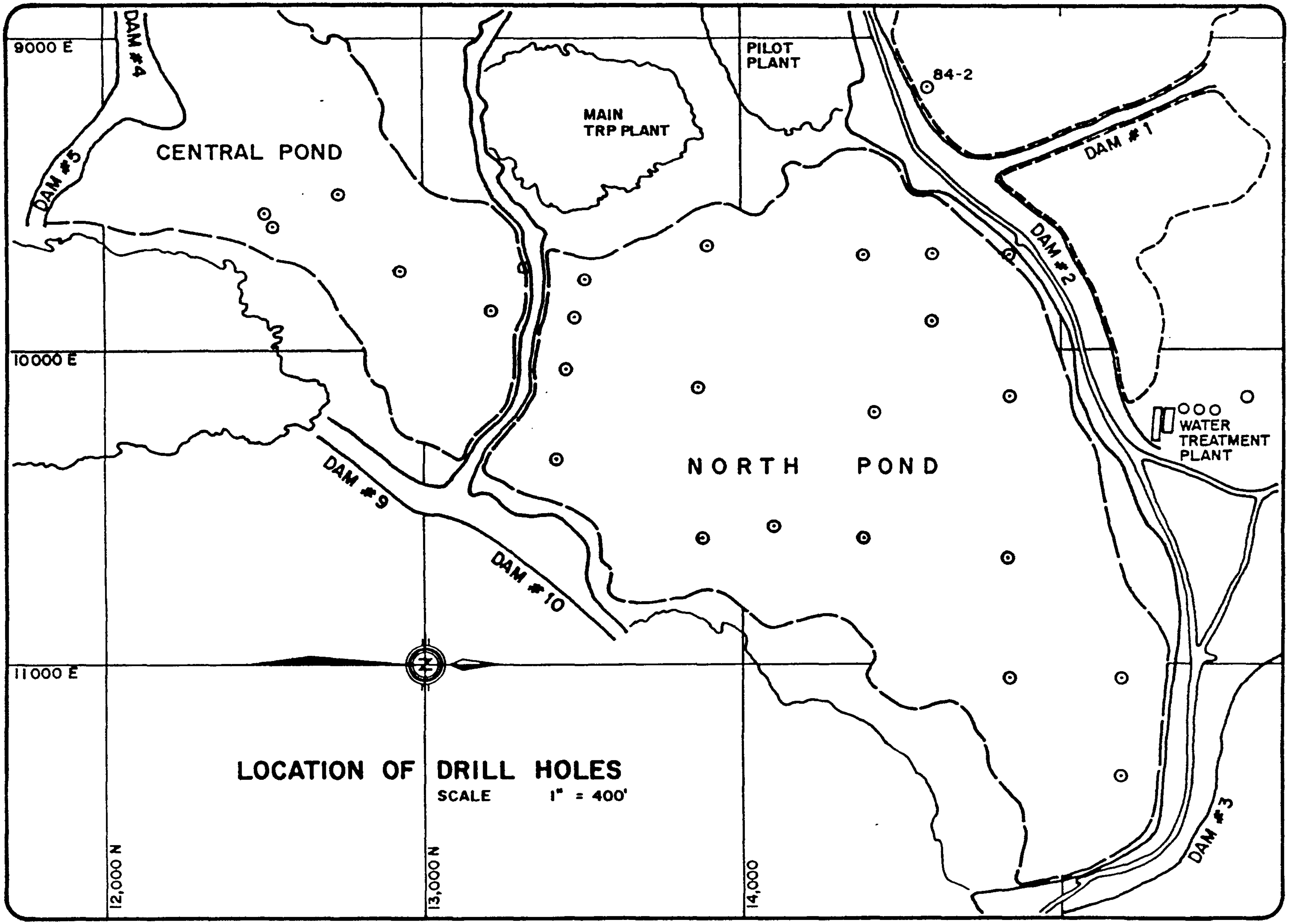
LOCATION OF DRILL HOLES

SCALE 1" = 400'

						.0785	.081					Avg Assay					.074	0.081	0.077						.075	

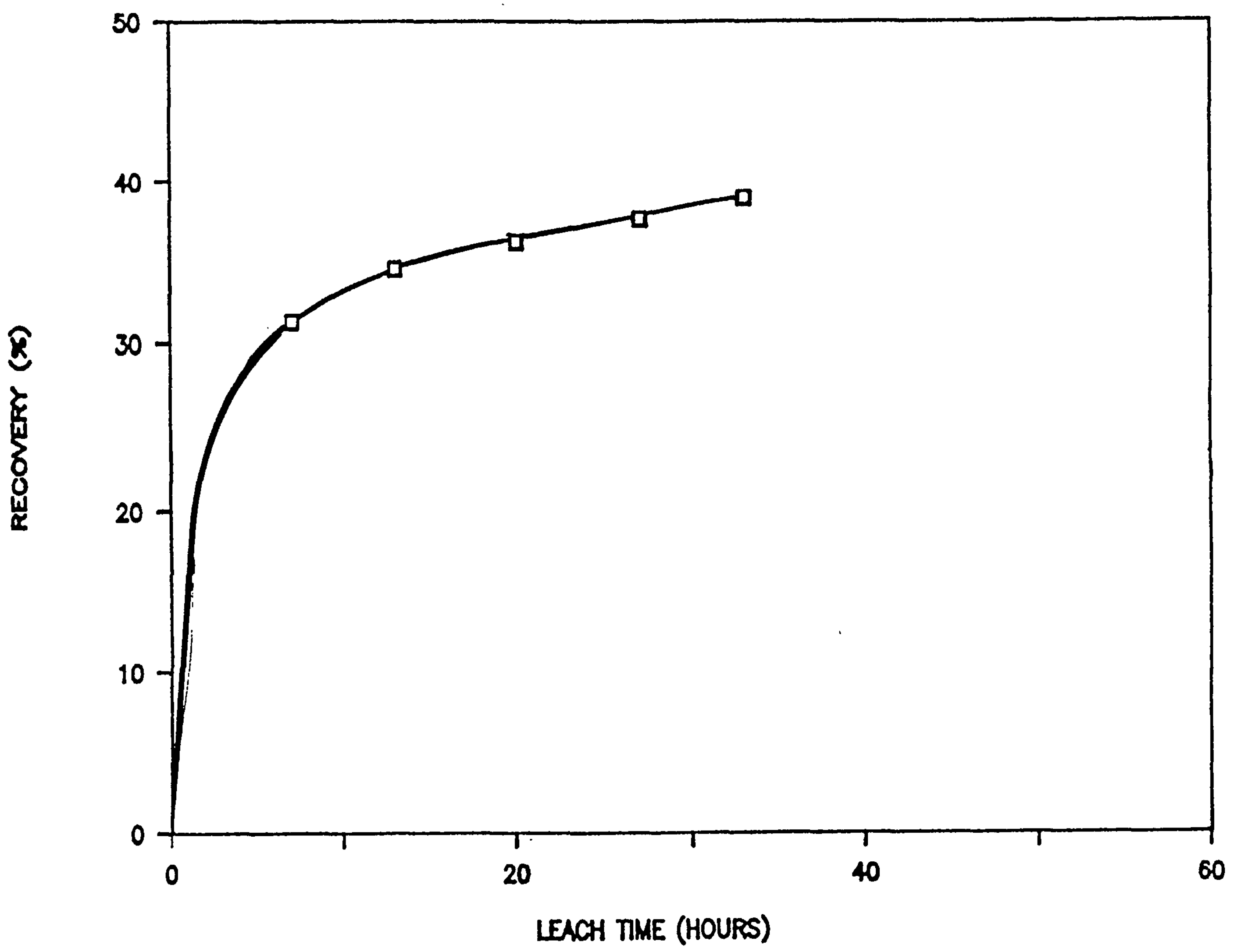
TABLE 3-2 ASSAY RESULTS

DEPTH	B1-1	TF-1	TF-2	TB4-1	TB4-2	TB4-3	TB4-4	TB4-5	TB4-6	TB4-7	TB4-8	TB4-9	TB4-10	TB4-11	TB6-15	TB6-16	TB6-17	TB6-18	TB6-19	TB6-20	TB6-21	TB6-22	TB6-23	TB6-24	TB6-25	TB6-26
0-2	0.034			ICE	ICE	ICE	0.029	0.040	0.046			ICE	0.032	ICE	0.048	0.042	0.024			0.028			0.045			0.045
2-4	0.034			ICE	0.033	0.036	0.032	0.040	0.042			ICE	0.053	0.040	0.047	0.042	0.038	0.040		0.031	0.065		0.031	0.028		0.053
4-6	0.034	0.039		0.092	0.037	0.039	0.036	0.040	0.048	0.046	ICE	0.042	0.040	0.036	0.049	0.049	0.041	0.042		0.026	0.051		0.035	0.038	0.034	0.039
6-8	0.034	0.039	0.038	0.040	0.049	0.188	0.042	0.040	0.043	0.052	0.073	0.050	0.040	0.041	0.048	0.040	0.032	0.039		0.027	0.048		0.030	0.030	0.029	0.041
8-10	0.034	0.041	0.052	0.053	0.044	0.053	0.062	0.040	0.041	0.043	0.040	0.051	0.048	0.047	0.048	0.040	0.035	0.044		0.027	0.041	0.038	0.043	0.040	0.030	0.045
10-12	0.087	0.042	0.052	0.072	0.044	0.042	0.045	0.040	0.048	0.042	0.041	0.054	0.043	0.042	0.048	0.045	0.034	0.043		0.030	0.035	0.034	0.048	0.040	0.032	0.050
12-14	0.087	0.042	0.052	0.108	0.052	0.042	0.053	0.040	0.051	0.043	0.044	0.053	0.048	0.046	0.048	0.050	0.045	0.042		0.030	0.033	0.038	0.042	0.042	0.034	0.045
14-16	0.087	0.043	0.053	0.048	0.049	0.040	0.045	0.036	0.048	0.043	0.044	0.058	0.050	0.046	0.048	0.046	0.042	0.045	0.031	0.022	0.024	0.050	0.045	0.054	0.030	0.052
16-18	0.087	0.042	0.051	0.045	0.049	0.042	0.053	0.039	0.055	0.049	0.048	0.058	0.051	0.046	0.040	0.039	0.043	0.042	0.059	0.011	0.025	0.067	0.042	0.041	0.056	0.040
18-20	0.087	0.043	0.049	0.054	0.054	0.039	0.054	0.040	0.046	0.056	0.039	0.058	0.050	0.046	0.040	0.042	0.048	0.043	0.037	0.015	0.030	0.045	0.043	0.042	0.050	0.044
20-22	0.127	0.044	0.049	0.043	0.071	0.039	0.070	0.048	0.067	0.046	0.043	0.058	0.048	0.043	0.047	0.047	0.063	0.040	0.029	0.011	0.031	0.045	0.058	0.069	0.040	0.039
22-24	0.127	0.045	0.048	0.069	0.068	0.046	0.051	0.059	0.075	0.061	0.041	0.058	0.047	0.040	0.049	0.086	0.070	0.062	0.043	0.015	0.063	0.055	0.082	0.067	0.086	0.045
24-26	0.127	0.043	0.055	0.082	0.046	0.050	0.079	0.061	0.076	0.044	0.038	0.049	0.062	0.048	0.049	0.069	0.069	0.090	0.046	0.017	0.049	0.054	0.068	0.078	0.058	0.049
26-28	0.089	0.049	0.045	0.082	0.052	0.066	0.073	0.064	0.069	0.053	0.048	0.049	0.045	0.050	0.057	0.076	0.073	0.073	0.088	0.019	0.049	0.059	0.073	0.085	0.059	0.045
28-30	0.089	0.057	0.048	0.082	0.058	0.078	0.076	0.060	0.087	0.067	0.063	0.053	0.056	0.049	0.048	0.093	0.073	0.073	0.065	0.021	0.048	0.070	0.076	0.079	0.068	0.047
30-32	0.089	0.061	0.047	0.082	0.080	0.079	0.081	0.102	0.088	0.074	0.047	0.058	0.085	0.052	0.049	0.097	0.063	0.072	0.061	0.023	0.078	0.078	0.064	0.076	0.064	0.049
32-34	0.064	0.061	0.048	0.082	0.069	0.099	0.084	0.096	0.078	0.098	0.052	0.054	0.086	0.049	0.046	0.070	0.090	0.058	0.057	0.021	0.087	0.099	0.072	0.088	0.079	0.049
34-36	0.064	0.059	0.048	0.082	0.087	0.095	0.081	0.113	0.080	0.085	0.048	0.060	0.085	0.059	0.055	0.093	0.113	0.078	0.075	0.032	0.097	0.118	0.080	0.092	0.079	0.064
36-38	0.064	0.071	0.045	0.082	0.053	0.078	0.073	0.085	0.080	0.112	0.059	0.112	0.085	0.066	0.092	0.078	0.136	0.083	0.079	0.033	0.108	0.080	0.080	0.152	0.118	0.099
38-40	0.085	0.070	0.060	0.082	0.080	0.070	0.087	0.090	0.079	0.076	0.046	0.066	0.085	0.067	0.071	0.114	0.119	0.089	0.107	0.036	0.104	0.020	0.085	0.133	0.139	0.098
40-42	0.085	0.058	0.061	0.082	0.129	0.079	0.074	0.140	0.082	0.075	0.046	0.066	0.085	0.060	0.076	0.112	0.104	0.112	0.084	0.038			0.124	0.113	0.159	0.077
42-44	0.143	0.053	0.050	0.082	0.129	0.082	0.113	0.144	0.075	0.081	0.050	0.066	0.035	0.078	0.076	0.186	0.162	0.101	0.143	0.071			0.156	0.167	0.119	0.103
44-46	0.143	0.065	0.056	0.201	0.129	0.105	0.079	0.274	0.079	0.100	0.058	0.071	0.085	0.050	0.064	0.087	0.139	0.129	0.089	0.012			0.104	0.147	0.149	0.124
46-48	0.141	0.073	0.092	0.192	0.129	0.105	0.106	0.112	0.068	0.100	0.079	0.098	0.085	0.085	0.074	0.117	0.123	0.160	0.079	0.008			0.139	0.101	0.119	0.135
48-50	0.141	0.072	0.090	0.534	0.129	0.105	0.120	0.102	0.084	0.100	0.094	0.078	0.085	0.085	0.081	0.122		0.139	0.108	0.009			0.087		0.086	0.077
50-52	0.141	0.077	0.093	0.086	0.129	0.105	0.119	0.122	0.090	0.100	0.091	0.085	0.085	0.085	0.087	0.147		0.091	0.168				0.128		0.083	0.070
52-54	0.116	0.072	0.095	0.082	0.129	0.105	0.094	0.146	0.104	0.078	0.109	0.085	0.085	0.085	0.112	0.072		0.133	0.089				0.086		0.080	0.092
54-56	0.116	0.073	0.091	0.074	0.129	0.105	0.142	0.146	0.133	0.071	0.109	0.103	0.085	0.085	0.139	0.057		0.152					0.119		0.119	0.090
56-58	0.180	0.100	0.090	0.159	0.129	0.105	0.124	0.146	0.130	0.103	0.086	0.090	0.085	0.085	0.127	0.055		0.108					0.082		0.060	0.127
58-60	0.180	0.098	0.090	0.150	0.129	0.105	0.089	0.151	0.171	0.122	0.085	0.099	0.085	0.085	0.127	0.022		0.104					0.079		0.048	0.158
60-62	0.180	0.105	0.098	0.179	0.129	0.086	0.122	0.174	0.113	0.132	0.085	0.133	0.085	0.085	0.127			0.114					0.051		0.030	0.140
62-64		0.104	0.098	0.134	0.129	0.119	0.116	0.104	0.097	0.160	0.085	0.151	0.085	0.085	0.091										0.023	0.136
64-66			0.092	0.140	0.129	0.136	0.123	0.064	0.100	0.120	0.058	0.085	0.085	0.085	0.066											0.116
66-68			0.092	0.282	0.129	0.153	0.110	0.100	0.100	0.120	0.047	0.085	0.085	0.085												0.141
68-70			0.132	0.496		0.112	0.099	0.139	0.100		0.085	0.100	0.085	0.085												0.143
70-72			0.132				0.030	0.100	0.083		0.097	0.110	0.085	0.085												0.128
72-74							0.039	0.069	0.091		0.092	0.114	0.085	0.085												0.079
74-76								0.028	0.088		0.092	0.159														0.101
76-78								0.056	0.284		0.092	0.138														0.071
78-80									0.110		0.092	0.135														0.095
80-82									0.082		0.083	0.112														0.038
82-84									0.058		0.088															0.129
84-8									0.041		0.108															
86-8											0.104															

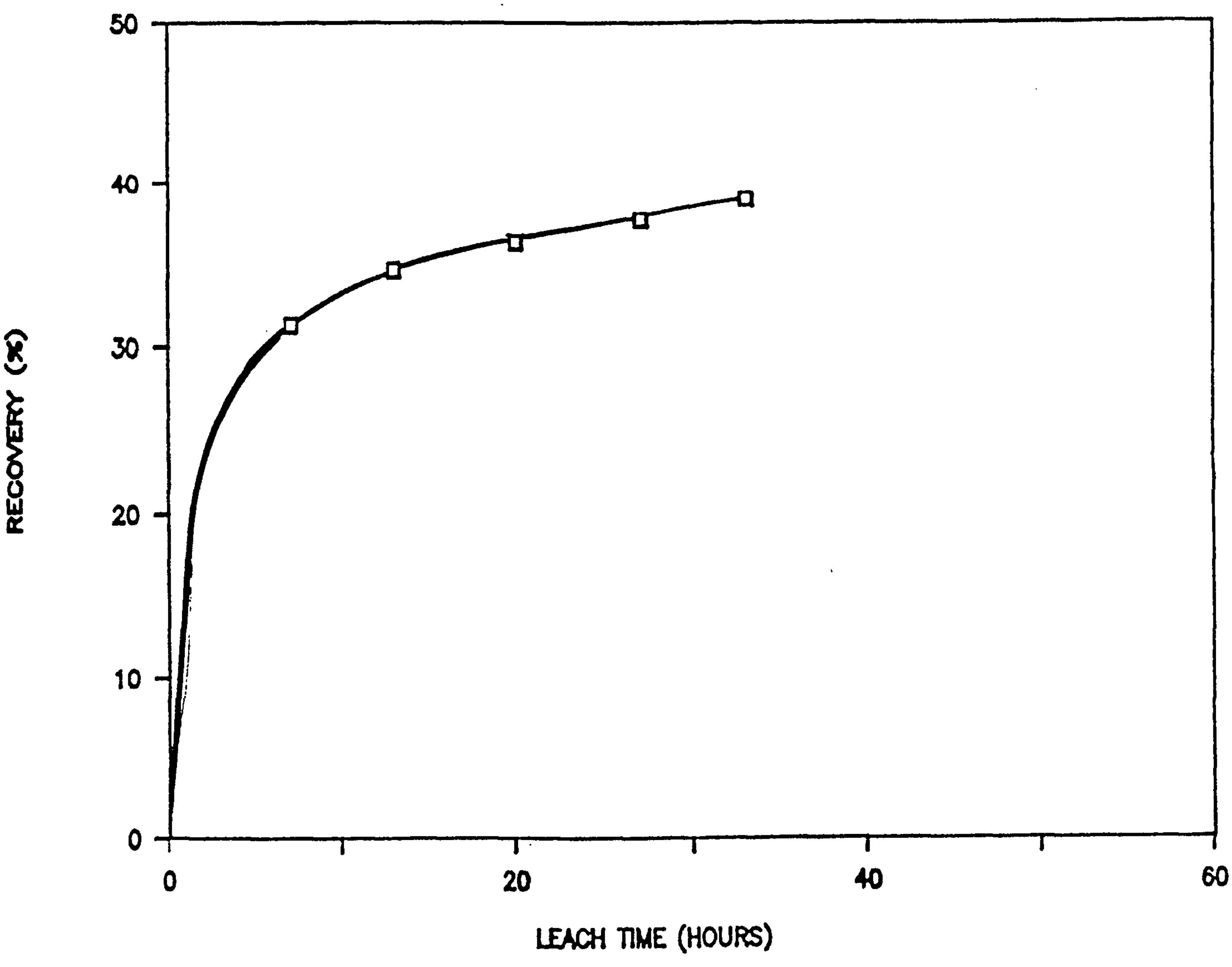


LOCATION OF DRILL HOLES
SCALE 1" = 400'

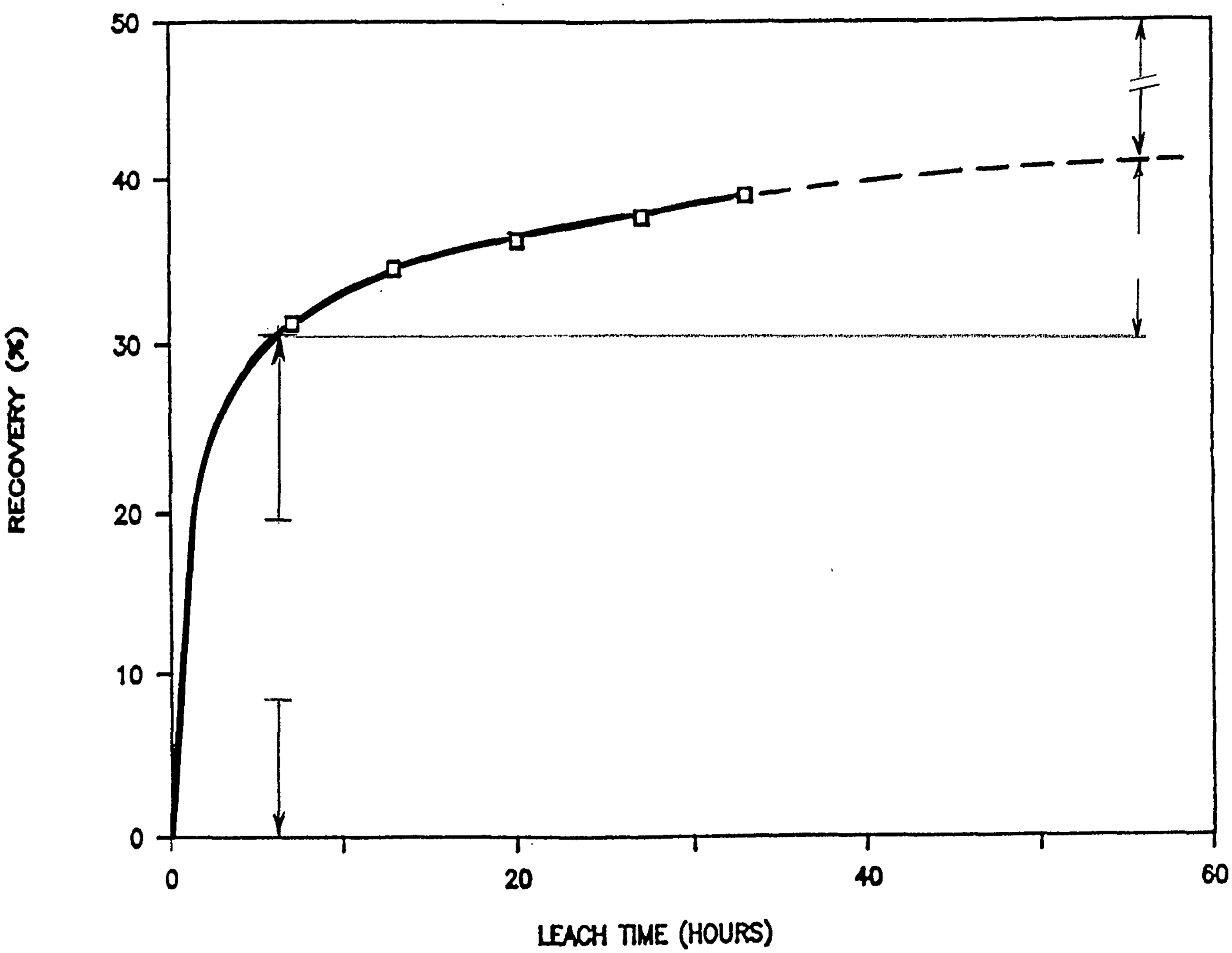
PILOT PLANT GOLD EXTRACTION CURVE



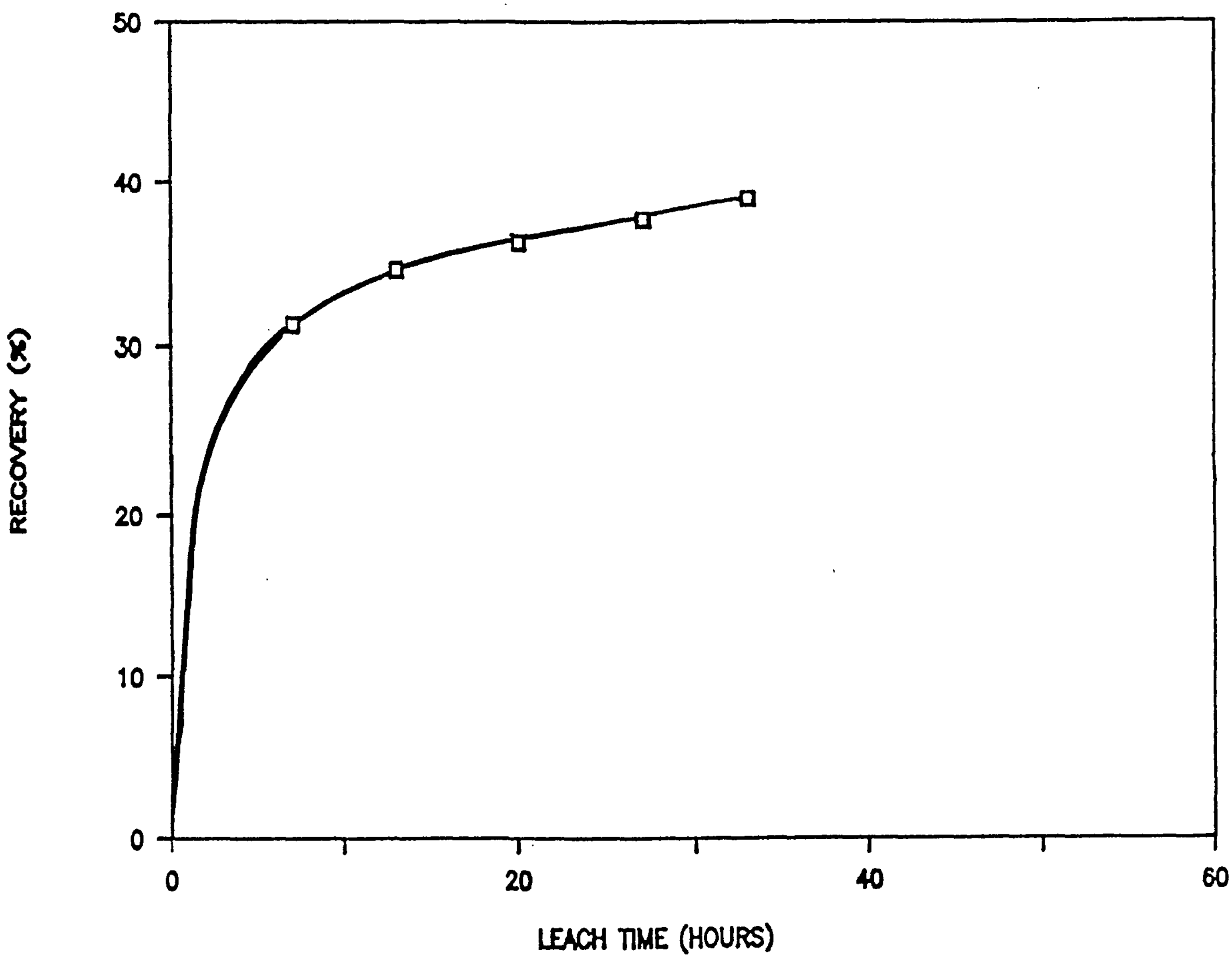
PILOT PLANT GOLD EXTRACTION CURVE



PILOT PLANT GOLD EXTRACTION CURVE



PILOT PLANT GOLD EXTRACTION CURVE



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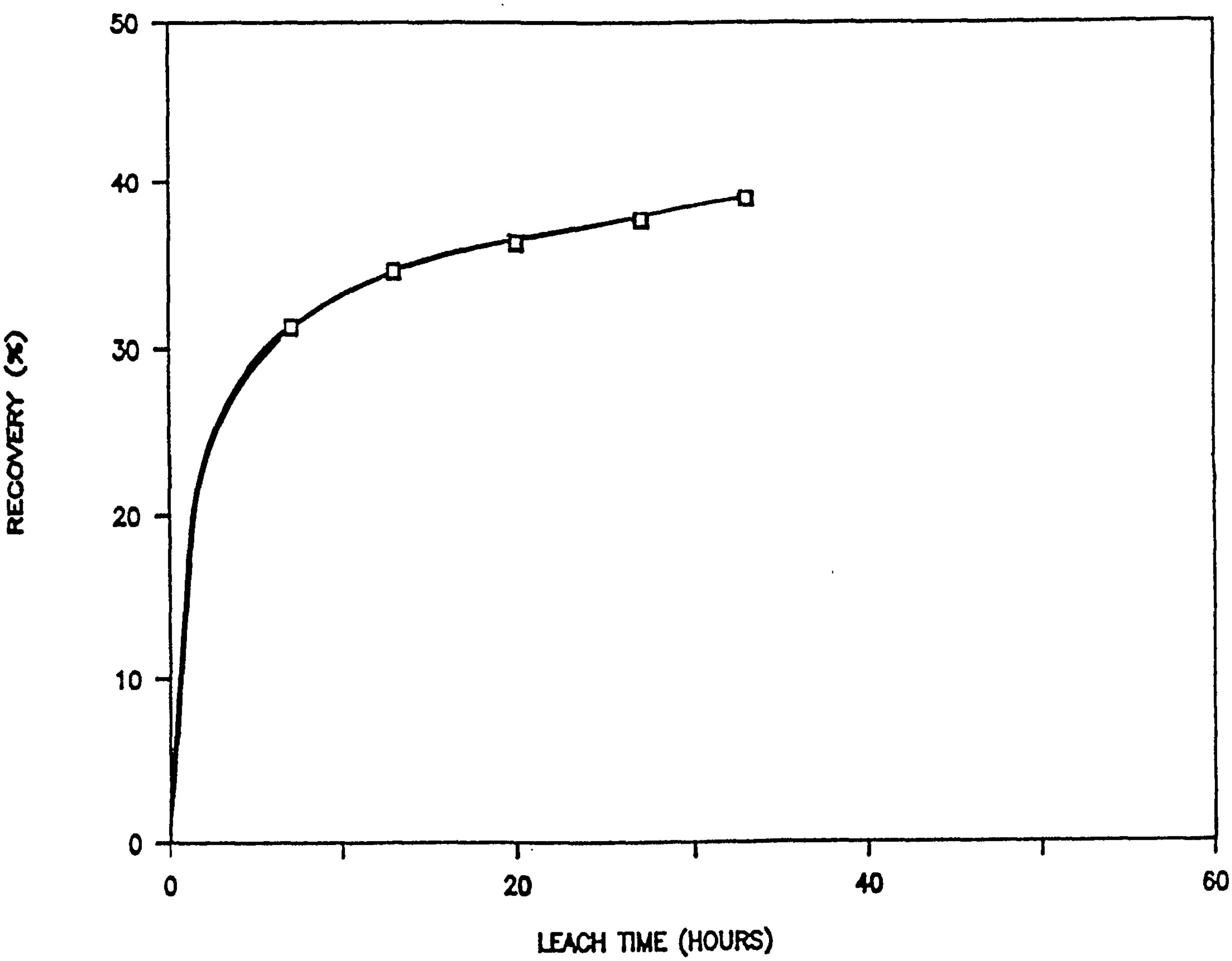

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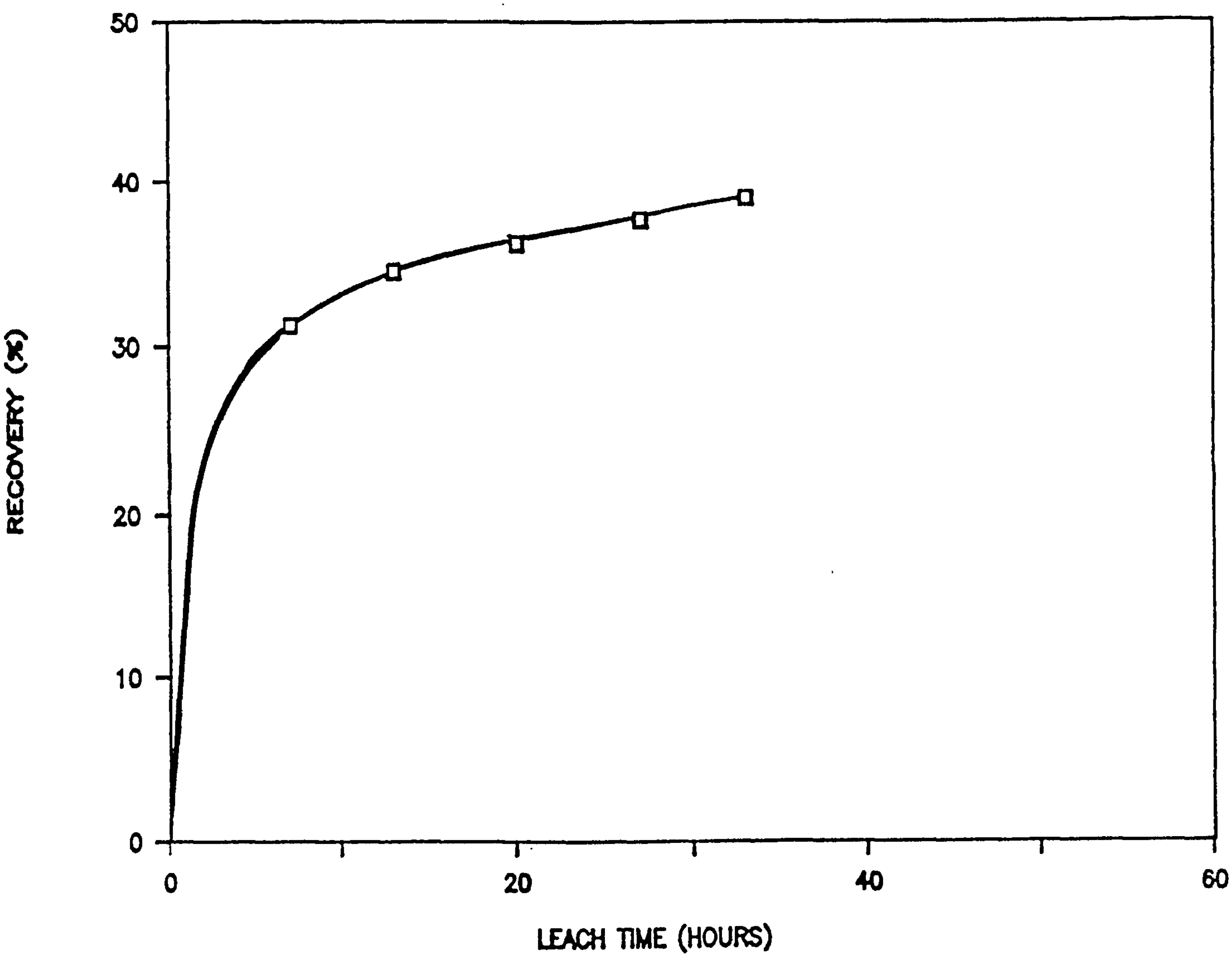


File note: DAS Oct 26/88

Effect of Cone Depth on Recovery. – Bulldozing

- Let's say Top 10' has a grade of 0.05 g/ton
  recovery of 40%.
- 10 – 70' has a grade of 0.09 g/ton
  recovery of 30%

1 : 1 mix

$$\text{Combined Recovery} = \frac{.05 \times .4 + .09 \times .3}{.05 + .09} = \frac{.047}{.14} \times 100$$

$$= 33.6\,\%$$

- Worst Case

  Top 10' .01 grade.
  35 % recovery.

  Bottom 70' .10 grade.
  30% recovery.

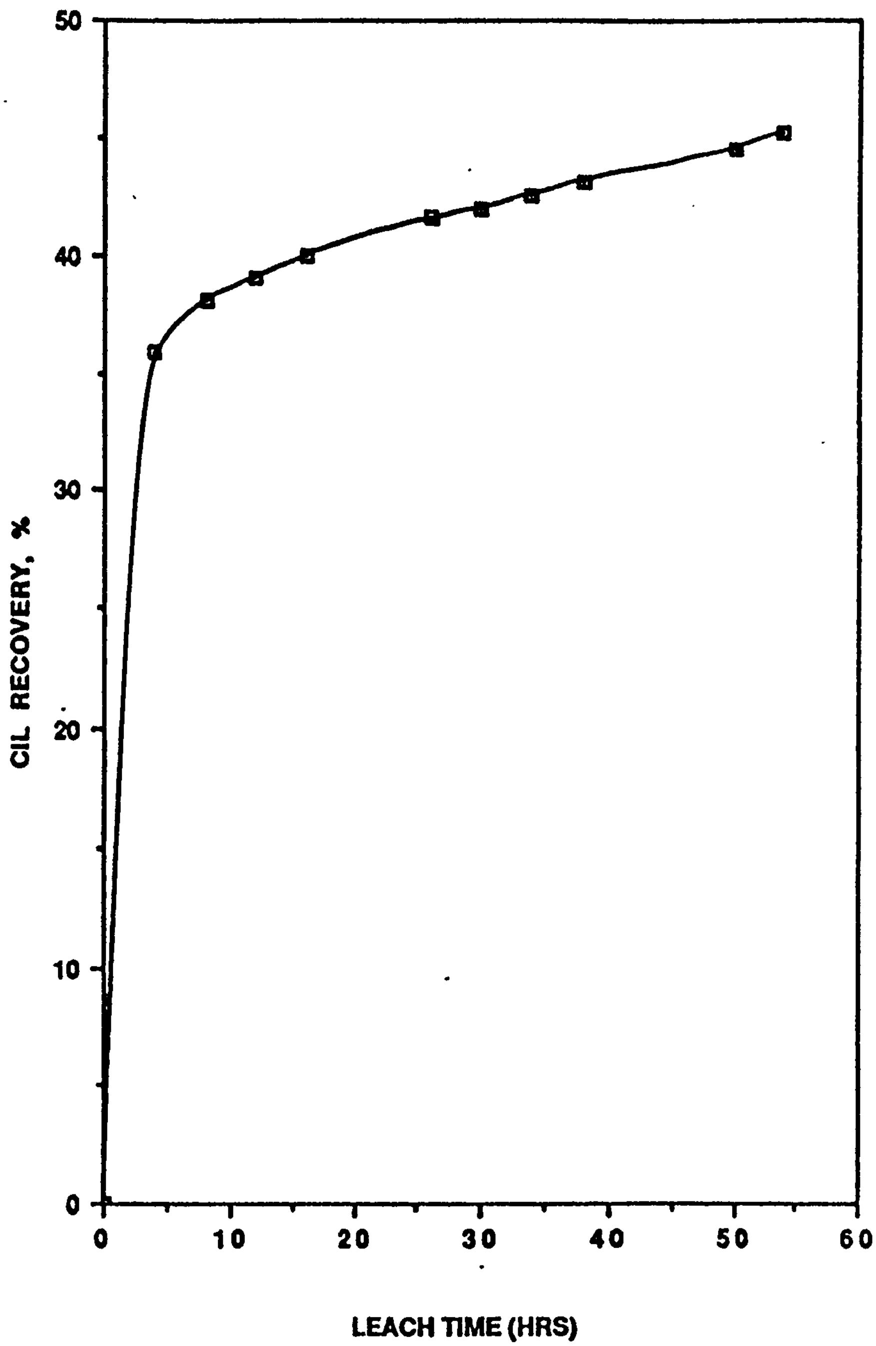
Split 7 Top / 1 Bottom

$$\text{Combined Recovery} = \frac{70 \text{ tons} \times .01 \times .35 + 10 \text{ tons} \times .10 \times .3}{70 \times .01 + 10 \times .1}$$

$$= \frac{0.245 + 0.30}{1.7} \times 100 = 32.06\,\%$$

∴ Grade always increases with inclusion of Top material.

GOLD EXTRACTION CURVE



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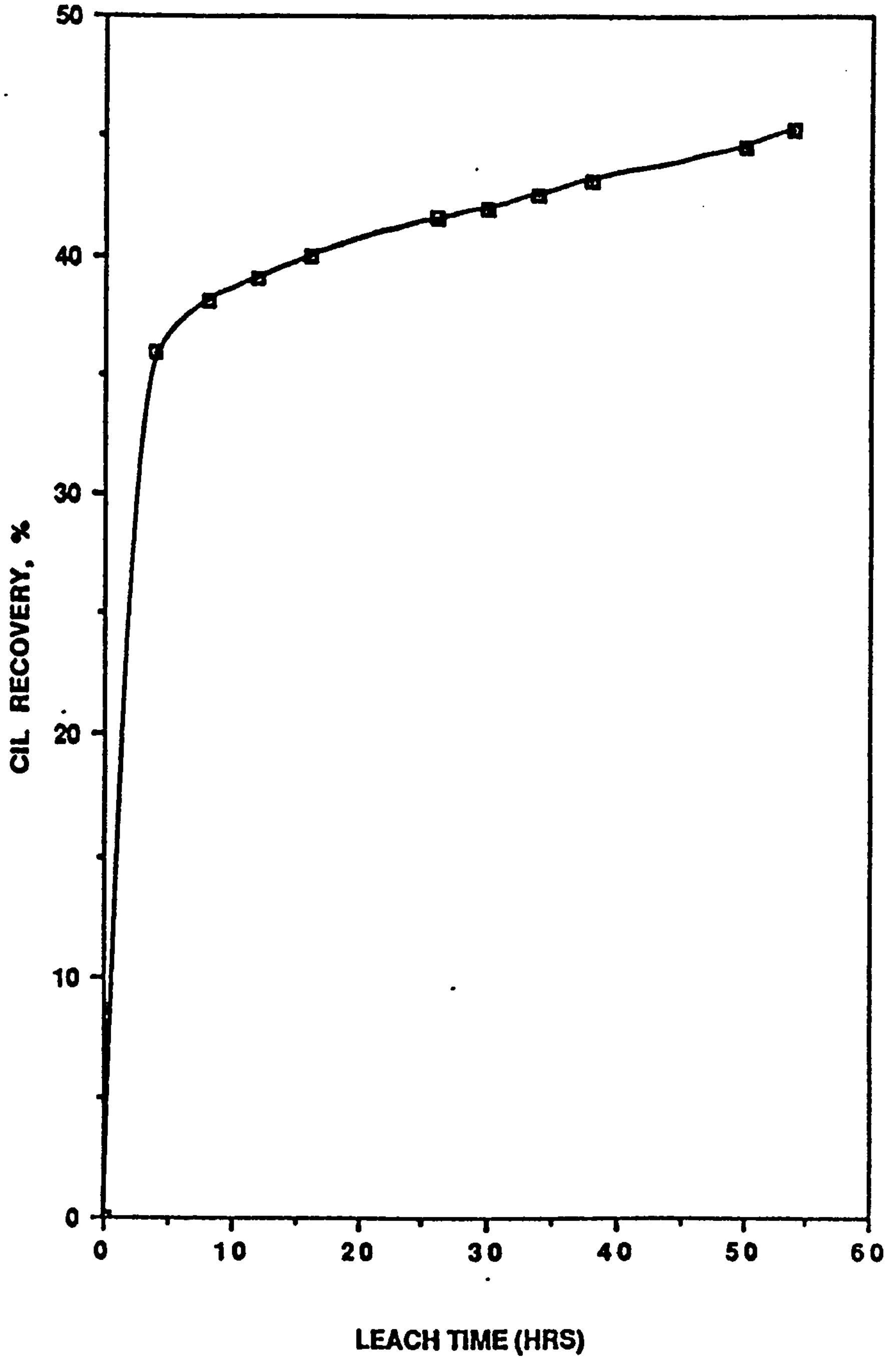

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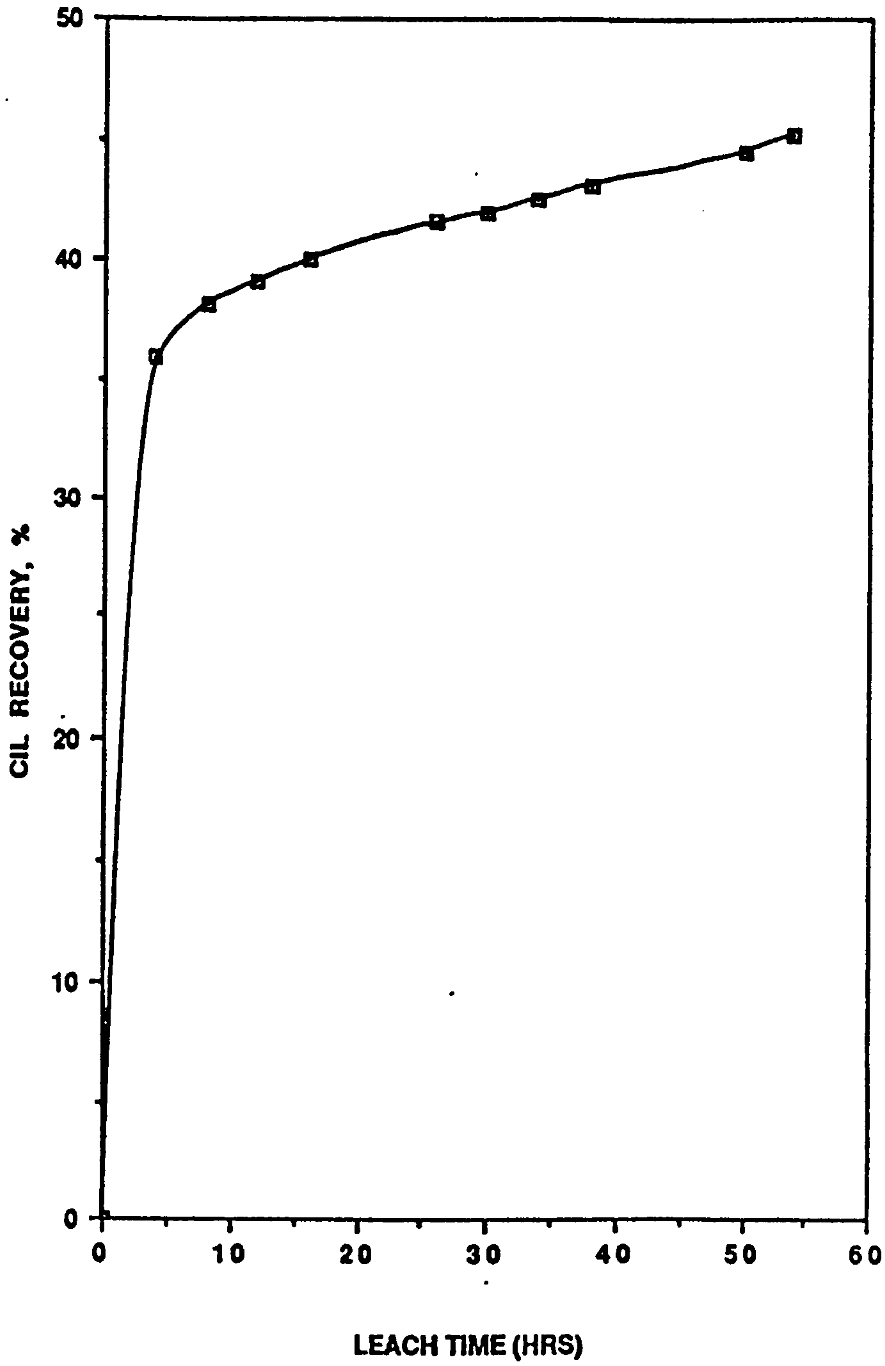

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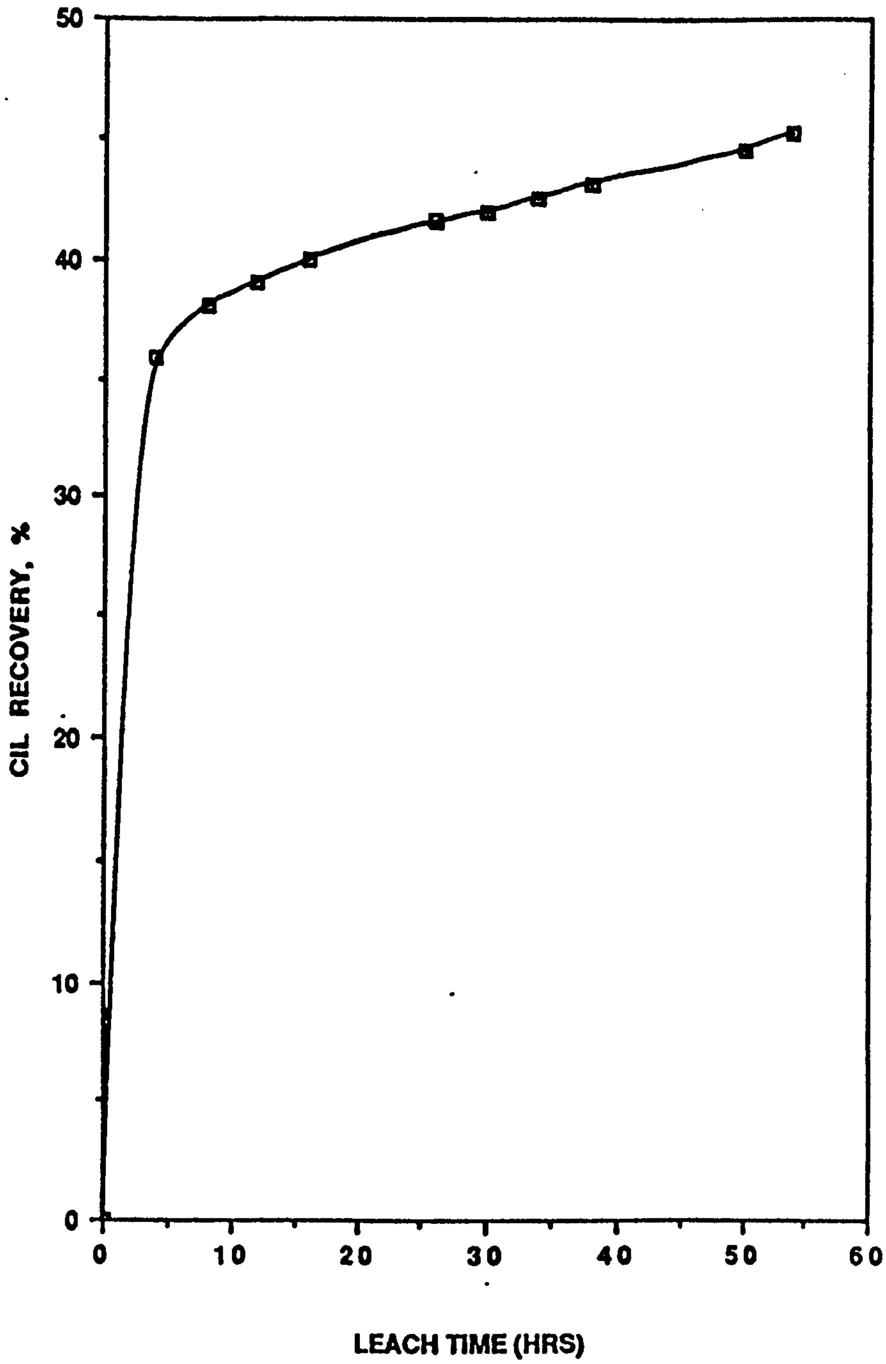

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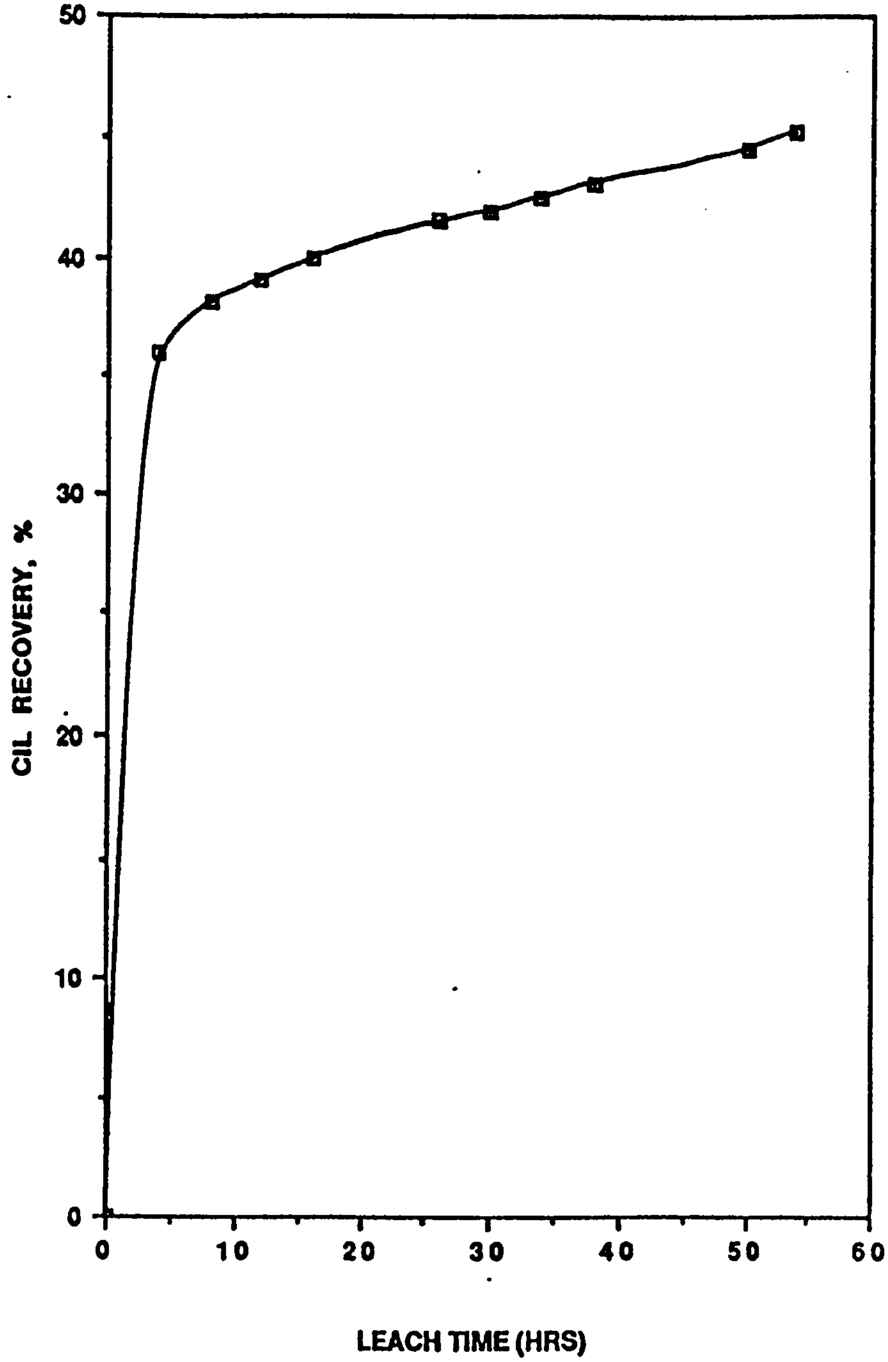

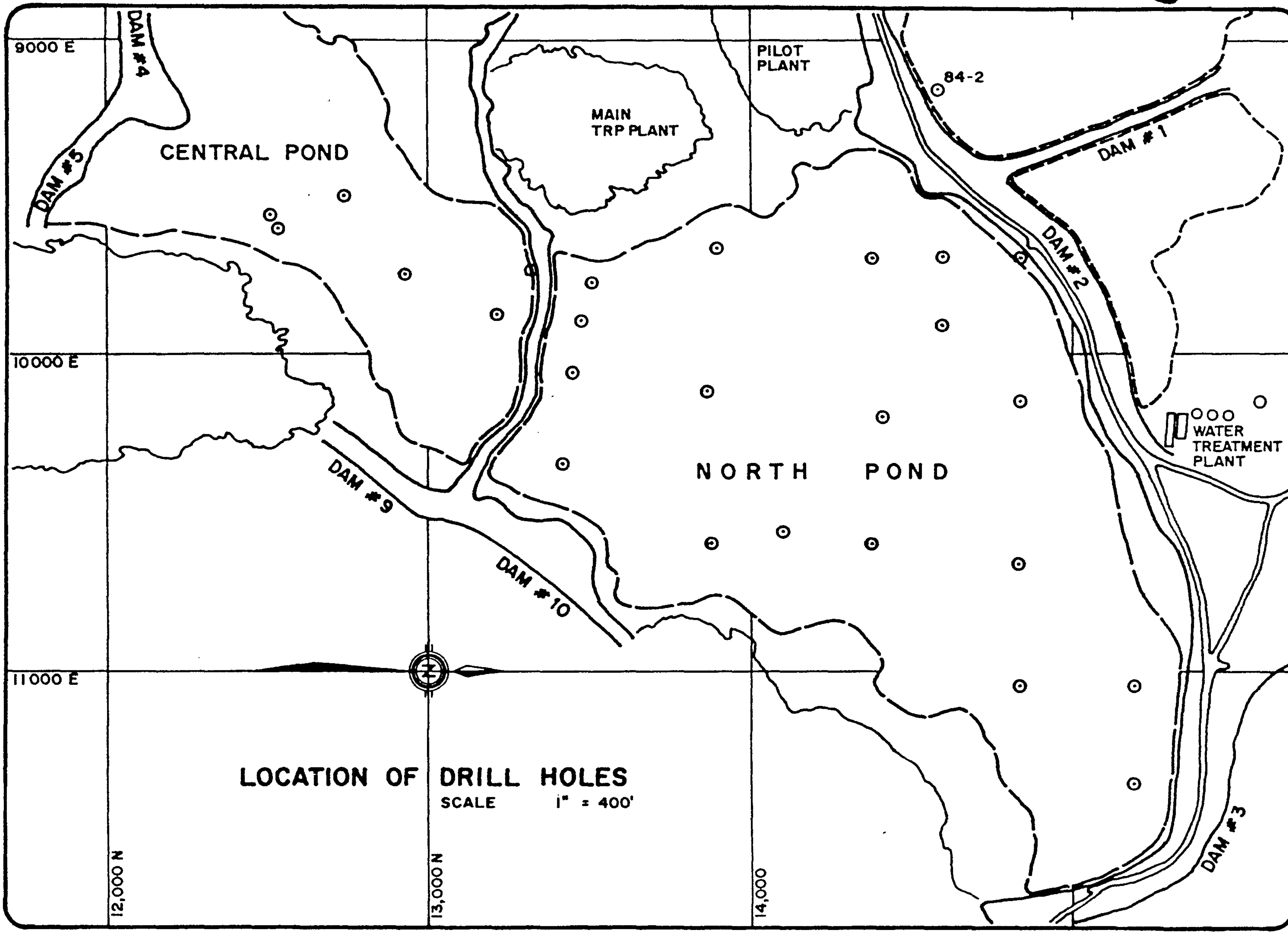

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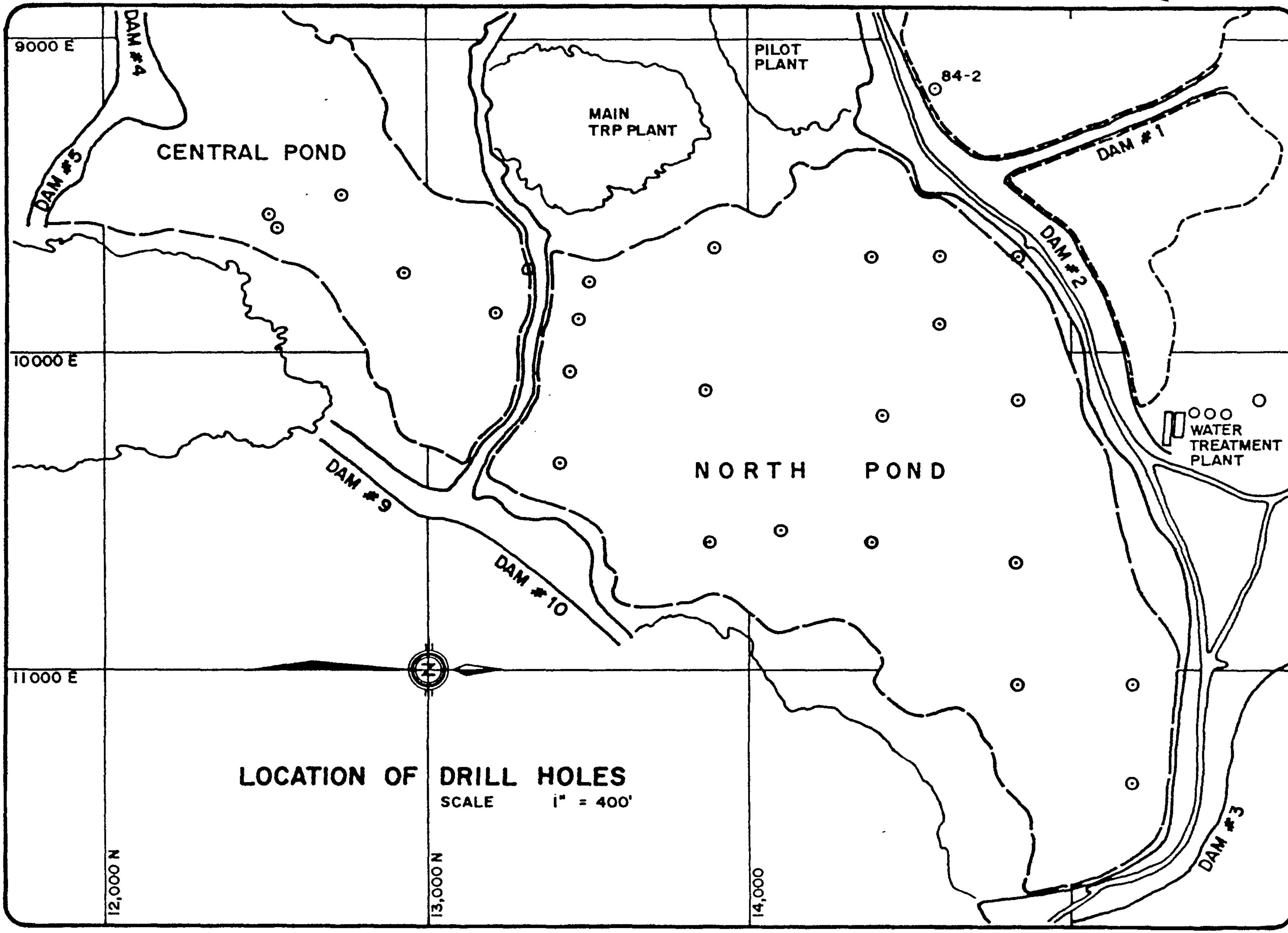
9000 E
10000 E
11000 E
12,000 N
13,000 N
14,000
DAM #4
DAM #5
CENTRAL POND
MAIN
TRP PLANT
PILOT
PLANT
84-2
DAM #1
DAM #2
DAM #9
DAM #10
DAM #3
NORTH POND
WATER
TREATMENT
PLANT
LOCATION OF DRILL HOLES
SCALE 1" = 400'

SECTION 2.

MEMO TO: Don Cooper

COPY TO: Doug Bartlett

FROM: Bryan Cross

DATE: November 4, 1988

SUBJECT: TRP RECOVERY IMPROVEMENT ACTIVITIES TO DATE.

DRB Comments

The following is a summary of the status to date of the improvement program initiated at the TRP as a result of the recommendations of John Bartrum following his site visit and memo of August 22nd, this year. The format here will be to address each item listed in the action plan schedule that was generated and issued August 25th.

ACTIVITY STATUS

1. Improve Agitation Via Areation: Done, rented a 1200 cfm compressor August 22nd and ran it for the duration of the operating season. Pressure was not considered adequate and capital expenditure request for an 1800 cfm unit has been applied for.

2. Carbon Transfer Rate: a) Pump Suctions - All complete August 24th 5 foot extensions to each placing the suction intakes 8 feet below the slurry surface. This is still not adequate for transfering carbon from tank to tank as the slurry percentage solids falls below approximately 35%, the transfer rate gets progressively slower as the slurry density falls.

b) Loaded Carbon Screen - 28 mesh screen replaced 35 mesh screen panels September 1st, and we found that we still could not open pinch valve on the feed line for full flow as too much slurry and woodchips remained with the carbon. A DSM Screen was installed ahead of the Simplicity Screen September 14th and the time to transfer a carbon batch was cut to about 4 hours from approximately 24. Carbon received in the Acid Wash Vessel remaind contaminated with woodchips and sand. On October 14th a 6 inch cyclone was installed on the Acid Wash Feed Line and woodchips were selectively removed from the carbon. The woodchip removal efficiency is about 70% with the cyclone and no carbon has been seen in the overflow. The woodchips are now a fairly minor problem however the sand is still clogging the Strip Vessel Internal Carbon Retention Screens, this results in batches being dumped on the floor when the lower screens have to be cleaned. Then the mess gets slowly washed into retreival sump where it then can be pumped back to the Strip Vessel. To alleviate this problem a capital expenditure request has been made for a second Simplicity Loaded Carbon Screen. The plan for 1989 is to continue pre-screening with the DSM, pass the pulp over the existing Simplicity unit, then repulp the overlow with the existing eductor and pass the flow over a second Simplicity Screen to wash away the sand adhering to the recovered carbon. The cyclone will continue to treat the overflow product from this screen for chip removal prior to acid washing.

c) Speed Up Eduction: The above listed remedies for carbon contamination should solve our remaining eduction problems. Instead of taking about two hours, eduction from the Strip Vessels was taking about six because of clogging screens.

The eductor for the Loaded Carbon oversize required frequent clearing as it was clogging frequently with garbage. A double layer of expanded metal over the eductor feed hopper solved the problem.

d) Speed Up Stripping: The previously described solutions to the carbon contamination should give the major contribution to speeding up the strip. A second solution is in the 1989 capital expenditure request for a heat exchanger system to allow maintaining 150 degree F barren solution between batches to be processed. This will eliminate about seven (7) hours waiting presently required for cooling and bringing the boiler back up to operating temperature.

3. Lengthening Downcomers: This is not recommended if increased aeration is to be continued. There is also a problem existing periodically of getting the downcomers to accept full flow. This phenomenon occurs it seems when there is a significant difference in a tank's content slurry density and the tank feed slurry density. If there is a high solids content in a tank, light feed slurry will overflow the feed box. It is not able to get down the downcomer and in overflowing the feed box sands out the tank's internal launder screens.

4. a) Trash Screen Finer Mesh - These machines were supplied with each having 3 - 0.85 mm urethane screen panels, these could not handle the flow and failed to adequately remove the woodchips. The first attempt with different screens was made September 18th when a 40 mesh, a 50 mesh and a 60 mesh, wire mesh screen panels were installed. They were placed so that the openings got larger as the flow approached the overflow launder. These panels worked well in taking out the wood however, they had to be replaced after 12 operating hours because of blinding with sand. The next change was made on October 5th when two 0.5 mm urethane screen panels were placed on the feed end of one machine followed by a 40 mesh wire panel. This combination worked when the feed split to each of the two screening machines was even (which was seldom). The west screen got the new panels as the splitter usually sent the majority of flow to the east unit where the 0.85 mm panels were retained to minimize spillage with the larger open area. The capital request to replace the radial feed splitters with a splitter boxes and for a third Derrick Screening Machine for trash removal if approved should solve the screening problems. Another type of 0.5 mm screen panel with a design for more open area per panel is also on hand for evaluation but the plant shutdown for the season before we could run a test.

b) Modify Sprays - This was done in September and to the end of the season washing was much improved. These new nozzels did not cut the screen panels which the original ones did.

5. CIL vs. Pilot Plant - A full report on this has not been completed. Examination of Lakefield data has shown that the best gold recovery obtained in lab tests was from near surface stored tailings. The Pilot Plant ran on a blend of surface recovered tailings from the Polishing Pond and the Central Pond. The Polishing Pond material being of higher gold grade was mixed in with the lower grade Central Pond tails to simulate the expected overall grade the TRP will treat. The surface if not deeply (>6feet) submerged in water is an active freeze - thaw zone. This weathering activity is suspected of enhancing gold recovery as water freezing in partical pores enlarges the pores cracking them open a little more with each freeze - thaw cycle. The depth of source of the treated material is thought to be the primary difference from the Pilot Plant affecting gold recovery at the TRP. Other differences of significance include agitation, carbon distribution,and tank carbon retention. The Pilot Plant had too much air, so much so that a good part of the supply had to be bled to atmospere. Agitation in the tanks there was visibly much more violent at the surface than it has yet to be in the TRP.

Agitation effect Needs ~~to~~ be quantified. No. Lakefield Lab tests showed no diff.

The TRP launder screens leaked carbon from tank to tank virtually the whole operating season. In the Pilot Plant no such leakage was noted. A tank to tank gradation increasing towards the CIL feed end in gold concentration was maintained in the TRP by frequently running the Carbon Advance Pumps and at times some of these ran continuosly. This should have led to substantially more carbon fines than in the Pilot Plant where little transfering took place. We will not be able to quantify the amount of fine carbon loss until we complete the processing through Strip & Regeneration of the total amount of carbon in the tanks yet.

6. Attrition all Carbon: Have done this with all the carbon used since August 25th and will continue to do so.

7. Low Return Barren Carbon Levels: Year to date 40 batches of carbon have been stripped with the YTD assay of the stripped carbon having a weighted average assay of 2.376 oz Au / ton. The October MTD value was 1.345, Septemer was 2.71 and August was 3.508. As the numbers show there is an improving trend although some regression occured with the last few batches processed. Values as low as 0.6 oz Au / ton have been obtained and it is the batches processed at low flowrates due to clogged screens that have been worse. Strip times have been cut short because of the need to clean clogged screens or more time has not been given to compensate for low flowrates. Operators skill and craft have definately improved with experience and the proposed carbon contamination remedies should yield good barrens in future.

1) 'Agitation Evaluation: Phone Roger Sawyer on get him to FAX all mixing quotations.

2) Contact Gus Van Weert for an independent investigation.

8. This Item was a repeat of the aforementioned Carbon Transfer Pump Suction extentions of Item 2a.

9. a) Organic/Inorganic Analysis: This has been done but it was not until October 24th that we received the correct results. We questioned some results on the original September 19th "Final Report" and found sulphur was analysed for not the requested sulphide. Also, wrong results had been originally released. A separate report will be prepared and distributed soon.

Action Schedule

b) Carbon Fines: Here we were unable to collect sufficient sample for an assay. S. Waller of Kilborn attempted this without success on August 24th. At that point in time the Carbon Fines Dewatering Screen had been taken out of service. The problem was too much flow for the 100 mesh screen cloth to handle in combination with blinding resulting in splashing of the tails pump motor. The screen panel was removed from the machine and the water directed to the tails box without screening.

c) Assay Wood Fibre: August 24th samples of woodchips taken from the Trommel Screen assayed 0.10 ozs Au / ton, samples of woodchips from the Safety Screens assayed 0.19 ozs Au / ton. The woodchips have been stockpiled and this winter the tonnage and grade will determine if ashing and cyanidation are economic.

Suggested Action

d) Tracer Salts: Lithium Chloride was added to CIL tank #6 on September 14th and the tank discharge sampled at 1/2 intervals for 6 hrs with all of the results coming back from the lab as either 0.2 or 0.3 ppm lithium. Subsequent investigation proved that the analytic procedure was inadequate at this level of detection and about three times as much lithium must be added to have any confidence in the results. The Engineering Department performed soundings on the leach vessels which convinced us that the tanks were not settled out however there is no accurate proof of the solids retention time. Pumping out CIL tank #6 to #1 did give physical evidence that there definately is settling occuring in the leach vessels. Tank #1 at 26% solids at surface had an increase to 55% when the bottom material from tank #6 which had 23% solids surface slurry was transfered.

e) Lead Salt Lab Test: This subject requires more work. A set of four bottle cyanidation tests was reported on Sept. 7th with somewhat ambiguous results. The 2 bottles without lead additions gave slightly lower residue gold assays while the two with lead gave higher calculated head assay grades and percentage overall dissolution. No firm conclusions could be drawn from this testwork and it will be repeated on stored plant feed samples before the next operating season.

Schedule Must do. Considering. 25 ppm $S^=$

10. Load Carbon Tank 6: This was an ongoing practice with all of the regenerated carbon plus an additional 60 tons of carbon that was purchased, pre-attritioned and added to tank #6 after the Recovery Improvement Plan was implemented. CIL operators made daily carbon concentration profiles for all the CIL tanks available from September 1st. These were attached as part of the daily Metallurgical Balance Report. Carbon gold assays on the carbon in each tank were only supposed to be available for Tuesdays and Thursdays each week. Actual results proved somewhat irregular but assays were performed at least weekly when tank densities were sufficient to suspend the carbon in the slurry to the tank surfaces.

Schedule Suspension Mixing Must be solved.

11. Control Tonnage 6,000 - 8,000 stpd: This was done pretty much of September. There was a period when the on hand cyanide supply was short and consequentially the tonnage was reduced. Also, in October the plant was ran to maximize tonnage to increase the total ounces of gold recovered from the plant for the year, over 10,000 stpd was acheived on a number of days. There was no clear indication of the residence time effect on recovery percentage as some days it appeared better other times worse.

12. This item was addressed as 9 (b) above.

13. Acid Wash and Regenerate Carbon: Carbon activity testwork showing lower adsorption efficiencies on partially loaded carbon prompted the continuation of thermal regeneration and plant tests showed a need for acid washing. All extra material left over from the assay samples for carbon have been saved and further adsorption testwork is planned. The strips ran in the plant without acid washing were very difficult to perform as slurry clung to the carbon making solution flow difficult. Water washing alone did not clean the carbon sufficiently.

Objectives. Schedule

14. Aeration Prior to Cyanidation: On September 3rd four air lines were installed in the Surge Tank extending to about 5 feet from the bottom of the tank. These were left on for the duration of the operating season. No quantification of the benefit has been done.

Schedule.

15. Electron Microscopy: Past work of this nature on mill flotation and calcine tails was reviewed and Doug Bartlett is arranging to have some weekly composites of TRP tailings examined. Also, AARL diagnostic leaching to determine the deportment of tailings gold or which minerals this gold resistant to a cyanide leach is associated, will be performed over the winter.

Schedule

16. This item was addressed in 9 (b) above.

17. Check Agitator Design: This was done with our conclusion that the design is inadequate. A 1200 cfm compressor was rented to augment the supply from our 400 Hp Ingersol- Rand unit. A capital expenditure request has been made for an 1800 cfm compressor.

Air does not give good solids profile. Solids retention time. Density effects on gold diss. Preg tank limit?

18. Replacement Metallurgist: Giant Yellowknife hired Doug Bartlett as Senior Project Metallurgist on October 3rd. Doug has a Masters degree and considerable experience with laboratory gold metallurgy. D. Kilvari of Kilborn replaced S. Waller also of Kilborn in a consultative and laboratory diagnostic capacity.

19. Reexamine Cyanide Levels: This was done and 1.0 pounds of sodium cyanide per ton of dry tons of tailings treated is the budget number for 1989. TRP final tailings run about 0.3 pounds of free cyanide ion per ton of solution. There remains a question as to the effect of free cyanide ion effect on gold adsorption. A reference has recently been found stating " if you drop below a certain minimum free cyanide content in your adsorption vessels, the gold just doesn't adsorb properly." The reference goes on to further state that at Homestake they kept levels above 0.015% which works out to 0.3 lbs/ton. Regarding the dissolution optimum concentration all indications are that this value is lower than 1.0 lb/ton total cyanide consumption.

20. Optimize Retention Time: Data has been collected but it has not yet been collated nor interpreted. Sample data on the gold concentrations in the liquid and solid phases in each tank are tabulated on the last page of the Daily Metallurgical Reports for those days that assay results are available, generally from about one data set per week starting at the beginning of September. There also were some earlier results which have to be sorted from assay records. This will be done soon. D. Kivari performed 24 hour lab bottle cyanidation tests on 10 TRP tailings composites with mixed results. Based on residue assays alone five samples showed greater than 5% further gold dissolution with a high of 12.2%. Two samples had zero leaching and the last three had a further 2.5% leached. Similar testwork performed early in the operating season when tank slurry densities were low and carbon distributions poor gave recovery improvements of greater than 20%.

High flowrate

Should have no effect.

21. Justify Installation of Delkor Screens: A 45 gallon drum of tailings was sent out for screen design testwork and no report has been received. Delkor Screens definately have the reputation as the solution for solving woodchip problems however our capital expenditure requests for 1989 do not include one.

– Should have run a null case with H_2O.

22. Test Carbon: Other priorities have minimized the amount of time spent on carbon activity testwork and only a few tests were ran. In some of those regenerated carbon performed better than virgin carbon and regeneration seemed necessary. Samples of loaded, stripped and regenerated carbon have been saved so further work can be done.

Action Schedule.

23. CIL Tank No. 1 to be Loaded with Carbon: This was done starting August 22nd.

Follow-up on report.

MEMO TO: Don Cooper

COPY TO: Doug Bartlett

FROM: Bryan Cross

DATE: November 5, 1988

SUBJECT: TRP RECOVERY IMPROVEMENT ACTIVITIES TO DATE.

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9. a) Organic/Inorganic Analysis: This has been done but it was not until October 24th that we received the correct results. We questioned some results on the original September 19th "Final Report" and found sulphur was analysed for not the requested sulphide. Also, wrong results had been originally released. A separate report will be prepared and distributed soon.

b) Carbon Fines: Here we were unable to collect sufficient sample for an assay. S. Waller of Kilborn attempted this without success on August 24th. At that point in time the Carbon Fines Dewatering Screen had been taken out of service. The problem was too much flow for the 100 mesh screen cloth to handle in combination with blinding resulting in splashing of the tails pump motor. The screen panel was removed from the machine and the water directed to the tails box without screening.

c) Assay Wood Fibre: August 24th samples of woodchips taken from the Trommel Screen assayed 0.10 ozs Au / ton, samples of woodchips from the Safety Screens assayed 0.19 ozs Au / ton. The woodchips have been stockpiled and this winter the tonnage and grade will determine if ashing and cyanidation are economic.

d) Tracer Salts: Lithium Chloride was added to CIL tank #6 on September 14th and the tank discharge sampled at 1/2 intervals for 6 hrs with all of the results coming back from the lab as either 0.2 or 0.3 ppm lithium. Subsequent investigation proved that the analytic procedure was inadequate at this level of detection and about three times as much lithium must be added to have any confidence in the results. The Engineering Department performed soundings on the leach vessels which convinced us that the tanks were not settled out however there is no accurate proof of the solids retention time. Pumping out about 12 feet of slurry from CIL tank #6 to #1 did give physical evidence that there definately is settling occuring in the leach vessels. Tank #1 at 26% solids at surface had an increase to 55% when the bottom material from tank #6 which had 23% solids surface slurry was transfered.

e) Lead Salt Lab Test: This subject requires more work. A set of four bottle cyanidation tests was reported on Sept. 7th with somewhat ambiguous results. The 2 bottles without lead additions gave slightly lower residue gold assays while the two with lead gave higher calculated head assay grades and percentage overall dissolution. No firm conclusions could be drawn from this testwork and it will be repeated on stored plant feed samples before the next operating season.

10. Load Carbon Tank 6: This was an ongoing practice with all of the regenerated carbon plus an additional 60 tons of carbon that was purchased, pre-attritioned and added to tank #6 after the Recovery Improvement Plan was implemented. CIL operators made daily carbon concentration profiles for all the CIL tanks available from September 1st. These were attached as part of the daily Metallurgical Balance Report. Carbon gold assays on the carbon in each tank were only supposed to be available for Tuesdays and Thursdays each week. Actual results proved somewhat irregular but assays were performed at least weekly when tank densities were sufficient to suspend the carbon in the slurry to the tank surfaces.

11. Control Tonnage 6,000 - 8,000 stpd: This was done pretty much of September. There was a period when the on hand cyanide supply was short and consequentially the tonnage was reduced. Also, in October the plant was ran to maximize tonnage to increase the total ounces of gold recovered from the plant for the year, over 10,000 stpd was acheived on a number of days. There was no clear indication of the residence time effect on recovery percentage as some days it appeared better other times worse.

12. This item was addressed as 9 (b) above.

13. Acid Wash and Regenerate Carbon: Carbon activity testwork showing lower adsorption efficiencies on partially loaded carbon prompted the continuation of thermal regeneration and plant tests showed a need for acid washing. All extra material left over from the assay samples for carbon have been saved and further adsorption testwork is planned. The strips ran in the plant without acid washing were very difficult to perform as slurry clung to the carbon making solution flow difficult. Water washing alone did not clean the carbon sufficiently.

14. Aeration Prior to Cyanidation: On September 3rd four air lines were installed in the Surge Tank extending to about 5 feet from the bottom of the tank. These were left on for the duration of the operating season. No quantification of the benefit has been done.

15. Electron Microscopy: Past work of this nature on mill flotation and calcine tails was reviewed and Doug Bartlett is arranging to have some weekly composites of TRP tailings examined. Also, AARL diagnostic leaching to determine the deportment of tailings gold or which minerals this gold resistant to a cyanide leach is associated, will be performed over the winter.

16. This item was addressed in 9 (b) above.

17. Check Agitator Design: This was done with our conclusion that the design is inadequate. A 1200 cfm compressor was rented to augment the supply from our 400 Hp Ingersol- Rand unit. A capital expenditure request has been made for an 1800 cfm compressor.

18. Replacement Metallurgist: Giant Yellowknife hired Doug Bartlett as Senior Project Metallurgist on October 3rd. Doug has a Masters degree and considerable experience with laboratory gold metallurgy. D. Kilvari of Kilborn replaced S. Waller also of Kilborn in a consultative and laboratory diagnostic capacity.

19. Reexamine Cyanide Levels: This was done and 1.0 pounds of sodium cyanide per ton of dry tons of tailings treated is the budget number for 1989. TRP final tailings run about 0.3 pounds of free cyanide ion per ton of solution. There remains a question as to the effect of free cyanide ion effect on gold adsorption. A reference has recently been found stating " if you drop below a certain minimum free cyanide content in your adsorption vessels, the gold just doesn't adsorb properly." The reference goes on to further state that at Homestake they kept levels above 0.015% which works out to 0.3 lbs/ton. Regarding the dissolution optimum concentration all indications are that this value is lower than 1.0 lb/ton total cyanide consumption.

20. Optimize Retention Time: Data has been collected but it has not yet been collated nor interpreted. Sample data on the gold concentrations in the liquid and solid phases in each tank are tabulated on the last page of the Daily Metallurgical Reports for those days that assay results are available, generally from about one data set per week starting at the beginning of September. There also were some earlier results which have to be sorted from assay records. This will be done soon. D. Kivari performed 24 hour lab bottle cyanidation tests on 10 TRP tailings composites with mixed results. Based on residue assays alone five samples showed greater than 5% further gold dissolution with a high of 12.2%. Two samples had zero leaching and the last three had a further 2.5% leached. Similar testwork performed early in the operating season when tank slurry densities were low and carbon distributions poor gave recovery improvements of greater than 20%.

21. Justify Installation of Delkor Screens: A 45 gallon drum of tailings was sent out for screen design testwork and no report has been received. Delkor Screens definately have the reputation as the solution for solving woodchip problems however our capital expenditure requests for 1989 do not include one.

22. Test Carbon: Other priorities have minimized the amount of time spent on carbon activity testwork and only a few tests were ran. In some of those regenerated carbon performed better than virgin carbon and regeneration seemed necessary. Samples of loaded, stripped and regenerated carbon have been saved so further work can be done.

23. CIL Tank No. 1 to be Loaded with Carbon: This was done starting August 22nd.

In closing you would be interested to know that if sufficient carbon of good quality had been in the CIL process with proper distribution the tailings solution loss could have averaged 0.001 ouncesof gold per ton. At 0.001 oz/ton the dissolved gold loss would have been 1997.645 oz rather than 6771.190 oz. The 4774.265 ozs lost through poor adsorption efficiency lowered the overall gold recovery from 29.44% to the obtained 23.18% for the year.

Bryan Cross

Giant
YELLOWKNIFE MINES LIMITED

MEMO TO: Don Cooper; Sadek El-Alfy

CC: Bryan Cross; Sean Waller; Steve McAlpine

FROM: John Bartrum

DATE: August 22, 1988

SUBJECT: **TREATMENT PLANT PERFORMANCE - REPORT NO. 1**

---

1. Following the change in metal accounting technique the problem statement now appears to be "of the 35-40% gold leached from the solids - close to half of this is lost to solution tailings.

2. High solution losses are generally associated with:

   ✓ (a) rate of carbon transfer through and out of the CIL tanks;
   ? (b) returned reactivated carbon barren levels are far too high;
   × (c) carbon activity too low;
   ✓ (d) other cations Ca, K, Si, Ti, Cu, As, Fe, Mn, Zn, Cr, Ni, Pb and Cd will load on to carbon resulting in poor gold loading and the need to transfer faster;
   ✓ (e) very fine dispersions of attritioned carbon can inflate solution loss;
   ✓ (f) soluble gold may be occluded in hydrated Fe_2O_3 suspensions;
   ✓ (g) soluble gold may be adsorbed by humic acids;
   ✓ (h) tank carbon dispersion, suspension, distribution and concentration;
   ✗ (i) tank short circuiting;
   × (j) presence of "preg robbers" other cyanicides;
   ✓ (k) co-precipitation with silver sulphide if silver present;
   (l) insufficient pre-aeration with lime prior to cyanidation;
   ? (m) the need for carbon loading prior to aeration.

3. As recommended in a previous fax it is essential that a complete and representative 100% chemical analysis be carried out on associated process solutions. For example, we know that the cations in (d) above are in the tailings in major proportions - Ref: Golden Dumps Report No. 98, but not how much is in solution. S, Th, Sr and W are present in minor proportions - but how soluble?

4. The carbon (loaded) should also have a complete analysis to see which of the cations adsorb significantly.

5. It would also be interesting to see what turns up in the bullion.

6. In the meantime carbon transfer rate should be accelerated and carbon loaded in the back end to save the approximate $1.0M CDN/month, and worry about the stripping problem later. There are current physical limitations and these should be addressed urgently.

7. The other part of the chemical question is "are there any elements in solution that will retard gold dissolution" for example:

    (a) soluble sulphides;
    (b) antimony in solution.

    This simply serves to emphasize the need for 3 above, and as soon as possible.

8. If there is anything in 7 above then this may help to achieve the goal of greater than 35-40% gold recovery.

9. <u>On the mechanical side</u>:

    ✓ (a) downcomers keep backing up; Problems agitation indicated
    (b) wood fibre stratifies (?) the carbon;
    (c) There is little carbon in the tops of the tanks and the transfer pump suctions are short;
    (d) There is insufficient air to agitate all 6 tanks properly;
    (e) carbon cannot be transferred fast enough (c) and (d) plus screen problems.

    All these may in fact disappear when the second air compressor is hooked in. The nett result will probably be less short circuiting, better carbon distributions in tanks and along the train and thus less solution losses.

    The other beneficial side effect may be better solids dissolution.

10. The downcomers appear to be short at halfway down the tank, however, the increased agitation from the second compressor may compensate for this. 30-35'

11. <u>Wood pulp/fibre problem</u>. Delkor linear screens are the only answer. However, this may not be up and running before the freeze. The trommel and trash screens appear to have additional capacity at 8,000 t.p.d. Can you go finer on the mesh size? Would speeding the trommel up help? The wash water on the trash screens is so efficient I believe it is washing the fibre through. Is it possible to float the wood off after the trommel or, use a tank with CIL screens in reverse?

12. <u>Better than 35-40% gold recovery</u>. Increased agitation through aeration may improve solids dissolution as a result of improved retention time and cyanide/solid contact. The addition of lead salts if the results of 7 above are significant will contribute. However, there is still a real and urgent need for some extensive electron microscopy. In a fax from Blower to Driscoll mention is made of 1 oz. dirt. There is a need to establish definitely where the gold is distributed. Blower also states "gold losses in calcine residues, dusts and tailings have decreased over the years." As you are mining the tailings in all 3 dimensions anything is possible, for example gravity concentration, magnetic concentration (as per Morton). As there are only 4 (?) seasons left on this project the work must be done now and urgently.

13. On the work of Morton "magnetic separation testwork" is bio-oxidation of the magnetic and flotation concentrate an alternative to roasting/ leaching?

14. There does seem to be a correlation between tonnes processed and recovery 6,000-8,000 t.p.d. gives 30-35% recovery; 8,000-10,000 t.p.d. gives 20-25%. The lower tonnage gives the higher daily gold production. (I understand that the correlation is rough!) It's about 20 ozs. at lower cost.

15. Carbon Distribution. Once the second air compressor is hooked in and agitation is improved significantly the following work must be completed as soon as possible:

   - carbon concentrations g/l per tank and thus decision to balance carbon loadings;
   - carbon loadings g/t per tank and solution loss per tank to establish CIL profile and CIL isotherms;
   - checks to make sure that carbon is no longer stratified in the tanks.

16. Stripping rates. The general rule of thumb for zadra process solution flow rates is 4-5 gpm/sq. ft. of cross sectional strip tank area - what's ours?

17. Loaded carbon screen capacity. May have to replace this urgently with a larger deck even after conversion to wire deck. Any spare decks around for parallel operation?

18. Carbon tank transfer pumps. Can these be sped up for the short term, once 17 is okay? 450 gpm. 4-5 hrs to transfer 5 tons.

19. Pilot plant results vs. CIL results. Maybe someone with experience with both operations (B. Cross?) should sit down and analyse what is significantly different, unique or peculiar between the two operations. This may help towards problem solving the CIL circuit.

20. Solution losses. While after so many years of operations, the assay lab should be highly creditable, are the solution assays real: I think they are but they should be checked by an external lab.

21. Ultra fine carbon losses. I think these may be playing a significant role in the overall metal accounting and could be inflating solution losses. Maybe they cancel out feed vs. tail, however, it should be checked.

22. Golden Dumps Research of significance to this problem:

   - Pyrite has been largely oxidized to goethite which should mean some hydrated iron oxides around;

- There is gold occlusion by goethite;

- Mineral acid treatment viz aqua reqia will give higher gold recoveries by cyanidation but are probably uneconomic;

- Sulphide content of the tailings was 0.1% or 1,000 ppm (?). If some of this is soluble it will give poor leach kinetics.

23. Head grade vs. recovery. To measure this accurately head grade should be measured against solids dissolution recovery. Overall recovery is distorted currently by not absorbing solution gold. Note pilot plant results showed good correlation.

24. Wood fibre adsorption. In the pilot plant this assayed 20-30 ozs/ton. Apparently it is only 5 ozs/ton in the CIL plant - why? Poor contact? Short circuiting, etc., etc.?

25. Froth. There are significant amounts of froth in the CIL tanks apparently as a result of frothing agents, surfactants and sewage dumped into the tailings pond. How damaging are these organics on the carbon? Of the 200 or so tonnes inventory how much is really active??

26. Lab vs. pilot plant and CIL plant. Laboratory results show 48% extraction is possible after 48 hours. The pilot plant achieved 35%, CIL plant? What would cause the 13% drop from lab to pilot plant to CIL plant?

27. Some plants treating reclaimed tailings which contain oxidized pyrite, introduce ferrous ions in solution with detrimental effects on gold recovery. Various solutions are:

    Pre-agitation ahead of cyanidation using:

    (a) portland cement;
    (b) pure oxygen.

28. Finally these suggestions, comments and observations have been made at random over the past 2 days. It is suggested that a meeting be held with the appropriate mining staff to establish which concerns have the highest priority and to set sensible deadlines within which the results can be achieved.

John Bartrum

/kid

APPENDIX TO T.R.P. PERFORMANCE - REPORT NO. 1

What are the Facts as of 22/08/88?

1. Gold solution losses are too high.

2. Carbon loadings are low.

3. Carbon transfer rate is far too low due to physical limitations:

   (a) stratification of carbon in tanks;
   (b) access to carbon through transfer pump suctions;
   (c) carbon (loaded) screen a bottleneck.

4. Agitation via aeration on one compressor is inadequate.

5. The downcomers are far too short.

6. Wood fibre is a problem.

7. The trommel and trash screens have additional capacity at 8,000 tpd.

8. Pyrite has been oxidized to goethite.

9. There is froth in the CIL tanks.

10. CIL performance is less than pilot plant performance.

11. Wood fibre in the pilot plant adsorbed gold to 20-30 ozs/ton yet the CIL plant is only 5 ozs/ton.

12. It has been plant practice to dump unattritioned carbon in the leach tanks with subsequent reporting of super fines to the tailings/return water system.

13. On the basis of general plant practice regenerated gold barren levels of 2 ozs/ton carbon are too high.

14. Significant levels of competing cations have been identified in the solids by X.R.D. Soluble levels are not known.

15. Sulphide levels in the tailings have been assayed at 1,000 ppm Soluble levels are not known.

16. Both CIL and pilot plant results are less than laboratory results.

17. We're losing $1.0M CDN per month.

ASSUMPTIONS AS OF 22/08/88

1. Humic acids are generally associated with rotten vegetation. Tannins

2. Soluble sulphide ions are normally present from rotten vegetation.

3. Stratification of carbon in CIL tanks probably gives poor contact with gold in solution.

4. Downcomers being too short associated with insufficient agitation due to insufficient aeration may contribute to short circuiting.

5. Carbon activity has been downgraded due to the presence of organics.

6. Carbon loadings will be significantly affected by competing cations.

7. Soluble sulphides are usually a by product of the oxidation of pyrite.

8. Solution losses appear to be aggravated by tonnages higher than 7,000 t.p.d.

9. Fine carbon losses may be causing metal accounting problems.

10. Hydrated iron oxides are generally associated with oxidation of pyrite to geothite.

11. There may be significant amounts of antimony in solution.

12. Improved air agitation will improve carbon dispersion, suspension and distribution in tanks.

13. At this critical stage all recycled carbon should be acid washed and regenerated.

14. The current metal accounting technique is correct.

15. There may be a need to pre-aerate with lime and portland cement/pure O_2 prior to cyanidation.

16. The water sprays of the trash screens are pumping wood fibre through the mesh.

17. Gold lost to wood fibre should be included in the metal accounting. 5 ozs. lost per day is significant if only 1 tonne of wood fibre in 8,000 tonnes of ore. Wood fibre is also lost prior to the CIL feed.

18. Some coarse free gold maybe short circuiting inflating solids loss.

ACTION AS OF 22/08/88 BASED ON FACTS/ASSUMPTIONS

1. Improve agitation through increased aeration.

* 2. Carbon transfer rate has to be accelerated urgently. Address bottlenecks:

   (a) loaded carbon screen;
   (b) transfer to stripping;
   (c) stripping performance;
   (d) others.

3. Downcomers to be extended, if 1 above fails to prevent short circuiting.

4. Examine smaller mesh on trommel, trash screens and address possible spray problem.

5. Examine why CIL performance is less than pilot plant performance.

6. Attrition all carbon returned to the process. Aug 21

7. Try to aim for the lowest possible gold loading on returned activated carbon within the constraints of stripping limitations.

* 8. Extend carbon transfer pump suctions. Aug 21

9. Carry out a complete organic/inorganic analysis of the process solutions. IN PROCESS

10. While addressing above problems load carbon into the back end of the process. Aug 22. 5T/day

* 11. Maintain tonnages 6,000-8,000 t.p.d. until solution loss is under control.

12. Examine metal accounting with respect to fine carbon losses and wood fibre losses.

? 13. Acid wash and regenerate all recycled carbon.

14. Examine pre-aeration prior to cyanidation.

15. Examine gold distribution in tailings using electron microscopy.

16. Complete analysis of loaded carbon required.

17. Density control.

18. LiCl, $PbSO_4$

19. Assays.

COMPLETION DATES FOR ACTION PLAN

1. In progress - compressor installed August 22nd.

2. To increase rate of carbon transfer:

   a) Tank to tank transfer

      - must improve densities - current range is 38-43% which is good;

      - improve agitation - done by installation of compressor - carbon distribution as of August 23 results in a calculated tonnage of 255 whereas actually have added 230 - very close - good dispersion;

      - extend transfer pump suctions by 5 ft. - 5 of 6 pumps done by August 23.

   b) CIL tanks to plant, i.e. loaded carbon

      - improve feed rate and slurry removal on loaded carbon screen - plan to change to 35 mesh woven wire screen. Simplicity to contact Don Cooper on August 24 for prices and delivery - should take 3 hours to transfer 5 tons.

   c) Acid Wash

      i) - deleted for time being - calcium is 0.14% still low;

      - Cu also low at 0.05%;

      - metal contents to be monitored weekly - will not let Ca exceed 0.50% - increased from 14 ppm at end of June to 1400 ppm at mid August - average 28 ppm per day - may have 128 days;

      - must note that acid wash can have significant effects on activity even without regeneration;

      ii) speed up carbon washing by doing 2 b) above for slurry removal - changeover of Derrick screens to wire mesh will eliminate entrance of excessive wood on new production - done August 19;

      iii) speed up of eduction process from acid wash vessel to strip vessel - minor problem now 4-6 hours required may be reduced to 2-3 hours depending on operating changes or replacing with larger eductors or by pumps - examine August 25.

...2

d) Stripping - extensive research required over a few days will be required to determine plan of action here. In addition, changes to each batch of carbon processed will be going. Current strip times used are 12 hours. Should be 8 hours.

i) increase stripping rate - try increasing flows;

ii) maximize temperature;

iii) maximize electrowinning efficiency - affected adversely by increased flow - increase number of cathodes or steel wool;

iv) eduction of carbon from strip vessel - maximize.

e) Regeneration - increase transfer rate of carbon by deleting this step while doing activity tests - to be monitored weekly - minimum acceptable activity 80% of fresh carbon - tests August 23/24.

Circuit Retention Times (target ranges)

1.	transfer loaded carbon to acid wash	3 hrs.	
2.	acid/caustic wash, etc.	1.5 hrs.	
3.	educting to strip vessel	2-3 hrs.	
4.	stripping and heat up/cool down	8-12 hrs.	
5.	educt from strip vessel	<u>2-3 hrs.</u>	
6.	regeneration (500 lbs./hr. design)		20 hrs.
	Total	16.5 to 22.5 hrs.	

A time study is required to determine how often regeneration can be done for the various time ranges since 2 strip vessels are used - August 24.

3. May not be necessary - if determined to be will be done after shut down.

4. i) Finer mesh already in place on Derrick Trash screens 45 mesh wire for 2 of 3 panels on each screen deck. Urethane panels were 20 mesh slots - completed August 19;

ii) Trommel screen - new screens will be on site by end of month to replace worn out units on trommel screen - <u>August 31</u>;

iii) Order conical sprays - check volume rating on existing sprays - <u>August 24</u>;

iv) Order spare screens for trash screens - check for finer mesh sizes <u>August 24</u>;

...3

5. Examine pilot plant - tank sizes, impeller type, diameter, distance from bottom, baffle dimensions, feed downcomer diameter and distance from bottom agitator horsepower and rpm, blower rating - Sean and Bryan August 24.

6. Carbon added initially and that added to tanks 2 and 3 later on were added directly. Since that time any extra carbon has been attritioned 1/2 hour in the attrition tank prior to pumping to CIL.

7. Is being done to the best of our current ability on limited data from few strip batches. Stripped carbon ranges from 2 to 5 oz/ton Au and averages about 3 oz. Au/ton. Maximum flows through strip circuit is about 60 to 65 USGPM which is limited by the electrowinning cells and pressure control system as well as possibly the heat exchange system. Normal flow rates used are 45 to 50 USGPM. J. Bartrum suggests 80 to 100 USGPM or 4 to 5 gpm/ft^2 of column area should be used.

8. Five of six pumps completed August 23, remainder will be done by August 25.

9. a) The following samples were sent out for analysis August 23:

   CIL Feed Solution
   CIL Tails Solution
   Loaded Carbon
   Stripped Carbon.

   The following will be sent during the next strip cycle when samples can be collected:

   Electrowinning Cell Feed (Pregnant Solution)
   Electrowinning Cell Tails (Barren Solution)

   Analyses: Ca, K, Si, Ti, Cu, As, Fe, Mn, Zn, Cr, Ni, Pb, Cd, Au and Ag
   S, Th, Sr and W - soluble portions
   tannic and humic acids.

   b) Tails to be checked for carbonaceous fines - August 24;

   c) Take samples on wood pulp at trommel and Derrick Trash Screens, Tank No. 6 - check for Au - August 24;

   d) Order 5 kg of lithium chloride August 24
   Lead Nitrate or Lead Acetate for removal of possible soluble sulphide effects - check prices based on 0.05 lb/ton and 0.25 lb/ton addition rates (400 to 2000 lbs./day) - August 24;

   e) Do lab tests using 0.01, 0.05, 0.25, 1.0 lbs./ton dosage of lead salt at pH 10.0 to 10.5, 24 hours, 40% solids and 1.0 lb/ton sodium cyanide additions - August 25/26;

...4

10. Carbon addition was commenced August 21 and is ongoing such that 5 tons minimum of a combination of fresh and stripped carbon is being added per day.

11. As of August 22 the tonnage is being held to a maximum of 8000 tpd.

12. See 9 b) above - assay solution before/after fine filtering - August 24. Find out assay lab technique for solution assays.

13. We disagree only to the point that the activity will be monitored closely. J. Bartrum has agreed to this only because of the necessity of increasing carbon transfer.

14. Dissolved oxygen levels to be checked at trommel screen, trash screens, feed to surge tank and CIL No. 1 feed August 24.

15. Sample of plant feed to be collected and sent out for analysis. This is not as critical at this time as the other items. To be sent by August 28/29.

16. See 9 a) above.

17. The importance of receiving assays over the weekend for the next month cannot be over emphasized. Check with Bill Richardson to have personnel available August 24.

Effect of Cake Washing

1. Do Oct 22.

Feed solids 0.050 (solids + preg).
Feed solution 0.0025 oz/ton.
Slurry SG 1.33

In 100 tons. slurry.

	Actual	Unwashed
39.48 tons solids. x .055 =	2.1714	2.238
60.52 tons solution x 0.0041 =	.248	.248
Combined Head Assay .061 =	2.419	2.486
	39.48	39.48
		.063

Case I

~~Filter~~

% H_2O = 30

Feed Solution = 0.0041 oz/ton

feed solids = 0.055 actual.

Feed to Storage TANK =

If cake is not washed, 100 ~~tons~~ cake.

70 tons x 0.055 oz/ton = 3.85 oz
30 tons x .0041 oz/ton = 0.12 oz.

Unwashed cake assay = 70 tons 3.97 oz
= .0567 oz/ton.

Tads Cake.

70 tons x .046 oz/ton =	3.22	2.73
30 tons x .0008 oz/ton =	.024	.02
70 tons.	3.244.	2.75

Unwashed cake assay = 0.0463

ight Washed Coke Recovery $= 1 - \frac{.046}{.061} = 24.6\%$

Wrong UnWashed coke Recovery $= 1 - \frac{.0463}{.063} = 27.0\%$

2.4

Washed Coke Recovery $= 1 - \frac{.039}{.061} = 36.0\%$

Unwashed Coke Recovery $= 1 - \frac{.0393}{.063} = 38.1\%$

2.1

SECTION 3.

REVIEW OF TAILINGS RETREATMENT PROJECT

Giant Yellowknife Mines Limited

Yellowknife Division

Kelvin Fiedler

September 1988

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1. SUMMARY OF LABORATORY TESTWORK

1.1 Lakefield Research has conducted a considerable amount of testwork on tailings samples submitted by Giant Yellowknife Mines.

1.1.1 Test Conditions

The standard test procedure adopted by Lakefield was a leach (or CIL test) with an initial cyanide solution concentration of 1000 ppm and pH controlled between 10.5 - 11.0.

The samples tested had characteristics such that cyanide additions were required during the tests to maintain adequate cyanide concentrations. Additional lime was required in some tests. The ongoing cyanide and lime consumptions which occurred in most tests, indicate the presence of cyanicides within the feed material. Dissolved oxygen levels were monitored and were generally steady over the duration of the tests.

1.1.2 Gold Recovery

Most laboratory test results gave recoveries between 30-40%.

Recovery improved slightly for longer dissolution times.

Attached is Figure 6 from the Lakefield Research report of August 24, 1988.

The graph shows an almost linear increase in recovery with respect to time after 16 hours dissolution. This is an unusual dissolution profile which could result from:

- incomplete dissolution of coarse gold;
- chemical inhibition of dissolution, or passivation of gold surfaces which retard dissolution;
- poor exposure/liberation characteristics of gold particles.

1.2 Laboratory results have been confirmed by Pilot Plant testwork. It is important that routine laboratory cyanidation tests are conducted on TRP feed samples to assess whether laboratory results reflect actual TRP operation, or give consistently better results than the TRP.

Several intensive cyanidation tests should be performed in parallel with laboratory cyanidation tests on TRP feed, to assess if improved recovery can be obtained under extreme test conditions.

Re-cyanidation of the TRP tailings samples should be conducted to assess if dissolution will continue on a laboratory scale.

2. SUMMARY OF PILOT PLANT TESTWORK

2.1 Recovery

The average gold recovery for the Pilot Plant test programme was 35.0%, which resulted from 38.9% gold dissolution, and 89.7% gold adsorption from solution onto carbon.

A histogram of daily percent dissolution values is shown in Figure 2.1. The daily dissolution values had a range from a low of 29.9% to a high of 48.2%.

The daily dissolution and adsorption results are shown in Figure 2.2. The plot of dissolution results shows considerable variability on a daily basis. It is important to note that although the results do show considerable variability, the daily dissolution results were generally above 35%.

It is understood that tailings solution losses were controlled by the addition of additional carbon to the tanks. It is unclear what carbon concentrations were in the Pilot Plant CIL tanks. It appears quite rapid fouling of the carbon occurred which required charging of fresh carbon. (Refer Figure 2.3 - plot of tailings solution loss versus date).

2.2 Dissolution Kinetics

A plot of the Pilot Plant (average) dissolution curve is shown in Figure 2.4.

Dissolution is reasonably rapid. This would be expected as the feed material was predominantly reclaimed from the Polishing Pond which has a relatively fine size distribution.

Cyanide was normally added in Tanks 1, 2, and 3. The raw data suggests cyanide was added to the Stock Tank from July 24 to July 29 inclusive, though it appeared not to make any significant difference to the ultimate recovery.

2.3 Reagents

2.3.1 Dissolved Oxygen

No dissolved oxygen data was included in the data reviewed. It would be expected that the slurry in all tanks would have been well saturated, as the compressor used for the Pilot Plant had excess capacity and had to be vented to atmosphere.

2.3.2 pH

Lime was mixed batchwise and the additions averaged over the duration of the Plot Plant. pH levels were generally above pH 10.0 except for the last eight days of operation.

The lime addition averaged 1.23 lb/s.t.

2.3.3 Cyanide

Cyanide was mixed batchwise and the additions averaged over the duration of the Pilot Plant.

The average cyanide addition was 2.01 lb/s.t.

Average free cyanide values to tailings were generally greater than 0.7 lb/s.t.

2.4 Agitation

It is expected that very efficient agitation was experienced in the Pilot Plant tanks, given the mechanical agitation was complimented by large volumes of air.

2.5 Discussion

2.5.1 Although the average recovery was 35.0% for the Pilot Plant testwork, dissolution results were quite variable.

Dissolution kinetics were quite rapid (for the averaged data), though this would be expected given the solids size distribution. Dissolution continued, though very slowly, with a cyanide contact time greater than approximately 20 hours.

There is insufficient plant data from the TRP to allow comparison of the Pilot Plant dissolution profile with TRP plant operation.

The Pilot Plant data supports laboratory bottle roll tests, which also indicate rapid dissolution kinetics.

The importance of rapid dissolution should not be underestimated in the setting of reagent levels and carbon concentrations in the TRP tanks, i.e. the first CIL tank should have a considerable excess of free cyanide to promote dissolution, together with a high carbon concentration to ensure the solution loss from Tank 1 is low.

2.5.2 Although no dissolved oxygen data for the Pilot Plant has been sighted, it is expected that all tanks contained highly saturated slurry. Recent TRP surveys have shown D.O. levels in the Surge Tank feed and Tank 1 feed to be lower than the remainder of the tanks.

It appears that there is a major difference between the D.O. levels of the Pilot Plant operation, and the TRP.

2.5.3 The lime addition to the Pilot Plant averaged 1.23 lb/s.t., with pH values generally above 10.0.

Given the refractory nature of the Yellowknife ore, it is expected that the tailings to be treated may contain a considerable amount of soluble metal ions.

It is therefore not only important to maintain a reasonably high pH to give high cyanide activity, but also to precipitate as many soluble ions as possible prior to the addition of cyanide. (Laboratory testwork sometimes required ongoing lime and cyanide additions to maintain reasonable free cyanide concentrations in solution).

2.5.4 The Pilot Plant average cyanide consumption was 2.01 lb/s.t. This figure is relatively low compared to most Australian operations that I am familiar with. It is important to monitor the free cyanide concentration in solution at the head of the circuit to ensure dissolution is not inhibited.

Normally, free cyanide in solution is kept greater than 300 ppm in the tank where cyanide is added. Regular cyanide titration of solutions is important. This allows adjustments to the cyanide addition rate to be made as feed characteristics vary.

2.5.5 Tank agitation in the Pilot Plant would presumably have been very efficient due to the mechanical agitation being complimented with high air additions.

The mechanical agitation in the TRP is inadequate, though good suspension of carbon is obtained with the introduction of compressed air. It still appears unclear if a solids density profile exists in the TRP tanks.

2.5.6 Apparently the majority of the feed to the Pilot Plant originated from the Polishing Pond. A comparison of results should be made between laboratory drill hole recoveries on samples located near the area(s) where Pilot Plant feed was obtained.

3. T.R.P.

3.1 Plant Operation

3.1.1 Carbon Profiles:

Run with more carbon at the front end of the CIL, i.e.:

	Tank 1	Tank 2	Tank 3	Tank 4	Tank 5	Tank 6
Carbon g/L	20-25	20-25	15-20	12-17	12-17	12-17

If more carbon is available, then increase the levels in Tanks 1 and 2 to 25-30 g/L.

Carbon levels in tanks should be checked once per day. It is important (given the agitation problems) that all operators use the same techniques and take samples from the same positions on the tanks.

The mechanical agitation is not satisfactory. I expect there will be sanding problems when the coarser sections of the dams are being processed. I do not see the use of air for agitation as a long term solution.

3.1.2 Dissolved Oxygen:

D.O. measurements should be taken at least every four hours at the stock tank, and all CIL tanks. If the amount of air that can be added is limited by compressor capacity, air additions to the Stock Tank and Tank 1 should take preference over the other tanks. Aim to have the D.O. level of the stock tank at a higher value than the CIL tanks (only time will tell if this is achievable).

Obviously sufficient air must be used to maintain adequate agitation in all tanks - if there are times when there are low D.O. values in the stock tank, air must not be reduced to (say) tank 1 or 2 to a point where efficient agitation is lost.

A more compact hand-held D.O. meter should be purchased to allow CIL operators to take in-tank D.O. measurements.

3.1.3 Cyanide:

Cyanide titrations should be performed every two hours on Tanks 1, 2 & 3. I feel it would be best to run at a solution cyanide concentration of 400-500 ppm in Tank 1. This strategy will mean that operators will have to adjust the cyanide addition rate depending on feed density variations, and variations in the amount of cyanicides entering the circuit.

An in-plant test should be conducted with all cyanide being added to Tank 1, to assist in enhancing dissolution kinetics.

Cyanide savings can be achieved by running at 43-45% solids (provided viscosity and agitator power-draw permits).

3.1.4 pH:

The pH of the Stock Tank should be run at 10.5-10.7. The CIL tanks should not be allowed to drop below pH 10.4. Feed variations may require lime additions along the CIL adsorption train if the oxidation of sulphide minerals continues in the CIL tanks. Even higher pH values may be beneficial.

pH checks of the Stock Tank and Tanks 1 to 6 should be performed every 2 hours.

It is worth considering relocating the pH probe from the trash screen undersize hopper to the stock tank, or Tank 1 feed launder. The existing location gives only a small amount of time for mixing and neutralization of any acidic components of the feed. Locating the probe in the stock tank may make pH control more difficult (due to the response lag), though if there is a continuing consumption of lime in the stock tank there is a chance the pH to Tank 1 could drop below 10.5.

The Stock Tank should be run at reasonably high levels to allow maximum contact with lime and air before coming into contact with cyanide in Tank 1.

A more compact hand-held pH meter should be purchased to allow CIL operators to take in-tank pH measurements.

3.1.5 Carbon Activity:

Carbon activity tests should be conducted at least twice per week on loaded carbon (acid wash feed) and regenerated carbon. If insufficient regeneration capacity is available, then carbon activity tests should be performed on stripped carbon that bypasses the regeneration furnace.

The compressors should be checked to ensure they are delivering oil free air to the tanks.

The use of a finer grade carbon should be investigated for use in the plant (carbon activity is very particle size dependent).

3.2 **Carbon Strip/Regeneration Rate:**

Design figures for a 15 g/L carbon level in the CIL tanks gives a carbon retention time through the CIL of approximately 40 days.

Some carbon has been in the plant for approximately 120 days. The Acid Wash/Strip/Regeneration rate should be increased to move all the carbon through the CIL plant more rapidly.

The design rate is 5 t/day. Ideally 10 t/day should be stripped during the "catch-up" phase, though given the present constraints with the loaded carbon screen and eductors, a rate of 15 t every 2 days may only be achievable. The operating water pressure of existing eductors should be checked. Pipe runs for transferring carbon should be rerouted to minimize bends.

Resolving the loaded carbon screen problem should be a high priority. Baffles should be placed across the feed end to reduce the velocity of the feed slurry. The kink in the feed hose should be straightened out. A speed reduction of the pump feeding the loaded carbon screen would allow the pinch valve to be opened up. This would decrease the problem of sanding up at the valve.

3.3 **Regeneration Capacity:**

The design values for regeneration throughput, temperature and retention time need to be obtained from vendor specifications, and checked against actual performance.

It appears that the existing furnace would not be able to process 10 t.p.d. at design operating conditions. A trade-off may be possible between temperature and retention time to satisfy the 10 t.p.d. throughput.

Close attention should be given to ensuring that the carbon quench hopper level is kept up to the required height. Combustion of the carbon will take place if the carbon is not quenched properly, which results in high carbon loss and very soft carbon reporting to Tank 6 (which will be lost through attrition).

3.4 Strip Circuit Water Quality:

The strip circuit operation should be checked against design values, i.e. heat-up and cool-down rates and cell efficiency (especially at high feed solution tenors).

It would be worthwhile to consider using potable or softened water for educting, stripping and quenching, rather than return circuit water. High quality water gives faster strip rates, lower stripped carbon assays, higher carbon activity and reduced scaling of heat exchangers and pipes.

It is normal in Australia to bleed off approximately 30% of the strip solution after each strip. The bleed strip solution is normally routed back to the CIL, or to tailings if the contaminants are high and the gold solution tenor is low (this prevents re-fouling carbon in the plant with contaminants eluted during stripping).

3.5 Trash Removal:

To improve trash removal prior to the CIL circuit, the new woven wire square aperture screens should be installed as soon as they arrive. Cloths should be regularly cleaned with a wire brush. It appears that trash wood chips are being regenerated and sent to Tank 6 with plant carbon. This will lead to gold loss to tailings on the soft carbon that originated from wood chips.

It may be worthwhile trying to place a baffle across the trash screens to reduce the velocity of slurry entry onto the screens. This may reduce the amount of trash that is forced through the apertures by the high velocity slurry.

If the problem of water sprays cutting screen cloths continues, a sacrificial strip of steel, rubber or conveyor belt could be placed below the sprays. Alternatively, can the spray water pressure be reduced?

3.6 Sizing Analyses:

Sizings and assays should be performed on T.R.P. tailings solids to assess the size distribution of solids and gold loss in various size fractions. Suggested size ranges are +53, +37 and -37 micron. This should be performed on a daily basis.

3.7 Tailings Dam Water:

Given the gold content of the water in the tailings dam, consideration should be given to passing tailings dam water through carbon columns. This exercise should be performed by someone other than T.R.P. personnel so that T.R.P. can maintain a high level of input into the plant.

4. RECOMMENDATIONS

4.1 Perform a daily laboratory leach test on TRP feed.

4.2 Perform a daily laboratory leach test on TRP tails.

4.3 Perform a daily sizing and assay on TRP tails.

4.4 Perform several intensive cyanidation tests on TRP feed.

4.5 Pan several TRP tails and assay the concentrates.

4.6 Perform carbon activity tests twice per week.

4.7 Compare laboratory test results of drill hole samples (near where the Pilot Plant feed was obtained) with Pilot Plant results.

4.8 Aim for high dissolved oxygen levels in all tanks. (Surge tank.)

* DO meter. 4.9 Purchase a compact, portable D.O. & pH. meter for use on the tanks.

✓ 4.10 Run tank pH's above 10.5 (higher pH's may be more beneficial).

DONE 4.11 Purchase a compact, portable pH meter for use on the tanks.

4.12 Perform in-plant testwork with Tank 1 free cyanide level greater than 400 ppm.

in process 4.13 Run carbon levels greater than 20 g/l in Tanks 1 and 2 (run Tank 1 at 25-30 g/l if possible).

4.14 Install wire square mesh cloths on trash screens as soon as they are on site. hold up due to sprays

4.15 Assess retrofit options for improving mechanical agitation.

4.16 Continue to resolve mechanical problems to allow 10 t of carbon to be stripped per day.

4.17 Increase the size of eductors and lines if improved carbon transfer rates can't be achieved.

4.18 Investigate heating the acid wash solution to improve acid wash rates and efficiency (use regeneration furnace off gasses).

4.19 Investigate the use of potable or softened water for stripping and regeneration quenching.

4.20 Compare strip circuit performance against design criteria.

up temp to 700 °C

4.21 Compare regeneration furnace performance against design criteria.

4.22 Investigate using regeneration kiln waste heat to pre-dry carbon in the regeneration furnace feed hopper.

4.23 Ensure the regeneration furnace quench hopper water level is maintained at the correct height.

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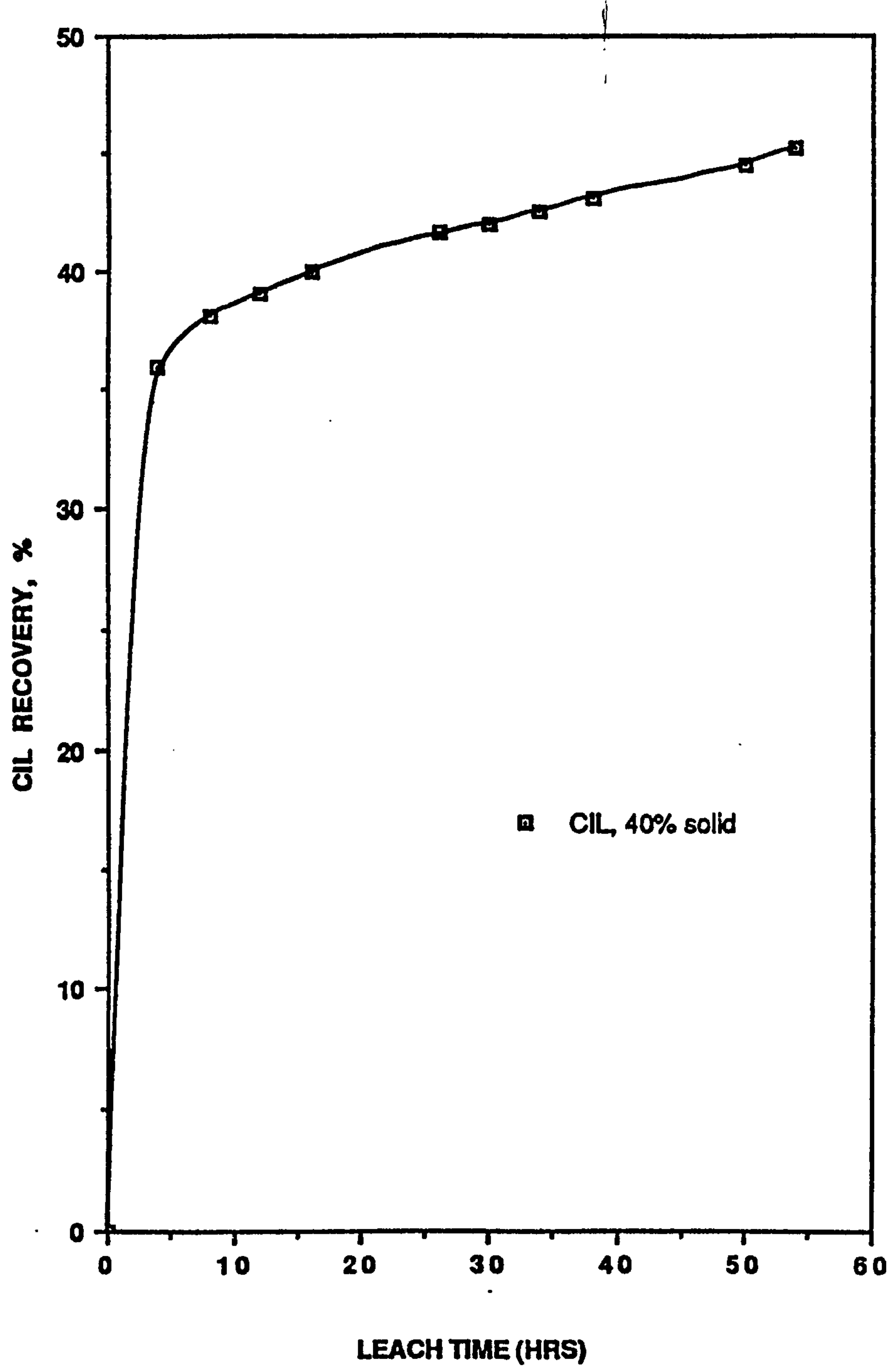
FIGURE NO. 6 COMPOSITE No. 1-12 (inclusive)



PILOT PLANT RESULTS: HISTOGRAM OF % DISSOLUTION.

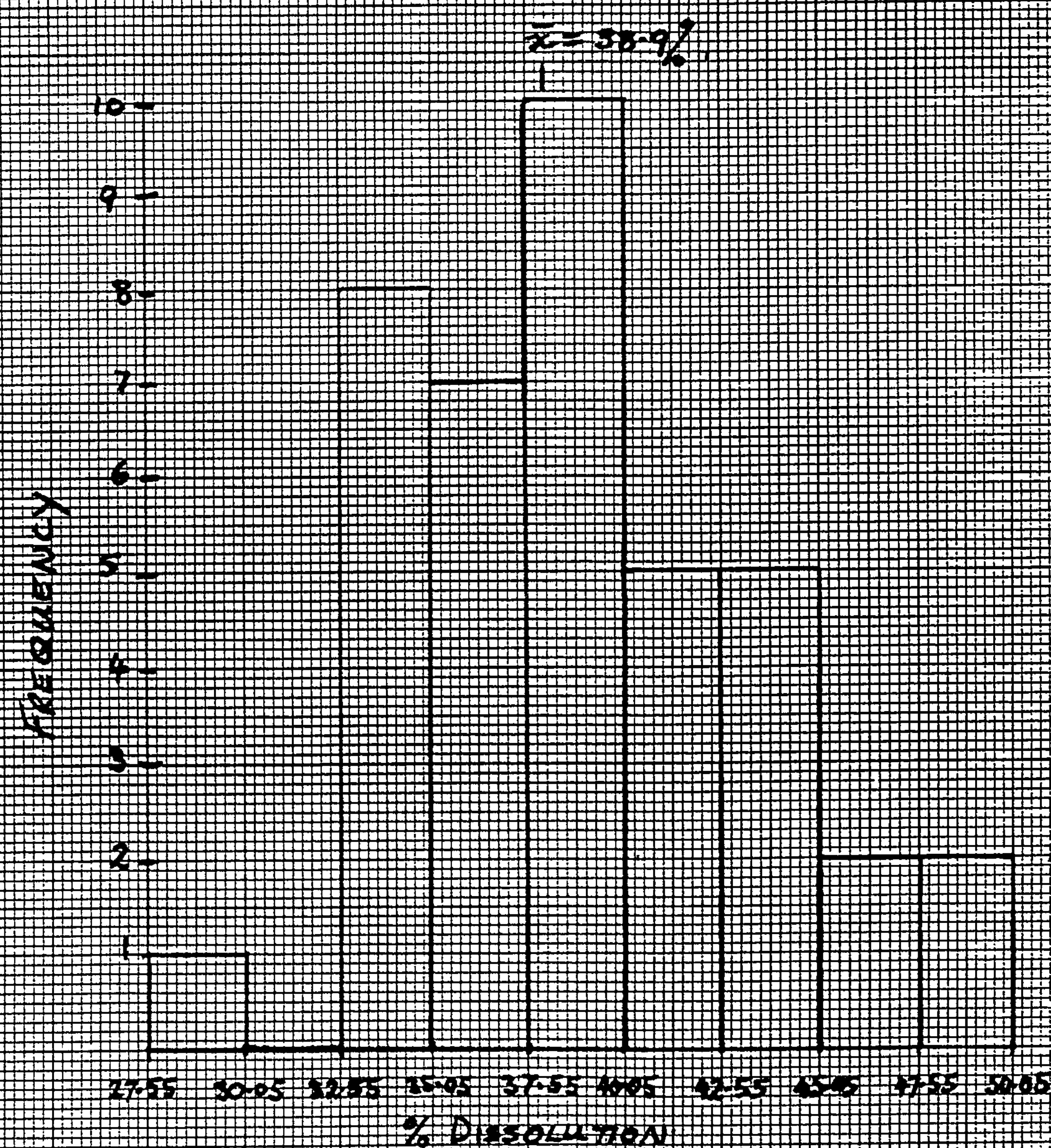


FIGURE 2.1.

PILOT PLANT RESULT - DAILY DISSOLUTION •
- DAILY ADSORPTION +

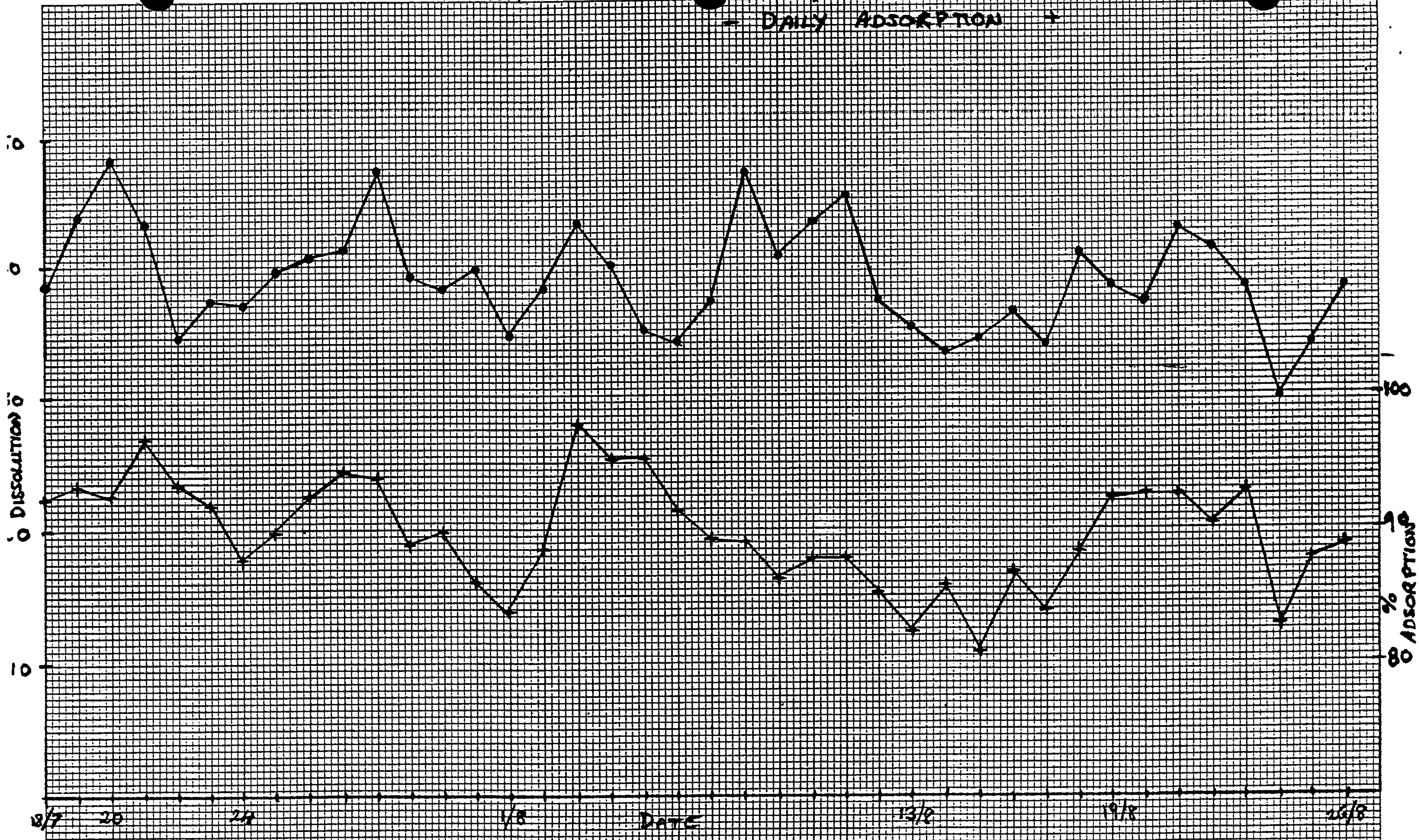


FIGURE 2-2

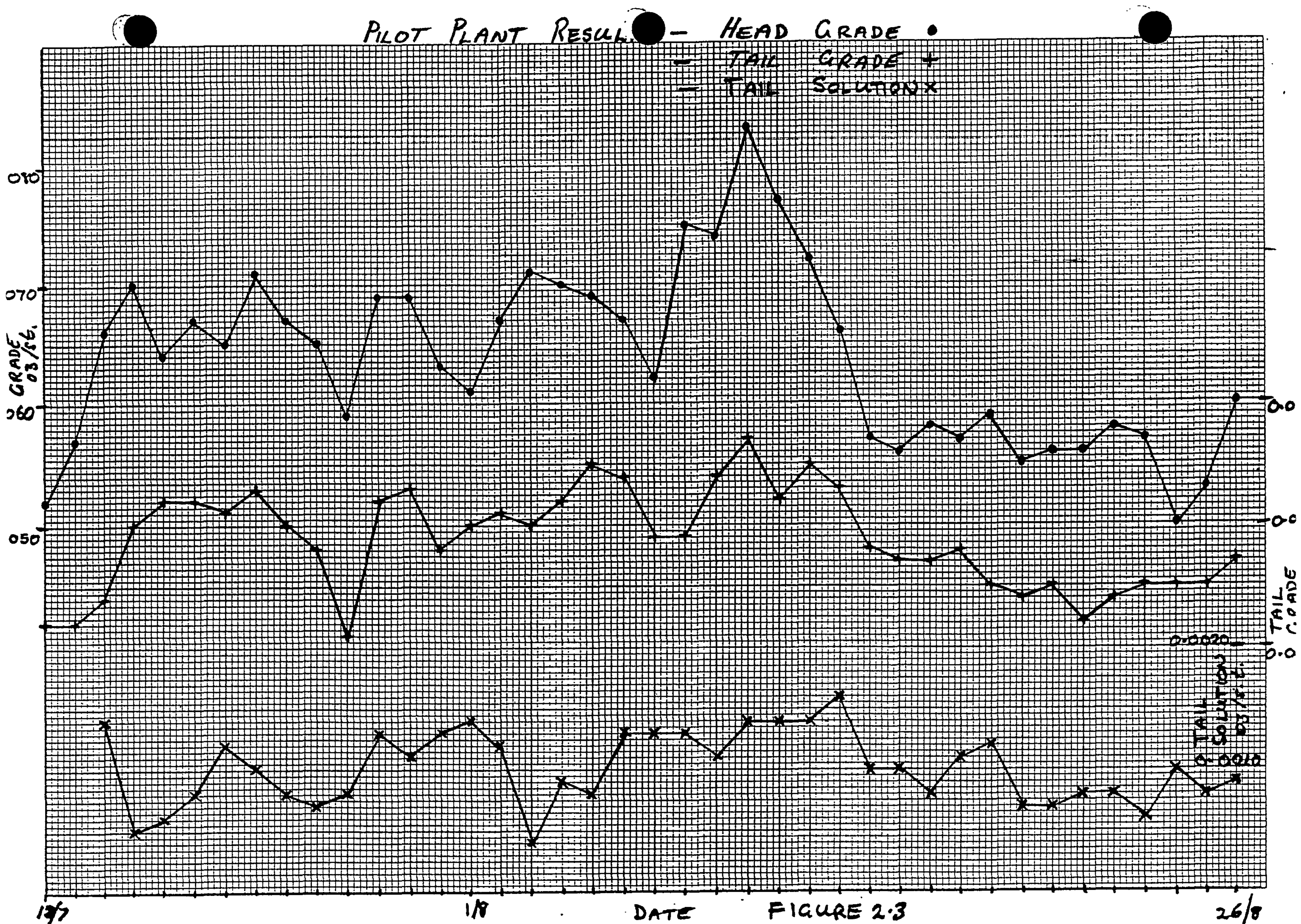

PILOT PLANT RESULTS - HEAD GRADE •
- TAIL GRADE +
- TAIL SOLUTON x
080
070
060
050
GRADE 03/5t.
0.0
0.0
0.0
TAIL GRADE
0.0020
TAIL SOLUTION 03/t.
0.0010
17/7
1/8
DATE
26/8

FIGURE 2·3

PILOT PLANT DISSOLUTION CURVE (AVERAGE OF DATA)

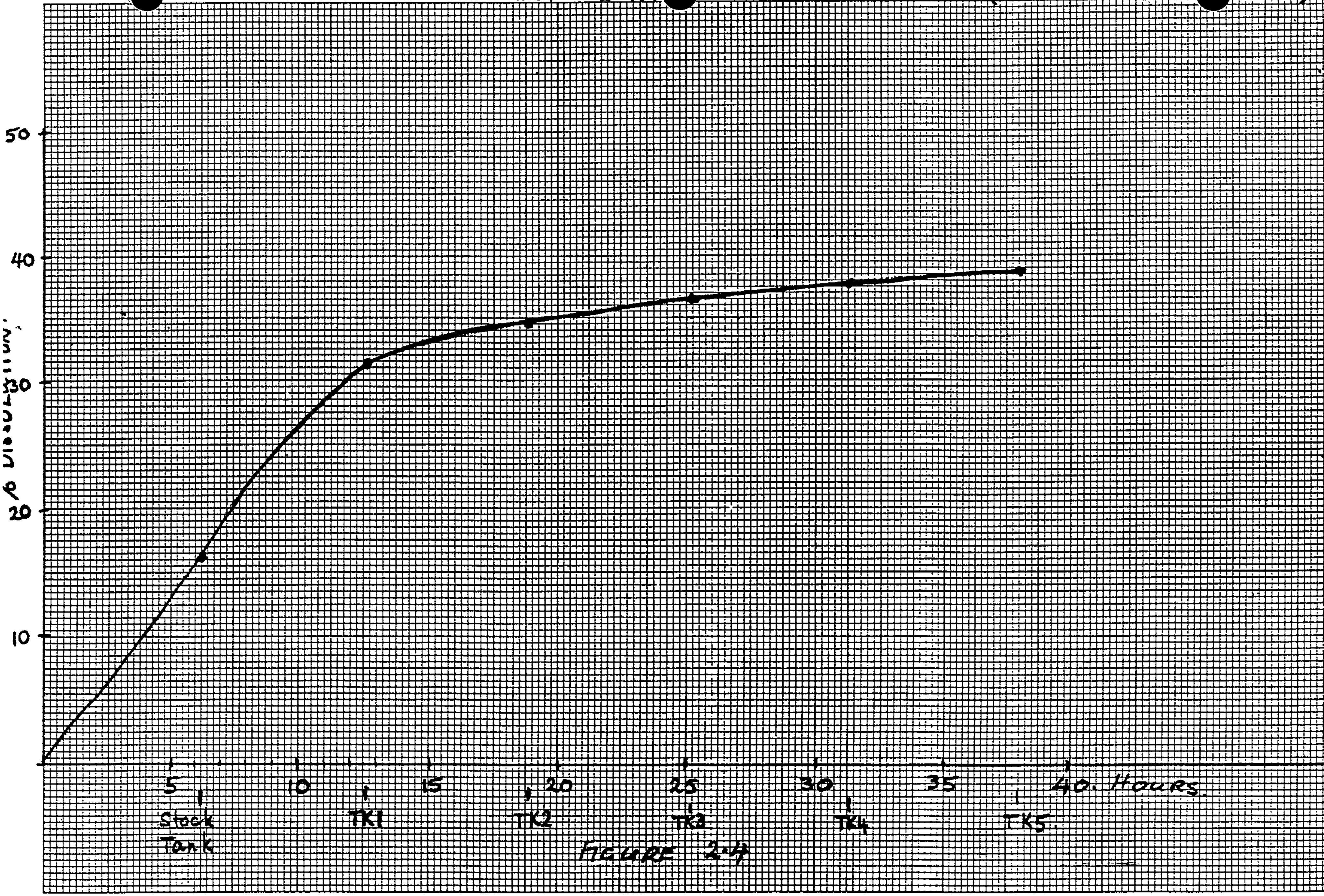


FIGURE 2.4

SECTION 4.