

65/205

COPY

4

COPY 4

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT
BUREAU OF MINERAL RESOURCES
GEOLOGY AND GEOPHYSICS

RECORDS:

1965/205



SURVEY OF MINERAL RESOURCES IN QUEENSLAND

TAILINGS DUMPS

By

R.W.L. King

The information contained in this report has been obtained by the Department of National Development, as part of the policy of the Commonwealth Government, to assist in the exploration and development of mineral resources. It may not be published in any form or used in a company prospectus without the permission in writing of the Director, Bureau of Mineral Resources, Geology and Geophysics.

SURVEY OF MINERAL RESOURCES IN

QUEENSLAND TAILINGS DUMPS.

by R.W.L. King

RECORDS 1965 - 205.

Table of Contents.

	page
SUMMARY	
INTRODUCTION	1
SCOPE OF SURVEY	1
METHOD OF SAMPLING	2
RESULTS - BY AREAS	3
ROCKHAMPTON .. INSPECTOR'S DISTRICT	3
Eidsvold	3
Hector Mine	3
Cawarral	3
Mt. Chalmers	4
Mt. Cannindah	4
Mt. Shamrock	4
CHARTERS TOWERS INSPECTOR'S DISTRICT	5
Ravenswood	5
Liontown	6
Black Jack Mine	7
Mt. Leyshon	7
Charters Towers	7
HERBERTON INSPECTOR'S DISTRICT	11
Silver Valley	11
Nymbool	12
Brownville	12
Croydon	12
Kidston	14
Ninety-Mile Copper Mine (Hall's Reward)	14

The information contained in this report has been obtained by the Department of National Development, as part of the policy of the Commonwealth Government to assist in the exploration and development of mineral resources. It may not be published in any form or used in a company prospectus or statement without the permission in writing of the Director, Bureau of Mineral Resources, Geology and Geophysics.

	Page
QUEENSLAND MINES DEPARTMENT SAMPLES	15
HERBERTON INSPECTOR'S DISTRICT	15
Irvinebank	15
MT. ISA INSPECTOR'S DISTRICT	15
Mt. Cobalt	15
Lawn Hills	15
MINING COMPANY SAMPLES	15
Golden Plateau N.L. Cracow	15
Mt. Morgan Ltd., Mt. Morgan	16
Mary Kathleen Uranium Ltd.	16
RESULTS BY ELEMENTS.	17
Beryllium	17
Cobalt	17
Indium	17
Germanium	17
Silver	17
Gold	18
Bismuth	18
Molybdenum	18
Tin	18
Tungsten	18
Chromium	18
Gallium	18
Vanadium	19
Lead	19
Zinc	19
Copper	19
CONCLUSIONS AND RECOMMENDATIONS	19
ACKNOWLEDGEMENTS	20
REFERENCES	21
APPENDICES	
IA Detection Limits of Spectrographic Analysis	
IB Detection Limits of Spectrographic Analysis - Irvinebank Sample	
II Detailed Result Sheets	
III Analysis of Mt. Morgan Samples, supplied by the Company.	

SURVEY OF MINERAL RESOURCES IN

QUEENSLAND TAILINGS DUMPS.

R.W.L. KING.

SUMMARY.

Selected tailings dumps in Queensland were sampled and measured and the samples examined by radioactive, spectrographic and chemical analysis for the less common elements. The highest grade tailings were at the Silver King Mine, Lawn Hill.

INTRODUCTION.

The purpose of the survey was;

(i) to disclose possible sources of the less common metals which are coming into prominence for such purposes as structural materials in nuclear engineering, in alloys of superior performance at high temperatures and for high purity metals and alloys with particular electronic properties;

(ii) to indicate dumps which, by reason of their size and metal content, may warrant re-treatment because of factors such as improved mineral dressing techniques, improved metal prices or the presence of metals of newly acquired importance mentioned in (i) above;

(iii) To discover sources of metals which would not, in the past, have been expected in certain types of deposit, but are now known to be sometimes found in them.

Surveys of dumps in New South Wales and Tasmania have been completed and the results reported elsewhere (King 1964 (a) and (b)). It is hoped to cover the rest of the states and the Northern Territory in due course.

SCOPE OF SURVEY.

The dumps selected for sampling were chosen following reference to the Queensland Mines Department, examination of general references and discussions with individual district Inspectors of Mines and geologists of the Geological Survey. Selection was based on size of dump and complexity of mineralization, together with consideration of obtaining a representative cover of dumps in the State.

As in the previous surveys, analytical work on samples was carried out by the Australian Mineral Development Laboratories. It included a qualitative assessment of radioactivity, with a detection limit equivalent to 0.002% U₃O₈. The limits of detection of the spectrographic method used are set out in Appendix IA. Silicon, aluminium, iron, magnesium, calcium, sodium, potassium and titanium (the "matrix" elements), were not sought. Chemical analysis was used for sulphur and selenium, detection limits being sulphur fifty

parts and selenium one part per million respectively. In the case of samples from Irvinebank State Treatment Works, selenium analysis was carried out by Xray fluorescent spectrometry with a lower limit of detection of about 10 parts per million, and spectrographic analysis to limits set out in Appendix IB.

METHOD OF SAMPLING.

Samples from dumps not associated with operating mines were collected in June 1964. Samples were composited from a number of smaller quantities taken by shovel, approximately six inches to one foot below surface, from a number of places in the eroded surfaces on tops and edges of the dumps.

Volumes of the dumps were measured, using pacing and compass surveys, and tape and clinometer to establish heights in some cases. Where the quantities of material available were obviously very large, the estimates of size were made in a more approximate manner, both because of the time involved in measuring them even approximately and also because the exact size of the dump is only important where a possibility of exploitation may be ruled out because of lack of reserves of material. Some arbitrary assumptions were made in cases where dumps were very irregular and the time consumed in making a detailed survey could not be justified. A factor of 20 cu.ft. = 1 ton was used in calculation of tonnages. Because the slope and shape of the ground surface beneath the dumps was not known, tonnage estimates are very rough and should be regarded as giving only the general order of size of the dumps.

Dumps associated with operating mines were sampled by the mining companies, who supplied estimates of the tonnages represented by the samples forwarded.

Each sample was about five pounds in weight and was subsequently divided into two roughly equal portions. One portion was used for the standard set of tests while the second was retained for possible mineragraphic examination or other tests if these were warranted by the analytical results and the size of the dump represented by the sample.

RESULTS - BY AREAS.

The semi-quantitative spectrographic measurements made on each sample are set out in the following paragraphs, together with a description of the location of the dumps, the samples taken and the tonnages represented by these samples. At the end of this Record, detail sheets set out the complete analytical results for each sample, including elements detected but not determined more closely than within the ranges of major (100 - 10%), minor (10 - 1%), heavy trace (1 - 0.1%), trace (0.1 - 0.01%), faint trace (0.01 - 0.001%) and very faint trace (0.001 - 0.0001%).

The results are set out by groups corresponding generally with the various Mines Inspectors Districts. Analyses of samples supplied by companies are discussed at the end of the section. Where no detailed geological references are given, the Queensland Mineral Index (Dunston 1913) will often provide some useful background information.

ROCKHAMPTON INSPECTOR'S DISTRICT.

Eidsvold - The dump sampled was estimated to contain 50,000 tons and was located at the foot of the hill approximately half a mile north-west of the township. There are isolated overgrown sand and slime dumps in this area but they are all much smaller than the dump sampled, which is being used as a source of sand for constructional purposes from time to time. There appear to be remnants of another dump in the creek, immediately to the south of the town, but this appears much overgrown, and from its location, had probably been retreated. It was not sampled or measured.

The one sample taken - number 64/24/055 gave the following results on analysis: silver 0.0006%, arsenic 0.25%, lithium 0.02%.

Hector Mine, Rockhampton. This old mine area is situated adjacent to the Mt. Morgan road, about 6 miles south of Rockhampton and on the north side of the road. One sample, number 64/24/054, was taken from the dump of slimes in this locality estimated at 3000 to 5000 tons. Elements measured were; copper 0.09%, arsenic 0.25%, silver 0.0006%.

Cawarral, Rockhampton - This mine area is now a butcher's paddock adjacent to tennis courts and visible from the road which crosses the

railway line at Cawarral Railway Station, 23 miles north-north-east of Rockhampton. The area is about half a mile north-east of the station. The sands have been retreated and, as a result, are fairly scattered, the tonnage remaining appearing to be of the order of 3,000 to 5,000 tons. Elements measured in sample 64/24/053 from this area were: chromium 0.08%, silver 0.0004%.

Mt. Chalmers, Rockhampton - Refer to Fisher and Owen (1952) for a detailed description of this area, situated on the Yeppoon railway line to the north-east of Rockhampton near Cawarral. The dumps from the flotation process used when the mine worked from 1908 -1914 are visible from the main road at the railway crossing, and the slag dump from the 300 tons per day copper blast furnace is further away to the north-east beyond the open cuts. The tailings dumps are very irregular and eroded but were estimated to contain approximately 20,000 tons, chiefly sands, but with some slimes. Sample number 64/24/052 was taken from the sands. The analysis showed silver 0.0002%.

Mt. Cannindah - This area is being investigated by Carpentaria Explorations Pty. Ltd., who were, at the time of the collection of samples, leaching the mine for recovery of copper. From Monto, the mine is reached by turning left (north) from the Monto - Kalpowah - Gladstone road, 21 miles beyond the turn-off to Gin Gin at Kalpowah Sawmill. Proceeding from the main road across a creek and through a gate at 0.55 miles, the mine is reached at the top of a hill a further 0.4 miles from the gate. The first sample, number 64/24/010 was taken from coarse dump material on the north (open cut) side of the hill. The second sample, number 64/24/011, was from mill tailings from beneath the slag dump on the side of the hill adjacent to the access road. Each of these two areas were estimated to contain 3,000 to 5,000 tons of material. The first sample, (number 64/24/010) contained silver 0.002%, lithium 0.03%, and the second sample (number 64/24/011) contained copper 1.5%, silver 0.002%. The silver content is equivalent to approximately two-thirds of an ounce per ton.

Mt. Shamrock - The dumps from the Mt. Shamrock gold mine are situated on the river flats below the mine workings. These are located beyond a gravel pit to the right of a road branching right from the Degilbo - Gayndah

road at 6.5 miles from Degilbo. The gravel pit is 1.1 miles from the main road. The one sample collected (number 64/24/009), was of slime, no sands being seen. However, the area is much overgrown with grass and boring or pitting would be necessary to make any sort of a tonnage estimate. The area was sampled on the advice of Mr. D. Munt, the Carpentaria Exploration geologist, stationed in Monto, who had studied the available records of old mines in the district. 30,000 tons of ore are said to have been treated at Mt. Shamrock. Elements measured in the sample (number 64/24/009) were; bismuth 0.02%, silver 0.0003%. Mr. Munt advised that the only other producer of any size in the district was Mt. Biggenden, but enquiries of the Sergeant of Police in Biggenden revealed that all the Biggenden tailings had been carted away to Brisbane for use in cement manufacture because of their high iron content. The area was not visited.

CHARTERS TOWERS INSPECTOR'S DISTRICT.

Ravenswood - The Totley Silver Mine is located approximately 1½ miles north-east of Ravenswood. At the time the dump was sampled the property was under option to purchase by a Canadian company. The dump was of jig tailings, and consisted of yellow and grey coloured material. A mixture of this was taken as sample 64/24/051 and found to contain; lead 2%, zinc 0.8%, silver 0.008% (equivalent to 2.6 oz. per ton), arsenic 0.8%, rubidium 0.01%. This compares with a head assay of 10 oz. of silver per ton, 3.55% lead and 1.75% zinc in a sample submitted by the owner of the property, Mr. P.E. Kean, to the C.S.I.R.O., Melbourne University Ore Dressing Laboratory. Blaskett, (1947) reported that though tabling and flotation could recover 56% of the silver in a concentrate assaying 41 oz. per ton, the return from the smelter would probably be reduced by penalties for arsenic and antimony and perhaps also for lead and zinc if a copper smelter were the purchaser.. Connah (1953). reported on the history and geology of the Totley mine.

Some small gold dumps in Ravenswood itself were not sampled. Blaskett (1950 and 1951) and Woodcock (1952), reported on concentration of gold ores from the Ravenswood area. Soluble copper minerals and high cyanide consumption seemed the main sources of difficulty in treating these ores.

Liontown - This mining area is located approximately 1 mile south of Oakvale Station, approximately 13 miles from the Charters Towers - Clermont road on the Windsor Station turn-off. The area was originally worked with a mill and smelter for copper but more recently some small scale lead mining has been carried out with the ore transported to the Venus Battery in Charters Towers for treatment or treated on the field in a small battery.

The largest quantity of tailings lies in the copper area where there are two main dumps and three smaller slime dumps all on the southern side of the ridge where the outcrop and workings are situated. Levingston (1953 and 1957), reported on the lead mining developments in this area. In 1960 he reported on a new copper-gold lode, and in 1963 on diamond drilling carried out by Broken Hill South Ltd., and the Queensland Mines Department. Geophysical surveys have been carried out by the Bureau of Mineral Resources, and Horvath (1953) and O'Connor and Horvath (1964), have reported the results of these surveys.

Sample No. 1 (64/24/048) was taken from greenish material in the dump west of the old mill site. This dump was estimated to contain 3,500 tons of material. Elements measured were; copper 2%, lead 0.3%, zinc 0.2%, silver 0.0015%, bismuth 0.025%, arsenic 0.25%, barium 0.4%.

The second sample (64/24/049) was taken from brown material overlying the green material of the first sample, and contained copper 0.25%, lead 0.25%, silver 0.0008%, bismuth 0.02%, barium 0.7%.

The third sample (64/24/050) was taken from a dump to the east of the old mill site, estimated to contain 2,500 tons, containing some grey-green material, but being mostly reddish-brown in colour. Analysis of this sample showed the following; copper 0.3%, lead 0.2%, silver 0.0008%, bismuth 0.01%, barium 0.06%.

The two dumps sampled above were heavily gullied and eroded. There are smaller dumps at the east end of the field, probably from lead ore treatment, but the quantity was too small to warrant sampling. Two dumps of slag from the copper smelter were also noted.

Black Jack Mine - This mine is situated about one quarter of a mile west of the Clermont road, six miles south of Charters Towers. The large dump remaining is estimated to contain 15,000 tons of tailings, the result of cyaniding of table tailings at the mine. Blaskett (1948), enlarges on this and describes the practice of dumping table tailings in the sun with periodic harrowing to encourage oxidation of sulphide minerals and thus increase cyanidation recovery of the gold associated with them.

Elements measured in the sample (64/24/047) were; lead 0.2%, zinc 0.2%, silver 0.0002%.

Mt. Leyshon - This old gold mining area is located to the south of Charters Towers. It is reached by turning east from the Clermont road, 11 miles from town, and then south at a "T" shaped junction, 3 miles further on. The mine area is 5 miles to the south along this road, between fences.

At the mine itself, there are two dumps each estimated to contain 20,000 to 30,000 tons, the easterly one containing slimes, the westerly one sands. The first sample of slimes, (64/24/043) contained the following elements; silver 0.0006%, bismuth 0.02%, and the second sample of sand, (64/24/044) contained silver 0.0002%.

About half a mile north of the mine site there is an old stamp battery on the banks of the creek. A sample (64/24/045) was taken from sandy material upstream from the breached dam adjacent to the battery. This sample was found to contain silver 0.00015%. A second sample (64/24/046) was taken from the area downstream from the dam which contained mostly slimes. The only element measured was silver 0.0005%.

The tonnages present in the area by the old battery were difficult to estimate, but there could be up to 10,000 tons in each of them.

Charters Towers - This area is described by Blatchford (1953), and also by Reid (1917). The map (G.S.Q. Publication 244) accompanying Reid's report, shows the mill locations in the Charters Towers district.

There are many large sand dumps in the area and some smaller quantities of sands in eroded areas now covered with rubber vines and scrub.

The field was originally developed by small syndicates of prospectors and it was general practice for mine operators to confine their activities to mining and trust the ore mined to custom milling companies for treatment. These custom mills were usually located along the banks of creeks in the area. Dumps cannot be related directly to adjacent mines, at least without considerable checking of such old records as may be available.

A number of streets and other landmarks mentioned in reports have now disappeared, though scattered houses continue to be occupied. No trace could be found of tailings from a mill thought to have been located on the west bank of the Burdekin River between the road and railway crossings. Smaller dumps of tailings, often from retreatment of yet older dumps and located along the banks of creeks between Charters Towers and the Burdekin River were not examined.

Dumps in the town area were reported to have been bored to determine their gold content by the Queensland Mines Department in 1939.

The first two dumps sampled in the present investigation were across the creek from the Venus Battery. The first dump, nearer the road, was estimated to contain 12,500 tons and the other dump to the north-west was estimated to contain 5,000 tons. Analysis of the sample from the first dump (64/24/027) showed lead 0.2%, silver 0.0005%, rubidium 0.01%, and that from the second dump (64/24/028), lead 0.3%, zinc 0.2%, silver 0.0008%.

The third sample (64/24/029) was taken from a high dump of sands estimated at about 100,000 tons in the area (? the Rainbow), between the old roaster plant and the railway line. The analysis showed lead 0.2%, zinc 0.1%, silver 0.0005%, arsenic 0.2%. Other flatter eroded dumps covered by vines were not sampled.

At the roaster plant, two dumps were separated by a series of old concrete vats. The dump nearest the adjacent hill seemed to be unleached and to contain about 60% of the total estimated quantity of 80,000 to 100,000 tons of reddish roasted material in the area. The sample (64/24/030) was taken from the apparently unleached portion of the dump and on analysis, gave lead 2%, zinc 1% and silver 0.004%.

Alongside a creek to the south, large dumps were visible from the top of the high dump from which the third sample was taken. It seemed probable that these were tailings from the Excelsior Mill on Millchester Creek.

Sample 64/24/031 was taken from a yellowish sand dump, closer to Millchester State School. The dump was estimated to contain 30,000 tons and the sample contained lead 0.2%, zinc 0.2%, silver 0.0003%. Sample No. 64/24/032 was taken from a greyish coloured dump of similar size, located adjacent to the yellow dump but further away from the school, and showed zinc 0.15%, silver 0.0004%. Other lower and more eroded dumps in this area were not measured or sampled.

The area upstream from the Venus Battery was checked for 500 yds., without finding any large dumps; however, the area is covered with scrub and grass growing in small quantities of tailings apparently washed down in times of flood from dumps further upstream.

Dumps in the area between the Mental Hospital and the Venus Battery are probably from the Brilliant & St. George Mill. The hillside dump nearest the mental hospital was estimated to contain 50,000 tons, and the analysis of the sample (number 64/24/033), showed lead 0.1%, silver 0.0002%.

An adjacent dump behind a concrete wall was relatively small (estimated at 5,000 to 10,000 tons), but was obviously rich in pyrite. Analysis of the sample (64/24/034) gave the following results; lead 0.8%, zinc 0.3%, silver 0.001% and sulphur 7.60% by chemical analysis.

There is a further large area lying to the north-west of the Venus Battery and east of the mental hospital with evidence of a cyanide plant and about 100,000 tons of tailings in dumps of varying heights, suggesting a dump retreatment operation suspended with only a portion of the original dump having been treated. Sample No. 9 was taken from the furthest north-west section of the area from apparently untreated material. Results of the analysis of this sample (64/24/035) were; lead 0.2%, zinc 0.15%, silver 0.0004%.

A dump of approximately 30,000 tons was located in what may have been the Queen Cross Mill area and distant about 0.9 miles from the Queentown railway crossing on the road to the Venus Battery and 0.2 miles to the right of

this road when travelling toward the Battery. This dump was not sampled in view of its isolation, size and doubtful identity.

Three dumps in the New Queen Mill area and between New Queen Road and the nearby creek were sampled and a composite (64/24/036) prepared. In some parts of the dumps there was some cream coloured material with some copper staining and this was excluded from the composite sample, as far as possible. The analysis had the following result: lead 0.1%, silver 0.0004%, arsenic 0.15%.

A number of dumps along the bank of the main creek, opposite All Souls College, were sampled as a composite 64/24/037. The material was mainly brown and earthy and the total tonnage difficult to estimate, but probably of the order of 50,000 to 100,000 tons. The sample gave the following result: lead 0.2%, zinc 0.2%, silver 0.0004%, tungsten 0.015%, rubidium 0.01%.

Another very large accumulation of sands, perhaps of the order of 200,000 tons, was located behind the T.R.E.B. Depot on the New Queen Road. This is almost certainly from the Enterprise Mill. The larger of the two main dumps in this area was sampled (number 64/24/038), with the following result: lead 0.1%, silver 0.0003%.

A composite sample of brown and grey material was prepared from two dumps to the north-east and east-north-east of the large dump, the subject of the preceding sample. The two dumps were estimated to total 50,000 tons and the composite 64/24/039, gave the following analytical results: lead 0.3%, zinc 0.15%, silver 0.0006%. A separate composite, 64/24/040, was made from yellowish material showing copper staining from the same two dumps. The results of analysis were: lead 0.4%, silver 0.0008%.

Sample 64/24/041 was taken from a large dump, perhaps of the order of 200,000 to 300,000 tons, located in Holliman Street and visible from the intersection of this street with Racecourse Road. This might be from the Brilliant Block Mill. Analysis of the sample showed: lead 0.01%, and silver 0.0004%.

The final sample from Charters Towers, number 64/24/042, was taken from the full height of the north east corner of the large dump, situated adjacent to the Gasworks and cycle track, and estimated to contain of the order of 100,000 tons. Analysis of this sample gave the following result: lead 0.2%, zinc 0.2%, silver 0.0006%.

HERBERTON INSPECTOR'S DISTRICT.

The potential of this area for accumulations of tailings had been examined on a previous visit. Generally speaking, the practice at batteries has been to accumulate tailings in a dam in a creek during the dry season, making use of recovered water to assist in provision of an adequate supply for the battery. In the wet season, floodwaters passing down the creek, are encouraged to scour out the tailings and carry them away. This practice is still followed in a number of places. The result is that the accumulation of tailings in the area is quite small in relation to the tonnage treated, and whatever tonnage remains at old battery sites is impounded in a silted-up, waterlogged dam. This makes sampling, with simple equipment, impossible.

Silver Valley - A typical example of this situation exists at the old battery at the Lancelot Mine in Silver Valley. Two samples were taken. The first, composed largely of material above normal water level in the dam and apparently the result of relatively recent crushings with reconditioned plant, represented only perhaps 2,000 tons. Elements measured in this sample (64/24/025 - Silver Valley) were: copper 0.2%, lead 1%, zinc 2%, silver 0.004%, tin 0.2% and lithium 0.04%, with sulphur 2.65% by chemical analysis.

A second sample was taken from material in the dam adjacent to the spillway. It was impossible to determine to what extent material in the dam was ordinary sediment, washed down by floods, and what was battery tailings. This second sample (64/24/026), gave lithium 0.04% and rubidium 0.01% on analysis and apparently represented fresh sediment. Silver Valley may be reached by a turn left from the Herberton - Irvinebank road, 2 miles from Herberton, or from the Northern Inland Highway at the Wild River crossing. Tracks in the area are very eroded and a four wheel drive vehicle is recommended for access.

Nymbool - At Nymbool, 7 miles to the north of Mt. Garnet, a dump of approximately 6,000 tons of tailings from the old Smith's Creek mine has accumulated on the bank of a creek in relatively flat country. This dump is reached by bearing right where the main road crosses Smith's Creek, travelling 0.3 miles and turning left from this track for a further 0.3 miles over the crest of the ridge to the creek. The sands are noticeably incoherent and not much gullied and are mostly grey or black in colour. Some of the slimes are orange coloured, but most are grey. Results of analysis showed the following elements in the first sample (64/24/024) of sands: copper 0.2%, silver 0.0003%, tin 0.25%, bismuth 0.01%, tungsten 0.05% and lithium 0.08%. The second sample from this dump (64/24/025 - Nymbool), was of slimes with the following analysis: copper 0.2%, silver 0.0002%, tin 0.3%, bismuth 0.01%, tungsten 0.08%, lithium 0.07% and rubidium 0.08%.

Brownville - There are two dams here, the upstream one containing water, the downstream one, sands from the old battery nearby. The area is reached from Mt. Garnet by turning left from the Coolgarra road 5.8 miles from Mt. Garnet. The battery site is a further 3.8 miles distant, and is not on the track to the right leading across the creek, which has been used for carting ore from the Extended Mine. Almost all the sands are below water level. The quantity was estimated at 2,000 tons. Two samples were taken, the first upstream from a small creek which cut across the tailings from the bank adjacent to the battery. Analysis of this sample (64/24/022), gave the following results: tin 0.1%, tungsten 0.04%, lithium 0.05%. The second sample (64/24/023) downstream from the small creek, contained: tin 0.1%, tungsten 0.06%, lithium 0.05%.

Zimmerman, Yates and Amos (1963) give a general description of the mineral deposits of the Mt. Garnet area.

Croydon - The main period of production for this area was between 1887 and 1907. Brooks & Wolff (1959) give a summary of drilling carried out by the Queensland Government in the nineteen thirties and provide a bibliography covering work carried out by the Aerial, Geological and Geophysical Survey of Northern Australia at this time and by earlier workers on this field.

Sample No. 1 from the Croydon district (64/24/013), was taken

from dumps estimated to contain 50,000 tons at an old battery site in the Golden Gate area, located approximately half a mile north-east along the creek which crosses the Croydon - Normanton road, 1.8 miles beyond Belmore or Station Creek. The scattered dumps in this area contain perhaps 50,000 tons, and the results of analysis of the sample were: silver 0.0007%, arsenic 0.2%, lithium 0.05%.

The second sample was from the large sand dump on Belmore Creek where the Croydon - Normanton road crosses it. Though eroded and gullied, the dump was estimated to contain about 200,000 tons. Elements measured in this sample (64/24/014) were silver 0.0008%, arsenic 0.2% and lithium 0.04%.

Sample No. 3 was taken from slimes in small dumps to the north-east of the large dump estimated to total 2,500 tons, some being grey and some red in colour. Elements measured in this sample (64/24/015) were: silver 0.0012%, lithium 0.04%.

Scattered dumps near the aerodrome (probably the Highland Mary area), were sampled as the fourth Croydon district sample. Only 5,000 tons of material were found in this area, and, on analysis, the sample (64/24/016) showed: silver 0.0012%, arsenic 0.2%, and lithium 0.02%.

There was another large dump, estimated at 80,000 to 100,000 tons on the bank of Belmore Creek, opposite Belmore Station homestead, about three quarters of a mile south-west of the Croydon - Normanton road. The sample collected from this area (64/24/017) contained: silver 0.0007%, lithium 0.01%.

Sample No. 6 was taken from dumps on the north-west side of a creek running through the Iguana area to the north - west of the township and between the Croydon - Normanton road and railway formation. The sands (64/24/018), were light coloured and estimated at 20,000 tons. Elements measured were: silver 0.001%, lithium 0.02%.

Sample No. 7 was taken from the dumps on the opposite (south-east) side of the creek, where there was a larger portion of slime and coarser material, the whole having a more earthy appearance than other tailings. The quantity of material present here was estimated at 10,000 tons

and the elements measured in this sample (64/24/019), were: silver 0.001%, and lithium 0.02%.

This concluded sampling in the area adjacent to Croydon township. In the hills to the north, a number of dumps in the Twelve Mile area were sampled. However, the dumps in this area were very much smaller than those in the Croydon - Golden Gate area. Refer to Plates 5 and 8 of AGG.S.N.A. Report for the six months ended December 1936 for locality maps of Croydon and surrounding areas.

Sample No. 8 was taken from a dump estimated to contain 3,000 tons lying between the road and a parallel creek (probably Jubilee Creek) in the 12 Mile Area, which is 8 miles by road from the township. The result of analysis of this sample (64/24/020) was: silver 0.0003%.

Sample No. 9 was taken from a larger dump up the hillside on the opposite side of the road in this area. The tonnage estimated was 5,000 - 7,000 tons and the only element measured in this sample (64/24/021), was: silver 0.0004%.

Other old workings in the Mountain Maid and Welcome Reef areas were visible from the road, but the small quantity of tailings present did not warrant further investigation. The Homeward Bound area was not visited.

Kidston - The main dumps at Kidston are located behind the hill to the north west of the township, and are reached by following the main road from Einasleigh through the town and along the river bank, taking a track to the right at 1.75 miles from town. The dumps are approximately half a mile along this track at the foot of the hill. Sands and slime are spread out among the trees and are to some extent, overgrown with grass. The sands are very free, white to pale brown or yellow in colour and glistening with mica flakes. The tonnage here was estimated at 50,000 tons. Dumps in the township itself on the river bank and at the State Battery are very much smaller and for this reason, were not sampled. The only element measured in the large dump sample (64/24/012), was silver 0.0002%.

Ninety-mile Copper Mine, (also known as Hall's Reward) - Dumps at this mine in the Greenvale area were inspected but not sampled

because of their small size. For a description of this mine area, refer to Connah (1954) and to White, Branch & Green (1958).

SAMPLES PROVIDED BY THE QUEENSLAND MINES DEPARTMENT

HERBERTON INSPECTOR'S DISTRICT.

Irvinebank - In 1963, a sample of the tailings at the Irvinebank State Treatment Works was provided by the Manager. This sample was a portion of a bulk sample obtained some years previously by boring the tailings dump with an auger. The dump was estimated to contain 100,000 tons of tailings. Elements measured were: zinc 0.2%, copper 0.15%, arsenic 0.25%, silver 0.0015%, tin 2%, rubidium 0.12%. Woodcock (1960) discusses the recovery of tin from this material by simple methods.

MT. ISA INSPECTOR'S DISTRICT.

Mt. Cobalt - A sample of the dump of tailings at the Mt. Cobalt Mine near Selwyn was provided by courtesy of the Mt. Isa Inspectors and the leaseholder, Mr. J. Tunny, of Kuridala. The Inspector collecting the sample, advised that the dump had been little eroded and that the estimate of 15,000 tons made by Rayner (1938), appeared to be conservative. The average grade estimated at that time was 1.9% Co. Elements measured in the sample (64/24/056) were: cobalt 0.6%, tungsten 0.02%, vanadium 0.02%, lithium 0.05%. The difference in cobalt assays may indicate a certain amount of leaching from the dump surface.

Lawn Hills - The dump at the Silver King Mine in the Lawn Hills area was sampled and measured in August 1964 by an Inspector from Mt. Isa. The quantity of tailings in the dump was 11,500 tons. This had accumulated as table tailings from the concentration plant which operated at the mine between 1958 and 1961. Brooks (1963) reported on the mine as at the close of operations in 1961. Results of analysis of the sample (64/24/002) were: lead 5%, zinc 10%, silver 0.007%, cadmium 0.02%, germanium 0.0002%, Li 0.03%.

SAMPLES PROVIDED BY MINING COMPANIES.

Golden Plateau N.L., Cracow - A sample of the tailings dump at this mine was supplied by the company whose estimate of the quantity of material in the mine dumps was one million tons. None of the tailing has been used for mine filling, but a small quantity has been lost by storm rains.

The dump is increasing at the rate of approximately 30,000 tons per year at the present time. Elements measured in the sample (64/24/008) were: silver 0.0005%, lithium 0.04%. Reports by Brooks (1959 a and b) are the most recent published on this mine.

Mt. Morgan Ltd., Mt. Morgan - This company supplied samples of the following materials:

Sulphide Waste - collected from the faces of the waste dumps; quantity available is very large. Elements measured in this sample (64/24/003) were: silver 0.0003%, sulphur 44.3% and selenium 15 parts per million.

Felsite Waste - collected from the faces of the waste dumps; quantity available is very large. No elements were measured in this sample (64/24/004) as concentrations in qualitative analysis were all relatively low.

Reverberatory Furnace Slag - taken as a channel sample from the face of the slag dump; quantity available is very large. Elements measured in this sample (64/24/005) were: copper 0.5%, zinc 0.4%, silver 0.0002%, molybdenum 0.02%.

Siliceous Waste - collected from the faces of the waste dumps; quantity available is very large. The only elements measured in the sample (64/24/006) were: silver 0.0001% by spectrographic analysis and sulphur 6.8% and selenium 9 parts per million by chemical analysis.

Tailings Dam - A composite sample was taken from the dry area of the tailings dam using a 10ft. long sampling spear; quantity available is very large. The only element measured in spectrographic analysis was silver 0.0002%, sulphur 19.3% and selenium 21 parts per million were also notable in this sample (64/24/007).

Chemical analyses of samples submitted were supplied by Mt. Morgan Ltd., and are set out in Appendix III. For a general description of the geology of this mine see Staines (1953).

Mary Kathleen Uranium Ltd., Mary Kathleen - A sample of the tailings dam, estimated to contain 2.4 million tons was supplied by the company. The method of tailings disposal used was to run both solids and

solution tailings through a common pipeline to an enclosed valley of approximately 28 acres area. Supernatant liquor overflowed into a larger enclosed area of 150 acres which acted as an evaporating pond. The sample was supplied from the smaller area of solid tailings and was broken down from a larger sample collected by taking grab samples of the top 8 - 10 inches at 6 - 8 foot intervals on two traverses across the dam. Production began at Mary Kathleen in June 1958 and ceased in November 1963 when sufficient uranium oxide had been produced to complete the sales contract. The mine has since been on a care and maintenance basis.

The results of the analysis of the sample (64/24/001) were as follows: phosphorous 0.2%, rubidium 0.05%, sulphur 2.05% and selenium 6 parts per million. Radioactivity equivalent to 0.03% U3O8 was measured.

RESULTS - BY ELEMENTS.

Beryllium - This element was detected in samples from Brownville (faint trace), Silver Valley sands and slimes (faint trace), Charters Towers (very faint trace in sulphide dump), and also at very faint trace level in the sample from the State Treatment Works at Irvinebank, and sands on the creek at Mt. Leyshon.

Cobalt - Detected at heavy trace level (0.6% on measurement) in the Mt. Cobalt tailings dump sample, as would be expected, cobalt also reported in most other samples, usually at the very faint trace level, but nowhere higher than the faint trace level.

Indium - This element was found in the sample from Irvinebank at the very faint trace level; from the Totley Silver Mine at Ravenswood at the faint trace level and at the same level in the Silver Valley sands and slimes. Very faint traces were also found in reverberatory slag from Mt. Morgan and in the sample from the Silver King at Lawn Hills.

Germanium - Germanium was present in a proportion of samples at the very faint trace level. The highest concentration was a faint trace in the sample from the Silver King silver-lead mine at Lawn Hills.

Silver. - This element was recorded from a number of places; at the faint trace level (0.01 - 0.001% or 3.27 to 0.327 oz. per long ton).

or above from the Silver King Mine, Lawn Hills, Mt. Cannindah (both samples), Croydon (Nos. 3, 4, 6, 7), Silver Valley (sands and slimes sample), Charters Towers (Nos. 4 & 8), Lontown No 1, Totley Silver Mine Ravenswood and Irvinebank. The highest concentration was in the Totley Silver Mine sample at 0.008% equivalent to 2.6 oz. per ton, closely followed by the Silver King Mine at Lawn Hills, 0.007% equivalent to 2.28 oz. per ton.

Gold - No gold was detected by spectrographic analysis. This is what one would expect as the detection limit of 0.001% is equivalent to 0.3 oz. per ton. Refer to Appendices IA and IB for detection limits.

Bismuth - Maximum concentration of bismuth was in the first sample from Lontown (0.025%) and other samples in the trace range were Mt. Shamrock, Nymbool 1 and 2, Mt. Leyshon No. 1, Irvinebank and the other two samples from Lontown.

Molybdenum - A trace of molybdenum (0.02%) was found in the reverberatory furnace slag from Mt. Morgan, but was found elsewhere only at lower concentrations. Faint trace concentrations were found in samples from the Silver King Mine, Lawn Hills, Mt. Morgan (Nos. 1, 2, 4 & 5), Mt. Cannindah (Nos. 1 & 2), Croydon (Nos. 4 & 6), Brownville No. 2, Charters Towers (Nos. 1, 2, 5, 6, 8, 12 & 13), Mt. Leyshon (Nos. 2 & 4), Lontown (Nos. 1, 2 & 3), Mt. Chalmers, Hector Mine Rockhampton and Mt. Cobalt.

Tin - Maximum value recorded was Irvinebank 2%. The next highest was 0.3% in the sample of slimes from the Smiths Creek mine at Nymbool. Other samples with values in the trace range were from Brownville, Nymbool and Silver Valley.

Tungsten - Surprisingly, tungsten was not recorded at all in the Irvinebank sample. The maximum value of 0.08% was recorded for the Nymbool slimes sample, and other results also in the trace range, were obtained from samples from Mt. Cobalt, Charters Towers (No. 11), Brownville and Nymbool.

Chromium - At the "trace" level, chromium was recorded only from the sample from Cawarral near Rockhampton and this was the highest concentration recorded. Faint traces were recorded from many other samples including the reverberatory furnace slag from Mt. Morgan.

Gallium - This element was present in a number of samples but at the very faint trace level only, except in the Mt. Cobalt sample where a faint trace was recorded.

Vanadium - The highest concentration of this element was measured at 0.02% in the Mt. Cobalt sample, but it was present at the lower "faint trace" level in samples from Mary Kathleen, Silver King, Silver Lead Mine at Lawn Hill, Mt. Morgan (Nos. 2, 4 & 5), Golden Plateau, Mt. Shamrock, Mt. Cannindah, Kidston, Croydon (No. 4 only), Brownville, Silver Valley sands and slimes, Charters Towers (all samples), Mt. Leyshon, Trolley Silver Mine Ravenswood, Mt. Chalmers, Cawarral, Hector Mine Rockhampton and Eidsvold.

Lead - Lead at "minor" concentration (10 - 1%) ~~was~~ found in samples from the Silver King Mine Lawn Hill (5%), roasted material from Charters Towers (2%), Trolley Silver Mine Ravenswood (2%) and sands and slimes at Silver Valley (1%). Heavy traces were recorded from Charters Towers (Nos. 1 - 5, 7 - 16), the Black Jack Mine and Liontown.

Zinc - The highest zinc concentration measured was 10% in the sample from the Silver King Mine, Lawn Hill. Other concentrations in the "minor" range were recorded for samples of Silver Valley sands and slimes (2%) and roasted material from Charters Towers. Heavy traces were recorded from Mt. Morgan reverberatory furnace slag, Charters Towers (Nos. 2, 3, 5, 6, 8, 9, 11, 13, 16), Black Jack Mine Charters Towers, Liontown (No. 1), Trolley Silver Mine Ravenswood, and Irvinebank.

Copper - The highest copper concentration was recorded in the first sample from Liontown - 2%. Tailings at Mt. Cannindah contained 1.5% copper while other samples from Nymbool, Silver Valley (sands & slimes), other dumps at Liontown and reverberatory furnace slag at Mt. Morgan contained copper at the heavy trace level.

CONCLUSIONS AND RECOMMENDATIONS.

None of the analysis showed surprisingly high concentrations of previously unexpected elements of economic value.

The elements which would normally be expected in the dumps and which appear interesting as a result of this survey include the zinc in the Silver King Silver-lead Mine at Lawn Hill (10% zinc in approximately 11,500 tons). At Charters Towers, the dumps of roasted material going 2% lead and 1% zinc are sufficiently large to suggest that some values might possibly be economically

recovered. The 2% tin dumps at Irvinebank might also be of some economic value, as might the lead zinc dumps at the Totley Silver Mine, Ravenswood.

Although the sensitivity of the spectrographic method is not sufficient to detect potentially economic gold values in dumps, the large quantities of sands at Charters Towers, the Black Jack Mine, Kidston and Croydon do not seem to be of value for any other contained minerals and if gold can be ruled out, there seems to be no reason for not using any of them as required for constructional purposes.

ACKNOWLEDGEMENTS.

The co-operation of mining companies, leaseholders and officers of the Queensland Mines Department was much appreciated and is gratefully acknowledged.

REFERENCES.

- Blaskett, K.S. 1947. Concentration of lead-silver ore and tailings from the Totley Silver Mine, Ravenswood, Queensland. Comm. Sci. Ind. Res. Org. and Min. Dept. Univ. Melb. Ore Dressing Investigations, Rpt. No. 314.
- Blaskett, K.S. 1948. Treatment of ore from Black Jack Gold Mining Co. N.L. near Charters Towers, Queensland. Comm. Sci. Ind. Res. Org. and Min. Dept. Univ. Melb. Ore Dressing Investigations, Rpt. No. 334.
- Blaskett, K.S. 1950. Treatment of ore from the Break O' Day Mine, Ravenswood, Queensland. Comm. Sci. Ind. Res. Org. and Min. Dept. Univ. Melb. Ore Dressing Investigations, Rpt. No. 395.
- Blaskett, K.S. 1951. Concentration of gold ore from the Mother Lode Mine, Ravenswood, Queensland. Comm. Sci. Ind. Res. Org. and Min. Dept. Univ. Melb. Ore Dressing Investigations, Rpt. No. 404.
- Blatchford, A. 1953. Charters Towers Goldfield in Geology of the Australian Ore Deposits (Ed. A.B. Edwards) pp 796 - 806 (Fifth Empire Min. Met. Congr. Melbourne).
- Brooks, J.H. 1959 (a). Golden Plateau Mine, Cracow. Qld. Govt. Min. J. Vol. 60 No. 695-6 Sept. - Oct. 1959 pp. 617 - 25.
- Brooks, J.H. 1959 (b). Inspection of Golden Plateau Mine, Cracow. Qld. Govt. Min. J. Vol. 60 No. 998 Dec. 1959 pp. 774 - 778.
- Brooks, J.H. 1963. Silver King Silver-lead Mine, Lawn Hill. Qld. Govt. Min. J. Vol. 64 No. 743 Sept. 1963 pp. 592 - 596.
- Brooks, J.H., and Wolff, K., 1959. Government Drilling - Golden Gate area, Croydon. Qld. Govt. Min. J. Vol. 60 No. 690 April 1959 pp. 263 - 271.
- Connah, T.H. 1953. Totley (King's) Silver Mine, Ravenswood. Qld. Govt. Min. J. Vol. 54 No. 617, March 1953 pp. 171 - 176.
- Connah, T.H. 1954. Ninety Mile Copper Mine, Greenvale. Qld. Govt. Min. J. Vol. 60 No. 693 - 694, July - Aug. 1959 pp. 525 - 532.
- Fisher, N.H., and Owen H.B., 1952. Mt. Chalmers Copper and Gold Mine, Queensland. Bur. Min. Res. Aust. Rpt. No. 7.
- Horvath, S., 1953. Geophysical test survey at Lione town near Charters Towers, Queensland. Bur. Min. Res. Aust. Rec. 1952/15.

King, R.W.L. 1964 (a). Survey of mineral resources in New South Wales tailings dumps. Bur. Min. Res. Aust. Rec. 1964/58.

King, R.W.L. 1964 (b). Survey of mineral resources in Tasmanian tailings dumps. Bur. Min. Res. Aust. Rec. 1964/59.

Levingston, K.R. 1953. Silver-lead discovery, Liontown area. Qld. Govt. Min. J. Vol. 53 No. 608 June 1952 pp. 492-493.

Levingston, K.R. 1956. Silver-lead workings, Liontown. Qld. Govt. Min. J. Vol. 57 No. 651 Jan 1956 pp. 57 - 60.

Levingston, K.R. 1960. Carrington's No. 2 W. Shaft, Liontown. Qld. Govt. Min. J. Vol. 61 No. 702. Apr. 1960 pp. 161 - 162.

Levingston, K.R. 1963. Departmental diamond drilling, Liontown. Qld. Govt. Min. J. Vol. 64 No. 742. Aug. 1963 pp. 533 - 539.

O'Connor, M.J. and Horvath, J. 1964. Liontown geophysical survey, Queensland 1959. Bur. Min. Res. Aust. Rec. 1964/24.

Rayner, E.O. 1938. The cobalt deposits of the Cloncurry district. A.G.G.S.N.A. Rpt. Qld. No. 34.

Reid, J.H. 1917. Charters Towers Goldfield. Qld. Geol. Surv. Pub. No. 256.

White, D.A. Branch, C.D. and Green, D.H., 1958. Geology of the Hall's Reward (Ninety Mile) Copper Mine Area, Northern Queensland. Bur. Min. Res. Aust. Rec. 1958/60.

Staines, H.R.E. 1953. The Mt. Morgan Copper and Gold Mine in Geology of the Australian Ore Deposits (Ed. A.B. Edwards) pp. 732 - 750. (Fifth Empire Min. Met. Congr. Melbourne).

Woodcock, J.T. 1952. Supplementary tests on ore from the Mother Lode Mine, Ravenswood, Queensland. Comm. Sci. Ind. Res. Org. and Min. Dept. Univ. Melb. Ore Dressing Investigations Rpt. No. 425.

Woodcock, J.T. 1960. Treatment of a tin tailing dump from Irvinebank, Qld. Comm Sci. Ind. Res. Org. and Min. Dept Univ. Melb. Ore Dressing Investigations. Rpt. No. 607.

Zimmerman, D.O., Yates, K.R. and Amos, B.J. 1963. The geology and mineral deposits of the Mt. Garnet area, Nth. Queensland. Bur. Min. Res. Aust. Rec. 1963/77.

APPENDIX IA.

SPECTROGRAPHIC ANALYSES.

Detection-Limit Concentrations of Elements.

D.C. Arc. Excitation.

<u>ELEMENT</u>	<u>per cent</u>	<u>p.p.m.</u>	<u>ELEMENT</u>	<u>per cent</u>	<u>p.p.m.</u>
Ag.	0.00005	0.5	Na	0.00005	0.5
Al	0.0002	2	Nb	0.003	30
As	0.01	100	Nd	0.001	10
Au	0.001	10	Ni	0.0002	2
B	0.001	10	Os	0.005	50
Ba	0.0002	2	P	0.02	200
Be	0.0005	50	Pb	0.0002	2
Bi	0.0005	5	Pd	0.001	10
Ca	0.0002	2	Pr	0.001	10
Cd	0.001	10	Pt	0.005	50
Ce	0.04	400	Rb	0.0001	1
Co	0.0002	2	Re	0.01	100
Cr	0.0001	1	Rh	0.001	10
Cs	0.0002	2	Ru	0.001	10
Cu	0.00005	0.5	Sb	0.002	20
Dy	0.001	10	Sc	0.0002	2
Er	0.001	10	Si	0.002	20
Eu	0.001	10	Sm	0.05	500
Fe	0.0005	5	Sn	0.001	10
Ga	0.0003	3	Sr	0.0001	1
Gd	0.02	200	Ta	0.01	100
Ge	0.0002	2	Tb	0.001	10
Hf	0.01	100	Te	0.02	200
Hg	0.01	100	Th	0.01	100
Ho	0.001	10	Ti	0.001	10
In	0.0001	1	Tl	0.0001	1
Ir	0.005	50	Tm	0.001	10
K	0.0002	2	U	0.02	200
La	0.001	10	V	0.0005	5
Li	0.0001	1	W	0.005	50
Lu	0.001	10	Y	0.001	10

<u>ELEMENT</u>	<u>per cent</u>	<u>p.p.m.</u>	<u>ELEMENT</u>	<u>per cent</u>	<u>p.p.m.</u>
Mg.	0.0002	2	Yb	0.001	10
Mn	0.001	10	Zn	0.0025	25
Mo	0.0005	5	Zr	0.001	10

APPENDIX IB.

SPECTROGRAPHIC ANALYSES

Detection-Limit Concentrations of Elements - Irvinebank Sample.

D.C. Arc Excitation

Ag	0.00005	0.5	Na	0.00005	0.5
Al	0.0002	2	Nb	0.003	30
As	0.01	100	Nd	0.001	10
Au	0.001	10	Ni	0.0002	2
B	0.001	10	Os	0.005	50
Ba	0.0002	2	P	0.05	500
Be	0.0005	5	Pb	0.0002	2
Bi	0.0005	5	Pd	0.001	10
Ca	0.0002	2	Pr	0.001	10
Cd	0.001	10	Pt	0.01	100
Ce	0.04	400	Rb	0.01	100
Co	0.0002	2	Re	0.01	100
Cr	0.0003	3	Rh	0.001	10
Cs	0.1	1000	Ru	0.001	10
Cu	0.00005	0.5	Sb	0.003	30
Dy	0.001	10	Sc	0.0002	2
Er	0.001	10	Si	0.002	20
Eu	0.001	10	Sm	0.05	500
Fe	0.0005	5	Sn	0.001	10
Ga	0.0003	3	Sr	0.0001	1
Gd	0.02	200	Ta	0.01	100
Ge	0.0005	5	Tb	0.001	10
Hf	0.01	100	Te	0.02	200
Hg	0.01	100	Th	0.01	100
Ho	0.001	10	Ti	0.001	10
In	0.0001	1	Tl	0.005	50
Ir	0.005	50	Tm	0.001	10

APPENDIX 1B (cont)

K	0.0002	2	U	0.05	500
La	0.001	10	V	0.0005	5
Li	0.01	100	W	0.005	50
Lu	0.001	10	Y	0.001	10
Mg	0.0002	2	Yb	0.001	10
Mn	0.001	10	Zn	0.0025	25
Mo	0.0005	5	Zr	0.002	20

APPENDIX III.

Chemical Analysis of Samples from Mt. Morgan Ltd.

Supplied by the Company.

Mt. Morgan No. 1 - 64/24/003 - Sulphide Waste Rock.

Au 0.3 dwt/ton, Cu 0.17%, S 45.40%, Fe 39.30%, Insoluble 14.22%.

Mt. Morgan No. 2 - 64/24/004 - Felsite Waste Rock.

Au 0.15 dwt/ton, Cu 0.076%, S 6.03%, Fe 9.7%, Insoluble 65.62%

Mt. Morgan No. 3 - 64/24/005 - Reverberatory slag not assayed.

Mt. Morgan No. 4 - 64/24/006 - Siliceous Waste Rock.

Au 0.3 dwt/ton, Cu 0.038%, S 0.37%, Fe 5.1%, Insoluble 86.44%.

Mt. Morgan No. 5 - 64/24/007 - Tailings Dam Composite Au 0.46 dwt/ton.

Cu 0.076%, S 20.33%, Fe 19.15%, Al_2O_3 1.67%, Insoluble 54.50%.

SURVEY OF MINERAL RESOURCES IN TAILINGS - DETAILED RESULTS - QUEENSLAND

Sample Location and Mark	Qualitative Analysis by Emission Spectroscopy - %						Semi-Quantitative Analysis by Emission Spectroscopy - %	Chem. Analysis		Radioactivity U ₃ O ₈ Equivalent	Tonnage Estimated in Dump	Date Sampled
	Major 100-10	Minor 10-1	Heavy Trace 1-0.1	Trace 0.1-0.01	Faint Trace 0.01-0.001	Very Faint Trace 0.001-0.0001		S %	Se ppm.			
Mary Kathleen Uranium Tailings 64/24/001			Mn, P.	Cu, B, Zr, Sc, Rb.	Pb, Zn, Ni, Co, Sn, Cr, V, Be, Sr.	Bi, Mo, Ge, Ga, Li.	PO.2, Rb0.05.	2.05	6	0.03%	2.4 million	September 1964
Lawn Hills Silver Lead Mine 64/24/002.	Zn	Pb		Cu, Cd, Mn, Li.	Ni, Ag, Mo, Cr, V, Ge, Sb, B, Ba	Co, Sn, Bi, In, Ge, Sr, Rb.	Pb5, Zn 10, Ag0.007, Cd 0.02, Ge 0.0002, Li 0.03.	5.45	6		11,500	August, 1964.
Mt. Morgan No. 1 - Sulphide Waste 64/24/003				Cu, Zn, Mn.	Ni, Pb, Co, Mo, Rb.	Ag, Sn, Bi, Cr, V, Ba, Li.	Ag 0.0003	44.3	15			
Mt. Morgan No. 2 - Felsite Waste 64/24/004				Cu	Zn, Mo, V, Mn, Ba, Sr.	Pb, Ni, Co, Sn, Bi, Cr, Ga, B, Li, Rb.		0.60	11			
Mt. Morgan No. 3 - Reverberatory Furnace Slag - 64/24/005			Cu, Zn.	Mo, Mn, P.	Pb, Ni, Co, Sn, Cr, Ba.	Ag, Bi, V, In, Ga, B, Sr, Li, Rb.	Cu 0.5, Zn 0.4, Ag 0.0002, Mo 0.02.	1.50	7			
Mt. Morgan No. 4 - Siliceous Waste - 64/24/006				Cu, Mn, P, Zr.	Zn, Ni, Co, Sn, Mo, V, Ba, Sr, Sc, Y, Li.	Pb, Ag, Bi, Cr, Ga, B, Rb.	Ag 0.0001.	6.80	9			
Mt. Morgan No. 5 - Tailings Dams Composite - 64/24/007				Cu, Mn.	Zn, Ni, Co, Mo, V, Ba, Sr, Sc.	Pb, Ag, Sn, Bi, Cr, Ga, B, Li, Rb.	Ag 0.0002.	19.3	21			
Golden Plateau N.L. Crazow Tailings Dump 64/24/008				Zn, As, Mn, P, Li.	Cu, Pb, V, Ba, Sr.	Ni, Co, Ag, Sn, Mo, Cr, B, Rb.	Ag 0.0005, Li 0.04.	0.40	3			
Mt. Shamrock - Biggenden. Tailings Dump 64/24/009				Bi, As, Mn, P, Zr, Ba.	Pb, Cu, Zn, Ni, Co, Cr, V, B, Sr, Sc, Y, Li, Rb.	Ag, Sn, Mo, Ga.	Ag 0.0003 Bi 0.02.	0.15	1			
Mt. Cannindah - Monto No. 1 Mine area 64/24/010.				Cu, As, Li.	Pb, Ni, Ag, Bi, Mo, W, Cr, V, Mn, B, Ba, Sr, Sc, Rb.	Zn, Co, Ga.	Ag 0.002, Li 0.03.	0.80	2			
Mt. Cannindah - Monto - No. 2 Tailings 64/24/011		Cu		Mn, Ba.	Zn, Pb, Ni, Ag, Bi, Mo, W, Cr, V, B, Sr, Sc, Li, Rb.	Co, Ga.	Cu 1.5, Ag 0.002,	0.75	2			
Kidston - Mine Area Tailings 64/24/012.				Pb, Zn, As, Mn, P, Ba, Sr.	Cu, Ni, W, Cr, V, B, Li, Rb.	Co, Ag, Sn, Bi, Mo, Ga.	Ag 0.0002.	0.25	*1			

Note: * means "less than".

SURVEY OF MINERAL RESOURCES IN TAILINGS - DETAILED RESULTS - QUEENSLAND

Sample Location and Mark	Qualitative Analysis by Emission Spectroscopy - %						Semi-Quantitative Analysis by Emission Spectroscopy - %	Chem. Analysis		Radioactivity U ₃ O ₈ Equivalent	Tonnage Estimated in Dump	Date Sampled
	Major 100-10	Minor 10-1	Heavy Trace 1-0.1	Trace 0.1-0.01	Faint Trace 0.01-0.001	Very Faint Trace 0.001-0.0001		S %	Se p.p.m.			
Croydon No. 1 - N.W. of Belmore Creek Crossing 64/24/013.			As	P, Li.	Cu, Pb, Zn, Ni, Cr, Mn, B, Ba, Sr.	Co, Ag, Sn, Bi, Mo, V, Ge, Rb.	Ag 0.0007, As 0.2 Li 0.05.	0.65	* 1	None detected at limit equivalent to 0.002 % U ₃ O ₈	50,000	19/6/64.
Croydon No. 2 - At Belmore Creek Crossing 64/24/014			As	Pb, P, Li.	Cu, Zn, Ni, Cr, Mn, Ba, Rb.	Co, Ag, Sn, Bi, Mo, V, Ge, B, Sr.	Ag 0.0008, As 0.2 Li 0.04.	0.45	* 1		200,000	19/6/64
Croydon No. 3 - Slimes at Belmore Creek Crossing 64/24/015				Pb, As, P, Li.	Cu, Zn, Ag, Mn, B, Ba, Rb.	Ni, Co, Sn, Bi, Mo, Cr, V, Ge, Sr.	Ag 0.0012, Li 0.04	0.80	1		2,500	19/6/64
Croydon No. 4 - at Aerodrome 64/24/016			As	Pb, P, Li.	Cu, Zn, Ni, Ag, Sn, Mo, Cr, V, Mn, B, Ba, Sr, Rb.	Co, Bi, Ge, Ga.	Ag 0.0012, As 0.2, Li 0.02.	0.15	* 1		5,000	19/6/64
Croydon No. 5 - opposite Belmore Homestead. 64/24/017				Pb, As, P, Li.	Cu, Zn, Ni, Cr, Mn, Ba, Sr, Rb.	Co, Ag, Sn, Bi, Mo, V, Ge, B.	Ag 0.0007, Li 0.01.	0.45	1		100,000	19/6/64
Croydon No. 6 - N.W. of Creek N.W. of Town. 64/24/018				Pb, As, P, Li.	Cu, Zn, Ni, Ag, Mo, Cr, Mn, Rb.	Co, Sn, Bi, V, Ge, B, Ba.	Ag 0.001, Li 0.02.	0.15	1		20,000	19/6/64
Croydon No. 7 - S.E. of Creek N.W. of Town - 64/24/019				Pb, As, P, Ba, Li.	Cu, Zn, Ni, Ag, Cr, Mn, B, Sr, Rb.	Co, Sn, Bi, Mo, V, Ge.	Ag 0.001, Li 0.02.	0.35	1		60,000	19/6/64
Croydon No. 8 - Twelve Mile Area 64/24/020				Pb, As, Mn, P.	Cu, Zn, Ni, Bi, W, Cr, Li, Rb.	Co, Ag, Sn, Mo, V, Ge, Ga, B, Ba.	Ag 0.0003,	0.07	3		4,000	19/6/64
Croydon No. 9 - Twelve Mile Area - 64/24/021				As, Pb, Mn, P.	Cu, Zn, Ni, Bi, W, Li.	Co, Ag, Sn, Mo, Cr, V, Ge, B, Ba, Rb.	Ag 0.0004	0.085	3		6,000	19/6/64
Brownville No. 1 - Mt. Garnet area - 64/24/022		Sn		Cu, W, As, Mn, Zr, Li.	Pb, Zn, Ni, Bi, Be, Cr, V, B, Ba, Sr, Sc, Y.	Co, Mo, Ge, Ga, Rb.	Sn 0.1, W 0.04, Li 0.05.	0.35	1		4,500	17/6/64
Brownville No. 2 - Lower Section Mt. Garnet Area 64/24/023		Sn		Cu, W, As, Mn, Zr, Li.	Pb, Zn, Ni, Bi, Be, Mo, Cr, V, B, Ba, Sr, Sc, Y, Rb.	Co, Ge, Ga.	Sn 0.1, W 0.06, Li 0.05	0.75	1			17/6/64
Nymbool - No. 1 - Sands from Smith's Creek Mine 64/24/024		Cu, Sn.		Zn, Bi, W, As, Mn, Ba, Li, Cs.	Co, B, Sc, Y, Rb.	Pb, Ni, Ag, Mo, Cr, V, Ge, Ga, Sr.	Cu 0.2, Ag 0.0003, Sn 0.25, Bi 0.01, W 0.05, Li 0.08.	0.25	1	6,000		17/6/64
Nymbool No. 2 - Slimes from Smith's Creek Mine - 64/24/025		Cu, Sn.		Zn, Bi, W, Mn, Li, Rb.	Pb, Co, B, Ba, Y, Cs.	Ni, Ag, Mo, Cr, V, Ge, Ga.	Cu 0.2, Ag 0.0002, Sn 0.3, Bi 0.01, W 0.08, Li 0.07, Rb 0.08.	0.30	1			17/6/64

Note: * means "less than".

SURVEY OF MINERAL RESOURCES IN TAILINGS - DETAILED RESULTS - QUEENSLAND

Sample Location and Mark	Qualitative Analysis by Emission Spectroscopy - %						Semi-Quantitative Analysis by Emission Spectroscopy - %	Chem. Analysis		Radioactivity U ₃ O ₈ Equivalent	Tonnage Estimated in Dump	Date Sampled
	Major 100-10	Minor 10-1	Heavy Trace 1-0.1	Trace 0.1-0.01	Faint Trace 0.01-0.001	Very Faint Trace 0.001 - 0.0001		S %	Se p.p.m.			
Silver Valley No. 1 - Sands and Slimes from dam - 64/24/025		Pb, Zn	Cu, Sn	Zr, Li.	Ag, Bi, Cd, Be, W, Cr, V, In, As, Sb, Mn, B, Ba, Sr, Sc, Y.	Ni, Co, Mo, Ga, Rb.	Cu 0.2, Pb 1, Zn 2 Ag 0.004, Sn 0.2, Li 0.04.	2.65	9	None detected at limit equivalent to 0.002 % U ₃ O ₈ .	Possibly of the order of 5,000 tons	16/6/64.
Silver Valley No. 2 - Sands at Dam Wall - 64/24/026				Li, Rb.	Cu, Pb, Zn, Ni, Sn, Cr, As, Mn, B, Ba.	Co, Bi, Mo, V, Ga, Sr.	Li 0.04 Rb 0.01	0.05	1			16/6/64
Charters Towers No. 1 Sands to S.E. of Venus Battery 64/24/027.			Pb.	Cu, Zn, P, Rb.	Ni, Mo, W, Cr, V, As, Sb, Mn, Ba, Sr, Li.	Co, Ag, Sn, Cd, Ge, B.	Pb 0.2, Ag 0.0005, Rb 0.01.	1.60	1		12,500	9/6/64
Charters Towers No. 2 Sands to N.W. of above 64/24/028.			Pb, Zn.	Cu, As, Mn.	Ni, Mo, W, Cr, V, Sb, Ba, Sr, Li.	Co, Ag, Sn, Bi, Cd, Ge, B, Rb.	Pb 0.3, Zn 0.2, Ag 0.0008, Li.	2.40	1		5,000	9/6/64
Charters Towers No. 3 - Sands from high dump near roaster area - 64/24/029			Pb, Zn, As.	Mn.	Cu, Ni, W, Cr, V, Ba, Sr, Sc, Li.	Co, Ag, Sn, Bi, Mo, Cd, Ge, B, Rb.	Pb 0.2, Zn 0.1, Ag 0.0005, As 0.2,	1.60	1		100,000	10/6/64
Charters Towers No. 4 roasted material - 64/24/030		Pb, Zn.		Cu, Mn, As, Zr.	Ni, Co, Ag, Cd, W, V, Sb, Ba, Sr, Sc.	Sn, Bi, Mo, Cr, Ge, B, Li, Rb.	Pb 2, Zn 1, Ag 0.004,	1.75	* 1		80,000	10/6/64
Charters Towers No. 5 Yellow dump near Millchester State School - 64/24/031			Pb, Zn.	Mn.	Cu, Ni, Mo, W, Cr, V, As, Sb, Ba, Sr, Sc, Li.	Co, Ag, Sn, Bi, Cd, Ge, Ga, B, Rb.	Pb 0.2, Zn 0.2, Ag 0.0003,	2.05	* 1		30,000	10/6/64
Charters Towers No. 6 Grey dump adjacent to No. 5 64/24/032.			Zn.	Pb, Mn.	Cu, Ni, Mo, W, Cr, V, As, Ba, Sr, Rb.	Co, Ag, Bi, Cd, Ge, Ga, B, Li.	Zn 0.15, Ag 0.0004	1.15	* 1		30,000	10/6/64
Charters Towers No. 7 Hillside dump near Mental Hospital - 64/24/033			Pb.	Zn, Mn.	Cu, Ni, W, Cr, V, As, Ba.	Co, Ag, Cd, Mo, Ge, B, Sr, Li, Rb.	Pb 0.1, Ag 0.0002.	1.80	1		50,000	11/6/64
Charters Towers No. 8 Pyrite dump between Venus Mill and Mental Hospital 64/24/034.			Pb, Zn.	Cu, As, Mn.	Ag, Cd, Mo, W, V, Sb, Ba, Rb.	Ni, Co, Bi, Be, Cr, B, Sr, Li.	Pb 0.8, Zn 0.3, Ag 0.001,	7.60	1		8,000	11/6/64
Charters Towers No. 9 Large dump East of Mental Hospital - 64/24/035.			Pb, Zn.	Cu, Mn.	Ni, Bi, W, Cr, V, Ba, Sr, Li, Rb.	Co, Ag, Sn, Cd, Mo, Ge, Ga, B.	Pb 0.2, Zn 0.15, Ag 0.0004	2.00	1		100,000	11/6/64
Charters Towers No. 10 New Queen Mill Area. 64/24/036.			Pb, As.	Zn, Mn.	Cu, Ni, W, Cr, V, Ba, Sr, Li, Rb.	Co, Ag, Sn, Bi, Cd, Mo, Ge, B.	Pb 0.1, Ag 0.0004, As 0.15	1.35	1		30,000	11/6/64
Charters Towers No. 11 Dumps opposite All Souls College 64/24/037			Pb, Zn.	W, Mn, Ba, Rb.	Cu, Cr, V, Sr, Li.	Ni, Co, Ag, Sn, Cd, Mo, Ge, B.	Pb 0.2, Zn 0.2, Ag 0.0004, W 0.015, Rb 0.01.	2.05	1		75,000	11/6/64

Note: * means "less than".

SURVEY OF MINERAL RESOURCES IN TAILINGS - DETAILED RESULTS - QUEENSLAND.

Sample Location and Mark	Qualitative Analysis by Emission Spectroscopy - %						Semi-Quantitative Analysis by Emission Spectroscopy - %	Chem. Analysis		Radioactivity U ₃ O ₈ Equivalent	Estimated Tonnage in Dump	Date Sampled
	Major 100-10	Minor 10-1	Heavy Trace 1-0.1	Trace 0.1-0.01	Faint Trace 0.01-0.001	Very Faint Trace 0.001-0.0001		S %	Se p.p.m.			
Charters Towers No.12 Large Dump Behind T.R.E.B. Depot - Enterprise Mill Area- 64/24/038			Pb.	Zn, Mn,	Ni, Cu, Mo, V, Ba, Cr, As, Li.	Co, Ag, Sn, Cd, Ge, Sr, Rb, B.	Pb 0.1, Ag 0.0003,	0.80	* 1	None detected at limit equivalent to 0.002% U ₃ O ₈ .	200,000	11/6/64
Charters Towers No.13 Smaller Dumps to N.E. and E.N.E. of /038 64/24/039			Pb, Zn	Cu, Mn.	Ni, Mo, W, Cr, V, As, Ba, Sr, Li.	Co, Ag, Sn, Bi, Cd, Ge, Ga, B, Rb.	Pb 0.3, Zn 0.15, Ag 0.0006.	1.60	* 1		50,000	11/6/64
Charters Towers No.14 Yellowish, copper stained material from same area as /039. 64/24/040			Pb.	Zn.	Cu, Ni, W, Cr, V, As, Sb, Mn, Ba, Sr, Li.	Co, Ag, Bi, Mo, Ge, B, Rb.	Pb 0.4, Ag 0.0008	2.50	* 1			11/6/64
Charters Towers No.15 Sands from Large Dump Holliman St. Area. 64/24/041			Pb.	Zn, As, Mn.	Cu, W, Cr, V, Ba, Sr, Li.	Co, Ag, Ni, Sn, Bi, Cd, Mo, Ge, B, Rb.	Pb 0.1, Ag 0.0004	1.30	1		200,000	11/6/64
Charters Towers No.16 Sands from N.E. corner of Dump behind Gasworks 64/24/042			Pb, Zn.	Cu, Mn.	Ni, W, Cr, V, Ba, Sr, Li.	Co, Ag, Sn, Mo, Bi, Cd, Ge, B, Rb.	Pb 0.2, Zn 0.2, Ag 0.0006	1.55	1		100,000	11/6/64
Mt. Leyshon No. 1 Slimes at Mine Site 64/24/043				Cu, Pb, Bi, Mn, P, Ba.	Zn, B, Li.	Ni, Co, Ag, Sn, Mo, Cr, V, Ga, Sr, Rb.	Ag 0.0006, Bi 0.02.	0.30	* 1		25,000	10/6/64
Mt. Leyshon No. 2 Sands at Mine Site 64/24/044				P, Ba.	Cu, Pb, Zn, Ni, Bi, Mo, Li, Rb, W, Cr, V, Mn, Sr.	Co, Ag, Sn, Ga, B.	Ag 0.0002	0.25	1		25,000	10/6/64
Mt. Leyshon No. 3 Sands upstream at Mill on Creek. 64/24/045				Cu, Mn.	Zn, V, As, Ba, Sc, Li, Rb.	Pb, Ni, Co, Ag, Sn, Bi, Be, Mo, Cr, Ga, B, Sr.	Ag 0.00015	0.20	1		10,000	10/6/64
Mt. Leyshon No. 4 Slimes downstream at Mill on Creek 64/24/046				Cu, Pb, Mn, P, Ba.	Zn, Bi, Mo, W, Cr, V, Sr, Li, Rb.	Ni, Co, Ag, Sn, Ga, B.	Ag 0.0005.	0.25	1		10,000	10/6/64
Charters Towers - Black Jack Mine Tailings 64/24/047			Pb, Zn	Mn, P.	Cu, Ni, W, Cr, V, B, Ba, Sr, Li, Rb.	Co, Ag, Cd, Mo, Ge, Ga.	Pb 0.2, Zn 0.2, Ag 0.0002.	1.00	2		15,000	9/6/64
Liontown No. 1 Green material west of mill site - 64/24/048	Cu		Pb, Zn, As, Ba.	Bi, Mn, P.	Ni, Ag, Mo, Cr, Sr, Li, Rb.	Co, Sn, Cd, V, Ga, B, Cs.	Cu 2.0, Pb 0.3, Zn 0.2, Ag 0.0015, Bi 0.025, Ba 0.4, As 0.25.	1.20	4	None detected at limit equivalent to 0.002% U ₃ O ₈ .	3,500	9/6/64
Liontown No. 2 Brown material west of mill site - 64/24/049			Cu, Pb, Ba.	Zn, Bi, Mn.	Ni, Mo, Sr, Sc, Li, Rb.	Co, Ag, Sn, Cr, V, Ga, B.	Cu 0.25, Pb 0.25, Ag 0.0008 Bi 0.02, Ba 0.7.	0.95	3			9/6/64
Liontown No. 3. Dump to east of old mill site - 64/24/050			Cu, Pb, Ba.	Zn, Bi, Mn.	Ni, Mo, Sr, Sc, Li, Rb.	Co, Ag, Sn, Cr, V, Ga, B, Cs.	Cu 0.3, Pb 0.2, Ag 0.0008, Bi 0.01, Ba 0.6.	0.95	2		2,200	9/6/64

SURVEY OF MINERAL RESOURCES IN TAILINGS - DETAILED RESULTS - QUEENSLAND.

[illegible]

Locality Map SURVEY OF MINERAL RESOURCES IN QUEENSLAND TAILINGS DUMPS

