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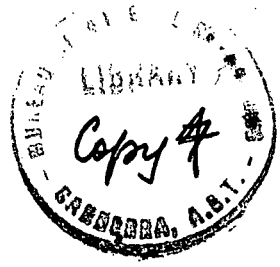

SURVEY OF MINERAL RESOURCES IN WESTERN AUSTRALIAN TAILINGS DUMPS

by

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SUMMARY.

Sampling of selected tailings dumps in Western Australia was followed by radioactive, spectrographic and chemical analysis of the samples for the less common elements. Some dumps in the Northampton area were of relatively small size and tonnages were estimated after pacing and compass surveys, but in most other cases the locations selected all contained large quantities (from several hundred thousand tons upwards) and rougher estimates of tonnage were made without the benefit of a survey. No dumps showed obvious potential for economic production of contained minerals under present circumstances.

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 features 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 dertain types of deposit but are now known to be sometimes found in them.

SCOPE OF SURVEY.

The dumps selected for sampling were chosen following reference to the Western Australian Mines Department. Examination of a variety of references and discussions with Inspectors of Mines. Selection was based on size of dump and complexity of mineralization in the parent deposit, together with consideration of obtaining a representative cover of dumps in the more accessible parts of the state. The Mines Department production records were particularly valuable as a guide to the size of dumps likely to be found in the various districts.

As in the case of previous surveys, analytical work on samples was carried out by the Australian Mineral Development Laboratories. It included a qualitative assessment of radioactivity, expressed as percentage U_3O_8 equivalent. The limits of detection of the spectrographic method used for samples from the Northampton area are set out on Table I. Phosphorus, silicon, aluminium, iron, magnesium, calcium, sodium, potassium and titanium were not sought. The analytical method used was not sensitive enough to detect gold at levels which would be interesting from a retreatment point of view. Chemical methods were used for sulphur and selenium, detection limits being for sulphur fifty parts and for selenium one part per million respectively.

METHOD OF SAMPLING

Samples from dumps not associated with operating mines were collected during August 1964 and August 1965. Portions were taken by shovel from below the surfaces of the dumps in a number of places and combined to give composite samples. Where different types of material were stacked separately in large quantities separate composites were usually made up from the various types of material. Wherever possible, advantage was taken of gullies and other erosion channels in the dumps to obtain fresh material from a range of depths below the top surface.

In the case of smaller dumps from lead mining in the Northampton area tonnage estimates were based on pacing and compass surveys. However, in the case of goldmining dumps the selection was restricted to the larger centres of production and in most cases dumps were obviously large enough to be of interest if significant values were obtained in the analyses.

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

Samples generally were about five pounds in weight and were 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.

In some cases it was found convenient to obtain samples of ore and rock from spillage in the vicinity of shafts and treatment plants. These collections were given a sample number and retained with the portions of tailings samples held in Canberra.

RESULTS - BY DEPOSITS

The semi-quantitive spectrographic measurements made on the Northampton area samples are set out in the following paragraphs together with a description of the location of the dumps, the samples taken and, where appropriate, the tonnages represented by the samples.

At the end of this Record, Table II sets out the complete analytical results for each sample, including elements detected but in the case of the Northampton area samples, 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 Northampton results are set out first, followed by the old gold mining dumps in the order in which they were sampled in August 1965 and then by the samples supplied by the companies.

In the case of samples from areas other than Northampton the major interesting quantitative results only are mentioned in the text and recorded in the standard form of result sheet. Table III lists the values obtained for each element determined. These were supplied by AMDEL for the gold mining samples as being a better indication of the elements present than the ranges of concentration given by them for previous tailings survey sample analyses. The folloiwng elements were not detected in the goldfields samples: Au, Pd, In, Rh, Ru, Ir, Os, Pt, Ta, Nb, Tl, Cs, Y, Ce.

Northampton Area

The State Battery at Northampton is located about 1 mile west of the town. It is a simple gravity plant capable of treating 1000 tons per month on a 3 shift basis. The tonnage of sands in the dump were estimated at 10,000. The elements measured in sample No.1 (64/24/057) included lead greater than 1%, zinc 0.2% and zirconium 0.2%. The second sample, 64/24/058 was from a small dump of reddish material with much mica. The lead content exceeded 1% and 0.02% beryllium was detected in the analysis. This material is understood to have been canted from outside the Northampton area for treatment at the Battery. The Northampton area is described by Campbell, F.A., (1965).

Galena Mine

This is the most northerly mine sampled in the Northampton area. The first sample (64/24/059) was taken from the northern brown coloured dump visible to the west of the North West Coastal Highway about half a mile south of the Murchison River Crossing. Elements measured included lead more than 1% zinc 0.25% and copper 0.025%. The second sample (64/24/060) was from the smaller yellow coloured dump to the south and the sample on analysis, proved to contain much the same elements as the first including lead more than 1%, zinc 0.15% and copper 0.03%. These two dumps together were estimated to contain about 17,000 tons of tailings. The barium content of these dumps is about three times that of the other dumps to the south, but even so is still under 1%.

Wheal Fortune

The tailings dumps here (3 miles west of Northampton on Vic.Loc 436) were found to be much washed away and it was estimated that about 10,000 tons remained. One sample, 64/24/061, was taken from this area and the elements measured included more than 1% lead, zinc 0.4% and copper 0.05%. The dump here was predominantly grey in colour in contrast to most of the other dumps which were yellow or brown.

Ghurka Mine

This area is six miles north of Northampton and to the west of the North West Coastal Highway. The dump material here consisted of dark brown to grey sands located in a creek below the mine. The tonnage was small and estimated at 8,000 tons only. Elements measured in the sample (64/24/062) included lead more than 1%, zinc 0.6% copper 0.25% and silver 0.001%.

Wheal Ellen

The mine area is approximately 1 mile south west of Northampton. The dump sampled consisted of brown-grey sands, and was estimated to contain about 4,500 tons only. Some slimes dumps further down the slope of the hill were not measured or sampled because of their apparent small size. Elements measured in sample 64/24/063 from this dump included lead and zinc both greater than 1%, copper 0.015%.

Baddera Mine

This is located east of the North West Coastal Highway but west of the railway line, about six and a half miles north of Northampton. It was estimated that the dump of brown-grey sands in this area contained 20,000 tons of tailings. Elements measured in the sample 64/24/064 from this area included more than 1% lead, zinc 0.1% copper 0.06%. Griffin and Hughes (1950), describe testing of gravity methods for retreatment of tailings from this area. Little success was obtained because of the large proportion of values found in the - 200 mesh fraction.

Protheroe Mine

Samples were taken from each of the three main dump areas at this mine which is situated on Vic.Loc.833 near Nabawa, 17miles south east of Northampton. It is the furthest south of the mines in the Northampton area included in this survey. The first sample, 64/24/065 was from a dump near the main shaft of most recent mining of the area for lead. The dump was composed of brown-grey sands and slimes and elements measured in the sample included more than 1% lead, zinc 0.15% and copper 0.004%. The second sample was from dumps on both sides of the creek in the area of recent mining activity. Elements measured in this sample (64/24/066) included lead more than 1%, zinc 0.3% and copper 0.015%. Dumps represented by these two samples were estimated at a total of 10,000 tons. The third sample was from old dumps, estimated to contain 30,000 tons located toward the crest of the hill overlooking the other dumps. Much copper stained slime was evident on the slope below the dumps which had apparently survived from the days when the area was worked as the Narra Tarra mine for copper. Elements measured in this sample (65/24/067) included more than 1% lead, zinc 0.06% and copper 0.08%. As would be expected this sample is appreciably higher in copper content than the other two from dumps in the lead mining area at Protheroe.

Thomas and Meharry (1951) and Hughes and Meharry (1952) describe tests of flotation as a method to recover lead and zinc from tailing from the gravity treatment plant operating at that time. The unusually active nature of the sphalerite amde separation of lead and zinc difficult and there was a considerable loss of oxidised material. Head values of samples supplied for these tests contained 4.34 and 5% lead, 2.1 and 2.5% zinc and 0.12% and 0.04% copper respectively. These results suggest that in the absence of any silver values, the quantity of lead present is not sufficient to warrant further treatment of tailings dumps in this general area at current lead prices.

Blaskett (1952) reported on sink-float tests carried out on Protheroe lead ore with a head value of 20.2% lead, 2.45% zinc and 7.15 dwt per ton of silver. Separation of lead and zinc was not effected at a heavy medium specific gravity of 2.91, but might be practical at higher specific gravities.

Nixon (1953) describes treatment plants then in use at the Protheroe and Galena mines which in all probability produced some of the tailings sampled in this survey.

Westonia

Access to the mine area which was examined was obtained by a track continuing on from the end of the main street of the township. Two samples were collected; the first was from dumps to the east which appeared scattered and may have been associated with the operation of a retreatment plant. This sample was numbered 65/24/018 and elements measured at noteworthy concentrations in it included barium 0.3% and strontium 0.05%. Other elements appear to be present at relatively low levels. The second sample, 65/24/019 was from a larger single dump to the west and contained 0.3% barium and 0.2% strontium, with tungsten and vanadium at 4 times the level of the first sample.

There was evidence that some of the mullock dumps were being removed for construction purposes. A representative sample of rocks was collected from the dump adjacent to the engine and stamp battery foundations and was labelled 65/24/020.

Operation of the treatment plant possibly responsible for some of the tailings sampled is reported by Williams (1919); Blatchford and Hosman (1917) describe the geology of the area and the mines operating at that time, the principal of which was the Edna May.

Mt. Palmer

This mining centre is reached by turning south off the Great Eastern Highway at Yellowdine for approximately nine miles. The principal mine is on a breakaway overlooking a salt lake. It was estimated that approximately 150,000 tons were present in sand and slime dumps. Sample 65/24/021 was taken from these and found to contain 0.1% arsenic and 0.07% manganese, other elements being present at relatively low concentrations. Some rock samples were collected from a mullock dump opposite the easternmost sand dump and labelled 65/24/022.

Matheson and Hobson (1940) describe the geology and mine workings in this area. Their plate 19 illustrates the mine area, the sample being taken from dumps in the area covered by the word "track" on GML3546. The report was made before the mine was fully in production and surface features have changed somewhat since that time.

Coolgardie Area

a) Bayley's Find. The dumps here amount to several hundreds of thousands of tons and have resulted from the treatment of ore from the Barbara, Surprise and Callion mines, as well as from Bayley's Find itself. One sample, 65/24/023, was taken from the dumps adjacent to Bayley's Find Mill and covered by TA98 and GML5609 on plate IX of McMath, Gray and Ward, (1953). These authors describe mines and geology in the Coolgardie area. The Bayley's Find Mill tailings sample contained 0.15% copper, 0.15% nickel and 0.08% chromium and is of interest because of the relatively high values in these elements compared with other samples. The sample also contained the highest bismuth content of any sample (0.025%).

b) Tindal's. This mine area is two miles south of Coolgardie along the Esperance railway line. A large intact dump at the south eastern end of the area was sampled. This lay on GML 5532 and 5529 on plate IV of McMath et al, (1953). The geology of this area is described in the reference on pages 135-139. At least 100,000 tons of tailings remain in this area. Elements of note measured in the sample (65/24/024) were strontium and tungsten, both 0.01%.

c) Burbanks. This area lies about six miles south of Coolgardie along the Londonderry road. Two distinct areas with dumps were noted. Sample 65/24/025 was taken from dumps in the Burbanks Central area, to the west of the road. Dumps were estimated to total 50,000 tons and elements measured in the sample at above normal concentrations included barium 0.12%, strontium 0.1% and manganese 0.2%. The second area, to the north, was the Burbanks Main Lode mine area. Dumps were located on both sides of the road and probably exceeded 100,000 tons in all. Sample 65/24/026 was taken from this area and noteworthy elements measured included barium 0.2% and strontium 0.2%. Other elements however were at an even lower level than in sample 65/24/025.

Plate VIII of McMath et al (1953), covers this area, the Burbanks Central dumps being in the area of GML5720 and the Burbanks Main Lode dumps in the general area covered by GML5717 and TL3 on that plate.

d) Bonnievale. This area lies about 7 miles north of Coolgardie. The dumps are all quite low and scattered over a large area. Many of the heaps of sand are quite white in colour while some are stained cream to brown. Sample 65/24/027 was taken from the western area, south and west of a peg numbered 5550. The dump area corresponds approximately with lease 5673 on plate XIII of McMath et al (1953). Elements present were all measured at very much lower levels than usual as would be expected from the very light colour of the sands.

Kunanalling Area

This centre is about 20 miles north of Coolgardie, on the road passing Bonnievale. The main mine here was the Premier, located behind a hill to the north east of the ruins of the town. Sample 65/24/028 was taken from sands located toward the top of the hill and slimes on the flat below the open cut. The location is shown on the geological sketch map in Gibson (1908 (a)). Even at that time the mine appears to have been almost abandoned, according to page 24 of the above reference. Apart from 0.1% arsenic the sample contained no elements at notable concentrations.

Ora Banda

The dump sampled here was on the eastern end of a series of dumps stretching away to the west to the Ora Banda - Coolgardie road. It was 0.7 miles south of the old Ora Banda Hotel and lay between an old headframe and the access road to the open cut being worked in August 1965. Reference to Jutson (1913) suggests that the dump was on the eastern end of theold Victorious mine leases. All the sands in the area appeared similar to those in the dump sampled and were estimated to total several hundred thousand tons. The sample contained 0.2% barium and 0.08% strontium. Other elements were generally present at unremarkable levels, with the exception of gallium which at 60 parts per million was the highest concentration measured.

Davyhurst - Golden Pole Mine

Sands in this area were dumped separately in an area to the north west of the shaft, and sample 65/24/030 was taken from them. Slimes were in a separate dump to the north east of the shaft and sample 65/24/031 was taken from them. A selection of rocks from surface dumps and shaft spillage was labelled 65/24/032. Access to this area was obtained from Ora Banda via Carbine, Credo and Callion. See plate 2 of Gibson (1904) for a locality map of this area. Both the dump samples were notable for their tungsten content -0.4%, but were otherwise generally low in metallic elements. Barium was present in both samples at 0.2% and strontium at 0.1%.

Comet Vale

At the time this area was visited a number of wind blown sand dumps lay in the area north and west of the headframe which stood close beside the main road. These dumps were apparently from the Sand Queen - Gladsome workings and the total quantity of tailings was several hundred thousand tons approximately. Jutson (1921 (a)) describes the mines and geology of this area as known at that time. Lead and zinc were present at 0.15% each and copper at about half that level in the sample collected from this area (65/24/033). Other elements were found at more usual levels with the exception of vanadium, which at 0.06% was unusually high.

Yunndaga - Menzies Consolidated Mine

This area is described in Woodward, (1906) at pages 62-64. The dumps are visible from the main Kalgoorlie - Menzies road and are located west of the railway formation and approximately 5 miles south of Menzies. There are several hundred thousand tons of sands, slimes and calcines in the area. The sands have been considerably windblown. Sample 65/24/034 was a composite of all three types of material from the area and contained 0.1% chromium, 0.15% barium and 0.1% strontium at unusual levels of concentration.

Menzies Area

a) Lady Shenton. This area is about $\frac{1}{4}$ mile south of the township to the west of the Kalgoorlie road, Woodward (1906) refers to the mines in this area. Sample 65/24/035 contained 0.15% lead but other elements were present at relatively lower and unremarkable levels.

b) First Hit. This is the other important mine area in the Menzies district. It is located north of the Riverina road about $\frac{1}{2}$ mile west of the town. A composite sample was made up from dumps north, east and west of the existing battery office situated on a prominent knoll. The tonnage here was estimated at 150,000 tons. Sample 65/24/036 contained 0.2% lead with barium 0.1% and strontium 0.2% the only other elements present at notable concentrations.

Mulline Battery

The Mulline and Riverina areas were examined, but dumps at Riverina were considered too small to warrant individual sampling. Approximately 50,000 tons was estimated to be present at the old Mulline Battery site, however. Sample 65/24/037 was collected from the dumps at this location. Gibson, (1904) and Feldtmann, (1915) describe the geology and mines in this area, none of which are particularly large. Apart from 0.2% lead, 0.15% zinc and 0.15% manganese the sample showed little by way of abnormal concentrations.

Kookynie

On closer examination the large dump visible $\frac{1}{4}$ mile east of the town was found to be divided into several parts. The sandy portions were somewhat blown about by the wind and some of them showed signs of copper staining. A separate dump some distance north of the town was not sampled. The composite sample from various parts of the dump close to the town contained 0.3% tungsten and 0.1% barium at the only outstanding elemental concentrations, Most of the others elements identified being at very low levels. Jutson, (1921 (a)) refers to this area on pages 41 and 42 and plate I. The sands apparently are the result of treatment of ore from the Cosmopolitan mine.

Sons of Gwalia Mine, Leonora

The very large sand dump from this mine was sampled in two sections. The first sample, 65/24/039 was taken from channels cut in small gullies dissecting the eastern and southern sections of the dump. Some of this material was reddish in colour, some greyish. This sample was found to contain 0.12% barium, 0.2% strontium, chromium also rather higher than usual at 0.08% and boron 0.008%. Other elements were present at unremarkable levels. In the northern and western section of this very large dump sample 65/24/040 was taken

from channels cut in the walls of a gully up to 7 feet deep which led lead away from the last location of the mill tailing discharge pipe. Elements found at notable concentrations in this sample included chromium 0.1% nickel 0.04% barium 0.08% strontium 0.01% and boron 0.12%.

The dump is generally about twelve feet high in the east, gradually decreasing to nothing in the west, and the tonnage is very large indeed. Most of the 7 million tons of ore treated during the life of the mine has finished up in this dump. For a description of the mine and plant see Anon (1933) and for the geology of the deposit, see Finucane (1965 (a)). Noldart and Bock (1959) describe the geology of the area.

Laverton Area

Gold deposits in the Laverton area are described in Gibson (1906). Refer also to plate VIII of Miles (1938) for the location of mines and to Hobson and Miles (1951) for a description of the geology of this area.

a) Ida H Mine. This mine area is located to the north east of the Burtville road, approximately eight miles from Laverton. Sands were collected from a number of dumps, some of which may have been retreated. A composite sample, 65/24/041 was made up. On analysis this was found to contain 0.3% arsenic and 0.012% boron. These were the only elements at unusual concentrations. A collection of rocks from mullock dumps and shaft bin spillage was numbered 65/24/042.

b) Craigie more Mine. This area is also described in Gibson, (1906) It lies about 3 miles south of Laverton on a hill to the west of the railway formation. The slimes dump is pink in colour and relatively intact but the sands are much windblown. A composite sample of sands and slimes, numbered 65/24/043 was taken. In this was found 0.1% arsenic and 0.15% manganese, with other elements at unremarkable levels of concentration. Rocks collected from mullock dumps and shaft bin spillage were labelled 65/24/044.

c) Lancefield. This was one of the last and largest mines to be worked in the Laverton area. The nearby mine township of Beria has been deserted for some years. Matheson, (1938) describes this deposit; appendices to his report describe the ore and mill products and plate II illustrates the surface features including the location of some of the tailings dumps. Sample 65/24/048 was taken from the easternmost dump which is very high and stands out prominently above the surrounding relatively flat country. Elements measured at notable concentrations in this sample were zinc 0.15%, cobalt 0.03%, arsenic 0.6%, manganese 0.15% and molybdenum 0.015%. The sample from the rectangular dump to the west was numbered 65/24/049 and found to contain arsenic 0.6%, manganese 0.1%, zinc 0.1% and cobalt 0.025% at unusually high concentrations. Two further dumps appear to have been added to the north of

those on Matheson's plate II since this was prepared. The eastern of these dumps appears to be the result of retreatment of previously cyanided calcines. The sample collected was numbered 65/24/047 and contained zinc 0.25%, silver 0.004%, copper 0.15% arsenic 0.6%, manganese 0.12% and antimony 0.015% as the elements present at noteworthy concentrations. The western of the two new dumps was yellow in colour and from it sample 65/24/046 was collected. Two portions of this were sent for analysis, the elements at noteworthy concentrations being arsenic 0.06% and manganese and strontium both 0.1%. A sample of rocks, largely spillage from the shaft bin, was collected and labelled 65/24/045. Tin and molybdenum, though present at low levels were relatively higher in the Lancefield dump samples than in those from most other gold mining centres.

d) Cox's Find This is one of the more recently operated mines in the Laverton area. It is located approximately 40 miles north of that centre. Matheson, (1937) describes the deposit as he found it at that time. A composite sample of sands and slimes collected from dumps in this mine area was numbered 65/24/055. Analysis showed it to be relatively low in nickel and chromium. Boron at 0.012% was the only element present at a notably high concentration. A suite of rocks collected from the vicinity of the shaft bin was labelled 65/24/056.

Mt. Morgans

The sands from the Mt. Morgans mine are visible from the main Leonora-Laverton road lying on the eastern side of a prominent jaspilite ridge. The deserted Mt. Morgans townsite lies on the western side of this ridge. The area is described by Jackson, (1905). The sands were much washed out and rather scattered, probably as a result of retreatment. A composite sample was found to contain 0.12% manganese and 0.008% molybdenum with no other elements present at unusually high levels. A collection of rocks, largely spillage from the shaft bin, was labelled 65/24/051.

Lawlers

This area is located about 80 miles north of Leonora and is now deserted, the nearest settlement being at Agnew, a few miles north. The main feature of mining operations in this area was the network of tramlines which brought ore from a number of outlying mines to a central treatment plant at the Great Eastern mine. This plant was located about $\frac{1}{4}$ mile north east of the townsite on the main road. Gibson, (1907), describes mines in this area. A sample of sands from dumps at the Great Eastern plant (65/24/052) contained notable concentrations of the following : arsenic 0.2%, nickel 0.07%, chromium 0.15%, and 0.3% each of barium and strontium. In a sample of slimes from the same area (65/24/053) zirconium at 0.03% was noted at the highest concentration in gold tailings. Arsenic 0.3% and nickel and chromium 0.12% were the only other elements present at notably high concentrations. A collection from rock dumps near the crusher site in the central treatment plant area was labelled 65/24/054.

Mt. Sir Samuel - Bellevue Mine

This area is described by Gibson, (1907). The presence of copper in the ore was evident from copper staining in the dumps and the presence of dissolved copper salts in rainwater pools lying amongst them. Sample 65/24/057 was of dump material and on analysis showed 0.3% copper, but little else in the way of unusually high elemental concentrations. The chromium content was unusually low. Sample 65/24/058 was taken from flue dust lying in the remains of the extensive roasting plant. Elements measures at notable concentrations in this sample included more than 1% copper, 10% sulphur and 80 parts per million selenium. Zinc and bismuth concentrations were somewhat increased relative to the dump material but were still not unusually high.

Wiluna

There were extensive sand dumps at the mine site, approximately three miles south of the town. A large grey-yellow sand and slime dump, cut up by gullies, was sampled to provide 65/24/059, which was found to contain 0.1% antimony and 0.2% strontium. Nickel and chromium were present at a medium level of concentration and lithium, rubidium and barium at a somewhat higher level than usual. A sample numbered 65/24/060 was taken from a low level dump of calcines, and on analysis found to contain arsenic 0.8%, antimony 0.15%, copper 0.15% lead 0.05%, zinc and nickel both 0.08% at unusual levels. Other dumps, including a high dump of calcines and a yellow sand dump, were not sampled. A collection of rocks from the vicinity of the shaft and crushing plant was labelled 65/24/061.

The geological setting of the Wiluna deposits is detailed in the Fifth Empire Congress geological volume G.O.A.O.D. (1953). Blaskett and Woodcock, (1953) describe ore dressing methods in use at this mine when it was operating. Minutes of the First Ordinary Meeting of the Aus. I.M.M. (A.I.M.M., 1933) describes the plant in the first few years of its life.

Meekatharra

This area is described in Clarke, (1916) and Noldart, (1960). Samples were taken from a line of extensive dumps beyond the railway yards and separated from the town by a low ridge. The main mines were the Fenian and Ingliston Consols. Sample 65/24/062 came from reddish dumps at the western end of the area and was found to contain 0.08% nickel, 0.15% chromium, 0.5% arsenic with other elements present at more usual levels.

The sample of greenish dumps in the centre of the area (65/24/063) was found to contain 0.2% nickel, 0.3% chromium and 0.05% arsenic at unusually high levels of concentration.

The sample of dumps of brownish material from the eastern end of the area (65/24/064) was found to contain the following elements at unusual concentration; nickel 0.12%, chromium 0.3% and arsenic 0.6%. The selenium content was reported as 70 parts per million, and is quite out of keeping with other results from the same area. It is probably either incorrect or the sample was unrepresentative

as regards the selenium content.

Some dumps in the "Queen of the Hill" area and to the north east of the main dump area were not sampled because of their relatively small size.

Peak Hill

Peak Hill township, which is now practically deserted, lies approximately 73 miles north of Meekatharra. The dumps sampled were apparently the result of treatment of ore from the open cuts to the south west of the town. The sands and slimes had been dumped so as to block the course of a small creek, and were somewhat washed out. Sands were white to light brown in colour and were clearly visible from the old hotel site, beside the Roy Hill road. Sample number 65/24/065 was taken from the sands, and on analysis shown to contain 80 ppm zirconium, 50 ppm bismuth, 50 ppm gallium, 0.02% molybdenum 0.05% scandium and 0.2% barium at relatively high levels of concentration. Lithium at 5 ppm was unusually low. A number of rocks were collected at the mill site and labelled 65/24/066. Some of these might be spillage from the old treatment plant, others from outcropping banded iron formation on the treatment plant site. In 1910 this mine was reported to be closing down - see D.M.W.A. (1910).

Reedy's Find - Triton Mine

This mine is located approximately 14 miles east of the main road and railway at Tuckenarra. Campbell (1953 (a)) describes the geology of this deposit. Sand and slime dumps lie on both sides of the access road. The slimes may be related to an old small plant situated at the south end of the main workings. Sands and slimes from the various dumps were combined to form sample 65/24/067. A number of rock samples from the crusher area were taken and labelled 65/24/068. The only elements noted as being present at an unusually high level were strontium 0.1% and sulphur 3.2%.

Cue Area

a) Big Bell Mine, is located about 18 miles west of Cue township. Big Bell townsite itself is deserted, but a small partnership is engaged in cyaniding remnants of material left by the abrupt closure of the mine. There is a single very large tailings dump which consists of sands and slimes in alternating layers. Sample 65/24/069 was taken from the south and west edges of the dump and in it barium 0.3% and molybdenum 0.02% were the two elements shown by analysis to be present at unusual concentrations. Sample 65/24/070 was taken from the full depth of the dump in a deep gully washed out of the northern edge and in this sample barium 0.2% and molybdenum 0.025% were the only noteworthy elemental concentrations. Some copper staining and black slimes were noted, and staining by iron was general throughout the tailings. A sample of rocks from the mullock dump was labelled 65/24/071. The Staff, (1953), describe the geology of the Big Bell deposit and some background to the operation is given by Thomas, (1948).

b) Great Fingal Mine, dumps are clearly visible from the main road to Mt. Magnet a few miles south of Cue. Calcines from the roasting plant and

reground fine material remain in neat heaps but the sands are very windblown, partly fill the open cut and have flowed through into the underground workings. A sample from a dump of slimes containing some calcined material, labelled 65/24/072, was found to contain 0.15% lead 0.2% tungsten and 0.4% arsenic, with other elements present at unremarkable levels. A sample of sands (65/24/073) was found to contain 0.25% arsenic. Sample 65/24/074) was composed entirely of calcines and was found to contain 0.3% lead, 0.5% tungsten and 0.5% arsenic, with other elements at more usual levels. A collection of rocks from the mullock dump near the shaft with headframe still standing was labelled 65/24/075. Woodward, (1907), describes the Great Fingal mine at that time.

Sandstone

There are two main dump areas at Sandstone. The first is visible from the Agnew road junction about ½ mile east of the township. In this particular area the sand dumps are wind blown, there is a high mullock dump and the slime dumps are low and pinkish in colour. A composite sample of sands and slimes was taken and labelled 65/24/076, the elements noted at unusual levels being arsenic 0.15% and manganese 0.2%. A collection of rocks from the mullock dump was labelled 65/24/077.

To the south west of the town there is a second area of dumps. Here the material is generally similar to that in the eastern area. A sample of sands and slimes, 65/24/078 was taken and the analysis indicated that arsenic 0.2% was the only unusual elemental concentration.

The Sandstone area is described by Gibson (1908 (b)). The western area, also known as Hack's is the one worked by the Oroya Black Range company, while the eastern area is that worked by the Sandstone Development Company.

Youanme

This area is located about sixty miles south east of Mt. Magnet. There is much more dump material here than at Sandstone, and the mine was operated much more recently. Two large calcines dumps were sampled to provide 65/24/079 which was found to contain lead 0.1%, arsenic 0.5% and lithium 0.06% (one of the highest levels in any sample). Molybdenum at 0.025% was also high. A large grey-yellow sand and slime dump provided sample 65/24/080, containing 0.2% barium and strontium, 0.06% lithium and0.3% arsenic, while a collection of rocks from dumps and spillage in the area was labelled 65/24/081. Gibson (1908 (b)) describes this area, but his report was made long before the dumps sampled were laid down by the company operating in the period 1937 - 1942.

SAMPLES SUPPLIED BY COMPANIES.

a) Central Norseman Gold Corporation N.L. Norseman

The company supplied samples from three dumps on its leases. The first sample was given number 65/24/082. It was a composite sample from the Phoenix dump which is estimated to contain 3million tons and is being added to at the rate of about 190,000 tons per year. Elements at notable concentrations in this sample included tungsten 0.05% and vanadium 0.04%. Concentrations generally were very low. The second sample was numbered 65/24/083., and came from the Northern Star dump, estimated to contain 32,000 tons. All elements in this sample were at relatively low concentrations. The third sample came from the Princess Royal dump and was numbered 65/24/084. Elements present were at slightly higher concentrations than the previous two samples, but were with the exception of chromium 0.1%, still low. A spectrographic analysis of a bulk sample of tailings collected over three working periods late in 1953 and early in 1954 is set out in Appendix I. Hall and Bekker, (1965), discuss the geology and mines of the Norseman area.

b) Great Boulder Gold Mines Ltd., Kalgoorlie. Two samples were supplied by this company. The first was of plant tailings, representative of 10 million tons held in tailings dumps. This was labelled 65/24/085 and on analysis proved to contain the following elements at noteworthy concentrations; vanadium 0.3%, molybdenum 0.02% and gallium 0.006%. The second sample was of flotation concentrate which, after treatment makes up 4% of the total tailing and amounts to about 20,000 tons per year. This sample was numbered 65/24/086, and on analysis was found to contain noteworthy concentrations of vanadium 0.2%, manganese 0.15% and strontium 0.1%. Gillies and Harris, 1955, describe the Great Boulder treatment plant and improvements made to it.

Woodall, (1965) and Finucane (1965(b)) discuss the geological setting of the gold deposits of Kalgoorlie.

c) North Kalgurli (1912) Ltd. Kalgoorlie. Two samples were supplied representing tailings produced during a period of two weeks ending 19th July 1965. The first sample was numbered 65/24/087 and consisted of flotation tailings. It contained the following elements at unusual concentrations: vanadium 0.08%, strontium 0.1% and manganese 0.12%. Most elements detected in this sample were present at relatively low levels. The second sample, numbered 65/24/088 was of calcine residues. Arsenic, base metals, molybdenum tellurium and silver were at higher levels than the tailings but tungsten vanadium and most other elements were lower. The arsenic content was 0.12%, zinc 0.09%, silver 0.004%, molybdenum 0.06%, boron 0.04% and tellurium 0.015%.

d) Lake View and Star Ltd., Kalgoorlie. Three samples were provided by this company. The first sample, number 65/24/092 was from the Chaffers Plant tailing dump, estimated to contain 12 million tons. Elements at notable concentrations were manganese 0.2% vanadium 0.07% tungsten 0.03%

strontium 0.1% and molybdenum 0.015%. Sample 65/24/093, the second sample supplied by this company, was from the Chaffers Retreatment Tailing Dump, estimated to contain approximately 16 million tons; in this sample the elements measured were at generally similar levels to the previous sample, with manganese 0.12% strontium 0.1% vanadium 0.07% tungsten 0.03% and molybdenum 0.04%. The third sample, 65/24/094, was from the Associated Retreatment tailings dump which was estimated to contain almost 4 million tons. The only elements at notable concentrations in this sample were vanadium 0.25% and tin which at 0.0025% was very low but was amongst the highest tin values recorded for gold mine dumps. A cyclone classification plant is used to produce an hydraulic backfill suitable for the current underground operations.

d) Hill 50 Gold Mine, Mt. Magnet. The first sample (65/24/089) forwarded by this company was from the Hill 60 mine tailings dump which was estimated to contain 300,000 tons. The elements determined in this sample were all at relatively low levels of concentration. De la Hunty, (1958) describes this area on page 56. The second sample, (65/24/090) came from the Morning Star dump, which was estimated at 150,000 tons. Elements at notable concentrations included chromium and manganese 0.1%, antimony 0.08%, molybdenum 0.05% and boron 0.02%. Lithium rubidium barium and strontium were all at elevated concentrations relative to the other two samples from the Mt. Magnet district. The Hill 50 mine tailings dump provided the third sample from this area, which was numbered 65/24/091. Lewis, (1965) and de la Hunty (1958) page 63 describe this mine. The dump was estimated to contain about 2 million tons and concentrations of elements were generally low with the exception of lead 0.12%, phosphorus 0.04% and sulphur 6.15%.

e) Western Mining Corporation - Frazer's Mine, Southern Cross. The first samples forwarded by this company were from Frazer's mine. A number ofindividual samples were combined to form sample 65/24/095 from the dump located west of the southern headframe. Elements present at notable concentrations in this sample included nickel 0.15% chromium 0.2% tungsten 0.3% and vanadium 0.06%. A second sample from Frazer's was composed of individual samples representative of the dump to the north of the southern headframe. Elements considered noteworthy in this sample included nickel and chromium at the same level as the previous sample with tungsten vanadium and other elements somewhat lower. Frazer's Mine dumps were estimated to contain 20,000 tons.

Williamson and Barr, (1965) describe the gold mines of the Yilgarn district and their environment.

f) Western Mining Corporation, Nevoria Mine, Marvel Loch. A number of samples were provided by Western Mining Corporation from small dumps at the Nevoria mine, said to total 5,000 tons. These samples were grouped into larger samples representative of dumps as follows: sample 65/24/097 from the first dump south of the magazine; sample 65/24/098 from the second dump south

of the magazine; sample 65/24/099 from the third dump south of the magazine; and sample 65/24/100 from the dump to the south of the headframe. Although elements were present at somewhat higher concentrations in this latter sample than in all the previous Nevoria samples, there were none at really noteworthy levels.

g) Western Mining Corporation, Copperhead Mine Bullfinch. Dumps at this area were the result of treatment of approximately 4.5 million tons of ore, but are now much eroded. Sample 65/24/101 was made up of samples from the old slime dump south of the shaft-elements at noteworthy levels were absent from this sample. A second sample, 65/24/102 was made up from samples taken from the main sand dump. Elements were present at relatively low levels in this sample also with the exception of manganese 0.1% and sulphur 2.28%. Penrose and Howard, (1956) describe milling practice at Copperhead when Great Western was operating there.

h) Ravensthorpe Copper Mines, N.L. Ravensthorpe. This company supplied samples of a variety of material from the Ravensthorpe district. Soufoulis, (1958) and Ellis and Lord, (1965) describe the mines and geology of this area. Sample 65/24/103 was taken from the Elverdton mine tailings dump, which was estimated to contain half a million tons. This is the result of recent operations of the company. Elements found at noteworthy concentrations include copper 0.15 %, zirconium 0.007% and lanthanum 0.03%. Lead and zinc were at relatively low levels. Sample number 65/24/104 was of current tailings from Ravensthorpe Copper Mines mill. As would be expected, it contained much the same elements and concentrations as the previous sample. The sample numbered 65/24/105 was taken from the Floater mine battery sand dump, estimated to contain 10,000 tons, and probably the largest of the gold mining dumps in the Ravensthorpe area. The mine is located 1½ miles north of Ravensthorpe in what Soufoulis calls the "Cattlin Group". Elements at higher than usual levels include copper 0.2%, bismuth 0.006%, manganese 0.25% and sulphur 2.39%. Payne, Clarke and Moore, (1937) report on the concentration of ore from the Floater Mine containing 0.12% copper, 0.04% arsenic, 1.5% sulphur and 2.6 dwt of gold per ton. Sample 65/24/106 was of current Ravensthorpe copper concentrate. The analytical results indicate low lead and zinc content of the concentrate with molybdenum 0.08%, lanthanum 0.03%, sulphur 29.3%, selenium 170 parts per million and radioactivity the highest of any sample from Western Australia, the value being equivalent to 0.008% U_3O_8. This latter results serves to recall that the present copper mining activity stems from interest aroused in the Elverdton mine during the uranium boom when specimens from this area were found to exhibit significant radioactivity - see Soufoulis p.63. Other Ravensthorpe samples show rather higher radioactivity than samples from most other areas. Sample 65/24/107 was of slag from the old smelter located about 3 miles south-south-east of Ravensthorpe township. This plant operated during the early days of

the field - continuously from 1906-1911 and intermittently from then to 1918. Elements at notable concentrations in this sample include copper 0.6%, cobalt 0.2% and molybdenum 0.025%. The dump is estimated to contain 15,000 tons of slag.

i) Moonlight Wiluna Gold Mines Ltd., Mt.Ida. Samples from two dumps in the Mt. Ida area were supplied by this company. The first was numbered 66/24/005 and was taken from tailings dump of the currently operating Timoni mine. It was estimated to amount to half a million tons. Elements at noteworthy levels included vanadium and manganese 0.08% and lead 0.05%. The second sample was from a smaller dump, estimated to contain 12,000 tons, from the Ida Mercer mine. Elements at notable levels detected on analysis of this sample include copper and vanadium both 0.08% and sulphur 2.36%. Gibson, (1907), described the Mt.Ida field and noted the presence of copper in some of the orebodies. Tomich, (1953 (b)) reports on the general geology of the Mt.Ida mining area.

RESULTS - BY ELEMENTS

A good general reference to be read in relation to this section of the Record is E.S. Simpson's three volume work on mineral occurrences in Western Australia (Simpson, 1948).

As would be expected, all the Northampton samples contained considerable quantities of lead - more than 1% in most cases. Zinc was the element with the next highest concentration in samples from this area. One sample (Wheal Ellen) showed over 1%, the others ranged down to 0.06% in the copper dump sample from Protheroe.

The second sample from the State Battery was clearly of material quite different from that derived from the lead deposits of the area, containing as it did beryllium and cesium, elements missing from the lead tailings.

A notable feature of the tailings from the Northampton lead deposits was the presence of zirconium at quite high levels - 0.3% in one case and up to 0.2% in others. The barium and strontium contents were in a fairly constant proportion of 8 to 10 to 1. Copper varied from 0.25% in the Ghurka mine sands to 0.004% in the tailings from the Protheroe lead deposit. The Ghurka mine sands also contained the highest percentage of sulphur (2.64%) and the evidence indicates that these are the highest grade tailings in the Northampton suite.

Elements at notable concentrations in the goldfields samples include nickel. This element was found at concentrations above 0.1% in tailings from Bayley's Find (but may have originated in ore carted from other mines in the district); from Lawlers (again possibly from carted ore); from Meekatharra and from Frazer's Mine at Southern Cross.

Chromium was high in Meekatharra samples (0.3%) and in those from Frazer's Mine (0.2%). These are associated with some of the high nickel values mentioned in the preceeding paragraph.

Copper lead and zinc were all at levels below 1%, with the unsurprising exceptions of the Ravensthorpe copper concentrate and flue dust from the old roasting plant at the Bellevue Mine, Mt. Sir Samuel. Some of the highest values were for lead and zinc from the Menzies and Mulline areas (up to 0.2%); zinc from the Lancefield mine, Laverton (0.25%); copper from the Bellvue mine dumps (0.3%) and lead and zinc in Great Fingal calcines (0.3% and 0.12% respectively).

The bismuth content of tailings dumps ranged from less than 1 part per million in a number of samples to a maximum of 250 parts per million (0.025%) in the Bayley's Find tailings dump sample. 200 parts per million was the next highest, at Kookynie.

Tin values were all very low, the highest being 25 parts per million in the Associated Retreatment Dump of Lake View & Star Ltd.

Tungsten values ranged from a low of less than 20 parts per million in a number of samples of 0.3% at Frazer's Mine, Southern Cross, 0.5% in Great Fingal calcines, 0.4% in both samples from the Golden Pole mine Davyhurst, 0.3% in the Kookynie dump sample, and 0.2% in the slime sample from Great Fingal.

The lowest molybdenum values were less than 1 part per million, but 800 parts per million were recorded in the Ravensthorpe copper concentrate sample and 600 parts per million in calcine residues from North Kalgoorlie.

Arsenic values showed great variation, from less than 50 parts per million in a number of samples to as high as 0.8% in Wiluna calcines. Values of 0.6% were recorded for Lancefield calcines and sand dumps, one of the Meekatharra samples and 0.5% for Lawlers slimes, a second Meekatharra sample, Great Fingal calcines and Youanme calcines.

Antimony was present at much lower levels of concentration than arsenic. The highest value was 0.15% in Wiluna calcines followed by 0.1% in the Wiluna sand and slime dump sample.

Manganese ranged from less than 5 parts per million in one of the Nevoria dumps at Marvel Loch to 0.25% in the Floater Battery sand dump sample from Ravensthorpe. Most samples fell in the range 200-2000 parts per million.

The North Kalgurli calcine residue showed 150 parts per million tellurium on analysis, the rest of the samples not showing values above 20 parts per million. It seems unlikely that this unique high result is representative of the North Kalgorli calcines.

Lithium, rubidium, barium and strontium generally varied consistently, with lithium and rubidium values less than barium and strontium ones. The highest lithium value of 600 parts per million was shared by the samples from the First Hit mine at Menzies, and Youame calcines and sands and slimes. Highest

rubidium values of 500 parts per million were recorded for the two Youame samples. Barium values of 0.3% were recorded for the Westonia samples and the Lawlers sands. Strontium values of 0.3% were recorded for Lawlers sands and Burbanks Main Lode area dumps.

Boron values were very low, ranging from 1 to 400 parts per million. The highest value was in the North Kalgurli calcines.

Lawlers slimes contained 300 parts per million zirconium; the Peak Hill sample 80 parts per million; Ravensthorpe tailings 70 parts per million and all others less than 50 parts per million. This is in contrast to the Northampton area samples which often showed values of several thousand parts per million.

The highest phosphorus value recorded was 600 parts per million at Youame, with many recorded as being less than 100 parts per million.

Scandium values ranged from less than 1 part per million at Kookynie and Cox's Find to 500 parts per million in the Peak Hill sample.

Most lanthanum values were below 100 parts per million. The only exceptions were samples from the Ravensthorpe area where 500 parts per million were found in tailings from the current operation and 300 parts per million in the concentrate.

General Comment on Results

The spectrographic method used was not sufficiently sensitive to detect gold in tailings at levels at which some dumps might be profitably worked. However it is felt that the possibility of working dumps for gold would have been adequately explored by prospector and company activity in recent years.

The presence of tungsten in dumps at Westonia, Davyhurst (the Golden Pole) and Southern Cross (Frazer's Mine) has been known for many years. The occurrence of tungsten in dumps at Kookynie and the Great Fingal mine at Day Dawn near Cue is probably less well known; it does not appear to be mentioned in Simpson, 1948.

The high nickel values encountered in a number of samples are probably related to the presence of basic rocks containing nickel as the host rocks to the ore deposits. It is doubtful if these high nickel values are much of a guide to possible economic nickel mineralization without some knowledge of the structural and other factors controlling the occurrence of economic concentrations of this element in Western Australia.

The future development of hydrometallurgical processes such as liquid-liquid separation may, at some future time, provide some prospect for the recovery of the commoner non ferrous metals and some of the rarer ones such as vanadium or molybdenum from dumps. Calcined material seems generally to contain greater elemental concentrations of potentially valuable elements than sands and slimes, and would be the favoured raw material for such processes. Though elemental separations using specific liquids are technically possible at present much development work will be required before they can be applied to mine tailings dumps in dry and isolated parts of Australia. The North Kalgurli calcine dumps would appear most favourably situated for exploitation of all the dumps sampled. Duncan, Walden and Trussell, (1966) refer to the bacterial leaching of copper and zinc from pyrite calcine.

Another possibility which may become economically feasible at some future time is the dry treatment of tailings, particularly sands, by air tabling and electrostatic and magnetic methods to produce tungsten concentrates. This method will only be practical if the bulk of the element is present as discrete tungsten minerals rather than as lattice substitutions in other minerals. Dumps at Kookynie and the Great Fingal seem most promising in this context, with dumps at Davyhurst and Westonia rather less attractive because of their smaller size.

The clean white sand at Bonnievale may have a very limited potential for use for decorative purposes in the district. It would not seem likely that the material could be economically upgraded and carted to Perth for use as glass sand in competition with higher grade naturally occurring material closer to market.

Water from recent rains lay amongst the dumps at Mt. Sir Samuel and a visible deposit of copper plated out on the blade of a shavel within a minute or so of being placed in this water. While it is possible that sufficient copper bearing material exists for dumps to be leached for copper the limited amount of material and its relatively low copper content suggest that an operation could only be undertaken on a small scale with simple equipment. The technical and economic aspects of such an operation would need very careful examination before its practicability could be determined. Any proposal to leach copper from the Elverdton tailings dumps at Ravensthorpe would require similar careful consideration.

Conclusions & Recommendations

The conclusion drawn from the survey is that under present economic conditions and at the present state of technology there are no dumps which have obvious possibilities for retreatment for metals other than gold.

The high nickel values in some sample analyses may be of value when related to other factors in suggesting areas which might contain economic deposits of this element.

Further laboratory work is not recommended but as hydrometallurgical processes are further developed, their possible application to calcine dumps and dumps containing copper should be kept in mind. The application of dry separation methods to tailings containing wolfram might warrant investigation at some future date when tungsten metal prices seem set for a lengthy period at a high level, and dry processing methods are further advanced.

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TABLE I

SPECTROGRAPHIC ANALYSES

Detection-Limit Concentrations of Elements-Northampton Samples

D.C. Arc. Excitation

ELEMENT	per cent	p.p.m.	ELEMENT	per cent	p.p.m.
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	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	0.005	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
Mg	0.0002	2	Yb	0.001	10
Mn	0.001	10	Zn	0.0025	25
Mo	0.0005	5	Zr	0.001	10

TABLE II

SURVEY OF MINERAL RESOURCES IN TAILINGS - DETAILED RESULTS - WESTERN AUSTRALIA

Sample Location and Mark	Quantitative Analysis by Emission Spectroscopy - %					Semi-Quantitative Analysis by Emission Spectroscopy %	Chemical Analysis		Radioactivity % U_3O_8 Equiv.	Est. of Dump Tonnage	Date Sampled & Remarks
	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%	Seppm.			
State Battery No.1 Northampton 64/24/057	Pb	Zn Zr	Cu Cr V Mn Li Rb P Ba	Co Ni Sn Ga Sr	Ag Be Mo B	Cu 0.015, Pb>1, Zn 0.2, Ag 0.0002, Cr 0.06, V0.02, Mn 0.015, Zr 0.2, Ba 0.6, Sr 0.08, P 0.02, Li 0.02, Rb 0.012.	0.6	*0.5	0.001	10,000	12/8/64
State Battery No.2 Northampton 64/24/058	Pb		Zn Cr Be Mn Li Cs Rb P Ba Sr	Cu Sn Ga Zr	Co Ni V Mo Ge B	Cu 0.004, Pb>1, Zn 0.02, Cr 0.04, Be 0.02, Mn 0.07, Zr 0.01, Ba 0.25, Sr 0.06, P 0.015, Li 0.06, Rb 0.06, Cs 0.03.	1.01	*0.5	0.001	Small	12/8/64
Galena Mine No.1 Northampton 64/24/059	Pb	Zn Zr Ba	Cu Co Ni Cr V Mn Li P Sr	Sn Ga Rb	Bi Ag Mo Ge B	Cu 0.02, Pb>1, Zn 0.25, Co 0.015, Ni 0.02, Ag 0.0002, Cr 0.07, V 0.02, Mn 0.01, Zr 0.3, Ba 0.8, Sr 0.1, P 0.015, Li 0.025, Rb 0.01.	0.71	0.5	0.002	5,500	12/8/64
Galena Mine No.2. Northampton 64/24/060	Pb	Zn Zr Ba	Cu Co Ni Cr V Mn Li P Sr	Sn Ga Rb	Bi Ag Mo Ge B	Cu 0.03, Pb>1, Zn 0.15, Co 0.012, Ni 0.015, Ag 0.0003, Cr 0.07, V 0.012, Mn 0.02, Zr 0.2, Ba 0.7, Sr 0.08, P 0.02, Li 0.015, Rb 0.01.	0.84	0.5	0.002	11,500	12/8/64
Wheal Fortune Northampton 64/24/061	Pb	Zn	Cu V Mn Li Rb P Ba Sr Cr	Co Ni Sn Cd Ga As Zr	Bi Ag Mo Ge B	Cu 0.05, Pb>1, Zn 0.4, Co 0.008, Ni 0.008, Ag 0.0002, Cr 0.07, V 0.015, Mn 0.015, Zr 0.01, Ba 0.25, Sr 0.025, P 0.03, Li 0.025, Rb 0.02.	0.61	0.5	0.002	10,000	12/8/64
Ghurka Mines Northampton 64/24/062	Pb	Cu Zn	Co Cr V Mn Li Zr P Ba	Ni Cd Ga Rb Sr	Sn Bi Ag Mo Ge In B	Cu 0.25, Pb>1, Zn 0.6, Co 0.015, Ni 0.009, Ag 0.001, Cr 0.07, V 0.015, Mn 0.015, Zr 0.1, Ba 0.25, Sr 0.025, P 0.06, Li 0.02.	2.06	0.5	0.002	8,000	12/8/64
Wheal Ellen Northampton 64/24/063	Pb	Zn	Cu Cr V Li Rb P Ba	Co Ni Cd Ga Mn Zr Sr	Sn Bi Ag Mo Ge In B	Cu 0.015, Pb>1, Zn 1, Ni 0.009, Ag 0.0002, Cr 0.07, V 0.025, Mn 0.008, Zr 0.005, Ba 0.15, Sr 0.015, P 0.03, Li 0.025,Rb 0.012.	1.10	*0.5	0.002	4,500	11/8/64
Baddera Mine Northampton 64/24/064	Pb	Zn Cr	Cu Li Rb P Ba	Co Ni Sn V Ga Mn Zr Sr	Bi Ag Mo Ge B	Cu 0.06, Pb>1, Zn 0.1, Ni 0.01, Ag 0.0002, Cr 0.1, V 0.007, Mn 0.007, Zr 0.003, Ba 0.2, Sr 0.025, P 0.015, Rb 0.015, Li 0.03	0.02	1.5	0.002	20,000	12/8/64
Protheroe Mine No.1 Northampton 64/24/065	Pb	Zn Cr	Mn Li Rb Zr P Ba Sr	Cu Sn V Ga	Co Ni Cd Ag Mo Ge B	Cu 0.004, Pb>1, Zn 0.15, Ag 0.0006, Cr 0.12, V 0.008, Mn 0.015, Zr 0.08, Ba 0.25, Sr 0.03, P 0.025, Li 0.025, Rb 0.015.	0.32	0.5	0.002	3,000	11/8/64
Protheroe Mine No.2 Northampton 64/24/066	Pb	Zn Zr	Cu Cr V Li Rb P Ba Sr	Co Ni Sn Ag Ga Mn	Cd Mo Ge In B	Cu 0.015, Pb>1, Zn 0.3, Ag 0.0012, Cr 0.08, V 0.02, Mn 0.008, Zr 0.15, Ba 0.3, Zr 0.025, P 0.03, Li 0.025, Rb 0.025.	1.05	1.0	0.001	10,000	11/8/64
Protheroe Mine No3 Northampton 64/24/067	Pb	Cr	Cu Zn V Li Rb Zr P As Ba Sr	Co Ni Sn Ag Ga Mn	Bi Mo Ge In B	Cu 0.08, Pb>1, Zn 0.06, Ag 0.002, Cr 0.15, V 0.02, As 0.01, Mn 0.01, Zr 0.025, Ba 0.3, Sr 0.03, P 0.01, Li 0.025, Rb 0.02.	0.47	0.5	0.003	30,000	11/8/64

SURVEY OF MINERAL RESOURCES IN TAILINGS - DETAILED RESULTS - WESTERN AUSTRALIA

Sample Location and Mark	Quantitative Analysis by Emission Spectroscopy - %					Semi-Quantitative Analysis by Emission Spectroscopy %	Chemical Analysis		Radioactivity % U_3O_8 Equiv.	Est. of Dump Tonnage	Date Sampled & Remarks
	Over 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.			
Westonia - Sand dumps - Eastern area. 65/24/018		Ba	Cu Pb Cr W Mn Li Sr P	Zn Ni V Mo Ga Rb Sc	Co Bi Ag Ge B	Ba 0.3, Sr 0.05.	0.46	3	*0.001	Total at Westonia of the order of 50,000 to 100,000.	17/8/65
Westonia - Larger single sand dump western area 65/24/019		Ba Sr	Cu Pb Cr W V Mn Li Rb P	Zn Ni Mo Ga Sc	Co Bi Ag Ge B	Ba 0.3, Sr 0.2.	0.06	3	*0.001		17/8/65
Mt. Palmer - Sands and slimes from dump area. 65/24/021		As	Cu Zn Ni Cr V Mn Li Rb Ba P	Pb Co Ga Sr Sc	Bi Ag Mo Ge B	As 0.1, Mn 0.07.	0.08	3	*0.001	At least 150,000	17/8/65
Coolgardie - Bayley's Find - Dumps east of W.M.C. Mill. 65/24/023.		Cu Ni	Pb Zn Co Bi Cr W V As Mn Li Ba Sr Sc	Ag Ga	Sn Mo Ge B	Ni 0.15, Cu 0.15, Cr 0.08, Bi 0.025.	1.47	4	*0.001	Hundreds of thousands of tons	19/8/65
Coolgardie - Tindal's Large intact dump to south east. 65/24/024		W Sr	Pb Ni Cr Mn Rb Ba P	Cu Zn Co V Ga Li Sc	Sn Bi Ag Mo Ge B	W 0.1, Sr 0.1	1.91	3	*0.001	100,000	19/8/65
Coolgardie - Burbanks Central area. 65/24/025		Mn Ba Sr	Cu Pb Zn Co Ni Cr W V Li Rb P Sc	Ag Ga	Sn Bi Mo Ge B	Mn 0.2, Ba 0.12, Sr 0.1	0.88	5	*0.001	50,000	19/8/65
Coolgardie - Burbanks Main Lode 65/24/026		Ba, Sr	Cu Pb Zn Co Ni Cr V Mn Li P Sc	Ag W Ga Rb	Sn Bi Mo Ge B	Ba 0.2, Sr 0,3.	0.34	6	*0.001	100,000 or more	19/8/65
Bonnie Vale - dumps west and south of peg 5550 - 65/24/027			Pb Zn Cr Mn P	Cu Ni V Li Ba	Co Bi Mo Ga Ge B Sc		0.05	5	*0.001	About 100,000	19/8/65
Kunanalling - Sands and slimes from the Premier mine 65/24/028		As	Cu Pb Zn Ni Cr V Mn Rb Ba P	Co W Li Sr B Sc	Sn Bi Ag Mo Ga Ge	As 0.1, Rb 0.04.	0.09	4	*0.001	Of the order of 100,000	19/8/65
Ora Banda - Dump at eastern end of area 65/24/029		Ba	Cu Pb Zn Ni Cr W V As Mn Li Rb Sr Sc	Co Ga B	Sn Bi Ag Mo Ge	Ga 0.006, Ba 0.2, Sc 0.04, Sr 0.08.	0.76	7	*0.001	Several hundred thousand	20/8/65
Davyhurst - Golden Pole mine sands 65/24/030		W Ba Sr	Cu Co Cr V Mn Li Rb P Sc	Zn Ni Ga B	Pb Sn Bi Ag Ge Mo	W 0.4, Ba 0.2, Sr 0.1.	0.20	5	*0.001	Golden Pole total of the order of 50,000	20/8/65
Davyhurst - Golden Pole mine slimes 65/24/031		W Mn Ba Sr	Cu Zn Co Ni Cr V Li Rb Sc	Pb Ga B	Sn Bi Ag Mo Ge	W 0.4, Mn 0.1, Ba 0.2, Sr 0.1	0.26	6	*0.001		20/8/65

SURVEY OF MINERAL RESOURCES IN TAILINGS - DETAILED RESULTS - WESTERN AUSTRALIA

Sample Location and Mark	Qualitative Analysis by Emission Spectroscopy - %					Semi-Quantitative Analysis by Emission Spectroscopy %	Chemical Analysis		Radioactivity U_3O_8 equiv. %	Est. of Dump Tonnage	Date Sampled & Remarks
	Over 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.			
Comet Vale - Dumps north west of head frame by road - 65/24/033		Pb Zn	Cu Co Ni Cr W V Mn Li Rb Ba Sr P	Bi Ag Mo Ga Sc	Sn Cd Ge B	Pb 0.15, Zn 0.15, V 0.06.	1.55	6	*0.001	Several hundred thousand	21/8/65
Yundega - Sands, slimes & calcines from Menzies Consolidated dumps. 65/24/034		Cr Ba Sr	Cu Zn Co Ni Bi W V As Mn Rb P Sc	Pb Ga Li	Sn Ag Mo Ge B	Cr 0.1, Ba 0.15, Sr 0.1	0.79	6	*0.001	Several hundred thousand	21/8/65
Menzies - Dumps at Lady Shenton 65/24/035		Pb Mn	Cu Zn Co Ni Cr W V As Rb Ba Sc	Bi Ag Ga Li Sr	Cd Mo Ge B	Pb 0.15, Mn 0.1	0.85	6	*0.001	About 50,000	21/8/65
Menzies - Dumps at FirstHit 65/24/036		Pb Ba Sr	Cu Zn Co Ni Cr W V As Mn Li Rb Sc	Cd Ag Ga	Sn Bi Mo Ge B	Pb 0.2, Li 0.06, Ba 0.1, Sr 0.2, Cd 0.001	0.92	3	*0.001	About 150,000	21/8/65
Mulline - Battery sands. 65/24/037		Pb Zn Mn	Cu Co Ni Bi Cr V Rb Ba Sr P	Ag W Ga Sc	Sn Cd Mo Ge Li B	Pb 0.2, Zn 0.15, Mn 0.15	0.22	3	*0.001	About 50,000	21/8/65
Kookynie - Large dump ¼m east of town 65/24/038		W Ba	Pb Bi Cr V Mn Rb P	Cu Zn Co Mo Ga Li Sr	Ni Sn Ag Ge B	W 0.3, Ba 0.1	0.68	2	*0.001	Several hundred thousand	22/8/65
Gwalia - east and south parts of Sons of Gwalia dump 65/24/039		Ba Sr	Cu Zn Co Ni Cr V As Mn Li Rb Sc	Pb W Ga B	Mo Ge	Ba 0.12, Sr 0.2, Cr 0.08, B 0.008	0.88	4	*0.001	This dump is very large indeed and probably contains much of the 7 million tons mined at Sons of Gwalia	22/8/65
Gwalia - west and north parts of Sons of Gwalia dump 65/24/040		Cr Sr	Cu Co Ni V As Mn Li Rb Ba B Sc	Zn W Ga	Pb Sn Mo Ge	Cr 0.1, Sr 0.1, B 0.012 Ba 0.08, Ni 0.04	0.97	5	*0.001		22/8/65
Laverton - Ida H dumps. 65/24/041		As	Cu Pb Zn Ni Cr W V Mn Ba B P	Co Ga Li Rb Sr	Sn Bi Ag Mo Ge Sc	As 0.3, B 0.012	0.50	4	*0.001	Perhaps 50,000	24/8/65
Laverton - Craigie more - sands and slimes. 65/24/043		As Mn	Cu Zn Co Ni V Ba P Sc	Pb Cr W Mo Ga Rb Sr B	Ag Ge Li	As 0.1, Mn 0.15	0.17	6	*0.001	Perhaps 100,000	24/8/65
Laverton - Lancefield - Yellow dump to north west. 65/24/046A		Sr	Cu Zn Co Ni Cr V As Mn Ba Sc	Mo Li Rb B	Pb Sn Bi Ag Ga	Mn 0.08, Sr 0.1	0.87	4	*0.001	At least several hundred thousand tons in each of the four Lancefield dumps.	24/8/65
As above 65/24/046B		Mn Sr	Cu Zn Co Ni Cr V As Li Ba P Sc	Pb W Mo Ga B	Sn Ag Ge	Mn 0.12, Sr 0.1	0.68	5	*0.001		24/8/65

SURVEY OF MINERAL RESOURCES IN TAILINGS - DETAILED RESULTS - WESTERN AUSTRALIA

Sample Location and Mark	Qualitative Analysis by Emission Spectroscopy - %					Semi-Quantitative Analysis by Emission Spectroscopy %	Chemical Analysis		Radioactivity U_3O_8 equiv. %	Est. of Dump Tonnage	Date Sampled & Remarks
	Over 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.			
Laverton - Lancefield Retreated calcines to north east. 65/24/047		Cu Zn As Mn	Pb Co Ni V Mo Sb Ba	Sn Ag Cr W Ga Li Sr B Sc	Cd Bi Ge	Cu 0.15, Zn 0.25, Ag 0.004, As 0.6, Mn 0.12, Sb 0.015.	1.31	8	*0.001		24/8/65
Laverton - Lancefield High sand dump to south east. 65/24/48		Zn As Mn	Cu Pb Co Ni Cr V Mo Ba	Sn Ag W Ga Sb Sr B Sc	Bi Be Ge Li	Zn 0.15, Mo 0.015, As 0.6, Mn 0.15, Co 0.03.	1.30	7	*0.001		24/8/65
Laverton - Lancefield Rectangular dump to south west. 65/24/049		Zn As Mn	Cu Pb Co Ni Cr V Li Ba Sc	Sn Ag W Mo Ga Sb Sr	Bi Ge B	Zn 0.1, As 0.6, Mn 0.1, Co 0.025.	1.93	7	*0.001		24/8/65
Mt. Morgans - washed out sand dump. 65/24/050		Mn	Cu Zn Ni V Ba P	Pb Co Cr Mo Ga Rb Sr	Sn Bi Ag Ge Li B Sc	Mn 0.12, Mo 0.008.	0.79	7	*0.001	Perhaps 100,000 tons	24/8/65
Lawlers - Sands from dumps to east of main road. 65/24/052		Cr As Ba Sr	Cu Zn Co Ni V Mn Li P Sc	Pb W Ga Rb	Sn Bi Ag Mo B	Cr 0.15, Ni 0.07, As 0.2, Ba 0.3, Sr 0.3.	0.25	6	*0.001	Several hundred thousand	25/8/65
Lawlers - Slimes from dumps to east of main road. 65/24/053		Ni Cr As	Cu Zn Co V Mn Ba Sr Zr Sc	Pb Bi W Ga Li	Sn Ag Mo Ge B	Ni 0.12, Cr 0.12, As 0.5, Zr 0.03.	0.18	6	*0.001	Several hundred thousand	25/8/65
Erlistoun - Cox's Find Sands and and slimes. 65/24/055			Cu Pb Zn Cr W As Mn Ba B P	Co Ni V Rb Sr	Sn Bi Ag Ga Ge Li	B 0.012.	0.64	4	*0.001	A few hundred thousand	23/8/65
Mt. Sir Samuel - Bellevue mine dumps. 65/24/057		Cu	Zn Co Ni V As Mn Ba	Pb Bi Ag Cr W Ga Rb Sr Sc	Sn Mo Li B	Cu 0.3	5.8	6	*0.001	Between 50 and 100 thousand	25/8/65
Mt. Sir Samuel - Bellevue mine flue dust. 65/24/058	Cu		Zn Co As	Pb Ni Bi Ag Mn Ba	Sn Cd Cr V Mo B Sc	Cu over 1%, Bi 0.004.	10.0	80	*0.001	Small only	25/8/65
Wiluna - Large grey yellow slimes and sands dump. 65/24/059		Sb Sr	Pb Co Ni Mn W V As Li Rb Ba Sc Cr	Cu Zn Ga B	Sn Ag Mo	Sb 0.1, Sr 0.2.	0.32	4	*0.001	About one million	25/8/65
Wiluna - Low dumps of red calcines. 65/24/060		Cu As Sb	Pb Zn Co Ni Cr Li Rb	Ag W V Mn Ba B	Sn Mo Ga Sr Sc	Cu 0.15, Zn 0.08, Ni 0.08, As 0.8, Sb 0.15, Pb 0.05.	1.59	5	*0.001	Perhaps one hundred thousand	25/8/65
Meekatharra - Western end of area 65/24/062		Cr As	Co Ni V Mn Li Ba Sc	Cu Pb Zn W Rb Sr	Sn Mo Ga Ge B	Ni 0.08, Cr 0.15, As 0.5.	0.20	5	*0.001	Several hundred thousand	26/8/65

SURVEY OF MINERAL RESOURCES IN TAILINGS - DETAILED RESULTS - WESTERN AUSTRALIA

Sample Location and Mark	Qualitative Analysis by Emission Spectroscopy - %					Semi-Quantitative Analysis by Emission Spectroscopy %	Chemical Analysis		Radioactivity U_3O_8 equiv. %	Est. of Dump Tonnage	Date Sampled & Remarks
	Over 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.			
Meekatharra - Central section - 65/24/063		Ni Cr	Cu Co V As Mn Li Sr Sc	Pb Zn W Rb Ba	Sn Mo Ga B	Ni 0.2, Cr 0.3, As 0.05.	0.24	6	*0.001	Several hundred thousand	26/8/65
Meekatharra - East end - 65/24/064		As Ni Cr	Mn Li Sr Sc Cu Zn Co V	Ba Pb W Ga Rb	B Sn Bi Mo Ge	Ni 0.12, Cr 0.3, As 0.6.	0.28	70	*0.001	Several hundred thousand	26/8/65
Peak Hill - Dumps of sands & slimes from north end of town. 65/24/065		Ba	Cu Pb Zn Ni Cr V Mo Mn Rb P Sc	Co Bi W Ga Sr Zr	B Sn Ag Ge Li	Bi 0.005, Ga 0.005, Mo 0.02, Ba 0.2, Zr 0.008, Sc 0.05.	0.06	6	*0.001	Several hundred thousand	27/8/65
Reedy's Find - Triton mine sands and slimes. 65/24/067		Sr	Cu Pb Co Ni Cr W V Mn Li Rb Ba	Zn Ga Sc	Sn Bi Mo Ge B	Sr 0.1.	3.20	7	0.001	Hundreds of thousands	28/8/65
Cue - Big Bell, south and west edge of dump 65/24/069		Ba	Pb Cr W V Mo As Sb Li Rb Sr P	Cu Zn Co Ni Ag Ga Mn B Sc	Sn Bi Ge	Mo 0.02, Ba 0.3.	1.27	7	0.002	Big Bell dump several million tons in size.	29/8/65
Cue - Big Bell, gully at north edge of dump 65/24/070		Ba	Cu Pb Zn Co Cr W V Mo As Sb Mn Li Rb Sr P Sc	Ni Ag Ga B	Sn Bi Ge	Mo 0.025, Ba 0.2.	1.28	8	0.002		29/8/65
Cue - Great Fingal - slimes dumps. 65/24/072		Pb W As	Cu Zn Co Ni Cr V Mn Li Rb Ba Sr P	Ag Ga B Sc	Sn Bi Mo Ge	Pb 0.15, W 0.2, As 0.4.	0.50	7	0.001	Hundreds of thousands	29/8/65
Cue - Great Fingal - wind blown sands. 65/24/073		As	Pb Zn Cr W V Mn Ba Sr P	Cu Co Ni Li Sc	Bi Ag Mo Be Ge B Ga	As 0.25.	0.26	8	0.001	Hundreds of thousands	29/8/65
Cue - Great Fingal - central area calcines. 65/24/074		Pb Zn W As Ba Sr	Cu Co Ni Cr V Mn Rb P	Ag Ga Li Sc	Sn Cd Bi Mo Ge B	Pb 0.3, Zn 0.12, Ag 0.003, W 0.5, As 0.5, Ba 0.2, Sr 0.1.	1.17	9	0.001	About one hundred thousand	29/8/65
Sandstone - Oroya area sands and slimes. 65/24/076		As Mn	Cu Pb Zn Co Ni Cr V Ba P	W Ga Li Rb Sr B Sc	Sn Bi Ag Mo Ge	As 0.15, Mn 0.2.	0.05	9	0.001	About 100,000	30/8/65
Sandstone - West end sands and slimes. 65/24/078		As	Cu Pb Zn Co Ni Cr V Mn Ba P	W Ga Li Rb Sr B Sc	Bi Ag Mo Ge	As 0.2.	0.12	5	*0.001	About 100,000	30/8/65
Youanme - Calcine dumps - 65/24/079		Pb As	Cu Zn Co Ni Sc Cr W V Mo Sb Mn Li Rb Ba Sr	Ga B Ag	Sn Bi Ge	Pb 0.1, As 0.5, Mo 0.025, Li 0.06, Rb 0.05, Sb 0.07.	1.15	4	0.002	Several hundred thousand	30/8/65
Youanme - Sands and slimes dumps.65/24/080		As Ba Sr	Cu Ni Cr W V Mn Li Rb P Sc	Pb Zn Co Ga B	Sn Bi Ag Mo Ge	As 0.3, Li 0.06, Rb 0.05, P 0.06, Ba 0.2, Sr 0.2.	0.30	5	0.001	Hundreds of Thousands	30/8/65
Norseman - Phoenix dump - 65/24/082			Cu Pb Co Ni Cr W V As Mn Li	Zn Ag Ga Rb Ba	Sn Bi Mo Ge Sr B Sc	W 0.05, V 0.04.	0.37	5	0.001	3,000,000	Company sample supplied July 1965
Norseman - Northern Star dump - 65/24/083			Pb Zn Ni Cr V Mn P	Cu Co Ag W Li Ba	Sn Bi Mo Be Ga Ge Sr B Sc		0.02	5	0.001	32,000	"

SURVEY OF MINERAL RESOURCES IN TAILINGS - DETAILED RESULTS - WESTERN AUSTRALIA

Sample Location and Mark	Qualitative Analysis by Emission Spectroscopy - %					Semi-Quantitative Analysis by Emission Spectroscopy %	Chemical Analysis		Radioactivity U_3O_8 equiv. %	Est. of Dump Tonnage	Date Sampled & Remarks
	Over 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.			
Norseman - Princess Royal dump. 65/24/084		Cr	Pb Zn Ni V Mn Ba P	Cu Co W Li Rb Sr Sc	Sn Bi Ag Mo Be Ga Ge B	Cr 0.1.	0.14	5	0.001	180,000	Company sample supplied July 1965
Kalgoorlie - Great Boulder flotation tailings. 65/24/085		V	Cu Pb Zn Co Ni Cr Mn Li Rb P Sc W Mo	Ag Ba Sr B Ga	Sn Ge	V 0.3, Mo 0.02, Ga 0.006.	0.33	5	0.001	10 million	Company sample - August 1965
Kalgoorlie - Great Boulder flotation concentrate. 65/24/086		V Mn Sr	Cu Zn Co Ni Cr W Mo Li Rb Ba P Sc	Pb Ag Ga B	Sn Ge	V 0.2, Mn 0.15, Sr 0.1.	0.46	7	0.001	20,000 short tons per year	" Added to tailing after treatment Constitutes 4% of total.
Kalgoorlie - North Kalgurli (1912) Ltd flotation tailings. 65/24/087		Mn Sr	Zn Ni Cr W V Mo Li Rb Ba P Sc	Cu Pb Co Ga B	Sn Ag Ge	V 0.08, Mn 0.12, Sr 0.1.	0.48	5	0.001	Very large	Company sample supplied August 1965
Kalgoorlie - North Kalgurli (1912) Ltd - Calcine residue. 65/24/088		As	Cu Pb Zn Ni Mo Sb Te Rb B P	Co Ag W Mn Ba	Sn Bi Cr V Be Ge Sr Sc	Ag 0.004, As 0.12, Mo 0.06, B 0.04, Te 0.015, Zn 0.08.	0.88	9	0.001	large	"
Mt. Magnet - Hill 60 tailings dump. 65/24/089			Ni Cr	Cu Zn V Mn Ba Sr Sc	Pb Co Sn Bi Mo Ge B		0.62	8	0.001	300,000	Company sample - September 1965
Mt. Magnet - Morning Star tailings dump 65/24/090		Cr Mn	Cu Pb Zn Co Ni W V Mo Sr Sb Li Rb Ba B P Sc	Ga As	Sn Bi Ag Be Ge	Cr 0.1, Mn 0.1, Sb 0.08, V 0.08, Mo 0.05, B 0.02.	0.89	8	0.001	150,000	"
Mt. Magnet - Hill 50 tailings dump. 65/24/091		Pb	Zn Mn P	Cu Ni V Ba Sr	Co Sn Bi Ag Cr Mo Be Ga Ge B Sc	Pb 0.12, P 0.04,	6.15	7	*0.001	2,000,000	"
Kalgoorlie - Lake View & Star Chaffers plant tailings. 65/24/092		Mn Sr	Cr W V Mo Li Rb Ba P Sc	Cu Pb Zn Co Ni Sn Ga B	Ag Ge	Mn 0.2, Mo 0.015, V 0.07, Sr 0.1, W 0.03.	0.11	8	*0.001	15.8 million	Company sample - July 1965
Kalgoorlie - Lake View & Star Chaffers re-treatment plant tailings. 65/24/093		Mn Sr	Cu Zn Co Ni Cr W V Mo As Li Rb Ba Sc	Pb Ag Ga B	Sn Ge	Mn 0.12, Mo 0.04, V 0.07, Sr 0.1, W 0.03	0.95	8	*0.001	3.8 million	"
Kalgoorlie - Lake View & Star - Associated retreatment plant tailings. 65/24/094		V	Cu Pb Zn Co Ni Cr W Mo As Mn Li Rb Ba Sr Sc	Sn Ag Ga B	Cd Bi Ge	Sn 0.0025, V 0.25.	1.32	9	*0.001	12.1 million	"
Southern Cross - Fraser's mine - west of south poppet legs 65/24/095		Ni Cr W	Cu Pb Zn Co V As Mn Li Ba	Bi Ga Rb Sr Sc	Sn Ag Mo Ge B	Ni 0.15, Cr 0.2, Bi 0.004, W 0.3,	0.54	5	*0.001	Fraser's mine total estimated as 20,000 tons	Company sample supplied November '65

SURVEY OF MINERAL RESOURCES IN TAILINGS - DETAILED RESULTS - WESTERN AUSTRALIA

Sample Location and Mark	Qualitative Analysis by Emission Spectroscopy - %					Semi-Quantitative Analysis by Emission Spectroscopy %	Chemical Analysis		Radioactivity U_3O_8 equiv. %	Est. of Dump Tonnage	Date Sampled & Remarks
	Over 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%	Sc. p.p.m.			
Southern Cross - Fraser's mine - north of south poppet legs. 65/24/096		Ni Cr	Cu Co W V As Mn Li	Pb Zn Rb Ba Sr Sc	Bi Ag Mo Be Ga B	Ni 0.15, Cr 0.2.	0.47	6	*0.001	Fraser's mine total estimated as 20,000 tons.	Company sample supplied November 1965.
Marvel Loch - Nevoria mine, first dump south of magazine. 65/24/097			Cu Zn Co Ni Cr V As Mn	Pb Li Ba Sc B	Sn Bi Mo Be Ga Ge		0.37	7	*0.001	Nevoria mine total estimated 5,000 tons	"
Marvel Loch- Nevoria mine, second dump south of magazine. 65/24/098			Cr As Mn	Cu Zn Ni	Pb Co V Be Li Ba B		0.36	5	*0.001		"
Marvel Loch - Nevoria mine, third dump south of magazine. 65/24/099				Cu Cr Ba B Sc	Pb Ni V Li Sr		0.44	5	*0.001		"
Marvel Loch - Nevoria mine, dump south of poppet legs.65/24/100			Cu Zn Ni Cr V As Mn	Pb Co W Ba Sr B Sc	Sn Bi Mo Ge Li		0.10	4	*0.001		"
Bullfinch - Copperhead mine - old slime dump south of shaft. 65/24/101			Cu Pb Zn Ni Cr Li Mn	Co Ba W	Sn Bi Ag B V Mo		0.35	6	*0.001	Copperhead mine total estimated as 4.5 million tons.	"
Bullfinch - Copperhead mine - main dump. 65/24/102		Mn	Cu Pb Zn Co Ni Cr V As Li	W Ba	Sn Bi Ag Mo Ga Ge Sr B	Mn 0.1.	2.28	6	*0.001		"
Ravensthorpe - Elverdton mine tailings dump.65/24/103		Cu	Co Ni Cr V Mo Mn Li Rb Ba Sr P La	Pb Zn Ga Zr Sc	Sn Bi Ag Ge B	Cu 0.15, Zr 0.007, La 0.05.	0.98	6	0.001	500,000	Company sample - supplied September 1965
Ravensthorpe - Current tailings from Ravensthorpe Copper Mines. N.L. 65/24/104.		Cu	Pb Co Ni Cr W V Mo Mn Li Rb Ba Sr P La.	Zn Bi Ga B Zr Sc	Sn Ag Be Ge	Cu 0.2, Mo 0.03, Zr 0.007, La 0.05.	0.35	7	0.002	Accumulating in Elverdton dump.	"
Ravensthorpe - Floater Battery sand dump 65/24/105.		Cu Mn	Zn Co Ni Cr W V Li	Pb Bi Ag Rb Ba B Sc	Sn Mo Be Ga Sr	Cu 0.2, Bi 0.006, Mn 0.25.	2.39	7	0.001	10,000	"
Ravensthorpe - Current concentrate from Ravensthorpe Copper Mines N.L. 65/24/106.	Cu	Zn	Pb Co Ni Mo Mn La	Sn Bi Ag Ba	Cd Cr V Ga Ge Sr B Sc	Cu over 1%, Zn 0.2, Ag 0.006, Bi 0.004, Mo 0.08, La 0.03.	29.0	170	0.008	None - despatched	"
Ravensthorpe - Smelter slag dump. 65/24/107.		Cu Co	Pb Zn Ni V Mo Mn Ba P	Li Rb B	Sn Ag Cr Ga Ge Sr Sc	Cu 0.6, Co 0.2, Mo 0.025.	0.36	7	*0.001	15,000	"

SURVEY OF MINERAL RESOURCES IN TAILINGS - DETAILED RESULTS - WESTERN AUSTRALIA

Sample Location and Mark	Qualitative Analysis by Emission Spectroscopy - %					Semi-Quantitative Analysis by Emission Spectroscopy %	Chemical Analysis		Radioactivity U_3O_8 equiv. %	Est. of Dump Tonnage	Date Sampled & Remarks
	Over 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.			
Mt. Ida - Timoni mine tailings 66/24/005			Cu Pb Zn Co Ni Cr W V Mn Li Rb Ba Sr P	Ga Sc	Sn Bi Ag Mo Be Ge B	V 0.08, Mn 0.08, Pb 0.05.	0.61	7	*0.001	500,000	Company Sample July 1965
Mt. Ida - Meteor mine tailings 66/24/006.			Cu Zn Co Ni Cr Mn Ba	Pb Bi V As Rb Sr B Sc	Sn Ag Mo Ga	Cu 0.08, V 0.08.	2.36	8	*0.001	12,000	"

NOTE: (1) * means "less than".

(2) Complete details of spectrographic analysis of 1965 and 1966 samples are set out in Table III.

TABLE III

THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES

REPORT AN 227/67

SEMI-QUANTITATIVE SPECTROGRAPHIC ANALYSIS

Sample No.	Cu	Pb	Zn	Co	Ni	Sn	Cd	Bi	Ag	Cr	W	V	Mo	Be	Ga	Ge	As	Sb	Mn	Te	Li	Rb	Ba	Sr	B	Zr	P	Sc	La
65/24/018	120	300	20	5	40	*1	*3	4	1.5	500	200	50	10	*1	15	1	*50	*30	150	*20	100	50	3,000	500	3	*50	200	25	*100
19	100	300	20	5	60	*1	*3	4	1.0	500	800	200	30	*1	20	1	*50	*30	150	*20	200	150	3,000	2,000	3	*50	200	50	*100
21	120	40	200	70	120	*1	*3	4	1.5	500	*20	400	2	*1	20	1	1,000	*30	700	*20	150	200	500	30	5	*50	200	50	*100
23	1,500	200	400	200	1,500	2	*3	250	12	800	400	250	3	*1	10	1	400	*30	700	*20	200	*30	500	300	3	*50	*100	300	*100
24	80	200	30	15	150	2	*3	1	1.2	600	1,000	80	1	*1	50	2	*50	*30	700	*20	20	100	500	1,000	3	*50	200	40	*100
25	150	100	200	100	150	1	*3	2	10	400	600	400	2	*1	40	1	*50	*30	2,000	*20	250	200	1,200	1,000	3	*50	200	200	*100
26	150	250	250	200	200	1	*3	3	10	500	40	500	3	*1	50	2	*50	*30	800	*20	300	50	2,000	3,000	3	*50	100	150	*100
27	60	250	120	3	30	*1	*3	3	0.5	500	*20	20	2	*1	5	1	*50	*30	100	*20	20	*30	20	*1	1	*50	100	3	*100
28	120	400	200	60	150	1	*3	3	0.7	600	25	250	2	*1	8	1	1,000	*30	250	*20	60	400	200	60	10	*50	150	30	*100
29	150	400	200	80	100	2	*3	2	8	300	150	500	1	*1	60	1	800	*30	700	*20	500	100	2,000	800	25	*50	*100	400	*100
30	100	5	80	100	80	3	*3	4	1.0	200	4,000	200	2	*1	15	1	*50	*30	700	*20	500	300	2,000	1,000	50	*50	200	200	*100
31	150	80	200	120	120	3	*3	5	1.5	600	4,000	300	2	*1	30	2	*50	*30	1,000	*20	300	100	2,000	1,000	50	*50	*100	300	*100
33	700	1,500	1,500	150	150	3	6	60	10	600	200	600	10	*1	30	3	*50	*30	700	*20	300	100	500	150	5	*50	150	25	*100
34	200	60	200	150	600	2	*3	150	1.5	1,000	400	250	6	*1	10	1	500	*30	700	*20	50	100	1,500	1,000	5	*50	150	200	*100
35	250	1,500	800	150	200	*1	6	10	15	600	150	500	5	*1	15	2	700	*30	1,000	*20	50	200	500	20	3	*50	*100	200	*100
36	250	2,000	800	150	250	1	10	3	10	600	200	500	3	*1	30	2	400	*30	700	*20	600	100	1,000	2,000	5	*50	*100	100	*100
37	250	2,000	1,500	120	200	1	4	150	10	300	50	500	3	*1	15	1	*50	*30	1,500	*20	6	100	800	100	5	*50	150	80	*100
38	70	150	50	20	6	2	*3	200	0.8	600	3,000	500	25	*1	15	1	*50	*30	150	*20	50	200	1,000	50	5	*50	200	*1	*100
39	200	40	150	100	250	*1	*3	*1	0.3	800	40	500	2	*1	25	1	100	*30	600	*20	200	200	1,200	2,000	80	*50	*100	200	*100
40	150	7	40	150	400	2	*3	*1	0.3	1,000	50	500	3	*1	15	1	100	*30	800	*20	300	100	800	1,000	120	*50	*100	200	*100
41	150	100	150	20	100	1	*3	3	0.8	500	150	200	3	*1	15	3	3,000	*30	300	*20	20	30	300	50	120	*50	200	1	*100
43	200	15	200	150	150	*1	*3	*1	0.6	20	50	400	15	*1	10	3	1,000	*30	1,500	*20	6	50	500	30	40	*50	100	300	*100
46(A)	100	8	200	100	200	3	*3	1	5	500	*20	300	40	*1	8	*1	500	*30	800	*20	40	40	500	1,000	20	*50	*100	200	*100
46(B)	150	15	400	150	250	8	*3	*1	5	500	30	500	50	*1	30	2	700	*30	1,200	*20	150	*30	500	1,000	10	*50	100	200	*100
047	1,500	200	2,500	400	400	15	4	8	40	20	30	200	150	*1	15	1	6,000	150	1,200	*20	20	*30	200	50	10	*50	*100	30	*100

KEY: * = less than

** = greater than

TABLE III (continued)

Sample No.	Cu	Pb	Zn	Co	Ni	Sn	Cd	Bi	Ag	Cr	W	V	Mo	Be	Ga	Ge	As	Sb	Mn	Te	Li	Rb	Ba	Sr	B	Zr	P	Sc	La
65/24/048	700	200	1,500	300	250	15	*3	4	15	150	20	250	150	3	15	2	6,000	80	1,500	*20	6	*30	100	20	10	*50	*100	30	*100
49	250	150	1,000	250	300	15	*3	3	12	300	25	250	60	*1	15	2	6,000	50	1,000	*20	150	*30	100	80	5	*50	*100	200	*100
50	200	60	300	50	150	3	*3	1	4	15	*20	150	80	*1	10	4	*50	*30	1,200	*20	8	50	500	80	3	*50	100	2	*100
52	150	60	150	150	700	1	*3	8	2	1,500	40	250	8	*1	30	*1	2,000	*30	500	*20	150	30	3,000	3,000	3	*50	100	200	*100
53	150	80	200	200	1,200	6	*3	20	0.6	1,200	40	200	4	*1	20	1	5,000	*30	500	*20	40	*30	500	200	5	300	*100	300	*100
55	120	150	400	25	60	2	*3	2	0.8	150	200	15	*1	*1	3	2	600	*30	500	*20	3	30	200	20	120	*50	100	*1	*100
57	3,000	15	150	150	120	3	*3	10	10	20	25	150	2	*1	15	*1	300	*30	600	*20	5	30	500	80	3	*50	*100	80	*100
58	**10,000	15	500	100	70	3	3	40	15	8	*20	3	2	*1	*1	*1	600	*30	50	*20	*3	*30	20	*1	1	*50	*100	3	*100
59	70	120	25	120	250	2	*3	*1	1.0	800	150	500	2	*1	40	*1	600	1,000	700	*20	300	200	300	2,000	40	*50	*100	150	*100
60	1,500	500	800	300	800	3	*3	*1	12	200	60	20	4	*1	2	*1	8,000	1,500	50	*20	150	100	30	3	60	*50	*100	2	*100
62	80	20	40	120	800	6	*3	*1	0.3	1,500	40	150	1	*1	3	1	5,000	*30	500	*20	200	30	100	80	5	*50	*100	200	*100
63	200	15	20	250	2,000	3	*3	*1	0.3	3,000	50	300	2	*1	3	*1	500	*30	800	*20	200	30	80	100	3	*50	*100	200	*100
64	150	60	120	200	1,200	8	*3	1	0.2	3,000	80	400	3	*1	10	1	6,000	*30	500	*20	300	30	80	100	3	*50	*100	100	*100
65	150	200	100	40	120	2	*3	50	0.8	700	80	500	200	*1	50	1	*50	*30	500	*20	5	100	2,000	60	3	80	150	500	*100
67	200	150	80	150	250	3	*3	2	0.2	800	200	600	5	*1	30	1	*50	*30	300	*20	400	250	500	1,000	3	*50	*100	80	*100
69	80	150	20	30	15	3	*3	1	10	600	500	600	200	*1	40	5	100	300	50	*20	250	250	3,000	300	50	*50	200	50	*100
70	200	150	150	100	70	3	*3	1	10	400	500	600	250	*1	40	6	150	400	200	*20	250	100	2,000	150	30	*50	150	100	*100
72	200	1,500	500	100	150	3	*3	2	10	500	2,000	500	5	*1	40	1	4,000	*30	700	*20	100	100	800	100	10	*50	100	80	*100
73	80	200	150	20	20	*1	*3	1	1.2	700	200	200	3	2	5	1	2,500	*30	300	*20	50	*30	800	400	5	*50	200	30	*100
74	300	3,000	1,200	250	200	4	3	5	30	200	5,000	250	6	*1	20	2	5,000	*30	400	*20	50	200	2,000	1,000	5	*50	100	60	*100
76	300	150	120	250	200	1	*3	1	1.5	700	25	500	3	*1	15	2	1,500	*30	2,000	*20	20	30	200	20	10	*50	100	10	*100
78	250	200	100	120	150	*1	*3	1	1.0	400	25	400	3	*1	10	1	2,000	*30	800	*20	10	30	400	30	10	*50	150	60	*100
79	300	1,000	200	200	300	3	*3	7	10	600	400	600	250	*1	40	3	5,000	700	150	*20	600	500	800	600	10	*50	*100	200	*100
80	100	60	30	10	100	2	*3	2	0.8	600	100	500	6	*1	40	2	3,000	*30	700	*20	600	500	2,000	2,000	15	*50	600	300	*100
082	200	200	60	200	250	2	*3	3	20	400	500	400	3	*1	20	2	400	*30	800	*20	150	80	10	2	2	*50	*100	5	*100

TABLE III (continued)

Sample No.	Cu	Pb	Zn	Co	Ni	Sn	Cd	Bi	Ag	Cr	W	V	Mo	Be	Ga	Ge	As	Sb	Mn	Te	Li	Rb	Ba	Sr	B	Zr	P	Sc	La
65/24/083	40	250	200	50	150	1	*3	6	10	400	40	200	1	1	5	1	*50	*30	800	*20	20	*30	15	2	5	*50	150	2	*100
84	70	100	120	30	200	2	*3	2	6	1,000	40	250	3	1	8	1	*50	*30	600	*20	30	60	200	40	8	*50	150	20	*100
85	200	100	150	300	200	3	*3	*1	12	500	500	3,000	200	*1	60	3	*50	*30	800	*20	300	300	80	40	50	*50	100	150	*100
86	200	80	150	300	200	3	*3	*1	15	300	200	2,000	150	*1	40	3	*50	*30	1,500	*20	500	300	300	1,000	50	*50	150	200	*100
87	50	10	120	50	120	3	*3	*1	1.5	700	150	800	100	*1	40	3	*50	*30	1,200	*20	200	300	600	1,000	50	*50	150	300	*100
88	150	400	800	80	100	3	*3	3	40	5	20	8	600	2	*1	2	1,200	100	50	150	*3	100	20	2	400	*50	100	1	*100
89	60	6	20	6	200	6	*3	1	*0.1	200	*20	10	1	*1	*1	1	*50	*30	80	*20	*3	*30	80	15	3	*50	*100	30	*100
90	200	400	150	200	250	3	*3	1	5	1,000	400	800	500	1	50	3	50	800	1,000	*20	500	200	800	800	200	*50	200	200	*100
91	70	1,200	150	3	20	2	*3	4	0.8	3	*20	10	5	3	1	5	*50	*30	700	*20	*3	*30	50	40	5	*50	400	3	*100
92	70	15	60	60	70	10	*3	*1	4	150	300	700	150	*1	40	1	*50	*30	2,000	*20	400	200	250	1,000	50	*50	100	200	*100
93	200	80	250	300	200	8	*3	*1	15	150	300	700	400	*1	30	2	300	*30	1,200	*20	150	150	500	1,000	50	*50	*100	200	*100
94	200	200	600	250	250	25	5	3	15	600	400	2,500	300	*1	40	5	300	*30	600	*20	250	200	250	250	15	*50	*100	150	*100
95	400	500	150	300	1,500	8	*3	40	4	2,000	3,000	600	3	*1	10	1	300	*30	700	*20	250	30	100	30	5	*50	*100	70	*100
96	200	30	50	300	1,500	*1	*3	5	5	2,000	600	500	2	2	5	*1	300	*30	700	*20	500	50	50	10	2	*50	*100	15	*100
97	200	50	150	100	150	2	*3	3	0.3	150	*20	500	4	1	3	1	300	*30	500	*20	30	*30	20	*1	20	*50	*100	80	*100
98	50	3	20	3	25	*1	*3	*1	*0.1	200	*20	6	*1	3	*1	*1	100	*30	100	*20	5	*30	3	*1	2	*50	*100	*1	*100
99	20	2	*20	*1	5	*1	*3	*1	*0.1	50	*20	4	*1	*1	*1	*1	*50	*30	*5	*20	3	*30	30	3	25	*50	*100	80	*100
100	150	30	150	20	200	2	*3	3	0.1	600	30	200	3	*1	*1	2	300	*30	100	*20	5	*30	50	40	60	*50	*100	40	*100
1	200	150	100	15	200	2	*3	3	4	300	20	4	1	*1	*1	*1	*50	*30	700	*20	150	*30	30	*1	3	*50	*100	*1	*100
2	200	150	120	150	300	2	*3	5	1.5	500	30	200	1	*1	1	1	300	*30	1,000	*20	150	*30	10	3	2	*50	*100	*1	*100
3	1,500	70	30	250	150	2	*3	2	1.5	200	*20	150	150	*1	15	1	*50	*30	500	*20	300	100	150	200	5	70	200	30	500
4	2,000	150	40	250	150	6	*3	10	4	400	150	400	300	2	60	1	*50	*30	700	*20	400	100	150	150	50	70	200	20	500
5	2,000	50	120	300	150	3	*3	60	10	300	150	300	1	3	5	*1	*50	*30	2,500	*20	250	60	20	1	40	*50	*100	10	*100
6	**10,000	800	2,000	800	200	15	8	40	60	5	*20	5	800	*1	3	1	*50	*30	200	*20	*3	*30	50	2	3	*50	*100	1	300
107	6,000	400	500	2,000	250	3	*3	*1	5	8	*20	200	250	*1	5	1	*50	*30	200	*20	50	60	200	5	40	*50	100	1	*100

TABLE III (continued)

Sample No.	Cu	Pb	Zn	Co	Ni	Sn	Cd	Bi	Ag	Cr	W	V	Mo	Be	Ga	Ge	As	Sb	Mn	Te	Li	Rb	Ba	Sr	B	Zr	P	Sc	La
66/24/005	250	500	200	250	300	5	*3	3	1.5	600	150	800	6	1	40	2	*50	*30	800	*20	300	100	150	200	6	*50	150	30	*100
006	800	12	100	150	300	4	*3	50	2.5	600	*20	50	1	*1	1	*1	50	*30	600	*20	*3	60	200	40	10	*50	*100	20	*100

RESULTS IN P.P.M. GEO A 5

ELEMENTS NOT DETECTED

Au. Pd. In. Rh. Ru. Ir. Os. Pt. Ta. Nb. Tl. Cs. Y. Ce.

APPENDIX I

TAILINGS ANALYSES SUPPLIED BY CENTRAL NORSEMAN GOLD CORPORATION N.L.

Sample: Mill Feed Bulk - 3 periods to 26-1-54.

The ranges for qualitative estimates are indicated as follows:-

8-100 to 1.0%	4-100 to 1.0 ppm (0.01 to 0.0001%)
7-10 to 0.1%	3-10 to 0.1 ppm (0.001 to 0.00001%)
6-1.0 to 0.01%	2-1.0 to 0.01 ppm (0.0001 to 0.000001%)
5-0.1 to 0.001%	1-less than 0.1 ppm

* - Metal not detected.

ELEMENT	RANGE	ELEMENT	RANGE
Al	8	Mn	4
Sb	*	Hg	4
As	4	Mo	*
Be	*	Ni	3
Bi	3	Nb	*
B	4	Pd	*
Cd	4	P	5
Ca	6	Pt	*
Cr	4	Si	8
Co	2	Ag	2
Cu	4	Na	5
Ga	3	Ta	*
Ge	*	Sn	*
Au	4	Ti	5
Fe	8	W	5
La	*	V	4
Pb	4	Zn	4
Mg	8	Zr	*

PLATE I

LOCALITY MAP

To accompany record 1966/219

W/A/168 G.E.